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Analysis Package for the Salado Transport Calculations (Task 2) of the Performance Assessment Analysis Supporting the Compliance Certification Application WPO# 40515

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NOTE

Appendix C is not available at this time and will be provided later.

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Glossary

accessible environment. "(1) [T]he atmosphere, (2) land surfaces, (3) surface waters, (4) oceans, and (5) all of the lithosphere that is beyond the controlled area." (40 CFR § 191.12[k])

CAMCON Compliance Assessment Methodology Controller

CCA - Compliance Certification Application. The application submitted by the DOE to the EPA in October 1996 for certification that the WIPP meets the disposal standards in 40 CFR Part 191.

CCDF - complementary cumulative distribution function. Mathematically, a complementary cumulative distribution function is equal to one minus a cumulative distribution function. A cumulative distribution function is the sum (or integral) of the probability of those values or variables that are less than or equal to a specified value.

For the WIPP, a CCDF is the ordered set of points that span the cumulative normalized releases from the waste isolation system for all combinations of future histories of the repository over the 10,000-year regulatory period. The CCDF is a graphical display of the probability (the ordinate) that the value of the cumulative release will be greater than the normalized release (the abscissa). The points are ordered by normalized cumulative releases.

Radionuclide releases are normalized as stipulated in 40 CFR Part 191, Appendix A, and the complementary cumulative distribution function is compared to the quantitative release limits specified in 40 CFR § 191.13(a) to determine compliance.

CDB A computational database in standard CAMCON binary format

CMS - Configuration Management System. The system used to provide traceability and reproducibility of the performance assessment calculations. Also referred to as SCMS - software configuration management system.

conceptual model. A statement of how important features, events, and processes are to be represented in performance assessment.

controlled area. The area within the withdrawal boundary (see land withdrawal boundary) and the underlying subsurface.

disposal system. "[A]ny combination of engineered and natural barriers that isolate ... radioactive waste after disposal" (40 CFR § 191.12[a]). For the purposes of the Waste Isolation Pilot Plant, this includes the combination of the repository/shaft system and the controlled area.

distribution. The statistical distribution of values of an entity over the range of expected values.

disturbed rock zone. That portion of the geologic barrier in which the physical and/or chemical properties are significantly altered by underground activities.

E1, E2. These are potential human-intrusion scenarios used in constructing the future histories of the disposal system for compliance purposes. E1 intrusions penetrate both the repository and an underlying brine reservoir in the Castile Formation. E2 intrusions penetrate the repository but do NOT penetrate an underlying brine reservoir.

E2E1. A scenario in which an E2 intrusion is followed by an E1 intrusion. The consequences of this particular intrusion were calculated in this performance assessment.

E1E2. Any multiple-human-intrusion scenario that includes at least one E1 intrusion (note that this also encompasses the E2E1 intrusion scenario described above).

Eh. The redox potential as defined by the Nernst equation

EPA. The Environmental Protection Agency

EPA unit. The inventory of an isotope in Curies divided by the EPA release limit for that isotope in Curies (as specified in 40CFR Part 191, Appendix A, Table 1).

event. A phenomenon that occurs instantaneously or within a short time interval relative to the time frame of interest.

FEPs - features, events, and processes. Features, events, and processes that are potentially important to long-term performance of the disposal system. A comprehensive set of features, events, and processes relevant to the WIPP was considered in applying a screening methodology to develop the conceptual model that is used to evaluate compliance with the numerical performance requirements provided in 40 CFR Part 191.

feature. An aspect or feature of the repository and its environment. For example, the mine shafts are a feature of the repository, and the stratigraphy is a feature of the repository environment.

human intrusion. (See Inadvertent Human Intrusion).

inadvertent human intrusion. The accidental violation of the disposal system through human activity such as mining or exploration drilling. Inadvertent and intermittent intrusion by drilling for resources (other than those resources provided by the waste in the disposal system or engineered barriers designed to isolate such waste) is the most severe human intrusion scenario (40 CFR § 194.33[b][1]).

LWA - Land Withdrawal Act. Public Law 102-579, which withdraws the land at the WIPP site from "entry, appropriation, and disposal"; transfers jurisdiction of the land from the Secretary of the Interior to the Secretary of Energy; reserves the land for activities associated with the development and operation of the WIPP; and includes many other requirements and provisions pertaining to the protection of public health and the environment.

LWB - land withdrawal boundary, WIPP site boundary. The boundary of the 16-section land withdrawal area defined by the Land Withdrawal Act.

LHS - Latin hypercube sampling. A Monte Carlo sampling technique that divides the range of each variable into intervals of equal probability and samples from each interval. (See Monte Carlo Analysis/Technique).

marker bed. One of the well-defined anhydrite layers in the Salado. Four of these thin, horizontal layers are located near the repository and are considered in performance assessment because their properties differ from those of the Salado halite: Marker Bed 139 (below the repository), anhydrites a and b (located between the repository floor and roof and combined into a single layer in the CCA calculations), and Marker Bed 138 (located above the repository).

mean. The probabilistic expectation of a random variable.

median. The value for which the probability of sampling a value greater than the median is 0.5.

Monte Carlo Analysis/Technique. A technique that obtains the statistical distribution of outcomes of deterministic calculations by statistical sampling of the input and computer simulations of disposal system performance. For the WIPP performance assessment, the method is used to evaluate the distribution of the consequences and approximate the uncertainty in the results.

parameter. The quantities in the mathematical model that incorporate information about the features, events, and processes included in the conceptual model of disposal system performance. Parameters are underlying elements ($x = x_1, ..., x_n, ..., x_{nV}$) of a computational model. As x changes so does the model result. The individual parameters, x_n, may be vectors, tensors, higher order quantities, or even functions, but are usually scalar quantities.

PICs - passive institutional controls. "(1) [P]ermanent markers placed at a disposal site, (2) public records and archives, (3) government ownership and regulations regarding land or resource use, and (4) other methods of preserving knowledge about the location, design, and contents of a disposal system." (40 CFR § 191.12[e])

PA - performance assessment. "[A]n analysis that: (1) Identifies the processes and events that might affect the disposal system; (2) examines the effects of these processes and events on the performance of the disposal system; and (3) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events. These estimates shall be incorporated into an overall probability distribution of cumulative release to the extent practicable. (40 CFR § 191.12[q])

performance modeling. A process of building models of the factors affecting the containment of nuclear waste to project into the future how the WIPP facility will respond to probabilistic events and processes. Calculations of system performance using mathematical implementation of the conceptual models.

pH. The negative log of the hydrogen ion activity.

pmH. The negative log of the hydrogen ion concentration in moles/kg solvent.

process. A natural or anthropogenic phenomenon that occurs continuously or over a significant portion of the time frame of interest; a "long-term" phenomenon; processes typically alter the physical state of material under consideration.

probabilistic analysis. Analysis through statistical investigations is referred to as probabilistic analysis. Monte Carlo analysis is used for probabilistic analysis in the WIPP PA. This analysis propagates uncertainties in the future, in the conceptual models, and in the parameters into the analytical results.

QA - quality assurance. The planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service.

realization. One set of values for all uncertain parameters selected through LHS; synonymous with vector.

release. Movement of regulated substances into the accessible environment as defined in 40 CFR Part 191.

replicate. One complete set of probabilistic performance assessment calculations made using a single random number seed to initiate the LHS procedure for generating values of uncertain parameters at the beginning of the calculations. Three independent replicates were made in the CCA performance assessment to demonstrate statistical confidence. The replicates differ from each other only in the random number seed.

repository. The portion of the WIPP underground system within the Salado Formation, including the access drifts, waste panels, and experimental areas, but excluding the shafts.

risk. In the performance assessment analyses, risk is defined by the triplet {what could happen (scenarios), likelihood that it will happen (probability), and the consequences}.

sample. A value randomly drawn from a probabilistic distribution.

SWCF - Sandia WIPP Central Files. A records system containing documentation related to WIPP.

scenario. A combination of naturally occurring or human-induced events and processes that represent realistic future changes to the repository, geologic, and geohydrologic systems that could cause or promote the escape of radionuclides and/or hazardous constituents from the repository.

screening argument. Criteria used to eliminate from scenario and conceptual model development those events and processes that are not applicable to a specific disposal system or that do not have the potential of contributing significantly to performance. The three screening criteria used for the CCA are *Regulatory Guidance*, *Probability of Occurrence*, and *Consequence*.

sensitivity and uncertainty analyses. Analyses to determine the sensitivity of performance to changes in the values of uncertain parameters (those that were expressed as probability distributions). The distributions represent the range of known values for a parameter and the uncertainty in the actual value.

SO-C. Screened-Out on the basis of Consequence: elimination of FEPs on the basis of low consequence to system performance.

SO-P. Screened-Out on the basis of low Probability: elimination of FEPs on the basis of low probability of occurrence.

SO-R. Screened-Out on the basis of Regulations: elimination of FEPs on the basis of regulations provided in 40 CFR Part 191 and criteria provided in 40 CFR Part 194.

subjective uncertainty. Subjective uncertainty derives from a lack of knowledge about quantities, attributes, or properties believed to have a single or certain range of values.

transmissivity. "[T]he hydraulic conductivity integrated over the saturated thickness of an underground formation." (40 CFR § 191.12[l])

TRU - transuranic waste. "[W]aste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive wastes; (2) wastes that the Department has determined, with the concurrence of the Administrator, do not need the degree of isolation required by this Part; or (3) wastes that the Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61" (40 CFR § 191.02[i]). The "Department" is DOE, the "Administrator" is the Administrator of the EPA, "this Part" is 40 CFR Part 191, and the "Commission" is the Nuclear Regulatory Commission.

uncertainty analysis. (1) An evaluation to determine the uncertainty in model predictions that results from imprecisely known input variables. (2) Determination of the degree of uncertainty in the results of a calculation based on uncertainties in the input parameters and underlying assumptions. Such an analysis requires definition of a system, description of the uncertainties in the factors that are to be investigated, and the characteristics of the system that are to be simulated, and the consequences of varying values on input parameters over their respective statistical distributions.

undisturbed performance. "[T]he predicted behavior of a disposal system, including consideration of the uncertainties in predicted behavior, if the disposal system is not disrupted by human intrusion or the occurrence of unlikely natural events." (40 CFR § 191.12[p])

vector. A mathematical construct that requires both a magnitude and direction. Many physical quantities such as force, velocity, acceleration, and fluxes are represented mathematically as vectors. In performance assessment, the term also means a vector over the real numbers and is therefore synonymous with realization (see realization).

View CCA5. The database view is the version of the tables that contain the values required for the calculation. View CCA5 was the fifth version of those tables and CCA10 was the tenth.

Preface

This analysis package is one of eight packages documenting analyses performed in support of the Compliance Certification Application (CCA) for the Waste Isolation Pilot Plant (WIPP). The following background and overview of the analyses is provided to assist the reader in understanding this analysis package and the overall strategy and framework of these analyses. The reader is also referred to the glossary for further information regarding terms used in this analysis package.

P.1 Background

The WIPP is a geologic repository operated by the U.S. Department of Energy (DOE) for disposal of transuranic radioactive wastes. The repository is located approximately 650 meters underground in the Salado Formation, and is connected to the surface by four shafts which will be sealed after waste emplacement is completed. The geologic formations immediately above and below the Salado are the Rustler and Castile Formations, respectively. The Rustler is considered important because it contains the most transmissive units above the repository; the most significant of these is considered to be the Culebra Dolomite Member. The Castile contains areas of pressurized brine (brine pockets); it is not known whether any such pockets are located under the repository. The area surrounding the shafts and surface facilities and the underlying subsurface are controlled by the DOE.

In October 1996, the DOE submitted the CCA to the U.S. Environmental Protection Agency (EPA) in accordance with the requirements of Title 40 of the Code of Federal Regulations (40 CFR) Parts 191 and 194. The containment requirements in 40 CFR 191.13(a) specify that the disposal system is to be designed to provide a reasonable expectation that radionuclide releases to the accessible environment during 10,000 years are not likely to exceed certain limits (the limits are based on the radionuclide inventory in the repository). The demonstration of having a reasonable expectation is to be based on a performance assessment. Performance assessment (PA) is defined in 40 CFR 191.12:

Performance assessment means an analysis that: (1) Identifies the processes and events that might affect the disposal system; (2) examines the effects of these processes and events on the performance of the disposal system; and (3) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events. These estimates shall be incorporated into an overall probability distribution of cumulative release to the extent practicable.

The PA process used in the CCA fulfills these requirements through 6 major steps, listed below.

(1) Collecting data, characterizing the site and disposal system, and developing the modeling system.

(2) Constructing scenarios (combinations of possible future events), with and without human activities.

(3) Estimating the probability that various scenarios will occur.

(4) Analyzing the consequences of the various scenarios (deterministic futures) which have sufficiently high consequences and probability of occurrence. There are four basic scenarios considered: (1) undisturbed performance (the absence of human intrusion); (2) the E1 intrusion scenario (a borehole which penetrates both the repository and an underlying pressurized brine reservoir in the Castile Formation); (3) the E2 intrusion scenario (a borehole which penetrates the repository); and (4) multiple intrusions (for example, an E2 intrusion followed by an E1 intrusion - E2E1). Each of these scenarios is considered with and without the effects of mining potash located in the Salado within the controlled area.

(5) Calculating cumulative radionuclide releases and comparing them to regulatory standards in 40 CFR Part 191. The releases are calculated using the consequences of each scenario and their combinations in various (probabilistic) futures. The releases are expressed as complementary cumulative distribution functions (CCDFs), the probability distribution of exceeding normalized cumulative radionuclide releases.

(6) Performing sensitivity analyses to identify the most significant factors.

The PA calculations described in these analysis packages (and in this overview) complete the fourth and fifth steps: analysis of scenario consequences and calculation of CCDFs, respectively. The other steps are addressed elsewhere.

P.2 PA Calculation Strategy

Because of the large number of complex calculations that are required to produce CCDFs, it is not practical, nor is it necessary, to model the total system in a single calculation. Instead, disposal system components and subsystems are modeled (in six separate tasks) to calculate consequences for the undisturbed scenario and for the E1, E2, and E2E1 human intrusion scenarios (with and without mining). Each of these tasks is performed for a set of reference conditions, which include specific intrusion scenarios at certain times. The reference conditions are designed to allow the results of the first six tasks to be incorporated into the CCDF calculations in a seventh task.

To perform the first six tasks, several major computer codes are used to simulate relevant features of the disposal system and calculate scenario consequences. An additional computer code is used to construct the CCDFs in the seventh task. The seven tasks are described in the Analysis Plan for the Performance Assessment Analyses Supporting the Compliance Certification Application (AP-AAD), dated March 8, 1996. They are summarized here, together with their major computer codes. The computer codes and disposal system components addressed in the first six tasks are also shown schematically in Figure P.1.

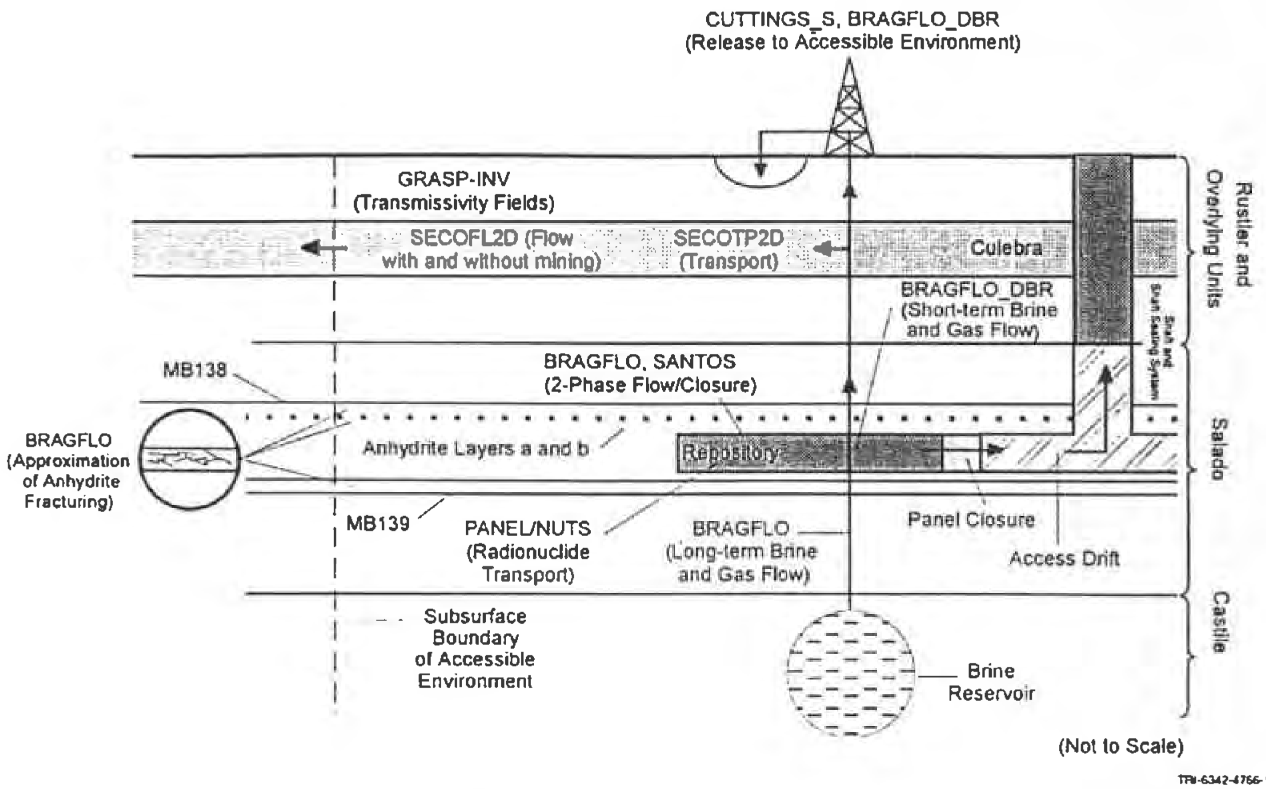

Figure P.1 Schematic Side View of the Disposal System Associating Performance Assessment Codes With the Components of the Disposal System Each Code Simulates.

Task 1

In the first task, overall flow of brine and gas is calculated for undisturbed conditions and for human intrusion scenarios. The flow of brine and gas is calculated in the repository, in the sealed shafts, in the Salado Formation (where the repository is located), and in the human intrusion boreholes. Brine flow in other formations is also calculated (except for the Culebra, which is addressed separately in Task 3 because of its significance as a pathway for long-term releases). Processes which are coupled to brine and gas flow are also included in this task: gas generation in the repository, disposal room closure and consolidation, brine flow, and effects on the rock surrounding the repository. Creep closure within the waste regions in the repository is represented in this task using a porosity surface describing porosity as a function of time and pressure. These calculations are performed for the set of system reference conditions, and provide results that are used in subsequent disposal system models (Tasks 2 through 6) and also in CCDF construction (Task 7).

The brine and gas flow and coupled repository processes are modeled using version 4.00 of the computer code BRAGFLO. The porosity surface describing closure of the modeled disposal room is generated using the code SANTOS. The codes and disposal system components are shown in Figure P.1. There are two analysis packages associated with this task: *Analysis Package for the Salado Flow Calculations (Task 1) of the Performance Assessment Analyses Supporting the Compliance Certification Application* (WPO# 40514) and *Final Porosity Surface Data* (WPO# 35697).

Task 2
This task is calculation of the overall long-term transport and radioactive decay of radionuclides from the waste in brine in the Salado and in the overlying Rustler Formation (except for the Culebra, which is addressed in Task 3). The brine flow fields and disposal system model geometry are those calculated in Task 1, and the transport calculations are performed for undisturbed conditions and for human-intrusion scenarios. The radionuclide source concentrations in the brine (the actinide source term) in the repository are the modeled solubilities of the radionuclides contained in the waste. These calculations are performed for the system reference conditions.

The overall transport and decay are calculated using the computer code NUTS for the undisturbed, E1, and E2 scenarios. In simulations of the E1 scenario, NUTS also tracks brine originating in the underlying Castile brine reservoir, including the fraction of Castile brine that has flowed out from the human-intrusion borehole into the waste in the repository. The code PANEL calculates radionuclide concentrations in brine and also radionuclide transport to the Culebra for the E2E1 scenario. In all scenarios, the quantity of brine flowing up the shafts or a degraded exploratory borehole to the Culebra calculated by BRAGFLO (Task 1), together with the concentration of radionuclides in that brine calculated by NUTS or PANEL (Task 2), is used to determine the quantity of radionuclides released to the Culebra (the Culebra is addressed in Task 3). The radionuclide concentration in brine calculated by PANEL is also used to determine the quantity of radionuclides released to the surface in Task 4. The codes and disposal system components are shown in Figure P.1. The analysis package for this task is *Analysis Package for the Salado Transport Calculations (Task 2) of the Performance Assessment Analysis Supporting the Compliance Certification Application* (WPO# 40515).

Task 3
Detailed fluid flow and radionuclide transport in the Culebra for each scenario are modeled in Task 3. The fluid flow calculations use transmissivity fields that are generated for the Culebra to represent the spatial heterogeneity in flow characteristics which has been observed experimentally. Each scenario may occur with or without potash mining in the Salado in the controlled area; this mining affects the transmissivity of the Culebra. Detailed movement of radionuclides is also calculated using a modeled double-porosity medium for the Culebra, accounting for flow in fractures, diffusion in the matrix, retardation, and radioactive decay. The transport is calculated using a unit source of radionuclides. These calculations are performed for the system reference conditions.

The computer code SECOFL2D calculates fluid flow in the Culebra, using transmissivity fields calculated by the code GRASP-INV (one field in each simulation). The code SECOTP2D calculates radionuclide transport in the Culebra. In Task 7, transport of the unit radionuclide source *in* the Culebra (from this task) is combined with the release *to* the Culebra (calculated in Task 2 using brine flows calculated in Task 1) to determine whether any radionuclides are actually released to the Culebra and subsequently transported through it for each scenario. The codes and disposal system components are shown in Figure P.1.

There are two analysis packages associated with this task: *Analysis Package for the Culebra Flow and Transport Calculations (Task 3) of the Performance Assessment Analyses Supporting the Compliance Certification Application* (WPO# 40516) and *Analysis of the Generation of Transmissivity Fields for the Culebra Dolomite* (WPO# 40517).

Task 4

Drilling intrusions into the repository (the E1, E2, and E2E1 scenarios) have immediate consequences: they lead to direct releases of material containing radionuclides to the accessible environment at the surface. These consequences are calculated for the system reference conditions in Tasks 4, 5, and 6. The radionuclide content of the materials released is dependent on the time of intrusion and is calculated separately using the system reference conditions.

Task 4 addresses brine containing dissolved radionuclides in the repository that may reach the surface if it is sufficiently pressurized. Short-term flow in the repository is modeled on a scale which includes repository features such as panel closures to calculate brine and gas flow (gas released to the surface is addressed in Task 6). The radionuclide concentration in the brine is calculated in Task 2. The short-term flow in the repository is modeled using version 4.01 of the code BRAGFLO (also referred to as BRAGFLO_DBR to differentiate it from the BRAGFLO code used in Task 1). The modeled geometry in Task 4 is different from the geometry used in the BRAGFLO code in Task 1, to account for the repository features. The initial conditions for Task 4 are provided by the long-term repository conditions calculated in Task 1. The code and modeled system components are shown in Figure P.1. The analysis package for this task is *Analysis Package for the BRAGFLO Direct Release Calculations (Task 4) of the Performance Assessment Analysis Supporting the Compliance Certification Application* (WPO# 40520).

Task 5

Task 5 addresses cuttings and cavings - the second direct release pathway associated with drilling intrusions into the repository (the E1, E2, and E2E1 scenarios). Cuttings and cavings are solid material carried to the surface by the drilling fluid during the process of drilling the borehole: cuttings are materials removed directly by the drill bit, and cavings are materials eroded from the walls of the borehole by the circulating drilling fluid. The code CUTTINGS_S calculates the quantity of material transported to the surface as cuttings for the system reference conditions. The radionuclide content of the materials released is dependent on the time and location of the intrusion; the content is calculated separately (using the results from the reference conditions) during construction of the CCDFs in Task 7. The code and modeled system components are shown in Figure P.1. The analysis package for this task is *Analysis Package for the Cuttings and Spallings Calculations (Tasks 5 and 6) of the Performance Assessment Analysis Supporting the Compliance Certification Application* (WPO# 40521).

Task 6

Task 6 addresses spallings - the third direct release pathway associated with drilling intrusions into the repository (the E1, E2, and E2E1 scenarios). Spallings are solid materials carried up the borehole by pressurized gas which may be present in the repository at the time of intrusion. The repository pressure and conditions are calculated in Task 1. The code CUTTINGS_S calculates the quantity of material transported to the surface as spallings for the system reference conditions. The radionuclide content of the materials released is dependent on the time of intrusion and is calculated separately (using the results from the reference conditions) during construction of the CCDFs in Task 7. The code and modeled system components are shown in Figure P.1. This task is discussed together with Task 5 in *Analysis Package for the Cuttings and Spallings Calculations (Tasks 5 and 6) of the Performance Assessment Analysis Supporting the Compliance Certification Application* (WPO# 40521).

Task 7
The final task is construction of CCDFs representing futures of the repository and calculation of cumulative releases (this task represents Step 5 in the performance assessment process described in the previous section). There are three parts in this task: (1) determine futures (random sequences of future events that may occur over the next 10,000 years at the WIPP site); (2) estimate the radionuclide releases resulting from these random sequences of future events, using the results of the calculations for each scenario and the reference conditions; and (3) construct a CCDF for each future. In order to efficiently calculate the consequences of multiple futures without repeating Tasks 1 through 6 for each history, the radionuclide releases for each future are calculated by scaling the reference-condition results from the first six tasks.

The computer code CCDF_GF is used to perform the steps in this task, using the results from all the previous tasks and associated computer codes. Task 7 does not address a component of the disposal system, therefore the CCDF_GF code is not shown in Figure P.1. The analysis package for this task is *Analysis Package for the CCDF Construction (Task 7) of the Performance Assessment Analysis Supporting the Compliance Certification Application* (WPO# 40524).

P.3 PA Computer Calculations
The major computer codes used in the analyses (including CCDF_GF) and the flow of information among them are illustrated in Figure 1.2. Combined, Figure P.1 and Figure P.2 illustrate the flow of information through the codes and the relationship between the codes and the physical system being simulated. In the PA calculations, the codes shown in the figures are executed under the requirements of the software configuration management system (CMS or SCMS), which creates and maintains a complete record of the input data and results of each calculation, together with the exact codes and scripts (commands for executing the codes) used to create those results.

Figure P.1 and Figure P.2 show only those codes that perform the bulk of the computational effort related to simulating the significant physical processes occurring within the disposal system. In addition to these codes, a variety of additional codes are used in this performance assessment. These additional codes are used for the transfer of data between codes, preparation of input data and files, model output processing, and similar tasks. Many of these additional codes are also executed within the CMS, and all are qualified for use in these analyses under applicable SNL WIPP quality assurance procedures.

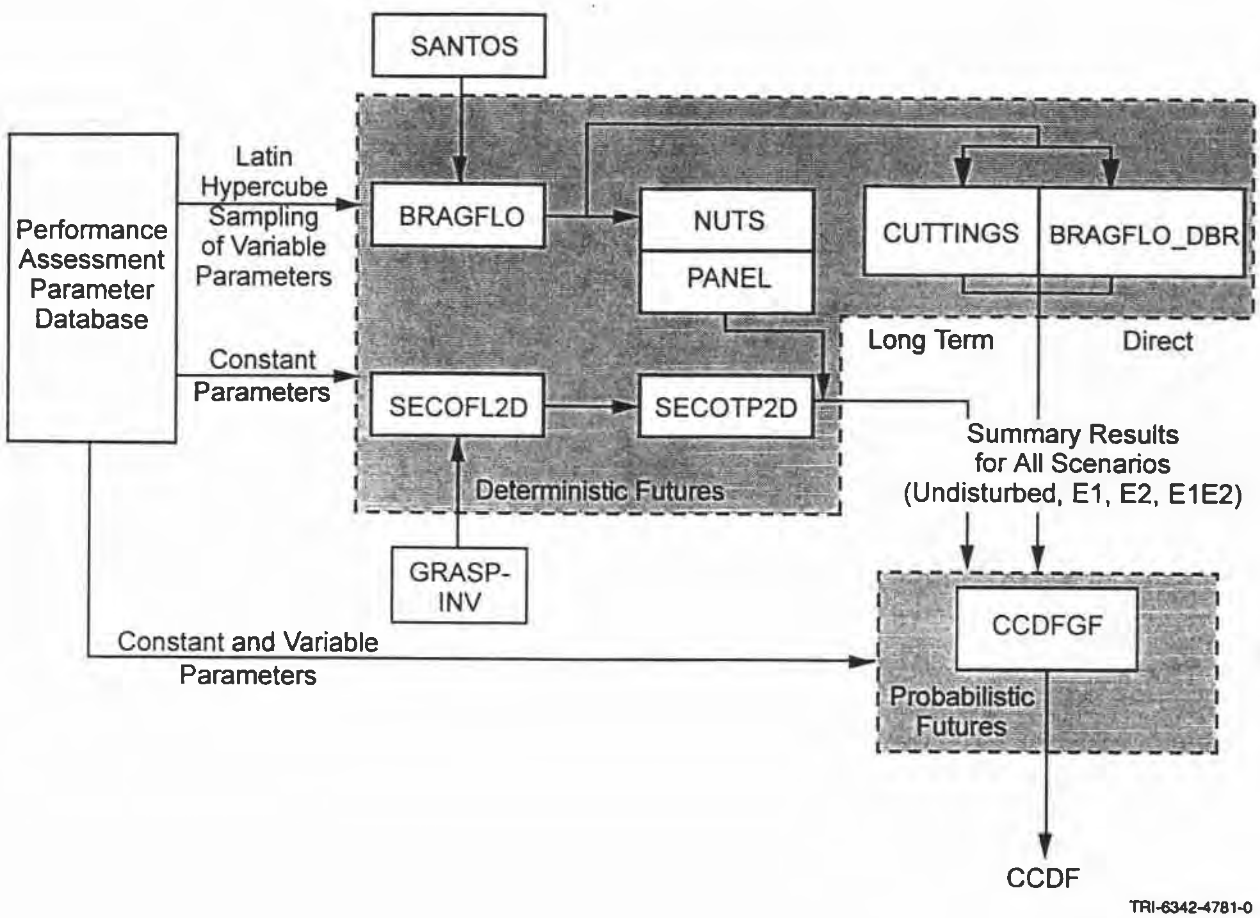

Figure P.2 Major Codes, Code Linkages, and Flow of Numerical Information in WIPP Performance Assessment

As shown in Figure P.2, there are three major calculation steps in analyzing the consequences of various scenarios (Tasks 1 through 6 in the previous section):

Preparation of input from submodels (GRASP-INV and SANTOS),

Latin hypercube sampling (LHS) of the variables in the parameter database that represent subjective uncertainty (such as spatial variability in a disposal system component property or processes), and

Execution of the codes within the "deterministic futures" box indicated by dashed lines in Figure P.2.

The parameter database is the initial element in the calculation process. The database includes the values of parameters used in performance assessment codes that pertain to the technical aspects of disposal system performance. Parameters pertaining only to the execution of the computer codes (for example, convergence criteria for Newton-Raphson numerical solvers) are generally not included in the database but are recorded in input files and are traceable through the CMS. The parameters in the database fall into two categories: those that are assigned fixed values, and those that are uncertain and are therefore assigned a range of values according to a cumulative distribution function (CDF).

For the analyses of scenario consequences (Tasks 1 through 6), vectors (sets) of parameter values are created from the variable parameters representing subjective uncertainty by LHS of each variable for the set of simulations in the analyses. Each of the fixed parameter values from the database and a vector of sampled parameter values are combined to form a realization (a set of input parameters that are used in one or more of the codes). Each set of input parameters is then propagated through Tasks 1 through 6 (that is, the codes are executed) under four code sequence configurations, one each for the undisturbed performance scenario, the E1 scenario, the E2 scenario, and the E2E1 scenario. In each configuration, the codes are executed sequentially, as shown in Figure P.2.

In this performance assessment, subjective uncertainty is addressed using a LHS sample size no less than a third larger than the number of uncertain parameters: there are 57 sampled parameters (used in one or more of the codes) that represent subjective uncertainty, and they are sampled to create 100 vectors. The entire process (LHS of uncertain parameters, creation of vectors, and evaluation of scenario consequences through execution of the codes) is repeated three times (each time comprises a replicate which is independent of the other replicates) to achieve confidence in the results.

Once the consequences of various scenarios are calculated, there are two major steps in evaluating consequences of probabilistic futures (Task 7):

Random sampling of parameters which address stochastic uncertainty (such as location of an intrusion borehole), and

Execution of the code in the "probabilistic futures" box (CCDF_GF) in Figure P.2, in which the releases for the futures are calculated using the results of the calculations for each scenario and the reference conditions, and a CCDF is constructed for each future.

This sequence of two steps is repeated once for each of the 100 vectors of uncertain parameters (that is, all the random sequences of future events that may occur over the next 10,000 years at the WIPP site are considered for each of the vectors). This yields a group (family) of 100 CCDFs (one for each of the vectors). The family arises from the fact that fixed, but unknown, quantities are needed in the estimation of each CCDF (these quantities are the uncertain parameters in each vector).

Each individual CCDF displays the effects of stochastic uncertainty in that the stepwise shape of the CCDF reflects the fact that a number of different occurrences have a real possibility of taking place. The variations between the individual CCDFs in the family display the effects of subjective uncertainty. The distribution of CCDFs in the family thus provide a complete display of both stochastic and subjective uncertainty.

In the final step, the family of CCDFs for each replicate is compared to the regulatory standard in 40 CFR 191.13(a) to determine compliance.

1. Introduction

This analysis package documents the mobilization and advective-transport calculations that were performed by NUTS and PANEL for the 1996 Compliance-Certification-Application (CCA) PA. Given inputs from other WIPP CCA codes (see Chapter 3), NUTS calculates the mobilization and subsequent migration of radioisotopes throughout the repository, shaft system, Salado formation, and possible human-intrusion boreholes and PANEL calculates the mobilization and movement through the repository and boreholes only. These regions are thoroughly described in the Analysis Package for the Salado Flow Calculations (Task 1), WPO# 40514 (Figure 1.1). The mobilization and transport calculations are integral parts of the overall calculation that leads to the complementary cumulative distribution function (CCDF) presented in Chapter 6.5 of the Compliance Certification Application (CCA). This analysis package documents the conceptual models, assumptions, data, and results impacting the 1996 CCA PA calculation of mobilization and transport of radioisotopes in the regions identified above. Adherence to all applicable quality assurance (QA) controls (QAP 6-3,9-1,9-2,9-5,17-1, and 19-1) is documented.

1.1 Overview of CCA Calculations, Roles of NUTS and PANEL in the 1996 CCA PA

The final compliance measure, the CCDF, was assembled with the code CCDFGF. A brief description of CCDFGF is presented here to explain how NUTS and PANEL were used. For a full description of the CCDFGF calculations see Analysis Package for the CCDF Construction (Task 7) of the Performance Assessment Analyses Supporting the Compliance Certification Assessment (WPO# 40524). CCDFGF assembled the total release to the accessible environment from the output of the codes which track three release mechanisms: direct solid release to the surface, direct contaminated brine release to the surface and contaminated brine release through underground pathways. NUTS and PANEL were used to model the mobilization of contaminants into brine and the flow of the contaminated brine from the repository in the later two mechanisms. NUTS modeled the movement of contaminated brine using the BRAGFLO grid (Figure 1.1). NUTS calculations showed some migration of contaminated brine toward the accessible environment through three pathways, (i) laterally through the disturbed-rock zone and marker beds near the repository, (ii) up the access shafts of the repository and, (iii) up human-intrusion boreholes. However, as will be shown in Chapter 7, only movement up the human-intrusion boreholes were significant. Contaminants moving up a borehole from the repository may either go directly to the surface, or may enter one of the more permeable underground units such as the Culebra and travel laterally to the accessible environment. Direct release of contaminated brine to the surface that might occur during drilling was modeled with BRAGFLO Version 4.01 and PANEL (see Section 2.3.3). Long term release of contaminated brine to the Culebra was modeled with both NUTS and PANEL using the flow fields of BRAGFLO Version 4.00(Sections 2.2 and 2.3). Further transport of contaminated brine through the Culebra to the accessible environment was calculated with SECO_TP, and is documented in the Analysis Package for the Culebra Flow and Transport Calculations (Task 3), WPO# 40516.

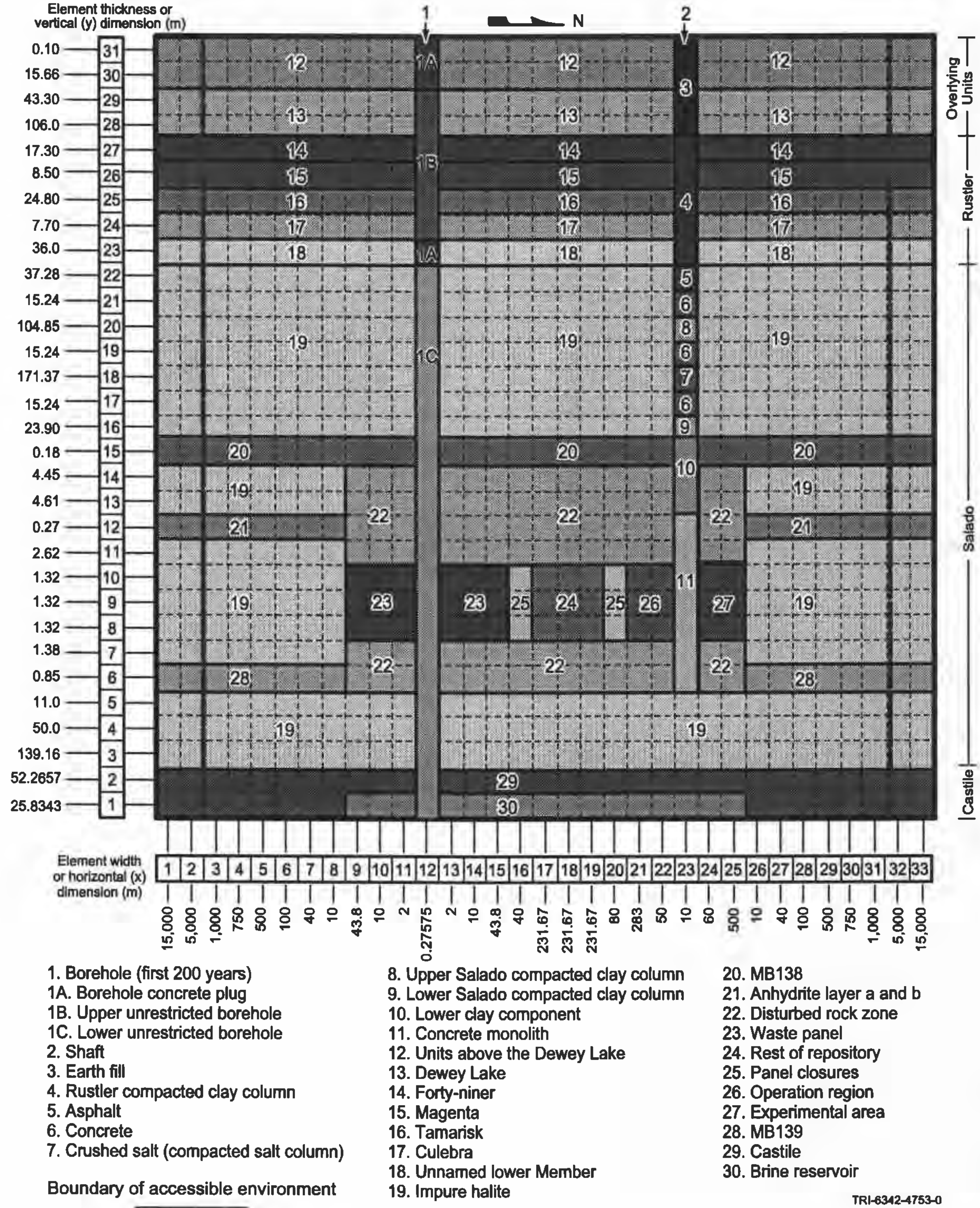

Figure 1.1 BRAGFLO's Grid
The grid blocks are of widely differing sizes, as shown on the x and y axes. This equal-sized-grid-block rendition of the grid makes it easier to identify specific material regions and specific element numbers.

Six scenarios were developed for the modeling of human intrusions in CCDFGF and BRAGFLO. These scenarios are described in detail in the Analysis Package for the Salado Flow Calculations (Task 1), WPO# 40514. The six scenarios fall into 4 categories: undisturbed (Figure 1.2), E1, where an intrusion borehole penetrates both the repository and a pressurized brine pocket (Figure 1.3), E2, where an intrusion borehole penetrates only the repository (Figure 1.4), and "E2E1", where there is an E2 intrusion followed by an E1 intrusion (Figure 1.5). The six scenarios are defined as follows:

1) the S1 scenario (the repository in the absence of human intrusions) ,
2) the S2 scenario (an exploratory borehole intersects both the repository and an underlying brine pocket at 350 years after closure; also known as an E1 scenario at 350 years) ,
3) the S3 scenario (the same as the S2 but with penetration occurring at 1000 years; also known as an E1 scenario at 1000 years) ,
4) the S4 scenario (an exploratory borehole intersects only the repository at 350 years after closure; also known as an E2 scenario at 350 years), and
5) the S5 scenario (the same as S4 but with penetration occurring at 1000 years; also known as an E2 scenario at 1000 years).
6) the S6 scenario (an E2 intrusion at 1000 years followed by a E1 intrusion at 2000 years).

BRAGFLO was used to calculate the flow fields for each of these scenarios, with a borehole in the center of a waste panel. Using these flows, NUTS was used to calculate the transport of radionuclides within brine in scenarios 1 through 5 and PANEL was used in scenario 6 as will be explained below. Future human intrusions, however, were modeled in CCDFGF using Monte Carlo sampling of, among other things, the locations and times of borehole drilling and whether the borehole intercepted a pressurized brine pocket. The sampled interception of brine pocket parameter was used to determine whether the intrusion was an E1, E2. The locations were used to determine if more than one intrusion penetrated the same waste panel. The use of random intrusion times, however required NUTS and PANEL calculations at times other than 350 and 1000 years. "Time shifted" NUTS and PANEL calculations were performed at regular time intervals so that CCDFGF could interpolate the resulting releases to any specific time.

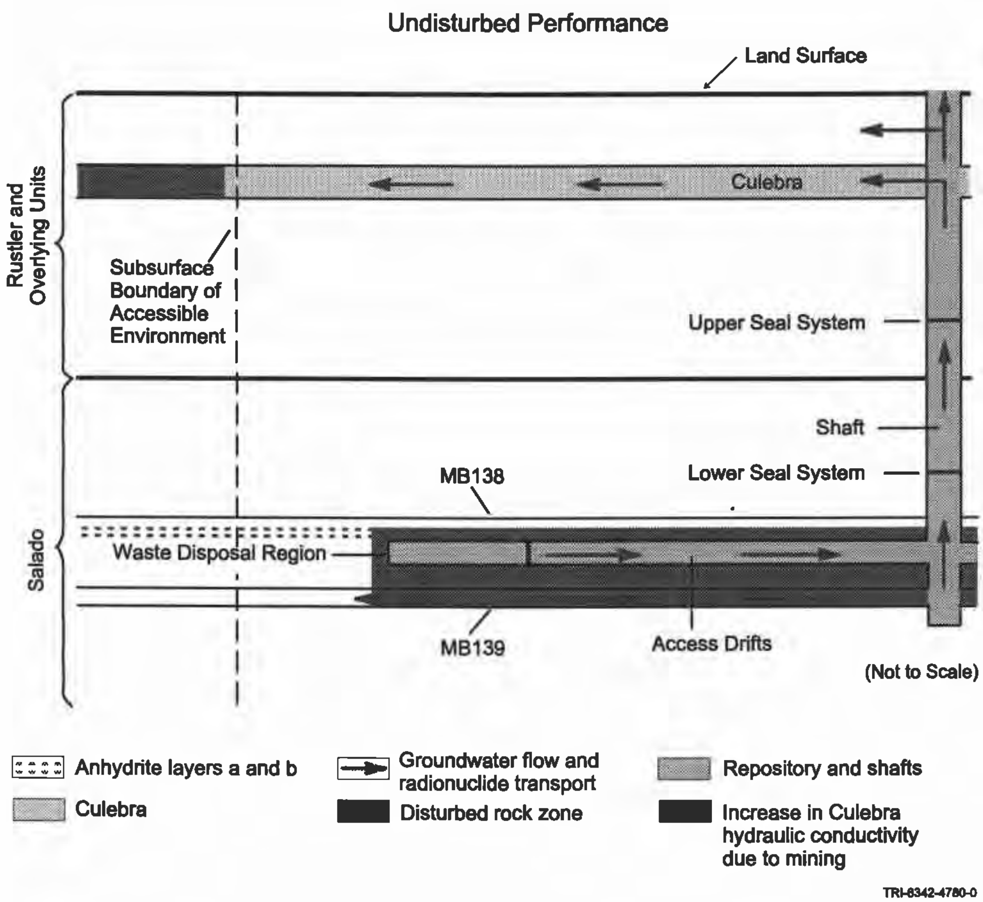

Figure 1.2 Undisturbed Scenario

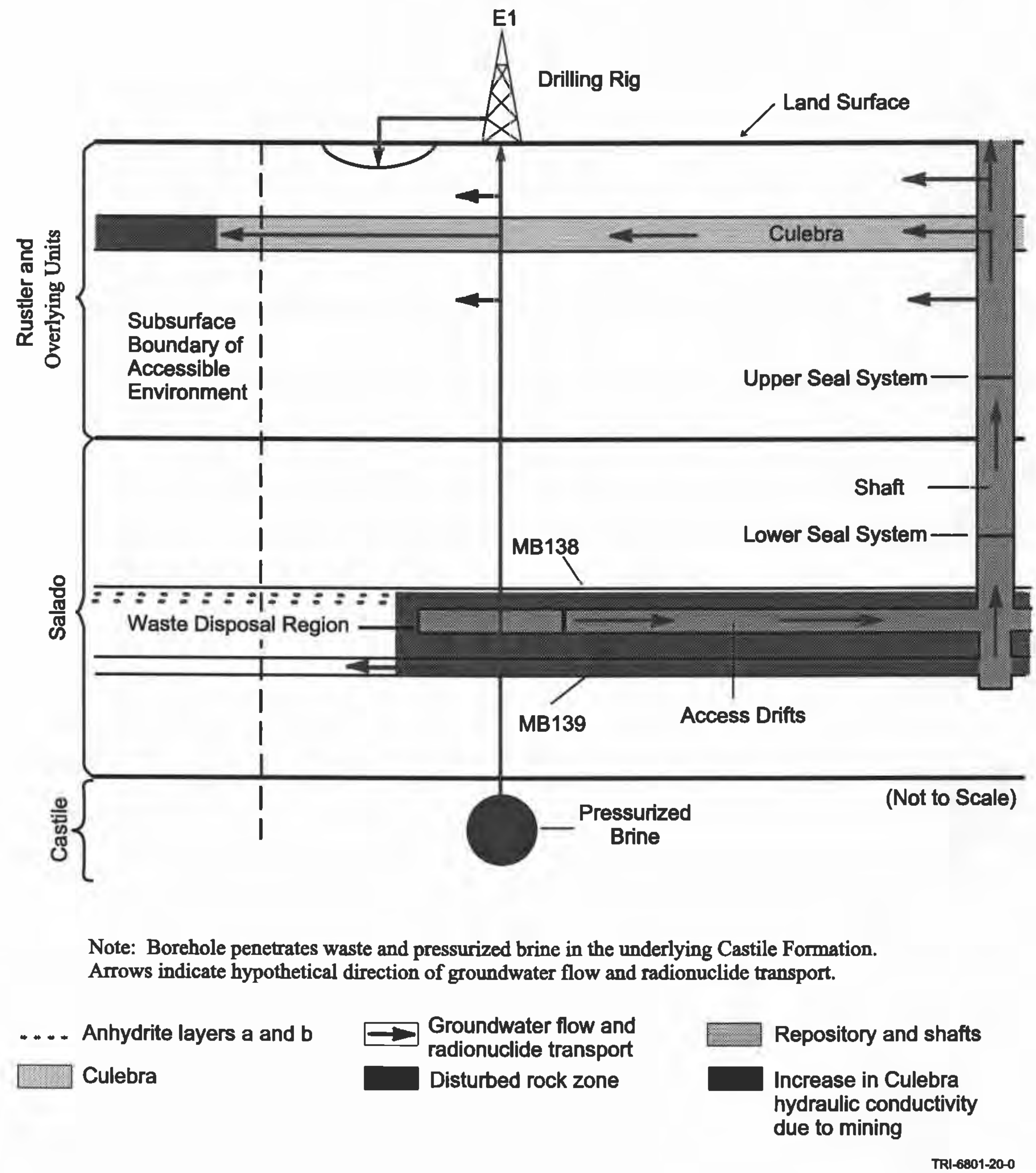

Figure 1.3 E1 Scenario

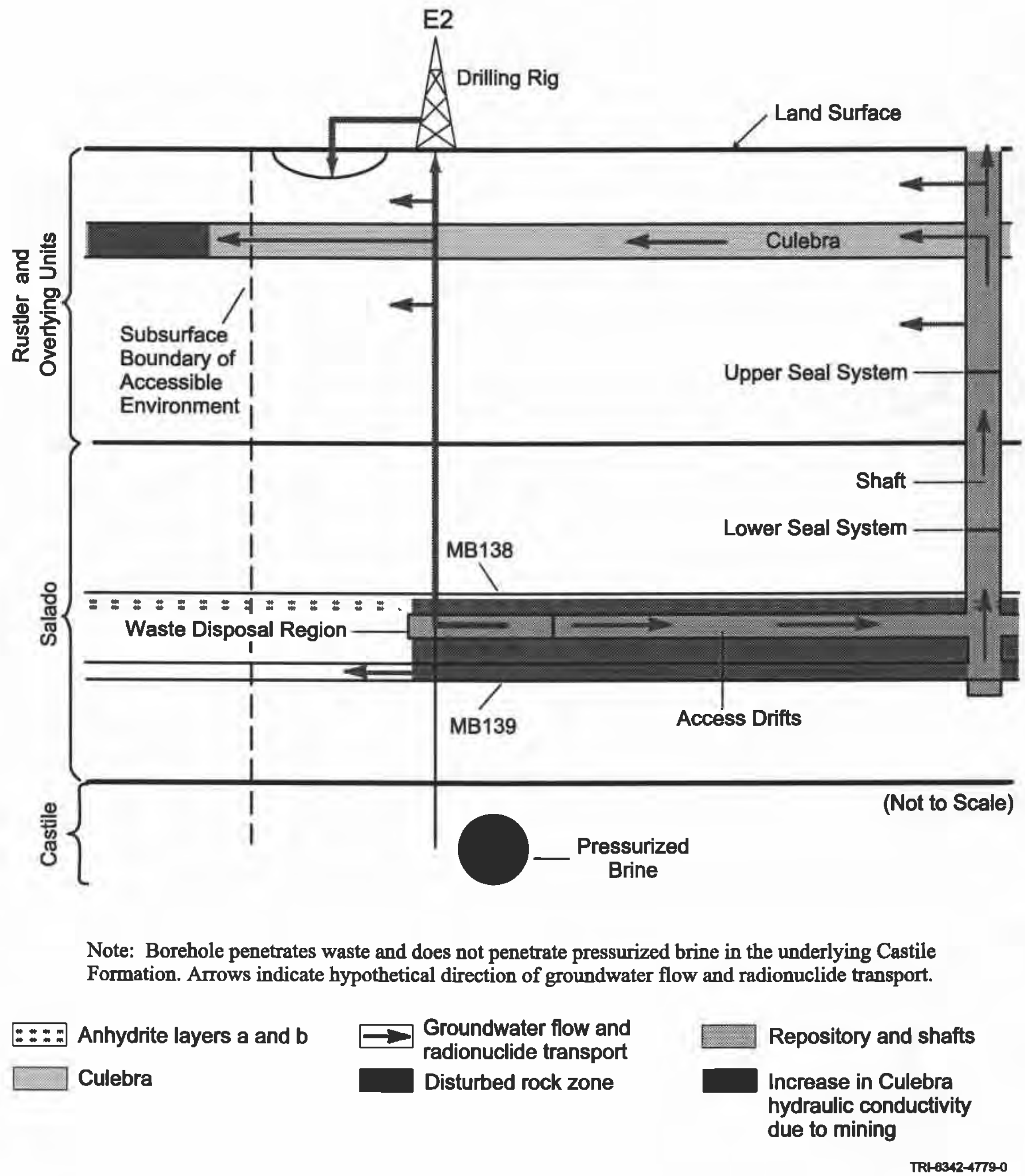

Figure 1.4 E2 Scenario

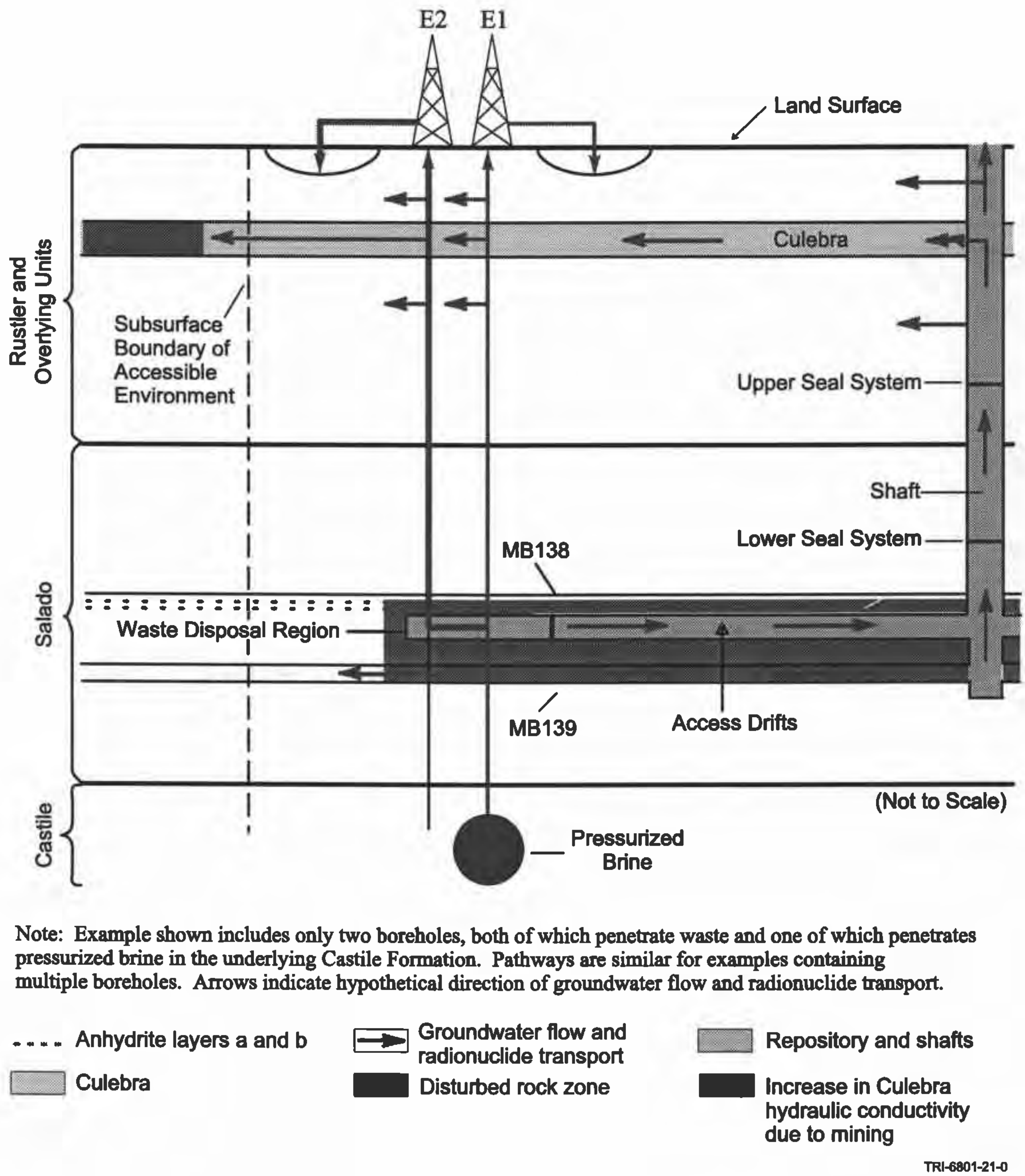

Figure 1.5 E2-E1 Scenario

The NUTS and PANEL calculations used in the CCA are categorized as follows:

1) Direct Brine Release (Section 2.3.3).): PANEL
2) Long Term Transport to the Culebra (Indirect Release) (Sections 2.2 and 2.3):
   A. Undisturbed (S1) -- NUTS
   B. Single Intrusion (S2-S5) -- NUTS
   C. Single Intrusion, Time Shifted -- NUTS
   D. Double Intrusion (S6) -- PANEL
   E. Double Intrusion, Time Shifted --PANEL

1.2 Code Identification

Before we continue with a discussion of Salado transport, it is important to clarify our use of code names.

The numerical models (codes) used to calculate the mobilization and local transport of radioisotopes in the 1996 CCA PA were

1) NUTS*	Version 2.03 , and
2) PANEL	Version 3.60 .

Before the above two codes were exercised in the 1996 CCA PA, it was necessary, as will be explained in Sections 2 and 4, to exercise or use the output of other WIPP PA codes. The upstream codes in question together with their corresponding version numbers, as applied in the 1996 CCA, are as follows:

ALGEBRACDB	Version 2.35	MATSET	Version 9.00
BRAGFLO	Version 4.00	PREBRAG	Version 6.00
BRAGFLO	Version 4.01	PRELHS	Version 2.10
GENMESH	Version 6.08	POSTBRAG	Version 4.00
LHS	Version 2.40	POSTLHS	Version 4.07

Down stream codes include:

CCDFGF	Version 1.00	SUMMARIZE	Version 2.10
SPLAT	Version 1.01		

In this document, the version numbers of the 1996 CCA PA codes will not be repeated unless they are required for clarity. Thus, it is to be understood that the above version numbers are in effect unless it is noted otherwise. The use of two versions of BRAGFLO, however, needs

* All WIPP CCA PA codes have two sets of identifiers. The names used herein are preferred terminology for prose, but each code also has a Configuration-Management-System (CMS) prefix that serves both as (1) its name and (2) an identifying prefix for its files. The prefix is usually a shortened form of the full name. For example, NUTS's prefix is NUT, while PANEL's is PANEL. GENMESH's is GM. PRELHS's prefix is LHS1, LHS's is LHS2, and POSTLHS's is LHS3, and that pattern is typical for code suites.

further discussion. The 1996 CCA PA calculation employed two applications of the BRAGFLO suite of codes. We will use the term "suite", to indicate a series of codes that are exercised together as a group such as PREBRAG, BRAGFLO, and POSTBRAG. PREBRAG and POSTBRAG are BRAGFLO's pre- and post-processors. BRAGFLO, the central code of the suite, performed the actual two-phase Darcy-flow calculation. In its long-term or *indirect* release applications, the central code of the triad is referred to by its actual name, that is BRAGFLO. In its *direct*-release applications, i.e., those involving direct releases up the human-intrusion borehole at time of drilling, the central code of the triad was referred to as BRAGFLO_DBR, where DBR stands for "direct brine release." The actual code applied in BRAGFLO_DBR runs is essentially identical to the code applied in BRAGFLO runs, accept for how the waste region was defined. BRAGFLO defined two waste regions and BRAGFLO_DBR used only one. Accordingly, the code had to be recompiled, and QA procedures required regression testing and a second-decimal increase in its version number. Thus, "BRAGFLO_DBR" is used to refer to BRAGFLO Version 4.01, and "BRAGFLO" is used to refer to BRAGFLO Version 4.00. Despite its higher version number, Version 4.01 is *not* a universal replacement for Version 4.00. *Both* versions were used in the 1996 CCA. Because both applications used the same pre and post processors, there are four BRAGFLO-related codes whose names, prefixes, and combinations are as follows: PREBRAG's prefix is BF1, "BRAGFLO" is BF2, "BRAGFLO_DBR" is BF4, and POSTBRAG's is BF3. The indirect-release suite is BF1, BF2, & BF3. The direct-release suite is BF1, BF4, & BF3.

1.3 Direct Brine Release

Direct brine release was calculated in CCDFGF by multiplying the volume of brine released during drilling calculated using BRAGFLO_DBR by the concentration of radionuclides within that brine calculated using PANEL. This use of PANEL, was not typical because PANEL did not calculate the release, but only the concentration. This use of PANEL is described in Section 2.3.3, and the BRAGFLO_DBR calculations are described in the Analysis Package for BRAGFLO Direct-Release Calculations (Task 4), WPO# 40520.

1.4 Indirect or Long-term Brine Release to the Culebra

As previously mentioned, the NUTS calculations used the BRAGFLO grid (Figure 1.1) and flow fields, to calculate the transport of radionuclides throughout the Salado Formation in the undisturbed and single human intrusion scenarios 1 through 5. NUTS was also used to calculate the transport throughout this region for intrusion times other than 350 and 1000 years. In order to reduce unnecessary computations, however, these calculations were done in two phases. In phase one, NUTS tracked a passive tracer in order to identify those realizations where contaminated brine reached the top of the salt or the land-withdrawal boundary (LWB) within the Salado in each of the 5 scenarios. Those realizations that had no contaminated brine transport out past these boundaries could not contribute to the total integrated release of radioisotopes from the disposal system, and were "screened out". For those realizations which were "screened in", NUTS was exercised again in phase two, modeling the mobilization and advective transport of selected radioisotopes. (See Section 3.1 for details of radioisotope selection.)

CCDFGF used the output of the phase II NUTS calculations to estimate the releases to the Culebra up to and including the first human intrusion within each panel. Modeling of the second intrusion borehole into the same panel, however, was not as straight forward. CCDFGF models the random placement and timing of boreholes, but it was not possible to run BRAGFLO calculations of the flow for any combination of location and timing of borehole intrusions. Instead, the flow field for a two intrusion scenario was approximated using the same grid as for S2 through S5 (see Analysis Package for the Salado Flow Calculations (Task 1) WPO# 40514). The BRAGFLO calculation of the S6 scenario flow fields approximated an E2 at 1000 years followed by an E1 at 2000 years by changing the properties of regions within the single borehole at the appropriate times. Thus, for S6 scenarios, BRAGFLO's inflow and outflow channels were vertically aligned. Correspondingly, the S6 lateral flow pattern within the repository did not represent actual flow patterns for spatially separated boreholes, thus reducing the interaction of waste with flowing brine. Using these flow fields in a NUTS calculation would result in possible underestimation of the contact of flowing brine with the waste throughout the panel. To eliminate that shortcoming, PANEL was used to mobilize wastes for all S6 scenarios. PANEL employed its own computational grid, treating an entire waste panel of the repository as though it were an efficient one-grid-block mixing cell. The entire contents of the penetrated waste panel were made equally available to all of the brine that entered that panel, no matter where the sampled inflow and outflow boreholes were located. In effect, that is equivalent to modeling the worst case of a double-intrusion scenario, that is, one in which the two boreholes were located at extreme opposite ends of the waste panel, and where no preferential flow paths were established. PANEL was also used to calculate the radioisotope mobilization and borehole transport in multiple intrusions (S6 or E2E1 events) that occurred at times other than those specified above as S6 times. See Section 2.3.2 for details.

The input flow-field variables used by both NUTS and PANEL, which were taken from the previously described BRAGFLO simulations, included collectively: the time history of brine velocity, brine saturation, and porosity in the repository, shaft, borehole, and surrounding formations; and brine volume in and brine outflow rate from the repository.

2. Description of NUTS and PANEL in the 1996 CCA Calculations

NUTS and PANEL both model the mobilization and transport of radionuclides within the Salado Formation, so these codes have many aspects in common. These are discussed first followed by descriptions of the codes capabilities and how they were used for the CCA.

2.1 Common Functionality and Assumptions

In the context of the 1996 CCA PA, the Salado transport codes had a single principal purpose -- to calculate the amount of each important isotope* that will exit the repository in contaminated brine and travel to selected boundaries. The regulated boundaries are 1) all underground locations at the LWB and 2) the surface, but NUTS was used only to calculate release out the marker beds to the LWB and up boreholes and the shafts to the Culebra member. (Transport within the Culebra member to the LWB was performed using SECO_TP.) PANEL was used only to calculate releases up the boreholes. Neither NUTS or PANEL calculated the fluid flow in or near the repository, but required this information from BRAGFLO or BRAGFLO_DBR calculations. The rate of contaminant exit from the repository depends on (i) the volume of brine released from the repository during a timestep and (ii) the concentration of radioisotopes within that flowing brine. For long term indirect releases, the first quantity was provided in advance by BRAGFLO, which analyses the 2-phase Darcy flow throughout the Castile, Salado, Rustler, and Dewey Lake Formations throughout the entire Land Withdrawal Act region. For direct releases, the flow was given by BRAGFLO_DBR. The two codes, NUTS and PANEL, were required to calculate the second quantity (concentration of each radioisotope), and to do so by treating the principal physical and chemical processes that can affect mobilization into a brine carrier that is flowing through a porous medium.

The principal physical and chemical processes that were modeled by both NUTS and PANEL were mobilization and radioactive decay. For mobilization, both codes required the isotope inventory and element solubility which were provided in the source term output files (see Section 2). The inventory was provided for the entire repository for the year of the start of the calculations, 2033. This inventory was apportioned using volume or areal fractions, to the computational cell(s) of NUTS and PANEL. Note that this is equivalent to assuming a homogenous waste inventory on the scale of the NUTS and PANEL computational grids. The contaminant "effective solubility", provided in the source term file, was the maximum concentration that the brine could hold both dissolved and suspended on colloids (See Section 3.3 for a discussion of the effective solubility). Both NUTS and PANEL assume *instantaneous* mobilization at this "effective solubility" limit provided sufficient inventory was present. Because sorption within the repository or pathways to the accessible environment was not modeled by either NUTS or PANEL, contaminant concentration was determined by the flow, inventory and effective solubility only. Inventory, however, is not static because of radioactive decay and ingrowth. Thus, both NUTS and PANEL calculated radioactive decay and ingrowth. Both codes also recognized that solubility was an element

---

* See Section 3.1 for isotope choice.

property while the inventory and release limits were isotope properties. Thus, both codes calculated "effective isotopic solubilities" using the element solubilities and the time dependent inventories of all isotopes of each element:

isotopic solubility = element solubility * moles isotope / total moles element.

2.2 NUTS
some text here

2.2.1 NUTS's Partial Differential Equation Treatment of Mobilization

Although NUTS is designed to treat a broad spectrum of transport problems, many of its options were disabled in the 1996 CCA calculations and the code was used solely to model mobilization and isothermal, purely advective transport in the matrix domain. Table 2.1 provides a summary of the features that are available in NUTS, and the features that were actually used in the 1996 CCA PA calculations. NUTS's general capabilities are described briefly in Appendix A, herein. For a thorough discussion of NUTS general features, scope of applications, assumptions, and limitations, the reader is referred to the WIPP PA User's Manual for NUTS, Version Number 2.02 (WPO #37927, 29 May 1996).

Table 2.1. NUTS Features Used in the CCA Calculations

NUTS Features	Features in the CCA Calculations	
	Used	Disabled
Single-porosity, fracture		x
Single-porosity, matrix	x	
Double-porosity		x
Double-permeability		x
Advective transport	x	
Diffusive-dispersive transport		x
Sorption		x
Colloid transport+		x+
Decay	x	
Gas phase transport		x
Temperature dependency		x
Multiple sites		x
Precipitation	x	
Solubility limit	x	
Interior sources	x	

+ Colloidal mobilization was combined with dissolution (see Section 3.3)

In the 1996 CCA PA calculation, the principle of the conservation of mass led to N governing partial-differential equations for purely advective, isothermal transport of N radioisotopes in a matrix domain. There were written as:

$$-\nabla . v_{wm} C_{wmn} + C^*_{wmn} q_{wm} = \frac{\partial}{\partial t}(\phi_{wm} S_{wm} C_{wmn}) + (\phi_{wm} S_{wm} C_{wmn})\lambda$$

$$-\sum_{j=1}^{J} (\phi_{wm} S_{wm} C_{wmn})_{pj} \lambda_{pj} C_{wmnpj}, \qquad n = 1,2,\ldots,N \qquad \text{Equation 2.1}$$

where the nomenclature and the subscripts are defined as follows:

q = solvent sink/source mass rate per unit volume ($m^3/s/m^3$)
ϕ = porosity of porous medium (dimensionless fraction given by BRAGFLO)
v = solvent advective velocity (m/s and given by BRAGFLO)
C = solute concentration (kg/m^3, the principal unknowns)
C^* = injected solute concentration (kg/m^3)
t = time (s)
S = saturation (dimensionless fraction given by BRAGFLO)
λ = decay constant (s^{-1} and known in advance)
m = matrix (the only medium treated in the 1996 CCA PA)
w = brine (the only phase treated in the 1996 CCA PA)
n = isotope index
p = parent
j = parent isotope index

The system of N transport equations given as Equation 2.1 constitutes only part of the relevant boundary-value problem. To complete the problem, it is necessary to add (i) an initialization condition throughout the domain, and (ii) boundary conditions for all time for the N dependent variables $C_{wmn}(x,y,z,t)$. In the 1996 CCA PA, NUTS's two-dimensional, radial-flared* domain was identical to BRAGFLO's (Version 4.00) domain, that is, it represented the entire LWB region. That domain is referred to herein as (0,X and 0,Y). NUTS's initial conditions were:

$$C_{wmn}(x,y,0) = f_{mn}(x,y) \qquad 0 \le x \le X,\ 0 \le y \le Y, \qquad \mathbf{2.2}$$

where $f_{mn}(x,y)$ represents the initial concentration field of the nth radioisotope and is understood to be known at every point in the domain. The boundary conditions may be either Dirichlet or Neumann boundary conditions of the first kind. If they are Dirichlet conditions, the dependent variable itself is specified at the boundaries, as follows:

* The 2-dimensional coordinate system is quasi-axisymmetric and is thereby able to describe the 3-dimensional LWB spatial domain. See the Analysis Package for the Salado Flow Calculations (Task 1), WPO# 40514, for details.

$$
\begin{aligned}
C_{wmn}(0,y,t) &= g_{1x}(t) & t \geq 0,\\
C_{wmn}(X,y,t) &= g_{1X}(t) & t \geq 0,\\
C_{wmn}(x,0,t) &= g_{1y}(t) & t \geq 0,\\
C_{wmn}(x,Y,t) &= g_{1Y}(t) & t \geq 0.
\end{aligned}
\tag{2.3}
$$

.

If they are Neumann boundary conditions, the normal derivatives of the dependent variable are specified at the boundaries, as follows

$$
\begin{aligned}
\frac{\partial}{\partial x}\left[C_{wmn}(0,y,t)\right] &= g_{2x}(t) & t \geq 0,\\
\frac{\partial}{\partial x}\left[C_{wmn}(X,y,t)\right] &= g_{2X}(t) & t \geq 0,\\
\frac{\partial}{\partial y}\left[C_{wmn}(x,0,t)\right] &= g_{2y}(t) & t \geq 0,\\
\frac{\partial}{\partial y}\left[C_{wmn}(x,Y,t)\right] &= g_{2Y}(t) & t \geq 0.
\end{aligned}
\tag{2.4}
$$

In this analysis document, Dirichlet boundary conditions are used internally as sources. Neumann boundary conditions, on the other hand are used to specify no-transport at the outer boundaries of the simulation domain, i.e., $\frac{\partial C_{wmn}}{\partial x} = 0$ and $\frac{\partial C_{wmn}}{\partial y} = 0$.

In the 1996 CCA PA calculations, NUTS imposed a no-flow or Neumann-type boundary condition at all exterior grid boundaries. Thus, no mass was transported across the exterior grid boundary. NUTS has the capability of imposing a Dirichlet type condition at any grid block location. This feature was used in screening calculations (see Section 2.2.3). For the screening calculations, a fixed inventory (unit concentration) was maintained for all time at each grid block within the waste regions. For isotope-transport calculations, the initial inventory was specified. The calculation of initial inventory is described in Section 3.7.3. For all calculations, the initial concentrations outside the waste regions were zero.

2.2.2 Discretization and Solution of NUTS's Transport Equations

The N partial differential equations that govern transport in the matrix (Equation 2.1) are discretized in two dimensions and then developed into a linear system in preparation for numerical implementation. In general, the discretized mass-transport equation for each constituent in the brine is written as follows (the subscript n has been dropped for ease in writing, the grid points i are identical with BRAGFLO's grid points (see Figure 1.1), fractional indices refer to quantities that are to be evaluated midway between grid points, and NUTS's time steps are 20 BRAGFLO time steps in duration):

$$q^{n+1}_{wmi+\frac{1}{2}} C^{n+1}_{wmi+\frac{1}{2}} - q^{n+1}_{wmi-\frac{1}{2}} C^{n+1}_{wmi-\frac{1}{2}} + q^{n+1}_{wmj+\frac{1}{2}} C^{n+1}_{wmj+\frac{1}{2}} - q^{n+1}_{wmj-\frac{1}{2}} C^{n+1}_{wmj-\frac{1}{2}} + C^{*n+1}_{wmi} Q^{n+1}_{wmi} =$$
$$\frac{V_{Ri}}{\Delta t}\left[\left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n+1} - \left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n}\right] + V_{Ri}\left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n+1}\lambda - V_{Ri}\sum_{l=1}^{L}\left\{\phi_{mi} S_{wmi} C_{wmli}\lambda_l\right\}^{n+1} \tag{2.5}$$

If the interfacial values of concentration in Equation 2.5 are discretized using the one-point upstream winding method, the resultant equation will be:

$$q^{n+1}_{wmi+\frac{1}{2}}\left(\omega_{mi+1} C^{n+1}_{wmi} + (1-\omega_{mi+1}) C^{n+1}_{wmi+1}\right) - q^{n+1}_{wmi-\frac{1}{2}}\left(\omega_{mi} C^{n+1}_{wmi-1} + (1-\omega_{mi}) C^{n+1}_{wmi}\right) +$$
$$q^{n+1}_{wmj+\frac{1}{2}}\left(\omega_{mj+1} C^{n+1}_{wmj} + (1-\omega_{mj+1}) C^{n+1}_{wmj+1}\right) - q^{n+1}_{wmj-\frac{1}{2}}\left(\omega_{mj} C^{n+1}_{wmj-1} + (1-\omega_{mj}) C^{n+1}_{wmj}\right) + \tag{2.6}$$
$$C^{*n+1}_{wmi} Q^{n+1}_{wmi} = \frac{V_{Ri}}{\Delta t}\left[\left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n+1} - \left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n}\right] + V_{Ri}\left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n+1}\lambda -$$
$$V_{Ri}\sum_{l=1}^{L}\left\{\phi_{mi} S_{wmi} C_{wmi}\lambda_l\right\}^{n+1}.$$

where q is the grid block interfacial brine volumetric rate in m^3/s, Q is the brine injection rate in m^3/s, and V_R is the grid block volume in m^3. By collecting similar terms, the above equation can be represented by the following linear system,

$$A_m C^{n+1}_{wmj-1} + B_m C^{n+1}_{wmi-1} + C_m C^{n+1}_{wmijk} + D_m C^{n+1}_{wmi+1} + E_m C^{n+1}_{wmj+1} = R^{n+1}_m \quad , \tag{2.7}$$

where

$$A_m = -\ \omega_{mj}\, q^{n+1}_{wmj-\frac{1}{2}},$$
$$B_m = -\ \omega_{mi}\, q^{n+1}_{wmi-\frac{1}{2}},$$
$$D_m = (1-\omega_{mi+1})\, q^{n+1}_{wmi+\frac{1}{2}},$$
$$E_m = (1-\omega_{mj+1})\, q^{n+1}_{wmj+\frac{1}{2}},$$
$$C^{n+1}_m = -(1-\omega_{mj})\, q^{n+1}_{wmj-\frac{1}{2}} - (1-\omega_{mi})\, q^{n+1}_{wmi-\frac{1}{2}} + \omega_{mj+1}\, q^{n+1}_{wmj+\frac{1}{2}} + \omega_{mi+1}\, q^{n+1}_{wmi+\frac{1}{2}} -,$$
$$\frac{V_{Ri}}{\Delta t}\left\{\phi_{mi} S_{wmi}\right\}^{n+1} + V_{Ri}\left\{\phi_{mi} S_{wmi}\right\}^{n+1}\lambda,$$

and

$$R^{n+1}_m = -\frac{V_{Ri}}{\Delta t}\left\{\phi_{mi} S_{wmi} C_{wmi}\right\}^{n} - C^{*}_{wmi} Q^{n+1}_{wmi} - V_{Ri}\sum_{i=1}^{L}\left\{\phi_{mi} S_{wmi} C_{wmli}\lambda_l\right\}^{n+1}.$$

In Equation 2.6, ω refers to the upstream weighting and takes on the values of 0 and 1. The value of ω is determined by the sign of the local velocity. For two adjacent blocks i-1 and i, the value of ω_i is:

$$\omega_i = \begin{Bmatrix} 1 & \textit{if the flow from } i-1, j, k \textit{ to } i, j, k \\ 0 & \textit{otherwise} \end{Bmatrix}.$$

Similarly, the weighting parameter in the other direction is

$$\omega_j = \begin{Bmatrix} 1 & \textit{if the flow from } i, j-1, k \textit{ to } i, j, k \\ 0 & \textit{otherwise} \end{Bmatrix}.$$

The transport equations (Equations 2.6) have N *G unknowns, where N is the number of equations in each grid block and G is the number of grid blocks in the simulated spatial domain. The system of governing partial differential equations is strongly coupled one to the other because of the strong contribution from parental decay to the concentration of the immediate daughter. Consequently, a sequential method is used to solve the system implicitly.

The matrix resulting from one-point upstream winding has the following structural form for a two-dimensional system of 3x3 grid blocks:

T	1	2	3	4	5	6	7	8	9
1	X	X	0	X					
2	X	X	X	0	X				
3	0	X	X	0	0	X			
4	X	0	0	X	X	0	X		
5		X	0	X	X	X	0	X	
6			X	0	X	X	0	0	X
7				X	0	0	X	X	0
8					X	0	X	X	X
9						X	0	X	X

where *X* refers to matrix entries, and *0* refers to zero entries.

Standard Gaussian elimination is used to invert the numerical matrix. Two techniques are applied to reduce the size of the numerical matrix to more manageable dimensions. In the first technique, an optimum dimension (in standard ordering) is chosen to define the connectivity of the grid blocks. The guideline for this choice is the minimum number of grid blocks. Hence, for a two dimensional problem in x and y, the numbering will start from min(x,y) and proceed to the next dimension. The second technique is used to straighten the numerical matrix diagonals and limit the calculation to the entries between the uppermost and the lowermost diagonals. Therefore, for a single-porosity, matrix system in two dimensions, a pentagonal matrix of IBW*G is inverted instead of G*G matrix, where IBW is the band width.

2.2.3 NUTS's Preliminary Screening Runs

NUTS calculations in the CCA could be performed for thousands of potential transport realizations. However, it is possible to show *a priori*, by performing upper-bound transport calculations using a hypothetical wholly-passive, non-decaying, non-sorbing tracer, that some of BRAGFLO's flow realizations present no possibility of transporting radioactive isotopes to the accessible environment. All BRAGFLO flow simulations were screened by NUTS using such a tracer, as described below.

NUTS screening simulations considered an infinite source of a non-decaying, non-dispersive, non-sorbing, hypothetical species as a tracer element. During the 10,000-year regulatory time period, the tracer was given a unit concentration of 1 kg/m^3 in all waste disposal areas (Castile brine may have another tracer for scenarios with intrusion). If the tracer did not reach the Land Withdrawal Boundary or Culebra (through the marker beds, the shaft and/or the well bore) in a realization, then the realization was screened out. If, however, a cumulative tracer mass $\geq 10^{-7}$ kg was observed at the Land Withdrawal Boundary or Culebra during the 10,000-year simulation time, then a complete transport analysis using selected isotopes was conducted.

The lower bound 10^{-7} kg was chosen by considering the regulated performance measure, the CCDF. The complementary cumulative distribution function shows the cumulative probability that the release in "total EPA units" will be below specified values on the x axis. For each radioisotope, an EPA unit is defined as the inventory of that isotope in Curies divided by the EPA release limit (as specified in 40CFR Part 191, Appendix A, Table 1) for that isotope in Curies. Once normalized by their EPA limits, all isotopes may be added up to obtain the "total EPA units". Since the minimum EPA unit considered in the CCDF calculations was 10^{-6} units, we calculated the mass of 10^{-6} EPA units of the four elements most likely to cause violation: Am, Pu, U and Th. Of these four, the minimum mass was from Am, 10^{-7} kg. (See Appendix B for a description of these calculations.) Thus the greatest EPA unit release associated with 10^{-7} kg release would be 10^{-6} for Am.

The use of 1 kg/m^3 concentration for the tracer is justified by comparison to the highest solubility limit used in the PA. The highest solubility range sampled in the PA was for Th(+IV) in Salado brine: $10^{-3.19}$ molar (M). Converted to kg/m^3 this is 0.15 kg/m^3. Because 1 kg/m^3 is greater than 0.15, the tracer calculations will overestimate the release of any single element, and there is no danger that important realizations were screened out.

2.2.4 NUTS Calculations for Intrusion Times other than 350 and 1000 years

In the Salado flow calculations, two specific intrusion times, 350 and 1000 years, were used by BRAGFLO. Probabilistic sampling of intrusion times, however, was not limited to those values. Intrusion(s) could occur at any time between 100 and 10,000 years. Therefore, a wider spectrum of intrusion times had to be considered in the transport calculations. Because it was not practical to run the entire suite of codes for every possible intrusion time, time shifting was used in NUTS. NUTS shifted BRAGFLO's (i) 350- and (ii) 1,000-year flow-field results and applied them to transport calculations for intrusions at (i) 100 and (ii) 3000, 5000, 7000, and 9000, respectively. The principal rationale behind applying BRAGFLO's computed flow fields to times other than the ones for which they were calculated is that repository performance is sensitive to and may even be overwhelmed by gas-pressure relief and brine inflow (from the high-pressure brine pocket and/or marker beds) that can occur at or soon after intrusion but is not overly sensitive to the kinds of changes (e.g., fracturing) that occur prior to intrusion.

In the shifted intrusion-time calculations, the period prior to intrusion is treated as undisturbed. Consequently the output from NUTS's undisturbed transport calculation (S1) for the same realization is used to initialize the calculation at the time of intrusion. Since BRAGFLO's output is controlled by an automatic time-stepping procedure, the likelihood of starting NUTS calculations exactly at one of the shifted times (e.g., 3000, 5000, etc.) is small. Therefore, the closest time greater or less than the intended shifted time was employed to commence the calculation.

As will be discussed in Section 7.2, only realizations for E1 and E2 scenarios that survived the screening process were considered for this kind of shifting in the CCA calculations. It should also be noted, that the output files from the time-shifted runs contain only the transport information from the time of intrusion onward. Because the only important transport to the accessible environment is through the borehole, and transport up the borehole is zero before intrusion, these output files are sufficient for the CCA calculations. Transport toward the accessible environment through other pathways such as the marker beds and shaft are insignificant, but the full time history of this transport could be assembled from the NUTS undisturbed and time shifted runs, using SUMMARIZE to interpolate to specified time steps and combining the SUMMARIZE tables.

2.3 PANEL

PANEL was used in two ways within the CCA. For the Scenario 6 long term releases, PANEL was used to calculate an upper-bound estimate of the discharge of radioisotopes to the Culebra, as described in Section 2.3.1. For the direct brine release calculations, PANEL was used in an atypical way, which will be described in Section 2.3.3.

2.3.1 Long Term releases

While PANEL serves a similar function as NUTS in the CCA, its calculations are much less sophisticated. Instead of solving full transport differential equations using BRAGFLO's time steps and grid, it solves simple integrated analytical equations using 50 year time steps and a single computational cell that represents a waste panel. The waste panel is assumed to be well mixed and radioactive decay is decoupled from transport.

PANEL's mass* conservation during each time step n+1 may be described by:

$$I_j(t_n) = I_i(t_{n-1}) - (V_{out}(t_n) * C_i(t_n)) - D_i(t_n) + G_i(t_n) \qquad \textbf{2.5}$$

where:

$I_i(t_n)$	= the inventory in moles of isotope i within the waste panel at the end of time step n
$V_{out}(t_n)$	= the volume of brine (m^3) flowing out of the panel during time step n
$C_i(t_n)$	= the concentration of isotope i within the waste panel brine at time (t_n) (moles/m^3)
$D_i(t_n)$	= represents the moles of isotope i lost by radioactive decay during the time step
$G_i(t_n)$	= represents the moles of isotope i gained by radioactive ingrowth during the t time step.

For the first time step, the waste panel inventory, I_0, is calculated from the repository inventory reported in the database as follows. PANEL assumed the entire inventory was distributed uniformly throughout the repository as a whole. PANEL then assumed the repository comprised (i) 8 storage panels, each having a plan-view area of 11,640 m^2 , (ii) a southern equivalent panel† having an area of 8,820 m^2, and (iii) a northern equivalent panel having an area of 9,564 m^2. These areas were then used to scale the inventory linearly to the appropriate panel size. The fraction of the repository that is available to brine flow is coded into PANEL and is not readily. In the 1996 CCA regulatory runs, that fraction was set to represent one standard panel, that is, 11,640 m^2. Since the net area of the repository was 111,504 m^2, the breached panel was taken to contain 0.1044 of the repository's waste. The areal data quoted above and used in the 1996 CCA PA PANEL calculations, derive from an earlier WIPP PA (WIPP PA Div., 1991, pages 3-5) and were not exactly the same as reported in the parameter database or the BRAGFLO grid. Had data from the 1996 CCA database been used, the resultant areal fraction of a panel would have been 0.1057. Had the BRAGFLO grid volume fraction been used, the fraction would have been .1058. Thus, PANEL underestimated the panel inventory by approximately 1.4%. Plutonium is not inventory limited in the PANEL calculations, so its release is not affected, but ^{241}Am is inventory limited by 4000 years in all realizations, so its release may be underestimated by up to 1.4%. However, compared to the large conservatism's in the PANEL calculations (see the summary at the end of this section), this effect is negligible. Treating a single waste panel is tantamount to assuming lower-level repository seals function well. The inventory is input in Curies and it is converted to moles as follows:

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* For convenience, PANEL internally tracks isotopes using moles, but outputs releases in kg.

† Equivalent panels are grids of access tunnels that will be used as waste-storage areas after their utility as access tunnels has ended.

$I_i(t_0) = Ci_i * T_i * 3.7x10^{10} / (\text{Avogadro's number} * \ln(2))$

where Ci_i is the Curies of isotope i, T_i is the half-life in seconds of isotope i, and $3.7x10^{10}$ is the number of becquerels in a Curie.

The $V_{out}(t_n)$ term was obtained by interpolating the cumulative flow (m^3) up into BRAGFLO grid block 575 to PANEL's times t_n and t_{n+1} and taking the difference. The cumulative flow was obtained by time-integrating the positive BRAGFLO flow rates at that cell, in an ALGEBRACDB calculation.

The $C_i(t_n)$ term is either the "effective isotope solubility" (see Section 3.3), $C_{max,i}$, or the inventory divided by the waste panel brine volume:

$$C_i(t_n) = \begin{cases} C_{max,i} & , \text{ if } I_i(t_n)/V(t_n) \geq C_{max,i} \\ I_i(t_n)/V(t_n) & , \text{ if } I_i(t_n)/V(t_n) < C_{max,i} \end{cases} ,$$

and where

$C_{max,i}$ = the "effective isotope solubility" of the ith isotope (moles/liter), and
$V(t_n)$ = volume (m^3) of brine contained in the panel at the beginning of the nth timestep, interpolated from the BRAGFLO brine volumes.

As previously described, the "effective isotope solubility", $C_{max,i}$, is

$$C_{max,i} = C_{max,e} \cdot (I_i(t_n)/ I_e(t_n))$$

where:
$C_{max,e}$ = the "effective elemental solubility" of element e,
$I_e(t_n)$ = the element inventory which is the sum of the inventory (moles) of all isotopes of element e.

The decay and ingrowth terms $D_i(t_n)$ and $G_i(t_n)$, represent the adjustment of the inventory for radioactive decay. In the PANEL, calculations, the adjustment of the inventory for radioactive decay is performed separately and after the adjustment for advective release. PANEL uses a algorithm based on the integrated Bateman equations (Bateman, 1910) that loops over 30 isotopes* and calculates the decay of each isotope and the ingrowth of progeny isotopes in up to 4 succeeding generations of each isotope. An example is given here of the calculations for an isotope which has two generations following it. The isotope is labeled 1, the daughter 2 and granddaughter 3.

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* PANEL uses a hard coded list of 30 important isotopes in simplified decay chains. (See the PANEL's User's Manual, WPO# 37361, 10 May 1996, for a complete description, and Section 3.1, for a discussion of isotopes.)

$$M_1(t_n) = [M_1(t_{n-1})]\,[e^{-\lambda_1 \Delta t}]$$

$$M_2(t_n) = [M_2(t_{n-1})]\,[e^{-\lambda_2 \Delta t}] + [\lambda_1 M_1(t_{n-1})]\,[e^{-\lambda_1 \Delta t} - e^{-\lambda_2 \Delta t}] / [\lambda_2 - \lambda_1]$$

$$M_3(t_n) = [M_3(t_{n-1})]\,[e^{-\lambda_3 \Delta t}] + [\lambda_2 M_2(t_{n-1})]\,[e^{-\lambda_2 \Delta t} - e^{-\lambda_3 \Delta t}] / [\lambda_3 - \lambda_{24}]$$

$$+ \lambda_1 \lambda_2 M_1(t_{n-1}) \{e^{-\lambda_1 \Delta t} / [\lambda_2 - \lambda_1][\lambda_3 - \lambda_1] + e^{-\lambda_2 \Delta t} / [\lambda_3 - \lambda_2][\lambda_1 - \lambda_2] + e^{-\lambda_3 \Delta t} / [\lambda_1 - \lambda_3][\lambda_2 - \lambda_3]\}$$

where $M_i(t_{n-1})$ is the moles of the ith isotope at the start of the time step, the decay constant, λ_i, is $\ln(2)/T_i$, T_i is the half-life of the ith isotope, and $\Delta t = t_n - t_{n-1}$.

The discharge of isotope i up the borehole, is written to an output file as the cumulative advective release (kg) up to time step n, $R_i(t_n)$.

$$R_i(t_n) = \sum_{m=0}^{n} V_{out}(t_m) \bullet C_i(t_m) \bullet MW_i \bullet 1000,$$

where MW_i is the molecular weight of isotope i in g/mole.

Through its simplified approach, PANEL calculates the theoretical upper-limit of release from the repository. Its use in providing release estimates to the Culebra is quite conservative for several reasons.

1) The 10 m3 of pore space within the borehole between the repository and Culebra, and the time it takes to travel through this pore space is ignored. With median cumulative volumes of brine flowing up into block 575 in 10,000 years of 1.96, 2.88 and 2.52 m^3 for replicates 1,2 and 3*, over half of the realizations would actually show no release because the brine would never make it up the borehole. (Compare this to the 222 out of 300 realizations that show discharge of greater than 10^{-6} EPA units in Section 7.3.4.)
2) The concentration term when the isotope is inventory limited $\{C_i(t_n) = I_i(t_n)/V(t_n)\}$ is maximized because the inventory is maximized and the volume is minimized. The inventory is maximized because it is assumed to remain within the panel until it travels up the borehole, ignoring any movement of radioisotopes into the DRZ or marker beds. It is also maximized because inventory within the panel is assumed equal contact with flowing brine, ignoring the possibility that inventory within far rooms, or at the top of the panel may not interact with flowing brine. The brine volume is minimized because it is summed within the panel only, ignoring the brine within the DRZ.
3) $V_{out}(t_n)$ is obtained by summing the positive flows into grid block 575 and ignoring the negative, thus, if any pumping action occurs within the borehole, the upward flow is counted more than once.
4) It assumed that all brine flowing up the borehole above the repository has come into contact with waste. After the waste panel has filled with brine, the brine from the Castile will flow directly up the borehole with very little contact with the waste.

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* from disk$tina_cca3:[bf.ldmille.cca.summz.r#s6]stats_r#s6_h-078.dat

2.3.2 PANEL's S6 Calculations for Intrusion times other than 2000

The basic S6 run was an E2 intrusion at 800 years followed by an E1 intrusion at 2000 years. For sampling purposes (treated by the code CCDFGF), it was necessary to know the resultant E2E1 flow field for intrusions at times other than the times at which it was actually calculated by BRAGFLO, specifically, for the second intrusion occurring at an intrusion time (IT) of 100, 350 1000, 4000, 6000, and 9000 years. That was accomplished by adding the time shift (IT - 2000) to the time on the S6 BRAGFLO output files using ALGEBRACDB. If the times were shifted backward (IT of 100, 350, and 1000 years), the resulting times were extended to 10,000 years (1) by keeping the panel volume constant at the last volume and (2) by computing the cumulative outflow by keeping the flow-rate constant at the last computed flow rate. If the times were shifted forward, (4000, 6000, and 9000 years), the initial conditions of small repository saturation and zero flow up the into grid block 575 where maintained until the first time shifted BRAGFLO time step.

2.3.3 Direct Brine Release

In the second type of application, PANEL was used to calculate the concentration of contaminants contained in brine released directly to the surface (if any) at the time of drilling a borehole. The time of intrusion varied between 100 to 10,000 years, and the release at intrusion is not expected to significantly change the panel inventory, so calculation of the panel concentrations as a function of time in an undisturbed repository was all that was required. Because PANEL output is cumulative release, not concentration, the following scheme was created to have PANEL provide the information necessary to construct a time history of repository concentrations. Using an ALGEBRACDB calculation, the BRAGFLO flow rates and panel volumes were reset to constant values. The panel brine volume was set to 4000 m^3*, and the flow rate was set to a constant rate that was low enough to prevent inventory depletion, but high enough to provide numerically accurate releases: 10^{-5} cubic meters per year. Panel concentrations (kg/m^3) could then be calculated at any time by the following equation.

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* A brine volume of 4000 m^3 was chosen as an estimate for the brine volume for realizations which had direct brine release after examining the BRAGFLO waste panel brine volumes for S1, S3, and S5. In each of these scenarios, the brine volumes changed with time and ranged from about 0 to 6000m^3. The visually determined median of the ranges were about 2000, 4000, and 3000 respectively. Direct brine release is only possible with high brine saturations, so the highest median brine volume from these three scenarios was selected.

$CONC_i(t_n) = [R_i(t_n) - R_i(t_{n-1})] / [V_{cumout}(t_n) - V_{cumout}(t_{n-1})]$
where $V_{cumout}(t_n) = \Sigma V_{out}(t_n)$, the cumulative volume of brine up the borehole at *time* t_n in m^3.
Note that $[V_{cumout}(t_n) - V_{cumout}(t_{n-1})] = V_{out}(t_n)$ = flow rate $\bullet$ Δt, and $[R_i(t_n) - R_i(t_{n-1})] = C_i \bullet V_{out}$ with unit conversions, thus the V_{out} and the assumed flow rate cancel out.

3. Source-Term Calculations

This chapter presents the (1) scientific basis for, and (2) detailed structure of Source-Term ALGEBRACDB's calculations, as well as (3) its application characteristics in NUTS and PANEL, as they were exercised in the 1996 CCA PA.

3.1 Radioisotopes Included in the 1996 CCA

Of the 135 radioisotopes reported in the TWBIR (DOE 1995), 47 are regulated by 40CFR191. Sanchez et al. (1996) compiled a projected WIPP inventory* of these 135 radioisotopes and reported their results in Curies, kg, and "EPA units".
For each radioisotope, an EPA unit is defined as the inventory of that isotope in Curies divided by the EPA release limit for that isotope in Curies (as specified in 40CFR Part 191, Appendix A, Table 1). Of the 135 isotopes listed, only 25 have more than 0.001 EPA units of inventory at any time within the 10,000 year regulatory period. Consequently, only those have a direct potential to affect calculated releases. In addition to those, however, there are several unregulated short-lived isotopes that (1) have significant inventory, and (2) decay to regulated isotopes. The radioisotopes that could affect regulated releases indirectly have long been included in the list of 30 radioisotopes treated by PANEL. The two lists of radioisotopes, i.e., (i) the 25-member list of top EPA-unit isotopes and (ii) PANEL's list of 30 isotopes were combined. Because of overlap, the amalgamated list included a total of 33 distinct isotopes, and they were taken to be the isotopes of interest for consideration for inclusion in the 1996 CCA PA. Table 3.1 lists the 33 chosen isotopes.

The order of the listing in Table 3.1 is according to decreasing number of "EPA units. All of the 33 radionuclides except ^{14}C, ^{137}Cs, ^{147}Pm, ^{147}Sm, ^{90}Sr, and ^{232}U belong to the following decay chains:

$$\qquad\qquad {}^{238}\mathrm{Pu} \searrow$$
$$ {}^{242}\mathrm{Pu} \rightarrow {}^{238}\mathrm{U} \rightarrow {}^{234}\mathrm{U} \rightarrow {}^{230}\mathrm{Th} \rightarrow {}^{226}\mathrm{Ra} \rightarrow {}^{210}\mathrm{Pb} \qquad (1)$$

$$ {}^{243}\mathrm{Cm} \searrow$$
$$ {}^{243}\mathrm{Am} \rightarrow {}^{239}\mathrm{Pu} \rightarrow {}^{235}\mathrm{U} \rightarrow {}^{231}\mathrm{Pa} \rightarrow {}^{227}\mathrm{Ac} \qquad (2)$$

$$\qquad\qquad\qquad {}^{244}\mathrm{Cm} \searrow$$
$$ {}^{252}\mathrm{Cf} \rightarrow {}^{248}\mathrm{Cm} \rightarrow {}^{244}\mathrm{Pu} \rightarrow {}^{240}\mathrm{Pu} \rightarrow {}^{236}\mathrm{U} \rightarrow {}^{232}\mathrm{Th} \rightarrow {}^{228}\mathrm{Ra} \qquad (3)$$

$$ {}^{245}\mathrm{Cm} \rightarrow {}^{241}\mathrm{Pu} \rightarrow {}^{241}\mathrm{Am} \rightarrow {}^{237}\mathrm{Np} \rightarrow {}^{233}\mathrm{U} \rightarrow {}^{229}\mathrm{Th} \quad (4)$$

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* As modeled in Source-Term ALGEBRACDB, contact-handled and remote-handled wastes were combined to form a homogeneous waste mixture that was distributed uniformly throughout the repository's ten waste panels. In contrast, CUTTINGS treated the two waste forms individually (see the Analysis Package for the Cuttings and Spallings Calculations (Tasks 5 & 6), WPO# 40521).

Table 3.1 The 33 Isotopes Considered for Modeling in the 1996 CCA PA (Based on the WIPP PA Analysis Report for EPAUNI (Sanchez et al., (1996)), WPO# 39259)

PANEL	NUTS			Half life	Release	0 years	0 years	100 years	350 years	10000 years	
			Isotope	(years)	Limit	Ci	EPA Units	EPA Units	EPA Units	EPA Units	MAX EPA
x	x	t,p	PU-238	8.77E+01	344	1.94E+06	5.63E+03	2.55E+03	3.54E+0	1.32E-22	5.63E+03
x	x	t,p	PU-239	2.41E+04	344	7.95E+05	2.31E+03	2.30E+03	2.29E+0	1.73E+03	2.31E+03
x	x	t,p	AM-241	4.32E+02	344	4.88E+05	1.42E+03	1.24E+03	8.31E+0	1.55E-01	1.42E+03
x	c	t,p	PU-240	6.54E+03	344	2.14E+05	6.23E+02	6.17E+02	6.01E+0	2.16E+02	6.23E+02
		t,p	CS-137	3.00E+01	3440	9.31E+04	2.71E+01	2.68E+00	8.32E-03	0.00E+00	2.71E+01
		t,p	SR-90	2.91E+01	3440	8.73E+04	2.54E+01	2.35E+00	6.12E-03	0.00E+00	2.54E+01
x	c	t,p	U -233	1.59E+05	344	1.95E+03	5.67E+00	5.66E+00	5.66E+0	5.44E+00	5.67E+00
x	x	t,p	U -234	2.45E+05	344	7.51E+02	2.18E+00	3.28E+00	4.07E+0	4.09E+00	4.09E+00
x	x	t,p	TH-230	7.70E+04	34	3.06E-01	8.88E-03	3.41E-02	1.20E-01	3.56E+00	3.56E+00
x	c	t,p	PU-242	3.76E+05	344	1.17E+03	3.40E+00	3.40E+00	3.40E+0	3.34E+00	3.40E+00
x	c	t,p	TH-229	7.34E+03	344	9.97E+00	2.90E-02	8.19E-02	2.12E-01	3.40E+00	3.40E+00
x		t,p	NP-237	2.14E+06	344	6.49E+01	1.89E-01	2.32E-01	3.15E-01	4.82E-01	4.82E-01
x		t,p	CM-245	8.53E+03	344	1.15E+02	3.33E-01	3.31E-01	3.24E-01	1.48E-01	3.33E-01
		t,p	RA-226	1.60E+03	344	1.14E+01	3.32E-02	3.19E-02	2.94E-02	2.77E-01	2.77E-01
		t,p	PB-210	2.23E+01	344	8.75E+00	2.54E-02	3.19E-02	2.96E-02	2.77E-01	2.77E-01
x		t,p	U -238	4.47E+09	344	5.01E+01	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01
x		t,p	U -236	2.34E+07	344	6.72E-01	1.95E-03	3.79E-03	8.29E-03	1.16E-01	1.16E-01
x		t,p	AM-243	7.37E+03	344	3.25E+01	9.45E-02	9.36E-02	9.14E-02	3.69E-02	9.45E-02
x		t,p	U -235	7.04E+08	344	1.75E+01	5.08E-02	5.10E-02	5.16E-02	7.06E-02	7.06E-02
x		t,p	CM-243	2.91E+01	344	2.07E+01	6.03E-02	5.30E-03	1.21E-05	0.00E+00	6.03E-02
		t	U -232	6.89E+01	344	1.79E+01	5.21E-02	1.99E-02	1.79E-03	0.00E+00	5.21E-02
		t	C -14	5.72E+03	344	1.28E+01	3.72E-02	3.68E-02	3.57E-02	1.11E-02	3.72E-02
x		t,p	TH-232	1.41E+10	34	1.01E+00	2.92E-02	2.92E-02	2.92E-02	2.92E-02	2.92E-02
		t	AC-227	2.18E+01	344	5.05E-01	1.47E-03	1.43E-03	1.69E-03	1.28E-02	1.28E-02
		t,p	PA-231	3.28E+04	344	4.67E-01	1.36E-03	1.46E-03	1.72E-03	1.28E-02	1.28E-02
x		p	CM-248	3.39E+05	344	3.72E-02	3.72E-04	3.72E-04	3.71E-04	3.64E-04	3.72E-04
x		p	PU-244	8.26E+07	344	1.51E-06	1.51E-08	1.54E-08	1.61E-08	4.34E-08	4.34E-08
		p	SM-147	1.06E+11	344	4.55E-10	4.55E-12	4.55E-12	4.55E-12	4.55E-12	4.55E-12
		p	PM-147	2.62E+00		8.10E-04					
		p	RA-228	5.75E+00		1.00E+00					
		p	CF-252	2.64E+00		1.72E-04					
x		p	CM-244	1.81E+01		7.44E+03					
x	c	p	PU-241	1.44E+01		3.94E+05					

x = included in calculation,
c = c - combined with a transported isotope
t = one of top 25 isotopes
p = one of panel isotopes

3.1.1 Isotopes included in the NUTS calculations

Because NUTS is a relatively slow-running code, and decreasing the number of isotopes it mobilizes can decrease its run time substantially, the above list of isotopes and decay chains was carefully examined to determine the minimum number of isotopes required to accurately describe the compliance behavior of the WIPP. Isotopes having similar decay behaviors and transport characteristics were combined in ways that would introduce little to no loss of release information in terms of normalized EPA units. Isotopes having low normalized EPA inventories and thus having insignificant effect on total releases were ignored. Using those guidelines, isotopes having EPA units the same or less than ^{237}Np in Table 3.1 were not modeled in NUTS. The *sum* of the *maximum* EPA units for all the eliminated isotopes is 1.6 EPA units, or .01% of the overall EPA units contained within the entire inventory. Nearly the entire inventory of these isotopes would have to be released to the accessible environment for a violation to occur from those isotopes. If conditions occurred that could transport almost the entire inventory of those isotopes to the accessible environment, a large fraction of the more important isotopes would also be brought to the accessible environment and an unmistakable violation would occur due to the more important isotopes. Even though ^{137}Cs and ^{90}Sr have significant initial inventories, they too were dropped because of the very low probability that a large fraction of the ^{137}Cs and ^{90}Sr inventory could be transported to the accessible environment before they had decayed to well less than an EPA unit (136 years for Cs and 128 years for Sr). Short-lived, and therefore unregulated isotopes at the top of the decay chains were reexamined to determine if their decay could significantly increase the inventory of important isotopes. ^{241}Pu was found to be such an isotope and it was added back to the list.

The remaining 10 isotopes account for 98.9% of the EPA units within the waste at the time of emplacement and belong to the following simplified decay chains:

$$\begin{array}{l} ^{238}\mathrm{Pu} \searrow \\ ^{242}\mathrm{Pu} \rightarrow {}^{234}\mathrm{U} \rightarrow {}^{230}\mathrm{Th} \end{array} \tag{5}$$

$$^{239}\mathrm{Pu} \tag{6}$$

$$^{240}\mathrm{Pu} \tag{7}$$

$$^{241}\mathrm{Pu} \rightarrow {}^{241}\mathrm{Am} \rightarrow {}^{233}\mathrm{U} \rightarrow {}^{229}\mathrm{Th}. \tag{8}$$

Focusing on the remaining group of 10 isotopes, if the isotopes having similar decay and transport characteristics are combined and treated as single "lumped equivalent" isotopes, the 7 isotopes: ^{234}U/^{233}U, ^{230}Th/^{229}Th, and ^{242}Pu/^{239}Pu/^{240}Pu may be grouped to form three internally similar groups. Thus, 4 isotopes can be eliminated by lumping. In addition, the 13 year half-lived ^{241}Pu was decayed and added to ^{241}Am. The list of 10 isotopes may therefore be reduced to five lumped equivalent isotopes. The three simplified decay chains those 5 obey are:

^{241}Am (9)

$^{238}Pu \rightarrow {}^{234}U \rightarrow {}^{230}Th$ (10)

^{239}Pu (11)

The inventories of the 10 isotopes were summed and assigned to the 5 lumped equivalent isotopes in the source term calculations as described in Section 3.7.3. Solubilities were also adjusted as described in Section 3.7.2. The paring down of the isotope list to 5 resulted in significant time savings. Had any calculated releases to the accessible environment approached the EPA regulatory limit, NUTS would have been rerun with a more complete list of isotopes.

3.1.2 Isotopes Treated by PANEL

The evaluation of isotope choice for both PANEL and NUTS started with the same list of 33 isotopes (see Section 3.1), but constraints particular to each code led to quite different final isotopes lists. NUTS's choice was dominated by its computational intensity. PANEL's calculations, however, are fast, even when all isotopes are modeled. Unlike NUTS, PANEL had a hard-coded default set of 30 isotopes which had been determined empirically, based on PA results accumulated though the WIPP PA modeling experience. Table 3.1 indicates the 30 isotopes with a "p" in the third column. PANEL calculates the *decay* of all 30 isotopes, but it calculated the *release* from the repository of only the 21 isotopes of Am, Cm, Np, Pu, Th, and U, as is indicated in the first column of Table 3.1. These 21 isotopes account for 98.9% of the EPA units within the waste at the time of emplacement and are modeled in the decay chains 1-4 (Section 3.1) While these decay chains contain isotopes whose release was not modeled, the decay of these isotopes is modeled so that ingrowth of released isotopes is properly taken into account. For example, release of ^{252}Cf is not modeled, but decay of ^{252}Cf to ^{248}Cm and ^{244}Pu (which are released) is modeled.

3.2 The Types of Data Required by NUTS and PANEL

As applied in the 1996 CCA PA, both NUTS and PANEL assumed, at each timestep, instant mobilization of radioisotopes (1) up to their mobilization limits if inventory was sufficient, or (2) up to their inventory limits if inventory was insufficient. NUTS applied that rule within each grid block, whereas PANEL applied it within the single waste panel it considered. The total inventory contained within the repository was assumed to be homogeneously and uniformly distributed throughout. NUTS assigned portions of the inventory to each grid block on the basis of that block's volume fraction of the repository as a whole. PANEL did the same, but it treated an entire waste panel as its one and only grid block. The Source-Term CDB provided NUTS (i) the total inventory of all its lumped equivalent isotopes, the half-lives and atomic weights of those isotopes, so NUTS could perform its decay calculations, in addition to (ii) the elemental effective solubility data required to mobilize the lumped equivalent isotopes. PANEL used decay and atomic-weight data from its own internal libraries, but queried the Source-Term output CDB for (i) the inventory of the 30 individual isotopes and (ii) the effective solubility of the 6 elements it mobilized.

3.3 "Effective Solubility" -- Combining Dissolution and Colloidal Mobilization

In addition to dissolution, the Actinide Source Term Program determined that actinides may mobilize within or on colloids (Papenguth 1996a,b,c,d). In general, dissolved and colloidal species may transport at different rates because of differences in their molecular-diffusion, sorption, and size-exclusion effects (filtration and "hydrodynamic chromatography"). Filtration was not included in either NUTS or PANEL, although its effects could have been approximated using NUTS's sorption models. However, sorption to fixed surfaces, molecular diffusion, and dispersion options were all intentionally omitted from the 1996 CCA mobilization codes. Hydrodynamic chromatography* may increase colloid transport rates over dissolved transport rates by factors up to 2 for theoretically perfect colloid-transport conditions. However, in practice, observed increases are usually much less, and well within the uncertainty of the WIPP calculated flow fields. Therefore this minor increase in transport rate of colloids over dissolved species was not modeled. Because the mechanisms that differentiate the transport of dissolved and colloidal species were turned off in the CCA calculations, these species were combined for transport within the Salado Formation. The combined mobilized actinide was assigned an "effective solubility" equal to the sum of the solubility and the maximum mobilized concentration of the actinide on each of four colloid types (humic, microbe, mineral fragment, and actinide intrinsic).

3.4 The Effects of Brine Composition on Solubility

The Actinide Source-Term Program found that actinide solubility and maximum actinide concentrations on humic colloids may vary significantly with oxidation state, pH, carbonate concentration, and brine composition. The pH and carbonate concentration within the repository were expected to be well controlled by the MgO backfill (Wang 1996), leaving brine composition and oxidation state as the major determinants of solubility. Oxidation state is described in Section 3.5. Brine composition is described here.

Brine may enter the repository from three sources, depending on the nature of future human intrusions. The six human-intrusion scenarios considered in the calculations may be categorized into three groups: 1) no human intrusion (see Figure 1.2) , 2) intrusion through the repository and into the Castile Formation intersecting a pressurized brine pocket (E1 Figure 1.3, and E2E1 Figure 1.5); and 3) intrusion through the repository but not into a pressurized brine pocket (E2 Figure 1.4). Under all scenarios, brine will flow from the surrounding Salado Formation through the disturbed rock zone (DRZ), and into the repository in response to the pressure difference between the repository at closure and the surrounding formation. In scenarios where a borehole is drilled into the repository but not into an underlying brine pocket, brine may flow down the borehole from the Rustler and Dewey Lake Formations. In scenarios where a pressurized Castile brine pocket is penetrated,

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* Hydrodynamic chromatography refers to the tendency of small suspended particles to migrate transversely within an advective current so as to congregate in the high-speed core of the flow field, which is usually near the center of a conduit. As a result, they travel not at the average speed, which is the advective speed, but rather at speeds approximating the maximum speed that occurs in the cross-sectional profile.

brine from the Castile Formation may flow up the borehole into the repository. The brines in these three formations have considerably different compositions and the solubilities of actinides are significantly different in each of the three end-member compositions. For example, the solubilities of actinides in each oxidation state in Salado and Castile brines provided by the Actinide Source Term Program (Siegel 1996) are shown below.

Table 3.2 Solubilities (moles/liter) of the actinide oxidation states in Salado and Castile brines controlled by the $MgO/MgCO_3$ buffer.

	+III	+IV	+V	+VI
Salado	5.82E-07	4.4E-06	2.3E-06	8.7E-06
Castile	6.52E-08	6.0E-09	2.2E-06	8.8E-06

The composition of the more dilute brines of the Rustler and Dewey Lake Formations, are expected to change rapidly upon entering the repository due to fast dissolution of host Salado Formation minerals (about 93.2% halite and about 1.7% each of polyhalite, gypsum, anhydrite, and magnesite; Brush, 1990). EQ3/6 calculations (see Appendix C) titrating Salado rock into a dilute brine show that the brine becomes saturated with gypsum, anhydrite and magnesite before it saturates with halite. When halite saturates, the brine composition is very similar to that of Castile brine. The brine saturates with polyhalite only when 100 times more Salado rock is added to the system than need to saturate the brine with halite. The resulting brine would then have a composition within the range observed for Salado brines. Thus, if dilute brines dissolve only the surfaces of the repository, they will attain Castile-like compositions, but if they circulate through the Salado Formation after saturating with halite, they may attain compositions similar to Salado brine. Similarly, if Castile brine circulates through enough host rock, it may also approach Salado brine composition. In either case, the actual brine within the repository may be described as a mixture of the two concentrated brine "end members" -- Salado and Castile. The brine ratio in this mixture is, however, difficult to quantify, since it is both temporally and spatially variable. Only in the undisturbed scenario, is the mixture well defined as 100% Salado brine over the 10,000 year time period.

For a panel intersected by a borehole, the BRAGFLO calculations show that the ratio of brine inflow that enters via the borehole versus inflow from the surrounding DRZ is variable both in time and sampled realization. This ratio was the only measure of brine mixing available for Source-Term ALGEBRA in the 1996 CCA PA. The ratio is somewhat crude because it: 1) did not account for brine-composition changes that occurred when water was consumed by corrosion reactions, 2) did not resolve the details of flow, diffusion, and brine interaction with internal pillars and the DRZ, and 3) was an average over the entire panel. It is expected that the fraction of Salado brine within the mixture will be high in areas of the repository distant from the borehole and the much lower near the borehole. Since radioisotope transport up the borehole is required for significant release, it is the solubility of radioisotopes near the borehole that is most important. Given these uncertainties, and NUTS's requirement for time-independent solubilities, calculation of brine mixing was not attempted in the CCA calculations. Instead, actinide solubilities in Castile brine were used for scenarios where a borehole hit a pressurized brine pocket and solubilities in Salado brine where used for scenarios where it did not. This simplification should bracket the range of behavior of the repository and should therefore suffice for CCDF calculations.

3.5 The Effects of Oxidation State on Actinide Solubility

The solubilities of actinides are dependent on actinide oxidation-state distributions (Weiner 1996). The oxidation-state distributions are expected to be determined by reactions of the actinides with the major components of the waste. Microbially mediated reactions with the organic waste and reactions with the Fe(0) and resulting dissolved Fe(II), are expected to have the largest impact on the oxidation-state distribution, but because the kinetics of these reactions are uncertain, it is impossible to define a single redox potential (Eh) for the repository. It is expected that the redox state of the repository may range from "reducing" to "extremely reducing", and experiments have shown (Weiner 1996) that the more highly oxidized actinide oxidation states do not persist. The most likely persistent oxidation states for the 6 actinides are shown below:

Am	+III
Cm	+III
Np	+IV, +V
Pu	+III, +IV
Th	+IV
U	+IV, +VI

For U, Np and Pu, two oxidation states are likely to persist depending on the reducing power of the waste. It is expected that under likely repository conditions, one oxidation state will dominate the dissolved concentration of each actinide, with the more reduced state dominating the solubility if the repository is "extremely reducing" and the more oxidized state dominating if the repository is "reducing". The uncertainty in the repository reducing power and resultant oxidation-state distribution is characterized in CCA modeling by the "OXSTAT" parameter. OXSTAT is sampled uniformly from 0 to 1. When the sampled OXSTAT is less than or equal to 0.5, the solubility of the lower oxidation state (U(+IV), Np(+IV), Pu(+III)) is used, when it is greater that 0.5, the solubility of the higher oxidation state (U(+VI), Np(+V), Pu(+IV))is used. The assignment of solubility for each realization was accomplished by exercising Source-Term ALGEBRACDB, which is described in detail in Section 3.7.

3.6 Choosing Source-Term Parameters for Sampling/Parameter Correlation

Up to 30 source-term parameters were supplied with distributions, but many of them were expected to have limited impact on the final CCDF. The most important parameters were expected to be the oxidation state parameter (OXSTAT) and the solubilities of Pu(+III), Pu(+IV), and Am(+III) in the two brine end members.

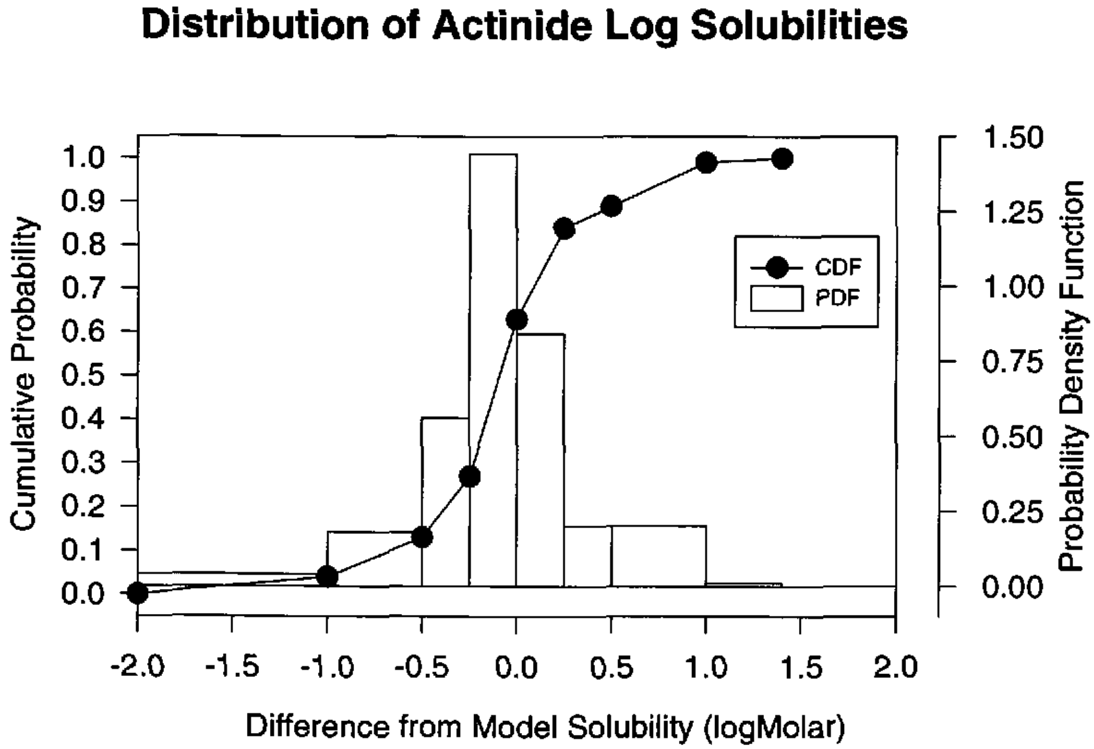


Figure 3.1 Solubility Distribution

A single distribution was used to model the uncertainty of the solubility of all oxidation states of all actinides in both brines (Bynum 1996). However, the amount of correlation between the solubilities of the actinides was uncertain. Some factors that cause uncertainty in the solubility affect all oxidation states of all actinides similarly, and some factors affect only some actinides or some oxidation states. For example, uncertainties in the sulfate concentrations have more effect on the uncertainty of the solubility of the actinides in the IV oxidation state, while uncertainties in the ionic strength have a more generalized effect of increasing the uncertainty in the stability of any highly-charged species. In nature, solubilities show correlation due to redox effects as well as major ion-concentration effects. It is therefore expected that solubilities within the WIPP should show some, but not complete correlation. The use of end-member brines in the calculations results in a correlation of solubilities due to ionic-strength and major-ion effects, and the use of the oxidation-state parameter results in a correlation due to redox effects. Because it was not possible to estimate the amount of correlation due to effects on solubility that were not modeled, a 0% correlation was used. A better estimate of this correlation would be necessary for more detailed chemical modeling, but, for use in constructing CCDFs, this estimate was sufficient. With 9 possible element/oxidation-state combinations (Am(+III), Cm(+III), Np(+IV), Np(+V), Pu(+III), Pu(+IV), Th(+IV), U(+IV), and U(+VI)), and two brines, a 0% correlation implies 18 independent samples of the distribution.

With 18 samples of the solubility distribution, 11 sampled colloid parameters (Papenguth 1996a,b,c,d) and 1 oxidation-state parameter, the calculation required 30 sampling slots to accommodate all parameters supplied with distributions. Many of the parameters supplied with distributions, however, were expected to have insignificant effect on repository performance, so this list was reduced to 12 as follows:

- Because Cm is a minor contributor to the total EPA units and it is expected to behave similarly to Am, a 100% correlation was made between Am and Cm. Only the parameters for Am were sampled, and these were copied for Cm.
- Because Np has a maximum of 0.48 EPA units during the 10,000-year regulatory period, Np solubilities were not sampled (see Section 3.1).
- The solubilities of U(+IV) and Th(+IV) in Castile brine were not sampled because 1) U and Th are only a little more important than Np, and 2) the solubility of the +IV oxidation state in Castile brine is low enough ($6x10^{-9}$M) that it cannot adversely effect system performance. (Sampling around a number that is too low to effect performance will not change the result.)
- The actinide concentration on mineral-fragment parameters was not sampled because the concentrations of actinides that may be mobilized on mineral fragments ($2.6x10^{-10}$ to $2.6x10^{-8}$M, Papenguth 1996a) were in most cases much lower than the possible concentrations of dissolved actinides.
- Of the humic-acid proportionality constants, only the one for the +III oxidation state in Castile brine was sampled because it was high (.065 to 1.6, Papenguth 1996b) and it applied to important elements (Pu and Am).The others were not sampled, but were held fixed at their maximum values during the calculations.

The 12 parameters that were sampled are listed below (see also Section 5):

Material Name	Parameter Name
SOLAM3	SOLSIM, SOLCIM
SOLPU3	SOLSIM, SOLCIM
SOLPU4	SOLSIM, SOLCIM
SOLU4	SOLSIM
SOLU6	SOLSIM, SOLCIM
SOLTH4	SOLSIM
GLOBAL	OXSTAT
PHUMOX3	PHUMCIM

where
SOLAM3 = distribution parameter for solubility of AM(+III),
SOLSIM = solubility in Salado brine, inorganic only, $Mg(OH)_2/MgCO_3$ buffer,
SOLCIM = solubility in Castile brine, inorganic only, $Mg(OH)_2/MgCO_3$ buffer,
OXSTAT = oxidation state parameter,

PHUMOX3 = the proportionality constant for humic colloids and actinides in the +3 oxidation state,
PHUMCIM = the proportionality constant for humic colloids in Castile brine, inorganic only, $Mg(OH)_2/MgCO_3$ buffer.

3.7 Constructing the Source Term Parameters

Many of the source term parameters such as half-life and molecular weight were read directly from the WIPP parameter database. However, the "effective element solubilities" needed by PANEL, and the "lumped inventories and effective solubilities" needed for NUTS, were constructed in the source term ALGEBRA run (see Appendix D for an example source term ALGEBRA Input file).

3.7.1 Effective Element Solubility

The parameters required for constructing the source term were: 1) modeled solubilities for four oxidation states in each end-member brine, 2) a distribution to be used to model solubility values, 3) the scheme for assigning sampled dominant oxidation states, 4) colloidal concentrations or proportionality constants for the 5 actinides or the 4 oxidation states for each of four colloid types, and 5) caps on the actinide concentrations that may be carried on two colloid types. Use of these parameters in the performance assessment calculations, required combining these into a single "effective solubility" or maximum concentration for each modeled actinide. This was performed with the Source-Term ALGEBRACDB runs as shown below. Parameters that are sampled, and values derived from them, have been indicated by italics. Parameters read by Source-Term ALGEBRACDB are bolded.

Dissolved Solubility = **Model Solubility** * $10^{\textit{Sampled from Solubility Distribution}}$

Humic Colloid Concentration = Dissolved Solubility * ***Proportionality Constant***
if *Dissolved* * ***Prop. Const.*** < **Humic Cap**, otherwise
Humic Colloid Concentration = **Humic Cap**

Microbe Colloid Concentration = Dissolved Solubility * **Proportionality Constant**
if the *Total Mobile* < **Microbe Cap**, otherwise
Microbe Colloid Concentration = **Microbe Cap**

Mineral Colloid Concentration = **Database Concentration**

Intrinsic Colloid Concentration = **Database Concentration**

Total Mobile = Dissolved + Humic + Microbe + Mineral + Intrinsic

LOGSOLM = log_{10}*(Total Mobile)*

where LOGSOLM is the log of the "effective solubility" in moles/liter used by NUTS and PANEL. Table 3.3 shows LOGSOLM for each brine and oxidation state calculated using median values for all sampled parameters.

Table 3.3 Median "Effective Log Solubilities" for each brine and oxidation state

Brine	Am(+III)	Pu(+III)	Pu(+IV)	U(+IV)	U(+VI)	Th(IV)	Np(IV)	Np(V)
Salado	-5.64	-6.14	-4.80	-4.84	-5.10	-4.59	-4.17	-4.52
Castile	-6.47	-6.77	-7.19	-7.16	-4.96	-7.05	-6.85	-4.54

For actinides with more than one oxidation state, the above procedure is performed for each oxidation state, and the final total mobile concentration is set based on the oxidation state parameter:

$$\text{Total Mobile} \begin{array}{l} = \text{Total Mobile(lower oxidation state) if OXSTAT} \leq 0.5 \\ = \text{Total Mobile(higher oxidation state) if OXSTAT} > 0.5 \quad , \end{array}$$

where OXSTAT is the oxidation-state parameter that is sampled uniformly from 0 to 1.

Source-Term ALGEBRACDB also calculates the fractions of each actinide that are mobilized by the 5 different mechanisms which are used by CCDF_GF (see the Analysis Package for the CCDF Construction (Task 7) (WPO# 40524)) as follows:

Fraction dissolved = Dissolved/Total Mobile
Fraction on humics = Humic/Total Mobile
Fraction in/on microbes = Microbe/Total Mobile
Fraction on mineral fragments = Mineral/Total Mobile
Fraction as intrinsic colloid = Intrinsic/Total Mobile

3.7.2 "Lumped Effective Solubilities"

Because the Source-Term ALGEBRACDB run was used for both NUTS and PANEL, it performed the above calculation for each of the five actinides: Am, Np, Pu, Th, and U. NUTS, however, needs the "effective solubility" for the four "lumped" elements designated: AmL, PuL, ThL, and UL. For Am, there is only one important isotope (the amount of ^{241}Am is orders of magnitude larger than the other isotopes), so it is not necessary to adjust the Am solubility due to shared solubility effects with other non-modeled isotopes. Therefore LOGSOLM of Am is just copied into LOGSOLM for AmL. Similarly, the NUTS modeled or "lumped" isotopes of Pu, (238, 239, 240, 242) account for more than 99.8% of the moles of Pu and more than 99.999% of the EPA units of Pu in the repository, so the LOGSOLM for Pu is copied into PuL. For U and Th, however, there are long-lived isotopes, ^{238}U and ^{232}Th, that are not modeled by NUTS, because they do not contribute significantly to the EPA normalized release, but that have large mole fractions within the repository. Since solubility is shared by isotopes on a mole-fraction basis, UL and ThL were assigned solubilities equal to their elemental solubilities times their maximum mole fraction during the 10,000 year regulatory period. (See Appendix E for calculation of the maximum mole fractions).

Consequently, LOGSOLM of UL was set to LOGSOLM of U minus 2.55, and LOGSOLM of ThL was set to LOGSOLM of Th minus 2.9.

3.7.3 "Lumped Inventories"

Finally, the Source-Term ALGEBRACDB combines the inventories of the isotopes that are "lumped" for NUTS transport. The inventory may be combined in either of two ways, namely: the moles of inventory may be calculated combined and converted back to Curies, or the Curies may be added directly. Use of the mole-addition method resulted in the highest combined inventory when the "lumped" isotope had a half-life longer than the modeled isotope, and use of the Curie addition method resulted in the highest combined inventory when the "lumped" isotope had a half-life shorter than the modeled isotope. In each case, the method that maximized the combined inventory was used, i.e.; ^{233}U was Curie added to ^{234}U, ^{240}Pu was Curie added to ^{239}Pu, ^{242}Pu was mole added to ^{239}Pu, and ^{229}Th was Curie added to ^{230}Th. In addition, ^{241}Pu was mole added to ^{241}Am because it has a half life of 14 years and will quickly decay to ^{241}Am, and neglect of this ingrowth would underestimate the ^{241}Am inventory by about 3%

4. PA Codes Suites

WIPP PA methodology employed a hierarchical code system in which suites of codes (consisting of interfacing sequentially-exercised codes) were themselves interfaced and exercised sequentially (see Figure 4.1). Each code suite served a principal science and/or engineering (S&E) code that took its input from and wrote its results to a files that were written in a standard binary format as defined in the CAMCON (Compliance Assessment Methodology Controller) system. Such files are called CDB files for "Computational Data Base." The output CDB file from each run tracked the calculation from beginning to end and was given a unique name. At each step, some information was copied from the input CDB into the output CDB along with the new data.

In the 1996 CCA PA, the initial CDB file for each S&E suite of codes was created by a mesh-generating code called GENMESH. GENMESH both defined the computational grid required for the S&E code it served, and created the CDB file for that particular run. The CDB file was then augmented to include material properties by a material-assignment code called MATSET. The CDB file was then cloned 100 times over with different sampled parameters written to each clone in a way that treated uncertainty representatively. The CDB-file cloning and data-assignment process was performed by POSTLHS, the post-processor for the WIPP's principal sampling code LHS (Latin Hypercube Sampling). One complete set of sampled parameter values is called a vector or realization. Thus, a single application of the Latin Hypercube sampling code produced 100 different vectors or realizations. To test statistical robustness in the 1996 CCA PA, the Latin Hypercube sampling code was exercised independently three different times, each time with a different random seed. In all, it produced 3 different collections of 100 vectors. Each set of 100 vectors of sampled parameter values was called a replicate. POSTLHS's set of 100 sampled output CDB files then served as the input CDB files for the various S&E codes. The output CDB files of the first S&E code suite were passed on to subsequent S&E code suites that required them. Often, the variables in the output CDB from one code where not exactly those needed by the next code, so algebraic manipulation such as changing units, integrating flows or summing the volumes were performed using ALGEBRACDB to produce new CDB files with the correct variables. The code SUMMARIZE was used to extract information from the CDB's and output it in tabular ASCII format for use both by CCDFGF and the plotting code SPLAT. SUMMARIZE also has the ability to interpolate between the CDB time steps to provide values at preset time intervals, a feature that was used extensively in the CCA analysis.

The S&E codes NUTS and PANEL were both exercised in the 1996 CCA PA as suites of codes, as will be discussed below. The specific code sequences of each code suite are shown in skeletal format in Figure 4.2 below. The BRAGFLO suites are described in the analysis packages for Salado flow calculations (Task 1) (WPO# 40514) and (Task 4) (WPO# 40520), and the source term suite is described below. Both NUTS and PANEL require two input CDB files, 1) the CDB containing the BRAGFLO grid and flows from the BRAGFLO suite of codes and 2) the CDB containing the source term properties such as solubility and inventory from the source term suite of codes. CCDFGF required the time history of the total contaminant concentration in EPA units /m^3 brine within the repository for the direct brine release calculations and the release of each of the five "lumped" isotopes past specific boundaries for the long term brine releases. To provide CCDFGF with this information, both ALGEBRACDB and SUMMARIZE were required. Additional ALGEBRACDB and SUMMARIZE runs were also required for analysis of the results.

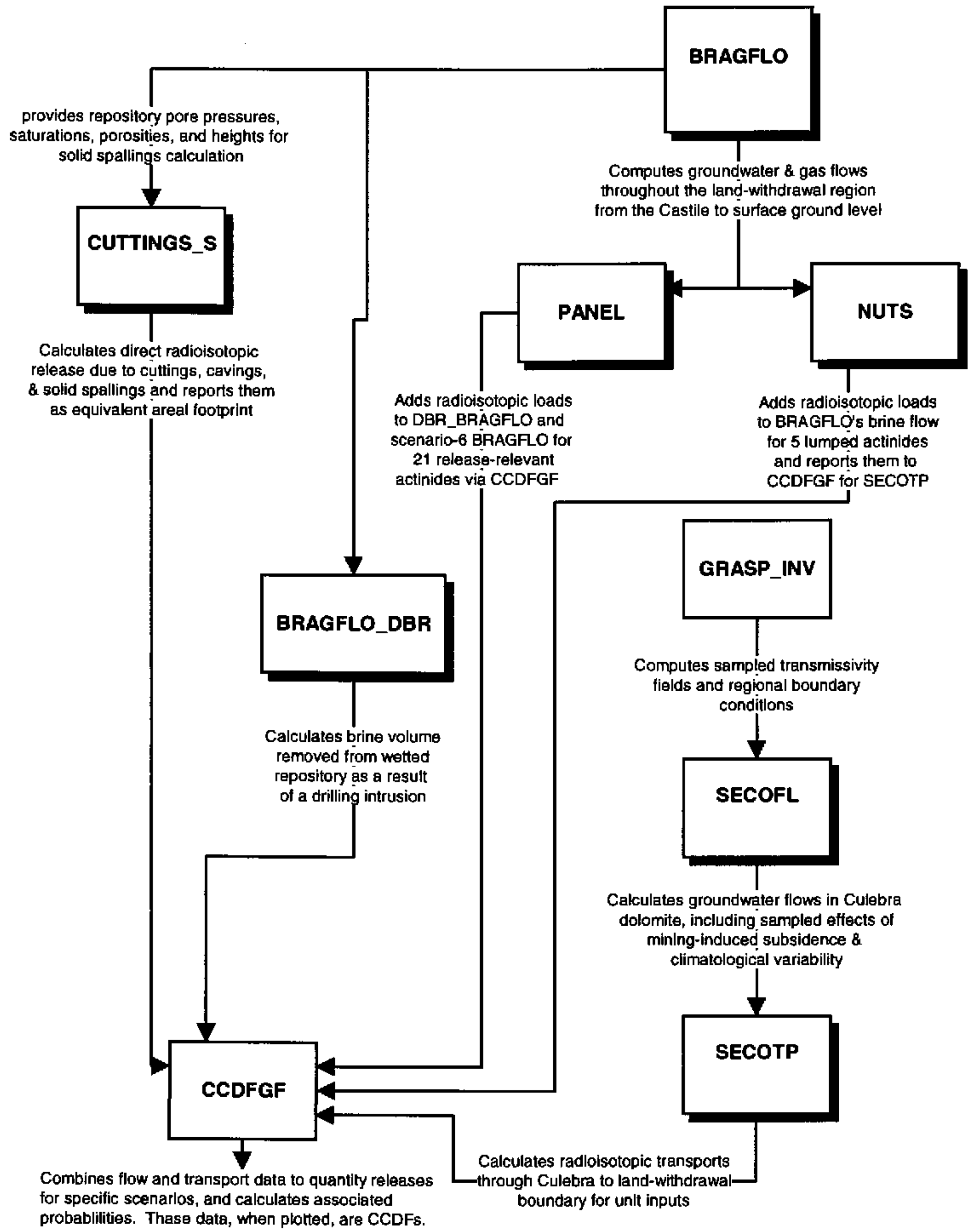
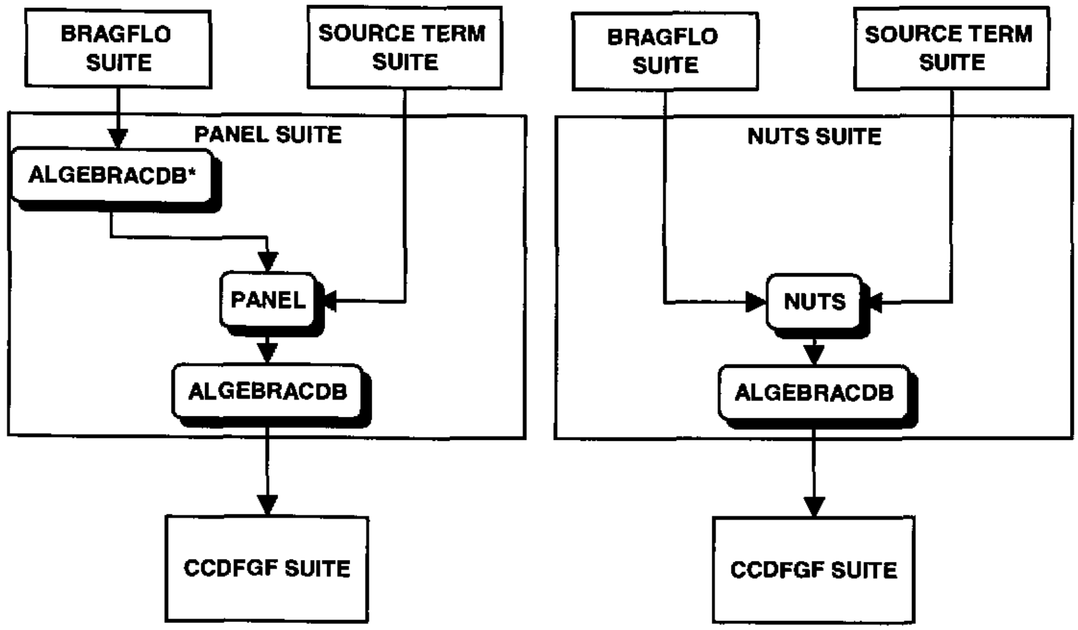


Figure 4.1 CCA Code Overview



* In the direct brine release and time shifted PANEL runs, an additional ALGEBRA run was included here.

Figure 4.2 Overview of NUTS and PANEL Code Suites

4.1 Source Term Suite

The source term suite is shown in Figure 4.3 with the details of file names included in Figure 4.4.

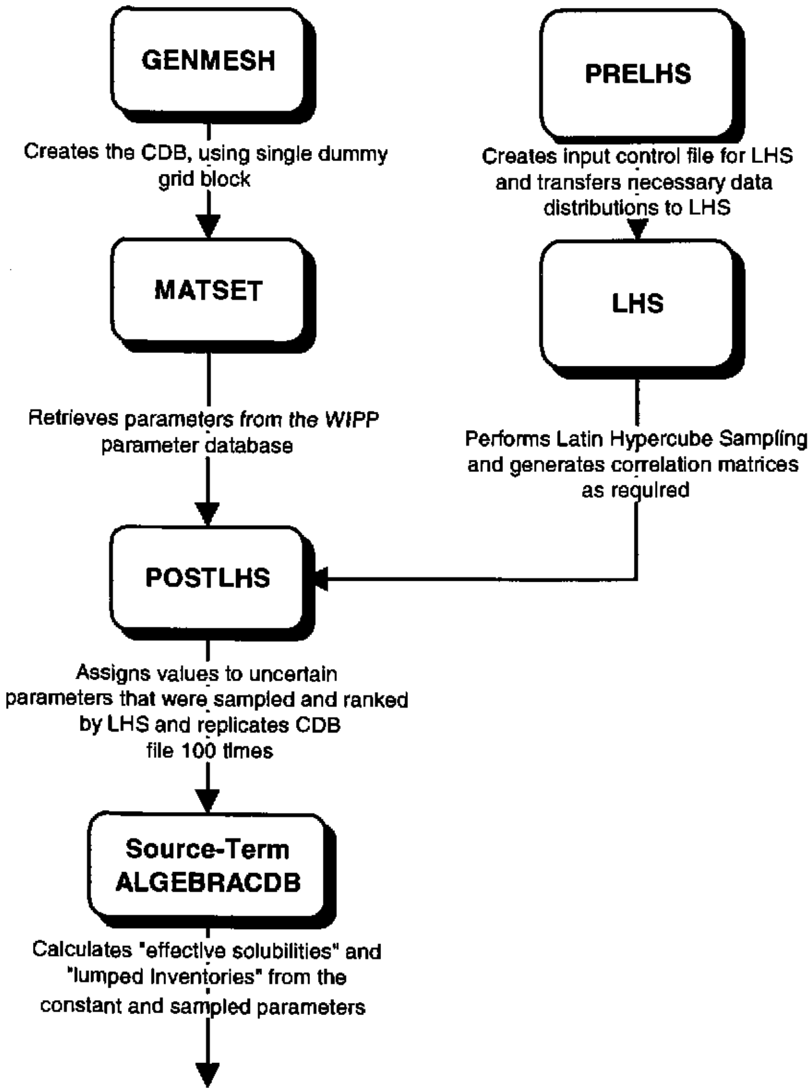


Figure 4.3 Source Term Suite

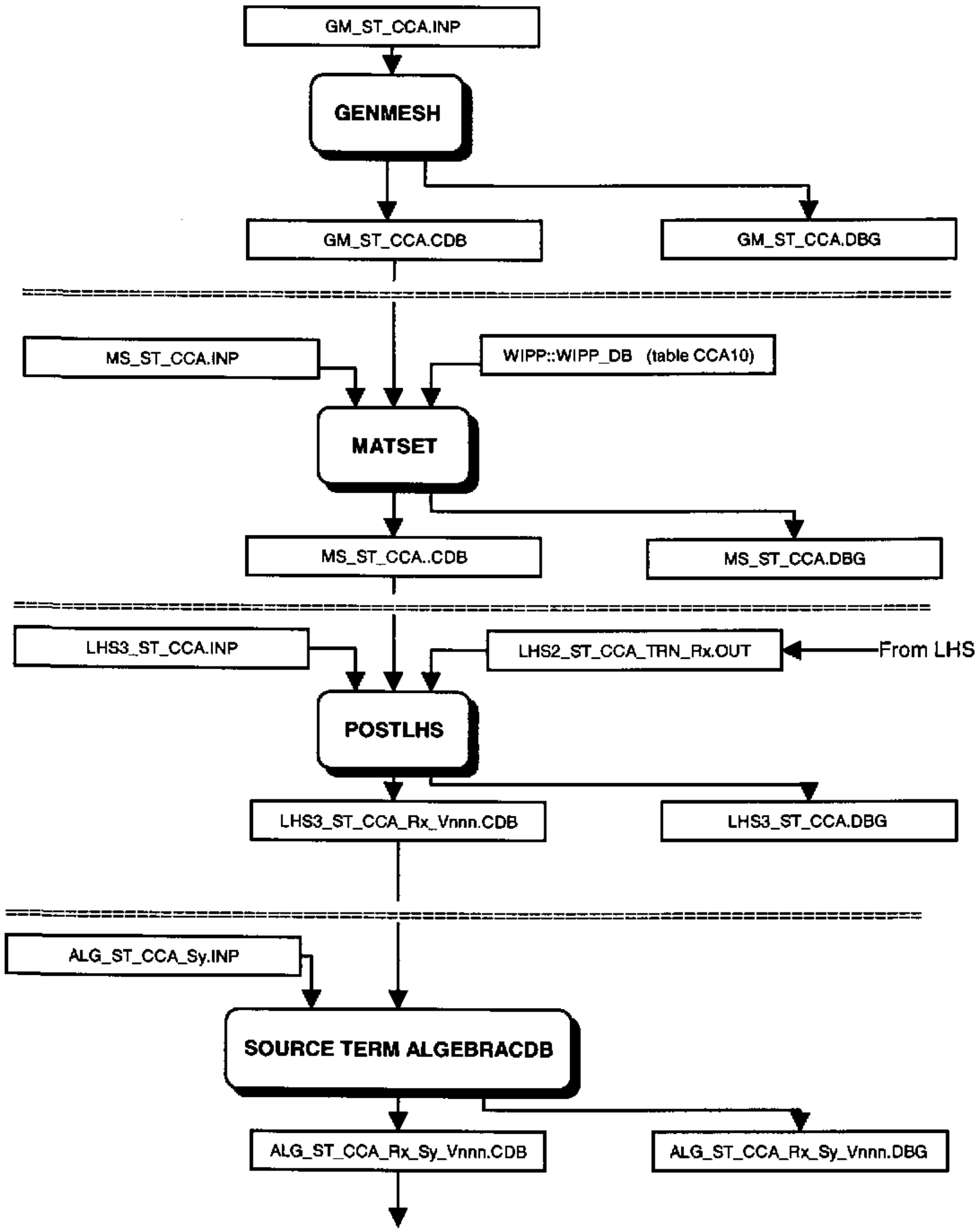


Figure 4.4 Source Term Suite Files
Rx signifies Replicate number where x = 1,2,3; Sy signifies Scenario number where y = 1,2,...,6; Vnnn signifies Vector or realization number where nnn = 001 to 100 (the preferred terminology is realization, but we use vector here to distinguish from replicate); INP signifies input file, CDB signifies computational data base, and DBG signifies debug.

GENMESH
GENMESH is the method of creating a CDB file and was used here even though no grid is required for the source term property CDB.

MATSET
MATSET was used to retrieve the properties needed for the source term calculations from the WIPP parameter database (Database View 10). These properties included the radionuclide inventory, the half-lives and atomic weight of the isotopes, solubility and colloid parameters etc.

LHS
The LHS code triad was required in the source term suite because new data had been added to the database and the sampled parameter list after they were used for the BRAGFLO suite. Had the database been completed before any calculations were begun, PRELHS and LHS would only have been run once for the entire PA. Then only POSTLHS would have been required in the source term suite. POSTLHS copied the input CDB into output CDB's whose values for the sampled parameters have been replaced by values sampled from the ranges entered in the database.

ALGEBRACDB
The output of GENMESH, MATSET, and POSTLHS, was a set CDB's with the appropriate sampled parameters needed to construct "effective solubilities" and "lumped inventories" for the isotopes. These calculations are described in Section 3.7.

4.2 NUTS Suite

NUTS accesses different combinations of input files depending on the type of the run: screening (see Section 2.2.3), non-screening isotope, and non-screening time shifted isotope. In all cases. NUTS requires three files: BRAGFLO's ASCII input file, BRAGFLO's binary CDB output file, and NUTS's ASCII input file. For non-screening runs, NUTS also requires the source-term property CDB files, and for time-shifted runs, it also requires the NUTS output CDB's from the undisturbed non-screening runs. Figure 4.5, Figure 4.6, and Figure 4.7 show the files used in each of these runs.

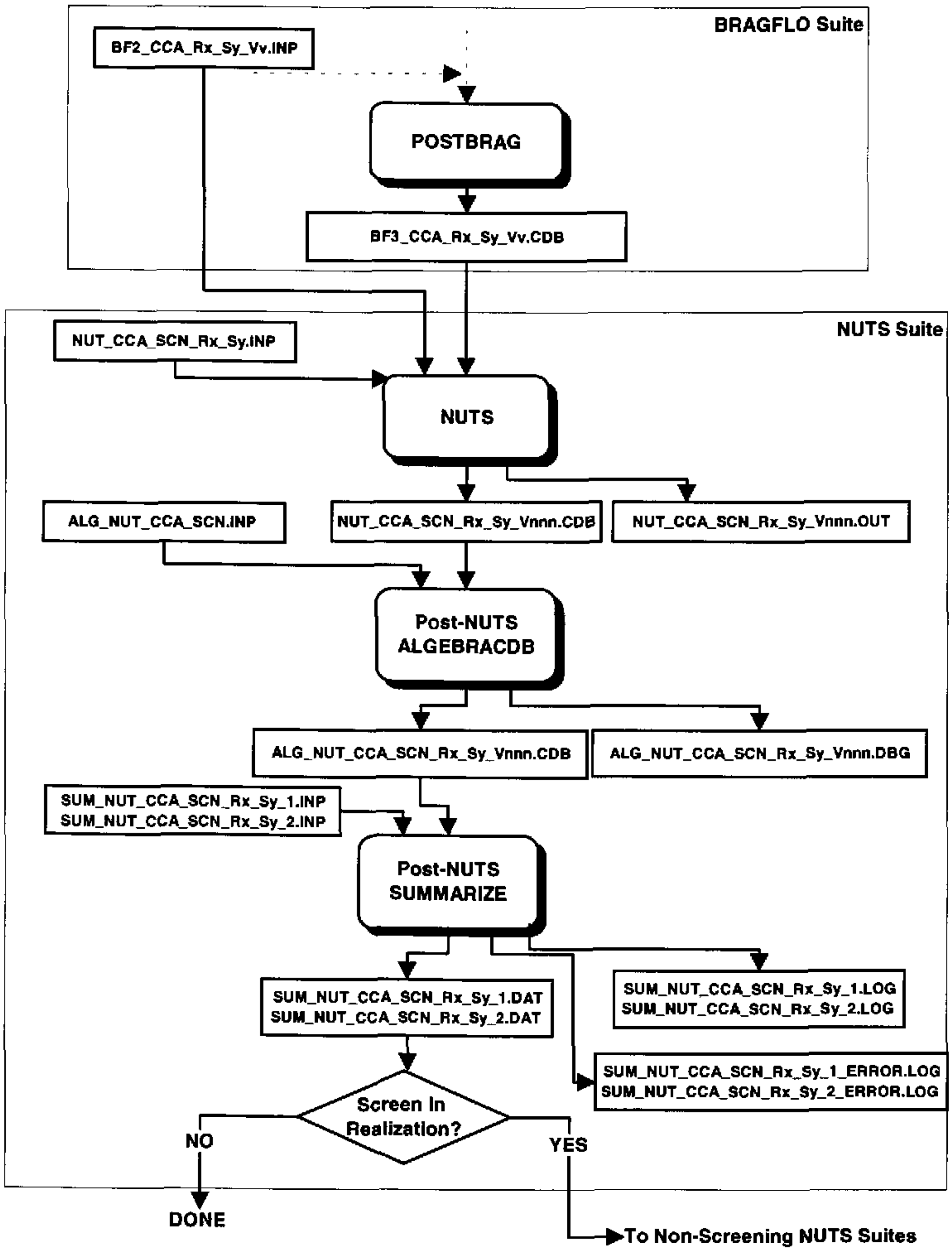


Figure 4.5 NUTS Screening Calculations.
Rx signifies Replicate number where x = 1,2,3; Sy signifies Scenario number where y = 1,2,...,6; Vnnn signifies Vector or realization number where nnn = 001 to 100 (the preferred terminology is realization, but we use vector here to distinguish from replicate); Vv also signifies Vector number but v = 1,2,...100; INP signifies input file; CDB signifies computational data base; and DBG signifies debug.

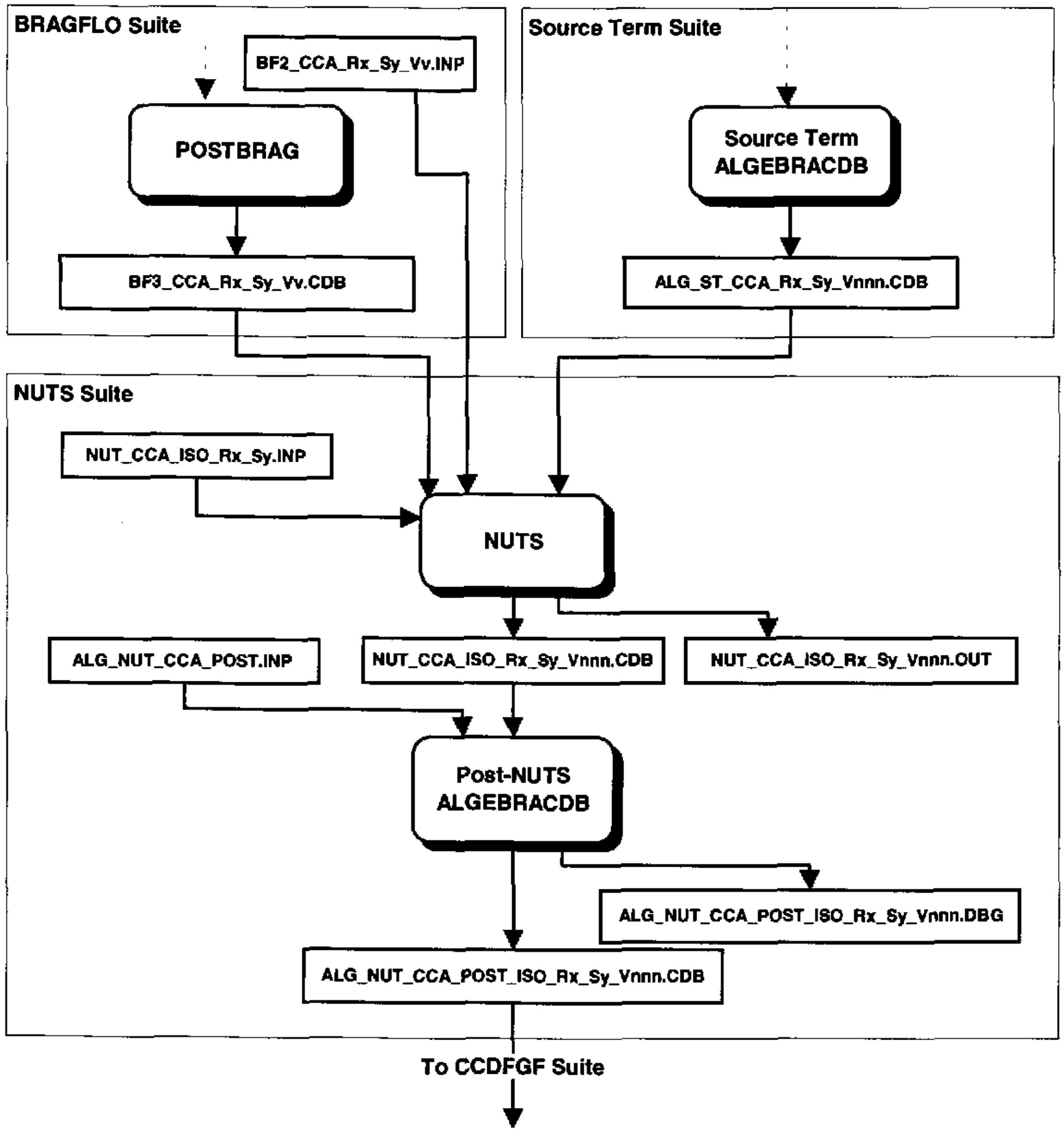


Figure 4.6 NUTS Non-Screening Isotope Calculations
Rx signifies Replicate number where x = 1,2,3; Sy signifies Scenario number where y = 1,2,...,6; Vnnn signifies Vector or realization number where nnn = 001 to 100 (the preferred terminology is realization, but we use vector here to distinguish from replicate); Vv also signifies Vector number but v = 1,2,...100; INP signifies input file; CDB signifies computational data base; and DBG signifies debug.

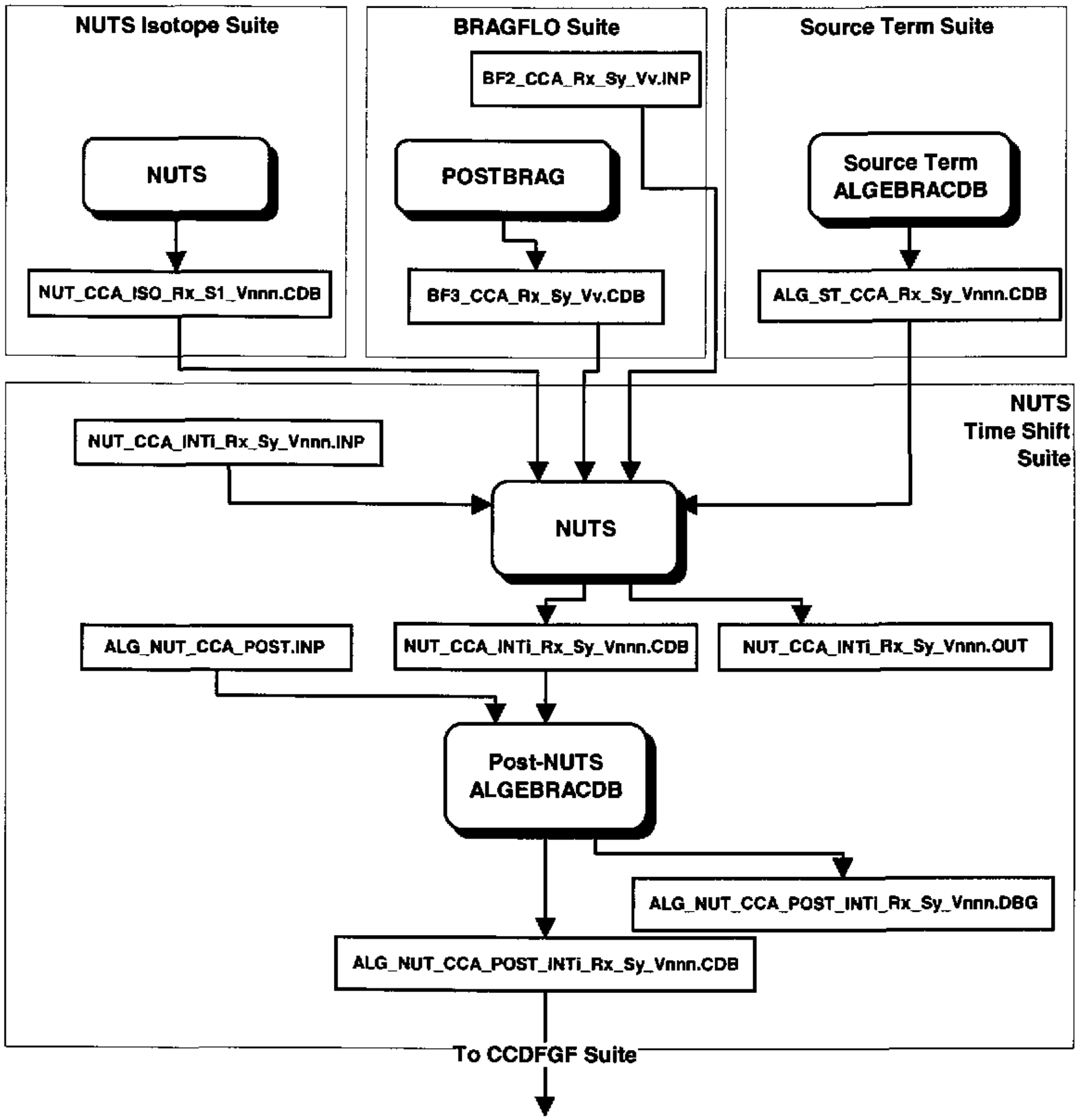


Figure 4.7 NUTS Time Shifted Calculations
Rx signifies Replicate number where x = 1,2,3; Sy signifies Scenario number where y = 1,2,...,6; Vnnn signifies Vector or realization number where nnn = 001 to 100 (the preferred terminology is realization, but we use vector here to distinguish from replicate); Vv also signifies Vector number but v = 1,2,...100; INTi signifies Intrusion Time where i=1 for 100 years, i=3 for 3000 years , i=5 for 5000 years, i=7 for 7000 years and i=9 for 9000 years; INP signifies input file; CDB signifies computational data base; and DBG signifies debug.

4.2.1 NUTS's Input Files

BRAGFLO's post-processed binary files (CDB) and ASCII input file both provided NUTS with hydrological information. The CDB files are the source for brine fluxes at the grid-block interfaces, porosity, saturation, pressure, as well as the geometrical information. Some initialization parameters, in addition to the material maps, are also read from BRAGFLO's

ASCII input. Regardless of the type of calculations (screening or non-screening), BRAGFLO's CDB and ASCII files are required by NUTS for the CCA calculation. These files along with the rest of the input reside in the SCMS (see Ref. Software Configuration Management System (SCMS) Plan Rev 1.X). BRAGFLO's ASCII input and CDB output files, which are required to run NUTS's calculations, are BF2_CCA_Rx_Sy_Vv.INP and BF3_CCA_Rx_Sy_Vv.CDB, respectively, where,

x = 1,2, or 3, the replicate number,
y = 1,2,..., 6, the scenario number, and
v = 1,2,..., 100, the realization number.

The "effective solubilities" and "lumped inventories" as well as atomic weight and half-lives are read from the source term CDB files ALG_ST_CCA_Rx_Sy_Vnnn.CDB.

In the screening calculations, the NUTS ASCII input file (see Appendix 0) contains the control parameters that guide the calculations. Also, tracer properties and locations in the spatial domain are defined in this input file. There are five NUTS ASCII input files required to run each replicate, one per scenario (there are 100 realizations in each scenario). Therefore, the SCMS holds 15 files used to run three replicate CCA calculations. The convention used in naming NUTS input file is NUT_CCA_SCN_ Rx_Sy.INP, where

x = 1,2, or 3, the replicate number,
y = 1,2,..., 5, the scenario number.

In non-screening CCA calculations, the NUTS ASCII input file (see Appendix 0) provides the calculation with control flags and isotope-chain descriptions. There were five isotopes transported in the brine phase, the two individual isotopes were ^{241}Am, ^{239}Pu, and the single chain was $^{238}Pu \rightarrow {}^{234}U \rightarrow {}^{230}Th$.

Non-screening CCA calculations are conducted in two categories, 1) regular and 2) time shifted. The first category includes screened-in realizations from scenarios 1 to 5. In the intrusion scenarios 2,3,4 and 5, only the standard intrusion times, 350 and 1000 years are used. Similar to the screening calculations, the number of NUTS ASCII input files required in the CCA calculations is one file per scenario for each replicate. The convention used in naming NUTS's input file is NUT_CCA_ISO_ Rx_Sy.INP, where

x = 1,2, or 3, the replicate number,
y = 1,2,..., 5, the scenario number.

The second category includes time shifted runs for the screened-in realizations from scenarios 2 to 5. The intrusion times used in this category are 100, 3000, 5000, 7000, and 9000 years. As described in Section 2.2.4, NUTS uses the output CDB of the undisturbed NUTS calculations to simulate the time before the time shifted intrusions. Thus for each replicate x, and realization nnn, NUT_CCA_ISO_Rx_S1_Vnnn.CDB is used. Therefore, in addition to the BRAGFLO and source term input files, the following input files are required in each screened-in realization used in the CCA calculations:

Scenario	Intrusion time in BRAGFLO (years)	Intrusion time in NUTS (years)	Input Files
S2	350	100	NUT_CCA_INT1_Rx_S2_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S3	1000	3000	NUT_CCA_INT3_Rx_S3_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S3	1000	5000	NUT_CCA_INT5_Rx_S3_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S3	1000	7000	NUT_CCA_INT7_Rx_S3_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S3	1000	9000	NUT_CCA_INT9_Rx_S3_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S4	350	100	NUT_CCA_INT1_Rx_S4_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S5	1000	3000	NUT_CCA_INT3_Rx_S5_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S5	1000	5000	NUT_CCA_INT5_Rx_S5_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S5	1000	7000	NUT_CCA_INT7_Rx_S5_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB
S5	1000	9000	NUT_CCA_INT9_Rx_S5_Vnnn.INP, NUT_CCA_ISO_Rx_S1_Vnnn.CDB

4.2.2 Post Processing NUTS's Output

Post-Processing of NUTS's output consisted of (1) constructing analysis variables from the detailed NUTS output data using Post-NUTS ALGEBRACDB, and (2) using SUMMARIZE to extract these analysis variables in tabular form. Some of the analysis variables were required for CCDFGF which read them from the SUMMARIZE tables. All the analysis variables were also plotted using SPLAT to show transports of radioisotopes or the tracer substance over the entire 10,000 year regulatory period. For example, NUTS's radionuclide flux output parameter was integrated, and converted to EPA units in an analysis variable that described the cumulative amount of radioactivity transported as a function of time at certain interior locations. NUTS output data varied depending on whether the NUTS output was taken from a screening or non-screening (isotope-transport) run, so separate sets of analysis variables were used to examine the different types of NUTS output. All together, fifteen replicate/scenario combinations (Replicates 1 through 3 and Scenarios 1 through 5) were post-processed using Post-NUTS ALGEBRACDB.

Output from the NUTS screening runs consisted of horizontal and vertical fluxes and concentration of the tracer substance in each grid element. The fluxes are mass-flow rates in units of kilograms per second, while the tracer concentration has units of kilograms per cubic meter of brine. Depending on the scenario, waste-contaminated brine or waste-contaminated brine plus Castile brine from the brine pocket below the repository may be transported up the borehole. The analysis variable set for the two scenarios (Scenarios 2 and 3) in which an intrusion penetrated into the brine pocket consequently included twice the number of analysis variables as the undisturbed cases, where only waste-contaminated brine was present. Each of the analysis variables was plotted as a function of time, with all one hundred screening vectors for a specific scenario of a particular replicate overlain on one ("hair") plot for each analysis variable. The NUTS screening runs, as their name indicates, were used to pare down the number of vectors in each replicate/scenario that was run with the full isotope-transport version of NUTS.

Output from the NUTS isotope transport runs consisted of horizontal and vertical fluxes in terms of an activity rate for each isotope species in units of Ci/s, mass concentration of each isotope in units of kilograms per cubic meter of brine, dissolved and undissolved masses of each isotope (kg), and the total mass activity (Curies) of each isotope. Five lumped isotopes were accounted for in each grid element: ^{241}Am, ^{239}Pu, ^{238}Pu, ^{234}U, and ^{230}Th. The NUTS non-screening, isotope-transport runs also included subcases for all but the undisturbed scenario (Scenario 1) in which drilling intrusions occur at various times. The same Post-NUTS ALGEBRACDB post-processing procedure was used for all isotope-transport cases. The number of vectors post-processed varied depending on the specific replicate/scenario case, however, and ranged from as few as one vector for Replicate 1, Scenario 1 to as many as 25 for Replicate 3, Scenario 3.

In general, the post-processing procedure was to run the Post-NUTS ALGEBRACDB code on all of the database files created by NUTS for each replicate/scenario. Although the input-equation files for Post-NUTS ALGEBRACDB and thus the set of post-processing analysis parameters varied as described above, (depending on the specific NUTS calculation), all the databases created by Post-NUTS ALGEBRACDB were subsequently processed by SUMMARIZE. SUMMARIZE was used to interpolate the analysis data to a common set of time steps and to output a set of "table" (.tbl) files that could be read by the plotting code SPLAT. The data tables included time steps at fifty-year increments for the first 1400 years, and two-hundred-year time-step increments for the final 8600 years.

NUTS's output ".CDB" files were the source of all data that was post-processed. The basic data contained in the NUTS-output databases was converted into sets of time-dependent parameters (analysis variables) that could be compared across realizations. The desired analysis variables were calculated with the code Post-NUTS ALGEBRACDB, using one of three specific equation-input files depending on the type of NUTS calculation. For NUTS screening runs, the equation-file input to Post-NUTS ALGEBRACDB along with the NUTS .CDB file was either the file ALG_NUT_SCN.INP or ALG_NUT_SCN_UND.INP, where the latter file was used scenario 1 only. For NUTS calculations involving transport of isotopes instead of tracers, equation file ALG_NUT_CCA_POST.INP was input to Post-NUTS ALGEBRACDB.

To plot each post-processed analysis variable, the code SUMMARIZE was used to interpolate values of each analysis variable to a set of common time values, resulting in a separate table of analysis-variable values for each vector. Although this interpolation was not strictly required for plotting with SPLAT, it allowed for direct comparison of the variables at specific times between different vectors.

To perform the interpolation, SUMMARIZE reads an input-command file and the database file written by Post-NUTS ALGEBRACDB. The input-command files that were used to control summarize were NUTS_SCN_RxSy.SMZ, NUTS_SCN_UND_RxSy.SMZ, NUTS_ISO_RxSy.SMZ, and NUTS_INTiii_RxSy.SMZ, where the filename parameters iii, x, y, and iii had the same meaning as described for the Post-NUTS ALGEBRACDB execution.

A complete listing of each analysis variable set calculated from the NUTS runs is shown in Appendix G and H. The name of each variable, a variable number for convenient reference, and a brief description of the variable are given. Appendix G lists the output variables for the screening runs. Odd-numbered analysis variables were generated in all screening runs, but the even-numbered ones were generated only for the cases in which the brine pocket below the repository was penetrated by a well intrusion, releasing Castile brine (*i.e.,* Scenarios 2 and 3). The analysis variable set calculated for all of the NUTS isotope-transport runs is listed in Appendix H. Many variables report results specific to BRAGFLO particular grid blocks. The BRAGFLO grid number map for the undisturbed scenario is shown in Appendix 0.

Appendix J and K give the complete text of two Post-NUTS ALGEBRACDB input files that calculate and extract the various analysis variables required to use and evaluate NUTS's output. They correspond to (and are named similarly to) the two NUTS input files described here one for (a) screening runs and one for (b) isotope transport runs. Comments in the text of the input files describe each variable in greater detail. Specialized functions in Post-NUTS ALGEBRACDB such as IFGT0 and IFLT0 were used to calculate specific flow or transport directionality, as desired. The INTRIGHT function provided the means to integrate rate data such as flux to obtain isotope activity.

A plot of the time variation for each analysis variable for all the 100 vectors in a given replicate and scenario is referred to as a "hair plot" because 100 traces are overlaid and sometimes resemble long unruly strands of hair. The SPLAT hair plot input file specifies the names of the 100 SUMMARIZE TBL files, title and axis text, and which columns are to be plotted, and is thus specific to a particular set of SUMMARIZE tables. Because of the large number of plots, the input files were not created by hand, but were generated by the FORTRAN codes NMC_SCN.FOR, NMC_SCN_UND.FOR, NMC_ISO.FOR, and NMC_INT.FOR, depending on whether plots were to be made for a disturbed- or an undisturbed-screening run or isotope-transport run (with either standard or time shifted intrusion times). Output of these codes were hand checked. Example summarize input files and the matching SPLAT input file generating source code and resulting SPLAT input files are included in Appendix L, M, and N.

The Analysis Plan specified traceability and reproducibility of analysis results, but did not specify which analysis variables were to be used. That is appropriate because analysis results must be examined to be understood, and examination of a certain result often leads to further, more detailed analysis which could not be anticipated in advance. In order to retain the flexibility to examine an evolving set of result plots, specific plotted results are not listed in the analysis plan since that would be too restrictive. All the Post-NUTS ALGEBRACDB runs were performed in CMS, but only the SUMMARIZE runs required for CCDFGF were run in CMS. Other SUMMARIZE and SPLAT calculations were run outside of CMS to allow flexibility during the analysis, but all input and command files used were saved in CMS for reproducibility and traceability. Specific plots are reproducible from the CMS databases using these saved input and command files. Output table and plot files were not saved due to disk-space limitations, but everything necessary to reproduce these files was saved.

4.3 Panel Suite

Like NUTS, there were differing input files for the three types of PANEL runs: 1) regular, 2) time shifted, and 3) concentration. The PANEL suite was outlined in Figure 4.2 and shown in detail for the three run types in Figure 4.8 through Figure 4.10.

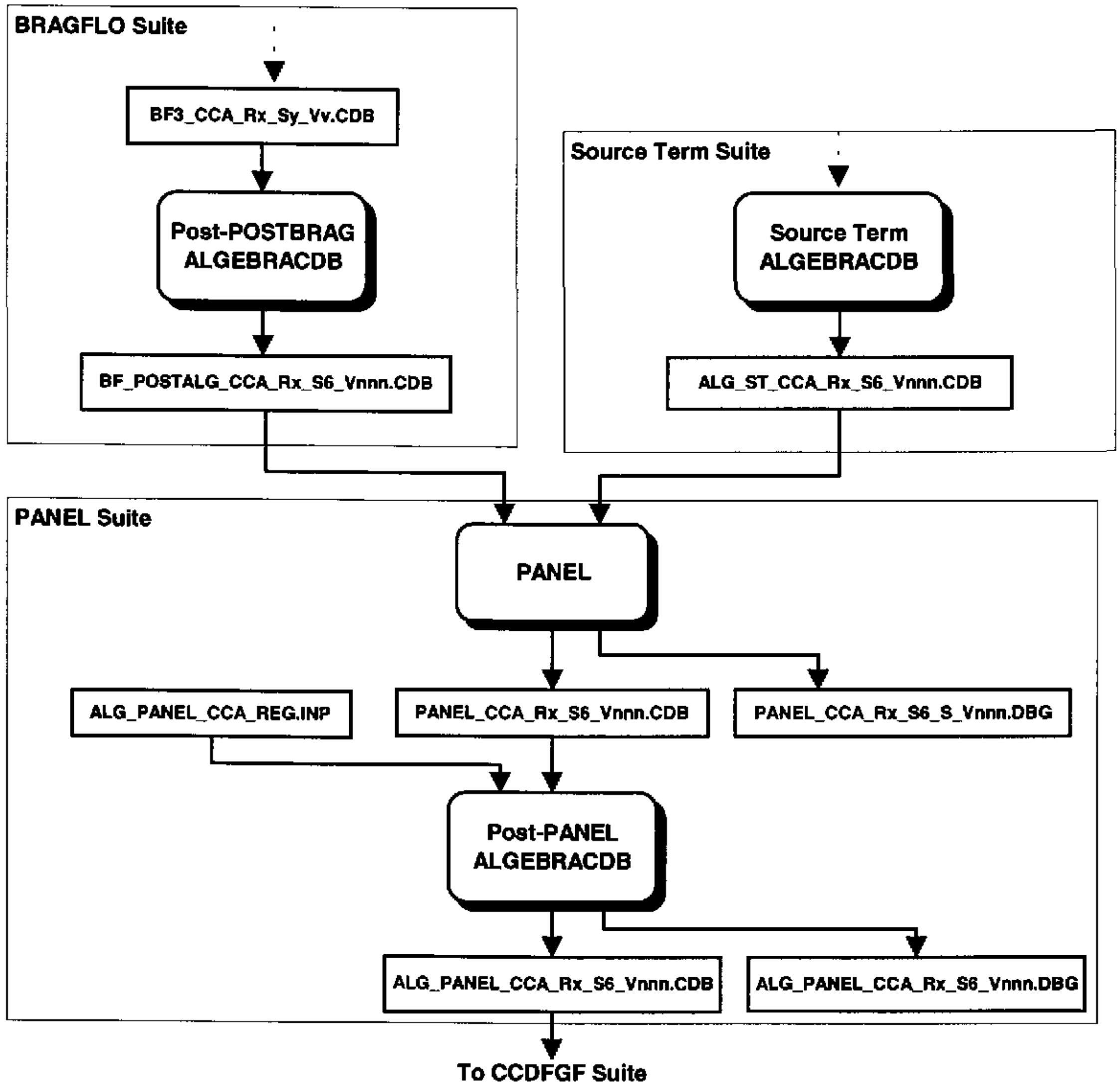


Figure 4.8 PANEL Regular Calculations

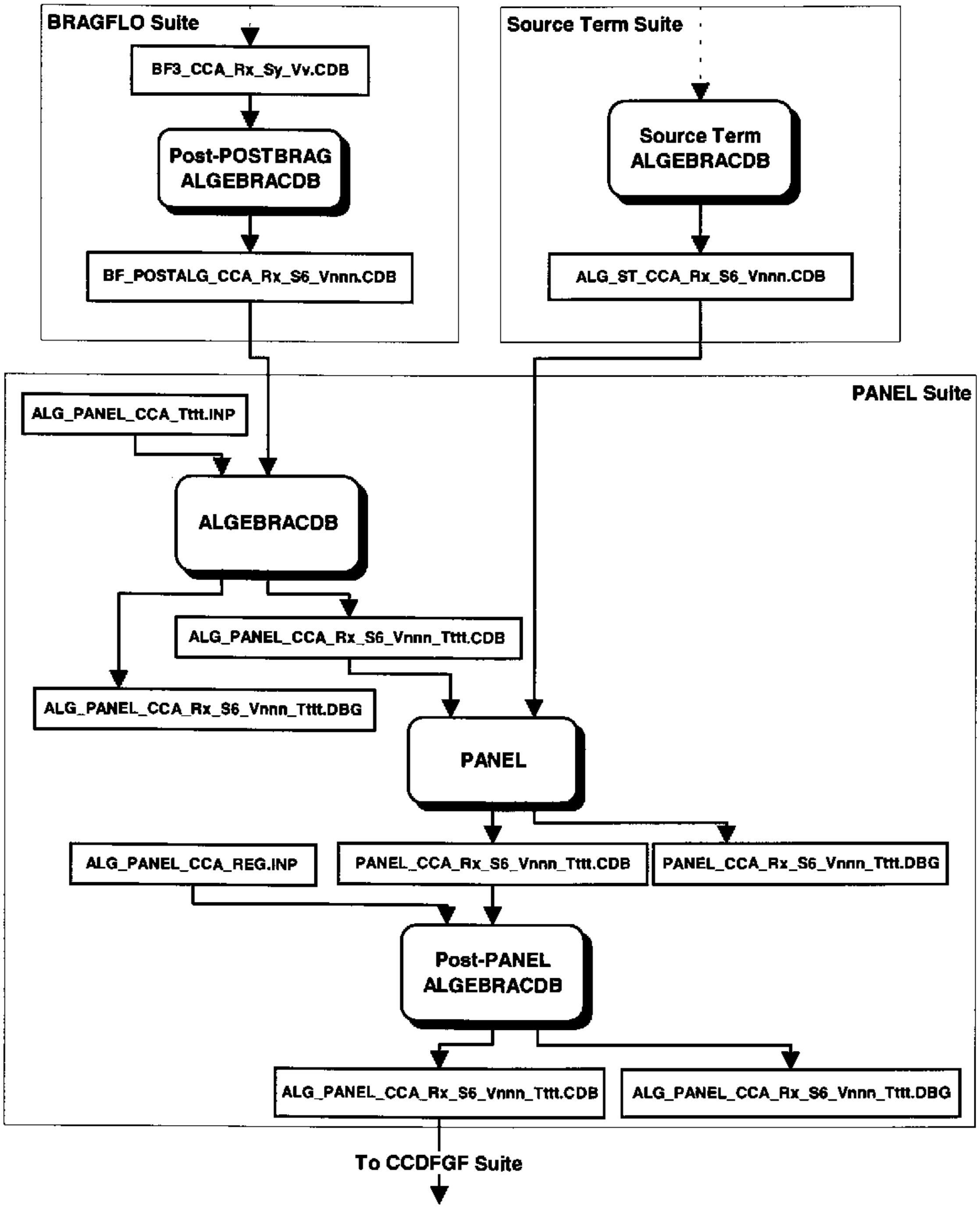


Figure 4.9 PANEL Time shifted Calculations

Tttt signifies the time of intrusion and ttt = 100, 350, 1000, 4000, 6000, and 9000 years.

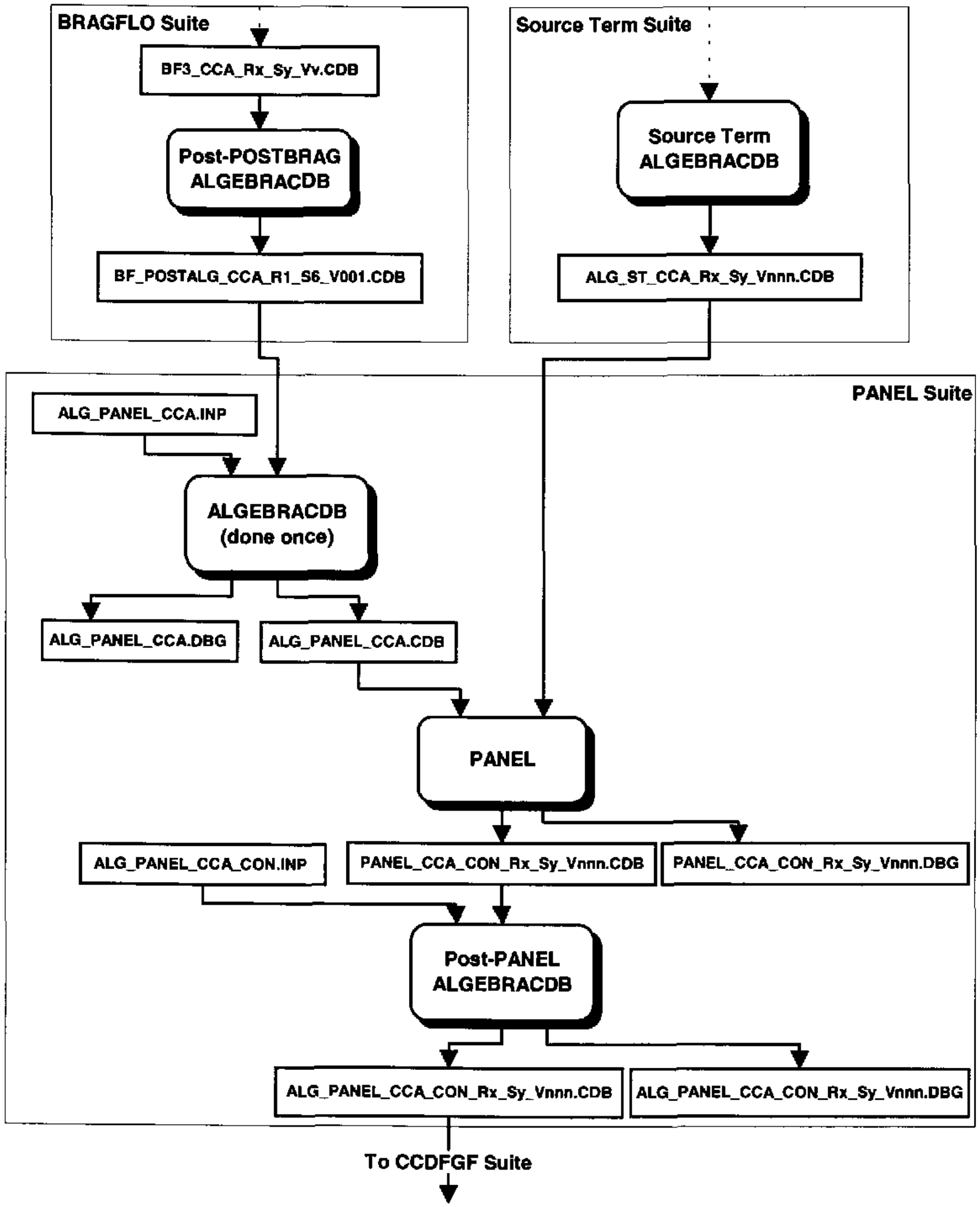


Figure 4.10 PANEL Concentration Calculations

4.3.1 PANEL's BRAGFLO Interface

PANEL requires two time-dependent quantities from BRAGFLO's output CDB file, namely: the time history of the waste panel brine volume and the amount of brine up the borehole. These data were not directly available from the BRAGFLO CDB but were calculated by summing the brine volumes in all the waste panel grid blocks and time integrating the brine release rates up the borehole in the post-POSTBRAGFLO ALGEBRACDB.

4.3.2 PANEL's Source-Term Input File

PANEL uses the same source-term property CDB file as NUTS (see Figure 4.2). Because PANEL models the individual isotopes, the parts of the Source-Term ALGEBRACDB input file that deal with lumping are not used by PANEL. Instead, PANEL reads the effective solubility parameter, LOGSOLM, for each of six elements, Am, Cm, Np, Pu, Th, and U, and the inventory parameters, INVCHD and INVRHD, for each isotope of these elements. As described in Section 3.6, the LOGSOLM for Cm was not calculated directly but copied from the corresponding LOGSOLM for Am.

4.3.3 Post-Processing of PANEL

PANEL mobilized all isotopes of Cm, Am, Pu, Np, U, and Th. To be usable by the analysis code CCDFGF, these isotopes must be 'lumped' into cumulative Curies of ^{241}Am, ^{238}Pu, ^{239}Pu, ^{234}U, and ^{230}Th. The data were so converted by a Post-PANEL ALGEBRACDB run. Post-PANEL ALGEBRACDB's input file for that task is shown in Appendix O.

5. Data

Data was supplied to NUTS and PANEL from the BRAGFLO and Source Term suites. The data read from the database for BRAGFLO is documented in the BRAGFLO Analysis Package. The data read from the database for the Source Term suite were obtained from the WIPP database (view CCA10) by applying MATSET. The following list of parameters is excerpted from MATSET's input file, which is named: MS_ST_CCA.INP. The parameters used for NUTS and PANEL are indicated by the section headings. The parameters that were sampled are bolded and the parameters that were calculated in the Source-Term ALGEBRACDB run are in italics. (Note: The material-parameter combinations for italicized parameters can not be found in the parameter database, but were added in the MATSET run to serve as place holders.)

```
! Misc. Properties
PROPERTY, MATERIAL=REFCON, NAMES =YRSEC

! Isotopes for PANEL
 PROPERTY  MATERIAL=Am241,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Am243,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Cf252,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Cm243,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Cm244,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Cm245,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Cm248,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Cs137,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Np237,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pa231,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pb210,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pm147,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pu238,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pu239,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pu240,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pu241,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pu242,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Pu244,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Ra226,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Ra228,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Sr90 ,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Th229,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Th230,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=Th232,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=U233,   NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=U234,   NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=U235,   NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=U236,   NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=U238,   NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE

! "Lumped" or "combined" isotopes for NUTS
 PROPERTY  MATERIAL=AM241L, NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=PU238L, NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=PU239L, NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=TH230L, NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
 PROPERTY  MATERIAL=U234L,  NAMES =InvCHD,InvRHD,ATWEIGHT,HALFLIFE
```

(Note: the parameters for the "normal" isotopes were read in for the "lumped" isotopes (e.g. Am241 values were used for Am241L) during the MATSET run, however, inventories for all the isotopes represented by the "lumped" isotopes were summed in the source term ALGEBRA run.)

```
! Elements for PANEL
 PROPERTY  MATERIAL=AM,       NAMES =CONCMIN,CONCINT,CAPHUM,CAPMIC,PROPMIC
 PROPERTY  MATERIAL=CF,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=CM,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=SR,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=CS,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=NP,       NAMES =CONCMIN,CONCINT,CAPHUM,CAPMIC,PROPMIC
 PROPERTY  MATERIAL=PA,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=PB,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=PM,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=PU,       NAMES =CONCMIN,CONCINT,CAPHUM,CAPMIC,PROPMIC
 PROPERTY  MATERIAL=RA,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=TH,       NAMES =CONCMIN,CONCINT,CAPHUM,CAPMIC,PROPMIC
 PROPERTY  MATERIAL=U,        NAMES =CONCMIN,CONCINT,CAPHUM,CAPMIC,PROPMIC
```

(note: ***LOGSOLM*** for Am, Np, Pu, Th, and U are calculated in the source term ALGEBRA run.)

```
! Elements for NUTS
 PROPERTY  MATERIAL=PUL,      NAMES =LOGSOLM
 PROPERTY  MATERIAL=AML,      NAMES =LOGSOLM
 PROPERTY  MATERIAL=UL,       NAMES =LOGSOLM
 PROPERTY  MATERIAL=THL,      NAMES =LOGSOLM

!Oxidation State Dependent Properties for both NUTS and PANEL
 PROPERTY, MATERIAL=GLOBAL,          NAMES =OXSTAT
!
 PROPERTY  MATERIAL=SOLMOD3,         NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=SOLMOD4,         NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=SOLMOD5,         NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=SOLMOD6,         NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=PHUMOX3,         NAMES =PHUMSIM,PHUMCIM
 PROPERTY  MATERIAL=PHUMOX4,         NAMES =PHUMSIM,PHUMCIM
 PROPERTY  MATERIAL=PHUMOX5,         NAMES =PHUMSIM,PHUMCIM
 PROPERTY  MATERIAL=PHUMOX6,         NAMES =PHUMSIM,PHUMCIM
!
 PROPERTY  MATERIAL=SOLAM3,          NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=SOLPU3,          NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=SOLPU4,          NAMES =SOLSIM,SOLCIM
 PROPERTY  MATERIAL=SOLTH4,          NAMES =SOLSIM
 PROPERTY  MATERIAL=SOLU6,           NAMES =SOLSIM
 PROPERTY  MATERIAL=SOLU6,           NAMES =SOLSIM,SOLCIM
```

where:
Properties:
YRSEC = number of <u>sec</u>onds in a <u>yea</u>r,
INVCHD = repository <u>inv</u>entory in Curies for <u>C</u>ontact <u>H</u>andled <u>W</u>aste,
INVRHD = repository <u>inv</u>entory in Curies for <u>R</u>emote <u>H</u>andled <u>W</u>aste,
ATWEIGHT = <u>at</u>omic <u>weight</u> in kg/mole,
HALFLIFE = the <u>half-life</u> in seconds,
CONCMIN = the maximum actinide <u>conc</u>entration in moles/liter suspended on <u>min</u>eral fragment colloids,
CONCINT = the maximum actinide <u>conc</u>entration in moles/liter suspended as actinide <u>int</u>rinsic colloids,
CAPHUM = the <u>cap</u> on the maximum actinide concentration in moles/liter suspended on <u>hum</u>ic colloids,
CAPMIC = the <u>cap</u> on the maximum actinide concentration in moles/liter suspended on <u>mic</u>robe colloids,
PROPMIC = the <u>prop</u>ortionality constant that is multiplied by the dissolved concentration to calculate the maximum actinide concentration in moles/liter suspended on <u>mic</u>robe colloids,
LOGSOLM = <u>log</u>$_{10}$ of the "effective" <u>sol</u>ubility in <u>m</u>oles/liter,
SOLSIM = the <u>sol</u>ubility parameter for <u>S</u>alado Brine, <u>i</u>norganic, <u>M</u>g(OH)$_2$/MgCO$_3$,
SOLCIM = the <u>sol</u>ubility parameter for <u>C</u>astile Brine, <u>i</u>norganic, <u>M</u>g(OH)$_2$/MgCO$_3$,
PHUMSIM = the <u>p</u>roportionality constant that is multiplied by the dissolved concentration to calculate the maximum actinide concentration in moles/liter suspended on <u>hum</u>ic colloids, for <u>S</u>alado Brine, <u>i</u>norganic, <u>M</u>g(OH)$_2$/MgCO$_3$,
PHUMCIM= the <u>p</u>roportionality constant that is multiplied by the dissolved concentration to calculate the maximum actinide concentration in moles/liter suspended on <u>hum</u>ic colloids, for <u>C</u>astile Brine, <u>i</u>norganic, <u>M</u>g(OH)$_2$/MgCO$_3$,

Materials:
isotope and element names represent those isotopes and elements,
isotopes and element names with an L ending are those "lumped" isotopes and elements as used by NUTS.
SOLMOD# = FMT modeled solubility in moles/liter of actinides in the +# oxidation state
PHUMOX# = the proportionality constant that is multiplied by the dissolved concentration to calculate the maximum actinide concentration in moles/liter suspended on humic colloids, for oxidation state #.
SOLAM3 = solubility distribution parameter for Am in the +3 oxidation state

5.1 Unused Parameters

Four "analyst choice" parameters (designated type 4B) were read from the database by the source term suite:

Material	Parameter
SR	LOGSOLM
CS	LOGSOLM
PB	LOGSOLM
RA	LOGSOLM

The solubilities of these elements were entered into the database as 1M to force the codes to use inventory limits for their concentrations, had they been modeled. Due to the choice of isotopes, however, neither NUTS nor PANEL modeled the mobilization of any of these elements and these parameters were not used.

In addition, solubilities of several elements were not on the database but calculated in the source term suite: Pa, Cf, Cm, and Pm. The solubility of these elements was calculated by analogy with that of Am and Np, however, only the solubility of Cm was used in the calculation. Use of the (+III) solubility for Cm is justified because Cm data was used to obtain the (+III) solubility modeling parameters.(see Siegel 1996).

5.2 Deviations from the Parameter Data Base

In NUTS's CCA calculations, the modules that control hydrodynamic dispersion and sorption were disabled. Thus, any related database parameters such as longitudinal and transverse dispersivities, molecular diffusion, tortuosity, grain density, and sorption coefficients were not read. The default values used by NUTS were zero for longitudinal and transverse dispersivities, molecular diffusion, grain density, and sorption coefficients, and one for the tortuosity. These values were used throughout the CCA calculations.

In the CCA calculations, PANEL did not use the half-lives and atomic weights from the database. Instead, PANEL extracted atomic weights from the isotope names, and supplied the half-lives in a data statement that resides within the code. Table 5.1 (excerpted from a table prepared by M. Martell) shows the differences between values occurring in the database and the corresponding values used by PANEL. All differences are minor except for the half-life of ^{228}Ra, which PANEL underestimates by about 15%. Since ^{228}Ra resides at the end of a decay chain, and PANEL did not calculate its release, its half-life did not effect the CCDFs.

Table 5.1 Listing of Parameters used in PANEL which differ from the PA Database

sec/yr = 3.1557E+07

material	PANEL half-life (years)	PANEL half-life converted to sec	db_val half-life (sec)	half-life % diff	PANEL atweight (g/mole)	database atweight (kg/mole)	atweight % diff
SR-90	2.9120E+01	9.1896E+08	9.1900E+08	0.01%	90	8.99080E-02	0.10%
CS-137	3.0000E+01	9.4671E+08	9.4670E+08	0.00%	137	1.36907E-01	0.07%
PB-210	2.2300E+01	7.0372E+08	7.0370E+08	0.00%	210	2.09984E-01	0.01%
RA-226	1.6000E+03	5.0491E+10	5.0490E+10	0.00%	226	2.26025E-01	0.01%
RA-228	5.7500E+00	1.8145E+08	2.1143E+08	14.18%	228	2.28031E-01	0.01%
TH-229	7.3400E+03	2.3163E+11	2.3160E+11	-0.01%	229	2.29032E-01	0.01%
TH-230	7.7000E+04	2.4299E+12	2.4300E+12	0.00%	230	2.30033E-01	0.01%
TH-232	1.4050E+10	4.4337E+17	4.4340E+17	0.01%	232	2.32038E-01	0.02%
PA-231	3.2760E+04	1.0338E+12	1.0340E+12	0.02%	231	2.31036E-01	0.02%
U -233	1.5850E+05	5.0018E+12	5.0020E+12	0.00%	233	2.33040E-01	0.02%
U -234	2.4450E+05	7.7157E+12	7.7160E+12	0.00%	234	2.34041E-01	0.02%
U -235	7.0380E+08	2.2210E+16	2.2210E+16	0.00%	235	2.35044E-01	0.02%
U -236	2.3420E+07	7.3906E+14	7.3890E+14	-0.02%	236	2.36046E-01	0.02%
U -238	4.4680E+09	1.4100E+17	1.4100E+17	0.00%	238	2.38051E-01	0.02%
NP-237	2.1400E+06	6.7532E+13	6.7530E+13	0.00%	237	2.37048E-01	0.02%
PU-238	8.7740E+01	2.7688E+09	2.7690E+09	0.01%	238	2.38050E-01	0.02%
PU-239	2.4070E+04	7.5958E+11	7.5940E+11	-0.02%	239	2.39052E-01	0.02%
PU-240	6.5370E+03	2.0629E+11	2.0630E+11	0.01%	240	2.40054E-01	0.02%
PU-241	1.4400E+01	4.5442E+08	4.5440E+08	0.00%	241	2.41057E-01	0.02%
PU-242	3.7630E+05	1.1875E+13	1.2210E+13	2.74%	242	2.42059E-01	0.02%
PU-244	8.2600E+07	2.6066E+15	2.6070E+15	0.02%	244	2.44064E-01	0.03%
AM-241	4.3220E+02	1.3639E+10	1.3640E+10	0.01%	241	2.41057E-01	0.02%
CM-244	1.8110E+01	5.7150E+08	5.7150E+08	0.00%	244	2.44063E-01	0.03%
CM-248	3.3900E+05	1.0698E+13	1.0700E+13	0.02%	248	2.48072E-01	0.03%
CF-252	2.6380E+00	8.3247E+07	8.3250E+07	0.00%	252	2.52082E-01	0.03%
PM-147	2.6234E+00	8.2786E+07	8.2790E+07	0.00%	147	1.46915E-01	0.06%
SM-147	1.0600E+11	3.3450E+18	3.3770E+18	0.95%	147	1.46915E-01	0.06%
AM-243	7.3700E+03	2.3257E+11	2.3290E+11	0.14%	243	2.43061E-01	0.03%
CM-243	2.9100E+01	9.1831E+08	8.9940E+08	-2.10%	243	2.43061E-01	0.03%
CM-245	8.5300E+03	2.6918E+11	2.6820E+11	-0.37%	245	2.45065E-01	0.03%

1. PANEL uses half-life in years. The value is converted to seconds using the sec/yr stored in the database.
2. from block data GE_CHART , taken from the SCMS version of cpanel.for.

As described in Section 6, initial NUTS and PANEL calculations were performed using View CCA5. These calculations were repeated using view CCA10 and the results from the final calculations are reported here.

6. Analysis Results - Direct Brine Release

The contaminant concentration in EPA units/ m^3 brine within the repository as a function of time for two brine compositions, Salado for S1, S4 and S5, and Castile for S2, S3 and S6 were performed by PANEL as shown Figure 4.10. These calculations were originally performed using the CCA5 view of the parameter database and the results used in the CCA are shown in Figure 6.1 and Figure 6.2.

In each of these figures, one can see 4 "regions". 1) In the first several hundred years, there is a drop in the EPA unit concentrations of some realizations as the EPA units of ^{238}Pu decays to below that of ^{241}Am. 2) There is then a constant concentration seen for the period where ^{241}Am controls the total EPA unit concentration and is solubility limited. For the realizations that sampled a higher Am solubility, this period is shorter than for the realizations that sampled a lower Am solubility. 3) After the Am changes from solubility to inventory limited, the EPA unit concentration drops until 4) the ^{239}Pu solubility controls the EPA unit concentration. In region 4, the higher concentrations are constant but the lower concentrations show a slow decrease with time, because the sampled ^{239}Pu solubility is low enough that other isotopes which are inventory limited and have intermediate half-lives contribute to the total EPA unit concentrations. The spread in concentrations seen in region 2 reflect the spread in Am solubility, and the higher Am solubility in Salado brine than in Castile brine is clearly seen. Similarly, the region 4 spread mainly reflects the spread in Pu(+III) and Pu(+IV) solubilities. As can be seen, the solubility of both oxidation states of Pu are quite low in Castile brine, but that in Salado brine there is a bimodal distribution showing the higher solubility of Pu(+III) and lower solubility of Pu(+IV).

Figure 6.1 and Figure 6.2 results were obtained using the CCA5 view of the parameter database. View CCA5 contained the inventory of 29 isotopes (the PANEL list minus ^{147}Sm which had no initial inventory) decayed to 1995. Due to uncertainties in the inventory of waste that is yet to be generated, the projected 1995 inventory was initially used at the start of the calculation as if it were generated at 2033. More recent calculations used the inventory decayed the additional 38 years 2033 before the start of the calculations (see Sanchez et. al.). Two methods were used to reflect this change in the PANEL runs. The faster method, included in the CCA documentation, time shifted the PANEL output by -38 years in the post-PANEL ALGEBRACDB calculation. The results of these calculations are shown in Figure 6.1and Figure 6.2. The slower method updated the parameter database (to view CCA10) and reran the code. An additional change was made when updating the post-PANEL ALGEBRACDB input file. In the runs used in the CCA, the time was not shifted -38 years but -63 years so that the reported result would be centered over the 50 year time step. Centering over the time step was reconsidered, and the concentrations were reported at the beginning of the time step because the code calculated releases based on concentrations at the beginning of the time step. Consequently, the time was shifted -50 years in the final calculations. These results are shown in Figure 6.3, and Figure 6.4. The results in these two methods would have been identical to 3 significant figures (the precision of the recorded inventory) had the time of reporting not changed from the center to the beginning of the time step. This 25 year change caused the shorter lived isotopes to switch from solubility limited concentration to inventory limited concentration 25 years sooner in the final calculations. The maximum over-prediction in the CCA calculations would occur for intrusions that occur in region 3 where ^{241}Am dominates the EPA unit concentration and is inventory limited. In this region, 25 years of decay results in about a 3.7% decrease in the ^{241}Am concentration.

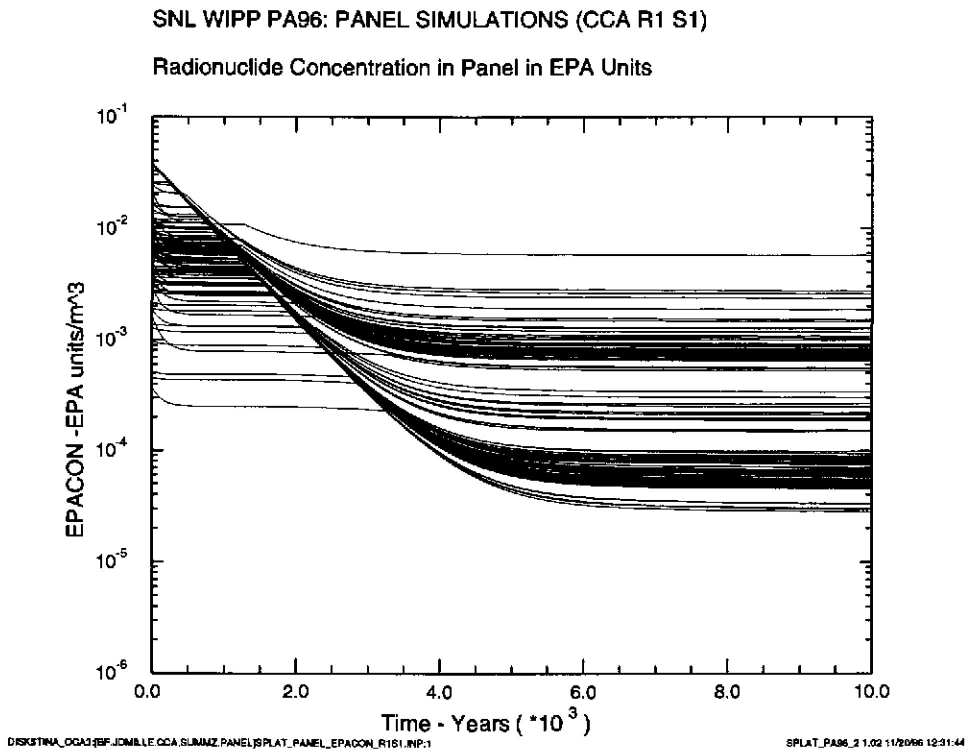


Figure 6.1 PANEL Concentrations, Salado, CCA5

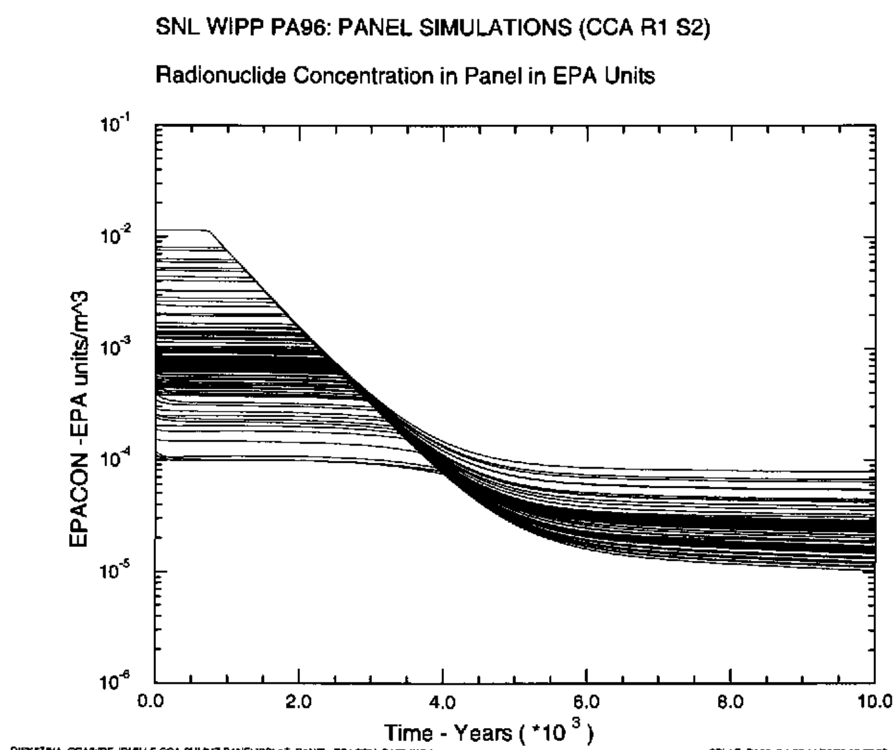


Figure 6.2 PANEL Concentrations, Castile, CCA5

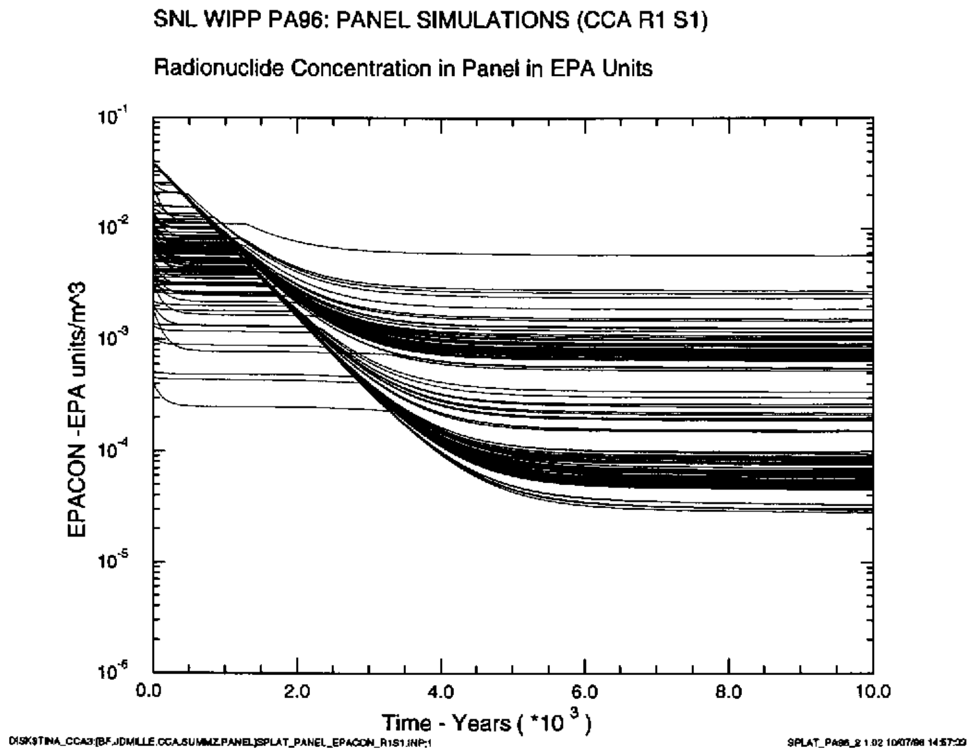


Figure 6.3 PANEL Concentrations, Salado, CCA10

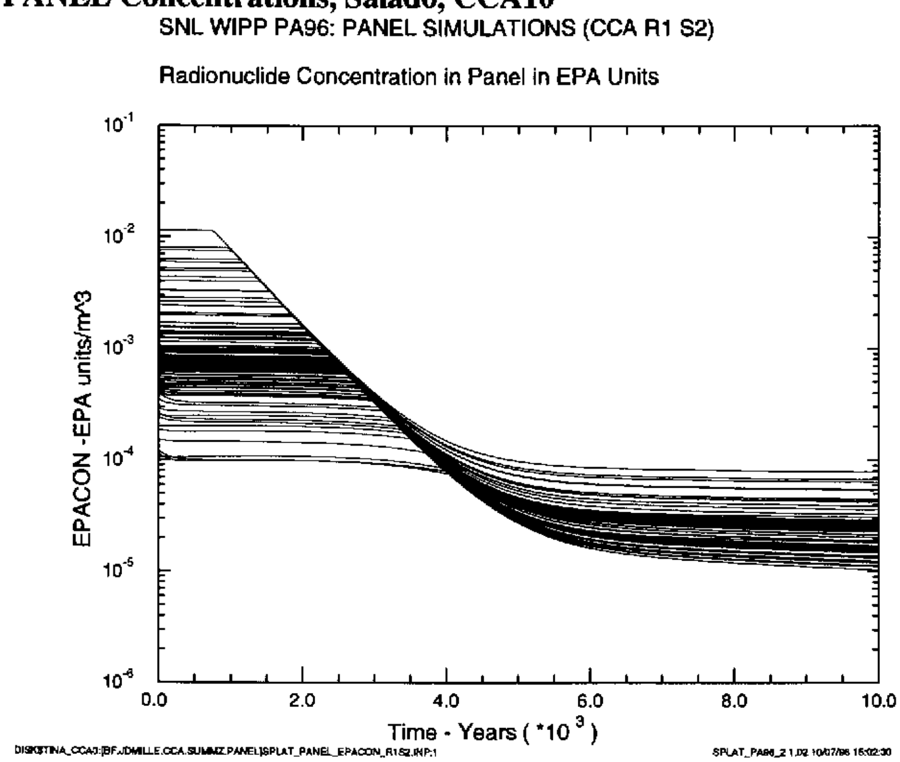


Figure 6.4 PANEL Concentrations, Castile, CCA10

7. Analysis Results - Long Term Discharge to Culebra

In this section, radioisotope migration modeling results are presented and discussed for undisturbed and disturbed repository performance. For disturbed performance, three representative borehole intrusion scenarios were considered. In the first scenario, the E1 scenario, at 1000 years a borehole penetrates a waste-filled panel and a hypothetical pressurized brine reservoir in the underlying Castile Formation. In the second scenario, the E2 scenario, at 1000 years a borehole penetrates the waste-filled panel only. In the third scenario, the E2E1 scenario, two boreholes penetrate the waste-filled panel. The first borehole penetrates the panel only at 800 years and a second borehole, drilled at 2000 years at the same location, penetrates both the repository and the hypothetical brine reservoir. To examine the impact of different intrusion times, the E1, E2, and E2E1 scenario calculations were also performed at additional intrusion times: 100, 350, 1000, 3000, 5000, 7000, and 9000 years for the E1 and E2 scenarios, and 100, 350, 1000, 4000, 6000, and 9000 years for the E2E1 scenario.

As explained in the source term description (Section 3), the behavior of mixed brines within the repository is bracketed using the chemistries of Castile and Salado brines. That is, the brine chemistry used in the source-term model corresponds to one of these two end-member brines, depending on the scenario. In general, the solubilities of the four actinides are lower in Castile brine than in Salado brine. The selected combinations of scenarios and end-member brines used in the NUTS and PANEL calculations are as follows. In the undisturbed scenario, the brine is assumed to be purely Salado brine since brine enters the repository from the Salado. In the E1 and E2E1 scenarios (intrusion borehole passes through the repository and penetrates a Castile brine reservoir), the brine is assumed to be dominantly Castile brine since most of the brine that contacts waste and flows up the borehole is likely to be Castile brine. In the E2 scenario, the brine is assumed to be Salado brine because it will either: a) originate in the Salado and flow through the waste before flowing up the borehole; or b) originate in the Rustler or Dewey Lakes as relatively fresh water, flow down the borehole and dissolve Salado minerals. Although the brine originating from overlying units is more likely to have Castile-like composition after dissolving Salado minerals, the brine in this scenario is conservatively assumed to be Salado.

Although the source-term assumptions described above are appropriate for the majority of realizations, there were instances where the results indicated that significant brine mixing occurred. An example is realization #23. In this realization, in scenario 2, about 4600 m^3 flowed into the panel from the Castile during the first 150 years following the intrusion (Analysis Package for the Salado Flow Calculations (Task 1), WPO# 40514). However, after the borehole plugs above the repository degraded (at 1200 years), 32,260 m^3 brine flowed down the borehole from the Dewey Lakes and Magenta. In addition, 56,000 m^3 of Salado brine flowed into the repository from the marker beds. Thus, the 35,000 m^3 of brine that flowed up the borehole to the Culebra was approximately 4,600+32,260/(4,600 + 32,260 + 56,000) or 40% Castile brine and 60% Salado brine. Therefore in the E1 scenario, in this realization, the assumption of 100% Castile brine with its lower actinide solubilities may have resulted in underestimated releases. On the other hand, in the E2 scenario, this realization showed about 45,000 m^3 of brine flowing down from the overlying units and 21,000 m^3 flowing in from the marker beds. Since the dilute waters from above are expected to attain Castile-like compositions, the 38,000 m^3 of brine that flowed up the borehole to the Culebra was approximately 45,000/(21,000+45,000) or 68% Castile and 32% Salado. Therefore in the E2 scenario, in this realization, the assumption of 100% Salado brine with its higher actinide solubilities may have resulted in over estimated releases. Thus, in realizations with extensive brine mixing such as realization 23, the E1 releases are expected to have been underestimated and the E2 releases are expected to have been overestimated. In most realizations, however, the mixing was minor and the simplification was justified.

The analysis results are presented as follows. The undisturbed scenario is presented first, followed by the E1, E2, and E2E1 scenarios. For each scenario, activity released via the important pathways are discussed.

7.1 BRAGFLO Time-Step effect on NUTS Results:

It is well understood that the size of the time step has a direct impact on the level of the truncation error found in any numerical approximation procedure. In particular, a fully implicit approach in treating the time level of dependent variables is attractive due to the ability to use large time steps. The time truncation error for larger time steps is, however, higher; consequently, the effect of the time step size on the resultant numerical dispersion was investigated.

For the same time step sizes, the amount of numerical dispersion introduced in transport codes is different from that introduced in fluid flow codes. Therefore, an appropriate time step size in BRAGFLO is not necessarily suitable for NUTS. Even though BRAGFLO uses an automatic time stepping procedure, it has the ability to output the element variables, using an input controlled frequency. Hence, a frequency of 5 will lead to a BRAGFLO output that combines five time steps in one and averages the time dependent element variables over the five time steps. Since BRAGFLO is the upstream code that feeds NUTS with the major hydrological input parameters, it is suitable to conduct a time step size analysis to choose a reasonable BRAGFLO frequency to conduct the CCA calculations. By reasonable, it is meant here that the size of the time step should be 1) big enough to conduct the calculation within reasonable computational time and reasonable disk storage space, and 2) numerical dispersion will not impair the accuracy of the solution. An analysis was carried out on two carefully selected realizations from the first replicate, one from the undisturbed and another from the E1 scenarios.

In this analysis, four isotopes were selected, two individuals and one chain. The individual isotopes are ^{241}Am and ^{239}Pu, and the chain is $^{234}U \rightarrow ^{230}Th$. In order to show the impact of the time stepping procedures alone, the same log molar solubility value of -4.0 (log mole/l) is assigned for the four isotopes. The rest of the input data is given in the property input file SORE1.CDB.

7.1.1 Generation of Analysis Variables

The code BRAGFLO was run with three time stepping frequencies: 5, 10, and 20. The realizations used for these runs were 46 and 25, from the first replicate undisturbed and human intrusion (E1) at 1000 years scenarios, respectively. The BRAGFLO input files were BF2_CCA_STEP*f*_R1_S1_V46.INP and BF2_CCA_STEP*f*_R1_S3_V25.INP, where *f* refers to the frequencies, and R1, S1 and S3 refer to the replicate and scenarios as previously described. The BRAGFLO output files had the corresponding names but with the BF3 prefix and CDB extension and were used as input to NUTS (similar to Figure 4.6). The NUTS ASCII files NUT_TANAL_UND.INP for the undisturbed, NUT_TANAL_E1.INP for the E1 scenarios were used and NUTS source term input file SORE1.CDB was used for both scenarios. The NUTS output CDB files, NUT_TANAL_ R*x*S*y*_STEP*f*_V*nnn*.CDB was post-processed using the ALGEBRACDB input file NUT_TANAL_AL.INP. The output from ALGEBRACDB was named NUT_ALTANAL_R*x*S*y*_STEP*f*_V*nnn*.CDB.

To plot the post-processed analysis variables, the code SUMMARIZE was used to interpolate the data from the output CDB files between 0 and 10,000 years at 500 years intervals and to store the analysis variables in SPLATCDB table format. The input files for SUMMARIZE were the files NUT_TANAL_E1_SUM_&&.INP, NUT_TANAL_UND_SUM_&&.INP, where && refers to AM (^{241}Am), P9 (^{239}Pu), U4 (^{234}U), or TH (^{230}Th).

7.1.2 Plotting Analysis Variables:

A complete list of the analysis variables generated by the ALGEBRACDB runs is presented in Table 7.1. The output from the code SUMMARIZE are the tables NUT_TANAL_E1_SUM_&&.DAT and NUT_TANAL_UND_SUM_&&.DAT, where && has the same meaning as above. The data in these tables are plotted by the code SPLATCDB using the command files NUT_TANAL_E1_%%%_&&.CMD and NUT_TANAL_UND_%%%_&&.CMD, where %%% represent CBH (the borehole where it intersects the Culebra), REP (the repository), or M39 (the Marker Bed 139).

Except for the BRAGFLO runs, the whole analysis was conducted by running the command file NUT_TANAL_ALL_ADOBE.COM.

7.1.3 Analysis of the Results

It is essential in such an analysis to decide on the acceptance criteria of the results. As the main objective of the isotopes transport was to compare the integrated releases at the Land Withdrawal Boundaries (LWBs) with the EPA limits, it was, therefore, appropriate to use the integrated releases as a criterion to compare the results. In this analysis ^{238}Pu was not included because with its small inventory and short half-life, it was not expected to have a significant impact on the outcome.

Table 7.1 List of Analysis Variables for Time Step Size Selection

Variable Name	Units	Description of the Variable
XXREPC	Ci	Cumulative release of ^{241}Am from the repository
XXMB39SC	Ci	Cumulative release of ^{241}Am at the south LWB of the Marker Bed 139
XXMBABSC	Ci	Cumulative release of ^{241}Am at the south LWB of the Marker Bed A&B
XXMB38SC	Ci	Cumulative release of ^{241}Am at the south LWB of the Marker Bed 138
XXMB39NC	Ci	Cumulative release of ^{241}Am at the north LWB of the Marker Bed 139
XXMBABNC	Ci	Cumulative release of ^{241}Am at the north LWB of the Marker Bed A&B
XXMB38NC	Ci	Cumulative release of ^{241}Am at the north LWB of the Marker Bed 138
XXCULBRC	Ci	Cumulative release of ^{241}Am passing the lower boundary of the Culebra
XXSHUPC	Ci	Cumulative release of ^{241}Am in the shaft at the Culebra member
XXBHUPC	Ci	Cumulative release of ^{241}Am in the borehole at the Culebra member
XXSURBHC	Ci	Cumulative release of ^{241}Am at the ground surface in the borehole
XXSURSHC	Ci	Cumulative release of ^{241}Am at the ground surface in the shaft
where XX = AM for ^{241}Am, P9 for ^{239}Pu, U4 for ^{234}U, TH for ^{230}Th		

7.1.3.1 Undisturbed, S1 Scenario

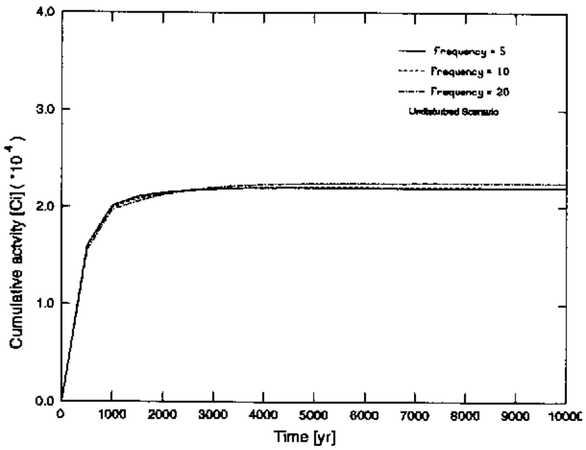
Even though the undisturbed scenario showed some releases in Replicate 2 and 3, realization 46 was chosen from Replicate 1, because it exhibited the highest release. Output frequencies from BRAGFLO at 5, 10, and 20 were evaluated. The analysis was performed by comparing the integrated releases from the repository and that detected at each LWB.

Examination of the tables NUT_TANAL_UND_SUM_&&.DAT indicates that:

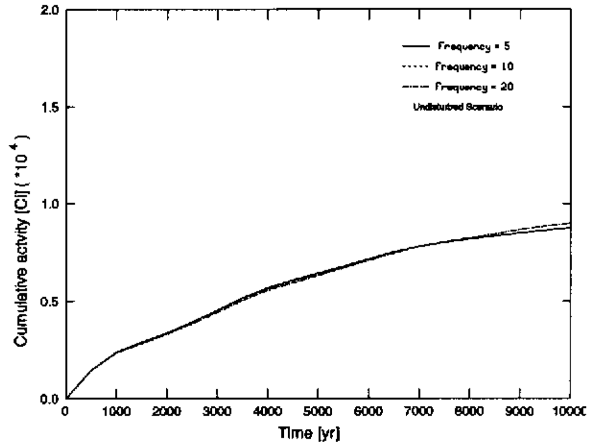
- The releases detected at the Marker beds 138 and A&B, in the shaft at the Culebra member and the surface are zero regardless of the frequency of the output.

- The percent of the total inventory released from the repository for each isotope at each frequency (Figure 7.1) are listed in Table 7.2.

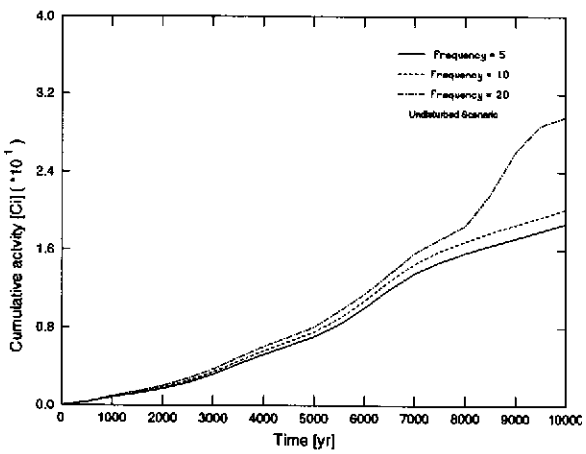
- The differences in the amount of the releases at different frequencies are displayed in



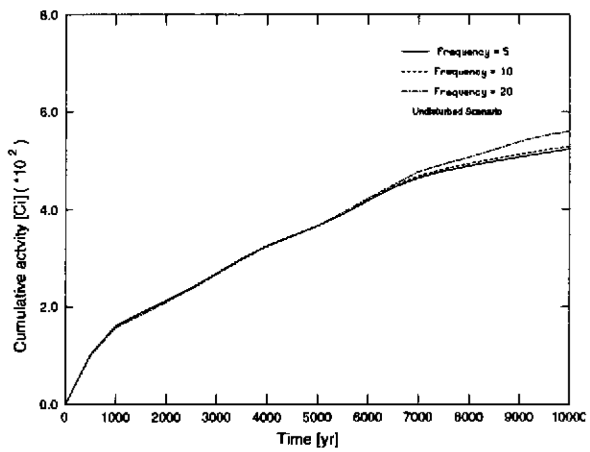
Cumulative Release from the repository for AM241,
at Different Bragflo Time-Stepping Frequency



Cumulative Release from the repository for PU239,
at Different Bragflo Time-Stepping Frequency



Cumulative Release from the repository for TH230,
at Different Bragflo Time-Stepping Frequency



Cumulative Release from the repository for U234,
at Different Bragflo Time-Stepping Frequency

. The percentage of releases out of the total inventory at the Marker Bed 139 are presented in Table 7.3.

- Using the output frequency of 20 results in an overestimation in the amount of the release and therefore is conservative.

Table 7.2 The percent of the total inventory released from the repository at different frequencies in the Undisturbed Scenario

Isotope	Inventory (curies)	% releases from the repository at different output frequencies		
		Freq. = 5	Freq. =10	Freq. =20
^{241}Am	529,655	4.15	4.17	4.24
^{239}Pu	101,154.	8.1	8.1	8.2
^{234}U	2,456	22.2	22.4	22.8
^{230}Th	225+	7.12	8.01	13.35

Table 7.3 The percent of the total inventory released out the LWB in marker bed 139 at different frequencies in the Undisturbed Scenario

Isotope	Inventory (curies)	% releases from MB 139 at different output frequencies		
		Freq. = 5	Freq. =10	Freq. =20
^{241}Am	529,655	1.77E-10	1.90E-10	2.00E-10
^{239}Pu	101,154	1.40E-06	1.70E-06	2.30E-06
^{234}U	2,456	3.34E-05	4.00E-05	6.10E-05
^{230}Th	225	3.12E-05	4.45E-05	8.01E-05

+ The inventory of ^{230}Th is based on the sum of the original inventory and the 10,000 years decayed inventory of ^{234}U.

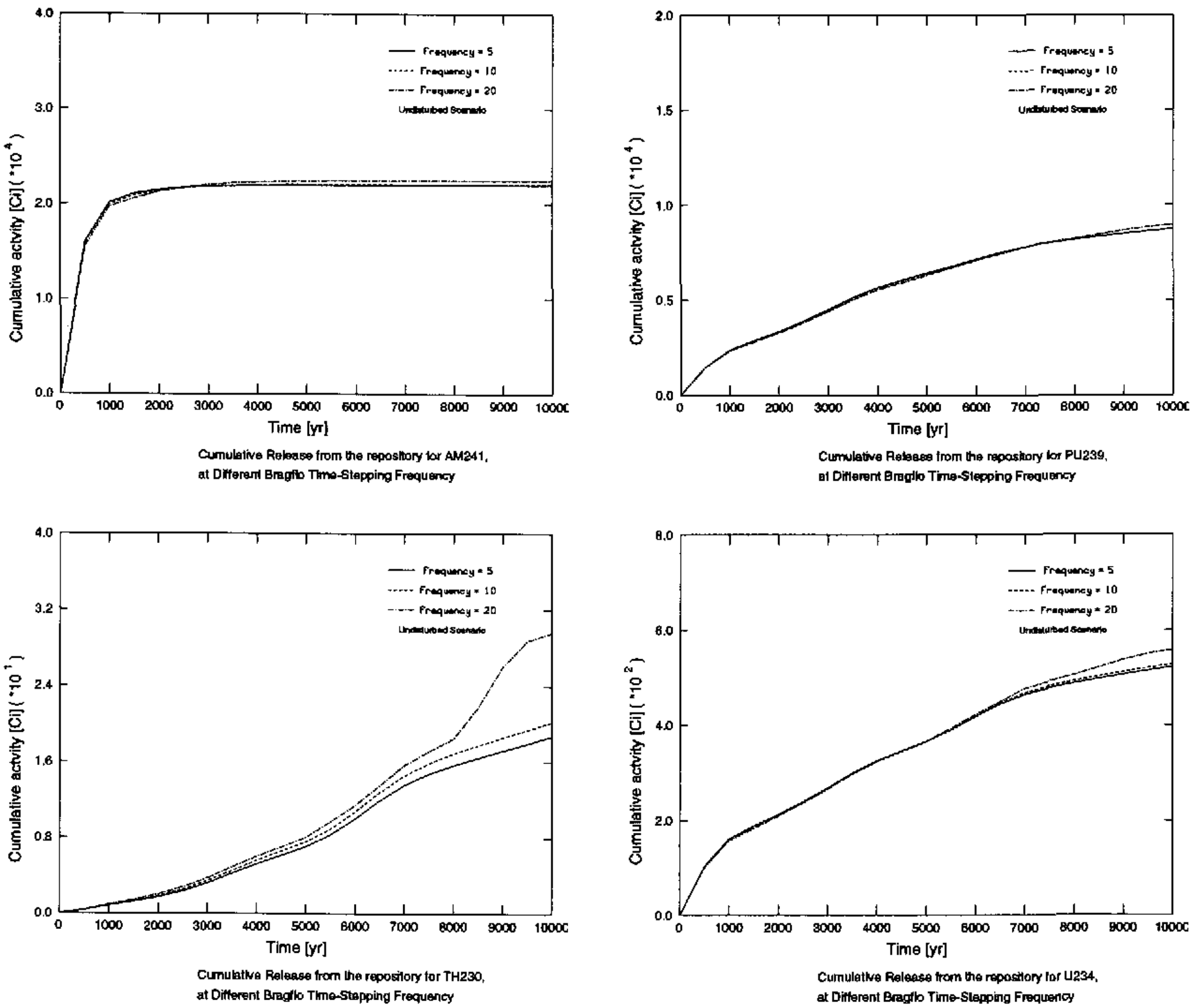


Figure 7.1 Cumulative Release from the repository at Different BRAGFLO Time-stepping Frequencies

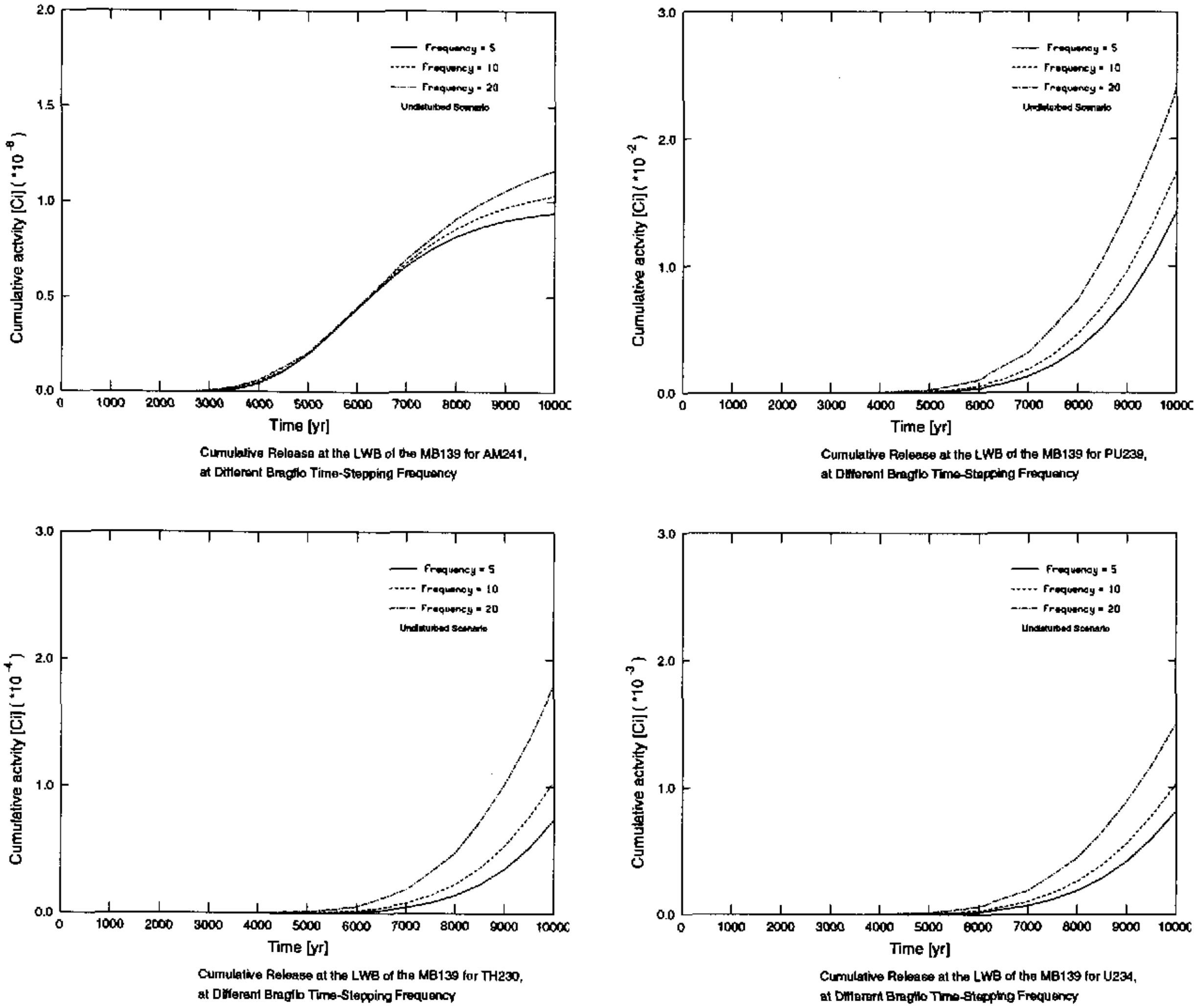


Figure 7.2..Cumulative Release at the LWB in MB139 at Different BRAGFLO Time-stepping Frequencies

7.1.3.2 Human Intrusion at 1000 years, S3 scenario

In this scenario, a high release realization was chosen from Replicate 1. The amount of the brine passing in the well-bore at the Culebra observed in BRAGFLO was approximately 10,800 m^3 , and was highly contaminated. Similar to the undisturbed scenario, BRAGFLO output frequencies of 5, 10, 20 were used and the analysis was performed by comparing the integrated releases detected at each LWB. Inspection of the tables NUT_TANAL_E1_SUM_&&.DAT shows that:

- The releases detected at the LWB in the Marker beds, in the shaft at the Culebra and the surface are zero regardless of the frequency of the output.

- The releases from the repository, Figure 7.3, show an insignificant differences for the reported three frequencies except for the ^{230}Th, where the frequency of 20 is higher than that of 5 by approximately 3% .

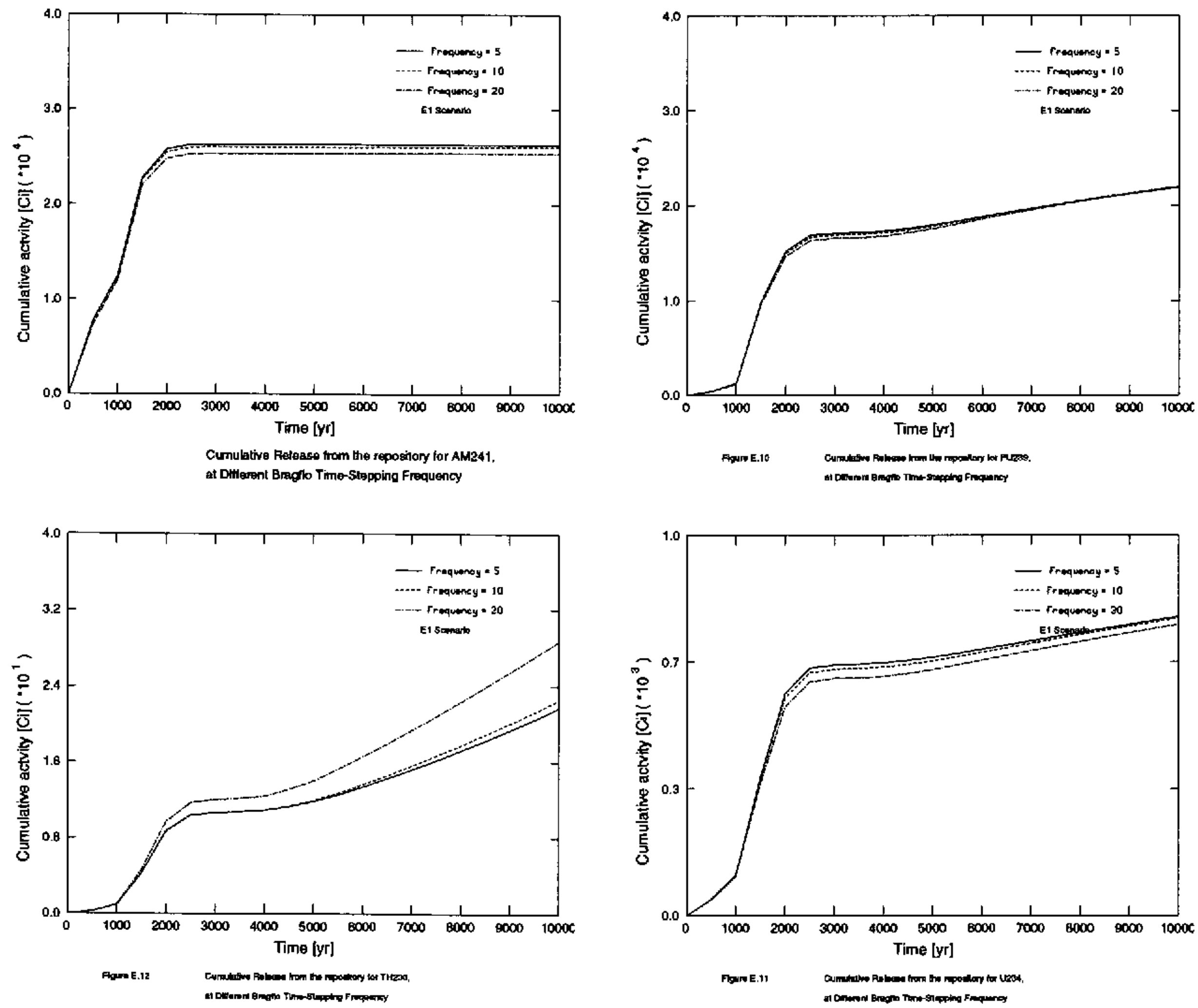


Figure 7.3.. Cumulative Release from the repository at Different BRAGFLO Time-stepping Frequencies

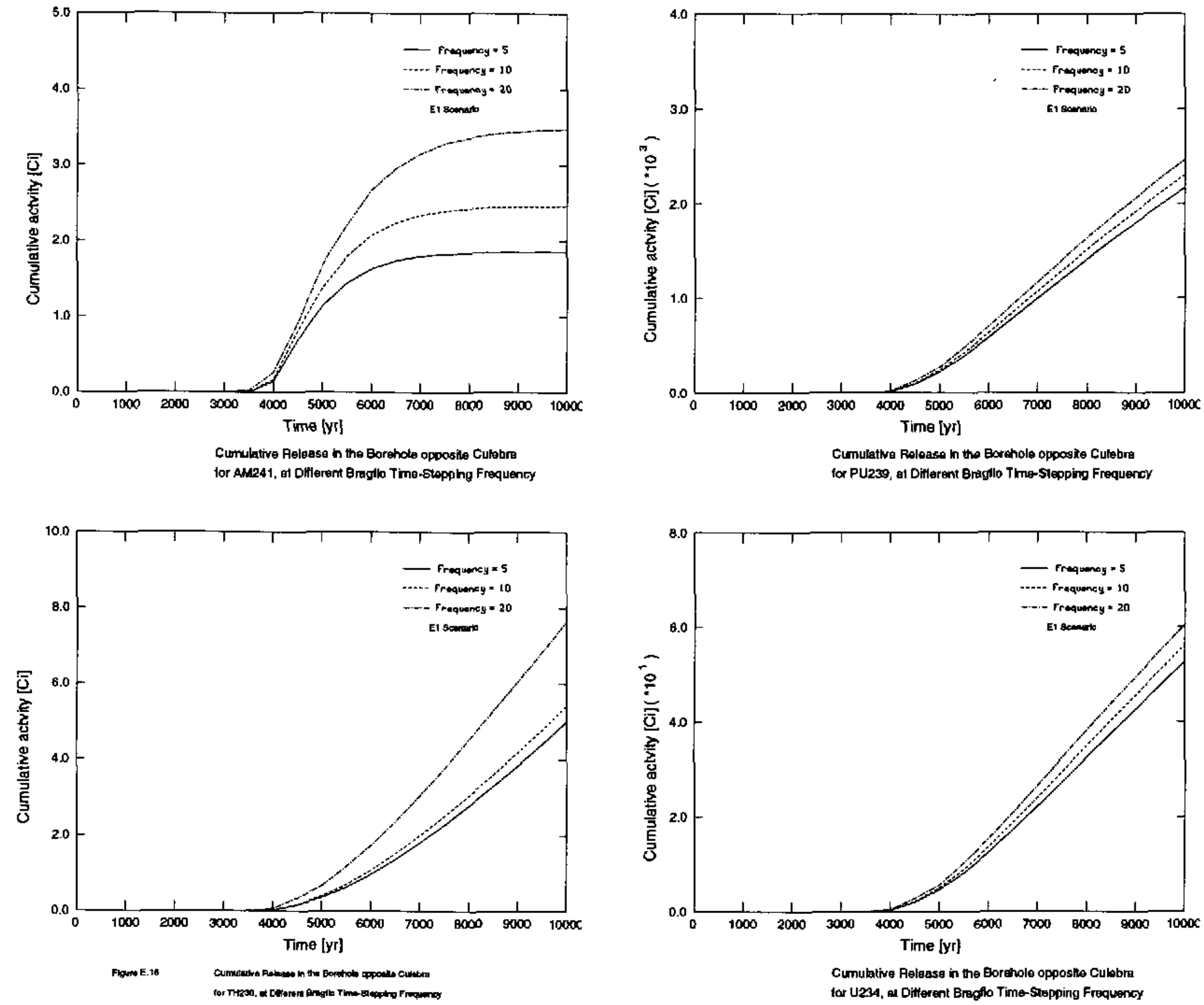


Figure 7.4.. Cumulative Release into the Culebra at Different BRAGFLO Time-stepping Frequencies

7.1.4 Conclusions

For the four isotopes tested, the following conclusions can be drawn from the above analysis:

1. The differences between 5 and 10 time steps frequencies are negligible.

2. For release up the borehole into the Culebra, the differences between 5 and 20 time steps frequency releases for the major contributor, ^{239}Pu, did not exceed 0.03% of the total curies in the repository. Taking in consideration the inventory of ^{239}Pu, this difference will add approximately 30 additional curies to the releases from the borehole to Culebra which is insignificant.

3. In addition to the high CPU time required to conduct the CCA calculations, lower frequencies (5 and 10) if adapted would crowd the storage area and would triple the amount of disk space required to store both the BRAGFLO and NUTS results.

4. Utilizing the higher output frequency tends to overestimate the releases by the above mentioned ratios and is therefore conservative.

5. As a result of the above analysis, it was recommended that BRAGFLO print out every 20 time steps for the CCA calculations.

7.2 Screening Results

A screening analysis was conducted to reduce the large number of potential transport simulations to a tractable number. This analysis, described in Section 2.2.3, was performed because only a fraction of the total number of realizations will result in transport of radioisotopes to the accessible environment. All realizations that transport a cumulative mass of inert tracer greater than or equal to 10^{-7} kg to the accessible environment over 10,000 years were considered significant and retained for complete transport analysis. The retained realizations are summarized in Table 7.4.

Table 7.4 Summary of Realizations Screened In.

Replicate	Scenario	Realization Number
R1	S1	46
	S2	4, 9, 13, 14, 19, 23, 25, 39, 40, 41, 48, 49, 50, 52, 54, 59, 64, 72, 77, 88, 90, 99, 100
	S3	09, 13, 19, 23, 25, 39, 40, 41, 48, 49, 50, 52, 64, 72, 77, 82, 88, 90, 98, 99, 100
	S4	7, 23, 25, 39, 64, 72
	S5	7, 23, 25, 39, 64, 72
R2	S1	16, 25, 33, 81, 90
	S2	8, 11, 24, 25, 26, 28, 30, 31, 35, 41, 47, 53, 65, 67, 74, 77, 81
	S3	8, 10, 11, 21, 24, 25, 26, 28, 30, 31, 35, 41, 47, 53, 63, 65, 67, 74, 77, 81, 83
	S4	24, 28, 41, 65, 91
	S5	24, 28, 41, 65, 91
R3	S1	3, 60, 64
	S2	6, 17, 21, 22, 25, 32, 36, 38, 45, 46, 50, 52, 53, 56, 60, 62, 67, 76, 80, 83, 90, 93
	S3	2, 17, 21, 22, 25, 27, 32, 35, 36, 38, 43, 45, 50, 52, 53, 56, 60, 62, 65, 67, 80, 83, 87, 90, 93
	S4	43, 56, 60, 66, 78, 80, 93
	S5	43, 56, 60, 66, 78, 80, 93

7.3 Isotope Transport Simulations

This section examines radioisotope transport for four groups of scenarios: undisturbed (S1, Figure 1.2), E1 (S2 and S3, Figure 1.3), E2 (S4 and S5, Figure 1.4), and E2E1(S6, Figure 1.5). Three potential pathways for migration of radioisotopes in dissolved brine are considered. In the first and most important pathway, contaminated brine may leave the repository through a human intrusion borehole and flow upward toward the Culebra Dolomite Member of the Rustler Formation. Once in the Culebra, contaminated brine may then move toward the subsurface land withdrawal boundary. In the second pathway, brine may migrate through or around the panel seals through the disturbed rock zone (DRZ) surrounding the repository to the shaft and then upward toward the Culebra. In the third pathway, brine may migrate from the repository through the DRZ and laterally toward the subsurface land withdrawal boundary within the anhydrite inter-beds (marker beds 138 and 139). As shown below for scenarios 1 through 5, NUTS calculations indicate that the only pathway from the repository for significant release is the intrusion borehole. This justifies the use of PANEL, which ignores all pathways other than the borehole for S6 calculations.

The brine flow fields required for NUTS transport calculations are provided by the two-phase flow model BRAGFLO. BRAGFLO is used to model two intrusion times of 350 and 1000 years. The flow fields corresponding to these two intrusion times are used to approximate flow fields for the additional intrusion times of 100, 3000, 5000, 7000, and 9000 years. For example, for the 100-year intrusion, flow fields from the 350-year intrusion are applied beginning at 100 years. For the period from time zero to 100 years, flow fields from the undisturbed scenario are used. Similarly, for each of the intrusions at 3000, 5000, 7000, and 9000 years, BRAGFLO flow fields from the 1,000-year intrusion are applied beginning at 3000, 5000, 7000, and 9000 years, respectively. In each of these intrusion cases, from time zero until the intrusion time, flow fields from the undisturbed scenario are used.

As discussed in Section 7.1, BRAGFLO's computed flow fields are stored at every 20-th time step only. However, because BRAGFLO automatically varies its time-step size to optimize the speed of the calculation, the times at which results are printed may not fall at exactly 100, 3000, 5000, 7000, and 9000 years. For example, the maximum time step allowed in BRAGFLO is 1.7280×10^9 s, or about 54.76 years. In some instances, a BRAGFLO calculation may take 20 time steps each of 54.8 years between printouts, for a total of 1095 years between printouts of results. In each NUTS realization, the intrusion flow fields are applied beginning with the printout time closest to the desired intrusion time. For example, for the 3000-year intrusion, if BRAGFLO results are output at 2720 years and 3170 years, then the 1000-year intrusion flow fields are applied starting with the output time closest to 3000 years, that is, 3170 years. Because BRAGFLO outputs may be separated by as much as 1095 years, the NUTS simulations may start as much as 548 years before or after the actual specified intrusion time.

PANEL uses 50 year time steps, so the second intrusions of the time shifted PANEL runs occur exactly at the specified times: 100, 350, 1000, 4000, 6000, and 9000 years.

7.3.1 Undisturbed Performance - NUTS

This section examines two potential pathways for migration of radioisotopes in dissolved brine (Figure 1.2). In the first pathway, brine may migrate through the panel seals or through the disturbed rock zone (DRZ) surrounding the repository to the shaft and then upward toward the Culebra Dolomite Member of the Rustler Formation. In the second pathway, brine may migrate from the repository through the DRZ and laterally toward the subsurface land withdrawal boundary within the anhydrite inter-beds in the Salado Formation.

7.3.1.1 Results

When brine enters the disposal region, gas is generated by anoxic corrosion of iron and biodegradation of organic materials, and radioisotopes are released into the brine from the waste. If sufficient quantities of gas are generated, pressures in the disposal region will increase. Brine flow into the repository will be reduced as repository pressure increases, and brine containing dissolved radioisotopes may be expelled from the repository if pressure there exceeds brine pressure in the immediately surrounding formation. Brine saturation has to exceed the residual brine saturation in order for brine to be expelled from the repository.

Because the highest releases occurred in replicate 1, only this replicate will be summarized here. The gas and brine migration analysis (Task 1) showed that only eight realizations produced flow outward beyond the land withdrawal boundary, ranging between 1 to 239 m^3 during the 10,000-year regulatory period. Of these eight realizations, NUTS calculations show that only one realization (#46) released radioisotopes beyond the land withdrawal boundary. These releases occurred at the land withdrawal boundary to the south of the repository (Figure 7.5), with a total activity of 3.33×10^{-10} EPA units. An examination of transport results in the individual marker beds reveals that all of this activity was released in Marker Bed 139. The majority of this activity was due to ^{239}Pu (3.08×10^{-10} EPA units) and ^{230}Th (1.81×10^{-11} EPA units). We believe, however, that these releases were due to numerical dispersion. This large dispersion was a consequence of the coarse lateral gridding between the repository and the LWB, and large time steps at later times in the calculation.

Upward brine flow in the shaft occurred in several realizations, with a maximum flow of 150 m^3. All of the brine that flowed up the shaft flows into the Culebra; none of it flowed higher in the shaft, and none of it flowed beyond the Rustler Formation. NUTS calculations indicated that the brine that flowed up the shaft, however, was not contaminated and no release of activity to the Culebra occurred via the shaft. Numerical dispersion was not as great for this pathway as for the marker bed pathway because of the finer lateral gridding within the repository region and finer vertical gridding up the shaft.

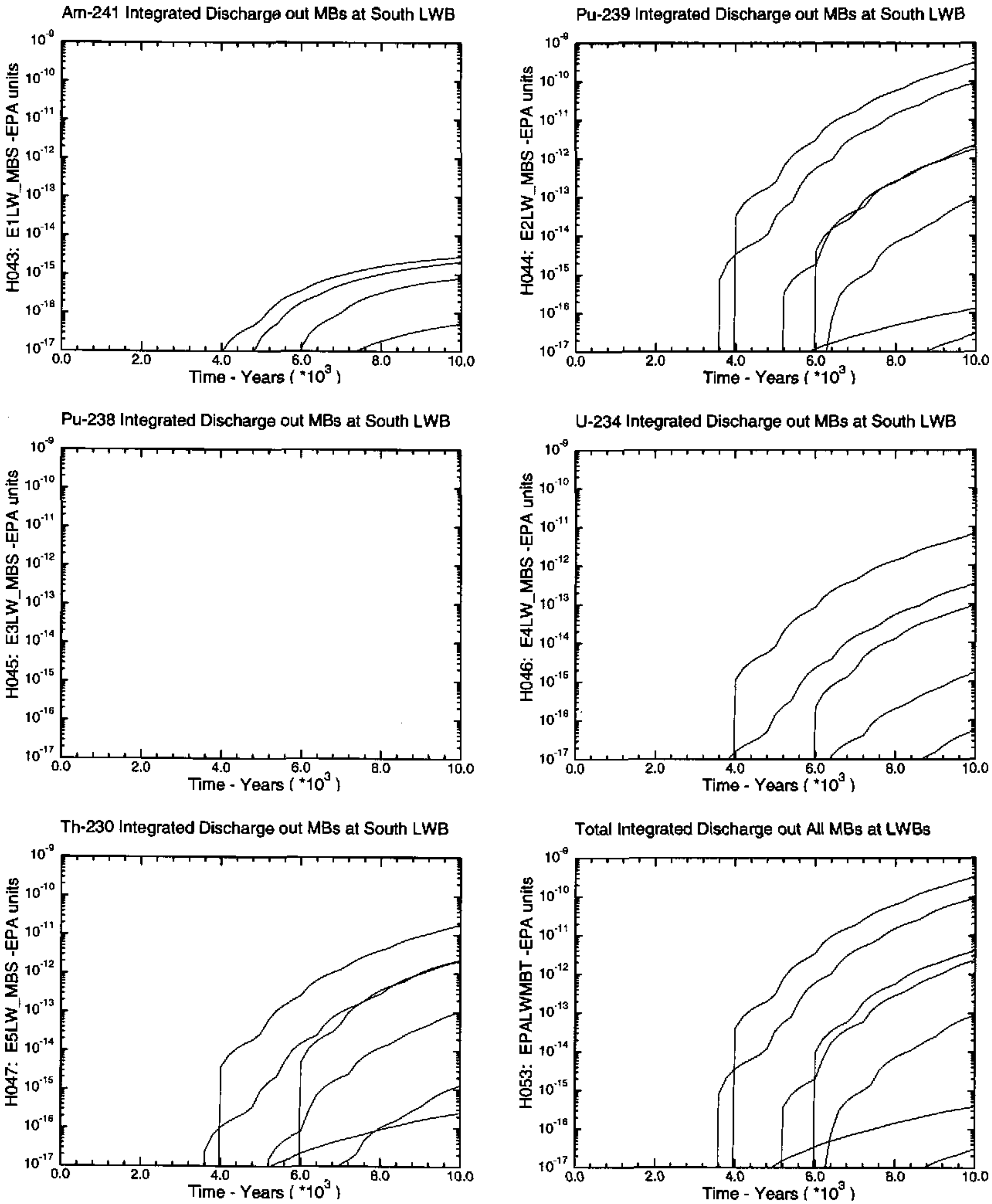


Figure 7.5 Scenario 1 Release out the Marker Beds

7.3.1.2 Error and Impact Assessment

Errors were found in the original NUTS runs. However, because the releases to the Culebra were effectively stopped in the Culebra (in all but one realization in 300, the release from a $1 kg/m^3$ source was less than 10^{-30}, see the Analysis Package for the Culebra Flow and Transport Calculations (Task 3) WPO# 40516), the NUTS calculated releases did not effect the final CCDF. Therefore the only NUTS results reported in the CCA were the small releases out the marker beds which were used for drinking water dose calculations in Chapter 8. Consequently, except for the releases out of the marker beds, we are reporting only the results of the corrected NUTS calculations here. This section reports the errors found, and both the old and new results that were used in the drinking water calculations (see Rahal et. al. 1996).

In the final NUTS calculations: 1) the database view CCA10 with inventories decayed to 2033 was used, 2) an error in the way NUTS read the solubilities was corrected, 3) the lumping of isotopes was improved, and 4) a decay chain was changed as discussed below.

As described in Section 6, the original runs were performed using parameter database view CCA5 with inventories at 1995 instead of 2033. This resulted in overestimated inventories for most isotopes, and an overestimated waste unit factor. For most long lived isotopes, the overestimated waste unit factor, caused the calculated EPA units released to be underestimated by about 18%. However, the Curies of the long-lived isotopes released out the marker beds were not affected by this change.

A code error was found in the way NUTS version 2.02 read the element solubilities. The index that was supposed to loop over the 4 elements: Am, Pu, U, Th instead looped over the 5 isotopes: ^{241}Am, ^{239}Pu, ^{238}Pu, ^{234}U, ^{230}Th. Thus, the Pu solubility was used for U and the U solubility was used for Th. This resulted in U and Th solubilities that were several orders of magnitude too high, which can be seen by comparing the numerical values in Table 7.5 and Table 7.6 for the old and new Table CCA 8-1. This error was corrected in NUTS version 2.03 which was used for the calculations reported here.

The lumping of isotope inventories for NUTS was reexamined and several oversights were found. First, lumping of ^{240}Pu into ^{239}Pu was missing, resulting in an underestimation of the "lumped" ^{239}Pu inventory of about 29%. In addition, decay of ^{241}Pu to ^{241}Am was not accounted for, resulting in an underestimation of the "lumped" ^{241}Am inventory of about 18%. Finally, ^{238}Pu was not included at the top of the ^{234}U chain and the effect was not accounted for in lumping. Had the lumping method been used, the "lumped" ^{234}U inventory would have increased by 54%. These underestimated inventories did not affect the releases for ^{239}Pu, ^{234}U, or ^{230}Th out the marker beds because these isotopes were not inventory limited. Because of their short half-lives, release out the marker beds of ^{241}Am and ^{238}Pu was never high. However, adding ^{238}Pu at the top of the ^{234}U chain increased the chance for higher releases of ^{234}U, particularly in the realizations that have a high and early outflow from the repository. This happened due to the higher rate of transport (higher solubility) of ^{238}Pu

as compared to ^{234}U. Because of the short life of the ^{238}Pu, it decayed quickly to ^{234}U which precipitated along the path of the flow. The precipitate of ^{234}U in turn, acted as a continuous source, providing more ^{234}U than released from the repository, and therefore, taking ^{234}U much further downstream.

The lumping of "isotope solubilities" was also reexamined and made more accurate. In the original runs, the solubility of Th was decreased by 3 orders of magnitude and the solubility of U was decreased by 2 orders of magnitude to account for the shared solubility of the selected isotopes with ^{232}Th and ^{238}U. A more detailed examination of the mole fractions of the isotopes (Appendix E) showed that the maximum mole fraction of the important Th isotopes is 1.26×10^{-3} and of the important U isotopes is 2.79×10^{-3}. This change is minor compared to the error in reading the solubilities in the original runs.

Table 7.5 and Table 7.6 as well as Figure 7.5 all show extremely low releases which are probably due to numerical dispersion associated with the large time steps and coarse gridding. The changes listed above resulted in lower releases in the new calculations as shown in Table 7.6.

Table 7.5 Concentrations of Radionuclides Within the Salado Interbeds at the Disposal System Boundary at 10,000 years reported in CCA Table 8-1.

Realization. No.	Vector No.	Maximum Concentration (Curies/liter)[1]				
		^{241}Am	^{239}Pu	^{238}Pu	^{234}U	^{230}Th
1	R1V046	1.36×10^{-17}	4.33×10^{-12}	N	5.82×10^{-13}	2.10×10^{-14}
2	R2V016	N	5.13×10^{-14}	N	6.77×10^{-15}	1.89×10^{-17}
3	R2V025	N	1.35×10^{-15}	N	1.65×10^{-16}	7.00×10^{-18}
4	R2V033	1.32×10^{-17}	7.18×10^{-14}	N	9.76×10^{-15}	9.36×10^{-16}
5	R2V081	N	6.23×10^{-18}	N	N	N
6	R2V090	N	5.20×10^{-16}	N	7.40×10^{-17}	N
7	R3V003	3.50×10^{-18}	3.08×10^{-13}	N	4.32×10^{-14}	1.07×10^{-16}
8	R3V060	5.98×10^{-17}	7.41×10^{-14}	N	9.09×10^{-15}	2.30×10^{-15}
9	R3V064	5.42×10^{-17}	5.85×10^{-12}	N	7.61×10^{-13}	4.68×10^{-15}
10-300	-	N	N	N	N	N

Table 7.6 Concentrations of Radionuclides Within the Salado Interbeds at the Disposal System Boundary at 10000 years (Table AD-1 of Rahal et. al. 1996).

Realization. No.	Vector No.	Maximum Concentration (Curies/liter)[1]				
		^{241}Am	^{239}Pu	^{238}Pu	^{234}U	^{230}Th
1	R1V046	N	1.3×10^{-13}	N	2.8×10^{-15}	7.4×10^{-16}
2	R2V016	N	1.6×10^{-15}	N	1.0×10^{-18}	2.3×10^{-18}
3	R2V025	N	4.2×10^{-17}	N	N	2.4×10^{-18}
4	R2V033	N	2.2×10^{-15}	N	1.2×10^{-16}	2.7×10^{-16}
5	R2V081	N	N	N	N	N
6	R2V090	N	1.6×10^{-17}	N	N	N
7	R3V003	N	9.5×10^{-15}	N	7.4×10^{-18}	4.4×10^{-17}
8	R3V060	N	2.3×10^{-15}	N	2.8×10^{-16}	2.9×10^{-16}
9	R3V064	1.7×10^{-18}	1.8×10^{-13}	N	6.7×10^{-16}	4.4×10^{-16}
10-300	-	N	N	N	N	N

1. Values less than 10^{-18} curies per liter were considered to be negligible relative to the other values and were not reported.

7.3.2 Human Intrusion Performance - E1 and E2 - NUTS

In the E1 scenarios, a borehole penetrated the waste panel and a brine reservoir in the underlying Castile Formation. Scenarios E2 also involved a borehole that penetrated the waste-filled panel, but the borehole did not intersect an underlying brine reservoir. The borehole intrusion is described in detail in the Analysis Package for the Salado Flow Calculations (Task 1) (WPO# 40514), and briefly summarized here. It was assumed that the borehole was instantly emplaced and plugged at the time of intrusion. Except for the plugs, the borehole was assumed to be open (actually the porosity is 0.32), with the high permeability of an open pipe, 1.0×10^{-9} m^2. Note that this permeability is several orders of magnitude greater than the permeabilities of the brine reservoir, repository, and borehole plugs. One borehole plug extends from the top of the Salado Formation up through the Unnamed Member of the Rustler Formation. The other plug extends downward from the surface through the Santa Rosa Formation. The permeability of the two plugs was set to 5.0 $\times 10^{-17}$ m^2. These conditions were assumed to exist for 200 years. At 200 years after intrusion, the borehole material properties were modified to represent the impact of caving, sloughing, and plug degradation. At this time the borehole was assigned uniform properties, with a permeability sampled from a range of 10^{-14} to 10^{-11} m^2. In the E2 Scenarios, these conditions persisted for the remainder of the 10,000 years. In the E1 Scenarios, these conditions remained in effect for 1000 years, after which the section of the borehole from the bottom of the lower DRZ (i.e., the bottom of MB139) down through the Castile was assumed to have undergone creep closure. Creep closure was accounted for by reducing the sampled permeability by another factor of 10.

In addition to the E1 and E2 intrusion times of 350 and 1,000 years, simulated in BRAGFLO, NUTS simulations were also performed for intrusion times of 100-, 3000-, 5000-, 7000-, and 9000- years. As discussed in Section 2.2.4 of this analysis package, flow fields at these times were approximated with BRAGFLO flow fields for the E1 and E2 intrusion times of 350 and 1000 years. That is, for the 100-year intrusion, the flow field from the 350-year intrusion was applied at 100 years. For each of the E1 and E2 intrusions at 3000, 5000, 7000, and 9000 years, the BRAGFLO flow field from the 1000-year intrusions is applied. In all additional intrusion cases, from time zero until the intrusion time, the flow fields from the undisturbed scenario was used.

In the E1 Scenarios, S2 and S3 (350- and 1000-year intrusions), brine flowed rapidly up from the Castile reservoir into the panel immediately following the borehole intrusion in most realizations. The amount of brine that flowed into the panel ranged from 0.0 m^3 to nearly 90,000 m^3 in the S2, and 80,000 m^3 in the S3 Scenarios. In many cases, once the borehole plugs degraded (at 200 years after intrusion), large quantities of brine from the Rustler and Dewey Lakes Formations flowed downward into the panel. These quantities are comparable to quantities that flowed upward from the Castile. In some realizations, the waste panel filled with brine and substantial quantities of brine flowed up the borehole beyond the top of the DRZ (i. e., at the bottom interface of MB138), the maximum being 62,000 m^3 in the S2, and

67,000 m^3 in the S3 Scenarios. Almost no brine flowed out across the land withdrawal boundary; the maximum total summed over all marker beds was less than 0.8 m^3 in the S2, and 1.28 m^3 in the S3 Scenarios. This small amount of brine was the in situ brine initially present in the Salado near or at the land withdrawal boundaries. Transport calculations verify that this brine was not contaminated.

In the E2 scenarios, S4 and S5 (350- and 1000-year intrusions), the largest releases of brine up the borehole occurred in realizations in which large amounts of brine first flowed down the borehole from Culebra and Dewey Lakes Formations. Cumulative brine flows down the borehole were as high as 53,000 m^3 in both S4 and S5 Scenarios. At later times, much of this brine was driven back up the borehole by continued brine inflow from the interbeds. Brine flow into the repository from the marker beds was as much as 66,000 m^3 in both S4 and S5 Scenarios. The largest flow up the borehole from the top of the DRZ was 40,000 m^3 for S4, and 36,000 m^3 for S5 Scenarios. Other realizations that did not rely on initial down flows to fill the repository showed lower quantities of brine flow up the borehole. Brine flows out of the repository and into the marker beds were very low. The maximum in S4 was 149 m^3 as compared to 761 m^3 in S5 scenario. The largest brine outflow in all marker beds across the land withdrawal boundary was less than 0.8 m^3 and 1.3 m^3 in S4 and S5 Scenarios, respectively.

In the human intrusion scenarios, transport calculations predicted that radionuclides were not released at the land withdrawal boundaries, via the shaft, or in the borehole above the Culebra. However, radionuclides were released to the Culebra via the borehole (see Figure 7.19 to Figure 7.32 at the end of this section). The total number of realizations with releases, that occurred in the human intrusion scenarios, is summarized in Table 7.7.

Table 7.7 Summary of the Total Number of Realizations Which Showed Release Up the Borehole into the Culebra

Scenario	Times of intrusion	Number of Realizations In Replicates	Total Number of Realizations
S2	100 and 350	R1 = 23, R2 = 17, R3 = 22	62
S3	1000, 3000, 5000, 7000, and 9000	R1 = 21, R2 = 21, R3 = 25	67
S4	100 and 350	R1 = 6, R2 = 5, R3 = 7	18
S5	1000, 3000, 5000, 7000, and 9000	R1 = 6, R2 = 5, R3 = 7	18
Total Number of Realization in Replicate #: R1 = 56, R2 = 48, R3 = 58			

Table 7.7 shows that the number of realizations with release was dominated by S2 and S3 scenarios in which the borehole intercepts the high pressure brine pocket.

To facilitate analysis and discussion, the realizations from the three replicates were renumbered from 1 to 300 for each scenario, with 1 to 100 for replicate 1, 101 to 200 for replicate 2, and 201 to 300 for replicate 3. For instance, S3V287 refers to realization (vector) 87 of scenario S3 in replicate R3. The integrated EPA releases up the borehole into the Culebra from NUTS calculations for all the realizations listed in Table 7.7 are shown in Tables 1 to 15 in Appendix P. The realizations in each of these tables were sorted by the total discharged EPA units summed for all 5 isotopes, and the top realization for each scenario and intrusion time was summarized in Table 1 of Appendix Q and Table 7.8 here. The realizations were similarly sorted by the total discharged EPA units for each of the 5 lumped isotopes and the top realizations were summarized in Tables 2 to 6 in Appendix Q. Table 7.8 indicates that the maximum release based on the total EPA units is about 21 EPA units. Also, high releases are controlled either by ^{241}Am or ^{239}Pu, depending on the flow pattern. The maximum releases from ^{241}Am, ^{239}Pu, ^{238}Pu, ^{234}U, and ^{230}Th are 6.57, 20.8, 4.46×10^{-3}, 1.31×10^{-2}, and 0.177 EPA units, respectively (see Tables 2 to 6 Appendix Q).

Based on the total number of the EPA units released from all the transported isotopes, and the flow patterns, thirteen realizations were chosen for elaborated discussion. These thirteen vectors are presented in Figure 7.6 for the base case (non-time shifted) runs of 350 and 1000 years. Table 7.9 summarizes the hydrological responses of the disposal system in the same 13 realizations. The ranges and the most important sampled parameters of these vectors are displayed in Table 7.10. Note that these parameters apply to all the time shifted runs as well as the base cases.

Table 7.8 Top Realizations for Total 10,000 Year Release (EPA units)

Scenario Intrusion Time	Vector	^{241}Am	^{239}Pu	^{238}Pu	^{234}U	^{230}Th	Total
S2							
100	111	6.57E+00	4.51E-02	1.73E-03	5.23E-05	9.40E-04	6.62E+00
350	111	6.00E+00	4.44E-02	8.07E-05	2.21E-05	9.28E-04	6.04E+00
S3							
1000	111	2.15E+00	4.40E-02	1.23E-06	7.48E-06	1.01E-03	2.19E+00
3000	128	4.32E-02	3.16E-01	2.69E-08	9.86E-06	3.21E-04	3.60E-01
5000	128	3.76E-03	2.36E-01	1.76E-10	7.20E-06	2.41E-04	2.40E-01
7000	128	2.06E-04	1.42E-01	2.67E-13	4.26E-06	1.49E-04	1.42E-01
9000	128	1.36E-05	3.53E-02	2.59E-15	1.05E-06	4.94E-05	3.54E-02
S4							
100	23	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
350	23	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
S5							
1000	23	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
3000	23	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
5000	23	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00
7000	23	6.81E-08	1.09E+00	1.68E-18	5.14E-04	9.24E-03	1.10E+00
9000	124	8.75E-08	2.67E-02	1.86E-18	3.54E-06	2.64E-04	2.70E-02
Maximum							2.11E+01

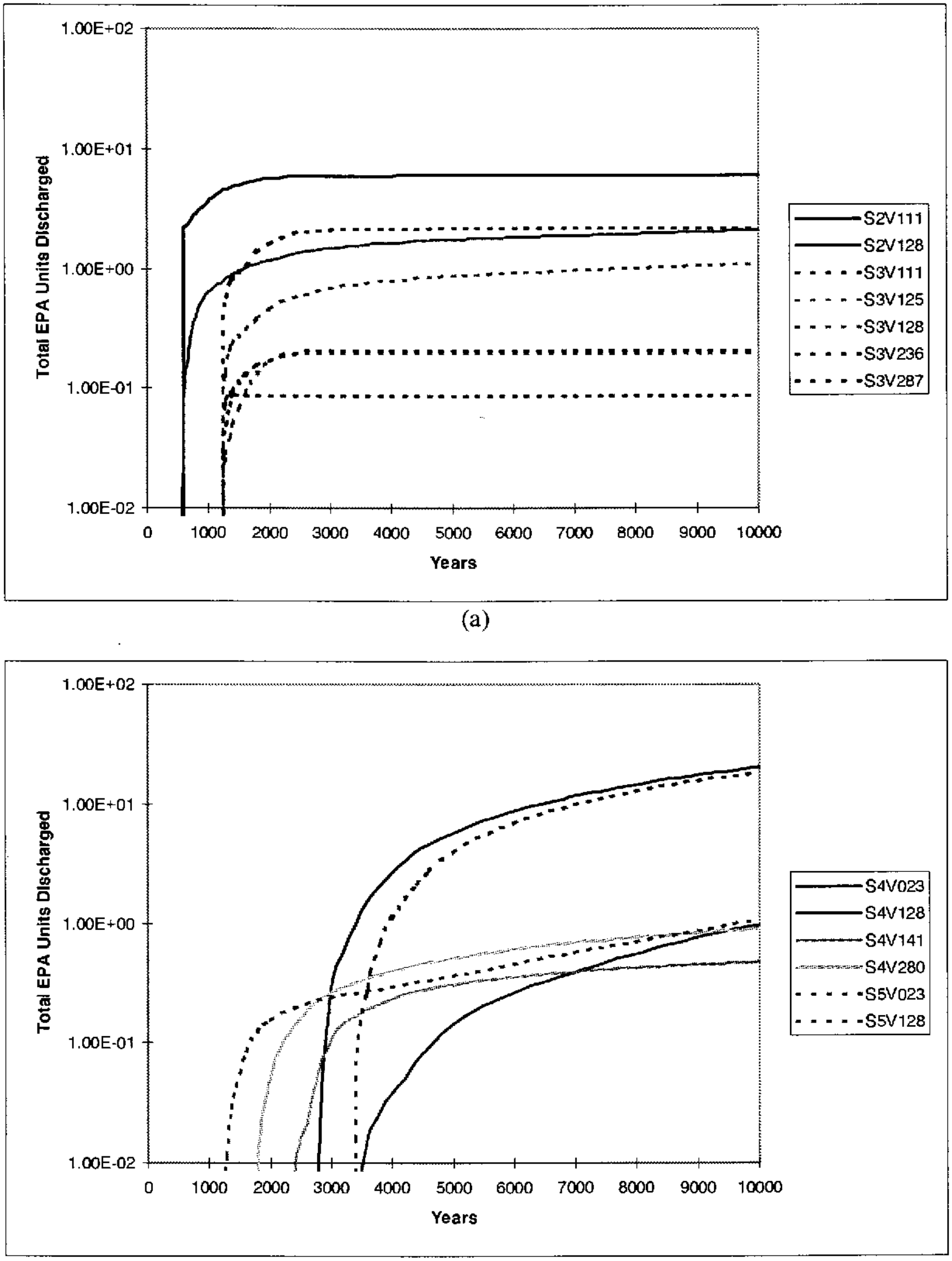


Figure 7.6 Time History of Discharge to the Culebra for Selected Realizations for the a) E1 scenario and b) E2 scenario.

Table 7.9 Hydrologic Behavior⁺ of Selected Realizations

Realization #	contaminated brine into Cul. ($x10^3 m^3$)	brine to/from Cul. ($x10^3 m^3$)	brine out of MB139($x10^3 m^3$)	brine out of Cast.($x10^3 m^3$)	Pressure level in the borehole at the panel entrance, MPa
S2V111	46	62 ECU	5.8	100	max 11, level to 7
S2V128	29	33ECU	11	66	max 12, level to 9
S3V111	50	68 ECU	5.8	93	max 11.4, level to 7
S3V125	2.8	EU3,LD5.3	5.8	12.25	max 8.8, level to 6
S3V128	22.5	28ECU	12.3	55	max 12, level to 8.8
S3V236	6.8	EU8.5, LD3	3.2	31.5	max 8, level to 6.3
S3V287	0.58	EU2, LD15	1.8	11	max 8, level to 6.2
S4V023	36	ED40, U38	20	0	CU to 7
S4V128	6.2	ED.8,U8	19	0	CU to 7.8
S4V141	17	ED45, U17	5.8	0	CU to 6.5
S4V280	3	ED20, U3.5	16	0	CU to 6.5
S5V023	32	ED33, U35	21	0	CU to 7
S5V128	5.4	8ECU	18	0	CU to 7.8
E=Early	C=Continuous	L=Late	U=up, D=Down		CU=continuous up

⁺ The numbers in this table are approximations based on visual inspection of plots.

Table 7.10 Sampled Parameters for Selected Realizations

		Salado				MB	BH	Castile				
		lsol						lsol				
		Pu	Am	lprm	P, MPa	lprm	lprm	Pu	Am	P, MPa	lprm	lcomp
Range	hi	-3.8	-4.2	-21.0	11.0	-17.0	-11.0	-5.4	-5.0	11.0	-9.8	-8.0
Range	low	-7.4	-7.3	-24.0	13.8	-21.0	-14.0	-7.6	-7.5	17.0	-14.7	-11.3
Vector	23	-4.8	-5.6	-23.2	13.1	-17.1	-11.4	-7.1	-6.5	11.7	-12.4	-10.2
	111	-6.8	-7.2	-21.7	13.5	-18.2	-11.2	-6.9	-5.6	15.2	-13.5	-8.4
	125	-6.2	-5.6	-23.0	12.1	-17.9	-11.5	-7.1	-6.7	14.2	-13.4	-9.0
	128	-5.4	-5.7	-22.0	11.9	-17.2	-12.2	-6.2	-6.6	16.0	-13.6	-10.2
	141	-6.7	-5.7	-22.8	12.8	-18.0	-11.0	-6.9	-5.6	12.2	-11.7	-10.4
	236	-5.4	-5.3	-21.7	12.9	-18.7	-11.2	-6.8	-6.5	12.0	-13.8	-8.5
	260	-7.4	-5.7	-21.3	12.1	-17.1	-12.2	-6.5	-6.3	13.0	-10.5	-10.6
	266	-6.3	-6.0	-22.9	13.6	-18.7	-11.1	-6.5	-6.4	13.7	-12.0	-9.6
	280	-5.1	-6.4	-21.6	12.3	-17.4	-11.2	-7.3	-5.1	13.5	-12.5	-10.4
	287	-4.7	-5.6	-22.0	11.1	-18.8	-11.0	-7.5	-6.2	13.1	-13.4	-9.3

lprm = log permeability, P = pressure, lcomp = log compressibility, BH = borehole, MB = marker bed, and lsol = log effective solubility

The realizations in Figure 7.6 have been separated according to scenario type, E1 in Figure 7.6a and E2 in Figure 7.6b. Some immediate differences between the two scenarios are obvious. First, the E1 scenarios showed nearly all of their release at the time of intrusion as is characteristic of releases dominated by ^{241}Am. Total inventory of ^{241}Am decayed from 1420 EPA units at closure to 293 EPA units at 1000 years and 12 EPA units at 3000 years (Sanchez et. al. 1996). Thus, little ^{241}Am discharge was seen after 3000 years (the integrated release curves are flat), and brine flow after 3000 years did not significantly increase the total

^{241}Am discharge. As discussed in Section 3.4 the solubilities of actinides in Castile brine were used in the E1 scenarios and the solubilities of actinides in Salado brine were used in the E2 scenario. As seen in Table 7.10, the high range of Am solubility was 10^{-5} M and Pu solubility was $10^{-5.4}$M in Castile brine which are 0.8 and 1.6 orders of magnitude lower than in Salado brine. Converted from moles per liter to EPA units per liter, these solubilities were 2.4×10^{-5} for ^{241}Am and 1.7×10^{-7} for ^{239}Pu, making the ^{241}Am top solubility in EPA units/liter 2.1 orders of magnitudes higher than the top ^{239}Pu solubility. This difference in EPA unit solubility as well as the large amount of brine often available at the time of intrusion into the brine pocket resulted in the Am dominance seen in Figure 7.6.

The E2 scenarios showed quite different behavior. They showed delayed releases which steadily rose with time as is typical of ^{239}Pu dominated releases. In the E2 scenarios, there was not a big pulse of brine from a brine pocket at the time of intrusion but a steady flow of brine either down the borehole from the overlying units or in from the marker beds. These brine flows resulted in slower repository filling and later time for the first flow of contaminated brine up the borehole. Once the repository was filled, flow up the borehole was driven by flow out of the marker beds. The later time of first brine flow up the borehole resulted in more decay of ^{241}Am, decreasing the importance of Am release. Moreover, the high range of Pu solubility ($10^{-3.8}$M) was higher than that of Am ($10^{-4.2}$M) in Salado brine. When converted to EPA units per liter, the top ^{241}Am solubility (1.5×10^{-4}) was still higher than that of ^{239}Pu (6.8×10^{-6}) but only by 1.3 orders of magnitude. After 3000 years of decay, the Am became inventory limited and decreased in importance while the Pu remained at its solubility limit.

The largest total EPA unit release in Table 7.8 occurred in realization S4V023, totaling 21.1 EPA units for the 100 year intrusion time, followed by 20.4 EPA units for the same realization at the 350 year intrusion time as also shown Figure 7.6b. Examination of Table 7.10 shows that vector 23 had a sampled marker bed permeability of $10^{-17.1}$, a halite permeability of $10^{-23.2}$, and a borehole permeability of $10^{-11.4}$. The solubility of ^{239}Pu in Salado brine was about $10^{-4.8}$ molar (M) which was higher than the ^{241}Am solubility of $10^{-5.6}$M. Realization #23 had exceptionally high releases because of a combination of factors, including a relatively high ^{239}Pu solubility, and a high borehole permeability, which allowed 40,000 m^3 of brine to easily flow into the repository from overlying units as shown in Figure 7.7. In addition to the very low gas generation, which lessened the impedance to brine inflow, the high marker permeability (ranked 99 of the 100 realizations), resulted in very high brine flow into the repository from the marker beds, as shown in Figure 7.8. Of the 38,000 m^3 of brine that flowed up the borehole (Figure 7.7) , 36,000 m^3 was contaminated (Figure 7.9). Releases were dominated by ^{239}Pu, rather than ^{241}Am, because releases occurred almost 2800 years after the intrusion, when most of the ^{241}Am had decayed away.

Realization S5V023's intrusion time of 1000 was later than S4V023's intrusion time of 350 years so more gas was generated prior to intrusion, and the pressure achieved a higher level in the waste. This in turn hindered brine entering the repository from the marker beds and Culebra as seen in Figure 7.10. The over all effect was less brine flowing down from Culebra

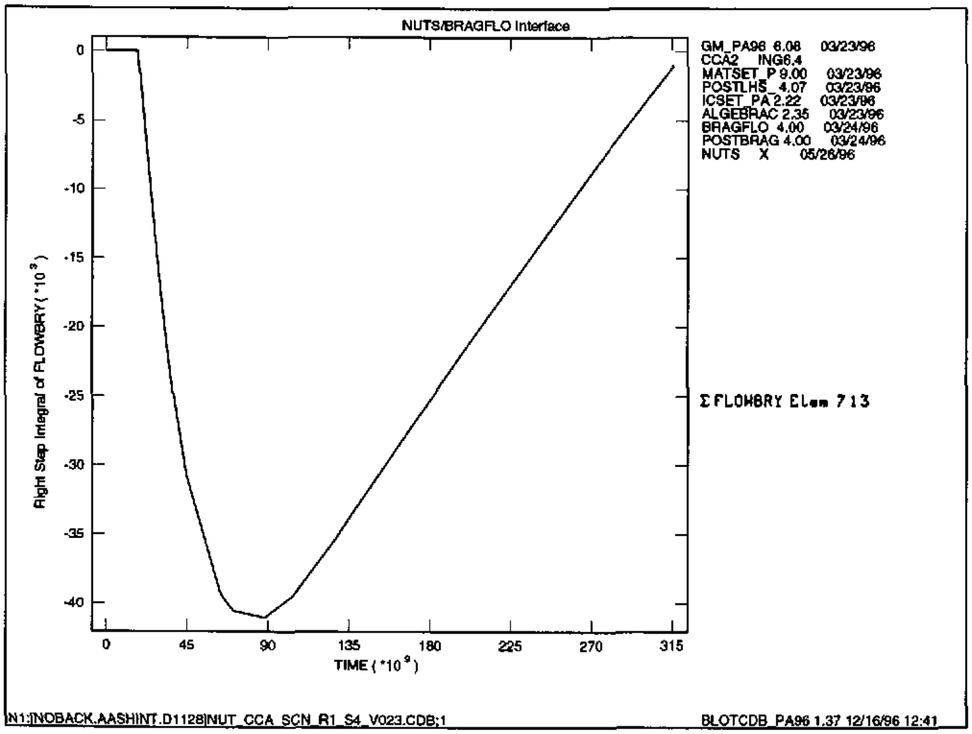


Figure 7.7 Integrated brine flow across the lower Culebra boundary within the borehole for S4V023.

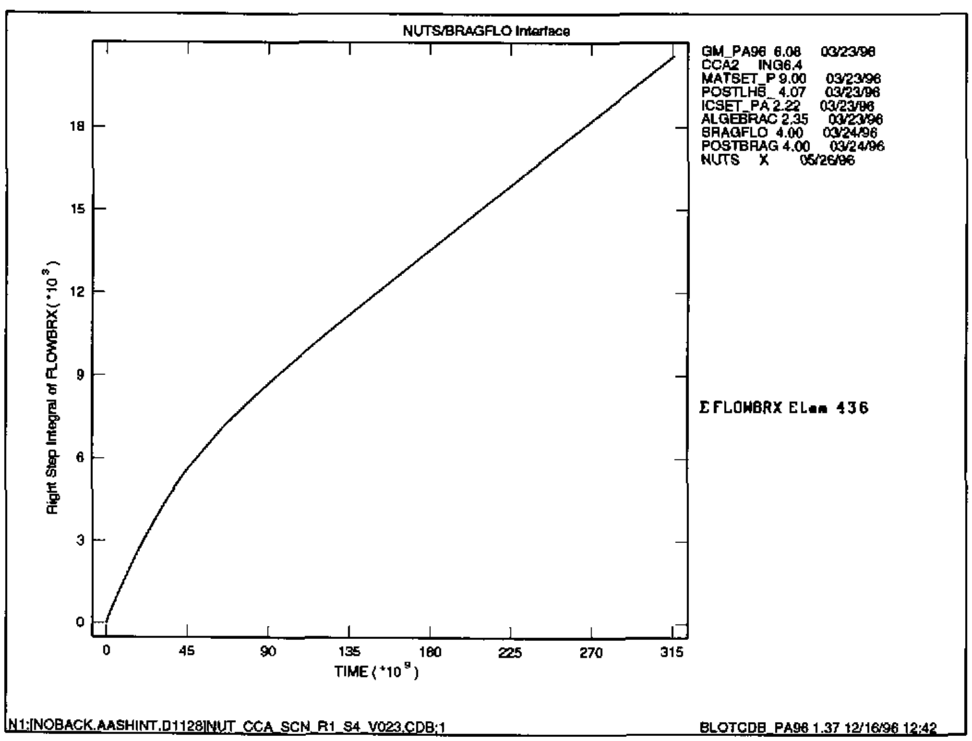


Figure 7.8 Integrated brine flow from the marker beds into the repository for S4V023.

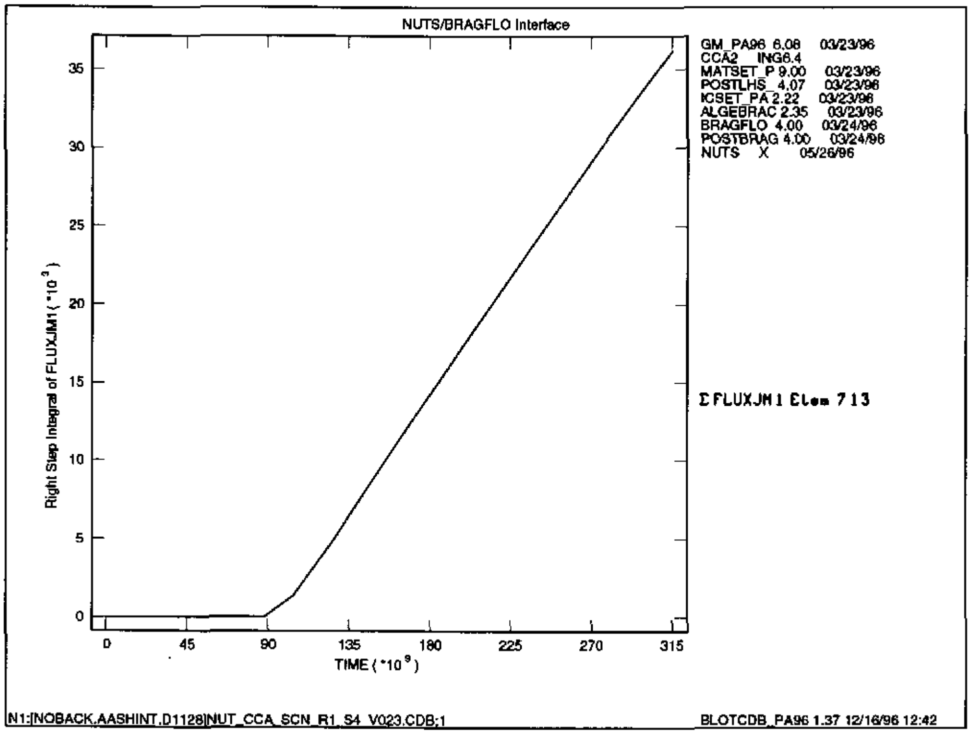


Figure 7.9 Integrated flux of contaminated brine up the borehole for S4V023.

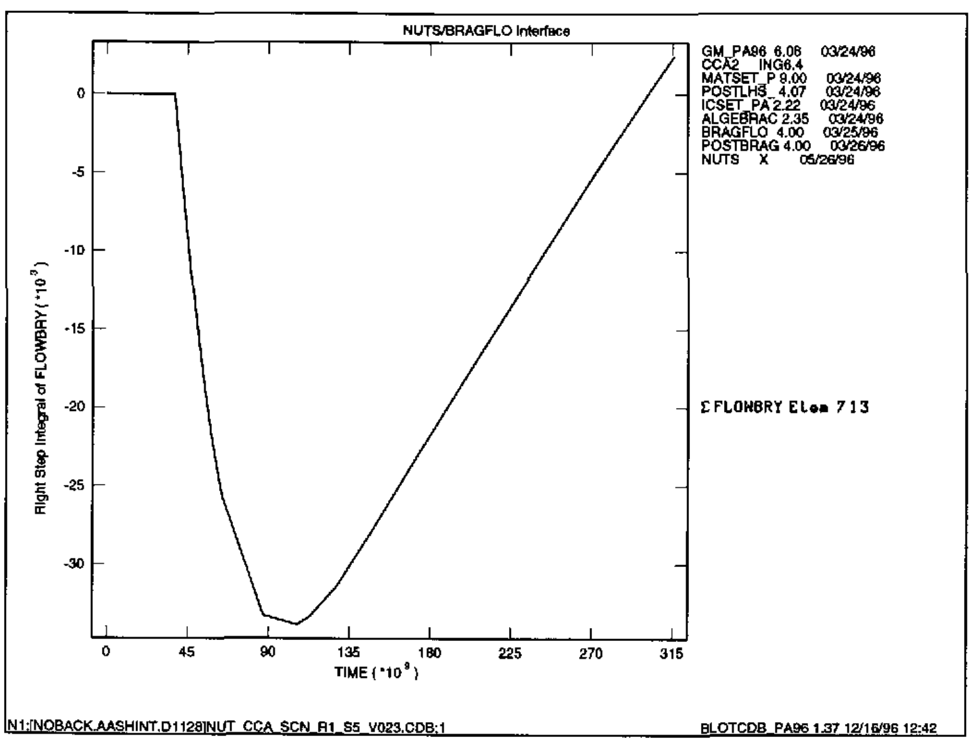


Figure 7.10 Integrated brine flow across the lower Culebra boundary within the borehole for S5V023.

($33{,}000\ m^3$), delayed breakthrough, and less contaminated brine flowing up the borehole into Culebra, (Figure 7.11). Figure 7.6b shows the lower release of S5V023 than S4V023. The total release to the Culebra was about 18.4 EPA units. Similarly, the release from S5V023 with an intrusion time of 3000 years was further reduced to 11.6 EPA units (Table 7.8). The S5V023 release was dominated by ^{239}Pu and was higher than the release in realization S3V023 (0.132 EPA) of the E1 scenario by a factor of 139. This difference in release between the two scenarios was due mainly to the different solubilities in the Salado versus Castile brines, with ^{239}Pu approximately 200 times more soluble in Salado brine than in Castile brine.

The releases dominated by ^{241}Am are exemplified by the next highest vectors S2V111 and S3V111 in Figure 7.6a. Realization 111 had a lower marker bed permeability of $10^{-18.2}$, and therefore, a lower marker bed brine discharge of nearly $5{,}800\ m^3$. In addition, the relatively high sampled borehole permeability (about $10^{-11.2}$), high Castile compressibility ($10^{-8.4}$), and high Castile pressure (15.2 MPa), caused a high brine discharge rate as soon as the intrusion occurred and the waste pressure was relieved. The sampled solubility of Am and Pu in Castile brine were $10^{-5.6}$ and $10^{-6.9}$ M, respectively. In S2V111, the pressure in the borehole at the panel entrance at the time of intrusion (350 years), was approximately 11 MPa. The pressure quickly dropped to about 9.5 MPa after the intrusion (Figure 7.12), which created a pressure gradient of 5.7 MPa between Castile reservoir and the repository (the potential gradient** was still up toward the repository). Vector S3V111 behaved similarly, with the exception that the intrusion took place 650 years later, which permitted more pressure build up in the waste region. The large pressure gradient, along with the high Castile compressibility and high borehole permeability in S2V111 and S3V111, were responsible for driving some of the highest volumes of Castile brine into the panel, about 100,000 (see Figure 7.13) and 99,000 respectively. The amount of the contaminated brine discharged into Culebra was between 46,000 to $50{,}000\ m^3$ and the breakthrough was quite early in time. The total release from this vector was 6.62 and 6.04 EPA units for NUTS time of intrusion of 100- and 350-years, respectively, with more than 99% of the total from ^{241}Am. For the vector S3V111, the total release in the 1000-years intrusion was 2.19 EPA units in which the ^{241}Am is about 98% of the total.

The third set of high releases in Figure 7.6 was from realization 128. This vector produced relatively high releases in all intrusion scenarios (S2, S3, S4, and S5). Table 7.10 indicates the high marker bed permeability of $10^{-17.2}$, moderate borehole permeability of $10^{-12.2}$, very high Castile pressure of 16 MPa, and moderate Castile compressibility. For this vector, the Pu solubilities of $10^{-5.4}$ M in Salado brine and $10^{-6.2}$ M in Castile brine were higher than the Am solubilities of $10^{-5.7}$ M and $10^{-6.6}$ M in Salado and Castile brines, respectively. In S2V128 and S3V128, comparable amount of brine flowed out of the marker bed (11,000 versus $12{,}300\ m^3$). Due to the high pressure in Castile reservoir compared with the pressure of the borehole in the panel, tremendous amount of Castile brine was discharged out of Castile at the time of intrusion totaling 66,000 and $100{,}000\ m^3$ in S2V128 and S3V128,

** The potential is defined here as $p + \rho gz$, where p is the pressure, ρ is the density, g is the gravitational constant, and z is the height above a reference point, all in a consistent units.

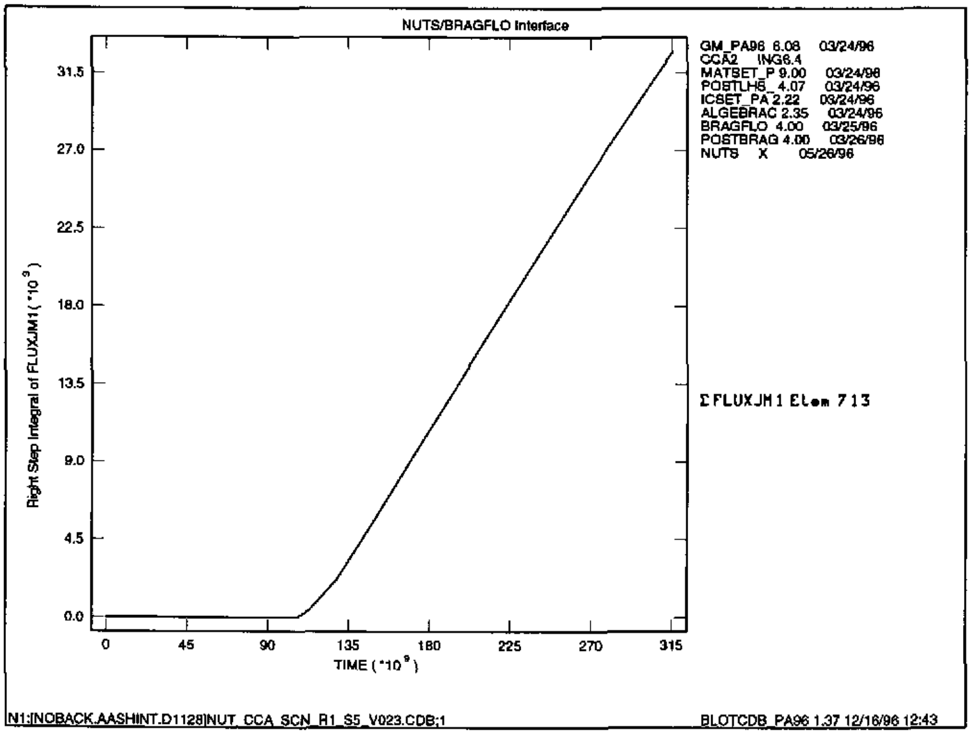


Figure 7.11 Integrated flux of contaminated brine up the borehole for S5V023.

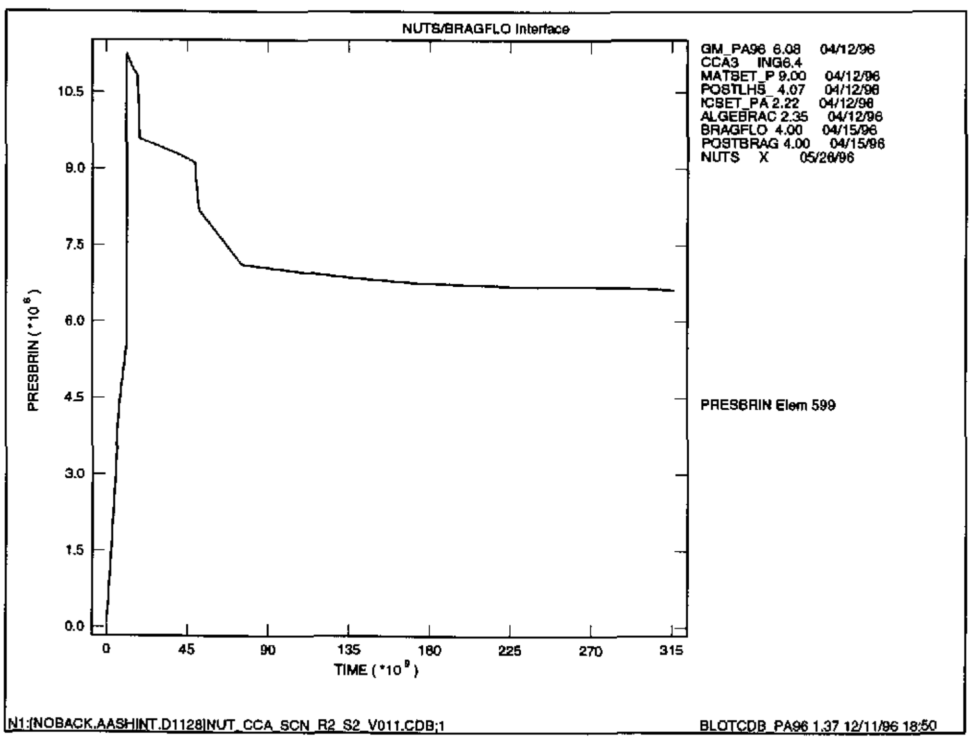


Figure 7.12, The pressure in the borehole at the panel entrance for S2V111.

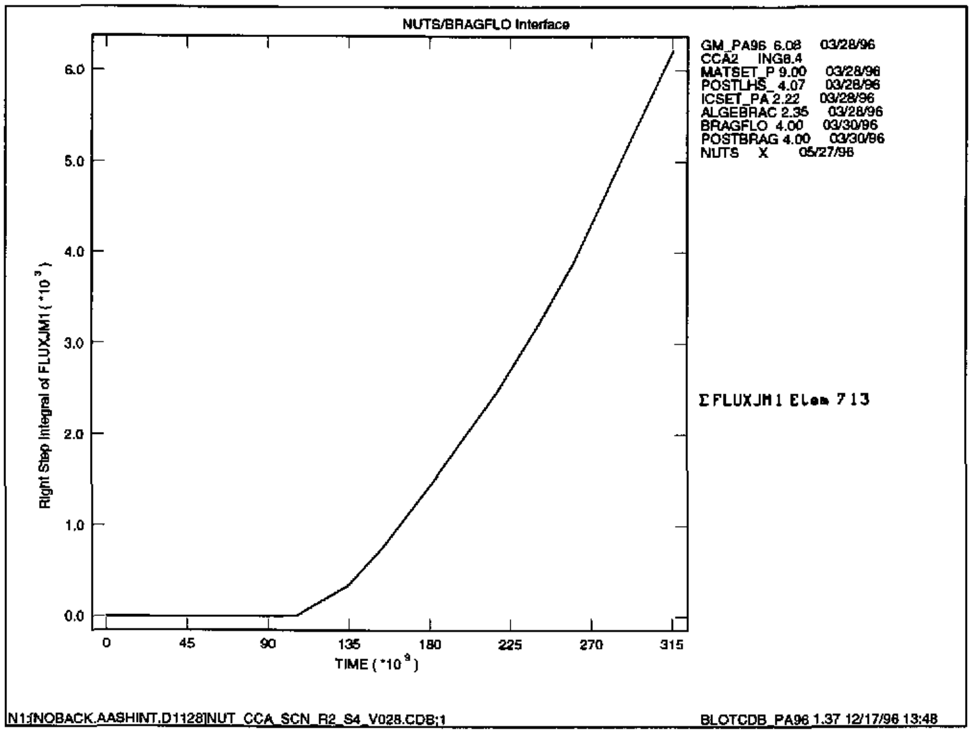


Figure 7.13 Integrated flux of contaminated brine up the borehole for S4V128

respectively. The discharge of the contaminated brine into Culebra from these two vectors continued steadily through the 10,000 years to total about 29,000 and 22,500 m^3. The total releases from S2V128 were 2.4 and 2.08 EPA units for the 100- and 350-years intrusions, respectively. Even though the solubility of the Pu was higher than Am in this realization, early release were responsible for taking appreciable amount of ^{241}Am out of the repository before its decay, and since ^{241}Am is a short-living isotope, it has higher activity which results in higher EPA units per volume. Of the total EPA units released, 73% and 70%, were from ^{241}Am, and 26% and 29% were from ^{239}Pu in the 100- and 350-year intrusions, respectively. Because of the later intrusion time (1000 years) in S3V128, more of the ^{241}Am was decayed away, and smaller releases were seen (1.11 EPA units). With its longer half-life, ^{239}Pu accounted for a larger fraction of the total release as the time of intrusion was increased. For example, the percentage of the total release from ^{239}Pu was 36.8% in the 1000-year intrusion, 87.8% in the 3000-year intrusion, and 98.3% in the 5000-year intrusion for realization S3V128.

Comparing the flow behavior of S4V128 with S5V128 (Figure 7.14 and Figure 7.15), one can notice that S4V128 had some flow of Culebra brine down into the repository while no such flow was seen in S5V128. This response was due to the low pressure in the waste (less gas generation) in the early intrusion, whereas at later intrusion, there was enough pressure in the panel to prevent the brine from flowing down. There was a similar contaminated brine discharge into the Culebra from this vector in the two scenarios (6,200 m^3 in S4 and 5,400 m^3

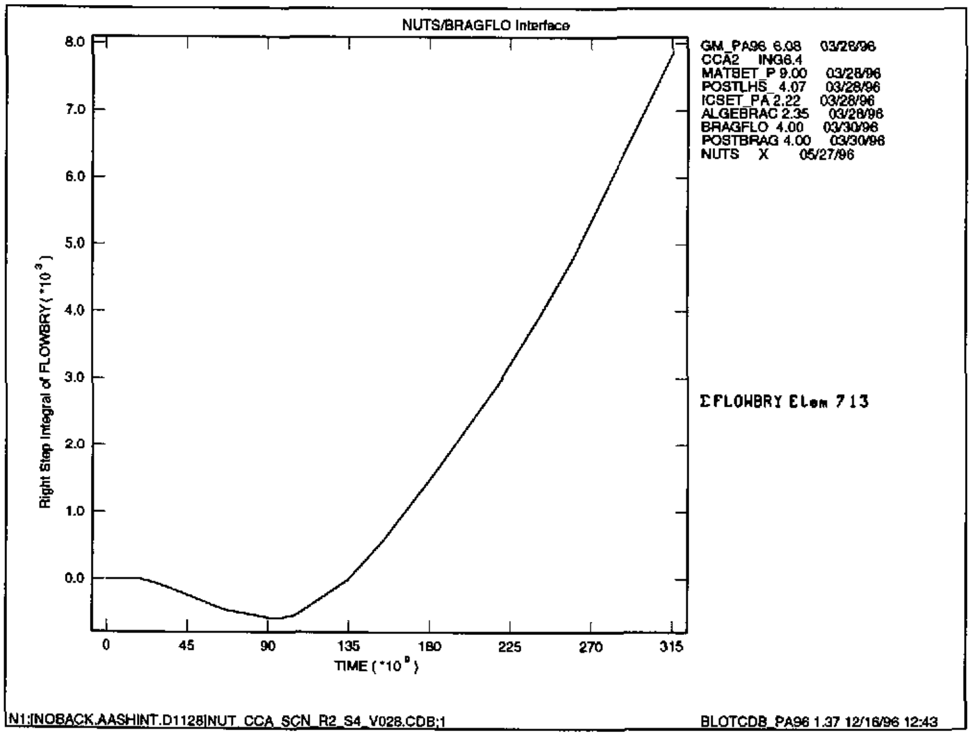


Figure 7.14, Integrated brine flow across the lower Culebra boundary within the borehole for S4V128.

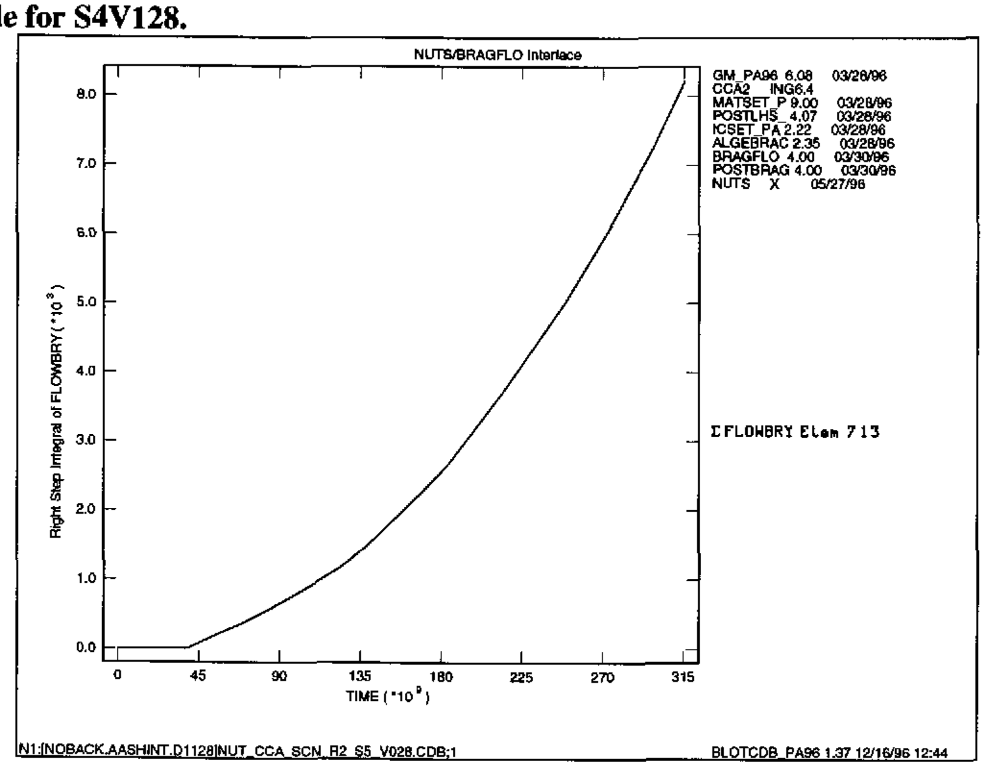


Figure 7.15, Integrated brine flow across the lower Culebra boundary within the borehole for S5V128

in S5), but the S4 discharge was delayed because of the increased time required to fill the repository. The total releases from the S4 100- and 350-year intrusion times were 1.02 and 0.971 EPA units. The releases were dominated by ^{239}Pu which accounted for 89% of the total release in the 100-year intrusion and 90% in the 350-year intrusion. The ^{230}Th contributed almost 8% of the total release in both times of intrusion, and the ^{241}Am contributed 2% in the 100-year and 1.5% in the 350-year intrusion times. In the S5 scenario, the highest release for V128 occurred in the 1000-year intrusion run, totaling 1.07 EPA units. The percent of the total release from each isotope was: 74.5% from ^{239}Pu, 18.4% from ^{241}Am, and 7% from ^{230}Th.

In Figure 7.6, vectors S3V125, S3V236, and S3V287 showed similar behavior. In these realizations with an intrusion time of 1000-years, a relatively small amount of brine flowed into the panel from the Castile right after the time of intrusion, (2,800, 6,800, and 580 m^3, respectively). This early brine flow forced contaminated brine up the borehole. Flow up the borehole continued for short time, followed by downward flow from Culebra to the waste panel. Downward flow was only possible if the waste panel potential dropped below that of the Culebra. The only mechanism for this to occur was consumption of brine by corrosion and venting of the gas to relieve the pressure. Our examination of the gas generation activity in the panel revealed that the biodegradation ceased early in time, but that corrosion continued to rapidly consume brine and generate gas until about 9,200 years. The continued corrosion may be seen in the consumption of ferrous materials in the waste panel grid blocks shown in Figure 7.16. (The borehole grid blocks show constant ferrous concentrations after intrusion because BRAGFLO handled the removal of material in the borehole by turning off its corrosion). The gas generation did not cause a pressure build up in the panel, because the gas was venting up the borehole, as shown in Figure 7.17. Despite the relatively high sampled permeability of the borehole and moderate Castile pressure in these realizations, the permeability in Castile reservoir was low which limited the amount of brine flow from this formation (see Table 7.10 for the sampled parameters). After creep closure of the borehole between the Castile and repository, brine flow from the Castile decreased further so that brine consumption by corrosion exceeded brine inflow from the Castile and marker beds and the repository depressurized. This in turn, lead to a back-flow (by gravity) from Culebra into the panel to equilibrate the pressure. The flow behavior in Figure 7.18 typified this pattern. The highest release in this group was 0.28 EPA units for realization 236, followed by 0.198 EPA units for realization 125, and 0.087 EPA units for realization 287, all for the 1000 intrusion time, and all dominated by ^{241}Am due to the early time of releases.

The last two realizations in Figure 7.6, S4V141 and S4V280 were, similar to realization 23, characterized by an early period of flow from the overlying units into the repository. In S4V141 which had a borehole permeability of 10^{-11}, 45,000 m^3 of brine streamed down from the Rustler members formation as compared to 20,00 m^3 in S4V280. Although the amount of brine displaced back into Culebra (either by the marker bed brine or the pressure build up in the repository) was higher in realization 141 (7,000 versus 3,500 m^3 in V280), the releases from S4V280 were higher. This was mainly due to higher Pu solubility in S4V280 ($10^{-5.1}$M) versus S4V141 ($10^{-6.7}$ M) and longer repository filling time for S4V141 which gave more time for the ^{241}Am to decay. The S4V280 release was ^{239}Pu dominated (.705 EPA units

^{239}Pu, and .182 EPA units ^{241}Am out of a total of 0.944 EPA units for the 100-years intrusion runs). Even with a longer period to fill the repository, the S4V141 release was ^{241}Am dominated (.235 EPA units ^{241}Am, .120 EPA units ^{239}Pu, and .02 EPA units ^{230}Th out of a total of 0.639 EPA units for the 100-years intrusion runs), because of its higher Am solubility ($10^{-5.7}$ M) and low Pu solubility ($10^{-6.7}$ M).

Figure 7.19 to Figure 7.32 show the discharge to the Culebra for all intrusion times for scenarios 2 through 5. For all scenarios, releases decreased with later intrusion times because of ^{241}Am decay. This was especially true for the E1 scenarios which were more dominated by ^{241}Am release. Releases also decreased with later intrusion time because of less time for long term flow after the intrusion. This was especially true for the E2 scenarios which were dominated by ^{239}Pu release.

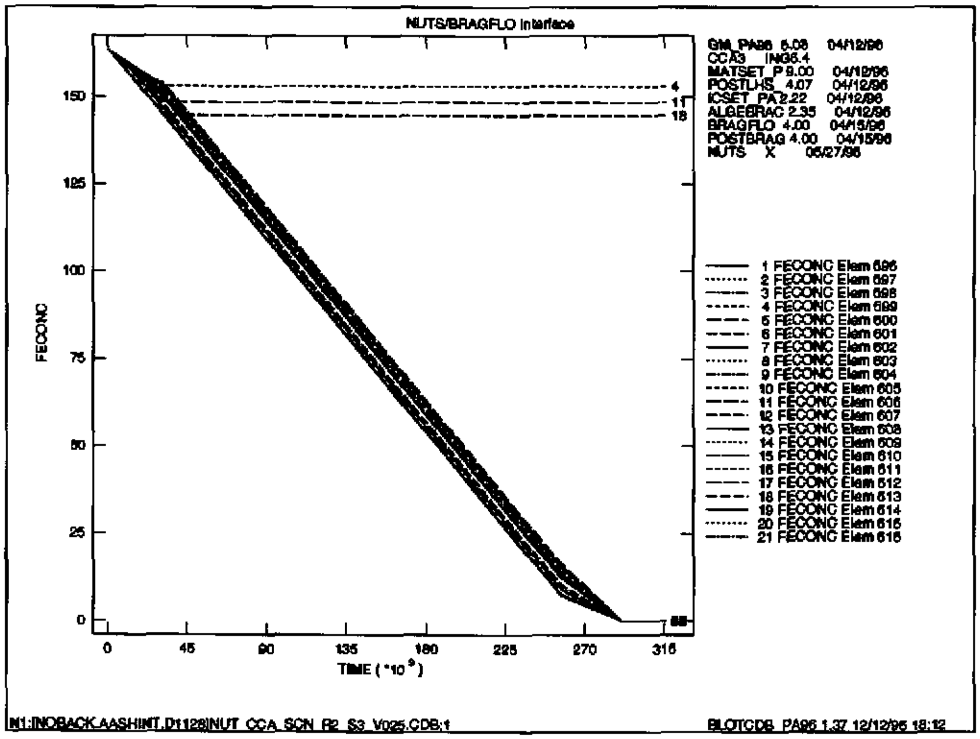


Figure 7.16 Iron Concentration In The Waste Panel Grid Blocks For S3V125.

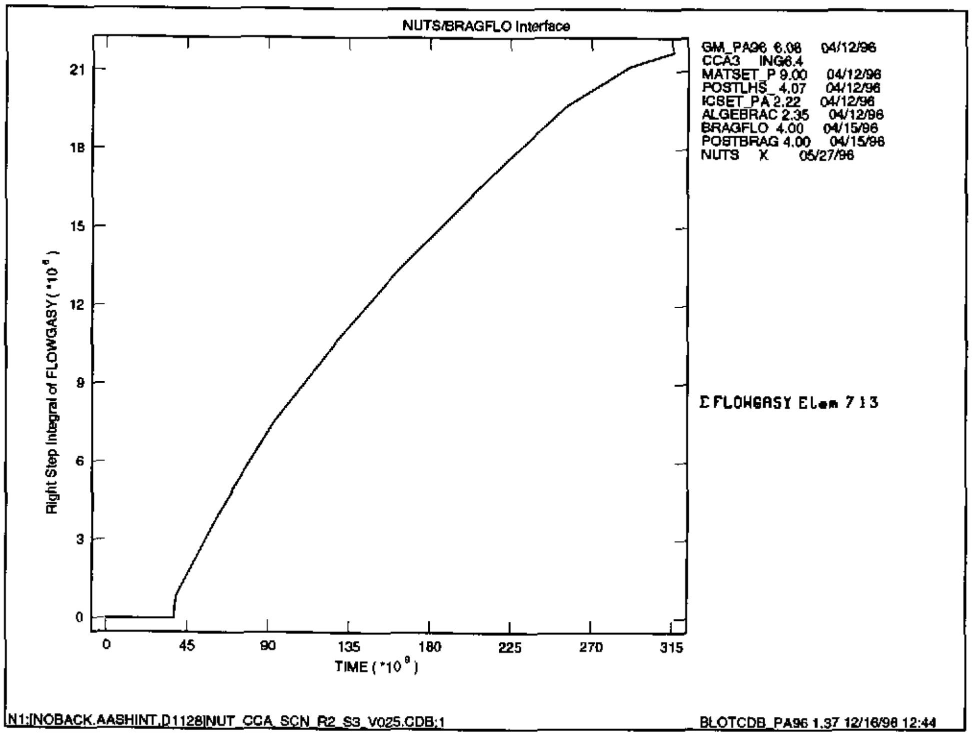


Figure 7.17, Integrated gas flow across the lower Culebra boundary within the borehole for S3V125.

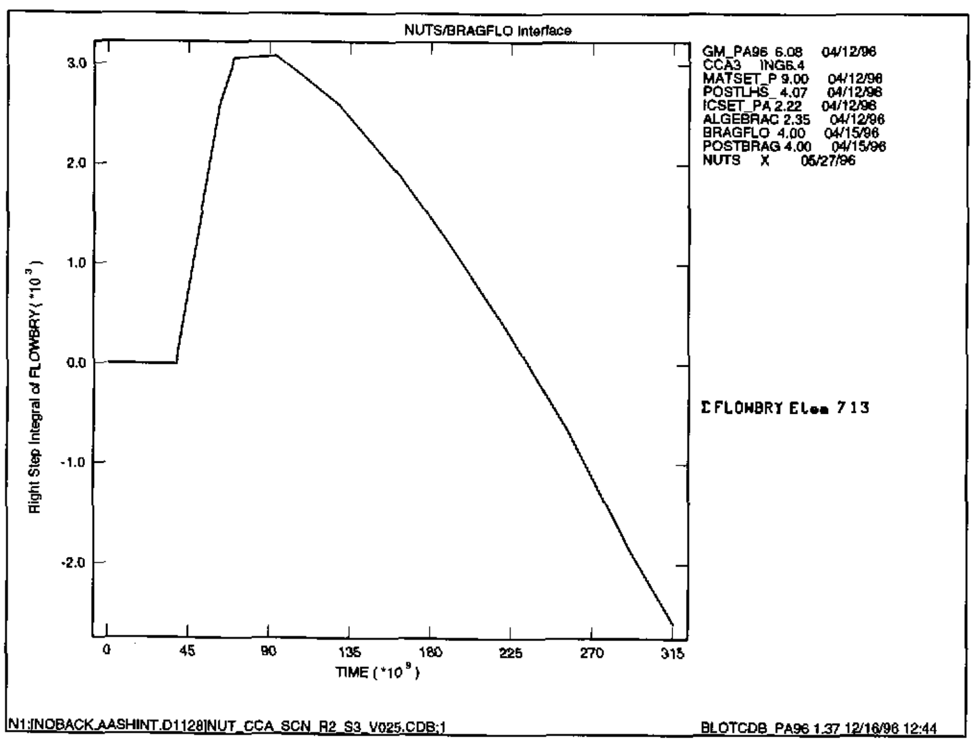


Figure 7.18 Integrated brine flow across the lower Culebra boundary within the borehole for S3V125.

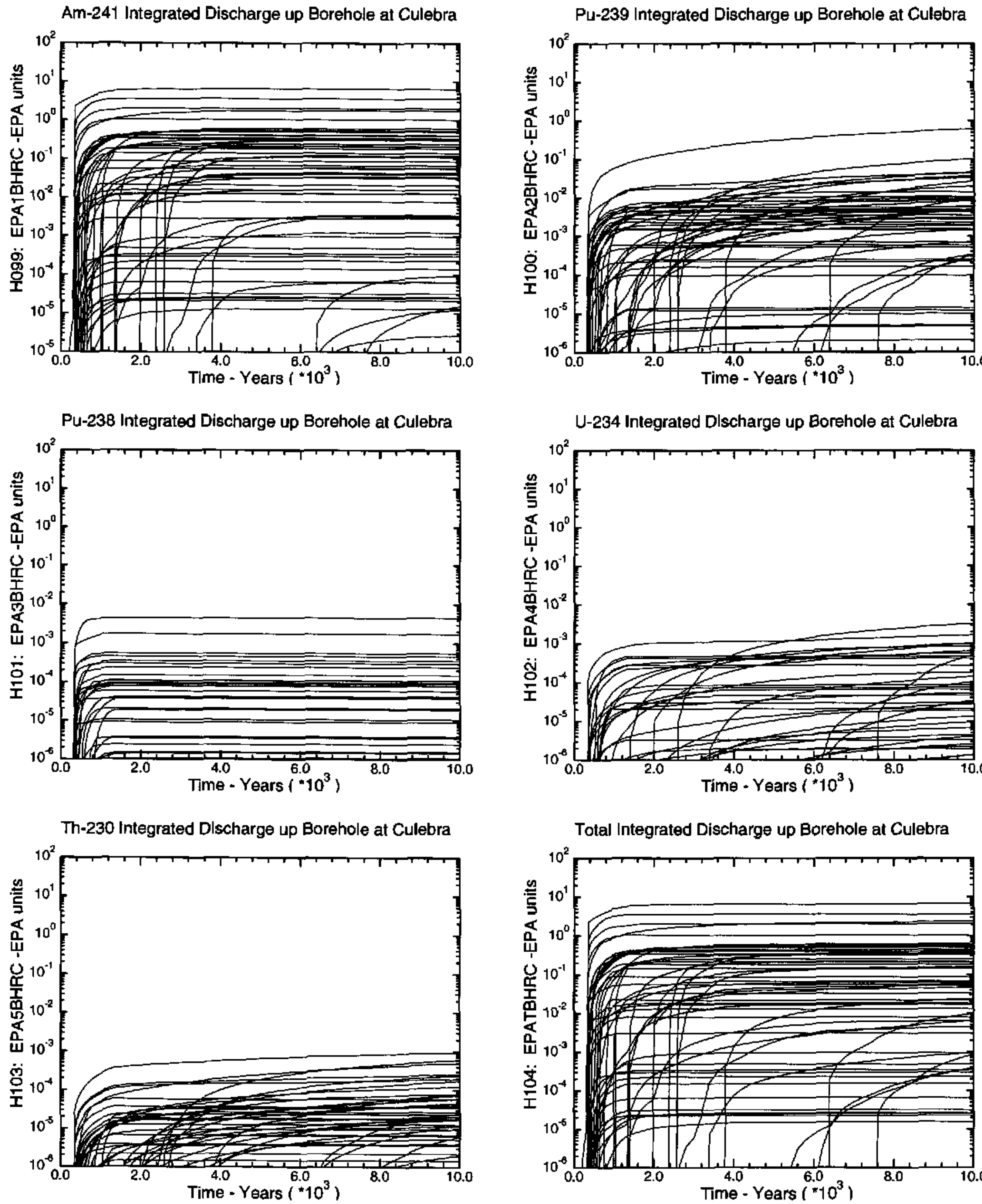


Figure 7.19 Scenario 2, Intrusion Time 100 Years

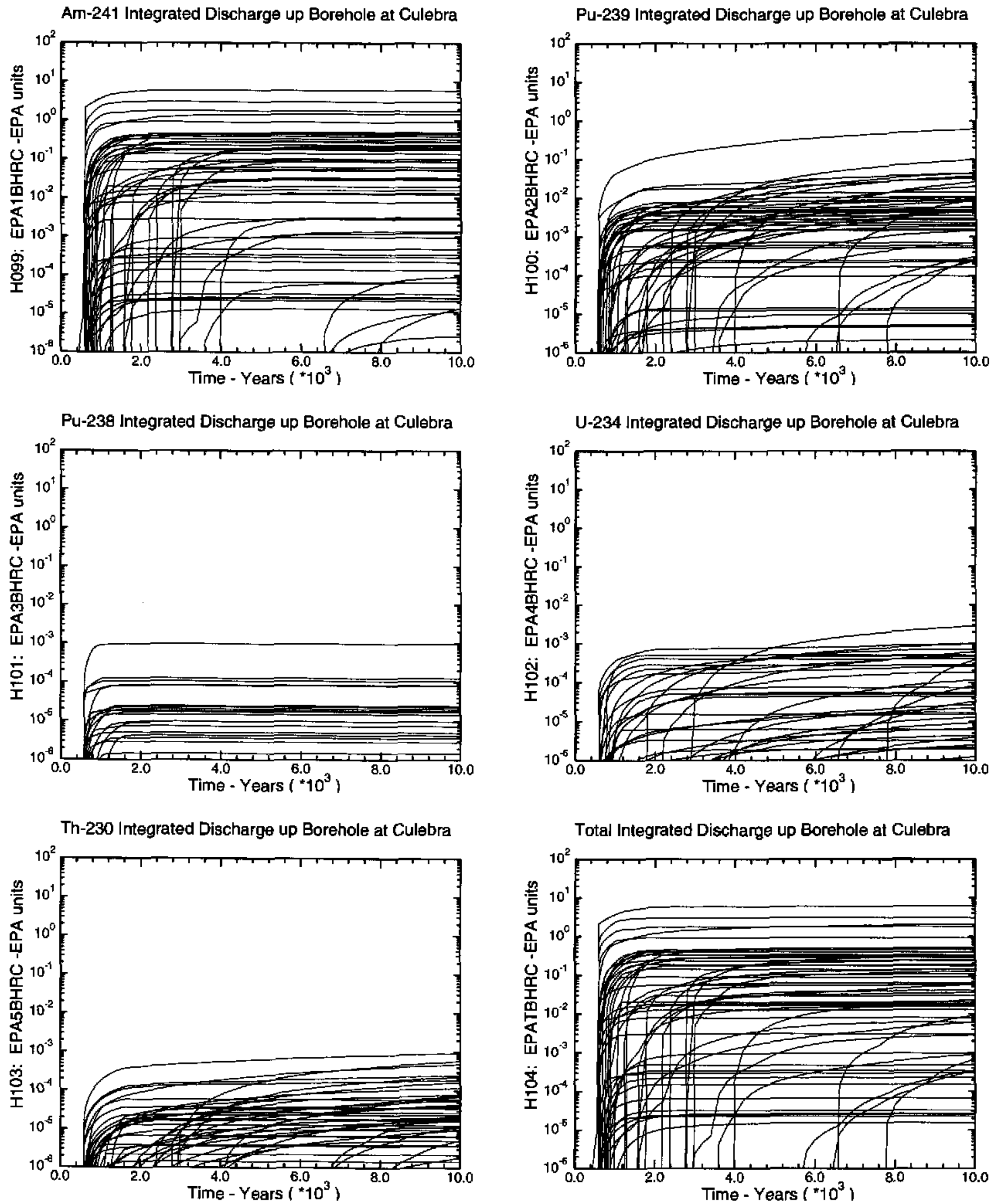


Figure 7.20 Scenario 2, Intrusion Time 350 Years

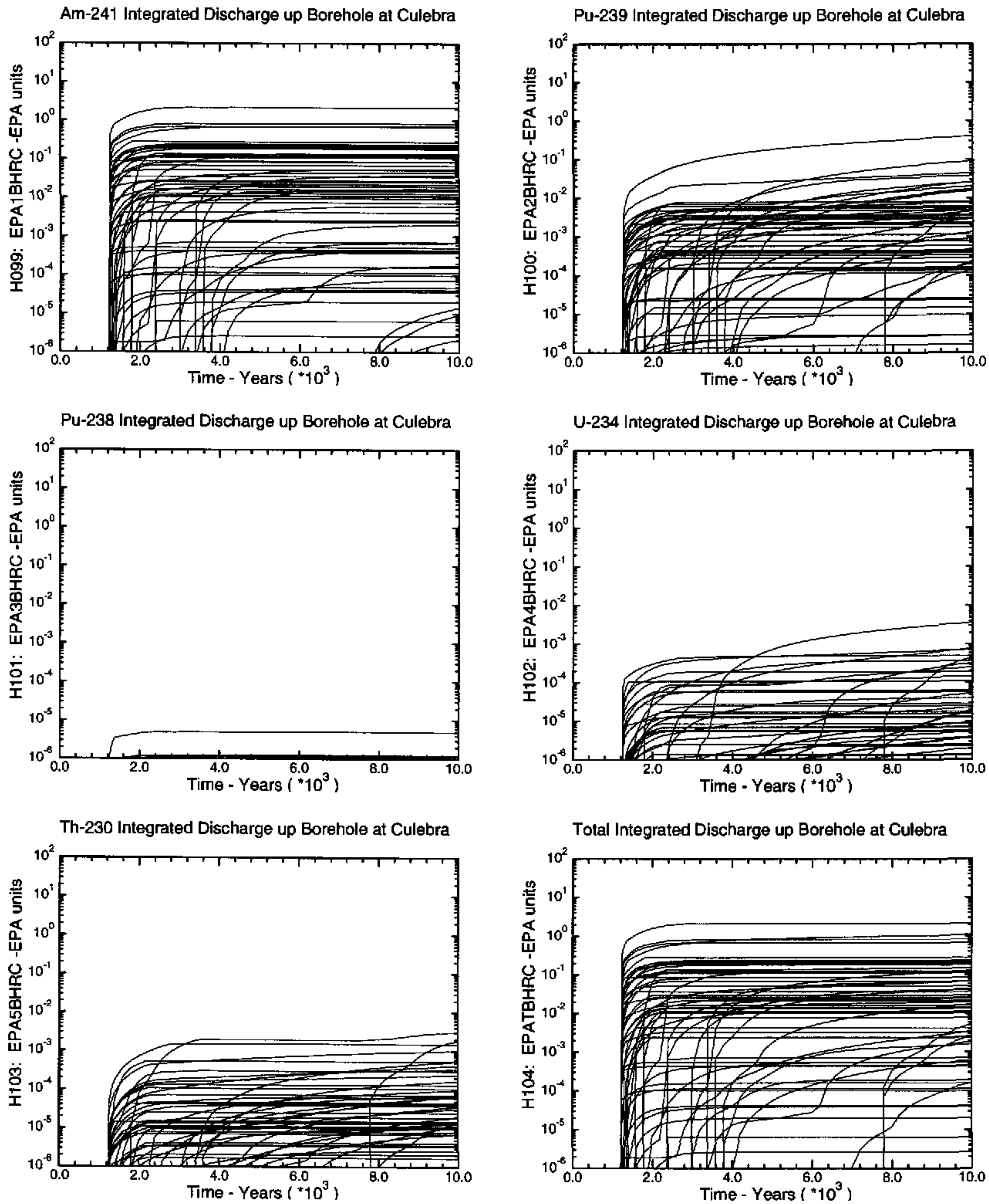
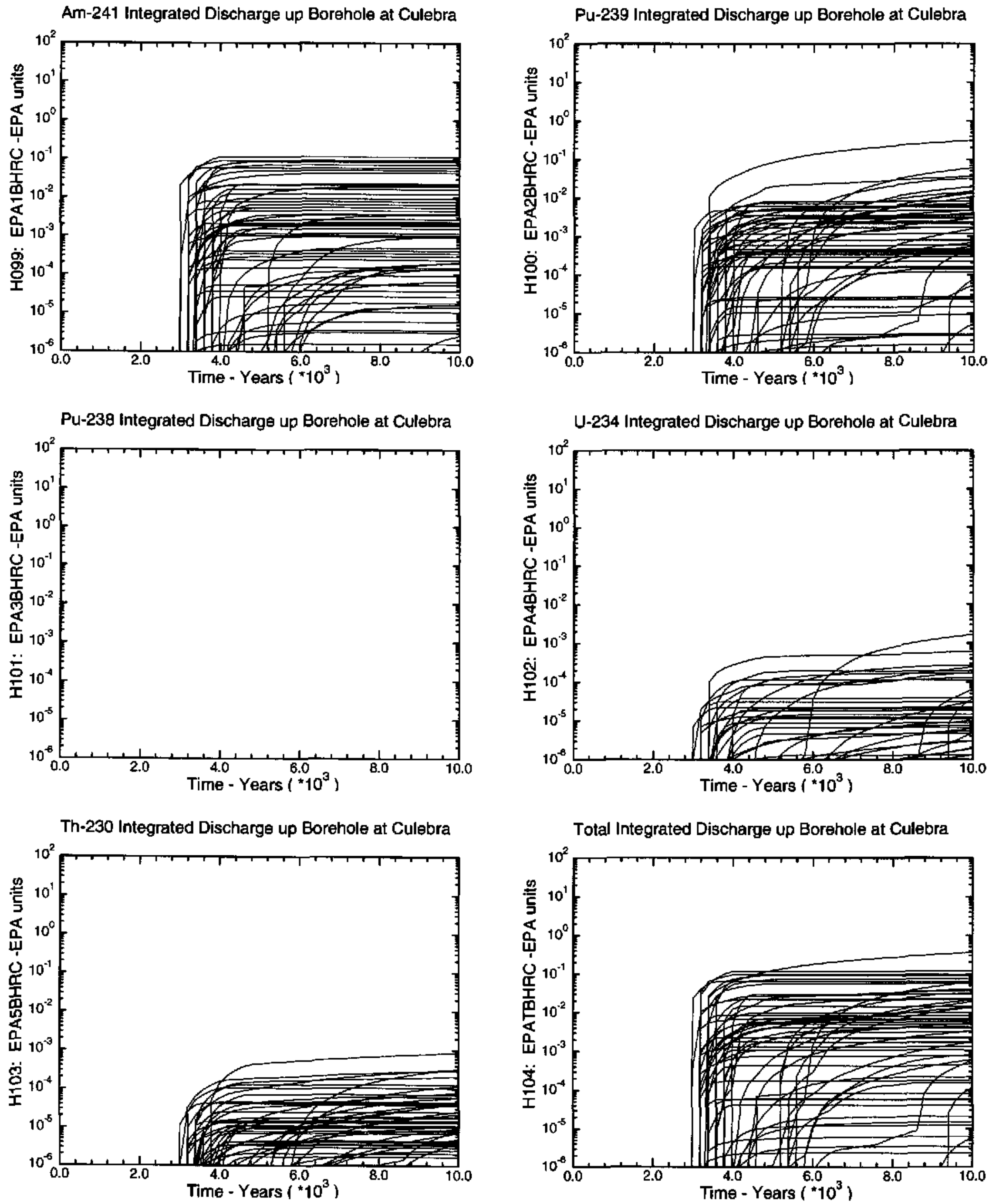


Figure 7.21 Scenario 3, Intrusion Time 1000 Years



Fifure 7.22 Scenario 3, Intrusion Time 3000 Years

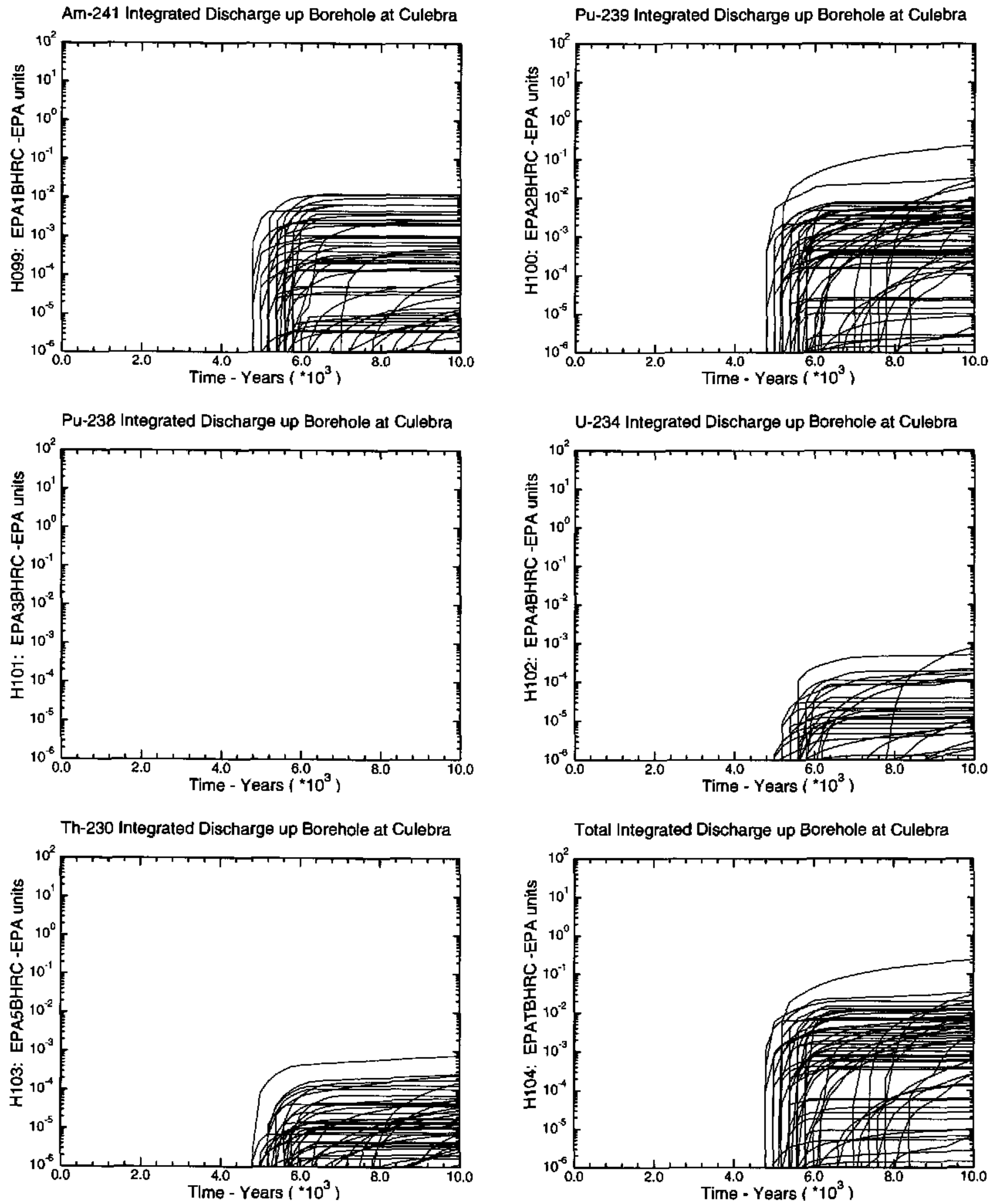


Figure 7.23 Scenario 3, Intrusion Time 5000 Years

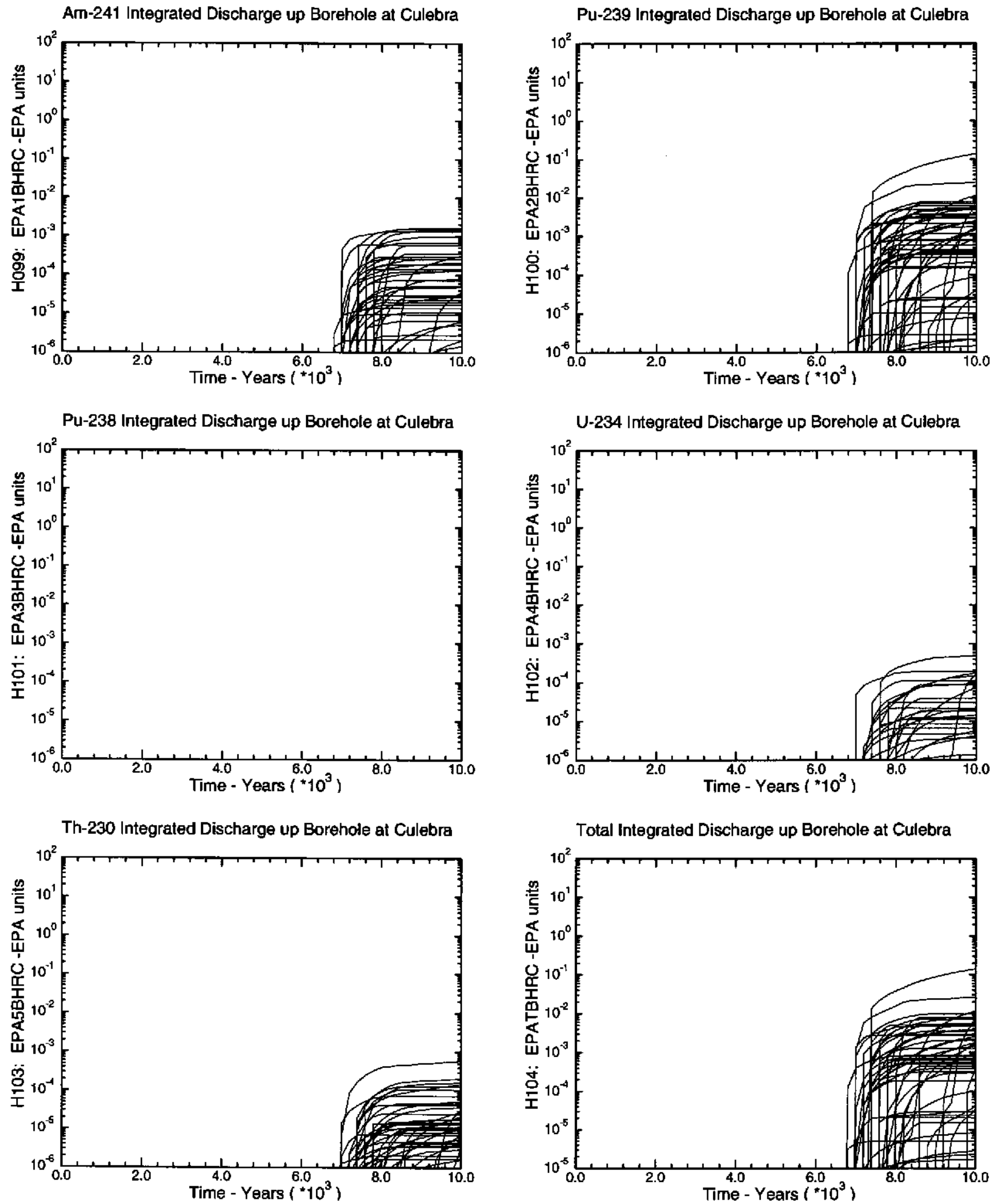


Figure 7.24 Scenario 3, Intrusion Time 7000 Years

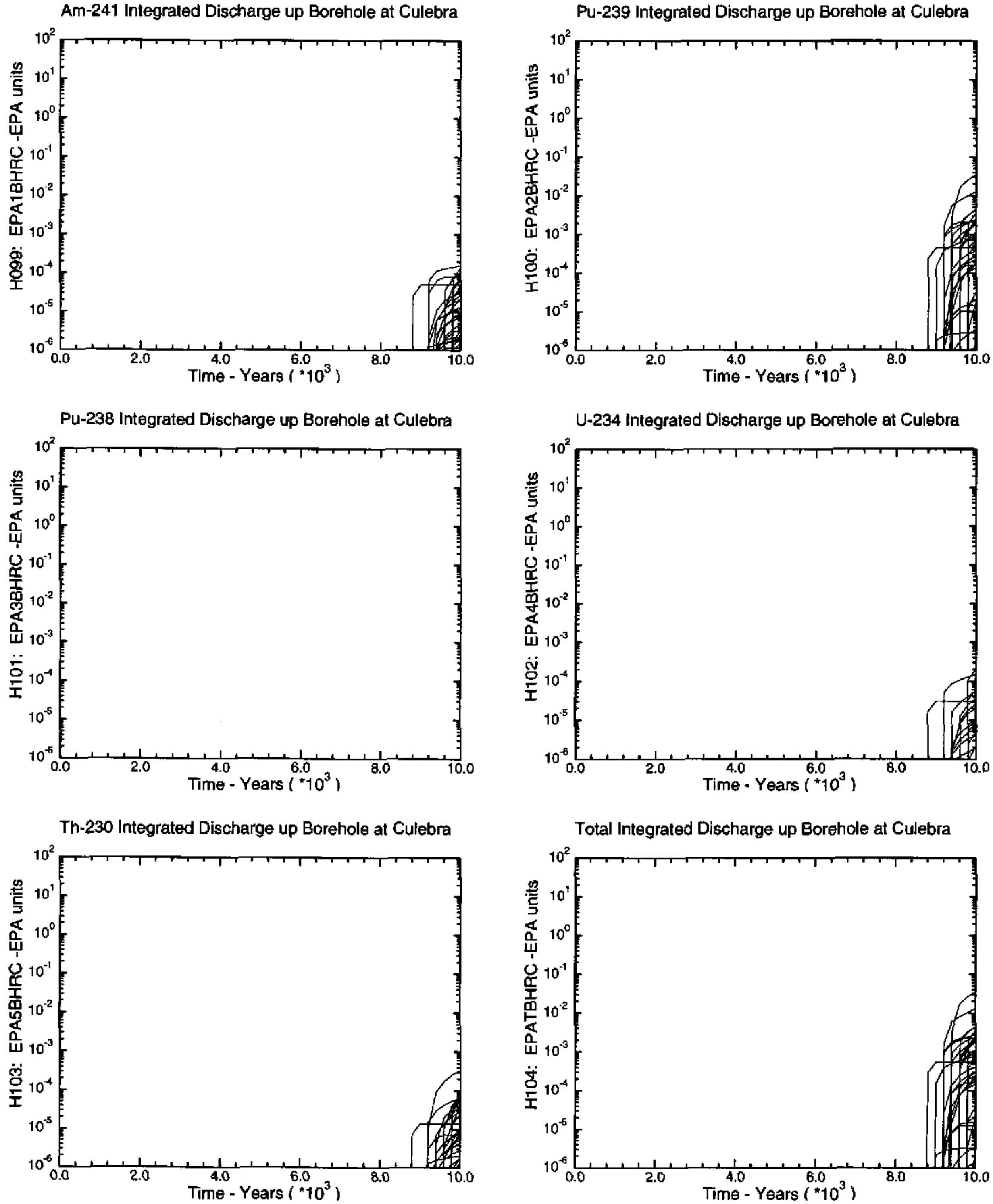


Figure 7.25 Scenario 3, Intrusion Time 9000 Years

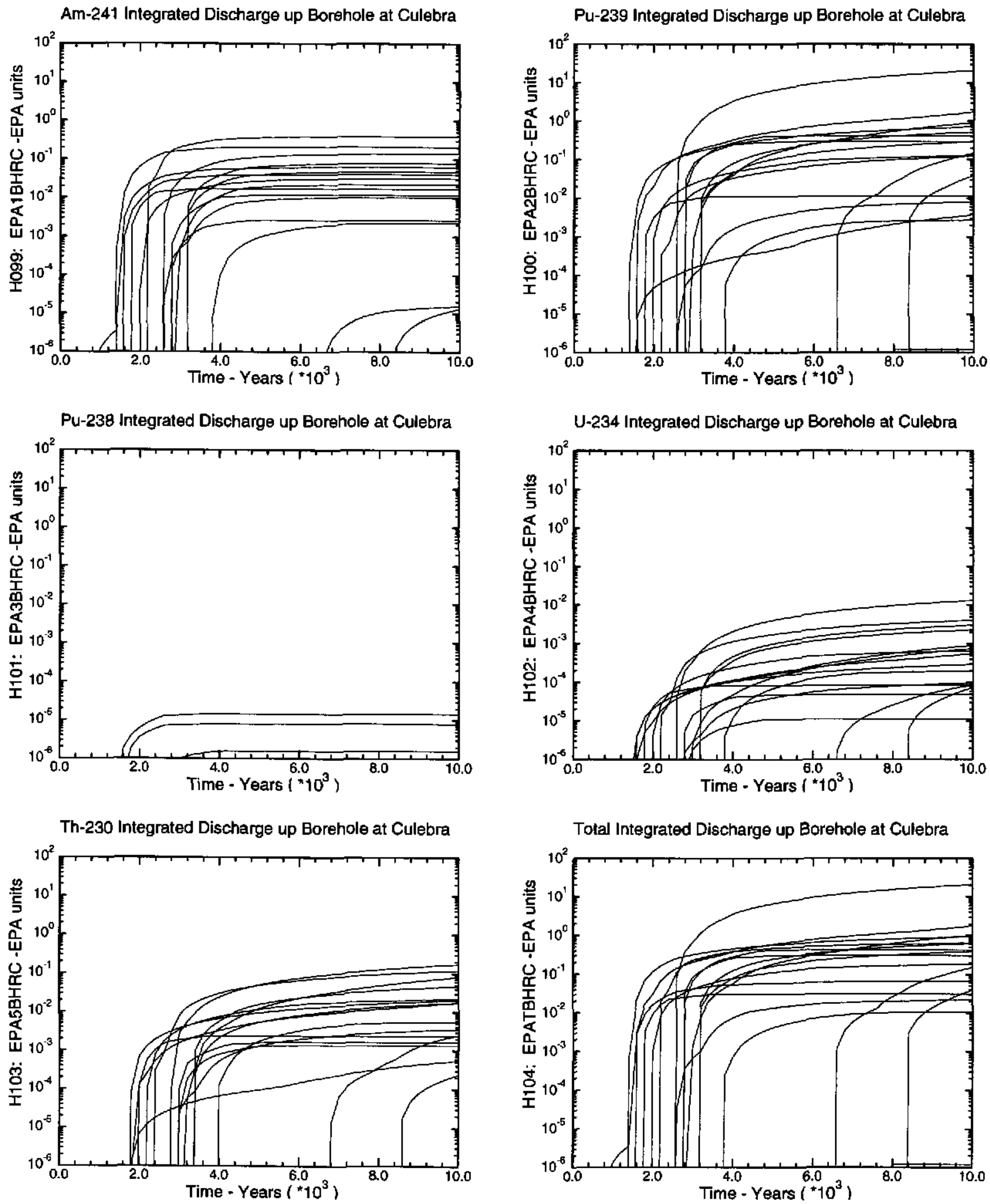


Figure 7.26 Scenario 4, Intrusion Time 100 Years

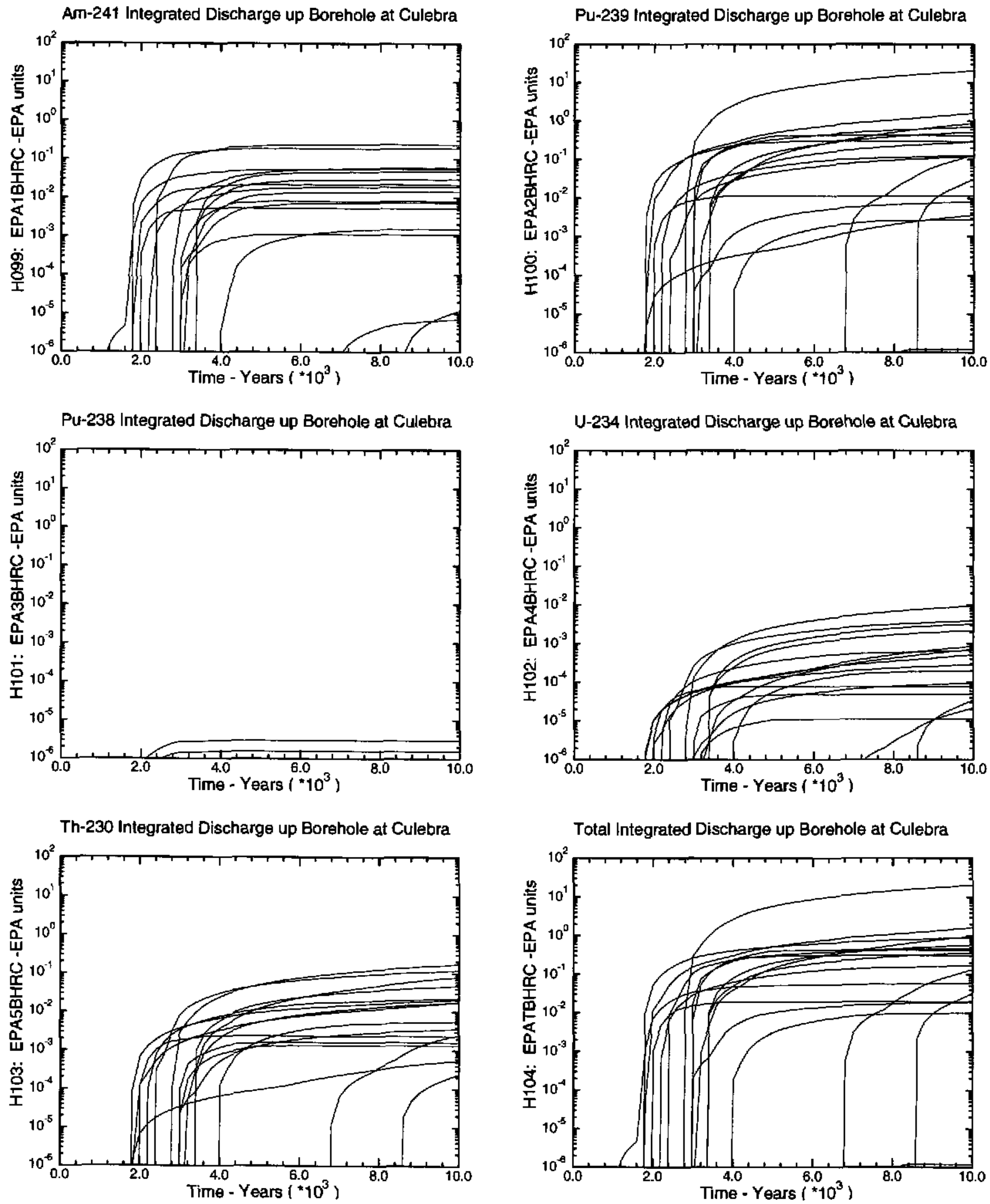


Figure 7.27 Scenario 4, Intrusion Time 350 Years

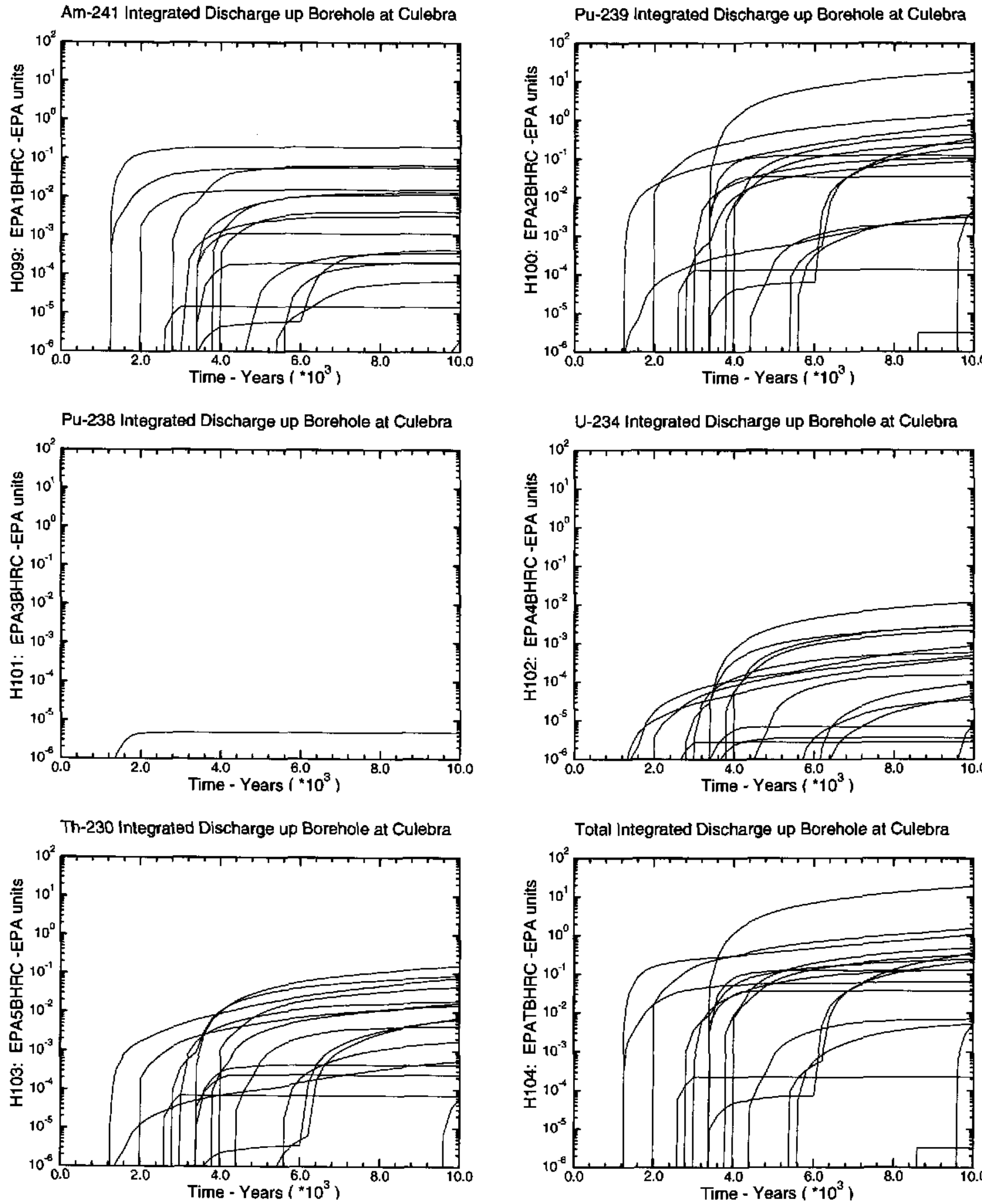


Figure 7.28 Scenario 5, Intrusion Time 1000 Years

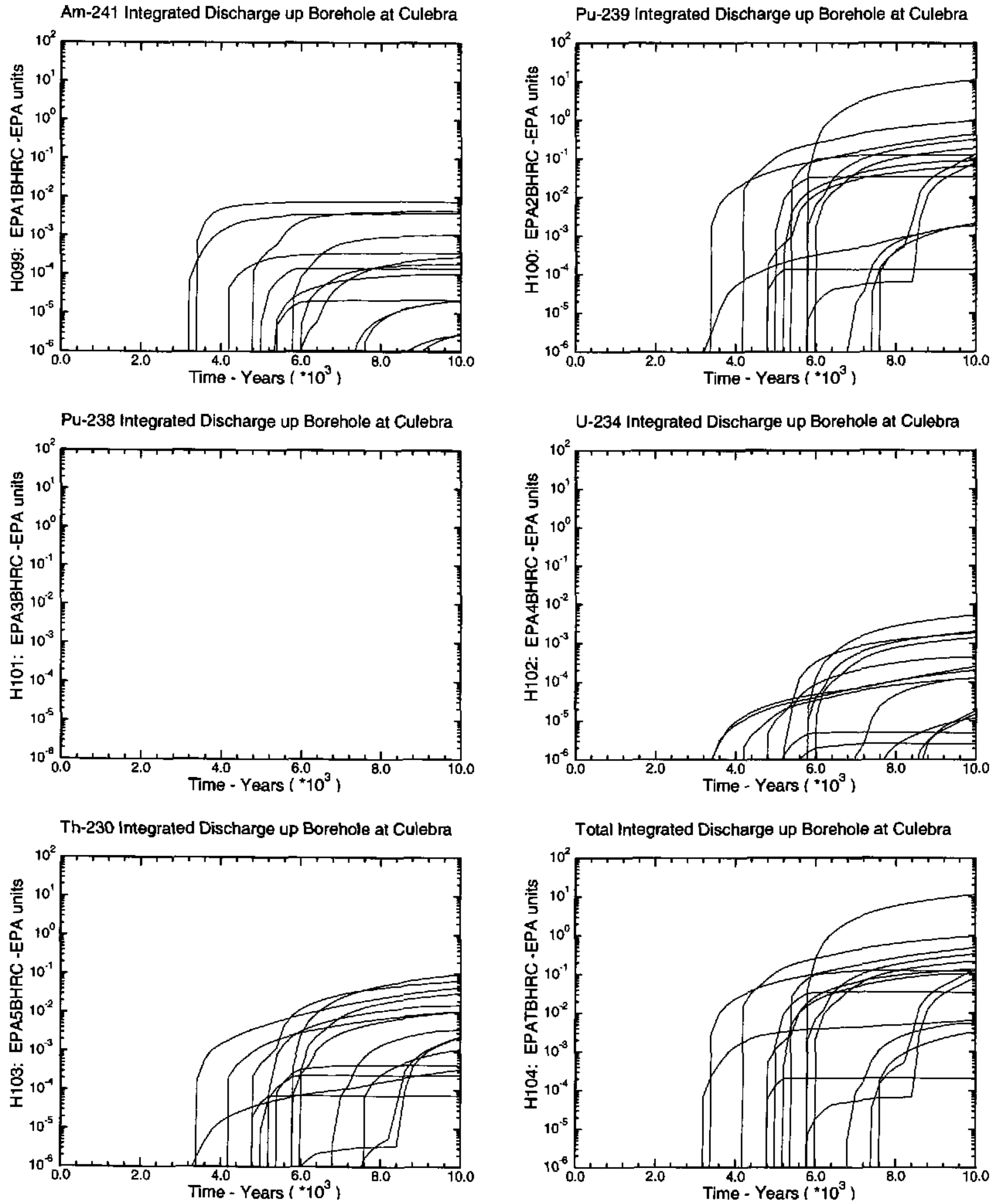


Figure 7.29 Scenario 5, Intrusion Time 3000 Years

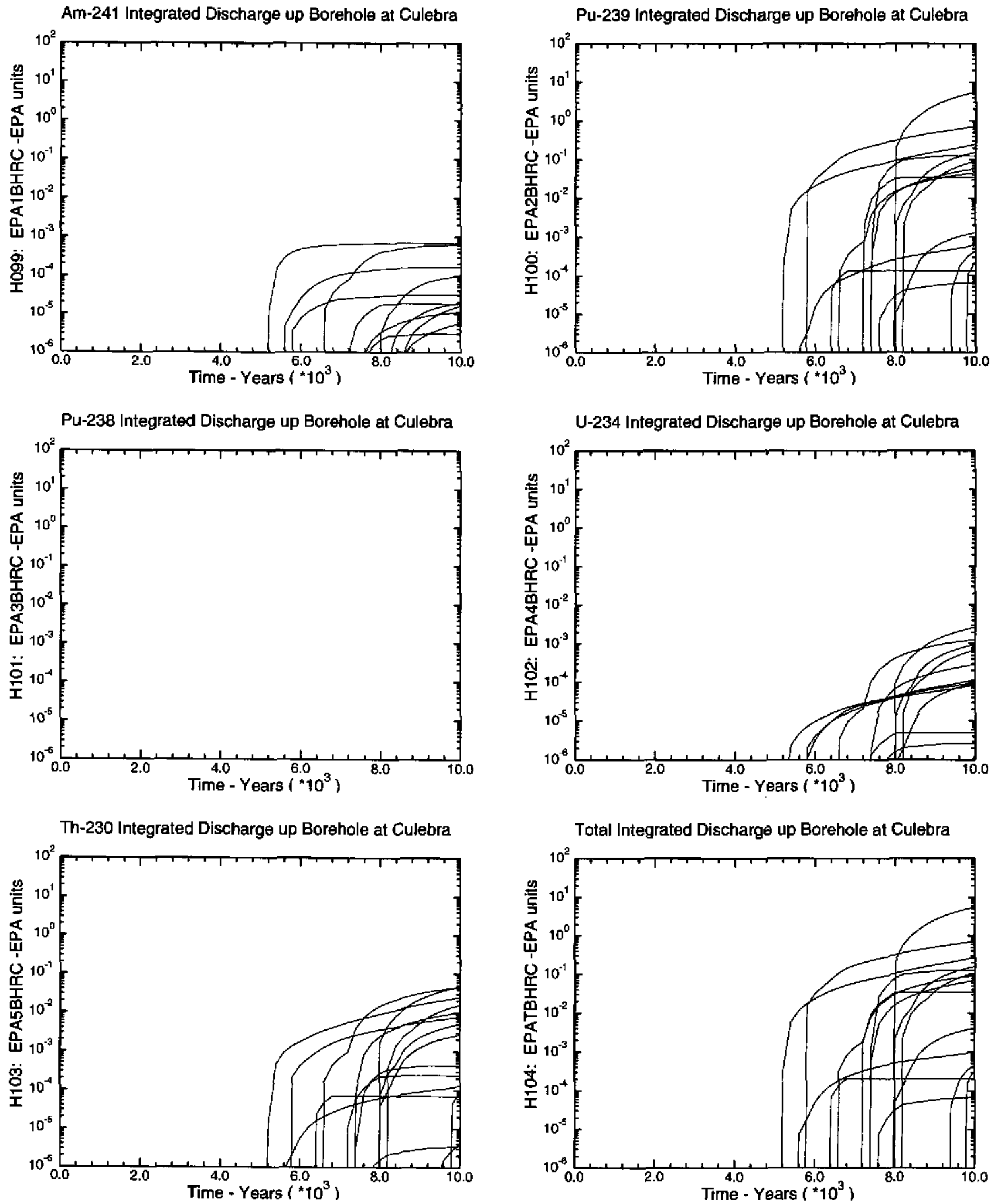


Figure 7.30 Scenario 5, Intrusion Time 5000 Years

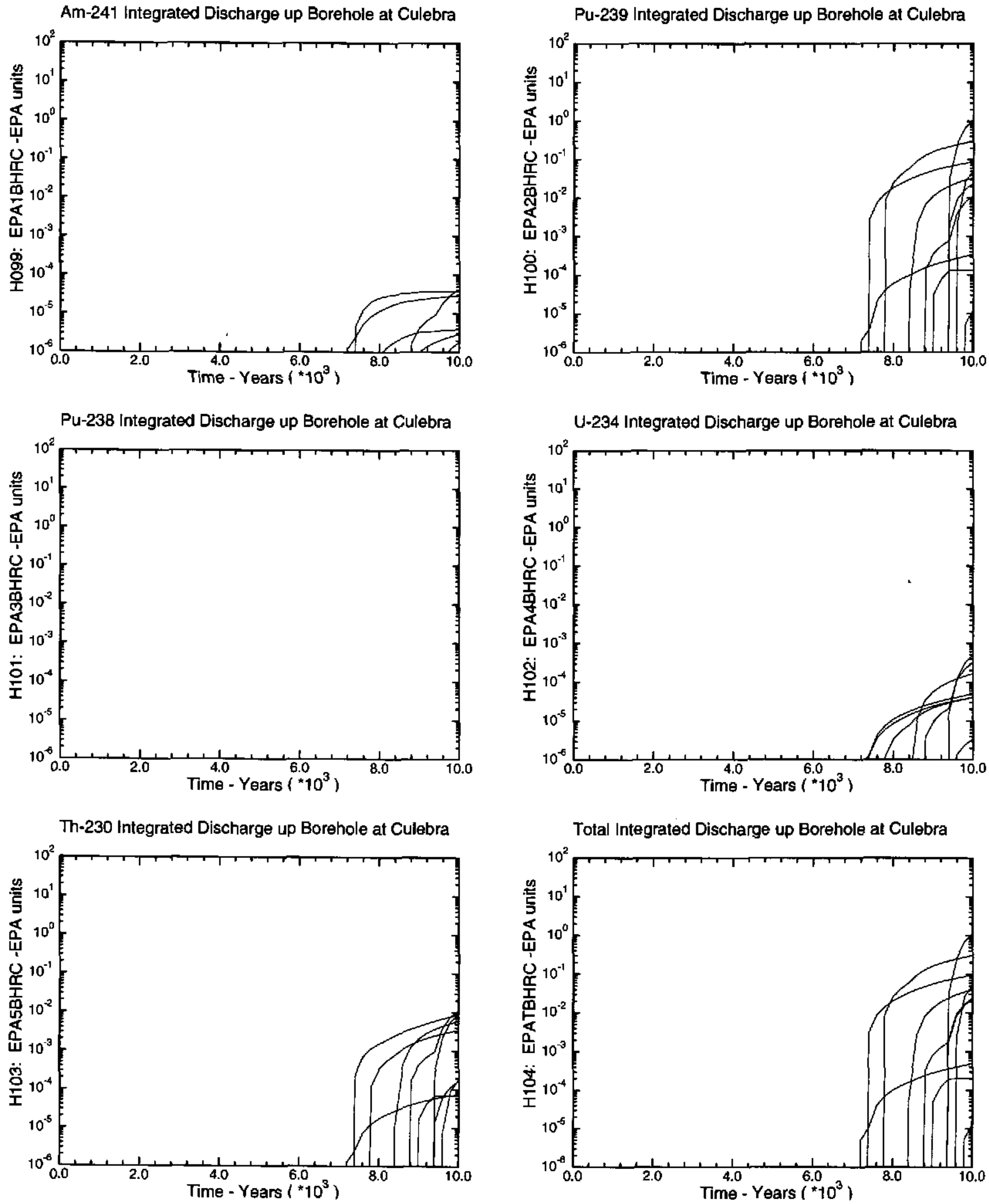


Figure 7.31 Scenario 5, Intrusion Time 7000 Years

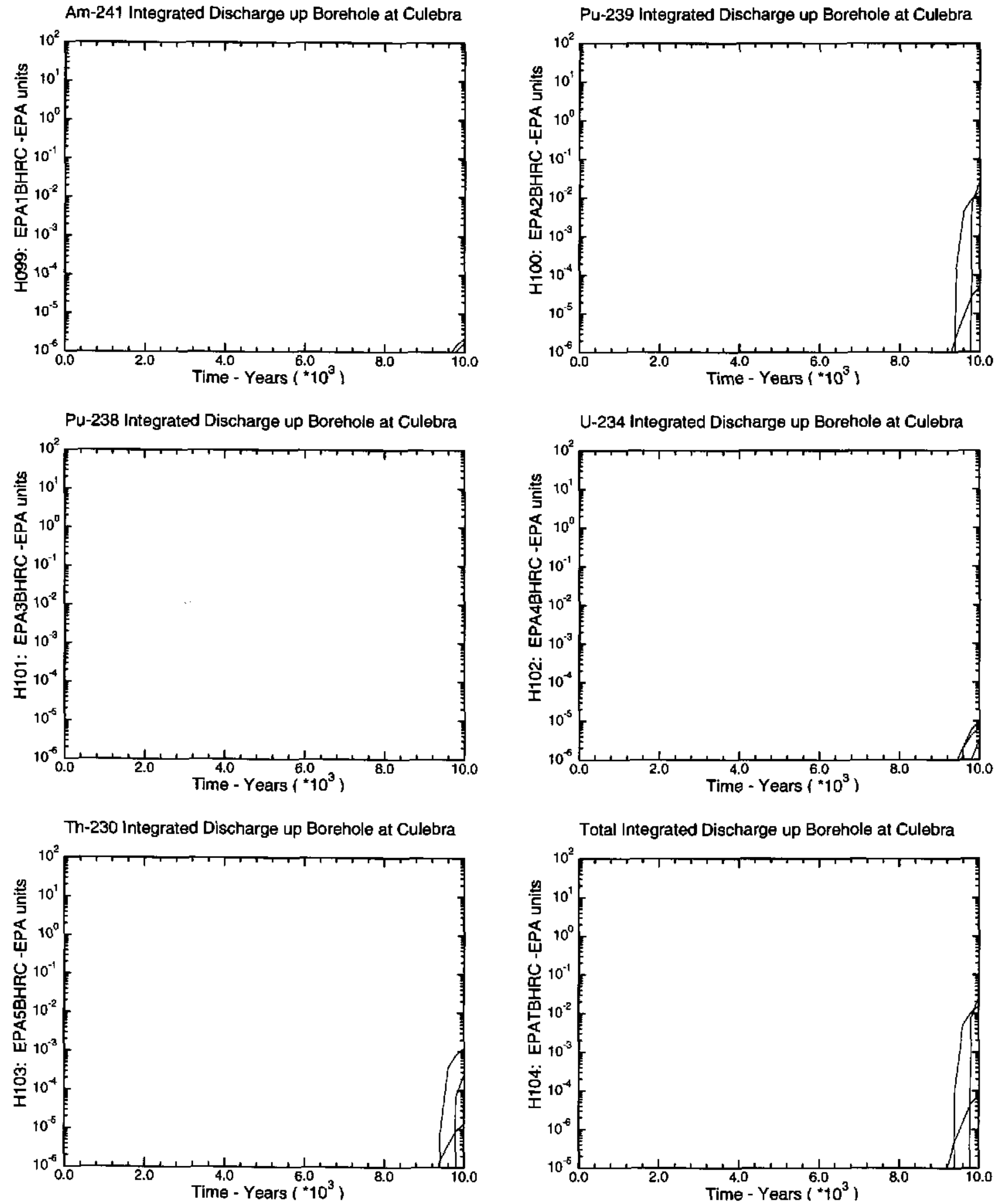


Figure 7.32 Scenario 5, Intrusion Time 9000 Years

7.3.3 Multiple Human Intrusion Performance - E2/E1 - PANEL

As described in Section 1.4, PANEL was used instead of NUTS for the multiple intrusion scenarios. Unlike NUTS which calculated transport throughout the BRAGFLO grid, PANEL treated the waste panel as a single mixing cell and assumed that all brine moving up the borehole past the top of the DRZ had contacted all the waste within the panel, and was then instantly injected into the Culebra. Thus, unlike NUTS which allowed brine to move straight up the borehole without mixing with the waste after the repository was saturated, all brine entering from the Castile was assumed to move through the waste.

Because the PANEL calculations were fast, it was not necessary to screen out the insignificant release realizations. As in the NUTS analysis, the three replicates were renumbered from 1 to 300 with 1 to 100 for replicate 1, 101 to 200 for replicate 2, and 201 to 300 for replicate 3, so that all three replicates could be examined at once.

Additional intrusion times were simulated by shifting the BRAGFLO flow conditions from the 800/2000-year intrusion to the nominal intrusion time of concern. For example, a 100 year intrusion is simulated by shifting the BRAGFLO time steps backwards in time by 1900 years. Thus at the start of the 100 year PANEL run, the repository had already had an E2 intrusion for 1100 years and at 100 years, the E1 intrusion occurred. The releases during the final 1900 years were obtained by using the panel brine volume and borehole flow rate from the final time step in the 800/2000-year results. For a nominal intrusion time after 2000, the BRAGFLO initial conditions were maintained until the first BRAGFLO time shifted time step. This method of time shifting resulted in artificially high repository saturations at very early times in the 100, 350, and 1000 year time shifted runs, which can be seen in the large volumes of brine that were released at early times in these calculations.

Table 7.11 shows the changes in borehole properties in the E2E1 scenario. The first intrusion which penetrates the repository only, occurs at 800 years. The borehole plug above the repository is assumed to work perfectly for 200 years after which it degraded to silty sand. Once the borehole degrades, the repository depressurizes and brine flows into the repository from the marker beds and down the borehole from the Culebra. In most cases, the marker bed and borehole permeability are not great enough for brine to fill the repository before the second intrusion at 2000 years. The second intrusion is simulated by assigning a very large borehole permeability typical of an open borehole between the Castile brine pocket and the repository for 200 years. During this time, there is rapid flow of brine from the underlying pocket into the repository. From 2200 to 3200, the casing of the lower portion of the borehole is assumed to have failed and the borehole is assumed to have filled with silty sand resulting in decreased flow from the pocket to the repository. After 3200 years, salt creep further reduces the borehole permeability and decreases the brine flow further.

Table 7.11 Changes in Borehole Properties in E2E1 Scenario.

Time (years)	Borehole Portion	Behavior	Permeability (m^2)
0 - 1000	All	Undisturbed conditions	Undisturbed conditions
1000 - 2000	Above panel Below panel	Silty sand Undisturbed conditions	10^{-14} - 10^{-11} Undisturbed conditions
2000 - 2200	Above panel Below panel	Silty sand Open borehole	10^{-14} - 10^{-11} 10^{-9}
2200 - 3200	Above panel Below panel	Silty sand Silty sand	10^{-14} - 10^{-11} 10^{-14} - 10^{-11}
3200 - 10,000	Above panel Below panel	Silty sand Tight silty sand	10^{-14} - 10^{-11} 10^{-15} - 10^{-12}

Similar to previously discussed scenarios (S2 to S5), in the E2/E1 scenario, high releases of brine up the borehole can occur in some realizations in which large amounts of brine first flow down the borehole from Culebra and Dewey Lakes Formations. Cumulative brine flows down the borehole were as high as 49,000 m^3. At later times, much of this brine was driven back up the borehole by continual brine inflow from the interbeds and/or the Castile reservoir. Brine flow into the repository from the marker beds was as much as 65,000 m^3. While the maximum amount of brine that flowed into the panel was approximately 95,000 m^3, the largest flow up the borehole past the top of the DRZ was around 62,000 m^3. Brine flows out of the repository and into the marker beds was very low. The maximum in S6 is about 550 m^3. The largest brine outflow in all marker beds across the land withdrawal boundary was less than 1.7 m^3, so NUTS calculations of transport out the marker beds was unnecessary.

Like the E1 scenarios, the E2/E1 scenario was ^{241}Am dominated for the first 3000 years for two reasons: 1) high early brine release up the borehole and 2) low Pu solubility. After 3000 years radioactive decay of ^{241}Am results in ^{239}Pu dominance. In the NUTS E2 calculations, the earliest intrusions were modeled at 100 years, so repository filling and flow up the borehole was not seen until after that time, but in the PANEL E2/E1 calculations, the earliest E2 intrusion was modeled at the fictitious -1100 years, giving the repository time to fill before the 100 year E1 intrusion and some releases occurred before 100 years. Unlike the NUTS E1 calculations were a significant amount of Castile brine was first used to fill the repository before brine flow up the borehole could occur, in some E2/E1 realizations the repository was already filled with marker bed brine and much more of the Castile brine was available for early flow up the borehole. These factors resulted in larger early brine flows up the borehole for the E2/E1 calculations than the E1 or E2 calculations with the same nominal intrusion times. Like the E1 scenario, the solubilities in the E2/E1 scenario were assumed to be those calculated in pure Castile brine. As seen in Table 7.10, the high range of Am solubility is 10^{-5} M and Pu solubility is $10^{-5.4}$M in Castile brine which are 0.8 and 1.6 orders of magnitude lower than in Salado brine. Converted from moles per liter to EPA units per liter, these solubilities are 2.4×10^{-5} for ^{241}Am and 1.7×10^{-7} for ^{239}Pu, making the ^{241}Am top solubility in EPA units/liter 2.1 orders of magnitudes higher than the top ^{239}Pu solubility. This dominance of Am solubility and the higher early brine release both contribute to the greater Am dominance in the E2/E1 scenarios.

As in the NUTS discussion, a number of realizations were selected for closer inspection. The total EPA unit discharge of the five realizations chosen are shown in Figure 7.33, the hydrologic behavior is shown in Table 7.12, and the ranges and sampled parameters are shown in Table 7.13.

Table 7.12 Hydrologic Behavior$^+$ of Selected Realizations

Realization #	brine into Culebra ($x10^3 m^3$)	brine out MB139 ($x10^3 m^3$)	brine out of Castile ($x10^3 m^3$)	Pressure level in Castile, MPa	Pressure level in the borehole at the panel entrance, MPa
S6V023	ED35, U37	21	U to 2, D to 0.9	M11.7, D to 9.1 CU to 10.5	CU to 7
S6V111	ED12,U62	5.8	CU 100	M15.5, CD to 11.5	E8, D to 1.5,U to 11 L at 6.5
S6V128	CU27	13	CU 51	M16, CD 15.2	CU 12, L at 8.8
S6V141	ED48, U18	5.8	U to 1 D to 0.76	M12.2, D to 9.2, CU to 10	EU to 5.5, D to 1.8, CU to 6.5
S6V236	ED17, U7.5, D2.5	3.3	CU 33	M11.9, CD 10	EU 6.5, D to 1.5, U to 8, L at 6.5
E=Early	L=Late	U=up, D=Down	C=Continuous	M= Maximum	CU=continuous up

Table 7.13 Sampled Parameters for Selected Realizations

		Salado		MB	BH	Castile				
						lsol				
		lprm	P,	lprm	lprm	Pu	Am	P,	lprm	lcomp
Range	hi	-21.0	11.0	-17.0	-11.0	-5.4	-5.0	11.0	-9.8	-8.0
Range	low	-24.0	13.8	-21.0	-14.0	-7.6	-7.5	17.0	-14.7	-11.3
	23	-23.2	13.1	-17.1	-11.4	-7.1	-6.5	11.7	-12.4	-10.2
	111	-21.7	13.5	-18.2	-11.2	-6.9	-5.6	15.2	-13.5	-8.4
	125	-23.0	12.1	-17.9	-11.5	-7.1	-6.7	14.2	-13.4	-9.0
	128	-22.0	11.9	-17.2	-12.2	-6.2	-6.6	16.0	-13.6	-10.2
Vector	141	-22.8	12.8	-18.0	-11.0	-6.9	-5.6	12.2	-11.7	-10.4
	236	-21.7	12.9	-18.7	-11.2	-6.8	-6.5	12.0	-13.8	-8.5
lprm = log permeability, P = pressure, lcomp = log compressibility, BH = borehole, MB = marker bed, and										

Table 7.14 Total Discharge from Selected Realizations (EPA Units) S6.

vector	^{241}Am	^{239}Pu	^{238}Pu	^{234}U	^{230}Th	Total
111	5.18E+00	3.87E-01	1.24E-08	6.29E-05	2.69E-03	5.57E+00
128	2.19E+00	8.64E-01	4.66E-07	2.68E-05	1.45E-03	3.06E+00
236	2.76E+00	5.48E-02	4.19E-09	7.39E-06	2.03E-04	2.81E+00
23	3.26E-01	1.51E-01	2.16E-11	4.50E-03	2.34E-03	4.83E-01
141	3.46E-01	1.08E-01	2.68E-12	1.97E-05	1.15E-03	4.55E-01

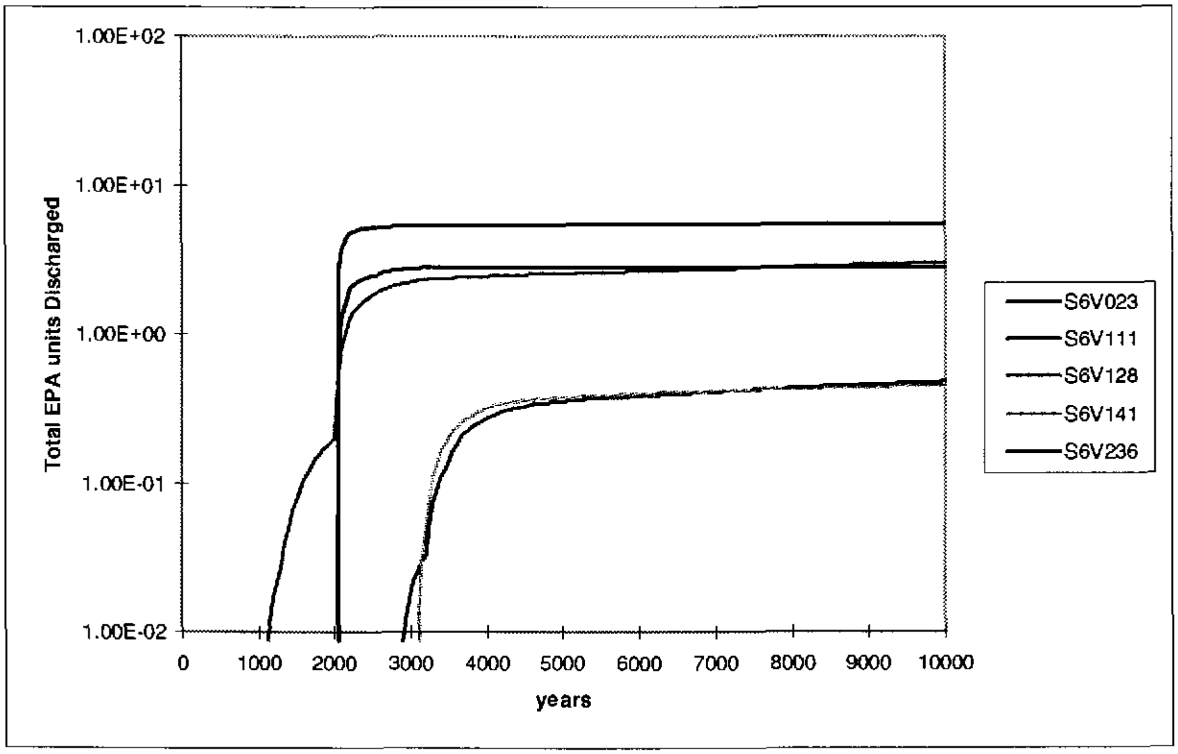


Figure 7.33 Cumulative Total EPA unit discharge to the Culebra in the Scenario 6.

Like the E1 scenario, the highest release in the E2/E1 scenario was seen in realization 111. Realization 111's high Castile pressure, 1.5 x 10-7, and high Castile compressibility, 10-8.39 resulted in some of the largest brine flows from the Castile (100,000 m3) and highest total brine discharge volume (62,100 m3). The marker bed permeability (10-18.18) and Pu solubility (10-6.9M) were not especially high so little discharge was seen before 2000 or after 3200 years.

The next highest total discharge and the highest 239Pu discharge is seen in realization 128 (R1V028). With realization 128's unusually high marker bed permeability (10-17.15), brine flowed rapidly from the marker beds throughout the 10,000 year regulatory and filled the repository by about 1250 when the first 239Pu was pushed up the borehole. At 2000 years, the 200 year rapid pulse of brine (51,000 m3) flowed up from the brine pocket causing a jump in the cumulative discharge of Pu followed by 1000 years of moderate discharge, both discharges dominated by brine flow from high pressure of the brine pocket. At 3200 years, borehole permeability between the brine pocket and repository decreased to 10-13.2, and marker bed flow once again dominated the Pu discharge. Realization 128 had the third highest total brine release volume, 26,700 m3, and highest Pu discharge (0.86 EPA units) but was still 241Am dominated (2.19 EPA units out of a total of 3.06).

The next largest release in Figure 7.33 was from realization 236. Realization 236 was one of the realizations that had the interesting up-down borehole flow pattern in the E1 scenarios. With an E2 intrusion before the E1 intrusion, S6V236 showed a down-up-down pattern

(Figure 7.34). With its moderate marker bed permeability, there was slow and continued flow of brine from the marker beds (Figure 7.35) which stared the gas generation and caused a rise in the panel pressure (Figure 7.36). At the time of the E2 intrusion, the gas vented reducing the panel pressure and brine flowed down the borehole from the higher units. At the time of the E1 intrusion, the high Castile compressibility allowed a 23,000 m^3 pulse of brine to be driven up from the Castile (Figure 7.37), and flow in the borehole above the repository changed from down to up. The pressure within the panel showed a spike at this time. After the initial pulse, Castile brine continued to flow up at a moderate rate until the creep closure reduced the borehole permeability between the Castile and the repository, reducing the flow to about .6 m^3 per year. At late time the marker beds continued to supply an additional .2 m^3 per year, but corrosion consumed more than the combined Castile and marker bed inflow and brine flow in the borehole above the repository once again changed direction. All release occurred between 2000 and 3200 years during the large Castile flow as can be see by the flat cumulative release line in Figure 7.33 and was ^{241}Am dominated.

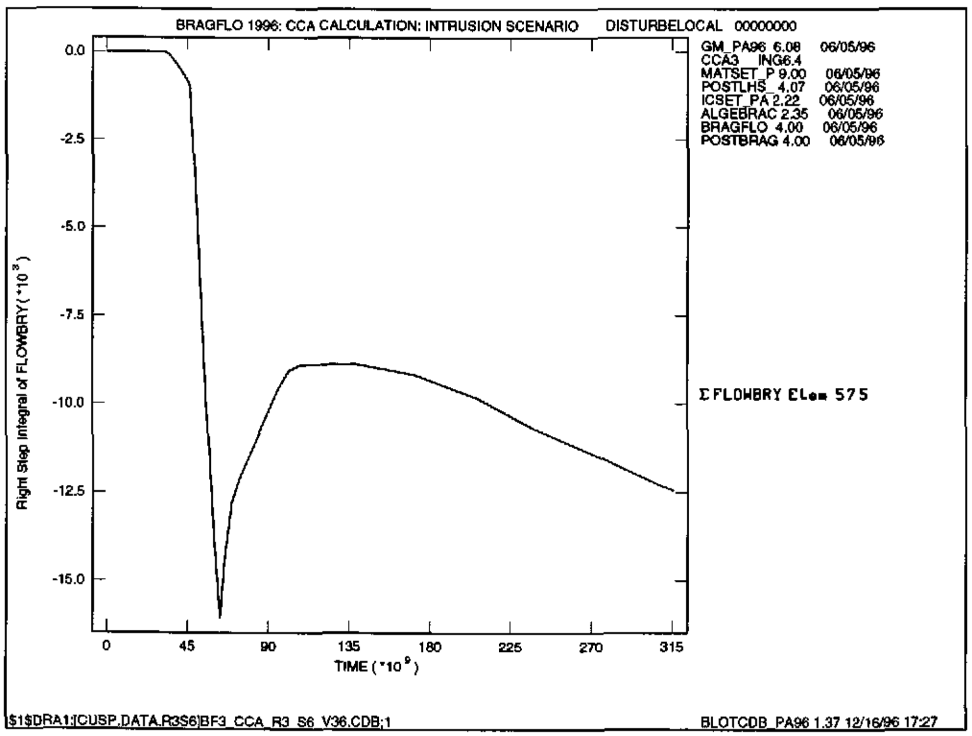


Figure 7.34 Integrated brine flow across the lower Marker Bed 138 boundary within the borehole for S6V236.

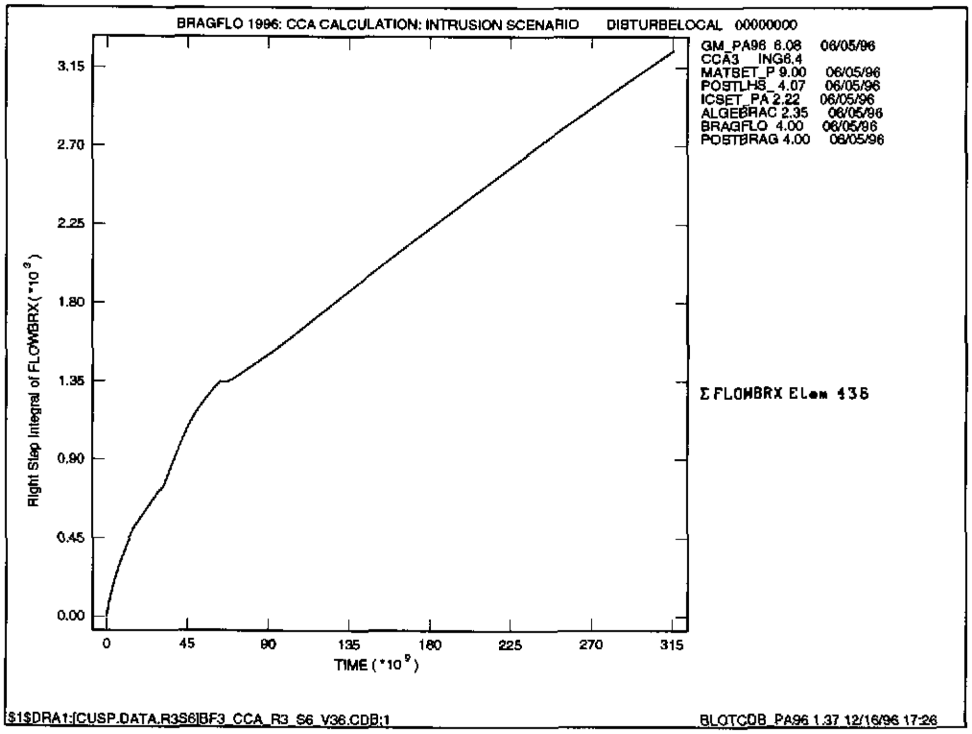


Figure 7.35, Integrated brine flow from the marker beds into the panel for S6V236.

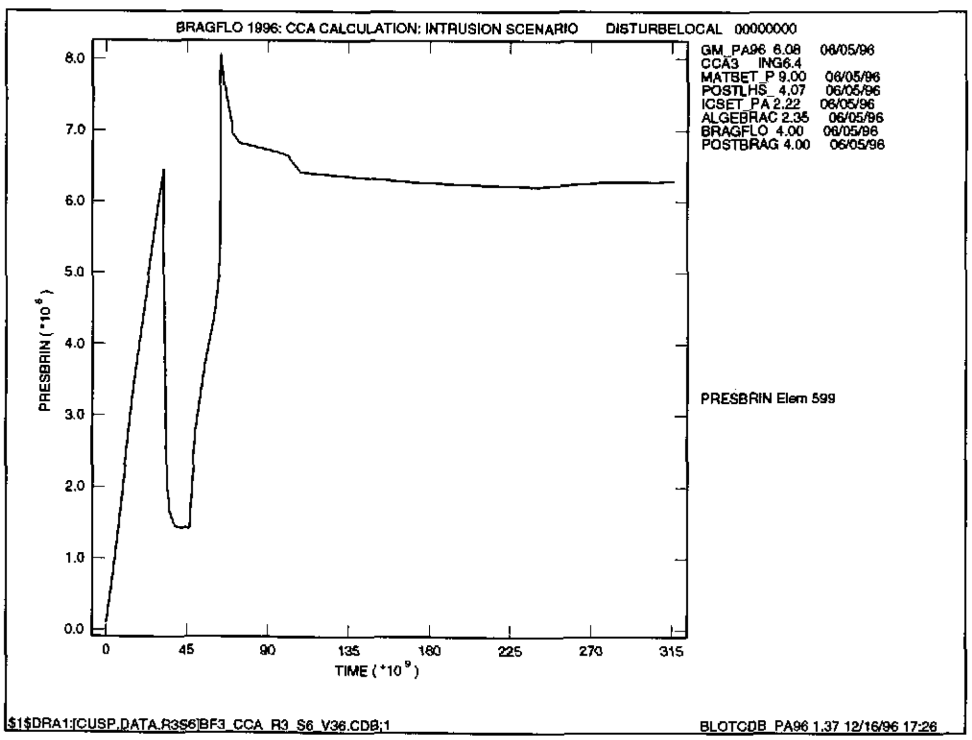


Figure 7.36, Brine pressure within the panel for S6V236.

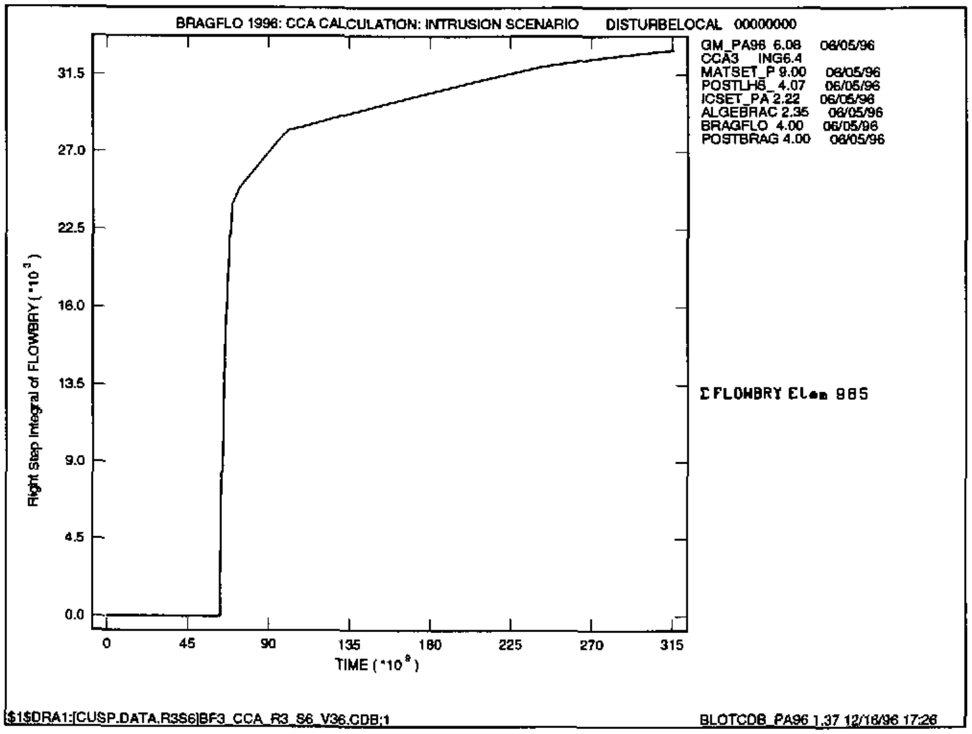


Figure 7.37, Integrated brine flow from the Castile into the panel for S6V236.

Realization 23 had even higher marker bed permeability and flow than realization 128, but lower Castile pressure, 1.2 x 10^{-7}, so it received less Castile brine at intrusion (2,000 m^3) and the repository did not fill and Pu discharge was not seen until after 3000 years. Realization 23 had the second highest total brine discharge volume, 3.73 x 10^4 m^3, but its late discharge time and lower Pu solubility ($10^{-7.1}$M) resulted in much lower release than in realization 128

Discharge from realization 141 is similar to realization 23 even though it received less brine from either the marker beds or Castile. More brine flowed down from the Culebra between the intrusions thus providing brine for a slightly sooner break through time. Its higher Am and Pu solubilities ($10^{-5.6}$ and $10^{-6.9}$M) allowed greater transport in the smaller amount of brine that flowed up the borehole.

Appendix P shows the cumulative discharge from all realizations for all intrusion times. . For the 2000 year intrusion time, ^{241}Am dominated the discharge for all 300 realizations, followed by ^{239}Pu which contributed a maximum of 42% of the total, followed by ^{234}U with a maximum of 14% of the total and Th230 with a maximum of .4%. The highest ^{241}Am discharge was 5.18 EPA units for vector 111 which also had the highest total discharge of 5.57 EPA units. The highest ^{239}Pu discharge was 0.86 EPA units from realization 128. The realizations in each of these tables in Appendix P were sorted by the total discharged EPA units summed for all 5 isotopes and individually for each isotope , and the top realization for each scenario and intrusion time was summarized in Appendix Q. The top realizations for the S6 scenario have been extracted from these tables and reproduced Table 7.15.

Table 7.15 reports the top realizations from each intrusion time where the realizations were sorted by total EPA unit discharge of: a) all isotopes, b) ^{241}Am, c) ^{239}Pu or ^{238}Pu, d) ^{234}U, and e) ^{230}Th. The releases were dominated by ^{241}Am for the early intrusions and by ^{239}Pu for the later times of intrusion when the ^{241}Am had decayed away. The largest releases occurred at the earliest intrusion times because the short lived isotopes had the highest inventory at early times and because there was more time for brine flow between the intrusion and the 10,000 year end of the regulatory period. The maximum total release was 95 EPA units for an intrusion at 100 years. The maximum ^{238}Pu discharge, 0.047 EPA units from realization 128, was also from the 100 year intrusion calculation and was 0.62% of the total EPA units discharged in that realization. ^{234}U and ^{230}Th contribute only a minor amount to the top releases with a maximum of 5.7×10^{-3} and 3.1×10^{-3} EPA units respectively. These top ^{234}U and ^{230}Th discharges are only 0.13% and 0.98% of the total EPA unit discharge of their respective realizations and the inclusion of ^{238}Pu, ^{234}U, and ^{230}Th in the analysis did not significantly effect the total EPA unit discharge to the Culebra.

Figure 7.38 through Figure 7.44 show the time dependent discharges for all intrusion times for scenario 6.

Table 7.15 Top Realizations for each intrusion time based on 10,000 year cumulative EPA unit discharge of: a) all isotopes, b) ^{241}Am, c) ^{239}Pu or ^{238}Pu, d) ^{234}U, and e) ^{230}Th.

Sorted by:	Time of 2nd Intrusion	Vector	^{241}Am	^{238}Pu	^{239}Pu	^{234}U	^{230}Th	Total
	100	111	9.46E+01	3.83E-02	4.29E-01	6.88E-05	2.03E-03	9.50E+01
	350	111	6.82E+01	5.36E-03	4.24E-01	6.85E-05	2.13E-03	6.87E+01
	1000	111	2.56E+01	3.23E-05	4.09E-01	6.63E-05	2.37E-03	2.60E+01
Total	2000	111	5.18E+00	1.24E-08	3.87E-01	6.29E-05	2.69E-03	5.57E+00
	4000	128	1.34E-01	6.83E-14	6.57E-01	2.05E-05	1.28E-03	7.92E-01
	6000	128	2.30E-02	1.00E-20	4.67E-01	1.46E-05	1.03E-03	4.91E-01
	9000	128	9.80E-03	5.60E-31	1.84E-01	5.78E-06	4.73E-04	1.95E-01
	100	111	9.46E+01	3.83E-02	4.29E-01	6.88E-05	2.03E-03	9.50E+01
	350	111	6.82E+01	5.36E-03	4.24E-01	6.85E-05	2.13E-03	6.87E+01
	1000	111	2.56E+01	3.23E-05	4.09E-01	6.63E-05	2.37E-03	2.60E+01
^{241}Am	2000	111	5.18E+00	1.24E-08	3.87E-01	6.29E-05	2.69E-03	5.57E+00
	4000	111	2.35E-01	1.81E-15	3.39E-01	5.55E-05	3.08E-03	5.78E-01
	6000	111	3.13E-02	2.65E-22	2.85E-01	4.68E-05	3.12E-03	3.20E-01
	9000	128	1.78E-02	1.44E-32	1.72E-01	2.84E-05	2.32E-03	1.92E-01
	100	128	6.55E+00	4.73E-02	1.07E+00	3.30E-05	1.50E-03	7.67E+00
	350	128	6.07E+00	1.58E-02	1.04E+00	3.23E-05	1.50E-03	7.13E+00
	1000	128	4.76E+00	1.21E-03	9.74E-01	3.02E-05	1.49E-03	5.73E+00
^{239}Pu or	2000	128	2.19E+00	4.66E-07	8.64E-01	2.68E-05	1.45E-03	3.06E+00
^{238}Pu	4000	128	1.34E-01	6.83E-14	6.57E-01	2.05E-05	1.28E-03	7.92E-01
	6000	128	2.30E-02	1.00E-20	4.67E-01	1.46E-05	1.03E-03	4.91E-01
	9000	128	9.80E-03	5.60E-31	1.84E-01	5.78E-06	4.73E-04	1.95E-01
	100	23	4.09E+00	3.69E-07	1.93E-01	5.74E-03	2.58E-03	4.30E+00
	350	23	3.23E+00	5.17E-08	1.87E-01	5.58E-03	2.56E-03	3.43E+00
	1000	23	1.48E+00	3.94E-10	1.73E-01	5.15E-03	2.49E-03	1.66E+00
^{234}U	2000	23	3.26E-01	2.16E-11	1.51E-01	4.50E-03	2.34E-03	4.83E-01
	4000	23	3.44E-02	-4.23E-11	1.06E-01	3.17E-03	1.85E-03	1.45E-01
	6000	256	2.00E-02	3.49E-23	2.12E-02	1.98E-03	4.34E-04	4.36E-02
	9000	128	1.04E-02	1.91E-33	1.52E-02	1.44E-03	4.00E-04	2.74E-02
	100	23	4.09E+00	3.69E-07	1.93E-01	5.74E-03	2.58E-03	4.30E+00
	350	23	3.23E+00	5.17E-08	1.87E-01	5.58E-03	2.56E-03	3.43E+00
	1000	23	1.48E+00	3.94E-10	1.73E-01	5.15E-03	2.49E-03	1.66E+00
^{230}Th	2000	111	5.18E+00	1.24E-08	3.87E-01	6.29E-05	2.69E-03	5.57E+00
	4000	111	2.35E-01	1.81E-15	3.39E-01	5.55E-05	3.08E-03	5.78E-01
	6000	111	3.13E-02	2.65E-22	2.85E-01	4.68E-05	3.12E-03	3.20E-01
	9000	111	1.78E-02	1.44E-32	1.72E-01	2.84E-05	2.32E-03	1.92E-01
Maximum			9.46E+01	4.73E-02	1.07E+00	5.74E-03	3.12E-03	9.50E+01

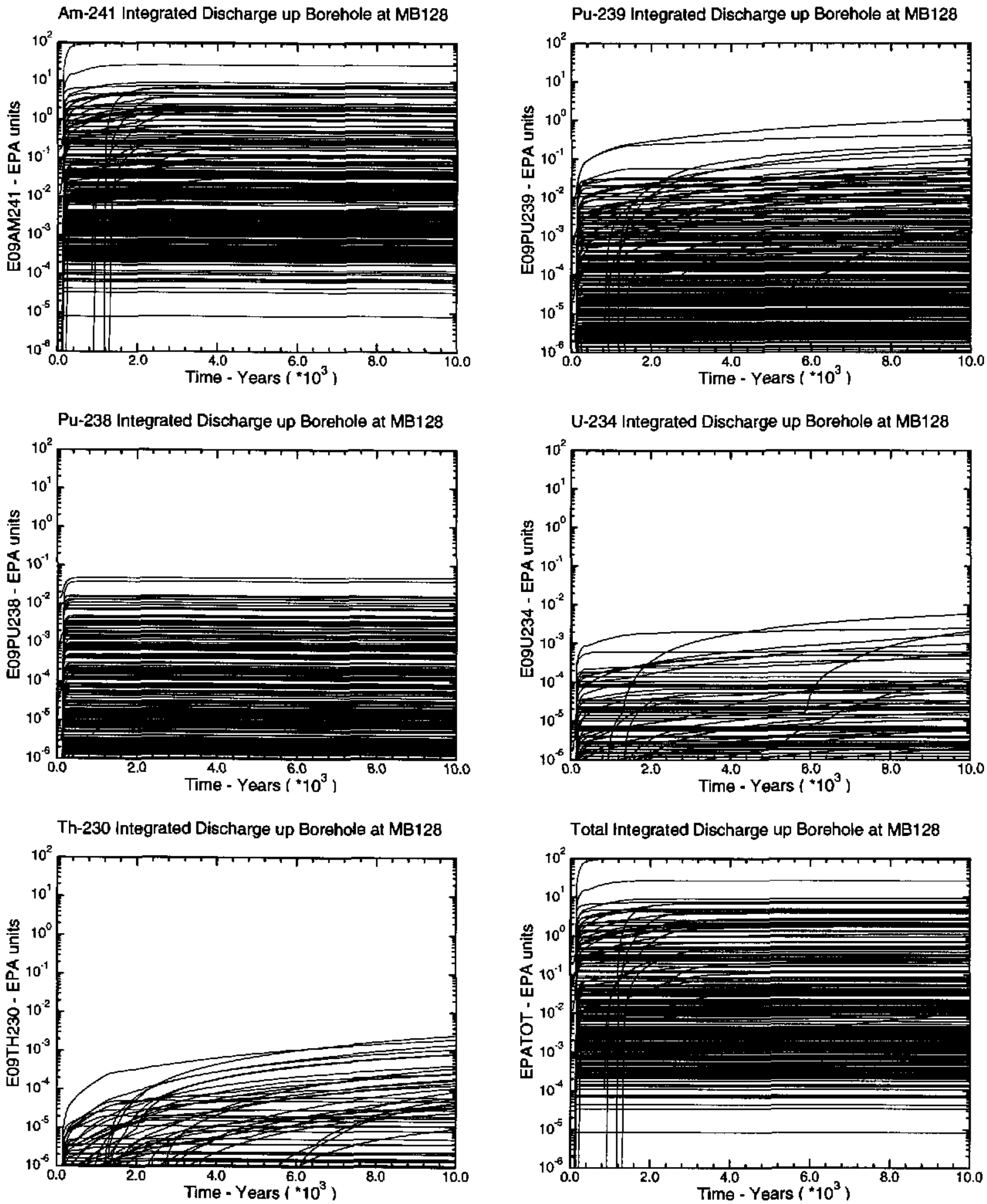


Figure 7.38 Scenario 6, Second Intrusion Time 100 Years

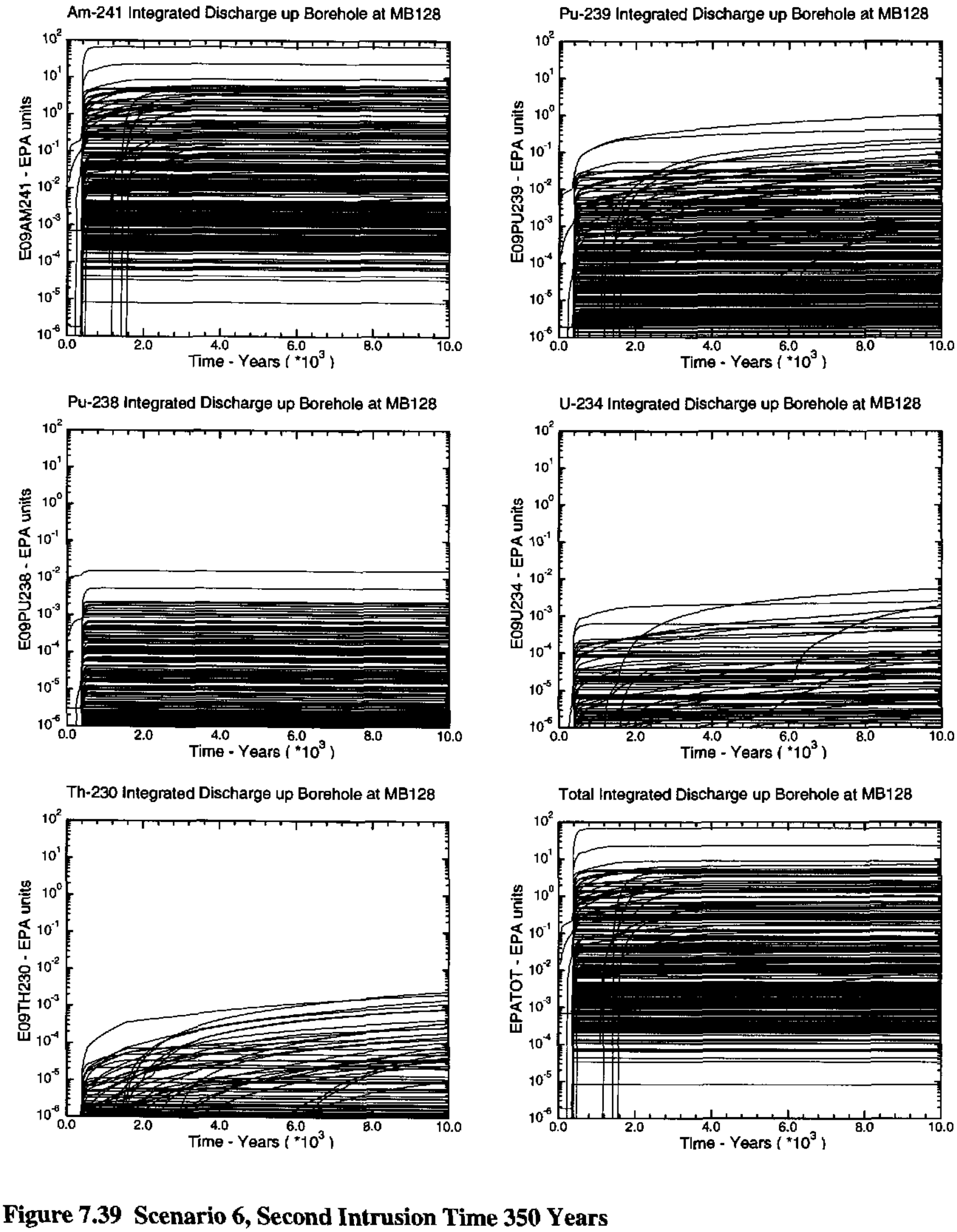


Figure 7.39 Scenario 6, Second Intrusion Time 350 Years

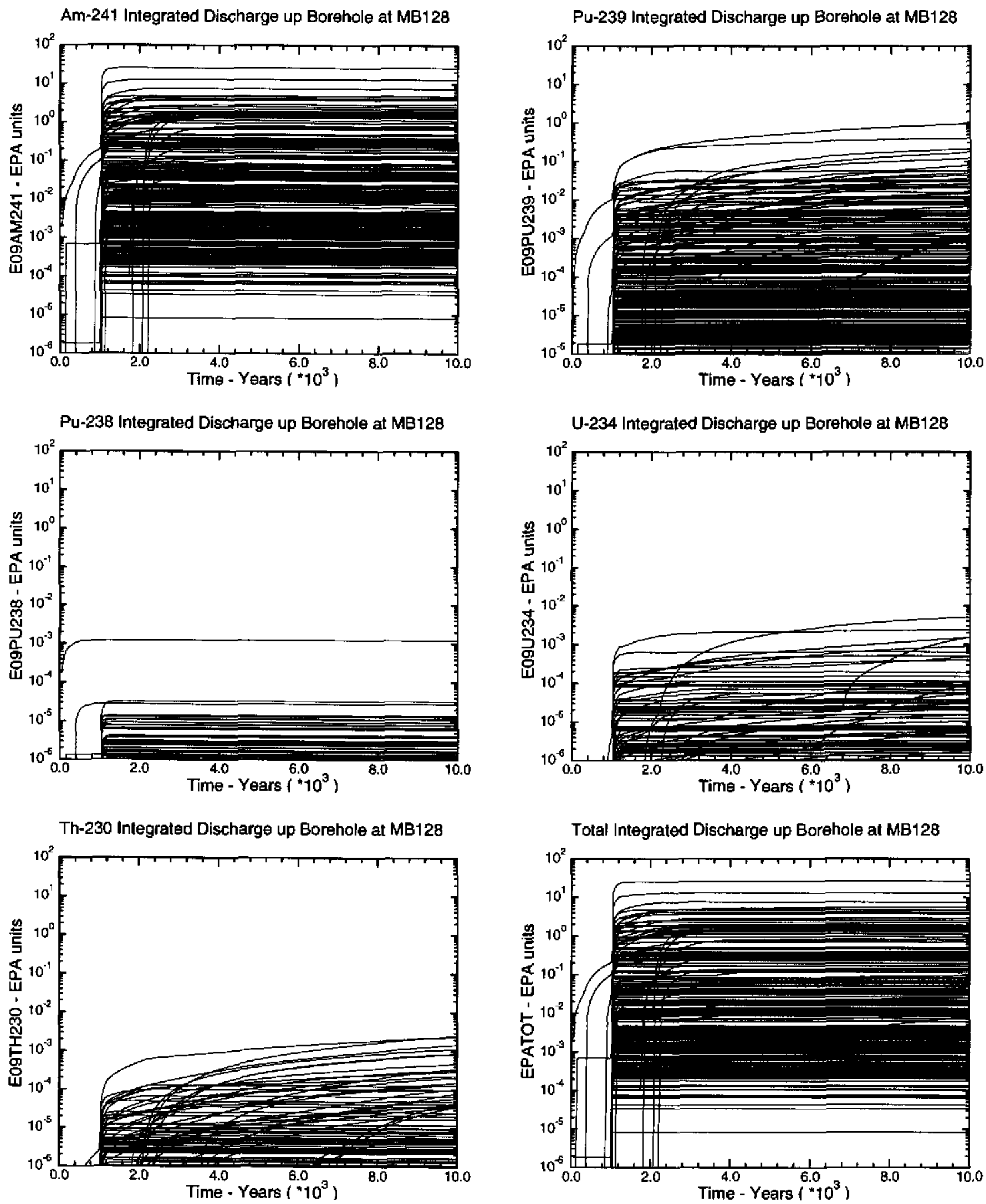


Figure 7.40 Scenario 6, Second Intrusion Time 1000 Years

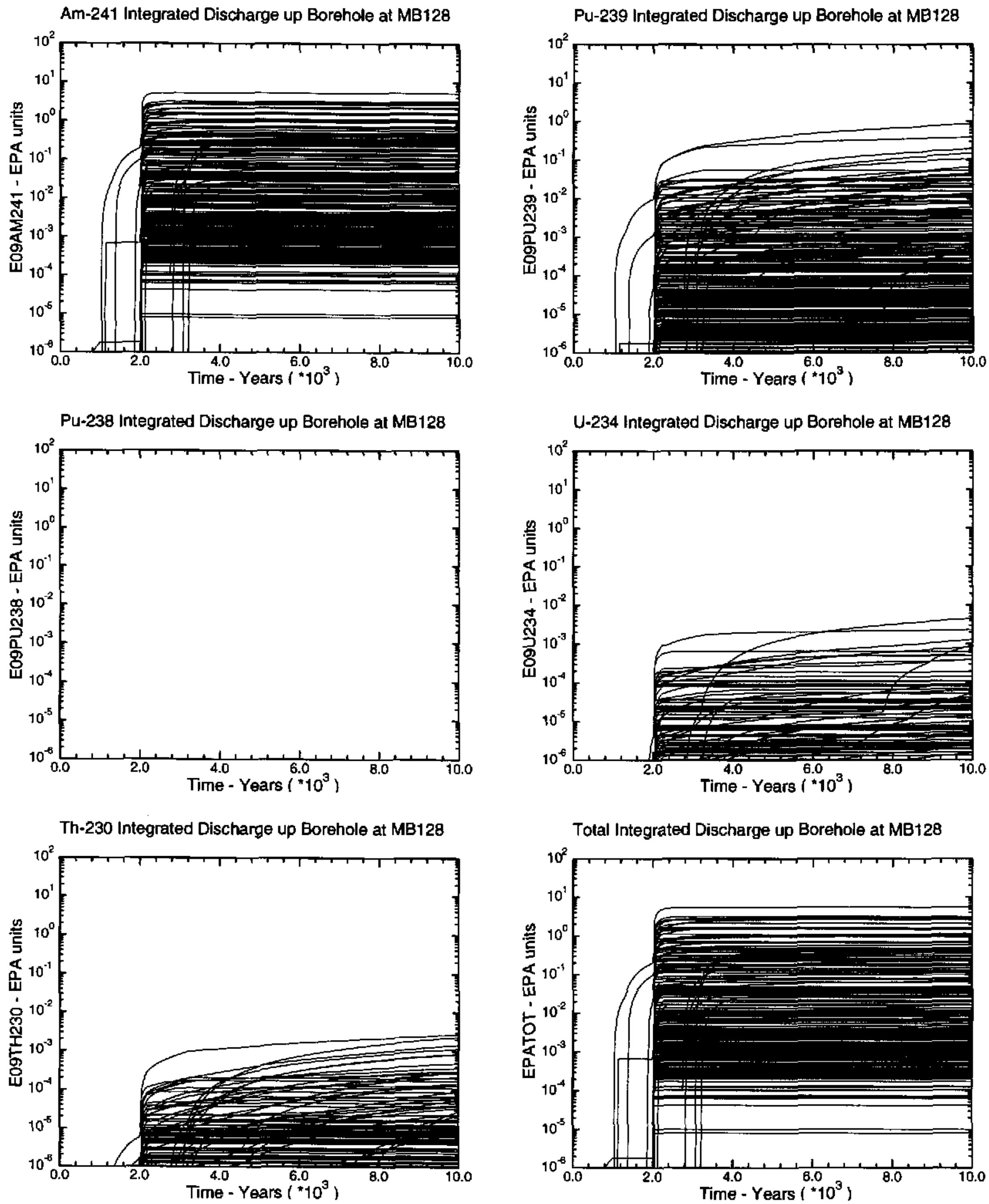


Figure 7.41 Scenario 6, Second Intrusion Time 2000 Years

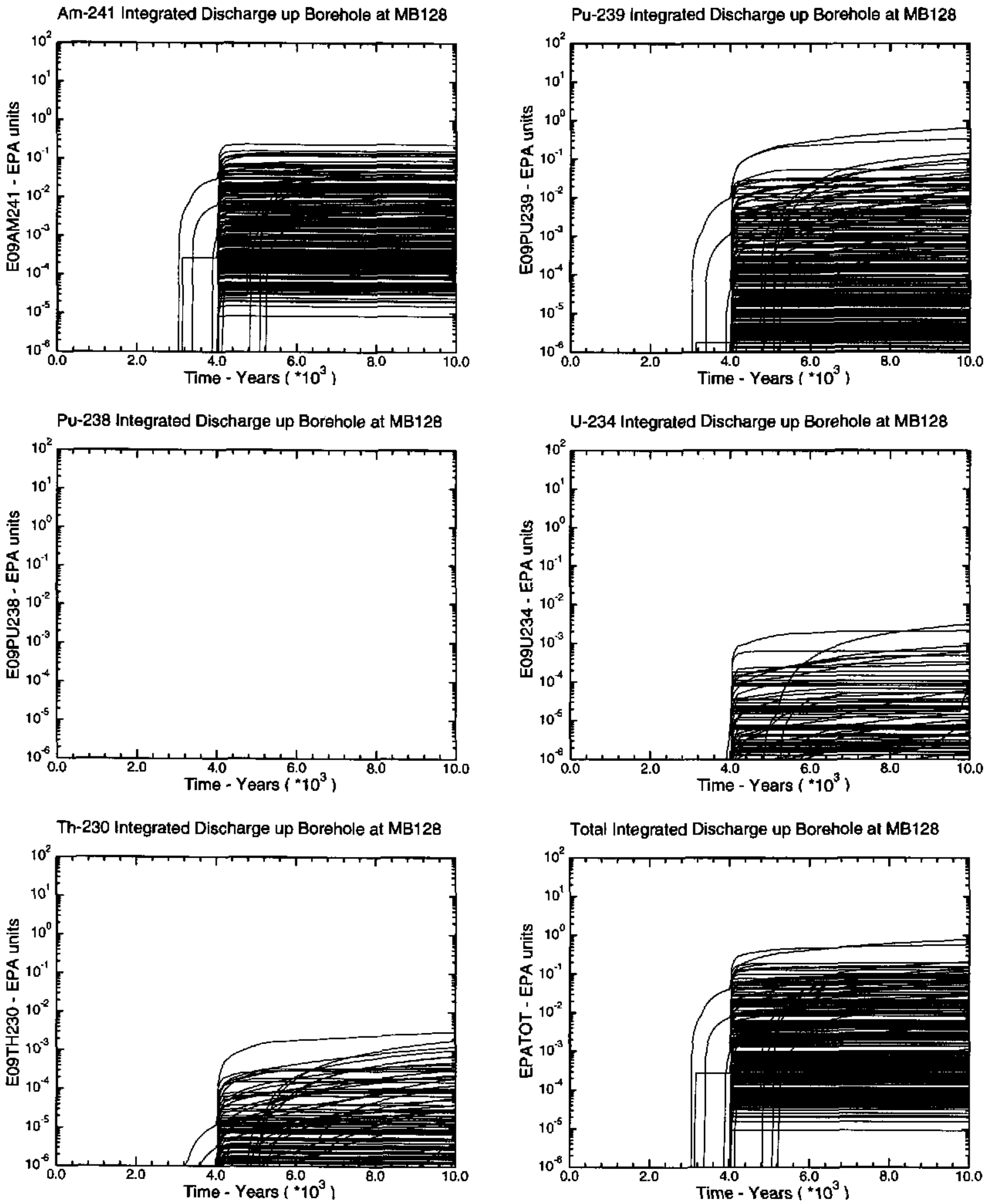


Figure 7.42 Scenario 6, Second Intrusion Time 4000 Years

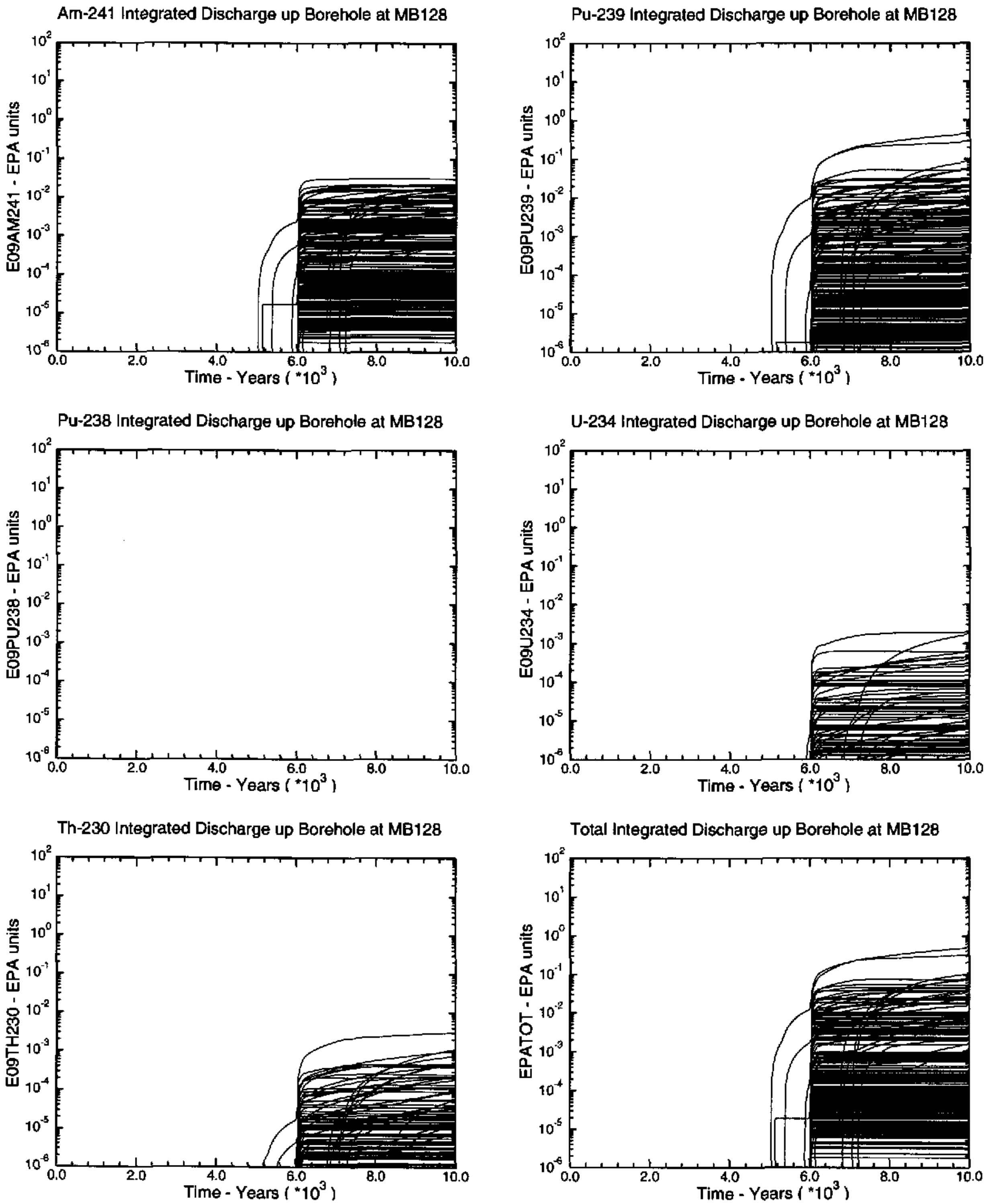


Figure 7.43 Scenario 6, Second Intrusion Time 6000 Years

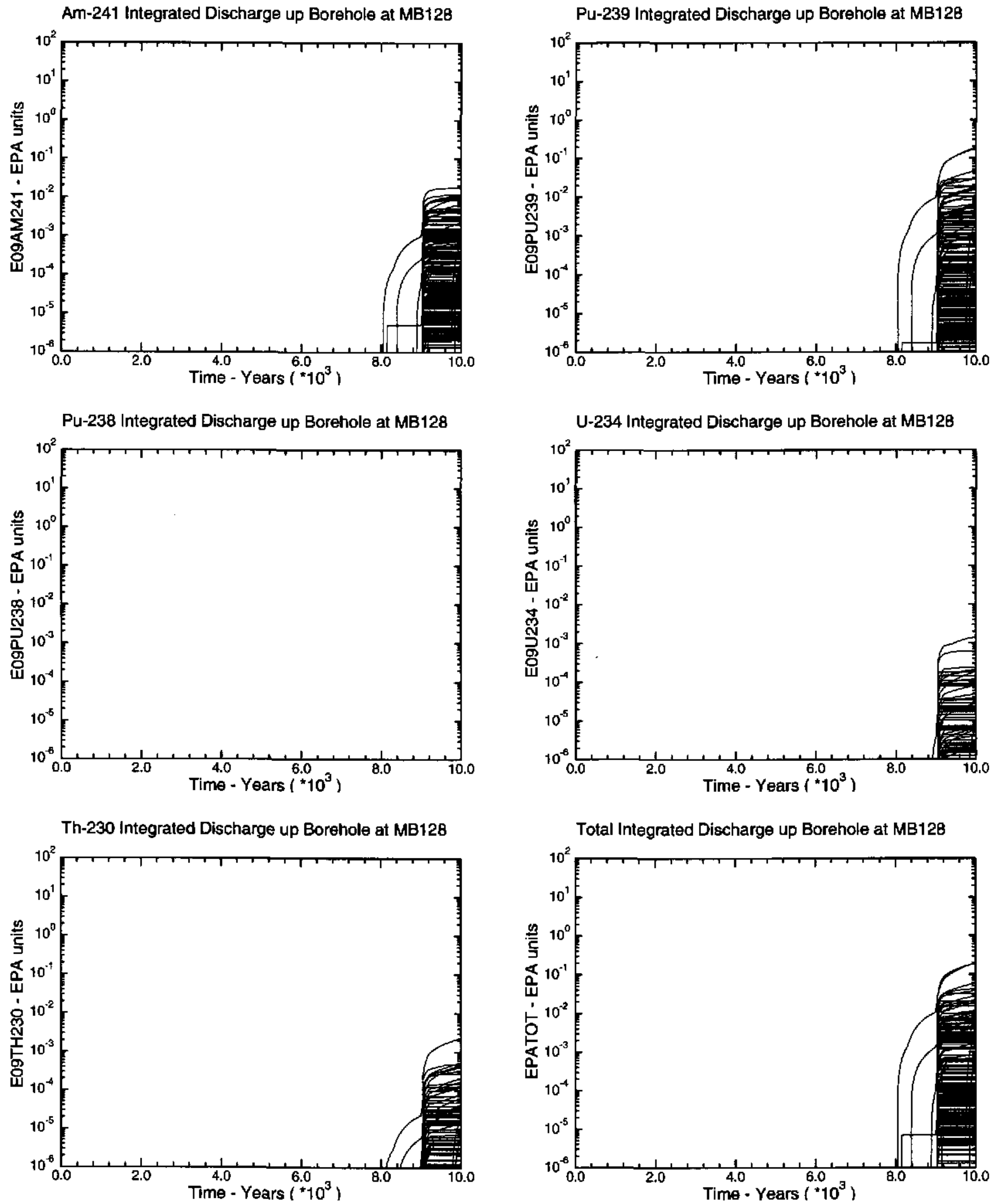


Figure 7.44 Scenario 6, Second Intrusion Time 9000 Years

7.3.4 Summary

Discharge of radionuclide from the repository by pathways other than up the borehole were insignificant. Discharge up the shaft was zero for all NUTS calculations. Discharge past the Land Withdrawal Boundary out the marker beds was very small and probably due to numerical dispersion. Thus there is no threat of human contamination in an undisturbed repository.

Table 7.16 shows the top realization numbers for all human intrusion scenarios when the realizations are sorted by total, ^{241}Am, ^{239}Pu, ^{238}Pu, ^{234}U, and ^{230}Th 10,000 year EPA unit discharge. Table 7.17 shows the releases for the top total EPA unit releases. Many of the top realizations have been discussed in detail in the preceding sections. The top release of 95 EPA units to the Culebra is from the 100 year intrusion S6 calculation.

Table 7.16 Top Realizations, All Scenarios, When Vectors are Sorted by EPA unit Discharge to Culebra from a) All Isotopes, b) ^{241}Am, c) ^{239}Pu or ^{238}Pu, d) ^{234}U, and e) ^{230}Th

Scenario	2nd Intrusion	Total	241Am	Sorted By 239Pu	238Pu	234U	230Th
S2	100	111	111	128	128	23	111
	350	111	111	128	128	23	111
	1000	111	111	128	128	23	181
	3000	128	125	128	82	23	111
S3	5000	128	236	128	236	23	111
	7000	128	236	128	19	256	111
	9000	128	90	128	287	256	111
S4	100	23	141	23	280	23	23
	350	23	141	23	280	23	23
	1000	23	128	23	128	23	23
	3000	23	128	23	128	23	23
S5	5000	23	128	23	128	23	23
	7000	23	141	23	128	23	141
	9000	124	128	124	128	260	128
	100	111	111	128	128	23	23
	350	111	111	128	128	23	23
	1000	111	111	128	128	23	23
S6	2000	111	111	128	128	23	111
	4000	128	111	128	128	23	111
	6000	128	111	128	128	256	111
	9000	128	111	128	128	256	111

maximum release	94.56	20.76	0.05	0.01	0.18	95.03

Table 7.17 Top Realizations, All Human Intrusion Scenarios, for Total 10,000 Year Release (EPA units)

Scenario	Intrusion	Vector	241Am	239Pu	238Pu	234U	230Th	Total
S2	100	111	6.57E+00	4.51E-02	1.73E-03	5.23E-05	9.40E-04	6.62E+00
	350	111	6.00E+00	4.44E-02	8.07E-05	2.21E-05	9.28E-04	6.04E+00
	1000	111	2.15E+00	4.40E-02	1.23E-06	7.48E-06	1.01E-03	2.19E+00
	3000	128	4.32E-02	3.16E-01	2.69E-08	9.86E-06	3.21E-04	3.60E-01
S3	5000	128	3.76E-03	2.36E-01	1.76E-10	7.20E-06	2.41E-04	2.40E-01
	7000	128	2.06E-04	1.42E-01	2.67E-13	4.26E-06	1.49E-04	1.42E-01
	9000	128	1.36E-05	3.53E-02	2.59E-15	1.05E-06	4.94E-05	3.54E-02
S4	100	23	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
	350	23	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
	1000	23	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
	3000	23	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
S5	5000	23	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00
	7000	23	6.81E-08	1.09E+00	1.68E-18	5.14E-04	9.24E-03	1.10E+00
	9000	124	8.75E-08	2.67E-02	1.86E-18	3.54E-06	2.64E-04	2.70E-02
	100	111	9.46E+01	4.29E-01	3.83E-02	6.88E-05	2.03E-03	9.50E+01
	350	111	6.82E+01	4.24E-01	5.36E-03	6.85E-05	2.13E-03	6.87E+01
	1000	111	2.56E+01	4.09E-01	3.23E-05	6.63E-05	2.37E-03	2.60E+01
S6	2000	111	5.18E+00	3.87E-01	1.24E-08	6.29E-05	2.69E-03	5.57E+00
	4000	128	1.34E-01	6.57E-01	6.83E-14	2.05E-05	1.28E-03	7.92E-01
	6000	128	2.30E-02	4.67E-01	1.00E-20	1.46E-05	1.03E-03	4.91E-01
	9000	128	9.80E-03	1.84E-01	5.60E-31	5.78E-06	4.73E-04	1.95E-01
maximum discharge								9.50E+01

8. Deviations from the Analysis Plan

This section documents of the performance of the Salado Transport analyses per the requirements in Analysis Plan AP-023, Analysis Plan for the Salado Transport Calculations (Task 2) of the Performance Assessment Analyses Supporting the Compliance Certification Application. The Salado Transport calculations defined in AP-023 were performed essentially as described. There were a few deviations from the analysis plan, including additional suites of transport calculations performed that were not originally defined in the analysis plan; these deviations are described below. There were also several pre-calculation decisions mentioned in AP-023 that require documentation; these points are described below

8.1 Deviations from AP-023

There were six significant deviations from AP-023 requirements in the performance of the Salado Transport analyses. These deviations are: 1) Version of NUTS used for the analysis; 2) The number of types of input files used by NUTS; 3) Dispersion was not considered in the screening calculations; 4) Additional transport intrusion time calculations; 5) Additional scenario calculations with the code PANEL; 6) Definition of personnel assignments.

1) Version of NUTS used for the analysis

Section 2.2 of AP-023 (Software Requirements) specified the use of Version 2.00 of NUTS for the Salado Transport calculations. Version 2.03 of NUTS was actually used for the screening and transport calculations. This version of NUTS allows the use of an additional input file for source-term parameters and corrects a bug in the routines that read solubility data.

2) The number of types of input files used by NUTS

Section 2.2 of AP-023 (Software Requirements) specified three types of input files to be used for the NUTS calculations:

1. BRAGFLO ASCII input file
2. BRAGFLO CDB (binary) output file
3. NUTS ASCII input file

Two additional types of input files were used for the NUTS calculations:

4. Property CDB file, which contains actinide inventory, isotope and material property, and solubility data
5. NUTS output CDB file from NUTS simulation of undisturbed scenarios.

The property CDB file implements the decisions regarding the selection of radioisotopes whose transport would be simulated by NUTS. Version 2.03 of NUTS reads this CDB file to obtain the radioisotope inventory, properties, and solubility. The NUTS CDB files were required for an additional suite of calculations to model different intrusion scenarios than those described in AP-023; these calculations are described later.

3) Dispersion was not considered in the screening calculations

Section 3.2, Subtask 3 of AP-023 describes the screening of BRAGFLO calculations for further transport analysis. These calculations considered the transport of an infinitely soluble (no precipitation), non-decaying, and non-adsorbing constituent as a tracer element. The description of the calculations in AP-023 states that dispersion would be considered. However, dispersion was not considered in the calculations. The rationale for this decision was to add additional conservatism to the screening process; i.e., to model the transport process such as to promote the highest probability of tracer transport to the regulatory boundaries, and thus to make the conditions to screen out a given BRAGFLO scenario as difficult as reasonably possible.

4) Additional transport intrusion calculations

Section 3.2 of AP-023 defines two subtasks that described the screening calculations and the Salado Transport calculations of the five CCA intrusion scenarios (undisturbed conditions, E1 intrusions at 350 and 1000 years, E2 intrusions at 350 and 1000 years). An additional suite of intrusion calculations was performed as part of the Salado Transport analyses. These calculations modeled single intrusions at each of the following times: 100, 3000, 5000, 7000, and 9000 years. The rationale for the performance of these calculations is described in Section 1.1 and 2.2.4. For the performance of these intrusion calculations, an additional input file was required. This file is the NUTS output file simulating radioisotope transport under the undisturbed scenario (S1) up to the intrusion time (Input file type 5 listed above). The flow field and associated radioisotope transport field from the NUTS output file were used as the initial conditions for the intrusion calculations. The BRAGFLO vectors identified in the screening process for further transport analysis were used for the additional intrusion calculations (see Table 8.1 for the identification of these vectors).

5) Additional scenario calculations with the code PANEL

An additional set of transport calculations using the code PANEL was performed. These calculations modeled a combined E2E1 scenario based upon BRAGFLO flow field calculations. The rationale, description, and results of the calculations are described in Sections 1.0, 2.3.1 and 7.3.3, respectively.

PANEL calculations were also performed in support of the Direct Brine release calculations as described in Sections 1.0, 2.3.3 and 6.

6) Definition of personnel assignments

Section 4.0 of AP-023 names Ali Shinta, Steve Sobolik, and Christine Stockman as Principal Investigators, and assigns them the responsibility for performing the calculations for the Salado Transport analysis. Jim Garner also assumed responsibility for the PANEL calculations. The process for performing NUTS, ALGEBRA, and SUMMARIZE calculation for the CCA analyses required that SCMS personnel (typically Kathy Aragon and Mike Williamson) perform the actual calculations with these codes with input files and input streams supplied by the Principal Investigators. All related input and output files and input streams for the Salado Transport analyses are documented in the SCMS.

8.2 Closure Items from AP-023

The remainder of this section documents specific items cited in AP-023 to be documented upon completion of the analyses. Included among these items are selection of radioisotope isotopes for transport analysis, selection of radioisotope properties, identification of BRAGFLO scenarios selected for transport analysis, and description of the results of the transport calculations.

Table 8.1 CCA Vectors Identified for Radioisotope Transport Calculations

Vector	Comments	Vector	Comments	Vector	Comments
R1 S1 V046	Undist. scenario only	R1 S3 V009	These vectors were used for the following calculations: 1. E1 scenario @ 1000 yrs. 2. Intrusion @ 3000, 5000, 7000, 9000 years 3. Undisturbed scenario (E0) calculated through 10,000 years for initialization of intrusion calcs.	R1 S4 V007	These vectors were used for the following calculations: 1. E2 scenario @ 350 yrs. 2. Intrusion @ 100 yrs. 3. Undisturbed scenario (E0) calculated to 100 years
R1 S2 V004	These vectors were used for the following calculations: 1. E1 scenario @ 350 yrs. 2. Intrusion @ 100 yrs. 3. Undisturbed scenario (E0) calculated to 100 years for initialization of intrusion calcs.	R1 S3 V013		R1 S4 V023	
R1 S2 V009		R1 S3 V019		R1 S4 V025	
R1 S2 V013		R1 S3 V023		R1 S4 V039	
R1 S2 V014		R1 S3 V025		R1 S4 V064	
R1 S2 V019		R1 S3 V039		R1 S4 V072	
R1 S2 V023		R1 S3 V040		R1 S5 V007	These vectors were used for the following calculations: 1. E2 scenario @ 1000 yrs. 2. Intrusion @ 3000, 5000, 7000, 9000 years 3. Undisturbed scenario (E0) calculated through 10,000 years for initialization of intrusion calcs.
R1 S2 V025		R1 S3 V041		R1 S5 V023	
R1 S2 V039		R1 S3 V048		R1 S5 V025	
R1 S2 V040		R1 S3 V049		R1 S5 V039	
R1 S2 V041		R1 S3 V050		R1 S5 V064	
R1 S2 V048		R1 S3 V052		R1 S5 V072	
R1 S2 V049		R1 S3 V064			
R1 S2 V050		R1 S3 V072			
R1 S2 V052		R1 S3 V077			
R1 S2 V054		R1 S3 V082			
R1 S2 V059		R1 S3 V088			
R1 S2 V064		R1 S3 V090			
R1 S2 V072		R1 S3 V098			
R1 S2 V077		R1 S3 V099			
R1 S2 V088		R1 S3 V100			
R1 S2 V090					
R1 S2 V099					
R1 S2 V100					

Table 8.2 CCA Vectors Identified for Radioisotope Transport Calculations (continued)

Vector	Comments	Vector	Comments	Vector	Comments
R2 S1 V016	Undist. scenario only	R2 S3 V008	These vectors were used for	R2 S4 V024	These vectors were used for
R2 S1 V025		R2 S3 V010	the following calculations:	R2 S4 V028	the following calculations:
R2 S1 V033		R2 S3 V011	1. E1 scenario @ 1000 yrs.	R2 S4 V041	1. E2 scenario @ 350 yrs.
R2 S1 V081		R2 S3 V021	2. Intrusion @ 3000, 5000,	R2 S4 V065	2. Intrusion @ 100 yrs.
R2 S1 V090		R2 S3 V024	7000, 9000 years	R2 S4 V091	3. Undisturbed scenario (E0)
R2 S2 V008	These vectors were used for	R2 S3 V025	3. Undisturbed scenario (E0)		calculated to 100 years
R2 S2 V011	the following calculations:	R2 S3 V026	calculated through 10,000	R2 S5 V024	These vectors were used for
R2 S2 V024	1. E1 scenario @ 350 yrs.	R2 S3 V028	years for initialization of	R2 S5 V028	the following calculations:
R2 S2 V025	2. Intrusion @ 100 yrs.	R2 S3 V030	intrusion calcs.	R2 S5 V041	1. E2 scenario @ 1000 yrs.
R2 S2 V026	3. Undisturbed scenario (E0)	R2 S3 V031		R2 S5 V065	2. Intrusion @ 3000, 5000,
R2 S2 V028	calculated to 100 years	R2 S3 V035		R2 S5 V091	7000, 9000 years
R2 S2 V030	for initialization of	R2 S3 V041			3. Undisturbed scenario (E0)
R2 S2 V031	intrusion calcs.	R2 S3 V047			calculated through 10,000
R2 S2 V035		R2 S3 V053			years for initialization of
R2 S2 V041		R2 S3 V063			intrusion calcs.
R2 S2 V047		R2 S3 V065			
R2 S2 V053		R2 S3 V067			
R2 S2 V065		R2 S3 V074			
R2 S2 V067		R2 S3 V077			
R2 S2 V074		R2 S3 V081			
R2 S2 V077		R2 S3 V083			
R2 S2 V081					
R3 S1 V003	Undist. scenario only	R3 S3 V002	These vectors were used for	R3 S4 V043	These vectors were used for
R3 S1 V060		R3 S3 V017	the following calculations:	R3 S4 V056	the following calculations:
R3 S1 V064		R3 S3 V021	1. E1 scenario @ 1000 yrs.	R3 S4 V060	1. E2 scenario @ 350 yrs.
R3 S2 V006	These vectors were used for	R3 S3 V022	2. Intrusion @ 3000, 5000,	R3 S4 V066	2. Intrusion @ 100 yrs.
R3 S2 V017	the following calculations:	R3 S3 V025	7000, 9000 years	R3 S4 V078	3. Undisturbed scenario (E0)
R3 S2 V021	1. E1 scenario @ 350 yrs.	R3 S3 V027	3. Undisturbed scenario (E0)	R3 S4 V080	calculated to 100 years
R3 S2 V022	2. Intrusion @ 100 yrs.	R3 S3 V032	calculated through 10,000	R3 S4 V093	
R3 S2 V025	3. Undisturbed scenario (E0)	R3 S3 V035	years for initialization of	R3 S5 V043	These vectors were used for
R3 S2 V032	calculated to 100 years	R3 S3 V036	intrusion calcs.	R3 S5 V056	the following calculations:
R3 S2 V036	for initialization of	R3 S3 V038		R3 S5 V060	1. E2 scenario @ 1000 yrs.
R3 S2 V038	intrusion calcs.	R3 S3 V043		R3 S5 V066	2. Intrusion @ 3000, 5000,
R3 S2 V045		R3 S3 V045		R3 S5 V078	7000, 9000 years
R3 S2 V046		R3 S3 V050		R3 S5 V080	3. Undisturbed scenario (E0)
R3 S2 V050		R3 S3 V052		R3 S5 V093	calculated through 10,000
R3 S2 V052		R3 S3 V053			years for initialization of
R3 S2 V053		R3 S3 V056			intrusion calcs.
R3 S2 V056		R3 S3 V060			
R3 S2 V060		R3 S3 V062			
R3 S2 V062		R3 S3 V065			
R3 S2 V067		R3 S3 V067			
R3 S2 V076		R3 S3 V080			
R3 S2 V080		R3 S3 V083			
R3 S2 V083		R3 S3 V087			
R3 S2 V090		R3 S3 V090			
R3 S2 V093		R3 S3 V093			

8.2.1 Radioisotope Selection

Section 2.3 of AP-023 states that decisions regarding the selection of the radioisotope isotopes whose transport would be simulated by NUTS will be documented as part of the records package for this analysis, and they are included in Section 3.1. The properties used by NUTS and PANEL in the source term property CDB file are documented in Section 5. Section 3 describes the use of the actinide source term in performance assessment, and how the ALGEBRA code was used to develop the properties in the property CDB file.

8.2.2 Screening of BRAGFLO calculations

The number of potential flow/transport scenarios for which NUTS calculations might be performed was in the thousands. Based on previous experience, it was thought that many of the flow scenarios may be determined *a priori* to present no possibility of transporting radioisotopes to the regulatory boundaries. These circumstances were demonstrated by the performance of calculations with NUTS simulating the transport of a non-sorbing tracer. All of the BRAGFLO scenarios were tested by this screening process (3 replicates × 5 .scenarios × 100 vectors = 1500 NUTS screening simulations).

The NUTS simulation considered an infinite source of a non-decaying, and non-adsorbing constituent as a tracer element. Dispersion was **<u>not</u>** considered (as opposed to the specification in the analysis plan). The tracer element was given a unit concentration in all waste disposal areas of 1 kg/m^3. If this element did not reach the regulatory boundaries the corresponding set of BRAGFLO files was screened out of the CCA analysis chain. If a non-zero cumulative mass of $\geq 10^{-7}$ kg over the 10,000 years of simulation time was observed at the regulatory boundaries, then a complete transport analysis for the five characterized isotopes (^{241}Am, ^{239}Pu, ^{238}Pu, ^{234}U, and ^{230}Th) was conducted. The number 10^{-7} kg was determined as documented in Appendix B.

Based on the results of the screening calculations, the vectors in Table 8.1 were identified for radioisotope transport analysis due to a non-zero cumulative mass of $\geq 10^{-7}$ kg over the 10,000 years of simulation time observed either the regulatory boundaries or the intersection of the borehole and the Culebra. All vectors not identified in Table 8.1 were screened out and not used for further transport analysis.

Input files of types 1, 2, and 3 listed above were used for the screening calculations. The NUTS runs were performed by SCMS personnel (Kathy Aragon and Mike Williamson) with BRAGFLO files from the Salado Flow portion of the CCA calculations and NUTS input files provided by Ali Shinta. The specific input files and input streams are documented in the SCMS management system. The results are described in Chapter 7 of this document.

8.2.3 Salado transport calculations

After the screening process of BRAGFLO calculations was completed, and specific BRAGFLO results were identified for continued analysis, NUTS calculations were performed using the BRAGFLO results from the vectors in Table 8.1 to estimate the radioisotope transport fields in the Salado formation corresponding to the flow fields predicted by BRAGFLO. The five CCA scenarios (undisturbed, E1 @ 350 and 1000 years, and E2 @ 350 and 1000 years) were modeled in the transport calculations. Input files of types 1, 2, 3, and 4 listed above were used for the transport calculations. The NUTS runs were performed by SCMS personnel with BRAGFLO files from the Salado Flow portion of the CCA calculations, NUTS input files provided by Ali Shinta, and property CDB files produced from ALGEBRA runs developed by Christine Stockman and run by SCMS personnel. The specific input files and input streams are documented in the SCMS management system. The results are described in Chapter 7 of this document.

8.2.4 Additional Salado transport calculations

An additional suite of intrusion calculations was performed as part of the Salado Transport analyses. These calculations modeled single intrusions at each of the following times: 100, 3000, 5000, 7000, and 9000 years. For the performance of these intrusion calculations, an additional input file was required. This file is the NUTS output file simulating radioisotope transport under the undisturbed scenario (S1) up to the intrusion time (Input file type 5 listed above). The flow field and associated radioisotope transport field from the NUTS output file was used as the initial conditions for the intrusion calculations. The BRAGFLO vectors identified in the screening process for further transport analysis were used for the additional intrusion calculations (see Table 8.1 for the identification of these vectors). All five input file types were used for the intrusion calculations. The NUTS intrusion runs were performed by SCMS personnel. The specific input files and input streams are documented in the SCMS management system. The results are described in Chapter 7 of this document.

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Analysis Package for the Cuttings and Spallings Calculations (Task 5 & 6) of the Performance Assessment Analyses Supporting the Compliance Certification Assessment (WPO# 40521)

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10. Appendixes

APPENDIX A: NUTS's Overall Capabilities

NUTS is a multidimensional, multicomponent, radioactive-contaminant transport code. It is designed to apply to single-porosity (SP), dual-porosity (DP), and/or dual-permeability (DPM) porous media. In two dimensions, the discretization employs five-point finite-difference methods.

The model simulates radioisotope transport through porous media for both brine and gas phases, and includes first-order radioactive decay processes. However, the simulator is not limited to radioactive materials. The transport of materials of all kinds, radioactive or not, may be simulated. In treating sorption between the waste and the media that surround it, NUTS allows for three types of sorption isotherms. They are: (1) linear, (2) Freundlich, and (3) Langumir equilibrium isotherms. NUTS normally models hydrodynamic dispersion under the assumption that the porous media through which the transport occurs are dispersively isotropic.

"Dissolution" of waste components into the brine carrier medium is modeled, and the possibility of their precipitation during migration is included, should solutes exceed their local "solubility" limits. Precipitates are required to undergo decay and are permitted to "redissolve" in the brine if the concentration drops below the solubility limit. Representation of multiple radioactive sites (repositories) is also possible. In that case, the contribution from each site to the component concentration and precipitation, if any, at each computational node can be found. A similar technique may be used to treat a daughter isotope generated from the decay of different parents.

NUTS also accounts for thermal dependency of some properties, such as solubility, molecular diffusion, and sorption equilibrium constant. Many options for transport equation(s) discretization are included. In the implicit solution, the system of governing partial-differential equations (mass conservation for each radioisotopic constituent) is discretized and solved sequentially to determine the contribution from a decaying parent to the immediate daughter. In the sequential method, the solution proceeds progressively from the top of each radioactive chain. Therefore, the contribution to any daughter from its decaying parent is available. This approach avoids the numerical problems associated with inverting a large, sparsely-populated matrix in which the bands are not well structured.

NUTS is designed to treat an enormously broad spectrum of transport problems. However, many of its options have been disabled in the 1996 CCA PA calculations. The code is used solely to model isothermal, purely advective transport in the matrix domain. Table 2.1 of Section 2.2 provides a summary for NUTS's general feature and of the features actually exercised in the 1996 CCA PA calculations. For complete details about the available features, scope of applications, assumptions, and limitations, the reader is referred to the WIPP PA User's Manual for NUTS, Version Number 2.02 (WPO #37927), which is an integral part of the code's Quality Assurance documentation.

APPENDIX B: Cut-Off for NUTS Screening

		Bq/Ci(1)	3.70E+10		Avogad(1)	6.02E+23				
		sec/yr	31557600							
		(Ci*yr/ mole)	357495.35		WUF(2)	3.44				
		halflife								
	MW(1)	years(2)	Ci/kg	Ci/epa (2)	epa/kg by iso	Ci at close(2)	moles at close	partial epa/kg	epa/kg by ele.	
Am	241.057	4.327E+02	3.4274E+03	344	9.96	4.88E+05	5.90E+02	9.96	9.96	Am
Pu	238.050	8.770E+01	1.7124E+04	344	49.78	1.94E+06	4.75E+02	0.40	0.61	Pu
Pu	239.052	2.410E+04	6.2053E+01	344	0.18	7.95E+05	5.36E+04	0.16		
Pu	240.054	6.560E+03	2.2702E+02	344	0.66	2.14E+05	3.93E+03	0.04		
Pu	242.000	3.750E+05	3.9393E+00	344	0.01	1.17E+03	1.23E+03	2.38E-04		
U	233.040	1.592E+05	9.6360E+00	344	0.03	1.95E+03	8.68E+02	0.02	0.01	U
U	234.041	2.460E+05	6.2093E+00	344	0.02	7.51E+02	5.17E+02	0.01		
Th	229.032	7.300E+03	2.1382E+02	344	0.62	9.97E+00	2.04E-01	0.47	0.62	Th
Th	230.033	7.540E+04	2.0611E+01	34.4	0.60	3.06E-01	6.45E-02	0.14		

(1) CRC Handbook of Chemistry and Physics, 72nd edition, 1991 (rounded to 7 significant figures)
(2) Sanchez 1996

From the above table, the maximum EPA units/kg was 9.96 for Am. 10^{-6} EPA units divided by 9.96 EPA units/kg is 10^{-7} kg which was used as the cut-off for screening.

APPENDIX C: EQ3/6 Calculation of Brines

To be supplied by Christine Stockman.

APPENDIX D: Source Term ALGEBRA Input File ALG_ST_CCA_S1.INP

This application of ALGEBRA is used to provide NUTS and PANEL with the parameters required to carry out dissolution-like calculations for the mobilization of radioisotopes by dissolution and colloidal transport, as described in the text. Note that an exclamation point in front of a line indicates that it is a comment and not executable.

```
!=============================================================
!TITLE: SOURCE TERM CALCULATIONS, SALADO BRINE
!ANALYSTS: CHRISTINE STOCKMAN SNL Org 6749
!CREATED:  MAY 29, 1996
!MODIFIED: OCT 25, 1996
!MODIFIED for: additional "lumping" of inventory
!===================================================================
!OX IS NEG AND 0 FOR LOW OX STATE AND POSITIVE FOR HIGH OX STATE
OX=OXSTAT[B:1]-0.5
!AM
!AM=32,SOLMOD3=45,SOLAM3=53,PHUMOX3=49
LIMIT BLOCKS 32DIS=MAKEPROP(10**SOLSIM[B:53]*SOLSIM[B:45])
HUM=MAKEPROP(MIN(CAPHUM,10**SOLSIM[B:53]*SOLSIM[B:45]*PHUMSIM[B:49]))
MIC1=MAKEPROP(10**SOLSIM[B:53]*SOLSIM[B:45]*PROPMIC)
TOT=MAKEPROP(DIS+HUM+MIC1+CONCINT+CONCMIN)
TOTNM=MAKEPROP(DIS+HUM+CONCINT+CONCMIN)
TOTSOL = MAKEPROP(IFLT0(CAPMIC-TOT,MIN(TOTNM+CAPMIC,TOT),TOT))
MIC= MAKEPROP(IFLT0(CAPMIC-TOT,TOTSOL-TOTNM,MIC1))
LOGSOLM=MAKEPROP(LOG10(TOTSOL))
FRCDIS=MAKEPROP(DIS/TOTSOL)
FRCHUM=MAKEPROP(HUM/TOTSOL)
FRCMIC=MAKEPROP(MIC/TOTSOL)
FRCINT=MAKEPROP(CONCINT/TOTSOL)
FRCMIN=MAKEPROP(CONCMIN/TOTSOL)
!TH
!TH=43,SOLMOD4=46,PHUMOX4=50, SOLTH4=56
LIMIT BLOCKS 43
DIS=MAKEPROP(10**SOLSIM[B:56]*SOLSIM[B:46])
HUM=MAKEPROP(MIN(CAPHUM,10**SOLSIM[B:56]*SOLSIM[B:46]*PHUMSIM[B:50]))
MIC1=MAKEPROP(10**SOLSIM[B:56]*SOLSIM[B:46]*PROPMIC)
TOT=MAKEPROP(DIS+HUM+MIC1+CONCINT+CONCMIN)
TOTNM=MAKEPROP(DIS+HUM+CONCINT+CONCMIN)
TOTSOL = MAKEPROP(IFLT0(CAPMIC-TOT,MIN(TOTNM+CAPMIC,TOT),TOT))
MIC= MAKEPROP(IFLT0(CAPMIC-TOT,TOTSOL-TOTNM,MIC1))
LOGSOLM=MAKEPROP(LOG10(TOTSOL))
FRCDIS=MAKEPROP(DIS/TOTSOL)
FRCHUM=MAKEPROP(HUM/TOTSOL)
FRCMIC=MAKEPROP(MIC/TOTSOL)
FRCINT=MAKEPROP(CONCINT/TOTSOL)
FRCMIN=MAKEPROP(CONCMIN/TOTSOL)
!PU3
!PUT LOGSOLM ETC INTO SOLPU3 UNTIL CHECK OXIDATION STATE, THEN PUT INTO PU
!PU=40,SOLMOD3=45,SOLPU3=54,PHUMOX3=49
LIMIT BLOCKS 54
DIS=MAKEPROP(10**SOLSIM[B:54]*SOLSIM[B:45])
```

```
HUM=MAKEPROP(MIN(CAPHUM[B:40],10**SOLSIM[B:54]*SOLSIM[B:45]*PHUMSIM[B:49]))
MIC1=MAKEPROP(10**SOLSIM[B:54]*SOLSIM[B:45]*PROPMIC[B:40])
TOTNM=MAKEPROP(DIS+HUM+CONCINT[B:40]+CONCMIN[B:40])
TOT=MAKEPROP(TOTNM+MIC1)
TOTSOL = MAKEPROP(IFLT0(CAPMIC[B:40]-TOT,MIN(TOTNM+CAPMIC[B:40],TOT),TOT))
MIC= MAKEPROP(IFLT0(CAPMIC[B:40]-TOT,TOTSOL-TOTNM,MIC1))
LOGSOLM=MAKEPROP(LOG10(TOTSOL))
FRCDIS=MAKEPROP(DIS/TOTSOL)
FRCHUM=MAKEPROP(HUM/TOTSOL)
FRCMIC=MAKEPROP(MIC/TOTSOL)
FRCINT=MAKEPROP(CONCINT[B:40]/TOTSOL)
FRCMIN=MAKEPROP(CONCMIN[B:40]/TOTSOL)
!PU4
!PUT LOGSOLM ETC INTO SOLPU4 UNTIL CHECK OXIDATION STATE, THEN PUT INTO PU
!PU=40,SOLMOD4=46,SOLPU4=55,PHUMOX4=50
LIMIT BLOCKS 55
DIS=MAKEPROP(10**SOLSIM[B:55]*SOLSIM[B:46])
HUM=MAKEPROP(MIN(CAPHUM[B:40],10**SOLSIM[B:55]*SOLSIM[B:46]*PHUMSIM[B:50]))
MIC1=MAKEPROP(10**SOLSIM[B:55]*SOLSIM[B:46]*PROPMIC[B:40])
TOTNM=MAKEPROP(DIS+HUM+CONCINT[B:40]+CONCMIN[B:40])
TOT=MAKEPROP(TOTNM+MIC1)
TOTSOL = MAKEPROP(IFLT0(CAPMIC[B:40]-TOT,MIN(TOTNM+CAPMIC[B:40],TOT),TOT))
MIC= MAKEPROP(IFLT0(CAPMIC[B:40]-TOT,TOTSOL-TOTNM,MIC1))
LOGSOLM=MAKEPROP(LOG10(TOTSOL))
FRCDIS=MAKEPROP(DIS/TOTSOL)
FRCHUM=MAKEPROP(HUM/TOTSOL)
FRCMIC=MAKEPROP(MIC/TOTSOL)
FRCINT=MAKEPROP(CONCINT[B:40]/TOTSOL)
FRCMIN=MAKEPROP(CONCMIN[B:40]/TOTSOL)
!NOW CHECK OX
LIMIT BLOCK 40
LOGSOLM=MAKEPROP(IFGT0(OX,LOGSOLM[B:55],LOGSOLM[B:54]))
FRCDIS =MAKEPROP(IFGT0(OX,FRCDIS[B:55],FRCDIS[B:54]))
FRCHUM =MAKEPROP(IFGT0(OX,FRCHUM[B:55],FRCHUM[B:54]))
FRCINT =MAKEPROP(IFGT0(OX,FRCINT[B:55],FRCINT[B:54]))
FRCMIN =MAKEPROP(IFGT0(OX,FRCMIN[B:55],FRCMIN[B:54]))
FRCMIC =MAKEPROP(IFGT0(OX,FRCMIC[B:55],FRCMIC[B:54]))
!U4
!PUT LOGSOLM ETC INTO SOLU4 UNTIL CHECK OXIDATION STATE, THEN PUT INTO U
!U=44,SOLMOD4=46,SOLU4=57,PHUMOX4=50
LIMIT BLOCKS 57
DIS=MAKEPROP(10**SOLSIM[B:57]*SOLSIM[B:46])
HUM=MAKEPROP(MIN(CAPHUM[B:44],10**SOLSIM[B:57]*SOLSIM[B:46]*PHUMSIM[B:50]))
MIC1=MAKEPROP(10**SOLSIM[B:57]*SOLSIM[B:46]*PROPMIC[B:44])
TOTNM=MAKEPROP(DIS+HUM+CONCINT[B:44]+CONCMIN[B:44])
TOT=MAKEPROP(TOTNM+MIC1)
TOTSOL = MAKEPROP(IFLT0(CAPMIC[B:44]-TOT,MIN(TOTNM+CAPMIC[B:44],TOT),TOT))
MIC= MAKEPROP(IFLT0(CAPMIC[B:44]-TOT,TOTSOL-TOTNM,MIC1))
LOGSOLM=MAKEPROP(LOG10(TOTSOL))
FRCDIS=MAKEPROP(DIS/TOTSOL)
FRCHUM=MAKEPROP(HUM/TOTSOL)
FRCMIC=MAKEPROP(MIC/TOTSOL)
FRCINT=MAKEPROP(CONCINT[B:44]/TOTSOL)
FRCMIN=MAKEPROP(CONCMIN[B:44]/TOTSOL)
!U6
```

```
!PUT LOGSOLM ETC INTO SOLU6 UNTIL CHECK OXIDATION STATE, THEN PUT INTO U
!U=44,SOLMOD6=48,SOLU6=58,PHUMOX6=52
LIMIT BLOCKS 58
DIS=MAKEPROP(10**SOLSIM[B:58]*SOLSIM[B:48])
HUM=MAKEPROP(MIN(CAPHUM[B:44],10**SOLSIM[B:58]*SOLSIM[B:48]*PHUMSIM[B:52]))
MIC1=MAKEPROP(10**SOLSIM[B:58]*SOLSIM[B:48]*PROPMIC[B:44])
TOTNM=MAKEPROP(DIS+HUM+CONCINT[B:44]+CONCMIN[B:44])
TOT=MAKEPROP(TOTNM + MIC1)
TOTSOL = MAKEPROP(IFLT0(CAPMIC[B:44]-TOT,MIN(TOTNM+CAPMIC[B:44],TOT),TOT))
MIC= MAKEPROP(IFLT0(CAPMIC[B:44]-TOT,TOTSOL-TOTNM,MIC1))
LOGSOLM=MAKEPROP(LOG10(TOTSOL))
FRCDIS=MAKEPROP(DIS/TOTSOL)
FRCHUM=MAKEPROP(HUM/TOTSOL)
FRCMIC=MAKEPROP(MIC/TOTSOL)
FRCINT=MAKEPROP(CONCINT[B:44]/TOTSOL)
FRCMIN=MAKEPROP(CONCMIN[B:44]/TOTSOL)
!NOW CHECK OX
LIMIT BLOCK 44
LOGSOLM=MAKEPROP(IFGT0(OX,LOGSOLM[B:58],LOGSOLM[B:57]))
FRCDIS =MAKEPROP(IFGT0(OX,FRCDIS[B:58],FRCDIS[B:57]))
FRCHUM =MAKEPROP(IFGT0(OX,FRCHUM[B:58],FRCHUM[B:57]))
FRCINT =MAKEPROP(IFGT0(OX,FRCINT[B:58],FRCINT[B:57]))
FRCMIN =MAKEPROP(IFGT0(OX,FRCMIN[B:58],FRCMIN[B:57]))
FRCMIC =MAKEPROP(IFGT0(OX,FRCMIC[B:58],FRCMIC[B:57]))
!
!NP
!PUT LOGSOLM ETC INTO SOLNP UNTIL CHECK OXIDATION STATE, THEN PUT INTO NP
!NP=36,SOLMOD4=46,PHUMOX4=50,SOLMOD5=47,PHIMOX5=51
LIMIT BLOCKS 36
DISNP4=MAKEPROP(SOLSIM[B:46])
HUMNP4=MAKEPROP(MIN(CAPHUM[B:36],SOLSIM[B:46]*PHUMSIM[B:50]))
MNP4=MAKEPROP(SOLSIM[B:46]*PROPMIC[B:36])
TNMNP4=MAKEPROP(DISNP4+HUMNP4+CONCINT[B:36]+CONCMIN[B:36])
TOT4=MAKEPROP(TNMNP4+MNP4)
TOTNP4 = MAKEPROP(IFLT0(CAPMIC-TOT4,MIN(TNMNP4+CAPMIC,TOT4),TOT4))
MICNP4=MAKEPROP(IFLT0(CAPMIC-TOT4,TOTNP4-TNMNP4,MNP4))
!
DISNP5=MAKEPROP(SOLSIM[B:47])
HUMNP5=MAKEPROP(MIN(CAPHUM[B:36],SOLSIM[B:47]*PHUMSIM[B:51]))
MNP5=MAKEPROP(SOLSIM[B:47]*PROPMIC[B:36])
TNMNP5=MAKEPROP(DISNP5+HUMNP5+CONCINT[B:36]+CONCMIN[B:36])
TOT5=MAKEPROP(TNMNP5+MNP5)
TOTNP5 = MAKEPROP(IFLT0(CAPMIC-TOT5,MIN(TNMNP5+CAPMIC,TOT5),TOT5))
MICNP5=MAKEPROP(IFLT0(CAPMIC-TOT5,TOTNP5-TNMNP5,MNP5))
LOGSOLM=MAKEPROP(IFGT0(OX,LOG10(TOTNP5),LOG10(TOTNP4)))
FRCDIS =MAKEPROP(IFGT0(OX,DISNP5/TOTNP5,DISNP4/TOTNP4))
FRCHUM =MAKEPROP(IFGT0(OX,HUMNP5/TOTNP5,HUMNP4/TOTNP4))
FRCMIC =MAKEPROP(IFGT0(OX,MICNP5/TOTNP5,MICNP4/TOTNP4))
FRCINT =MAKEPROP(IFGT0(OX,CONCINT[B:36]/TOTNP5,CONCINT[B:36]/TOTNP4))
FRCMIN =MAKEPROP(IFGT0(OX,CONCMIN[B:36]/TOTNP5,CONCMIN[B:36]/TOTNP4))
!
!PA
!PA=37, NP=36
LIMIT BLOCKS 37
LOGSOLM=MAKEPROP(LOGSOLM[B:36])
```

```
!
!CF,CM,PM SET TO AM=32
LIMIT BLOCKS 33, 34, 39
LOGSOLM=MAKEPROP(LOGSOLM[B:32])
!
!NOW TO LUMP FOR NUTS
!NOW INVENTORY ARE FOR SINGLE SPECIES, NEED TO ADD IN TH229, U233,
!Pu241, Pu240, Pu242
!
!use most conservative method: if added species is shorter-lived, add curies
!if added species is longer-lived, add curies scaled by halflives (add grams)
!
!U234L=63, U234=28, U233=27
LIMIT BLOCK 63
INVCHD=MAKEPROP(INVCHD[B:28]+INVCHD[B:27])
INVRHD=MAKEPROP(INVRHD[B:28]+INVRHD[B:27])
!
!TH230L=62, TH229=24, TH230=25
LIMIT BLOCK 62
INVCHD=MAKEPROP(INVCHD[B:25]+INVCHD[B:24])
INVRHD=MAKEPROP(INVRHD[B:25]+INVRHD[B:24])
!
!AM241L=59, AM241=3, PU241=18
!DECAY ALL PU241 TO AM241 AND ADD THIS IN TO AM241
!SO CONVERT CI PU241 TO KG PU241, CONVERT TO KG AM241, CONVERT BACK TO CI
M241
!THIS IS DONE USING RATIO OF HALFLIFES
LIMIT BLOCK 59
INVCHD=MAKEPROP(INVCHD[B:3]+INVCHD[B:18]*HALFLIFE[B:18]/HALFLIFE[B:3])
INVRHD=MAKEPROP(INVRHD[B:3]+INVRHD[B:18]*HALFLIFE[B:18]/HALFLIFE[B:3])
!
!PU239L=61, PU239=16, PU240=17, PU242=19
LIMIT BLOCK 61
IFERATO = HALFLIFE[B:19]/HALFLIFE[B:16]
INVCHD=MAKEPROP(INVCHD[B:16]+INVCHD[B:17]+INVCHD[B:19]*LIFERATO)
INVRHD=MAKEPROP(INVRHD[B:16]+INVRHD[B:17]+INVCHD[B:19]*LIFERATO)
!
!REDUCE SOLUBILITIES BY RATIO'S WITH OTHER ISOTOPES
!AML=64,PUL=65,THL=66,UL=67: AM=32,PU=40,TH=43,U=44
!AML
LIMIT BLOCK 64
LOGSOLM=MAKEPROP(LOGSOLM[B:32])
FRCDIS=MAKEPROP(FRCDIS[B:32])
FRCHUM=MAKEPROP(FRCHUM[B:32])
FRCMIC=MAKEPROP(FRCMIC[B:32])
FRCINT=MAKEPROP(FRCINT[B:32])
FRCMIN=MAKEPROP(FRCMIN[B:32])
!PUL
LIMIT BLOCK 65
LOGSOLM=MAKEPROP(LOGSOLM[B:40])
FRCDIS=MAKEPROP(FRCDIS[B:40])
FRCHUM=MAKEPROP(FRCHUM[B:40])
FRCMIC=MAKEPROP(FRCMIC[B:40])
FRCINT=MAKEPROP(FRCINT[B:40])
FRCMIN=MAKEPROP(FRCMIN[B:40])
```

```
!THL
LIMIT BLOCK 66
OGSOLM=MAKEPROP(LOGSOLM[B:43]-2.9)
FRCDIS=MAKEPROP(FRCDIS[B:43])
FRCHUM=MAKEPROP(FRCHUM[B:43])
FRCMIC=MAKEPROP(FRCMIC[B:43])
FRCINT=MAKEPROP(FRCINT[B:43])
FRCMIN=MAKEPROP(FRCMIN[B:43])
!UL
LIMIT BLOCK 67
LOGSOLM=MAKEPROP(LOGSOLM[B:44]-2.55)
FRCDIS=MAKEPROP(FRCDIS[B:44])
FRCHUM=MAKEPROP(FRCHUM[B:44])
FRCMIC=MAKEPROP(FRCMIC[B:44])
FRCINT=MAKEPROP(FRCINT[B:44])
FRCMIN=MAKEPROP(FRCMIN[B:44])
!
END
```

APPENDIX E: Maximum Mole Fractions for Th and U

					Constants					
	Bq/Ci(1)		3.70E+10		Avogadro(1)		6.02E+23		sec/d	8.64E+04
	sec/yr		3.16E+07						sec/h	3.60E+03
	(Ci*yr/mole)		3.57E+05			WUF(2)	3.44E+00			
	(Ci*sec/mole)		1.13E+13							
				halflife						
	MW	halflife(2	units(2)	seconds	mole/ci	Ci/g				
Th227	2.27E+02	1.87E+01	d	1.62E+06	1.43E-07	3.07E+04				
Th228	2.28E+02	1.91E+00	a	6.04E+07	5.35E-06	8.20E+02				
Th229	2.29E+02	7.30E+03	a	2.30E+11	2.04E-02	2.14E-01				
Th230	2.30E+02	7.54E+04	a	2.38E+12	2.11E-01	2.06E-02				
Th231	2.31E+02	1.06E+00	d	9.18E+04	8.14E-09	5.32E+05				
Th232	2.32E+02	1.40E+10	a	4.42E+17	3.92E+04	1.10E-07				
Th234	2.34E+02	2.41E+01	d	2.08E+06	1.85E-07	2.32E+04				
U232	2.32E+02	7.00E+01	a	2.21E+09	1.96E-04	2.20E+01				
U233	2.33E+02	1.59E+05	a	5.02E+12	4.45E-01	9.64E-03				
U234	2.34E+02	2.46E+05	a	7.76E+12	6.88E-01	6.21E-03				
U235	2.35E+02	7.04E+08	a	2.22E+16	1.97E+03	2.16E-06				
U236	2.36E+02	2.34E+07	a	7.39E+14	6.55E+01	6.46E-05				
U237	2.37E+02	6.75E+00	d	5.83E+05	5.17E-08	8.16E+04				
U238	2.38E+02	4.47E+09	a	1.41E+17	1.25E+04	3.36E-07				
U240	2.40E+02	1.41E+01	h	5.08E+04	4.50E-09	9.26E+05				

(1) CRC

(2) Sanchez et. al. 1996

	total	curies(2):										
	t=0 (1995)	t=38	t=138	t=163	t=213	t=388	t=1038	t=3038	t=5038	t=7538	t=10038	
Th227	6.02E-01	4.99E-01	4.87E-01	4.95E-01	5.12E-01	5.74E-01	8.20E-01	1.56E+00	2.33E+00	3.33E+00	4.35E+00	
Th228	2.72E+01	1.94E+01	8.03E+00	6.53E+00	4.42E+00	1.64E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	
Th229	3.00E+00	9.97E+00	2.82E+01	3.27E+01	4.17E+01	7.30E+01	1.84E+02	4.85E+02	7.32E+02	9.78E+02	1.17E+03	
Th230	8.82E-02	3.06E-01	1.17E+00	1.44E+00	1.99E+00	4.11E+00	1.25E+01	3.79E+01	6.27E+01	9.30E+01	1.22E+02	
Th231	1.74E+01	1.75E+01	1.76E+01	1.76E+01	1.76E+01	1.77E+01	1.82E+01	1.97E+01	2.11E+01	2.28E+01	2.43E+01	
Th232	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00	
Th234	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	
U232	2.58E+01	1.79E+01	6.84E+00	5.37E+00	3.32E+00	6.16E-01	1.18E-03	5.13E-12	2.22E-20	0.00E+00	0.00E+00	
U233	1.95E+03	1.95E+03	1.95E+03	1.95E+03	1.95E+03	1.95E+03	1.94E+03	1.93E+03	1.91E+03	1.89E+03	1.87E+03	
U234	5.08E+02	7.51E+02	1.13E+03	1.19E+03	1.27E+03	1.40E+03	1.44E+03	1.43E+03	1.43E+03	1.42E+03	1.41E+03	
U235	1.74E+01	1.75E+01	1.76E+01	1.76E+01	1.76E+01	1.77E+01	1.82E+01	1.97E+01	2.11E+01	2.28E+01	2.43E+01	
U236	4.30E-01	6.72E-01	1.30E+00	1.46E+00	1.77E+00	2.85E+00	6.70E+00	1.70E+01	2.53E+01	3.35E+01	3.98E+01	
U237	6.01E+01	9.67E+00	8.12E-02	2.63E-02	4.90E-03	2.74E-03	2.60E-03	2.20E-03	1.87E-03	1.53E-03	1.25E-03	
U238	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	5.01E+01	
U240	1.50E-06	1.51E-06	1.54E-06	1.55E-06	1.56E-06	1.61E-06	1.80E-06	2.36E-06	2.93E-06	3.64E-06	4.34E-06	
												10038
	total	moles:										mole
	t=0 (1995)	t=38	t=138	t=163	t=213	t=388	t=1038	t=3038	t=5038	t=7538	t=10038	fraction
Th227	8.63E-08	7.15E-08	6.98E-08	7.10E-08	7.34E-08	8.23E-08	1.18E-07	2.24E-07	3.34E-07	4.77E-07	6.24E-07	1.58E-11
Th228	1.45E-04	1.04E-04	4.30E-05	3.49E-05	2.36E-05	8.77E-06	5.39E-06	5.38E-06	5.38E-06	5.38E-06	5.38E-06	1.36E-10
Th229	6.12E-02	2.04E-01	5.76E-01	6.68E-01	8.52E-01	1.49E+00	3.76E+00	9.91E+00	1.49E+01	2.00E+01	2.39E+01	6.05E-04
Th230	1.86E-02	6.45E-02	2.48E-01	3.03E-01	4.19E-01	8.67E-01	2.63E+00	7.99E+00	1.32E+01	1.96E+01	2.58E+01	6.54E-04
Th231	1.42E-07	1.42E-07	1.43E-07	1.43E-07	1.43E-07	1.44E-07	1.48E-07	1.61E-07	1.72E-07	1.85E-07	1.98E-07	5.01E-12
Th232	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	9.99E-01
Th234	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	9.25E-06	2.35E-10
tot	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	
U232	5.05E-03	3.51E-03	1.34E-03	1.05E-03	6.50E-04	1.21E-04	2.31E-07	1.00E-15	4.35E-24	0.00E+00	0.00E+00	0.00E+00
U233	8.68E+02	8.68E+02	8.67E+02	8.67E+02	8.67E+02	8.67E+02	8.64E+02	8.57E+02	8.51E+02	8.42E+02	8.34E+02	1.23E-03
U234	3.50E+02	5.17E+02	7.78E+02	8.17E+02	8.75E+02	9.64E+02	9.92E+02	9.87E+02	9.81E+02	9.75E+02	9.68E+02	1.43E-03
U235	3.43E+04	3.44E+04	3.46E+04	3.46E+04	3.47E+04	3.49E+04	3.59E+04	3.88E+04	4.16E+04	4.48E+04	4.78E+04	7.04E-02
U236	2.82E+01	4.40E+01	8.54E+01	9.56E+01	1.16E+02	1.87E+02	4.39E+02	1.11E+03	1.66E+03	2.20E+03	2.61E+03	3.84E-03
U237	3.11E-06	5.00E-07	4.20E-09	1.36E-09	2.53E-10	1.41E-10	1.34E-10	1.14E-10	9.68E-11	7.89E-11	6.44E-11	9.49E-17
U238	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	6.27E+05	9.23E-01
U240	6.75E-15	6.79E-15	6.92E-15	6.96E-15	7.02E-15	7.24E-15	8.08E-15	1.06E-14	1.32E-14	1.64E-14	1.95E-14	2.87E-20
tot	6.62E+05	6.63E+05	6.63E+05	6.63E+05	6.63E+05	6.64E+05	6.65E+05	6.69E+05	6.72E+05	6.76E+05	6.79E+05	

ratio of tracked isotopes to total isotopes											
	t=0	t=38	t=138	t=163	t=213	t=388	t=1038	t=3038	t=5038	t=7538	t=10038
Th	2.03E-06	6.80E-06	2.09E-05	2.46E-05	3.23E-05	5.98E-05	1.62E-04	4.54E-04	7.15E-04	1.00E-03	1.26E-03
U	1.84E-03	2.09E-03	2.48E-03	2.54E-03	2.63E-03	2.76E-03	2.79E-03	2.76E-03	2.73E-03	2.69E-03	2.65E-03
	max	log max									
	molefrac	molefrac									
Th	1.26E-03	-2.90									
U	2.79E-03	-2.55									

APPENDIX F: NUTS ASCII Input Files

Input file for Screening R2 S2 T350 Calculations

```
** NUTS TITLE **
'NUTS TRACER SCREENING TEST FOR CCA R2S2 SCENARIO (E1 350 YRS INTRUSION)'
** 1.# OF SITES,# OF MATERIAL,(2.SITE NAME,# COMP. TO BE MODELED)1,..,NSITES **
1,50
'WIPP_SITE'   2
**(1. SITE, 2.COMP., DAUGHTER, PARENT, GROUP NAMES)1,..,NSITES **
'WIPP_SITE'
'TWASTE'        'NONE'          'NONE'          'WASTE'
'TCASTL'        'NONE'          'NONE'          'CASTL'
** 1.# OF ELEMENT,(2.ELEM. NAME, TEMP. DEPEND., TABLE LOOK-UP)1,..,NELEMENT **
2
'WASTE'         .FALSE.         .FALSE.
'CASTL'         .FALSE.         .FALSE.
** COLLOIDAL TRANSPORT FLAG (T/F) **
.FALSE.
** PH DEPENDENT SOLUBILITY(IS PH REQUIRED (Y/N)) **
'N'
** ORDER OF THE METHOD **
1
** DEGREE OF IMPLICITNESS **
1.D0
** IS MATRIX ADSORPTION REQUIRED (Y/N) **
'N'
** DO YOU HAVE DISPERSION IN THE MATRIX (Y/N) **
'N'
** DOES MATRIX HAVE SYMMETRIC DISPERSION (T/F): ANSWER IF DISPERSION IS Y **
** DO YOU HAVE INJECTION/PRODUCTION IN THE MATRIX (Y/N) **
'N'
** DO YOU HAVE DIRICHLET B.CS. IN THE MATRIX (F/T) **
.TRUE.
** IS CONCENTRATION INITIALIZED MANUALLY IN THE MATRIX (F/T) **
.FALSE.
** OPEN NUTS UNDISTURBED CDB FOR INTRUSION TIME OTHER THAN 350,1000 YRS **
.FALSE.
** PRINT FLAGS OF MATRIX VARIABLES IN A BINARY FILE **
0,0,0,0,0,0,1,0,0,0,0,0,0,0
** TEMP. DEPEND. OF Kd (ENTER DATA IF ADSORP. IS (Y) AND TEMP. DEPEND.) **
** PRINTING FREQUENCY IN A BINARY FILE **
1,1.D14
** DO YOU HAVE EXTERNAL NUCLIDE SOURCE? (T/F) **
.FALSE.
** MINIMUM LIMITS OF SATURATION AND TIME TO BE SET IF ZERO ENCOUNTERED **
1.D-18
** INTRUSION TIME, ITERPOLATED INTRUSION TIME, TOLERANCE **
*** END MATERIAL MAP AND START NUCLIDES PROPERTIES ***
** IF NOT TEMP. DEPEND. (ELEMENT NAME, SOLUBILITY LIMIT) 1,..,NELEMENT **
'WASTE'         -2.D0
'CASTL'         -2.D0
** (COMP. NAME, MOL.(ATOMIC) WT., INITIAL INVENTS., HALF LIFE)1,..,NUCLIDE **
'TWASTE'        .1D0    0.D0    0.D0    0.D0
'TCASTL'        .1D0    0.D0    0.D0    0.D0
** GROUND WATER PH INPUT **
** STANDARD BR. DENS. IF NOT BRAGFLO RUN (READ ASCII FILE FOR FLUX FIELD) **
** MOLECULAR DIFFUSION OF EACH COMPONENT **
** ROCK GRAIN DENSITY INPUT (REQUIRED ONLY IF SORPTION OR SOIL BASE CONC.) **
** WASTE MATRIX INPUT (1.# OF ISO,2.NAME, LOC. IN THE INPUT, WASTE SITE #) **
1
'TWASTE'       1       1
*** (1.SITE NAME, NUMBER OF GRIDS IN THE SITE 2.INDECES)1...NSITES ***
'WIPP_SITE' 30
    9,8,1     10,8,1     11,8,1     12,8,1      13,8,1     14,8,1     15,8,1
  17,8,1     18,8,1     19,8,1
    9,9,1     10,9,1     11,9,1     12,9,1      13,9,1     14,9,1     15,9,1
  17,9,1     18,9,1     19,9,1
  9,10,1  10,10,1  11,10,1  12,10,1  13,10,1  14,10,1  15,10,1
17,10,1  18,10,1  19,10,1
** MATRIX ADSORPTION INPUT **
** MATRIX DISPERSION INPUT **
** MATRIX SOURCE INPUT (INJECTED NUCLIDES IF ANY) **
** MATRIX DIR. B.CS. INPUT (REP.='GENERAL',ANYWHERE= 'NOT_GENERAL') **
2  'NOT_GENERAL'
'TWASTE'     1     30
    9,8,1     10,8,1     11,8,1     12,8,1     13,8,1     14,8,1     15,8,1
```

```
  17,8,1    18,8,1    19,8,1
    9,9,1    10,9,1    11,9,1    12,9,1    13,9,1    14,9,1    15,9,1
  17,9,1    18,9,1    19,9,1
  9,10,1  10,10,1  11,10,1  12,10,1  13,10,1  14,10,1  15,10,1
17,10,1  18,10,1  19,10,1
'TCASTL'   2     17
   9,1,1   10,1,1   11,1,1   12,1,1   13,1,1   14,1,1   15,1,1
 16,1,1   17,1,1   18,1,1   19,1,1   20,1,1   21,1,1   22,1,1
 23,1,1   24,1,1   25,1,1
'TWASTE'
 1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0
 1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0
 1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0
'TCASTL'
 1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0
 1.D0  1.D0  1.D0  1.D0  1.D0  1.D0  1.D0
** TIME DEPENDENT SOURCE IN THE MATRIX **
** MATRIX CONCENTRATION INITIALIZATION **
** COLLOID TRANSPORT VELOCITY SCALING FACTORS IN THE MATRIX **
```

Input file for Isotope R2 S2 T350 Calculations

```
** NUTS TITLE **
'NUTS RADIOLOGICAL TRANSPORT FOR CCA R2S2 (E1 SCENARIO, 350 YRS INTRUSION)'
** 1.# OF SITES,# OF MATERIAL,(2.SITE NAME,# COMP. TO BE MODELED)1,..,NSITES **
1,50
'WIPP_SITE'   5
**(1. SITE, 2.COMP., DAUGHTER, PARENT, GROUP NAMES)1,..,NSITES **
'WIPP_SITE'
'AM241L'       'NONE'         'NONE'         'AML'
'PU239L'       'NONE'         'NONE'         'PUL'
'PU238L'       'U234L'        'NONE'         'PUL'
'U234L'        'TH230L'       'PU238L'       'UL'
'TH230L'       'TH230D'       'U234L'        'THL'
** 1.# OF ELEMENT,(2.ELEM. NAME, TEMP. DEPEND., TABLE LOOK-UP)1,..,NELEMENT **
4
'AML'          .FALSE.        .FALSE.
'PUL'          .FALSE.        .FALSE.
'UL'           .FALSE.        .FALSE.
'THL'   .FALSE.        .FALSE.
** COLLOIDAL TRANSPORT FLAG (T/F) **
.FALSE.
** PH DEPENDENT SOLUBILITY(IS PH REQUIRED (Y/N)) **
'N'
** ORDER OF THE METHOD **
1
** DEGREE OF IMPLICITNESS **
1.D0
** IS MATRIX ADSORPTION REQUIRED (Y/N) **
'N'
** DO YOU HAVE DISPERSION IN THE MATRIX (Y/N) **
'N'
** DOES MATRIX HAVE SYMMETRIC DISPERSION (T/F): ANSWER IF DISPERSION IS Y **
** DO YOU HAVE INJECTION/PRODUCTION IN THE MATRIX (Y/N) **
'N'
** DO YOU HAVE DIRICHLET B.CS. IN THE MATRIX (F/T) **
.FALSE.
** IS CONCENTRATION INITIALIZED MANUALLY IN THE MATRIX (F/T) **
.FALSE.
** OPEN NUTS UNDISTURBED CDB FOR INTRUSION TIME OTHER THAN 350,1000 YRS **
.FALSE.
** PRINT FLAGS OF MATRIX VARIABLES IN A BINARY FILE **
0,0,0,0,0,0,1,1,1,0,0,0,0,1
** TEMP. DEPEND. OF Kd (ENTER DATA IF ADSORP. IS (Y) AND TEMP. DEPEND.) **
** PRINTING FREQUENCY IN A BINARY FILE **
1,1.D12
** DO YOU HAVE EXTERNAL NUCLIDE SOURCE? (T/F) **
.FALSE.
** MINIMUM LIMITS OF TIME TO BE SET IF ZERO ENCOUNTERED **
1.D-18
** INTRUSION TIME, ITERPOLATED INTRUSION TIME, TOLERANCE **
*** END MATERIAL MAP AND START NUCLIDES PROPERTIES ***
** IF NOT TEMP. DEPEND. (ELEMENT NAME, SOLUBILITY LIMIT) 1,..,NELEMENT **
** (COMP. NAME, MOL.(ATOMIC) WT., INITIAL INVENTS., HALF LIFE)1,..,NUCLIDE **
** GROUND WATER PH INPUT **
** STANDARD BR. DENS. IF NOT BRAGFLO RUN (READ ASCII FILE FOR FLUX FIELD) **
** MOLECULAR DIFFUSION INPUT **
** ROCK DENSITY INPUT **
** WASTE MATRIX INPUT (LOCATION OF THE WASTE) **
5
```

```
'AM241L'       1      1
'PU239L'       2      1
'PU238L'       3      1
'U234L'        4      1
'TH230L'       5      1
*** (1.SITE NAME, NUMBER OF GRIDS IN THE SITE 2.INDECES)1...NSITES ***
'WIPP_SITE' 30
    9,8,1    10,8,1     11,8,1     12,8,1     13,8,1    14,8,1    15,8,1
  17,8,1    18,8,1     19,8,1
    9,9,1    10,9,1     11,9,1     12,9,1     13,9,1    14,9,1    15,9,1
  17,9,1    18,9,1     19,9,1
  9,10,1  10,10,1   11,10,1    12,10,1   13,10,1  14,10,1  15,10,1
17,10,1  18,10,1   19,10,1
** MATRIX ADSORPTION INPUT **
** MATRIX DISPERSION INPUT **
** MATRIX SOURCE INPUT (INJECTED NUCLIDES IF ANY) **
** MATRIX DIR. B.CS. INPUT (REP.='GENERAL',ANYWHERE= 'NOT_GENERAL') **
** TIME DEPENDENT SOURCE IN THE MATRIX **
** MATRIX CONCENTRATION INITIALIZATION **
** COLLOID TRANSPORT VELOCITY SCALING FACTORS IN THE MATRIX **
```

APPENDIX G: NUTS Screening Variables

List of Analysis Variables for NUTS Screening Runs

Var. No.	Variable	Units	Brief Description
1	FLXWBREP	kg/s	Waste-contaminated brine flow rate outward across the repository boundary
2	FLXCBREP	kg/s	Castile brine flow rate outward across the repository boundary
3	MKGWBREP	kg	Waste-contaminated brine mass outward across the repository boundary
4	MKGCBREP	kg	Castile brine mass outward across the repository boundary
5	FLWBM38N	kg/s	Waste-contaminated brine flow rate across the repository boundary into Marker Bed 138 north of the repository
6	FLCBM38N	kg/s	Castile brine flow rate across the repository boundary into Marker Bed 138 north of the repository
7	FLWBAABN	kg/s	Waste-contaminated brine flow rate across the repository boundary into the Anhydrite A/B layer north of the repository
8	FLCBAABN	kg/s	Castile brine flow rate across repository boundary into the Anhydrite A/B layer north of the repository
9	FLWBM39N	kg/s	Waste-contaminated brine flow rate across the repository boundary into Marker Bed 139 north of the repository
10	FLCBM39N	kg/s	Castile brine flow rate across the repository boundary into Marker Bed 139 north of the repository
11	FLWBM38S	kg/s	Waste-contaminated brine flow rate across the repository boundary into Marker Bed 138 south of the repository
12	FLCBM38S	kg/s	Castile brine flow rate across the repository boundary into Marker Bed 138 south of the repository
13	FLWBAABS	kg/s	Waste-contaminated brine flow rate across the repository boundary into the Anhydrite A/B layer south of the repository
14	FLCBAABS	kg/s	Castile brine flow rate across the repository boundary into the Anhydrite A/B layer south of the repository
15	FLWBM39S	kg/s	Waste-contaminated brine flow rate across the repository boundary into Marker Bed 139 south of the repository
16	FLCBM39S	kg/s	Castile brine flow rate across the repository boundary into Marker Bed 139 south of the repository
17	FLWB_MBC	kg/s	Total waste-contaminated brine flow rate across the repository boundaries into all of the marker beds
18	FLCB_MBC	kg/s	Total Castile brine flow rate across the repository boundaries into all of the marker beds
19	KGWBM38N	kg	Waste-contaminated brine mass flowing outward across the repository boundary into Marker Bed 138 north of the repository
20	KGCBM38N	kg	Castile brine mass flowing outward across the repository boundary into Marker Bed 138 north of the repository

21	KGWBAABN	kg	Waste-contaminated brine mass flowing outward across the repository boundary into the Anhydrite A/B layer to the north
22	KGCBAABN	kg	Castile brine mass flowing outward across the repository boundary into the Anhydrite A/B layer north of the repository
23	KGWBM39N	kg	Waste-contaminated brine mass flowing outward across the repository boundary into Marker Bed 139 north of the repository
24	KGCBM39N	kg	Castile brine mass flowing outward across the repository boundary into Marker Bed 139 north of the repository
25	KGWBM38S	kg	Waste-contaminated brine mass flowing outward across the repository boundary into Marker Bed 138 south of the repository
26	KGCBM38S	kg	Castile brine mass flowing outward across the repository boundary into Marker Bed 138 south of the repository
27	KGWBAABS	kg	Waste-contaminated brine mass flowing across the repository boundary into the Anhydrite A/B layer south of the repository
28	KGCBAABS	kg	Castile brine mass flowing outward across the repository boundary into the Anhydrite A/B layer south of the repository
29	KGWBM39S	kg	Waste-contaminated brine mass flowing outward across the repository boundary into Marker Bed 139 south of the repository
30	KGCBM39S	kg	Castile brine mass flowing outward across the repository boundary into Marker Bed 139 south of the repository
31	KGWB_MBC	kg	Total waste-contaminated brine mass flowing outward across the repository boundaries into all of the marker beds
32	KGCB_MBC	kg	Total Castile brine mass flowing outward across the repository boundaries into all of the marker beds
33	WBFLM38N	kg/s	Waste-contaminated brine flow rate outward across the land-withdrawal boundary in Marker Bed 138 north of the repository
34	CBFLM38N	kg/s	Castile brine flow rate outward across the land-withdrawal boundary in Marker Bed 138 north of the repository
35	WBFLAABN	kg/s	Waste-contaminated brine flow rate across the land-withdrawal boundary in the Anhydrite A/B layer north of the repository
36	CBFLAABN	kg/s	Castile brine flow rate outward across the land-withdrawal boundary in the Anhydrite A/B layer north of the repository
37	WFLM39N	kg/s	Waste-contaminated brine flow rate outward across the land-withdrawal boundary in Marker Bed 139 north of the repository
38	CFLM39N	kg/s	Castile brine flow rate outward across the land-withdrawal boundary in Marker Bed 139 north of the repository
39	WBFLM38S	kg/s	Waste-contaminated brine flow rate outward across the land-withdrawal boundary in Marker Bed 138 south of the repository
40	CBFLM38S	kg/s	Castile brine flow rate outward across the land-withdrawal boundary in Marker Bed 138 south of the repository
41	WBFLAABS	kg/s	Waste-contaminated brine flow rate across the land-withdrawal boundary in the Anhydrite A/B layer south of the repository
42	CBFLAABS	kg/s	Castile brine flow rate outward across the land-withdrawal boundary in the Anhydrite A/B layer south of the repository
43	WBFLM39S	kg/s	Waste-contaminated brine flow rate outward across the land-withdrawal boundary in Marker Bed 139 south of the repository
44	CBFLM39S	kg/s	Castile brine flow rate outward across the land-withdrawal boundary in Marker Bed 139 south of the repository

45	WBFL_MBC	kg/s	Total waste-contaminated brine flow rate outward across the land-withdrawal boundaries in all of the marker beds
46	CBFL_MBC	kg/s	Total Castile brine flow rate outward across the land-withdrawal boundaries in all of the marker beds
47	WBLWM38N	kg	Waste-contaminated brine mass flowing outward across the land-withdrawal boundary in Marker Bed 138 north of the repository
48	CBLWM38N	kg	Castile brine mass flowing outward across the land-withdrawal boundary in Marker Bed 138 north of the repository
49	WBLWAABN	kg	Waste-contaminated brine mass flowing outward across the land-withdrawal boundary in the Anhydrite A/B layer to the north
50	CBLWAABN	kg	Castile brine mass flowing outward across the land-withdrawal boundary in the Anhydrite A/B layer north of the repository
51	WBLWM39N	kg	Waste-contaminated brine mass flowing outward across the land-withdrawal boundary in Marker Bed 139 north of the repository
52	CBLWM39N	kg	Castile brine mass flowing outward across the land-withdrawal boundary in Marker Bed 139 north of the repository
53	WBLWM38S	kg	Waste-contaminated brine mass flowing outward across the land-withdrawal boundary in Marker Bed 138 south of the repository
54	CBLWM38S	kg	Castile brine mass flowing outward across the land-withdrawal boundary in Marker Bed 138 south of the repository
55	WBLWAABS	kg	Waste-contaminated brine mass flowing outward across the land-withdrawal boundary in the Anhydrite A/B layer to the south
56	CBLWAABS	kg	Castile brine mass flowing outward across the land-withdrawal boundary in the Anhydrite A/B layer south of the repository
57	WBLWM39S	kg	Waste-contaminated brine mass flowing outward across the land-withdrawal boundary in Marker Bed 139 south of the repository
58	CBLWM39S	kg	Castile brine mass flowing outward across the land-withdrawal boundary in Marker Bed 139 south of the repository
59	WBLW_MBC	kg	Total waste-contaminated brine mass flowing outward across the land-withdrawal boundaries in all of the marker beds
60	CBLW_MBC	kg	Total Castile brine mass flowing outward across the land-withdrawal boundaries in all of the marker beds
61	XLWBM38N	m	Length of the waste-contaminated brine flow zone outward from the repository in Marker Bed 138 north of the repository
62	XLCBM38N	m	Length of the Castile brine flow zone outward from the repository in Marker Bed 138 north of the repository
63	XLWBAABN	m	Length of the waste-contaminated brine flow zone outward from the repository in the Anhydrite A/B layer north of the repository
64	XLCBAABN	m	Length of the Castile brine flow zone outward from the repository in the Anhydrite A/B layer north of the repository
65	XLWBM39N	m	Length of the waste-contaminated brine flow zone outward from the repository in Marker Bed 139 north of the repository
66	XLCBM39N	m	Length of the Castile brine flow zone outward from the repository in Marker Bed 139 north of the repository
67	XLWBM38S	m	Length of the waste-contaminated brine flow zone outward from the repository in Marker Bed 138 south of the repository
68	XLCBM38S	m	Length of the Castile brine flow zone outward from the repository in Marker Bed 138 south of the repository

69	XLWBAABS	m	Length of the waste-contaminated brine flow zone outward from the repository in the Anhydrite A/B layer south of the repository
70	XLCBAABS	m	Length of the Castile brine flow zone outward from the repository in the Anhydrite A/B layer south of the repository
71	XLWBM39S	m	Length of the waste-contaminated brine flow zone outward from the repository in Marker Bed 139 south of the repository
72	XLCBM39S	m	Length of the Castile brine flow zone outward from the repository in Marker Bed 139 south of the repository
73	WBFBH_SU	kg/s	Waste-contaminated brine flow rate up the borehole to the surface
74	CBFBH_SU	kg/s	Castile brine flow rate up the borehole to the surface
75	WBFBH_DL	kg/s	Waste-contaminated brine flow rate up the borehole past the Dewey Lake layer
76	CBFBH_DL	kg/s	Castile brine flow rate up the borehole past the Dewey Lake layer
77	WBFBH_RU	kg/s	Waste-contaminated brine flow rate up the borehole past the Rustler formation
78	CBFBH_RU	kg/s	Castile brine flow rate up the borehole past the Rustler formation
79	WBFBH_MD	kg/s	Waste-contaminated brine flow rate up the borehole at the Magenta Dolomite formation
80	CBFBH_MD	kg/s	Castile brine flow rate up the borehole at the Magenta Dolomite
81	WBFBH_RC	kg/s	Waste-contaminated brine flow rate up the borehole at the Rustler/Culebra interface
82	CBFBH_RC	kg/s	Castile brine flow rate up the borehole at Rustler/Culebra
83	WBFBH_SR	kg/s	Waste-contaminated brine flow rate up the borehole at the Salado/Rustler interface
84	CBFBH_SR	kg/s	Castile brine flow rate up the borehole at Salado/Rustler
85	WBFBH_CB	kg/s	Waste-contaminated brine flow rate down the borehole past the Castile formation
86	CBFBH_CB	kg/s	Castile brine flow rate down the borehole past Castile formation
87	WB_BH_SU	kg	Waste-contaminated brine mass flow up borehole to the surface
88	CB_BH_SU	kg	Castile brine mass flowing up the borehole to the surface
89	WB_BH_DL	kg	Waste-contaminated brine mass flowing up the borehole past the Dewey Lake layer
90	CB_BH_DL	kg	Castile brine mass flowing up the borehole past Dewey Lake
91	WB_BH_RU	kg	Waste-contaminated brine mass flow up the borehole past Rustler
92	CB_BH_RU	kg	Castile brine mass flowing up the borehole past the Rustler layer

93	WB_BH_MD	kg	Waste-contaminated brine mass flow up the borehole at Magenta
94	CB_BH_MD	kg	Castile brine mass flowing up the borehole at Magenta Dolomite
95	WB_BH_RC	kg	Waste-contaminated brine mass flowing up the borehole at the Rustler/Culebra interface
96	CB_BH_RC	kg	Castile brine mass flowing up the borehole at Rustler/Culebra
97	WB_BH_SR	kg	Waste-contaminated brine mass flowing up the borehole at the Salado/Rustler interface
98	CB_BH_SR	kg	Castile brine mass flowing up the borehole at Salado/Rustler
99	WB_BH_CB	kg	Waste-contaminated brine mass flowing down the borehole past the Castile formation
100	CB_BH_CB	kg	Castile brine mass flow down the borehole past Castile formation
101	XLWBBPN	m	Extent of waste-contaminated brine flow zone in brine pocket north of the borehole
102	XLCBBPN	m	Extent of Castile brine flow in the brine pocket north of borehole
103	XLWBBPS	m	Extent of waste-contaminated brine flow zone in brine pocket south of the borehole
104	XLCBBPS	m	Extent of Castile brine flow in the brine pocket south of borehole
105	WBFSH_SU	kg/s	Waste-contaminated brine flow rate up the shaft to the surface
106	CBFSH_SU	kg/s	Castile brine flow rate up the shaft to the surface
107	WBFSH_DL	kg/s	Waste-contaminated brine flow rate up the shaft past Dewey Lake
108	CBFSH_DL	kg/s	Castile brine flow rate up the shaft past Dewey Lake
109	WBFSH_RU	kg/s	Waste-contaminated brine flow rate up the shaft past Rustler
110	CBFSH_RU	kg/s	Castile brine flow rate up the shaft past Rustler
111	WBFSH_MD	kg/s	Waste-contaminated brine flow rate up the shaft at Magenta
112	CBFSH_MD	kg/s	Castile brine flow rate up the shaft at Magenta
113	WBFSH_RC	kg/s	Waste-contaminated brine flow rate up shaft at Rustler/Culebra
114	CBFSH_RC	kg/s	Castile brine flow rate up the shaft at Rustler/Culebra
115	WBFSH_SR	kg/s	Waste-contaminated brine flow rate up the shaft at Salado/Rustler
116	CBFSH_SR	kg/s	Castile brine flow rate up the shaft at Salado/Rustler
117	WB_SH_SU	kg	Waste-contaminated brine mass flow up the shaft to the surface
118	CB_SH_SU	kg	Castile brine mass flowing up the shaft to the surface
119	WB_SH_DL	kg	Waste-contaminated brine mass up the shaft past Dewey Lake
120	CB_SH_DL	kg	Castile brine mass flowing up the shaft past Dewey Lake
121	WB_SH_RU	kg	Waste-contaminated brine mass flowing up the shaft past Rustler
122	CB_SH_RU	kg	Castile brine mass flowing up the shaft past Rustler
123	WB_SH_MD	kg	Waste-contaminated brine mass flowing up the shaft at Magenta
124	CB_SH_MD	kg	Castile brine mass flowing up the shaft at Magenta
125	WB_SH_RC	kg	Waste-contaminated brine mass flow up shaft at Rustler/Culebra
126	CB_SH_RC	kg	Castile brine mass flow up the shaft at Rustler/Culebra
127	WB_SH_SR	kg	Waste-contaminated brine mass flow up shaft at Salado/Rustler
128	CB_SH_SR	kg	Castile brine mass flow up the shaft at Salado/Rustler
129	WBC_E223	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 223
130	CBC_E223	kg/m^3-brine	Castile brine concentration in borehole element 223

131	WBC_E681	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 681
132	CBC_E681	kg/m^3-brine	Castile brine concentration in borehole element 681
133	WBC_E713	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 713
134	CBC_E713	kg/m^3-brine	Castile brine concentration in borehole element 713
135	WBC_E745	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 745
136	CBC_E745	kg/m^3-brine	Castile brine concentration in borehole element 745
137	WBC_E777	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 777
138	CBC_E777	kg/m^3-brine	Castile brine concentration in borehole element 777
139	WBC_E809	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 809
140	CBC_E809	kg/m^3-brine	Castile brine concentration in borehole element 809
141	WBC_E841	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 841
142	CBC_E841	kg/m^3-brine	Castile brine concentration in borehole element 841
143	WBC_E873	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 873
144	CBC_E873	kg/m^3-brine	Castile brine concentration in borehole element 873
145	WBC_E905	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 905
146	CBC_E905	kg/m^3-brine	Castile brine concentration in borehole element 905
147	WBC_E937	kg/m^3-brine	Waste-contaminated brine concentration in borehole element 937
148	CBC_E937	kg/m^3-brine	Castile brine concentration in borehole element 937
149	WBC_E661	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 661
150	CBC_E661	kg/m^3-brine	Castile brine concentration in shaft element 661
151	WBC_E662	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 662
152	CBC_E662	kg/m^3-brine	Castile brine concentration in shaft element 662
153	WBC_E663	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 663
154	CBC_E663	kg/m^3-brine	Castile brine concentration in shaft element 663
155	WBC_E664	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 664
156	CBC_E664	kg/m^3-brine	Castile brine concentration in shaft element 664
157	WBC_E665	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 665
158	CBC_E665	kg/m^3-brine	Castile brine concentration in shaft element 665
159	WBC_E666	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 666
160	CBC_E666	kg/m^3-brine	Castile brine concentration in shaft element 666
161	WBC_E667	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 667
162	CBC_E667	kg/m^3-brine	Castile brine concentration in shaft element 667
163	WBC_E668	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 668
164	CBC_E668	kg/m^3-brine	Castile brine concentration in shaft element 668
165	WBC_E669	kg/m^3-brine	Waste-contaminated brine concentration in shaft element 669
166	CBC_E669	kg/m^3-brine	Castile brine concentration in shaft element 669
167	WBC_E593	kg/m^3-brine	Waste-contaminated brine concentration in Marker Bed 138 element 593, north of the repository just inside the land-
168	CBC_E593	kg/m^3-brine	Castile brine concentration in Marker Bed 138 element 593, north of the repository just inside the land-withdrawal boundary
169	WBC_E566	kg/m^3-brine	Waste-contaminated brine concentration in Marker Bed 138 element 566, south of the repository just inside the land-
170	CBC_E566	kg/m^3-brine	Castile brine concentration in Marker Bed 138 element 566, south of the repository just inside the land-withdrawal boundary
171	WBC_E561	kg/m^3-brine	Waste-contaminated brine concentration in Anhydrite A/B element 561, north of the repository just inside the land-
172	CBC_E561	kg/m^3-brine	Castile brine concentration in Anhydrite A/B element 561, north of the repository just inside the land-withdrawal boundary

173	WBC_E550	kg/m^3-brine	Waste-contaminated brine concentration in Anhydrite A/B element 550, south of the repository just inside the land-
174	CBC_E550	kg/m^3-brine	Castile brine concentration in Anhydrite A/B element 550, south of the repository just inside the land-withdrawal boundary
175	WBC_E545	kg/m^3-brine	Waste-contaminated brine concentration in Marker Bed 139 element 545, north of the repository just inside the land-
176	CBC_E545	kg/m^3-brine	Castile brine concentration in Marker Bed 139 element 545, north of the repository just inside the land-withdrawal boundary
177	WBC_E534	kg/m^3-brine	Waste-contaminated brine concentration in Marker Bed 139 element 534, south of the repository just inside the land-
178	CBC_E534	kg/m^3-brine	Castile brine concentration in Marker Bed 139 element 534, south of the repository just inside the land-withdrawal boundary
179	WBVAC_WP	kg/m^3-brine	Volume-averaged waste-contaminated brine concentration in the waste panel
180	CBVAC_WP	kg/m^3-brine	Volume-averaged Castile brine concentration in the waste panel
181	WBVAC_RR	kg/m^3-brine	Volume-averaged waste-contaminated brine concentration in the rest of the repository
182	CBVAC_RR	kg/m^3-brine	Volume-averaged Castile brine concentration in rest of repository
183	WBVACREP	kg/m^3-brine	Volume-averaged waste-contaminated brine concentration in the repository (waste panel plus rest of repository)
184	CBVACREP	kg/m^3-brine	Volume-averaged Castile brine concentration in the repository
185	WBVAC_BP	kg/m^3-brine	Volume-averaged waste-contaminated brine concentration in the brine pocket
186	CBVAC_BP	kg/m^3-brine	Volume-averaged Castile brine concentration in the brine pocket

APPENDIX H: NUTS Non-Screening Analysis Variables

List of Analysis Variables for NUTS Isotope-Transport Runs

No.	Variable Name	Units	Brief Description
1	EPA1_REP	EPA units	Activity (integrated flux) of Am^{241} outward across the
2	EPA2_REP	EPA units	Activity of Pu^{239} outward across the repository boundaries
3	EPA3_REP	EPA units	Activity of Pu^{238} outward across the repository boundaries
4	EPA4_REP	EPA units	Activity of U^{234} outward across the repository boundaries
5	EPA5_REP	EPA units	Activity of Th^{230} *outward* across the repository boundaries
6	EPAT_REP	EPA units	Total isotope activity outward across the repository boundaries
7	EPA1_MBN	EPA units	Activity of Am^{241} in marker beds at North repository border
8	EPA2_MBN	EPA units	Activity of Pu^{239} in marker beds at North repository border
9	EPA3_MBN	EPA units	Activity of Pu^{238} in marker beds at North repository border
10	EPA4_MBN	EPA units	Activity of U^{234} in marker beds at North repository border
11	EPA5_MBN	EPA units	Activity of Th^{230} in marker beds at North repository border
12	EPA1_MBS	EPA units	Activity of Am^{241} in marker beds at South repository border
13	EPA2_MBS	EPA units	Activity of Pu^{239} in marker beds at South repository border
14	EPA3_MBS	EPA units	Activity of Pu^{238} in marker beds at South repository border
15	EPA4_MBS	EPA units	Activity of U^{234} in marker beds at South repository border
16	EPA5_MBS	EPA units	Activity of Th^{230} in marker beds at South repository border
17	EPA1_MBT	EPA units	Activity of Am^{241} in all marker beds at repository borders
18	EPA2_MBT	EPA units	Activity of Pu^{239} in all marker beds at repository borders
19	EPA3_MBT	EPA units	Activity of Pu^{238} in all marker beds at repository borders
20	EPA4_MBT	EPA units	Activity of U^{234} in all marker beds at repository borders
21	EPA5_MBT	EPA units	Activity of Th^{230} in all marker beds at repository borders
22	EPA_MB_T	EPA units	Total isotope activity in marker beds at repository borders
23	F1LW_MBN	mRem/year	Am^{241} flux in marker beds at North land-withdrawal boundary
24	F2LW_MBN	mRem/year	Pu^{239} flux in marker beds at North land-withdrawal boundary
25	F3LW_MBN	mRem/year	Pu^{238} flux in marker beds at North land-withdrawal boundary
26	F4LW_MBN	mRem/year	U^{234} flux in marker beds at North land-withdrawal boundary
27	F5LW_MBN	mRem/year	Th^{230} flux in marker beds at North land-withdrawal boundary
28	F1LW_MBS	mRem/year	Am^{241} flux in marker beds at South land-withdrawal boundary
29	F2LW_MBS	mRem/year	Pu^{239} flux in marker beds at South land-withdrawal boundary
30	F3LW_MBS	mRem/year	Pu^{238} flux in marker beds at South land-withdrawal boundary
31	F4LW_MBS	mRem/year	U^{234} flux in marker beds at South land-withdrawal boundary
32	F5LW_MBS	mRem/year	Th^{230} flux in marker beds at South land-withdrawal boundary
33	F1LW_MBC	mRem/year	Am^{241} flux in all marker beds at land-withdrawal boundaries
34	F2LW_MBC	mRem/year	Pu^{239} flux in all marker beds at land-withdrawal boundaries
35	F3LW_MBC	mRem/year	Pu^{238} flux in all marker beds at land-withdrawal boundaries
36	F4LW_MBC	mRem/year	U^{234} flux in all marker beds at land-withdrawal boundaries
37	F5LW_MBC	mRem/year	Th^{230} flux in all marker beds at land-withdrawal boundaries
38	E1LW_MBN	EPA units	Am^{241} activity in marker beds at North land-withdrawal bndry
39	E2LW_MBN	EPA units	Pu^{239} activity in marker beds at North land-withdrawal bndry
40	E3LW_MBN	EPA units	Pu^{238} activity in marker beds at North land-withdrawal bndry
41	E4LW_MBN	EPA units	U^{234} activity in marker beds at North land-withdrawal boundary

42	E5LW_MBN	EPA units	Th^{230} activity in marker beds at North land-withdrawal bndry
43	E1LW_MBS	EPA units	Am^{241} activity in marker beds at South land-withdrawal bndry
44	E2LW_MBS	EPA units	Pu^{239} activity in marker beds at South land-withdrawal bndry
45	E3LW_MBS	EPA units	Pu^{238} activity in marker beds at South land-withdrawal bndry
46	E4LW_MBS	EPA units	U^{234} activity in marker beds at South land-withdrawal boundary
47	E5LW_MBS	EPA units	Th^{230} activity in marker beds at South land-withdrawal bndry
48	E1LW_MBT	EPA units	Am^{241} activity in all marker beds at land-withdrawal boundaries
49	E2LW_MBT	EPA units	Pu^{239} activity in all marker beds at land-withdrawal boundaries
50	E3LW_MBT	EPA units	Pu^{238} activity in all marker beds at land-withdrawal boundaries
51	E4LW_MBT	EPA units	U^{234} activity in all marker beds at land-withdrawal boundaries
52	E5LW_MBT	EPA units	Th^{230} activity in all marker beds at land-withdrawal boundaries
53	EPALWMBT	EPA units	Total activity of all isotopes in all marker beds at both North
54	XL1_M38N	m	Extent of Am^{241} penetration in Marker Bed 138 outward and to
55	XL2_M38N	m	Extent of Pu^{239} penetration in Marker Bed 138 outward and to
56	XL3_M38N	m	Extent of Pu^{238} penetration in Marker Bed 138 outward and to
57	XL4_M38N	m	Extent of U^{234} penetration in Marker Bed 138 outward and to
58	XL5_M38N	m	Extent of Th^{230} penetration in Marker Bed 138 outward and to
59	XL1_AABN	m	Extent of Am^{241} penetration in Anhydrite A/B outward and to
60	XL2_AABN	m	Extent of Pu^{239} penetration in Anhydrite A/B outward and to the
61	XL3_AABN	m	Extent of Pu^{238} penetration in Anhydrite A/B outward and to the
62	XL4_AABN	m	Extent of U^{234} penetration in Anhydrite A/B outward and to the
63	XL5_AABN	m	Extent of Th^{230} penetration in Anhydrite A/B outward and to the
64	XL1_M39N	m	Extent of Am^{241} penetration in Marker Bed 139 outward and to
65	XL2_M39N	m	Extent of Pu^{239} penetration in Marker Bed 139 outward and to
66	XL3_M39N	m	Extent of Pu^{238} penetration in Marker Bed 139 outward and to
67	XL4_M39N	m	Extent of U^{234} penetration in Marker Bed 139 outward and to
68	XL5_M39N	m	Extent of Th^{230} penetration in Marker Bed 139 outward and to
69	XL1_M38S	m	Extent of Am^{241} penetration in Marker Bed 138 outward and to
70	XL2_M38S	m	Extent of Pu^{239} penetration in Marker Bed 138 outward and to
71	XL3_M38S	m	Extent of Pu^{238} penetration in Marker Bed 138 outward and to
72	XL4_M38S	m	Extent of U^{234} penetration in Marker Bed 138 outward and to
73	XL5_M38S	m	Extent of Th^{230} penetration in Marker Bed 138 outward and to
74	XL1_AABS	m	Extent of Am^{241} penetration in Anhydrite A/B outward and to
75	XL2_AABS	m	Extent of Pu^{239} penetration in Anhydrite A/B outward and to the
76	XL3_AABS	m	Extent of Pu^{238} penetration in Anhydrite A/B outward and to the
77	XL4_AABS	m	Extent of U^{234} penetration in Anhydrite A/B outward and to the
78	XL5_AABS	m	Extent of Th^{230} penetration in Anhydrite A/B outward and to the
79	XL1_M39S	m	Extent of Am^{241} penetration in Marker Bed 139 outward and to
80	XL2_M39S	m	Extent of Pu^{239} penetration in Marker Bed 139 outward and to
81	XL3_M39S	m	Extent of Pu^{238} penetration in Marker Bed 139 outward and to
82	XL4_M39S	m	Extent of U^{234} penetration in Marker Bed 139 outward and to
83	XL5_M39S	m	Extent of Th^{230} penetration in Marker Bed 139 outward and to
84	MAX2_MBN	m	Maximum extent of Pu^{239} penetration in marker beds to the
85	MAX4_MBN	m	Maximum extent of U^{234} penetration in marker beds to the north
86	MAX2_MBS	m	Maximum extent of Pu^{239} penetration in marker beds to the
87	MAX4_MBS	m	Maximum extent of U^{234} penetration in marker beds to the south
88	A00AM241	Ci	Am^{241} integrated flux up borehole at Rustler/Culebra interface
89	A00PU239	Ci	Pu^{239} integrated flux up borehole at Rustler/Culebra interface
90	A00PU238	Ci	Pu^{238} integrated flux up borehole at Rustler/Culebra interface

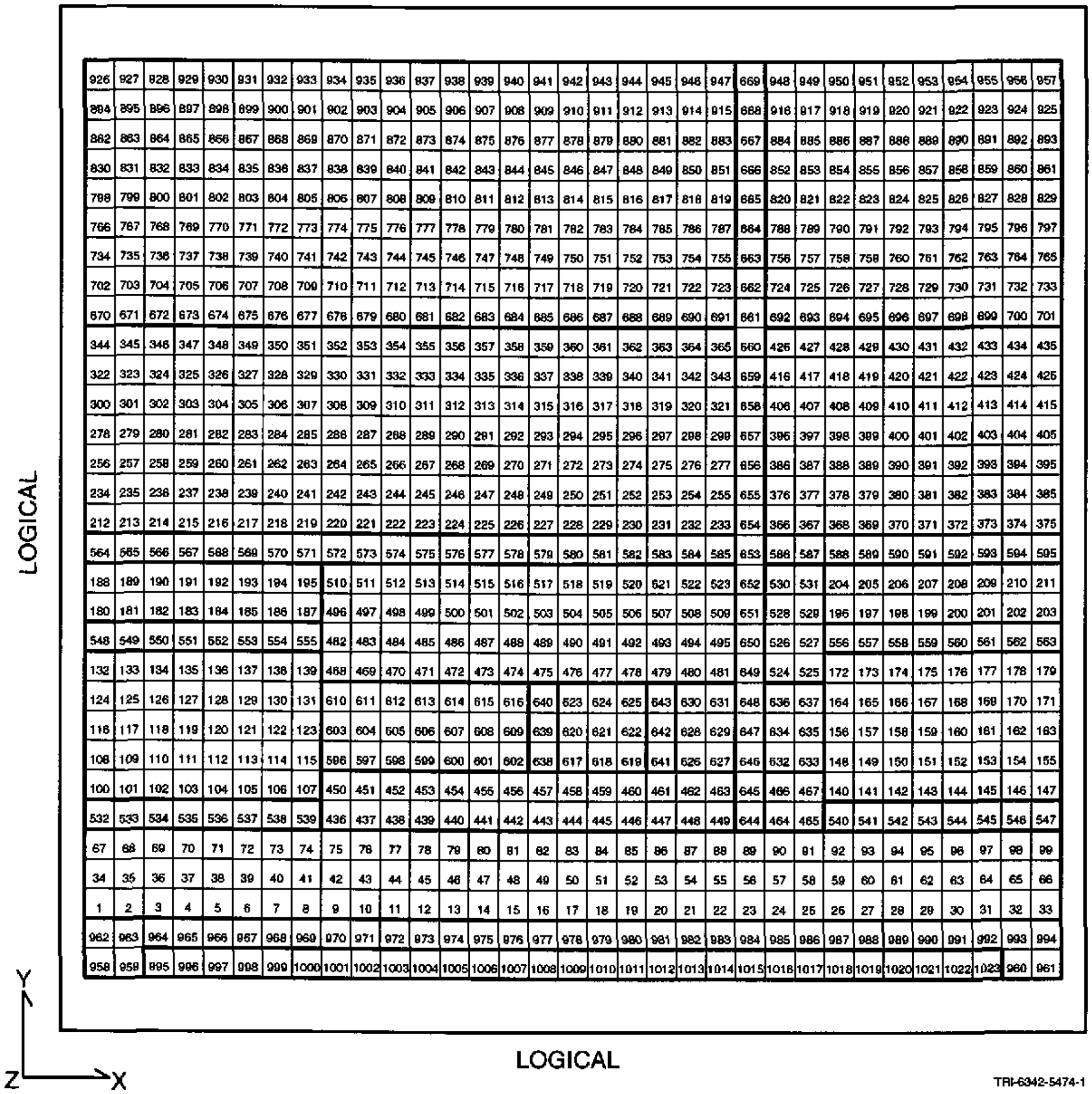
91	A00U234	Ci	U^{234} integrated flux up borehole at Rustler/Culebra interface
92	A00TH230	Ci	Th^{230} integrated flux up borehole at Rustler/Culebra interface
93	EPA1BHMD	EPA units	Activity of Am^{241} up the borehole at Magenta Dolomite
94	EPA2BHMD	EPA units	Activity of Pu^{239} up the borehole at Magenta Dolomite
95	EPA3BHMD	EPA units	Activity of Pu^{238} up the borehole at Magenta Dolomite
96	EPA4BHMD	EPA units	Activity of U^{234} up the borehole at Magenta Dolomite
97	EPA5BHMD	EPA units	Activity of Th^{230} up the borehole at Magenta Dolomite
98	EPATBHMD	EPA units	Total isotope activity up the borehole at Magenta Dolomite
99	EPA1BHRC	EPA units	Activity of Am^{241} up the borehole at Rustler/Culebra interface
100	EPA2BHRC	EPA units	Activity of Pu^{239} up the borehole at Rustler/Culebra interface
101	EPA3BHRC	EPA units	Activity of Pu^{238} up the borehole at Rustler/Culebra interface
102	EPA4BHRC	EPA units	Activity of U^{234} up the borehole at Rustler/Culebra interface
103	EPA5BHRC	EPA units	Activity of Th^{230} up the borehole at Rustler/Culebra interface
104	EPATBHRC	EPA units	Total isotope activity up borehole at Rustler/Culebra interface
105	EPATBHCB	EPA units	Total isotope activity down the borehole at Castile
106	FL1SH_SR	mRem/year	Flux of Am^{241} up the shaft at Salado/Rustler interface
107	FL2SH_SR	mRem/year	Flux of Pu^{239} up the shaft at Salado/Rustler interface
108	FL3SH_SR	mRem/year	Flux of Pu^{238} up the shaft at Salado/Rustler interface
109	FL4SH_SR	mRem/year	Flux of U^{234} up the shaft at Salado/Rustler interface
110	FL5SH_SR	mRem/year	Flux of Th^{230} up the shaft at Salado/Rustler interface
111	EPA1SHRC	mRem/year	Activity of Am^{241} up the shaft at Rustler/Culebra interface
112	EPA2SHRC	mRem/year	Activity of Pu^{239} up the shaft at Rustler/Culebra interface
113	EPA3SHRC	mRem/year	Activity of Pu^{238} up the shaft at Rustler/Culebra interface
114	EPA4SHRC	mRem/year	Activity of U^{234} up the shaft at Rustler/Culebra interface
115	EPA5SHRC	mRem/year	Activity of Th^{230} up the shaft at Rustler/Culebra interface
116	EPATSHRC	mRem/year	Total isotope activity up the shaft at Rustler/Culebra interface
117	EPAC1_WP	EPA units/m^3	Volume-averaged concentration of Am^{241} in Waste Panel
118	EPAC2_WP	EPA units/m^3	Volume-averaged concentration of Pu^{239} in Waste Panel
119	EPAC3_WP	EPA units/m^3	Volume-averaged concentration of Pu^{238} in Waste Panel
120	EPAC4_WP	EPA units/m^3	Volume-averaged concentration of U^{234} in Waste Panel
121	EPAC5_WP	EPA units/m^3	Volume-averaged concentration of Th^{230} in Waste Panel
122	EPACT_WP	EPA units/m^3	Volume-averaged concentration of all isotopes in Waste Panel
123	EPAC1_RR	EPA units/m^3	Volume-averaged concentration of Am^{241} in Rest of Repository
124	EPAC2_RR	EPA units/m^3	Volume-averaged concentration of Pu^{239} in Rest of Repository
125	EPAC3_RR	EPA units/m^3	Volume-averaged concentration of Pu^{238} in Rest of Repository
126	EPAC4_RR	EPA units/m^3	Volume-Averaged concentration of U^{234} in Rest of Repository
127	EPAC5_RR	EPA units/m^3	Volume-averaged concentration of Th^{230} in Rest of Repository
128	EPACT_RR	EPA units/m^3	Volume-averaged concentration of all isotopes in Rest of
129	DMEPA1WP	EPA units/m^3	Activity of Am^{241} dissolved mass in Waste Panel
130	DMEPA2WP	EPA units/m^3	Activity of Pu^{239} dissolved mass in Waste Panel
131	DMEPA3WP	EPA units/m^3	Activity of Pu^{238} dissolved mass in Waste Panel
132	DMEPA4WP	EPA units/m^3	Activity of U^{234} dissolved mass in Waste Panel
133	DMEPA5WP	EPA units/m^3	Activity of Th^{230} dissolved mass in Waste Panel
134	DMEPATWP	EPA units/m^3	Total activity of dissolved mass of isotopes in Waste Panel
135	DMEPA1RR	EPA units/m^3	Activity of Am^{241} dissolved mass in Rest of Repository
136	DMEPA2RR	EPA units/m^3	Activity of Pu^{239} dissolved mass in Rest of Repository
137	DMEPA3RR	EPA units/m^3	Activity of Pu^{238} dissolved mass in Rest of Repository
138	DMEPA4RR	EPA units/m^3	Activity of U^{234} dissolved mass in Rest of Repository
139	DMEPA5RR	EPA units/m^3	Activity of Th^{230} dissolved mass in Rest of Repository

140	DMEPATRR	EPA units/m^3	Total activity of dissolved mass of isotopes in Rest of
141	PMEPA1WP	EPA units/m^3	Activity of Am^{241} undissolved mass in Waste Panel
142	PMEPA2WP	EPA units/m^3	Activity of Pu^{239} undissolved mass in Waste Panel
143	PMEPA3WP	EPA units/m^3	Activity of Pu^{238} undissolved mass in Waste Panel
144	PMEPA4WP	EPA units/m^3	Activity of U^{234} undissolved mass in Waste Panel
145	PMEPA5WP	EPA units/m^3	Activity of Th^{230} undissolved mass in Waste Panel
146	PMEPATWP	EPA units/m^3	Total activity of undissolved mass of isotopes in Waste Panel
147	PMEPA1RR	EPA units/m^3	Activity of Am^{241} undissolved mass in Rest of Repository
148	PMEPA2RR	EPA units/m^3	Activity of Pu^{239} undissolved mass in Rest of Repository
149	PMEPA3RR	EPA units/m^3	Activity of Pu^{238} undissolved mass in Rest of Repository
150	PMEPA4RR	EPA units/m^3	Activity of U^{234} undissolved mass in Rest of Repository
151	PMEPA5RR	EPA units/m^3	Activity of Th^{230} undissolved mass in Rest of Repository
152	PMEPATRR	EPA units/m^3	Total activity of undissolved mass of isotopes in Rest of
153	TA1_MBN	Ci	Total activity of Am^{241} in marker beds north of the repository
154	TA2_MBN	Ci	Total activity of Pu^{239} in marker beds north of the repository
155	TA3_MBN	Ci	Total activity of Pu^{238} in marker beds north of the repository
156	TA4_MBN	Ci	Total activity of U^{234} in marker beds north of the repository
157	TA5_MBN	Ci	Total activity of Th^{230} in marker beds north of the repository
158	TA1_MBS	Ci	Total activity of Am^{241} in marker beds south of the repository
159	TA2_MBS	Ci	Total activity of Pu^{239} in marker beds south of the repository
160	TA3_MBS	Ci	Total activity of Pu^{238} in marker beds south of the repository
161	TA4_MBS	Ci	Total activity of U^{234} in marker beds south of the repository
162	TA5_MBS	Ci	Total activity of Th^{230} in marker beds south of the repository
163	TA1_MBT	Ci	Total activity of Am^{241} in all marker beds
164	TA2_MBT	Ci	Total activity of Pu^{239} in all marker beds
165	TA3_MBT	Ci	Total activity of Pu^{238} in all marker beds
166	TA4_MBT	Ci	Total activity of U^{234} in all marker beds
167	TA5_MBT	Ci	Total activity of Th^{230} in all marker beds
168	TEPA1MBN	EPA units	Total EPA activity of Am^{241} in marker beds north of repository
169	TEPA2MBN	EPA units	Total EPA activity of Pu^{239} in marker beds north of repository
170	TEPA3MBN	EPA units	Total EPA activity of Pu^{238} in marker beds north of repository
171	TEPA4MBN	EPA units	Total EPA activity of U^{234} in marker beds north of repository
172	TEPA5MBN	EPA units	Total EPA activity of Th^{230} in marker beds north of repository
173	TEPA1MBS	EPA units	Total EPA activity of Am^{241} in marker beds south of repository
174	TEPA2MBS	EPA units	Total EPA activity of Pu^{239} in marker beds south of repository
175	TEPA3MBS	EPA units	Total EPA activity of Pu^{238} in marker beds south of repository
176	TEPA4MBS	EPA units	Total EPA activity of U^{234} in marker beds south of repository
177	TEPA5MBS	EPA units	Total EPA activity of Th^{230} in marker beds south of repository
178	TEPA1MBT	EPA units	Total EPA activity of Am^{241} in all marker beds
179	TEPA2MBT	EPA units	Total EPA activity of Pu^{239} in all marker beds
180	TEPA3MBT	EPA units	Total EPA activity of Pu^{238} in all marker beds
181	TEPA4MBT	EPA units	Total EPA activity of U^{234} in all marker beds
182	TEPA5MBT	EPA units	Total EPA activity of Th^{230} in all marker beds
183	TEPATMBN	EPA units	Total EPA activity of all isotopes in North marker beds
184	TEPATMBS	EPA units	Total EPA activity of all isotopes in South marker beds
185	TEPATMBT	EPA units	Total EPA activity of all isotopes in all marker beds
186	TEPA1_WP	EPA units	Total activity of Am^{241} in Waste Panel
187	TEPA2_WP	EPA units	Total activity of Pu^{239} in Waste Panel
188	TEPA3_WP	EPA units	Total activity of Pu^{238} in Waste Panel

189	TEPA4_WP	EPA units	Total activity of U^{234} in Waste Panel
190	TEPA5_WP	EPA units	Total activity of Th^{230} in Waste Panel
191	TEPAT_WP	EPA units	Total isotope activity in Waste Panel
192	TEPA1_RR	EPA units	Total activity of Am^{241} in Rest of Repository
193	TEPA2_RR	EPA units	Total activity of Pu^{239} in Rest of Repository
194	TEPA3_RR	EPA units	Total activity of Pu^{238} in Rest of Repository
195	TEPA4_RR	EPA units	Total activity of U^{234} in Rest of Repository
196	TEPA5_RR	EPA units	Total activity of Th^{230} in Rest of Repository
197	TEPAT_RR	EPA units	Total isotope activity in Rest of Repository
198	FL1BH_RC	Ci/s	Flux of Am^{241} up the borehole at Rustler/Culebra interface
199	FL2BH_RC	Ci/s	Flux of Pu^{239} up the borehole at Rustler/Culebra interface
200	FL3BH_RC	Ci/s	Flux of Pu^{238} up the borehole at Rustler/Culebra interface
201	FL4BH_RC	Ci/s	Flux of U^{234} up the borehole at Rustler/Culebra interface
202	FL5BH_RC	Ci/s	Flux of Th^{230} up the borehole at Rustler/Culebra interface
203	CON1BHRC	kg/m^3 brine	Concentration of Am^{241} in borehole at Rustler/Culebra interface
204	CON2BHRC	kg/m^3 brine	Concentration of Pu^{239} in borehole at Rustler/Culebra interface
205	CON3BHRC	kg/m^3 brine	Concentration of Pu^{238} in borehole at Rustler/Culebra interface
206	CON4BHRC	kg/m^3 brine	Concentration of U^{234} in borehole at Rustler/Culebra interface
207	CON5BHRC	kg/m^3 brine	Concentration of Th^{230} in borehole at Rustler/Culebra interface

APPENDIX I: BRAGFLO Logical Grid Blocks

The gridding below is for the undisturbed scenario 1. The disturbed scenario has different grid numbering in the Castile region. The only important difference for our use is for the grid blocks where the borehole intersects the Castile. In the undisturbed grid, these are blocks 973 and 1004, while in the disturbed grid, these are block 985 and 1010 respectively.



APPENDIX J: Post-NUTS ALGEBRACDB Screening Input File

```
!===========================================================================
!
! ALGEBRA file for post-processing NUTS (screening runs) output
!
! 6 August 1996 - Corrected mesh numbering error involving brine pocket
!             element numbers
!
! Author:  Joel D. Miller, SNL Org. 9363
!
!===========================================================================
!
! Eliminate excess output
!
DELETE ALL
!
GRIDVOL = DEL_X * DEL_Y * THICK
!
!***************************************************************************
!***************************************************************************
!
! Brine fluxes (flow rates in kg/s) across the repository boundary
!
!  Param 001: outward flux of waste-c brine at repository boundary --> FLXWBREP
!  Param 002: outward flux of Castile brine at repository boundary --> FLXCBREP
!
! Brine masses (kg) across the repository boundary
!
!  Param 003: waste-c brine mass outward past repository boundary --> MKGWBREP
!  Param 004: Castile brine mass outware past repository boundary --> MKGCBREP
!
!***************************************
!
! Cumulative outward flux across repository boundary, waste-contaminated brine
!
!  Accumulate x-direction outward fluxes from left side of repository
!
FLXWBREP =            IFLT0(FLUXIM1[E:596],-1.0*FLUXIM1[E:596],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXIM1[E:603],-1.0*FLUXIM1[E:603],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXIM1[E:610],-1.0*FLUXIM1[E:610],0.0)
!
!  Add x-direction outward flux contributions from right side
!
FLXWBREP = FLXWBREP + IFGT0(FLUXIM1[E:641],FLUXIM1[E:641],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXIM1[E:642],FLUXIM1[E:642],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXIM1[E:643],FLUXIM1[E:643],0.0)
!
!  Add y-direction outward fluxes from bottom of repository
!
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:596],-1.0*FLUXJM1[E:596],0.0)
```

```
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:597],-1.0*FLUXJM1[E:597],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:598],-1.0*FLUXJM1[E:598],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:599],-1.0*FLUXJM1[E:599],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:600],-1.0*FLUXJM1[E:600],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:601],-1.0*FLUXJM1[E:601],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:602],-1.0*FLUXJM1[E:602],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:638],-1.0*FLUXJM1[E:638],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:617],-1.0*FLUXJM1[E:617],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:618],-1.0*FLUXJM1[E:618],0.0)
FLXWBREP = FLXWBREP + IFLT0(FLUXJM1[E:619],-1.0*FLUXJM1[E:619],0.0)
!
!  Add Y-direction outward flux contributions from top side
!
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:468],FLUXJM1[E:468],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:469],FLUXJM1[E:469],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:470],FLUXJM1[E:470],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:471],FLUXJM1[E:471],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:472],FLUXJM1[E:472],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:473],FLUXJM1[E:473],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:474],FLUXJM1[E:474],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:475],FLUXJM1[E:475],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:476],FLUXJM1[E:476],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:477],FLUXJM1[E:477],0.0)
FLXWBREP = FLXWBREP + IFGT0(FLUXJM1[E:478],FLUXJM1[E:478],0.0)
!
!*****************************************
!
! Cumulative outward flux across repository boundary, Castile brine
!
!  Accumulate x-direction outward fluxes from left side of repository
!
FLXCBREP =            IFLT0(FLUXIM2[E:596],-1.0*FLUXIM2[E:596],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXIM2[E:603],-1.0*FLUXIM2[E:603],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXIM2[E:610],-1.0*FLUXIM2[E:610],0.0)
!
!  Add x-direction outward flux contributions from right side
!
FLXCBREP = FLXCBREP + IFGT0(FLUXIM2[E:641],FLUXIM2[E:641],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXIM2[E:642],FLUXIM2[E:642],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXIM2[E:643],FLUXIM2[E:643],0.0)
!
!  Add y-direction outward fluxes from bottom of repository
!
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:596],-1.0*FLUXJM2[E:596],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:597],-1.0*FLUXJM2[E:597],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:598],-1.0*FLUXJM2[E:598],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:599],-1.0*FLUXJM2[E:599],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:600],-1.0*FLUXJM2[E:600],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:601],-1.0*FLUXJM2[E:601],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:602],-1.0*FLUXJM2[E:602],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:638],-1.0*FLUXJM2[E:638],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:617],-1.0*FLUXJM2[E:617],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:618],-1.0*FLUXJM2[E:618],0.0)
FLXCBREP = FLXCBREP + IFLT0(FLUXJM2[E:619],-1.0*FLUXJM2[E:619],0.0)
!
```

```
!  Add Y-direction outward flux contributions from top side
!
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:468],FLUXJM2[E:468],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:469],FLUXJM2[E:469],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:470],FLUXJM2[E:470],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:471],FLUXJM2[E:471],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:472],FLUXJM2[E:472],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:473],FLUXJM2[E:473],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:474],FLUXJM2[E:474],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:475],FLUXJM2[E:475],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:476],FLUXJM2[E:476],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:477],FLUXJM2[E:477],0.0)
FLXCBREP = FLXCBREP + IFGT0(FLUXJM2[E:478],FLUXJM2[E:478],0.0)
!
!*************************************
!
!  Integrate over time to get brine mass (kg) across repository boundary
!
MKGWBREP = INTRIGHT(FLXWBREP)
MKGCBREP = INTRIGHT(FLXCBREP)
!
!***************************************************************************
!***************************************************************************
!
! Brine fluxes (flow rates in kg/s) into marker beds at repository
!
!  Param 005: waste-c brine flux, MB 138 close-in, North ---------> FLWBM38N
!  Param 006: Castile brine flux, MB 138 close-in, North ---------> FLCBM38N
!
!  Param 007: waste-c brine flux, Anhydrite A&B close-in, North --> FLWBAABN
!  Param 008: Castile brine flux, Anhydrite A&B close-in, North --> FLCBAABN
!
!  Param 009: waste-c brine flux, MB 139 close-in, North ---------> FLWBM39N
!  Param 010: Castile brine flux, MB 139 close-in, North ---------> FLCBM39N
!
!  Param 011: waste-c brine flux, MB 138 close-in, South ---------> FLWBM38S
!  Param 012: Castile brine flux, MB 138 close-in, South ---------> FLCBM38S
!
!  Param 013: waste-c brine flux, Anhydrite A&B close-in, South --> FLWBAABS
!  Param 014: Castile brine flux, Anhydrite A&B close-in, South --> FLCBAABS
!
!  Param 015: waste-c brine flux, MB 139 close-in, South ---------> FLWBM39S
!  Param 016: Castile brine flux, MB 139 close-in, South ---------> FLCBM39S
!
!  Param 017: waste-c brine, flux in all marker beds, close-in ---> FLWB_MBC
!  Param 018: Castile brine, flux in all marker beds, close-in ---> FLCB_MBC
!
! Brine masses (kg) into marker beds at repository
!
!  Param 019: waste-c brine, MB 138 close-in, North --------------> KGWBM38N
!  Param 020: Castile brine, MB 138 close-in, North --------------> KGCBM38N
!
!  Param 021: waste-c brine, Anhydrite A&B close-in, North -------> KGWBAABN
!  Param 022: Castile brine, Anhydrite A&B close-in, North -------> KGCBAABN
!
```

```
!  Param 023: waste-c brine, MB 139 close-in, North --------------> KGWBM39N
!  Param 024: Castile brine, MB 139 close-in, North --------------> KGCBM39N
!
!  Param 025: waste-c brine, MB 138 close-in, South --------------> KGWBM38S
!  Param 026: Castile brine, MB 138 close-in, South --------------> KGCBM38S
!
!  Param 027: waste-c brine, Anhydrite A&B close-in, South -------> KGWBAABS
!  Param 028: Castile brine, Anhydrite A&B close-in, South -------> KGCBAABS
!
!  Param 029: waste-c brine, MB 139 close-in, South --------------> KGWBM39S
!  Param 030: Castile brine, MB 139 close-in, South --------------> KGCBM39S
!
!  Param 031: waste-c brine in all marker beds, close-in ---------> KGWB_MBC
!  Param 032: Castile brine in all marker beds, close-in ---------> KGCB_MBC
!
!***************************************
!
! Brine fluxes into MB 138 away from repository, north (right) side
!
FLWBM38N = IFGT0(FLUXIM1[E:588],FLUXIM1[E:588],0.0)
FLCBM38N = IFGT0(FLUXIM2[E:588],FLUXIM2[E:588],0.0)
!
!***************************************
!
! Brine fluxes into Anhydrite A&B away from repository, north side
!
FLWBAABN = IFGT0(FLUXIM1[E:556],FLUXIM1[E:556],0.0)
FLCBAABN = IFGT0(FLUXIM2[E:556],FLUXIM2[E:556],0.0)
!
!***************************************
!
! Brine fluxes into MB 139 away from repository, north (right) side
!
FLWBM39N = IFGT0(FLUXIM1[E:540],FLUXIM1[E:540],0.0)
FLCBM39N = IFGT0(FLUXIM2[E:540],FLUXIM2[E:540],0.0)
!
!***************************************
!
! Brine fluxes into MB 138 away from repository, south (left) side
!
FLWBM38S = IFLT0(FLUXIM1[E:572],-1.0*FLUXIM1[E:572],0.0)
FLCBM38S = IFLT0(FLUXIM2[E:572],-1.0*FLUXIM2[E:572],0.0)
!
!***************************************
!
! Brine fluxes into Anhydrite A&B away from repository, south side
!
FLWBAABS = IFLT0(FLUXIM1[E:482],-1.0*FLUXIM1[E:482],0.0)
FLCBAABS = IFLT0(FLUXIM2[E:482],-1.0*FLUXIM2[E:482],0.0)
!
!***************************************
!
! Brine fluxes into MB 139 away from repository, south (left) side
!
FLWBM39S = IFLT0(FLUXIM1[E:436],-1.0*FLUXIM1[E:436],0.0)
```

```
FLCBM39S = IFLT0(FLUXIM2[E:436],-1.0*FLUXIM2[E:436],0.0)
!
!***************************************
!
! Total outward brine fluxes into all anhydrite layers
!
FLWB_MBC = FLWBM38N + FLWBAABN + FLWBM39N + FLWBM38S + FLWBAABS + FLWBM39S
FLCB_MBC = FLCBM38N + FLCBAABN + FLCBM39N + FLCBM38S + FLCBAABS + FLCBM39S
!
!***************************************
!***************************************
!
! Brine masses in MB 138 away from repository, north (right) side
!
!  Integrate flux (kg/s) over time to get mass (kg)
!
KGWBM38N = INTRIGHT(FLWBM38N)
KGCBM38N = INTRIGHT(FLCBM38N)
!
!***************************************
!
! Brine masses in Anhydrite A&B away from repository, north side
!
KGWBAABN = INTRIGHT(FLWBAABN)
KGCBAABN = INTRIGHT(FLCBAABN)
!
!***************************************
!
! Brine masses in MB 139 away from repository, north (right) side
!
KGWBM39N = INTRIGHT(FLWBM39N)
KGCBM39N = INTRIGHT(FLCBM39N)
!
!***************************************
!
! Brine masses in MB 138 away from repository, south (left) side
!
KGWBM38S = INTRIGHT(FLWBM38S)
KGCBM38S = INTRIGHT(FLCBM38S)
!
!***************************************
!
! Brine masses in Anhydrite A&B away from repository, south side
!
KGWBAABS = INTRIGHT(FLWBAABS)
KGCBAABS = INTRIGHT(FLCBAABS)
!
!***************************************
!
! Brine masses in MB 139 away from repository, south (left) side
!
KGWBM39S = INTRIGHT(FLWBM39S)
KGCBM39S = INTRIGHT(FLCBM39S)
!
!***************************************
```

```
!
! Total brine mass outward into all anhydrite layers, close-in
!
KGWB_MBC = INTRIGHT(FLWB_MBC)
KGCB_MBC = INTRIGHT(FLCB_MBC)
!
!*****************************************************************************
!*****************************************************************************
!
! Brine fluxes (flow rates in kg/s) in marker beds at land-withdrawal boundary
!
!  Param 033: waste-c brine flux, MB 138 l-w bdry, North ---------> WBFLM38N
!  Param 034: Castile brine flux, MB 138 l-w bdry, North ---------> CBFLM38N
!
!  Param 035: waste-c brine flux, Anhydrite A&B l-w bdry, North --> WBFLAABN
!  Param 036: Castile brine flux, Anhydrite A&B l-w bdry, North --> CBFLAABN
!
!  Param 037: waste-c brine flux, MB 139 l-w bdry, North ---------> WBFLM39N
!  Param 038: Castile brine flux, MB 139 l-w bdry, North ---------> CBFLM39N
!
!  Param 039: waste-c brine flux, MB 138 l-w bdry, South ---------> WBFLM38S
!  Param 040: Castile brine flux, MB 138 l-w bdry, South ---------> CBFLM38S
!
!  Param 041: waste-c brine flux, Anhydrite A&B l-w bdry, South --> WBFLAABS
!  Param 042: Castile brine flux, Anhydrite A&B l-w bdry, South --> CBFLAABS
!
!  Param 043: waste-c brine flux, MB 139 l-w bdry, South ---------> WBFLM39S
!  Param 044: Castile brine flux, MB 139 l-w bdry, South ---------> CBFLM39S
!
!  Param 045: waste-c brine, flux in all marker beds, l-w bdry ---> WBFL_MBC
!  Param 046: Castile brine, flux in all marker beds, l-w bdry ---> CBFL_MBC
!
! Brine masses (kg) in marker beds across land-withdrawal boundary
!
!  Param 047: waste-c brine, MB 138 l-w bdry, North --------------> WBLWM38N
!  Param 048: Castile brine, MB 138 l-w bdry, North --------------> CBLWM38N
!
!  Param 049: waste-c brine, Anhydrite A&B l-w bdry, North -------> WBLWAABN
!  Param 050: Castile brine, Anhydrite A&B l-w bdry, North -------> CBLWAABN
!
!  Param 051: waste-c brine, MB 139 l-w bdry, North --------------> WBLWM39N
!  Param 052: Castile brine, MB 139 l-w bdry, North --------------> CBLWM39N
!
!  Param 053: waste-c brine, MB 138 l-w bdry, South --------------> WBLWM38S
!  Param 054: Castile brine, MB 138 l-w bdry, South --------------> CBLWM38S
!
!  Param 055: waste-c brine, Anhydrite A&B l-w bdry, South -------> WBLWAABS
!  Param 056: Castile brine, Anhydrite A&B l-w bdry, South -------> CBLWAABS
!
!  Param 057: waste-c brine, MB 139 l-w bdry, South --------------> WBLWM39S
!  Param 058: Castile brine, MB 139 l-w bdry, South --------------> CBLWM39S
!
!  Param 059: waste-c brine in all marker beds, l-w bdry ---------> WBLW_MBC
!  Param 060: Castile brine in all marker beds, l-w bdry ---------> CBLW_MBC
!
```

```
!****************************************
!
! Brine fluxes in MB 138 across land-withdrawal boundary, north (right) side
!
WBFLM38N = IFGT0(FLUXIM1[E:594],FLUXIM1[E:594],0.0)
CBFLM38N = IFGT0(FLUXIM2[E:594],FLUXIM2[E:594],0.0)
!
!****************************************
!
! Brine fluxes in Anhydrite A&B across land-withdrawal boundary, north side
!
WBFLAABN = IFGT0(FLUXIM1[E:562],FLUXIM1[E:562],0.0)
CBFLAABN = IFGT0(FLUXIM2[E:562],FLUXIM2[E:562],0.0)
!
!****************************************
!
! Brine fluxes in MB 139 across land-withdrawal boundary, north (right) side
!
WBFLM39N = IFGT0(FLUXIM1[E:546],FLUXIM1[E:546],0.0)
CBFLM39N = IFGT0(FLUXIM2[E:546],FLUXIM2[E:546],0.0)
!
!****************************************
!
! Brine fluxes in MB 138 across land-withdrawal boundary, south (left) side
!
WBFLM38S = IFLT0(FLUXIM1[E:566],-1.0*FLUXIM1[E:566],0.0)
CBFLM38S = IFLT0(FLUXIM2[E:566],-1.0*FLUXIM2[E:566],0.0)
!
!****************************************
!
! Brine fluxes in Anhydrite A&B across land-withdrawal boundary, south side
!
WBFLAABS = IFLT0(FLUXIM1[E:550],-1.0*FLUXIM1[E:550],0.0)
CBFLAABS = IFLT0(FLUXIM2[E:550],-1.0*FLUXIM2[E:550],0.0)
!
!****************************************
!
! Brine fluxes in MB 139 across land-withdrawal boundary, south (left) side
!
WBFLM39S = IFLT0(FLUXIM1[E:534],-1.0*FLUXIM1[E:534],0.0)
CBFLM39S = IFLT0(FLUXIM2[E:534],-I.0*FLUXIM2[E:534],0.0)
!
!****************************************
!
! Total outward fluxes across land-withdrawal boundary in all anhydrite layers
!
WBFL_MBC = WBFLM38N + WBFLAABN + WBFLM39N + WBFLM38S + WBFLAABS + WBFLM39S
CBFL_MBC = CBFLM38N + CBFLAABN + CBFLM39N + CBFLM38S + CBFLAABS + CBFLM39S
!
!****************************************
!****************************************
!
! Brine masses in MB 138 across land-withdrawal boundary, north (right) side
!
!  Integrate flow rate (kg/s) over time to get mass (kg)
```

```
!
WBLWM38N = INTRIGHT(WBFLM38N)
CBLWM38N = INTRIGHT(CBFLM38N)
!
!**************************************
!
! Brine masses in Anhydrite A&B across land-withdrawal boundary, north side
!
WBLWAABN = INTRIGHT(WBFLAABN)
CBLWAABN = INTRIGHT(CBFLAABN)
!
!**************************************
!
! Brine masses in MB 139 across land-withdrawal boundary, north (right) side
!
WBLWM39N = INTRIGHT(WBFLM39N)
CBLWM39N = INTRIGHT(CBFLM39N)
!
!**************************************
!
! Brine masses in MB 138 across land-withdrawal boundary, south (left) side
!
WBLWM38S = INTRIGHT(WBFLM38S)
CBLWM38S = INTRIGHT(CBFLM38S)
!
!**************************************
!
! Brine masses in Anhydrite A&B across land-withdrawal boundary, south side
!
WBLWAABS = INTRIGHT(WBFLAABS)
CBLWAABS = INTRIGHT(CBFLAABS)
!
!**************************************
!
! Brine masses in MB 138 across land-withdrawal boundary, south (left) side
!
WBLWM39S = INTRIGHT(WBFLM39S)
CBLWM39S = INTRIGHT(CBFLM39S)
!
!**************************************
!
! Total brine mass in all anhydrite layers, across land-withdrawal boundary
!
WBLW_MBC = INTRIGHT(WBFL_MBC)
CBLW_MBC = INTRIGHT(CBFL_MBC)
!
!***************************************************************************
!***************************************************************************
!
! Length of brineflow zones in marker beds outward from repository (m)
!
!  Param 061: waste-c brineflow zone length, MB 138 North ---------> XLWBM38N
!  Param 062: Castile brineflow zone length, MB 138 North ---------> XLCBM38N
!
!  Param 063: waste-c brineflow zone length, Anhydrite A&B North --> XLWBAABN
```

```
!  Param 064: Castile brineflow zone length, Anhydrite A&B North --> XLCBAABN
!
!  Param 065: waste-c brineflow zone length, MB 139 North ---------> XLWBM39N
!  Param 066: Castile brineflow zone length, MB 139 North ---------> XLCBM39N
!
!  Param 067: waste-c brineflow zone length, MB 138 South ---------> XLWBM38S
!  Param 068: Castile brineflow zone length, MB 138 South ---------> XLCBM38S
!
!  Param 069: waste-c brineflow zone length, Anhydrite A&B South --> XLWBAABS
!  Param 070: Castile brineflow zone length, Anhydrite A&B South --> XLCBAABS
!
!  Param 071: waste-c brineflow zone length, MB 139 South ---------> XLWBM39S
!  Param 072: Castile brineflow zone length, MB 139 South ---------> XLCBM39S
!
!****************************************
!
! Brineflow zone in MB 138 away from repository, north (right) side
!
LIMIT ELEMENT 588 TO 595
!
!  Define meaningful contamination level as exceeding 1E-7 kg
!
MTOL = 1.0E-7
!
!  Determine masses of brine present in each element to be examined
!
FLUX_R1 = IFGT0(FLUXIM1,FLUXIM1,0.0)
FLUX_R2 = IFGT0(FLUXIM2,FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_R1)
MASSCB  = INTRIGHT(FLUX_R2)
!
!  Set reference point for front length at the north repository border
!
XREF38N = X[N:1590]
!
!  Determine average x-coordinate of element centroid as element variable
!
XECENT = NOD2ELE(X)
!
!  Compare mass of brine against contamination limit
!    If criterion met then calculate front length as distance from
!    reference point to centroid of element, otherwise set to zero
!
XDIST1 = IFGT0(MASSWB-MTOL,XECENT-XREF38N,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XECENT-XREF38N,0.0)
!
!  Extract maximum values of front length at each time
!
XLWBM38N = SMAX(XDIST1)
XLCBM38N = SMAX(XDIST2)
!
!  Delete temporary variables (tolerance used below, then deleted)
!
DELETE XREF38N, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_R1, FLUX_R2
!
```

```
!***************************************
!
! Brineflow zone in Anhydrite A&B away from repository, north (right) side
!
LIMIT ELEMENT 556 TO 563
!
FLUX_R1 = IFGT0(FLUXIM1,FLUXIM1,0.0)
FLUX_R2 = IFGT0(FLUXIM2,FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_R1)
MASSCB  = INTRIGHT(FLUX_R2)
!
XREFABN = X[N:1488]
XECENT  = NOD2ELE(X)
!
XDIST1 = IFGT0(MASSWB-MTOL,XECENT-XREFABN,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XECENT-XREFABN,0.0)
!
XLWBAABN = SMAX(XDIST1)
XLCBAABN = SMAX(XDIST2)
!
DELETE XREFABN, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_R1, FLUX_R2
!
!***************************************
!
! Brineflow zone in MB 139 away from repository, north (right) side
!
LIMIT ELEMENT 540 TO 547
!
FLUX_R1 = IFGT0(FLUXIM1,FLUXIM1,0.0)
FLUX_R2 = IFGT0(FLUXIM2,FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_R1)
MASSCB  = INTRIGHT(FLUX_R2)
!
XREF39N = X[N:1284]
XECENT  = NOD2ELE(X)
!
XDIST1 = IFGT0(MASSWB-MTOL,XECENT-XREF39N,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XECENT-XREF39N,0.0)
!
XLWBM39N = SMAX(XDIST1)
XLCBM39N = SMAX(XDIST2)
!
DELETE XREF39N, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_R1, FLUX_R2
!
!***************************************
!***************************************
!
! Brineflow zone in MB 138 away from repository, south (left) side
!
LIMIT ELEMENT 564 TO 571
!
FLUX_L1 = IFLT0(FLUXIM1,-1.0*FLUXIM1,0.0)
FLUX_L2 = IFLT0(FLUXIM2,-1.0*FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_L1)
MASSCB  = INTRIGHT(FLUX_L2)
```

```
!
XREF38S = X[N:1573]
XECENT  = NOD2ELE(X)
!
XDIST1 = IFGT0(MASSWB-MTOL,XREF38S-XECENT,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XREF38S-XECENT,0.0)
!
XLWBM38S = SMAX(XDIST1)
XLCBM38S = SMAX(XDIST2)
!
DELETE XREF38S, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_L1, FLUX_L2
!
!****************************************
!
! Brineflow zone in Anhydrite A&B away from repository, south (left) side
!
LIMIT ELEMENT 548 TO 555
!
FLUX_L1 = IFLT0(FLUXIM1,-1.0*FLUXIM1,0.0)
FLUX_L2 = IFLT0(FLUXIM2,-1.0*FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_L1)
MASSCB  = INTRIGHT(FLUX_L2)
!
XREFABS = X[N:1471]
XECENT  = NOD2ELE(X)
!
XDIST1 = IFGT0(MASSWB-MTOL,XREFABS-XECENT,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XREFABS-XECENT,0.0)
!
XLWBAABS = SMAX(XDIST1)
XLCBAABS = SMAX(XDIST2)
!
DELETE XREFABS, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_L1, FLUX_L2
!
!****************************************
!
! Brineflow zone in MB 139 away from repository, south (left) side
!
LIMIT ELEMENT 532 to 539
!
FLUX_L1 = IFLT0(FLUXIM1,-1.0*FLUXIM1,0.0)
FLUX_L2 = IFLT0(FLUXIM2,-1.0*FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_L1)
MASSCB  = INTRIGHT(FLUX_L2)
!
XREF39S = X[N:1267]
XECENT  = NOD2ELE(X)
!
XDIST1 = IFGT0(MASSWB-MTOL,XREF39S-XECENT,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XREF39S-XECENT,0.0)
!
XLWBM39S = SMAX(XDIST1)
XLCBM39S = SMAX(XDIST2)
!
DELETE XREF39S, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_L1, FLUX_L2
```

```
!
!*****************************************************************************
!*****************************************************************************
!
! Brine fluxes (flow rates in kg/s) in borehole
!
!  Param 073: waste-c brine flux up borehole to surface (el.937) --> WBFBH_SU
!  Param 074: Castile brine flux up borehole to surface (el.937) --> CBFBH_SU
!
!  Param 075: waste-c brine flux up bh past Dewey Lake (el.905) ---> WBFBH_DL
!  Param 076: Castile brine flux up bh past Dewey Lake (el.905) ---> CBFBH_DL
!
!  Param 077: waste-c brn flx up borehole past Rustler (el.841) ---> WBFBH_RU
!  Param 078: Castile brn flx up borehole past Rustler (el.841) ---> CBFBH_RU
!
!  Param 079: waste-c brine flux up borehole at Magenta (el.777) --> WBFBH_MD
!  Param 080: Castile brine flux up borehole at Magenta (el.777) --> CBFBH_MD
!
!  Param 081: waste-c brn flx up bh at Rustler/Culebra (el.713) ---> WBFBH_RC
!  Param 082: Castile brn flx up bh at Rustler/Culebra (el.713) ---> CBFBH_RC
!
!  Param 083: waste-c brn flux up bh at Salado/Rustler (el.681) ---> WBFBH_SR
!  Param 084: Castile brn flux up bh at Salado/Rustler (el.681) ---> CBFBH_SR
!
!  Param 085: waste-c brn flx down bh at Castile/Brine (el.985) ---> WBFBH_CB
!  Param 086: Castile brn flx down bh at Castile/Brine (el.985) ---> CBFBH_CB
!
! Brine masses (kg) in borehole
!
!  Param 087: waste-c brine mass up borehole to surface (el.937) ----> WB_BH_SU
!  Param 088: Castile brine mass up borehole to surface (el.937) ----> CB_BH_SU
!
!  Param 089: waste-c brine mass up bh past Dewey Lake (el.905) -----> WB_BH_DL
!  Param 090: Castile brine mass up bh past Dewey Lake (el.905) -----> CB_BH_DL
!
!  Param 091: waste-c brine mass up borehole past Rustler (el.841) --> WB_BH_RU
!  Param 092: Castile brine mass up borehole past Rustler (el.841) --> CB_BH_RU
!
!  Param 093: waste-c brine mass up borehole at Magenta (el.777) ----> WB_BH_MD
!  Param 094: Castile brine mass up borehole at Magenta (el.777) ----> CB_BH_MD
!
!  Param 095: waste-c brine mass up bh at Rustler/Culebra (el.713) --> WB_BH_RC
!  Param 096: Castile brine mass up bh at Rustler/Culebra (el.713) --> CB_BH_RC
!
!  Param 097: waste-c brine mass up bh at Salado/Rustler (el.661) ---> WB_BH_SR
!  Param 098: Castile brine mass up bh at Salado/Rustler (el.661) ---> CB_BH_SR
!
!  Param 099: waste-c brine mass down bh at Castile/Brine (el.985) --> WB_BH_CB
!  Param 100: Castile brine mass down bh at Castile/Brine (el.985) --> CB_BH_CB
!
!****************************************
!
LIMIT ELEMENT OFF
!
!****************************************
```

```
!
! Brine fluxes (flow rates) up borehole to surface (kg/s)
!
WBFBH_SU = IFGT0(FLUXJM1[E:937],FLUXJM1[E:937],0.0)
CBFBH_SU = IFGT0(FLUXJM2[E:937],FLUXJM2[E:937],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up borehole past Dewey Lake (kg/s)
!
WBFBH_DL = IFGT0(FLUXJM1[E:905],FLUXJM1[E:905],0.0)
CBFBH_DL = IFGT0(FLUXJM2[E:905],FLUXJM2[E:905],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up borehole past Rustler (kg/s)
!
WBFBH_RU = IFGT0(FLUXJM1[E:841],FLUXJM1[E:841],0.0)
CBFBH_RU = IFGT0(FLUXJM2[E:841],FLUXJM2[E:841],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up borehole at Magenta (kg/s)
!
WBFBH_MD = IFGT0(FLUXJM1[E:777],FLUXJM1[E:777],0.0)
CBFBH_MD = IFGT0(FLUXJM2[E:777],FLUXJM2[E:777],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up borehole at Rustler/Culebra interface (kg/s)
!
WBFBH_RC = IFGT0(FLUXJM1[E:713],FLUXJM1[E:713],0.0)
CBFBH_RC = IFGT0(FLUXJM2[E:713],FLUXJM2[E:713],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up borehole at Salado/Rustler interface (kg/s)
!
WBFBH_SR = IFGT0(FLUXJM1[E:681],FLUXJM1[E:681],0.0)
CBFBH_SR = IFGT0(FLUXJM2[E:681],FLUXJM2[E:681],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) down borehole at Castile/Brine interface (kg/s)
!
WBFBH_CB = IFLT0(FLUXJM1[E:985],-1.0*FLUXJM1[E:985],0.0)
CBFBH_CB = IFLT0(FLUXJM2[E:985],-1.0*FLUXJM2[E:985],0.0)
!
!****************************************
!****************************************
!
! Brine masses up borehole to surface (kg)
!
WB_BH_SU = INTRIGHT(WBFBH_SU)
CB_BH_SU = INTRIGHT(CBFBH_SU)
```

```
!
!**************************************
!
! Brine masses up borehole past Dewey Lake (kg)
!
WB_BH_DL = INTRIGHT(WBFBH_DL)
CB_BH_DL = INTRIGHT(CBFBH_DL)
!
!**************************************
!
! Brine masses up borehole past Rustler (kg)
!
WB_BH_RU = INTRIGHT(WBFBH_RU)
CB_BH_RU = INTRIGHT(CBFBH_RU)
!
!**************************************
!
! Brine masses up borehole at Magenta (kg)
!
WB_BH_MD = INTRIGHT(WBFBH_MD)
CB_BH_MD = INTRIGHT(CBFBH_MD)
!
!**************************************
!
! Brine masses up borehole at Rustler/Culebra interface (kg)
!
WB_BH_RC = INTRIGHT(WBFBH_RC)
CB_BH_RC = INTRIGHT(CBFBH_RC)
!
!**************************************
!
! Brine masses up borehole at Salado/Rustler interface (kg)
!
WB_BH_SR = INTRIGHT(WBFBH_SR)
CB_BH_SR = INTRIGHT(CBFBH_SR)
!
!**************************************
!
! Brine masses down borehole at Castile/Brine interface (kg)
!
WB_BH_CB = INTRIGHT(WBFBH_CB)
CB_BH_CB = INTRIGHT(CBFBH_CB)
!
!****************************************************************************
!****************************************************************************
!
! Extent of brine flow zone in brine pocket outward from borehole (m)
!
!  Param 101: waste-c brineflow zone length in brine pocket, North --> XLWBBPN
!  Param 102: Castile brineflow zone length in brine pocket, North --> XLCBBPN
!
!  Param 103: waste-c brineflow zone length in brine pocket, South --> XLWBBPS
!  Param 104: Castile brineflow zone length in brine pocket, South --> XLCBBPS
!
!**************************************
```

```
!
! Brine pocket, brineflow zone length (m), North (right) side
!
LIMIT ELEMENT 1011 TO 1023
!
FLUX_R1 = IFGT0(FLUXIM1,FLUXIM1,0.0)
FLUX_R2 = IFGT0(FLUXIM2,FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_R1)
MASSCB  = INTRIGHT(FLUX_R2)
!
XREFBPN = X[N:1101]
XECENT  = NOD2ELE(X)
!
XDIST1 = IFGT0(MASSWB-MTOL,XECENT-XREFBPN,0.0)
XDIST2 = IFGT0(MASSCB-MTOL,XECENT-XREFBPN,0.0)
!
XLWBBPN = SMAX(XDIST1)
XLCBBPN = SMAX(XDIST2)
!
DELETE XREFBPN, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, FLUX_R1, FLUX_R2
!
!*************************************
!
! Brine pocket, brineflow zone length (m), South (left) side
!
LIMIT ELEMENT 1007 to 1009
!
FLUX_L1 = IFLT0(FLUXIM1,-1.0*FLUXIM1,0.0)
FLUX_L2 = IFLT0(FLUXIM2,-1.0*FLUXIM2,0.0)
MASSWB  = INTRIGHT(FLUX_L1)
MASSCB  = INTRIGHT(FLUX_L2)
!
XREFBPS  = X[N:1100]
XECENT   = NOD2ELE(X)
!
XDIST1   = IFGT0(MASSWB-MTOL,XREFBPS-XECENT,0.0)
XDIST2   = IFGT0(MASSCB-MTOL,XREFBPS-XECENT,0.0)
!
XLWBBPS = SMAX(XDIST1)
XLCBBPS = SMAX(XDIST2)
!
DELETE XREFBPS, XECENT, XDIST1, XDIST2, MASSWB, MASSCB, MTOL, FLUX_L1, FLUX_L2
!
!****************************************************************************
!****************************************************************************
!
! Brine fluxes (flow rates in kg/s) in shaft
!
!  Param 105: waste-c brine flux up shaft to surface (el.669) -------> WBFSH_SU
!  Param 106: Castile brine flux up shaft to surface (el.669) -------> CBFSH_SU
!
!  Param 107: waste-c brine flux up shaft past Dewey Lake (el.668) --> WBFSH_DL
!  Param 108: Castile brine flux up shaft past Dewey Lake (el.668) --> CBFSH_DL
!
!  Param 109: waste-c brine flux up shaft past Rustler (el.666) -----> WBFSH_RU
```

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!  Param 110: Castile brine flux up shaft past Rustler (el.666) -----> CBFSH_RU
!
!  Param 111: waste-c brine flux up shaft at Magenta (el.664) -------> WBFSH_MD
!  Param 112: Castile brine flux up shaft at Magenta (el.664) -------> CBFSH_MD
!
!  Param 113: waste-c brn flx up shaft at Rustler/Culebra (el.662) --> WBFSH_RC
!  Param 114: Castile brn flx up shaft at Rustler/Culebra (el.662) --> CBFSH_RC
!
!  Param 115: waste-c brn flx up shaft at Salado/Rustler (el.661) ---> WBFSH_SR
!  Param 116: Castile brn flx up shaft at Salado/Rustler (el.661) ---> CBFSH_SR
!
! Brine masses (kg) in shaft
!
!  Param 117: waste-c brine mass up shaft to surface (el.669) -------> WB_SH_SU
!  Param 118: Castile brine mass up shaft to surface (el.669) -------> CB_SH_SU
!
!  Param 119: waste-c brine mass up shaft past Dewey Lake (el.668) --> WB_SH_DL
!  Param 120: Castile brine mass up shaft past Dewey Lake (el.668) --> CB_SH_DL
!
!  Param 121: waste-c brine mass up shaft past Rustler (el.666) -----> WB_SH_RU
!  Param 122: Castile brine mass up shaft past Rustler (el.666) -----> CB_SH_RU
!
!  Param 123: waste-c brine mass up shaft at Magenta (el.664) -------> WB_SH_MD
!  Param 124: Castile brine mass up shaft at Magenta (el.664) -------> CB_SH_MD
!
!  Param 125: waste-c brn mass up shft at Rustler/Culebra (el.662) --> WB_SH_RC
!  Param 126: Castile brn mass up shft at Rustler/Culebra (el.662) --> CB_SH_RC
!
!  Param 127: waste-c brn mass up shaft at Salado/Rustler (el.661) --> WB_SH_SR
!  Param 128: Castile brn mass up shaft at Salado/Rustler (el.661) --> CB_SH_SR
!
!****************************************
!
LIMIT ELEMENT OFF
!
!****************************************
!
! Brine fluxes up shaft to surface (kg/s)
!
WBFSH_SU = IFGT0(FLUXJM1[E:669],FLUXJM1[E:669],0.0)
CBFSH_SU = IFGT0(FLUXJM2[E:669],FLUXJM2[E:669],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up shaft past Dewey Lake (kg/s)
!
WBFSH_DL = IFGT0(FLUXJM1[E:668],FLUXJM1[E:668],0.0)
CBFSH_DL = IFGT0(FLUXJM2[E:668],FLUXJM2[E:668],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up shaft past Rustler (kg/s)
!
WBFSH_RU = IFGT0(FLUXJM1[E:666],FLUXJM1[E:666],0.0)
CBFSH_RU = IFGT0(FLUXJM2[E:666],FLUXJM2[E:666],0.0)
```

```
!
!****************************************
!
! Brine fluxes (flow rates) up shaft at Magenta (kg/s)
!
WBFSH_MD = IFGT0(FLUXJM1[E:664],FLUXJM1[E:664],0.0)
CBFSH_MD = IFGT0(FLUXJM2[E:664],FLUXJM2[E:664],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up shaft at Rustler/Culebra interface (kg/s)
!
WBFSH_RC = IFGT0(FLUXJM1[E:662],FLUXJM1[E:662],0.0)
CBFSH_RC = IFGT0(FLUXJM2[E:662],FLUXJM2[E:662],0.0)
!
!****************************************
!
! Brine fluxes (flow rates) up shaft at Salado/Rustler interface (kg/s)
!
WBFSH_SR = IFGT0(FLUXJM1[E:661],FLUXJM1[E:661],0.0)
CBFSH_SR = IFGT0(FLUXJM2[E:661],FLUXJM2[E:661],0.0)
!
!****************************************
!****************************************
!
! Brine masses up shaft to surface (kg)
!
WB_SH_SU = INTRIGHT(WBFSH_SU)
CB_SH_SU = INTRIGHT(CBFSH_SU)
!
!****************************************
!
! Brine masses up shaft past Dewey Lake (kg)
!
WB_SH_DL = INTRIGHT(WBFSH_DL)
CB_SH_DL = INTRIGHT(CBFSH_DL)
!
!****************************************
!
! Brine masses up shaft past Rustler (kg)
!
WB_SH_RU = INTRIGHT(WBFSH_RU)
CB_SH_RU = INTRIGHT(CBFSH_RU)
!
!****************************************
!
! Brine masses up shaft at Magenta (kg)
!
WB_SH_MD = INTRIGHT(WBFSH_MD)
CB_SH_MD = INTRIGHT(CBFSH_MD)
!
!****************************************
!
! Brine masses up shaft at Rustler/Culebra interface (kg)
!
```

```
WB_SH_RC = INTRIGHT(WBFSH_RC)
CB_SH_RC = INTRIGHT(CBFSH_RC)
!
!**************************************
!
! Brine masses up shaft at Salado/Rustler interface (kg)
!
WB_SH_SR = INTRIGHT(WBFSH_SR)
CB_SH_SR = INTRIGHT(CBFSH_SR)
!
!***************************************************************************
!***************************************************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole
!
!  Param 129: waste-c brine concentration in borehole element 223 --> WBC_E223
!  Param 130: Castile brine concentration in borehole element 223 --> CBC_E223
!
!  Param 131: waste-c brine concentration in borehole element 681 --> WBC_E681
!  Param 132: Castile brine concentration in borehole element 681 --> CBC_E681
!
!  Param 133: waste-c brine concentration in borehole element 713 --> WBC_E713
!  Param 134: Castile brine concentration in borehole element 713 --> CBC_E713
!
!  Param 135: waste-c brine concentration in borehole element 745 --> WBC_E745
!  Param 136: Castile brine concentration in borehole element 745 --> CBC_E745
!
!  Param 137: waste-c brine concentration in borehole element 777 --> WBC_E777
!  Param 138: Castile brine concentration in borehole element 777 --> CBC_E777
!
!  Param 139: waste-c brine concentration in borehole element 809 --> WBC_E809
!  Param 140: Castile brine concentration in borehole element 809 --> CBC_E809
!
!  Param 141: waste-c brine concentration in borehole element 841 --> WBC_E841
!  Param 142: Castile brine concentration in borehole element 841 --> CBC_E841
!
!  Param 143: waste-c brine concentration in borehole element 873 --> WBC_E873
!  Param 144: Castile brine concentration in borehole element 873 --> CBC_E873
!
!  Param 145: waste-c brine concentration in borehole element 905 --> WBC_E905
!  Param 146: Castile brine concentration in borehole element 905 --> CBC_E905
!
!  Param 147: waste-c brine concentration in borehole element 937 --> WBC_E937
!  Param 148: Castile brine concentration in borehole element 937 --> CBC_E937
!
!**************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 223
!
WBC_E223 = CM1[E:223]
CBC_E223 = CM2[E:223]
!
!**************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 681
```

```
!
WBC_E681 = CM1[E:681]
CBC_E681 = CM2[E:681]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 713
!
WBC_E713 = CM1[E:713]
CBC_E713 = CM2[E:713]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 745
!
WBC_E745 = CM1[E:745]
CBC_E745 = CM2[E:745]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 777
!
WBC_E777 = CM1[E:777]
CBC_E777 = CM2[E:777]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 809
!
WBC_E809 = CM1[E:809]
CBC_E809 = CM2[E:809]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 841
!
WBC_E841 = CM1[E:841]
CBC_E841 = CM2[E:841]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 873
!
WBC_E873 = CM1[E:873]
CBC_E873 = CM2[E:873]
!
!***************************************
!
! Concentration of tracers (kg/m^3 brine) in borehole element 905
!
WBC_E905 = CM1[E:905]
CBC_E905 = CM2[E:905]
!
!***************************************
!
```

```
! Concentration of tracers (kg/m^3 brine) in borehole element 937
!
WBC_E937 = CM1[E:937]
CBC_E937 = CM2[E:937]
!
!*****************************************************************************
!*****************************************************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft
!
!  Param 149: waste-c brine concentration in shaft element 661 --> WBC_E661
!  Param 150: Castile brine concentration in shaft element 661 --> CBC_E661
!
!  Param 151: waste-c brine concentration in shaft element 662 --> WBC_E662
!  Param 152: Castile brine concentration in shaft element 662 --> CBC_E662
!
!  Param 153: waste-c brine concentration in shaft element 663 --> WBC_E663
!  Param 154: Castile brine concentration in shaft element 663 --> CBC_E663
!
!  Param 155: waste-c brine concentration in shaft element 664 --> WBC_E664
!  Param 156: Castile brine concentration in shaft element 664 --> CBC_E664
!
!  Param 157: waste-c brine concentration in shaft element 665 --> WBC_E665
!  Param 158: Castile brine concentration in shaft element 665 --> CBC_E665
!
!  Param 159: waste-c brine concentration in shaft element 666 --> WBC_E666
!  Param 160: Castile brine concentration in shaft element 666 --> CBC_E666
!
!  Param 161: waste-c brine concentration in shaft element 667 --> WBC_E667
!  Param 162: Castile brine concentration in shaft element 667 --> CBC_E667
!
!  Param 163: waste-c brine concentration in shaft element 668 --> WBC_E668
!  Param 164: Castile brine concentration in shaft element 668 --> CBC_E668
!
!  Param 165: waste-c brine concentration in shaft element 669 --> WBC_E669
!  Param 166: Castile brine concentration in shaft element 669 --> CBC_E669
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 661
!
WBC_E661 = CM1[E:661]
CBC_E661 = CM2[E:661]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 662
!
WBC_E662 = CM1[E:662]
CBC_E662 = CM2[E:662]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 663
!
```

```
WBC_E663 = CM1[E:663]
CBC_E663 = CM2[E:663]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 664
!
WBC_E664 = CM1[E:664]
CBC_E664 = CM2[E:664]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 665
!
WBC_E665 = CM1[E:665]
CBC_E665 = CM2[E:665]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 666
!
WBC_E666 = CM1[E:666]
CBC_E666 = CM2[E:666]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 667
!
WBC_E667 = CM1[E:667]
CBC_E667 = CM2[E:667]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 668
!
WBC_E668 = CM1[E:668]
CBC_E668 = CM2[E:668]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in shaft element 669
!
WBC_E669 = CM1[E:669]
CBC_E669 = CM2[E:669]
!
!****************************************************************************
!****************************************************************************
!
! Concentration of tracers (kg/m^3 brine) in marker beds
!
!  Param 167: waste-c brine concen. in MB 138 (N) element 593 -----> WBC_E593
!  Param 168: Castile brine concen. in MB 138 (N) element 593 -----> CBC_E593
!
!  Param 169: waste-c brine concen. in MB 138 (S) element 566 -----> WBC_E566
!  Param 170: Castile brine concen. in MB 138 (S) element 566 -----> CBC_E566
```

```
!
!  Param 171: waste-c brine concen. in Anhyd.A&B (N) element 561 --> WBC_E561
!  Param 172: Castile brine concen. in Anhyd.A&B (N) element 561 --> CBC_E561
!
!  Param 173: waste-c brine concen. in Anhyd.A&B (S) element 550 --> WBC_E550
!  Param 174: Castile brine concen. in Anhyd.A&B (S) element 550 --> CBC_E550
!
!  Param 175: waste-c brine concen. in MB 139 (N) element 545 -----> WBC_E545
!  Param 176: Castile brine concen. in MB 139 (N) element 545 -----> CBC_E545
!
!  Param 177: waste-c brine concen. in MB 139 (S) element 534 -----> WBC_E534
!  Param 178: Castile brine concen. in MB 139 (S) element 534 -----> CBC_E534
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in MB 138 (N) element 593
!
WBC_E593 = CM1[E:593]
CBC_E593 = CM2[E:593]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in MB 138 (S) element 566
!
WBC_E566 = CM1[E:566]
CBC_E566 = CM2[E:566]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in Anhyd.A&B (N) element 561
!
WBC_E561 = CM1[E:561]
CBC_E561 = CM2[E:561]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in Anhyd.A&B (S) element 550
!
WBC_E550 = CM1[E:550]
CBC_E550 = CM2[E:550]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in MB 139 (N) element 545
!
WBC_E545 = CM1[E:545]
CBC_E545 = CM2[E:545]
!
!****************************************
!
! Concentration of tracers (kg/m^3 brine) in MB 139 (S) element 534
!
WBC_E534 = CM1[E:534]
CBC_E534 = CM2[E:534]
!
```

```
!***************************************************************************
!***************************************************************************
!
! Volume-averaged concentration of tracers (kg/m^3 brine) in waste panel
!
!  Param 179: waste-c brine vol-avg concentration in waste panel ---> WBVAC_WP
!  Param 180: Castile brine vol-avg concentration in waste panel ---> CBVAC_WP
!
! Volume-averaged concentration of tracers (kg/m^3 brine) in rest of repository
!
!  Param 181: waste-c brine vol-avg concen. in rest of repository --> WBVAC_RR
!  Param 182: Castile brine vol-avg concen. in rest of repository --> CBVAC_RR
!
! Volume-averaged concentration of tracers (kg/m^3 brine) in repository
!
!  Param 183: waste-c brine vol-avg concentration in repository ----> WBVACREP
!  Param 184: Castile brine vol-avg concentration in repository ----> CBVACREP
!
!***************************************
!
! Waste panel
!
LIMIT ELEMENT 596 TO 616
!
! Total volume of waste area
!
WPVOL = SUM(GRIDVOL)
!
!***************************************
!
! waste-c brine volume-averaged concentration in waste panel (kg/m^3 brine)
!
!  Add up individual element concentrations weighted by element volume
!
WBCWPSUM = SUM(GRIDVOL*CM1)
!
!  Determine average concentration by dividing by total volume of waste panel
!
WBVAC_WP = WBCWPSUM/WPVOL
!
!***************************************
!
! Castile brine volume-averaged concentration in waste panel (kg/m^3 brine)
!
CBCWPSUM = SUM(GRIDVOL*CM2)
CBVAC_WP = CBCWPSUM/WPVOL
!
!***************************************
!
DELETE WPVOL, WBCWPSUM, CBCWPSUM
!
!***************************************
!***************************************
!
! Rest of repository
```

```
!
LIMIT ELEMENT 617 TO 625
!
! Total volume of rest of repository
!
RRVOL = SUM(GRIDVOL)
!
!**************************************
!
! waste-contam brine vol-avgd concentration in rest of repository (kg/m^3 brine)
!
WBCRRSUM = SUM(GRIDVOL*CM1)
WBVAC_RR = WBCRRSUM/RRVOL
!
!**************************************
!
! Castile brine volume-avgd concentration in rest of repository (kg/m^3 brine)
!
CBCRRSUM = SUM(GRIDVOL*CM2)
CBVAC_RR = CBCRRSUM/RRVOL
!
!**************************************
!
DELETE RRVOL, WBCRRSUM, CBCRRSUM
!
!**************************************
!**************************************
!
! Total repository
!
LIMIT ELEMENT 596 TO 625
!
! Total volume of repository
!
REPVOL = SUM(GRIDVOL)
!
!**************************************
!
! waste-c brine volume-averaged concentration in repository (kg/m^3 brine)
!
WBCTRSUM = SUM(GRIDVOL*CM1)
WBVACREP = WBCTRSUM/REPVOL
!
!**************************************
!
! Castile brine volume-averaged concentration in repository (kg/m^3 brine)
!
CBCTRSUM = SUM(GRIDVOL*CM2)
CBVACREP = CBCTRSUM/REPVOL
!
!**************************************
!
DELETE REPVOL, WBCTRSUM, CBCTRSUM
!
!*************************************************************************
```

```
!*******************************************************************************
!
! Volume-averaged concentration of tracers (kg/m^3 brine) in brine pocket
!
!  Param 185: waste-c brine vol-avg concentration in brine pocket --> WBVAC_BP
!  Param 186: Castile brine vol-avg concentration in brine pocket --> CBVAC_BP
!
!****************************************
!
! Brine Pocket
!
LIMIT ELEMENT 1007 TO 1023
!
! Total volume of brine pocket
!
BPVOL = SUM(GRIDVOL)
!
!****************************************
!
! waste-c brine volume-averaged concentration in brine pocket (kg/m^3 brine)
!
WBCBPSUM = SUM(GRIDVOL*CM1)
WBVAC_BP = WBCBPSUM/BPVOL
!
!****************************************
!
! Castile brine volume-averaged concentration in brine pocket (kg/m^3 brine)
!
CBCBPSUM = SUM(GRIDVOL*CM2)
CBVAC_BP = CBCBPSUM/BPVOL
!
!****************************************
!
DELETE BPVOL, WBCBPSUM, CBCBPSUM
!
!*******************************************************************************
!*******************************************************************************
!
LIMIT ELEMENT OFF
!
DELETE GRIDVOL
!
!*******************************************************************************
!*******************************************************************************
END
```

APPENDIX K: Post-NUTS ALGEBRACDB Non-screening Input File

The Post-NUTS ALGEBRACDB file listed below was used to calculate and extract the various analysis variables required to use and evaluate NUTS's computations. They correspond to the NUTS input files discussed in Section 4.2.

```
!==========================================================================
!
! ALGEBRA file for post-processing NUTS (non-screening runs) output
!
! 31 July 1996
!
! NOTE:  This file is for post-processing the disturbed cases only, since
!     it uses a different mesh than the undisturbed case, although the
!     only difference is in the element numbering of the brine pocket.
!     The only parameter calculated here that is affected by the change
!     in element numbers is parameter number 105 = EPATBHCB
!
! Author:  Joel D. Miller, SNL Org. 9363
!
! December 3, 1996
!
! Note:  Evaluation of the mass fluxes for both Uranium and Thorium are
!        added. Although available in NUTS output CDB, they are not
!        solubility limited. One-point upstream winding is used, consistent
!        with NUTS. Solubility limited fluxes will only be different from
!        that reported in NUTS CDB for the isotopes that experience ingrowth.
!
!
! Modified by Ali A. Shinta
!
!==========================================================================
!
! Eliminate excess output
!
DELETE ALL
!
GRIDVOL = DEL_X * DEL_Y * THICK
!
!
!**********                                          **********
!********** START NEW SECTION FOR SOLUBILITY LIMITED FLUXES **********
!**********                              **********
!
!       FLUXIM4N: U-234  fluxes in x-direction in Ci/s
!    FLUXJM4N: U-234  fluxes in y-direction in Ci/s
!    FLUXIM5N: TH-230 fluxes in x-direction in Ci/s
!    FLUXJM5N: TH-230 fluxes in y-direction in Ci/s
!
!
```

```
! Define the conversion factors from kg to Ci for U-234 and Th-230
!
CPKU  = 6.247136468
CPKTH = 20.18221091
!
! Evaluate solubility limited fluxes for the elments of interest
! in x-direction. The elements are: 596, 603, 610, 641, 642, 643,
! 588, 556, 540, 572, 482, 436, 594, 562, 546, 566, 550, 534.
!
!
! Solubility limited fluxes in Ci/s
!
! Uranium 234
!
LIMIT ELEMENT 596
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:596],FLOWBRX[E:596]*CM4[E:115],&
FLOWBRX[E:596]*CM4[E:596])*CPKU)
LIMIT ELEMENT 603
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:603],FLOWBRX[E:603]*CM4[E:123],&
FLOWBRX[E:603]*CM4[E:603])*CPKU)
LIMIT ELEMENT 610
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:610],FLOWBRX[E:610]*CM4[E:131],&
FLOWBRX[E:610]*CM4[E:610])*CPKU)
LIMIT ELEMENT 641
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:641],FLOWBRX[E:641]*CM4[E:619],&
FLOWBRX[E:641]*CM4[E:641])*CPKU)
LIMIT ELEMENT 642
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:642],FLOWBRX[E:642]*CM4[E:622],&
FLOWBRX[E:642]*CM4[E:642])*CPKU)
LIMIT ELEMENT 643
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:643],FLOWBRX[E:643]*CM4[E:625],&
FLOWBRX[E:643]*CM4[E:643])*CPKU)
LIMIT ELEMENT 588
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:588],FLOWBRX[E:588]*CM4[E:587],&
FLOWBRX[E:588]*CM4[E:588])*CPKU)
LIMIT ELEMENT 556
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:556],FLOWBRX[E:556]*CM4[E:527],&
FLOWBRX[E:556]*CM4[E:556])*CPKU)
LIMIT ELEMENT 540
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:540],FLOWBRX[E:540]*CM4[E:465],&
FLOWBRX[E:540]*CM4[E:540])*CPKU)
LIMIT ELEMENT 572
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:572],FLOWBRX[E:572]*CM4[E:571],&
FLOWBRX[E:572]*CM4[E:572])*CPKU)
LIMIT ELEMENT 482
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:482],FLOWBRX[E:482]*CM4[E:555],&
FLOWBRX[E:482]*CM4[E:482])*CPKU)
LIMIT ELEMENT 436
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:436],FLOWBRX[E:436]*CM4[E:539],&
FLOWBRX[E:436]*CM4[E:436])*CPKU)
LIMIT ELEMENT 594
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:594],FLOWBRX[E:594]*CM4[E:593],&
FLOWBRX[E:594]*CM4[E:594])*CPKU)
LIMIT ELEMENT 562
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:562],FLOWBRX[E:562]*CM4[E:561],&
```

```
FLOWBRX[E:562]*CM4[E:562])*CPKU)
LIMIT ELEMENT 546
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:546],FLOWBRX[E:546]*CM4[E:545],&
FLOWBRX[E:546]*CM4[E:546])*CPKU)
LIMIT ELEMENT 566
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:566],FLOWBRX[E:566]*CM4[E:565],&
FLOWBRX[E:566]*CM4[E:566])*CPKU)
LIMIT ELEMENT 550
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:550],FLOWBRX[E:550]*CM4[E:549],&
FLOWBRX[E:550]*CM4[E:550])*CPKU)
LIMIT ELEMENT 534
FLUXIM4N = MAKEELEM(IFGT0(FLOWBRX[E:534],FLOWBRX[E:534]*CM4[E:533],&
FLOWBRX[E:534]*CM4[E:534])*CPKU)
!
! Thorium 230
!
LIMIT ELEMENT 596
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:596],FLOWBRX[E:596]*CM5[E:115],&
FLOWBRX[E:596]*CM5[E:596])*CPKTH)
LIMIT ELEMENT 603
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:603],FLOWBRX[E:603]*CM5[E:123],&
FLOWBRX[E:603]*CM5[E:603])*CPKTH)
LIMIT ELEMENT 610
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:610],FLOWBRX[E:610]*CM5[E:131],&
FLOWBRX[E:610]*CM5[E:610])*CPKTH)
LIMIT ELEMENT 641
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:641],FLOWBRX[E:641]*CM5[E:619],&
FLOWBRX[E:641]*CM5[E:641])*CPKTH)
LIMIT ELEMENT 642
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:642],FLOWBRX[E:642]*CM5[E:622],&
FLOWBRX[E:642]*CM5[E:642])*CPKTH)
LIMIT ELEMENT 643
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:643],FLOWBRX[E:643]*CM5[E:625],&
FLOWBRX[E:643]*CM5[E:643])*CPKTH)
LIMIT ELEMENT 588
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:588],FLOWBRX[E:588]*CM5[E:587],&
FLOWBRX[E:588]*CM5[E:588])*CPKTH)
LIMIT ELEMENT 556
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:556],FLOWBRX[E:556]*CM5[E:527],&
FLOWBRX[E:556]*CM5[E:556])*CPKTH)
LIMIT ELEMENT 540
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:540],FLOWBRX[E:540]*CM5[E:465],&
FLOWBRX[E:540]*CM5[E:540])*CPKTH)
LIMIT ELEMENT 572
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:572],FLOWBRX[E:572]*CM5[E:571],&
FLOWBRX[E:572]*CM5[E:572])*CPKTH)
LIMIT ELEMENT 482
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:482],FLOWBRX[E:482]*CM5[E:555],&
FLOWBRX[E:482]*CM5[E:482])*CPKTH)
LIMIT ELEMENT 436
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:436],FLOWBRX[E:436]*CM5[E:539],&
FLOWBRX[E:436]*CM5[E:436])*CPKTH)
LIMIT ELEMENT 594
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:594],FLOWBRX[E:594]*CM5[E:593],&
FLOWBRX[E:594]*CM5[E:594])*CPKTH)
```

```
LIMIT ELEMENT 562
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:562],FLOWBRX[E:562]*CM5[E:561],&
FLOWBRX[E:562]*CM5[E:562])*CPKTH)
LIMIT ELEMENT 546
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:546],FLOWBRX[E:546]*CM5[E:545],&
FLOWBRX[E:546]*CM5[E:546])*CPKTH)
LIMIT ELEMENT 566
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:566],FLOWBRX[E:566]*CM5[E:565],&
FLOWBRX[E:566]*CM5[E:566])*CPKTH)
LIMIT ELEMENT 550
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:550],FLOWBRX[E:550]*CM5[E:549],&
FLOWBRX[E:550]*CM5[E:550])*CPKTH)
LIMIT ELEMENT 534
FLUXIM5N = MAKEELEM(IFGT0(FLOWBRX[E:534],FLOWBRX[E:534]*CM5[E:533],&
FLOWBRX[E:534]*CM5[E:534])*CPKTH)
!
! Evaluate solubility limited fluxes for the elments of interest
! in y-direction. The elements are: 596 to 602, 638, 617 to 619,
! 468 to 478, 713, 777, 985, 661, 662
!
! Uranium 234
!
LIMIT ELEMENT 596
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:596],FLOWBRY[E:596]*CM4[E:450],&
FLOWBRY[E:596]*CM4[E:596])*CPKU)
LIMIT ELEMENT 597
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:597],FLOWBRY[E:597]*CM4[E:451],&
FLOWBRY[E:597]*CM4[E:597])*CPKU)
LIMIT ELEMENT 598
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:598],FLOWBRY[E:598]*CM4[E:452],&
FLOWBRY[E:598]*CM4[E:598])*CPKU)
LIMIT ELEMENT 599
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:599],FLOWBRY[E:599]*CM4[E:453],&
FLOWBRY[E:599]*CM4[E:599])*CPKU)
LIMIT ELEMENT 600
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:600],FLOWBRY[E:600]*CM4[E:454],&
FLOWBRY[E:600]*CM4[E:600])*CPKU)
LIMIT ELEMENT 601
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:601],FLOWBRY[E:601]*CM4[E:455],&
FLOWBRY[E:601]*CM4[E:601])*CPKU)
LIMIT ELEMENT 602
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:602],FLOWBRY[E:602]*CM4[E:456],&
FLOWBRY[E:602]*CM4[E:602])*CPKU)
LIMIT ELEMENT 638
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:638],FLOWBRY[E:638]*CM4[E:457],&
FLOWBRY[E:638]*CM4[E:638])*CPKU)
LIMIT ELEMENT 617
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:617],FLOWBRY[E:617]*CM4[E:458],&
FLOWBRY[E:617]*CM4[E:617])*CPKU)
LIMIT ELEMENT 618
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:618],FLOWBRY[E:618]*CM4[E:459],&
FLOWBRY[E:618]*CM4[E:618])*CPKU)
LIMIT ELEMENT 619
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:619],FLOWBRY[E:619]*CM4[E:460],&
FLOWBRY[E:619]*CM4[E:619])*CPKU)
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LIMIT ELEMENT 468
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:468],FLOWBRY[E:468]*CM4[E:610],&
FLOWBRY[E:468]*CM4[E:468])*CPKU)
LIMIT ELEMENT 469
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:469],FLOWBRY[E:469]*CM4[E:611],&
FLOWBRY[E:469]*CM4[E:469])*CPKU)
LIMIT ELEMENT 470
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:470],FLOWBRY[E:470]*CM4[E:612],&
FLOWBRY[E:470]*CM4[E:470])*CPKU)
LIMIT ELEMENT 471
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:471],FLOWBRY[E:471]*CM4[E:613],&
FLOWBRY[E:471]*CM4[E:471])*CPKU)
LIMIT ELEMENT 472
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:472],FLOWBRY[E:472]*CM4[E:614],&
FLOWBRY[E:472]*CM4[E:472])*CPKU)
LIMIT ELEMENT 473
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:473],FLOWBRY[E:473]*CM4[E:615],&
FLOWBRY[E:473]*CM4[E:473])*CPKU)
LIMIT ELEMENT 474
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:474],FLOWBRY[E:474]*CM4[E:616],&
FLOWBRY[E:474]*CM4[E:474])*CPKU)
LIMIT ELEMENT 475
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:475],FLOWBRY[E:475]*CM4[E:640],&
FLOWBRY[E:475]*CM4[E:475])*CPKU)
LIMIT ELEMENT 476
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:476],FLOWBRY[E:476]*CM4[E:623],&
FLOWBRY[E:476]*CM4[E:476])*CPKU)
LIMIT ELEMENT 477
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:477],FLOWBRY[E:477]*CM4[E:624],&
FLOWBRY[E:477]*CM4[E:477])*CPKU)
LIMIT ELEMENT 478
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:478],FLOWBRY[E:478]*CM4[E:625],&
FLOWBRY[E:478]*CM4[E:478])*CPKU)
LIMIT ELEMENT 713
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:713],FLOWBRY[E:713]*CM4[E:681],&
FLOWBRY[E:713]*CM4[E:713])*CPKU)
LIMIT ELEMENT 777
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:777],FLOWBRY[E:777]*CM4[E:745],&
FLOWBRY[E:777]*CM4[E:777])*CPKU)
LIMIT ELEMENT 985
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:985],FLOWBRY[E:985]*CM4[E:1010],&
FLOWBRY[E:985]*CM4[E:985])*CPKU)
LIMIT ELEMENT 661
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:661],FLOWBRY[E:661]*CM4[E:660],&
FLOWBRY[E:661]*CM4[E:661])*CPKU)
LIMIT ELEMENT 662
FLUXJM4N = MAKEELEM(IFGT0(FLOWBRY[E:662],FLOWBRY[E:662]*CM4[E:661],&
FLOWBRY[E:662]*CM4[E:662])*CPKU)
!
! Thorium 230
!
LIMIT ELEMENT 596
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:596],FLOWBRY[E:596]*CM5[E:450],&
FLOWBRY[E:596]*CM5[E:596])*CPKTH)
LIMIT ELEMENT 597
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FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:597],FLOWBRY[E:597]*CM5[E:451],&
FLOWBRY[E:597]*CM5[E:597])*CPKTH)
LIMIT ELEMENT 598
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:598],FLOWBRY[E:598]*CM5[E:452],&
FLOWBRY[E:598]*CM5[E:598])*CPKTH)
LIMIT ELEMENT 599
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:599],FLOWBRY[E:599]*CM5[E:453],&
FLOWBRY[E:599]*CM5[E:599])*CPKTH)
LIMIT ELEMENT 600
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:600],FLOWBRY[E:600]*CM5[E:454],&
FLOWBRY[E:600]*CM5[E:600])*CPKTH)
LIMIT ELEMENT 601
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:601],FLOWBRY[E:601]*CM5[E:455],&
FLOWBRY[E:601]*CM5[E:601])*CPKTH)
LIMIT ELEMENT 602
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:602],FLOWBRY[E:602]*CM5[E:456],&
FLOWBRY[E:602]*CM5[E:602])*CPKTH)
LIMIT ELEMENT 638
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:638],FLOWBRY[E:638]*CM5[E:457],&
FLOWBRY[E:638]*CM5[E:638])*CPKTH)
LIMIT ELEMENT 617
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:617],FLOWBRY[E:617]*CM5[E:458],&
FLOWBRY[E:617]*CM5[E:617])*CPKTH)
LIMIT ELEMENT 618
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:618],FLOWBRY[E:618]*CM5[E:459],&
FLOWBRY[E:618]*CM5[E:618])*CPKTH)
LIMIT ELEMENT 619
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:619],FLOWBRY[E:619]*CM5[E:460],&
FLOWBRY[E:619]*CM5[E:619])*CPKTH)
LIMIT ELEMENT 468
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:468],FLOWBRY[E:468]*CM5[E:610],&
FLOWBRY[E:468]*CM5[E:468])*CPKTH)
LIMIT ELEMENT 469
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:469],FLOWBRY[E:469]*CM5[E:611],&
FLOWBRY[E:469]*CM5[E:469])*CPKTH)
LIMIT ELEMENT 470
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:470],FLOWBRY[E:470]*CM5[E:612],&
FLOWBRY[E:470]*CM5[E:470])*CPKTH)
LIMIT ELEMENT 471
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:471],FLOWBRY[E:471]*CM5[E:613],&
FLOWBRY[E:471]*CM5[E:471])*CPKTH)
LIMIT ELEMENT 472
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:472],FLOWBRY[E:472]*CM5[E:614],&
FLOWBRY[E:472]*CM5[E:472])*CPKTH)
LIMIT ELEMENT 473
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:473],FLOWBRY[E:473]*CM5[E:615],&
FLOWBRY[E:473]*CM5[E:473])*CPKTH)
LIMIT ELEMENT 474
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:474],FLOWBRY[E:474]*CM5[E:616],&
FLOWBRY[E:474]*CM5[E:474])*CPKTH)
LIMIT ELEMENT 475
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:475],FLOWBRY[E:475]*CM5[E:640],&
FLOWBRY[E:475]*CM5[E:475])*CPKTH)
LIMIT ELEMENT 476
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:476],FLOWBRY[E:476]*CM5[E:623],&
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FLOWBRY[E:476]*CM5[E:476])*CPKTH)
LIMIT ELEMENT 477
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:477],FLOWBRY[E:477]*CM5[E:624],&
FLOWBRY[E:477]*CM5[E:477])*CPKTH)
LIMIT ELEMENT 478
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:478],FLOWBRY[E:478]*CM5[E:625],&
FLOWBRY[E:478]*CM5[E:478])*CPKTH)
LIMIT ELEMENT 713
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:713],FLOWBRY[E:713]*CM5[E:681],&
FLOWBRY[E:713]*CM5[E:713])*CPKTH)
LIMIT ELEMENT 777
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:777],FLOWBRY[E:777]*CM5[E:745],&
FLOWBRY[E:777]*CM5[E:777])*CPKTH)
LIMIT ELEMENT 985
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:985],FLOWBRY[E:985]*CM5[E:1010],&
FLOWBRY[E:985]*CM5[E:985])*CPKTH)
LIMIT ELEMENT 661
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:661],FLOWBRY[E:661]*CM5[E:660],&
FLOWBRY[E:661]*CM5[E:661])*CPKTH)
LIMIT ELEMENT 662
FLUXJM5N = MAKEELEM(IFGT0(FLOWBRY[E:662],FLOWBRY[E:662]*CM5[E:661],&
FLOWBRY[E:662]*CM5[E:662])*CPKTH)
!
LIMIT ELEMENT OFF
!
DELETE CPKTH, CPKU
!
!********                                                  ********
!************************ END THE NEW SECTION ************************
!********                                                  ********
!
!
!*****************************************************************************
!*****************************************************************************
!
! Activities (integrated fluxes) across the repository boundary (EPA units)
!
!  Param 001: Am-241, activity across repository boundary --> EPA1_REP
!  Param 002: Pu-239, activity across repository boundary --> EPA2_REP
!  Param 003: Pu-238, activity across repository boundary --> EPA3_REP
!  Param 004: U--234, activity across repository boundary --> EPA4_REP
!  Param 005: Th-230, activity across repository boundary --> EPA5_REP
!  Param 006: Total activity across repository boundary ----> EPAT_REP
!
!*********************************************************************
!
! Americium-241 (Am-241) across repository boundary
!
!  Accumulate x-direction outward fluxes from left side of repository
!
FLX1_REP =            IFLT0(FLUXIM1[E:596],-1.0*FLUXIM1[E:596],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXIM1[E:603],-1.0*FLUXIM1[E:603],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXIM1[E:610],-1.0*FLUXIM1[E:610],0.0)
!
!  Add x-direction outward flux contributions from right side
```

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!
FLX1_REP = FLX1_REP + IFGT0(FLUXIM1[E:641],FLUXIM1[E:641],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXIM1[E:642],FLUXIM1[E:642],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXIM1[E:643],FLUXIM1[E:643],0.0)
!
! Add y-direction outward fluxes from bottom of repository
!
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:596],-1.0*FLUXJM1[E:596],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:597],-1.0*FLUXJM1[E:597],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:598],-1.0*FLUXJM1[E:598],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:599],-1.0*FLUXJM1[E:599],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:600],-1.0*FLUXJM1[E:600],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:601],-1.0*FLUXJM1[E:601],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:602],-1.0*FLUXJM1[E:602],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:638],-1.0*FLUXJM1[E:638],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:617],-1.0*FLUXJM1[E:617],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:618],-1.0*FLUXJM1[E:618],0.0)
FLX1_REP = FLX1_REP + IFLT0(FLUXJM1[E:619],-1.0*FLUXJM1[E:619],0.0)
!
! Add Y-direction outward flux contributions from top side
!
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:468],FLUXJM1[E:468],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:469],FLUXJM1[E:469],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:470],FLUXJM1[E:470],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:471],FLUXJM1[E:471],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:472],FLUXJM1[E:472],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:473],FLUXJM1[E:473],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:474],FLUXJM1[E:474],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:475],FLUXJM1[E:475],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:476],FLUXJM1[E:476],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:477],FLUXJM1[E:477],0.0)
FLX1_REP = FLX1_REP + IFGT0(FLUXJM1[E:478],FLUXJM1[E:478],0.0)
!
! Integrate over time to get activity (Curies)
!
RAD1_REP = INTRIGHT(FLX1_REP)
!
!***************************************
!
! Plutonium-239 (Pu-239) across repository boundary
!
! Accumulate x-direction outward fluxes from left side of repository
!
FLX2_REP =            IFLT0(FLUXIM2[E:596],-1.0*FLUXIM2[E:596],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXIM2[E:603],-1.0*FLUXIM2[E:603],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXIM2[E:610],-1.0*FLUXIM2[E:610],0.0)
!
! Add x-direction outward flux contributions from right side
!
FLX2_REP = FLX2_REP + IFGT0(FLUXIM2[E:641],FLUXIM2[E:641],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXIM2[E:642],FLUXIM2[E:642],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXIM2[E:643],FLUXIM2[E:643],0.0)
!
! Add y-direction outward fluxes from bottom of repository
!
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FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:596],-1.0*FLUXJM2[E:596],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:597],-1.0*FLUXJM2[E:597],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:598],-1.0*FLUXJM2[E:598],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:599],-1.0*FLUXJM2[E:599],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:600],-1.0*FLUXJM2[E:600],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:601],-1.0*FLUXJM2[E:601],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:602],-1.0*FLUXJM2[E:602],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:638],-1.0*FLUXJM2[E:638],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:617],-1.0*FLUXJM2[E:617],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:618],-1.0*FLUXJM2[E:618],0.0)
FLX2_REP = FLX2_REP + IFLT0(FLUXJM2[E:619],-1.0*FLUXJM2[E:619],0.0)
!
!  Add Y-direction outward flux contributions from top side
!
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:468],FLUXJM2[E:468],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:469],FLUXJM2[E:469],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:470],FLUXJM2[E:470],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:471],FLUXJM2[E:471],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:472],FLUXJM2[E:472],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:473],FLUXJM2[E:473],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:474],FLUXJM2[E:474],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:475],FLUXJM2[E:475],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:476],FLUXJM2[E:476],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:477],FLUXJM2[E:477],0.0)
FLX2_REP = FLX2_REP + IFGT0(FLUXJM2[E:478],FLUXJM2[E:478],0.0)
!
!  Integrate over time to get activity (Curies)
!
RAD2_REP = INTRIGHT(FLX2_REP)
!
!****************************************
!
! Plutonium-238 (Pu-238) across repository boundary
!
!  Accumulate x-direction outward fluxes from left side of repository
!
FLX3_REP =            IFLT0(FLUXIM3[E:596],-1.0*FLUXIM3[E:596],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXIM3[E:603],-1.0*FLUXIM3[E:603],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXIM3[E:610],-1.0*FLUXIM3[E:610],0.0)
!
!  Add x-direction outward flux contributions from right side
!
FLX3_REP = FLX3_REP + IFGT0(FLUXIM3[E:641],FLUXIM3[E:641],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXIM3[E:642],FLUXIM3[E:642],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXIM3[E:643],FLUXIM3[E:643],0.0)
!
!  Accumulate y-direction outward fluxes from bottom of repository
!
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:596],-1.0*FLUXJM3[E:596],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:597],-1.0*FLUXJM3[E:597],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:598],-1.0*FLUXJM3[E:598],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:599],-1.0*FLUXJM3[E:599],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:600],-1.0*FLUXJM3[E:600],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:601],-1.0*FLUXJM3[E:601],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:602],-1.0*FLUXJM3[E:602],0.0)
```

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FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:638],-1.0*FLUXJM3[E:638],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:617],-1.0*FLUXJM3[E:617],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:618],-1.0*FLUXJM3[E:618],0.0)
FLX3_REP = FLX3_REP + IFLT0(FLUXJM3[E:619],-1.0*FLUXJM3[E:619],0.0)
!
!  Add Y-direction outward flux contributions from top side
!
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:468],FLUXJM3[E:468],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:469],FLUXJM3[E:469],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:470],FLUXJM3[E:470],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:471],FLUXJM3[E:471],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:472],FLUXJM3[E:472],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:473],FLUXJM3[E:473],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:474],FLUXJM3[E:474],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:475],FLUXJM3[E:475],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:476],FLUXJM3[E:476],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:477],FLUXJM3[E:477],0.0)
FLX3_REP = FLX3_REP + IFGT0(FLUXJM3[E:478],FLUXJM3[E:478],0.0)
!
!  Integrate over time to get activity (Curies)
!
RAD3_REP = INTRIGHT(FLX3_REP)
!
!***************************************
!
! Uranium-234 (U-234) across repository boundary
!
!  Accumulate x-direction outward fluxes from left side of repository
!
FLX4_REP =          IFLT0(FLUXIM4N[E:596],-1.0*FLUXIM4N[E:596],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXIM4N[E:603],-1.0*FLUXIM4N[E:603],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXIM4N[E:610],-1.0*FLUXIM4N[E:610],0.0)
!
!  Add x-direction outward flux contributions from right side
!
FLX4_REP = FLX4_REP + IFGT0(FLUXIM4N[E:641],FLUXIM4N[E:641],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXIM4N[E:642],FLUXIM4N[E:642],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXIM4N[E:643],FLUXIM4N[E:643],0.0)
!
!  Accumulate y-direction outward fluxes from bottom of repository
!
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:596],-1.0*FLUXJM4N[E:596],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:597],-1.0*FLUXJM4N[E:597],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:598],-1.0*FLUXJM4N[E:598],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:599],-1.0*FLUXJM4N[E:599],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:600],-1.0*FLUXJM4N[E:600],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:601],-1.0*FLUXJM4N[E:601],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:602],-1.0*FLUXJM4N[E:602],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:638],-1.0*FLUXJM4N[E:638],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:617],-1.0*FLUXJM4N[E:617],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:618],-1.0*FLUXJM4N[E:618],0.0)
FLX4_REP = FLX4_REP + IFLT0(FLUXJM4N[E:619],-1.0*FLUXJM4N[E:619],0.0)
!
!  Add Y-direction outward flux contributions from top side
!
```

```
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:468],FLUXJM4N[E:468],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:469],FLUXJM4N[E:469],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:470],FLUXJM4N[E:470],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:471],FLUXJM4N[E:471],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:472],FLUXJM4N[E:472],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:473],FLUXJM4N[E:473],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:474],FLUXJM4N[E:474],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:475],FLUXJM4N[E:475],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:476],FLUXJM4N[E:476],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:477],FLUXJM4N[E:477],0.0)
FLX4_REP = FLX4_REP + IFGT0(FLUXJM4N[E:478],FLUXJM4N[E:478],0.0)
!
!  Integrate over time to get activity (Curies)
!
RAD4_REP = INTRIGHT(FLX4_REP)
!
!****************************************
!
! Thorium-230 (Th-230) across repository boundary
!
!  Accumulate x-direction outward fluxes from left side of repository
!
FLX5_REP =          IFLT0(FLUXIM5N[E:596],-1.0*FLUXIM5N[E:596],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXIM5N[E:603],-1.0*FLUXIM5N[E:603],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXIM5N[E:610],-1.0*FLUXIM5N[E:610],0.0)
!
!  Add x-direction outward flux contributions from right side
!
FLX5_REP = FLX5_REP + IFGT0(FLUXIM5N[E:641],FLUXIM5N[E:641],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXIM5N[E:642],FLUXIM5N[E:642],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXIM5N[E:643],FLUXIM5N[E:643],0.0)
!
!  Accumulate y-direction outward fluxes from bottom of repository
!
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:596],-1.0*FLUXJM5N[E:596],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:597],-1.0*FLUXJM5N[E:597],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:598],-1.0*FLUXJM5N[E:598],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:599],-1.0*FLUXJM5N[E:599],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:600],-1.0*FLUXJM5N[E:600],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:601],-1.0*FLUXJM5N[E:601],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:602],-1.0*FLUXJM5N[E:602],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:638],-1.0*FLUXJM5N[E:638],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:617],-1.0*FLUXJM5N[E:617],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:618],-1.0*FLUXJM5N[E:618],0.0)
FLX5_REP = FLX5_REP + IFLT0(FLUXJM5N[E:619],-1.0*FLUXJM5N[E:619],0.0)
!
!  Add Y-direction outward flux contributions from top side
!
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:468],FLUXJM5N[E:468],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:469],FLUXJM5N[E:469],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:470],FLUXJM5N[E:470],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:471],FLUXJM5N[E:471],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:472],FLUXJM5N[E:472],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:473],FLUXJM5N[E:473],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:474],FLUXJM5N[E:474],0.0)
```

```
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:475],FLUXJM5N[E:475],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:476],FLUXJM5N[E:476],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:477],FLUXJM5N[E:477],0.0)
FLX5_REP = FLX5_REP + IFGT0(FLUXJM5N[E:478],FLUXJM5N[E:478],0.0)
!
! Integrate over time to get activity (Curies)
!
RAD5_REP = INTRIGHT(FLX5_REP)
!
!*****************************************
!
DELETE FLX1_REP, FLX2_REP, FLX3_REP, FLX4_REP, FLX5_REP
!
!*****************************************
!
! Convert activities to EPA units and sum to get total
!
! Conversion factors
!
!   Qi_Ci  = amount of radionuclide i in Curies
!   Qi_EPA = amount of radionuclide i in EPA units
!
!   Qi_Ci*(1/RLi)*(1.0E6_Ci/Total_inventory) = Qi_EPA
!
!   where Total_inventory is the number of Curies of alpha emitters
!       with half lives greater than twenty years placed in repository,
!       and RLi is the EPA release limit for radionuclide i
!
!   Total_inventory = 4.0736E6 Ci
!   RLi (Am, U, Pu) = 100.0   Ci
!   Rli (Th)        = 10.0    Ci
!
!   Thus, for Am, U, and Pu, Qi_EPA = Qi_Ci/407.36
!       for Th,          Qi_EPA = Qi_Ci/40.736
!
!CI_2_EPA = 407.36
!CI_5_EPA = 40.736
!
! CHANGE FROM 4.07 TO 3.44 MJS 22OCT96
!
CI_2_EPA = 344.0
CI_5_EPA = 34.4
!
EPA1_REP = RAD1_REP/CI_2_EPA
EPA2_REP = RAD2_REP/CI_2_EPA
EPA3_REP = RAD3_REP/CI_2_EPA
EPA4_REP = RAD4_REP/CI_2_EPA
EPA5_REP = RAD5_REP/CI_5_EPA
!
EPAT_REP = EPA1_REP + EPA2_REP + EPA3_REP + EPA4_REP + EPA5_REP
!
! Delete temporary variables
!
DELETE RAD1_REP, RAD2_REP, RAD3_REP, RAD4_REP, RAD5_REP
!
```

```
!****************************************************************************
!****************************************************************************
!
! Activities (integrated fluxes) into marker beds at repository (EPA units)
!
!  Param 007: Am-241 in marker beds at north repository border -----> EPA1_MBN
!  Param 008: Pu-239 in marker beds at north repository border -----> EPA2_MBN
!  Param 009: Pu-238 in marker beds at north repository border -----> EPA3_MBN
!  Param 010: U--234 in marker beds at north repository border -----> EPA4_MBN
!  Param 011: Th-230 in marker beds at north repository border -----> EPA5_MBN
!
!  Param 012: Am-241 in marker beds at south repository border -----> EPA1_MBS
!  Param 013: Pu-239 in marker beds at south repository border -----> EPA2_MBS
!  Param 014: Pu-238 in marker beds at south repository border -----> EPA3_MBS
!  Param 015: U--234 in marker beds at south repository border -----> EPA4_MBS
!  Param 016: Th-230 in marker beds at south repository border -----> EPA5_MBS
!
!  Param 017: Am-241 in all marker beds at repository borders ------> EPA1_MBT
!  Param 018: Pu-239 in all marker beds at repository borders ------> EPA2_MBT
!  Param 019: Pu-238 in all marker beds at repository borders ------> EPA3_MBT
!  Param 020: U--234 in all marker beds at repository borders ------> EPA4_MBT
!  Param 021: Th-230 in all marker beds at repository borders ------> EPA5_MBT
!  Param 022: Total activity in marker beds at repository borders --> EPA_MB_T
!
!****************************************
!
! North side of repository activity (Ci)
!
!  Fluxes (Ci/s) into MB 138 away from repository, north (right) side
!
FLX1M38N = IFGT0(FLUXIM1[E:588],FLUXIM1[E:588],0.0)
FLX2M38N = IFGT0(FLUXIM2[E:588],FLUXIM2[E:588],0.0)
FLX3M38N = IFGT0(FLUXIM3[E:588],FLUXIM3[E:588],0.0)
FLX4M38N = IFGT0(FLUXIM4N[E:588],FLUXIM4N[E:588],0.0)
FLX5M38N = IFGT0(FLUXIM5N[E:588],FLUXIM5N[E:588],0.0)
!
!  Fluxes (Ci/s) into Anhydrite A&B away from repository, north side
!
FLX1AABN = IFGT0(FLUXIM1[E:556],FLUXIM1[E:556],0.0)
FLX2AABN = IFGT0(FLUXIM2[E:556],FLUXIM2[E:556],0.0)
FLX3AABN = IFGT0(FLUXIM3[E:556],FLUXIM3[E:556],0.0)
FLX4AABN = IFGT0(FLUXIM4N[E:556],FLUXIM4N[E:556],0.0)
FLX5AABN = IFGT0(FLUXIM5N[E:556],FLUXIM5N[E:556],0.0)
!
!  Fluxes (Ci/s) into MB 139 away from repository, north (right) side
!
FLX1M39N = IFGT0(FLUXIM1[E:540],FLUXIM1[E:540],0.0)
FLX2M39N = IFGT0(FLUXIM2[E:540],FLUXIM2[E:540],0.0)
FLX3M39N = IFGT0(FLUXIM3[E:540],FLUXIM3[E:540],0.0)
FLX4M39N = IFGT0(FLUXIM4N[E:540],FLUXIM4N[E:540],0.0)
FLX5M39N = IFGT0(FLUXIM5N[E:540],FLUXIM5N[E:540],0.0)
!
!  Total outward fluxes into all anhydrite layers, north side of repository
!
FLX1_MBN = FLX1M38N + FLX1AABN + FLX1M39N
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FLX2_MBN = FLX2M38N + FLX2AABN + FLX2M39N
FLX3_MBN = FLX3M38N + FLX3AABN + FLX3M39N
FLX4_MBN = FLX4M38N + FLX4AABN + FLX4M39N
FLX5_MBN = FLX5M38N + FLX5AABN + FLX5M39N
!
!  Total activity (Ci) in anhydrite layers at north repository border
!
RAD1_MBN = INTRIGHT(FLX1_MBN)
RAD2_MBN = INTRIGHT(FLX2_MBN)
RAD3_MBN = INTRIGHT(FLX3_MBN)
RAD4_MBN = INTRIGHT(FLX4_MBN)
RAD5_MBN = INTRIGHT(FLX5_MBN)
!
!  Delete fluxes
!
DELETE FLX1_MBN, FLX1M38N, FLX1AABN, FLX1M39N
DELETE FLX2_MBN, FLX2M38N, FLX2AABN, FLX2M39N
DELETE FLX3_MBN, FLX3M38N, FLX3AABN, FLX3M39N
DELETE FLX4_MBN, FLX4M38N, FLX4AABN, FLX4M39N
DELETE FLX5_MBN, FLX5M38N, FLX5AABN, FLX5M39N
!
!****************************************
!
! South side of repository activity (Ci)
!
!  Fluxes (Ci/s) into MB 138 away from repository, south (left) side
!
FLX1M38S = IFLT0(FLUXIM1[E:572],-1.0*FLUXIM1[E:572],0.0)
FLX2M38S = IFLT0(FLUXIM2[E:572],-1.0*FLUXIM2[E:572],0.0)
FLX3M38S = IFLT0(FLUXIM3[E:572],-1.0*FLUXIM3[E:572],0.0)
FLX4M38S = IFLT0(FLUXIM4N[E:572],-1.0*FLUXIM4N[E:572],0.0)
FLX5M38S = IFLT0(FLUXIM5N[E:572],-1.0*FLUXIM5N[E:572],0.0)
!
!  Fluxes (Ci/s) into Anhydrite A&B away from repository, south side
!
FLX1AABS = IFLT0(FLUXIM1[E:482],-1.0*FLUXIM1[E:482],0.0)
FLX2AABS = IFLT0(FLUXIM2[E:482],-1.0*FLUXIM2[E:482],0.0)
FLX3AABS = IFLT0(FLUXIM3[E:482],-1.0*FLUXIM3[E:482],0.0)
FLX4AABS = IFLT0(FLUXIM4N[E:482],-1.0*FLUXIM4N[E:482],0.0)
FLX5AABS = IFLT0(FLUXIM5N[E:482],-1.0*FLUXIM5N[E:482],0.0)
!
!  Fluxes (Ci/s) into MB 139 away from repository, south (left) side
!
FLX1M39S = IFLT0(FLUXIM1[E:436],-1.0*FLUXIM1[E:436],0.0)
FLX2M39S = IFLT0(FLUXIM2[E:436],-1.0*FLUXIM2[E:436],0.0)
FLX3M39S = IFLT0(FLUXIM3[E:436],-1.0*FLUXIM3[E:436],0.0)
FLX4M39S = IFLT0(FLUXIM4N[E:436],-1.0*FLUXIM4N[E:436],0.0)
FLX5M39S = IFLT0(FLUXIM5N[E:436],-1.0*FLUXIM5N[E:436],0.0)
!
!  Total outward fluxes into all anhydrite layers, south side of repository
!
FLX1_MBS = FLX1M38S + FLX1AABS + FLX1M39S
FLX2_MBS = FLX2M38S + FLX2AABS + FLX2M39S
FLX3_MBS = FLX3M38S + FLX3AABS + FLX3M39S
FLX4_MBS = FLX4M38S + FLX4AABS + FLX4M39S
```

```
FLX5_MBS = FLX5M38S + FLX5AABS + FLX5M39S
!
!  Total activity (Ci) in anhydrite layers at south repository border
!
RAD1_MBS = INTRIGHT(FLX1_MBS)
RAD2_MBS = INTRIGHT(FLX2_MBS)
RAD3_MBS = INTRIGHT(FLX3_MBS)
RAD4_MBS = INTRIGHT(FLX4_MBS)
RAD5_MBS = INTRIGHT(FLX5_MBS)
!
!  Delete fluxes
!
DELETE FLX1_MBS, FLX1M38S, FLX1AABS, FLX1M39S
DELETE FLX2_MBS, FLX2M38S, FLX2AABS, FLX2M39S
DELETE FLX3_MBS, FLX3M38S, FLX3AABS, FLX3M39S
DELETE FLX4_MBS, FLX4M38S, FLX4AABS, FLX4M39S
DELETE FLX5_MBS, FLX5M38S, FLX5AABS, FLX5M39S
!
!****************************************
!
! Total activity (Ci) in anhydrite layers at repository borders
!
RAD1_MBT = RAD1_MBN + RAD1_MBS
RAD2_MBT = RAD2_MBN + RAD2_MBS
RAD3_MBT = RAD3_MBN + RAD3_MBS
RAD4_MBT = RAD4_MBN + RAD4_MBS
RAD5_MBT = RAD5_MBN + RAD5_MBS
!
!****************************************
!
! Convert to EPA units and sum to get total marker bed activity at repository
!
EPA1_MBN = RAD1_MBN/CI_2_EPA
EPA2_MBN = RAD2_MBN/CI_2_EPA
EPA3_MBN = RAD3_MBN/CI_2_EPA
EPA4_MBN = RAD4_MBN/CI_2_EPA
EPA5_MBN = RAD5_MBN/CI_5_EPA
!
EPA1_MBS = RAD1_MBS/CI_2_EPA
EPA2_MBS = RAD2_MBS/CI_2_EPA
EPA3_MBS = RAD3_MBS/CI_2_EPA
EPA4_MBS = RAD4_MBS/CI_2_EPA
EPA5_MBS = RAD5_MBS/CI_5_EPA
!
EPA1_MBT = RAD1_MBT/CI_2_EPA
EPA2_MBT = RAD2_MBT/CI_2_EPA
EPA3_MBT = RAD3_MBT/CI_2_EPA
EPA4_MBT = RAD4_MBT/CI_2_EPA
EPA5_MBT = RAD5_MBT/CI_5_EPA
!
EPA_MB_T = EPA1_MBT + EPA2_MBT + EPA3_MBT + EPA4_MBT + EPA5_MBT
!
! Delete temporary variables
!
DELETE RAD1_MBN, RAD2_MBN, RAD3_MBN, RAD4_MBN, RAD5_MBN
```

```
DELETE RAD1_MBS, RAD2_MBS, RAD3_MBS, RAD4_MBS, RAD5_MBS
DELETE RAD1_MBT, RAD2_MBT, RAD3_MBT, RAD4_MBT, RAD5_MBT
!
!***************************************************************************
!***************************************************************************
!
! Total flux (mRem/yr) in marker beds across l-w boundary
!
!  Param 023: Am-241 flux in marker beds at north l-w boundary ----> F1LW_MBN
!  Param 024: Pu-239 flux in marker beds at north l-w boundary ----> F2LW_MBN
!  Param 025: Pu-238 flux in marker beds at north l-w boundary ----> F3LW_MBN
!  Param 026: U--234 flux in marker beds at north l-w boundary ----> F4LW_MBN
!  Param 027: Th-230 flux in marker beds at north l-w boundary ----> F5LW_MBN
!
!  Param 028: Am-241 flux in marker beds at south l-w boundary ----> F1LW_MBS
!  Param 029: Pu-239 flux in marker beds at south l-w boundary ----> F2LW_MBS
!  Param 030: Pu-238 flux in marker beds at south l-w boundary ----> F3LW_MBS
!  Param 031: U--234 flux in marker beds at south l-w boundary ----> F4LW_MBS
!  Param 032: Th-230 flux in marker beds at south l-w boundary ----> F5LW_MBS
!
!  Param 033: Am-241 total flux in all marker beds, l-w boundary --> F1LW_MBC
!  Param 034: Pu-239 total flux in all marker beds, l-w boundary --> F2LW_MBC
!  Param 035: Pu-238 total flux in all marker beds, l-w boundary --> F3LW_MBC
!  Param 036: U--234 total flux in all marker beds, l-w boundary --> F4LW_MBC
!  Param 037: Th-230 total flux in all marker beds, l-w boundary --> F5LW_MBC
!
!****************************************
!
! Fluxes in marker beds at north land-withdrawal boundary (Ci/s)
!
!  Fluxes in MB 138 across l-w boundary, north (right) side
!
F1LWM38N = IFGT0(FLUXIM1[E:594],FLUXIM1[E:594],0.0)
F2LWM38N = IFGT0(FLUXIM2[E:594],FLUXIM2[E:594],0.0)
F3LWM38N = IFGT0(FLUXIM3[E:594],FLUXIM3[E:594],0.0)
F4LWM38N = IFGT0(FLUXIM4N[E:594],FLUXIM4N[E:594],0.0)
F5LWM38N = IFGT0(FLUXIM5N[E:594],FLUXIM5N[E:594],0.0)
!
!  Fluxes in Anhydrite A&B across l-w boundary, north side
!
F1LWAABN = IFGT0(FLUXIM1[E:562],FLUXIM1[E:562],0.0)
F2LWAABN = IFGT0(FLUXIM2[E:562],FLUXIM2[E:562],0.0)
F3LWAABN = IFGT0(FLUXIM3[E:562],FLUXIM3[E:562],0.0)
F4LWAABN = IFGT0(FLUXIM4N[E:562],FLUXIM4N[E:562],0.0)
F5LWAABN = IFGT0(FLUXIM5N[E:562],FLUXIM5N[E:562],0.0)
!
!  Fluxes in MB 139 across l-w boundary, north (right) side
!
F1LWM39N = IFGT0(FLUXIM1[E:546],FLUXIM1[E:546],0.0)
F2LWM39N = IFGT0(FLUXIM2[E:546],FLUXIM2[E:546],0.0)
F3LWM39N = IFGT0(FLUXIM3[E:546],FLUXIM3[E:546],0.0)
F4LWM39N = IFGT0(FLUXIM4N[E:546],FLUXIM4N[E:546],0.0)
F5LWM39N = IFGT0(FLUXIM5N[E:546],FLUXIM5N[E:546],0.0)
!
!  Total fluxes across north land-withdrawal boundary in all anhydrite layers
```

```
!
F1LWMBN  = F1LWM38N + F1LWAABN + F1LWM39N
F2LWMBN  = F2LWM38N + F2LWAABN + F2LWM39N
F3LWMBN  = F3LWM38N + F3LWAABN + F3LWM39N
F4LWMBN  = F4LWM38N + F4LWAABN + F4LWM39N
F5LWMBN  = F5LWM38N + F5LWAABN + F5LWM39N
!
! Convert flux units from Ci/s to mRem/yr
!
!   Conversion factors, 1 Ci/s = C_i mRem/yr
!
!       where i = 1 for Am-241
!             i = 2 for Pu-239
!             i = 3 for Pu-238
!             i = 4 for U-234
!             i = 5 for Am-241
!
C_1 = 6.9426E16
C_2 = 1.3570E16
C_3 = 1.7041E19
C_4 = 2.2406E17
C_5 = 1.6725E16
!
F1LW_MBN = F1LWMBN*C_1
F2LW_MBN = F2LWMBN*C_2
F3LW_MBN = F3LWMBN*C_3
F4LW_MBN = F4LWMBN*C_4
F5LW_MBN = F5LWMBN*C_5
!
! Delete fluxes not needed
!
DELETE F1LWM38N, F1LWAABN, F1LWM39N
DELETE F2LWM38N, F2LWAABN, F2LWM39N
DELETE F3LWM38N, F3LWAABN, F3LWM39N
DELETE F4LWM38N, F4LWAABN, F4LWM39N
DELETE F5LWM38N, F5LWAABN, F5LWM39N
!
!**************************************
!
! Fluxes in marker beds at south land-withdrawal boundary (Ci/s)
!
! Fluxes in MB 138 across l-w boundary, south (left) side
!
F1LWM38S = IFLT0(FLUXIM1[E:566],-1.0*FLUXIM1[E:566],0.0)
F2LWM38S = IFLT0(FLUXIM2[E:566],-1.0*FLUXIM2[E:566],0.0)
F3LWM38S = IFLT0(FLUXIM3[E:566],-1.0*FLUXIM3[E:566],0.0)
F4LWM38S = IFLT0(FLUXIM4N[E:566],-1.0*FLUXIM4N[E:566],0.0)
F5LWM38S = IFLT0(FLUXIM5N[E:566],-1.0*FLUXIM5N[E:566],0.0)
!
! Fluxes in Anhydrite A&B across l-w, south side
!
F1LWAABS = IFLT0(FLUXIM1[E:550],-1.0*FLUXIM1[E:550],0.0)
F2LWAABS = IFLT0(FLUXIM2[E:550],-1.0*FLUXIM2[E:550],0.0)
F3LWAABS = IFLT0(FLUXIM3[E:550],-1.0*FLUXIM3[E:550],0.0)
F4LWAABS = IFLT0(FLUXIM4N[E:550],-1.0*FLUXIM4N[E:550],0.0)
```

```
F5LWAABS = IFLT0(FLUXIM5N[E:550],-1.0*FLUXIM5N[E:550],0.0)
!
! Fluxes in MB 139 across l-w boundary, south (left) side
!
F1LWM39S = IFLT0(FLUXIM1[E:534],-1.0*FLUXIM1[E:534],0.0)
F2LWM39S = IFLT0(FLUXIM2[E:534],-1.0*FLUXIM2[E:534],0.0)
F3LWM39S = IFLT0(FLUXIM3[E:534],-1.0*FLUXIM3[E:534],0.0)
F4LWM39S = IFLT0(FLUXIM4N[E:534],-1.0*FLUXIM4N[E:534],0.0)
F5LWM39S = IFLT0(FLUXIM5N[E:534],-1.0*FLUXIM5N[E:534],0.0)
!
! Total fluxes across south land-withdrawal boundary in all anhydrite layers
!
F1LWMBS = F1LWM38S + F1LWAABS + F1LWM39S
F2LWMBS = F2LWM38S + F2LWAABS + F2LWM39S
F3LWMBS = F3LWM38S + F3LWAABS + F3LWM39S
F4LWMBS = F4LWM38S + F4LWAABS + F4LWM39S
F5LWMBS = F5LWM38S + F5LWAABS + F5LWM39S
!
! Convert flux units from Ci/s to mRem/yr
!
F1LW_MBS = F1LWMBS*C_1
F2LW_MBS = F2LWMBS*C_2
F3LW_MBS = F3LWMBS*C_3
F4LW_MBS = F4LWMBS*C_4
F5LW_MBS = F5LWMBS*C_5
!
! Delete fluxes not needed
!
DELETE F1LWM38S, F1LWAABS, F1LWM39S
DELETE F2LWM38S, F2LWAABS, F2LWM39S
DELETE F3LWM38S, F3LWAABS, F3LWM39S
DELETE F4LWM38S, F4LWAABS, F4LWM39S
DELETE F5LWM38S, F5LWAABS, F5LWM39S
!
!****************************************
!
! Total fluxes across land-withdrawal boundary in all anhydrite layers (mRem/yr)
!
F1LW_MBT = F1LW_MBN + F1LW_MBS
F2LW_MBT = F2LW_MBN + F2LW_MBS
F3LW_MBT = F3LW_MBN + F3LW_MBS
F4LW_MBT = F4LW_MBN + F4LW_MBS
F5LW_MBT = F5LW_MBN + F5LW_MBS
!
!******************************************************************************
!******************************************************************************
!
! Total activity (integrated flux) in marker beds at l-w boundary (EPA units)
!
! Param 038: Am-241 in all marker beds across north l-w boundary --> E1LW_MBN
! Param 039: Pu-239 in all marker beds across north l-w boundary --> E2LW_MBN
! Param 040: Pu-238 in all marker beds across north l-w boundary --> E3LW_MBN
! Param 041: U--234 in all marker beds across north l-w boundary --> E4LW_MBN
! Param 042: Th-230 in all marker beds across north l-w boundary --> E5LW_MBN
!
```

```
!  Param 043: Am-241 in all marker beds across south l-w boundary --> E1LW_MBS
!  Param 044: Pu-239 in all marker beds across south l-w boundary --> E2LW_MBS
!  Param 045: Pu-238 in all marker beds across south l-w boundary --> E3LW_MBS
!  Param 046: U--234 in all marker beds across south l-w boundary --> E4LW_MBS
!  Param 047: Th-230 in all marker beds across south l-w boundary --> E5LW_MBS
!
!  Param 048: Am-241 in all marker beds across l-w boundaries ------> E1LW_MBT
!  Param 049: Pu-239 in all marker beds across l-w boundaries ------> E2LW_MBT
!  Param 050: Pu-238 in all marker beds across l-w boundaries ------> E3LW_MBT
!  Param 051: U--234 in all marker beds across l-w boundaries ------> E4LW_MBT
!  Param 052: Th-230 in all marker beds across l-w boundaries ------> E5LW_MBT
!  Param 053: Total activity in all marker beds at l-w boundaries --> EPALWMBT
!
!**************************************
!
! Activities in marker beds across north land-withdrawal boundary (Ci)
!
R1LW_MBN = INTRIGHT(F1LWMBN)
R2LW_MBN = INTRIGHT(F2LWMBN)
R3LW_MBN = INTRIGHT(F3LWMBN)
R4LW_MBN = INTRIGHT(F4LWMBN)
R5LW_MBN = INTRIGHT(F5LWMBN)
!
DELETE F1LWMBN, F2LWMBN, F3LWMBN, F4LWMBN, F5LWMBN
!
!**************************************
!
! Activities in marker beds across south land-withdrawal boundary (Ci)
!
R1LW_MBS = INTRIGHT(F1LWMBS)
R2LW_MBS = INTRIGHT(F2LWMBS)
R3LW_MBS = INTRIGHT(F3LWMBS)
R4LW_MBS = INTRIGHT(F4LWMBS)
R5LW_MBS = INTRIGHT(F5LWMBS)
!
DELETE F1LWMBS, F2LWMBS, F3LWMBS, F4LWMBS, F5LWMBS
!
!**************************************
!
! Total activity in all anhydrite layers across land-withdrawal boundary
!
R1LW_MBT = R1LW_MBN + R1LW_MBS
R2LW_MBT = R2LW_MBN + R2LW_MBS
R3LW_MBT = R3LW_MBN + R3LW_MBS
R4LW_MBT = R4LW_MBN + R4LW_MBS
R5LW_MBT = R5LW_MBN + R5LW_MBS
!
!**************************************
!
! Convert to EPA units and sum to get total marker bed activity at l-w bndry
!
E1LW_MBN = R1LW_MBN/CI_2_EPA
E2LW_MBN = R2LW_MBN/CI_2_EPA
E3LW_MBN = R3LW_MBN/CI_2_EPA
E4LW_MBN = R4LW_MBN/CI_2_EPA
```

```
E5LW_MBN = R5LW_MBN/CI_5_EPA
!
E1LW_MBS = R1LW_MBS/CI_2_EPA
E2LW_MBS = R2LW_MBS/CI_2_EPA
E3LW_MBS = R3LW_MBS/CI_2_EPA
E4LW_MBS = R4LW_MBS/CI_2_EPA
E5LW_MBS = R5LW_MBS/CI_5_EPA
!
E1LW_MBT = R1LW_MBT/CI_2_EPA
E2LW_MBT = R2LW_MBT/CI_2_EPA
E3LW_MBT = R3LW_MBT/CI_2_EPA
E4LW_MBT = R4LW_MBT/CI_2_EPA
E5LW_MBT = R5LW_MBT/CI_5_EPA
!
EPALWMBT = E1LW_MBT + E2LW_MBT + E3LW_MBT + E4LW_MBT + E5LW_MBT
!
! Delete temporary variables
!
DELETE R1LW_MBN, R2LW_MBN, R3LW_MBN, R4LW_MBN, R5LW_MBN
DELETE R1LW_MBS, R2LW_MBS, R3LW_MBS, R4LW_MBS, R5LW_MBS
DELETE R1LW_MBT, R2LW_MBT, R3LW_MBT, R4LW_MBT, R5LW_MBT
!
!****************************************************************************
!****************************************************************************
!
! Extent of radioactive penetration in marker beds outward from repository (m)
!
!  Param 054: Am-241 zone length, MB 138 North ---------> XL1_M38N
!  Param 055: Pu-239 zone length, MB 138 North ---------> XL2_M38N
!  Param 056: Pu-238 zone length, MB 138 North ---------> XL3_M38N
!  Param 057: U--234 zone length, MB 138 North ---------> XL4_M38N
!  Param 058: Th-230 zone length, MB 138 North ---------> XL5_M38N
!
!  Param 059: Am-241 zone length, Anhydrite A&B North --> XL1_AABN
!  Param 060: Pu-239 zone length, Anhydrite A&B North --> XL2_AABN
!  Param 061: Pu-238 zone length, Anhydrite A&B North --> XL3_AABN
!  Param 062: U--234 zone length, Anhydrite A&B North --> XL4_AABN
!  Param 063: Th-230 zone length, Anhydrite A&B North --> XL5_AABN
!
!  Param 064: Am-241 zone length, MB 139 North ---------> XL1_M39N
!  Param 065: Pu-239 zone length, MB 139 North ---------> XL2_M39N
!  Param 066: Pu-238 zone length, MB 139 North ---------> XL3_M39N
!  Param 067: U--234 zone length, MB 139 North ---------> XL4_M39N
!  Param 068: Th-230 zone length, MB 139 North ---------> XL5_M39N
!
!  Param 069: Am-241 zone length, MB 138 South ---------> XL1_M38S
!  Param 070: Pu-239 zone length, MB 138 South ---------> XL2_M38S
!  Param 071: Pu-238 zone length, MB 138 South ---------> XL3_M38S
!  Param 072: U--234 zone length, MB 138 South ---------> XL4_M38S
!  Param 073: Th-230 zone length, MB 138 South ---------> XL5_M38S
!
!  Param 074: Am-241 zone length, Anhydrite A&B South --> XL1_AABS
!  Param 075: Pu-239 zone length, Anhydrite A&B South --> XL2_AABS
!  Param 076: Pu-238 zone length, Anhydrite A&B South --> XL3_AABS
!  Param 077: U--234 zone length, Anhydrite A&B South --> XL4_AABS
```

```
!  Param 078: Th-230 zone length, Anhydrite A&B South --> XL5_AABS
!
!  Param 079: Am-241 zone length, MB 139 South ---------> XL1_M39S
!  Param 080: Pu-239 zone length, MB 139 South ---------> XL2_M39S
!  Param 081: Pu-238 zone length, MB 139 South ---------> XL3_M39S
!  Param 082: U--234 zone length, MB 139 South ---------> XL4_M39S
!  Param 083: Th-230 zone length, MB 139 South ---------> XL5_M39S
!
! Maximum values of radioactive penetration zones in marker beds (m)
!
!  Param 084: Maximum Pu-239 penetration in north marker beds --> MAX2_MBN
!  Param 085: Maximum U--234 penetration in north marker beds --> MAX4_MBN
!
!  Param 086: Maximum Pu-239 penetration in south marker beds --> MAX2_MBS
!  Param 087: Maximum U--234 penetration in south marker beds --> MAX4_MBS
!
!****************************************
!
! Radionuclides in MB 138 away from repository, north (right) side
!
LIMIT ELEMENT 588 TO 595
!
!  Define meaningful contamination level as exceeding 1E-7 kg
!
MTOL = 1.0E-7
!
!  Set reference point for front length at the north repository border
!
XREF38N  = X[N:1590]
!
!  Determine average x-coordinate of element centroid as element variable
!
XECENT   = NOD2ELE(X)
!
!  Compare radionuclides dissolved masses against contamination limit
!    If criterion met then calculate front length as distance from
!    reference point to centroid of element, otherwise set to zero
!
XDIST1   = IFGT0(BMDISM1-MTOL,XECENT-XREF38N,0.0)
XDIST2   = IFGT0(BMDISM2-MTOL,XECENT-XREF38N,0.0)
XDIST3   = IFGT0(BMDISM3-MTOL,XECENT-XREF38N,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XECENT-XREF38N,0.0)
XDIST5   = IFGT0(BMDISM5-MTOL,XECENT-XREF38N,0.0)
!
!  Extract maximum values of front length at each time
!
XL1_M38N = SMAX(XDIST1)
XL2_M38N = SMAX(XDIST2)
XL3_M38N = SMAX(XDIST3)
XL4_M38N = SMAX(XDIST4)
XL5_M38N = SMAX(XDIST5)
!
!  Delete temporary variables (tolerance used below, then deleted)
!
DELETE XREF38N, XECENT, XDIST1, XDIST2, XDIST3, XDIST4, XDIST5
```

```
!
!**************************************
!
! Radionuclides in Anhydrite A&B away from repository, north (right) side
!
LIMIT ELEMENT 556 TO 563
!
XREFABN  = X[N:1488]
XECENT   = NOD2ELE(X)
!
XDIST1   = IFGT0(BMDISM1-MTOL,XECENT-XREFABN,0.0)
XDIST2   = IFGT0(BMDISM2-MTOL,XECENT-XREFABN,0.0)
XDIST3   = IFGT0(BMDISM3-MTOL,XECENT-XREFABN,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XECENT-XREFABN,0.0)
XDIST5   = IFGT0(BMDISM5-MTOL,XECENT-XREFABN,0.0)
!
XL1_AABN = SMAX(XDIST1)
XL2_AABN = SMAX(XDIST2)
XL3_AABN = SMAX(XDIST3)
XL4_AABN = SMAX(XDIST4)
XL5_AABN = SMAX(XDIST5)
!
DELETE XREFABN, XECENT, XDIST1, XDIST2, XDIST3, XDIST4, XDIST5
!
!**************************************
!
! Radionuclides in MB 139 away from repository, north (right) side
!
LIMIT ELEMENT 540 TO 547
!
XREF39N  = X[N:1284]
XECENT   = NOD2ELE(X)
!
XDIST1   = IFGT0(BMDISM1-MTOL,XECENT-XREF39N,0.0)
XDIST2   = IFGT0(BMDISM2-MTOL,XECENT-XREF39N,0.0)
XDIST3   = IFGT0(BMDISM3-MTOL,XECENT-XREF39N,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XECENT-XREF39N,0.0)
XDIST5   = IFGT0(BMDISM5-MTOL,XECENT-XREF39N,0.0)
!
XL1_M39N = SMAX(XDIST1)
XL2_M39N = SMAX(XDIST2)
XL3_M39N = SMAX(XDIST3)
XL4_M39N = SMAX(XDIST4)
XL5_M39N = SMAX(XDIST5)
!
DELETE XREF39N, XECENT, XDIST1, XDIST2, XDIST3, XDIST4, XDIST5
!
!**************************************
!**************************************
!
! Radionuclides in MB 138 away from repository, south (left) side
!
LIMIT ELEMENT 564 TO 571
!
XREF38S  = X[N:1573]
```

```
XECENT   = NOD2ELE(X)
!
XDIST1   = IFGT0(BMDISM1-MTOL,XREF38S-XECENT,0.0)
XDIST2   = IFGT0(BMDISM2-MTOL,XREF38S-XECENT,0.0)
XDIST3   = IFGT0(BMDISM3-MTOL,XREF38S-XECENT,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XREF38S-XECENT,0.0)
XDIST5   = IFGT0(BMDISM5-MTOL,XREF38S-XECENT,0.0)
!
XL1_M38S = SMAX(XDIST1)
XL2_M38S = SMAX(XDIST2)
XL3_M38S = SMAX(XDIST3)
XL4_M38S = SMAX(XDIST4)
XL5_M38S = SMAX(XDIST5)
!
DELETE XREF38S, XECENT, XDIST1, XDIST2, XDIST3, XDIST4, XDIST5
!
!***************************************
!
! Radionuclides in Anhydrite A&B away from repository, south (left) side
!
LIMIT ELEMENT 548 TO 555
!
XREFABS  = X[N:1471]
XECENT   = NOD2ELE(X)
!
XDIST1   = IFGT0(BMDISM1-MTOL,XREFABS-XECENT,0.0)
XDIST2   = IFGT0(BMDISM2-MTOL,XREFABS-XECENT,0.0)
XDIST3   = IFGT0(BMDISM3-MTOL,XREFABS-XECENT,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XREFABS-XECENT,0.0)
XDIST5   = IFGT0(BMDISM5-MTOL,XREFABS-XECENT,0.0)
!
XL1_AABS = SMAX(XDIST1)
XL2_AABS = SMAX(XDIST2)
XL3_AABS = SMAX(XDIST3)
XL4_AABS = SMAX(XDIST4)
XL5_AABS = SMAX(XDIST5)
!
DELETE XREFABS, XECENT, XDIST1, XDIST2, XDIST3, XDIST4, XDIST5
!
!***************************************
!
! Radionuclides in MB 139 away from repository, south (left) side
!
LIMIT ELEMENT 532 to 539
!
XREF39S  = X[N:1267]
XECENT   = NOD2ELE(X)
!
XDIST1   = IFGT0(BMDISM1-MTOL,XREF39S-XECENT,0.0)
XDIST2   = IFGT0(BMDISM2-MTOL,XREF39S-XECENT,0.0)
XDIST3   = IFGT0(BMDISM3-MTOL,XREF39S-XECENT,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XREF39S-XECENT,0.0)
XDIST5   = IFGT0(BMDISM5-MTOL,XREF39S-XECENT,0.0)
!
XL1_M39S = SMAX(XDIST1)
```

```
XL2_M39S = SMAX(XDIST2)
XL3_M39S = SMAX(XDIST3)
XL4_M39S = SMAX(XDIST4)
XL5_M39S = SMAX(XDIST5)
!
DELETE XREF39S, XECENT, XDIST1, XDIST2, XDIST3, XDIST4, XDIST5
!
!**************************************
!**************************************
!
! Maximum isotope penetration in north marker beds (m), Pu-239 & U-234
!
LIMIT ELEMENT 540 TO 547, 556 TO 563, 588 TO 595
!
XREFMBN  = X[N:1284]
XECENT   = NOD2ELE(X)
!
XDIST2   = IFGT0(BMDISM2-MTOL,XECENT-XREFMBN,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XECENT-XREFMBN,0.0)
!
MAX2_MBN = SMAX(XDIST2)
MAX4_MBN = SMAX(XDIST4)
!
DELETE XREFMBN, XECENT, XDIST2, XDIST4
!
!**************************************
!
! Maximum isotope penetration in south marker beds (m), Pu-239 & U-234
!
LIMIT ELEMENT 532 to 539, 548 TO 555, 564 TO 571
!
XREFMBS  = X[N:1267]
XECENT   = NOD2ELE(X)
!
XDIST2   = IFGT0(BMDISM2-MTOL,XREFMBS-XECENT,0.0)
XDIST4   = IFGT0(BMDISM4-MTOL,XREFMBS-XECENT,0.0)
!
MAX2_MBS = SMAX(XDIST2)
MAX4_MBS = SMAX(XDIST4)
!
DELETE XREFMBS, XECENT, XDIST2, XDIST4
!
!**************************************
!
LIMIT ELEMENT OFF
!
DELETE MTOL
!
!***************************************************************************
!***************************************************************************
!
! Integrated fluxes (Ci) in borehole at Rustler/Culebra (for PANEL calculations)
!
!   Param 088: Am-241 int. flux up bh at Rustler/Culebra (el.713) --> A00AM241
!   Param 089: Pu-239 int. flux up bh at Rustler/Culebra (el.713) --> A00PU239
```

```
!  Param 090: Pu-238 int. flux up bh at Rustler/Culebra (el.713) --> A00PU238
!  Param 091: U--234 int. flux up bh at Rustler/Culebra (el.713) --> A00U234
!  Param 092: Th-230 int. flux up bh at Rustler/Culebra (el.713) --> A00TH230
!
!***************************************
!
! Fluxes up borehole at Rustler/Culebra (Element 713), (Ci/s)
!
FL1BHRC  = IFGT0(FLUXJM1[E:713],FLUXJM1[E:713],0.0)
FL2BHRC  = IFGT0(FLUXJM2[E:713],FLUXJM2[E:713],0.0)
FL3BHRC  = IFGT0(FLUXJM3[E:713],FLUXJM3[E:713],0.0)
FL4BHRC  = IFGT0(FLUXJM4N[E:713],FLUXJM4N[E:713],0.0)
FL5BHRC  = IFGT0(FLUXJM5N[E:713],FLUXJM5N[E:713],0.0)
!
! Integrated flux (Ci)
!
A00AM241 = INTRIGHT(FL1BHRC)
A00PU239 = INTRIGHT(FL2BHRC)
A00PU238 = INTRIGHT(FL3BHRC)
A00U234  = INTRIGHT(FL4BHRC)
A00TH230 = INTRIGHT(FL5BHRC)
!
! Note: Fluxes will be output below as Params 198 to 202
!
!****************************************************************************
!****************************************************************************
!
! Activities (integrated fluxes) up borehole (EPA units)
!
!  Param 093: Am-241 up borehole at Magenta Dolomite (el.777) ---> EPA1BHMD
!  Param 094: Pu-239 up borehole at Magenta Dolomite (el.777) ---> EPA2BHMD
!  Param 095: Pu-238 up borehole at Magenta Dolomite (el.777) ---> EPA3BHMD
!  Param 096: U--234 up borehole at Magenta Dolomite (el.777) ---> EPA4BHMD
!  Param 097: Th-230 up borehole at Magenta Dolomite (el.777) ---> EPA5BHMD
!  Param 098: Total activity up borehole at Magenta (el.777) ----> EPATBHMD
!
!  Param 099: Am-241 up borehole at Rustler/Culebra (el.713) ----> EPA1BHRC
!  Param 100: Pu-239 up borehole at Rustler/Culebra (el.713) ----> EPA2BHRC
!  Param 101: Pu-238 up borehole at Rustler/Culebra (el.713) ----> EPA3BHRC
!  Param 102: U--234 up borehole at Rustler/Culebra (el.713) ----> EPA4BHRC
!  Param 103: Th-230 up borehole at Rustler/Culebra (el.713) ----> EPA5BHRC
!  Param 104: Total activity up bh at Rustler/Culebra (el.713) --> EPATBHRC
!
!***************************************
!
! Radionuclides up borehole at Magenta Dolomite (Ci)
!
!  Fluxes up borehole at Magenta (Ci/s)
!
FL1BH_MD = IFGT0(FLUXJM1[E:777],FLUXJM1[E:777],0.0)
FL2BH_MD = IFGT0(FLUXJM2[E:777],FLUXJM2[E:777],0.0)
FL3BH_MD = IFGT0(FLUXJM3[E:777],FLUXJM3[E:777],0.0)
FL4BH_MD = IFGT0(FLUXJM4N[E:777],FLUXJM4N[E:777],0.0)
FL5BH_MD = IFGT0(FLUXJM5N[E:777],FLUXJM5N[E:777],0.0)
!
```

```
!  Integrate flux to get activity
!
RN1BH_MD = INTRIGHT(FL1BH_MD)
RN2BH_MD = INTRIGHT(FL2BH_MD)
RN3BH_MD = INTRIGHT(FL3BH_MD)
RN4BH_MD = INTRIGHT(FL4BH_MD)
RN5BH_MD = INTRIGHT(FL5BH_MD)
!
DELETE FL1BH_MD, FL2BH_MD, FL3BH_MD, FL4BH_MD, FL5BH_MD
!
!***************************************
!
! Convert to EPA units and sum to get total activities up borehole
!
!  At Magenta Dolomite
!
EPA1BHMD = RN1BH_MD/CI_2_EPA
EPA2BHMD = RN2BH_MD/CI_2_EPA
EPA3BHMD = RN3BH_MD/CI_2_EPA
EPA4BHMD = RN4BH_MD/CI_2_EPA
EPA5BHMD = RN5BH_MD/CI_5_EPA
!
EPATBHMD = EPA1BHMD + EPA2BHMD + EPA3BHMD + EPA4BHMD + EPA5BHMD
!
!  At Rustler/Culebra interface
!
EPA1BHRC = A00AM241/CI_2_EPA
EPA2BHRC = A00PU239/CI_2_EPA
EPA3BHRC = A00PU238/CI_2_EPA
EPA4BHRC = A00U234/CI_2_EPA
EPA5BHRC = A00TH230/CI_5_EPA
!
EPATBHRC = EPA1BHRC + EPA2BHRC + EPA3BHRC + EPA4BHRC + EPA5BHRC
!
!  Delete temporary variables
!
DELETE RN1BH_MD, RN2BH_MD, RN3BH_MD, RN4BH_MD, RN5BH_MD
!
!***************************************************************************
!***************************************************************************
!
! Activity down borehole at Castile/Brine interface (EPA units)
!
!  Param 105: Total activity down bh at Castile/Brine (el.985) --> EPATBHCB
!
!***************************************
!
! Activity at Castile/Brine (EPA units)
!
!  Fluxes down borehole at Castile/Brine interface (Ci/s)
!
FL1BH_CB = IFLT0(FLUXJM1[E:985],-1.0*FLUXJM1[E:985],0.0)
FL2BH_CB = IFLT0(FLUXJM2[E:985],-1.0*FLUXJM2[E:985],0.0)
FL3BH_CB = IFLT0(FLUXJM3[E:985],-1.0*FLUXJM2[E:985],0.0)
FL4BH_CB = IFLT0(FLUXJM4N[E:985],-1.0*FLUXJM2[E:985],0.0)
```

```
FL5BH_CB = IFLT0(FLUXJM5N[E:985],-1.0*FLUXJM2[E:985],0.0)
!
! Radionuclides down borehole at Castile/Brine interface (Ci)
!
RN1BH_CB = INTRIGHT(FL1BH_CB)
RN2BH_CB = INTRIGHT(FL2BH_CB)
RN3BH_CB = INTRIGHT(FL3BH_CB)
RN4BH_CB = INTRIGHT(FL4BH_CB)
RN5BH_CB = INTRIGHT(FL5BH_CB)
!
! Convert to EPA units and sum to get total
!
EPA1BHCB = RN1BH_CB/CI_2_EPA
EPA2BHCB = RN2BH_CB/CI_2_EPA
EPA3BHCB = RN3BH_CB/CI_2_EPA
EPA4BHCB = RN4BH_CB/CI_2_EPA
EPA5BHCB = RN5BH_CB/CI_5_EPA
!
EPATBHCB = EPA1BHCB + EPA2BHCB + EPA3BHCB + EPA4BHCB + EPA5BHCB
!
DELETE FL1BH_CB, FL2BH_CB, FL3BH_CB, FL4BH_CB, FL5BH_CB
DELETE RN1BH_CB, RN2BH_CB, RN3BH_CB, RN4BH_CB, RN5BH_CB
DELETE EPA1BHCB, EPA2BHCB, EPA3BHCB, EPA4BHCB, EPA5BHCB
!
!******************************************************************************
!******************************************************************************
!
! Fluxes (mRem/yr) in shaft at Salado/Rustler interface
!
! Param 106: Am-241 flux up shaft at Salado/Rustler (el.661) ---> FL1SH_SR
! Param 107: Pu-239 flux up shaft at Salado/Rustler (el.661) ---> FL2SH_SR
! Param 108: Pu-238 flux up shaft at Salado/Rustler (el.661) ---> FL3SH_SR
! Param 109: U--234 flux up shaft at Salado/Rustler (el.661) ---> FL4SH_SR
! Param 110: Th-230 flux up shaft at Salado/Rustler (el.661) ---> FL5SH_SR
!
!**************************************
!
! Fluxes up shaft at Salado/Rustler interface (Ci/s)
!
FL1SHSR  = IFGT0(FLUXJM1[E:661],FLUXJM1[E:661],0.0)
FL2SHSR  = IFGT0(FLUXJM2[E:661],FLUXJM2[E:661],0.0)
FL3SHSR  = IFGT0(FLUXJM3[E:661],FLUXJM3[E:661],0.0)
FL4SHSR  = IFGT0(FLUXJM4N[E:661],FLUXJM4N[E:661],0.0)
FL5SHSR  = IFGT0(FLUXJM5N[E:661],FLUXJM5N[E:661],0.0)
!
! Convert flux units from Ci/s to mRem/yr
!
FL1SH_SR = FL1SHSR*C_1
FL2SH_SR = FL2SHSR*C_2
FL3SH_SR = FL3SHSR*C_3
FL4SH_SR = FL4SHSR*C_4
FL5SH_SR = FL5SHSR*C_5
!
! Delete fluxes not needed
!
```

```
DELETE FL1SHSR, FL2SHSR, FL3SHSR, FL4SHSR, FL5SHSR
!
!  Delete flux conversion factors
!
DELETE C_1, C_2, C_3, C_4, C_5
!
!***************************************************************************
!***************************************************************************
!
! Activity (integrated flux) in shaft at Rustler/Culebra interface (EPA units)
!
!  Param 111: Am-241 up shaft at Rustler/Culebra (el.662) ----------> EPA1SHRC
!  Param 112: Pu-239 up shaft at Rustler/Culebra (el.662) ----------> EPA2SHRC
!  Param 113: Pu-238 up shaft at Rustler/Culebra (el.662) ----------> EPA3SHRC
!  Param 114: U--234 up shaft at Rustler/Culebra (el.662) ----------> EPA4SHRC
!  Param 115: Th-230 up shaft at Rustler/Culebra (el.662) ----------> EPA5SHRC
!  Param 116: Total activity up shaft at Rustler/Culebra (el.662) --> EPATSHRC
!
!***************************************
!
! Activity at Rustler/Culebra interface
!
!  Fluxes up shaft at Rustler/Culebra interface (Ci/s)
!
FL1SH_RC = IFGT0(FLUXJM1[E:662],FLUXJM1[E:662],0.0)
FL2SH_RC = IFGT0(FLUXJM2[E:662],FLUXJM2[E:662],0.0)
FL3SH_RC = IFGT0(FLUXJM3[E:662],FLUXJM3[E:662],0.0)
FL4SH_RC = IFGT0(FLUXJM4N[E:662],FLUXJM4N[E:662],0.0)
FL5SH_RC = IFGT0(FLUXJM5N[E:662],FLUXJM5N[E:662],0.0)
!
!  Radionuclides up shaft at Rustler/Culebra interface (Ci)
!
RN1SH_RC = INTRIGHT(FL1SH_RC)
RN2SH_RC = INTRIGHT(FL2SH_RC)
RN3SH_RC = INTRIGHT(FL3SH_RC)
RN4SH_RC = INTRIGHT(FL4SH_RC)
RN5SH_RC = INTRIGHT(FL5SH_RC)
!
!  Radionuclides up shaft at Rustler/Culebra interface (EPA units)
!
EPA1SHRC = RN1SH_RC/CI_2_EPA
EPA2SHRC = RN2SH_RC/CI_2_EPA
EPA3SHRC = RN3SH_RC/CI_2_EPA
EPA4SHRC = RN4SH_RC/CI_2_EPA
EPA5SHRC = RN5SH_RC/CI_5_EPA
!
EPATSHRC = EPA1SHRC + EPA2SHRC + EPA3SHRC + EPA4SHRC + EPA5SHRC
!
!  Delete fluxes and activities in Curies
!
DELETE FL1SH_RC, FL2SH_RC, FL3SH_RC, FL4SH_RC, FL5SH_RC
DELETE RN1SH_RC, RN2SH_RC, RN3SH_RC, RN4SH_RC, RN5SH_RC
!
!***************************************************************************
!***************************************************************************
```

```
!
! Volume-averaged isotope concentration (EPA units/m^3 brine) in waste panel
!
!  Param 117: Am-241 vol-avg concentration in waste panel ---------> EPAC1_WP
!  Param 118: Pu-239 vol-avg concentration in waste panel ---------> EPAC2_WP
!  Param 119: Pu-238 vol-avg concentration in waste panel ---------> EPAC3_WP
!  Param 120: U--234 vol-avg concentration in waste panel ---------> EPAC4_WP
!  Param 121: Th-230 vol-avg concentration in waste panel ---------> EPAC5_WP
!  Param 122: Total vol-avg isotope concentration in waste panel --> EPACT_WP
!
! Volume-avg isotope concentration (EPA units/m^3 brine) in rest of repository
!
!  Param 123: Am-241 vol-avg concentration in rest of repository --> EPAC1_RR
!  Param 124: Pu-239 vol-avg concentration in rest of repository --> EPAC2_RR
!  Param 125: Pu-238 vol-avg concentration in rest of repository --> EPAC3_RR
!  Param 126: U--234 vol-avg concentration in rest of repository --> EPAC4_RR
!  Param 127: Th-230 vol-avg concentration in rest of repository --> EPAC5_RR
!  Param 128: Total vol-avg isotope conc. in rest of repository ---> EPACT_RR
!
!***************************************
!
! Conversion factors (Curies per kilogram), where
!     radionuclides are numbered
!        1 = Am-241
!        2 = Pu-239
!        3 = Pu-238
!        4 = U-234
!        5 = Th-230
!
A1 = 3431.154
A2 = 62.14574
A3 = 17115.25
A4 = 6.247269
A5 = 20.18264
!
!***************************************
!
! Waste panel
!
LIMIT ELEMENT 596 TO 616
!
! Total volume of waste area
!
WPVOL = SUM(GRIDVOL)
!
!***************************************
!
! Volume-averaged concentration in waste panel
!
!  Add up individual element concentrations (kg/m^3 brine)
!    weighted by element volume
!
CM1WPSUM = SUM(GRIDVOL*CM1)
CM2WPSUM = SUM(GRIDVOL*CM2)
CM3WPSUM = SUM(GRIDVOL*CM3)
```

```
CM4WPSUM = SUM(GRIDVOL*CM4)
CM5WPSUM = SUM(GRIDVOL*CM5)
!
!  Determine average concentration (kg/m^3 brine)
!    by dividing by total volume of waste panel
!
CM1_WP   = CM1WPSUM/WPVOL
CM2_WP   = CM2WPSUM/WPVOL
CM3_WP   = CM3WPSUM/WPVOL
CM4_WP   = CM4WPSUM/WPVOL
CM5_WP   = CM5WPSUM/WPVOL
!
!  Convert from mass to activity per unit volume (Ci/m^3 brine)
!
CCM1_WP  = CM1_WP*A1
CCM2_WP  = CM2_WP*A2
CCM3_WP  = CM3_WP*A3
CCM4_WP  = CM4_WP*A4
CCM5_WP  = CM5_WP*A5
!
!  Convert to EPA units
!
EPAC1_WP = CCM1_WP/CI_2_EPA
EPAC2_WP = CCM2_WP/CI_2_EPA
EPAC3_WP = CCM3_WP/CI_2_EPA
EPAC4_WP = CCM4_WP/CI_2_EPA
EPAC5_WP = CCM5_WP/CI_5_EPA
!
!  Add up total
!
EPACT_WP = EPAC1_WP + EPAC2_WP + EPAC3_WP + EPAC4_WP + EPAC5_WP
!
!  Delete temporary variables
!
DELETE WPVOL
DELETE CM1WPSUM, CM2WPSUM, CM3WPSUM, CM4WPSUM, CM5WPSUM
DELETE CM1_WP,   CM2_WP,   CM3_WP,   CM4_WP,   CM5_WP
DELETE CCM1_WP,  CCM2_WP,  CCM3_WP,  CCM4_WP,  CCM5_WP
!
!****************************************
!****************************************
!
! Rest of repository
!
LIMIT ELEMENT 617 TO 625
!
! Total volume of rest of repository
!
RRVOL = SUM(GRIDVOL)
!
!****************************************
!
! Volume-averaged concentration rest of repository
!
!  Add up individual element concentrations (kg/m^3 brine)
```

```
!   weighted by element volume
!
CM1RRSUM = SUM(GRIDVOL*CM1)
CM2RRSUM = SUM(GRIDVOL*CM2)
CM3RRSUM = SUM(GRIDVOL*CM3)
CM4RRSUM = SUM(GRIDVOL*CM4)
CM5RRSUM = SUM(GRIDVOL*CM5)
!
! Determine average concentration (kg/m^3 brine)
!   by dividing by total volume of rest of repository
!
CM1_RR  = CM1RRSUM/RRVOL
CM2_RR  = CM2RRSUM/RRVOL
CM3_RR  = CM3RRSUM/RRVOL
CM4_RR  = CM4RRSUM/RRVOL
CM5_RR  = CM5RRSUM/RRVOL
!
! Convert from mass to activity per unit volume (Ci/m^3 brine)
!
CCM1_RR  = CM1_RR*A1
CCM2_RR  = CM2_RR*A2
CCM3_RR  = CM3_RR*A3
CCM4_RR  = CM4_RR*A4
CCM5_RR  = CM5_RR*A5
!
! Convert to EPA units
!
EPAC1_RR = CCM1_RR/CI_2_EPA
EPAC2_RR = CCM2_RR/CI_2_EPA
EPAC3_RR = CCM3_RR/CI_2_EPA
EPAC4_RR = CCM4_RR/CI_2_EPA
EPAC5_RR = CCM5_RR/CI_5_EPA
!
! Add up total
!
EPACT_RR = EPAC1_RR + EPAC2_RR + EPAC3_RR + EPAC4_RR + EPAC5_RR
!
! Delete temporary variables
!
DELETE RRVOL
DELETE CM1RRSUM, CM2RRSUM, CM3RRSUM, CM4RRSUM, CM5RRSUM
DELETE CM1_RR,  CM2_RR,  CM3_RR,  CM4_RR,  CM5_RR
DELETE CCM1_RR,  CCM2_RR,  CCM3_RR,  CCM4_RR,  CCM5_RR
!
!*****************************************************************************
!*****************************************************************************
!
! Activity of dissolved mass of isotopes in waste panel (EPA units)
!
! Param 129: Am-241 dissolved mass activity in waste panel ---------> DMEPA1WP
! Param 130: Pu-239 dissolved mass activity in waste panel ---------> DMEPA2WP
! Param 131: Pu-238 dissolved mass activity in waste panel ---------> DMEPA3WP
! Param 132: U--234 dissolved mass activity in waste panel ---------> DMEPA4WP
! Param 133: Th-230 dissolved mass activity in waste panel ---------> DMEPA5WP
! Param 134: Total dissolved mass activity in waste panel ----------> DMEPATWP
```

```
!
! Activity of dissolved mass of isotopes in rest of repository (EPA units)
!
!  Param 135: Am-241 dissolved mass activity in rest of repository --> DMEPA1RR
!  Param 136: Pu-239 dissolved mass activity in rest of repository --> DMEPA2RR
!  Param 137: Pu-238 dissolved mass activity in rest of repository --> DMEPA3RR
!  Param 138: U--234 dissolved mass activity in rest of repository --> DMEPA4RR
!  Param 139: Th-230 dissolved mass activity in rest of repository --> DMEPA5RR
!  Param 140: Total dissolved mass activity in rest of repository ---> DMEPATRR
!
!***************************************
!
! Waste panel
!
LIMIT ELEMENT 596 TO 616
!
!***************************************
!
! Activity of dissolved mass of isotopes in waste panel
!
!  Dissolved masses in waste panel (kg)
!
DM1_WP = SUM(BMDISM1)
DM2_WP = SUM(BMDISM2)
DM3_WP = SUM(BMDISM3)
DM4_WP = SUM(BMDISM4)
DM5_WP = SUM(BMDISM5)
!
!  Activities of dissolved masses (Ci)
!
DMC1_WP  = DM1_WP*A1
DMC2_WP  = DM2_WP*A2
DMC3_WP  = DM3_WP*A3
DMC4_WP  = DM4_WP*A4
DMC5_WP  = DM5_WP*A5
!
!  Activities converted to EPA units
!
DMEPA1WP = DMC1_WP/CI_2_EPA
DMEPA2WP = DMC2_WP/CI_2_EPA
DMEPA3WP = DMC3_WP/CI_2_EPA
DMEPA4WP = DMC4_WP/CI_2_EPA
DMEPA5WP = DMC5_WP/CI_5_EPA
!
!  Total EPA activity
!
DMEPATWP = DMEPA1WP + DMEPA2WP + DMEPA3WP + DMEPA4WP + DMEPA5WP
!
!  Delete temporary variables
!
DELETE DM1_WP,  DM2_WP,  DM3_WP,  DM4_WP,  DM5_WP
DELETE DMC1_WP, DMC2_WP, DMC3_WP, DMC4_WP, DMC5_WP
!
!***************************************
!***************************************
```

```
!
! Rest of repository
!
LIMIT ELEMENT 617 TO 625
!
!**************************************
!
! Activity of dissolved mass of isotopes in rest of repository
!
!  Dissolved masses in rest of repository (kg)
!
DM1_RR = SUM(BMDISM1)
DM2_RR = SUM(BMDISM2)
DM3_RR = SUM(BMDISM3)
DM4_RR = SUM(BMDISM4)
DM5_RR = SUM(BMDISM5)
!
!  Activities of dissolved masses (Ci)
!
DMC1_RR  = DM1_RR*A1
DMC2_RR  = DM2_RR*A2
DMC3_RR  = DM3_RR*A3
DMC4_RR  = DM4_RR*A4
DMC5_RR  = DM5_RR*A5
!
!  Activities converted to EPA units
!
DMEPA1RR = DMC1_RR/CI_2_EPA
DMEPA2RR = DMC2_RR/CI_2_EPA
DMEPA3RR = DMC3_RR/CI_2_EPA
DMEPA4RR = DMC4_RR/CI_2_EPA
DMEPA5RR = DMC5_RR/CI_5_EPA
!
!  Total EPA activity
!
DMEPATRR = DMEPA1RR + DMEPA2RR + DMEPA3RR + DMEPA4RR + DMEPA5RR
!
!  Delete temporary variables
!
DELETE DM1_RR,  DM2_RR,  DM3_RR,  DM4_RR,  DM5_RR
DELETE DMC1_RR, DMC2_RR, DMC3_RR, DMC4_RR, DMC5_RR
!
!**************************************************************************
!**************************************************************************
!
! Activity of undissolved mass of isotopes in waste panel (EPA units)
!
!  Param 141: Am-241 undissolved mass activity in waste panel -------> PMEPA1WP
!  Param 142: Pu-239 undissolved mass activity in waste panel -------> PMEPA2WP
!  Param 143: Pu-238 undissolved mass activity in waste panel -------> PMEPA3WP
!  Param 144: U--234 undissolved mass activity in waste panel -------> PMEPA4WP
!  Param 145: Th-230 undissolved mass activity in waste panel -------> PMEPA5WP
!  Param 146: Total undissolved mass activity in waste panel --------> PMEPATWP
!
! Activity of undissolved mass of isotopes in rest of repository (EPA units)
```

```
!
!  Param 147: Am-241 undisslvd mass activity in rest of repository --> PMEPA1RR
!  Param 148: Pu-239 undisslvd mass activity in rest of repository --> PMEPA2RR
!  Param 149: Pu-238 undisslvd mass activity in rest of repository --> PMEPA3RR
!  Param 150: U--234 undisslvd mass activity in rest of repository --> PMEPA4RR
!  Param 151: Th-230 undisslvd mass activity in rest of repository --> PMEPA5RR
!  Param 152: Total undisslvd mass activity in rest of repository ---> PMEPATRR
!
!***************************************
!
! Waste panel
!
LIMIT ELEMENT 596 TO 616
!
!***************************************
!
! Activity of undissolved mass of isotopes in waste panel
!
!  undissolved masses in waste panel (kg)
!
PM1_WP = SUM(BMPRCM1)
PM2_WP = SUM(BMPRCM2)
PM3_WP = SUM(BMPRCM3)
PM4_WP = SUM(BMPRCM4)
PM5_WP = SUM(BMPRCM5)
!
!  Activities of undissolved masses (Ci)
!
PMC1_WP  = PM1_WP*A1
PMC2_WP  = PM2_WP*A2
PMC3_WP  = PM3_WP*A3
PMC4_WP  = PM4_WP*A4
PMC5_WP  = PM5_WP*A5
!
!  Activities converted to EPA units
!
PMEPA1WP = PMC1_WP/CI_2_EPA
PMEPA2WP = PMC2_WP/CI_2_EPA
PMEPA3WP = PMC3_WP/CI_2_EPA
PMEPA4WP = PMC4_WP/CI_2_EPA
PMEPA5WP = PMC5_WP/CI_5_EPA
!
!  Total EPA activity
!
PMEPATWP = PMEPA1WP + PMEPA2WP + PMEPA3WP + PMEPA4WP + PMEPA5WP
!
!  Delete temporary variables
!
DELETE PM1_WP,  PM2_WP,  PM3_WP,  PM4_WP,  PM5_WP
DELETE PMC1_WP, PMC2_WP, PMC3_WP, PMC4_WP, PMC5_WP
!
!***************************************
!***************************************
!
! Rest of repository
```

```
!
LIMIT ELEMENT 617 TO 625
!
!*************************************
!
! Activity of undissolved mass of isotopes in rest of repository
!
!  Undissolved masses in rest of repository (kg)
!
PM1_RR = SUM(BMPRCM1)
PM2_RR = SUM(BMPRCM2)
PM3_RR = SUM(BMPRCM3)
PM4_RR = SUM(BMPRCM4)
PM5_RR = SUM(BMPRCM5)
!
!  Activities of undissolved masses (Ci)
!
PMC1_RR  = PM1_RR*A1
PMC2_RR  = PM2_RR*A2
PMC3_RR  = PM3_RR*A3
PMC4_RR  = PM4_RR*A4
PMC5_RR  = PM5_RR*A5
!
!  Activities converted to EPA units
!
PMEPA1RR = PMC1_RR/CI_2_EPA
PMEPA2RR = PMC2_RR/CI_2_EPA
PMEPA3RR = PMC3_RR/CI_2_EPA
PMEPA4RR = PMC4_RR/CI_2_EPA
PMEPA5RR = PMC5_RR/CI_5_EPA
!
!  Total EPA activity
!
PMEPATRR = PMEPA1RR + PMEPA2RR + PMEPA3RR + PMEPA4RR + PMEPA5RR
!
!  Delete temporary variables
!
DELETE PM1_RR,  PM2_RR,  PM3_RR,  PM4_RR,  PM5_RR
DELETE PMC1_RR, PMC2_RR, PMC3_RR, PMC4_RR, PMC5_RR
!
DELETE A1, A2, A3, A4, A5
!
!*****************************************************************************
!*****************************************************************************
!
! Total activities of isotopes in marker beds (Ci)
!
!  Param 153: Am-241 total activity in north marker beds --> TA1_MBN
!  Param 154: Pu-239 total activity in north marker beds --> TA2_MBN
!  Param 155: Pu-238 total activity in north marker beds --> TA3_MBN
!  Param 156: U--234 total activity in north marker beds --> TA4_MBN
!  Param 157: Th-230 total activity in north marker beds --> TA5_MBN
!
!  Param 158: Am-241 total activity in south marker beds --> TA1_MBS
!  Param 159: Pu-239 total activity in south marker beds --> TA2_MBS
```

```
!  Param 160: Pu-238 total activity in south marker beds --> TA3_MBS
!  Param 161: U--234 total activity in south marker beds --> TA4_MBS
!  Param 162: Th-230 total activity in south marker beds --> TA5_MBS
!
!  Param 163: Am-241 total activity in all marker beds ----> TA1_MBT
!  Param 164: Pu-239 total activity in all marker beds ----> TA2_MBT
!  Param 165: Pu-238 total activity in all marker beds ----> TA3_MBT
!  Param 166: U--234 total activity in all marker beds ----> TA4_MBT
!  Param 167: Th-230 total activity in all marker beds ----> TA5_MBT
!
! Total activities of isotopes in marker beds (EPA units)
!
!  Param 168: Am-241 total activity in north marker beds --> TEPA1MBN
!  Param 169: Pu-239 total activity in north marker beds --> TEPA2MBN
!  Param 170: Pu-238 total activity in north marker beds --> TEPA3MBN
!  Param 171: U--234 total activity in north marker beds --> TEPA4MBN
!  Param 172: Th-230 total activity in north marker beds --> TEPA5MBN
!
!  Param 173: Am-241 total activity in south marker beds --> TEPA1MBS
!  Param 174: Pu-239 total activity in south marker beds --> TEPA2MBS
!  Param 175: Pu-238 total activity in south marker beds --> TEPA3MBS
!  Param 176: U--234 total activity in south marker beds --> TEPA4MBS
!  Param 177: Th-230 total activity in south marker beds --> TEPA5MBS
!
!  Param 178: Am-241 total activity in all marker beds ----> TEPA1MBT
!  Param 179: Pu-239 total activity in all marker beds ----> TEPA2MBT
!  Param 180: Pu-238 total activity in all marker beds ----> TEPA3MBT
!  Param 181: U--234 total activity in all marker beds ----> TEPA4MBT
!  Param 182: Th-230 total activity in all marker beds ----> TEPA5MBT
!
!  Param 183: Total activity in all marker beds, north ----> TEPATMBN
!  Param 184: Total activity in all marker beds, south ----> TEPATMBS
!  Param 185: Total activity in all marker beds, overall --> TEPATMBT
!
!***************************************
!
! Total activities of isotopes in north marker beds (Ci)
!
LIMIT ELEMENT 540 TO 547, 556 TO 563, 588 TO 595
!
TA1_MBN = SUM(TOTMMC1)
TA2_MBN = SUM(TOTMMC2)
TA3_MBN = SUM(TOTMMC3)
TA4_MBN = SUM(TOTMMC4)
TA5_MBN = SUM(TOTMMC5)
!
!***************************************
!
! Total activities of isotopes in south marker beds (Ci)
!
LIMIT ELEMENT 532 TO 539, 548 TO 555, 564 TO 571
!
TA1_MBS = SUM(TOTMMC1)
TA2_MBS = SUM(TOTMMC2)
TA3_MBS = SUM(TOTMMC3)
```

```
TA4_MBS = SUM(TOTMMC4)
TA5_MBS = SUM(TOTMMC5)
!
!***************************************
!
! Total activities of isotopes in north and south marker beds (Ci)
!
LIMIT ELEMENT 532 TO 547, 548 TO 563, 564 TO 571, 588 TO 595
!
TA1_MBT = SUM(TOTMMC1)
TA2_MBT = SUM(TOTMMC2)
TA3_MBT = SUM(TOTMMC3)
TA4_MBT = SUM(TOTMMC4)
TA5_MBT = SUM(TOTMMC5)
!
!***************************************
!***************************************
!
! Total activities of isotopes in north marker beds (EPA units)
!
TEPA1MBN = TA1_MBN/CI_2_EPA
TEPA2MBN = TA2_MBN/CI_2_EPA
TEPA3MBN = TA3_MBN/CI_2_EPA
TEPA4MBN = TA4_MBN/CI_2_EPA
TEPA5MBN = TA5_MBN/CI_5_EPA
!
!***************************************
!
! Total activities of isotopes in south marker beds (EPA units)
!
TEPA1MBS = TA1_MBS/CI_2_EPA
TEPA2MBS = TA2_MBS/CI_2_EPA
TEPA3MBS = TA3_MBS/CI_2_EPA
TEPA4MBS = TA4_MBS/CI_2_EPA
TEPA5MBS = TA5_MBS/CI_5_EPA
!
!***************************************
!
! Total activities of isotopes in north and south marker beds (EPA units)
!
TEPA1MBT = TA1_MBT/CI_2_EPA
TEPA2MBT = TA2_MBT/CI_2_EPA
TEPA3MBT = TA3_MBT/CI_2_EPA
TEPA4MBT = TA4_MBT/CI_2_EPA
TEPA5MBT = TA5_MBT/CI_5_EPA
!
!***************************************
!
! Sum of activity in north marker beds (EPA units)
!
TEPATMBN = TEPA1MBN +  TEPA2MBN +  TEPA3MBN +  TEPA4MBN +  TEPA5MBN
!
! Sum of activity in south marker beds (EPA units)
!
TEPATMBS = TEPA1MBS +  TEPA2MBS +  TEPA3MBS +  TEPA4MBS +  TEPA5MBS
```

```
!
! Sum of activities in north and south marker beds (EPA units)
!
TEPATMBT = TEPATMBN + TEPATMBS
!
!**************************************************************************
!**************************************************************************
!
! Total activities of isotopes in waste panel (EPA units)
!
!  Param 186: Am-241 total activity in waste panel ----------> TEPA1_WP
!  Param 187: Pu-239 total activity in waste panel ----------> TEPA2_WP
!  Param 188: Pu-238 total activity in waste panel ----------> TEPA3_WP
!  Param 189: U--234 total activity in waste panel ----------> TEPA4_WP
!  Param 190: Th-230 total activity in waste panel ----------> TEPA5_WP
!  Param 191: Total isotope activity in waste panel ---------> TEPAT_WP
!
! Total activities of isotopes in rest of repository (EPA units)
!
!  Param 192: Am-241 total activity in rest of repository ---> TEPA1_RR
!  Param 193: Pu-239 total activity in rest of repository ---> TEPA2_RR
!  Param 194: Pu-238 total activity in rest of repository ---> TEPA3_RR
!  Param 195: U--234 total activity in rest of repository ---> TEPA4_RR
!  Param 196: Th-230 total activity in rest of repository ---> TEPA5_RR
!  Param 197: Total isotope activity in rest of repository --> TEPAT_RR
!
!***************************************
!
! Waste panel
!
LIMIT ELEMENT 596 TO 616
!
!***************************************
!
! Total activities in waste panel (Curies)
!
TA1_WP = SUM(TOTMMC1)
TA2_WP = SUM(TOTMMC2)
TA3_WP = SUM(TOTMMC3)
TA4_WP = SUM(TOTMMC4)
TA5_WP = SUM(TOTMMC5)
!
! Convert to EPA units
!
TEPA1_WP = TA1_WP/CI_2_EPA
TEPA2_WP = TA2_WP/CI_2_EPA
TEPA3_WP = TA3_WP/CI_2_EPA
TEPA4_WP = TA4_WP/CI_2_EPA
TEPA5_WP = TA5_WP/CI_5_EPA
!
! Add isotope activities together for EPA total
!
TEPAT_WP = TEPA1_WP + TEPA2_WP + TEPA3_WP + TEPA4_WP + TEPA5_WP
!
! Delete temporary variables
```

```
!
DELETE TA1_WP, TA2_WP, TA3_WP, TA4_WP, TA5_WP
!
!*************************************
!*************************************
!
! Rest of repository
!
LIMIT ELEMENT 617 TO 625
!
!*************************************
!
! Total activities in rest of repository (Curies)
!
TA1_RR = SUM(TOTMMC1)
TA2_RR = SUM(TOTMMC2)
TA3_RR = SUM(TOTMMC3)
TA4_RR = SUM(TOTMMC4)
TA5_RR = SUM(TOTMMC5)
!
! Convert to EPA units
!
TEPA1_RR = TA1_RR/CI_2_EPA
TEPA2_RR = TA2_RR/CI_2_EPA
TEPA3_RR = TA3_RR/CI_2_EPA
TEPA4_RR = TA4_RR/CI_2_EPA
TEPA5_RR = TA5_RR/CI_5_EPA
!
! Add isotope activities together for EPA total
!
TEPAT_RR = TEPA1_RR + TEPA2_RR + TEPA3_RR + TEPA4_RR + TEPA5_RR
!
! Delete temporary variables
!
DELETE TA1_RR, TA2_RR, TA3_RR, TA4_RR, TA5_RR
!
DELETE CI_2_EPA, CI_5_EPA
!
!***************************************************************************
!***************************************************************************
!
! Fluxes (Ci/s) in borehole at Rustler/Culebra Interface
!
!  Param 198: Am-241 flux up borehole at Rustler/Culebra (el.713) --> FL1BH_RC
!  Param 199: Pu-239 flux up borehole at Rustler/Culebra (el.713) --> FL2BH_RC
!  Param 200: Pu-238 flux up borehole at Rustler/Culebra (el.713) --> FL3BH_RC
!  Param 201: U--234 flux up borehole at Rustler/Culebra (el.713) --> FL4BH_RC
!  Param 202: Th-230 flux up borehole at Rustler/Culebra (el.713) --> FL5BH_RC
!
!*************************************
!
FL1BH_RC  = FL1BHRC
FL2BH_RC  = FL2BHRC
FL3BH_RC  = FL3BHRC
FL4BH_RC  = FL4BHRC
```

```
FL5BH_RC  = FL5BHRC
!
DELETE FL1BHRC, FL2BHRC, FL3BHRC, FL4BHRC, FL5BHRC
!
!*****************************************************************************
!*****************************************************************************
!
! Concentration (kg/m^3 brine) of isotopes in borehole at Rustler/Culebra
!
!  Param 203: Am-241 concen. in bh at Rustler/Culebra (el.713) --> CON1BHRC
!  Param 204: Pu-239 concen. in bh at Rustler/Culebra (el.713) --> CON2BHRC
!  Param 205: Pu-238 concen. in bh at Rustler/Culebra (el.713) --> CON3BHRC
!  Param 206: U--234 concen. in bh at Rustler/Culebra (el.713) --> CON4BHRC
!  Param 207: Th-230 concen. in bh at Rustler/Culebra (el.713) --> CON5BHRC
!
!****************************************
!
LIMIT ELEMENT OFF
!
CON1BHRC = CM1[E:713]
CON2BHRC = CM2[E:713]
CON3BHRC = CM3[E:713]
CON4BHRC = CM4[E:713]
CON5BHRC = CM5[E:713]
!
!*****************************************************************************
!*****************************************************************************
!
DELETE GRIDVOL
!
!*****************************************************************************
!*****************************************************************************
END
```

APPENDIX L: SUMMARIZE Input Files

Below are some example SUMMARIZE Input Files for use with the PANEL output.. These files have been selected as an example because they output only 6 variables. The corresponding files for the NUTS calculations output the 207 variables defined in the post-NUTS ALGEBRA file shown in Appendix K.

The following is an example SUMMARIZE Input file to obtain the final total EPA releases for all vectors in a PANEL run. This SUMMARIZE Input file creates a single table with all vectors as shown in the S6T2000 table in Appendix P. The table was re-sorted in EXCEL before it was reported in Appendix P, but it originally was in the order of the vector numbers.

```
*input files
        template= ALG_PANEL_CCA_ANA1_S6_V###
        disk=   DISK$IKE_CCA3:
        directory=[PANEL.ANA1.REG.DATA.S6]
        type=   CDB

*vector
        id=   #
        vector= 1 to 300

*times
        read=  seconds
        input=  years
        output= years
times= 10000

*items
        type= HISTORY
name= E09AM241, E09PU238, E09PU239, E09U234, E09TH230, EPATOT

*output
        driver= SPLAT
        write=  vector vs item
        name=   ALG_PANEL__chris_S6T2000
*end
```

This SUMMARIZE Input file was used to generate a set of separate tables for each realization in the non-time shifted S6 PANEL calculations. Each table has the six output variables as a function of time. The full set of these tables was read by a SPLAT Input file to produce Figure 7.41.

```
*input files
        template= ALG_PANEL_CCA_ANA1_S6_V###
        disk=    DISK$IKE_CCA3:
```

```
        directory=[PANEL.ANA1.REG.DATA.S6]
        type=    CDB

*vector
        id=    #
        vector= 1 to 300

*times
        read=   seconds
        input=  years
        output= years
steps=  0 to 1000 by 500, 1000 to 5000 by 50, 5000 to 10000 by 200

*items
        type= HISTORY
name= E09AM241, E09PU239, E09PU238, E09U234, E09TH230, EPATOT

*output
        driver= SPLAT
        write=  time vs item
        MULTIPLE FILES
        name=   ALG_PANEL_S6T2000_V###
*end
```

APPENDIX M: Code to Create SPLAT Input Files

A number of small codes were written to automate the preparation of SPLAT Input files and the manipulation of SUMMARIZE output tables. These codes were quite simple and the output files were hand-checked. We present here the codes used for the PANEL calculations because of the smaller number of variables plotted, but these codes include the same features as the ones written for NUTS. There were two codes that were used in the process of generating the plots shown in Section 7. The first code, FIXZERO, was used to create a new version of all the SUMMARIZE tables that had all zeros set to 10^{-30}. This was necessary for the data to be plotted on a log scale with SPLAT. The array "ivno" contained the numbers of the realizations that had non-zero releases and was used so that the vectors which were zero at all times would not be plotted. This version of FIXZERO for PANEL also has a feature not used in the NUTS version. It has code that checks to see if the parameters change from time step to time step. If there is a long period of unchanging cumulative release, FIXZERO only outputs the first and last time steps of that sequence in order to reduce the file size. This was necessary for the PANEL runs because the PANEL outputted results at every 50 year time step, and had 222 realizations with non-zero releases. The output tables of FIXZERO with this feature were an order of magnitude smaller than the original tables. This space saving feature was not needed for the NUTS SPLAT runs because the NUTS SUMMARIZE tables had fewer time steps and there were a maximum of 67 realizations per scenario.

```
PROGRAM FIXZERO
   IMPLICIT REAL (A-H,O-Z)
   DIMENSION ANEW(7,200), A(7,200), ivno(222)
   CHARACTER*132 IFILE,OFILE
   CHARACTER*4 INTR(7)
   data nv/222/
   DATA (INTR(I),I=1,7)/'0100','0350','1000','2000','4000',
  +    '6000','9000'/


   data (ivno(ii),ii=1,222)/
  +    2, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, 21,
  +    23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 39,
  +    40, 41, 42, 43, 44, 48, 49, 50, 51, 52, 54, 57, 60,
  +    62, 63, 64, 65, 66, 68, 69, 71, 72, 73, 74, 76, 77,
  +    78, 81, 82, 84, 85, 87, 88, 89, 90, 91, 92, 93, 94,
  +    95, 96, 97, 98, 99, 100, 102, 103, 104, 105, 108,
  +    109, 110, 111, 112, 113, 114, 116, 117, 118, 119,
  +    120, 121, 124, 125, 126, 127, 128, 130, 131, 134,
  +    135, 136, 138, 139, 140, 141, 142, 143, 144, 145,
  +    147, 148, 150, 152, 153, 154, 156, 157, 159, 161,
  +    163, 165, 166, 167, 169, 170, 171, 172, 173, 174,
  +    175, 177, 179, 180, 181, 182, 183, 184, 185, 188,
  +    189, 190, 191, 193, 194, 195, 196, 198, 199, 200,
  +    201, 202, 203, 204, 205, 207, 210, 211, 213, 214,
  +    215, 216, 217, 218, 220, 221, 222, 224, 225, 226,
  +    227, 228, 229, 230, 231, 232, 233, 234, 235, 236,
  +    237, 238, 240, 241, 242, 243, 245, 246, 249, 250,
```

```
     +    251, 252, 253, 255, 256, 258, 260, 261, 262, 265,
     +    266, 267, 268, 269, 270, 272, 273, 275, 276, 278,
     +    279, 280, 281, 282, 283, 284, 285, 287, 289, 290,
     +    293, 294, 295, 299, 300/

      DO 400 ITIME=1,7
      do 300 IVEC=1,222

       write(Ifile,2000) INTR(ITIME), iVNO(IVEC)
       write(Ofile,2001) INTR(ITIME), iVNO(IVEC)

       open(unit=6,file=Ifile,status='OLD')
       open(unit=7,file=Ofile,status='NEW')
          DO 100 M=1,200
           READ (6,*,END=500) IVECNO, (A(N,M), N=1,7)
           DO N=2,7
         IF (A(N,M) .LE.1.0E-30) THEN
                 A(N,M) = 1.0E-30
            ENDIF
           END DO
100    CONTINUE
          ILST = 1
          INEW = 1
          DO N=1,7
            ANEW(N,INEW)=A(N,1)
          END DO

          DO 200 M=2,199
           IF(A(2,M).EQ.A(2,ILST).AND.A(3,M).EQ.A(3,ILST).AND.
     +    A(4,M).EQ.A(4,ILST).AND.A(5,M).EQ.A(5,ILST).AND.
     +    A(6,M).EQ.A(6,ILST).AND.A(7,M).EQ.A(7,ILST)) GOTO 200
        IF(M-1.NE.ILST) THEN
                 INEW = INEW+1
                 DO N=1,7
                   ANEW(N,INEW)=A(N,M-1)
                 END DO
           ENDIF
           INEW = INEW+1
           DO N=1,7
                 ANEW(N,INEW)=A(N,M)
           END DO
           ILST = M
200    CONTINUE
          INEW = INEW+1
          DO N=1,7
            ANEW(N,INEW)=A(N,200)
          END DO
          DO M=1,INEW
           WRITE(7,1000) IVECNO, (ANEW(N,M), N=1,7)
       END DO
300  CONTINUE
400  CONTINUE
      STOP
500  WRITE(*,*) 'READ PAST END OF FILE '
2000 format('disk$tina_cca3:[bf.mjshort.PANEL]ALG_PANEL_S6t',A4,'_V',i3
```

```
    +.3,'.TBL')
2001 format('ALG_PANEL_S6t',A4,'_V',i3.3,'F.TBL')
1000 FORMAT (2X, 13, 1P7E14.6)
     END
```

MAKESPLAT was the program that created the SPLAT input files to match the PANEL SUMMARIZE tables created using the input files shown in Appendix L. MAKESPLAT created a SPLAT input file for each plot variable, and each intrusion time for scenario 6. Note the SPLAT command "axis log y" which necessitated the use of the program FIXZERO. An example of a resulting SPLAT input file is shown in Appendix N. (Note the typographical error "MB128" which should be "MB138".

```
      PROGRAM MAKESPLAT
C
      character*130 title(6), ylabel(6), yunits(6), sfile
      character*200 txt(11)
      dimension ltxt(8), ltxtlab(6), ltitle(6)
      dimension ivno(222)
      parameter(np=6,ncarlab=130,ncartxt=200)
      CHARACTER*4 INTR(7)
      data nv/222/
      DATA (INTR(I),I=1,7)/'0100','0350','1000','2000','4000',
     +     '6000','9000'/

      data (ivno(ii),ii=1,222)/
     +  2, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, 21,
     +  23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 39,
     +  40, 41, 42, 43, 44, 48, 49, 50, 51, 52, 54, 57, 60,
     +  62, 63, 64, 65, 66, 68, 69, 71, 72, 73, 74, 76, 77,
     +  78, 81, 82, 84, 85, 87, 88, 89, 90, 91, 92, 93, 94,
     +  95, 96, 97, 98, 99, 100, 102, 103, 104, 105, 108,
     +  109, 110, 111, 112, 113, 114, 116, 117, 118, 119,
     +  120, 121, 124, 125, 126, 127, 128, 130, 131, 134,
     +  135, 136, 138, 139, 140, 141, 142, 143, 144, 145,
     +  147, 148, 150, 152, 153, 154, 156, 157, 159, 161,
     +  163, 165, 166, 167, 169, 170, 171, 172, 173, 174,
     +  175, 177, 179, 180, 181, 182, 183, 184, 185, 188,
     +  189, 190, 191, 193, 194, 195, 196, 198, 199, 200,
     +  201, 202, 203, 204, 205, 207, 210, 211, 213, 214,
     +  215, 216, 217, 218, 220, 221, 222, 224, 225, 226,
     +  227, 228, 229, 230, 231, 232, 233, 234, 235, 236,
     +  237, 238, 240, 241, 242, 243, 245, 246, 249, 250,
     +  251, 252, 253, 255, 256, 258, 260, 261, 262, 265,
     +  266, 267, 268, 269, 270, 272, 273, 275, 276, 278,
     +  279, 280, 281, 282, 283, 284, 285, 287, 289, 290,
     +  293, 294, 295, 299, 300/

      data (title(i),i=1,6)/
     1 'Am-241 Integrated Discharge up Borehole at MB128',
     2 'Pu-238 Integrated Discharge up Borehole at MB128',
     3 'Pu-239 Integrated Discharge up Borehole at MB128',
     4 'U-234 Integrated Discharge up Borehole at MB128',
```

```
     5 'Th-230 Integrated Discharge up Borehole at MB128',
     6 'Total Integrated Discharge up Borehole at MB128'/

      data (ylabel(i),i=1,6)/ 'E09AM241', 'E09PU238','E09PU239',
     +                    'E09U234','E09TH230','EPATOT'/

      data (yunits(i),i=1,6)/ ' EPA units', ' EPA units', ' EPA units',
     +                         ' EPA units', ' EPA units', ' EPA units'/

c     define character strings which do not change
      txt(1) = 'size text 0.017'
      txt(11)= 'PORTRAIT'
      txt(4) = 'lstyle curve solid'
      txt(10) = 'axis log y'
      txt(5) = 'axis scale user 0,10000,1.0e-6,100,5,5,2,5'
      txt(7) = 'width curve 0.7'
      txt(8) = 'replot 0,10000,1.0e-6,100,5,5,2,5'
      txt(9) = 'exit'

c     determine character string length for yaxis units
      do 30 i=1,np
       do 40 k=ncarlab,1,-1
        if(yunits(i)(k:k).ne.' ')then
         ltxtlab(i) = k
         go to 30
        endif
40      continue
30     continue

c     determine character string length for plot titles
      do 50 i=1,np
       do 60 k=ncarlab,1,-1
        if(title(i)(k:k).ne.' ')then
         ltitle(i) = k
         go to 50
        endif
60      continue
50     continue

      DO 300 ITIME = 1,7
      do 100 iplot = 1,6
       write(sfile,2000) INTR(iTIME), IPLOT
       open(unit=6,file=sfile,status='new')
       write(txt(2),4000) iNTR(ITIME)
       write(txt(3),4500) title(iplot)(1:ltitle(iplot))
       write(txt(6),5000) ylabel(iplot)
c      determine character string length
       do 20 i=1,9
        do 10 k=ncartxt,1,-1
         if(txt(i)(k:k).ne.' ')then
          ltxt(i) = k
          go to 20
         endif
10       continue
20      continue
```

```
c     add yaxis units label to txt(6)
      l1 = ltxt(6) + 3
      l2 = l1 +  ltxtlab(iplot)
      txt(6)(l1-1:l1) ='- '
      txt(6)(l1:l2) = yunits(iplot)(1:ltxtlab(iplot))

c     adjust character string 6
      txt(6)(l2+1:l2+1) = '"'
      ltxt(6) = l2 + 1

      write(6,3000) txt(11)(1:10)
      write(6,3000) (txt(j)(1:ltxt(j)),j=1,4)
      write(6,3000) txt(10)(1:10)
      write(6,3000) (txt(j)(1:ltxt(j)),j=5,7)

      do 200 ivec  = 1, NV
        write(6,1000) intR(ITIME), ivno(ivec), iplot+2
200    continue

      write(6,3000) (txt(j)(1:ltxt(j)),j=8,9)
      write(*,2001) intR(ITIME), iplot

100  continue
300  CONTINUE
     write(*,*)
     write(*,*)'MAKESPLAT EXECUTION COMPLETED'
     write(*,*)

1000  format('overlay ALG_PANEL_S6t',A4,'_V',i3.3,'F.TBL 2,'i3)
2000  format('splat_PANEL_S6_T',A4,'_h',i1,'.inp')
2001  format('+','WRITING SPLAT INPUT FILE FOR PANEL T',A4,' H',I1)
3000  format(a)
4000  format('title device 0.15,0.75 "SNL WIPP PA96: PANEL SIMULATIONS (
    +CCA S6 T',A4,')"')
4500  format('title device 0.15,0.70 "',a,'"')
5000  format('label "Time - Years", "', a)
6000  format(a,' "')
     end
```

APPENDIX N: SPLAT Input file

Below is an example SPLAT input file. It was generated with MAKESPLAT (Appendix M) for the S6 PANEL calculation with the 1000 year intrusion time. This example shows the SPLAT input file for plotting the ^{241}Am discharge up the borehole at marker bed 138.

```
PORTRAIT
size text 0.017
title device 0.15,0.75 "SNL WIPP PA96: PANEL SIMULATIONS (CCA S6 T1000)"
title device 0.15,0.70 "Am-241 Integrated Discharge up Borehole at MB128"
lstyle curve solid
axis log y
axis scale user 0,10000,1.0e-6,100,5,5,2,5
label "Time - Years", "E09AM241 - EPA units "
width curve 0.7
overlay ALG_PANEL_S6t1000_V002F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V006F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V007F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V008F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V009F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V011F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V012F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V013F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V014F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V015F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V016F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V017F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V019F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V021F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V023F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V024F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V025F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V027F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V028F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V029F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V030F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V031F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V032F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V033F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V034F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V035F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V039F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V040F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V041F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V042F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V043F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V044F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V048F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V049F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V050F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V051F.TBL 2, 3
```

overlay ALG_PANEL_S6t1000_V052F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V054F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V057F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V060F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V062F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V063F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V064F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V065F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V066F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V068F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V069F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V071F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V073F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V074F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V076F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V077F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V078F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V081F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V082F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V084F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V085F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V087F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V088F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V089F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V090F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V091F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V094F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V095F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V096F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V097F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V098F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V099F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V100F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V102F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V103F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V104F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V105F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V108F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V109F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V110F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V111F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V112F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V113F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V114F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V116F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V117F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V118F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V119F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V120F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V121F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V124F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V125F.TBL 2, 3

overlay ALG_PANEL_S6t1000_V126F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V135F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V136F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V138F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V139F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V140F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V141F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V143F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V144F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V145F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V147F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V148F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V150F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V153F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V154F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V169F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V173F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V174F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V175F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V177F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V179F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V183F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V184F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V185F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V188F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V189F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V190F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V191F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V193F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V194F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V195F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V196F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V198F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V199F.TBL 2, 3

overlay ALG_PANEL_S6t1000_V200F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V201F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V202F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V203F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V205F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V210F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V211F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V213F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V214F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V215F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V216F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V217F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V218F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V220F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V231F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V232F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V233F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V234F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V235F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V236F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V237F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V238F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V240F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V241F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V242F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V243F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V245F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V246F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V249F.TBL 2, 3
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overlay ALG_PANEL_S6t1000_V251F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V252F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V253F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V255F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V256F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V258F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V260F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V261F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V262F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V265F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V266F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V267F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V268F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V269F.TBL 2, 3

```
overlay ALG_PANEL_S6t1000_V270F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V272F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V273F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V275F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V276F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V278F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V279F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V280F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V281F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V282F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V283F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V284F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V285F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V287F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V289F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V290F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V293F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V294F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V295F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V299F.TBL 2, 3
overlay ALG_PANEL_S6t1000_V300F.TBL 2, 3
replot 0,10000,1.0e-6,100,5,5,2,5
exit
```

APPENDIX O: Post-PANEL ALGEBRACDB Input Files

The application of ALGEBRACDB for the input-control file listed below post processes PANEL's results, converting units from kg to Curies and lumping PANEL's 21 radioisotope outputs to form the 5 equivalent lumped radioisotopes used by CCDFGF to scale SECOTP's outputs. The kg to Curie conversion factors were calculated in PANEL using PANEL's half-lives, and were copied from the PANEL debug file. The units of the five lumped isotopes are also converted to EPA units for display purposes. Note that an exclamation point at the start of a line indicates that the line is a comment and not executed. Some "commented out" sections of this file have been deleted for clarity.

```
!A00PB210=SD0PB210*7.6338E4
A00RA226=SD0RA226*9.8863E2
AL0RA226=SL0RA226*9.8863E2
AS0RA226=SS0RA226*9.8863E2
!A00RA228=SD0RA228*2.7268E5
A00TH229=SD0TH229*2.1268E2
AL0TH229=SL0TH229*2.1268E2
AS0TH229=SS0TH229*2.1268E2
A00TH230=SD0TH230*2.0186E1
AL0TH230=SL0TH230*2.0186E1
AS0TH230=SS0TH230*2.0186E1
!A00TH232=SD0TH232*1.0967E-4
!A00PA231=SD0PA231*4.7240E1
A00U233=SD0U233*9.6801E0
AL0U233=SL0U233*9.6801E0
AS0U233=SS0U233*9.6801E0
A00U234=SD0U234*6.2484E0
AL0U234=SL0U234*6.2484E0
AS0U234=SS0U234*6.2484E0
!A00U235=SD0U235*2.1615E-3
!A00U236=SD0U236*6.4679E-2
!A00U238=SD0U238*3.3618E-4
A00NP237=SD0NP237*7.0486E-1
AL0NP237=SL0NP237*7.0486E-1
AS0NP237=SS0NP237*7.0486E-1
A00PU238=SD0PU238*1.7119E4
AL0PU238=SL0PU238*1.7119E4
AS0PU238=SS0PU238*1.7119E4
A00PU239=SD0PU239*6.2143E1
AL0PU239=SL0PU239*6.2143E1
AS0PU239=SS0PU239*6.2143E1
A00PU240=SD0PU240*2.2786E2
AL0PU240=SL0PU240*2.2786E2
AS0PU240=SS0PU240*2.2786E2
A00PU242=SD0PU242*3.9257E0
A00AM241=SD0AM241*3.4321E3
AL0AM241=SL0AM241*3.4321E3
AS0AM241=SS0AM241*3.4321E3
```

```
!STATEMENTS BELOW ARE TO COMBINE CURIES FOR CCA96 CALCULATIONS
A09AM241=A00AM241
A09PU238=A00PU238
A09PU239=A00PU239+A00PU240+A00PU242
A09U234=A00U233+A00U234
A09TH230=A00TH229+A00TH230
epalwmbt=makehist(0.)

!SCALE=4.0736
SCALE=3.44

E09AM241=A09AM241/100./SCALE
E09PU238=A09PU238/100./SCALE
E09PU239=A09PU239/100./SCALE
E09U234=A09U234/100./SCALE
E09TH230=A09TH230/10./SCALE
EPATOT=E09AM241+E09PU238+E09PU239+E09U234+E09TH230
END
```

APPENDIX P: 10,000 Year Integrated Releases for All Calculations.

Table 10.1 S1

vector	time	E1LW_MBS [G] 241Am	E2LW_MBS [G] 239Pu	E3LW_MBS [G] 238Pu	E4LW_MBS [G] 234U	E5LW_MBS [G] 230Th	EPALWMBT [G] Total - All MB	EPALWM9S [G] Total, MB129S
46	10000	2.82E-15	3.08E-10	1.70E-24	6.79E-12	1.81E-11	3.33E-10	3.33E-10
264	10000	2.12E-15	9.30E-11	7.52E-25	3.46E-13	2.26E-12	9.56E-11	9.56E-11
133	10000	7.90E-16	1.77E-12	8.98E-28	9.65E-14	2.13E-12	3.99E-12	3.99E-12
203	10000	5.27E-17	2.26E-12	6.39E-27	1.75E-15	1.03E-13	2.36E-12	2.36E-12
116	10000	5.28E-20	8.82E-14	5.52E-29	5.74E-17	1.29E-15	8.95E-14	8.95E-14
181	10000	3.45E-19	1.30E-16	1.39E-29	5.29E-18	2.52E-16	3.88E-16	3.88E-16
190	10000	1.80E-21	2.94E-17	0.00E+00	9.60E-21	1.09E-18	3.05E-17	3.05E-17
125	10000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
260	10000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 10. 10.2 S2T100

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
111	1.00E+04	6.57E+00	4.51E-02	1.73E-03	5.23E-05	9.40E-04	6.62E+00
256	1.00E+04	3.58E+00	1.07E-02	5.47E-04	1.65E-03	1.90E-04	3.60E+00
128	1.00E+04	1.76E+00	6.27E-01	4.46E-03	2.79E-05	5.01E-04	2.40E+00
9	1.00E+04	2.02E+00	8.97E-03	4.59E-04	5.67E-04	2.51E-04	2.03E+00
90	1.00E+04	1.04E+00	3.48E-03	3.01E-04	4.16E-04	3.67E-05	1.05E+00
64	1.00E+04	6.11E-01	6.17E-03	1.06E-06	6.75E-06	1.21E-04	6.18E-01
290	1.00E+04	5.48E-01	1.07E-02	7.95E-05	1.94E-06	3.49E-05	5.59E-01
217	1.00E+04	5.13E-01	4.70E-03	4.18E-05	4.54E-05	2.68E-05	5.18E-01
177	1.00E+04	5.02E-01	5.02E-03	8.89E-05	7.34E-05	2.35E-05	5.07E-01
130	1.00E+04	4.15E-01	3.43E-02	3.52E-04	6.56E-04	4.46E-05	4.51E-01
23	1.00E+04	3.16E-01	1.02E-01	1.78E-08	3.28E-03	6.08E-04	4.22E-01
77	1.00E+04	3.99E-01	4.45E-03	1.50E-04	2.79E-04	2.30E-05	4.04E-01
141	1.00E+04	3.16E-01	4.70E-02	1.36E-08	9.56E-06	1.72E-04	3.63E-01
50	1.00E+04	3.44E-01	2.79E-03	1.07E-04	3.24E-06	5.82E-05	3.47E-01
236	1.00E+04	3.32E-01	5.72E-03	2.40E-04	1.01E-06	1.82E-05	3.38E-01
52	1.00E+04	3.10E-01	1.42E-02	4.07E-05	4.72E-04	5.84E-05	3.24E-01
181	1.00E+04	2.44E-01	9.75E-03	1.88E-05	2.22E-06	3.99E-05	2.54E-01
126	1.00E+04	2.15E-01	6.97E-04	3.86E-06	8.51E-05	1.77E-05	2.16E-01
280	1.00E+04	2.07E-01	4.54E-03	7.38E-08	1.02E-03	5.78E-05	2.12E-01
125	1.00E+04	1.82E-01	2.31E-03	1.10E-04	7.12E-07	1.28E-05	1.85E-01
25	1.00E+04	1.21E-01	3.74E-02	1.16E-09	1.31E-05	2.35E-04	1.58E-01
72	1.00E+04	1.13E-01	4.36E-02	1.03E-10	4.44E-06	7.97E-05	1.56E-01
54	1.00E+04	1.42E-01	1.52E-03	2.04E-05	4.67E-04	6.68E-06	1.44E-01
19	1.00E+04	8.71E-02	1.45E-03	5.84E-05	2.13E-07	3.83E-06	8.86E-02
153	1.00E+04	6.71E-02	7.02E-04	1.44E-06	6.55E-05	6.38E-06	6.79E-02
267	1.00E+04	5.81E-02	4.62E-03	1.54E-06	8.50E-04	2.04E-05	6.35E-02
260	1.00E+04	3.44E-02	2.77E-02	1.58E-07	4.13E-06	7.43E-05	6.21E-02
108	1.00E+04	5.53E-02	5.17E-04	3.76E-05	5.13E-08	9.19E-07	5.59E-02

222	1.00E+04	4.34E-02	8.35E-03	7.38E-08	1.01E-06	1.81E-05	5.17E-02
124	1.00E+04	4.00E-02	5.25E-03	7.68E-09	1.06E-03	7.95E-05	4.64E-02
14	1.00E+04	3.24E-02	2.48E-04	6.02E-07	2.02E-07	3.63E-06	3.27E-02
221	1.00E+04	3.46E-03	2.05E-02	3.28E-10	2.55E-06	4.58E-05	2.40E-02
245	1.00E+04	2.12E-02	5.80E-04	3.48E-06	2.05E-05	2.17E-06	2.18E-02
135	1.00E+04	1.60E-02	1.86E-03	1.20E-07	1.82E-04	1.16E-05	1.80E-02
40	1.00E+04	1.59E-02	2.01E-03	7.80E-05	2.06E-07	3.69E-06	1.80E-02
147	1.00E+04	1.25E-02	4.29E-03	9.51E-05	5.28E-07	9.48E-06	1.69E-02
276	1.00E+04	1.27E-02	1.63E-04	9.18E-06	1.37E-08	2.41E-07	1.28E-02
100	1.00E+04	9.17E-05	9.75E-03	7.56E-14	1.38E-06	2.48E-05	9.87E-03
262	1.00E+04	7.80E-03	9.52E-05	2.44E-06	2.94E-05	1.44E-06	7.93E-03
225	1.00E+04	1.21E-03	5.17E-03	2.79E-08	1.32E-06	2.38E-05	6.41E-03
88	1.00E+04	3.23E-03	2.98E-03	7.20E-09	1.81E-05	5.07E-06	6.23E-03
99	1.00E+04	2.94E-03	1.49E-03	5.32E-11	9.53E-07	1.72E-05	4.45E-03
252	1.00E+04	2.83E-03	2.22E-04	1.07E-05	1.02E-06	7.53E-07	3.07E-03
49	1.00E+04	9.47E-04	1.01E-05	6.21E-09	1.06E-08	2.33E-07	9.57E-04
41	1.00E+04	6.38E-05	7.28E-04	1.33E-11	1.42E-04	9.79E-06	9.44E-04
165	1.00E+04	1.55E-05	3.34E-04	6.51E-16	5.26E-04	6.13E-06	8.81E-04
253	1.00E+04	4.73E-04	1.22E-05	3.04E-08	5.26E-09	9.45E-08	4.85E-04
39	1.00E+04	2.68E-06	2.64E-04	5.97E-14	1.06E-04	1.29E-05	3.86E-04
13	1.00E+04	1.22E-05	3.34E-04	4.01E-14	3.36E-05	1.98E-06	3.82E-04
48	1.00E+04	3.42E-04	4.65E-06	2.61E-08	3.96E-09	6.47E-08	3.47E-04
59	1.00E+04	2.92E-04	4.98E-06	1.42E-07	6.05E-09	1.15E-07	2.98E-04
283	1.00E+04	2.23E-04	4.82E-06	2.48E-08	9.34E-09	9.69E-08	2.28E-04
238	1.00E+04	1.38E-04	1.40E-05	8.96E-08	2.86E-07	4.16E-08	1.52E-04
174	1.00E+04	6.51E-05	4.51E-07	5.63E-09	1.30E-07	2.84E-08	6.57E-05
232	1.00E+04	2.62E-05	2.48E-07	2.83E-10	6.69E-08	1.32E-08	2.65E-05
206	1.00E+04	2.48E-05	6.48E-07	2.82E-09	1.21E-07	4.77E-08	2.56E-05
131	1.00E+04	2.16E-05	1.04E-06	3.85E-09	4.44E-08	1.59E-08	2.27E-05
167	1.00E+04	1.31E-05	2.14E-06	4.78E-10	1.70E-07	7.02E-08	1.55E-05
250	1.00E+04	2.18E-07	4.12E-09	1.54E-11	1.54E-09	2.22E-10	2.24E-07
293	1.00E+04	4.21E-08	1.55E-07	1.50E-15	9.89E-09	8.52E-09	2.16E-07
4	1.00E+04	7.21E-08	9.25E-08	2.38E-11	4.06E-09	1.25E-09	1.70E-07

*break

Table 10.3 S2T350

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
111	1.00E+04	6.00E+00	4.44E-02	8.07E-05	2.21E-05	9.28E-04	6.04E+00
256	1.00E+04	3.03E+00	1.06E-02	1.26E-04	1.01E-03	1.88E-04	3.04E+00
128	1.00E+04	1.47E+00	6.12E-01	9.71E-04	2.72E-05	4.88E-04	2.08E+00
9	1.00E+04	1.77E+00	8.86E-03	1.06E-04	2.62E-04	2.48E-04	1.78E+00
90	1.00E+04	9.20E-01	3.49E-03	4.98E-06	4.04E-04	3.67E-05	9.24E-01
64	1.00E+04	4.98E-01	6.05E-03	2.31E-07	6.63E-06	1.19E-04	5.04E-01
130	1.00E+04	4.34E-01	3.32E-02	8.31E-05	4.85E-04	4.32E-05	4.68E-01
177	1.00E+04	4.50E-01	5.03E-03	2.01E-05	7.30E-05	2.35E-05	4.55E-01
290	1.00E+04	4.43E-01	1.07E-02	1.70E-05	1.94E-06	3.49E-05	4.54E-01
77	1.00E+04	3.91E-01	4.45E-03	3.63E-06	2.79E-04	2.30E-05	3.95E-01
236	1.00E+04	3.28E-01	5.72E-03	7.37E-06	1.01E-06	1.82E-05	3.33E-01
23	1.00E+04	2.19E-01	9.92E-02	3.87E-09	2.87E-03	5.88E-04	3.22E-01
52	1.00E+04	2.90E-01	1.41E-02	9.71E-06	4.72E-04	5.84E-05	3.04E-01
217	1.00E+04	2.78E-01	4.70E-03	9.58E-06	4.38E-05	2.68E-05	2.82E-01

141	1.00E+04	2.00E-01	4.55E-02	1.15E-09	9.27E-06	1.66E-04	2.46E-01
50	1.00E+04	2.30E-01	2.79E-03	1.47E-06	3.24E-06	5.82E-05	2.33E-01
125	1.00E+04	1.82E-01	2.32E-03	2.43E-05	7.12E-07	1.28E-05	1.84E-01
181	1.00E+04	1.72E-01	9.59E-03	4.24E-06	2.19E-06	3.93E-05	1.81E-01
126	1.00E+04	1.75E-01	6.97E-04	8.18E-07	5.02E-05	1.77E-05	1.76E-01
54	1.00E+04	1.39E-01	1.52E-03	6.83E-07	5.07E-04	6.68E-06	1.41E-01
72	1.00E+04	9.71E-02	4.29E-02	8.36E-12	4.37E-06	7.85E-05	1.40E-01
25	1.00E+04	8.84E-02	3.64E-02	2.37E-10	1.27E-05	2.29E-04	1.25E-01
280	1.00E+04	1.02E-01	4.47E-03	1.53E-08	9.92E-04	5.64E-05	1.07E-01
19	1.00E+04	8.61E-02	1.45E-03	1.46E-05	2.13E-07	3.83E-06	8.75E-02
153	1.00E+04	6.16E-02	7.02E-04	3.30E-07	5.44E-05	6.38E-06	6.24E-02
260	1.00E+04	3.10E-02	2.67E-02	4.24E-08	3.93E-06	7.05E-05	5.77E-02
267	1.00E+04	5.12E-02	4.59E-03	4.71E-07	7.10E-04	2.02E-05	5.65E-02
108	1.00E+04	5.46E-02	5.18E-04	4.86E-07	4.71E-08	9.19E-07	5.51E-02
222	1.00E+04	3.29E-02	8.19E-03	1.67E-08	9.86E-07	1.77E-05	4.11E-02
124	1.00E+04	2.97E-02	5.07E-03	1.52E-09	6.26E-04	7.56E-05	3.54E-02
14	1.00E+04	2.89E-02	2.48E-04	1.20E-08	6.62E-08	3.63E-06	2.92E-02
221	1.00E+04	3.17E-03	1.99E-02	6.68E-11	2.47E-06	4.44E-05	2.31E-02
245	1.00E+04	1.95E-02	5.80E-04	3.37E-08	6.19E-06	2.17E-06	2.01E-02
40	1.00E+04	1.59E-02	2.02E-03	1.82E-05	2.06E-07	3.69E-06	1.79E-02
147	1.00E+04	1.25E-02	4.29E-03	2.29E-05	5.28E-07	9.48E-06	1.68E-02
135	1.00E+04	1.33E-02	1.86E-03	2.35E-09	1.83E-04	1.15E-05	1.54E-02
276	1.00E+04	1.25E-02	1.64E-04	1.98E-07	1.28E-08	2.40E-07	1.26E-02
100	1.00E+04	9.08E-05	9.08E-03	1.75E-14	1.28E-06	2.30E-05	9.19E-03
262	1.00E+04	7.80E-03	9.53E-05	5.31E-08	1.50E-05	1.44E-06	7.91E-03
225	1.00E+04	1.21E-03	4.92E-03	6.65E-09	1.26E-06	2.27E-05	6.15E-03
88	1.00E+04	3.10E-03	2.98E-03	1.76E-09	1.70E-05	5.07E-06	6.10E-03
252	1.00E+04	2.83E-03	2.22E-04	2.86E-06	6.69E-07	7.53E-07	3.06E-03
99	1.00E+04	1.36E-03	1.45E-03	3.03E-12	9.32E-07	1.67E-05	2.83E-03
49	1.00E+04	9.47E-04	1.02E-05	1.23E-10	1.02E-08	2.54E-07	9.57E-04
41	1.00E+04	6.38E-05	7.00E-04	2.83E-12	1.16E-04	9.47E-06	8.89E-04
165	1.00E+04	1.39E-05	2.75E-04	1.20E-16	3.84E-04	5.31E-06	6.78E-04
253	1.00E+04	4.68E-04	1.22E-05	5.58E-10	3.46E-09	9.45E-08	4.80E-04
13	1.00E+04	1.16E-05	3.06E-04	5.51E-18	3.28E-05	1.84E-06	3.52E-04
48	1.00E+04	3.41E-04	4.67E-06	7.64E-10	1.81E-09	6.18E-08	3.46E-04
39	1.00E+04	2.60E-06	2.42E-04	1.39E-14	8.30E-05	1.18E-05	3.39E-04
59	1.00E+04	2.91E-04	4.99E-06	3.69E-08	5.21E-09	1.04E-07	2.96E-04
283	1.00E+04	2.22E-04	4.82E-06	1.10E-09	1.12E-08	1.01E-07	2.27E-04
238	1.00E+04	1.36E-04	1.40E-05	2.58E-08	1.28E-07	3.88E-08	1.51E-04
174	1.00E+04	6.51E-05	4.52E-07	8.36E-11	1.13E-07	2.88E-08	6.57E-05
232	1.00E+04	2.61E-05	2.49E-07	6.42E-11	3.41E-08	8.85E-09	2.64E-05
206	1.00E+04	2.46E-05	6.49E-07	6.58E-10	4.35E-08	2.72E-08	2.53E-05
131	1.00E+04	2.16E-05	1.04E-06	1.15E-10	3.81E-08	1.56E-08	2.27E-05
167	1.00E+04	1.31E-05	2.14E-06	1.10E-10	8.52E-08	5.04E-08	1.54E-05
250	1.00E+04	2.18E-07	4.12E-09	4.58E-12	9.54E-10	1.78E-10	2.23E-07
293	1.00E+04	4.20E-08	1.45E-07	3.16E-16	4.58E-09	5.10E-09	1.97E-07
4	1.00E+04	7.21E-08	9.27E-08	5.63E-12	3.62E-09	1.10E-09	1.70E-07

*break

Table 10.4 S3T1000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
111	1.00E+04	2.15E+00	4.40E-02	1.23E-06	7.48E-06	1.01E-03	2.19E+00
128	1.00E+04	6.97E-01	4.09E-01	5.00E-06	2.30E-05	4.13E-04	1.11E+00
9	1.00E+04	8.23E-01	7.80E-03	2.63E-07	1.48E-04	3.32E-04	8.31E-01
256	1.00E+04	6.81E-01	8.13E-03	6.23E-07	7.29E-04	2.34E-04	6.90E-01
82	1.00E+04	2.72E-01	4.76E-03	8.31E-07	2.88E-05	4.22E-05	2.77E-01
217	1.00E+04	2.36E-01	2.36E-03	2.84E-07	6.50E-05	3.83E-05	2.39E-01
19	1.00E+04	2.12E-01	6.19E-03	9.92E-07	5.90E-06	1.06E-04	2.18E-01
236	1.00E+04	2.00E-01	8.05E-03	1.04E-06	7.26E-06	1.30E-04	2.08E-01
125	1.00E+04	1.94E-01	3.60E-03	4.48E-07	2.55E-06	4.63E-05	1.98E-01
90	1.00E+04	1.87E-01	3.14E-03	4.97E-07	1.93E-04	7.28E-05	1.90E-01
52	1.00E+04	1.80E-01	5.67E-03	2.97E-07	5.04E-04	6.24E-05	1.86E-01
130	1.00E+04	1.33E-01	2.04E-02	7.71E-08	2.52E-04	3.22E-05	1.54E-01
23	1.00E+04	3.68E-02	9.10E-02	4.83E-12	3.58E-03	5.32E-04	1.32E-01
64	1.00E+04	1.24E-01	4.91E-03	2.20E-09	5.34E-06	9.60E-05	1.29E-01
177	1.00E+04	1.20E-01	1.73E-03	1.59E-07	2.51E-05	1.50E-03	1.23E-01
202	1.00E+04	1.14E-01	3.45E-04	6.45E-08	1.36E-05	3.65E-06	1.14E-01
253	1.00E+04	1.07E-01	2.92E-03	4.69E-07	2.32E-07	1.02E-05	1.10E-01
287	1.00E+04	8.60E-02	4.56E-04	1.93E-07	1.08E-04	1.39E-05	8.66E-02
290	1.00E+04	8.29E-02	3.63E-03	2.62E-07	1.05E-06	1.88E-05	8.65E-02
141	1.00E+04	5.34E-02	1.74E-02	8.40E-11	3.75E-06	6.74E-05	7.08E-02
260	1.00E+04	4.38E-02	2.67E-02	1.03E-07	3.97E-06	7.12E-05	7.05E-02
163	1.00E+04	6.72E-02	4.24E-04	5.35E-08	5.58E-06	5.32E-04	6.82E-02
265	1.00E+04	5.12E-02	1.16E-03	2.05E-07	1.84E-07	1.33E-05	5.23E-02
72	1.00E+04	5.77E-03	3.83E-02	2.19E-13	3.90E-06	7.00E-05	4.41E-02
25	1.00E+04	1.68E-02	2.56E-02	4.88E-13	9.23E-06	1.66E-04	4.26E-02
243	1.00E+04	3.46E-02	2.13E-03	5.17E-07	3.65E-07	7.03E-06	3.68E-02
235	1.00E+04	2.53E-02	4.76E-03	1.14E-06	5.79E-05	1.09E-05	3.01E-02
183	1.00E+04	2.68E-02	2.88E-04	1.64E-08	1.25E-05	7.89E-06	2.71E-02
124	1.00E+04	2.14E-02	4.67E-03	1.44E-10	7.70E-04	7.02E-05	2.69E-02
98	1.00E+04	2.50E-02	3.35E-04	9.84E-09	1.13E-04	3.39E-06	2.54E-02
181	1.00E+04	1.89E-02	3.07E-03	3.76E-09	3.70E-07	3.06E-03	2.51E-02
153	1.00E+04	2.17E-02	2.20E-04	5.25E-09	1.64E-05	2.99E-04	2.22E-02
222	1.00E+04	1.48E-02	5.50E-03	4.60E-10	5.44E-07	1.31E-05	2.03E-02
221	1.00E+04	1.96E-03	1.56E-02	1.70E-13	2.03E-06	3.65E-05	1.76E-02
108	1.00E+04	1.61E-02	3.94E-04	3.11E-08	2.61E-08	1.00E-06	1.64E-02
147	1.00E+04	1.10E-02	3.48E-03	3.83E-07	6.02E-07	1.12E-05	1.45E-02
245	1.00E+04	1.28E-02	8.09E-04	4.97E-09	8.67E-06	1.52E-05	1.36E-02
267	1.00E+04	9.47E-03	1.78E-03	2.23E-09	3.73E-04	9.93E-06	1.16E-02
77	1.00E+04	1.10E-02	4.00E-04	3.91E-09	1.82E-05	4.09E-06	1.14E-02
227	1.00E+04	1.05E-02	1.48E-04	1.76E-08	6.81E-06	1.68E-06	1.07E-02
50	1.00E+04	7.33E-03	5.83E-04	7.07E-09	8.14E-08	2.50E-05	7.94E-03
100	1.00E+04	1.43E-05	5.58E-03	3.01E-17	7.95E-07	1.43E-05	5.61E-03
110	1.00E+04	4.15E-03	1.60E-04	4.86E-08	3.31E-08	1.02E-06	4.31E-03
225	1.00E+04	4.40E-04	3.00E-03	8.84E-12	8.21E-07	1.48E-05	3.45E-03
40	1.00E+04	2.53E-03	7.79E-04	1.61E-07	6.14E-08	2.05E-06	3.31E-03
39	1.00E+04	2.33E-03	2.14E-04	2.46E-09	1.99E-05	1.16E-05	2.58E-03
165	1.00E+04	9.31E-06	2.42E-04	7.54E-18	4.63E-04	1.78E-03	2.49E-03
121	1.00E+04	2.47E-03	1.46E-05	1.51E-10	1.40E-06	1.86E-07	2.48E-03

280	1.00E+04	1.76E-04	1.35E-03	1.36E-13	3.22E-04	1.96E-05	1.87E-03
99	1.00E+04	6.74E-04	9.18E-04	4.45E-14	6.49E-07	1.16E-05	1.60E-03
126	1.00E+04	7.01E-04	2.57E-05	6.15E-11	1.32E-06	8.48E-07	7.29E-04
41	1.00E+04	7.40E-05	4.89E-04	2.78E-14	5.33E-05	7.13E-06	6.23E-04
238	1.00E+04	5.14E-04	2.30E-05	5.21E-09	1.83E-07	9.39E-08	5.38E-04
135	1.00E+04	3.77E-04	1.18E-04	1.80E-11	3.95E-05	2.56E-06	5.37E-04
49	1.00E+04	4.41E-04	9.72E-06	1.39E-11	9.60E-09	1.58E-07	4.51E-04
252	1.00E+04	4.09E-04	2.62E-05	7.57E-09	1.94E-07	1.58E-07	4.36E-04
88	1.00E+04	4.72E-05	1.39E-04	3.92E-13	2.27E-06	6.25E-07	1.89E-04
13	1.00E+04	2.15E-06	1.42E-04	3.39E-19	1.80E-05	1.01E-06	1.63E-04
48	1.00E+04	1.59E-04	2.72E-06	4.11E-11	8.64E-10	5.91E-08	1.61E-04
174	1.00E+04	1.14E-04	6.63E-07	1.32E-11	1.46E-07	3.28E-08	1.14E-04
131	1.00E+04	9.84E-05	2.89E-06	5.58E-10	4.77E-08	5.27E-08	1.01E-04
283	1.00E+04	4.03E-05	1.65E-06	3.31E-11	3.96E-09	4.54E-08	4.19E-05
167	1.00E+04	3.64E-05	2.89E-06	1.40E-11	1.62E-07	7.74E-08	3.95E-05
232	1.00E+04	1.97E-05	2.89E-07	1.66E-12	3.66E-08	1.24E-08	2.00E-05
262	1.00E+04	6.26E-06	1.48E-07	8.80E-13	2.12E-08	6.51E-09	6.44E-06
250	1.00E+04	2.61E-06	4.65E-08	2.13E-13	1.10E-08	2.19E-09	2.67E-06
293	1.00E+04	2.23E-14	1.18E-11	7.88E-28	3.20E-13	1.18E-12	1.33E-11

*break

Table 10.5 S3T3000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
128	1.00E+04	4.32E-02	3.16E-01	2.69E-08	9.86E-06	3.21E-04	3.60E-01
125	1.00E+04	1.13E-01	3.60E-03	6.42E-09	9.79E-07	4.63E-05	1.17E-01
19	1.00E+04	8.97E-02	6.20E-03	9.95E-08	8.41E-07	1.06E-04	9.60E-02
90	1.00E+04	9.15E-02	3.14E-03	5.33E-08	1.91E-04	7.28E-05	9.49E-02
236	1.00E+04	8.38E-02	8.10E-03	1.07E-07	1.03E-06	1.30E-04	9.20E-02
217	1.00E+04	7.05E-02	2.40E-03	1.66E-08	2.06E-05	3.83E-05	7.30E-02
82	1.00E+04	5.83E-02	4.76E-03	1.76E-07	2.19E-05	4.22E-05	6.31E-02
23	1.00E+04	2.06E-04	6.03E-02	2.41E-15	1.67E-03	3.33E-04	6.25E-02
256	1.00E+04	5.03E-02	7.16E-03	1.15E-08	6.18E-04	2.09E-04	5.83E-02
111	1.00E+04	3.71E-03	3.64E-02	4.03E-09	5.52E-06	8.47E-04	4.09E-02
130	1.00E+04	2.29E-02	1.44E-02	5.92E-10	1.75E-04	2.19E-05	3.75E-02
72	1.00E+04	6.39E-05	3.22E-02	3.46E-16	3.06E-06	5.88E-05	3.23E-02
9	1.00E+04	2.25E-02	7.24E-03	2.99E-08	1.31E-04	3.00E-04	3.01E-02
64	1.00E+04	1.92E-02	4.02E-03	5.72E-11	2.96E-06	7.89E-05	2.33E-02
177	1.00E+04	2.09E-02	1.74E-03	5.49E-08	2.10E-05	1.78E-05	2.27E-02
235	1.00E+04	1.65E-02	4.78E-03	3.28E-09	3.89E-05	1.09E-05	2.14E-02
25	1.00E+04	9.69E-04	1.98E-02	3.78E-15	6.24E-06	1.21E-04	2.09E-02
260	1.00E+04	3.74E-03	1.55E-02	3.64E-11	1.95E-06	4.48E-05	1.93E-02
141	1.00E+04	3.57E-03	1.09E-02	1.88E-13	1.89E-06	4.25E-05	1.45E-02
243	1.00E+04	1.24E-02	2.13E-03	4.93E-10	2.21E-07	7.03E-06	1.45E-02
221	1.00E+04	1.92E-04	1.35E-02	2.31E-15	1.30E-06	2.61E-05	1.37E-02
202	1.00E+04	9.38E-03	3.46E-04	1.81E-10	1.13E-05	3.65E-06	9.74E-03
287	1.00E+04	7.87E-03	4.56E-04	4.05E-09	3.04E-05	1.39E-05	8.37E-03
52	1.00E+04	2.14E-03	5.78E-03	1.17E-08	1.70E-04	6.24E-05	8.16E-03
163	1.00E+04	6.56E-03	4.34E-04	4.55E-10	4.66E-06	4.52E-06	7.00E-03
265	1.00E+04	5.44E-03	1.16E-03	2.51E-08	1.65E-07	1.33E-05	6.61E-03
290	1.00E+04	2.69E-03	3.63E-03	3.49E-09	5.52E-07	1.88E-05	6.34E-03

153	1.00E+04	5.45E-03	2.21E-04	1.92E-10	1.48E-05	2.97E-06	5.69E-03
147	1.00E+04	2.12E-03	3.52E-03	1.57E-08	3.19E-07	1.12E-05	5.66E-03
222	1.00E+04	4.87E-04	4.75E-03	5.82E-12	5.02E-07	1.10E-05	5.25E-03
98	1.00E+04	4.50E-03	3.35E-04	1.78E-10	1.13E-04	3.39E-06	4.95E-03
267	1.00E+04	2.27E-03	1.75E-03	1.86E-11	2.69E-04	9.06E-06	4.30E-03
253	1.00E+04	1.17E-03	2.92E-03	1.14E-08	2.00E-07	1.02E-05	4.09E-03
124	1.00E+04	1.28E-04	2.98E-03	7.09E-13	2.44E-04	4.42E-05	3.40E-03
181	1.00E+04	9.31E-04	2.29E-03	2.62E-12	2.73E-07	1.51E-05	3.24E-03
77	1.00E+04	1.84E-03	4.00E-04	8.14E-11	1.82E-05	4.09E-06	2.27E-03
110	1.00E+04	2.02E-03	1.60E-04	2.41E-09	1.74E-08	1.02E-06	2.18E-03
225	1.00E+04	1.90E-04	1.58E-03	1.91E-14	3.43E-07	7.24E-06	1.77E-03
50	1.00E+04	1.15E-03	5.83E-04	4.05E-11	8.13E-08	2.50E-05	1.76E-03
227	1.00E+04	1.52E-03	1.49E-04	7.93E-10	6.58E-06	1.68E-06	1.68E-03
183	1.00E+04	1.03E-03	2.88E-04	1.84E-09	1.24E-05	7.89E-06	1.34E-03
245	1.00E+04	2.37E-04	8.09E-04	2.92E-14	8.67E-06	1.52E-05	1.07E-03
40	1.00E+04	2.86E-04	7.80E-04	1.46E-09	3.94E-08	2.05E-06	1.07E-03
99	1.00E+04	1.33E-04	6.74E-04	1.08E-15	3.06E-07	8.83E-06	8.16E-04
108	1.00E+04	3.47E-04	3.94E-04	7.14E-11	2.60E-08	1.00E-06	7.42E-04
41	1.00E+04	1.63E-05	5.55E-04	2.22E-16	3.11E-05	4.94E-06	6.07E-04
280	1.00E+04	2.56E-06	5.17E-04	1.72E-16	6.52E-05	8.10E-06	5.93E-04
39	1.00E+04	4.09E-04	5.42E-05	1.39E-12	4.82E-06	4.05E-06	4.72E-04
135	1.00E+04	9.25E-05	1.18E-04	3.54E-13	7.43E-06	2.50E-06	2.20E-04
252	1.00E+04	1.46E-04	2.62E-05	7.47E-11	6.05E-08	1.55E-07	1.73E-04
88	1.00E+04	1.37E-05	1.39E-04	1.42E-15	6.11E-07	6.25E-07	1.54E-04
165	1.00E+04	5.70E-07	7.75E-05	3.46E-20	3.73E-05	1.07E-06	1.16E-04
126	1.00E+04	5.35E-05	2.57E-05	2.71E-13	1.32E-06	8.48E-07	8.14E-05
238	1.00E+04	3.67E-05	2.30E-05	1.28E-10	1.82E-07	9.39E-08	6.00E-05
131	1.00E+04	5.39E-05	2.89E-06	4.33E-11	4.54E-08	5.26E-08	5.69E-05
121	1.00E+04	2.61E-05	1.46E-05	1.57E-11	3.82E-07	1.86E-07	4.13E-05
167	1.00E+04	1.80E-05	2.80E-06	4.61E-14	1.00E-07	6.69E-08	2.10E-05
49	1.00E+04	5.93E-06	9.41E-06	2.40E-13	1.07E-09	1.01E-07	1.54E-05
283	1.00E+04	1.05E-05	1.59E-06	3.75E-13	3.42E-10	4.30E-08	1.21E-05
48	1.00E+04	3.49E-06	2.71E-06	4.02E-14	8.56E-10	5.86E-08	6.26E-06
13	1.00E+04	2.07E-09	5.41E-06	7.69E-22	3.43E-07	1.46E-07	5.90E-06
100	1.00E+04	1.53E-08	5.46E-06	5.12E-21	3.92E-10	1.13E-07	5.59E-06
232	1.00E+04	3.13E-06	2.89E-07	8.90E-15	3.61E-08	1.23E-08	3.47E-06
174	1.00E+04	1.56E-06	6.63E-07	9.60E-12	1.22E-07	3.19E-08	2.37E-06
250	1.00E+04	4.18E-07	4.64E-08	5.21E-14	1.04E-08	2.16E-09	4.77E-07
262	1.00E+04	3.82E-08	1.48E-07	2.50E-14	2.12E-08	6.51E-09	2.14E-07
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.6 S3T5000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
128	1.00E+04	3.76E-03	2.36E-01	1.76E-10	7.20E-06	2.41E-04	2.40E-01
111	1.00E+04	9.92E-04	3.26E-02	1.02E-10	4.94E-06	7.63E-04	3.44E-02
23	1.00E+04	1.15E-05	2.88E-02	5.86E-18	7.96E-04	1.57E-04	2.97E-02
236	1.00E+04	1.24E-02	8.06E-03	5.37E-10	1.02E-06	1.30E-04	2.05E-02
72	1.00E+04	7.91E-06	1.99E-02	3.08E-18	1.88E-06	3.65E-05	1.99E-02
125	1.00E+04	1.16E-02	3.65E-03	2.41E-11	1.00E-06	4.63E-05	1.53E-02

130	1.00E+04	3.85E-03	9.40E-03	2.37E-12	1.14E-04	1.35E-05	1.34E-02
256	1.00E+04	6.61E-03	6.04E-03	1.28E-10	5.19E-04	1.82E-04	1.33E-02
19	1.00E+04	6.55E-03	6.20E-03	3.78E-10	8.41E-07	1.06E-04	1.29E-02
217	1.00E+04	9.72E-03	2.41E-03	1.73E-10	2.06E-05	3.83E-05	1.22E-02
90	1.00E+04	6.56E-03	3.14E-03	9.60E-11	1.91E-04	7.28E-05	9.96E-03
25	1.00E+04	8.18E-05	9.62E-03	3.44E-17	3.07E-06	5.96E-05	9.77E-03
9	1.00E+04	1.96E-03	6.18E-03	8.28E-11	1.11E-04	2.55E-04	8.51E-03
235	1.00E+04	2.66E-03	4.77E-03	3.48E-11	3.89E-05	1.09E-05	7.48E-03
82	1.00E+04	2.22E-03	4.76E-03	9.91E-11	2.19E-05	4.22E-05	7.05E-03
243	1.00E+04	4.46E-03	2.13E-03	5.05E-11	2.21E-07	7.03E-06	6.60E-03
141	1.00E+04	5.03E-04	6.00E-03	2.64E-15	1.04E-06	2.41E-05	6.53E-03
52	1.00E+04	2.97E-04	5.73E-03	9.04E-11	1.68E-04	6.17E-05	6.26E-03
64	1.00E+04	2.64E-03	2.87E-03	5.79E-13	2.08E-06	5.58E-05	5.57E-03
260	1.00E+04	1.62E-04	5.04E-03	1.16E-14	7.70E-07	1.76E-05	5.22E-03
177	1.00E+04	2.69E-03	1.73E-03	4.98E-10	2.10E-05	1.78E-05	4.46E-03
290	1.00E+04	3.54E-04	3.63E-03	3.30E-11	5.52E-07	1.88E-05	4.01E-03
147	1.00E+04	2.21E-04	3.53E-03	4.14E-11	3.19E-07	1.12E-05	3.77E-03
222	1.00E+04	5.08E-05	3.38E-03	2.48E-14	3.70E-07	8.34E-06	3.44E-03
253	1.00E+04	1.30E-04	2.92E-03	2.46E-10	2.00E-07	1.02E-05	3.06E-03
221	1.00E+04	5.51E-06	2.74E-03	3.39E-18	3.26E-07	7.27E-06	2.75E-03
163	1.00E+04	2.13E-03	4.36E-04	1.88E-11	4.67E-06	4.52E-06	2.58E-03
181	1.00E+04	7.63E-06	2.20E-03	6.37E-16	2.61E-07	1.43E-05	2.23E-03
124	1.00E+04	1.13E-05	2.00E-03	4.98E-16	1.66E-04	3.02E-05	2.21E-03
267	1.00E+04	3.55E-04	1.48E-03	1.58E-13	2.26E-04	7.13E-06	2.07E-03
265	1.00E+04	7.15E-04	1.16E-03	1.30E-10	1.65E-07	1.33E-05	1.89E-03
287	1.00E+04	1.05E-03	4.56E-04	4.69E-11	3.04E-05	1.39E-05	1.55E-03
202	1.00E+04	9.30E-04	3.50E-04	2.95E-13	1.14E-05	3.65E-06	1.30E-03
98	1.00E+04	5.92E-04	3.35E-04	1.79E-12	1.13E-04	3.39E-06	1.04E-03
245	1.00E+04	2.63E-08	8.09E-04	2.68E-16	8.67E-06	1.52E-05	8.33E-04
40	1.00E+04	3.77E-05	7.80E-04	1.29E-11	3.94E-08	2.05E-06	8.19E-04
153	1.00E+04	5.68E-04	2.21E-04	6.57E-13	1.48E-05	2.97E-06	8.07E-04
50	1.00E+04	1.38E-04	5.83E-04	1.69E-13	8.14E-08	2.50E-05	7.46E-04
77	1.00E+04	2.04E-04	4.00E-04	8.63E-13	1.82E-05	4.09E-06	6.26E-04
225	1.00E+04	2.89E-05	5.73E-04	2.39E-16	1.33E-07	3.10E-06	6.05E-04
227	1.00E+04	4.09E-04	1.50E-04	1.23E-11	6.59E-06	1.68E-06	5.67E-04
110	1.00E+04	2.46E-04	1.60E-04	8.13E-12	1.74E-08	1.02E-06	4.08E-04
108	1.00E+04	5.13E-06	3.94E-04	5.18E-13	2.60E-08	1.00E-06	4.00E-04
183	1.00E+04	4.94E-05	2.88E-04	5.40E-12	1.24E-05	7.89E-06	3.58E-04
41	1.00E+04	2.61E-06	2.52E-04	3.22E-18	1.15E-05	2.54E-06	2.69E-04
99	1.00E+04	1.35E-05	2.49E-04	1.01E-17	1.12E-07	3.99E-06	2.66E-04
88	1.00E+04	5.18E-06	1.39E-04	1.37E-16	6.11E-07	6.25E-07	1.46E-04
135	1.00E+04	1.47E-05	1.13E-04	3.09E-15	7.10E-06	2.08E-06	1.36E-04
39	1.00E+04	5.02E-05	1.03E-05	8.04E-15	9.15E-07	3.70E-07	6.19E-05
252	1.00E+04	3.17E-05	2.62E-05	4.48E-13	6.05E-08	1.56E-07	5.81E-05
126	1.00E+04	9.27E-06	2.57E-05	1.95E-15	1.32E-06	8.48E-07	3.71E-05
238	1.00E+04	3.72E-06	2.30E-05	7.78E-13	1.82E-07	9.39E-08	2.70E-05
121	1.00E+04	3.37E-06	1.46E-05	6.43E-14	3.82E-07	1.86E-07	1.85E-05
49	1.00E+04	7.33E-07	8.82E-06	6.33E-16	1.00E-09	8.41E-08	9.64E-06
131	1.00E+04	6.38E-06	2.89E-06	4.23E-13	4.54E-08	5.26E-08	9.37E-06
167	1.00E+04	3.79E-06	2.71E-06	3.69E-15	9.67E-08	6.41E-08	6.66E-06
280	1.00E+04	3.06E-08	4.80E-06	1.03E-19	6.06E-07	1.18E-06	6.61E-06
283	1.00E+04	3.77E-06	1.56E-06	3.44E-14	3.34E-10	4.20E-08	5.37E-06
48	1.00E+04	2.90E-08	2.59E-06	1.42E-16	8.15E-10	5.54E-08	2.67E-06
232	1.00E+04	1.13E-06	2.87E-07	9.44E-16	3.59E-08	1.22E-08	1.46E-06

174	1.00E+04	2.29E-07	6.60E-07	3.36E-14	1.22E-07	3.21E-08	1.04E-06
262	1.00E+04	4.98E-09	1.48E-07	2.03E-16	2.12E-08	6.50E-09	1.81E-07
250	1.00E+04	6.54E-08	4.62E-08	5.24E-16	1.04E-08	2.16E-09	1.24E-07
13	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.7 S3T7000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
128	1.00E+04	2.06E-04	1.42E-01	2.67E-13	4.26E-06	1.49E-04	1.42E-01
111	1.00E+04	1.25E-04	2.54E-02	9.16E-13	3.83E-06	5.82E-04	2.61E-02
72	1.00E+04	2.01E-06	1.16E-02	2.77E-19	1.09E-06	2.14E-05	1.16E-02
236	1.00E+04	1.59E-03	8.06E-03	3.59E-12	1.02E-06	1.30E-04	9.78E-03
130	1.00E+04	5.83E-04	7.17E-03	1.54E-14	8.69E-05	9.49E-06	7.85E-03
256	1.00E+04	9.67E-04	5.57E-03	1.48E-12	4.78E-04	1.64E-04	7.18E-03
19	1.00E+04	6.65E-04	6.20E-03	3.70E-12	8.41E-07	1.06E-04	6.97E-03
23	1.00E+04	1.35E-07	5.98E-03	7.74E-20	1.63E-04	3.25E-05	6.17E-03
9	1.00E+04	2.59E-04	5.08E-03	6.00E-13	9.08E-05	2.03E-04	5.63E-03
52	1.00E+04	4.75E-05	5.03E-03	1.20E-12	1.47E-04	5.30E-05	5.27E-03
125	1.00E+04	1.49E-03	3.71E-03	1.57E-13	1.01E-06	4.63E-05	5.24E-03
235	1.00E+04	3.57E-04	4.77E-03	3.79E-13	3.89E-05	1.09E-05	5.18E-03
82	1.00E+04	2.93E-04	4.76E-03	9.71E-13	2.19E-05	4.22E-05	5.12E-03
90	1.00E+04	1.31E-03	3.14E-03	2.19E-12	1.91E-04	7.28E-05	4.72E-03
217	1.00E+04	1.43E-03	2.33E-03	1.40E-12	2.00E-05	3.72E-05	3.82E-03
290	1.00E+04	5.22E-05	3.56E-03	1.09E-13	5.41E-07	1.85E-05	3.63E-03
147	1.00E+04	1.10E-05	3.53E-03	1.92E-14	3.19E-07	1.12E-05	3.56E-03
253	1.00E+04	1.71E-05	2.92E-03	1.79E-12	2.00E-07	1.02E-05	2.94E-03
243	1.00E+04	5.87E-04	2.13E-03	5.27E-13	2.21E-07	7.03E-06	2.73E-03
260	1.00E+04	2.74E-05	2.54E-03	5.35E-17	4.26E-07	9.91E-06	2.58E-03
181	1.00E+04	2.61E-07	2.20E-03	4.64E-19	2.64E-07	1.43E-05	2.22E-03
177	1.00E+04	3.03E-04	1.73E-03	3.70E-12	2.10E-05	1.78E-05	2.07E-03
141	1.00E+04	3.58E-05	1.74E-03	2.24E-17	3.04E-07	7.03E-06	1.78E-03
64	1.00E+04	3.09E-04	1.44E-03	6.05E-15	1.04E-06	2.76E-05	1.78E-03
222	1.00E+04	6.21E-06	1.59E-03	3.04E-16	1.80E-07	4.48E-06	1.60E-03
267	1.00E+04	1.27E-04	1.15E-03	1.55E-14	1.75E-04	5.51E-06	1.45E-03
265	1.00E+04	7.15E-05	1.16E-03	8.74E-14	1.64E-07	1.33E-05	1.24E-03
124	1.00E+04	1.43E-06	9.01E-04	4.66E-18	7.48E-05	1.22E-05	9.90E-04
245	1.00E+04	3.46E-09	8.09E-04	1.96E-18	8.67E-06	1.52E-05	8.33E-04
40	1.00E+04	1.37E-05	7.80E-04	1.14E-12	3.94E-08	2.05E-06	7.95E-04
163	1.00E+04	2.59E-04	4.36E-04	5.76E-14	4.70E-06	4.52E-06	7.05E-04
287	1.00E+04	1.39E-04	4.56E-04	5.28E-13	3.04E-05	1.39E-05	6.39E-04
50	1.00E+04	1.96E-05	5.83E-04	1.47E-15	8.16E-08	2.50E-05	6.28E-04
202	1.00E+04	1.82E-04	3.53E-04	2.41E-15	1.14E-05	3.65E-06	5.49E-04
98	1.00E+04	4.88E-05	3.35E-04	1.06E-15	1.13E-04	3.39E-06	5.00E-04
77	1.00E+04	2.68E-05	4.00E-04	9.95E-15	1.82E-05	4.09E-06	4.49E-04
25	1.00E+04	4.99E-07	3.92E-04	9.12E-20	1.40E-07	3.12E-06	3.96E-04
108	1.00E+04	6.75E-07	3.94E-04	4.73E-15	2.60E-08	1.00E-06	3.95E-04
183	1.00E+04	6.50E-06	2.88E-04	2.34E-14	1.24E-05	7.89E-06	3.15E-04

153	1.00E+04	7.76E-05	2.15E-04	6.52E-15	1.43E-05	2.89E-06	3.10E-04
227	1.00E+04	2.93E-05	1.50E-04	3.26E-14	6.59E-06	1.68E-06	1.87E-04
110	1.00E+04	2.28E-05	1.60E-04	3.28E-14	1.74E-08	1.02E-06	1.84E-04
135	1.00E+04	5.17E-06	8.92E-05	2.87E-16	5.59E-06	1.61E-06	1.02E-04
88	1.00E+04	3.57E-07	4.00E-05	1.04E-18	1.73E-07	2.85E-07	4.08E-05
225	1.00E+04	7.55E-07	2.95E-05	2.17E-18	8.06E-09	3.47E-07	3.06E-05
252	1.00E+04	2.80E-06	2.62E-05	1.28E-15	6.05E-08	1.57E-07	2.92E-05
126	1.00E+04	7.51E-07	2.57E-05	4.70E-18	1.32E-06	8.48E-07	2.86E-05
238	1.00E+04	4.53E-07	2.30E-05	4.11E-15	1.82E-07	9.39E-08	2.38E-05
39	1.00E+04	9.32E-06	1.03E-05	1.00E-16	9.14E-07	2.63E-07	2.08E-05
121	1.00E+04	2.01E-07	1.46E-05	6.56E-17	3.82E-07	1.86E-07	1.53E-05
49	1.00E+04	2.61E-07	8.05E-06	6.37E-17	9.11E-10	7.10E-08	8.38E-06
131	1.00E+04	2.11E-06	2.89E-06	1.92E-14	4.53E-08	5.26E-08	5.10E-06
167	1.00E+04	4.76E-07	2.21E-06	4.19E-17	7.81E-08	4.54E-08	2.81E-06
48	1.00E+04	3.78E-09	2.23E-06	2.23E-19	6.97E-10	4.66E-08	2.28E-06
283	1.00E+04	2.01E-07	1.46E-06	3.42E-17	3.12E-10	3.92E-08	1.70E-06
174	1.00E+04	3.61E-08	6.40E-07	2.61E-16	1.18E-07	3.10E-08	8.25E-07
280	1.00E+04	7.54E-10	3.48E-07	3.49E-22	4.36E-08	1.33E-07	5.25E-07
232	1.00E+04	1.36E-07	2.68E-07	7.11E-18	3.33E-08	1.11E-08	4.48E-07
262	1.00E+04	6.61E-10	1.48E-07	1.70E-18	2.12E-08	6.49E-09	1.77E-07
41	1.00E+04	2.57E-10	8.92E-08	3.60E-23	2.52E-09	3.56E-09	9.55E-08
250	1.00E+04	8.23E-09	4.39E-08	4.80E-18	9.86E-09	2.02E-09	6.40E-08
99	1.00E+04	5.73E-12	3.90E-11	2.06E-23	1.75E-14	1.65E-11	6.12E-11
13	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
221	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.8 S3T9000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
128	1.00E+04	1.36E-05	3.53E-02	2.59E-15	1.05E-06	4.94E-05	3.54E-02
111	1.00E+04	1.18E-05	1.29E-02	9.46E-15	1.95E-06	3.36E-04	1.33E-02
82	1.00E+04	3.70E-05	4.56E-03	7.76E-15	2.09E-05	3.92E-05	4.65E-03
236	1.00E+04	1.06E-04	4.34E-03	5.69E-15	5.48E-07	6.29E-05	4.51E-03
19	1.00E+04	6.79E-05	3.70E-03	2.01E-14	4.98E-07	5.31E-05	3.82E-03
90	1.00E+04	1.57E-04	2.45E-03	2.11E-14	1.49E-04	6.54E-05	2.82E-03
256	1.00E+04	4.97E-05	2.39E-03	4.44E-15	2.04E-04	4.07E-05	2.69E-03
253	1.00E+04	2.09E-06	2.47E-03	1.16E-14	1.69E-07	7.82E-06	2.48E-03
243	1.00E+04	8.12E-05	2.13E-03	5.80E-15	2.21E-07	7.03E-06	2.22E-03
9	1.00E+04	2.12E-05	2.04E-03	4.29E-15	3.63E-05	7.37E-05	2.17E-03
125	1.00E+04	7.88E-05	2.02E-03	8.18E-16	5.46E-07	2.40E-05	2.13E-03
52	1.00E+04	7.42E-06	1.88E-03	1.38E-14	5.48E-05	2.87E-05	1.97E-03
147	1.00E+04	8.52E-07	1.89E-03	1.79E-16	1.70E-07	6.27E-06	1.90E-03
130	1.00E+04	2.80E-05	1.80E-03	5.27E-17	2.17E-05	2.50E-06	1.85E-03
290	1.00E+04	4.96E-06	1.17E-03	8.33E-16	1.76E-07	6.54E-06	1.18E-03
265	1.00E+04	8.41E-06	9.62E-04	9.30E-16	1.37E-07	9.07E-06	9.80E-04
40	1.00E+04	1.78E-06	7.56E-04	8.50E-15	3.82E-08	2.00E-06	7.60E-04
217	1.00E+04	1.37E-04	6.04E-04	5.46E-15	5.13E-06	1.08E-05	7.57E-04

177	1.00E+04	2.80E-05	7.08E-04	2.37E-14	8.49E-06	6.38E-06	7.51E-04
235	1.00E+04	7.89E-06	6.26E-04	2.39E-15	5.04E-06	1.83E-06	6.41E-04
287	1.00E+04	5.07E-05	4.56E-04	5.55E-14	3.04E-05	1.39E-05	5.51E-04
163	1.00E+04	3.14E-05	3.80E-04	4.46E-16	4.10E-06	4.02E-06	4.20E-04
260	1.00E+04	1.51E-06	3.01E-04	4.59E-19	7.01E-08	1.73E-06	3.05E-04
202	1.00E+04	2.09E-05	2.70E-04	2.31E-17	8.67E-06	2.77E-06	3.02E-04
98	1.00E+04	2.47E-06	1.81E-04	3.98E-18	6.05E-05	1.67E-06	2.46E-04
183	1.00E+04	7.12E-07	2.29E-04	1.89E-16	9.84E-06	4.37E-06	2.44E-04
267	1.00E+04	9.62E-06	1.76E-04	1.36E-16	2.66E-05	1.22E-06	2.14E-04
108	1.00E+04	5.33E-08	1.79E-04	2.71E-17	1.17E-08	5.99E-07	1.80E-04
110	1.00E+04	2.20E-06	1.60E-04	7.59E-17	1.74E-08	1.02E-06	1.63E-04
227	1.00E+04	3.63E-06	1.36E-04	2.46E-16	5.99E-06	1.54E-06	1.47E-04
50	1.00E+04	1.07E-07	5.84E-05	3.48E-19	8.31E-09	2.69E-06	6.12E-05
153	1.00E+04	3.48E-06	3.32E-05	9.57E-18	2.18E-06	8.20E-07	3.97E-05
77	1.00E+04	3.00E-07	2.85E-05	3.48E-17	1.29E-06	6.69E-07	3.07E-05
238	1.00E+04	5.70E-08	2.12E-05	4.66E-17	1.68E-07	8.63E-08	2.15E-05
252	1.00E+04	3.15E-07	2.03E-05	1.27E-17	4.67E-08	1.19E-07	2.07E-05
121	1.00E+04	7.32E-08	1.46E-05	6.93E-18	3.82E-07	1.86E-07	1.52E-05
39	1.00E+04	1.15E-06	1.03E-05	1.03E-18	9.14E-07	2.63E-07	1.27E-05
49	1.00E+04	2.33E-08	3.50E-06	6.04E-19	3.91E-10	2.20E-08	3.54E-06
131	1.00E+04	2.76E-07	2.83E-06	2.12E-16	4.44E-08	5.14E-08	3.20E-06
222	1.00E+04	1.34E-08	2.55E-06	2.79E-19	4.16E-10	4.50E-08	2.61E-06
167	1.00E+04	7.82E-08	1.22E-06	6.93E-19	4.27E-08	2.03E-08	1.36E-06
283	1.00E+04	2.15E-08	9.49E-07	3.44E-19	2.01E-10	2.53E-08	9.96E-07
135	1.00E+04	5.03E-08	7.24E-07	1.18E-18	4.40E-08	1.41E-07	9.59E-07
48	1.00E+04	3.17E-10	9.23E-07	1.42E-21	2.84E-10	1.86E-08	9.43E-07
174	1.00E+04	4.45E-09	3.61E-07	2.32E-18	6.61E-08	1.65E-08	4.48E-07
262	1.00E+04	2.40E-10	1.48E-07	1.71E-19	2.12E-08	6.49E-09	1.76E-07
232	1.00E+04	1.21E-08	1.33E-07	6.23E-20	1.64E-08	5.03E-09	1.66E-07
225	1.00E+04	3.19E-09	6.83E-08	3.61E-20	1.47E-11	3.04E-09	7.46E-08
250	1.00E+04	9.41E-11	2.54E-09	8.99E-21	5.66E-10	9.38E-11	3.30E-09
41	1.00E+04	1.48E-17	2.25E-14	2.50E-26	1.63E-16	2.96E-16	2.30E-14
13	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
99	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
124	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
126	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
141	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
181	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
221	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
245	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
280	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.9 S4T100

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
23	1.00E+04	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
124	1.00E+04	3.99E-02	1.75E+00	7.98E-06	5.59E-04	1.87E-02	1.81E+00
128	1.00E+04	2.23E-02	9.10E-01	5.61E-08	7.54E-04	8.49E-02	1.02E+00
280	1.00E+04	2.06E-01	7.17E-01	1.43E-05	2.94E-04	2.08E-02	9.44E-01
141	1.00E+04	3.90E-01	1.23E-01	1.36E-08	4.03E-03	1.21E-01	6.39E-01
25	1.00E+04	7.76E-02	5.26E-01	5.13E-09	3.03E-03	1.78E-02	6.24E-01
278	1.00E+04	2.62E-03	4.22E-01	2.33E-09	1.12E-05	1.34E-03	4.26E-01
266	1.00E+04	4.76E-02	2.91E-01	6.08E-11	2.29E-03	4.78E-02	3.89E-01
191	1.00E+04	1.17E-02	2.93E-01	7.52E-10	4.85E-05	1.63E-03	3.06E-01
72	1.00E+04	3.12E-02	1.30E-01	3.58E-08	6.62E-04	2.26E-02	1.85E-01
39	1.00E+04	1.52E-05	1.47E-01	3.25E-12	8.57E-05	2.93E-03	1.50E-01
260	1.00E+04	6.27E-02	3.79E-03	5.18E-08	9.06E-04	5.76E-04	6.80E-02
165	1.00E+04	1.32E-05	3.84E-02	9.97E-14	7.39E-05	2.82E-04	3.88E-02
7	1.00E+04	1.69E-02	1.15E-02	4.23E-08	8.43E-05	2.35E-03	3.08E-02
64	1.00E+04	1.00E-02	8.03E-03	6.48E-10	9.66E-05	3.68E-03	2.18E-02
243	1.00E+04	2.23E-03	2.78E-03	3.33E-13	1.97E-04	5.60E-03	1.08E-02
256	1.00E+04	2.29E-12	1.19E-06	6.18E-22	1.99E-10	1.48E-09	1.20E-06
293	1.00E+04	2.58E-15	2.37E-10	1.51E-25	2.69E-14	2.02E-12	2.39E-10

*break

Table 10.10 S4T350

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
23	1.00E+04	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
124	1.00E+04	2.18E-02	1.61E+00	1.56E-06	5.25E-04	1.77E-02	1.65E+00
128	1.00E+04	1.41E-02	8.75E-01	1.17E-08	7.14E-04	8.06E-02	9.71E-01
280	1.00E+04	1.82E-01	7.05E-01	2.96E-06	2.87E-04	2.03E-02	9.08E-01
25	1.00E+04	4.71E-02	5.12E-01	6.66E-10	3.26E-03	1.73E-02	5.80E-01
141	1.00E+04	2.35E-01	1.20E-01	2.42E-09	3.94E-03	1.18E-01	4.77E-01
278	1.00E+04	1.09E-03	4.22E-01	4.98E-10	1.12E-05	1.34E-03	4.25E-01
266	1.00E+04	2.94E-02	2.84E-01	1.17E-11	2.20E-03	4.66E-02	3.62E-01
191	1.00E+04	8.05E-03	2.93E-01	1.70E-10	4.85E-05	1.63E-03	3.02E-01
72	1.00E+04	1.89E-02	1.28E-01	4.69E-11	6.75E-04	2.22E-02	1.70E-01
39	1.00E+04	6.96E-06	1.32E-01	8.25E-13	2.14E-05	2.48E-03	1.35E-01
260	1.00E+04	5.41E-02	3.65E-03	1.60E-08	8.61E-04	5.47E-04	5.91E-02
165	1.00E+04	1.20E-05	3.10E-02	1.77E-14	3.44E-05	2.39E-04	3.13E-02
7	1.00E+04	5.22E-03	1.15E-02	7.80E-09	7.65E-05	2.35E-03	1.91E-02
64	1.00E+04	7.29E-03	7.95E-03	1.51E-10	9.48E-05	3.57E-03	1.89E-02
243	1.00E+04	1.51E-03	2.76E-03	1.90E-14	1.98E-04	5.56E-03	1.00E-02
256	1.00E+04	1.91E-12	1.19E-06	1.41E-22	2.14E-10	1.47E-09	1.20E-06
293	1.00E+04	1.28E-15	1.57E-10	3.59E-26	9.44E-15	1.33E-12	1.59E-10

*break

Table 10.11 S5T1000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]

23	1.00E+04	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
124	1.00E+04	1.55E-02	1.52E+00	4.74E-07	4.88E-04	1.70E-02	1.55E+00
128	1.00E+04	1.97E-01	7.97E-01	4.80E-06	4.29E-04	7.57E-02	1.07E+00
25	1.00E+04	1.17E-02	4.46E-01	4.13E-12	2.97E-03	1.49E-02	4.76E-01
39	1.00E+04	6.63E-05	3.55E-01	1.13E-11	4.52E-05	6.99E-03	3.62E-01
266	1.00E+04	4.17E-03	2.69E-01	7.52E-13	2.23E-03	4.44E-02	3.20E-01
141	1.00E+04	6.61E-02	8.94E-02	9.34E-11	2.90E-03	8.71E-02	2.45E-01
280	1.00E+04	4.25E-04	2.14E-01	2.20E-11	9.21E-05	6.52E-03	2.22E-01
72	1.00E+04	3.20E-03	1.10E-01	1.75E-12	5.81E-04	1.91E-02	1.33E-01
278	1.00E+04	1.96E-04	1.25E-01	4.51E-11	3.63E-06	4.34E-04	1.26E-01
260	1.00E+04	5.80E-02	3.71E-03	1.37E-08	8.63E-04	5.49E-04	6.31E-02
191	1.00E+04	1.13E-03	3.46E-02	5.11E-11	7.06E-06	2.38E-04	3.59E-02
243	1.00E+04	3.61E-04	2.15E-03	2.09E-15	1.55E-04	4.33E-03	7.00E-03
64	1.00E+04	2.07E-04	3.19E-03	3.63E-13	3.52E-05	1.74E-03	5.17E-03
165	1.00E+04	1.92E-06	5.01E-03	7.89E-16	8.37E-06	6.02E-05	5.08E-03
7	1.00E+04	1.47E-05	1.34E-04	6.27E-13	2.77E-06	7.05E-05	2.22E-04
256	1.00E+04	8.67E-12	3.14E-06	3.86E-22	5.11E-10	6.10E-09	3.14E-06
293	1.00E+04	1.37E-14	5.99E-09	1.08E-26	1.18E-12	6.44E-11	6.06E-09

*break

Table 10.12 S5T3000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
23	1.00E+04	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
124	1.00E+04	3.54E-04	9.79E-01	1.62E-10	1.31E-04	1.10E-02	9.91E-01
128	1.00E+04	7.62E-03	4.47E-01	8.10E-09	2.07E-04	4.56E-02	5.00E-01
25	1.00E+04	1.05E-03	3.25E-01	1.18E-14	2.04E-03	1.09E-02	3.39E-01
266	1.00E+04	1.81E-04	1.91E-01	9.76E-15	1.42E-03	3.16E-02	2.25E-01
141	1.00E+04	4.42E-03	6.81E-02	1.75E-13	1.87E-03	6.65E-02	1.41E-01
39	1.00E+04	2.80E-06	1.31E-01	4.24E-15	1.54E-05	2.40E-03	1.33E-01
278	1.00E+04	2.14E-05	1.25E-01	9.05E-13	2.57E-06	4.34E-04	1.26E-01
72	1.00E+04	1.02E-04	9.20E-02	1.43E-15	4.53E-04	1.60E-02	1.09E-01
280	1.00E+04	2.81E-06	8.13E-02	1.05E-14	1.83E-05	2.37E-03	8.37E-02
191	1.00E+04	1.40E-04	3.46E-02	5.40E-13	5.02E-06	2.38E-04	3.49E-02
260	1.00E+04	3.89E-03	2.14E-03	3.03E-11	2.54E-04	3.44E-04	6.63E-03
243	1.00E+04	2.08E-05	1.82E-03	5.69E-18	1.27E-04	3.67E-03	5.63E-03
64	1.00E+04	2.07E-05	2.15E-03	8.95E-15	1.21E-05	1.13E-03	3.31E-03
7	1.00E+04	1.08E-06	1.33E-04	1.05E-15	8.59E-07	7.09E-05	2.06E-04
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
256	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.13 S5T5000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
23	1.00E+04	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00

124	1.00E+04	3.09E-05	7.22E-01	1.82E-13	9.62E-05	7.71E-03	7.30E-01
128	1.00E+04	6.86E-04	2.51E-01	5.58E-11	1.16E-04	2.49E-02	2.77E-01
25	1.00E+04	9.93E-05	1.56E-01	1.07E-16	9.64E-04	5.18E-03	1.62E-01
278	1.00E+04	2.97E-06	1.25E-01	8.75E-15	2.57E-06	4.34E-04	1.26E-01
266	1.00E+04	1.95E-05	9.20E-02	9.71E-17	6.84E-04	1.57E-02	1.08E-01
141	1.00E+04	6.30E-04	4.60E-02	2.51E-15	1.29E-03	4.53E-02	9.32E-02
72	1.00E+04	1.14E-05	5.87E-02	1.34E-17	2.88E-04	1.03E-02	6.93E-02
191	1.00E+04	1.84E-05	3.46E-02	5.29E-15	5.01E-06	2.38E-04	3.48E-02
243	1.00E+04	5.73E-06	1.32E-03	5.51E-19	9.24E-05	2.71E-03	4.12E-03
260	1.00E+04	1.69E-04	6.66E-04	1.04E-14	8.93E-05	1.33E-04	1.06E-03
39	1.00E+04	6.22E-08	4.51E-04	6.39E-18	5.61E-08	3.96E-06	4.56E-04
64	1.00E+04	8.05E-07	2.36E-04	4.75E-17	1.31E-06	9.79E-05	3.36E-04
7	1.00E+04	1.80E-07	1.33E-04	6.31E-18	8.59E-07	7.06E-05	2.05E-04
280	1.00E+04	4.76E-09	6.40E-05	1.41E-18	1.46E-08	3.45E-06	6.75E-05
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
256	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.14 S5T7000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
23	1.00E+04	6.81E-08	1.09E+00	1.68E-18	5.14E-04	9.24E-03	1.10E+00
124	1.00E+04	3.91E-06	3.01E-01	1.98E-15	4.01E-05	3.49E-03	3.05E-01
128	1.00E+04	3.79E-05	8.92E-02	8.41E-14	4.12E-05	8.57E-03	9.79E-02
278	1.00E+04	1.98E-07	5.15E-02	6.59E-17	1.04E-06	1.87E-04	5.17E-02
72	1.00E+04	2.95E-06	3.41E-02	1.27E-18	1.67E-04	6.02E-03	4.03E-02
191	1.00E+04	1.83E-06	2.43E-02	4.58E-17	3.51E-06	1.72E-04	2.45E-02
141	1.00E+04	4.38E-05	1.17E-02	2.19E-17	3.25E-04	1.14E-02	2.35E-02
260	1.00E+04	2.89E-05	3.43E-04	4.80E-17	4.98E-05	7.65E-05	4.98E-04
25	1.00E+04	2.95E-08	3.66E-04	3.35E-20	2.13E-06	1.76E-05	3.86E-04
7	1.00E+04	1.35E-08	1.33E-04	1.12E-20	8.59E-07	7.03E-05	2.05E-04
280	1.00E+04	1.92E-10	1.30E-05	7.17E-21	2.94E-09	4.31E-07	1.34E-05
39	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
243	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
256	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
266	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.15 S5T9000

vector	time	EPA1BHRC [G]	EPA2BHRC [G]	EPA3BHRC [G]	EPA4BHRC [G]	EPA5BHRC [G]	EPATBHRC [G]
124	1.00E+04	8.75E-08	2.67E-02	1.86E-18	3.54E-06	2.64E-04	2.70E-02
128	1.00E+04	2.27E-06	1.46E-02	7.20E-16	6.71E-06	1.26E-03	1.58E-02
260	1.00E+04	1.72E-06	5.08E-05	4.26E-19	9.96E-06	1.39E-05	7.64E-05

7	1.00E+04	9.00E-13	1.27E-07	1.86E-24	8.06E-10	2.41E-08	1.52E-07
23	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
141	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
165	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
191	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
243	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
256	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
266	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
278	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
280	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
293	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.16 S6T100

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
111	1.00E+04	9.46E+01	3.83E-02	4.29E-01	6.88E-05	2.03E-03	9.50E+01
256	1.00E+04	2.62E+01	5.03E-03	2.77E-02	2.50E-03	1.81E-04	2.63E+01
9	1.00E+04	9.14E+00	3.65E-03	2.21E-02	4.15E-04	2.64E-04	9.17E+00
128	1.00E+04	6.55E+00	4.73E-02	1.07E+00	3.30E-05	1.50E-03	7.67E+00
280	1.00E+04	7.52E+00	4.67E-04	7.41E-03	9.97E-04	1.53E-04	7.53E+00
141	1.00E+04	6.79E+00	4.10E-07	1.30E-01	2.36E-05	1.14E-03	6.92E+00
236	1.00E+04	4.89E+00	1.30E-02	5.59E-02	7.29E-06	5.08E-05	4.96E+00
287	1.00E+04	4.69E+00	4.46E-03	9.01E-03	6.09E-04	1.13E-05	4.70E+00
217	1.00E+04	4.66E+00	2.39E-03	7.57E-03	6.64E-05	1.87E-05	4.67E+00
23	1.00E+04	4.09E+00	3.69E-07	1.93E-01	5.74E-03	2.58E-03	4.30E+00
228	1.00E+04	4.15E+00	1.34E-02	3.31E-02	6.48E-06	3.01E-05	4.20E+00
64	1.00E+04	3.85E+00	1.02E-03	1.53E-02	1.12E-05	4.34E-04	3.87E+00
266	1.00E+04	2.63E+00	9.38E-03	2.34E-01	1.69E-05	8.45E-04	2.87E+00
19	1.00E+04	2.52E+00	1.08E-02	3.07E-02	4.19E-06	2.07E-05	2.56E+00
87	1.00E+04	2.20E+00	1.63E-02	2.97E-02	1.81E-06	5.23E-06	2.25E+00
124	1.00E+04	2.17E+00	5.10E-04	1.91E-02	1.72E-03	3.73E-04	2.19E+00
181	1.00E+04	1.96E+00	4.60E-03	4.69E-02	5.71E-06	1.94E-04	2.01E+00
177	1.00E+04	1.90E+00	1.97E-03	8.51E-03	1.06E-04	1.57E-05	1.91E+00
50	1.00E+04	1.88E+00	7.12E-03	1.09E-02	1.50E-06	3.73E-06	1.90E+00
290	1.00E+04	1.75E+00	1.89E-03	1.19E-02	1.89E-06	3.02E-05	1.76E+00
25	1.00E+04	1.67E+00	8.65E-04	5.41E-02	1.70E-05	8.65E-04	1.73E+00
52	1.00E+04	1.69E+00	3.33E-03	1.61E-02	4.89E-04	6.27E-05	1.71E+00
90	1.00E+04	1.39E+00	2.03E-03	2.96E-03	1.78E-04	2.10E-06	1.40E+00
7	1.00E+04	1.33E+00	7.76E-03	2.19E-02	5.65E-07	3.86E-06	1.36E+00
253	1.00E+04	1.29E+00	3.54E-03	5.25E-03	3.56E-07	8.66E-07	1.30E+00
260	1.00E+04	1.04E+00	2.37E-03	9.27E-02	6.39E-06	3.67E-04	1.13E+00
245	1.00E+04	9.52E-01	2.40E-03	3.29E-03	3.46E-05	4.72E-07	9.58E-01
130	1.00E+04	6.83E-01	9.17E-03	4.42E-02	5.64E-04	9.11E-05	7.37E-01
204	1.00E+04	7.03E-01	3.01E-04	4.79E-03	7.92E-07	3.48E-05	7.08E-01
222	1.00E+04	6.82E-01	2.91E-04	9.43E-03	8.42E-07	3.66E-05	6.91E-01
72	1.00E+04	5.06E-01	6.61E-06	6.11E-02	6.11E-06	2.69E-04	5.67E-01

276	1.00E+04	5.24E-01	9.06E-04	2.27E-03	8.99E-08	3.30E-07	5.28E-01
82	1.00E+04	4.92E-01	3.11E-03	4.30E-03	1.94E-05	1.36E-06	5.00E-01
285	1.00E+04	4.63E-01	1.84E-03	2.56E-03	7.54E-05	1.58E-06	4.67E-01
152	1.00E+04	4.54E-01	6.61E-04	9.06E-04	3.03E-07	7.02E-07	4.56E-01
93	1.00E+04	3.94E-01	4.01E-04	5.49E-04	7.28E-06	6.45E-07	3.95E-01
163	1.00E+04	3.40E-01	1.78E-04	2.45E-04	2.60E-06	1.66E-07	3.41E-01
240	1.00E+04	2.93E-01	1.51E-02	2.06E-02	3.96E-07	9.17E-07	3.29E-01
153	1.00E+04	3.03E-01	2.50E-04	7.82E-04	5.29E-05	2.33E-06	3.04E-01
110	1.00E+04	3.01E-01	1.22E-03	1.67E-03	1.78E-07	4.12E-07	3.03E-01
154	1.00E+04	3.00E-01	1.22E-03	1.69E-03	2.43E-07	5.69E-07	3.03E-01
265	1.00E+04	2.68E-01	2.35E-03	3.31E-03	4.65E-07	1.09E-06	2.74E-01
278	1.00E+04	2.70E-01	3.67E-09	4.80E-04	5.38E-05	8.45E-06	2.71E-01
81	1.00E+04	2.62E-01	8.12E-04	1.23E-03	1.84E-07	4.59E-07	2.64E-01
202	1.00E+04	2.62E-01	5.18E-05	8.26E-05	2.67E-06	7.49E-08	2.62E-01
77	1.00E+04	2.59E-01	1.41E-03	1.95E-03	8.69E-05	9.24E-07	2.62E-01
108	1.00E+04	2.57E-01	6.35E-04	1.13E-03	7.43E-08	2.07E-07	2.59E-01
183	1.00E+04	2.51E-01	3.92E-04	5.42E-04	2.30E-05	3.73E-07	2.52E-01
166	1.00E+04	2.45E-01	4.44E-04	6.09E-04	6.32E-06	4.66E-07	2.46E-01
102	1.00E+04	2.26E-01	3.04E-03	4.17E-03	3.42E-07	7.92E-07	2.33E-01
221	1.00E+04	1.98E-01	9.15E-04	2.73E-02	2.50E-06	1.34E-04	2.26E-01
126	1.00E+04	1.98E-01	1.99E-04	2.82E-04	1.41E-05	3.89E-07	1.98E-01
14	1.00E+04	1.95E-01	4.56E-04	8.11E-04	2.13E-07	5.94E-07	1.97E-01
267	1.00E+04	1.67E-01	5.09E-04	3.21E-03	5.05E-04	1.18E-05	1.72E-01
142	1.00E+04	1.64E-01	1.25E-04	1.72E-04	3.34E-05	2.67E-07	1.64E-01
243	1.00E+04	1.07E-01	1.81E-03	1.87E-02	2.08E-06	1.14E-04	1.28E-01
125	1.00E+04	1.26E-01	6.73E-04	9.22E-04	2.44E-07	5.64E-07	1.28E-01
121	1.00E+04	1.18E-01	2.41E-05	3.30E-05	8.34E-07	1.43E-08	1.18E-01
92	1.00E+04	1.10E-01	2.79E-03	3.82E-03	1.05E-04	3.75E-07	1.17E-01
99	1.00E+04	8.53E-02	4.32E-05	1.65E-03	7.59E-07	4.16E-05	8.70E-02
98	1.00E+04	8.29E-02	1.84E-04	2.53E-04	8.30E-05	1.51E-07	8.34E-02
27	1.00E+04	7.48E-02	2.32E-03	3.17E-03	6.22E-08	1.44E-07	8.03E-02
40	1.00E+04	6.62E-02	1.36E-03	4.60E-03	2.37E-07	1.44E-06	7.21E-02
34	1.00E+04	6.75E-02	1.73E-04	3.81E-04	4.85E-08	1.57E-07	6.80E-02
145	1.00E+04	6.56E-02	7.33E-04	1.00E-03	2.26E-05	2.43E-07	6.74E-02
191	1.00E+04	5.61E-02	1.19E-04	8.83E-04	3.23E-05	5.25E-06	5.71E-02
184	1.00E+04	4.64E-02	3.00E-03	4.10E-03	1.03E-07	2.39E-07	5.35E-02
238	1.00E+04	4.76E-02	8.05E-04	1.48E-03	1.17E-05	1.81E-07	4.98E-02
28	1.00E+04	4.36E-02	1.28E-04	1.75E-04	1.37E-04	1.21E-07	4.40E-02
147	1.00E+04	3.44E-02	2.02E-03	5.12E-03	4.66E-07	2.36E-06	4.15E-02
49	1.00E+04	4.07E-02	2.95E-05	5.77E-05	6.38E-09	1.92E-08	4.08E-02
195	1.00E+04	4.02E-02	1.09E-04	1.49E-04	2.75E-08	6.36E-08	4.05E-02
225	1.00E+04	3.49E-02	8.29E-05	5.17E-03	1.08E-06	6.42E-05	4.02E-02
88	1.00E+04	3.78E-02	4.24E-04	6.70E-04	2.69E-06	1.61E-07	3.89E-02
100	1.00E+04	3.43E-02	1.58E-03	2.23E-03	1.57E-07	3.72E-07	3.81E-02
13	1.00E+04	3.66E-02	2.05E-04	1.01E-03	6.16E-05	9.98E-06	3.78E-02
227	1.00E+04	3.72E-02	1.14E-04	1.56E-04	6.71E-06	6.98E-08	3.75E-02
135	1.00E+04	3.44E-02	1.61E-04	3.40E-04	2.06E-05	3.10E-07	3.49E-02
262	1.00E+04	3.26E-02	1.39E-04	2.02E-04	2.82E-05	1.85E-07	3.29E-02
205	1.00E+04	3.07E-02	1.59E-04	2.34E-04	2.74E-08	6.71E-08	3.11E-02
235	1.00E+04	2.38E-02	1.82E-03	2.60E-03	2.07E-05	5.04E-07	2.83E-02
295	1.00E+04	2.27E-02	6.22E-06	8.52E-06	3.35E-07	6.05E-09	2.27E-02
229	1.00E+04	2.21E-02	5.77E-05	1.55E-04	6.93E-06	1.89E-07	2.23E-02
246	1.00E+04	2.08E-02	9.76E-06	1.90E-05	5.67E-09	1.65E-08	2.09E-02
109	1.00E+04	1.97E-02	2.03E-04	2.78E-04	3.38E-08	7.83E-08	2.02E-02

41	1.00E+04	1.81E-02	8.26E-05	1.26E-03	1.23E-04	2.60E-05	1.96E-02
78	1.00E+04	1.91E-02	5.52E-06	7.57E-06	5.26E-07	1.05E-08	1.91E-02
148	1.00E+04	1.72E-02	7.41E-05	2.34E-04	2.56E-06	2.71E-07	1.75E-02
35	1.00E+04	1.72E-02	7.31E-05	1.00E-04	1.95E-08	4.52E-08	1.74E-02
251	1.00E+04	1.65E-02	1.54E-04	5.46E-04	2.05E-05	2.20E-07	1.72E-02
215	1.00E+04	1.50E-02	8.88E-04	1.22E-03	7.18E-06	5.95E-08	1.71E-02
284	1.00E+04	1.16E-02	1.52E-03	2.08E-03	1.21E-07	2.80E-07	1.52E-02
193	1.00E+04	1.39E-02	1.72E-05	2.36E-05	1.92E-06	1.97E-08	1.40E-02
66	1.00E+04	1.38E-02	1.66E-05	2.58E-05	1.02E-08	2.58E-08	1.39E-02
48	1.00E+04	1.28E-02	2.00E-05	4.23E-05	1.31E-08	4.12E-08	1.29E-02
131	1.00E+04	1.21E-02	6.97E-05	1.39E-04	2.20E-06	1.09E-07	1.23E-02
63	1.00E+04	1.14E-02	6.76E-05	9.26E-05	1.21E-08	2.79E-08	1.16E-02
39	1.00E+04	1.01E-02	1.52E-05	1.28E-03	1.23E-04	6.07E-05	1.16E-02
169	1.00E+04	1.08E-02	3.11E-04	4.26E-04	2.48E-09	5.74E-09	1.16E-02
16	1.00E+04	1.06E-02	6.78E-05	9.29E-05	6.57E-07	4.54E-09	1.07E-02
43	1.00E+04	1.06E-02	1.76E-05	2.41E-05	1.21E-06	3.12E-08	1.07E-02
71	1.00E+04	1.04E-02	1.55E-05	2.16E-05	6.15E-06	3.28E-08	1.04E-02
29	1.00E+04	1.01E-02	1.79E-06	2.45E-06	6.25E-07	1.97E-09	1.01E-02
252	1.00E+04	9.42E-03	2.24E-04	4.15E-04	9.63E-07	1.13E-07	1.01E-02
198	1.00E+04	9.87E-03	5.68E-05	7.78E-05	1.24E-06	3.51E-08	1.00E-02
165	1.00E+04	6.44E-03	9.10E-06	1.43E-03	2.07E-03	4.74E-05	1.00E-02
144	1.00E+04	8.80E-03	8.16E-05	1.51E-04	7.04E-07	3.17E-08	9.04E-03
203	1.00E+04	8.94E-03	1.85E-05	2.54E-05	1.50E-06	7.43E-09	8.99E-03
188	1.00E+04	8.64E-03	5.01E-05	6.86E-05	9.08E-08	4.21E-08	8.76E-03
174	1.00E+04	8.46E-03	1.17E-05	2.11E-05	3.86E-06	3.45E-08	8.49E-03
161	1.00E+04	7.32E-03	3.22E-05	4.49E-05	7.22E-09	1.69E-08	7.40E-03
68	1.00E+04	7.32E-03	2.93E-05	4.01E-05	7.78E-07	2.34E-08	7.39E-03
104	1.00E+04	6.16E-03	1.64E-05	2.24E-05	5.30E-07	1.57E-08	6.20E-03
69	1.00E+04	4.14E-03	4.55E-04	6.24E-04	1.21E-08	2.79E-08	5.22E-03
275	1.00E+04	4.60E-03	2.21E-05	3.02E-05	3.63E-09	8.40E-09	4.66E-03
293	1.00E+04	4.32E-03	1.08E-05	1.79E-05	2.75E-07	2.02E-08	4.35E-03
189	1.00E+04	4.14E-03	1.85E-05	2.54E-05	4.69E-09	1.09E-08	4.19E-03
200	1.00E+04	4.18E-03	1.50E-06	6.02E-06	1.61E-09	6.27E-09	4.19E-03
218	1.00E+04	4.14E-03	5.17E-06	7.09E-06	2.50E-07	5.12E-09	4.15E-03
159	1.00E+04	4.12E-03	9.81E-06	1.34E-05	2.86E-09	6.61E-09	4.14E-03
282	1.00E+04	3.87E-03	4.83E-06	6.74E-06	3.99E-09	9.37E-09	3.88E-03
120	1.00E+04	3.68E-03	2.33E-05	3.19E-05	4.40E-09	1.02E-08	3.74E-03
134	1.00E+04	3.68E-03	7.81E-06	1.07E-05	7.23E-07	9.44E-09	3.70E-03
226	1.00E+04	3.63E-03	1.76E-05	2.42E-05	2.62E-09	6.06E-09	3.67E-03
261	1.00E+04	3.49E-03	2.88E-05	3.94E-05	6.55E-09	1.52E-08	3.56E-03
44	1.00E+04	3.34E-03	1.36E-06	1.87E-06	7.33E-08	9.83E-10	3.35E-03
250	1.00E+04	3.31E-03	1.32E-05	1.92E-05	4.19E-06	1.51E-08	3.35E-03
118	1.00E+04	3.21E-03	2.29E-05	3.14E-05	3.44E-09	7.97E-09	3.26E-03
300	1.00E+04	3.21E-03	1.89E-05	2.59E-05	2.27E-06	1.58E-08	3.26E-03
269	1.00E+04	3.22E-03	8.52E-06	1.17E-05	5.91E-07	1.16E-08	3.24E-03
112	1.00E+04	3.06E-03	1.21E-05	1.66E-05	9.20E-08	9.10E-09	3.09E-03
299	1.00E+04	2.91E-03	4.02E-06	5.51E-06	9.59E-08	5.66E-09	2.92E-03
179	1.00E+04	2.52E-03	1.38E-04	1.89E-04	5.91E-09	1.37E-08	2.85E-03
54	1.00E+04	2.80E-03	1.63E-05	2.23E-05	5.72E-06	9.72E-09	2.85E-03
249	1.00E+04	2.70E-03	3.07E-05	4.21E-05	4.36E-09	1.01E-08	2.78E-03
185	1.00E+04	2.72E-03	6.16E-06	8.44E-06	1.10E-09	2.54E-09	2.74E-03
73	1.00E+04	2.72E-03	8.26E-06	1.16E-05	8.97E-07	8.24E-09	2.74E-03
231	1.00E+04	2.60E-03	1.20E-05	1.64E-05	6.70E-09	1.55E-08	2.63E-03
33	1.00E+04	2.52E-03	1.21E-05	1.66E-05	1.25E-06	1.25E-08	2.55E-03

194	1.00E+04	2.27E-03	8.44E-05	1.36E-04	2.69E-09	7.01E-09	2.49E-03
84	1.00E+04	2.32E-03	1.51E-05	2.07E-05	9.62E-07	9.23E-09	2.36E-03
17	1.00E+04	2.34E-03	4.15E-06	5.69E-06	2.40E-07	4.19E-09	2.35E-03
214	1.00E+04	2.30E-03	4.08E-06	5.59E-06	6.08E-07	6.47E-09	2.31E-03
172	1.00E+04	2.25E-03	3.52E-06	4.82E-06	2.01E-07	3.17E-09	2.26E-03
180	1.00E+04	2.21E-03	7.31E-06	1.00E-05	2.34E-07	4.39E-09	2.23E-03
138	1.00E+04	2.15E-03	6.70E-06	9.17E-06	5.21E-07	6.95E-09	2.17E-03
127	1.00E+04	2.15E-03	3.30E-06	4.53E-06	8.75E-07	6.79E-09	2.16E-03
175	1.00E+04	2.14E-03	8.33E-07	1.14E-06	2.92E-10	6.75E-10	2.14E-03
196	1.00E+04	2.10E-03	2.89E-06	3.96E-06	2.60E-09	6.01E-09	2.11E-03
167	1.00E+04	2.03E-03	1.53E-05	2.78E-05	9.59E-07	1.85E-08	2.08E-03
30	1.00E+04	2.04E-03	2.36E-06	3.23E-06	1.09E-07	4.39E-09	2.05E-03
213	1.00E+04	1.86E-03	6.64E-06	9.10E-06	8.65E-08	7.08E-09	1.87E-03
95	1.00E+04	1.73E-03	4.46E-05	6.11E-05	3.94E-09	9.13E-09	1.84E-03
211	1.00E+04	1.78E-03	5.38E-06	7.36E-06	3.75E-07	5.02E-09	1.80E-03
182	1.00E+04	1.76E-03	2.09E-06	2.87E-06	2.32E-07	4.57E-09	1.76E-03
2	1.00E+04	1.72E-03	7.82E-06	1.07E-05	2.24E-09	5.19E-09	1.74E-03
94	1.00E+04	1.60E-03	2.66E-05	3.65E-05	2.34E-09	5.42E-09	1.66E-03
31	1.00E+04	1.63E-03	2.26E-06	3.10E-06	7.34E-08	3.25E-09	1.64E-03
270	1.00E+04	1.56E-03	2.86E-06	3.92E-06	2.52E-07	5.51E-09	1.57E-03
119	1.00E+04	1.50E-03	1.12E-05	2.19E-05	8.10E-09	2.36E-08	1.53E-03
233	1.00E+04	1.45E-03	2.83E-06	3.87E-06	3.00E-06	3.70E-09	1.46E-03
143	1.00E+04	1.40E-03	7.36E-06	1.01E-05	1.78E-09	4.12E-09	1.42E-03
210	1.00E+04	1.38E-03	1.89E-06	2.59E-06	8.75E-08	1.34E-09	1.38E-03
220	1.00E+04	1.20E-03	6.81E-05	9.32E-05	1.37E-09	3.17E-09	1.36E-03
8	1.00E+04	1.27E-03	1.39E-05	1.91E-05	2.81E-09	6.51E-09	1.31E-03
57	1.00E+04	1.28E-03	1.97E-06	2.70E-06	3.74E-10	8.66E-10	1.29E-03
116	1.00E+04	1.23E-03	1.41E-05	1.93E-05	5.55E-06	1.41E-08	1.27E-03
12	1.00E+04	1.18E-03	2.29E-05	3.14E-05	1.46E-06	2.89E-08	1.23E-03
294	1.00E+04	1.21E-03	2.45E-06	3.36E-06	2.67E-07	2.63E-09	1.22E-03
91	1.00E+04	1.21E-03	2.81E-06	3.84E-06	8.24E-07	4.00E-09	1.21E-03
199	1.00E+04	1.11E-03	7.78E-06	1.07E-05	1.58E-09	3.66E-09	1.13E-03
289	1.00E+04	1.03E-03	1.14E-05	1.56E-05	1.64E-09	3.80E-09	1.06E-03
170	1.00E+04	9.64E-04	1.99E-06	2.73E-06	2.46E-07	2.30E-09	9.69E-04
283	1.00E+04	9.18E-04	2.20E-06	5.27E-06	1.12E-09	3.60E-09	9.26E-04
268	1.00E+04	8.03E-04	1.25E-05	1.71E-05	1.79E-09	4.15E-09	8.33E-04
51	1.00E+04	7.46E-04	7.05E-06	9.66E-06	1.35E-09	3.13E-09	7.62E-04
173	1.00E+04	7.28E-04	1.49E-06	2.09E-06	2.99E-10	7.06E-10	7.32E-04
105	1.00E+04	6.96E-04	2.62E-06	3.59E-06	3.32E-07	3.62E-09	7.02E-04
150	1.00E+04	6.68E-04	1.27E-06	1.74E-06	5.71E-08	8.30E-10	6.71E-04
140	1.00E+04	6.14E-04	3.21E-06	4.39E-06	6.83E-10	1.58E-09	6.21E-04
136	1.00E+04	6.12E-04	1.56E-06	2.14E-06	7.28E-08	1.33E-09	6.15E-04
117	1.00E+04	4.31E-04	5.13E-05	7.03E-05	4.25E-09	9.83E-09	5.53E-04
89	1.00E+04	5.45E-04	1.85E-06	2.54E-06	3.14E-10	7.27E-10	5.49E-04
232	1.00E+04	5.34E-04	6.29E-07	8.82E-07	1.06E-07	8.10E-10	5.35E-04
11	1.00E+04	4.42E-04	3.80E-05	5.21E-05	4.92E-09	1.14E-08	5.32E-04
21	1.00E+04	5.04E-04	7.26E-06	9.95E-06	4.93E-10	1.14E-09	5.21E-04
272	1.00E+04	5.12E-04	1.87E-06	2.56E-06	5.88E-10	1.36E-09	5.16E-04
279	1.00E+04	4.86E-04	7.44E-06	1.02E-05	1.78E-09	4.12E-09	5.04E-04
216	1.00E+04	4.74E-04	6.64E-06	9.10E-06	7.29E-10	1.69E-09	4.89E-04
255	1.00E+04	4.23E-04	1.20E-05	1.65E-05	4.56E-07	1.86E-09	4.52E-04
32	1.00E+04	4.43E-04	2.89E-06	4.90E-06	3.31E-07	5.12E-09	4.51E-04
242	1.00E+04	4.01E-04	2.47E-06	3.39E-06	6.77E-10	1.57E-09	4.07E-04
6	1.00E+04	3.92E-04	3.53E-06	4.83E-06	6.09E-10	1.41E-09	4.00E-04

139	1.00E+04	3.57E-04	1.53E-05	2.09E-05	4.40E-10	1.02E-09	3.93E-04
241	1.00E+04	1.73E-04	8.75E-05	1.25E-04	9.88E-10	2.37E-09	3.86E-04
76	1.00E+04	3.59E-04	1.61E-06	2.21E-06	1.17E-07	1.35E-09	3.63E-04
207	1.00E+04	3.29E-04	1.23E-05	1.68E-05	4.08E-09	9.44E-09	3.58E-04
74	1.00E+04	3.23E-04	1.52E-06	2.08E-06	3.92E-10	9.07E-10	3.27E-04
281	1.00E+04	3.21E-04	1.07E-06	1.47E-06	9.09E-09	9.66E-10	3.23E-04
62	1.00E+04	2.95E-04	6.57E-06	9.00E-06	7.96E-10	1.84E-09	3.11E-04
201	1.00E+04	2.77E-04	2.59E-06	3.55E-06	4.28E-07	3.65E-09	2.84E-04
237	1.00E+04	2.82E-04	6.48E-07	8.88E-07	4.39E-10	1.02E-09	2.84E-04
230	1.00E+04	2.61E-04	3.58E-06	4.91E-06	2.52E-06	5.42E-09	2.72E-04
258	1.00E+04	2.59E-04	2.54E-06	3.48E-06	7.14E-10	1.65E-09	2.65E-04
15	1.00E+04	2.44E-04	3.04E-06	4.16E-06	9.10E-08	7.76E-10	2.51E-04
96	1.00E+04	2.34E-04	6.23E-07	8.54E-07	2.33E-10	5.39E-10	2.36E-04
190	1.00E+04	2.22E-04	1.07E-06	1.47E-06	6.04E-08	9.03E-10	2.25E-04
114	1.00E+04	2.08E-04	9.88E-07	1.35E-06	3.07E-10	7.11E-10	2.11E-04
234	1.00E+04	2.06E-04	5.70E-07	7.81E-07	1.63E-08	5.22E-10	2.07E-04
97	1.00E+04	2.05E-04	5.24E-07	7.17E-07	2.31E-08	5.10E-10	2.06E-04
113	1.00E+04	1.71E-04	3.50E-06	4.79E-06	7.06E-08	9.68E-10	1.79E-04
103	1.00E+04	1.23E-04	8.87E-06	1.21E-05	7.01E-10	1.62E-09	1.44E-04
24	1.00E+04	1.22E-04	2.56E-06	3.60E-06	4.60E-10	1.09E-09	1.28E-04
156	1.00E+04	9.71E-05	5.34E-06	7.32E-06	4.39E-08	4.32E-10	1.10E-04
85	1.00E+04	1.08E-04	5.85E-07	8.01E-07	2.41E-10	5.58E-10	1.09E-04
157	1.00E+04	7.48E-05	7.12E-07	9.75E-07	3.55E-09	6.11E-10	7.65E-05
65	1.00E+04	7.16E-05	1.73E-06	2.37E-06	3.58E-08	1.01E-09	7.57E-05
42	1.00E+04	7.05E-05	5.75E-07	7.87E-07	3.48E-11	8.05E-11	7.19E-05
171	1.00E+04	6.32E-05	1.79E-06	2.46E-06	5.35E-10	1.24E-09	6.74E-05
273	1.00E+04	4.26E-05	3.40E-07	4.66E-07	3.13E-09	1.28E-10	4.34E-05
60	1.00E+04	3.35E-05	3.16E-07	4.33E-07	6.59E-12	1.53E-11	3.42E-05
224	1.00E+04	8.18E-06	4.17E-08	5.71E-08	2.88E-09	2.67E-11	8.28E-06
208	1.00E+04	4.23E-07	8.28E-10	1.13E-09	3.52E-13	8.16E-13	4.25E-07
115	1.00E+04	2.77E-07	3.21E-09	4.40E-09	4.22E-13	9.77E-13	2.84E-07
83	1.00E+04	1.87E-07	1.62E-09	1.01E-09	1.22E-13	1.38E-13	1.89E-07
1	1.00E+04	7.55E-08	4.98E-10	6.71E-10	3.70E-11	4.57E-13	7.67E-08
101	1.00E+04	1.19E-08	3.15E-11	1.97E-11	2.60E-12	2.48E-15	1.19E-08
45	1.00E+04	1.19E-08	5.66E-12	3.54E-12	3.44E-15	1.45E-15	1.19E-08
296	1.00E+04	9.32E-09	4.01E-11	2.51E-11	1.23E-12	7.69E-15	9.39E-09
75	1.00E+04	9.29E-09	1.41E-11	8.82E-12	1.12E-12	3.48E-15	9.32E-09
53	1.00E+04	6.19E-09	2.60E-11	1.63E-11	1.64E-15	1.86E-15	6.24E-09
3	1.00E+04	4.28E-09	1.14E-11	7.15E-12	3.14E-12	4.99E-15	4.30E-09
107	1.00E+04	2.99E-09	4.16E-10	2.60E-10	4.02E-15	4.56E-15	3.67E-09
259	1.00E+04	3.64E-09	1.03E-11	6.43E-12	4.62E-13	1.76E-15	3.66E-09
122	1.00E+04	2.90E-09	1.31E-11	8.19E-12	3.33E-15	3.77E-15	2.92E-09
298	1.00E+04	2.08E-09	1.11E-10	6.95E-11	3.98E-15	4.52E-15	2.26E-09
164	1.00E+04	2.08E-09	9.83E-12	6.14E-12	1.47E-12	1.54E-15	2.09E-09
264	1.00E+04	1.66E-09	8.10E-12	5.06E-12	1.40E-13	1.85E-15	1.67E-09
263	1.00E+04	1.04E-09	1.43E-10	8.93E-11	1.04E-15	1.18E-15	1.27E-09
197	1.00E+04	1.24E-09	1.60E-11	1.00E-11	9.54E-13	4.30E-15	1.27E-09
271	1.00E+04	1.25E-09	5.11E-12	3.19E-12	2.35E-14	2.28E-15	1.25E-09
192	1.00E+04	1.13E-09	1.02E-12	6.34E-13	4.44E-16	1.57E-16	1.13E-09
123	1.00E+04	9.46E-10	1.06E-11	6.63E-12	3.08E-13	1.58E-15	9.64E-10
160	1.00E+04	9.54E-10	5.07E-12	3.17E-12	4.13E-13	9.89E-16	9.63E-10
297	1.00E+04	8.63E-10	3.96E-11	2.47E-11	3.12E-15	3.54E-15	9.27E-10
248	1.00E+04	8.89E-10	1.52E-11	9.52E-12	8.29E-16	9.39E-16	9.14E-10
158	1.00E+04	8.25E-10	2.16E-11	1.35E-11	9.82E-16	1.11E-15	8.60E-10

80	1.00E+04	5.13E-10	1.06E-11	6.64E-12	7.61E-17	8.63E-17	5.30E-10
132	1.00E+04	5.19E-10	1.62E-12	1.01E-12	1.58E-16	1.79E-16	5.22E-10
86	1.00E+04	4.78E-10	5.21E-12	3.26E-12	8.05E-16	9.12E-16	4.87E-10
186	1.00E+04	4.73E-10	3.25E-12	2.03E-12	5.76E-16	6.53E-16	4.79E-10
79	1.00E+04	3.57E-10	8.89E-12	5.55E-12	7.69E-16	8.71E-16	3.72E-10
106	1.00E+04	3.14E-10	1.19E-11	7.45E-12	4.27E-13	6.15E-16	3.33E-10
277	1.00E+04	3.01E-10	1.20E-12	7.47E-13	2.68E-14	1.81E-16	3.03E-10
176	1.00E+04	2.72E-10	1.89E-11	1.18E-11	1.39E-15	1.58E-15	3.02E-10
46	1.00E+04	2.20E-10	5.66E-12	3.53E-12	1.38E-15	1.56E-15	2.29E-10
212	1.00E+04	2.21E-10	2.74E-12	1.71E-12	6.03E-14	5.55E-16	2.25E-10
274	1.00E+04	1.86E-10	1.66E-12	1.04E-12	1.39E-16	1.58E-16	1.89E-10
254	1.00E+04	1.51E-10	1.77E-12	1.11E-12	1.52E-16	1.72E-16	1.54E-10
56	1.00E+04	1.20E-10	5.53E-13	3.45E-13	1.14E-15	1.51E-16	1.21E-10
155	1.00E+04	9.87E-11	1.66E-13	1.03E-13	1.76E-14	4.82E-17	9.90E-11
151	1.00E+04	7.81E-11	1.23E-12	7.70E-13	5.34E-17	6.05E-17	8.01E-11
59	1.00E+04	4.88E-11	5.16E-13	3.23E-13	7.52E-17	8.52E-17	4.96E-11
58	1.00E+04	1.95E-11	6.69E-13	4.18E-13	4.43E-17	5.02E-17	2.06E-11
129	1.00E+04	1.72E-11	4.73E-14	2.95E-14	1.71E-15	1.80E-17	1.73E-11
61	1.00E+04	1.45E-11	5.94E-13	3.71E-13	2.62E-17	2.97E-17	1.55E-11
5	1.00E+04	1.47E-11	1.70E-13	1.06E-13	3.76E-15	3.44E-17	1.50E-11
257	1.00E+04	6.57E-12	1.06E-13	6.62E-14	3.80E-18	4.31E-18	6.75E-12
247	1.00E+04	4.47E-12	1.58E-14	9.86E-15	2.27E-18	2.57E-18	4.49E-12
137	1.00E+04	2.07E-12	2.23E-14	1.39E-14	5.67E-18	6.42E-18	2.11E-12
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.17 S6T350

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
111	1.00E+04	6.82E+01	5.36E-03	4.24E-01	6.85E-05	2.13E-03	6.87E+01
256	1.00E+04	2.33E+01	7.05E-04	2.73E-02	2.51E-03	1.96E-04	2.33E+01
9	1.00E+04	8.88E+00	5.12E-04	2.18E-02	4.16E-04	2.80E-04	8.90E+00
128	1.00E+04	6.07E+00	1.58E-02	1.04E+00	3.23E-05	1.50E-03	7.13E+00
280	1.00E+04	5.48E+00	6.55E-05	7.23E-03	9.78E-04	1.53E-04	5.49E+00
236	1.00E+04	4.88E+00	1.82E-03	5.58E-02	7.44E-06	7.24E-05	4.94E+00
287	1.00E+04	4.68E+00	6.25E-04	9.00E-03	6.37E-04	2.19E-05	4.70E+00
141	1.00E+04	4.56E+00	5.73E-08	1.27E-01	2.31E-05	1.15E-03	4.68E+00
217	1.00E+04	4.46E+00	3.35E-04	7.56E-03	6.83E-05	2.51E-05	4.47E+00
228	1.00E+04	4.15E+00	1.88E-03	3.30E-02	6.72E-06	5.00E-05	4.18E+00
64	1.00E+04	3.58E+00	1.43E-04	1.50E-02	1.11E-05	4.44E-04	3.60E+00
23	1.00E+04	3.23E+00	5.17E-08	1.87E-01	5.58E-03	2.56E-03	3.43E+00
19	1.00E+04	2.52E+00	1.51E-03	3.07E-02	4.33E-06	3.35E-05	2.55E+00
266	1.00E+04	2.15E+00	1.32E-03	2.28E-01	1.66E-05	8.47E-04	2.38E+00
87	1.00E+04	2.20E+00	2.29E-03	2.96E-02	1.90E-06	1.09E-05	2.23E+00
124	1.00E+04	1.96E+00	7.31E-05	1.84E-02	1.66E-03	3.67E-04	1.98E+00
181	1.00E+04	1.89E+00	6.45E-04	4.59E-02	5.65E-06	1.99E-04	1.94E+00
50	1.00E+04	1.88E+00	9.99E-04	1.09E-02	1.59E-06	8.52E-06	1.89E+00
177	1.00E+04	1.88E+00	2.77E-04	8.49E-03	1.08E-04	2.12E-05	1.89E+00
290	1.00E+04	1.65E+00	2.65E-04	1.19E-02	1.92E-06	3.54E-05	1.67E+00
52	1.00E+04	1.59E+00	4.67E-04	1.60E-02	4.98E-04	7.19E-05	1.61E+00
25	1.00E+04	1.41E+00	1.21E-04	5.28E-02	1.67E-05	8.67E-04	1.46E+00
90	1.00E+04	1.39E+00	2.84E-04	2.96E-03	1.89E-04	4.90E-06	1.40E+00
7	1.00E+04	1.32E+00	1.09E-03	2.19E-02	5.83E-07	5.56E-06	1.34E+00
253	1.00E+04	1.29E+00	4.97E-04	5.25E-03	3.79E-07	2.01E-06	1.30E+00
260	1.00E+04	9.49E-01	8.75E-04	8.93E-02	6.17E-06	3.60E-04	1.04E+00
245	1.00E+04	9.51E-01	3.37E-04	3.29E-03	3.70E-05	1.13E-06	9.55E-01
130	1.00E+04	6.78E-01	1.29E-03	4.24E-02	5.51E-04	8.84E-05	7.23E-01
204	1.00E+04	6.53E-01	4.22E-05	4.67E-03	7.76E-07	3.48E-05	6.58E-01
222	1.00E+04	5.78E-01	4.09E-05	9.26E-03	8.30E-07	3.73E-05	5.87E-01
276	1.00E+04	5.21E-01	1.27E-04	2.26E-03	9.32E-08	6.07E-07	5.23E-01
72	1.00E+04	4.60E-01	9.26E-07	6.02E-02	6.02E-06	2.75E-04	5.21E-01
82	1.00E+04	4.92E-01	4.36E-04	4.30E-03	2.07E-05	3.26E-06	4.97E-01
285	1.00E+04	4.62E-01	2.58E-04	2.56E-03	8.07E-05	3.77E-06	4.65E-01
152	1.00E+04	4.54E-01	9.27E-05	9.06E-04	3.25E-07	1.68E-06	4.55E-01
93	1.00E+04	3.93E-01	5.62E-05	5.49E-04	7.80E-06	1.54E-06	3.94E-01
163	1.00E+04	3.40E-01	2.50E-05	2.44E-04	2.78E-06	3.99E-07	3.40E-01
240	1.00E+04	2.93E-01	2.11E-03	2.06E-02	4.24E-07	2.20E-06	3.16E-01
110	1.00E+04	3.00E-01	1.71E-04	1.67E-03	1.91E-07	9.87E-07	3.02E-01
154	1.00E+04	3.00E-01	1.71E-04	1.69E-03	2.60E-07	1.35E-06	3.02E-01
153	1.00E+04	2.96E-01	3.50E-05	7.81E-04	5.44E-05	3.18E-06	2.97E-01
265	1.00E+04	2.68E-01	3.30E-04	3.31E-03	4.97E-07	2.59E-06	2.72E-01
81	1.00E+04	2.61E-01	1.14E-04	1.23E-03	1.96E-07	1.05E-06	2.63E-01

202	1.00E+04	2.62E-01	7.27E-06	8.26E-05	2.83E-06	1.67E-07	2.62E-01
77	1.00E+04	2.59E-01	1.98E-04	1.95E-03	9.30E-05	2.21E-06	2.61E-01
108	1.00E+04	2.57E-01	8.91E-05	1.13E-03	7.82E-08	4.42E-07	2.58E-01
183	1.00E+04	2.51E-01	5.50E-05	5.42E-04	2.46E-05	8.93E-07	2.51E-01
166	1.00E+04	2.45E-01	6.22E-05	6.09E-04	6.76E-06	1.11E-06	2.45E-01
278	1.00E+04	2.45E-01	5.14E-10	4.79E-04	5.38E-05	9.37E-06	2.45E-01
102	1.00E+04	2.26E-01	4.26E-04	4.16E-03	3.66E-07	1.90E-06	2.31E-01
126	1.00E+04	1.98E-01	2.79E-05	2.82E-04	1.51E-05	9.17E-07	1.98E-01
14	1.00E+04	1.95E-01	6.39E-05	8.10E-04	2.24E-07	1.27E-06	1.96E-01
221	1.00E+04	1.65E-01	1.28E-04	2.67E-02	2.45E-06	1.34E-04	1.92E-01
142	1.00E+04	1.64E-01	1.76E-05	1.72E-04	3.58E-05	6.41E-07	1.64E-01
267	1.00E+04	1.59E-01	7.14E-05	3.20E-03	5.11E-04	1.32E-05	1.63E-01
125	1.00E+04	1.26E-01	9.44E-05	9.22E-04	2.61E-07	1.35E-06	1.27E-01
243	1.00E+04	1.00E-01	2.55E-04	1.80E-02	2.02E-06	1.12E-04	1.19E-01
121	1.00E+04	1.18E-01	3.38E-06	3.30E-05	8.93E-07	3.43E-08	1.18E-01
92	1.00E+04	1.10E-01	3.91E-04	3.82E-03	1.13E-04	8.97E-07	1.14E-01
98	1.00E+04	8.28E-02	2.58E-05	2.53E-04	8.88E-05	3.60E-07	8.32E-02
27	1.00E+04	7.47E-02	3.25E-04	3.17E-03	6.66E-08	3.45E-07	7.82E-02
99	1.00E+04	7.54E-02	6.06E-06	1.61E-03	7.40E-07	4.14E-05	7.71E-02
40	1.00E+04	6.61E-02	1.90E-04	4.59E-03	2.44E-07	2.16E-06	7.09E-02
34	1.00E+04	6.74E-02	2.42E-05	3.81E-04	5.05E-08	3.07E-07	6.78E-02
145	1.00E+04	6.56E-02	1.03E-04	1.00E-03	2.42E-05	5.82E-07	6.67E-02
191	1.00E+04	5.52E-02	1.66E-05	8.81E-04	3.26E-05	6.04E-06	5.62E-02
184	1.00E+04	4.64E-02	4.20E-04	4.10E-03	1.11E-07	5.73E-07	5.09E-02
238	1.00E+04	4.75E-02	1.13E-04	1.48E-03	1.23E-05	3.80E-07	4.91E-02
28	1.00E+04	4.36E-02	1.80E-05	1.75E-04	1.47E-04	2.90E-07	4.39E-02
49	1.00E+04	4.07E-02	4.14E-06	5.77E-05	6.69E-09	3.92E-08	4.07E-02
195	1.00E+04	4.02E-02	1.53E-05	1.49E-04	2.94E-08	1.52E-07	4.03E-02
147	1.00E+04	3.44E-02	2.83E-04	5.11E-03	4.82E-07	3.79E-06	3.98E-02
88	1.00E+04	3.77E-02	5.95E-05	6.70E-04	2.85E-06	2.91E-07	3.84E-02
13	1.00E+04	3.65E-02	2.87E-05	9.72E-04	6.01E-05	9.69E-06	3.75E-02
227	1.00E+04	3.72E-02	1.60E-05	1.56E-04	7.19E-06	1.67E-07	3.74E-02
100	1.00E+04	3.43E-02	2.21E-04	2.22E-03	1.68E-07	8.78E-07	3.67E-02
225	1.00E+04	3.05E-02	1.16E-05	4.99E-03	1.04E-06	6.30E-05	3.55E-02
135	1.00E+04	3.43E-02	2.26E-05	3.40E-04	2.15E-05	5.32E-07	3.47E-02
262	1.00E+04	3.26E-02	1.95E-05	2.02E-04	3.01E-05	4.32E-07	3.28E-02
205	1.00E+04	3.07E-02	2.22E-05	2.34E-04	2.92E-08	1.55E-07	3.10E-02
235	1.00E+04	2.38E-02	2.55E-04	2.60E-03	2.21E-05	1.18E-06	2.67E-02
295	1.00E+04	2.27E-02	8.72E-07	8.52E-06	3.59E-07	1.45E-08	2.27E-02
229	1.00E+04	2.21E-02	8.09E-06	1.55E-04	7.16E-06	3.51E-07	2.22E-02
246	1.00E+04	2.08E-02	1.37E-06	1.89E-05	5.94E-09	3.43E-08	2.09E-02
109	1.00E+04	1.97E-02	2.85E-05	2.78E-04	3.62E-08	1.88E-07	2.00E-02
78	1.00E+04	1.91E-02	7.75E-07	7.56E-06	5.63E-07	2.52E-08	1.91E-02
41	1.00E+04	1.61E-02	1.16E-05	1.22E-03	1.20E-04	2.57E-05	1.75E-02
148	1.00E+04	1.71E-02	1.04E-05	2.34E-04	2.63E-06	4.77E-07	1.74E-02
35	1.00E+04	1.72E-02	1.03E-05	1.00E-04	2.09E-08	1.08E-07	1.73E-02
251	1.00E+04	1.65E-02	2.16E-05	5.45E-04	2.10E-05	3.77E-07	1.70E-02
215	1.00E+04	1.49E-02	1.25E-04	1.22E-03	7.68E-06	1.43E-07	1.63E-02
193	1.00E+04	1.39E-02	2.41E-06	2.36E-05	2.05E-06	4.72E-08	1.39E-02
284	1.00E+04	1.16E-02	2.13E-04	2.08E-03	1.29E-07	6.70E-07	1.39E-02

66	1.00E+04	1.38E-02	2.32E-06	2.58E-05	1.08E-08	5.83E-08	1.38E-02
48	1.00E+04	1.28E-02	2.80E-06	4.23E-05	1.37E-08	8.21E-08	1.29E-02
131	1.00E+04	1.21E-02	9.77E-06	1.39E-04	2.30E-06	2.22E-07	1.22E-02
63	1.00E+04	1.14E-02	9.48E-06	9.26E-05	1.29E-08	6.69E-08	1.15E-02
169	1.00E+04	1.08E-02	4.36E-05	4.26E-04	2.65E-09	1.37E-08	1.13E-02
39	1.00E+04	9.76E-03	4.66E-06	1.19E-03	1.14E-04	5.67E-05	1.11E-02
43	1.00E+04	1.06E-02	2.47E-06	2.41E-05	1.30E-06	7.48E-08	1.07E-02
16	1.00E+04	1.05E-02	9.51E-06	9.29E-05	7.03E-07	1.09E-08	1.07E-02
71	1.00E+04	1.04E-02	2.18E-06	2.15E-05	6.58E-06	7.80E-08	1.04E-02
29	1.00E+04	1.01E-02	2.51E-07	2.45E-06	6.69E-07	4.73E-09	1.01E-02
198	1.00E+04	9.87E-03	7.97E-06	7.78E-05	1.33E-06	8.39E-08	9.95E-03
252	1.00E+04	9.41E-03	3.14E-05	4.15E-04	1.01E-06	2.38E-07	9.86E-03
165	1.00E+04	6.19E-03	1.28E-06	1.33E-03	1.92E-03	4.44E-05	9.48E-03
203	1.00E+04	8.94E-03	2.60E-06	2.54E-05	1.61E-06	1.78E-08	8.97E-03
144	1.00E+04	8.80E-03	1.14E-05	1.51E-04	7.39E-07	6.62E-08	8.96E-03
188	1.00E+04	8.64E-03	7.03E-06	6.86E-05	9.72E-08	1.01E-07	8.71E-03
174	1.00E+04	8.45E-03	1.64E-06	2.11E-05	4.06E-06	7.29E-08	8.48E-03
161	1.00E+04	7.32E-03	4.52E-06	4.49E-05	7.72E-09	4.02E-08	7.37E-03
68	1.00E+04	7.32E-03	4.11E-06	4.01E-05	8.33E-07	5.59E-08	7.36E-03
104	1.00E+04	6.16E-03	2.30E-06	2.24E-05	5.67E-07	3.76E-08	6.18E-03
69	1.00E+04	4.14E-03	6.39E-05	6.24E-04	1.29E-08	6.69E-08	4.83E-03
275	1.00E+04	4.60E-03	3.09E-06	3.02E-05	3.88E-09	2.01E-08	4.63E-03
293	1.00E+04	4.32E-03	1.51E-06	1.78E-05	2.90E-07	3.14E-08	4.34E-03
200	1.00E+04	4.17E-03	2.10E-07	6.00E-06	1.64E-09	1.12E-08	4.18E-03
189	1.00E+04	4.14E-03	2.60E-06	2.54E-05	5.02E-09	2.60E-08	4.17E-03
218	1.00E+04	4.14E-03	7.26E-07	7.09E-06	2.68E-07	1.23E-08	4.15E-03
159	1.00E+04	4.12E-03	1.38E-06	1.34E-05	3.06E-09	1.58E-08	4.13E-03
282	1.00E+04	3.87E-03	6.77E-07	6.74E-06	4.26E-09	2.22E-08	3.88E-03
120	1.00E+04	3.68E-03	3.27E-06	3.19E-05	4.71E-09	2.44E-08	3.72E-03
134	1.00E+04	3.68E-03	1.10E-06	1.07E-05	7.74E-07	2.26E-08	3.69E-03
226	1.00E+04	3.63E-03	2.48E-06	2.42E-05	2.80E-09	1.45E-08	3.66E-03
261	1.00E+04	3.49E-03	4.04E-06	3.94E-05	7.01E-09	3.63E-08	3.53E-03
44	1.00E+04	3.34E-03	1.91E-07	1.87E-06	7.85E-08	2.35E-09	3.34E-03
250	1.00E+04	3.31E-03	1.85E-06	1.92E-05	4.47E-06	3.51E-08	3.33E-03
118	1.00E+04	3.21E-03	3.22E-06	3.14E-05	3.69E-09	1.91E-08	3.24E-03
300	1.00E+04	3.21E-03	2.65E-06	2.59E-05	2.43E-06	3.79E-08	3.24E-03
269	1.00E+04	3.21E-03	1.20E-06	1.17E-05	6.33E-07	2.78E-08	3.23E-03
112	1.00E+04	3.06E-03	1.70E-06	1.66E-05	9.85E-08	2.18E-08	3.08E-03
299	1.00E+04	2.91E-03	5.64E-07	5.51E-06	1.03E-07	1.35E-08	2.91E-03
54	1.00E+04	2.80E-03	2.28E-06	2.23E-05	6.12E-06	2.33E-08	2.83E-03
249	1.00E+04	2.70E-03	4.31E-06	4.21E-05	4.67E-09	2.42E-08	2.75E-03
185	1.00E+04	2.72E-03	8.64E-07	8.44E-06	1.18E-09	6.09E-09	2.73E-03
179	1.00E+04	2.52E-03	1.93E-05	1.89E-04	6.32E-09	3.27E-08	2.73E-03
73	1.00E+04	2.71E-03	1.16E-06	1.16E-05	9.59E-07	1.95E-08	2.73E-03
231	1.00E+04	2.60E-03	1.68E-06	1.64E-05	7.17E-09	3.71E-08	2.62E-03
33	1.00E+04	2.52E-03	1.70E-06	1.66E-05	1.34E-06	3.00E-08	2.54E-03
194	1.00E+04	2.27E-03	1.18E-05	1.36E-04	2.85E-09	1.56E-08	2.42E-03
17	1.00E+04	2.33E-03	5.83E-07	5.69E-06	2.57E-07	1.00E-08	2.34E-03
84	1.00E+04	2.32E-03	2.12E-06	2.07E-05	1.03E-06	2.21E-08	2.34E-03
214	1.00E+04	2.30E-03	5.72E-07	5.58E-06	6.51E-07	1.55E-08	2.30E-03

172	1.00E+04	2.25E-03	4.94E-07	4.82E-06	2.15E-07	7.59E-09	2.25E-03
180	1.00E+04	2.21E-03	1.03E-06	1.00E-05	2.51E-07	1.05E-08	2.22E-03
138	1.00E+04	2.15E-03	9.39E-07	9.17E-06	5.58E-07	1.66E-08	2.16E-03
127	1.00E+04	2.15E-03	4.63E-07	4.53E-06	9.37E-07	1.63E-08	2.16E-03
175	1.00E+04	2.14E-03	1.18E-07	1.14E-06	3.12E-10	1.62E-09	2.14E-03
196	1.00E+04	2.10E-03	4.06E-07	3.96E-06	2.78E-09	1.44E-08	2.11E-03
167	1.00E+04	2.03E-03	2.15E-06	2.77E-05	1.01E-06	3.88E-08	2.06E-03
30	1.00E+04	2.04E-03	3.30E-07	3.23E-06	1.16E-07	1.05E-08	2.04E-03
213	1.00E+04	1.86E-03	9.32E-07	9.10E-06	9.26E-08	1.70E-08	1.87E-03
95	1.00E+04	1.73E-03	6.25E-06	6.11E-05	4.22E-09	2.19E-08	1.80E-03
211	1.00E+04	1.78E-03	7.54E-07	7.36E-06	4.02E-07	1.20E-08	1.79E-03
182	1.00E+04	1.76E-03	2.94E-07	2.87E-06	2.48E-07	1.09E-08	1.76E-03
2	1.00E+04	1.72E-03	1.10E-06	1.07E-05	2.40E-09	1.24E-08	1.73E-03
94	1.00E+04	1.60E-03	3.74E-06	3.65E-05	2.51E-09	1.30E-08	1.64E-03
31	1.00E+04	1.63E-03	3.17E-07	3.10E-06	7.85E-08	7.78E-09	1.63E-03
270	1.00E+04	1.56E-03	4.01E-07	3.92E-06	2.70E-07	1.32E-08	1.56E-03
119	1.00E+04	1.50E-03	1.58E-06	2.19E-05	8.49E-09	4.90E-08	1.52E-03
233	1.00E+04	1.45E-03	3.96E-07	3.87E-06	3.21E-06	8.86E-09	1.45E-03
143	1.00E+04	1.40E-03	1.03E-06	1.01E-05	1.90E-09	9.86E-09	1.41E-03
210	1.00E+04	1.38E-03	2.65E-07	2.59E-06	9.37E-08	3.20E-09	1.38E-03
220	1.00E+04	1.20E-03	9.55E-06	9.32E-05	1.46E-09	7.58E-09	1.30E-03
8	1.00E+04	1.27E-03	1.95E-06	1.91E-05	3.01E-09	1.56E-08	1.29E-03
57	1.00E+04	1.28E-03	2.77E-07	2.70E-06	4.00E-10	2.07E-09	1.29E-03
116	1.00E+04	1.23E-03	1.98E-06	1.93E-05	5.94E-06	3.37E-08	1.26E-03
294	1.00E+04	1.21E-03	3.44E-07	3.36E-06	2.86E-07	6.29E-09	1.22E-03
12	1.00E+04	1.18E-03	3.21E-06	3.14E-05	1.56E-06	6.93E-08	1.21E-03
91	1.00E+04	1.20E-03	3.94E-07	3.84E-06	8.82E-07	9.57E-09	1.21E-03
199	1.00E+04	1.11E-03	1.09E-06	1.07E-05	1.69E-09	8.76E-09	1.12E-03
289	1.00E+04	1.03E-03	1.60E-06	1.56E-05	1.76E-09	9.11E-09	1.04E-03
170	1.00E+04	9.63E-04	2.80E-07	2.73E-06	2.64E-07	5.51E-09	9.67E-04
283	1.00E+04	9.18E-04	3.08E-07	5.27E-06	1.16E-09	7.07E-09	9.23E-04
268	1.00E+04	8.03E-04	1.75E-06	1.71E-05	1.92E-09	9.94E-09	8.21E-04
51	1.00E+04	7.45E-04	9.89E-07	9.65E-06	1.45E-09	7.50E-09	7.56E-04
173	1.00E+04	7.28E-04	2.09E-07	2.09E-06	3.19E-10	1.67E-09	7.30E-04
105	1.00E+04	6.95E-04	3.68E-07	3.59E-06	3.56E-07	8.66E-09	7.00E-04
150	1.00E+04	6.67E-04	1.78E-07	1.74E-06	6.11E-08	1.99E-09	6.69E-04
140	1.00E+04	6.13E-04	4.50E-07	4.39E-06	7.32E-10	3.79E-09	6.18E-04
136	1.00E+04	6.11E-04	2.19E-07	2.14E-06	7.79E-08	3.18E-09	6.14E-04
89	1.00E+04	5.44E-04	2.60E-07	2.54E-06	3.36E-10	1.74E-09	5.47E-04
232	1.00E+04	5.33E-04	8.83E-08	8.81E-07	1.13E-07	1.91E-09	5.34E-04
21	1.00E+04	5.04E-04	1.02E-06	9.95E-06	5.28E-10	2.73E-09	5.15E-04
272	1.00E+04	5.12E-04	2.63E-07	2.56E-06	6.29E-10	3.26E-09	5.14E-04
117	1.00E+04	4.31E-04	7.19E-06	7.02E-05	4.55E-09	2.35E-08	5.08E-04
11	1.00E+04	4.41E-04	5.33E-06	5.21E-05	5.27E-09	2.73E-08	4.99E-04
279	1.00E+04	4.86E-04	1.04E-06	1.02E-05	1.91E-09	9.87E-09	4.97E-04
216	1.00E+04	4.73E-04	9.32E-07	9.10E-06	7.81E-10	4.04E-09	4.83E-04
32	1.00E+04	4.43E-04	4.05E-07	4.90E-06	3.49E-07	1.11E-08	4.49E-04
255	1.00E+04	4.23E-04	1.69E-06	1.65E-05	4.88E-07	4.46E-09	4.41E-04
242	1.00E+04	4.01E-04	3.47E-07	3.39E-06	7.25E-10	3.76E-09	4.04E-04
6	1.00E+04	3.91E-04	4.95E-07	4.83E-06	6.52E-10	3.37E-09	3.97E-04

139	1.00E+04	3.57E-04	2.14E-06	2.09E-05	4.71E-10	2.44E-09	3.80E-04
76	1.00E+04	3.59E-04	2.26E-07	2.21E-06	1.25E-07	3.23E-09	3.61E-04
207	1.00E+04	3.29E-04	1.72E-06	1.68E-05	4.36E-09	2.26E-08	3.48E-04
74	1.00E+04	3.23E-04	2.13E-07	2.08E-06	4.20E-10	2.17E-09	3.25E-04
281	1.00E+04	3.20E-04	1.51E-07	1.47E-06	9.73E-09	2.31E-09	3.22E-04
241	1.00E+04	1.73E-04	1.23E-05	1.25E-04	1.05E-09	5.54E-09	3.10E-04
62	1.00E+04	2.95E-04	9.21E-07	8.99E-06	8.52E-10	4.41E-09	3.05E-04
237	1.00E+04	2.82E-04	9.09E-08	8.87E-07	4.69E-10	2.43E-09	2.83E-04
201	1.00E+04	2.77E-04	3.63E-07	3.55E-06	4.59E-07	8.74E-09	2.81E-04
230	1.00E+04	2.61E-04	5.03E-07	4.91E-06	2.70E-06	1.30E-08	2.69E-04
258	1.00E+04	2.59E-04	3.56E-07	3.48E-06	7.65E-10	3.96E-09	2.62E-04
15	1.00E+04	2.43E-04	4.26E-07	4.16E-06	9.74E-08	1.86E-09	2.48E-04
96	1.00E+04	2.34E-04	8.74E-08	8.53E-07	2.49E-10	1.29E-09	2.35E-04
190	1.00E+04	2.22E-04	1.51E-07	1.47E-06	6.46E-08	2.16E-09	2.24E-04
114	1.00E+04	2.08E-04	1.39E-07	1.35E-06	3.29E-10	1.70E-09	2.10E-04
234	1.00E+04	2.06E-04	7.99E-08	7.80E-07	1.74E-08	1.25E-09	2.07E-04
97	1.00E+04	2.04E-04	7.34E-08	7.17E-07	2.47E-08	1.22E-09	2.05E-04
113	1.00E+04	1.71E-04	4.91E-07	4.79E-06	7.56E-08	2.32E-09	1.76E-04
103	1.00E+04	1.23E-04	1.24E-06	1.21E-05	7.50E-10	3.89E-09	1.36E-04
24	1.00E+04	1.22E-04	3.59E-07	3.60E-06	4.91E-10	2.57E-09	1.26E-04
85	1.00E+04	1.08E-04	8.21E-08	8.01E-07	2.58E-10	1.34E-09	1.09E-04
156	1.00E+04	9.71E-05	7.49E-07	7.32E-06	4.70E-08	1.03E-09	1.05E-04
157	1.00E+04	7.48E-05	9.98E-08	9.75E-07	3.80E-09	1.46E-09	7.59E-05
65	1.00E+04	7.15E-05	2.42E-07	2.37E-06	3.83E-08	2.41E-09	7.42E-05
42	1.00E+04	7.05E-05	8.06E-08	7.87E-07	3.72E-11	1.93E-10	7.13E-05
171	1.00E+04	6.32E-05	2.51E-07	2.46E-06	5.73E-10	2.97E-09	6.59E-05
273	1.00E+04	4.26E-05	4.77E-08	4.66E-07	3.35E-09	3.07E-10	4.31E-05
60	1.00E+04	3.35E-05	4.43E-08	4.33E-07	7.06E-12	3.65E-11	3.40E-05
224	1.00E+04	8.17E-06	5.85E-09	5.71E-08	3.08E-09	6.40E-11	8.24E-06
208	1.00E+04	4.23E-07	1.17E-10	1.13E-09	3.77E-13	1.95E-12	4.24E-07
115	1.00E+04	2.77E-07	4.50E-10	4.40E-09	4.52E-13	2.34E-12	2.82E-07
83	1.00E+04	1.87E-07	1.62E-09	1.01E-09	1.22E-13	1.38E-13	1.89E-07
1	1.00E+04	7.54E-08	8.29E-11	6.70E-10	3.96E-11	1.09E-12	7.62E-08
101	1.00E+04	1.19E-08	3.15E-11	1.97E-11	2.60E-12	2.48E-15	1.19E-08
45	1.00E+04	1.19E-08	5.66E-12	3.54E-12	3.44E-15	1.45E-15	1.19E-08
296	1.00E+04	9.32E-09	4.01E-11	2.51E-11	1.23E-12	7.69E-15	9.39E-09
75	1.00E+04	9.29E-09	1.41E-11	8.82E-12	1.12E-12	3.48E-15	9.32E-09
53	1.00E+04	6.19E-09	2.60E-11	1.63E-11	1.64E-15	1.86E-15	6.24E-09
3	1.00E+04	4.28E-09	1.14E-11	7.15E-12	3.14E-12	4.99E-15	4.30E-09
107	1.00E+04	2.99E-09	4.16E-10	2.60E-10	4.02E-15	4.56E-15	3.67E-09
259	1.00E+04	3.64E-09	1.03E-11	6.43E-12	4.62E-13	1.76E-15	3.66E-09
122	1.00E+04	2.90E-09	1.31E-11	8.19E-12	3.33E-15	3.77E-15	2.92E-09
298	1.00E+04	2.08E-09	1.11E-10	6.95E-11	3.98E-15	4.52E-15	2.26E-09
164	1.00E+04	2.08E-09	9.83E-12	6.14E-12	1.47E-12	1.54E-15	2.09E-09
264	1.00E+04	1.66E-09	8.10E-12	5.06E-12	1.40E-13	1.85E-15	1.67E-09
263	1.00E+04	1.04E-09	1.43E-10	8.93E-11	1.04E-15	1.18E-15	1.27E-09
197	1.00E+04	1.24E-09	1.60E-11	1.00E-11	9.54E-13	4.30E-15	1.27E-09
271	1.00E+04	1.25E-09	5.11E-12	3.19E-12	2.35E-14	2.28E-15	1.25E-09
192	1.00E+04	1.13E-09	1.02E-12	6.34E-13	4.44E-16	1.57E-16	1.13E-09
123	1.00E+04	9.46E-10	1.06E-11	6.63E-12	3.08E-13	1.58E-15	9.64E-10

160	1.00E+04	9.54E-10	5.07E-12	3.17E-12	4.13E-13	9.89E-16	9.63E-10
297	1.00E+04	8.63E-10	3.96E-11	2.47E-11	3.12E-15	3.54E-15	9.27E-10
248	1.00E+04	8.89E-10	1.52E-11	9.52E-12	8.29E-16	9.39E-16	9.14E-10
158	1.00E+04	8.25E-10	2.16E-11	1.35E-11	9.82E-16	1.11E-15	8.60E-10
80	1.00E+04	5.13E-10	1.06E-11	6.64E-12	7.61E-17	8.63E-17	5.30E-10
132	1.00E+04	5.19E-10	1.62E-12	1.01E-12	1.58E-16	1.79E-16	5.22E-10
86	1.00E+04	4.78E-10	5.21E-12	3.26E-12	8.05E-16	9.12E-16	4.87E-10
186	1.00E+04	4.73E-10	3.25E-12	2.03E-12	5.76E-16	6.53E-16	4.79E-10
79	1.00E+04	3.57E-10	8.89E-12	5.55E-12	7.69E-16	8.71E-16	3.72E-10
106	1.00E+04	3.14E-10	1.19E-11	7.45E-12	4.27E-13	6.15E-16	3.33E-10
277	1.00E+04	3.01E-10	1.20E-12	7.47E-13	2.68E-14	1.81E-16	3.03E-10
176	1.00E+04	2.72E-10	1.89E-11	1.18E-11	1.39E-15	1.58E-15	3.02E-10
46	1.00E+04	2.20E-10	5.66E-12	3.53E-12	1.38E-15	1.56E-15	2.29E-10
212	1.00E+04	2.21E-10	2.74E-12	1.71E-12	6.03E-14	5.55E-16	2.25E-10
274	1.00E+04	1.86E-10	1.66E-12	1.04E-12	1.39E-16	1.58E-16	1.89E-10
254	1.00E+04	1.51E-10	1.77E-12	1.11E-12	1.52E-16	1.72E-16	1.54E-10
56	1.00E+04	1.20E-10	5.53E-13	3.45E-13	1.14E-15	1.51E-16	1.21E-10
155	1.00E+04	9.87E-11	1.66E-13	1.03E-13	1.76E-14	4.82E-17	9.90E-11
151	1.00E+04	7.81E-11	1.23E-12	7.70E-13	5.34E-17	6.05E-17	8.01E-11
59	1.00E+04	4.88E-11	5.16E-13	3.23E-13	7.52E-17	8.52E-17	4.96E-11
58	1.00E+04	1.95E-11	6.69E-13	4.18E-13	4.43E-17	5.02E-17	2.06E-11
129	1.00E+04	1.72E-11	4.73E-14	2.95E-14	1.71E-15	1.80E-17	1.73E-11
61	1.00E+04	1.45E-11	5.94E-13	3.71E-13	2.62E-17	2.97E-17	1.55E-11
5	1.00E+04	1.47E-11	1.70E-13	1.06E-13	3.76E-15	3.44E-17	1.50E-11
257	1.00E+04	6.57E-12	1.06E-13	6.62E-14	3.80E-18	4.31E-18	6.75E-12
247	1.00E+04	4.47E-12	1.58E-14	9.86E-15	2.27E-18	2.57E-18	4.49E-12
137	1.00E+04	2.07E-12	2.23E-14	1.39E-14	5.67E-18	6.42E-18	2.11E-12
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.18 S6T1000

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
111	1.00E+04	2.56E+01	3.23E-05	4.09E-01	6.63E-05	2.37E-03	2.60E+01
256	1.00E+04	1.29E+01	4.24E-06	2.64E-02	2.44E-03	2.32E-04	1.29E+01
9	1.00E+04	7.37E+00	3.08E-06	2.11E-02	4.04E-04	3.21E-04	7.40E+00
128	1.00E+04	4.76E+00	1.21E-03	9.74E-01	3.02E-05	1.49E-03	5.73E+00
236	1.00E+04	4.76E+00	1.09E-05	5.54E-02	7.43E-06	1.26E-04	4.82E+00
287	1.00E+04	4.66E+00	3.76E-06	8.93E-03	6.39E-04	4.85E-05	4.67E+00
228	1.00E+04	4.12E+00	1.13E-05	3.28E-02	6.74E-06	9.98E-05	4.15E+00
217	1.00E+04	3.74E+00	2.02E-06	7.51E-03	6.83E-05	4.12E-05	3.75E+00
64	1.00E+04	2.86E+00	8.61E-07	1.43E-02	1.06E-05	4.66E-04	2.88E+00
19	1.00E+04	2.51E+00	9.11E-06	3.04E-02	4.33E-06	6.54E-05	2.54E+00
87	1.00E+04	2.19E+00	1.38E-05	2.94E-02	1.91E-06	2.52E-05	2.22E+00
280	1.00E+04	1.94E+00	3.94E-07	6.75E-03	9.15E-04	1.52E-04	1.95E+00
50	1.00E+04	1.87E+00	6.01E-06	1.08E-02	1.60E-06	2.05E-05	1.88E+00
141	1.00E+04	1.62E+00	3.48E-10	1.19E-01	2.17E-05	1.16E-03	1.74E+00
177	1.00E+04	1.71E+00	1.66E-06	8.43E-03	1.08E-04	3.51E-05	1.72E+00
181	1.00E+04	1.65E+00	3.88E-06	4.36E-02	5.37E-06	2.09E-04	1.69E+00
23	1.00E+04	1.48E+00	3.94E-10	1.73E-01	5.15E-03	2.49E-03	1.66E+00
266	1.00E+04	1.37E+00	7.92E-06	2.14E-01	1.56E-05	8.48E-04	1.59E+00
124	1.00E+04	1.42E+00	4.40E-07	1.67E-02	1.51E-03	3.47E-04	1.44E+00
90	1.00E+04	1.39E+00	1.71E-06	2.94E-03	1.90E-04	1.19E-05	1.39E+00
290	1.00E+04	1.34E+00	1.60E-06	1.18E-02	1.91E-06	4.83E-05	1.35E+00
52	1.00E+04	1.32E+00	2.81E-06	1.59E-02	4.98E-04	9.47E-05	1.33E+00
253	1.00E+04	1.29E+00	2.99E-06	5.22E-03	3.81E-07	4.86E-06	1.29E+00
7	1.00E+04	1.11E+00	6.55E-06	2.17E-02	5.84E-07	9.81E-06	1.13E+00
245	1.00E+04	9.48E-01	2.03E-06	3.27E-03	3.73E-05	2.78E-06	9.52E-01
25	1.00E+04	7.89E-01	7.30E-07	4.96E-02	1.57E-05	8.68E-04	8.39E-01
260	1.00E+04	7.16E-01	2.74E-05	8.06E-02	5.57E-06	3.38E-04	7.97E-01
130	1.00E+04	6.70E-01	7.74E-06	3.77E-02	4.91E-04	8.05E-05	7.08E-01
204	1.00E+04	4.91E-01	2.54E-07	4.35E-03	7.25E-07	3.48E-05	4.96E-01
82	1.00E+04	4.90E-01	2.62E-06	4.27E-03	2.09E-05	8.02E-06	4.95E-01
285	1.00E+04	4.61E-01	1.55E-06	2.54E-03	8.12E-05	9.25E-06	4.63E-01
152	1.00E+04	4.53E-01	5.58E-07	8.99E-04	3.27E-07	4.13E-06	4.54E-01
72	1.00E+04	3.44E-01	5.57E-09	5.78E-02	5.79E-06	2.89E-04	4.02E-01
93	1.00E+04	3.92E-01	3.38E-07	5.45E-04	7.85E-06	3.80E-06	3.93E-01
276	1.00E+04	3.64E-01	7.64E-07	2.25E-03	9.34E-08	1.30E-06	3.67E-01

163	1.00E+04	3.39E-01	1.51E-07	2.43E-04	2.80E-06	9.80E-07	3.39E-01
222	1.00E+04	3.29E-01	2.46E-07	8.83E-03	7.92E-07	3.87E-05	3.38E-01
240	1.00E+04	2.92E-01	1.27E-05	2.05E-02	4.27E-07	5.40E-06	3.12E-01
110	1.00E+04	2.99E-01	1.03E-06	1.66E-03	1.92E-07	2.43E-06	3.01E-01
154	1.00E+04	2.99E-01	1.03E-06	1.68E-03	2.62E-07	3.32E-06	3.00E-01
153	1.00E+04	2.71E-01	2.11E-07	7.76E-04	5.44E-05	5.31E-06	2.72E-01
265	1.00E+04	2.67E-01	1.98E-06	3.29E-03	5.00E-07	6.34E-06	2.70E-01
81	1.00E+04	2.61E-01	6.86E-07	1.22E-03	1.97E-07	2.52E-06	2.62E-01
77	1.00E+04	2.58E-01	1.19E-06	1.94E-03	9.36E-05	5.44E-06	2.60E-01
108	1.00E+04	2.56E-01	5.36E-07	1.12E-03	7.85E-08	1.03E-06	2.58E-01
183	1.00E+04	2.50E-01	3.31E-07	5.39E-04	2.48E-05	2.20E-06	2.50E-01
166	1.00E+04	2.44E-01	3.74E-07	6.05E-04	6.81E-06	2.74E-06	2.45E-01
102	1.00E+04	2.25E-01	2.57E-06	4.14E-03	3.68E-07	4.66E-06	2.30E-01
126	1.00E+04	1.97E-01	1.68E-07	2.80E-04	1.52E-05	2.24E-06	1.97E-01
14	1.00E+04	1.95E-01	3.85E-07	8.04E-04	2.25E-07	2.95E-06	1.95E-01
202	1.00E+04	1.69E-01	4.38E-08	8.20E-05	2.84E-06	3.98E-07	1.69E-01
142	1.00E+04	1.64E-01	1.06E-07	1.70E-04	3.60E-05	1.58E-06	1.64E-01
221	1.00E+04	1.22E-01	7.72E-07	2.50E-02	2.30E-06	1.34E-04	1.47E-01
267	1.00E+04	1.35E-01	4.30E-07	3.18E-03	5.11E-04	1.69E-05	1.38E-01
278	1.00E+04	1.27E-01	3.43E-12	4.76E-04	5.35E-05	1.17E-05	1.28E-01
125	1.00E+04	1.26E-01	5.68E-07	9.16E-04	2.63E-07	3.32E-06	1.26E-01
92	1.00E+04	1.10E-01	2.35E-06	3.79E-03	1.13E-04	2.21E-06	1.14E-01
243	1.00E+04	7.91E-02	1.53E-06	1.63E-02	1.83E-06	1.05E-04	9.55E-02
98	1.00E+04	8.26E-02	1.55E-07	2.51E-04	8.94E-05	8.85E-07	8.29E-02
27	1.00E+04	7.45E-02	1.95E-06	3.15E-03	6.71E-08	8.49E-07	7.76E-02
40	1.00E+04	6.55E-02	1.14E-06	4.56E-03	2.44E-07	3.94E-06	7.00E-02
34	1.00E+04	6.72E-02	1.46E-07	3.78E-04	5.06E-08	6.85E-07	6.76E-02
145	1.00E+04	6.54E-02	6.19E-07	9.97E-04	2.43E-05	1.43E-06	6.64E-02
99	1.00E+04	6.22E-02	3.65E-08	1.49E-03	6.88E-07	4.06E-05	6.37E-02
121	1.00E+04	5.89E-02	2.03E-08	3.28E-05	8.99E-07	8.45E-08	5.89E-02
191	1.00E+04	5.17E-02	1.01E-07	8.75E-04	3.26E-05	8.03E-06	5.26E-02
184	1.00E+04	4.62E-02	2.53E-06	4.07E-03	1.11E-07	1.41E-06	5.03E-02
238	1.00E+04	4.74E-02	6.80E-07	1.47E-03	1.24E-05	8.78E-07	4.88E-02
28	1.00E+04	4.34E-02	1.08E-07	1.74E-04	1.48E-04	7.14E-07	4.38E-02
195	1.00E+04	4.01E-02	9.20E-08	1.48E-04	2.96E-08	3.75E-07	4.02E-02
147	1.00E+04	3.42E-02	1.70E-06	5.07E-03	4.83E-07	7.34E-06	3.93E-02
88	1.00E+04	3.75E-02	3.58E-07	6.65E-04	2.87E-06	6.19E-07	3.82E-02
227	1.00E+04	3.71E-02	9.63E-08	1.55E-04	7.23E-06	4.11E-07	3.72E-02
13	1.00E+04	3.62E-02	1.73E-07	8.63E-04	5.36E-05	8.86E-06	3.71E-02
100	1.00E+04	3.41E-02	1.33E-06	2.21E-03	1.69E-07	2.15E-06	3.64E-02
135	1.00E+04	3.35E-02	1.36E-07	3.37E-04	2.15E-05	1.09E-06	3.39E-02
262	1.00E+04	3.25E-02	1.17E-07	2.00E-04	3.03E-05	1.05E-06	3.27E-02
205	1.00E+04	3.06E-02	1.34E-07	2.33E-04	2.94E-08	3.76E-07	3.08E-02
49	1.00E+04	3.04E-02	2.49E-08	5.73E-05	6.71E-09	8.93E-08	3.05E-02
235	1.00E+04	2.37E-02	1.53E-06	2.58E-03	2.23E-05	2.88E-06	2.63E-02
225	1.00E+04	2.13E-02	6.99E-08	4.52E-03	9.44E-07	5.96E-05	2.58E-02
295	1.00E+04	2.26E-02	5.26E-09	8.46E-06	3.61E-07	3.56E-08	2.26E-02
229	1.00E+04	2.20E-02	4.87E-08	1.54E-04	7.17E-06	7.55E-07	2.22E-02
246	1.00E+04	2.07E-02	8.23E-09	1.88E-05	5.96E-09	7.89E-08	2.07E-02
109	1.00E+04	1.96E-02	1.72E-07	2.76E-04	3.65E-08	4.61E-07	1.99E-02

78	1.00E+04	1.90E-02	4.66E-09	7.51E-06	5.67E-07	6.20E-08	1.90E-02
148	1.00E+04	1.71E-02	6.25E-08	2.32E-04	2.63E-06	9.93E-07	1.73E-02
35	1.00E+04	1.71E-02	6.18E-08	9.95E-05	2.10E-08	2.66E-07	1.72E-02
251	1.00E+04	1.64E-02	1.30E-07	5.41E-04	2.10E-05	7.70E-07	1.70E-02
215	1.00E+04	1.49E-02	7.50E-07	1.21E-03	7.73E-06	3.51E-07	1.61E-02
193	1.00E+04	1.39E-02	1.45E-08	2.34E-05	2.06E-06	1.16E-07	1.39E-02
66	1.00E+04	1.38E-02	1.40E-08	2.56E-05	1.09E-08	1.40E-07	1.38E-02
284	1.00E+04	1.16E-02	1.28E-06	2.06E-03	1.30E-07	1.65E-06	1.36E-02
41	1.00E+04	1.19E-02	6.98E-08	1.13E-03	1.11E-04	2.50E-05	1.32E-02
48	1.00E+04	1.28E-02	1.69E-08	4.20E-05	1.37E-08	1.85E-07	1.28E-02
131	1.00E+04	1.20E-02	5.88E-08	1.38E-04	2.31E-06	5.04E-07	1.22E-02
63	1.00E+04	1.14E-02	5.70E-08	9.19E-05	1.30E-08	1.64E-07	1.15E-02
169	1.00E+04	1.08E-02	2.63E-07	4.23E-04	2.67E-09	3.38E-08	1.12E-02
43	1.00E+04	1.06E-02	1.48E-08	2.39E-05	1.31E-06	1.84E-07	1.06E-02
16	1.00E+04	1.05E-02	5.74E-08	9.22E-05	7.08E-07	2.68E-08	1.06E-02
71	1.00E+04	1.03E-02	1.31E-08	2.14E-05	6.62E-06	1.91E-07	1.04E-02
39	1.00E+04	9.03E-03	1.36E-06	9.39E-04	9.04E-05	4.59E-05	1.01E-02
198	1.00E+04	9.84E-03	4.79E-08	7.73E-05	1.34E-06	2.06E-07	9.91E-03
252	1.00E+04	9.38E-03	1.89E-07	4.12E-04	1.02E-06	5.49E-07	9.79E-03
203	1.00E+04	8.91E-03	1.56E-08	2.52E-05	1.62E-06	4.38E-08	8.94E-03
144	1.00E+04	8.77E-03	6.89E-08	1.50E-04	7.42E-07	1.53E-07	8.92E-03
29	1.00E+04	8.81E-03	1.51E-09	2.43E-06	6.73E-07	1.16E-08	8.81E-03
188	1.00E+04	8.61E-03	4.23E-08	6.81E-05	9.79E-08	2.48E-07	8.68E-03
174	1.00E+04	8.42E-03	9.84E-09	2.10E-05	4.08E-06	1.69E-07	8.45E-03
165	1.00E+04	5.62E-03	7.68E-09	1.05E-03	1.52E-03	3.61E-05	8.24E-03
161	1.00E+04	7.29E-03	2.72E-08	4.46E-05	7.77E-09	9.86E-08	7.34E-03
68	1.00E+04	7.29E-03	2.47E-08	3.98E-05	8.38E-07	1.38E-07	7.34E-03
104	1.00E+04	6.14E-03	1.38E-08	2.23E-05	5.71E-07	9.26E-08	6.16E-03
69	1.00E+04	4.13E-03	3.84E-07	6.19E-04	1.30E-08	1.65E-07	4.75E-03
275	1.00E+04	4.59E-03	1.86E-08	3.00E-05	3.91E-09	4.95E-08	4.62E-03
293	1.00E+04	4.30E-03	9.11E-09	1.77E-05	2.92E-07	5.93E-08	4.32E-03
200	1.00E+04	4.16E-03	1.27E-09	5.96E-06	1.64E-09	2.33E-08	4.16E-03
189	1.00E+04	4.13E-03	1.56E-08	2.52E-05	5.06E-09	6.40E-08	4.15E-03
218	1.00E+04	4.13E-03	4.37E-09	7.04E-06	2.70E-07	3.02E-08	4.13E-03
159	1.00E+04	4.10E-03	8.28E-09	1.33E-05	3.08E-09	3.89E-08	4.12E-03
282	1.00E+04	3.86E-03	4.07E-09	6.69E-06	4.29E-09	5.44E-08	3.86E-03
120	1.00E+04	3.67E-03	1.97E-08	3.17E-05	4.74E-09	6.00E-08	3.70E-03
134	1.00E+04	3.67E-03	6.59E-09	1.06E-05	7.79E-07	5.56E-08	3.68E-03
226	1.00E+04	3.62E-03	1.49E-08	2.40E-05	2.82E-09	3.57E-08	3.64E-03
261	1.00E+04	3.48E-03	2.43E-08	3.91E-05	7.06E-09	8.93E-08	3.52E-03
44	1.00E+04	3.33E-03	1.15E-09	1.86E-06	7.90E-08	5.79E-09	3.33E-03
250	1.00E+04	3.30E-03	1.11E-08	1.90E-05	4.50E-06	8.51E-08	3.32E-03
118	1.00E+04	3.20E-03	1.94E-08	3.12E-05	3.71E-09	4.70E-08	3.23E-03
300	1.00E+04	3.20E-03	1.59E-08	2.57E-05	2.44E-06	9.33E-08	3.22E-03
269	1.00E+04	3.20E-03	7.20E-09	1.16E-05	6.37E-07	6.84E-08	3.22E-03
112	1.00E+04	3.05E-03	1.02E-08	1.65E-05	9.91E-08	5.36E-08	3.07E-03
299	1.00E+04	2.90E-03	3.39E-09	5.47E-06	1.03E-07	3.33E-08	2.90E-03
54	1.00E+04	2.79E-03	1.37E-08	2.21E-05	6.16E-06	5.72E-08	2.82E-03
249	1.00E+04	2.69E-03	2.59E-08	4.18E-05	4.70E-09	5.94E-08	2.74E-03
185	1.00E+04	2.71E-03	5.20E-09	8.38E-06	1.18E-09	1.50E-08	2.72E-03

73	1.00E+04	2.71E-03	6.97E-09	1.15E-05	9.65E-07	4.78E-08	2.72E-03
179	1.00E+04	2.51E-03	1.16E-07	1.88E-04	6.36E-09	8.05E-08	2.70E-03
231	1.00E+04	2.59E-03	1.01E-08	1.63E-05	7.22E-09	9.13E-08	2.61E-03
33	1.00E+04	2.51E-03	1.03E-08	1.65E-05	1.35E-06	7.37E-08	2.53E-03
194	1.00E+04	2.27E-03	7.12E-08	1.35E-04	2.86E-09	3.70E-08	2.40E-03
17	1.00E+04	2.33E-03	3.52E-09	5.65E-06	2.58E-07	2.47E-08	2.33E-03
84	1.00E+04	2.31E-03	1.28E-08	2.06E-05	1.04E-06	5.44E-08	2.33E-03
214	1.00E+04	2.29E-03	3.44E-09	5.55E-06	6.56E-07	3.81E-08	2.30E-03
172	1.00E+04	2.24E-03	2.97E-09	4.79E-06	2.17E-07	1.87E-08	2.24E-03
180	1.00E+04	2.20E-03	6.17E-09	9.94E-06	2.52E-07	2.59E-08	2.21E-03
138	1.00E+04	2.14E-03	5.65E-09	9.11E-06	5.61E-07	4.09E-08	2.15E-03
127	1.00E+04	2.14E-03	2.79E-09	4.49E-06	9.43E-07	4.00E-08	2.15E-03
175	1.00E+04	2.13E-03	2.24E-09	1.13E-06	3.14E-10	3.98E-09	2.13E-03
196	1.00E+04	2.10E-03	2.44E-09	3.94E-06	2.80E-09	3.54E-08	2.10E-03
167	1.00E+04	2.02E-03	1.29E-08	2.76E-05	1.01E-06	8.97E-08	2.05E-03
30	1.00E+04	2.03E-03	1.99E-09	3.20E-06	1.17E-07	2.59E-08	2.04E-03
213	1.00E+04	1.85E-03	5.61E-09	9.03E-06	9.33E-08	4.17E-08	1.86E-03
95	1.00E+04	1.73E-03	3.76E-08	6.06E-05	4.25E-09	5.38E-08	1.79E-03
211	1.00E+04	1.78E-03	4.54E-09	7.31E-06	4.04E-07	2.96E-08	1.78E-03
182	1.00E+04	1.75E-03	1.77E-09	2.85E-06	2.50E-07	2.69E-08	1.76E-03
2	1.00E+04	1.72E-03	6.60E-09	1.06E-05	2.41E-09	3.05E-08	1.73E-03
94	1.00E+04	1.59E-03	2.25E-08	3.62E-05	2.52E-09	3.19E-08	1.63E-03
31	1.00E+04	1.63E-03	1.91E-09	3.07E-06	7.91E-08	1.91E-08	1.63E-03
270	1.00E+04	1.55E-03	2.42E-09	3.89E-06	2.72E-07	3.24E-08	1.56E-03
119	1.00E+04	1.49E-03	9.48E-09	2.17E-05	8.52E-09	1.13E-07	1.51E-03
233	1.00E+04	1.44E-03	2.39E-09	3.84E-06	3.23E-06	2.18E-08	1.45E-03
143	1.00E+04	1.39E-03	6.22E-09	1.00E-05	1.92E-09	2.42E-08	1.40E-03
210	1.00E+04	1.37E-03	1.59E-09	2.57E-06	9.43E-08	7.86E-09	1.37E-03
8	1.00E+04	1.27E-03	1.18E-08	1.89E-05	3.03E-09	3.84E-08	1.29E-03
220	1.00E+04	1.19E-03	5.75E-08	9.26E-05	1.47E-09	1.87E-08	1.28E-03
57	1.00E+04	1.28E-03	1.67E-09	2.68E-06	4.03E-10	5.10E-09	1.28E-03
116	1.00E+04	1.23E-03	1.19E-08	1.92E-05	5.98E-06	8.29E-08	1.25E-03
294	1.00E+04	1.21E-03	2.07E-09	3.33E-06	2.87E-07	1.55E-08	1.21E-03
91	1.00E+04	1.20E-03	2.37E-09	3.82E-06	8.88E-07	2.35E-08	1.21E-03
12	1.00E+04	1.17E-03	1.93E-08	3.12E-05	1.57E-06	1.70E-07	1.20E-03
199	1.00E+04	1.11E-03	6.58E-09	1.06E-05	1.70E-09	2.15E-08	1.12E-03
289	1.00E+04	1.02E-03	9.67E-09	1.55E-05	1.77E-09	2.24E-08	1.04E-03
170	1.00E+04	9.60E-04	1.73E-09	2.71E-06	2.65E-07	1.36E-08	9.63E-04
283	1.00E+04	9.14E-04	1.85E-09	5.23E-06	1.16E-09	1.58E-08	9.20E-04
268	1.00E+04	8.00E-04	1.06E-08	1.70E-05	1.93E-09	2.45E-08	8.17E-04
51	1.00E+04	7.43E-04	5.95E-09	9.59E-06	1.46E-09	1.85E-08	7.52E-04
173	1.00E+04	7.25E-04	1.26E-09	2.08E-06	3.21E-10	4.08E-09	7.27E-04
105	1.00E+04	6.93E-04	2.21E-09	3.57E-06	3.58E-07	2.13E-08	6.97E-04
150	1.00E+04	6.65E-04	1.07E-09	1.73E-06	6.15E-08	4.89E-09	6.67E-04
140	1.00E+04	6.11E-04	2.71E-09	4.36E-06	7.37E-10	9.32E-09	6.16E-04
136	1.00E+04	6.09E-04	1.32E-09	2.12E-06	7.84E-08	7.83E-09	6.11E-04
89	1.00E+04	5.42E-04	1.57E-09	2.52E-06	3.39E-10	4.29E-09	5.45E-04
232	1.00E+04	5.31E-04	5.31E-10	8.75E-07	1.14E-07	4.65E-09	5.32E-04
272	1.00E+04	5.10E-04	1.58E-09	2.55E-06	6.34E-10	8.02E-09	5.13E-04
21	1.00E+04	5.02E-04	6.13E-09	9.88E-06	5.32E-10	6.73E-09	5.12E-04

117	1.00E+04	4.30E-04	4.33E-08	6.98E-05	4.58E-09	5.79E-08	4.99E-04
279	1.00E+04	4.84E-04	6.28E-09	1.01E-05	1.92E-09	2.43E-08	4.94E-04
11	1.00E+04	4.40E-04	3.21E-08	5.17E-05	5.30E-09	6.71E-08	4.92E-04
216	1.00E+04	4.72E-04	5.61E-09	9.04E-06	7.86E-10	9.95E-09	4.81E-04
32	1.00E+04	4.41E-04	2.44E-09	4.86E-06	3.51E-07	2.61E-08	4.47E-04
255	1.00E+04	4.21E-04	1.02E-08	1.64E-05	4.91E-07	1.10E-08	4.38E-04
242	1.00E+04	3.99E-04	2.09E-09	3.37E-06	7.30E-10	9.24E-09	4.03E-04
6	1.00E+04	3.90E-04	2.98E-09	4.80E-06	6.56E-10	8.30E-09	3.95E-04
139	1.00E+04	3.55E-04	1.31E-08	2.08E-05	4.74E-10	6.00E-09	3.76E-04
76	1.00E+04	3.58E-04	1.37E-09	2.19E-06	1.26E-07	7.94E-09	3.60E-04
207	1.00E+04	3.28E-04	1.04E-08	1.67E-05	4.39E-09	5.56E-08	3.45E-04
74	1.00E+04	3.22E-04	1.29E-09	2.06E-06	4.22E-10	5.34E-09	3.24E-04
281	1.00E+04	3.19E-04	9.07E-10	1.46E-06	9.79E-09	5.69E-09	3.21E-04
62	1.00E+04	2.94E-04	5.55E-09	8.93E-06	8.57E-10	1.08E-08	3.03E-04
241	1.00E+04	1.72E-04	7.39E-08	1.25E-04	1.06E-09	1.35E-08	2.97E-04
237	1.00E+04	2.81E-04	5.47E-10	8.81E-07	4.73E-10	5.98E-09	2.82E-04
201	1.00E+04	2.76E-04	2.19E-09	3.52E-06	4.62E-07	2.15E-08	2.80E-04
230	1.00E+04	2.60E-04	3.03E-09	4.88E-06	2.72E-06	3.19E-08	2.67E-04
258	1.00E+04	2.58E-04	2.14E-09	3.45E-06	7.70E-10	9.74E-09	2.61E-04
15	1.00E+04	2.43E-04	2.56E-09	4.13E-06	9.80E-08	4.57E-09	2.47E-04
96	1.00E+04	2.33E-04	5.26E-10	8.48E-07	2.51E-10	3.18E-09	2.34E-04
190	1.00E+04	2.22E-04	9.46E-10	1.46E-06	6.50E-08	5.32E-09	2.23E-04
114	1.00E+04	2.08E-04	8.34E-10	1.34E-06	3.31E-10	4.19E-09	2.09E-04
234	1.00E+04	2.05E-04	4.83E-10	7.75E-07	1.75E-08	3.07E-09	2.06E-04
97	1.00E+04	2.04E-04	4.45E-10	7.12E-07	2.49E-08	3.00E-09	2.05E-04
113	1.00E+04	1.70E-04	2.95E-09	4.76E-06	7.61E-08	5.70E-09	1.75E-04
103	1.00E+04	1.22E-04	7.49E-09	1.21E-05	7.55E-10	9.56E-09	1.34E-04
24	1.00E+04	1.22E-04	2.16E-09	3.57E-06	4.94E-10	6.28E-09	1.25E-04
85	1.00E+04	1.07E-04	4.94E-10	7.96E-07	2.60E-10	3.29E-09	1.08E-04
156	1.00E+04	9.68E-05	4.51E-09	7.26E-06	4.73E-08	2.54E-09	1.04E-04
157	1.00E+04	7.45E-05	6.01E-10	9.68E-07	3.82E-09	3.60E-09	7.55E-05
65	1.00E+04	7.13E-05	1.46E-09	2.35E-06	3.86E-08	5.94E-09	7.37E-05
42	1.00E+04	7.03E-05	4.85E-10	7.82E-07	3.75E-11	4.74E-10	7.10E-05
171	1.00E+04	6.30E-05	1.53E-09	2.44E-06	5.77E-10	7.30E-09	6.54E-05
273	1.00E+04	4.24E-05	2.87E-10	4.63E-07	3.38E-09	7.55E-10	4.29E-05
60	1.00E+04	3.34E-05	2.67E-10	4.30E-07	7.10E-12	8.99E-11	3.38E-05
224	1.00E+04	8.14E-06	3.67E-11	5.67E-08	3.10E-09	1.57E-10	8.20E-06
208	1.00E+04	4.22E-07	1.13E-12	1.13E-09	3.80E-13	4.80E-12	4.23E-07
115	1.00E+04	2.76E-07	2.71E-12	4.37E-09	4.55E-13	5.76E-12	2.80E-07
83	1.00E+04	1.87E-07	1.62E-09	1.01E-09	1.22E-13	1.38E-13	1.89E-07
1	1.00E+04	7.52E-08	1.56E-11	6.66E-10	3.98E-11	2.68E-12	7.59E-08
101	1.00E+04	1.19E-08	3.15E-11	1.97E-11	2.60E-12	2.48E-15	1.19E-08
45	1.00E+04	1.19E-08	5.66E-12	3.54E-12	3.44E-15	1.45E-15	1.19E-08
296	1.00E+04	9.32E-09	4.01E-11	2.51E-11	1.23E-12	7.69E-15	9.39E-09
75	1.00E+04	9.29E-09	1.41E-11	8.82E-12	1.12E-12	3.48E-15	9.32E-09
53	1.00E+04	6.19E-09	2.60E-11	1.63E-11	1.64E-15	1.86E-15	6.24E-09
3	1.00E+04	4.28E-09	1.14E-11	7.15E-12	3.14E-12	4.99E-15	4.30E-09
107	1.00E+04	2.99E-09	4.16E-10	2.60E-10	4.02E-15	4.56E-15	3.67E-09
259	1.00E+04	3.64E-09	1.03E-11	6.43E-12	4.62E-13	1.76E-15	3.66E-09
122	1.00E+04	2.90E-09	1.31E-11	8.19E-12	3.33E-15	3.77E-15	2.92E-09

298	1.00E+04	2.08E-09	1.11E-10	6.95E-11	3.98E-15	4.52E-15	2.26E-09
164	1.00E+04	2.08E-09	9.83E-12	6.14E-12	1.47E-12	1.54E-15	2.09E-09
264	1.00E+04	1.66E-09	8.10E-12	5.06E-12	1.40E-13	1.85E-15	1.67E-09
263	1.00E+04	1.04E-09	1.43E-10	8.93E-11	1.04E-15	1.18E-15	1.27E-09
197	1.00E+04	1.24E-09	1.60E-11	1.00E-11	9.54E-13	4.30E-15	1.27E-09
271	1.00E+04	1.25E-09	5.11E-12	3.19E-12	2.35E-14	2.28E-15	1.25E-09
192	1.00E+04	1.13E-09	1.02E-12	6.34E-13	4.44E-16	1.57E-16	1.13E-09
123	1.00E+04	9.46E-10	1.06E-11	6.63E-12	3.08E-13	1.58E-15	9.64E-10
160	1.00E+04	9.54E-10	5.07E-12	3.17E-12	4.13E-13	9.89E-16	9.63E-10
297	1.00E+04	8.63E-10	3.96E-11	2.47E-11	3.12E-15	3.54E-15	9.27E-10
248	1.00E+04	8.89E-10	1.52E-11	9.52E-12	8.29E-16	9.39E-16	9.14E-10
158	1.00E+04	8.25E-10	2.16E-11	1.35E-11	9.82E-16	1.11E-15	8.60E-10
80	1.00E+04	5.13E-10	1.06E-11	6.64E-12	7.61E-17	8.63E-17	5.30E-10
132	1.00E+04	5.19E-10	1.62E-12	1.01E-12	1.58E-16	1.79E-16	5.22E-10
86	1.00E+04	4.78E-10	5.21E-12	3.26E-12	8.05E-16	9.12E-16	4.87E-10
186	1.00E+04	4.73E-10	3.25E-12	2.03E-12	5.76E-16	6.53E-16	4.79E-10
79	1.00E+04	3.57E-10	8.89E-12	5.55E-12	7.69E-16	8.71E-16	3.72E-10
106	1.00E+04	3.14E-10	1.19E-11	7.45E-12	4.27E-13	6.15E-16	3.33E-10
277	1.00E+04	3.01E-10	1.20E-12	7.47E-13	2.68E-14	1.81E-16	3.03E-10
176	1.00E+04	2.72E-10	1.89E-11	1.18E-11	1.39E-15	1.58E-15	3.02E-10
46	1.00E+04	2.20E-10	5.66E-12	3.53E-12	1.38E-15	1.56E-15	2.29E-10
212	1.00E+04	2.21E-10	2.74E-12	1.71E-12	6.03E-14	5.55E-16	2.25E-10
274	1.00E+04	1.86E-10	1.66E-12	1.04E-12	1.39E-16	1.58E-16	1.89E-10
254	1.00E+04	1.51E-10	1.77E-12	1.11E-12	1.52E-16	1.72E-16	1.54E-10
56	1.00E+04	1.20E-10	5.53E-13	3.45E-13	1.14E-15	1.51E-16	1.21E-10
155	1.00E+04	9.87E-11	1.66E-13	1.03E-13	1.76E-14	4.82E-17	9.90E-11
151	1.00E+04	7.81E-11	1.23E-12	7.70E-13	5.34E-17	6.05E-17	8.01E-11
59	1.00E+04	4.88E-11	5.16E-13	3.23E-13	7.52E-17	8.52E-17	4.96E-11
58	1.00E+04	1.95E-11	6.69E-13	4.18E-13	4.43E-17	5.02E-17	2.06E-11
129	1.00E+04	1.72E-11	4.73E-14	2.95E-14	1.71E-15	1.80E-17	1.73E-11
61	1.00E+04	1.45E-11	5.94E-13	3.71E-13	2.62E-17	2.97E-17	1.55E-11
5	1.00E+04	1.47E-11	1.70E-13	1.06E-13	3.76E-15	3.44E-17	1.50E-11
257	1.00E+04	6.57E-12	1.06E-13	6.62E-14	3.80E-18	4.31E-18	6.75E-12
247	1.00E+04	4.47E-12	1.58E-14	9.86E-15	2.27E-18	2.57E-18	4.49E-12
137	1.00E+04	2.07E-12	2.23E-14	1.39E-14	5.67E-18	6.42E-18	2.11E-12
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.19 S6T2000

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
111	1.00E+04	5.18E+00	1.24E-08	3.87E-01	6.29E-05	2.69E-03	5.57E+00
228	1.00E+04	3.13E+00	4.34E-09	3.24E-02	6.70E-06	1.71E-04	3.16E+00
128	1.00E+04	2.19E+00	4.66E-07	8.64E-01	2.68E-05	1.45E-03	3.06E+00
256	1.00E+04	2.83E+00	1.62E-09	2.51E-02	2.32E-03	2.80E-04	2.86E+00
236	1.00E+04	2.76E+00	4.19E-09	5.48E-02	7.39E-06	2.03E-04	2.81E+00
9	1.00E+04	2.79E+00	1.19E-09	2.00E-02	3.84E-04	3.74E-04	2.81E+00
287	1.00E+04	2.60E+00	1.44E-09	8.84E-03	6.35E-04	8.65E-05	2.61E+00
19	1.00E+04	2.09E+00	3.49E-09	3.01E-02	4.31E-06	1.11E-04	2.12E+00
87	1.00E+04	1.59E+00	5.28E-09	2.91E-02	1.90E-06	4.56E-05	1.62E+00
64	1.00E+04	1.57E+00	3.30E-10	1.32E-02	9.83E-06	4.89E-04	1.58E+00
217	1.00E+04	1.48E+00	7.73E-10	7.43E-03	6.79E-05	6.42E-05	1.49E+00
50	1.00E+04	1.46E+00	2.33E-09	1.07E-02	1.59E-06	3.76E-05	1.47E+00
266	1.00E+04	9.58E-01	3.05E-09	1.92E-01	1.40E-05	8.33E-04	1.15E+00
90	1.00E+04	1.09E+00	6.59E-10	2.90E-03	1.89E-04	2.19E-05	1.10E+00
181	1.00E+04	1.03E+00	1.53E-09	3.99E-02	4.94E-06	2.20E-04	1.07E+00
177	1.00E+04	9.53E-01	6.39E-10	8.35E-03	1.07E-04	5.49E-05	9.62E-01
52	1.00E+04	9.22E-01	1.08E-09	1.58E-02	4.95E-04	1.27E-04	9.38E-01
253	1.00E+04	7.03E-01	1.15E-09	5.16E-03	3.78E-07	8.94E-06	7.08E-01
290	1.00E+04	6.56E-01	6.12E-10	1.17E-02	1.90E-06	6.69E-05	6.68E-01
130	1.00E+04	6.34E-01	2.96E-09	3.05E-02	3.98E-04	6.55E-05	6.65E-01
124	1.00E+04	5.66E-01	1.79E-10	1.41E-02	1.27E-03	3.09E-04	5.81E-01
82	1.00E+04	4.81E-01	1.01E-09	4.22E-03	2.07E-05	1.48E-05	4.86E-01
23	1.00E+04	3.26E-01	2.16E-11	1.51E-01	4.50E-03	2.34E-03	4.83E-01
141	1.00E+04	3.46E-01	2.68E-12	1.08E-01	1.97E-05	1.15E-03	4.55E-01
285	1.00E+04	4.53E-01	5.94E-10	2.51E-03	8.07E-05	1.71E-05	4.55E-01
245	1.00E+04	4.25E-01	9.91E-10	3.24E-03	3.70E-05	5.14E-06	4.28E-01

7	1.00E+04	4.03E-01	2.52E-09	2.15E-02	5.80E-07	1.59E-05	4.24E-01
280	1.00E+04	3.97E-01	1.51E-10	6.01E-03	8.17E-04	1.48E-04	4.04E-01
260	1.00E+04	3.34E-01	1.05E-08	6.73E-02	4.66E-06	2.99E-04	4.01E-01
93	1.00E+04	3.85E-01	1.30E-10	5.39E-04	7.80E-06	7.01E-06	3.86E-01
152	1.00E+04	3.81E-01	2.14E-10	8.90E-04	3.25E-07	7.63E-06	3.82E-01
25	1.00E+04	3.07E-01	2.80E-10	4.46E-02	1.41E-05	8.54E-04	3.52E-01
240	1.00E+04	2.87E-01	4.87E-09	2.03E-02	4.24E-07	9.97E-06	3.07E-01
110	1.00E+04	2.94E-01	3.94E-10	1.64E-03	1.91E-07	4.48E-06	2.96E-01
154	1.00E+04	2.91E-01	3.94E-10	1.66E-03	2.60E-07	6.12E-06	2.93E-01
265	1.00E+04	2.62E-01	7.62E-10	3.25E-03	4.97E-07	1.17E-05	2.66E-01
77	1.00E+04	2.53E-01	4.58E-10	1.92E-03	9.30E-05	1.00E-05	2.55E-01
183	1.00E+04	2.45E-01	1.27E-10	5.33E-04	2.46E-05	4.06E-06	2.46E-01
166	1.00E+04	2.39E-01	1.44E-10	5.98E-04	6.77E-06	5.06E-06	2.40E-01
81	1.00E+04	2.25E-01	2.63E-10	1.21E-03	1.96E-07	4.63E-06	2.26E-01
72	1.00E+04	1.71E-01	2.13E-12	5.42E-02	5.44E-06	3.06E-04	2.26E-01
102	1.00E+04	2.21E-01	9.84E-10	4.09E-03	3.66E-07	8.61E-06	2.26E-01
126	1.00E+04	1.89E-01	7.01E-11	2.77E-04	1.51E-05	4.12E-06	1.89E-01
153	1.00E+04	1.80E-01	8.08E-11	7.68E-04	5.41E-05	8.34E-06	1.81E-01
14	1.00E+04	1.79E-01	1.48E-10	7.96E-04	2.24E-07	5.35E-06	1.80E-01
204	1.00E+04	1.69E-01	1.05E-10	3.87E-03	6.47E-07	3.39E-05	1.73E-01
276	1.00E+04	1.66E-01	2.97E-10	2.22E-03	9.28E-08	2.29E-06	1.68E-01
108	1.00E+04	1.44E-01	2.09E-10	1.11E-03	7.80E-08	1.87E-06	1.45E-01
142	1.00E+04	1.30E-01	4.05E-11	1.69E-04	3.58E-05	2.91E-06	1.30E-01
163	1.00E+04	1.25E-01	5.77E-11	2.40E-04	2.78E-06	1.81E-06	1.25E-01
125	1.00E+04	1.23E-01	2.23E-10	9.06E-04	2.61E-07	6.14E-06	1.24E-01
221	1.00E+04	1.01E-01	2.96E-10	2.26E-02	2.08E-06	1.32E-04	1.23E-01
92	1.00E+04	1.08E-01	9.09E-10	3.75E-03	1.13E-04	4.08E-06	1.12E-01
267	1.00E+04	9.63E-02	1.65E-10	3.15E-03	5.08E-04	2.21E-05	1.00E-01
222	1.00E+04	7.51E-02	9.45E-11	8.16E-03	7.34E-07	4.01E-05	8.33E-02
98	1.00E+04	8.07E-02	5.94E-11	2.49E-04	8.89E-05	1.63E-06	8.11E-02
27	1.00E+04	7.32E-02	7.49E-10	3.12E-03	6.67E-08	1.57E-06	7.63E-02
243	1.00E+04	5.82E-02	5.87E-10	1.35E-02	1.52E-06	9.19E-05	7.19E-02
145	1.00E+04	6.42E-02	2.39E-10	9.86E-04	2.42E-05	2.64E-06	6.52E-02
40	1.00E+04	6.01E-02	5.00E-10	4.51E-03	2.42E-07	6.48E-06	6.47E-02
184	1.00E+04	4.54E-02	9.69E-10	4.03E-03	1.11E-07	2.60E-06	4.94E-02
238	1.00E+04	4.65E-02	2.66E-10	1.45E-03	1.23E-05	1.59E-06	4.79E-02
34	1.00E+04	4.50E-02	6.49E-11	3.74E-04	5.03E-08	1.22E-06	4.54E-02
99	1.00E+04	4.28E-02	1.40E-11	1.31E-03	6.07E-07	3.86E-05	4.41E-02
28	1.00E+04	4.27E-02	4.14E-11	1.72E-04	1.47E-04	1.32E-06	4.30E-02
195	1.00E+04	3.93E-02	3.58E-11	1.47E-04	2.94E-08	6.92E-07	3.95E-02
147	1.00E+04	3.32E-02	6.53E-10	5.02E-03	4.80E-07	1.24E-05	3.82E-02
88	1.00E+04	3.65E-02	1.39E-10	6.58E-04	2.85E-06	1.09E-06	3.72E-02
227	1.00E+04	3.64E-02	3.69E-11	1.53E-04	7.19E-06	7.58E-07	3.66E-02
13	1.00E+04	3.54E-02	6.63E-11	6.96E-04	4.32E-05	7.35E-06	3.62E-02
100	1.00E+04	3.35E-02	5.11E-10	2.19E-03	1.68E-07	3.95E-06	3.57E-02
202	1.00E+04	3.42E-02	1.87E-11	8.11E-05	2.82E-06	7.28E-07	3.43E-02
191	1.00E+04	3.26E-02	3.87E-11	8.66E-04	3.24E-05	1.09E-05	3.35E-02
135	1.00E+04	3.17E-02	5.20E-11	3.34E-04	2.14E-05	1.88E-06	3.21E-02
262	1.00E+04	3.19E-02	4.49E-11	1.98E-04	3.01E-05	1.93E-06	3.21E-02
205	1.00E+04	2.90E-02	5.33E-11	2.30E-04	2.92E-08	6.90E-07	2.92E-02

278	1.00E+04	2.70E-02	1.34E-13	4.71E-04	5.32E-05	1.49E-05	2.76E-02
235	1.00E+04	2.33E-02	5.88E-10	2.55E-03	2.21E-05	5.30E-06	2.59E-02
229	1.00E+04	2.15E-02	1.97E-11	1.52E-04	7.13E-06	1.33E-06	2.17E-02
109	1.00E+04	1.92E-02	6.67E-11	2.73E-04	3.62E-08	8.52E-07	1.95E-02
148	1.00E+04	1.67E-02	2.60E-11	2.30E-04	2.62E-06	1.73E-06	1.69E-02
35	1.00E+04	1.68E-02	5.70E-11	9.84E-05	2.09E-08	4.91E-07	1.69E-02
225	1.00E+04	1.28E-02	2.68E-11	3.80E-03	7.95E-07	5.33E-05	1.66E-02
251	1.00E+04	1.60E-02	5.42E-11	5.35E-04	2.09E-05	1.33E-06	1.65E-02
215	1.00E+04	1.46E-02	3.09E-10	1.20E-03	7.69E-06	6.47E-07	1.58E-02
193	1.00E+04	1.36E-02	1.30E-11	2.31E-05	2.05E-06	2.14E-07	1.36E-02
284	1.00E+04	1.14E-02	4.91E-10	2.04E-03	1.29E-07	3.04E-06	1.34E-02
66	1.00E+04	1.20E-02	5.35E-12	2.54E-05	1.08E-08	2.56E-07	1.20E-02
131	1.00E+04	1.18E-02	2.39E-11	1.37E-04	2.29E-06	9.06E-07	1.19E-02
121	1.00E+04	1.19E-02	1.07E-11	3.24E-05	8.93E-07	1.56E-07	1.19E-02
78	1.00E+04	1.15E-02	1.79E-12	7.43E-06	5.63E-07	1.15E-07	1.15E-02
63	1.00E+04	1.12E-02	2.19E-11	9.09E-05	1.29E-08	3.04E-07	1.13E-02
48	1.00E+04	1.07E-02	6.96E-12	4.15E-05	1.36E-08	3.31E-07	1.07E-02
43	1.00E+04	1.04E-02	5.69E-12	2.37E-05	1.30E-06	3.40E-07	1.04E-02
71	1.00E+04	1.01E-02	5.07E-12	2.12E-05	6.58E-06	3.53E-07	1.02E-02
41	1.00E+04	8.97E-03	2.68E-11	9.81E-04	9.67E-05	2.34E-05	1.01E-02
246	1.00E+04	9.89E-03	3.15E-12	1.86E-05	5.92E-09	1.42E-07	9.91E-03
49	1.00E+04	9.69E-03	9.53E-12	5.67E-05	6.67E-09	1.61E-07	9.75E-03
198	1.00E+04	9.66E-03	1.92E-11	7.64E-05	1.33E-06	3.81E-07	9.74E-03
252	1.00E+04	9.20E-03	7.37E-11	4.07E-04	1.01E-06	9.93E-07	9.61E-03
144	1.00E+04	8.60E-03	2.66E-11	1.48E-04	7.38E-07	2.76E-07	8.75E-03
39	1.00E+04	7.98E-03	5.29E-10	5.60E-04	5.39E-05	2.81E-05	8.63E-03
188	1.00E+04	8.46E-03	1.69E-11	6.74E-05	9.73E-08	4.57E-07	8.52E-03
174	1.00E+04	8.26E-03	3.77E-12	2.07E-05	4.05E-06	3.06E-07	8.29E-03
68	1.00E+04	7.16E-03	1.03E-11	3.94E-05	8.33E-07	2.54E-07	7.21E-03
161	1.00E+04	7.15E-03	1.20E-11	4.41E-05	7.72E-09	1.82E-07	7.19E-03
169	1.00E+04	6.24E-03	3.28E-10	4.18E-04	2.65E-09	6.24E-08	6.66E-03
165	1.00E+04	4.81E-03	2.94E-12	6.34E-04	9.17E-04	2.24E-05	6.38E-03
104	1.00E+04	6.03E-03	5.33E-12	2.20E-05	5.68E-07	1.71E-07	6.05E-03
203	1.00E+04	5.45E-03	5.99E-12	2.49E-05	1.61E-06	8.08E-08	5.48E-03
295	1.00E+04	5.47E-03	5.12E-12	8.37E-06	3.59E-07	6.57E-08	5.48E-03
69	1.00E+04	4.06E-03	1.47E-10	6.13E-04	1.29E-08	3.04E-07	4.67E-03
275	1.00E+04	4.50E-03	8.25E-12	2.97E-05	3.89E-09	9.13E-08	4.53E-03
189	1.00E+04	4.05E-03	5.99E-12	2.49E-05	5.03E-09	1.18E-07	4.08E-03
218	1.00E+04	4.05E-03	1.67E-12	6.96E-06	2.68E-07	5.57E-08	4.06E-03
159	1.00E+04	4.03E-03	3.25E-12	1.32E-05	3.06E-09	7.19E-08	4.04E-03
282	1.00E+04	3.79E-03	1.61E-12	6.62E-06	4.26E-09	1.00E-07	3.79E-03
16	1.00E+04	3.57E-03	4.47E-11	9.13E-05	7.03E-07	4.94E-08	3.67E-03
120	1.00E+04	3.60E-03	7.76E-12	3.13E-05	4.71E-09	1.11E-07	3.63E-03
134	1.00E+04	3.60E-03	2.53E-12	1.05E-05	7.75E-07	1.03E-07	3.62E-03
226	1.00E+04	3.55E-03	5.71E-12	2.37E-05	2.80E-09	6.59E-08	3.58E-03
293	1.00E+04	3.51E-03	1.19E-11	1.75E-05	2.90E-07	9.91E-08	3.53E-03
261	1.00E+04	3.42E-03	9.31E-12	3.87E-05	7.02E-09	1.65E-07	3.46E-03
250	1.00E+04	3.24E-03	4.26E-12	1.88E-05	4.47E-06	1.57E-07	3.26E-03
118	1.00E+04	3.14E-03	7.90E-12	3.09E-05	3.69E-09	8.67E-08	3.17E-03
300	1.00E+04	3.14E-03	6.12E-12	2.54E-05	2.43E-06	1.72E-07	3.17E-03

269	1.00E+04	3.15E-03	5.31E-12	1.15E-05	6.33E-07	1.26E-07	3.16E-03
112	1.00E+04	2.99E-03	3.92E-12	1.63E-05	9.85E-08	9.89E-08	3.01E-03
299	1.00E+04	2.85E-03	1.30E-12	5.41E-06	1.03E-07	6.15E-08	2.85E-03
54	1.00E+04	2.74E-03	5.27E-12	2.19E-05	6.13E-06	1.06E-07	2.77E-03
249	1.00E+04	2.65E-03	1.58E-11	4.13E-05	4.67E-09	1.10E-07	2.69E-03
73	1.00E+04	2.66E-03	2.76E-12	1.14E-05	9.59E-07	8.81E-08	2.67E-03
179	1.00E+04	2.47E-03	4.46E-11	1.86E-04	6.33E-09	1.49E-07	2.65E-03
231	1.00E+04	2.55E-03	3.88E-12	1.61E-05	7.17E-09	1.69E-07	2.56E-03
33	1.00E+04	2.46E-03	5.53E-12	1.63E-05	1.34E-06	1.36E-07	2.48E-03
185	1.00E+04	2.39E-03	2.00E-12	8.29E-06	1.18E-09	2.76E-08	2.40E-03
194	1.00E+04	2.22E-03	3.44E-11	1.33E-04	2.84E-09	6.76E-08	2.36E-03
17	1.00E+04	2.29E-03	1.69E-12	5.59E-06	2.57E-07	4.56E-08	2.29E-03
84	1.00E+04	2.27E-03	6.43E-12	2.04E-05	1.03E-06	1.00E-07	2.29E-03
214	1.00E+04	2.25E-03	1.71E-12	5.49E-06	6.52E-07	7.03E-08	2.26E-03
172	1.00E+04	2.20E-03	1.14E-12	4.74E-06	2.15E-07	3.45E-08	2.20E-03
180	1.00E+04	2.17E-03	2.37E-12	9.83E-06	2.51E-07	4.77E-08	2.18E-03
138	1.00E+04	2.11E-03	2.17E-12	9.01E-06	5.58E-07	7.56E-08	2.12E-03
127	1.00E+04	2.10E-03	1.07E-12	4.45E-06	9.37E-07	7.39E-08	2.11E-03
196	1.00E+04	2.06E-03	9.95E-13	3.89E-06	2.78E-09	6.54E-08	2.06E-03
167	1.00E+04	1.99E-03	4.96E-12	2.73E-05	1.01E-06	1.62E-07	2.01E-03
30	1.00E+04	2.00E-03	1.07E-12	3.17E-06	1.16E-07	4.77E-08	2.00E-03
213	1.00E+04	1.82E-03	4.25E-12	8.94E-06	9.27E-08	7.70E-08	1.83E-03
29	1.00E+04	1.78E-03	5.78E-13	2.41E-06	6.69E-07	2.15E-08	1.78E-03
95	1.00E+04	1.70E-03	1.52E-11	6.00E-05	4.22E-09	9.92E-08	1.76E-03
211	1.00E+04	1.75E-03	1.76E-12	7.23E-06	4.02E-07	5.46E-08	1.75E-03
182	1.00E+04	1.72E-03	6.77E-13	2.82E-06	2.48E-07	4.97E-08	1.72E-03
2	1.00E+04	1.69E-03	2.53E-12	1.05E-05	2.40E-09	5.64E-08	1.70E-03
94	1.00E+04	1.57E-03	8.61E-12	3.58E-05	2.51E-09	5.89E-08	1.60E-03
31	1.00E+04	1.60E-03	1.42E-12	3.04E-06	7.86E-08	3.53E-08	1.60E-03
270	1.00E+04	1.52E-03	1.54E-12	3.85E-06	2.70E-07	5.99E-08	1.53E-03
119	1.00E+04	1.46E-03	3.76E-12	2.15E-05	8.46E-09	2.03E-07	1.49E-03
233	1.00E+04	1.42E-03	9.14E-13	3.80E-06	3.21E-06	4.02E-08	1.42E-03
143	1.00E+04	1.37E-03	2.95E-12	9.91E-06	1.90E-09	4.48E-08	1.38E-03
210	1.00E+04	1.35E-03	6.69E-13	2.54E-06	9.38E-08	1.45E-08	1.35E-03
8	1.00E+04	1.25E-03	4.50E-12	1.87E-05	3.01E-09	7.08E-08	1.27E-03
220	1.00E+04	1.17E-03	2.64E-11	9.16E-05	1.47E-09	3.44E-08	1.26E-03
57	1.00E+04	1.26E-03	6.52E-13	2.66E-06	4.01E-10	9.42E-09	1.26E-03
116	1.00E+04	1.20E-03	7.23E-12	1.90E-05	5.94E-06	1.53E-07	1.23E-03
200	1.00E+04	1.22E-03	8.97E-12	5.90E-06	1.63E-09	4.07E-08	1.22E-03
294	1.00E+04	1.19E-03	7.93E-13	3.30E-06	2.86E-07	2.86E-08	1.19E-03
91	1.00E+04	1.18E-03	1.01E-12	3.78E-06	8.82E-07	4.34E-08	1.18E-03
12	1.00E+04	1.15E-03	7.42E-12	3.08E-05	1.56E-06	3.15E-07	1.18E-03
199	1.00E+04	1.09E-03	6.74E-12	1.05E-05	1.69E-09	3.98E-08	1.10E-03
289	1.00E+04	1.01E-03	2.27E-11	1.53E-05	1.76E-09	4.14E-08	1.02E-03
170	1.00E+04	9.43E-04	1.30E-11	2.68E-06	2.64E-07	2.50E-08	9.46E-04
283	1.00E+04	8.69E-04	8.71E-13	5.17E-06	1.16E-09	2.81E-08	8.74E-04
44	1.00E+04	8.29E-04	4.41E-13	1.84E-06	7.85E-08	1.07E-08	8.31E-04
268	1.00E+04	7.86E-04	4.05E-12	1.68E-05	1.92E-09	4.51E-08	8.03E-04
51	1.00E+04	7.30E-04	2.75E-12	9.48E-06	1.45E-09	3.41E-08	7.39E-04
173	1.00E+04	6.86E-04	5.72E-13	2.05E-06	3.19E-10	7.52E-09	6.88E-04

105	1.00E+04	6.81E-04	1.39E-12	3.53E-06	3.56E-07	3.93E-08	6.85E-04
150	1.00E+04	6.53E-04	4.11E-13	1.71E-06	6.11E-08	9.02E-09	6.55E-04
140	1.00E+04	6.00E-04	3.19E-12	4.31E-06	7.32E-10	1.72E-08	6.05E-04
136	1.00E+04	5.98E-04	5.05E-13	2.10E-06	7.79E-08	1.45E-08	6.01E-04
175	1.00E+04	5.41E-04	6.36E-12	1.12E-06	3.13E-10	7.34E-09	5.42E-04
89	1.00E+04	5.33E-04	3.08E-12	2.49E-06	3.37E-10	7.91E-09	5.35E-04
232	1.00E+04	5.14E-04	2.04E-13	8.66E-07	1.13E-07	8.56E-09	5.15E-04
272	1.00E+04	5.01E-04	6.05E-13	2.52E-06	6.30E-10	1.48E-08	5.03E-04
21	1.00E+04	4.93E-04	2.35E-12	9.77E-06	5.28E-10	1.24E-08	5.03E-04
117	1.00E+04	4.22E-04	1.66E-11	6.90E-05	4.55E-09	1.07E-07	4.91E-04
279	1.00E+04	4.75E-04	2.41E-12	1.00E-05	1.91E-09	4.48E-08	4.85E-04
11	1.00E+04	4.32E-04	1.92E-11	5.12E-05	5.27E-09	1.24E-07	4.83E-04
216	1.00E+04	4.64E-04	2.94E-12	8.94E-06	7.81E-10	1.84E-08	4.72E-04
32	1.00E+04	4.33E-04	1.09E-12	4.81E-06	3.49E-07	4.74E-08	4.38E-04
255	1.00E+04	4.14E-04	3.90E-12	1.62E-05	4.88E-07	2.03E-08	4.31E-04
242	1.00E+04	3.92E-04	1.46E-12	3.33E-06	7.26E-10	1.71E-08	3.96E-04
6	1.00E+04	3.83E-04	1.28E-12	4.75E-06	6.52E-10	1.53E-08	3.88E-04
139	1.00E+04	3.49E-04	7.44E-11	2.06E-05	4.71E-10	1.11E-08	3.70E-04
76	1.00E+04	3.51E-04	6.96E-13	2.17E-06	1.25E-07	1.47E-08	3.54E-04
207	1.00E+04	3.22E-04	4.72E-12	1.65E-05	4.37E-09	1.03E-07	3.39E-04
74	1.00E+04	3.16E-04	5.20E-12	2.04E-06	4.20E-10	9.86E-09	3.18E-04
281	1.00E+04	3.14E-04	3.47E-13	1.45E-06	9.73E-09	1.05E-08	3.15E-04
62	1.00E+04	2.89E-04	3.94E-12	8.83E-06	8.52E-10	2.00E-08	2.97E-04
241	1.00E+04	1.69E-04	4.39E-11	1.23E-04	1.05E-09	2.49E-08	2.92E-04
237	1.00E+04	2.76E-04	2.92E-13	8.72E-07	4.70E-10	1.10E-08	2.77E-04
201	1.00E+04	2.71E-04	8.37E-13	3.48E-06	4.59E-07	3.97E-08	2.75E-04
230	1.00E+04	2.55E-04	1.16E-12	4.82E-06	2.70E-06	5.89E-08	2.63E-04
258	1.00E+04	2.53E-04	8.21E-13	3.42E-06	7.65E-10	1.80E-08	2.57E-04
15	1.00E+04	2.38E-04	9.82E-13	4.09E-06	9.74E-08	8.44E-09	2.43E-04
96	1.00E+04	2.29E-04	2.02E-13	8.38E-07	2.50E-10	5.86E-09	2.30E-04
190	1.00E+04	2.18E-04	1.45E-11	1.44E-06	6.46E-08	9.82E-09	2.19E-04
114	1.00E+04	2.04E-04	3.19E-13	1.33E-06	3.29E-10	7.73E-09	2.05E-04
234	1.00E+04	2.01E-04	1.23E-12	7.67E-07	1.74E-08	5.67E-09	2.02E-04
97	1.00E+04	2.00E-04	1.72E-13	7.04E-07	2.47E-08	5.54E-09	2.01E-04
113	1.00E+04	1.67E-04	1.13E-12	4.71E-06	7.56E-08	1.05E-08	1.72E-04
103	1.00E+04	1.20E-04	2.87E-12	1.19E-05	7.51E-10	1.76E-08	1.32E-04
24	1.00E+04	1.20E-04	8.37E-13	3.54E-06	4.91E-10	1.16E-08	1.23E-04
85	1.00E+04	1.06E-04	6.93E-13	7.87E-07	2.58E-10	6.06E-09	1.06E-04
156	1.00E+04	9.51E-05	2.50E-12	7.19E-06	4.70E-08	4.69E-09	1.02E-04
157	1.00E+04	7.32E-05	2.30E-13	9.57E-07	3.80E-09	6.65E-09	7.42E-05
65	1.00E+04	7.00E-05	1.32E-12	2.32E-06	3.84E-08	1.10E-08	7.24E-05
42	1.00E+04	6.90E-05	2.74E-13	7.73E-07	3.72E-11	8.75E-10	6.98E-05
171	1.00E+04	6.18E-05	4.00E-12	2.41E-06	5.73E-10	1.35E-08	6.43E-05
273	1.00E+04	4.17E-05	2.18E-13	4.58E-07	3.36E-09	1.39E-09	4.21E-05
60	1.00E+04	9.65E-06	1.02E-13	4.25E-07	7.06E-12	1.66E-10	1.01E-05
224	1.00E+04	8.00E-06	1.16E-12	5.61E-08	3.08E-09	2.90E-10	8.06E-06
208	1.00E+04	4.14E-07	3.81E-13	1.11E-09	3.77E-13	8.87E-12	4.15E-07
115	1.00E+04	2.71E-07	1.04E-15	4.32E-09	4.52E-13	1.06E-11	2.75E-07
83	1.00E+04	1.86E-07	1.30E-11	1.01E-09	1.46E-13	1.34E-12	1.87E-07
1	1.00E+04	7.38E-08	9.37E-12	6.59E-10	3.96E-11	4.94E-12	7.46E-08

101	1.00E+04	1.19E-08	3.87E-12	1.97E-11	3.06E-12	1.13E-14	1.19E-08
45	1.00E+04	1.19E-08	2.02E-12	3.54E-12	3.89E-15	6.24E-15	1.19E-08
296	1.00E+04	9.32E-09	2.22E-11	2.51E-11	1.34E-12	2.17E-14	9.37E-09
75	1.00E+04	9.29E-09	5.19E-12	8.84E-12	1.26E-12	1.19E-14	9.30E-09
53	1.00E+04	6.19E-09	1.98E-11	1.63E-11	1.72E-15	2.99E-15	6.23E-09
3	1.00E+04	4.28E-09	4.19E-12	7.16E-12	3.54E-12	2.10E-14	4.29E-09
259	1.00E+04	3.63E-09	2.29E-12	6.43E-12	5.34E-13	1.05E-14	3.64E-09
107	1.00E+04	2.99E-09	2.40E-10	2.60E-10	4.37E-15	1.07E-14	3.49E-09
122	1.00E+04	2.90E-09	6.14E-12	8.20E-12	3.69E-15	1.35E-14	2.91E-09
298	1.00E+04	2.08E-09	2.66E-11	6.96E-11	4.60E-15	2.54E-14	2.17E-09
164	1.00E+04	2.08E-09	3.67E-12	6.16E-12	1.66E-12	4.98E-15	2.09E-09
264	1.00E+04	1.66E-09	4.09E-12	5.07E-12	1.54E-13	5.87E-15	1.67E-09
197	1.00E+04	1.24E-09	7.10E-12	1.00E-11	1.06E-12	1.38E-14	1.26E-09
271	1.00E+04	1.24E-09	1.70E-12	3.19E-12	2.67E-14	9.57E-15	1.25E-09
263	1.00E+04	1.04E-09	3.95E-11	8.95E-11	1.19E-15	5.56E-15	1.17E-09
192	1.00E+04	1.13E-09	8.42E-13	6.35E-13	4.59E-16	2.80E-16	1.13E-09
160	1.00E+04	9.54E-10	2.44E-12	3.17E-12	4.57E-13	3.19E-15	9.60E-10
123	1.00E+04	9.44E-10	1.13E-13	6.62E-12	3.69E-13	1.48E-14	9.51E-10
248	1.00E+04	8.89E-10	2.58E-12	9.54E-12	9.69E-16	3.72E-15	9.01E-10
297	1.00E+04	8.62E-10	1.18E-11	2.48E-11	3.56E-15	1.62E-14	8.99E-10
158	1.00E+04	8.25E-10	1.49E-11	1.35E-11	1.04E-15	2.05E-15	8.53E-10
80	1.00E+04	5.13E-10	1.06E-11	6.64E-12	7.61E-17	8.63E-17	5.30E-10
132	1.00E+04	5.19E-10	5.23E-13	1.01E-12	1.80E-16	7.80E-16	5.20E-10
86	1.00E+04	4.78E-10	3.23E-12	3.26E-12	8.68E-16	2.11E-15	4.85E-10
186	1.00E+04	4.73E-10	2.06E-12	2.04E-12	6.19E-16	1.80E-15	4.77E-10
79	1.00E+04	3.57E-10	3.85E-12	5.56E-12	8.57E-16	2.83E-15	3.67E-10
106	1.00E+04	3.13E-10	7.31E-12	7.46E-12	4.61E-13	1.78E-15	3.29E-10
277	1.00E+04	3.01E-10	6.95E-13	7.48E-13	2.91E-14	5.28E-16	3.02E-10
176	1.00E+04	2.71E-10	2.54E-13	1.18E-11	1.67E-15	1.42E-14	2.83E-10
46	1.00E+04	2.20E-10	2.32E-12	3.54E-12	1.54E-15	6.81E-15	2.25E-10
212	1.00E+04	2.21E-10	1.39E-12	1.71E-12	6.63E-14	1.59E-15	2.24E-10
274	1.00E+04	1.86E-10	1.31E-12	1.04E-12	1.45E-16	2.89E-16	1.89E-10
254	1.00E+04	1.51E-10	9.05E-13	1.11E-12	1.67E-16	4.60E-16	1.53E-10
56	1.00E+04	1.20E-10	2.15E-13	3.46E-13	1.29E-15	5.79E-16	1.20E-10
155	1.00E+04	9.87E-11	1.06E-13	1.04E-13	1.89E-14	9.05E-17	9.89E-11
151	1.00E+04	7.81E-11	1.23E-12	7.70E-13	5.34E-17	6.05E-17	8.01E-11
59	1.00E+04	4.88E-11	4.12E-13	3.23E-13	7.83E-17	1.19E-16	4.95E-11
58	1.00E+04	1.95E-11	5.78E-13	4.18E-13	4.55E-17	8.27E-17	2.05E-11
129	1.00E+04	1.72E-11	1.81E-14	2.95E-14	1.93E-15	7.98E-17	1.72E-11
61	1.00E+04	1.45E-11	5.94E-13	3.71E-13	2.62E-17	2.97E-17	1.55E-11
5	1.00E+04	1.47E-11	1.70E-13	1.06E-13	3.76E-15	3.44E-17	1.50E-11
257	1.00E+04	6.57E-12	1.06E-13	6.62E-14	3.80E-18	4.31E-18	6.75E-12
247	1.00E+04	4.47E-12	1.58E-14	9.86E-15	2.27E-18	2.57E-18	4.49E-12
137	1.00E+04	2.07E-12	2.23E-14	1.39E-14	5.67E-18	6.42E-18	2.11E-12
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.20 S6T4000

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
128	1.00E+04	1.34E-01	6.83E-14	6.57E-01	2.05E-05	1.28E-03	7.92E-01
111	1.00E+04	2.35E-01	1.81E-15	3.39E-01	5.55E-05	3.08E-03	5.78E-01
266	1.00E+04	6.46E-02	4.47E-16	1.45E-01	1.06E-05	7.24E-04	2.10E-01
236	1.00E+04	1.39E-01	6.14E-16	5.38E-02	7.30E-06	3.37E-04	1.94E-01
228	1.00E+04	1.60E-01	6.36E-16	3.18E-02	6.62E-06	2.94E-04	1.93E-01
256	1.00E+04	1.32E-01	2.38E-16	2.31E-02	2.15E-03	3.72E-04	1.58E-01
9	1.00E+04	1.35E-01	1.74E-16	1.77E-02	3.42E-04	4.44E-04	1.53E-01
19	1.00E+04	1.18E-01	5.12E-16	2.95E-02	4.25E-06	1.90E-04	1.48E-01
23	1.00E+04	3.44E-02	-4.23E-11	1.06E-01	3.17E-03	1.85E-03	1.45E-01
287	1.00E+04	1.17E-01	2.11E-16	8.66E-03	6.27E-04	1.53E-04	1.27E-01
141	1.00E+04	3.40E-02	3.96E-19	8.33E-02	1.52E-05	1.03E-03	1.18E-01
87	1.00E+04	7.16E-02	7.74E-16	2.85E-02	1.88E-06	8.10E-05	1.00E-01
64	1.00E+04	8.78E-02	4.84E-17	1.10E-02	8.23E-06	5.00E-04	9.94E-02
181	1.00E+04	6.40E-02	2.24E-16	3.28E-02	4.08E-06	2.23E-04	9.70E-02
52	1.00E+04	7.01E-02	1.58E-16	1.55E-02	4.89E-04	1.84E-04	8.63E-02
50	1.00E+04	6.65E-02	3.42E-16	1.05E-02	1.57E-06	6.75E-05	7.70E-02
217	1.00E+04	6.88E-02	1.13E-16	7.28E-03	6.71E-05	1.04E-04	7.63E-02
25	1.00E+04	4.09E-02	4.10E-17	3.37E-02	1.07E-05	7.44E-04	7.53E-02

177	1.00E+04	5.92E-02	9.37E-17	8.19E-03	1.06E-04	8.93E-05	6.76E-02
72	1.00E+04	1.97E-02	3.13E-19	4.64E-02	4.68E-06	3.18E-04	6.65E-02
260	1.00E+04	2.32E-02	1.54E-15	4.08E-02	2.83E-06	1.97E-04	6.43E-02
90	1.00E+04	6.11E-02	9.66E-17	2.85E-03	1.87E-04	3.94E-05	6.42E-02
130	1.00E+04	4.02E-02	4.35E-16	2.27E-02	2.98E-04	5.64E-05	6.33E-02
290	1.00E+04	4.59E-02	8.98E-17	1.15E-02	1.88E-06	9.91E-05	5.75E-02
265	1.00E+04	4.78E-02	1.12E-16	3.19E-03	4.91E-07	2.10E-05	5.10E-02
253	1.00E+04	3.95E-02	1.68E-16	5.06E-03	3.74E-07	1.60E-05	4.46E-02
124	1.00E+04	3.32E-02	2.62E-17	9.76E-03	8.86E-04	2.39E-04	4.41E-02
285	1.00E+04	4.04E-02	8.71E-17	2.46E-03	7.97E-05	3.07E-05	4.30E-02
240	1.00E+04	2.18E-02	7.14E-16	1.99E-02	4.19E-07	1.79E-05	4.16E-02
82	1.00E+04	3.74E-02	1.47E-16	4.14E-03	2.05E-05	2.66E-05	4.16E-02
7	1.00E+04	1.87E-02	3.69E-16	2.11E-02	5.74E-07	2.64E-05	3.98E-02
77	1.00E+04	3.17E-02	6.72E-17	1.88E-03	9.19E-05	1.81E-05	3.37E-02
243	1.00E+04	2.33E-02	8.61E-17	8.48E-03	9.55E-07	6.19E-05	3.19E-02
14	1.00E+04	2.93E-02	2.18E-17	7.80E-04	2.21E-07	9.53E-06	3.01E-02
221	1.00E+04	1.19E-02	4.34E-17	1.63E-02	1.50E-06	1.08E-04	2.83E-02
280	1.00E+04	2.26E-02	2.21E-17	4.53E-03	6.17E-04	1.29E-04	2.79E-02
102	1.00E+04	2.36E-02	1.44E-16	4.01E-03	3.62E-07	1.55E-05	2.76E-02
245	1.00E+04	1.90E-02	1.45E-16	3.17E-03	3.66E-05	9.24E-06	2.22E-02
147	1.00E+04	1.65E-02	9.57E-17	4.92E-03	4.75E-07	2.13E-05	2.14E-02
183	1.00E+04	2.04E-02	1.86E-17	5.22E-04	2.43E-05	7.30E-06	2.09E-02
125	1.00E+04	1.92E-02	3.27E-17	8.88E-04	2.58E-07	1.10E-05	2.01E-02
166	1.00E+04	1.87E-02	2.10E-17	5.86E-04	6.68E-06	9.10E-06	1.93E-02
93	1.00E+04	1.85E-02	1.90E-17	5.28E-04	7.71E-06	1.26E-05	1.90E-02
152	1.00E+04	1.71E-02	3.13E-17	8.72E-04	3.21E-07	1.37E-05	1.79E-02
110	1.00E+04	1.60E-02	5.78E-17	1.61E-03	1.88E-07	8.06E-06	1.76E-02
81	1.00E+04	1.59E-02	3.85E-17	1.19E-03	1.93E-07	8.29E-06	1.71E-02
92	1.00E+04	1.18E-02	1.33E-16	3.68E-03	1.11E-04	7.33E-06	1.56E-02
154	1.00E+04	1.38E-02	5.77E-17	1.63E-03	2.57E-07	1.10E-05	1.54E-02
100	1.00E+04	1.32E-02	7.49E-17	2.14E-03	1.66E-07	7.10E-06	1.54E-02
267	1.00E+04	1.16E-02	2.41E-17	3.06E-03	4.97E-04	3.07E-05	1.52E-02
184	1.00E+04	1.11E-02	1.42E-16	3.95E-03	1.09E-07	4.68E-06	1.50E-02
262	1.00E+04	1.45E-02	6.58E-18	1.94E-04	2.97E-05	3.46E-06	1.47E-02
98	1.00E+04	1.42E-02	8.70E-18	2.44E-04	8.78E-05	2.94E-06	1.46E-02
235	1.00E+04	1.19E-02	8.62E-17	2.50E-03	2.19E-05	9.53E-06	1.44E-02
126	1.00E+04	1.38E-02	1.03E-17	2.71E-04	1.49E-05	7.40E-06	1.40E-02
40	1.00E+04	8.49E-03	7.34E-17	4.42E-03	2.39E-07	1.09E-05	1.29E-02
222	1.00E+04	5.06E-03	1.39E-17	6.71E-03	6.06E-07	3.96E-05	1.18E-02
204	1.00E+04	8.76E-03	1.53E-17	2.92E-03	4.89E-07	2.96E-05	1.17E-02
108	1.00E+04	1.05E-02	3.07E-17	1.09E-03	7.71E-08	3.33E-06	1.16E-02
153	1.00E+04	1.03E-02	1.18E-17	7.53E-04	5.34E-05	1.36E-05	1.11E-02
284	1.00E+04	8.11E-03	7.20E-17	2.00E-03	1.28E-07	5.47E-06	1.01E-02
276	1.00E+04	7.70E-03	4.36E-17	2.18E-03	9.17E-08	4.02E-06	9.88E-03
27	1.00E+04	6.15E-03	1.10E-16	3.05E-03	6.59E-08	2.82E-06	9.21E-03
145	1.00E+04	8.18E-03	3.50E-17	9.67E-04	2.39E-05	4.75E-06	9.18E-03
238	1.00E+04	6.86E-03	3.89E-17	1.42E-03	1.22E-05	2.83E-06	8.30E-03
205	1.00E+04	6.11E-03	7.82E-18	2.26E-04	2.89E-08	1.24E-06	6.34E-03
142	1.00E+04	5.82E-03	5.94E-18	1.65E-04	3.54E-05	5.23E-06	6.03E-03
163	1.00E+04	5.59E-03	8.46E-18	2.35E-04	2.75E-06	3.25E-06	5.83E-03

191	1.00E+04	4.79E-03	5.67E-18	8.50E-04	3.20E-05	1.58E-05	5.69E-03
28	1.00E+04	5.18E-03	6.07E-18	1.69E-04	1.45E-04	2.37E-06	5.49E-03
225	1.00E+04	3.02E-03	3.93E-18	2.16E-03	4.52E-07	3.27E-05	5.21E-03
188	1.00E+04	5.04E-03	2.49E-18	6.61E-05	9.61E-08	8.23E-07	5.11E-03
13	1.00E+04	4.67E-03	9.72E-18	3.78E-04	2.35E-05	3.80E-06	5.08E-03
41	1.00E+04	4.00E-03	3.93E-18	6.38E-04	6.30E-05	1.68E-05	4.72E-03
227	1.00E+04	4.42E-03	5.41E-18	1.50E-04	7.10E-06	1.36E-06	4.58E-03
99	1.00E+04	3.42E-03	2.06E-18	9.61E-04	4.46E-07	3.23E-05	4.41E-03
135	1.00E+04	3.90E-03	7.62E-18	3.27E-04	2.11E-05	3.26E-06	4.25E-03
215	1.00E+04	2.96E-03	-1.35E-12	1.17E-03	7.59E-06	1.16E-06	4.14E-03
131	1.00E+04	3.96E-03	3.50E-18	1.34E-04	2.27E-06	1.61E-06	4.09E-03
34	1.00E+04	3.72E-03	9.52E-18	3.66E-04	4.97E-08	2.16E-06	4.09E-03
229	1.00E+04	3.81E-03	2.89E-18	1.49E-04	7.04E-06	2.34E-06	3.97E-03
88	1.00E+04	2.95E-03	2.04E-17	6.45E-04	2.82E-06	1.90E-06	3.60E-03
278	1.00E+04	2.57E-03	1.97E-20	4.63E-04	5.26E-05	2.06E-05	3.10E-03
148	1.00E+04	2.74E-03	3.81E-18	2.25E-04	2.59E-06	3.01E-06	2.97E-03
109	1.00E+04	2.48E-03	9.78E-18	2.68E-04	3.58E-08	1.53E-06	2.75E-03
252	1.00E+04	2.10E-03	1.08E-17	3.99E-04	9.97E-07	1.77E-06	2.50E-03
71	1.00E+04	2.28E-03	7.43E-19	2.07E-05	6.50E-06	6.34E-07	2.31E-03
251	1.00E+04	1.75E-03	7.95E-18	5.25E-04	2.06E-05	2.30E-06	2.30E-03
195	1.00E+04	1.99E-03	5.25E-18	1.44E-04	2.91E-08	1.24E-06	2.13E-03
35	1.00E+04	1.96E-03	8.39E-18	9.65E-05	2.06E-08	8.83E-07	2.06E-03
66	1.00E+04	1.92E-03	7.85E-19	2.49E-05	1.07E-08	4.58E-07	1.94E-03
300	1.00E+04	1.90E-03	8.97E-19	2.49E-05	2.40E-06	3.10E-07	1.93E-03
104	1.00E+04	1.88E-03	7.82E-19	2.16E-05	5.61E-07	3.07E-07	1.91E-03
69	1.00E+04	1.11E-03	2.16E-17	6.00E-04	1.28E-08	5.46E-07	1.71E-03
202	1.00E+04	1.53E-03	2.74E-18	7.95E-05	2.79E-06	1.30E-06	1.62E-03
68	1.00E+04	1.56E-03	1.51E-18	3.86E-05	8.23E-07	4.57E-07	1.60E-03
48	1.00E+04	1.54E-03	1.02E-18	4.07E-05	1.35E-08	5.85E-07	1.58E-03
161	1.00E+04	1.38E-03	1.76E-18	4.32E-05	7.63E-09	3.27E-07	1.42E-03
269	1.00E+04	1.39E-03	7.81E-19	1.12E-05	6.25E-07	2.27E-07	1.40E-03
43	1.00E+04	1.32E-03	8.34E-19	2.32E-05	1.28E-06	6.11E-07	1.34E-03
174	1.00E+04	1.30E-03	5.53E-19	2.03E-05	4.00E-06	5.45E-07	1.32E-03
39	1.00E+04	1.05E-03	-7.15E-11	8.68E-05	8.35E-06	4.16E-06	1.15E-03
120	1.00E+04	1.00E-03	1.14E-18	3.07E-05	4.65E-09	1.99E-07	1.03E-03
63	1.00E+04	9.20E-04	3.21E-18	8.91E-05	1.28E-08	5.46E-07	1.01E-03
95	1.00E+04	8.87E-04	2.23E-18	5.88E-05	4.17E-09	1.78E-07	9.46E-04
198	1.00E+04	8.40E-04	2.82E-18	7.49E-05	1.31E-06	6.86E-07	9.17E-04
144	1.00E+04	7.10E-04	3.90E-18	1.45E-04	7.29E-07	4.90E-07	8.57E-04
12	1.00E+04	8.21E-04	1.09E-18	3.02E-05	1.54E-06	5.66E-07	8.54E-04
112	1.00E+04	8.19E-04	5.75E-19	1.60E-05	9.73E-08	1.78E-07	8.36E-04
250	1.00E+04	7.99E-04	6.25E-19	1.85E-05	4.42E-06	2.81E-07	8.22E-04
179	1.00E+04	5.73E-04	6.54E-18	1.82E-04	6.25E-09	2.67E-07	7.55E-04
196	1.00E+04	7.20E-04	1.46E-19	3.82E-06	2.75E-09	1.18E-07	7.24E-04
193	1.00E+04	6.96E-04	1.91E-18	2.27E-05	2.03E-06	3.85E-07	7.21E-04
167	1.00E+04	6.68E-04	7.27E-19	2.67E-05	9.95E-07	2.88E-07	6.96E-04
169	1.00E+04	2.79E-04	4.82E-17	4.10E-04	2.62E-09	1.12E-07	6.89E-04
84	1.00E+04	6.57E-04	9.45E-19	2.00E-05	1.02E-06	1.80E-07	6.79E-04
246	1.00E+04	6.59E-04	4.63E-19	1.82E-05	5.85E-09	2.53E-07	6.77E-04
261	1.00E+04	6.20E-04	1.36E-18	3.79E-05	6.93E-09	2.97E-07	6.58E-04

165	1.00E+04	4.89E-04	4.31E-19	5.30E-05	7.65E-05	1.79E-06	6.20E-04
231	1.00E+04	6.03E-04	5.68E-19	1.58E-05	7.09E-09	3.03E-07	6.20E-04
218	1.00E+04	6.09E-04	2.45E-19	6.83E-06	2.65E-07	1.00E-07	6.16E-04
134	1.00E+04	5.93E-04	3.70E-19	1.03E-05	7.65E-07	1.85E-07	6.04E-04
116	1.00E+04	5.63E-04	1.06E-18	1.86E-05	5.87E-06	2.75E-07	5.88E-04
121	1.00E+04	5.32E-04	1.57E-18	3.18E-05	8.83E-07	2.81E-07	5.65E-04
213	1.00E+04	5.25E-04	6.25E-19	8.76E-06	9.16E-08	1.38E-07	5.34E-04
78	1.00E+04	5.13E-04	2.62E-19	7.28E-06	5.56E-07	2.06E-07	5.22E-04
194	1.00E+04	3.71E-04	5.05E-18	1.31E-04	2.81E-09	1.21E-07	5.01E-04
49	1.00E+04	4.35E-04	1.40E-18	5.55E-05	6.59E-09	2.85E-07	4.91E-04
119	1.00E+04	4.57E-04	5.52E-19	2.11E-05	8.36E-09	3.62E-07	4.78E-04
189	1.00E+04	4.15E-04	8.78E-19	2.44E-05	4.97E-09	2.12E-07	4.39E-04
249	1.00E+04	3.87E-04	2.32E-18	4.05E-05	4.61E-09	1.97E-07	4.27E-04
8	1.00E+04	3.91E-04	6.60E-19	1.84E-05	2.98E-09	1.27E-07	4.09E-04
214	1.00E+04	4.02E-04	2.51E-19	5.38E-06	6.44E-07	1.27E-07	4.08E-04
289	1.00E+04	3.92E-04	3.34E-18	1.50E-05	1.74E-09	7.44E-08	4.07E-04
73	1.00E+04	3.91E-04	4.05E-19	1.11E-05	9.48E-07	1.58E-07	4.03E-04
54	1.00E+04	3.60E-04	7.73E-19	2.15E-05	6.05E-06	1.90E-07	3.88E-04
33	1.00E+04	3.69E-04	8.13E-19	1.60E-05	1.32E-06	2.45E-07	3.86E-04
118	1.00E+04	3.54E-04	1.16E-18	3.02E-05	3.65E-09	1.56E-07	3.84E-04
117	1.00E+04	3.01E-04	2.43E-18	6.76E-05	4.49E-09	1.92E-07	3.69E-04
11	1.00E+04	3.08E-04	2.82E-18	5.01E-05	5.21E-09	2.23E-07	3.59E-04
270	1.00E+04	3.44E-04	2.26E-19	3.77E-06	2.67E-07	1.08E-07	3.48E-04
31	1.00E+04	3.28E-04	2.08E-19	2.98E-06	7.76E-08	6.35E-08	3.31E-04
275	1.00E+04	2.93E-04	1.21E-18	2.91E-05	3.84E-09	1.64E-07	3.22E-04
138	1.00E+04	3.08E-04	3.17E-19	8.83E-06	5.51E-07	1.36E-07	3.17E-04
182	1.00E+04	3.07E-04	9.93E-20	2.76E-06	2.45E-07	8.93E-08	3.10E-04
294	1.00E+04	3.05E-04	1.16E-19	3.23E-06	2.82E-07	5.14E-08	3.09E-04
226	1.00E+04	2.59E-04	8.37E-19	2.33E-05	2.77E-09	1.18E-07	2.83E-04
180	1.00E+04	2.69E-04	3.47E-19	9.64E-06	2.48E-07	8.59E-08	2.79E-04
159	1.00E+04	2.60E-04	4.77E-19	1.29E-05	3.02E-09	1.29E-07	2.73E-04
203	1.00E+04	2.44E-04	8.78E-19	2.44E-05	1.59E-06	1.45E-07	2.70E-04
2	1.00E+04	2.55E-04	3.71E-19	1.03E-05	2.37E-09	1.01E-07	2.65E-04
282	1.00E+04	2.54E-04	2.36E-19	6.49E-06	4.21E-09	1.80E-07	2.61E-04
295	1.00E+04	2.45E-04	7.53E-19	8.20E-06	3.55E-07	1.18E-07	2.53E-04
16	1.00E+04	1.60E-04	6.58E-18	8.94E-05	6.95E-07	8.89E-08	2.50E-04
207	1.00E+04	2.30E-04	6.92E-19	1.62E-05	4.31E-09	1.85E-07	2.46E-04
143	1.00E+04	2.36E-04	4.32E-19	9.71E-06	1.88E-09	8.05E-08	2.46E-04
211	1.00E+04	2.37E-04	2.58E-19	7.09E-06	3.97E-07	9.83E-08	2.45E-04
299	1.00E+04	2.34E-04	1.91E-19	5.30E-06	1.02E-07	1.11E-07	2.39E-04
127	1.00E+04	2.33E-04	1.57E-19	4.36E-06	9.26E-07	1.33E-07	2.39E-04
30	1.00E+04	2.22E-04	1.57E-19	3.11E-06	1.15E-07	8.59E-08	2.26E-04
51	1.00E+04	2.13E-04	4.04E-19	9.30E-06	1.43E-09	6.13E-08	2.22E-04
105	1.00E+04	2.07E-04	2.04E-19	3.46E-06	3.52E-07	7.07E-08	2.10E-04
220	1.00E+04	1.16E-04	3.87E-18	8.98E-05	1.45E-09	6.19E-08	2.05E-04
241	1.00E+04	8.29E-05	6.45E-18	1.21E-04	1.04E-09	4.46E-08	2.04E-04
94	1.00E+04	1.63E-04	1.26E-18	3.51E-05	2.48E-09	1.06E-07	1.98E-04
201	1.00E+04	1.94E-04	1.23E-19	3.41E-06	4.53E-07	7.13E-08	1.98E-04
230	1.00E+04	1.82E-04	1.71E-19	4.73E-06	2.67E-06	1.06E-07	1.90E-04
279	1.00E+04	1.76E-04	3.53E-19	9.82E-06	1.88E-09	8.06E-08	1.85E-04

293	1.00E+04	1.58E-04	1.75E-18	1.71E-05	2.85E-07	1.67E-07	1.76E-04
6	1.00E+04	1.69E-04	1.88E-19	4.65E-06	6.44E-10	2.76E-08	1.74E-04
17	1.00E+04	1.67E-04	2.48E-19	5.48E-06	2.54E-07	8.20E-08	1.72E-04
91	1.00E+04	1.60E-04	1.47E-19	3.70E-06	8.72E-07	7.81E-08	1.65E-04
136	1.00E+04	1.59E-04	7.40E-20	2.06E-06	7.70E-08	2.60E-08	1.61E-04
268	1.00E+04	1.43E-04	5.93E-19	1.65E-05	1.90E-09	8.12E-08	1.60E-04
32	1.00E+04	1.48E-04	1.59E-19	4.72E-06	3.44E-07	8.47E-08	1.54E-04
199	1.00E+04	1.29E-04	9.92E-19	1.03E-05	1.67E-09	7.15E-08	1.40E-04
139	1.00E+04	1.19E-04	1.10E-17	2.02E-05	4.66E-10	1.99E-08	1.39E-04
172	1.00E+04	1.32E-04	1.67E-19	4.64E-06	2.13E-07	6.20E-08	1.37E-04
233	1.00E+04	1.09E-04	1.34E-19	3.73E-06	3.18E-06	7.23E-08	1.16E-04
185	1.00E+04	1.07E-04	2.94E-19	8.12E-06	1.16E-09	4.97E-08	1.15E-04
57	1.00E+04	1.04E-04	9.56E-20	2.60E-06	3.96E-10	1.69E-08	1.06E-04
216	1.00E+04	8.97E-05	4.32E-19	8.76E-06	7.72E-10	3.30E-08	9.85E-05
170	1.00E+04	9.30E-05	1.92E-18	2.63E-06	2.61E-07	4.50E-08	9.59E-05
190	1.00E+04	9.09E-05	2.15E-18	1.42E-06	6.39E-08	1.77E-08	9.24E-05
89	1.00E+04	8.72E-05	4.54E-19	2.44E-06	3.33E-10	1.42E-08	8.96E-05
210	1.00E+04	8.45E-05	9.82E-20	2.49E-06	9.26E-08	2.61E-08	8.71E-05
76	1.00E+04	8.10E-05	1.02E-19	2.13E-06	1.23E-07	2.64E-08	8.33E-05
29	1.00E+04	7.96E-05	8.48E-20	2.36E-06	6.61E-07	3.86E-08	8.26E-05
24	1.00E+04	7.64E-05	1.23E-19	3.47E-06	4.85E-10	2.08E-08	7.99E-05
255	1.00E+04	5.84E-05	5.71E-19	1.59E-05	4.82E-07	3.64E-08	7.48E-05
103	1.00E+04	5.75E-05	4.20E-19	1.17E-05	7.42E-10	3.17E-08	6.93E-05
21	1.00E+04	5.73E-05	3.44E-19	9.58E-06	5.22E-10	2.23E-08	6.69E-05
232	1.00E+04	6.32E-05	2.98E-20	8.49E-07	1.12E-07	1.54E-08	6.41E-05
140	1.00E+04	5.98E-05	4.71E-19	4.23E-06	7.23E-10	3.09E-08	6.40E-05
200	1.00E+04	5.57E-05	1.32E-18	5.78E-06	1.61E-09	7.10E-08	6.16E-05
113	1.00E+04	5.50E-05	1.66E-19	4.61E-06	7.47E-08	1.89E-08	5.97E-05
156	1.00E+04	5.17E-05	3.67E-19	7.04E-06	4.64E-08	8.44E-09	5.88E-05
242	1.00E+04	5.38E-05	2.14E-19	3.26E-06	7.17E-10	3.07E-08	5.71E-05
157	1.00E+04	5.23E-05	3.37E-20	9.38E-07	3.75E-09	1.20E-08	5.32E-05
65	1.00E+04	5.00E-05	1.95E-19	2.28E-06	3.79E-08	1.97E-08	5.23E-05
258	1.00E+04	4.81E-05	1.20E-19	3.35E-06	7.56E-10	3.23E-08	5.15E-05
62	1.00E+04	4.26E-05	5.79E-19	8.66E-06	8.42E-10	3.60E-08	5.13E-05
283	1.00E+04	4.59E-05	1.28E-19	5.07E-06	1.14E-09	4.97E-08	5.10E-05
15	1.00E+04	4.38E-05	1.44E-19	4.01E-06	9.63E-08	1.52E-08	4.79E-05
171	1.00E+04	4.41E-05	5.89E-19	2.36E-06	5.67E-10	2.42E-08	4.65E-05
272	1.00E+04	4.21E-05	8.88E-20	2.47E-06	6.22E-10	2.66E-08	4.46E-05
114	1.00E+04	4.12E-05	4.68E-20	1.30E-06	3.25E-10	1.39E-08	4.25E-05
74	1.00E+04	4.05E-05	7.67E-19	2.00E-06	4.15E-10	1.77E-08	4.25E-05
237	1.00E+04	4.14E-05	4.29E-20	8.54E-07	4.64E-10	1.99E-08	4.23E-05
281	1.00E+04	3.86E-05	5.09E-20	1.42E-06	9.62E-09	1.89E-08	4.00E-05
44	1.00E+04	3.71E-05	6.47E-20	1.80E-06	7.75E-08	1.92E-08	3.90E-05
150	1.00E+04	3.38E-05	6.03E-20	1.68E-06	6.04E-08	1.62E-08	3.56E-05
173	1.00E+04	3.30E-05	8.38E-20	2.01E-06	3.16E-10	1.35E-08	3.51E-05
234	1.00E+04	3.08E-05	1.81E-19	7.52E-07	1.72E-08	1.02E-08	3.16E-05
175	1.00E+04	2.43E-05	9.33E-19	1.10E-06	3.09E-10	1.32E-08	2.54E-05
96	1.00E+04	2.10E-05	2.95E-20	8.22E-07	2.47E-10	1.05E-08	2.18E-05
97	1.00E+04	2.04E-05	2.52E-20	6.91E-07	2.44E-08	9.97E-09	2.11E-05
85	1.00E+04	1.94E-05	1.02E-19	7.71E-07	2.55E-10	1.09E-08	2.02E-05

273	1.00E+04	1.51E-05	3.20E-20	4.49E-07	3.32E-09	2.51E-09	1.56E-05
42	1.00E+04	8.47E-06	4.03E-20	7.58E-07	3.68E-11	1.57E-09	9.23E-06
224	1.00E+04	7.93E-07	1.71E-19	5.50E-08	3.04E-09	5.22E-10	8.51E-07
60	1.00E+04	4.32E-07	1.50E-20	4.17E-07	6.98E-12	2.98E-10	8.49E-07
83	1.00E+04	1.75E-07	1.90E-18	9.90E-10	1.44E-13	4.41E-12	1.76E-07
115	1.00E+04	1.13E-07	1.52E-22	4.23E-09	4.47E-13	1.91E-11	1.17E-07
208	1.00E+04	9.78E-08	5.63E-20	1.09E-09	3.73E-13	1.60E-11	9.89E-08
1	1.00E+04	3.21E-08	1.38E-18	6.46E-10	3.92E-11	8.95E-12	3.28E-08
101	1.00E+04	9.70E-09	5.68E-19	1.93E-11	3.09E-12	6.85E-14	9.72E-09
296	1.00E+04	9.05E-09	3.27E-18	2.46E-11	1.46E-12	2.02E-13	9.08E-09
75	1.00E+04	7.07E-09	7.65E-19	8.67E-12	1.33E-12	9.30E-14	7.08E-09
53	1.00E+04	6.04E-09	2.93E-18	1.60E-11	1.95E-15	4.68E-14	6.06E-09
3	1.00E+04	4.13E-09	6.18E-19	7.02E-12	3.73E-12	1.37E-13	4.14E-09
45	1.00E+04	3.56E-09	2.98E-19	3.47E-12	4.09E-15	3.99E-14	3.56E-09
107	1.00E+04	2.92E-09	3.54E-17	2.56E-10	4.79E-15	1.18E-13	3.17E-09
122	1.00E+04	2.81E-09	9.06E-19	8.05E-12	3.96E-15	1.01E-13	2.82E-09
259	1.00E+04	2.67E-09	3.38E-19	6.30E-12	5.48E-13	5.08E-14	2.68E-09
298	1.00E+04	1.99E-09	3.92E-18	6.82E-11	4.73E-15	1.29E-13	2.06E-09
164	1.00E+04	2.02E-09	5.40E-19	6.04E-12	1.75E-12	4.08E-14	2.02E-09
264	1.00E+04	1.59E-09	6.04E-19	4.97E-12	1.66E-13	4.90E-14	1.59E-09
197	1.00E+04	1.21E-09	1.05E-18	9.85E-12	1.13E-12	1.14E-13	1.22E-09
271	1.00E+04	1.20E-09	2.51E-19	3.13E-12	2.80E-14	6.24E-14	1.21E-09
263	1.00E+04	1.00E-09	5.82E-18	8.77E-11	1.23E-15	3.27E-14	1.09E-09
160	1.00E+04	9.26E-10	3.60E-19	3.11E-12	4.92E-13	2.63E-14	9.30E-10
123	1.00E+04	8.89E-10	1.65E-20	6.48E-12	3.65E-13	5.00E-14	8.96E-10
248	1.00E+04	8.62E-10	3.80E-19	9.35E-12	9.85E-16	2.55E-14	8.71E-10
297	1.00E+04	8.32E-10	1.74E-18	2.43E-11	3.71E-15	9.79E-14	8.57E-10
192	1.00E+04	8.20E-10	1.24E-19	6.24E-13	5.28E-16	3.98E-15	8.20E-10
158	1.00E+04	8.05E-10	2.21E-18	1.33E-11	1.17E-15	2.83E-14	8.18E-10
80	1.00E+04	5.02E-10	1.57E-18	6.54E-12	9.06E-17	2.13E-15	5.08E-10
132	1.00E+04	4.99E-10	7.72E-20	9.92E-13	1.88E-16	4.93E-15	5.00E-10
86	1.00E+04	4.66E-10	4.77E-19	3.20E-12	9.58E-16	2.35E-14	4.69E-10
186	1.00E+04	4.60E-10	3.05E-19	2.00E-12	6.85E-16	1.71E-14	4.62E-10
79	1.00E+04	3.47E-10	5.67E-19	5.46E-12	9.14E-16	2.31E-14	3.52E-10
106	1.00E+04	3.04E-10	1.08E-18	7.32E-12	5.08E-13	1.61E-14	3.12E-10
277	1.00E+04	2.90E-10	-1.56E-12	7.29E-13	3.88E-14	7.81E-15	2.89E-10
176	1.00E+04	2.56E-10	3.72E-20	1.16E-11	1.65E-15	4.94E-14	2.67E-10
212	1.00E+04	2.14E-10	2.05E-19	1.68E-12	7.17E-14	1.46E-14	2.16E-10
46	1.00E+04	2.12E-10	3.42E-19	3.47E-12	1.64E-15	4.30E-14	2.15E-10
274	1.00E+04	1.82E-10	1.93E-19	1.02E-12	1.65E-16	4.00E-15	1.83E-10
254	1.00E+04	1.47E-10	1.34E-19	1.09E-12	1.81E-16	4.49E-15	1.48E-10
56	1.00E+04	1.16E-10	3.18E-20	3.39E-13	1.36E-15	4.10E-15	1.16E-10
155	1.00E+04	9.63E-11	1.56E-20	1.02E-13	2.09E-14	1.22E-15	9.64E-11
151	1.00E+04	7.64E-11	1.82E-19	7.59E-13	6.36E-17	1.49E-15	7.71E-11
59	1.00E+04	4.77E-11	6.08E-20	3.18E-13	8.95E-17	2.13E-15	4.80E-11
58	1.00E+04	1.90E-11	8.54E-20	4.11E-13	5.27E-17	1.27E-15	1.94E-11
129	1.00E+04	1.66E-11	2.67E-21	2.90E-14	2.04E-15	4.97E-16	1.66E-11
61	1.00E+04	1.42E-11	8.79E-20	3.66E-13	3.12E-17	7.33E-16	1.46E-11
5	1.00E+04	1.44E-11	2.51E-20	1.05E-13	4.48E-15	8.50E-16	1.45E-11
257	1.00E+04	6.43E-12	1.57E-20	6.51E-14	4.52E-18	1.06E-16	6.50E-12

247	1.00E+04	4.37E-12	2.33E-21	9.71E-15	2.70E-18	6.34E-17	4.38E-12
137	1.00E+04	2.02E-12	3.30E-21	1.37E-14	6.75E-18	1.59E-16	2.04E-12
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*break

Table 10.21 S6T6000

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
128	1.00E+04	2.30E-02	1.00E-20	4.67E-01	1.46E-05	1.03E-03	4.91E-01
111	1.00E+04	3.13E-02	2.65E-22	2.85E-01	4.68E-05	3.12E-03	3.20E-01
266	1.00E+04	1.58E-02	6.54E-23	8.95E-02	6.55E-06	4.96E-04	1.06E-01
23	1.00E+04	1.87E-02	-4.42E-11	5.91E-02	1.78E-03	1.14E-03	8.07E-02
236	1.00E+04	2.06E-02	8.98E-23	5.28E-02	7.22E-06	4.49E-04	7.39E-02
141	1.00E+04	1.70E-02	5.81E-26	5.51E-02	1.01E-05	7.66E-04	7.29E-02
228	1.00E+04	2.14E-02	9.31E-23	3.12E-02	6.54E-06	3.97E-04	5.30E-02
19	1.00E+04	1.63E-02	7.50E-23	2.90E-02	4.21E-06	2.56E-04	4.56E-02
256	1.00E+04	2.00E-02	3.49E-23	2.12E-02	1.98E-03	4.34E-04	4.36E-02
181	1.00E+04	1.12E-02	3.29E-23	2.81E-02	3.50E-06	2.32E-04	3.95E-02

72	1.00E+04	8.50E-03	4.58E-26	2.94E-02	2.97E-06	2.24E-04	3.81E-02
87	1.00E+04	9.03E-03	1.13E-22	2.80E-02	1.85E-06	1.11E-04	3.72E-02
9	1.00E+04	2.02E-02	2.55E-23	1.53E-02	2.98E-04	4.73E-04	3.63E-02
25	1.00E+04	1.39E-02	6.01E-24	2.00E-02	6.38E-06	4.88E-04	3.44E-02
52	1.00E+04	1.21E-02	2.31E-23	1.44E-02	4.56E-04	2.15E-04	2.71E-02
64	1.00E+04	1.72E-02	7.08E-24	8.39E-03	6.28E-06	4.39E-04	2.60E-02
130	1.00E+04	5.28E-03	6.37E-23	1.93E-02	2.53E-04	5.87E-05	2.49E-02
287	1.00E+04	1.51E-02	3.10E-23	8.51E-03	6.20E-04	2.08E-04	2.44E-02
260	1.00E+04	4.77E-03	2.26E-22	1.91E-02	1.32E-06	9.57E-05	2.39E-02
7	1.00E+04	2.83E-03	5.41E-23	2.07E-02	5.67E-07	3.52E-05	2.36E-02
240	1.00E+04	2.64E-03	1.05E-22	1.95E-02	4.14E-07	2.45E-05	2.22E-02
290	1.00E+04	7.81E-03	1.31E-23	1.10E-02	1.80E-06	1.21E-04	1.89E-02
50	1.00E+04	8.16E-03	5.00E-23	1.03E-02	1.55E-06	9.22E-05	1.85E-02
217	1.00E+04	1.02E-02	1.66E-23	7.16E-03	6.64E-05	1.37E-04	1.76E-02
177	1.00E+04	8.96E-03	1.37E-23	8.04E-03	1.05E-04	1.18E-04	1.72E-02
124	1.00E+04	8.32E-03	3.84E-24	6.70E-03	6.10E-04	1.84E-04	1.58E-02
221	1.00E+04	2.72E-03	6.35E-24	7.86E-03	7.27E-07	5.67E-05	1.06E-02
90	1.00E+04	7.41E-03	1.41E-23	2.80E-03	1.85E-04	5.39E-05	1.04E-02
253	1.00E+04	4.78E-03	2.46E-23	4.97E-03	3.70E-07	2.19E-05	9.77E-03
265	1.00E+04	5.79E-03	1.64E-23	3.13E-03	4.85E-07	2.88E-05	8.95E-03
243	1.00E+04	3.53E-03	1.26E-23	5.13E-03	5.79E-07	4.05E-05	8.70E-03
82	1.00E+04	4.54E-03	2.16E-23	4.07E-03	2.02E-05	3.64E-05	8.67E-03
280	1.00E+04	4.90E-03	3.24E-24	2.86E-03	3.90E-04	8.96E-05	8.23E-03
147	1.00E+04	2.70E-03	1.40E-23	4.84E-03	4.69E-07	2.86E-05	7.57E-03
285	1.00E+04	4.91E-03	1.28E-23	2.42E-03	7.88E-05	4.20E-05	7.45E-03
102	1.00E+04	2.86E-03	2.11E-23	3.94E-03	3.58E-07	2.12E-05	6.82E-03
222	1.00E+04	1.58E-03	2.03E-24	4.95E-03	4.48E-07	3.34E-05	6.56E-03
77	1.00E+04	3.84E-03	9.84E-24	1.84E-03	9.08E-05	2.47E-05	5.80E-03
40	1.00E+04	1.21E-03	1.07E-23	4.34E-03	2.37E-07	1.46E-05	5.57E-03
245	1.00E+04	2.31E-03	2.13E-23	3.12E-03	3.62E-05	1.26E-05	5.47E-03
267	1.00E+04	2.13E-03	3.53E-24	2.69E-03	4.39E-04	3.30E-05	5.29E-03
184	1.00E+04	1.34E-03	2.08E-23	3.88E-03	1.08E-07	6.40E-06	5.23E-03
92	1.00E+04	1.44E-03	1.95E-23	3.61E-03	1.10E-04	1.00E-05	5.17E-03
14	1.00E+04	3.59E-03	3.19E-24	7.66E-04	2.18E-07	1.30E-05	4.37E-03
235	1.00E+04	1.45E-03	1.26E-23	2.46E-03	2.16E-05	1.30E-05	3.94E-03
27	1.00E+04	7.46E-04	1.61E-23	3.00E-03	6.51E-08	3.86E-06	3.75E-03
204	1.00E+04	1.60E-03	2.25E-24	2.12E-03	3.56E-07	2.43E-05	3.74E-03
100	1.00E+04	1.61E-03	1.10E-23	2.10E-03	1.64E-07	9.72E-06	3.72E-03
110	1.00E+04	1.94E-03	8.46E-24	1.58E-03	1.86E-07	1.10E-05	3.53E-03
154	1.00E+04	1.67E-03	8.46E-24	1.60E-03	2.54E-07	1.51E-05	3.29E-03
284	1.00E+04	1.31E-03	1.05E-23	1.97E-03	1.26E-07	7.49E-06	3.28E-03
125	1.00E+04	2.33E-03	4.78E-24	8.72E-04	2.55E-07	1.51E-05	3.22E-03
276	1.00E+04	9.71E-04	6.38E-24	2.14E-03	9.06E-08	5.45E-06	3.12E-03
81	1.00E+04	1.94E-03	5.64E-24	1.17E-03	1.91E-07	1.13E-05	3.11E-03
183	1.00E+04	2.46E-03	2.72E-24	5.13E-04	2.40E-05	9.99E-06	3.01E-03
152	1.00E+04	2.07E-03	4.59E-24	8.56E-04	3.17E-07	1.88E-05	2.95E-03
166	1.00E+04	2.27E-03	3.08E-24	5.76E-04	6.61E-06	1.25E-05	2.86E-03
93	1.00E+04	2.24E-03	2.78E-24	5.19E-04	7.62E-06	1.73E-05	2.79E-03
108	1.00E+04	1.29E-03	4.50E-24	1.07E-03	7.62E-08	4.54E-06	2.37E-03
153	1.00E+04	1.54E-03	1.73E-24	7.40E-04	5.28E-05	1.80E-05	2.35E-03

238	1.00E+04	8.46E-04	5.70E-24	1.40E-03	1.20E-05	3.85E-06	2.26E-03
191	1.00E+04	1.21E-03	8.31E-25	8.36E-04	3.16E-05	1.99E-05	2.10E-03
98	1.00E+04	1.73E-03	1.27E-24	2.39E-04	8.68E-05	4.02E-06	2.06E-03
262	1.00E+04	1.76E-03	9.64E-25	1.91E-04	2.94E-05	4.74E-06	1.99E-03
145	1.00E+04	9.93E-04	5.13E-24	9.50E-04	2.36E-05	6.50E-06	1.97E-03
126	1.00E+04	1.67E-03	1.51E-24	2.66E-04	1.47E-05	1.01E-05	1.96E-03
278	1.00E+04	1.36E-03	2.90E-27	4.55E-04	5.20E-05	2.54E-05	1.89E-03
225	1.00E+04	6.81E-04	5.75E-25	9.13E-04	1.91E-07	1.45E-05	1.61E-03
215	1.00E+04	3.59E-04	-1.41E-12	1.15E-03	7.51E-06	1.59E-06	1.52E-03
99	1.00E+04	7.57E-04	3.01E-25	4.04E-04	1.87E-07	1.46E-05	1.18E-03
88	1.00E+04	3.65E-04	2.99E-24	6.33E-04	2.79E-06	2.57E-06	1.00E-03
205	1.00E+04	7.43E-04	1.14E-24	2.22E-04	2.85E-08	1.69E-06	9.66E-04
28	1.00E+04	6.28E-04	8.89E-25	1.66E-04	1.44E-04	3.25E-06	9.41E-04
41	1.00E+04	6.18E-04	5.76E-25	2.80E-04	2.76E-05	7.64E-06	9.33E-04
163	1.00E+04	6.78E-04	1.24E-24	2.31E-04	2.71E-06	4.46E-06	9.17E-04
142	1.00E+04	7.06E-04	8.70E-25	1.62E-04	3.50E-05	7.16E-06	9.11E-04
13	1.00E+04	5.63E-04	1.42E-24	2.88E-04	1.80E-05	3.32E-06	8.72E-04
135	1.00E+04	5.01E-04	1.12E-24	3.22E-04	2.09E-05	4.40E-06	8.48E-04
34	1.00E+04	4.66E-04	1.39E-24	3.60E-04	4.91E-08	2.94E-06	8.29E-04
251	1.00E+04	2.41E-04	1.16E-24	5.15E-04	2.04E-05	3.11E-06	7.80E-04
69	1.00E+04	1.34E-04	3.16E-24	5.90E-04	1.26E-08	7.48E-07	7.25E-04
227	1.00E+04	5.36E-04	7.92E-25	1.48E-04	7.02E-06	1.87E-06	6.93E-04
131	1.00E+04	5.45E-04	5.13E-25	1.32E-04	2.24E-06	2.19E-06	6.81E-04
188	1.00E+04	6.12E-04	3.64E-25	6.49E-05	9.50E-08	1.13E-06	6.78E-04
252	1.00E+04	2.64E-04	1.58E-24	3.92E-04	9.86E-07	2.41E-06	6.59E-04
229	1.00E+04	4.82E-04	4.23E-25	1.46E-04	6.96E-06	3.17E-06	6.38E-04
148	1.00E+04	3.66E-04	5.57E-25	2.21E-04	2.56E-06	4.07E-06	5.93E-04
109	1.00E+04	3.01E-04	1.43E-24	2.63E-04	3.54E-08	2.10E-06	5.66E-04
169	1.00E+04	3.39E-05	7.06E-24	4.03E-04	2.59E-09	1.54E-07	4.37E-04
195	1.00E+04	2.41E-04	7.69E-25	1.41E-04	2.87E-08	1.70E-06	3.84E-04
35	1.00E+04	2.38E-04	1.23E-24	9.48E-05	2.04E-08	1.21E-06	3.34E-04
12	1.00E+04	2.97E-04	1.59E-25	2.97E-05	1.53E-06	7.74E-07	3.29E-04
71	1.00E+04	2.77E-04	1.09E-25	2.04E-05	6.42E-06	8.68E-07	3.05E-04
202	1.00E+04	1.89E-04	4.01E-25	7.81E-05	2.76E-06	1.78E-06	2.72E-04
66	1.00E+04	2.33E-04	1.15E-25	2.44E-05	1.05E-08	6.26E-07	2.59E-04
300	1.00E+04	2.30E-04	1.31E-25	2.45E-05	2.37E-06	4.24E-07	2.58E-04
104	1.00E+04	2.29E-04	1.15E-25	2.12E-05	5.54E-07	4.21E-07	2.51E-04
179	1.00E+04	6.95E-05	9.58E-25	1.79E-04	6.18E-09	3.66E-07	2.48E-04
144	1.00E+04	8.89E-05	5.72E-25	1.43E-04	7.20E-07	6.68E-07	2.33E-04
48	1.00E+04	1.90E-04	1.50E-25	4.00E-05	1.33E-08	7.96E-07	2.31E-04
68	1.00E+04	1.90E-04	2.21E-25	3.79E-05	8.14E-07	6.25E-07	2.29E-04
161	1.00E+04	1.68E-04	2.58E-25	4.25E-05	7.54E-09	4.47E-07	2.10E-04
63	1.00E+04	1.12E-04	4.70E-25	8.75E-05	1.26E-08	7.48E-07	2.00E-04
43	1.00E+04	1.60E-04	1.22E-25	2.28E-05	1.27E-06	8.36E-07	1.84E-04
174	1.00E+04	1.60E-04	8.09E-26	2.00E-05	3.96E-06	7.44E-07	1.84E-04
269	1.00E+04	1.69E-04	1.14E-25	1.10E-05	6.18E-07	3.11E-07	1.81E-04
198	1.00E+04	1.02E-04	4.12E-25	7.36E-05	1.30E-06	9.39E-07	1.78E-04
194	1.00E+04	4.53E-05	7.40E-25	1.28E-04	2.78E-09	1.65E-07	1.74E-04
95	1.00E+04	1.08E-04	3.27E-25	5.78E-05	4.12E-09	2.44E-07	1.66E-04
120	1.00E+04	1.21E-04	1.67E-25	3.02E-05	4.60E-09	2.73E-07	1.52E-04

11	1.00E+04	1.01E-04	4.13E-25	4.93E-05	5.15E-09	3.05E-07	1.51E-04
241	1.00E+04	1.01E-05	9.45E-25	1.19E-04	1.03E-09	6.11E-08	1.29E-04
250	1.00E+04	9.72E-05	9.15E-26	1.81E-05	4.36E-06	3.84E-07	1.20E-04
112	1.00E+04	9.94E-05	8.42E-26	1.57E-05	9.62E-08	2.44E-07	1.15E-04
39	1.00E+04	9.32E-05	-7.57E-11	1.76E-05	1.69E-06	6.63E-07	1.13E-04
261	1.00E+04	7.52E-05	2.00E-25	3.73E-05	6.85E-09	4.06E-07	1.13E-04
167	1.00E+04	8.23E-05	1.06E-25	2.62E-05	9.83E-07	3.93E-07	1.10E-04
193	1.00E+04	8.44E-05	2.80E-25	2.23E-05	2.00E-06	5.27E-07	1.09E-04
49	1.00E+04	5.42E-05	2.05E-25	5.46E-05	6.51E-09	3.89E-07	1.09E-04
117	1.00E+04	4.16E-05	3.56E-25	6.64E-05	4.44E-09	2.63E-07	1.08E-04
16	1.00E+04	1.94E-05	9.63E-25	8.79E-05	6.87E-07	1.22E-07	1.08E-04
220	1.00E+04	1.40E-05	5.68E-25	8.82E-05	1.43E-09	8.48E-08	1.02E-04
84	1.00E+04	7.98E-05	1.38E-25	1.96E-05	1.01E-06	2.47E-07	1.01E-04
246	1.00E+04	8.11E-05	6.77E-26	1.79E-05	5.78E-09	3.45E-07	9.94E-05
121	1.00E+04	6.45E-05	2.29E-25	3.12E-05	8.73E-07	3.84E-07	9.70E-05
116	1.00E+04	6.84E-05	1.56E-25	1.83E-05	5.80E-06	3.77E-07	9.28E-05
196	1.00E+04	8.74E-05	2.14E-26	3.75E-06	2.72E-09	1.61E-07	9.13E-05
231	1.00E+04	7.32E-05	8.32E-26	1.55E-05	7.01E-09	4.15E-07	8.92E-05
249	1.00E+04	4.69E-05	3.41E-25	3.98E-05	4.56E-09	2.70E-07	8.70E-05
134	1.00E+04	7.20E-05	5.42E-26	1.01E-05	7.56E-07	2.53E-07	8.31E-05
218	1.00E+04	7.39E-05	3.59E-26	6.70E-06	2.62E-07	1.37E-07	8.10E-05
165	1.00E+04	5.15E-05	6.32E-26	1.18E-05	1.69E-05	3.12E-07	8.06E-05
119	1.00E+04	5.73E-05	8.08E-26	2.07E-05	8.27E-09	4.93E-07	7.85E-05
189	1.00E+04	5.03E-05	1.29E-25	2.40E-05	4.91E-09	2.91E-07	7.46E-05
118	1.00E+04	4.29E-05	1.70E-25	2.97E-05	3.60E-09	2.13E-07	7.29E-05
213	1.00E+04	6.37E-05	9.16E-26	8.60E-06	9.05E-08	1.90E-07	7.26E-05
54	1.00E+04	4.37E-05	1.13E-25	2.11E-05	5.98E-06	2.60E-07	7.10E-05
78	1.00E+04	6.23E-05	3.83E-26	7.15E-06	5.50E-07	2.82E-07	7.03E-05
8	1.00E+04	4.74E-05	9.67E-26	1.80E-05	2.94E-09	1.74E-07	6.57E-05
275	1.00E+04	3.55E-05	1.77E-25	2.86E-05	3.80E-09	2.25E-07	6.43E-05
289	1.00E+04	4.75E-05	4.90E-25	1.48E-05	1.72E-09	1.02E-07	6.24E-05
33	1.00E+04	4.47E-05	1.19E-25	1.57E-05	1.31E-06	3.35E-07	6.21E-05
73	1.00E+04	4.75E-05	5.93E-26	1.09E-05	9.37E-07	2.17E-07	5.96E-05
207	1.00E+04	4.30E-05	1.01E-25	1.59E-05	4.26E-09	2.53E-07	5.92E-05
203	1.00E+04	2.96E-05	1.29E-25	2.40E-05	1.57E-06	1.99E-07	5.53E-05
214	1.00E+04	4.88E-05	3.68E-26	5.28E-06	6.36E-07	1.73E-07	5.49E-05
226	1.00E+04	3.14E-05	1.23E-25	2.29E-05	2.74E-09	1.62E-07	5.45E-05
94	1.00E+04	1.98E-05	1.85E-25	3.45E-05	2.45E-09	1.45E-07	5.44E-05
230	1.00E+04	4.36E-05	2.50E-26	4.64E-06	2.64E-06	1.45E-07	5.10E-05
138	1.00E+04	3.73E-05	4.65E-26	8.67E-06	5.45E-07	1.86E-07	4.67E-05
270	1.00E+04	4.17E-05	3.31E-26	3.70E-06	2.64E-07	1.47E-07	4.59E-05
159	1.00E+04	3.16E-05	6.99E-26	1.27E-05	2.99E-09	1.77E-07	4.45E-05
31	1.00E+04	3.98E-05	3.05E-26	2.93E-06	7.67E-08	8.70E-08	4.29E-05
180	1.00E+04	3.26E-05	5.08E-26	9.47E-06	2.45E-07	1.18E-07	4.25E-05
2	1.00E+04	3.09E-05	5.43E-26	1.01E-05	2.34E-09	1.39E-07	4.12E-05
294	1.00E+04	3.70E-05	1.70E-26	3.17E-06	2.79E-07	7.03E-08	4.06E-05
182	1.00E+04	3.73E-05	1.45E-26	2.71E-06	2.43E-07	1.22E-07	4.03E-05
143	1.00E+04	2.86E-05	6.33E-26	9.54E-06	1.86E-09	1.10E-07	3.83E-05
295	1.00E+04	2.97E-05	1.10E-25	8.05E-06	3.51E-07	1.62E-07	3.82E-05
282	1.00E+04	3.09E-05	3.46E-26	6.37E-06	4.16E-09	2.47E-07	3.76E-05

211	1.00E+04	2.88E-05	3.77E-26	6.96E-06	3.93E-07	1.35E-07	3.63E-05
293	1.00E+04	1.94E-05	2.57E-25	1.57E-05	2.64E-07	2.04E-07	3.56E-05
51	1.00E+04	2.58E-05	5.91E-26	9.13E-06	1.42E-09	8.39E-08	3.51E-05
139	1.00E+04	1.44E-05	1.61E-24	1.98E-05	4.60E-10	2.73E-08	3.42E-05
299	1.00E+04	2.83E-05	2.79E-26	5.21E-06	1.00E-07	1.51E-07	3.38E-05
268	1.00E+04	1.74E-05	8.69E-26	1.62E-05	1.88E-09	1.11E-07	3.37E-05
127	1.00E+04	2.83E-05	2.29E-26	4.28E-06	9.15E-07	1.82E-07	3.37E-05
279	1.00E+04	2.13E-05	5.17E-26	9.64E-06	1.86E-09	1.10E-07	3.11E-05
30	1.00E+04	2.70E-05	2.31E-26	3.05E-06	1.14E-07	1.18E-07	3.03E-05
105	1.00E+04	2.51E-05	2.99E-26	3.40E-06	3.48E-07	9.68E-08	2.89E-05
201	1.00E+04	2.44E-05	1.80E-26	3.35E-06	4.48E-07	9.77E-08	2.83E-05
17	1.00E+04	2.02E-05	3.64E-26	5.38E-06	2.51E-07	1.12E-07	2.60E-05
199	1.00E+04	1.57E-05	1.45E-25	1.01E-05	1.65E-09	9.79E-08	2.59E-05
6	1.00E+04	2.05E-05	2.75E-26	4.57E-06	6.37E-10	3.77E-08	2.51E-05
91	1.00E+04	1.95E-05	2.16E-26	3.63E-06	8.61E-07	1.07E-07	2.41E-05
32	1.00E+04	1.84E-05	2.34E-26	4.63E-06	3.40E-07	1.16E-07	2.35E-05
255	1.00E+04	7.09E-06	8.36E-26	1.56E-05	4.77E-07	4.99E-08	2.32E-05
136	1.00E+04	1.93E-05	1.08E-26	2.02E-06	7.61E-08	3.56E-08	2.15E-05
185	1.00E+04	1.30E-05	4.30E-26	7.98E-06	1.15E-09	6.80E-08	2.10E-05
172	1.00E+04	1.61E-05	2.44E-26	4.56E-06	2.10E-07	8.49E-08	2.09E-05
233	1.00E+04	1.33E-05	1.96E-26	3.66E-06	3.14E-06	9.90E-08	2.02E-05
216	1.00E+04	1.09E-05	6.33E-26	8.61E-06	7.63E-10	4.52E-08	1.95E-05
103	1.00E+04	6.98E-06	6.16E-26	1.15E-05	7.33E-10	4.34E-08	1.85E-05
21	1.00E+04	6.96E-06	5.04E-26	9.41E-06	5.16E-10	3.06E-08	1.64E-05
57	1.00E+04	1.26E-05	1.40E-26	2.56E-06	3.91E-10	2.32E-08	1.52E-05
170	1.00E+04	1.13E-05	2.82E-25	2.58E-06	2.58E-07	6.16E-08	1.42E-05
62	1.00E+04	5.17E-06	8.49E-26	8.51E-06	8.32E-10	4.93E-08	1.37E-05
200	1.00E+04	7.69E-06	1.94E-25	5.68E-06	1.59E-09	9.61E-08	1.35E-05
156	1.00E+04	6.27E-06	5.37E-26	6.92E-06	4.59E-08	1.16E-08	1.33E-05
89	1.00E+04	1.06E-05	6.65E-26	2.40E-06	3.29E-10	1.95E-08	1.30E-05
210	1.00E+04	1.02E-05	1.44E-26	2.45E-06	9.16E-08	3.57E-08	1.28E-05
24	1.00E+04	9.28E-06	1.80E-26	3.40E-06	4.80E-10	2.84E-08	1.27E-05
29	1.00E+04	9.65E-06	1.24E-26	2.32E-06	6.53E-07	5.28E-08	1.27E-05
190	1.00E+04	1.10E-05	3.14E-25	1.39E-06	6.31E-08	2.42E-08	1.25E-05
76	1.00E+04	9.83E-06	1.50E-26	2.09E-06	1.22E-07	3.61E-08	1.21E-05
140	1.00E+04	7.25E-06	6.90E-26	4.15E-06	7.15E-10	4.24E-08	1.14E-05
113	1.00E+04	6.67E-06	2.43E-26	4.53E-06	7.39E-08	2.59E-08	1.13E-05
283	1.00E+04	5.93E-06	1.87E-26	4.98E-06	1.13E-09	6.76E-08	1.10E-05
65	1.00E+04	7.75E-06	2.86E-26	2.24E-06	3.75E-08	2.70E-08	1.01E-05
242	1.00E+04	6.53E-06	3.14E-26	3.21E-06	7.09E-10	4.20E-08	9.78E-06
15	1.00E+04	5.31E-06	2.11E-26	3.93E-06	9.52E-08	2.08E-08	9.36E-06
258	1.00E+04	5.84E-06	1.76E-26	3.29E-06	7.47E-10	4.43E-08	9.18E-06
232	1.00E+04	7.67E-06	4.37E-27	8.34E-07	1.10E-07	2.10E-08	8.64E-06
171	1.00E+04	6.14E-06	8.64E-26	2.32E-06	5.60E-10	3.32E-08	8.49E-06
157	1.00E+04	7.02E-06	4.94E-27	9.22E-07	3.71E-09	1.64E-08	7.96E-06
272	1.00E+04	5.11E-06	1.30E-26	2.43E-06	6.15E-10	3.64E-08	7.57E-06
74	1.00E+04	4.91E-06	1.12E-25	1.96E-06	4.10E-10	2.43E-08	6.90E-06
44	1.00E+04	4.50E-06	9.47E-27	1.77E-06	7.67E-08	2.63E-08	6.37E-06
114	1.00E+04	5.00E-06	6.86E-27	1.28E-06	3.21E-10	1.90E-08	6.30E-06
281	1.00E+04	4.68E-06	7.46E-27	1.39E-06	9.51E-09	2.59E-08	6.11E-06

173	1.00E+04	4.01E-06	1.23E-26	1.98E-06	3.12E-10	1.85E-08	6.01E-06
237	1.00E+04	5.03E-06	6.28E-27	8.39E-07	4.59E-10	2.72E-08	5.89E-06
150	1.00E+04	4.10E-06	8.82E-27	1.65E-06	5.97E-08	2.22E-08	5.83E-06
234	1.00E+04	3.74E-06	2.65E-26	7.38E-07	1.70E-08	1.40E-08	4.51E-06
175	1.00E+04	2.94E-06	1.37E-25	1.08E-06	3.05E-10	1.81E-08	4.03E-06
96	1.00E+04	2.54E-06	4.33E-27	8.07E-07	2.44E-10	1.44E-08	3.36E-06
97	1.00E+04	2.47E-06	3.69E-27	6.78E-07	2.42E-08	1.36E-08	3.19E-06
85	1.00E+04	2.35E-06	1.50E-26	7.58E-07	2.52E-10	1.49E-08	3.13E-06
273	1.00E+04	1.83E-06	4.69E-27	4.41E-07	3.28E-09	3.43E-09	2.28E-06
42	1.00E+04	1.03E-06	5.91E-27	7.44E-07	3.64E-11	2.15E-09	1.77E-06
60	1.00E+04	5.24E-08	2.19E-27	4.09E-07	6.89E-12	4.09E-10	4.62E-07
224	1.00E+04	9.62E-08	2.51E-26	5.40E-08	3.01E-09	7.15E-10	1.54E-07
115	1.00E+04	1.37E-08	2.23E-29	4.16E-09	4.42E-13	2.62E-11	1.79E-08
208	1.00E+04	1.19E-08	8.26E-27	1.07E-09	3.69E-13	2.18E-11	1.30E-08
83	1.00E+04	1.15E-08	2.79E-25	9.71E-10	1.42E-13	6.95E-12	1.25E-08
1	1.00E+04	4.35E-09	2.03E-25	6.34E-10	3.88E-11	1.23E-11	5.03E-09
296	1.00E+04	1.34E-09	4.80E-25	2.41E-11	1.45E-12	3.51E-13	1.37E-09
107	1.00E+04	8.56E-10	5.18E-24	2.51E-10	4.73E-15	2.07E-13	1.11E-09
122	1.00E+04	6.22E-10	1.33E-25	7.89E-12	3.91E-15	1.74E-13	6.30E-10
3	1.00E+04	5.66E-10	9.07E-26	6.88E-12	3.69E-12	2.33E-13	5.77E-10
197	1.00E+04	5.65E-10	1.53E-25	9.66E-12	1.12E-12	1.97E-13	5.76E-10
53	1.00E+04	4.73E-10	4.29E-25	1.57E-11	1.93E-15	8.32E-14	4.89E-10
101	1.00E+04	4.55E-10	8.33E-26	1.89E-11	3.05E-12	1.16E-13	4.77E-10
298	1.00E+04	3.67E-10	5.75E-25	6.69E-11	4.68E-15	2.15E-13	4.34E-10
297	1.00E+04	4.02E-10	2.55E-25	2.38E-11	3.66E-15	1.66E-13	4.26E-10
75	1.00E+04	4.02E-10	1.12E-25	8.50E-12	1.31E-12	1.60E-13	4.12E-10
271	1.00E+04	4.07E-10	3.68E-26	3.07E-12	2.77E-14	1.06E-13	4.10E-10
263	1.00E+04	2.06E-10	8.54E-25	8.60E-11	1.22E-15	5.53E-14	2.92E-10
158	1.00E+04	2.77E-10	3.23E-25	1.30E-11	1.16E-15	5.01E-14	2.90E-10
264	1.00E+04	2.44E-10	8.85E-26	4.88E-12	1.64E-13	8.49E-14	2.49E-10
160	1.00E+04	2.05E-10	5.28E-26	3.05E-12	4.86E-13	4.54E-14	2.09E-10
164	1.00E+04	1.95E-10	7.92E-26	5.92E-12	1.73E-12	7.06E-14	2.02E-10
248	1.00E+04	1.84E-10	5.57E-26	9.16E-12	9.74E-16	4.36E-14	1.93E-10
79	1.00E+04	1.67E-10	8.31E-26	5.35E-12	9.03E-16	4.00E-14	1.73E-10
259	1.00E+04	1.63E-10	4.96E-26	6.18E-12	5.42E-13	8.44E-14	1.69E-10
45	1.00E+04	1.63E-10	4.37E-26	3.41E-12	4.04E-15	6.79E-14	1.67E-10
86	1.00E+04	1.52E-10	6.99E-26	3.14E-12	9.46E-16	4.13E-14	1.55E-10
176	1.00E+04	1.22E-10	5.46E-27	1.14E-11	1.63E-15	7.87E-14	1.34E-10
186	1.00E+04	1.28E-10	4.47E-26	1.96E-12	6.77E-16	2.98E-14	1.30E-10
212	1.00E+04	1.25E-10	3.00E-26	1.65E-12	7.08E-14	2.54E-14	1.27E-10
106	1.00E+04	1.07E-10	1.58E-25	7.18E-12	5.02E-13	2.81E-14	1.15E-10
46	1.00E+04	1.01E-10	5.01E-26	3.40E-12	1.62E-15	7.31E-14	1.05E-10
123	1.00E+04	7.09E-11	2.43E-27	6.36E-12	3.60E-13	7.92E-14	7.77E-11
254	1.00E+04	3.95E-11	1.96E-26	1.07E-12	1.79E-16	7.85E-15	4.05E-11
192	1.00E+04	3.68E-11	1.82E-26	6.12E-13	5.22E-16	7.06E-15	3.74E-11
274	1.00E+04	3.53E-11	2.83E-26	1.00E-12	1.63E-16	7.08E-15	3.63E-11
132	1.00E+04	3.21E-11	1.13E-26	9.73E-13	1.86E-16	8.38E-15	3.31E-11
56	1.00E+04	3.14E-11	4.66E-27	3.32E-13	1.34E-15	7.02E-15	3.17E-11
80	1.00E+04	2.35E-11	2.31E-25	6.41E-12	8.95E-17	3.83E-15	2.99E-11
151	1.00E+04	1.65E-11	2.67E-26	7.44E-13	6.28E-17	2.69E-15	1.72E-11

59	1.00E+04	1.66E-11	8.91E-27	3.11E-13	8.84E-17	3.81E-15	1.69E-11
58	1.00E+04	1.26E-11	1.25E-26	4.03E-13	5.21E-17	2.25E-15	1.30E-11
155	1.00E+04	1.19E-11	2.29E-27	9.98E-14	2.07E-14	2.17E-15	1.20E-11
5	1.00E+04	9.36E-12	3.69E-27	1.03E-13	4.42E-15	1.53E-15	9.47E-12
61	1.00E+04	8.08E-12	1.29E-26	3.58E-13	3.08E-17	1.32E-15	8.44E-12
129	1.00E+04	3.46E-12	3.91E-28	2.84E-14	2.01E-15	8.44E-16	3.49E-12
137	1.00E+04	1.45E-12	4.84E-28	1.35E-14	6.67E-18	2.85E-16	1.46E-12
257	1.00E+04	1.17E-12	2.30E-27	6.39E-14	4.47E-18	1.91E-16	1.24E-12
247	1.00E+04	6.99E-13	3.42E-28	9.52E-15	2.66E-18	1.14E-16	7.08E-13
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
277	1.00E+04	-3.38E-11	-1.64E-12	7.04E-13	3.85E-14	1.41E-14	-3.47E-11

*break

Table 10.22 S6T9000

vector	time	E09AM241 [H]	E09PU238 [H]	E09PU239 [H]	E09U234 [H]	E09TH230 [H]	EPATOT [H]
128	1.00E+04	9.80E-03	5.60E-31	1.84E-01	5.78E-06	4.73E-04	1.95E-01
111	1.00E+04	1.78E-02	1.44E-32	1.72E-01	2.84E-05	2.32E-03	1.92E-01

236	1.00E+04	1.16E-02	4.94E-33	4.60E-02	6.32E-06	5.15E-04	5.81E-02
228	1.00E+04	1.20E-02	5.15E-33	2.94E-02	6.19E-06	4.99E-04	4.19E-02
19	1.00E+04	9.36E-03	4.16E-33	2.76E-02	4.03E-06	3.26E-04	3.73E-02
87	1.00E+04	5.07E-03	6.34E-33	2.74E-02	1.82E-06	1.46E-04	3.26E-02
256	1.00E+04	1.04E-02	1.91E-33	1.52E-02	1.44E-03	4.00E-04	2.74E-02
9	1.00E+04	1.04E-02	1.37E-33	1.08E-02	2.11E-04	4.23E-04	2.18E-02
181	1.00E+04	4.98E-03	1.82E-33	1.63E-02	2.04E-06	1.66E-04	2.14E-02
130	1.00E+04	2.91E-03	3.56E-33	1.78E-02	2.35E-04	7.14E-05	2.10E-02
240	1.00E+04	1.46E-03	5.85E-33	1.91E-02	4.07E-07	3.24E-05	2.05E-02
7	1.00E+04	1.52E-03	3.02E-33	1.76E-02	4.84E-07	3.93E-05	1.91E-02
287	1.00E+04	8.50E-03	1.71E-33	8.30E-03	6.08E-04	2.72E-04	1.77E-02
266	1.00E+04	3.14E-03	3.66E-33	1.22E-02	8.93E-07	7.11E-05	1.54E-02
50	1.00E+04	4.52E-03	2.80E-33	1.00E-02	1.53E-06	1.22E-04	1.47E-02
52	1.00E+04	4.69E-03	1.29E-33	6.57E-03	2.09E-04	1.16E-04	1.16E-02
177	1.00E+04	4.61E-03	7.52E-34	6.17E-03	8.09E-05	1.17E-04	1.10E-02
217	1.00E+04	5.03E-03	9.20E-34	5.24E-03	4.88E-05	1.29E-04	1.04E-02
64	1.00E+04	6.61E-03	3.52E-34	3.36E-03	2.52E-06	2.05E-04	1.02E-02
290	1.00E+04	3.33E-03	7.27E-34	5.67E-03	9.37E-07	7.62E-05	9.07E-03
253	1.00E+04	2.63E-03	1.38E-33	4.85E-03	3.64E-07	2.90E-05	7.51E-03
260	1.00E+04	1.22E-03	1.26E-32	5.84E-03	4.07E-07	3.31E-05	7.10E-03
90	1.00E+04	4.08E-03	7.91E-34	2.73E-03	1.82E-04	7.12E-05	7.07E-03
82	1.00E+04	2.50E-03	1.21E-33	3.97E-03	1.99E-05	4.82E-05	6.54E-03
265	1.00E+04	3.19E-03	9.15E-34	3.06E-03	4.77E-07	3.80E-05	6.28E-03
147	1.00E+04	1.49E-03	7.81E-34	4.41E-03	4.31E-07	3.47E-05	5.94E-03
102	1.00E+04	1.58E-03	1.18E-33	3.85E-03	3.52E-07	2.80E-05	5.45E-03
285	1.00E+04	2.70E-03	7.14E-34	2.36E-03	7.75E-05	5.55E-05	5.20E-03
184	1.00E+04	7.41E-04	1.16E-33	3.79E-03	1.06E-07	8.46E-06	4.54E-03
40	1.00E+04	6.61E-04	6.00E-34	3.81E-03	2.09E-07	1.69E-05	4.49E-03
124	1.00E+04	2.23E-03	2.04E-34	1.99E-03	1.82E-04	6.25E-05	4.47E-03
92	1.00E+04	7.92E-04	1.09E-33	3.53E-03	1.08E-04	1.33E-05	4.44E-03
245	1.00E+04	1.27E-03	1.19E-33	3.04E-03	3.56E-05	1.67E-05	4.37E-03
77	1.00E+04	2.12E-03	5.50E-34	1.80E-03	8.93E-05	3.27E-05	4.04E-03
243	1.00E+04	1.40E-03	7.05E-34	2.30E-03	2.60E-07	2.07E-05	3.71E-03
27	1.00E+04	4.11E-04	8.99E-34	2.93E-03	6.40E-08	5.10E-06	3.35E-03
235	1.00E+04	8.01E-04	7.06E-34	2.40E-03	2.12E-05	1.72E-05	3.24E-03
100	1.00E+04	8.87E-04	6.14E-34	2.06E-03	1.61E-07	1.28E-05	2.95E-03
72	1.00E+04	6.55E-04	1.55E-36	2.11E-03	2.14E-07	1.81E-05	2.79E-03
14	1.00E+04	1.99E-03	1.78E-34	7.48E-04	2.15E-07	1.72E-05	2.75E-03
284	1.00E+04	7.22E-04	5.89E-34	1.92E-03	1.24E-07	9.90E-06	2.65E-03
110	1.00E+04	1.07E-03	4.73E-34	1.54E-03	1.83E-07	1.46E-05	2.62E-03
276	1.00E+04	5.43E-04	3.56E-34	2.07E-03	8.84E-08	7.09E-06	2.62E-03
154	1.00E+04	9.23E-04	4.73E-34	1.56E-03	2.50E-07	1.99E-05	2.51E-03
25	1.00E+04	1.31E-03	3.36E-34	1.09E-03	3.49E-07	2.78E-05	2.44E-03
280	1.00E+04	1.26E-03	1.78E-34	8.66E-04	1.19E-04	3.02E-05	2.28E-03
81	1.00E+04	1.07E-03	3.15E-34	1.14E-03	1.88E-07	1.50E-05	2.22E-03
267	1.00E+04	7.83E-04	1.96E-34	1.22E-03	1.99E-04	1.76E-05	2.22E-03
125	1.00E+04	1.28E-03	2.67E-34	8.52E-04	2.51E-07	2.00E-05	2.15E-03
152	1.00E+04	1.14E-03	2.57E-34	8.37E-04	3.12E-07	2.48E-05	2.00E-03
183	1.00E+04	1.35E-03	1.52E-34	5.01E-04	2.36E-05	1.32E-05	1.89E-03
238	1.00E+04	4.70E-04	3.19E-34	1.37E-03	1.18E-05	5.08E-06	1.85E-03

166	1.00E+04	1.25E-03	1.72E-34	5.62E-04	6.50E-06	1.65E-05	1.83E-03
93	1.00E+04	1.24E-03	1.56E-34	5.07E-04	7.49E-06	2.28E-05	1.77E-03
108	1.00E+04	7.14E-04	2.51E-34	1.05E-03	7.49E-08	5.99E-06	1.77E-03
204	1.00E+04	6.27E-04	1.23E-34	1.04E-03	1.76E-07	1.43E-05	1.68E-03
221	1.00E+04	5.04E-04	3.55E-34	1.16E-03	1.07E-07	8.54E-06	1.67E-03
145	1.00E+04	5.47E-04	2.87E-34	9.28E-04	2.32E-05	8.59E-06	1.51E-03
153	1.00E+04	7.60E-04	9.64E-35	5.59E-04	4.02E-05	1.76E-05	1.38E-03
215	1.00E+04	1.98E-04	-1.44E-12	1.12E-03	7.38E-06	2.11E-06	1.33E-03
98	1.00E+04	9.51E-04	7.13E-35	2.34E-04	8.54E-05	5.31E-06	1.28E-03
126	1.00E+04	9.23E-04	8.40E-35	2.60E-04	1.45E-05	1.34E-05	1.21E-03
262	1.00E+04	9.73E-04	5.39E-35	1.86E-04	2.89E-05	6.26E-06	1.19E-03
222	1.00E+04	2.10E-04	1.13E-34	6.37E-04	5.78E-08	4.66E-06	8.52E-04
88	1.00E+04	1.99E-04	1.67E-34	5.96E-04	2.64E-06	3.23E-06	8.02E-04
251	1.00E+04	1.41E-04	6.50E-35	5.04E-04	2.00E-05	4.08E-06	6.68E-04
28	1.00E+04	3.46E-04	4.97E-35	1.62E-04	1.41E-04	4.29E-06	6.53E-04
69	1.00E+04	7.40E-05	1.77E-34	5.76E-04	1.24E-08	9.88E-07	6.51E-04
205	1.00E+04	4.10E-04	6.38E-35	2.16E-04	2.81E-08	2.24E-06	6.28E-04
34	1.00E+04	2.61E-04	7.78E-35	3.52E-04	4.83E-08	3.87E-06	6.16E-04
13	1.00E+04	3.11E-04	7.96E-35	2.82E-04	1.77E-05	4.38E-06	6.14E-04
163	1.00E+04	3.74E-04	6.93E-35	2.26E-04	2.67E-06	5.89E-06	6.08E-04
142	1.00E+04	3.89E-04	4.86E-35	1.58E-04	3.44E-05	9.46E-06	5.91E-04
135	1.00E+04	2.71E-04	6.24E-35	2.93E-04	1.91E-05	5.34E-06	5.89E-04
252	1.00E+04	1.48E-04	8.84E-35	3.83E-04	9.69E-07	3.18E-06	5.35E-04
23	1.00E+04	2.02E-04	-4.50E-11	2.47E-04	7.46E-06	5.22E-06	4.62E-04
227	1.00E+04	2.95E-04	4.43E-35	1.44E-04	6.90E-06	2.47E-06	4.49E-04
131	1.00E+04	3.03E-04	2.84E-35	1.29E-04	2.20E-06	2.89E-06	4.36E-04
148	1.00E+04	2.10E-04	2.93E-35	2.16E-04	2.51E-06	5.33E-06	4.34E-04
109	1.00E+04	1.66E-04	7.99E-35	2.57E-04	3.48E-08	2.77E-06	4.26E-04
229	1.00E+04	2.70E-04	2.27E-35	1.43E-04	6.85E-06	4.17E-06	4.24E-04
169	1.00E+04	1.86E-05	3.95E-34	3.93E-04	2.55E-09	2.03E-07	4.12E-04
191	1.00E+04	2.22E-04	4.65E-35	1.75E-04	6.63E-06	4.87E-06	4.08E-04
188	1.00E+04	3.37E-04	2.02E-35	6.34E-05	9.34E-08	1.49E-06	4.02E-04
41	1.00E+04	2.18E-04	3.21E-35	1.05E-04	1.04E-05	3.16E-06	3.37E-04
225	1.00E+04	1.21E-04	3.22E-35	1.69E-04	3.55E-08	2.84E-06	2.93E-04
195	1.00E+04	1.33E-04	4.29E-35	1.38E-04	2.83E-08	2.25E-06	2.73E-04
12	1.00E+04	2.32E-04	8.90E-36	2.90E-05	1.50E-06	1.02E-06	2.63E-04
35	1.00E+04	1.31E-04	6.87E-35	9.26E-05	2.01E-08	1.60E-06	2.26E-04
179	1.00E+04	3.83E-05	5.36E-35	1.75E-04	6.08E-09	4.84E-07	2.13E-04
99	1.00E+04	1.35E-04	1.68E-35	6.71E-05	3.12E-08	2.49E-06	2.04E-04
144	1.00E+04	4.97E-05	3.20E-35	1.39E-04	7.08E-07	8.81E-07	1.91E-04
202	1.00E+04	1.05E-04	2.22E-35	7.63E-05	2.71E-06	2.35E-06	1.87E-04
71	1.00E+04	1.53E-04	6.03E-36	1.99E-05	6.32E-06	1.15E-06	1.80E-04
300	1.00E+04	1.27E-04	7.34E-36	2.39E-05	2.33E-06	5.61E-07	1.54E-04
66	1.00E+04	1.29E-04	6.42E-36	2.39E-05	1.04E-08	8.26E-07	1.54E-04
194	1.00E+04	2.51E-05	4.11E-35	1.25E-04	2.73E-09	2.18E-07	1.51E-04
63	1.00E+04	6.15E-05	2.62E-35	8.55E-05	1.24E-08	9.88E-07	1.48E-04
104	1.00E+04	1.26E-04	6.36E-36	2.07E-05	5.45E-07	5.56E-07	1.48E-04
48	1.00E+04	1.06E-04	8.13E-36	3.91E-05	1.31E-08	1.05E-06	1.46E-04
68	1.00E+04	1.04E-04	1.20E-35	3.71E-05	8.00E-07	8.27E-07	1.43E-04
161	1.00E+04	9.24E-05	1.45E-35	4.15E-05	7.42E-09	5.91E-07	1.34E-04

198	1.00E+04	5.61E-05	2.31E-35	7.19E-05	1.28E-06	1.24E-06	1.31E-04
241	1.00E+04	5.57E-06	5.27E-35	1.16E-04	1.01E-09	8.07E-08	1.21E-04
95	1.00E+04	5.93E-05	1.80E-35	5.64E-05	4.06E-09	3.23E-07	1.16E-04
174	1.00E+04	8.86E-05	4.52E-36	1.95E-05	3.89E-06	9.81E-07	1.13E-04
43	1.00E+04	8.79E-05	6.83E-36	2.22E-05	1.25E-06	1.10E-06	1.13E-04
269	1.00E+04	9.30E-05	6.27E-36	1.08E-05	6.08E-07	4.11E-07	1.05E-04
11	1.00E+04	5.57E-05	2.28E-35	4.81E-05	5.06E-09	4.03E-07	1.04E-04
16	1.00E+04	1.07E-05	5.36E-35	8.58E-05	6.76E-07	1.61E-07	9.73E-05
120	1.00E+04	6.69E-05	9.31E-36	2.95E-05	4.52E-09	3.60E-07	9.67E-05
220	1.00E+04	7.73E-06	3.16E-35	8.61E-05	1.41E-09	1.12E-07	9.40E-05
117	1.00E+04	2.29E-05	1.99E-35	6.49E-05	4.37E-09	3.48E-07	8.82E-05
49	1.00E+04	3.03E-05	1.14E-35	5.33E-05	6.41E-09	5.12E-07	8.41E-05
261	1.00E+04	4.14E-05	1.12E-35	3.64E-05	6.74E-09	5.37E-07	7.84E-05
250	1.00E+04	5.36E-05	5.12E-36	1.77E-05	4.29E-06	5.08E-07	7.61E-05
167	1.00E+04	4.57E-05	5.91E-36	2.56E-05	9.67E-07	5.19E-07	7.28E-05
193	1.00E+04	4.65E-05	1.57E-35	2.18E-05	1.97E-06	6.97E-07	7.10E-05
112	1.00E+04	5.48E-05	4.71E-36	1.53E-05	9.46E-08	3.22E-07	7.05E-05
121	1.00E+04	3.55E-05	1.26E-35	3.05E-05	8.58E-07	5.08E-07	6.74E-05
39	1.00E+04	4.70E-05	-7.75E-11	1.72E-05	1.66E-06	8.81E-07	6.68E-05
249	1.00E+04	2.59E-05	1.90E-35	3.89E-05	4.48E-09	3.57E-07	6.51E-05
84	1.00E+04	4.40E-05	7.50E-36	1.92E-05	9.89E-07	3.27E-07	6.44E-05
246	1.00E+04	4.50E-05	3.72E-36	1.75E-05	5.69E-09	4.55E-07	6.29E-05
116	1.00E+04	3.77E-05	8.46E-36	1.79E-05	5.71E-06	4.98E-07	6.17E-05
165	1.00E+04	2.84E-05	3.53E-36	1.15E-05	1.67E-05	4.12E-07	5.70E-05
231	1.00E+04	4.03E-05	4.66E-36	1.52E-05	6.89E-09	5.49E-07	5.61E-05
118	1.00E+04	2.37E-05	9.49E-36	2.90E-05	3.54E-09	2.82E-07	5.30E-05
119	1.00E+04	3.21E-05	4.47E-36	2.02E-05	8.13E-09	6.50E-07	5.29E-05
196	1.00E+04	4.81E-05	1.12E-36	3.66E-06	2.67E-09	2.13E-07	5.20E-05
189	1.00E+04	2.77E-05	7.19E-36	2.34E-05	4.83E-09	3.84E-07	5.15E-05
54	1.00E+04	2.41E-05	6.32E-36	2.06E-05	5.88E-06	3.44E-07	5.09E-05
134	1.00E+04	3.97E-05	3.03E-36	9.88E-06	7.44E-07	3.34E-07	5.06E-05
275	1.00E+04	1.96E-05	9.92E-36	2.79E-05	3.73E-09	2.97E-07	4.78E-05
218	1.00E+04	4.07E-05	2.01E-36	6.55E-06	2.58E-07	1.81E-07	4.77E-05
94	1.00E+04	1.09E-05	1.03E-35	3.37E-05	2.41E-09	1.92E-07	4.48E-05
8	1.00E+04	2.61E-05	5.41E-36	1.76E-05	2.89E-09	2.30E-07	4.40E-05
213	1.00E+04	3.51E-05	4.85E-36	8.40E-06	8.90E-08	2.51E-07	4.38E-05
78	1.00E+04	3.43E-05	2.14E-36	6.99E-06	5.41E-07	3.73E-07	4.22E-05
33	1.00E+04	2.46E-05	6.52E-36	1.54E-05	1.29E-06	4.43E-07	4.17E-05
203	1.00E+04	1.63E-05	7.19E-36	2.34E-05	1.54E-06	2.63E-07	4.15E-05
289	1.00E+04	2.62E-05	2.73E-35	1.44E-05	1.69E-09	1.35E-07	4.08E-05
226	1.00E+04	1.73E-05	6.85E-36	2.23E-05	2.69E-09	2.14E-07	3.99E-05
207	1.00E+04	2.37E-05	5.67E-36	1.56E-05	4.19E-09	3.34E-07	3.96E-05
73	1.00E+04	2.62E-05	3.07E-36	1.07E-05	9.21E-07	2.86E-07	3.81E-05
214	1.00E+04	2.69E-05	1.77E-36	5.16E-06	6.26E-07	2.29E-07	3.29E-05
230	1.00E+04	2.40E-05	1.39E-36	4.54E-06	2.59E-06	1.92E-07	3.14E-05
159	1.00E+04	1.74E-05	3.81E-36	1.24E-05	2.94E-09	2.34E-07	3.01E-05
138	1.00E+04	2.06E-05	2.60E-36	8.47E-06	5.36E-07	2.46E-07	2.98E-05
180	1.00E+04	1.80E-05	2.84E-36	9.25E-06	2.41E-07	1.55E-07	2.76E-05
139	1.00E+04	7.93E-06	8.98E-35	1.93E-05	4.53E-10	3.61E-08	2.73E-05
2	1.00E+04	1.70E-05	3.04E-36	9.90E-06	2.30E-09	1.83E-07	2.71E-05

270	1.00E+04	2.30E-05	1.63E-36	3.62E-06	2.59E-07	1.95E-07	2.71E-05
293	1.00E+04	1.07E-05	1.41E-35	1.54E-05	2.59E-07	2.69E-07	2.66E-05
268	1.00E+04	9.59E-06	4.86E-36	1.58E-05	1.84E-09	1.47E-07	2.56E-05
143	1.00E+04	1.58E-05	3.44E-36	9.32E-06	1.83E-09	1.46E-07	2.52E-05
31	1.00E+04	2.19E-05	1.46E-36	2.86E-06	7.55E-08	1.15E-07	2.50E-05
295	1.00E+04	1.63E-05	5.83E-36	7.87E-06	3.45E-07	2.14E-07	2.48E-05
294	1.00E+04	2.04E-05	9.52E-37	3.10E-06	2.74E-07	9.29E-08	2.39E-05
282	1.00E+04	1.71E-05	1.80E-36	6.23E-06	4.09E-09	3.26E-07	2.36E-05
182	1.00E+04	2.05E-05	8.14E-37	2.65E-06	2.39E-07	1.62E-07	2.36E-05
51	1.00E+04	1.42E-05	3.28E-36	8.92E-06	1.39E-09	1.11E-07	2.33E-05
211	1.00E+04	1.58E-05	2.09E-36	6.80E-06	3.86E-07	1.78E-07	2.32E-05
279	1.00E+04	1.17E-05	2.89E-36	9.42E-06	1.83E-09	1.46E-07	2.13E-05
299	1.00E+04	1.56E-05	1.56E-36	5.09E-06	9.87E-08	2.00E-07	2.10E-05
127	1.00E+04	1.56E-05	1.28E-36	4.18E-06	9.00E-07	2.40E-07	2.09E-05
255	1.00E+04	3.91E-06	4.68E-36	1.52E-05	4.69E-07	6.59E-08	1.97E-05
199	1.00E+04	8.65E-06	7.77E-36	9.84E-06	1.63E-09	1.29E-07	1.86E-05
30	1.00E+04	1.49E-05	1.19E-36	2.98E-06	1.12E-07	1.55E-07	1.81E-05
105	1.00E+04	1.38E-05	1.53E-36	3.32E-06	3.42E-07	1.28E-07	1.76E-05
201	1.00E+04	1.34E-05	1.01E-36	3.28E-06	4.41E-07	1.29E-07	1.73E-05
17	1.00E+04	1.11E-05	1.78E-36	5.26E-06	2.47E-07	1.48E-07	1.68E-05
6	1.00E+04	1.13E-05	1.54E-36	4.46E-06	6.26E-10	4.99E-08	1.58E-05
91	1.00E+04	1.07E-05	1.09E-36	3.55E-06	8.47E-07	1.41E-07	1.53E-05
32	1.00E+04	1.02E-05	9.86E-37	4.52E-06	3.35E-07	1.52E-07	1.52E-05
103	1.00E+04	3.85E-06	3.44E-36	1.12E-05	7.21E-10	5.74E-08	1.51E-05
185	1.00E+04	7.16E-06	2.39E-36	7.79E-06	1.13E-09	8.99E-08	1.50E-05
216	1.00E+04	5.99E-06	3.44E-36	8.41E-06	7.50E-10	5.97E-08	1.45E-05
233	1.00E+04	7.31E-06	1.10E-36	3.58E-06	3.09E-06	1.31E-07	1.41E-05
172	1.00E+04	8.84E-06	1.37E-36	4.45E-06	2.07E-07	1.12E-07	1.36E-05
21	1.00E+04	3.83E-06	2.82E-36	9.19E-06	5.08E-10	4.04E-08	1.31E-05
136	1.00E+04	1.06E-05	6.06E-37	1.98E-06	7.49E-08	4.70E-08	1.27E-05
62	1.00E+04	2.85E-06	4.49E-36	8.31E-06	8.18E-10	6.52E-08	1.12E-05
156	1.00E+04	3.46E-06	2.95E-36	6.76E-06	4.51E-08	1.53E-08	1.03E-05
200	1.00E+04	4.49E-06	1.08E-35	5.55E-06	1.57E-09	1.26E-07	1.02E-05
57	1.00E+04	6.94E-06	7.66E-37	2.50E-06	3.85E-10	3.06E-08	9.46E-06
170	1.00E+04	6.22E-06	1.54E-35	2.52E-06	2.53E-07	8.15E-08	9.07E-06
24	1.00E+04	5.12E-06	9.44E-37	3.32E-06	4.72E-10	3.76E-08	8.48E-06
283	1.00E+04	3.36E-06	8.36E-37	4.87E-06	1.11E-09	8.90E-08	8.32E-06
29	1.00E+04	5.32E-06	6.94E-37	2.26E-06	6.42E-07	6.98E-08	8.29E-06
113	1.00E+04	3.68E-06	1.36E-36	4.43E-06	7.26E-08	3.42E-08	8.21E-06
89	1.00E+04	5.83E-06	3.33E-36	2.34E-06	3.23E-10	2.57E-08	8.20E-06
210	1.00E+04	5.65E-06	7.33E-37	2.39E-06	9.00E-08	4.72E-08	8.17E-06
140	1.00E+04	4.00E-06	3.41E-36	4.06E-06	7.03E-10	5.60E-08	8.11E-06
76	1.00E+04	5.42E-06	6.26E-37	2.04E-06	1.20E-07	4.77E-08	7.62E-06
190	1.00E+04	6.07E-06	1.71E-35	1.36E-06	6.21E-08	3.20E-08	7.53E-06
15	1.00E+04	2.93E-06	1.18E-36	3.84E-06	9.36E-08	2.75E-08	6.89E-06
242	1.00E+04	3.60E-06	1.58E-36	3.13E-06	6.97E-10	5.55E-08	6.79E-06
65	1.00E+04	4.27E-06	1.45E-36	2.19E-06	3.68E-08	3.57E-08	6.53E-06
258	1.00E+04	3.22E-06	9.86E-37	3.21E-06	7.35E-10	5.85E-08	6.49E-06
171	1.00E+04	3.38E-06	4.56E-36	2.27E-06	5.51E-10	4.38E-08	5.69E-06
272	1.00E+04	2.81E-06	7.27E-37	2.37E-06	6.05E-10	4.82E-08	5.23E-06

232	1.00E+04	4.23E-06	2.43E-37	8.14E-07	1.08E-07	2.78E-08	5.18E-06
157	1.00E+04	3.87E-06	2.76E-37	9.00E-07	3.65E-09	2.16E-08	4.79E-06
74	1.00E+04	2.70E-06	6.16E-36	1.92E-06	4.03E-10	3.21E-08	4.66E-06
44	1.00E+04	2.48E-06	5.30E-37	1.73E-06	7.54E-08	3.48E-08	4.32E-06
173	1.00E+04	2.21E-06	5.53E-37	1.93E-06	3.07E-10	2.44E-08	4.17E-06
114	1.00E+04	2.76E-06	3.84E-37	1.25E-06	3.16E-10	2.51E-08	4.03E-06
281	1.00E+04	2.58E-06	4.17E-37	1.36E-06	9.35E-09	3.42E-08	3.98E-06
150	1.00E+04	2.26E-06	4.94E-37	1.61E-06	5.87E-08	2.94E-08	3.96E-06
237	1.00E+04	2.77E-06	2.52E-37	8.20E-07	4.51E-10	3.59E-08	3.63E-06
234	1.00E+04	2.06E-06	1.27E-36	7.21E-07	1.67E-08	1.85E-08	2.82E-06
175	1.00E+04	1.61E-06	7.53E-36	1.05E-06	3.00E-10	2.39E-08	2.69E-06
96	1.00E+04	1.40E-06	2.42E-37	7.88E-07	2.40E-10	1.91E-08	2.21E-06
97	1.00E+04	1.36E-06	2.03E-37	6.63E-07	2.38E-08	1.80E-08	2.07E-06
85	1.00E+04	1.30E-06	7.33E-37	7.40E-07	2.48E-10	1.97E-08	2.06E-06
273	1.00E+04	1.01E-06	0.00E+00	4.31E-07	3.22E-09	4.54E-09	1.45E-06
42	1.00E+04	5.66E-07	2.23E-37	7.27E-07	3.58E-11	2.85E-09	1.30E-06
60	1.00E+04	2.89E-08	0.00E+00	4.00E-07	6.78E-12	5.40E-10	4.29E-07
224	1.00E+04	5.30E-08	1.26E-36	5.28E-08	2.96E-09	9.45E-10	1.10E-07
115	1.00E+04	7.54E-09	0.00E+00	4.06E-09	4.34E-13	3.46E-11	1.16E-08
208	1.00E+04	6.54E-09	3.83E-37	1.05E-09	3.63E-13	2.89E-11	7.61E-09
278	1.00E+04	2.67E-09	0.00E+00	7.84E-10	8.98E-11	4.80E-11	3.59E-09
83	1.00E+04	2.26E-09	1.55E-35	9.47E-10	1.40E-13	9.99E-12	3.21E-09
1	1.00E+04	2.13E-09	1.11E-35	6.19E-10	3.81E-11	1.63E-11	2.80E-09
107	1.00E+04	8.15E-11	2.90E-34	2.44E-10	4.65E-15	3.13E-13	3.26E-10
296	1.00E+04	1.30E-10	2.67E-35	2.35E-11	1.42E-12	5.30E-13	1.56E-10
298	1.00E+04	4.31E-11	3.19E-35	6.52E-11	4.60E-15	3.18E-13	1.09E-10
263	1.00E+04	2.40E-11	4.75E-35	8.38E-11	1.20E-15	8.23E-14	1.08E-10
101	1.00E+04	5.48E-11	4.66E-36	1.85E-11	3.00E-12	1.73E-13	7.64E-11
197	1.00E+04	6.28E-11	8.36E-36	9.41E-12	1.10E-12	2.97E-13	7.36E-11
297	1.00E+04	4.93E-11	1.40E-35	2.32E-11	3.60E-15	2.47E-13	7.28E-11
122	1.00E+04	6.36E-11	7.19E-36	7.69E-12	3.84E-15	2.61E-13	7.16E-11
3	1.00E+04	6.08E-11	4.81E-36	6.71E-12	3.62E-12	3.47E-13	7.15E-11
53	1.00E+04	4.28E-11	2.38E-35	1.53E-11	1.89E-15	1.27E-13	5.82E-11
75	1.00E+04	4.10E-11	5.98E-36	8.28E-12	1.29E-12	2.41E-13	5.09E-11
271	1.00E+04	4.54E-11	1.78E-36	2.99E-12	2.72E-14	1.59E-13	4.86E-11
158	1.00E+04	2.56E-11	1.80E-35	1.27E-11	1.14E-15	7.61E-14	3.84E-11
176	1.00E+04	2.20E-11	0.00E+00	1.11E-11	1.60E-15	1.14E-13	3.32E-11
248	1.00E+04	2.09E-11	3.08E-36	8.93E-12	9.57E-16	6.53E-14	2.99E-11
264	1.00E+04	2.34E-11	4.81E-36	4.75E-12	1.62E-13	1.28E-13	2.84E-11
164	1.00E+04	1.99E-11	4.21E-36	5.77E-12	1.70E-12	1.06E-13	2.75E-11
259	1.00E+04	2.00E-11	2.49E-36	6.03E-12	5.33E-13	1.24E-13	2.67E-11
160	1.00E+04	2.08E-11	2.78E-36	2.97E-12	4.77E-13	6.83E-14	2.44E-11
79	1.00E+04	1.73E-11	4.42E-36	5.21E-12	8.88E-16	6.02E-14	2.25E-11
45	1.00E+04	1.69E-11	2.04E-36	3.32E-12	3.98E-15	1.01E-13	2.03E-11
123	1.00E+04	1.33E-11	0.00E+00	6.20E-12	3.54E-13	1.14E-13	1.99E-11
46	1.00E+04	1.63E-11	2.61E-36	3.32E-12	1.59E-15	1.09E-13	1.98E-11
106	1.00E+04	1.00E-11	8.57E-36	7.00E-12	4.94E-13	4.23E-14	1.75E-11
86	1.00E+04	1.39E-11	3.73E-36	3.06E-12	9.30E-16	6.26E-14	1.70E-11
212	1.00E+04	1.26E-11	1.46E-36	1.61E-12	6.96E-14	3.82E-14	1.43E-11
186	1.00E+04	1.22E-11	2.21E-36	1.91E-12	6.65E-16	4.49E-14	1.42E-11

141	1.00E+04	6.53E-12	2.92E-36	1.90E-12	3.48E-16	2.34E-14	8.46E-12
80	1.00E+04	2.01E-12	1.29E-35	6.25E-12	8.80E-17	5.86E-15	8.26E-12
254	1.00E+04	3.91E-12	8.12E-37	1.04E-12	1.76E-16	1.18E-14	4.96E-12
132	1.00E+04	3.66E-12	4.78E-37	9.48E-13	1.83E-16	1.25E-14	4.62E-12
274	1.00E+04	3.15E-12	1.34E-36	9.76E-13	1.61E-16	1.08E-14	4.14E-12
192	1.00E+04	3.27E-12	9.22E-37	5.96E-13	5.13E-16	1.07E-14	3.87E-12
56	1.00E+04	3.39E-12	0.00E+00	3.24E-13	1.32E-15	1.05E-14	3.73E-12
151	1.00E+04	1.41E-12	1.50E-36	7.24E-13	6.18E-17	4.11E-15	2.14E-12
59	1.00E+04	1.46E-12	4.94E-37	3.03E-13	8.69E-17	5.80E-15	1.77E-12
58	1.00E+04	1.12E-12	6.37E-37	3.93E-13	5.12E-17	3.42E-15	1.52E-12
155	1.00E+04	1.11E-12	0.00E+00	9.72E-14	2.03E-14	3.29E-15	1.23E-12
61	1.00E+04	6.92E-13	7.22E-37	3.49E-13	3.03E-17	2.02E-15	1.04E-12
5	1.00E+04	8.01E-13	2.07E-37	9.99E-14	4.35E-15	2.34E-15	9.08E-13
129	1.00E+04	3.94E-13	0.00E+00	2.77E-14	1.98E-15	1.26E-15	4.25E-13
137	1.00E+04	1.50E-13	0.00E+00	1.31E-14	6.55E-18	4.36E-16	1.63E-13
257	1.00E+04	1.00E-13	0.00E+00	6.22E-14	4.39E-18	2.92E-16	1.63E-13
247	1.00E+04	5.98E-14	0.00E+00	9.27E-15	2.62E-18	1.74E-16	6.93E-14
4	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
36	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
37	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
38	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
47	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
70	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
133	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
149	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
162	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
168	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
178	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
187	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
206	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
209	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
219	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
223	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
239	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
244	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
288	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
291	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
292	1.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
277	1.00E+04	-2.13E-10	-1.67E-12	6.71E-13	3.77E-14	2.20E-14	-2.14E-10

*break

APPENDIX Q: Top Realizations

Table Q-1. Top Realizations for Total 10,000 Year Release (EPA units)

	Vector	241Am	239Pu	238Pu	234U	230Th	Total
s2							
100	111	6.57E+00	4.51E-02	1.73E-03	5.23E-05	9.40E-04	6.62E+00
350	111	6.00E+00	4.44E-02	8.07E-05	2.21E-05	9.28E-04	6.04E+00
s3							
1000	111	2.15E+00	4.40E-02	1.23E-06	7.48E-06	1.01E-03	2.19E+00
3000	128	4.32E-02	3.16E-01	2.69E-08	9.86E-06	3.21E-04	3.60E-01
5000	128	3.76E-03	2.36E-01	1.76E-10	7.20E-06	2.41E-04	2.40E-01
7000	128	2.06E-04	1.42E-01	2.67E-13	4.26E-06	1.49E-04	1.42E-01
9000	128	1.36E-05	3.53E-02	2.59E-15	1.05E-06	4.94E-05	3.54E-02
s4							
100	23	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
350	23	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
s5							
1000	23	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
3000	23	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
5000	23	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00
7000	23	6.81E-08	1.09E+00	1.68E-18	5.14E-04	9.24E-03	1.10E+00
9000	124	8.75E-08	2.67E-02	1.86E-18	3.54E-06	2.64E-04	2.70E-02
s6							
100	111	9.46E+01	4.29E-01	3.83E-02	6.88E-05	2.03E-03	9.50E+01
350	111	6.82E+01	4.24E-01	5.36E-03	6.85E-05	2.13E-03	6.87E+01
1000	111	2.56E+01	4.09E-01	3.23E-05	6.63E-05	2.37E-03	2.60E+01
2000	111	5.18E+00	3.87E-01	1.24E-08	6.29E-05	2.69E-03	5.57E+00
4000	128	1.34E-01	6.57E-01	6.83E-14	2.05E-05	1.28E-03	7.92E-01
6000	128	2.30E-02	4.67E-01	1.00E-20	1.46E-05	1.03E-03	4.91E-01
9000	128	9.80E-03	1.84E-01	5.60E-31	5.78E-06	4.73E-04	1.95E-01
max							9.50E+01

Table Q-2. Top Realizations for ^{241}Am 10,000 Year Release (EPA units)

	Vector	241Am	239Pu	238Pu	234U	230Th	Total
s2							
100	111	6.57E+00	4.51E-02	1.73E-03	5.23E-05	9.40E-04	6.62E+00
350	111	6.00E+00	4.44E-02	8.07E-05	2.21E-05	9.28E-04	6.04E+00
s3							
1000	111	2.15E+00	4.40E-02	1.23E-06	7.48E-06	1.01E-03	2.19E+00
3000	125	1.13E-01	3.60E-03	6.42E-09	9.79E-07	4.63E-05	1.17E-01
5000	236	1.24E-02	8.06E-03	5.37E-10	1.02E-06	1.30E-04	2.05E-02
7000	236	1.59E-03	8.06E-03	3.59E-12	1.02E-06	1.30E-04	9.78E-03
9000	90	1.57E-04	2.45E-03	2.11E-14	1.49E-04	6.54E-05	2.82E-03
s4							
100	141	3.90E-01	1.23E-01	1.36E-08	4.03E-03	1.21E-01	6.39E-01
350	141	2.35E-01	1.20E-01	2.42E-09	3.94E-03	1.18E-01	4.77E-01
s5							
1000	128	1.97E-01	7.97E-01	4.80E-06	4.29E-04	7.57E-02	1.07E+00
3000	128	7.62E-03	4.47E-01	8.10E-09	2.07E-04	4.56E-02	5.00E-01
5000	128	6.86E-04	2.51E-01	5.58E-11	1.16E-04	2.49E-02	2.77E-01
7000	141	4.38E-05	1.17E-02	2.19E-17	3.25E-04	1.14E-02	2.35E-02
9000	128	2.27E-06	1.46E-02	7.20E-16	6.71E-06	1.26E-03	1.58E-02
s6							
100	111	9.46E+01	4.29E-01	3.83E-02	6.88E-05	2.03E-03	9.50E+01
350	111	6.82E+01	4.24E-01	5.36E-03	6.85E-05	2.13E-03	6.87E+01
1000	111	2.56E+01	4.09E-01	3.23E-05	6.63E-05	2.37E-03	2.60E+01
2000	111	5.18E+00	3.87E-01	1.24E-08	6.29E-05	2.69E-03	5.57E+00
4000	111	2.35E-01	3.39E-01	1.81E-15	5.55E-05	3.08E-03	5.78E-01
6000	111	3.13E-02	2.85E-01	2.65E-22	4.68E-05	3.12E-03	3.20E-01
9000	111	1.78E-02	1.72E-01	1.44E-32	2.84E-05	2.32E-03	1.92E-01
max		9.46E+01					

Table Q-3. Top Realizations for ^{239}Pu 10,000 Year Release (EPA units)

	Vector	241Am	239Pu	238Pu	234U	230Th	Total
s2							
100	128	1.76E+00	6.27E-01	4.46E-03	2.79E-05	5.01E-04	2.40E+00
350	128	1.47E+00	6.12E-01	9.71E-04	2.72E-05	4.88E-04	2.08E+00
s3							
1000	128	6.97E-01	4.09E-01	5.00E-06	2.30E-05	4.13E-04	1.11E+00
3000	128	4.32E-02	3.16E-01	2.69E-08	9.86E-06	3.21E-04	3.60E-01
5000	128	3.76E-03	2.36E-01	1.76E-10	7.20E-06	2.41E-04	2.40E-01
7000	128	2.06E-04	1.42E-01	2.67E-13	4.26E-06	1.49E-04	1.42E-01
9000	128	1.36E-05	3.53E-02	2.59E-15	1.05E-06	4.94E-05	3.54E-02
s4							
100	23	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
350	23	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
s5							
1000	23	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
3000	23	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
5000	23	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00
7000	23	6.81E-08	1.09E+00	1.68E-18	5.14E-04	9.24E-03	1.10E+00
9000	124	8.75E-08	2.67E-02	1.86E-18	3.54E-06	2.64E-04	2.70E-02
s6							
100	128	6.55E+00	1.07E+00	4.73E-02	3.30E-05	1.50E-03	7.67E+00
350	128	6.07E+00	1.04E+00	1.58E-02	3.23E-05	1.50E-03	7.13E+00
1000	128	4.76E+00	9.74E-01	1.21E-03	3.02E-05	1.49E-03	5.73E+00
2000	128	2.19E+00	8.64E-01	4.66E-07	2.68E-05	1.45E-03	3.06E+00
4000	128	1.34E-01	6.57E-01	6.83E-14	2.05E-05	1.28E-03	7.92E-01
6000	128	2.30E-02	4.67E-01	1.00E-20	1.46E-05	1.03E-03	4.91E-01
9000	128	9.80E-03	1.84E-01	5.60E-31	5.78E-06	4.73E-04	1.95E-01
max			2.08E+01				

Table Q-4. Top Realizations for ^{238}Pu 10,000 Year Release (EPA units)

	Vector	241Am	239Pu	238Pu	234U	230Th	Total
s2							
100	128	1.76E+00	6.27E-01	4.46E-03	2.79E-05	5.01E-04	2.40E+00
350	128	1.47E+00	6.12E-01	9.71E-04	2.72E-05	4.88E-04	2.08E+00
s3							
1000	128	6.97E-01	4.09E-01	5.00E-06	2.30E-05	4.13E-04	1.11E+00
3000	82	5.83E-02	4.76E-03	1.76E-07	2.19E-05	4.22E-05	6.31E-02
5000	236	1.24E-02	8.06E-03	5.37E-10	1.02E-06	1.30E-04	2.05E-02
7000	19	6.65E-04	6.20E-03	3.70E-12	8.41E-07	1.06E-04	6.97E-03
9000	287	5.07E-05	4.56E-04	5.55E-14	3.04E-05	1.39E-05	5.51E-04
s4							
100	280	2.06E-01	7.17E-01	1.43E-05	2.94E-04	2.08E-02	9.44E-01
350	280	1.82E-01	7.05E-01	2.96E-06	2.87E-04	2.03E-02	9.08E-01
s5							
1000	128	1.97E-01	7.97E-01	4.80E-06	4.29E-04	7.57E-02	1.07E+00
3000	128	7.62E-03	4.47E-01	8.10E-09	2.07E-04	4.56E-02	5.00E-01
5000	128	6.86E-04	2.51E-01	5.58E-11	1.16E-04	2.49E-02	2.77E-01
7000	128	3.79E-05	8.92E-02	8.41E-14	4.12E-05	8.57E-03	9.79E-02
9000	128	2.27E-06	1.46E-02	7.20E-16	6.71E-06	1.26E-03	1.58E-02
s6							
100	128	6.55E+00	1.07E+00	4.73E-02	3.30E-05	1.50E-03	7.67E+00
350	128	6.07E+00	1.04E+00	1.58E-02	3.23E-05	1.50E-03	7.13E+00
1000	128	4.76E+00	9.74E-01	1.21E-03	3.02E-05	1.49E-03	5.73E+00
2000	128	2.19E+00	8.64E-01	4.66E-07	2.68E-05	1.45E-03	3.06E+00
4000	128	1.34E-01	6.57E-01	6.83E-14	2.05E-05	1.28E-03	7.92E-01
6000	128	2.30E-02	4.67E-01	1.00E-20	1.46E-05	1.03E-03	4.91E-01
9000	128	9.80E-03	1.84E-01	5.60E-31	5.78E-06	4.73E-04	1.95E-01
max				4.73E-02			

Table Q-5. Top Realizations for ^{234}U 10,000 Year Release (EPA units)

	Vector	241Am	239Pu	238Pu	234U	230Th	Total
s2							
100	23	3.16E-01	1.02E-01	1.78E-08	3.28E-03	6.08E-04	4.22E-01
350	23	2.19E-01	9.92E-02	3.87E-09	2.87E-03	5.88E-04	3.22E-01
s3							
1000	23	3.68E-02	9.10E-02	4.83E-12	3.58E-03	5.32E-04	1.32E-01
3000	23	2.06E-04	6.03E-02	2.41E-15	1.67E-03	3.33E-04	6.25E-02
5000	23	1.15E-05	2.88E-02	5.86E-18	7.96E-04	1.57E-04	2.97E-02
7000	256	9.67E-04	5.57E-03	1.48E-12	4.78E-04	1.64E-04	7.18E-03
9000	256	4.97E-05	2.39E-03	4.44E-15	2.04E-04	4.07E-05	2.69E-03
s4							
100	23	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
350	23	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
s5							
1000	23	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
3000	23	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
5000	23	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00
7000	23	6.81E-08	1.09E+00	1.68E-18	5.14E-04	9.24E-03	1.10E+00
9000	260	1.72E-06	5.08E-05	4.26E-19	9.96E-06	1.39E-05	7.64E-05
s6							
100	23	4.09E+00	1.93E-01	3.69E-07	5.74E-03	2.58E-03	4.30E+00
350	23	3.23E+00	1.87E-01	5.17E-08	5.58E-03	2.56E-03	3.43E+00
1000	23	1.48E+00	1.73E-01	3.94E-10	5.15E-03	2.49E-03	1.66E+00
2000	23	3.26E-01	1.51E-01	2.16E-11	4.50E-03	2.34E-03	4.83E-01
4000	23	3.44E-02	1.06E-01	-4.23E-11	3.17E-03	1.85E-03	1.45E-01
6000	256	2.00E-02	2.12E-02	3.49E-23	1.98E-03	4.34E-04	4.36E-02
9000	256	1.04E-02	1.52E-02	1.91E-33	1.44E-03	4.00E-04	2.74E-02
max					1.31E-02		

Table Q-6. Top Realizations for ^{230}Th 10,000 Year Release (EPA units)

	Vector	241Am	239Pu	238Pu	234U	230Th	Total
s2							
100	111	6.57E+00	4.51E-02	1.73E-03	5.23E-05	9.40E-04	6.62E+00
350	111	6.00E+00	4.44E-02	8.07E-05	2.21E-05	9.28E-04	6.04E+00
s3							
1000	181	1.89E-02	3.07E-03	3.76E-09	3.70E-07	3.06E-03	2.51E-02
3000	111	3.71E-03	3.64E-02	4.03E-09	5.52E-06	8.47E-04	4.09E-02
5000	111	9.92E-04	3.26E-02	1.02E-10	4.94E-06	7.63E-04	3.44E-02
7000	111	1.25E-04	2.54E-02	9.16E-13	3.83E-06	5.82E-04	2.61E-02
9000	111	1.18E-05	1.29E-02	9.46E-15	1.95E-06	3.36E-04	1.33E-02
s4							
100	23	1.41E-01	2.08E+01	1.55E-06	1.31E-02	1.77E-01	2.11E+01
350	23	5.87E-02	2.01E+01	2.39E-07	9.43E-03	1.72E-01	2.04E+01
s5							
1000	23	1.34E-02	1.82E+01	6.12E-09	1.16E-02	1.55E-01	1.84E+01
3000	23	2.82E-04	1.15E+01	6.59E-14	5.47E-03	9.85E-02	1.16E+01
5000	23	1.65E-05	5.57E+00	1.39E-16	2.72E-03	4.76E-02	5.62E+00
7000	141	4.38E-05	1.17E-02	2.19E-17	3.25E-04	1.14E-02	2.35E-02
9000	128	2.27E-06	1.46E-02	7.20E-16	6.71E-06	1.26E-03	1.58E-02
s6							
100	23	4.09E+00	1.93E-01	3.69E-07	5.74E-03	2.58E-03	4.30E+00
350	23	3.23E+00	1.87E-01	5.17E-08	5.58E-03	2.56E-03	3.43E+00
1000	23	1.48E+00	1.73E-01	3.94E-10	5.15E-03	2.49E-03	1.66E+00
2000	111	5.18E+00	3.87E-01	1.24E-08	6.29E-05	2.69E-03	5.57E+00
4000	111	2.35E-01	3.39E-01	1.81E-15	5.55E-05	3.08E-03	5.78E-01
6000	111	3.13E-02	2.85E-01	2.65E-22	4.68E-05	3.12E-03	3.20E-01
9000	111	1.78E-02	1.72E-01	1.44E-32	2.84E-05	2.32E-03	1.92E-01
max						1.77E-01	