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Definition of Loss-of-Coolant Accident Radiation Source: Summary and Conclusions

Lloyd L. Bonzon, Sandia Laboratories
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Sandia Laboratories

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DEFINITION OF LOSS-OF-COOLANT ACCIDENT RADIATION SOURCE:
SUMMARY AND CONCLUSIONS

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ABSTRACT

The technical aspects of this report were prepared by IRT Corporation under contract to Sandia Laboratories. This study is an elaboration on, and update of, an earlier report, SAND76-0740, NUREG76-6521, "Radiation Signature Following the Hypothesized LOCA," October, 1977 (Revised); in general there is good agreement. A full report, with complete data, was also generated under this contract; but because of its substantial bulk, it has not been issued for wide distribution. Its principal utility is as a reference source of additional data and, if required, it is available through the National Technical Information Service (NTIS) as SAND78-0090, "Definition of Loss-of-Coolant Accident Radiation Source."

The radiation energy release rates and spectra corresponding to those sources specified in USNRC Regulatory Guide 1.89 for the radiation qualification of Class 1E equipment were calculated. The effects of several parameters (some not specific in the Guide), such as reactor fuel composition, operating duration and power level, and treatment of progeny, are evaluated. The results are presented as time-dependent beta and gamma-ray energy release rates and spectra which are fundamental quantities that are not specific to a plant design but are generally applicable to any nuclear power station.

The reported work is a part of the Qualification Testing Evaluation Program (FIN No. A-1051-8) being conducted at Sandia Laboratories, Albuquerque, for the United States Nuclear Regulatory Commission, Research Support Branch, Office of Water Reactor Safety Research.

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DEFINITION OF LOSS-OF-COOLANT ACCIDENT RADIATION SOURCE: SUMMARY AND CONCLUSIONS

PART I Program Continuity

The second part of this document is the full summary report, prepared by IRT Corporation, which parametrically examines the LOCA-radiation source signature as specified in Regulatory Guide 1.89 [1]; the Guide is to be used in the radiation qualification of Class 1E (i.e., safety-related) equipment [2]. While Part II is a stand-alone report with respect to its specific goals and objectives, it requires elaboration in two areas to provide a continuity and context for the reader. These two areas, overall programmatic objective and report impact and conclusions, are the subject of Part I.

I.1 Background

IEEE-323 [2] is regarded as the parent document for describing the qualification of Class 1E equipment and includes the principles, procedures, and methods of qualification. These requirements, when met, will confirm the adequacy of the equipment design under normal, abnormal, design basis event, post-design basis event, and containment test conditions. IEEE-323 recognizes that qualification may be accomplished in several ways, through typetesting, operating experience, analyses, on-going, or combinations. In typetesting, it is expected that equipment will be subjected to the environments and operating conditions for which it was designed and its performance measured. In a test program, however, it is usually practical only to simulate environments and operating conditions. The limitations in such simulations must be evaluated on a case-by-case basis. Both operating experience and analysis are recognized as methods of only limited value, whereas typetesting of actual equipment in simulated service conditions is the preferred method. However, it was recognized that a typetest alone satisfies qualification only if the equipment to be tested is aged, subjected to all environmental influences, and operated under post-event conditions to provide assurance that the equipment will be able to perform its intended function for at least the required operating time. When size or other practical requirements limit or preclude type-tests, this method of qualification is suspect. A further practical limitation in qualification testing has been that it is difficult to apply all test environments simultaneously. In particular, radiation exposure is usually done sequentially and separately from the other environments.

A principal controversy in qualification testing has been in the definition of the radiation environment. The most widely accepted industry standard is contained in IEEE-323; unfortunately, the specified radiation environments are relegated to an Appendix, which means they are not officially a part of the standard. Two separate radiation

profiles are presented, one for the pressurized water reactor and one for the boiling water reactor. For the pressurized water reactor, it is specified that the radiation dose to the containment atmosphere is 4 MR after one hour, 20 MR after twelve hours, etc., to a total of 150 MR after one year. The boiling water reactor profile is even less specific in that the radiation environment is specified as 26 MR integrated over the accident. It was recognized that the values would vary from plant to plant and they may or may not contain adequate margin. However, a footnote to that table indicates that the values are a "... conservative calculation of radiation dose to the containment atmosphere resulting from beta and gamma radiation emitters released from the primary system and at a location within the primary containment."

More recently, various drafts of Regulatory Guide 1.89 [3,1] have defined the radiation source to be used as a basis in defining the LOCA-radiation signature. Although the Guide generally endorses the principles of IEEE-323, in the area of the applicable radiation sources, it [1] endorses two sources based on Regulatory Guides 1.25 [4], 1.3 [5], 1.4 [6] and 1.7 [7]; these are shown in Table 1.

TABLE 1
Sources Specification

Source 1 (Containment heat- removal systems, etc.)	Airborne	100% Noble Gases, 25% Iodines
	Plateout	25% Iodines, 1% Solids
	Waterborne	50% Halogens, 1% Solids
Source 2 (Other safety- related electrical systems)	Airborne	10% Noble Gases (except Kr-85), 30% Kr-85, 5% Iodines
	Plateout	5% Iodines
	Waterborne	10% Halogens

The translation of these nuclide fraction specifications into energy release rates, radiation type, and radiation spectra as functions of time is the subject of the full summary report (Part II). The report also establishes the sensitivity of these measurables to parametric variation of certain key explicit, implicit, and unspecified assumptions in the Guide.

I.2 Overall Programmatic Objectives

The specific objectives of the reported study (Section I.3) are better understood in light of the overall program objectives.

Ultimately, this program will assess the "adequacy" of radiation simulators in duplicating "damage" to Class 1E equipment resulting from the LOCA sources signatures, as hypothesized in the Regulatory Guide. Adequacy may involve a three-stage evaluation process. First, simulators can be adjudged on the basis of nearly identical (with the LOCA sources signature) measurables inherent to any radiation environment, i.e., dose rate, dose, energy spectra, and particle type. Second, adequacy can be judged on the basis of nearly identical calculated depositions in the equipment, e.g., depth-dose or charged-particle depositions. For example, depth-dose accounts for the energy dependence and particle type dependence of the radiation signature; equivalent component damage is assured by equivalent depth-dose profiles. Third, and lastly, equipment "damage" equivalence is the fundamental measure of simulator adequacy.

While the adequacy assessment may need to proceed sequentially through each of these stages, the first requirement is an accurate definition of the actual (i.e., hypothesized) LOCA-radiation source signatures.

I.3 Objectives of Study

Necessarily preceding the assessment of simulator "adequacy", the LOCA radiation environment must be adequately defined.

Initial source signature definition under this program is contained in SAND76-0740 [8]. That work was based on the earlier draft of the Guide [3] where only one source (but with the three spatial variations) was specified; that source was similar to Source 1 in Table 1. Four significant features of that study were:

1. A definition of the LOCA radiation sources energy release rate as a function of time following the hypothesized releases.
2. A definition of the LOCA radiation sources energy spectra as a function of time following the hypothesized releases, with both the gamma and beta spectra exhibiting a changing energy dependence with time.
3. A (formal) definition of expectable magnitudes of the gamma and beta dose and rate for a typical containment, using the applicable Regulatory Guide.

4. A (formal) recognition that the beta dose and rate are significantly greater than the corresponding gamma values.

While these results appeared to be at odds with usual methods of radiation qualification testing, it was immediately recognized that additional source definition efforts should be undertaken. Impetuses for expanding the effort were many and varied:

- The evolution of Regulatory Guide 1.89 drafts into its current version [1] with its newly specified Source 1 and additionally specified Source 2.
- The need to incorporate the latest fission product decay scheme data [9], but particularly the best available beta spectra data [10,11] which was not available for the earlier study [8].
- The desirability of establishing the signature sensitivity to certain key explicit, implicit, and unspecified assumptions in the Guide.
- The repeated inquiries by utilities, architect-engineers, and equipment manufacturers as to the accuracy of the signature with respect to the data base and assumptions and the signature sensitivity to various assumptions.

To facilitate this effort, a subcontract was negotiated with IRT Corporation to perform calculations to define the radiation signature resulting from the hypothesized loss-of-coolant accident and to support the evaluation of the effect of that environment on selected Class 1 equipment. Effectively, the contract encompassed six distinct phases. The first phase was to provide a definition of contractor capabilities to perform the overall contract. This phase was satisfactorily concluded by IRT report 8167-001 [12].

Phases 2-4 ran concurrently and the report in Part II of this document satisfies the contractual requirements. Phase 2 involved calculation of the LOCA radiation release rates, Phase 3 the LOCA radiation spectra, and Phase 4 the verification and correlation of the calculations. These phases involved numerous parametric calculations, besides the specific sources specified in the Guide [1], including reactor fuel composition, operating duration and power level, and treatment of progeny. While variations in fission product release assumptions was not a specific part of the contract, radiation signatures for the natural grouping of nuclides (i.e., halogens, iodines, noble gases and solids) were also calculated and could be used to evaluate the release magnitude/spectra sensitivity to nuclide percentage release assumptions.

Phases 5 and 6 are presently being performed concurrently. In these phases, depth-dose and charged-particle distribution profiles are being generated for a typical Class 1E electric cable comparing

the LOCA signatures and various radiation simulators signatures. These will be used to make preliminary judgments of simulator "adequacy".

I.4 Presentation of Information

Part II presents the full summary report of Phases 2-4 as developed by IRT Corporation and reviewed by Sandia Laboratories staff. Initially, IRT provided a full report, with complete data; this was given limited distribution under SAND78-0090 designation [13]. The very substantial size of that document limited its (likely) utility to the general readership. For particular purposes it may be a useful reference source of additional data and, thus, it has been made available through NTIS. It is also extensively cross-referenced in this report to provide guidance to the potential readership.

While Part II is singularly complete with respect to its specific goals and objectives, Section I.5 presents an elaboration of the data in terms of its impact and programmatic conclusions. In certain areas, additional efforts can be outlined as well.

I.5 Summary, Conclusions and Impact

Section 5 of the Part II report summarizes specific conclusions developed in the course of the study by IRT Corporation. Generally the work is significant as (1) the most detailed definition of the hypothesized LOCA-radiation signature to date, and (2) the parametric evaluation of signature sensitivity indicates relatively little effect from varying most parameters over conservative or expectable ranges.

Perhaps more significantly is the potential and impact of this work as a comprehensive data base and serial report. In that light, consider the following topics.

- The range of parameters influencing the radiation signature suggests the need for greater preciseness in their specification to avoid variations in the resultant calculations by licensees.
- It may be prudent to adopt a uniform source signature (from this work), as a replacement for nuclide fractionation specifications, to assure identical generic data base by licensees.
- The greatest signature-influencing factor appears to be the original nuclide fractionation specifications; it would be useful to support these with experimental data base if

possible, to avoid future respecification and subsequent influence on past radiation qualification programs.

- Early assessment of beta radiation significance is important in evaluating radiation qualification programs.
- With generic data base established, the plant-specific dose and rate values can be accurately established within the bounds of plant-layout assumptions.
- The evaluation of simulator "adequacy" can proceed from this generic data base, as discussed in Section I.2.
- An even more realistic representation of the LOCA radiation source could be constructed, by techniques similar to those used here, based on a prescribed accident sequencing as suggested in WASH-1400 [14] and supported by ongoing experimental programs. The sequencing would account for the time-dependence and the magnitude of the releases. WASH-1400 provides estimates for the four categories of release (gap, meltdown, vaporization, and steam explosion fractions) and for the time (given as a range) of each release occurrence.

In summary, this work, of itself, provides a formal definition of the currently hypothesized LOCA radiation signatures and a signature-sensitivity study. Beyond those immediate objectives, the work can be viewed as a generic data base influencing standards developments/revisions and as a prerequisite serial in the evaluation of radiation qualification adequacy.

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DEFINITION OF LOSS-OF-COOLANT
ACCIDENT RADIATION SOURCE:
SUMMARY AND CONCLUSIONS

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I. INTRODUCTION

Meaningful qualification testing of nuclear reactor equipment requires a knowledge of the radiation fields expected in a loss-of-coolant accident (LOCA). The overall objective of the entire program is to define the LOCA source terms and compare the calculated "damage" produced by the sources in modeled class IE equipment to the calculated "damage" produced by a test source or simulator used for qualification testing.

This document is a summary of the comprehensive final report (Ref. 1) covering the calculations of the LOCA source energy release rates and spectra (Phases 2,3,4). The methodology and discussions of the results are given here in their entirety, but the extensive tabulations and plots of energy release rates and spectral data are not reproduced here. Selected results and comparisons of greatest interest and significance are presented to illustrate the types of results obtained in this study. The energy release rate and spectra calculations were validated by comparison with other calculations using different codes since experimental data appropriate to these calculations do not exist.

2. LOCA ENERGY RELEASE RATES

The fission product energy release rate or decay power after reactor shutdown or accident is a complicated time-dependent quantity. There are a number of variables that control the inventory of fission products which exists in the reactor at any time, and therefore control the energy release rate. These variables include the length of time the reactor has been in operation, the power levels during operation and the fissile composition of the core. In realistic situations the operating power varies and there are periods that the reactor is shut down. These conditions make it difficult to provide precise detailed information on fission product inventories applicable to all plants. Rather, general trends and simplified irradiation histories have been used to investigate bounding conditions which are pertinent to the present purposes.

The effects of the parameters mentioned that control the fission product inventory have been investigated. Other variables which affect the energy release rates were also studied. The complete results are presented in both tabular and graphical forms in Reference 1, and many cross-comparisons are presented to more clearly show the differences.

A description of the source terms investigated in this work and the method of calculating the decay power are given in the following sections. These are followed by a presentation of selected results and a discussion of the conclusions drawn from the results.

2.1 SOURCES INVESTIGATED

The LOCA radiation sources appropriate for qualification testing have, to an extent, been specified in U.S.N.R.C. Regulatory Guide 1.89 (Ref. 2). The assumed fractionation of species is based on other Regulatory Guides. For example, the waterborne source is based on Regulatory Guide 1.7, and the airborne sources are defined by Regulatory Guides 1.3 and 1.4 (Refs. 3-5). In this study no attempt was made to verify or justify the appropriateness of the specified sources as given in the Guide; this is a subject for future inquiry. Another important assumption implicit in the source

specifications is that the specified fractions of the core inventory are instantaneously released at shutdown or LOCA, and no additional releases are made. This is an oversimplification of the complex dynamics of fission product release and transport that would likely occur during a LOCA.

The sources are divided into two source strengths (for safety-related electrical systems, and for containment heat-removal systems) and three distribution categories: (1) airborne (uniformly dispersed in the containment atmosphere); (2) plate-out (plated out on surfaces exposed to the containment atmosphere); and (3) waterborne (intimately mixed with coolant water). Table 2.1 summarizes the specifications from the Guide and lists all the various sources used in the calculations.

Table 2.1. SOURCE DEFINITIONS

Source 1 (Containment heat- removal systems, etc.)	Airborne	100% Noble gases, 25% Iodines
	Plate-Out	25% Iodines, 1% Solids
	Waterborne	50% Halogens, 1% Solids
Source 2 (Safety-related electrical systems)	Airborne	10% Noble gases (except Kr-85), 30% Kr-85, 5% Iodines
	Plate-Out	1% Iodines
	Waterborne	10% Halogens
Source 3		100% Halogens
Source 4		100% Iodines
Source 5		100% Noble Gases
Source 6		100% Solids
Source 7		100% All Fission Products

To better understand the implications and importance of assumptions about irradiation history and other parameters, a series of calculations was undertaken for a range of parameters which span the conditions of interest. The parameters investigated include length of irradiation, power level, and fissile composition of the fuel. The Guide is also nonspecific about whether or not progeny of the species of interest are to be included; this point was also investigated.

In addition to the sources listed in Regulatory Guide 1.89, calculations were made for each of the major constituents, i.e., 100% halogens, 100% iodines, 100% noble gases, 100% solids, and all fission products. The latter source was intended primarily as a reference for comparison with published calculations or with experimental decay heat data. For each of the sources, separate beta and gamma-ray contributions were calculated.

2.2 METHODS OF CALCULATION

The primary code used for fission product energy release rate calculations was RIBD-II (Ref. 6). To provide verification of the results, a limited number of calculations were compared with results from other codes. The results of these comparisons will be discussed in greater detail in Section 4. The recent work on fission product decay heat calculations has established that with proper input assumptions, all the codes give virtually identical results when the same data base is used (Ref. 7). All of the results reported here utilize the ENDF/B-IV fission product data library with corrections (Refs. 8,9).

Modifications to RIBD-II were required to tally the selected groups of fission products specified in the previous section. The specified types were tracked with and without allowing their daughters to be included in the tally. At each cooling time for which a tally was made the ten nuclides which constitute the most significant contributors to the energy release rate were determined.

2.3 RESULTS

Gamma-ray and beta energy release rates were calculated for each of the seven sources listed in Table 2.1, for each of four irradiation times and for pure U-235 at a power level of 1 watt. The irradiation times studied were 200 d, 500 d, 5000 d and equilibrium. For the latter, a time of 10^{13} seconds was used in accordance with the

usual convention as specified in the proposed revised ANS decay heat standard (Ref. 10). Contributions from all daughters of the specified types are included in the energy release rates.

The results for the energy release rates (expressed in MeV/sec) are tabulated in Table 2.2 through 2.9 and plotted in Figures 2.1 through 2.22. In each figure the energy release rates are plotted for a given source and distribution (air, plate-out, water) for the four different irradiation times. For most cases it may be seen that there is little difference in the energy release rates at cooling times less than about 1 day (86,400 sec). The cases which show the greatest effect of length of irradiation are Sources 6 and 7 (100% solids and all fission products).

Tabulations of the ten nuclides which are the greatest contributors to the energy release rates for Sources 1, 2 and 7 for equilibrium and 200-day irradiations are given in Appendix A. These tables list the nuclides in order of their importance and the percentage of the total beta or gamma decay power which they contribute. In nearly every case beyond 30-days cooling, almost all the decay power comes from one or two nuclides. Data for the other sources and irradiations are given in Reference 1.

To study the effects that power levels have on energy release rates, additional calculations were performed with the power assumed to be 4000 MW(t). This can have two effects: (1) the increased neutron flux can result in transmutation by neutron capture, thus altering the inventory of fission products present; and (2) at a high sustained operating power, depletion of the fuel and conversion of the fertile isotopes present to fissile isotopes also changes the mixture of fission products present.

The first case was investigated by simply increasing the operating power and flux. All fissions were assumed to come from U-235 and no depletion effects were considered. In the absence of neutron capture effects, the decay power should scale linearly with the operating power. The results of these calculations for Source 1 are summarized in Table 2.10. Tabulations of the 10 greatest contributing nuclides for these calculations are given in Appendix B of Reference 1. The results are discussed in Section 2.4.1.

The second case was studied by permitting a specific (increasing) fraction of the fissions to occur in Pu-239 over the irradiation period. Only the equilibrium and 200-day irradiations were studied for this case. For the former it was assumed that initially all of the fissions were occurring in U-235 and by the end of the irradiation period 50

Table 2.2

SOURCE=1, POWER=1 WATT, PURE U-235

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCA (SEC)	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.362+10	6.745+09	1.569+10	2.362+10	6.754+09	1.568+10	2.362+10	6.750+09	1.567+10	2.362+10	6.744+09	1.567+10
1.000+00	2.266+10	6.526+09	1.488+10	2.266+10	6.517+09	1.487+10	2.266+10	6.515+09	1.487+10	2.266+10	6.507+09	1.486+10
2.000+00	2.205+10	6.377+09	1.435+10	2.205+10	6.368+09	1.434+10	2.205+10	6.364+09	1.434+10	2.205+10	6.358+09	1.433+10
5.000+00	2.087+10	6.086+09	1.335+10	2.087+10	6.077+09	1.334+10	2.087+10	6.073+09	1.334+10	2.087+10	6.067+09	1.333+10
1.000+01	1.981+10	5.790+09	1.241+10	1.981+10	5.781+09	1.240+10	1.981+10	5.777+09	1.240+10	1.981+10	5.771+09	1.239+10
2.000+01	1.850+10	5.434+09	1.136+10	1.850+10	5.424+09	1.135+10	1.850+10	5.421+09	1.135+10	1.850+10	5.415+09	1.134+10
5.000+01	1.621+10	4.895+09	9.888+09	1.621+10	4.885+09	9.879+09	1.621+10	4.882+09	9.875+09	1.621+10	4.876+09	9.869+09
1.000+01	1.570+10	4.782+09	9.592+09	1.570+10	4.773+09	9.582+09	1.570+10	4.769+09	9.578+09	1.570+10	4.763+09	9.572+09
2.000+02	1.427+10	4.470+09	8.802+09	1.427+10	4.465+09	8.792+09	1.427+10	4.462+09	8.789+09	1.427+10	4.455+09	8.783+09
5.000+02	1.254+10	4.119+09	7.945+09	1.254+10	4.110+09	7.936+09	1.254+10	4.106+09	7.932+09	1.254+10	4.100+09	7.926+09
1.000+02	1.075+10	3.772+09	7.254+09	1.075+10	3.768+09	7.245+09	1.075+10	3.765+09	7.241+09	1.075+10	3.759+09	7.235+09
2.000+03	9.656+09	3.511+09	6.755+09	9.656+09	3.500+09	6.745+09	9.656+09	3.497+09	6.742+09	9.656+09	3.491+09	6.736+09
5.000+03	8.449+09	3.114+09	5.986+09	8.449+09	3.105+09	5.977+09	8.448+09	3.101+09	5.974+09	8.448+09	3.095+09	5.970+09
2.000+03	7.016+09	2.647+09	5.059+09	7.015+09	2.637+09	5.049+09	7.015+09	2.634+09	5.046+09	7.015+09	2.628+09	5.040+09
5.000+03	6.078+09	2.342+09	4.452+09	6.073+09	2.333+09	4.442+09	6.073+09	2.329+09	4.439+09	6.073+09	2.324+09	4.433+09
1.000+04	4.093+09	1.687+09	3.153+09	4.093+09	1.677+09	3.144+09	4.093+09	1.674+09	3.141+09	4.093+09	1.669+09	3.134+09
2.000+04	2.460+09	1.150+09	2.125+09	2.459+09	1.150+09	2.116+09	2.459+09	1.147+09	2.113+09	2.459+09	1.141+09	2.107+09
5.000+04	1.199+09	7.255+08	1.320+09	1.199+09	7.262+08	1.311+09	1.199+09	7.326+08	1.307+09	1.199+09	7.266+08	1.301+09
1.000+04	1.039+09	6.799+08	1.193+09	1.038+09	6.707+08	1.183+09	1.038+09	6.671+08	1.180+09	1.038+09	6.611+08	1.174+09
2.000+04	8.214+08	4.611+08	7.806+08	8.212+08	4.588+08	7.756+08	8.211+08	4.552+08	7.719+08	8.211+08	4.492+08	7.660+08
5.000+04	5.456+08	4.213+08	6.956+08	5.455+08	4.120+08	6.893+08	5.454+08	4.084+08	6.827+08	5.454+08	4.028+08	6.767+08
2.000+05	3.095+08	2.618+08	3.965+08	3.094+08	2.525+08	3.873+08	3.093+08	2.489+08	3.836+08	3.093+08	2.450+08	3.777+08
5.000+05	2.103+08	1.932+08	2.747+08	2.102+08	1.840+08	2.654+08	2.101+08	1.804+08	2.618+08	2.101+08	1.740+08	2.560+08
1.000+05	1.596+08	1.623+08	2.233+08	1.595+08	1.531+08	2.141+08	1.594+08	1.495+08	2.105+08	1.594+08	1.437+08	2.047+08
2.000+05	9.386+07	1.240+08	1.638+08	9.375+07	1.151+08	1.546+08	9.365+07	1.115+08	1.510+08	9.364+07	1.060+08	1.455+08
5.000+05	7.806+07	1.147+08	1.484+08	7.795+07	1.054+08	1.376+08	7.785+07	1.019+08	1.360+08	7.784+07	9.644+07	1.306+08
2.000+06	2.190+07	7.287+07	8.513+07	2.183+07	6.365+07	7.588+07	2.173+07	6.011+07	7.234+07	2.172+07	5.523+07	7.466+07
5.000+06	1.047+07	6.044+07	6.725+07	1.077+07	5.128+07	5.801+07	1.067+07	4.777+07	5.449+07	1.066+07	4.318+07	4.991+07
2.000+06	9.636+05	3.043+07	4.006+07	9.635+05	3.023+07	3.084+07	9.636+05	2.679+07	2.739+07	9.639+05	2.323+07	2.583+07
5.000+06	8.343+05	3.462+07	3.915+07	7.264+05	2.943+07	2.993+07	6.294+05	2.599+07	2.650+07	6.198+05	2.250+07	2.500+07
1.000+07	2.257+05	2.676+07	2.679+07	1.185+05	1.760+07	1.760+07	2.252+04	1.427+07	1.428+07	1.299+04	1.211+07	1.211+07
2.000+07	2.190+05	2.277+07	2.280+07	1.171+05	1.363+07	1.363+07	1.686+04	1.036+07	1.036+07	7.366+03	8.708+06	8.708+06
5.000+07	2.158+05	1.720+07	1.727+07	1.107+05	8.144+06	8.144+06	1.614+04	4.963+06	4.963+06	6.883+03	4.017+06	4.017+06
2.000+07	2.110+05	1.586+07	1.588+07	1.076+05	4.837+06	4.837+06	1.577+04	1.761+06	1.761+06	6.646+03	1.244+06	1.244+06

Table 2.3

SOURCE=1, POWER=1 WATT, PIURE 11=235

BEIA ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCAL (SEC)	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.255+10	4.200+09	1.165+10	2.255+10	4.182+09	1.162+10	2.253+10	4.168+09	1.160+10	2.253+10	4.158+09	1.159+10
1.000+00	2.144+10	3.957+09	1.066+10	2.144+10	3.939+09	1.066+10	2.144+10	3.925+09	1.065+10	2.144+10	3.915+09	1.062+10
2.000+00	2.074+10	3.810+09	1.002+10	2.069+10	3.793+09	1.000+10	2.068+10	3.779+09	9.988+09	2.068+10	3.768+09	9.978+09
5.000+00	1.904+10	3.530+09	8.830+09	1.905+10	3.512+09	8.812+09	1.904+10	3.499+09	8.798+09	1.904+10	3.488+09	8.788+09
1.000+01	1.737+10	3.251+09	7.701+09	1.736+10	3.233+09	7.721+09	1.735+10	3.219+09	7.709+09	1.735+10	3.209+09	7.699+09
2.000+01	1.569+10	2.925+09	6.597+09	1.539+10	2.907+09	6.570+09	1.548+10	2.893+09	6.565+09	1.538+10	2.883+09	6.555+09
5.000+01	1.263+10	2.454+09	5.122+09	1.262+10	2.437+09	5.104+09	1.261+10	2.423+09	5.090+09	1.261+10	2.412+09	5.079+09
6.000+01	1.207+10	2.358+09	4.840+09	1.206+10	2.340+09	4.822+09	1.205+10	2.326+09	4.808+09	1.204+10	2.316+09	4.798+09
1.000+02	1.048+10	2.094+09	4.109+09	1.047+10	2.076+09	4.091+09	1.046+10	2.062+09	4.077+09	1.046+10	2.052+09	4.066+09
2.000+02	8.510+09	1.794+09	3.335+09	8.501+09	1.776+09	3.317+09	8.490+09	1.762+09	3.303+09	8.489+09	1.751+09	3.293+09
5.000+02	6.511+09	1.537+09	2.771+09	6.502+09	1.519+09	2.753+09	6.491+09	1.505+09	2.739+09	6.490+09	1.495+09	2.729+09
1.000+03	5.475+09	1.388+09	2.503+09	5.466+09	1.370+09	2.485+09	5.455+09	1.356+09	2.471+09	5.453+09	1.346+09	2.461+09
2.000+03	5.325+09	1.218+09	2.201+09	5.316+09	1.201+09	2.183+09	5.305+09	1.187+09	2.169+09	5.304+09	1.176+09	2.158+09
3.000+03	4.820+09	1.055+09	1.888+09	4.811+09	1.038+09	1.870+09	4.800+09	1.024+09	1.856+09	4.799+09	1.013+09	1.846+09
5.000+03	4.347+09	9.407+08	1.700+09	4.338+09	9.429+08	1.682+09	4.327+09	9.420+08	1.668+09	4.326+09	9.418+08	1.658+09
1.000+04	3.087+09	7.891+08	1.322+09	3.078+09	7.513+08	1.300+09	3.067+09	7.374+08	1.291+09	3.066+09	7.269+08	1.280+09
2.000+04	1.887+09	6.114+08	1.028+09	1.878+09	5.936+08	1.010+09	1.867+09	5.797+08	9.960+08	1.865+09	5.692+08	9.855+08
4.000+04	9.402+08	4.609+08	7.588+08	9.371+08	4.432+08	7.411+08	9.260+08	4.292+08	7.271+08	9.250+08	4.187+08	7.166+08
5.000+04	8.279+08	4.322+08	7.077+08	8.188+08	4.144+08	6.899+08	8.077+08	4.005+08	6.766+08	8.067+08	3.900+08	6.655+08
6.000+04	5.182+08	3.248+08	5.101+08	5.091+08	3.071+08	4.980+08	4.981+08	2.932+08	4.824+08	4.970+08	2.827+08	4.719+08
1.000+05	4.400+08	2.975+08	4.661+08	4.313+08	2.798+08	4.463+08	4.403+08	2.659+08	4.328+08	4.392+08	2.554+08	4.219+08
2.000+05	2.758+08	1.931+08	2.724+08	2.667+08	1.754+08	2.547+08	2.557+08	1.615+08	2.408+08	2.546+08	1.511+08	2.303+08
3.000+05	2.099+08	1.081+08	1.920+08	1.918+08	1.304+08	1.793+08	1.808+08	1.165+08	1.404+08	1.797+08	1.061+08	1.501+08
5.000+05	1.617+08	1.303+08	1.622+08	1.526+08	1.126+08	1.405+08	1.616+08	9.873+07	1.304+08	1.405+08	8.844+07	1.203+08
6.000+05	1.055+08	1.182+08	1.366+08	9.607+07	9.253+07	1.129+08	8.547+07	7.878+07	9.917+07	8.438+07	6.866+07	8.905+07
1.000+06	9.115+07	1.051+08	1.222+08	8.211+07	8.743+07	1.050+08	7.112+07	7.370+07	9.132+07	7.003+07	6.365+07	8.127+07
2.000+06	1.049+07	8.218+07	8.834+07	3.043+07	6.451+07	7.394+07	1.946+07	4.099+07	5.713+07	1.837+07	4.139+07	4.753+07
2.592+06	2.987+07	7.409+07	7.827+07	2.082+07	5.720+07	6.056+07	9.880+06	4.385+07	4.717+07	8.773+06	3.450+07	3.782+07
5.180+06	2.217+07	6.080+07	6.113+07	1.316+07	4.317+07	4.346+07	2.261+06	3.026+07	3.054+07	1.179+06	2.181+07	2.210+07
5.184+06	2.208+07	6.017+07	6.045+07	1.308+07	4.254+07	4.278+07	2.182+06	2.966+07	2.990+07	1.100+06	2.126+07	2.152+07
1.000+07	2.153+07	4.986+07	4.991+07	1.262+07	3.250+07	3.230+07	1.828+06	2.027+07	2.028+07	7.566+05	1.326+07	1.326+07
1.296+07	2.140+07	4.612+07	4.616+07	1.250+07	2.859+07	2.850+07	1.812+06	1.704+07	1.704+07	7.473+05	1.068+07	1.068+07
2.000+07	2.109+07	4.032+07	4.036+07	1.235+07	2.289+07	2.285+07	1.783+06	1.731+07	1.231+07	7.332+05	7.187+06	7.187+06
3.156+07	2.060+07	3.497+07	3.561+07	1.208+07	1.769+07	1.769+07	1.740+06	8.369+06	8.369+06	7.147+05	4.554+06	4.554+06

GAMMA RAYS-SOURCE 1 (AIR), 1 WATT, PURE U-235

Figure 2.1

Figure 2.2

Figure 2.3

BETA RAYS- SOURCE 1 (PLATE OUT), 1 WATT, PURE U-235

Figure 2.4

Figure 2.5

BETA RAYS- SOURCE 1 (WATER), 1 WATT, PURE U-235

Figure 2.6

Table 2.4

SOURCE-7, POWER=1 WATT, PURE U-235

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME AFTER LOCA (SEC)	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.909+00	1.063+00	2.847+00	2.909+00	1.063+00	2.847+00	2.909+00	1.063+00	2.847+00	2.909+00	1.063+00	2.847+00
1.000+00	2.800+00	1.037+00	2.708+00	2.800+00	1.037+00	2.708+00	2.800+00	1.037+00	2.708+00	2.800+00	1.037+00	2.708+00
2.000+00	2.729+00	1.018+00	2.613+00	2.729+00	1.018+00	2.613+00	2.729+00	1.018+00	2.613+00	2.729+00	1.018+00	2.613+00
5.000+00	2.592+00	9.785+08	2.432+00	2.592+00	9.785+08	2.432+00	2.592+00	9.785+08	2.432+00	2.592+00	9.785+08	2.432+00
1.000+01	2.464+00	9.362+08	2.260+00	2.464+00	9.362+08	2.260+00	2.464+00	9.362+08	2.260+00	2.464+00	9.362+08	2.260+00
2.000+01	2.307+00	8.844+08	2.070+00	2.307+00	8.844+08	2.070+00	2.307+00	8.844+08	2.070+00	2.307+00	8.844+08	2.070+00
5.000+01	2.038+00	8.050+08	1.804+00	2.038+00	8.050+08	1.804+00	2.038+00	8.050+08	1.804+00	2.038+00	8.050+08	1.804+00
6.000+01	1.979+00	7.883+08	1.750+00	1.979+00	7.883+08	1.750+00	1.979+00	7.883+08	1.750+00	1.979+00	7.883+08	1.750+00
1.000+02	1.813+00	7.429+08	1.608+00	1.813+00	7.429+08	1.608+00	1.813+00	7.429+08	1.608+00	1.813+00	7.429+08	1.608+00
2.000+02	1.615+00	6.924+08	1.454+00	1.615+00	6.924+08	1.454+00	1.615+00	6.924+08	1.454+00	1.615+00	6.924+08	1.454+00
5.000+02	1.413+00	6.474+08	1.343+00	1.413+00	6.474+08	1.343+00	1.413+00	6.474+08	1.343+00	1.413+00	6.474+08	1.343+00
1.000+03	1.285+00	6.102+08	1.259+00	1.285+00	6.102+08	1.259+00	1.285+00	6.102+08	1.259+00	1.285+00	6.102+08	1.259+00
2.000+03	1.132+00	5.476+08	1.122+00	1.132+00	5.475+08	1.122+00	1.132+00	5.475+08	1.122+00	1.132+00	5.475+08	1.122+00
3.000+03	9.479+08	4.670+08	9.494+08	9.479+08	4.670+08	9.494+08	9.479+08	4.670+08	9.494+08	9.479+08	4.670+08	9.494+08
5.000+03	8.256+08	4.122+08	8.340+08	8.256+08	4.122+08	8.340+08	8.256+08	4.122+08	8.340+08	8.256+08	4.122+08	8.340+08
1.000+04	5.647+08	2.913+08	5.846+08	5.647+08	2.912+08	5.846+08	5.647+08	2.912+08	5.846+08	5.647+08	2.912+08	5.846+08
2.000+04	3.887+08	1.927+08	3.859+08	3.887+08	1.927+08	3.859+08	3.887+08	1.927+08	3.859+08	3.887+08	1.927+08	3.859+08
4.320+04	1.797+08	1.188+08	2.297+08	1.796+08	1.188+08	2.296+08	1.796+08	1.188+08	2.296+08	1.796+08	1.188+08	2.296+08
5.000+04	1.569+08	1.025+08	2.051+08	1.569+08	1.025+08	2.051+08	1.568+08	1.025+08	2.051+08	1.568+08	1.025+08	2.051+08
8.400+04	9.621+07	6.334+07	1.267+08	9.618+07	6.334+07	1.267+08	9.615+07	6.334+07	1.267+08	9.615+07	6.334+07	1.267+08
1.000+05	8.223+07	5.485+07	1.097+08	8.220+07	5.484+07	1.097+08	8.217+07	5.484+07	1.097+08	8.217+07	5.484+07	1.097+08
2.000+05	4.867+07	2.674+07	5.389+07	4.843+07	2.694+07	5.388+07	4.840+07	2.694+07	5.388+07	4.840+07	2.694+07	5.388+07
3.456+05	2.921+07	1.628+07	3.257+07	2.918+07	1.628+07	3.256+07	2.915+07	1.628+07	3.256+07	2.915+07	1.628+07	3.256+07
5.000+05	2.211+07	1.221+07	2.441+07	2.208+07	1.220+07	2.440+07	2.205+07	1.220+07	2.440+07	2.204+07	1.220+07	2.440+07
8.400+05	1.337+07	7.890+06	1.578+07	1.334+07	7.888+06	1.577+07	1.331+07	7.884+06	1.577+07	1.331+07	7.884+06	1.577+07
1.000+06	1.126+07	6.851+06	1.368+07	1.123+07	6.829+06	1.365+07	1.120+07	6.826+06	1.365+07	1.120+07	6.826+06	1.365+07
2.000+06	3.458+06	7.457+06	4.904+06	3.429+06	7.448+06	4.892+06	3.399+06	7.444+06	4.892+06	3.397+06	7.444+06	4.892+06
2.592+06	1.801+06	1.350+06	2.701+06	1.772+06	1.345+06	2.689+06	1.743+06	1.345+06	2.689+06	1.740+06	1.345+06	2.689+06
5.000+06	1.984+05	1.270+05	2.548+05	1.849+05	1.218+05	2.427+05	1.398+05	1.218+05	2.427+05	1.369+05	1.214+05	2.427+05
5.184+06	1.754+05	1.068+05	2.135+05	1.659+05	1.011+05	2.023+05	1.168+05	1.011+05	2.023+05	1.139+05	1.011+05	2.023+05
1.000+07	6.809+04	6.573+03	1.315+04	6.767+04	6.566+03	1.315+04	6.729+04	6.566+03	1.315+04	6.729+04	6.566+03	1.315+04
1.296+07	6.275+04	5.705+03	1.141+04	6.157+04	6.068+03	1.214+04	6.132+04	6.068+03	1.214+04	6.099+04	6.044+03	1.214+04
2.000+07	6.186+04	5.686+03	1.129+04	6.301+04	1.259+04	2.528+00	6.785+03	1.038+00	2.088+00	1.982+03	1.023+00	2.056+00
3.156+07	6.054+04	5.646+03	1.129+04	3.274+04	1.052+00	2.113+00	6.673+03	8.311+01	1.671+00	1.936+03	8.164+01	1.642+00

Table 2.5

SOURCE=2, POWER=1 WATT, PURE U-235

HFPA ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCA (SEC)	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.535+09	5.150+08	2.002+09	2.532+09	5.150+08	2.002+09	2.529+09	5.150+08	2.002+09	2.529+09	5.150+08	2.002+09
1.000+00	2.417+09	4.964+08	1.837+09	2.415+09	4.964+08	1.837+09	2.411+09	4.964+08	1.837+09	2.411+09	4.964+08	1.837+09
2.000+00	2.334+09	4.825+08	1.724+09	2.331+09	4.825+08	1.724+09	2.328+09	4.825+08	1.724+09	2.327+09	4.825+08	1.724+09
5.000+00	2.155+09	4.530+08	1.513+09	2.152+09	4.530+08	1.513+09	2.149+09	4.530+08	1.513+09	2.149+09	4.530+08	1.513+09
1.000+01	1.970+09	4.210+08	1.319+09	1.967+09	4.210+08	1.319+09	1.964+09	4.210+08	1.319+09	1.964+09	4.210+08	1.319+09
2.000+01	1.750+09	3.815+08	1.116+09	1.751+09	3.815+08	1.116+09	1.748+09	3.815+08	1.116+09	1.747+09	3.815+08	1.116+09
5.000+01	1.446+09	3.199+08	8.533+08	1.443+09	3.199+08	8.533+08	1.440+09	3.199+08	8.533+08	1.439+09	3.199+08	8.533+08
6.000+01	1.381+09	3.068+08	8.032+08	1.380+09	3.067+08	8.032+08	1.377+09	3.067+08	8.032+08	1.376+09	3.067+08	8.032+08
1.000+02	1.204+09	2.704+08	6.734+08	1.203+09	2.704+08	6.733+08	1.200+09	2.704+08	6.733+08	1.200+09	2.704+08	6.733+08
2.000+02	9.889+08	2.304+08	5.387+08	9.862+08	2.304+08	5.387+08	9.829+08	2.304+08	5.387+08	9.820+08	2.304+08	5.387+08
5.000+02	7.747+08	2.022+08	4.490+08	7.720+08	2.022+08	4.490+08	7.686+08	2.022+08	4.490+08	7.683+08	2.022+08	4.490+08
1.000+03	6.841+08	1.894+08	4.124+08	6.815+08	1.894+08	4.124+08	6.782+08	1.894+08	4.124+08	6.779+08	1.894+08	4.124+08
2.000+03	6.400+08	1.723+08	3.687+08	6.372+08	1.723+08	3.687+08	6.339+08	1.723+08	3.687+08	6.336+08	1.723+08	3.687+08
5.000+03	5.779+08	1.513+08	3.179+08	5.752+08	1.513+08	3.179+08	5.719+08	1.513+08	3.179+08	5.715+08	1.513+08	3.179+08
1.000+04	5.226+08	1.373+08	2.851+08	5.199+08	1.373+08	2.851+08	5.166+08	1.373+08	2.851+08	5.163+08	1.373+08	2.851+08
2.000+04	3.785+08	1.068+08	2.174+08	3.758+08	1.067+08	2.174+08	3.725+08	1.067+08	2.174+08	3.722+08	1.067+08	2.174+08
5.000+04	2.419+08	8.199+07	1.653+08	2.392+08	8.199+07	1.652+08	2.359+08	8.199+07	1.652+08	2.355+08	8.199+07	1.652+08
4.320+04	1.316+08	5.939+07	1.190+08	1.289+08	5.939+07	1.190+08	1.256+08	5.938+07	1.190+08	1.252+08	5.938+07	1.190+08
5.000+04	1.168+08	5.499+07	1.101+08	1.141+08	5.499+07	1.101+08	1.108+08	5.498+07	1.101+08	1.105+08	5.498+07	1.101+08
8.640+04	7.554+07	3.785+07	7.570+07	7.285+07	3.784+07	7.569+07	6.955+07	3.784+07	7.568+07	6.922+07	3.784+07	7.568+07
1.000+05	6.733+07	3.331+07	6.662+07	6.461+07	3.330+07	6.660+07	6.130+07	3.330+07	6.660+07	6.098+07	3.330+07	6.660+07
2.000+05	3.999+07	1.586+07	3.171+07	3.717+07	1.585+07	3.170+07	3.387+07	1.585+07	3.170+07	3.354+07	1.585+07	3.170+07
3.456+05	2.886+07	8.790+06	1.758+07	2.614+07	8.782+06	1.756+07	2.284+07	8.782+06	1.756+07	2.251+07	8.782+06	1.756+07
5.000+05	2.374+07	6.386+06	1.277+07	2.102+07	6.378+06	1.275+07	1.772+07	6.378+06	1.275+07	1.739+07	6.378+06	1.275+07
8.640+05	1.694+07	4.087+06	8.173+06	1.425+07	4.078+06	8.156+06	1.090+07	4.078+06	8.156+06	1.063+07	4.078+06	8.156+06
1.000+06	1.526+07	3.531+06	7.063+06	1.254+07	3.521+06	7.045+06	9.243+06	3.523+06	7.045+06	8.916+06	3.523+06	7.045+06
2.000+06	8.934+06	1.236+06	2.473+06	6.220+06	1.228+06	2.455+06	2.929+06	1.228+06	2.455+06	2.603+06	1.228+06	2.455+06
2.592+06	7.684+06	6.727+05	1.345+06	4.974+06	6.639+05	1.329+06	1.687+06	6.639+05	1.328+06	1.361+06	6.639+05	1.328+06
5.000+06	6.590+06	6.594+04	1.319+05	3.892+06	5.713+04	1.143+05	6.220+05	5.713+04	1.143+05	2.973+05	5.713+04	1.143+05
5.184+06	6.575+06	5.627+04	1.125+05	3.878+06	4.746+04	9.494+04	6.091+05	4.746+04	9.494+04	2.845+05	4.746+04	9.494+04
1.000+07	6.454+06	9.188+03	1.839+04	3.784+06	3.826+02	7.741+02	5.466+05	3.822+02	7.734+02	2.251+05	3.822+02	7.733+02
1.296+07	6.414+06	8.826+03	1.766+04	3.760+06	2.052+01	4.714+01	5.426+05	2.017+01	4.645+01	2.231+05	2.015+01	4.640+01
2.000+07	6.322+06	8.806+03	1.762+04	3.706+06	6.289+01	4.071+00	5.345+05	2.841+01	3.381+00	2.196+05	2.611+01	3.333+00
3.156+07	6.174+06	8.806+03	1.761+04	3.619+06	6.092+01	2.611+00	5.218+05	2.644+01	1.921+00	2.143+05	2.414+01	1.875+00

Figure 2.7

Figure 2.8

Figure 2.9

BETA RAYS- SOURCE 2 (PLATE OUT), 1 WATT, PURE U-235

Figure 2.10

Figure 2.11

BETA RAYS- SOURCE 2 (WATER), 1 WATT, PURE U-235

Figure 2.12

Table 2.6

SOURCES 3,4,5, POWER=1 WATT, PUNE 1=235

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCA (SEC)	100% HALOGENS	100% IODINES	100% NORF GASES	100% HALOGENS	100% IODINES	100% NORF GASES	100% HALOGENS	100% IODINES	100% NORF GASES	100% HALOGENS	100% IODINES	100% NORF GASES
0.000	2.848+10	2.126+10	1.831+10	2.848+10	2.126+10	1.831+10	2.848+10	2.126+10	1.831+10	2.848+10	2.126+10	1.831+10
1.000+00	2.708+10	2.074+10	1.748+10	2.708+10	2.074+10	1.748+10	2.708+10	2.074+10	1.748+10	2.708+10	2.074+10	1.748+10
2.000+00	2.613+10	2.036+10	1.694+10	2.613+10	2.036+10	1.694+10	2.613+10	2.036+10	1.694+10	2.613+10	2.036+10	1.694+10
5.000+00	2.432+10	1.957+10	1.598+10	2.432+10	1.957+10	1.598+10	2.432+10	1.957+10	1.598+10	2.432+10	1.957+10	1.598+10
1.000+01	2.260+10	1.872+10	1.513+10	2.260+10	1.872+10	1.513+10	2.260+10	1.872+10	1.513+10	2.260+10	1.872+10	1.513+10
2.000+01	2.070+10	1.769+10	1.408+10	2.070+10	1.769+10	1.408+10	2.070+10	1.769+10	1.408+10	2.070+10	1.769+10	1.408+10
5.000+01	1.808+10	1.610+10	1.218+10	1.808+10	1.610+10	1.218+10	1.808+10	1.610+10	1.218+10	1.808+10	1.610+10	1.218+10
6.000+01	1.750+10	1.577+10	1.175+10	1.750+10	1.577+10	1.175+10	1.750+10	1.577+10	1.175+10	1.750+10	1.577+10	1.175+10
1.000+02	1.608+10	1.486+10	1.055+10	1.608+10	1.486+10	1.055+10	1.608+10	1.486+10	1.055+10	1.608+10	1.486+10	1.055+10
2.000+02	1.458+10	1.385+10	9.073+09	1.458+10	1.385+10	9.073+09	1.458+10	1.385+10	9.073+09	1.458+10	1.385+10	9.073+09
5.000+02	1.343+10	1.295+10	7.513+09	1.343+10	1.295+10	7.513+09	1.343+10	1.295+10	7.513+09	1.343+10	1.295+10	7.513+09
1.000+03	1.259+10	1.220+10	6.605+09	1.259+10	1.220+10	6.605+09	1.259+10	1.220+10	6.605+09	1.259+10	1.220+10	6.605+09
2.000+03	1.122+10	1.095+10	5.711+09	1.122+10	1.095+10	5.711+09	1.122+10	1.095+10	5.711+09	1.122+10	1.095+10	5.711+09
3.000+03	9.498+09	9.340+09	4.680+09	9.498+09	9.340+09	4.680+09	9.498+09	9.340+09	4.680+09	9.498+09	9.340+09	4.680+09
5.000+03	8.341+09	8.245+09	4.012+09	8.341+09	8.245+09	4.012+09	8.341+09	8.245+09	4.012+09	8.341+09	8.245+09	4.012+09
1.000+04	5.887+09	5.825+09	2.637+09	5.887+09	5.825+09	2.637+09	5.887+09	5.825+09	2.637+09	5.887+09	5.825+09	2.637+09
2.000+04	3.859+09	3.855+09	1.496+09	3.859+09	3.855+09	1.496+09	3.859+09	3.855+09	1.496+09	3.859+09	3.855+09	1.496+09
8.320+04	2.297+09	2.295+09	6.251+08	2.296+09	2.295+09	6.252+08	2.296+09	2.295+09	6.251+08	2.296+09	2.295+09	6.251+08
5.000+04	2.651+09	2.650+09	5.261+08	2.651+09	2.650+09	5.260+08	2.651+09	2.650+09	5.259+08	2.651+09	2.650+09	5.259+08
8.640+04	1.267+09	1.267+09	3.044+08	1.267+09	1.267+09	3.045+08	1.267+09	1.267+09	3.044+08	1.267+09	1.267+09	3.044+08
1.000+05	1.097+09	1.097+09	2.714+08	1.097+09	1.097+09	2.713+08	1.097+09	1.097+09	2.712+08	1.097+09	1.097+09	2.712+08
2.000+05	5.389+08	5.389+08	1.748+08	5.388+08	5.388+08	1.747+08	5.388+08	5.388+08	1.748+08	5.388+08	5.388+08	1.746+08
3.050+05	3.257+08	3.257+08	1.288+08	3.256+08	3.256+08	1.287+08	3.256+08	3.256+08	1.287+08	3.256+08	3.256+08	1.287+08
5.000+05	2.441+08	2.441+08	9.842+07	2.440+08	2.440+08	9.852+07	2.440+08	2.440+08	9.842+07	2.440+08	2.440+08	9.841+07
8.640+05	1.578+08	1.578+08	5.441+07	1.577+08	1.577+08	5.432+07	1.577+08	1.577+08	5.423+07	1.577+08	1.577+08	5.422+07
1.000+06	1.366+08	1.366+08	4.390+07	1.365+08	1.365+08	4.382+07	1.365+08	1.365+08	4.372+07	1.365+08	1.365+08	4.371+07
2.000+06	4.898+07	4.898+07	9.678+06	4.892+07	4.892+07	9.598+06	4.892+07	4.892+07	9.597+06	4.892+07	4.892+07	9.496+06
2.592+06	2.701+07	2.701+07	4.123+06	2.689+07	2.689+07	4.003+06	2.689+07	2.689+07	3.945+06	2.689+07	2.689+07	3.935+06
5.000+06	2.540+06	2.540+06	3.285+05	2.427+06	2.427+06	2.088+05	2.427+06	2.427+06	1.515+05	2.427+06	2.427+06	1.421+05
5.188+06	2.135+06	2.135+06	3.005+05	2.023+06	2.023+06	2.207+05	2.023+06	2.023+06	1.233+05	2.023+06	2.023+06	1.141+05
1.000+07	1.315+05	1.315+05	1.928+05	1.856+04	1.856+04	1.139+05	1.856+04	1.856+04	1.788+04	1.856+04	1.856+04	6.348+03
1.296+07	1.141+05	1.141+05	1.905+05	1.214+03	1.214+03	1.120+05	1.209+03	1.209+03	1.656+04	1.209+03	1.209+03	7.084+03
2.000+07	1.129+05	1.129+05	1.876+05	2.528+01	2.518+01	1.102+05	2.086+01	2.076+01	1.614+04	2.086+01	2.086+01	6.788+03
3.156+07	1.129+05	1.129+05	1.832+05	2.113+01	2.108+01	1.076+05	1.671+01	1.662+01	1.576+04	1.662+01	1.663+01	6.602+03

Table 2.7

SOURCE S, 4, 5, POWER 1 WATT, PURE U-235

HEAT ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			500 DAYS			500 DAYS			200 DAYS		
AFTER LOCA (SEC)	100% HALOGENS	100% IODINES	100% NORLE GASES	100% HALOGENS	100% IODINES	100% NORLE GASES	100% HALOGENS	100% IODINES	100% NORLE GASES	100% HALOGENS	100% IODINES	100% NORLE GASES
0.000	2.002+10	1.030+10	1.097+10	2.002+10	1.030+10	1.096+10	2.002+10	1.030+10	1.095+10	2.002+10	1.030+10	1.095+10
1.000+00	1.837+10	0.929+09	1.894+10	1.837+10	0.929+09	1.897+10	1.817+10	0.928+09	1.896+10	1.837+10	0.928+09	1.894+10
2.000+00	1.724+10	0.850+09	1.828+10	1.724+10	0.850+09	1.828+10	1.724+10	0.850+09	1.828+10	1.724+10	0.850+09	1.828+10
5.000+00	1.513+10	0.660+09	1.679+10	1.513+10	0.659+09	1.678+10	1.513+10	0.659+09	1.677+10	1.513+10	0.659+09	1.677+10
1.000+01	1.319+10	0.420+09	1.526+10	1.319+10	0.420+09	1.525+10	1.319+10	0.420+09	1.524+10	1.319+10	0.420+09	1.524+10
2.000+01	1.116+10	0.269+09	1.349+10	1.116+10	0.269+09	1.349+10	1.116+10	0.269+09	1.347+10	1.116+10	0.269+09	1.347+10
5.000+01	0.534+09	0.399+09	1.103+10	0.533+09	0.399+09	1.102+10	0.533+09	0.399+09	1.101+10	0.533+09	0.399+09	1.101+10
6.000+01	0.032+09	0.135+09	1.053+10	0.032+09	0.135+09	1.052+10	0.032+09	0.135+09	1.051+10	0.032+09	0.135+09	1.051+10
1.000+02	0.673+09	0.509+09	0.130+09	0.673+09	0.509+09	0.121+09	0.673+09	0.509+09	0.110+09	0.673+09	0.509+09	0.105+10
2.000+02	0.587+09	0.408+09	0.735+09	0.587+09	0.408+09	0.734+09	0.587+09	0.408+09	0.733+09	0.587+09	0.408+09	0.733+09
5.000+02	0.491+09	0.045+09	0.500+09	0.490+09	0.044+09	0.499+09	0.490+09	0.044+09	0.489+09	0.490+09	0.044+09	0.489+09
1.000+03	0.424+09	0.378+09	0.472+09	0.424+09	0.378+09	0.471+09	0.424+09	0.378+09	0.470+09	0.424+09	0.378+09	0.470+09
2.000+03	0.387+09	0.345+09	0.463+09	0.387+09	0.345+09	0.463+09	0.387+09	0.345+09	0.463+09	0.387+09	0.345+09	0.463+09
3.000+03	0.317+09	0.302+09	0.406+09	0.317+09	0.302+09	0.405+09	0.317+09	0.302+09	0.404+09	0.317+09	0.302+09	0.404+09
5.000+03	0.285+09	0.274+09	0.361+09	0.285+09	0.274+09	0.362+09	0.285+09	0.274+09	0.361+09	0.285+09	0.274+09	0.363+09
1.000+04	0.217+09	0.2135+09	0.255+09	0.217+09	0.2135+09	0.254+09	0.217+09	0.2135+09	0.253+09	0.217+09	0.2135+09	0.253+09
2.000+04	0.1553+09	0.1640+09	0.1477+09	0.1552+09	0.1640+09	0.1468+09	0.1552+09	0.1640+09	0.1457+09	0.1552+09	0.1640+09	0.1456+09
4.320+04	0.190+09	0.188+09	0.402+09	0.190+09	0.188+09	0.402+09	0.190+09	0.188+09	0.402+09	0.190+09	0.188+09	0.402+09
5.000+04	0.101+09	0.100+09	0.529+09	0.101+09	0.100+09	0.529+09	0.101+09	0.100+09	0.529+09	0.101+09	0.100+09	0.529+09
6.000+04	0.757+09	0.756+09	0.329+09	0.756+09	0.756+09	0.329+09	0.756+09	0.756+09	0.329+09	0.756+09	0.756+09	0.329+09
1.000+05	0.662+08	0.662+08	0.939+09	0.660+08	0.660+08	0.939+09	0.660+08	0.660+08	0.939+09	0.660+08	0.660+08	0.939+09
2.000+05	0.317+08	0.317+08	0.1965+09	0.317+08	0.317+08	0.1965+09	0.317+08	0.317+08	0.1965+09	0.317+08	0.317+08	0.1965+09
3.000+05	0.175+08	0.175+08	0.1569+09	0.175+08	0.175+08	0.1569+09	0.175+08	0.175+08	0.1569+09	0.175+08	0.175+08	0.1569+09
5.000+05	0.1277+08	0.1277+08	0.1294+09	0.1275+08	0.1275+08	0.1294+09	0.1275+08	0.1275+08	0.1294+09	0.1275+08	0.1275+08	0.1294+09
6.000+05	0.113+07	0.113+07	0.512+07	0.113+07	0.113+07	0.512+07	0.113+07	0.113+07	0.512+07	0.113+07	0.113+07	0.512+07
1.000+06	0.7063+07	0.7063+07	0.7533+07	0.7045+07	0.7045+07	0.7533+07	0.7045+07	0.7045+07	0.7533+07	0.7045+07	0.7045+07	0.7533+07
2.000+06	0.4733+07	0.4733+07	0.3331+07	0.4557+07	0.4557+07	0.3331+07	0.4557+07	0.4557+07	0.3331+07	0.4557+07	0.4557+07	0.3331+07
2.502+06	0.345+07	0.345+07	0.265+07	0.328+07	0.328+07	0.265+07	0.328+07	0.328+07	0.265+07	0.328+07	0.328+07	0.265+07
5.000+06	0.1319+06	0.1319+06	0.1844+07	0.1303+06	0.1303+06	0.1844+07	0.1303+06	0.1303+06	0.1844+07	0.1303+06	0.1303+06	0.1844+07
5.184+06	0.125+06	0.125+06	0.2180+07	0.124+06	0.124+06	0.2180+07	0.124+06	0.124+06	0.2180+07	0.124+06	0.124+06	0.2180+07
1.000+07	0.139+05	0.139+05	0.2149+07	0.138+05	0.138+05	0.2149+07	0.138+05	0.138+05	0.2149+07	0.138+05	0.138+05	0.2149+07
1.296+07	0.1766+05	0.1766+05	0.2135+07	0.1741+05	0.1741+05	0.2135+07	0.1741+05	0.1741+05	0.2135+07	0.1741+05	0.1741+05	0.2135+07
2.000+07	0.1762+05	0.1761+05	0.2105+07	0.1740+05	0.1740+05	0.2105+07	0.1740+05	0.1740+05	0.2105+07	0.1740+05	0.1740+05	0.2105+07
3.154+07	0.1761+05	0.1761+05	0.2055+07	0.1741+05	0.1741+05	0.2055+07	0.1741+05	0.1741+05	0.2055+07	0.1741+05	0.1741+05	0.2055+07

Figure 2.13

Figure 2.14

Figure 2.15

Figure 2.16

Figure 2.17

Figure 2.18

Table 2.8

SOURCE 6,7, POWER=1 WATT, PWR 11-235

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM		5000 DAYS		500 DAYS		200 DAYS	
AFTER LIFE (SEC)	100% SOLIDS	100% ALL F P	100% SOLIDS	100% ALL F P	100% SOLIDS	100% ALL F P	100% SOLIDS	100% ALL F P
0.000	1.449+11	1.917+11	1.400+11	1.908+11	1.436+11	1.904+11	1.430+11	1.898+11
1.000+00	1.340+11	1.786+11	1.331+11	1.776+11	1.327+11	1.773+11	1.321+11	1.767+11
2.000+00	1.285+11	1.716+11	1.276+11	1.707+11	1.273+11	1.704+11	1.267+11	1.697+11
3.000+00	1.193+11	1.596+11	1.184+11	1.587+11	1.180+11	1.583+11	1.174+11	1.577+11
4.000+01	1.109+11	1.486+11	1.100+11	1.477+11	1.096+11	1.473+11	1.090+11	1.467+11
5.000+01	1.012+11	1.359+11	1.007+11	1.350+11	1.004+11	1.347+11	1.000+11	1.340+11
6.000+01	8.697+10	1.172+11	8.605+10	1.163+11	8.569+10	1.159+11	8.508+10	1.153+11
7.000+01	8.407+10	1.133+11	8.315+10	1.124+11	8.279+10	1.120+11	8.218+10	1.114+11
8.000+01	7.598+10	1.026+11	7.506+10	1.017+11	7.470+10	1.013+11	7.409+10	1.007+11
9.000+01	6.569+10	8.934+10	6.477+10	8.842+10	6.441+10	8.806+10	6.381+10	8.745+10
1.000+02	5.406+10	7.500+10	5.314+10	7.408+10	5.278+10	7.372+10	5.218+10	7.311+10
2.000+02	4.594+10	6.510+10	4.498+10	6.417+10	4.461+10	6.381+10	4.401+10	6.321+10
3.000+02	3.741+10	5.454+10	3.669+10	5.367+10	3.633+10	5.326+10	3.572+10	5.265+10
4.000+02	3.116+10	4.531+10	3.028+10	4.441+10	2.988+10	4.405+10	2.927+10	4.345+10
5.000+02	2.811+10	4.046+10	2.719+10	3.954+10	2.683+10	3.918+10	2.622+10	3.858+10
6.000+02	2.513+10	3.511+10	2.418+10	3.059+10	2.474+10	3.022+10	2.414+10	2.962+10
7.000+02	2.214+10	2.944+10	2.106+10	2.402+10	2.130+10	2.365+10	2.170+10	2.305+10
8.000+02	1.916+10	2.009+10	1.828+10	1.916+10	1.880+10	1.800+10	1.828+10	1.820+10
9.000+02	1.674+10	1.932+10	1.587+10	1.840+10	1.546+10	1.804+10	1.486+10	1.743+10
1.000+03	1.513+10	1.671+10	1.421+10	1.578+10	1.385+10	1.542+10	1.325+10	1.482+10
2.000+03	1.470+10	1.407+10	1.378+10	1.515+10	1.342+10	1.479+10	1.282+10	1.419+10
3.000+03	1.271+10	1.342+10	1.179+10	1.250+10	1.143+10	1.214+10	1.081+10	1.155+10
4.000+03	1.118+10	1.164+10	1.024+10	1.072+10	9.902+09	1.036+10	9.320+09	9.774+09
5.000+03	1.013+10	1.047+10	9.204+09	9.544+09	8.846+09	9.189+09	8.274+09	8.616+09
6.000+03	8.491+09	8.703+09	7.571+09	7.783+09	7.213+09	7.425+09	6.662+09	6.874+09
7.000+03	8.052+09	8.232+09	7.132+09	7.312+09	6.775+09	6.955+09	6.232+09	6.412+09
8.000+03	6.061+09	6.119+09	5.142+09	5.200+09	4.788+09	4.847+09	4.300+09	4.359+09
9.000+03	5.374+09	5.005+09	4.456+09	4.487+09	4.104+09	4.135+09	3.646+09	3.677+09
1.000+04	3.879+09	3.882+09	2.962+09	2.965+09	2.614+09	2.621+09	2.267+09	2.265+09
2.000+04	3.169+09	3.111+09	2.892+09	2.894+09	2.548+09	2.551+09	2.199+09	2.201+09
3.000+04	2.673+09	2.673+09	1.759+09	1.759+09	1.827+09	1.827+09	1.210+09	1.210+09
4.000+04	2.275+09	2.275+09	1.363+09	1.363+09	1.036+09	1.036+09	8.708+08	8.704+08
5.000+04	1.721+09	1.721+09	8.144+08	8.145+08	4.943+08	4.944+08	4.017+08	4.017+08
6.000+04	1.343+09	1.343+09	4.837+08	4.838+08	1.761+08	1.761+08	1.244+08	1.244+08

Table 2.9

SOURCES 6,7, POKER#1 WATT, PURE U-235

RFIA ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME AFTER LINCA (SEC)	EQUILIBRIUM		5000 DAYS		500 DAYS		200 DAYS	
	100% SOLIDS	100% ALL F P	100% SOLIDS	100% ALL F P	100% SOLIDS	100% ALL F P	100% SOLIDS	100% ALL F P
0.000	1.625+11	2.025+11	1.607+11	2.007+11	1.593+11	1.993+11	1.583+11	1.982+11
1.000+00	1.475+11	1.848+11	1.457+11	1.831+11	1.443+11	1.816+11	1.433+11	1.806+11
2.000+00	1.398+11	1.753+11	1.380+11	1.735+11	1.366+11	1.721+11	1.356+11	1.711+11
5.000+00	1.265+11	1.585+11	1.248+11	1.567+11	1.234+11	1.553+11	1.223+11	1.542+11
1.000+01	1.146+11	1.430+11	1.128+11	1.413+11	1.114+11	1.399+11	1.104+11	1.388+11
2.000+01	1.018+11	1.264+11	9.999+10	1.246+11	9.860+10	1.232+11	9.754+10	1.222+11
5.000+01	8.548+10	1.050+11	8.371+10	1.033+11	8.231+10	1.019+11	8.126+10	1.008+11
6.000+01	8.241+10	1.010+11	8.069+10	9.919+10	7.924+10	9.779+10	7.819+10	9.673+10
1.000+02	7.417+10	9.004+10	7.201+10	8.828+10	7.101+10	8.685+10	6.946+10	8.580+10
2.000+02	6.416+10	7.691+10	6.239+10	7.511+10	6.100+10	7.373+10	5.995+10	7.267+10
5.000+02	5.257+10	6.256+10	5.088+10	6.078+10	4.940+10	5.937+10	4.835+10	5.832+10
1.000+03	4.407+10	5.292+10	4.230+10	5.115+10	4.091+10	4.974+10	3.986+10	4.869+10
2.000+03	3.571+10	4.386+10	3.394+10	4.209+10	3.255+10	4.068+10	3.149+10	3.962+10
3.000+03	2.989+10	3.713+10	2.812+10	3.536+10	2.873+10	3.395+10	2.568+10	3.290+10
5.000+03	2.743+10	3.394+10	2.566+10	3.217+10	2.427+10	3.076+10	2.322+10	2.971+10
1.000+04	2.353+10	2.825+10	2.176+10	2.644+10	2.036+10	2.507+10	1.931+10	2.402+10
2.000+04	2.014+10	2.327+10	1.837+10	2.149+10	1.698+10	2.004+10	1.593+10	1.403+10
4.320+04	1.640+10	1.821+10	1.463+10	1.646+10	1.324+10	1.505+10	1.218+10	1.400+10
5.000+04	1.572+10	1.738+10	1.346+10	1.560+10	1.256+10	1.420+10	1.151+10	1.314+10
8.640+04	1.356+10	1.465+10	1.180+10	1.287+10	1.040+10	1.147+10	9.353+09	1.042+10
1.000+05	1.310+10	1.406+10	1.153+10	1.228+10	9.938+09	1.088+10	8.888+09	9.826+09
2.000+05	1.139+10	1.190+10	9.620+09	1.012+10	8.229+09	8.123+09	7.185+09	7.677+09
3.456+05	1.041+10	1.075+10	8.649+09	8.972+09	7.262+09	7.575+09	6.225+09	6.536+09
5.000+05	9.833+09	1.009+10	8.068+09	8.316+09	6.685+09	6.922+09	5.655+09	5.891+09
8.640+05	8.979+09	9.140+09	7.214+09	7.372+09	5.839+09	5.985+09	4.827+09	4.973+09
1.000+06	8.746+09	8.840+09	6.982+09	7.117+09	5.609+09	5.733+09	4.604+09	4.727+09
2.000+06	7.600+09	7.658+09	5.817+09	5.886+09	4.485+09	4.523+09	3.526+09	3.562+09
2.592+06	7.154+09	7.194+09	5.392+09	5.423+09	4.053+09	4.073+09	3.118+09	3.137+09
5.000+06	6.047+09	6.070+09	4.289+09	4.303+09	2.997+09	3.000+09	2.153+09	2.155+09
5.184+06	5.989+09	6.012+09	4.231+09	4.244+09	2.943+09	2.966+09	2.105+09	2.107+09
1.000+07	4.982+09	5.003+09	3.230+09	3.242+09	2.027+09	2.029+09	1.328+09	1.326+09
1.296+07	4.907+09	4.929+09	2.859+09	2.872+09	1.708+09	1.706+09	1.068+09	1.068+09
2.000+07	4.027+09	4.049+09	2.289+09	2.301+09	1.231+09	1.233+09	7.147+08	7.154+08
3.156+07	3.992+09	3.513+09	1.709+09	1.711+09	8.369+08	8.367+08	4.554+08	4.561+08

Figure 2.19

Figure 2.20

GAMMA RAYS-ALL FISSION PRODUCTS, 1 WATT, PURE U-235

Figure 2.21

BETA RAYS- ALL FISSION PRODUCTS, 1 WATT, PURE U-235

Figure 2.22

Table 2.10

SOURCE=1, POWER=4000MW, PURE U-235

ENERGY RELEASE RATES (MW/SEC/HAFT)

GAMMAS

BETAS

TIME AFTER LOCA (SEC)	EQUILIBRIUM			200 DAYS			EQUILIBRIUM			200 DAYS		
	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.755+10	9.690+09	1.901+10	2.324+10	6.747+09	1.567+10	3.340+10	7.064+09	1.401+10	2.206+10	4.159+09	1.159+10
1.000+00	2.658+10	9.411+09	1.816+10	2.277+10	6.509+09	1.486+10	3.229+10	6.803+09	1.362+10	2.097+10	3.916+09	1.062+10
2.000+00	2.595+10	9.254+09	1.762+10	2.166+10	6.368+09	1.433+10	3.149+10	6.638+09	1.296+10	2.021+10	3.770+09	9.974+09
5.000+00	2.477+10	8.954+09	1.661+10	2.048+10	6.069+09	1.334+10	2.976+10	6.308+09	1.172+10	1.857+10	3.489+09	8.789+09
1.000+01	2.368+10	8.645+09	1.565+10	1.901+10	5.773+09	1.239+10	2.793+10	5.956+09	1.056+10	1.688+10	3.218+09	7.700+09
2.000+01	2.233+10	8.266+09	1.458+10	1.811+10	5.417+09	1.135+10	2.569+10	5.516+09	9.305+09	1.491+10	2.884+09	6.556+09
5.000+01	1.993+10	7.686+09	1.307+10	1.581+10	4.878+09	9.872+09	2.212+10	4.854+09	7.636+09	1.214+10	2.413+09	5.090+09
6.000+01	1.938+10	7.565+09	1.276+10	1.530+10	4.768+09	9.576+09	2.131+10	4.720+09	7.318+09	1.158+10	2.316+09	4.794+09
1.000+02	1.782+10	7.234+09	1.195+10	1.388+10	4.458+09	8.788+09	1.881+10	4.368+09	6.497+09	9.094+09	2.053+09	4.067+09
2.000+02	1.580+10	6.850+09	1.106+10	1.214+10	4.102+09	7.930+09	1.497+10	3.989+09	5.647+09	8.023+09	1.752+09	3.242+09
5.000+02	1.344+10	6.474+09	1.033+10	1.036+10	3.761+09	7.238+09	9.789+09	3.678+09	5.016+09	6.026+09	1.495+09	2.729+09
1.000+03	1.187+10	6.173+09	9.792+09	9.271+09	3.493+09	6.739+09	7.223+09	3.489+09	4.694+09	5.195+09	1.366+09	2.661+09
2.000+03	1.024+10	5.730+09	8.969+09	8.071+09	3.097+09	5.971+09	6.308+09	3.263+09	4.328+09	4.854+09	1.177+09	2.194+09
3.600+03	8.522+09	5.214+09	7.985+09	6.650+09	2.629+09	5.043+09	5.634+09	3.039+09	3.943+09	4.364+09	1.014+09	1.647+09
5.000+03	7.462+09	4.879+09	7.341+09	5.719+09	2.325+09	4.435+09	5.061+09	2.905+09	3.710+09	3.904+09	9.189+09	1.658+09
1.000+04	5.302+09	4.141+09	5.945+09	3.774+09	1.869+09	3.137+09	3.581+09	2.622+09	3.231+09	2.688+09	7.273+09	1.261+09
2.000+04	3.542+09	3.501+09	4.776+09	2.201+09	1.142+09	2.109+09	2.219+09	2.360+09	2.842+09	1.558+09	5.958+09	9.660+09
4.320+04	2.194+09	2.922+09	3.752+09	1.040+09	7.278+09	1.303+09	1.283+09	2.076+09	2.413+09	7.359+09	4.190+09	7.170+09
5.000+04	2.016+09	2.819+09	3.574+09	9.007+09	6.622+09	1.176+09	1.171+09	2.018+09	2.330+09	6.255+09	3.903+09	6.659+09
8.640+04	1.519+09	2.446+09	2.949+09	5.571+09	4.501+09	7.672+09	8.861+09	1.784+09	2.003+09	4.204+09	2.830+09	4.722+09
1.000+05	1.415+09	2.351+09	2.796+09	4.973+09	4.033+09	6.778+09	8.360+09	1.719+09	1.910+09	3.818+09	2.556+09	4.222+09
2.000+05	9.991+08	1.943+09	2.178+09	3.035+09	2.436+09	3.784+09	6.525+09	1.429+09	1.529+09	2.474+09	1.513+09	2.305+09
3.456+05	7.143+08	1.684+09	1.823+09	2.999+09	1.751+09	2.586+09	5.243+09	1.253+09	1.313+09	1.792+09	1.063+09	1.622+09
5.000+05	5.319+08	1.536+09	1.635+09	1.594+09	1.442+09	2.052+09	4.608+09	1.160+09	1.205+09	1.404+09	8.854+09	1.204+09
8.640+05	2.933+08	1.339+09	1.399+09	9.763+07	1.065+09	1.459+09	3.183+09	1.041+09	1.076+09	8.433+07	6.873+07	8.912+07
1.000+06	2.400+08	1.268+09	1.339+09	7.742+07	9.683+07	1.310+09	2.789+09	1.010+09	1.035+09	6.999+07	6.372+07	8.133+07
2.000+06	6.586+07	1.028+09	1.046+09	2.172+07	5.552+07	6.775+07	1.334+09	8.609+09	8.649+09	1.836+07	4.143+07	4.757+07
2.592+06	3.360+07	9.251+08	9.351+08	1.066+07	4.344+07	5.016+07	1.068+09	8.021+09	8.070+09	8.768+06	3.953+07	3.785+07
5.000+06	3.838+06	6.732+08	6.741+08	7.489+05	2.334+07	2.399+07	8.674+07	6.495+09	6.499+09	1.177+06	2.183+07	2.211+07
5.184+06	3.385+06	6.602+08	6.609+08	6.197+05	2.264+07	2.315+07	8.654+07	6.411+09	6.414+09	1.098+06	2.130+07	2.153+07
1.000+07	8.247+05	4.458+08	4.458+08	1.297+04	1.218+07	1.218+07	8.503+07	4.896+09	4.896+09	7.547+05	1.326+07	1.327+07
1.296+07	7.619+05	3.754+08	3.754+08	7.769+03	8.757+06	8.757+06	8.451+07	4.323+09	4.323+09	7.454+05	1.066+07	1.066+07
2.000+07	7.426+05	2.847+08	2.847+08	6.787+03	4.047+06	4.047+06	8.330+07	3.438+09	3.438+09	7.314+05	7.147+06	7.148+06
3.156+07	7.252+05	2.304+08	2.304+08	6.630+03	1.265+06	1.265+06	8.135+07	2.639+09	2.639+09	7.129+05	4.554+06	4.554+06

percent of the fissions were occurring in each U-235 and Pu-239. For the 200-day case, the final fractions were 75 percent (U-235) and 25 percent (Pu-239). These choices were somewhat arbitrary; a more realistic case will be discussed below. The results (expressed in MeV/sec/watt) for Sources 1 and 2 are given in Reference 1. It was found that there is a much greater difference between equilibrium and 200-day irradiations than was found for the pure U-235 case. This is the result of the different contributions of Pu-239 to the decay power, and the capture effects at the high power level.

The effect that fissile loading has on the energy release rates was examined by considering a "realistic" case which consisted of a typical fissile loading of fuel and allowing conversion of the fertile U-238 material to Pu-239 over the irradiation period. For this case a power level of 4000 MW(t) for 200 days was calculated assuming realistic fluxes, but not including the contribution to the decay power from the decay of U-239 and Np-239 to Pu-239. Both Sources 1 and 2 were calculated.

The initial fuel enrichment was taken to be 3.3 percent with an average thermal flux of 2×10^{13} neutrons/cm²-sec. The calculated burnup after 200 days at 4000 MW(t) is ~6000 MWD/MT. At the end of the cycle 88 percent of the fissions are occurring in U-235 and 12 percent in Pu-239. The conversion rate for this design is 0.56 g Pu/MWD. The contribution from fissions in U-238 was not included.

The results of these calculations are given in Tables 2.11 and 2.12 in units of MeV/sec/watt. Also given in Tables 2.11 and 2.12 are the results for exclusion of daughters if they are different from the originally specified types.

There are several ways one might handle the effects of daughter nuclides of the originally specified elements; no explicit guidance for this is given in Regulatory Guide 1.89. One might take the most conservative approach and include all daughters of the original nuclides. This gives the maximum energy release but is probably not a very realistic situation. For example, some of the daughters of the gaseous nuclides are solids which are unlikely to remain airborne. This conservative assumption (that is, including all daughters) was made for most of the calculations.

A second possibility is to include the daughter contributions only if they are of the same type as originally specified. For example, for Source 1-airborne, any daughters that are also noble gases or iodines would be included, others would not. This case, denoted "no daughters", was also calculated for Sources 1-5 and the resulting tables (Tables 2.13-2.18) follow.

A third treatment of daughters was investigated in which all fission products are released but only the specified types are tallied at each cooling time. This differs from

Text continues on page 47

Table 2.11

SOURCE 1, POWER=4000 MW, 200 DAYS, U=235+PU=239

ENERGY RELEASE RATES (MEV/SEC/WATT)

GAMMAS

BETAS

TIME AFTER LOCA (SFC)	DAUGHTERS			NO DAUGHTERS			DAUGHTERS			NO DAUGHTERS		
	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.201+10	6.661+09	1.520+10	2.201+10	6.661+09	1.520+10	2.086+10	4.079+09	1.101+10	2.086+10	4.079+09	1.101+10
1.000+00	2.112+10	6.436+09	1.446+10	2.091+10	6.433+09	1.445+10	1.987+10	3.848+09	1.012+10	1.953+10	3.843+09	1.010+10
2.000+00	2.056+10	6.295+09	1.397+10	2.023+10	6.290+09	1.395+10	1.917+10	3.708+09	9.538+09	1.865+10	3.700+09	9.507+09
5.000+00	1.946+10	6.017+09	1.305+10	1.899+10	6.010+09	1.302+10	1.766+10	3.440+09	8.443+09	1.699+10	3.424+09	8.399+09
1.000+01	1.847+10	5.733+09	1.217+10	1.781+10	5.724+09	1.213+10	1.610+10	3.170+09	7.434+09	1.543+10	3.148+09	7.378+09
2.000+01	1.725+10	5.389+09	1.119+10	1.632+10	5.380+09	1.115+10	1.427+10	2.855+09	6.365+09	1.355+10	2.825+09	6.294+09
5.000+01	1.510+10	4.867+09	9.787+09	1.388+10	4.857+09	9.752+09	1.167+10	2.396+09	4.972+09	1.074+10	2.357+09	4.685+09
6.000+01	1.462+10	4.757+09	9.504+09	1.338+10	4.747+09	9.470+09	1.113+10	2.302+09	4.704+09	1.018+10	2.262+09	4.615+09
1.000+02	1.329+10	4.457+09	8.744+09	1.204+10	4.447+09	8.716+09	9.623+09	2.043+09	4.006+09	6.643+09	2.003+09	3.918+09
2.000+02	1.166+10	4.108+09	7.924+09	1.047+10	4.097+09	7.892+09	7.732+09	1.707+09	3.263+09	6.732+09	1.716+09	3.192+09
5.000+02	9.991+09	3.771+09	7.244+09	8.601+09	3.755+09	7.211+09	5.796+09	1.493+09	2.716+09	4.525+09	1.479+09	2.682+09
1.000+03	8.953+09	3.504+09	6.751+09	7.453+09	3.481+09	6.701+09	4.975+09	1.305+09	2.454+09	3.273+09	1.339+09	2.437+09
2.000+03	7.793+09	3.109+09	5.989+09	6.126+09	3.070+09	5.916+09	4.630+09	1.176+09	2.155+09	2.531+09	1.170+09	2.138+09
3.000+03	6.417+09	2.601+09	5.064+09	5.055+09	2.599+09	4.974+09	4.152+09	1.013+09	1.846+09	2.047+09	1.003+09	1.822+09
5.000+03	5.516+09	2.337+09	4.454+09	4.053+09	2.291+09	4.363+09	3.711+09	9.189+08	1.659+09	1.786+09	9.047+08	1.628+09
1.000+04	3.645+09	1.680+09	3.158+09	3.157+09	1.624+09	3.052+09	2.560+09	7.273+08	1.283+09	1.294+09	7.019+08	1.231+09
2.000+04	2.142+09	1.149+09	2.123+09	1.942+09	1.092+09	2.007+09	1.501+09	5.694+08	9.681+08	6.881+08	5.293+08	9.075+08
4.320+04	1.032+09	7.320+08	1.311+09	9.719+08	6.764+08	1.200+09	7.268+08	4.191+08	7.189+08	6.029+08	3.694+08	6.193+08
5.000+04	8.973+08	6.662+08	1.183+09	8.121+08	6.134+08	1.078+09	6.380+08	3.405+08	6.677+08	5.603+08	3.415+08	5.697+08
6.640+04	5.607+08	4.537+08	7.741+08	5.546+08	4.168+08	7.001+08	4.223+08	2.835+08	4.744+08	4.199+08	2.470+08	4.013+08
1.000+05	5.012+08	4.068+08	6.846+08	5.008+08	3.751+08	6.212+08	3.834+08	2.542+08	4.243+08	3.812+08	2.249+08	3.617+08
2.000+05	3.069+08	2.467+08	3.843+08	3.049+08	2.344+08	3.597+08	2.493+08	1.518+08	2.324+08	2.492+08	1.414+08	2.116+08
3.450+05	2.126+08	1.774+08	2.613+08	2.176+08	1.701+08	2.444+08	1.807+08	1.066+08	1.516+08	1.807+08	1.008+08	1.399+08
5.000+05	1.617+08	1.462+08	2.092+08	1.617+08	1.406+08	1.979+08	1.416+08	8.867+07	1.215+08	1.416+08	8.384+07	1.118+08
8.640+05	9.515+07	1.077+08	1.448+08	9.513+07	1.048+08	1.426+08	8.515+07	6.859+07	8.961+07	8.511+07	6.559+07	8.363+07
1.000+06	7.914+07	7.791+07	1.137+08	7.913+07	7.555+07	1.285+08	7.068+07	6.351+07	8.167+07	7.065+07	6.104+07	7.674+07
2.000+06	7.214+07	5.584+07	6.850+07	7.217+07	5.531+07	6.745+07	1.858+07	4.102+07	4.736+07	1.855+07	4.044+07	4.624+07
2.592+06	1.091+07	4.357+07	5.053+07	1.090+07	4.333+07	5.005+07	8.448+06	3.411+07	3.754+07	8.843+06	3.388+07	3.708+07
5.000+06	7.719+05	2.336+07	2.393+07	7.699+05	2.324+07	2.389+07	1.160+06	2.153+07	2.182+07	1.144+06	2.152+07	2.181+07
5.184+06	6.389+05	2.254+07	2.309+07	6.372+05	2.254+07	2.305+07	1.040+06	2.101+07	2.125+07	1.064+06	2.100+07	2.124+07
1.000+07	1.295+04	1.208+07	1.209+07	1.259+04	1.208+07	1.209+07	7.294+05	1.318+07	1.319+07	7.213+05	1.318+07	1.319+07
1.294+07	7.160+03	8.644+06	8.644+06	6.856+03	8.684+06	8.644+06	7.198+05	1.067+07	1.067+07	7.150+05	1.067+07	1.067+07
2.000+07	6.565+03	4.019+06	4.019+06	6.274+03	4.019+06	4.019+06	7.064+05	7.215+06	7.215+06	7.047+05	7.215+06	7.215+06
3.156+07	6.413+03	1.273+06	1.273+06	6.125+03	1.273+06	1.273+06	6.886+05	4.643+06	4.643+06	6.882+05	4.643+06	4.643+06

Table 2.12

SOURCE 2, POWER=4000 MW, 200 DAYS, U=235+PU=239

ENERGY RELEASE RATES (MEV/SEC/WATT)

GAMMAS

BETAS

TIME	DAUGHTERS			NO DAUGHTERS			DAUGHTERS			NO DAUGHTERS		
	AFTER LOCA (SFC)	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.740+00	1.051+00	2.758+00	2.740+00	1.051+00	2.758+00	2.355+00	5.039+00	1.890+00	2.355+00	5.039+00	1.890+00
1.000+00	2.639+00	1.027+00	2.632+00	2.619+00	1.027+00	2.620+00	2.248+00	4.865+00	1.741+00	2.213+00	4.857+00	1.737+00
2.000+00	2.573+00	1.009+00	2.545+00	2.502+00	1.009+00	2.540+00	2.171+00	4.734+00	1.639+00	2.119+00	4.721+00	1.633+00
5.000+00	2.444+00	9.717+00	2.378+00	2.398+00	9.707+00	2.372+00	2.000+00	4.455+00	1.346+00	1.949+00	4.431+00	1.437+00
1.000+01	2.327+00	9.313+00	2.219+00	2.261+00	9.302+00	2.211+00	1.835+00	4.151+00	1.208+00	1.788+00	4.115+00	1.256+00
2.000+01	2.179+00	8.817+00	2.061+00	2.087+00	8.803+00	2.033+00	1.633+00	3.771+00	1.079+00	1.561+00	3.720+00	1.065+00
5.000+01	1.926+00	8.049+00	1.789+00	1.805+00	8.033+00	1.781+00	1.343+00	3.177+00	8.327+00	1.251+00	3.103+00	8.147+00
6.000+01	1.871+00	7.887+00	1.738+00	1.740+00	7.871+00	1.730+00	1.283+00	3.044+00	7.853+00	1.188+00	2.972+00	7.869+00
1.000+02	1.715+00	7.446+00	1.603+00	1.591+00	7.428+00	1.595+00	1.114+00	2.806+00	6.621+00	1.016+00	2.618+00	6.438+00
2.000+02	1.528+00	6.951+00	1.458+00	1.409+00	6.931+00	1.451+00	9.057+00	2.305+00	5.336+00	8.056+00	2.243+00	5.189+00
5.000+02	1.338+00	6.506+00	1.348+00	1.203+00	6.475+00	1.338+00	6.981+00	2.030+00	4.476+00	5.709+00	2.001+00	4.403+00
1.000+03	1.215+00	6.134+00	1.261+00	1.055+00	6.088+00	1.252+00	6.093+00	1.901+00	4.120+00	4.390+00	1.890+00	4.082+00
2.000+03	1.067+00	5.567+00	1.127+00	9.008+00	5.438+00	1.112+00	5.655+00	1.732+00	3.689+00	3.555+00	1.719+00	3.653+00
3.000+03	8.887+00	4.701+00	9.546+00	7.255+00	4.618+00	9.387+00	5.062+00	1.522+00	3.187+00	2.957+00	1.501+00	3.135+00
5.000+03	7.705+00	4.152+00	8.392+00	6.441+00	4.060+00	8.207+00	4.543+00	1.381+00	2.862+00	2.627+00	1.353+00	2.707+00
1.000+04	5.204+00	2.937+00	5.890+00	4.716+00	2.833+00	5.681+00	3.211+00	1.075+00	2.187+00	1.945+00	1.024+00	2.081+00
2.000+04	3.173+00	1.943+00	3.891+00	2.972+00	1.820+00	3.659+00	1.988+00	8.254+07	1.663+00	1.375+00	7.452+07	1.501+00
4.320+04	1.432+00	1.156+00	2.310+00	1.592+00	1.008+00	2.093+00	1.054+00	5.976+07	1.197+00	9.301+07	4.982+07	9.979+07
5.000+04	1.430+00	1.033+00	2.067+00	1.405+00	9.277+07	1.856+00	9.363+07	5.534+07	1.108+00	8.586+07	4.554+07	9.119+07
8.640+04	8.843+07	6.403+07	1.281+00	8.822+07	5.660+07	1.133+00	6.188+07	3.816+07	7.633+07	6.123+07	3.086+07	6.172+07
1.000+05	7.807+07	5.551+07	1.111+00	7.708+07	4.917+07	9.884+07	5.556+07	3.361+07	6.737+07	5.531+07	2.736+07	5.471+07
2.000+05	4.443+07	2.749+07	5.449+07	4.403+07	2.503+07	5.088+07	3.313+07	1.611+07	3.223+07	3.313+07	1.403+07	2.807+07
3.456+05	2.963+07	1.673+07	3.348+07	2.943+07	1.524+07	3.050+07	2.272+07	8.999+00	1.800+07	2.271+07	7.833+06	1.567+07
5.000+05	2.246+07	1.254+07	2.517+07	2.206+07	1.146+07	2.292+07	1.759+07	6.582+06	1.312+07	1.759+07	5.597+06	1.114+07
8.640+05	1.559+07	8.150+06	1.630+07	1.359+07	7.550+06	1.512+07	1.076+07	4.205+06	8.400+06	1.676+07	3.807+06	7.214+06
1.000+06	1.144+07	2.057+06	1.411+07	1.144+07	6.587+06	1.317+07	9.032+00	3.634+06	7.267+06	9.028+06	3.100+06	6.281+06
2.000+06	3.485+06	2.532+06	5.063+06	3.484+06	2.427+06	4.853+06	2.836+06	1.268+06	2.637+06	2.635+06	1.156+06	2.313+06
2.592+06	1.789+06	1.392+06	2.788+06	1.788+06	1.144+06	2.689+06	1.378+06	6.664+05	1.373+06	1.373+06	6.400+05	1.281+06
5.000+06	1.413+05	1.257+05	2.515+05	1.412+05	1.217+05	2.433+05	2.910+05	5.410+04	1.183+05	2.893+05	5.797+04	1.159+05
5.180+06	1.174+05	1.008+05	2.095+05	1.174+05	1.013+05	2.024+05	2.778+05	4.915+04	9.831+04	2.783+05	4.825+04	9.950+04
1.000+07	3.058+03	9.674+02	1.221+03	3.019+03	8.242+02	1.658+03	2.169+05	3.960+02	8.000+02	2.162+05	3.952+02	7.903+02
1.296+07	2.020+03	6.257+01	1.251+02	1.989+03	4.327+01	8.855+01	2.150+05	2.086+01	4.721+01	2.145+05	2.003+01	4.126+01
2.000+07	1.911+03	5.988+01	1.202+00	1.882+03	4.841+02	9.682+02	2.116+05	2.532+01	3.759+00	2.114+05	3.704+02	8.755+02
3.156+07	1.863+03	7.830+01	1.575+00	1.837+03	9.883+03	1.977+02	2.085+05	2.329+01	1.748+00	2.085+05	1.542+02	3.083+02

Table 2.13

SOURCE=1, POWER=1 WATT, PURE U-235 (NO DAUGHTERS)

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME AFTER LOCA (SEC)	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.362+10	6.763+09	1.569+10	2.362+10	6.754+09	1.568+10	2.362+10	6.750+09	1.567+10	2.362+10	6.744+09	1.567+10
1.000+00	2.244+10	6.522+09	1.486+10	2.244+10	6.513+09	1.485+10	2.244+10	6.509+09	1.485+10	2.244+10	6.503+09	1.484+10
2.000+00	2.170+10	6.372+09	1.437+10	2.170+10	6.362+09	1.431+10	2.170+10	6.359+09	1.431+10	2.170+10	6.353+09	1.431+10
5.000+00	2.035+10	6.078+09	1.332+10	2.035+10	6.069+09	1.331+10	2.035+10	6.065+09	1.330+10	2.035+10	6.059+09	1.330+10
1.000+01	1.909+10	5.781+09	1.237+10	1.909+10	5.771+09	1.236+10	1.909+10	5.768+09	1.235+10	1.909+10	5.762+09	1.235+10
2.000+01	1.749+10	5.423+09	1.137+10	1.749+10	5.414+09	1.131+10	1.749+10	5.410+09	1.131+10	1.749+10	5.404+09	1.130+10
5.000+01	1.489+10	4.684+09	9.850+09	1.489+10	4.675+09	9.841+09	1.489+10	4.672+09	9.837+09	1.489+10	4.668+09	9.831+09
6.000+01	1.435+10	4.772+09	9.555+09	1.435+10	4.763+09	9.545+09	1.435+10	4.759+09	9.542+09	1.435+10	4.753+09	9.536+09
1.000+02	1.293+10	4.464+09	8.767+09	1.293+10	4.455+09	8.758+09	1.293+10	4.451+09	8.754+09	1.293+10	4.445+09	8.748+09
2.000+02	1.126+10	4.108+09	7.913+09	1.126+10	4.099+09	7.903+09	1.126+10	4.095+09	7.900+09	1.126+10	4.089+09	7.894+09
5.000+02	9.318+09	3.762+09	7.216+09	9.317+09	3.753+09	7.207+09	9.317+09	3.749+09	7.203+09	9.317+09	3.743+09	7.197+09
1.000+03	7.971+09	3.486+09	6.703+09	7.971+09	3.477+09	6.693+09	7.971+09	3.473+09	6.690+09	7.971+09	3.467+09	6.684+09
2.000+03	6.700+09	3.080+09	5.914+09	6.699+09	3.070+09	5.904+09	6.699+09	3.067+09	5.901+09	6.699+09	3.061+09	5.895+09
5.000+03	5.584+09	2.604+09	4.970+09	5.584+09	2.595+09	4.960+09	5.584+09	2.591+09	4.957+09	5.584+09	2.585+09	4.951+09
1.000+04	4.951+09	2.296+09	4.356+09	4.951+09	2.287+09	4.347+09	4.951+09	2.284+09	4.343+09	4.951+09	2.278+09	4.337+09
2.000+04	3.570+09	1.635+09	3.047+09	3.570+09	1.626+09	3.038+09	3.570+09	1.622+09	3.034+09	3.570+09	1.616+09	3.028+09
5.000+04	2.243+09	1.102+09	2.009+09	2.243+09	1.093+09	2.000+09	2.243+09	1.089+09	1.997+09	2.243+09	1.083+09	1.991+09
1.000+04	1.566+09	6.903+08	1.209+09	1.566+09	6.811+08	1.200+09	1.565+09	6.774+08	1.196+09	1.565+09	6.714+08	1.190+09
2.000+04	1.011+09	6.272+08	1.087+09	1.011+09	6.179+08	1.078+09	1.011+09	6.143+08	1.074+09	1.011+09	6.083+08	1.068+09
5.000+04	6.191+08	4.311+08	7.109+08	6.189+08	4.218+08	7.016+08	6.188+08	4.182+08	6.980+08	6.188+08	4.122+08	6.920+08
1.000+05	5.447+08	3.896+08	6.322+08	5.446+08	3.803+08	6.229+08	5.445+08	3.767+08	6.193+08	5.445+08	3.707+08	6.133+08
2.000+05	3.095+08	2.495+08	3.720+08	3.094+08	2.403+08	3.627+08	3.093+08	2.367+08	3.591+08	3.093+08	2.307+08	3.532+08
5.000+05	2.103+08	1.858+08	2.598+08	2.102+08	1.766+08	2.506+08	2.101+08	1.730+08	2.470+08	2.101+08	1.672+08	2.411+08
1.000+05	1.506+08	1.567+08	2.121+08	1.505+08	1.474+08	2.028+08	1.504+08	1.439+08	1.993+08	1.504+08	1.381+08	1.935+08
2.000+05	9.383+07	1.214+08	1.579+08	9.372+07	1.122+08	1.487+08	9.362+07	1.086+08	1.451+08	9.362+07	1.031+08	1.396+08
5.000+05	7.804+07	1.123+08	1.441+08	7.793+07	1.031+08	1.348+08	7.783+07	9.953+07	1.313+08	7.782+07	9.410+07	1.259+08
1.000+06	2.193+07	7.234+07	6.408+07	2.192+07	6.313+07	7.488+07	2.172+07	5.959+07	7.130+07	2.171+07	5.471+07	6.642+07
2.000+06	1.087+07	6.026+07	6.677+07	1.076+07	5.105+07	5.753+07	1.066+07	4.753+07	5.402+07	1.065+07	4.295+07	4.943+07
5.000+06	9.616+05	3.941+07	4.002+07	8.536+05	3.021+07	3.080+07	7.566+05	2.677+07	2.736+07	7.469+05	2.321+07	2.380+07
1.000+06	8.325+05	3.860+07	3.912+07	7.246+05	2.941+07	2.990+07	6.276+05	2.597+07	2.646+07	6.179+05	2.248+07	2.297+07
2.000+06	7.253+05	2.676+07	2.679+07	1.162+05	1.760+07	1.760+07	2.215+04	1.427+07	1.427+07	1.262+04	1.211+07	1.211+07
5.000+06	2.187+05	2.277+07	2.280+07	1.120+05	1.363+07	1.363+07	1.656+04	1.036+07	1.036+07	7.079+03	8.708+06	8.708+06
1.000+07	2.155+05	1.724+07	1.727+07	1.099+05	8.144+06	8.144+06	1.585+04	4.963+06	4.963+06	6.511+03	4.017+06	4.017+06
2.000+07	2.111+05	1.388+07	1.388+07	1.074+05	4.837+06	4.837+06	1.588+04	1.761+06	1.761+06	6.356+03	1.244+06	1.244+06

Table 2.14

SOURCE=1, POWER=1 WATT, PURE U-235 (NO DAUGHTERS)

BETA ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCA (SEC)	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.255+10	4.200+09	1.163+10	2.254+10	4.182+09	1.162+10	2.253+10	4.168+09	1.160+10	2.253+10	4.158+09	1.159+10
1.000+00	2.109+10	3.951+09	1.064+10	2.108+10	3.934+09	1.062+10	2.107+10	3.920+09	1.061+10	2.107+10	3.909+09	1.059+10
2.000+00	2.013+10	3.801+09	9.987+09	2.012+10	3.784+09	9.969+09	2.011+10	3.770+09	9.955+09	2.011+10	3.759+09	9.944+09
5.000+00	1.832+10	3.514+09	8.781+09	1.831+10	3.496+09	8.764+09	1.830+10	3.482+09	8.750+09	1.830+10	3.472+09	8.739+09
1.000+01	1.664+10	3.227+09	7.680+09	1.663+10	3.210+09	7.663+09	1.662+10	3.196+09	7.649+09	1.662+10	3.185+09	7.638+09
2.000+01	1.462+10	2.894+09	6.523+09	1.461+10	2.876+09	6.506+09	1.460+10	2.862+09	6.492+09	1.460+10	2.851+09	6.481+09
5.000+01	1.164+10	2.414+09	5.030+09	1.163+10	2.396+09	5.012+09	1.162+10	2.382+09	4.998+09	1.162+10	2.372+09	4.988+09
6.000+01	1.105+10	2.316+09	4.746+09	1.104+10	2.298+09	4.729+09	1.103+10	2.284+09	4.715+09	1.102+10	2.274+09	4.704+09
1.000+02	9.429+09	2.052+09	4.016+09	9.420+09	2.035+09	3.998+09	9.409+09	2.021+09	3.984+09	9.408+09	2.010+09	3.974+09
2.000+02	7.439+09	1.761+09	3.261+09	7.429+09	1.743+09	3.244+09	7.418+09	1.729+09	3.230+09	7.417+09	1.719+09	3.219+09
5.000+02	5.156+09	1.522+09	2.735+09	5.146+09	1.504+09	2.717+09	5.135+09	1.490+09	2.703+09	5.134+09	1.480+09	2.693+09
1.000+03	3.860+09	1.382+09	2.485+09	3.851+09	1.364+09	2.467+09	3.840+09	1.350+09	2.454+09	3.839+09	1.339+09	2.443+09
2.000+03	3.084+09	1.212+09	2.184+09	3.075+09	1.194+09	2.166+09	3.064+09	1.180+09	2.152+09	3.063+09	1.170+09	2.141+09
3.600+03	2.566+09	1.045+09	1.864+09	2.557+09	1.027+09	1.846+09	2.546+09	1.013+09	1.832+09	2.545+09	1.003+09	1.821+09
5.000+03	2.290+09	9.465+08	1.669+09	2.281+09	9.288+08	1.651+09	2.270+09	9.148+08	1.637+09	2.269+09	9.043+08	1.627+09
1.000+04	1.721+09	7.437+08	1.270+09	1.712+09	7.260+08	1.252+09	1.701+09	7.120+08	1.238+09	1.700+09	7.015+08	1.228+09
2.000+04	1.224+09	5.712+08	9.471+08	1.215+09	5.535+08	9.293+08	1.204+09	5.396+08	9.153+08	1.203+09	5.290+08	9.048+08
4.320+04	6.121+08	4.111+08	6.592+08	6.030+08	3.934+08	6.415+08	5.920+08	3.795+08	6.275+08	5.809+08	3.690+08	6.170+08
5.000+04	7.439+08	3.313+08	6.096+08	7.347+08	3.654+08	5.919+08	7.237+08	3.515+08	5.779+08	7.226+08	3.410+08	5.674+08
6.640+04	5.113+08	2.883+08	4.410+08	5.022+08	2.706+08	4.233+08	4.911+08	2.567+08	4.094+08	4.801+08	2.462+08	3.988+08
1.000+05	4.577+08	2.662+08	4.014+08	4.486+08	2.485+08	3.837+08	4.376+08	2.346+08	3.698+08	4.365+08	2.241+08	3.593+08
2.000+05	2.758+08	1.827+08	2.517+08	2.667+08	1.651+08	2.329+08	2.557+08	1.512+08	2.200+08	2.546+08	1.407+08	2.096+08
3.456+05	2.008+08	1.423+08	1.804+08	1.917+08	1.246+08	1.627+08	1.807+08	1.107+08	1.468+08	1.796+08	1.003+08	1.384+08
5.000+05	1.617+08	1.254+08	1.526+08	1.526+08	1.078+08	1.368+08	1.416+08	9.392+07	1.210+08	1.405+08	8.362+07	1.107+08
6.640+05	1.055+08	1.072+08	1.247+08	9.643+07	8.955+07	1.070+08	8.543+07	7.579+07	9.320+07	8.434+07	6.567+07	8.308+07
1.000+06	9.115+07	1.027+08	1.178+08	8.207+07	8.497+07	1.001+08	7.108+07	7.124+07	8.640+07	6.999+07	6.119+07	7.634+07
2.000+06	3.946+07	6.162+07	8.724+07	3.040+07	6.395+07	6.953+07	5.043+07	5.043+07	5.601+07	1.834+07	4.084+07	4.642+07
2.592+06	2.984+07	7.467+07	7.781+07	2.079+07	5.701+07	6.010+07	9.833+06	4.362+07	4.671+07	8.745+06	3.427+07	3.737+07
5.000+06	2.215+07	6.080+07	6.112+07	1.314+07	4.317+07	4.345+07	2.243+06	3.025+07	3.053+07	1.161+06	2.181+07	2.209+07
5.184+06	2.206+07	6.017+07	6.044+07	1.306+07	4.254+07	4.277+07	2.165+06	2.966+07	2.989+07	1.083+06	2.128+07	2.151+07
1.000+07	2.152+07	4.986+07	4.991+07	1.261+07	3.230+07	3.230+07	1.820+06	2.027+07	2.028+07	7.484+05	1.326+07	1.326+07
1.296+07	2.139+07	4.612+07	4.616+07	1.253+07	2.859+07	2.859+07	1.807+06	1.704+07	1.704+07	7.421+05	1.068+07	1.068+07
2.000+07	2.109+07	4.432+07	4.036+07	1.235+07	2.289+07	2.289+07	1.781+06	1.231+07	1.231+07	7.313+05	7.147+06	7.147+06
3.156+07	2.060+07	3.497+07	3.501+07	1.206+07	1.769+07	1.769+07	1.739+06	8.369+06	8.369+06	7.142+05	4.554+06	4.554+06

Table 2.15

SOURCE=2, POWER=1 WATT, PURE U-235 (NO DAUGHTERS)

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCAL (SEC)	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.909+09	1.063+09	2.847+09	2.909+09	1.063+09	2.847+09	2.909+09	1.063+09	2.847+09	2.909+09	1.063+09	2.847+09
1.000+00	2.778+09	1.037+09	2.705+09	2.778+09	1.037+09	2.705+09	2.778+09	1.037+09	2.705+09	2.778+09	1.037+09	2.705+09
2.000+00	2.695+09	1.017+09	2.608+09	2.695+09	1.017+09	2.608+09	2.695+09	1.017+09	2.608+09	2.695+09	1.017+09	2.608+09
3.000+00	2.540+09	9.775+08	2.424+09	2.540+09	9.774+08	2.424+09	2.540+09	9.774+08	2.424+09	2.540+09	9.774+08	2.424+09
1.000+01	2.392+09	9.349+08	2.251+09	2.392+09	9.349+08	2.251+09	2.392+09	9.349+08	2.251+09	2.392+09	9.349+08	2.251+09
2.000+01	2.206+09	8.829+08	2.061+09	2.206+09	8.829+08	2.061+09	2.206+09	8.829+08	2.061+09	2.206+09	8.829+08	2.061+09
5.000+01	1.906+09	8.033+08	1.795+09	1.906+09	8.033+08	1.795+09	1.906+09	8.033+08	1.795+09	1.906+09	8.033+08	1.795+09
6.000+01	1.844+09	7.866+08	1.742+09	1.844+09	7.866+08	1.742+09	1.844+09	7.866+08	1.742+09	1.844+09	7.866+08	1.742+09
1.000+02	1.679+09	7.411+08	1.600+09	1.679+09	7.411+08	1.600+09	1.679+09	7.411+08	1.600+09	1.679+09	7.411+08	1.600+09
2.000+02	1.487+09	6.903+08	1.450+09	1.487+09	6.903+08	1.450+09	1.487+09	6.903+08	1.450+09	1.487+09	6.903+08	1.450+09
5.000+02	1.270+09	6.443+08	1.334+09	1.270+09	6.443+08	1.334+09	1.270+09	6.443+08	1.334+09	1.270+09	6.443+08	1.334+09
1.000+03	1.116+09	6.054+08	1.248+09	1.116+09	6.054+08	1.248+09	1.116+09	6.054+08	1.248+09	1.116+09	6.054+08	1.248+09
2.000+03	9.575+08	5.406+08	1.107+09	9.574+08	5.406+08	1.107+09	9.574+08	5.406+08	1.107+09	9.574+08	5.406+08	1.107+09
3.000+03	8.048+08	4.585+08	9.314+08	8.047+08	4.585+08	9.313+08	8.047+08	4.585+08	9.313+08	8.047+08	4.585+08	9.313+08
5.000+03	7.133+08	4.030+08	8.148+08	7.133+08	4.030+08	8.148+08	7.133+08	4.030+08	8.148+08	7.133+08	4.030+08	8.148+08
1.000+04	5.124+08	2.809+08	5.632+08	5.124+08	2.809+08	5.632+08	5.124+08	2.809+08	5.632+08	5.124+08	2.809+08	5.632+08
2.000+04	3.270+08	1.813+08	3.627+08	3.270+08	1.813+08	3.627+08	3.270+08	1.813+08	3.627+08	3.270+08	1.813+08	3.627+08
4.320+04	1.753+08	1.037+08	2.075+08	1.753+08	1.037+08	2.075+08	1.753+08	1.037+08	2.075+08	1.753+08	1.037+08	2.075+08
5.000+04	1.561+08	9.195+07	1.839+08	1.561+08	9.195+07	1.839+08	1.561+08	9.195+07	1.839+08	1.561+08	9.195+07	1.839+08
6.000+04	9.392+07	5.594+07	1.119+08	9.392+07	5.594+07	1.119+08	9.392+07	5.594+07	1.119+08	9.392+07	5.594+07	1.119+08
1.000+05	8.210+07	4.851+07	9.702+07	8.210+07	4.851+07	9.702+07	8.210+07	4.851+07	9.702+07	8.210+07	4.851+07	9.702+07
2.000+05	4.446+07	2.449+07	4.899+07	4.443+07	2.448+07	4.897+07	4.440+07	2.448+07	4.897+07	4.440+07	2.448+07	4.897+07
3.456+05	2.921+07	1.480+07	2.960+07	2.918+07	1.479+07	2.959+07	2.915+07	1.479+07	2.959+07	2.915+07	1.479+07	2.959+07
5.000+05	2.210+07	1.108+07	2.217+07	2.207+07	1.108+07	2.216+07	2.204+07	1.108+07	2.216+07	2.204+07	1.108+07	2.216+07
6.440+05	1.337+07	7.301+06	1.460+07	1.334+07	7.296+06	1.459+07	1.331+07	7.296+06	1.459+07	1.330+07	7.296+06	1.459+07
1.000+06	1.126+07	6.363+06	1.273+07	1.123+07	6.357+06	1.271+07	1.120+07	6.357+06	1.271+07	1.120+07	6.357+06	1.271+07
2.000+06	3.457+06	2.348+06	4.695+06	3.426+06	2.342+06	4.684+06	3.398+06	2.342+06	4.684+06	3.395+06	2.342+06	4.684+06
2.592+06	1.801+06	1.303+06	2.606+06	1.771+06	1.297+06	2.595+06	1.742+06	1.297+06	2.595+06	1.739+06	1.297+06	2.595+06
5.000+06	1.963+05	1.230+05	2.461+05	1.967+05	1.174+05	2.348+05	1.396+05	1.174+05	2.348+05	1.367+05	1.174+05	2.348+05
5.184+06	1.752+05	1.034+05	2.067+05	1.457+05	9.772+04	1.954+05	1.166+05	9.772+04	1.954+05	1.137+05	9.772+04	1.954+05
1.000+07	6.405+04	6.445+03	1.289+04	3.472+04	6.005+02	1.601+03	5.914+03	8.003+02	1.601+03	3.054+03	8.003+02	1.600+03
1.296+07	6.272+04	5.687+03	1.137+04	3.353+04	4.200+01	8.399+01	4.401+03	4.178+01	8.355+01	2.058+03	4.176+01	8.352+01
2.000+07	6.183+04	5.645+03	1.129+04	3.398+04	2.822+01	5.643+01	4.755+03	6.113+02	1.223+01	1.953+03	4.641+02	9.282+02
3.156+07	6.051+04	5.645+03	1.129+04	3.221+04	2.450+01	4.900+01	4.644+03	2.396+02	4.791+02	1.907+03	9.229+03	1.846+02

Table 2.16

SOURCE=2, POWER=1 WATT, PURE U-235 (NO DAUGHTERS)

BETA ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCAL (SEC)	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER	AIR	PLATE OUT	WATER
0.000	2.535+09	5.150+08	2.002+09	2.532+09	5.150+08	2.002+09	2.529+09	5.150+08	2.002+09	2.529+09	5.150+08	2.002+09
1.000+00	2.380+09	4.956+08	1.832+09	2.377+09	4.956+08	1.832+09	2.374+09	4.956+08	1.832+09	2.374+09	4.956+08	1.832+09
2.000+00	2.277+09	4.811+08	1.718+09	2.274+09	4.811+08	1.718+09	2.271+09	4.811+08	1.718+09	2.271+09	4.811+08	1.718+09
5.000+00	2.081+09	4.505+08	1.503+09	2.079+09	4.505+08	1.503+09	2.075+09	4.505+08	1.503+09	2.075+09	4.505+08	1.503+09
1.000+01	1.897+09	4.173+08	1.307+09	1.894+09	4.173+08	1.306+09	1.891+09	4.173+08	1.306+09	1.891+09	4.173+08	1.306+09
2.000+01	1.676+09	3.761+08	1.101+09	1.673+09	3.761+08	1.101+09	1.670+09	3.761+08	1.101+09	1.669+09	3.761+08	1.101+09
5.000+01	1.346+09	3.122+08	8.343+08	1.344+09	3.122+08	8.343+08	1.340+09	3.122+08	8.343+08	1.340+09	3.122+08	8.343+08
6.000+01	1.281+09	2.987+08	7.837+08	1.278+09	2.987+08	7.837+08	1.275+09	2.987+08	7.837+08	1.274+09	2.987+08	7.837+08
1.000+02	1.101+09	2.623+08	6.541+08	1.098+09	2.623+08	6.540+08	1.095+09	2.623+08	6.540+08	1.094+09	2.623+08	6.540+08
2.000+02	8.817+08	2.239+08	5.232+08	8.790+08	2.239+08	5.232+08	8.757+08	2.239+08	5.232+08	8.754+08	2.239+08	5.232+08
5.000+02	6.391+08	1.993+08	4.413+08	6.364+08	1.993+08	4.413+08	6.331+08	1.993+08	4.413+08	6.328+08	1.993+08	4.413+08
1.000+03	5.028+08	1.881+08	4.085+08	5.001+08	1.881+08	4.084+08	4.968+08	1.881+08	4.084+08	4.965+08	1.881+08	4.084+08
2.000+03	4.150+08	1.710+08	3.649+08	4.132+08	1.710+08	3.649+08	4.099+08	1.710+08	3.649+08	4.095+08	1.710+08	3.649+08
3.000+03	3.525+08	1.492+08	3.126+08	3.498+08	1.492+08	3.126+08	3.465+08	1.492+08	3.126+08	3.461+08	1.492+08	3.126+08
5.000+03	3.169+08	1.344+08	2.786+08	3.142+08	1.344+08	2.786+08	3.109+08	1.344+08	2.786+08	3.106+08	1.344+08	2.786+08
1.000+04	2.819+08	1.017+08	2.068+08	2.792+08	1.017+08	2.068+08	2.759+08	1.017+08	2.068+08	2.756+08	1.017+08	2.068+08
2.000+04	1.756+08	7.397+07	1.490+08	1.729+08	7.396+07	1.490+08	1.696+08	7.396+07	1.490+08	1.693+08	7.396+07	1.490+08
3.000+04	1.182+08	4.944+07	9.904+07	1.154+08	4.943+07	9.902+07	1.121+08	4.943+07	9.902+07	1.118+08	4.943+07	9.902+07
5.000+04	1.084+08	4.518+07	9.047+07	1.057+08	4.518+07	9.045+07	1.024+08	4.518+07	9.045+07	1.021+08	4.518+07	9.045+07
6.000+04	7.089+07	3.053+07	6.108+07	7.216+07	3.053+07	6.106+07	6.886+07	3.053+07	6.106+07	6.853+07	3.053+07	6.106+07
1.000+05	6.706+07	2.795+07	5.410+07	6.433+07	2.704+07	5.408+07	6.103+07	2.704+07	5.408+07	6.070+07	2.704+07	5.408+07
2.000+05	3.989+07	1.378+07	2.756+07	3.717+07	1.377+07	2.755+07	3.387+07	1.377+07	2.755+07	3.354+07	1.377+07	2.755+07
3.000+05	2.886+07	7.627+06	1.525+07	2.814+07	7.618+06	1.524+07	2.728+07	7.618+06	1.524+07	2.725+07	7.618+06	1.524+07
5.000+05	2.374+07	5.425+06	1.085+07	2.102+07	5.416+06	1.083+07	1.772+07	5.416+06	1.083+07	1.739+07	5.416+06	1.083+07
6.000+05	1.697+07	3.490+06	6.980+06	1.425+07	3.481+06	6.962+06	1.095+07	3.481+06	6.962+06	1.062+07	3.481+06	6.962+06
1.000+06	1.526+07	3.040+06	6.079+06	1.254+07	3.031+06	6.061+06	9.240+06	3.031+06	6.061+06	8.912+06	3.031+06	6.061+06
2.000+06	8.931+06	1.125+06	2.250+06	6.217+06	1.116+06	2.232+06	7.926+06	1.116+06	2.232+06	7.600+06	1.116+06	2.232+06
2.592+06	7.682+06	6.270+05	1.254+06	4.971+06	6.182+05	1.236+06	1.684+06	6.182+05	1.236+06	1.358+06	6.182+05	1.236+06
5.000+06	6.588+06	6.475+04	1.295+05	3.891+06	5.595+04	1.119+05	6.202+05	5.595+04	1.119+05	2.955+05	5.595+04	1.119+05
5.184+06	6.573+06	5.537+04	1.107+05	3.877+06	4.656+04	9.313+04	6.074+05	4.656+04	9.313+04	2.828+05	4.656+04	9.313+04
1.000+07	6.453+06	9.187+03	1.837+04	3.743+06	3.817+02	7.634+02	5.457+05	3.814+02	7.627+02	2.243+05	3.813+02	7.627+02
1.296+07	6.414+06	8.826+03	1.765+04	3.760+06	2.628+01	4.058+01	5.421+05	1.993+01	3.987+01	2.226+05	1.991+01	3.982+01
2.000+07	6.322+06	8.806+03	1.761+04	3.760+06	3.999+01	7.998+01	5.343+05	5.509+02	1.102+01	2.194+05	3.211+02	6.823+02
3.156+07	6.174+06	8.806+03	1.761+04	3.619+06	3.822+01	7.648+01	5.218+05	3.737+02	7.978+02	2.143+05	1.880+02	2.879+02

Table 2.17

SOURCES 3,4,5, POWER=1 WATT, PURF 11-235 (NO DAUGHTERS)

GAMMA-RAY ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
AFTER LOCA (SEC)	100X HALOGENS	100X IODINES	100X NOBLE GASES	100X HALOGENS	100X IODINES	100X NOBLE GASES	100X HALOGENS	100X IODINES	100X NOBLE GASES	100X HALOGENS	100X IODINES	100X NOBLE GASES
0.000	2.848+10	2.126+10	1.831+10	2.848+10	2.126+10	1.831+10	2.848+10	2.126+10	1.831+10	2.848+10	2.126+10	1.831+10
1.000+00	2.705+10	2.073+10	1.725+10	2.705+10	2.073+10	1.725+10	2.705+10	2.073+10	1.725+10	2.705+10	2.073+10	1.725+10
2.000+00	2.608+10	2.035+10	1.661+10	2.608+10	2.035+10	1.661+10	2.608+10	2.035+10	1.661+10	2.608+10	2.035+10	1.661+10
5.000+00	2.424+10	1.955+10	1.546+10	2.424+10	1.955+10	1.546+10	2.424+10	1.955+10	1.546+10	2.424+10	1.955+10	1.546+10
1.000+01	2.251+10	1.870+10	1.441+10	2.251+10	1.870+10	1.441+10	2.251+10	1.870+10	1.441+10	2.251+10	1.870+10	1.441+10
2.000+01	2.061+10	1.766+10	1.307+10	2.061+10	1.766+10	1.307+10	2.061+10	1.766+10	1.307+10	2.061+10	1.766+10	1.307+10
5.000+01	1.795+10	1.607+10	1.086+10	1.795+10	1.607+10	1.086+10	1.795+10	1.607+10	1.086+10	1.795+10	1.607+10	1.086+10
6.000+01	1.742+10	1.573+10	1.041+10	1.742+10	1.573+10	1.041+10	1.742+10	1.573+10	1.041+10	1.742+10	1.573+10	1.041+10
1.000+02	1.600+10	1.482+10	9.211+09	1.600+10	1.482+10	9.211+09	1.600+10	1.482+10	9.211+09	1.600+10	1.482+10	9.211+09
2.000+02	1.450+10	1.381+10	7.794+09	1.450+10	1.381+10	7.794+09	1.450+10	1.381+10	7.794+09	1.450+10	1.381+10	7.794+09
5.000+02	1.334+10	1.289+10	6.081+09	1.334+10	1.289+10	6.081+09	1.334+10	1.289+10	6.081+09	1.334+10	1.289+10	6.081+09
1.000+03	1.248+10	1.211+10	4.921+09	1.248+10	1.211+10	4.921+09	1.248+10	1.211+10	4.921+09	1.248+10	1.211+10	4.921+09
2.000+03	1.107+10	1.081+10	3.962+09	1.107+10	1.081+10	3.962+09	1.107+10	1.081+10	3.962+09	1.107+10	1.081+10	3.962+09
3.600+03	9.314+09	9.169+09	3.289+09	9.313+09	9.169+09	3.289+09	9.313+09	9.169+09	3.289+09	9.313+09	9.169+09	3.289+09
5.000+03	8.148+09	8.061+09	2.890+09	8.148+09	8.061+09	2.890+09	8.148+09	8.061+09	2.890+09	8.148+09	8.061+09	2.890+09
1.000+04	5.633+09	5.618+09	2.114+09	5.633+09	5.618+09	2.114+09	5.633+09	5.618+09	2.114+09	5.633+09	5.618+09	2.114+09
2.000+04	3.627+09	3.626+09	1.279+09	3.627+09	3.626+09	1.279+09	3.627+09	3.626+09	1.279+09	3.627+09	3.626+09	1.279+09
4.320+04	2.075+09	2.075+09	5.817+08	2.075+09	2.075+09	5.817+08	2.075+09	2.075+09	5.817+08	2.075+09	2.075+09	5.817+08
5.000+04	1.839+09	1.839+09	4.986+08	1.839+09	1.839+09	4.986+08	1.839+09	1.839+09	4.986+08	1.839+09	1.839+09	4.986+08
8.640+04	1.119+09	1.119+09	3.022+08	1.119+09	1.119+09	3.022+08	1.119+09	1.119+09	3.022+08	1.119+09	1.119+09	3.022+08
1.000+05	9.703+08	9.703+08	2.702+08	9.702+08	9.701+08	2.703+08	9.702+08	9.701+08	2.702+08	9.702+08	9.701+08	2.702+08
2.000+05	4.899+08	4.898+08	1.748+08	4.897+08	4.897+08	1.747+08	4.897+08	4.897+08	1.746+08	4.897+08	4.897+08	1.746+08
3.450+05	2.960+08	2.960+08	1.289+08	2.959+08	2.959+08	1.289+08	2.959+08	2.959+08	1.287+08	2.959+08	2.959+08	1.287+08
5.000+05	2.217+08	2.217+08	9.858+07	2.216+08	2.216+08	9.858+07	2.216+08	2.216+08	9.860+07	2.216+08	2.216+08	9.839+07
8.640+05	1.450+08	1.450+08	5.419+07	1.450+08	1.450+08	5.419+07	1.450+08	1.450+08	5.420+07	1.450+08	1.450+08	5.419+07
1.000+06	1.273+08	1.273+08	4.380+07	1.271+08	1.271+08	4.380+07	1.271+08	1.271+08	4.370+07	1.271+08	1.271+08	4.369+07
2.000+06	4.695+07	4.695+07	9.667+06	4.694+07	4.688+07	9.586+06	4.689+07	4.684+07	9.488+06	4.684+07	4.684+07	9.479+06
2.592+06	2.606+07	2.606+07	4.115+06	2.595+07	2.595+07	4.035+06	2.595+07	2.595+07	3.937+06	2.595+07	2.595+07	3.927+06
5.000+06	2.461+06	2.461+06	3.265+05	2.348+06	2.348+06	2.468+05	2.348+06	2.348+06	1.498+05	2.348+06	2.348+06	1.401+05
5.184+06	2.067+06	2.067+06	2.988+05	1.954+06	1.954+06	2.189+05	1.954+06	1.954+06	1.219+05	1.954+06	1.954+06	1.123+05
1.000+07	1.289+05	1.289+05	1.925+05	1.601+04	1.601+04	1.135+05	1.601+04	1.601+04	1.752+04	1.600+04	1.600+04	7.981+03
1.296+07	1.137+05	1.137+05	1.902+05	8.399+07	8.399+02	1.117+05	8.355+02	8.355+02	1.626+04	8.352+02	8.352+02	6.781+03
2.000+07	1.129+05	1.129+05	1.873+05	5.683+00	5.683+00	1.099+05	1.223+00	1.223+00	1.585+04	4.282+01	4.282+01	6.510+03
3.156+07	1.129+05	1.129+05	1.829+05	4.900+00	4.900+00	1.073+05	4.791+01	4.791+01	1.548+04	1.846+01	1.846+01	6.356+03

Table 2.18

SOURCES 3,4,5, POWER1 WATT, PURE U-235 (NO DAUGHTERS)

BETA ENERGY RELEASE RATE (MEV/SEC/WATT)

TIME AFTER LOCA (SEC)	EQUILIBRIUM			5000 DAYS			500 DAYS			200 DAYS		
	100% HALOGENS	100% IODINES	100% NOBLE GASES	100% HALOGENS	100% IODINES	100% NOBLE GASES	100% HALOGENS	100% IODINES	100% NOBLE GASES	100% HALOGENS	100% IODINES	100% NOBLE GASES
0.000	2.002+10	1.037+10	1.997+10	2.002+10	1.036+10	1.996+10	2.002+10	1.037+10	1.995+10	2.002+10	1.036+10	1.995+10
1.000+00	1.832+10	9.912+09	1.861+10	1.832+10	9.912+09	1.860+10	1.832+10	9.912+09	1.859+10	1.832+10	9.912+09	1.858+10
2.000+00	1.718+10	9.623+09	1.772+10	1.718+10	9.623+09	1.771+10	1.718+10	9.623+09	1.770+10	1.718+10	9.623+09	1.770+10
5.000+00	1.503+10	9.010+09	1.606+10	1.503+10	9.010+09	1.605+10	1.503+10	9.010+09	1.604+10	1.503+10	9.010+09	1.604+10
1.000+01	1.307+10	8.345+09	1.453+10	1.307+10	8.345+09	1.452+10	1.307+10	8.345+09	1.451+10	1.307+10	8.345+09	1.451+10
2.000+01	1.101+10	7.522+09	1.271+10	1.101+10	7.521+09	1.270+10	1.101+10	7.521+09	1.269+10	1.101+10	7.521+09	1.269+10
5.000+01	8.343+09	6.244+09	1.004+10	8.343+09	6.244+09	1.003+10	8.343+09	6.244+09	1.002+10	8.343+09	6.244+09	1.002+10
6.000+01	7.837+09	5.974+09	9.512+09	7.837+09	5.974+09	9.502+09	7.837+09	5.974+09	9.492+09	7.837+09	5.974+09	9.490+09
1.000+02	6.541+09	5.246+09	8.077+09	6.540+09	5.246+09	8.064+09	6.540+09	5.246+09	8.057+09	6.540+09	5.246+09	8.056+09
2.000+02	5.232+09	4.478+09	6.287+09	5.232+09	4.478+09	6.276+09	5.232+09	4.478+09	6.267+09	5.232+09	4.478+09	6.266+09
5.000+02	4.414+09	3.986+09	4.145+09	4.413+09	3.985+09	4.136+09	4.413+09	3.985+09	4.125+09	4.413+09	3.985+09	4.124+09
1.000+03	4.085+09	3.763+09	2.914+09	4.084+09	3.763+09	2.905+09	4.084+09	3.763+09	2.894+09	4.084+09	3.763+09	2.893+09
2.000+03	3.649+09	3.420+09	2.273+09	3.649+09	3.419+09	2.264+09	3.649+09	3.419+09	2.253+09	3.649+09	3.419+09	2.252+09
3.600+03	3.126+09	2.983+09	1.810+09	3.126+09	2.983+09	1.801+09	3.126+09	2.983+09	1.790+09	3.126+09	2.983+09	1.789+09
5.000+03	2.786+09	2.688+09	1.604+09	2.786+09	2.688+09	1.595+09	2.786+09	2.688+09	1.584+09	2.786+09	2.688+09	1.583+09
1.000+04	2.068+09	2.034+09	1.188+09	2.068+09	2.033+09	1.178+09	2.068+09	2.033+09	1.167+09	2.068+09	2.033+09	1.166+09
2.000+04	1.490+09	1.479+09	8.142+08	1.490+09	1.479+09	8.131+08	1.490+09	1.479+09	8.121+08	1.490+09	1.479+09	8.120+08
4.320+04	9.904+08	9.887+08	5.152+08	9.902+08	9.885+08	5.094+08	9.902+08	9.885+08	5.084+08	9.902+08	9.885+08	5.084+08
5.000+04	9.047+08	9.037+08	4.689+08	9.045+08	9.035+08	4.598+08	9.045+08	9.035+08	4.588+08	9.045+08	9.035+08	4.587+08
8.640+04	8.108+08	8.107+08	3.220+08	8.106+08	8.106+08	3.130+08	8.106+08	8.106+08	3.020+08	8.106+08	8.106+08	3.009+08
1.000+05	5.410+08	5.410+08	2.911+08	5.408+08	5.408+08	2.821+08	5.408+08	5.408+08	2.711+08	5.408+08	5.408+08	2.700+08
2.000+05	2.756+08	2.756+08	1.965+08	2.755+08	2.755+08	1.874+08	2.755+08	2.755+08	1.764+08	2.755+08	2.755+08	1.753+08
3.456+05	1.525+08	1.525+08	1.569+08	1.524+08	1.524+08	1.478+08	1.524+08	1.524+08	1.368+08	1.524+08	1.524+08	1.357+08
5.000+05	1.085+08	1.085+08	1.297+08	1.083+08	1.083+08	1.207+08	1.083+08	1.083+08	1.097+08	1.083+08	1.083+08	1.086+08
8.640+05	6.098+07	6.098+07	4.508+07	6.092+07	6.092+07	3.962+07	6.092+07	6.092+07	3.855+07	6.092+07	6.092+07	3.845+07
1.000+06	6.079+07	6.079+07	7.389+07	6.061+07	6.061+07	6.446+07	6.061+07	6.061+07	5.347+07	6.061+07	6.061+07	5.237+07
2.000+06	2.250+07	2.250+07	3.788+07	2.247+07	2.247+07	2.428+07	2.247+07	2.247+07	1.329+07	2.247+07	2.247+07	1.220+07
2.592+06	1.258+07	1.254+07	2.684+07	1.246+07	1.236+07	1.747+07	1.236+07	1.236+07	8.513+06	1.236+07	1.236+07	5.426+06
5.000+06	1.295+06	1.295+06	2.182+07	1.119+06	1.119+06	1.286+07	1.119+06	1.119+06	1.958+06	1.119+06	1.119+06	8.753+05
5.184+06	1.107+06	1.107+06	2.178+07	9.313+05	9.313+05	1.282+07	9.313+05	9.313+05	1.927+06	9.313+05	9.313+05	8.455+05
1.000+07	1.837+05	1.837+05	2.188+07	7.834+03	7.834+03	1.261+07	7.827+03	7.827+03	1.818+06	7.827+03	7.827+03	7.455+05
1.296+07	1.765+05	1.765+05	2.135+07	4.956+02	4.956+02	1.253+07	3.987+02	3.987+02	1.807+06	3.982+02	3.982+02	7.420+05
2.000+07	1.761+05	1.761+05	2.104+07	7.998+00	7.998+00	1.235+07	1.102+00	1.102+00	1.781+06	8.423+01	8.423+01	7.313+05
3.156+07	1.761+05	1.761+05	2.055+07	7.684+00	7.684+00	1.206+07	7.474+01	7.474+01	1.739+06	2.880+01	2.880+01	7.142+05

the Regulatory Guide 1.89 specifications, but it is of interest because it is a much simpler case to calculate. In essence it permits the daughters of nonspecified fission products to be included if they are the same species. Most of the standard fission product codes can perform these calculations with little or no modification. These results for Sources 1 and 2 at the four irradiation times are given in Reference 1. We denote this treatment the "continuous release" method. The results of these calculations are discussed in Section 2.4.2.

2.4 DISCUSSION OF THE RESULTS

The voluminous quantity of data generated in this study and described in the previous section requires much intercomparison in order to draw conclusions concerning the effects of the various parameters considered. In the following sections brief discussions of the effects of each of the parameters is given and illustrated with cross plots of the data.

2.4.1 Effects of Irradiation History

The length of irradiation and operating power are two variables which influence the fission product energy release rates and spectra. The length of irradiation affects the buildup and inventory of fission products in a well understood way described by the equations of radioactive decay. At long irradiation and cooling times, for example, the results are dominated by the long half-life species. As noted earlier, the energy release rate results for equilibrium, 5000-d, 500-d and 200-d irradiations showed little difference at short cooling times (≤ 1 day). At longer times, however, there are notable differences. Tables 2.19 and 2.20 show the percentage difference (from the equilibrium case) at a few selected cooling times. Clearly at "long" cooling times the length of irradiation time chosen for the calculations can have a significant effect on the energy release rates. For Source 1, "long" means greater than a few days, for Source 2, "long" means greater than 30 days. However, there are only very minor differences for irradiation times of 200 days and 500 days.

With depletion not a consideration, the reactor operating power affects the inventory of fission products only by neutron capture transmutation of the fission products. That is, without depletion or capture the decay power scales with operating power (assuming constant power operation). In general, (for the case of all fission products) neutron capture tends to increase the decay power. The magnitude is very much cooling time dependent with the largest capture effect occurring at long cooling

Table 2.19
PERCENT DEVIATION FROM EQUILIBRIUM
ENERGY RELEASE RATE

SOURCE I (Gamma)

Cooling Time	Air			Plate Out			Water		
	5000 d	500 d	200 d	5000 d	500 d	200 d	5000 d	500 d	200 d
1 d	3.2×10^{-2}	4.8×10^{-2}	4.8×10^{-2}	1.99	2.76	4.04	1.17	1.64	2.40
4 d	<0.1	<0.1	<0.1	4.76	6.63	9.63	3.39	4.70	6.81
10 d	0.12	0.22	0.23	7.48	10.4	14.8	5.62	7.81	11.2
30 d	0.92	1.84	1.93	15.2	21.0	28.6	13.7	19.0	25.8
60 d	12.9	24.6	25.7	23.8	32.7	41.7	23.6	32.3	41.3
1 y	49.1	92.5	96.9	65.1	87.3	91.0	65.2	87.3	91.0

SOURCE I (Beta)

Cooling Time	Air			Plate Out			Water		
	5000 d	500 d	200 d	5000 d	500 d	200 d	5000 d	500 d	200 d
1 d	1.76	3.88	4.09	5.45	9.73	13.0	3.44	6.17	8.21
4 d	4.53	10.0	10.6	12.0	21.3	28.4	9.22	16.5	21.8
10 d	8.56	19.0	20.0	16.0	28.5	37.7	13.6	24.1	31.8
30 d	30.3	67.0	70.6	23.6	41.5	53.9	22.6	39.7	55.9
60 d	40.8	90.1	95.0	29.3	50.7	64.6	29.2	50.5	64.4
1 y	41.5	91.6	96.5	49.4	76.1	87.0	49.5	76.1	87.0

Table 2.20
PERCENT DEVIATION FROM EQUILIBRIUM
ENERGY RELEASE RATE

SOURCE 2 (Gamma)

Cooling Time	Air			Plate Out			Water		
	5000 d	500 d	200 d	5000 d	500 d	200 d	5000 d	500 d	200 d
1 d	<0.1	<0.1	<0.1	0	0	0	0	0	0
4 d	0.10	0.21	0.21	0	0	0	<0.1	<0.1	<0.1
10 d	0.22	0.45	0.45	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
30 d	1.61	3.22	3.39	0.37	0.37	0.37	0.44	0.44	0.44
60 d	16.8	33.4	35.1	5.34	5.34	5.34	5.25	5.25	5.25
1 y	46.7	92.3	96.8	100	100	100	100	100	100

SOURCE 2 (Beta)

Cooling Time	Air			Plate Out			Water		
	5000 d	500 d	200 d	5000 d	500 d	200 d	5000 d	500 d	200 d
1 d	3.61	7.98	8.41	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4 d	9.42	20.9	22.0	<0.1	<0.1	<0.1	0.11	0.11	0.11
10 d	16.1	35.5	37.4	0.22	0.22	0.22	0.21	0.21	0.21
30 d	35.3	78.0	82.3	1.31	1.31	1.31	1.26	1.26	1.26
60 d	41.0	90.7	95.7	15.7	15.7	15.7	15.6	15.6	15.6
1 y	41.4	91.5	96.5	100	100	100	100	100	100

times ($\sim 10^7 - 10^8$ sec). The effect also increases with increasing flux level or length of irradiation. However, when looking at a restricted set of fission products, as is the case here, it is difficult to make such generalizations.

We have attempted to investigate the magnitude of this effect on the specialized sources of interest by performing calculations at high power levels, 4000 MW(t), and corresponding high flux levels (2×10^{13} n/cm²-sec). For these calculations depletion or capture in the fuel was not allowed. Calculations for equilibrium and 200-day irradiations for Source 1 were performed and compared against similar calculations at low power (and low flux). The equilibrium results are probably not very meaningful since this unrealistically long irradiation (10^{13} sec) results in very high capture. The results for the 200-day irradiation indicate that capture is not a significant effect at shorter and more realistic irradiation times.

Another effect of operating power is depletion or burnup of the fuel and possible transmutation of fertile material to fissile. In order to maintain the power level constant, a decrease in the fission rate due to burnup must be compensated by an increase of fission rate in a second fuel. This effect was examined for a power level of 4000 MW(t) and the assumption that all fissions were initially coming from U-235 but at the end of the irradiation period a certain percentage of the fissions were coming from Pu-239. The assumptions were 50 percent in each isotope at the end of the equilibrium irradiation, and 25 percent of the fissions from Pu-239 at the end of the 200-day irradiation.

Since the decay power for Pu-239 is generally less than that for U-235, these assumptions tend to decrease the decay power compared to the pure U-235 case, all other conditions being equal. Comparison of Source 1 calculations for pure U-235 with capture effects only at 4000 MW(t) and the calculations which include both U-235 and Pu-239 show that in most cases the effect of depletion and transmutation of fertile U-238 to Pu-239 during irradiation is to reduce the decay power compared to the U-235 case.

2.4.2 Treatment of Daughter Nuclides

A method for handling the daughter nuclides of the specified release fractions is not given in Regulatory Guide 1.89. In this program we investigated and compared several ways one might treat the daughters.

The most conservative assumption (leading to the largest decay power) is to include all progeny of the specified elements in the determination of the energy release

rates. The procedure was followed for the majority of the calculations reported here. Another possibility is to keep only those daughters which are of the same species as originally specified, and reject all others. For example, for an airborne source of 100 percent noble gases and 25 percent iodines, the decay of iodine builds up certain xenon isotopes in addition to any that may be present at shutdown. These would be retained. The xenon, however, decays to nongaseous isotopes, and the subsequent decay of these would not be included in the decay power. The logic behind this treatment is that the solids would not remain in the air and therefore would not continue to contribute to the decay power of the airborne source.

Calculations with the latter assumption were made for Sources 1 and 2, and for the 100 percent groups - halogens, iodines and noble gases (Sources 3, 4, 5). The results for Sources 1 and 2 are compared with the more conservative assumption (all daughters retained) and shown in Figures 2.23 through 2.34 for the case of equilibrium irradiation. In most cases the daughters that are not of the originally specified types are seen to contribute a small amount to the energy release rates. The region where the discrepancies are the largest is the middle time region from $\sim 10^2$ to 10^5 seconds cooling. The most dramatic difference occurs for the noble gases (and the airborne sources which are dominated by the noble gases). For the other cases the inclusion of all daughters results in a slightly conservative energy release rate.

Similar comparisons (i.e., with and without daughters that are of nonspecified types) are shown for the calculations of 100 percent halogens, 100 percent iodines and 100 percent noble gases (Sources 3, 4, 5) in Figures 2.35 through 2.40. These results also demonstrate that it is the noble gases (see Figures 2.39 and 2.40) which show the largest effect of including all daughters.

A third treatment was investigated. For this case it was assumed that all fission products were released or available for release at all times after shutdown. At each cooling time the decay power from the specified release fractions was tallied. This model essentially allows daughters from nuclides not included in the originally specified groups to be included if they are of the appropriate species, but as with the "no daughters" case described above, daughters are discarded unless they are also members of the elemental groups being followed.

This model is not strictly in keeping with the Guide description, but in some sense is more realistic in that it allows gaseous decay products of solids in the water, for example, to contribute to the atmospheric source. This model is also much simpler to calculate with standard fission product codes. Only a single time-dependent calculation

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GAMMA RAYS-SOURCE 1 (AIR), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.23

BETA RAYS- SOURCE 1 (AIR), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.24

GAMMA RAYS-SOURCE 1 (P.O.), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.25

BETA RAYS- SOURCE 1 (P.O.), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.26

GAMMA RAYS-SOURCE 1 (WATER), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.27

BETA RAYS- SOURCE 1 (WATER), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.28

GAMMA RAYS-SOURCE 2 (AIR), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.29

BETA RAYS- SOURCE 2 (AIR), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.30

GAMMA RAYS-SOURCE 2 (P.O.), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.31

BETA RAYS- SOURCE 2 (P.O.), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.32

GAMMA RAYS-SOURCE 2 (WATER), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.33

BETA RAYS- SOURCE 2 (WATER), EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.34

GAMMA RAYS-100% HALOGENS, EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.35

Figure 2.36

GAHMA RAYS-100% IODINES, EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.37

Figure 2.38

GAMMA RAYS-100% NOBLE GASES, EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.39

BETA RAYS- 100% NOBLE GASES, EQUILIBRIUM, -EFFECTS OF DAUGHTERS

Figure 2.40

with 100 percent of all fission products released need be made. All the information pertaining to the various sources can be computed afterward from these data.

Examples of the results of the latter treatment compared to the calculations which include all daughter contributions are shown in Figures 2.41-2.46 for Source 1 (equilibrium). At short and long cooling times the results are very close. In the middle cooling time region, however, there are significant differences; generally, the "continuous release" model produces a larger energy release rate. For Source 2 the differences between the two models are much greater. These results indicate that the continuous release method of calculation must be used with caution. It remains to be shown whether or not this case is closer to a realistic situation than the instantaneous release approach specified in Regulatory Guide 1.89.

2.4.3 Effects of Fissile Loading

For most of the calculations described, the fuel was pure U-235. In a power reactor fissions will come from U-235 and Pu-239 which is produced by neutron capture in (and subsequent decay of) U-238. A so-called "realistic" case was calculated as described in Section 2.3. This was intended to serve as an illustration of the effect that conditions closer to realistic have on the decay power compared to the pure U-235 case without capture. It was found that for Sources 1 and 2 for an irradiation of 200 days, the differences are negligibly small.

2.4.4 Largest Contributing Nuclides

For all of the energy release rate calculations presented in this report and in Reference 1, a compilation was made of the ten nuclides which are the most significant contributors to the decay power. These are given for reference in Appendix A for the case of Sources 1, 2 and 7 at 1 watt and pure U-235 with all daughters included. The other cases are given in the appendices to Reference 1.

A few general conclusions may be drawn from these results. Except at very short times, relatively few nuclides contribute the bulk of the decay power for Sources 1 and 2. At long cooling times (30 days) only one or two nuclides are responsible for almost all the decay power.

It was also found that the realistic case that included Pu-239 did not significantly alter the types or percentage contribution of nuclides which are the most significant.

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GAMMA RAYS-- SOURCE 1 (AIR) - EFFECTS OF DAUGHTERS

Figure 2.41

Figure 2.42

Figure 2.43

BETA RAYS - - SOURCE 1 (P.O.) - EFFECTS OF DAUGHTERS

Figure 2.44

Figure 2.45

BETA RAYS- - SOURCE 1 (WATER) - EFFECTS OF DAUGHTERS

Figure 2.46

3. RADIATION SPECTRA

The beta and gamma-ray spectra of the fission product sources specified in Regulatory Guide 1.89 (Ref. 2) are reported in this section. Like the energy release rates discussed in the previous section the spectra are dependent upon many parameters associated with the power history of the reactor. In addition, the spectra are dependent upon cooling time or time after shutdown. It is therefore of interest to determine the importance of all of these variables on the spectra.

In this section we report the results of beta and gamma spectra calculated for certain selected sources described previously. The calculational methods are described in Section 3.1 followed by a presentation of a few selected results in the form of tables and plots; complete spectral data are given in Reference 1. Some discussion and conclusions are also given.

These spectra will be used in Phase 5 of this program as sources for calculations of energy deposition in modeled reactor equipment.

3.1 METHOD OF CALCULATION

The procedure used for calculation of composite spectra of fission products is based on the technique used by England and co-workers in conjunction with the CINDER family of fission product codes (Ref.11). A block diagram outlining the method is shown in Figure 3.1. The concentrations of all the fission product nuclides of interest are tallied by RIBD-II as described in Section 2. At the cooling times at which spectra are desired, these concentrations are dumped onto a tape along with the total beta and gamma energy release rates. Spectra of all of the individual nuclides in ENDF/B-IV for which spectral data are known (180 nuclides) have been calculated in a fixed group structure by England and Stamatelatos (Ref.12). For gamma rays this is simply a matter of properly binning the ENDF data (line energies and intensities) into a 150-group energy structure (50-keV bins) between 0 and 7.5 MeV. For beta particles the problem is more complex since beta spectra are continuous. It is necessary to use a theoretical formulation to generate individual nuclide beta spectra using the intensity

and endpoint energy specified in the ENDF/B-IV files. This has been done using an "exact" beta theory and tabulated in a 75-energy group (100 keV bins) structure by England and Stamatelatos (Ref.12). These individual nuclide data are folded with the concentrations of nuclides of interest to produce the desired fission product spectrum. The final spectra were collapsed to a 50-group (150 keV) structure for gamma rays and 25 groups (300 keV bins) for betas.

Figure 3.1

The 180 nuclides for which spectral information is available are the most important for decay heating. Recent comparisons have shown that for all fission products, the 180 nuclides account for about two-thirds of the total decay energy at short cooling times (~ 10 s), and account for 90 to 98 percent of the total decay energy at times $\gtrsim 100$ s after shutdown (Ref. 12).

In order to approximately account for the missing nuclides at each cooling time the spectra have been normalized so that the total energy (integral of the spectrum) is equal to the total decay energy from all 818 of the fission products as calculated by RIBD-II. At short cooling times this may not be accurate since the spectral shape could be altered by the missing nuclides. It should be noted that the summation method under-predicts the decay heat at short times. However, for the cooling times of concern here, it is not expected to be important.

3.2 RESULTS

In the energy release rate studies (Section 2) a very large number of source calculations were prepared. It was not practical to calculate spectra for all those cases nor for all the cooling times calculated (34). We therefore limited the spectral calculations to 10 time points between shutdown and one year after shutdown, as shown in Table 3.1.

Table 3.1 COOLING TIMES FOR SPECTRUM CALCULATIONS

Shutdown	4 days
1 minute	10 days
1 hour	30 days
12 hours	60 days
1 day	1 year

There are several useful forms in which to express spectral information: Number spectra (number of particles per second in a given energy bin); energy spectra (particle energy per unit time in a specified bin); cumulative spectra (fraction of energy below the specified energy).

All three of these forms were calculated and tabulated separately for beta and gamma rays in Reference 1. In this report we present only the cumulative beta and gamma spectra for selected sources. In addition the average particle energy at each of the cooling times was also determined. The shutdown spectra should be interpreted with caution since the spectral shape could be significantly altered by the large contribution of missing nuclides as discussed in the previous section.

The information presented in graphical form was further condensed for clarity. Only cumulative spectra have been plotted at selected times (1 minute, 1 hour, 1 day and 30 days).

The results for Sources 1, 2 and 7 for an equilibrium irradiation are given in Appendix B. The plotted energy spectra could more properly be shown as histograms. Results for other irradiation times and other conditions are presented in Reference 1.

It is difficult to make very many generalizations about such a large body of data. It is clear, however, that the spectral shapes are changing very dramatically with cooling time. The spectra at one minute bear little resemblance to those at 30 days. Initial inspection of the complete Reference 1 spectral data indicate that very little shape changes occur as a function of length of irradiation.

It is interesting to compare the Source 1 and 2 spectra with the spectra for all fission products (Source 7). The 30-day cooling time spectra for Source 7 are much harder than for either Source 1 or 2. The short-time (1-minute) spectra, however, have very similar shapes; of course the magnitudes are quite different.

Spectral calculations for the cases without daughters were limited to only equilibrium irradiations since little difference is expected for the other irradiation times. The results given in Reference 1 show that contribution of daughters to the spectral shape is mixed, with certain cooling times showing little or no effect and others showing significant changes. It has not been possible to fully analyze these results and to make general conclusions (if indeed such are possible) pertaining to the importance of daughters on the spectrum as a function of source type or cooling time. It is anticipated, however, that the overall effects of daughters (that are nonspecified types) on both beta and gamma spectra are insignificant.

Spectra have also been calculated for the case where effects of capture were included at high power. Spectra for Source 1 at both equilibrium and 200-day irradiations are presented in Reference 1. The so-called realistic case calculations for a 200-day irradiation only for Sources 1 and 2 are also given in Reference 1. In all the cases the effects of capture and fissile loading on the spectra are very minor.

A parameter of interest in comparing the behavior of spectra is the average energy. For all the spectra reported here average particle energy has been computed using the following definition:

$$\bar{E} = \frac{\int_0^{\infty} EN(E)dE}{\int_0^{\infty} N(E)dE}$$

where E is the particle energy and $N(E)$ is the number spectrum. The results for Sources 1 through 7 are listed in Table 3.2. This quantity was found to be nearly independent of length of irradiation; in fact the differences are so small that they would not show up on the plots. Graphs of average gamma or beta energy versus cooling time are shown in Figures 3.2 through 3.10. The data points have been connected by smooth curves. Note that there are insufficient data at short cooling times to properly define the shape of the curve. Thus at short times the curves should be taken only as an indication of the behavior of the average energy.

As may be observed in the figures, there is a softening of the spectra with a minimum in the neighborhood of 1 to 10 days, and then there is a rehardening at longer cooling times. The beta spectra show only a slight rehardening, but in the case of the gamma-ray spectra the effect is much more pronounced. This result is also found in the Source 7 spectra which include all fission products (Figure 3.10). This agrees qualitatively with the results reported by Bonzon (Reference 10).

The average energy for spectra which do not include daughters if they are different than the originally specified types is given in Table 3.3 for the equilibrium case only. Other irradiation times are essentially the same.

The average energy behavior with cooling time for the high power operation is shown in Figures 3.15 and 3.16 and listed in Table 3.4. Both equilibrium and 200-day irradiations are shown, but unlike the low power operation, there is an observable difference with irradiation time. Shape changes are not very different; generally the shorter irradiation spectra are higher, meaning the spectra are harder. This holds for both gamma-ray spectra and beta spectra.

Table 3.5 lists average energies for Sources 1 and 2 and 200-day irradiation under realistic conditions. These results are plotted in Figures 3.17 through 3.20.

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Table 3.2 AVERAGE PARTICLE ENERGY (MeV) (POWER = 1 WATT, PURE U-235)

	Equilib.	5000 d	500 d	200 d	Equilib.	5000 d	500 d	200 d
Source 1 (Air) - γ					Source 1 (Air) - β			
0	0.7095	0.7096	0.7096	0.7096	1.0066	1.0080	1.0098	1.0100
1 min.	0.7556	0.7556	0.7556	0.7556	0.7866	0.7879	0.7895	0.7897
1 hr.	0.6361	0.6361	0.6361	0.6361	0.5609	0.5622	0.5638	0.5639
12 hr.	0.2864	0.2864	0.2864	0.2864	0.2652	0.2654	0.2656	0.2657
1 day	0.2248	0.2247	0.2247	0.2247	0.2102	0.2098	0.2092	0.2092
4 days	0.1638	0.1638	0.1637	0.1637	0.1656	0.1638	0.1615	0.1612
10 days	0.1640	0.1639	0.1637	0.1637	0.1678	0.1643	0.1595	0.1590
30 days	0.2297	0.2284	0.2268	0.2267	0.2158	0.2014	0.1746	0.1700
60 days	0.3567	0.3428	0.3224	0.3201	0.2441	0.2432	0.2325	0.2217
1 year	0.5252	0.5253	0.5269	0.5296	0.2456	0.2456	0.2456	0.2456
Source 1 (Plate Out) γ					Source 1 (Plate Out) β			
0	0.8320	0.8323	0.8325	0.8327	0.7492	0.7528	0.7550	0.7570
1 min.	0.8263	0.8266	0.8269	0.8271	0.6475	0.6501	0.6517	0.6530
1 hr.	0.7776	0.7780	0.7783	0.7785	0.4657	0.4663	0.4660	0.4659
12 hrs.	0.5367	0.5357	0.5354	0.5343	0.3719	0.3698	0.3670	0.3648
1 day	0.4781	0.4756	0.4748	0.4727	0.3493	0.3456	0.3409	0.3373
4 days	0.5012	0.4954	0.4937	0.4887	0.3131	0.3025	0.2901	0.2796
10 days	0.5282	0.5201	0.5179	0.5110	0.3307	0.3174	0.3002	0.2849
30 days	0.6069	0.5974	0.5966	0.5881	0.3934	0.3829	0.3613	0.3375
60 days	0.6466	0.6393	0.6425	0.6370	0.4249	0.4210	0.4012	0.3712
1 year	0.6551	0.6222	0.5985	0.6398	0.4631	0.4922	0.5568	0.5473
Source 1 (Water) γ					Source 1 (Water) β			
0	0.8917	0.8914	0.8915	0.8917	0.8307	0.8330	0.8345	0.8357
1 min.	0.8658	0.8660	0.8661	0.8662	0.7063	0.7081	0.7092	0.7101
1 hr.	0.7876	0.7878	0.7880	0.7881	0.4628	0.4631	0.4630	0.4629
12 hrs.	0.5267	0.5260	0.5258	0.5252	0.3592	0.3578	0.3559	0.3546
1 day	0.4568	0.4552	0.4547	0.4534	0.3357	0.3331	0.3301	0.3278
4 days	0.4552	0.4505	0.4490	0.4452	0.2825	0.2736	0.2642	0.2566
10 days	0.4728	0.4654	0.4630	0.4570	0.2964	0.2836	0.2691	0.2568
30 days	0.5705	0.5585	0.5558	0.5460	0.3772	0.3641	0.3415	0.3181
60 days	0.6408	0.6322	0.6345	0.6281	0.4230	0.4185	0.3982	0.3680
1 year	0.6551	0.6222	0.5985	0.6398	0.4631	0.4922	0.5568	0.5473

Table 3.2 (continued)

	Equilib.	5000 d	500 d	200 d	Equilib.	5000 d	500 d	200 d
Source 2 (Air) γ					Source 2 (Air) β			
0	0.7192	0.7192	0.7192	0.7192	0.9435	0.9468	0.9510	0.9514
1 min.	0.7550	0.7550	0.7550	0.7550	0.7408	0.7438	0.7474	0.7478
1 hr.	0.6502	0.6502	0.6502	0.6502	0.5246	0.5273	0.5306	0.5310
12 hrs.	0.3369	0.3369	0.3369	0.3369	0.2785	0.2792	0.2801	0.2802
1 day	0.2766	0.2766	0.2765	0.2765	0.2296	0.2291	0.2285	0.2284
4 days	0.2109	0.2107	0.2105	0.2105	0.1781	0.1743	0.1691	0.1686
10 days	0.2099	0.2095	0.2091	0.2091	0.1829	0.1762	0.1660	0.1648
30 days	0.2803	0.2782	0.2755	0.2753	0.2283	0.2205	0.1895	0.1816
60 days	0.3951	0.3784	0.3513	0.3481	0.2449	0.2444	0.2387	0.2317
1 year	0.5251	0.5251	0.5257	0.5266	0.2455	0.2456	0.2456	0.2456
Source 2 (Plate Out) γ					Source 2 (Plate Out) β			
0	0.8397	0.8397	0.8397	0.8397	0.6820	0.6820	0.6820	0.6820
1 min.	0.8331	0.8331	0.8331	0.8331	0.6049	0.6049	0.6049	0.6049
1 hr.	0.7870	0.7870	0.7870	0.7870	0.4389	0.4389	0.4389	0.4389
12 hrs.	0.5141	0.5141	0.5141	0.5141	0.3411	0.3411	0.3411	0.3411
1 day	0.4286	0.4286	0.4286	0.4286	0.3146	0.3146	0.3146	0.3146
4 days	0.3716	0.3716	0.3716	0.3716	0.2155	0.2155	0.2155	0.2155
10 days	0.3528	0.3528	0.3528	0.3528	0.1959	0.1959	0.1959	0.1959
30 days	0.3698	0.3698	0.3698	0.3698	0.2025	0.2025	0.2025	0.2025
60 days	0.3801	0.3801	0.3801	0.3801	0.2075	0.2075	0.2075	0.2075
1 year	0.6750	0.6750	0.6750	0.6750	0.1993	0.1993	0.1993	0.1993
Source 2 (Water) γ					Source 2 (Water) β			
0	0.9007	0.9007	0.9007	0.9007	0.8165	0.8165	0.8165	0.8165
1 min.	0.8727	0.8727	0.8727	0.8727	0.6974	0.6974	0.6974	0.6974
1 hr.	0.7950	0.7950	0.7950	0.7950	0.4492	0.4492	0.4492	0.4492
12 hrs.	0.5141	0.5141	0.5141	0.5141	0.3411	0.3411	0.3411	0.3411
1 day	0.4286	0.4286	0.4286	0.4286	0.3146	0.3146	0.3146	0.3146
4 days	0.3716	0.3716	0.3716	0.3716	0.2155	0.2155	0.2155	0.2155
10 days	0.3528	0.3528	0.3528	0.3528	0.1959	0.1959	0.1959	0.1959
30 days	0.3698	0.3698	0.3698	0.3698	0.2025	0.2025	0.2025	0.2025
60 days	0.3801	0.3801	0.3801	0.3801	0.2075	0.2075	0.2075	0.2075
1 year	0.6738	0.6738	0.6738	0.6738	0.2576	0.2576	0.2576	0.2576

Table 3.2 (continued)

	Equilib.	5000 d	500 d	200 d	Equilib.	5000 d	500 d	200 d
Source 3 (100% Halogens) γ					Source 3 (100% Halogens) β			
0	0.9007	0.9007	0.9007	0.9007	0.8165	0.8165	0.8165	0.8165
1 min.	0.8727	0.8727	0.8727	0.8727	0.6974	0.6974	0.6974	0.6974
1 hr.	0.7930	0.7930	0.7930	0.7930	0.4492	0.4492	0.4492	0.4492
12 hr.	0.5141	0.5141	0.5141	0.5141	0.3411	0.3411	0.3411	0.3411
1 day	0.4286	0.4286	0.4286	0.4286	0.3146	0.3146	0.3146	0.3146
4 days	0.3716	0.3716	0.3716	0.3716	0.2154	0.2154	0.2154	0.2154
10 days	0.3528	0.3528	0.3528	0.3528	0.1959	0.1959	0.1959	0.1959
30 days	0.3698	0.3698	0.3698	0.3698	0.2025	0.2025	0.2025	0.2025
60 days	0.3801	0.3801	0.3801	0.3801	0.2075	0.2075	0.2075	0.2075
1 year	0.6738	0.6738	0.6738	0.6738	0.2576	0.2576	0.2576	0.2576
Source 4 (100% Iodines) γ					Source 4 (100% Iodines) β			
0	0.8397	0.8397	0.8397	0.8397	0.6820	0.6820	0.6820	0.6820
1 min.	0.8331	0.8331	0.8331	0.8331	0.6049	0.6049	0.6049	0.6049
1 hr.	0.7870	0.7870	0.7870	0.7870	0.4389	0.4389	0.4389	0.4389
12 hr.	0.5141	0.5141	0.5141	0.5141	0.3411	0.3411	0.3411	0.3411
1 day	0.4286	0.4286	0.4286	0.4286	0.3146	0.3146	0.3146	0.3146
4 days	0.3716	0.3716	0.3716	0.3716	0.2154	0.2154	0.2154	0.2154
10 days	0.3528	0.3528	0.3528	0.3528	0.1959	0.1959	0.1959	0.1959
30 days	0.3698	0.3698	0.3698	0.3698	0.2025	0.2025	0.2025	0.2025
60 days	0.3801	0.3801	0.3801	0.3801	0.2075	0.2075	0.2075	0.2075
1 year	0.6750	0.6750	0.6750	0.6750	0.1993	0.1993	0.1993	0.1993
Source 5 (100% Noble Gases) γ					Source 5 (100% Noble Gases) β			
0	0.6797	0.6797	0.6797	0.6797	1.0570	1.0588	1.0609	1.0612
1 min.	0.7329	0.7329	0.7329	0.7329	0.8207	0.8224	0.8244	0.8246
1 hr.	0.5793	0.5793	0.5793	0.5793	0.5907	0.5925	0.5947	0.5949
12 hr.	0.1887	0.1887	0.1887	0.1187	0.2433	0.2433	0.2433	0.2433
1 day	0.1187	0.1187	0.1187	0.1186	0.1821	0.1811	0.1798	0.1797
4 days	0.0787	0.0786	0.0784	0.0784	0.1573	0.1550	0.1520	0.1517
10 days	0.0770	0.0767	0.0764	0.0763	0.1629	0.1585	0.1524	0.1517
30 days	0.0856	0.0817	0.0768	0.0763	0.2131	0.2011	0.1646	0.1575
60 days	0.3138	0.2555	0.1196	0.0982	0.2447	0.2441	0.2364	0.2264
1 year	0.5252	0.5253	0.5269	0.5296	0.2456	0.2456	0.2456	0.2456

Table 3.2 (continued)

	Equilib.	5000 d	500 d	200 d	Equilib.	5000 d	500 d	200 d
Source 6 (100% Solids) γ					Source 6 (100% Solids) β			
0	0.7962	0.7976	0.7985	0.7994	0.9094	0.9281	0.9415	0.9530
1 min.	0.7922	0.7938	0.7949	0.7959	0.7582	0.7732	0.7835	0.7925
1 hr.	0.7126	0.7137	0.7150	0.7155	0.5500	0.5592	0.5639	0.5687
12 hr.	0.6317	0.6296	0.6301	0.6277	0.4438	0.4448	0.4410	0.4383
1 day	0.6312	0.6289	0.6293	0.6266	0.4127	0.4096	0.4014	0.3944
4 days	0.6599	0.6587	0.6604	0.6584	0.3952	0.3883	0.3744	0.3614
10 days	0.6784	0.6788	0.6821	0.6812	0.4006	0.3934	0.3773	0.3610
30 days	0.6593	0.6566	0.6603	0.6567	0.4130	0.4067	0.3876	0.3648
60 days	0.6527	0.6467	0.6510	0.6465	0.4268	0.4236	0.4044	0.3746
1 year	0.6551	0.6222	0.5985	0.6398	0.4631	0.4922	0.5568	0.5473
Source 7 (All Fission Prod.) γ					Source 7 (All Fission Prod.) β			
0	0.7944	0.7954	0.7960	0.7966	0.9192	0.9343	0.9452	0.9542
1 min.	0.7972	0.7984	0.7992	0.8000	0.7595	0.7715	0.7798	0.7867
1 hr.	0.7112	0.7119	0.7128	0.7131	0.5439	0.5509	0.5544	0.5577
12 hr.	0.5822	0.5787	0.5782	0.5748	0.4218	0.4207	0.4158	0.4119
1 day	0.5843	0.5801	0.5795	0.5755	0.3927	0.3879	0.3791	0.3714
4 days	0.6307	0.6276	0.6281	0.6245	0.3785	0.3698	0.3551	0.3413
10 days	0.6572	0.6554	0.6575	0.6547	0.3898	0.3812	0.3643	0.3474
30 days	0.6556	0.6522	0.6555	0.6515	0.4108	0.4043	0.3854	0.3624
60 days	0.6524	0.6464	0.6506	0.6461	0.4256	0.4226	0.4041	0.3744
1 year	0.6551	0.6222	0.5985	0.6398	0.4608	0.4891	0.5543	0.5464

Figure 3.2

RT-16054

Figure 3.3

RT-16055

Figure 3.4

RT-16056

Figure 3.5

RT-16057

Figure 3.6

RT-16208

Figure 3.7

Figure 3.8

Figure 3.9

RT-16210

Figure 3.10

RT-16058

**Table 3.3 AVERAGE PARTICLE ENERGY (MeV)
(EQUILIBRIUM - NO DAUGHTERS)**

	Air	Plate Out	Water	Air	Plate Out	Water
	Source 1 γ			Source 1 β		
0	0.7095	0.8320	0.8912	1.0066	0.7492	0.8307
1 min.	0.7191	0.8268	0.8663	0.7522	0.6400	0.6982
1 hr.	0.5573	0.7941	0.8055	0.3583	0.4682	0.4652
12 hrs.	0.2766	0.6523	0.6553	0.2358	0.3844	0.3719
1 day	0.2238	0.5782	0.5681	0.2081	0.3629	0.3498
4 days	0.1638	0.5284	0.4869	0.1655	0.3324	0.3049
10 days	0.1640	0.5508	0.5005	0.1678	0.3466	0.3165
30 days	0.2295	0.6114	0.5777	0.2117	0.3961	0.3818
60 days	0.3561	0.6468	0.6412	0.2440	0.4249	0.4232
1 year	0.5250	0.6551	0.6551	0.2455	0.4631	0.4631
	Source 2 γ			Source 2 β		
0	0.7192	0.8397	0.9007	0.9435	0.6820	0.8165
1 min.	0.7264	0.8338	0.8730	0.7110	0.5943	0.6873
1 hr.	0.5936	0.8064	0.8124	0.3672	0.4416	0.4512
12 hrs.	0.3298	0.6593	0.6593	0.2559	0.3527	0.3527
1 day	0.2759	0.5533	0.5533	0.2279	0.3274	0.3274
4 days	0.2109	0.4073	0.4073	0.1781	0.2346	0.2346
10 days	0.2098	0.3846	0.3846	0.1829	0.2098	0.2098
30 days	0.2802	0.3842	0.3842	0.2283	0.2094	0.2094
60 days	0.3948	0.3842	0.3842	0.2449	0.2094	0.2094
1 year	0.5250	0.3842	0.3842	0.2455	0.2094	0.2094

Figure 3.11

Figure 3.12

Figure 3.13

RT-16061

Figure 3.14

RT-16062

**Table 3.4 AVERAGE PARTICLE ENERGY (MeV) HIGH POWER AND FLUX
(EQUILIBRIUM AND 200 d)**

	Air		Plate Out		Water	
	Equilibrium	200 d	Equilibrium	200 d	Equilibrium	200 d
Source 1 γ						
0	0.6905	0.7793	0.7331	0.8326	0.8151	0.8916
1 min.	0.7247	0.8598	0.7227	0.8270	0.7883	0.8662
1 hr.	0.6215	0.8034	0.6684	0.7785	0.7063	0.7881
12 hrs.	0.2504	0.3530	0.5519	0.5344	0.5403	0.5253
1 day	0.1846	0.2474	0.5419	0.4730	0.5184	0.4536
4 days	0.1311	0.1638	0.5588	0.4892	0.5377	0.4455
10 days	0.1281	0.1637	0.5644	0.5115	0.5472	0.4574
30 days	0.1779	0.2267	0.5728	0.5885	0.5678	0.5464
60 days	0.3488	0.3201	0.5870	0.6370	0.5864	0.6282
1 year	0.5252	0.5296	0.7079	0.6413	0.7079	0.6413
Source 1 β						
0	1.0643	1.0701	0.5740	0.7570	0.6806	0.8357
1 min.	0.9037	0.8425	0.5040	0.6530	0.5824	0.7101
1 hr.	0.4767	0.6116	0.3801	0.4660	0.3969	0.4629
12 hrs.	0.2122	0.2564	0.3148	0.3649	0.3173	0.3546
1 day	0.1804	0.1992	0.2994	0.3373	0.2994	0.3278
4 days	0.1628	0.1611	0.2651	0.2798	0.2591	0.2567
10 days	0.1676	0.1590	0.2484	0.2850	0.2441	0.2569
30 days	0.2160	0.1700	0.2331	0.3375	0.2324	0.3181
60 days	0.2446	0.2217	0.2254	0.3712	0.2254	0.3679
1 year	0.2455	0.2456	0.2405	0.5479	0.2405	0.5479

Figure 3.15

RT-16064

Figure 3.16

RT-16063

Table 3.5 AVERAGE PARTICLE ENERGY (MeV) REALISTIC FUEL LOADING (200 d)

	Air	Plate Out	Water	Air	Plate Out	Water
	Source 1 - γ			Source 1 - β		
0	1.0560	0.8278	0.8835	0.7742	0.7498	0.8223
1 min.	0.8353	0.8225	0.8597	0.8495	0.6477	0.6999
1 hr.	0.5965	0.7765	0.7860	0.7903	0.4636	0.4605
12 hrs.	0.2534	0.5330	0.5242	0.3487	0.3627	0.3530
1 day	0.1990	0.4717	0.4527	0.2474	0.3354	0.3262
4 days	0.1613	0.4857	0.4433	0.1654	0.2778	0.2552
10 days	0.1592	0.5065	0.4541	0.1658	0.2827	0.2551
30 days	0.1702	0.5807	0.5397	0.2292	0.3355	0.3158
60 days	0.2209	0.6286	0.6199	0.3216	0.3706	0.3672
1 year	0.2456	0.6401	0.6401	0.5298	0.5538	0.5538
	Source 2 - γ			Source 2 - β		
0	0.7726	0.8361	0.8929	0.9843	0.6761	0.8022
1 min.	0.8268	0.8298	0.8665	0.7804	0.6002	0.6866
1 hr.	0.7615	0.7857	0.7913	0.5508	0.4379	0.4475
12 hrs.	0.3952	0.5134	0.5134	0.2727	0.3401	0.3401
1 day	0.3027	0.4283	0.4283	0.2216	0.3134	0.3134
4 days	0.2127	0.3719	0.3719	0.1687	0.2153	0.2153
10 days	0.2116	0.3537	0.3537	0.1651	0.1962	0.1962
30 days	0.2776	0.3702	0.3702	0.1817	0.2027	0.2027
60 days	0.3490	0.3803	0.3803	0.2311	0.2075	0.2075
1 year	0.5267	0.6750	0.6738	0.2456	0.1993	0.2559

Figure 3.17

RT-16065

Figure 3.18

RT-16066

Figure 3.19

RT-16067

Figure 3.20

RT-16068

4. VERIFICATION OF RESULTS

The fourth phase of this program was devoted to verification of the calculated energy release rates and spectra reported in previous sections. There are at least two approaches one might take to verify these calculations: (1) comparisons with the calculations of other people or other codes; (2) comparisons with experimental results. Although it is potentially the more meaningful, the latter approach is very limited in this case since no measurements have been reported for the partitioned fission product sources of interest here. One can only hope to compare the results of Source 7 (all fission products) with experimental data. A second difficulty with this approach is that the experiments which do exist for fission product decay power are mostly for very short irradiation times compared to the irradiation times of concern here (> 200 days).

In recent years renewed interest in the fission product decay power has produced a considerable amount of high quality data on U-235 decay power (Ref. 14). The longest irradiation time reported is that of the IRT experiments (Ref. 15) which was 24 hours. This is still very short compared to 200 days, and it means that the distribution of fission products responsible for the decay power could be quite different for these two cases. Furthermore, other comparisons of calculated decay power with experimental results (Ref. 14) indicate that there are slight disagreements particularly at short cooling times. These are mostly attributed to insufficient fission product data at the early times.

A more appropriate test of the present calculations is by comparison with energy release rate or decay power calculations using other codes. Again only calculations of 100 percent release of all fission products are reported in the literature. As noted earlier, these calculations have been found to be independent of choice of code and only dependent on choice of data set (Ref. 7). Our results for equilibrium irradiation and pure U-235 without capture or depletion effects were compared with the tabulated decay heat data given in the draft of the ANS decay heat standard (Ref. 10). The calculations agree to three significant figures or better. The same calculations for pure Pu-239 also show complete agreement with the ANS standard.

No decay power calculations have been found in the literature for the restricted source calculations of interest here with the exception of those recently reported by Bonzon (Ref. 13). For the cases reported by Bonzon where the conditions overlap with the present study, the results are in reasonable qualitative agreement. It should be noted that Bonzon's calculations included only a limited data base consisting of 326 nuclides, whereas the present results utilized the ENDF/B-IV fission product data set consisting of data for 818 nuclides.

Verification of the special partitioning of fission product nuclides necessary for the calculations was made by inspecting a full print-out of all the fission product isotopes as a function of cooling time. For a few cases hand calculations of the concentrations of certain daughter and granddaughter isotopes were made and compared with the computer results. These agreed precisely within the numerical accuracy of the hand calculations.

Verification of the spectral calculations is only possible in a limited sense for the same reasons discussed above. For all practical purposes, comparison with experimental data is not possible. Reported calculated spectra are few and limited to 100 percent release of all fission products. Some measure of confidence in the calculated spectra may be provided by comparison with a CINDER-10 result reported by Stamatelatos and England (Ref. 11). Their example was for a short (10 second) exposure, high power (fission rate, 2.475×10^{21} fissions/second) irradiation. The spectra were calculated at 185 seconds after the conclusion of the irradiation. We carried out a calculation under identical conditions, and the results are compared in Figures 4.1 and 4.2 for gamma-ray and beta spectra respectively. The finer group structure of the LASL results was rebinned to conform to our group structure. For both the gamma and beta cases the number spectra are plotted versus bin or channel number with the bin widths indicated on the figures.

The highly structured gamma-ray spectrum shows slight differences in the amplitudes (both peaks and valleys). The differences are random. We attribute this to numerical differences, probably having to do with the details of the binning procedures. The beta spectra shown in Figure 4.2 are identical. Because the beta spectra are unstructured, slight numerical differences are not likely to have an effect on the shape. We take these results as verification of the correctness of the spectrum code.

Figure 4.1

Figure 4.2

5. CONCLUSIONS

In this report we have attempted to translate the LOCA sources as specified in *Regulatory Guide 1.89* into energy release rates and spectra for both gamma rays and beta particles. In the process of doing so, it was necessary to provide certain interpretations of the Regulatory Guide specifications. That is, the Guide does not provide all the information necessary to carry out such calculations. To better understand the implication of various possible interpretations, the unspecified variables were treated parametrically. These included length of irradiation, power level during irradiation, fuel composition, and treatment of progeny of the fission product nuclides.

This report provides a wealth of data pertaining to energy release rates and spectra. Some conclusions resulting from inspection and analysis of the data have been given. However, because there is such a large quantity of data it has not been possible to do an exhaustive analysis, particularly with regard to the spectra. Instead the data are presented here, and in Reference 1 in their entirety, to permit additional analysis if it is desired.

Some of the conclusions that have been made are summarized as follows. It was found that in the exposure range of 200 days to equilibrium (defined as 10^{13} sec), the irradiation time does affect the decay power at long cooling times. The definition of long varies somewhat with the source under consideration, but it is generally greater than a few days. At shorter cooling times the decay power is very insensitive to length of exposure in the range studied here.

Calculations at a high power level and flux but without including depletion effects were intended to show the effects of neutron capture. This is a complicated function of exposure and cooling times as well as flux level. For most cases neutron capture in the fission products increases the decay power. The equilibrium case, which showed the most dramatic effect, are probably not very meaningful because the long exposure time exaggerates the importance of capture. At more realistic exposure times the effect of capture is small.

When effects of depletion and transmutation are included in the calculations the results are that the decay power in most cases decreases slightly. However, this is not a very large effect. The so-called realistic situation similarly shows only minor differences compared to the ideal pure U-235 calculations without capture or depletion effects.

The spectra calculated for the various sources discussed in Section 2 are presented largely without analysis. The trends of softening and rehardening as a function of cooling time are evident in the spectra presented and in plots of average energy as a function of cooling time. It was also noted that except for the case of high power operation, the spectrum shapes and average energies show little or no variation with exposure time. Selected cases from the large body of spectral data will be used to investigate energy deposition in modeled reactor equipment in the next phase of this program.

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APPENDIX A. TEN GREATEST CONTRIBUTORS TO DECAY POWER

Sources 1, 2, 7 Power = 1 Watt, Pure U-235

Equilibrium and 200u Irradiations - All Daughters Included

Table A.1

TIME AFTER LUNTA	1	2	3	4	5	6	7	8	9	10
0 SEC.	KR 00 12.9	KR 00 11.1	KR 00 10.6	KR 00 10.0	KR 00 9.4	KR 00 8.8	KR 00 8.2	KR 00 7.6	KR 00 7.0	KR 00 6.4
1.0 SEC.	KR 00 13.4	KR 00 11.6	KR 00 11.1	KR 00 10.5	KR 00 9.9	KR 00 9.3	KR 00 8.7	KR 00 8.1	KR 00 7.5	KR 00 6.9
2.0 SEC.	KR 00 13.7	KR 00 11.9	KR 00 11.4	KR 00 10.8	KR 00 10.2	KR 00 9.6	KR 00 9.0	KR 00 8.4	KR 00 7.8	KR 00 7.2
3.0 SEC.	KR 00 14.0	KR 00 12.2	KR 00 11.7	KR 00 11.1	KR 00 10.5	KR 00 9.9	KR 00 9.3	KR 00 8.7	KR 00 8.1	KR 00 7.5
4.0 SEC.	KR 00 14.3	KR 00 12.5	KR 00 12.0	KR 00 11.4	KR 00 10.8	KR 00 10.2	KR 00 9.6	KR 00 9.0	KR 00 8.4	KR 00 7.8
5.0 SEC.	KR 00 14.6	KR 00 12.8	KR 00 12.3	KR 00 11.7	KR 00 11.1	KR 00 10.5	KR 00 9.9	KR 00 9.3	KR 00 8.7	KR 00 8.1
6.0 SEC.	KR 00 14.9	KR 00 13.1	KR 00 12.6	KR 00 12.0	KR 00 11.4	KR 00 10.8	KR 00 10.2	KR 00 9.6	KR 00 9.0	KR 00 8.4
7.0 SEC.	KR 00 15.2	KR 00 13.4	KR 00 12.9	KR 00 12.3	KR 00 11.7	KR 00 11.1	KR 00 10.5	KR 00 9.9	KR 00 9.3	KR 00 8.7
8.0 SEC.	KR 00 15.5	KR 00 13.7	KR 00 13.2	KR 00 12.6	KR 00 12.0	KR 00 11.4	KR 00 10.8	KR 00 10.2	KR 00 9.6	KR 00 9.0
9.0 SEC.	KR 00 15.8	KR 00 14.0	KR 00 13.5	KR 00 12.9	KR 00 12.3	KR 00 11.7	KR 00 11.1	KR 00 10.5	KR 00 9.9	KR 00 9.3
10.0 SEC.	KR 00 16.1	KR 00 14.3	KR 00 13.8	KR 00 13.2	KR 00 12.6	KR 00 12.0	KR 00 11.4	KR 00 10.8	KR 00 10.2	KR 00 9.6
11.0 SEC.	KR 00 16.4	KR 00 14.6	KR 00 14.1	KR 00 13.5	KR 00 12.9	KR 00 12.3	KR 00 11.7	KR 00 11.1	KR 00 10.5	KR 00 9.9
12.0 SEC.	KR 00 16.7	KR 00 14.9	KR 00 14.4	KR 00 13.8	KR 00 13.2	KR 00 12.6	KR 00 12.0	KR 00 11.4	KR 00 10.8	KR 00 10.2
13.0 SEC.	KR 00 17.0	KR 00 15.2	KR 00 14.7	KR 00 14.1	KR 00 13.5	KR 00 12.9	KR 00 12.3	KR 00 11.7	KR 00 11.1	KR 00 10.5
14.0 SEC.	KR 00 17.3	KR 00 15.5	KR 00 15.0	KR 00 14.4	KR 00 13.8	KR 00 13.2	KR 00 12.6	KR 00 12.0	KR 00 11.4	KR 00 10.8
15.0 SEC.	KR 00 17.6	KR 00 15.8	KR 00 15.3	KR 00 14.7	KR 00 14.1	KR 00 13.5	KR 00 12.9	KR 00 12.3	KR 00 11.7	KR 00 11.1
16.0 SEC.	KR 00 17.9	KR 00 16.1	KR 00 15.6	KR 00 15.0	KR 00 14.4	KR 00 13.8	KR 00 13.2	KR 00 12.6	KR 00 12.0	KR 00 11.4
17.0 SEC.	KR 00 18.2	KR 00 16.4	KR 00 15.9	KR 00 15.3	KR 00 14.7	KR 00 14.1	KR 00 13.5	KR 00 12.9	KR 00 12.3	KR 00 11.7
18.0 SEC.	KR 00 18.5	KR 00 16.7	KR 00 16.2	KR 00 15.6	KR 00 15.0	KR 00 14.4	KR 00 13.8	KR 00 13.2	KR 00 12.6	KR 00 12.0
19.0 SEC.	KR 00 18.8	KR 00 17.0	KR 00 16.5	KR 00 15.9	KR 00 15.3	KR 00 14.7	KR 00 14.1	KR 00 13.5	KR 00 12.9	KR 00 12.3
20.0 SEC.	KR 00 19.1	KR 00 17.3	KR 00 16.8	KR 00 16.2	KR 00 15.6	KR 00 15.0	KR 00 14.4	KR 00 13.8	KR 00 13.2	KR 00 12.6
21.0 SEC.	KR 00 19.4	KR 00 17.6	KR 00 17.1	KR 00 16.5	KR 00 15.9	KR 00 15.3	KR 00 14.7	KR 00 14.1	KR 00 13.5	KR 00 12.9
22.0 SEC.	KR 00 19.7	KR 00 17.9	KR 00 17.4	KR 00 16.8	KR 00 16.2	KR 00 15.6	KR 00 15.0	KR 00 14.4	KR 00 13.8	KR 00 13.2
23.0 SEC.	KR 00 20.0	KR 00 18.2	KR 00 17.7	KR 00 17.1	KR 00 16.5	KR 00 15.9	KR 00 15.3	KR 00 14.7	KR 00 14.1	KR 00 13.5
24.0 SEC.	KR 00 20.3	KR 00 18.5	KR 00 18.0	KR 00 17.4	KR 00 16.8	KR 00 16.2	KR 00 15.6	KR 00 15.0	KR 00 14.4	KR 00 13.8
25.0 SEC.	KR 00 20.6	KR 00 18.8	KR 00 18.3	KR 00 17.7	KR 00 17.1	KR 00 16.5	KR 00 15.9	KR 00 15.3	KR 00 14.7	KR 00 14.1

Source: Fair, Equilibrium, Power = 1 watt, Pure 1'-2335

Table A.2

GREATEST CONTRIBUTORS TO PEAK DAY POWER (PERCENT OF TOTAL)

TIME AFTER LUNAR	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	XE 137 15.7	XE 139 12.8	KR 91 12.0	KR 89 6.0	KR 90 7.8	XE 138 5.7	KR 92 5.1	KR 87 4.7	XE 140 4.5	XE 135 2.8
1.0 SEC.	XE 137 16.4	XE 139 13.2	KR 91 12.2	KR 89 6.4	KR 90 8.0	XE 138 6.0	KR 92 4.9	XE 140 4.5	KR 92 3.7	XE 135 3.0
2.0 SEC.	XF 137 17.0	XE 139 13.5	KR 91 11.7	KR 89 6.7	KR 90 8.1	XE 138 6.2	KR 92 5.1	XE 140 4.5	XE 135 3.1	KR 92 2.6
5.0 SEC.	XE 137 18.3	XF 139 13.9	KR 91 10.0	KR 89 6.1	KR 90 8.3	XE 138 6.7	KR 92 5.0	XE 140 4.2	XE 135 3.0	I 134 2.2
10.0 SEC.	XE 137 19.8	XE 139 14.0	KR 89 10.1	KR 90 6.2	KR 91 7.4	XE 138 7.3	KR 92 4.9	XE 140 4.2	XE 135 3.0	I 134 2.4
20.0 SEC.	XE 137 21.0	XE 139 13.3	KR 89 10.9	XE 138 6.2	KR 90 7.4	KR 87 6.0	XE 135 4.1	KR 91 3.7	I 134 2.7	XE 140 2.4
50.0 SEC.	XE 137 24.0	KR 89 12.0	XE 138 6.8	XE 139 6.7	KR 87 6.3	XE 135 5.1	KR 90 4.6	I 134 3.2	CS 140 2.4	I 136 2.2
60.0 SEC.	XE 137 24.0	KR 89 12.1	XF 138 10.1	KR 87 6.7	XE 139 6.5	XE 135 5.3	KR 90 4.6	I 134 3.4	CS 140 2.4	KR 88 2.3
100.0 SEC.	XF 137 25.3	KR 89 12.0	XF 138 11.3	KR 87 10.0	XE 135 6.1	XE 139 4.9	I 134 3.4	KR 88 2.6	KR 90 2.6	I 133 2.1
3.1 MIN.	XF 137 23.1	XE 138 12.8	KR 87 12.1	KR 89 10.2	XF 135 7.5	I 134 4.6	KR 88 3.3	KR 88 3.2	I 133 2.9	XE 135 2.5
8.3 MIN.	KR 87 15.1	XE 138 13.1	XF 137 12.3	KR 88 9.8	XE 135 9.7	I 134 5.7	CS 138 5.1	KR 89 4.5	KR 88 4.1	I 133 3.4
16.7 MIN.	KR 88 19.0	KR 87 16.0	XE 135 11.1	XE 138 10.0	CS 138 8.7	I 134 5.8	KR 88 4.6	I 133 3.4	XE 133 3.6	I 135 3.3
33.3 MIN.	KR 88 20.4	KR 87 14.7	XE 135 11.6	CS 138 10.6	I 134 5.0	XE 138 4.7	KR 88 4.6	I 133 4.1	XE 133 4.0	I 135 3.5
60.0 MIN.	KR 88 17.1	KR 87 12.7	XF 135 12.5	CS 138 8.9	KR 88 4.5	XE 133 4.5	I 133 4.4	I 134 3.9	I 135 3.6	I 132 2.7
1.4 HR.	KR 88 40.3	XF 135 13.6	KR 87 11.4	CS 138 6.7	XE 133 4.9	I 133 4.9	KR 88 4.5	I 135 3.9	I 134 3.2	I 132 2.6
2.8 HR.	KR 88 42.4	XE 135 17.6	KR 87 7.5	XE 133 6.9	I 133 6.5	I 135 4.7	KR 88 4.5	I 132 2.4	KR 85 1.9	CS 138 1.7
5.6 HR.	KR 88 35.4	XE 135 24.4	XF 133 11.2	I 133 9.7	I 135 5.8	KR 88 3.7	KR 87 2.7	I 131 2.1	KR 85 2.1	I 132 1.7
12.0 HR.	XE 135 32.4	XE 133 21.8	I 133 15.7	KR 88 10.1	I 135 5.8	I 131 4.2	KR 85 2.3	KR 85 1.5	KR 88 1.5	I 132 1.5
13.9 HR.	XE 135 32.7	XE 133 20.7	I 133 16.8	KR 88 10.1	I 135 5.5	I 131 4.7	KR 85 2.6	KR 85 1.3	KR 88 1.1	I 132 1.3
1.0 DAYS	XF 133 31.9	XE 135 26.5	I 133 19.2	I 131 7.1	KR 85 4.2	I 135 3.0	KR 88 1.3	KR 85 1.4	KR 88 1.1	I 132 1.0
1.2 DAYS	XF 133 42.0	XF 135 22.9	I 133 19.0	I 131 8.1	KR 85 4.8	I 135 2.3	KR 88 1.3	KR 85 1.3	KR 88 1.1	I 129 1.0
2.3 DAYS	XF 133 61.8	I 133 12.6	I 131 12.2	KR 85 7.9	XE 135 5.2	I 135 2.1	I 129 2.0	SR 89 0.0	SR 89 0.0	LA 140 0.0
4.0 DAYS	XF 133 60.7	I 131 14.5	KR 85 10.9	I 133 4.5	XF 135 4.1	I 129 0.0	SR 89 0.0	I 135 0.0	LA 140 0.0	BA 140 0.0
5.8 DAYS	XF 133 60.6	I 131 15.4	KR 85 13.5	I 133 1.3	I 129 0.0	SR 89 0.0	XE 135 0.0	LA 140 0.0	BA 140 0.0	Y 91 0.0
10.0 DAYS	XF 133 62.7	KR 85 20.7	I 131 16.4	I 133 1.1	I 129 0.0	SR 89 0.0	LA 140 0.0	LA 140 0.0	Y 91 0.0	CS 137 0.0
11.6 DAYS	XF 133 59.3	KR 85 24.0	I 131 16.8	I 129 0.0	SR 89 0.0	I 133 0.0	LA 140 0.0	BA 140 0.0	Y 91 0.0	CS 137 0.0
23.1 DAYS	KR 85 55.3	XF 133 16.1	I 131 16.1	I 129 0.1	SR 89 0.0	LA 140 0.0	BA 140 0.0	Y 91 0.0	CS 137 0.0	Y 90 0.0
30.0 DAYS	KR 85 73.0	XF 133 16.4	I 131 10.3	I 129 0.1	SR 89 0.0	LA 140 0.0	Y 91 0.0	BA 140 0.0	CS 137 0.0	Y 90 0.0
57.9 DAYS	KR 85 97.9	I 131 1.3	XE 133 0.0	I 129 0.2	SR 89 0.0	Y 91 0.0	LA 140 0.0	BA 140 0.0	CS 137 0.0	Y 90 0.0
60.0 DAYS	KR 85 98.2	I 131 1.1	XF 133 0.0	I 129 0.2	SR 89 0.0	Y 91 0.0	LA 140 0.0	BA 140 0.0	CS 137 0.0	Y 90 0.0
115.7 DAYS	KR 85 99.7	I 129 0.2	SR 89 0.0	I 131 0.0	Y 91 0.0	CS 137 0.0	XE 133 0.0	Y 90 0.0	LA 140 0.0	SR 90 0.0
150.0 DAYS	KR 85 99.8	I 129 0.2	SR 89 0.0	Y 91 0.0	I 131 0.0	CS 137 0.0	Y 90 0.0	SR 90 0.0	LA 140 0.0	CE 141 0.0
231.5 DAYS	KR 85 99.8	I 129 0.2	SR 89 0.0	CS 137 0.0	Y 91 0.0	Y 90 0.0	SR 90 0.0	CE 141 0.0	I 131 0.0	CS 135 0.0
1.0 YRS.	KR 85 99.8	I 129 0.2	SR 89 0.0	CS 137 0.0	Y 90 0.0	Y 91 0.0	SR 90 0.0	CS 135 0.0	PR 144 0.0	CE 141 0.0

Source 1 (air), Equilibrium, Power = 1 watt, Pure U-235

Table A.3

GREATEST CONTRIBUTIONS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	KR 89 12.9	KR 90 11.1	KR 88 10.6	XF 138 10.0	XE 140 6.8	I 140 6.6	XE 150 6.4	XF 141 3.7	KR 91 3.4	I 152 3.2
1.0 SEC.	KR 59 13.0	KR 90 11.3	KR 88 11.1	XF 138 10.4	I 139 6.2	XF 140 6.7	XF 139 6.4	I 152 3.3	KR 91 3.3	I 155 3.2
2.0 SEC.	KR 49 13.7	KR 88 11.0	KR 90 11.4	XF 138 10.7	I 139 7.1	XF 140 6.6	XF 140 6.6	I 152 3.4	I 155 3.3	KR 91 3.1
5.0 SEC.	KR 49 14.4	KR 88 12.0	KR 90 11.5	XF 138 11.3	I 139 7.5	XE 139 6.7	XF 140 5.9	I 152 3.6	I 155 3.5	KR 87 3.1
10.0 SEC.	KR 89 14.9	KR 88 12.7	XF 138 11.8	KR 90 10.7	I 139 7.9	XE 139 6.5	XF 140 4.9	I 152 3.8	I 155 3.7	KR 87 3.2
20.0 SEC.	KR 89 15.4	KR 88 13.4	XF 138 12.6	KR 90 9.2	I 139 8.4	XF 139 5.8	I 152 4.1	I 155 4.0	KR 87 3.9	XF 140 3.1
50.0 SEC.	KR 89 15.7	KR 88 15.7	XF 138 14.0	I 139 9.0	KR 90 5.6	I 152 4.0	I 155 4.5	XF 139 4.0	KR 87 3.9	XE 135 3.8
60.0 SEC.	KR 88 16.0	KR 89 15.7	XF 138 14.4	I 139 9.0	I 152 4.4	I 155 4.7	KR 90 4.6	KR 87 4.0	XE 135 3.5	XE 139 3.5
180.0 SEC.	KR 88 17.6	XF 138 15.3	KR 89 14.9	I 139 10.8	I 152 5.2	I 155 5.1	KR 87 4.6	XF 135 3.8	KR 90 3.2	I 153 2.3
3.3 MIN.	KR 88 19.4	XF 138 16.1	I 139 12.0	KR 89 11.8	I 152 5.9	I 155 5.8	KR 87 5.0	XE 135 4.4	KR 90 2.8	KR 89 2.7
8.3 MIN.	KR 88 22.8	XF 138 16.7	I 139 13.2	I 152 6.7	I 155 6.7	CS 138 5.8	KR 87 4.5	XE 135 5.1	KR 89 4.6	KR 89 4.4
16.7 MIN.	KR 88 26.4	I 139 13.1	XE 138 10.9	CS 138 9.7	I 155 7.4	I 152 7.2	KR 87 4.7	XE 135 5.6	KR 89 4.1	QB 88 3.7
33.3 MIN.	KR 88 26.0	CS 138 12.4	I 139 12.0	I 155 8.2	I 152 7.5	XE 135 6.3	KR 88 6.1	KR 87 5.6	XE 138 5.5	I 153 3.7
60.0 MIN.	KR 88 28.1	CS 138 11.5	I 139 10.2	I 155 9.4	QR 88 8.4	I 152 7.9	XE 135 7.4	KR 87 5.3	I 153 4.4	XE 133 2.5
1.4 HR.	KR 88 29.5	I 135 10.5	QR 88 9.5	CS 138 9.0	I 139 8.7	XE 135 8.4	I 152 8.2	I 153 5.1	KR 87 4.9	XF 133 2.4
2.8 HR.	KR 88 31.2	I 135 11.5	XF 135 11.5	QB 88 10.8	I 152 8.0	I 153 7.2	I 154 4.5	XF 135 4.8	KR 87 3.4	CS 138 2.3
5.6 HR.	KR 88 26.5	I 135 17.0	XF 135 16.4	I 153 11.1	QR 88 9.0	XE 133 7.1	I 152 5.8	I 153 3.6	KR 85 1.3	KR 87 1.3
12.0 HR.	XF 135 23.0	I 135 18.9	I 155 18.1	XF 133 14.7	KR 88 11.1	I 151 7.3	QR 88 3.8	I 152 1.7	KR 85 1.0	KR 87 1.1
13.9 HR.	XE 135 23.6	I 135 20.6	I 155 17.3	XF 133 16.4	I 151 8.5	KR 88 8.2	KR 88 2.8	I 152 1.1	KR 85 0.8	KR 87 0.8
1.0 DAYS	XF 133 27.9	I 133 25.3	XF 135 20.5	I 151 14.0	I 155 10.2	KR 88 1.2	QR 88 1.2	KR 85 1.1	I 152 1.1	SR 91 0.0
1.2 DAYS	XF 133 31.5	I 133 25.6	XF 135 18.2	I 151 15.9	I 155 7.9	KR 88 5.5	KR 85 2.8	QR 88 2.1	I 152 0.8	SR 91 0.0
2.3 DAYS	XF 133 50.3	I 133 26.0	I 155 18.4	XF 135 9.5	I 155 1.4	LA 140 0.0	KR 85 0.0	KR 85 0.0	SR 91 0.0	HA 140 0.0
4.0 DAYS	XF 133 40.0	I 133 32.7	I 155 6.9	XF 135 3.3	I 155 0.0	LA 140 0.0	KR 85 0.0	HA 140 0.0	I 150 0.0	SR 91 0.0
5.8 DAYS	XE 133 61.0	I 133 46.0	I 155 2.1	XE 135 0.0	LA 140 0.0	KR 85 0.0	HA 140 0.0	I 155 0.0	I 150 0.0	CE 141 0.0
10.0 DAYS	XE 133 56.2	I 133 40.7	I 155 1.4	LA 140 0.0	KR 85 0.0	HA 140 0.0	CF 141 0.0	XF 135 0.0	Y 91 0.0	SR 95 0.0
11.4 DAYS	XE 133 57.0	I 133 42.3	I 155 0.0	LA 140 0.0	KR 85 0.0	HA 140 0.0	CF 141 0.0	Y 91 0.0	SR 95 0.0	SR 95 0.0
23.1 DAYS	I 151 54.9	XE 133 45.0	LA 140 0.0	KR 85 0.0	HA 140 0.0	CF 141 0.0	Y 91 0.0	I 153 0.0	SR 95 0.0	SR 95 0.0
30.0 DAYS	I 151 42.3	XF 133 37.4	LA 140 0.0	KR 85 0.0	HA 140 0.0	CF 141 0.0	Y 91 0.0	I 153 0.0	SR 95 0.0	I 129 0.0
57.9 DAYS	I 151 34.2	XE 133 14.6	KR 85 1.0	LA 140 0.0	HA 140 0.0	CF 141 0.0	Y 91 0.0	I 153 0.0	SR 95 0.0	I 129 0.0
60.0 DAYS	I 151 35.2	XE 133 13.4	KR 85 1.2	LA 140 0.0	HA 140 0.0	CF 141 0.0	Y 91 0.0	I 153 0.0	SR 95 0.0	I 129 0.0
115.7 DAYS	KR 85 61.7	I 133 37.1	LA 140 0.0	XE 133 0.0	HA 140 0.0	CF 141 0.0	Y 91 0.0	I 153 0.0	SR 95 0.0	I 129 0.0
50.0 DAYS	KR 85 46.7	I 131 5.1	LA 140 0.0	BA 140 0.0	Y 91 0.0	CF 141 0.0	XE 133 0.0	SR 95 0.0	I 129 0.0	SR 95 0.0
131.5 DAYS	KR 85 100.0	Y 91 0.0	I 131 0.0	LA 140 0.0	CF 141 0.0	I 129 0.0	SR 95 0.0	Y 90 0.0	SR 95 0.0	HA 140 0.0
1.0 YRS.	KR 85 100.0	Y 91 0.0	I 129 0.0	Y 90 0.0	CF 141 0.0	SR 95 0.0	CF 141 0.0	SR 140 0.0	CF 144 0.0	CS 135 0.0

Source: (air), 200 d, Power = 1 watt, Pure U-235

Table A.4

GREATEST CONTRIBUTORS TO HFA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	XF 137 15.7	XF 139 12.8	KR 01 12.0	RR 00 8.0	KR 00 7.8	XE 138 5.7	KR 02 5.1	KR 07 4.7	XE 140 4.5	XE 135 2.8
1.0 SEC.	XF 137 16.5	XE 139 13.2	KR 01 12.2	KR 00 8.4	KR 00 8.0	XE 138 6.0	KR 07 4.9	XE 140 4.5	KR 02 3.7	XE 135 3.0
2.0 SEC.	XF 137 17.0	XF 139 13.5	KR 01 11.7	KR 00 8.7	KR 00 8.1	XE 138 6.2	KR 07 5.1	XE 140 4.5	XE 135 3.1	KR 02 2.8
5.0 SEC.	XF 137 18.3	XF 139 13.9	KR 01 10.0	KR 00 9.1	KR 00 8.3	XE 138 6.7	KR 07 5.6	XE 140 4.2	XE 135 3.4	I 134 2.2
10.0 SEC.	XF 137 19.0	XF 139 14.0	KR 00 10.1	KR 00 8.2	KR 01 7.0	XE 138 7.3	KR 07 6.1	XF 135 1.7	XE 140 3.5	I 134 2.0
20.0 SEC.	XE 137 21.8	XF 139 13.3	KR 00 11.0	XF 138 9.2	KR 00 7.0	KR 07 6.9	XF 135 4.2	KR 01 3.7	I 134 2.7	XE 140 2.4
40.0 SEC.	XE 137 24.4	KR 00 12.0	XE 138 9.8	XF 139 9.7	KR 07 8.5	XE 135 5.1	KR 00 4.8	I 134 3.4	CS 140 2.4	I 130 2.2
60.0 SEC.	XF 137 24.4	KR 00 12.1	XF 138 10.2	KR 07 8.7	XF 139 8.0	XE 135 5.3	KR 00 4.0	I 134 3.4	CS 140 2.4	KR 08 2.3
100.0 SEC.	XF 137 25.0	KR 00 12.0	XF 138 11.3	KR 07 10.0	XF 135 6.1	XE 139 5.0	I 134 3.9	KR 00 3.6	KR 00 2.6	I 133 2.1
3.3 MIN.	XF 137 25.2	XE 138 12.9	KR 07 12.1	KR 00 10.3	XF 135 7.5	I 134 4.0	KR 00 3.1	KR 00 3.2	I 133 2.6	XE 135 2.5
8.3 MIN.	KR 07 15.1	XE 138 13.2	XE 137 12.3	RR 00 9.8	XF 135 9.8	I 134 5.7	CS 138 5.1	KR 00 4.5	KR 00 4.2	I 133 1.4
16.7 MIN.	RR 00 19.1	KR 07 10.1	XE 135 11.1	XE 138 10.1	CS 138 8.6	I 134 5.9	KR 00 4.0	I 133 3.9	XF 133 3.0	I 135 3.3
33.3 MIN.	RR 00 29.6	KR 07 14.7	XE 135 11.7	CS 138 10.7	I 134 5.0	XE 138 4.8	KR 00 4.0	I 133 4.1	XF 133 4.1	I 135 3.5
60.0 MIN.	RR 00 37.3	KR 07 12.4	XE 135 12.0	CS 138 9.0	KR 00 4.9	XE 135 4.5	I 133 4.5	I 134 3.9	I 135 3.7	I 132 2.7
1.4 HR.	RR 00 40.5	XF 135 13.7	KR 07 11.5	CS 138 6.7	XF 133 5.0	I 133 4.9	KR 00 4.0	I 135 3.9	I 134 3.2	I 132 2.6
2.8 HR.	RR 00 42.7	XE 135 17.8	KR 07 7.0	XF 133 7.0	I 133 6.0	I 135 4.7	KR 00 4.0	I 132 2.4	KR 05 2.0	CS 138 1.7
5.6 HR.	RR 00 35.4	XF 135 24.7	XF 133 11.3	I 133 9.8	I 135 5.8	KR 00 3.8	KR 07 2.7	I 131 2.2	KR 05 2.1	I 132 1.7
12.0 HR.	XF 135 33.1	XF 133 22.3	I 133 10.0	RR 00 14.5	I 135 6.0	I 131 4.2	KR 05 1.6	KR 01 1.5	I 132 1.5	KR 07 1.1
13.9 HR.	XF 135 33.6	XF 133 25.4	I 131 17.2	RR 00 10.4	I 135 5.0	I 131 4.8	KR 05 1.3	KR 00 1.1	I 132 1.3	KR 05 1.1
1.0 DAYS	XE 133 39.5	XF 135 27.6	I 131 20.0	I 131 7.8	I 135 3.1	KR 00 1.4	KR 05 1.3	KR 00 1.1	I 132 1.1	I 132 1.0
1.2 DAYS	XF 133 40.0	XF 135 24.0	I 131 19.9	I 131 8.5	I 135 2.4	RR 00 1.4	KR 05 1.3	KR 00 1.1	I 132 1.1	I 132 1.0
2.3 DAYS	XF 133 67.0	I 133 13.6	I 131 13.2	XE 135 5.8	KR 05 3.1	I 135 2.2	SR 09 0.0	KR 05 0.0	LA 140 0.0	LA 140 0.0
4.0 DAYS	XF 133 76.0	I 131 16.2	I 131 5.0	KR 05 4.4	XF 135 0.0	SR 09 0.0	I 135 0.0	LA 140 0.0	LA 140 0.0	Y 01 0.0
5.8 DAYS	XF 133 80.1	I 131 17.7	I 133 1.5	KR 05 4.5	SR 09 0.0	XE 135 0.0	LA 140 0.0	HA 140 0.0	Y 01 0.0	I 135 0.0
10.0 DAYS	XF 133 78.4	I 131 20.5	KR 05 1.1	I 133 1.5	SR 09 0.0	LA 140 0.0	HA 140 0.0	Y 01 0.0	CS 137 0.0	Y 01 0.0
11.8 DAYS	XF 133 77.2	I 131 21.6	KR 05 1.1	I 133 1.5	SR 09 0.0	LA 140 0.0	HA 140 0.0	Y 01 0.0	CS 137 0.0	Y 01 0.0
23.1 DAYS	XF 133 65.1	I 131 30.4	KR 05 4.1	SR 09 0.0	LA 140 0.0	HA 140 0.0	Y 01 0.0	CS 137 0.0	Y 01 0.0	Y 01 0.0
30.0 DAYS	XF 133 55.8	I 131 35.2	KR 05 4.6	SR 09 0.0	LA 140 0.0	HA 140 0.0	Y 01 0.0	CS 137 0.0	Y 01 0.0	Y 01 0.0
57.9 DAYS	KR 05 60.0	I 131 23.7	XE 133 10.8	SR 09 1.4	Y 01 0.0	LA 140 0.0	HA 140 0.0	CS 137 0.0	Y 01 0.0	Y 01 0.0
60.0 DAYS	KR 05 60.5	I 131 21.2	XE 133 8.7	SR 09 1.5	Y 01 0.0	LA 140 0.0	HA 140 0.0	CS 137 0.0	Y 01 0.0	Y 01 0.0
115.7 DAYS	KR 05 98.7	SR 09 1.0	I 131 3.3	Y 01 0.0	CS 137 0.0	XE 133 0.0	Y 01 0.0	LA 140 0.0	Y 01 0.0	Y 01 0.0
150.0 DAYS	KR 05 99.3	SR 09 1.0	Y 01 0.0	I 131 0.0	CS 137 0.0	Y 01 0.0	SR 09 0.0	LA 140 0.0	Y 01 0.0	Y 01 0.0
211.5 DAYS	KR 05 99.7	SR 09 1.2	CS 137 0.0	Y 01 0.0	Y 01 0.0	SR 09 0.0	CF 141 0.0	I 131 0.0	CS 135 0.0	I 129 0.0
1.0 YRS.	KR 05 99.9	SR 09 1.0	CS 137 0.0	Y 01 0.0	Y 01 0.0	SR 09 0.0	CF 135 0.0	I 129 0.0	CF 141 0.0	Y 01 0.0

Source 1 (air), 200 d, Power = 1 watt, Pure 1 - 215

Table A.5

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	I 134 23.0	I 132 11.0	I 135 10.7	I 136 7.8	I 137 7.7	I 138 5.2	I 139 4.7	I 136 4.5	I 139 2.2	I 131 1.5
1.0 SEC.	I 134 23.8	I 132 11.4	I 135 11.1	I 136 8.0	I 137 7.7	I 138 4.9	I 139 4.6	I 136 4.6	I 139 1.7	I 131 1.3
2.0 SEC.	I 134 24.4	I 132 11.7	I 135 11.4	I 136 8.1	I 137 7.7	I 138 5.0	I 139 4.6	I 136 4.6	I 139 1.7	I 131 1.3
5.0 SEC.	I 134 25.5	I 132 12.3	I 135 11.9	I 136 8.3	I 137 7.8	I 138 5.2	I 139 4.6	I 136 4.6	I 139 1.7	I 131 1.3
10.0 SEC.	I 134 26.8	I 132 12.9	I 135 12.6	I 136 8.8	I 137 8.0	I 138 5.5	I 139 4.5	I 136 4.5	I 139 1.5	I 131 1.3
20.0 SEC.	I 134 28.5	I 132 13.7	I 135 13.4	I 136 9.2	I 137 8.5	I 138 5.9	I 139 4.2	I 131 1.6	LA 142	CS 138
50.0 SEC.	I 134 31.5	I 132 15.2	I 135 14.8	I 136 7.1	I 133 6.5	I 136 3.0	I 137 2.6	I 131 1.8	LA 142	CS 138
60.0 SEC.	I 134 32.2	I 132 15.6	I 135 15.2	I 136 6.7	I 133 6.7	I 136 2.7	I 137 2.0	I 131 1.8	LA 142	CS 138
100.0 SEC.	I 134 34.1	I 132 16.6	I 135 16.2	I 133 7.2	I 136 5.2	I 131 1.9	I 136 1.6	LA 142	CS 138	LA 140
3.3 MIN.	I 134 36.4	I 132 17.9	I 135 17.6	I 133 7.8	I 136 2.4	I 131 2.1	LA 142	CS 138	LA 140	LA 140
6.3 MIN.	I 134 37.3	I 132 19.1	I 135 19.1	I 133 8.5	I 131 2.3	LA 142	CS 138	LA 140	CS 138	LA 140
16.7 MIN.	I 134 36.3	I 135 20.3	I 132 19.8	I 133 9.1	I 131 2.5	LA 142	CS 138	LA 140	CS 138	LA 140
33.3 MIN.	I 134 33.2	I 135 22.3	I 132 20.7	I 133 10.2	I 131 2.8	LA 140	LA 142	CS 138	LA 140	CS 138
60.0 MIN.	I 134 27.9	I 135 25.2	I 132 21.5	I 133 11.0	I 131 3.3	LA 140	LA 142	CS 138	LA 140	CS 138
1.4 HR.	I 135 27.4	I 134 23.5	I 132 21.8	I 133 13.1	I 131 4.6	LA 140	LA 142	CS 138	LA 140	CS 138
2.8 HR.	I 135 13.1	I 132 20.7	I 133 17.8	I 134 11.2	I 131 5.2	LA 140	LA 142	CS 138	LA 140	CS 138
5.0 HR.	I 135 36.3	I 133 23.8	I 132 14.5	I 131 7.6	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
12.0 HR.	I 133 30.1	I 135 28.8	I 131 11.7	I 132 6.5	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
13.0 HR.	I 133 31.0	I 135 25.9	I 131 12.7	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
1.0 DAYS	I 133 32.1	I 131 17.9	I 135 13.1	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
1.2 DAYS	I 133 31.7	I 131 19.7	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
2.4 DAYS	I 131 29.1	I 133 20.6	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
4.0 DAYS	I 131 30.6	LA 140	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
5.8 DAYS	I 131 35.6	LA 140	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
10.0 DAYS	I 131 32.9	LA 140	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
11.6 DAYS	I 131 31.3	LA 140	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
23.1 DAYS	NR 05 24.6	LA 140	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
30.0 DAYS	NR 05 10.1	PR 05 22.6	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
47.9 DAYS	NR 05 05.9	PR 05 20.9	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
60.0 DAYS	NR 05 06.7	PR 05 10.1	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
115.7 DAYS	NR 05 55.3	PR 05 10.3	LA 140	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
150.0 DAYS	NR 05 56.2	PR 05 20.0	PR 05 14.0	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
231.5 DAYS	NR 05 51.5	PR 05 25.5	PR 05 14.0	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140
1.0 YRS.	NR 05 18.9	PR 05 17.7	PR 05 14.0	LA 140	LA 140	LA 142	CS 138	LA 140	CS 138	LA 140

Source: (Plate out), Equilibrium, Power = 1 watt, Pure U-235

Table A.6

GREATEST CONTRIBUTORS TO BETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCAL	1	2	3	4	5	6	7	8	9	10
1.0 SEC.	I 136 10.2	I 134 9.8	I 137 9.2	I 136 7.2	I 138 6.5	I 133 5.3	I 135 4.6	I 132 4.1	I 139 2.5	RM 92 1.2
1.0 SEC.	I 136 10.7	I 134 10.4	I 137 9.5	I 136 7.5	I 138 6.2	I 133 5.0	I 135 4.9	I 132 4.4	I 139 2.0	Y 96 1.1
2.0 SEC.	I 136 11.1	I 134 10.8	I 137 9.8	I 136 7.7	I 138 5.8	I 135 5.8	I 135 5.1	I 132 4.6	I 139 1.5	Y 96 1.2
5.0 SEC.	I 136 11.6	I 134 11.6	I 137 9.5	I 136 7.9	I 138 6.3	I 135 5.5	I 132 4.9	I 138 4.5	Y 96 1.3	I 131 1.2
10.0 SEC.	I 136 12.0	I 136 12.1	I 137 9.0	I 136 8.0	I 138 6.8	I 135 6.0	I 132 5.3	I 138 2.9	Y 96 1.3	I 131 1.3
20.0 SEC.	I 136 14.0	I 136 12.4	I 136 7.7	I 137 7.6	I 137 7.5	I 135 6.7	I 132 5.9	Y 96 1.4	I 131 1.4	Y 95 1.2
50.0 SEC.	I 136 16.6	I 136 11.6	I 133 9.0	I 135 7.9	I 137 7.1	I 136 6.0	I 137 5.8	I 131 1.7	Y 96 1.5	RE 137 1.4
60.0 SEC.	I 136 17.2	I 136 11.1	I 133 9.0	I 135 8.3	I 132 7.3	I 136 5.4	I 137 5.0	I 131 1.7	XE 137 1.5	Y 96 1.4
100.0 SEC.	I 136 19.3	I 133 10.5	I 135 9.3	I 136 8.1	I 132 8.2	I 136 3.4	I 131 2.0	FE 137 1.6	Y 94 1.6	Y 95 1.6
3.1 MIN.	I 136 22.0	I 133 12.3	I 135 10.8	I 132 9.5	I 136 4.5	I 131 2.3	Y 94 1.6	FE 137 1.7	Y 95 1.6	CS 139 1.6
8.3 MIN.	I 136 24.2	I 133 14.3	I 135 12.5	I 132 10.9	I 131 2.7	Y 92 1.8	Y 94 1.8	Y 93 1.5	CS 138 1.4	PR 144 1.4
16.7 MIN.	I 136 26.1	I 133 15.8	I 135 13.6	I 132 11.6	I 131 3.0	Y 92 2.0	Y 93 1.7	PR 144 1.5	Y 94 1.4	CS 138 1.3
33.3 MIN.	I 136 27.2	I 133 17.8	I 135 15.1	I 132 12.1	I 131 3.4	Y 92 2.2	Y 93 1.9	PR 144 1.8	LA 141 1.4	Y 90 1.4
60.0 MIN.	I 136 29.3	I 134 18.2	I 135 16.6	I 132 12.3	I 131 3.9	Y 92 2.5	Y 93 2.1	PR 144 2.0	Y 90 1.6	LA 141 1.6
1.0 HR.	I 136 29.7	I 135 17.5	I 136 16.8	I 132 12.1	I 131 4.3	Y 92 2.7	Y 93 2.3	PR 144 2.2	Y 90 1.8	LA 141 1.6
2.0 HR.	I 136 29.7	I 135 16.9	I 137 10.2	I 136 6.3	I 131 5.3	FE 135 3.2	Y 92 2.3	PR 144 2.4	Y 93 2.6	Y 90 2.2
5.0 HR.	I 133 30.1	I 135 17.8	I 131 6.6	FE 145 6.4	I 132 6.2	PR 144 3.5	Y 92 2.9	Y 90 2.8	Y 93 2.7	Y 91 1.6
12.0 HR.	I 133 32.2	I 135 12.0	FE 135 10.3	I 131 8.5	PR 144 4.7	Y 90 3.7	Y 91 2.4	I 132 2.3	Y 93 2.3	LA 140 2.2
13.9 HR.	I 133 32.2	FE 135 10.7	I 135 10.5	I 131 9.0	PR 144 5.0	Y 90 4.0	Y 91 2.6	LA 140 2.4	Y 93 2.1	I 132 2.0
1.0 DAYS	I 133 30.6	I 131 11.6	FE 135 10.0	PR 144 6.6	Y 90 5.3	I 135 4.8	Y 91 3.4	LA 140 3.1	SR 89 2.7	PR 143 1.8
1.2 DAYS	I 133 29.5	I 131 12.5	FE 135 9.1	PR 144 7.2	Y 90 5.8	Y 91 3.7	I 135 3.5	LA 140 3.4	SR 89 2.9	PR 143 2.0
2.3 DAYS	I 133 18.0	I 131 17.4	PR 144 11.1	Y 90 6.9	Y 91 5.7	LA 140 5.1	SR 89 4.4	PR 143 3.0	XL 133 2.9	BA 140 2.5
4.0 DAYS	I 131 19.6	PR 144 14.4	Y 90 11.6	Y 91 7.3	LA 140 6.2	I 133 6.1	SR 89 5.6	FE 133 3.6	PR 143 3.6	BA 140 3.5
5.8 DAYS	I 131 19.2	PR 144 16.3	Y 90 13.2	Y 91 8.1	LA 140 6.5	SR 89 6.3	PR 143 3.8	FE 133 3.7	BA 140 3.1	SR 89 2.8
10.0 DAYS	PR 144 19.0	I 131 15.7	Y 90 15.6	Y 91 9.1	SR 89 7.0	LA 140 6.2	PR 143 3.7	SR 90 3.3	CS 137 1.1	BA 140 2.9
11.8 DAYS	PR 144 19.0	Y 90 16.3	I 131 14.4	Y 91 9.4	SR 89 7.2	LA 140 6.0	PR 143 3.5	SR 90 3.5	CS 137 1.2	BA 140 2.8
23.1 DAYS	PR 144 24.7	Y 90 20.9	Y 91 10.4	SR 89 7.9	I 131 6.8	SR 90 4.4	CS 137 4.1	LA 140 4.1	PR 143 2.5	ZH 95 2.2
30.0 DAYS	PR 144 26.7	Y 90 22.9	Y 91 10.6	SR 89 7.9	SR 90 4.9	CS 137 4.5	I 131 4.1	LA 140 3.1	ZR 95 2.5	HM 106 2.2
47.9 DAYS	PR 144 30.7	Y 90 28.2	Y 91 9.4	SR 89 6.7	SR 90 6.0	CS 137 5.6	RM 106 2.6	ZR 95 2.1	CE 144 2.0	CE 141 1.4
60.0 DAYS	PR 144 30.9	Y 90 28.4	Y 91 9.2	SR 89 6.8	SR 90 6.0	CS 137 5.6	RM 106 2.6	ZR 95 2.1	CE 144 2.0	CE 141 1.4
115.7 DAYS	Y 90 34.2	PR 144 32.4	SR 90 7.3	CS 137 6.8	Y 91 5.8	SR 89 3.8	RM 106 2.8	CE 144 2.1	ZR 95 1.4	HM 95 1.9
160.0 DAYS	Y 90 36.9	PR 144 32.4	SR 90 7.8	CS 137 7.3	Y 91 4.1	RM 106 2.9	SR 89 2.6	CF 144 2.1	ZR 95 1.0	PR 95 1.7
231.5 DAYS	Y 90 42.8	PR 144 30.3	SR 90 8.9	CS 137 8.3	HM 106 2.8	CE 144 2.0	Y 91 1.8	SR 89 1.0	PM 147 0.9	ZR 95 1.5
1.0 YRS.	Y 90 47.9	PR 144 25.2	SR 90 10.2	CS 137 9.5	RM 106 2.5	CE 144 1.7	PM 147 1.0	Y 91 1.4	CS 135 0.4	SR 89 0.2

Source 1 (plate out), Equilibrium, Power = 1 watt, Pure U-235

Table A.7

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	I 134 23.0	I 132 11.1	I 135 10.7	I 136 7.8	I 137 7.7	I 138 5.2	I 133 4.7	I 134 4.5	I 139 2.2	I 131 1.3
1.0 SEC.	I 134 23.4	I 132 11.5	I 135 11.1	I 136 8.0	I 137 7.8	I 138 4.9	I 134 4.8	I 136 4.6	I 139 1.7	I 131 1.3
2.0 SEC.	I 134 24.4	I 132 11.7	I 135 11.4	I 136 8.1	I 137 7.7	I 138 5.0	I 136 4.6	I 138 4.4	I 131 1.4	I 139 1.3
5.0 SEC.	I 134 25.6	I 132 12.3	I 135 12.0	I 136 8.3	I 137 7.4	I 138 5.3	I 136 4.6	I 138 3.4	I 131 1.4	I 139 1.3
10.0 SEC.	I 134 26.8	I 132 12.9	I 135 12.6	I 136 8.4	I 137 6.8	I 138 5.5	I 136 4.5	I 138 2.1	I 131 1.5	I 139 1.3
20.0 SEC.	I 134 28.4	I 132 13.4	I 135 13.4	I 136 8.3	I 137 5.9	I 138 5.5	I 136 4.2	I 131 1.6	I 139 1.4	I 139 1.3
40.0 SEC.	I 134 31.5	I 132 15.2	I 135 14.9	I 136 7.2	I 137 5.5	I 138 3.0	I 137 2.6	I 131 1.8	I 139 1.0	I 139 1.3
60.0 SEC.	I 134 32.2	I 132 15.4	I 135 15.2	I 136 6.7	I 137 5.7	I 138 2.7	I 137 2.0	I 131 1.8	I 139 1.0	I 139 1.3
100.0 SEC.	I 134 34.2	I 132 16.4	I 135 16.3	I 136 7.2	I 137 5.7	I 138 1.9	I 136 1.6	I 139 1.4	I 139 1.0	I 139 1.3
3.3 MIN.	I 134 36.4	I 132 17.9	I 135 17.6	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
8.3 MIN.	I 134 37.4	I 132 19.1	I 135 19.1	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
16.7 MIN.	I 134 38.3	I 135 20.3	I 135 19.8	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
33.3 MIN.	I 134 39.1	I 135 20.3	I 135 20.7	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
60.0 MIN.	I 134 39.0	I 135 21.0	I 135 21.0	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
1.4 HR.	I 135 37.5	I 134 21.5	I 135 21.9	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
2.8 HR.	I 135 38.1	I 132 20.8	I 135 21.9	I 136 7.4	I 137 5.9	I 138 2.1	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
5.6 HR.	I 135 38.5	I 131 24.0	I 132 14.6	I 131 7.7	I 134 14.0	I 135 3.0	I 134 1.9	I 139 1.2	I 139 1.1	I 139 1.3
12.0 HR.	I 133 30.4	I 135 29.1	I 131 11.8	I 132 6.4	I 134 14.0	I 135 3.0	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.3
13.9 HR.	I 133 31.3	I 135 26.2	I 131 12.9	I 134 14.0	I 135 3.0	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
1.0 DAYS	I 133 32.1	I 131 18.2	I 131 13.3	I 134 14.0	I 135 3.0	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.3
1.2 DAYS	I 133 32.1	I 131 20.0	I 134 11.0	I 135 3.0	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
2.3 DAYS	I 131 24.9	I 131 21.1	I 134 10.7	I 132 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
4.0 DAYS	I 131 23.0	I 134 23.0	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
5.8 DAYS	I 131 37.2	I 134 25.6	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
10.0 DAYS	I 131 34.8	I 134 27.7	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
11.6 DAYS	I 131 33.1	I 134 28.0	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
23.1 DAYS	I 134 26.1	I 131 21.4	I 131 21.4	I 132 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
50.0 DAYS	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
72.9 DAYS	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
100.0 DAYS	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
115.7 DAYS	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
140.0 DAYS	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
231.5 DAYS	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3
1.0 YRS.	I 131 27.1	I 134 23.1	I 132 7.4	I 133 7.4	I 139 1.9	I 139 1.2	I 139 1.1	I 139 1.1	I 139 1.1	I 139 1.3

Source 1 (plate out), 200 d, Power = 1 watt, Pure U-235

Table A.8

GREATEST CONTRIBUTIONS TO BETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC	I 136 10.3	I 134 9.9	I 137 9.3	I 1336 7.1	I 135 6.5	I 133 5.3	I 135 4.7	I 132 4.2	I 139 2.5	RB 92 1.3
1.0 SEC	I 136 10.9	I 134 10.5	I 137 9.9	I 1336 7.6	I 134 6.2	I 133 5.6	I 135 5.0	I 132 4.4	I 134 2.0	Y 96 1.2
2.0 SEC	I 136 11.2	I 134 10.9	I 137 9.7	I 1336 7.6	I 133 5.9	I 134 5.4	I 135 5.2	I 132 4.6	I 134 1.5	Y 96 1.2
5.0 SEC	I 136 11.8	I 134 11.6	I 137 9.6	I 1336 8.0	I 133 6.3	I 135 5.8	I 132 5.0	I 134 4.0	Y 96 1.3	I 131 1.2
10.0 SEC	I 134 12.8	I 136 12.3	I 137 9.1	I 1336 8.1	I 133 6.9	I 135 6.1	I 132 5.4	I 134 2.9	Y 96 1.4	I 131 1.3
20.0 SEC	I 134 14.2	I 136 12.6	I 136 7.8	I 133 7.7	I 137 7.6	I 135 8.0	I 132 6.0	Y 96 1.4	I 131 1.4	Y 95 1.2
50.0 SEC	I 134 16.9	I 136 11.8	I 133 9.2	I 135 8.1	I 132 7.2	I 136 6.1	I 137 3.9	I 131 1.7	Y 96 1.5	XE 137 1.4
60.0 SEC	I 134 17.6	I 136 11.3	I 133 9.5	I 135 8.4	I 132 7.5	I 136 5.5	I 137 3.1	I 131 1.6	XE 137 1.6	Y 96 1.5
180.0 SEC	I 134 19.6	I 133 10.8	I 135 9.5	I 136 9.1	I 132 8.4	I 136 3.5	I 131 2.0	XE 137 1.9	Y 94 1.9	Y 95 1.6
3.3 MIN	I 134 22.6	I 133 12.6	I 135 11.1	I 132 9.8	I 136 8.6	I 131 2.3	Y 94 1.8	XE 137 1.7	Y 95 1.7	CS 139 1.6
6.3 MIN	I 134 24.8	I 133 16.7	I 135 12.9	I 132 11.2	I 131 2.7	Y 92 1.8	Y 94 1.8	Y 93 1.5	CS 138 1.5	Y 95 1.4
10.7 MIN	I 134 24.8	I 133 16.3	I 135 14.1	I 132 11.9	I 131 3.0	Y 92 2.0	Y 93 1.7	Y 94 1.5	CS 138 1.4	LA 141 1.3
33.3 MIN	I 134 23.0	I 133 18.4	I 135 15.6	I 132 12.6	I 131 3.5	Y 92 2.3	Y 93 2.0	LA 141 1.5	BA 139 1.3	LA 142 1.3
40.0 MIN	I 133 21.1	I 134 19.0	I 135 17.3	I 132 12.9	I 131 4.0	Y 92 2.6	Y 93 2.2	LA 141 1.6	ZR 97 1.2	LA 142 1.2
1.4 HR	I 133 23.0	I 135 18.3	I 134 15.5	I 132 12.7	I 131 4.4	Y 92 2.8	Y 93 2.4	LA 141 1.7	XE 135 1.5	ZR 97 1.3
2.8 HR	I 131 27.7	I 135 20.0	I 132 10.8	I 134 8.7	I 131 5.6	XE 135 3.4	Y 92 3.3	Y 93 2.7	LA 141 1.7	ZR 97 1.6
5.8 HR	I 133 32.3	I 135 19.1	I 131 7.1	XE 135 6.8	I 132 6.6	Y 92 3.1	Y 93 2.9	ZR 97 1.8	LA 140 1.8	Y 91 1.8
12.0 HR	I 133 35.4	I 135 13.2	XF 135 11.3	I 131 9.0	I 132 2.6	Y 93 2.5	LA 140 2.4	Y 91 2.4	PR 144 2.0	SR 89 1.9
13.9 HR	I 133 35.7	XF 135 11.9	I 135 11.6	I 131 10.0	LA 140 2.0	Y 91 2.6	Y 93 2.4	I 132 2.3	PR 144 2.1	SR 89 2.1
1.0 DAYS	I 133 35.2	XF 131 13.3	XE 135 11.5	I 135 5.8	LA 140 3.6	Y 91 3.0	PR 144 2.9	SR 89 2.9	PR 143 2.1	I 132 2.1
1.2 DAYS	I 133 34.3	I 131 14.6	XF 135 10.8	I 135 4.1	LA 140 3.9	Y 91 3.0	PR 144 3.2	SR 89 3.2	PR 143 2.3	I 132 2.2
2.3 DAYS	I 133 33.0	I 131 22.3	Y 91 6.6	LA 140 0.5	PR 144 5.3	SR 89 5.3	PR 143 1.8	XE 133 3.7	BA 140 3.2	XE 135 3.1
4.0 DAYS	I 131 27.4	Y 91 9.2	LA 140 8.6	I 133 8.5	PR 144 7.7	SR 89 7.3	XE 133 5.2	PR 143 5.1	LA 140 4.2	I 132 2.9
5.8 DAYS	I 131 28.2	Y 91 10.8	LA 140 9.5	PR 144 9.2	SR 89 8.6	PR 143 5.6	XE 133 5.4	LA 140 4.6	CE 141 2.9	I 133 2.4
10.0 DAYS	I 131 25.3	Y 91 13.2	PR 144 11.8	SR 89 10.4	LA 140 9.6	PR 143 5.9	BA 140 4.7	XE 133 4.3	CE 141 3.4	ZR 95 2.7
11.6 DAYS	I 131 23.8	Y 91 14.0	PR 144 12.7	SR 89 11.6	LA 140 9.8	PR 143 5.8	BA 140 4.6	XE 133 3.9	CE 141 3.6	ZR 95 2.9
23.1 DAYS	PR 144 18.9	Y 91 18.8	SR 89 14.5	I 131 13.5	LA 140 8.1	PR 143 5.0	CE 141 4.3	ZR 95 3.9	BA 140 3.8	NR 95 1.0
30.0 DAYS	PR 144 22.4	Y 91 20.8	SR 89 15.9	I 131 6.9	LA 140 6.7	CE 141 4.0	ZR 95 4.4	PR 143 4.7	BA 140 3.2	NR 95 1.9
57.9 DAYS	PR 144 31.0	Y 91 23.6	SR 89 17.4	ZR 95 5.1	CE 141 3.9	NR 95 2.7	LA 140 2.3	CE 144 2.3	CE 144 2.3	PR 143 1.6
80.0 DAYS	PR 144 33.7	Y 91 25.0	SR 89 17.3	ZR 95 5.1	CE 141 3.8	NR 95 2.7	RM 106 2.3	CE 144 2.2	LA 140 2.1	PR 143 1.5
115.7 DAYS	PR 144 47.2	Y 91 19.6	SR 89 13.2	ZR 95 4.6	RM 106 3.4	CE 144 3.1	NR 95 2.9	CE 141 1.9	Y 90 1.7	RU 103 0.0
150.0 DAYS	PR 144 53.9	Y 91 18.2	SR 89 10.4	ZR 95 4.0	RM 106 3.9	CE 144 3.5	NR 95 2.7	Y 90 2.1	CE 141 1.1	PM 147 0.5
231.5 DAYS	PR 144 66.0	Y 91 4.2	SR 89 5.2	RM 106 5.0	CE 144 4.3	Y 90 3.2	ZR 95 2.5	NR 95 1.9	PM 147 0.7	SR 90 0.7
1.0 YRS.	PR 144 74.8	RM 106 6.1	Y 90 4.0	CE 144 4.9	Y 91 3.0	SR 89 1.8	SR 90 1.1	PM 147 1.0	ZR 95 0.9	CS 137 0.9

Source 1 (Inlet out), 250 d, Power = 1 watt, Pure Li-235

Table A.9

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	I 130 19.8	I 132 9.5	I 135 9.2	I 136 6.7	I 137 6.6	BR 8A 4.7	I 138 4.4	I 133 4.1	BR 8B 3.8	I 130 3.6
1.0 SEC.	I 130 20.8	I 132 10.0	I 135 9.7	I 136 7.0	I 137 6.8	BR 8A 4.8	I 133 4.3	I 138 4.2	I 130 4.0	BR 87 3.9
2.0 SEC.	I 130 21.6	I 132 10.4	I 135 10.1	I 136 7.2	I 137 6.8	BR 8A 4.7	I 133 4.4	I 138 4.1	BR 87 4.0	I 130 3.9
5.0 SEC.	I 130 23.2	I 132 11.2	I 135 10.8	I 136 7.6	I 137 6.7	I 133 4.8	BR 8A 4.5	I 138 4.2	BR 87 4.2	BR 86 3.5
10.0 SEC.	I 130 24.9	I 132 12.0	I 135 11.7	I 136 7.4	I 137 6.3	I 133 5.1	BR 87 4.2	I 138 4.2	BR 86 3.9	BR 86 3.5
20.0 SEC.	I 130 27.2	I 132 13.1	I 135 12.8	I 136 7.8	I 137 5.6	I 137 5.2	BR 87 4.1	I 138 4.0	BR 86 3.4	BR 86 2.7
50.0 SEC.	I 130 31.1	I 132 15.0	I 135 14.6	I 136 7.0	I 131 6.4	BR 87 3.2	I 130 3.0	PR 86 2.7	BR 84 2.6	I 137 2.6
100.0 SEC.	I 130 32.0	I 132 15.5	I 135 15.1	I 136 6.7	I 133 6.0	BR 87 2.9	BR 84 2.7	I 130 2.6	BR 84 2.4	I 137 2.0
13.1 MIN.	I 130 34.6	I 132 16.8	I 135 16.4	I 133 7.2	I 130 5.2	BR 84 2.9	I 131 2.0	BR 87 2.0	I 130 1.6	BR 86 1.6
8.3 MIN.	I 130 37.5	I 132 18.5	I 135 18.2	I 133 6.0	BR 84 3.1	I 130 2.5	I 131 2.2	BR 87 2.0	LA 142 1.6	CS 138 1.6
16.7 MIN.	I 130 38.7	I 132 19.8	I 135 19.8	I 133 6.8	BR 84 3.1	I 131 2.4	LA 142 1.7	LA 140 1.6	CS 138 1.6	RB 89 1.4
33.1 MIN.	I 130 37.0	I 135 21.0	I 137 20.4	I 133 9.4	BR 84 2.8	I 131 2.8	LA 142 1.7	LA 140 1.7	CS 138 1.5	SR 92 1.3
60.0 MIN.	I 130 34.1	I 135 23.1	I 137 21.3	I 133 10.6	I 131 2.9	BR 84 2.2	LA 140 1.7	LA 142 1.7	CS 138 1.5	SR 92 1.4
1.4 HR.	I 130 28.7	I 135 20.2	I 137 22.2	I 133 12.4	I 131 3.5	BR 84 1.4	LA 140 1.4	LA 142 1.7	SR 92 1.4	CS 135 1.3
2.8 HR.	I 130 28.6	I 134 24.2	I 137 22.6	I 133 13.0	I 131 3.9	LA 140 1.0	BR 84 1.0	LA 142 1.7	SR 92 1.5	SR 92 1.4
5.6 HR.	I 135 35.2	I 132 21.4	I 133 18.9	I 134 11.6	I 131 5.6	LA 140 1.4	SR 92 1.5	LA 142 1.5	SR 92 1.5	SR 92 1.5
12.0 HR.	I 135 39.2	I 133 25.7	I 132 14.6	I 131 8.2	SR 92 1.3	LA 140 2.1	I 134 2.0	NR 95 1.4	NR 95 1.7	NR 97 1.5
13.9 HR.	I 133 33.6	I 135 32.2	I 131 13.0	SR 95 6.3	I 137 5.2	LA 140 3.4	NR 95 1.2	NR 95 1.2	NR 97 1.7	SR 91 1.4
1.0 DAYS	I 133 34.9	I 135 34.9	I 131 14.3	SR 95 6.8	I 132 4.2	LA 140 3.8	NR 95 1.3	NR 95 1.3	NR 97 1.7	SR 91 1.4
1.2 DAYS	I 133 37.9	I 131 21.0	I 135 15.3	SR 95 7.3	LA 140 5.7	I 132 3.4	NR 95 2.1	NR 95 2.0	SR 95 1.3	NR 97 1.7
2.3 DAYS	I 131 37.8	I 131 23.4	I 135 11.9	SR 95 11.0	SR 95 13.2	3.4	NR 95 2.3	NR 95 2.2	SR 95 1.3	NR 97 1.7
4.0 DAYS	I 131 37.8	I 133 26.7	LA 140 11.2	I 132 5.0	NR 95 4.1	NR 95 3.0	SR 95 2.3	SR 95 2.1	SR 95 1.3	NR 97 1.7
5.8 DAYS	I 131 47.8	LA 140 15.3	I 133 10.1	NR 95 6.0	NR 95 5.6	I 132 5.1	SR 95 3.5	SR 95 3.0	SR 95 1.6	BA 140 1.3
10.0 DAYS	I 131 50.7	LA 140 17.0	NR 95 7.5	NR 95 6.8	I 132 4.3	SR 95 3.7	I 133 3.0	SR 95 1.0	SR 95 1.5	BA 140 1.3
11.6 DAYS	I 131 48.6	LA 140 19.4	NR 95 10.2	NR 95 8.9	SR 95 3.3	RU 103 2.7	I 132 2.9	BA 140 1.7	CE 141 1.7	PR 144 1.3
23.1 DAYS	I 131 47.0	LA 140 19.7	NR 95 11.3	NR 95 9.7	SR 95 3.3	RU 103 2.9	I 132 1.9	BA 140 1.7	CE 141 1.7	PR 144 1.3
50.0 DAYS	I 131 32.4	LA 140 20.4	LA 140 14.7	NR 95 16.1	RU 103 4.4	BA 140 1.7	SR 95 1.2	CE 141 1.1	PR 144 1.7	CF 144 1.6
57.9 DAYS	NR 95 26.4	I 131 23.4	NR 95 19.4	LA 140 14.1	RU 103 5.2	BA 140 1.5	CF 141 1.3	PR 144 1.9	CE 144 1.4	SR 95 1.7
115.7 DAYS	NR 95 44.9	NR 95 29.2	LA 140 7.9	RU 103 6.3	I 131 4.3	PR 144 1.7	CE 144 1.6	PR 144 1.4	SR 95 1.6	BA 140 1.7
150.0 DAYS	NR 95 56.1	NR 95 29.6	LA 140 7.3	RU 103 6.3	I 131 3.7	PR 144 1.7	CE 144 1.6	SR 95 1.4	SR 95 1.4	BA 140 1.7
231.5 DAYS	NR 95 55.2	NR 95 30.2	LA 140 7.3	RU 103 6.3	I 131 3.7	PR 144 1.7	CE 144 1.6	SR 95 1.4	SR 95 1.4	BA 140 1.7
1.0 YRS.	NR 95 78.3	NR 95 17.4	PR 144 12.1	CE 144 11.3	SR 95 6.9	I 129 3.2	EU 152 2.2	SR 95 1.4	SR 95 1.4	BA 140 1.7

Source 1 (water), Equilibrium, Power = 1 watt, Pure U-235

Table A.10

GREATEST CONTRIBUTORS TO RETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0 SEC.	BR 8A 10.4	I 116 7.0	BR 8A 7.3	I 134 7.1	I 137 6.6	BR 87 6.3	BR 90 6.1	I 136 5.2	I 138 4.7	BR 86 4.0
1.0 SEC.	BR 8A 10.4	I 116 4.4	I 134 7.7	I 137 7.0	BR 89 6.9	BR 87 6.2	I 136 5.6	I 138 4.6	BR 90 4.3	I 133 4.1
2.0 SEC.	BR 8A 11.0	I 136 8.4	I 134 8.2	I 137 7.3	BR 87 7.1	BR 89 6.3	I 136 5.6	I 133 4.4	I 138 4.4	I 135 3.4
5.0 SEC.	BR 8A 11.0	I 134 9.3	I 136 9.3	BR 87 7.8	I 137 7.6	I 136 6.4	I 133 5.0	BR 89 4.5	I 135 4.4	I 132 3.4
10.0 SEC.	I 134 10.6	I 136 10.2	BR 8A 10.1	BR 87 8.3	I 137 7.5	I 136 6.7	I 133 5.7	I 135 5.0	I 132 4.5	BR 86 3.0
20.0 SEC.	I 134 12.4	I 136 11.0	BR 87 8.7	BR 88 7.7	I 136 6.8	I 133 6.7	I 137 6.7	I 135 5.9	I 132 5.3	BR 86 3.1
40.0 SEC.	I 134 15.9	I 136 11.0	I 133 8.6	BR 87 7.7	I 135 7.6	I 132 6.8	I 136 5.7	I 137 5.7	BR 84 3.6	BR 85 3.2
80.0 SEC.	I 134 16.8	I 136 10.8	I 133 9.1	I 135 8.0	BR 87 7.2	I 132 7.1	I 136 5.2	BR 84 3.6	BR 85 3.3	I 137 2.9
160.0 SEC.	I 134 19.6	I 136 10.7	I 135 9.5	I 136 9.1	I 132 8.4	BR 87 5.1	BR 84 4.5	I 136 3.5	BR 85 3.3	I 131 2.6
3.3 MIN.	I 134 23.7	I 133 13.2	I 135 11.6	I 132 10.3	BR 84 5.3	I 136 4.9	BR 85 2.7	I 131 2.5	BR 87 1.8	XE 137 1.8
6.7 MIN.	I 134 26.7	I 133 15.9	I 135 13.9	I 132 12.0	BR 84 5.7	I 131 3.0	Y 92 1.0	Y 90 1.0	BR 85 1.0	BR 83 .9
16.7 MIN.	I 134 28.6	I 133 17.5	I 135 15.1	I 132 12.8	BR 84 5.3	I 131 3.3	Y 92 1.1	BR 83 1.0	Y 93 .9	PR 144 .9
33.3 MIN.	I 134 24.4	I 133 19.7	I 135 16.7	I 132 13.4	BR 84 4.2	I 131 3.7	Y 92 1.2	Y 93 1.0	BR 83 1.0	PR 144 1.0
60.0 MIN.	I 133 22.8	I 134 20.1	I 135 18.6	I 132 13.7	I 131 4.3	BR 84 2.7	Y 92 1.4	Y 91 1.2	PR 144 1.1	XE 135 1.1
1.4 HR.	I 133 24.8	I 135 19.8	I 134 16.5	I 132 13.6	I 131 4.6	BR 84 1.8	XF 135 1.6	Y 92 1.5	Y 93 1.3	PR 144 1.3
2.8 HR.	I 133 30.5	I 135 22.0	I 137 11.6	I 134 7.2	I 131 6.1	XF 135 3.7	Y 92 1.8	PR 144 1.6	Y 93 1.5	Y 90 1.3
5.6 HR.	I 133 35.7	I 135 21.1	I 131 7.8	XE 135 7.6	I 132 6.8	PR 144 2.1	Y 92 1.7	Y 90 1.7	Y 93 1.6	Y 91 1.1
12.0 HR.	I 133 39.1	I 135 19.5	XE 135 12.5	I 131 10.4	PR 144 2.8	Y 92 2.3	I 132 2.0	Y 91 1.5	Y 93 1.4	LA 140 1.3
13.9 HR.	I 133 39.1	XF 135 13.1	I 135 12.8	I 131 11.0	PR 144 3.0	Y 92 2.4	I 132 1.8	Y 91 1.6	LA 140 1.4	Y 93 1.3
1.0 DAYS	I 133 38.6	I 131 14.7	XF 135 12.7	I 135 6.1	PR 144 4.2	Y 90 1.3	Y 91 2.2	LA 140 2.0	SR 89 1.7	XE 133 1.6
1.2 DAYS	I 133 37.7	I 131 16.0	XF 135 11.6	PR 144 4.6	I 135 4.5	Y 90 3.7	Y 91 2.4	LA 140 2.2	XE 133 1.9	SR 89 1.9
2.3 DAYS	I 133 35.5	I 131 24.7	PR 144 7.8	Y 90 6.3	XF 133 4.1	Y 91 4.0	LA 140 3.6	XE 135 3.5	SR 89 3.1	PR 143 2.1
4.0 DAYS	I 131 30.3	PR 144 11.1	I 133 9.9	Y 90 8.0	XF 133 5.5	Y 91 5.6	LA 140 4.8	SR 89 4.3	PR 143 2.8	BA 140 2.3
5.8 DAYS	I 131 30.7	PR 144 13.1	Y 90 10.6	Y 91 6.5	XF 133 5.0	LA 140 5.2	SR 89 5.0	PR 143 3.1	I 133 2.7	BA 140 2.5
10.0 DAYS	I 131 26.5	PR 144 16.1	Y 90 13.1	Y 91 7.7	SR 89 5.9	LA 140 5.2	XF 133 4.6	PR 143 3.1	SR 89 2.8	CS 137 2.6
11.6 DAYS	I 131 26.7	PR 144 17.0	Y 90 14.0	Y 91 8.0	SR 89 6.1	LA 140 5.1	XE 133 4.0	PR 143 3.0	SR 89 3.0	CS 137 2.6
23.1 DAYS	PR 144 25.0	Y 90 19.4	I 131 12.0	Y 91 9.7	SR 89 7.3	SR 90 4.1	CS 137 3.9	LA 140 3.8	PR 143 2.3	ZR 95 2.1
30.0 DAYS	PR 144 25.5	Y 90 21.9	Y 91 10.1	I 131 7.5	SR 89 7.5	SR 90 4.7	CS 137 4.4	LA 140 3.0	ZR 75 2.2	SR 136 2.1
57.9 DAYS	PR 144 30.5	Y 90 28.0	Y 91 9.3	SR 89 6.7	SR 90 6.0	CS 137 5.0	PR 144 2.8	ZR 95 2.1	CE 144 2.0	CE 141 1.4
80.0 DAYS	PR 144 30.7	Y 90 28.3	Y 91 9.2	SR 89 6.5	SR 90 6.0	CS 137 5.6	PR 144 2.6	ZR 95 2.1	CE 144 2.0	CE 141 1.4
115.7 DAYS	Y 90 36.2	PR 144 32.5	SR 90 7.3	CS 137 6.8	Y 91 5.7	SR 89 3.8	PR 144 2.8	CE 144 2.1	ZR 95 1.4	NB 95 .9
150.0 DAYS	Y 90 36.0	PR 144 32.3	SR 90 7.8	CS 137 7.3	Y 91 4.1	PR 144 2.9	SR 89 2.6	CE 144 2.1	ZR 95 1.0	PM 147 .9
231.5 DAYS	Y 90 41.0	PR 144 30.3	SR 90 8.9	CS 137 8.1	PR 144 2.8	CE 144 2.0	Y 91 1.8	SR 89 1.0	PM 147 .9	ZR 95 .5
1.0 YRS.	Y 90 47.0	PR 144 25.2	SR 90 10.2	CS 137 9.5	PR 144 2.5	CE 144 1.7	PM 147 1.0	Y 91 .4	CS 135 .4	I 129 .3

Source 1 (water), Equilibrium, Power = 1 watt. Pure U-235

Table A.11

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10	
0 SEC.	I 134 19.8	I 132 9.5	I 135 9.2	I 136 6.7	I 137 6.6	BR 8A	4.7	I 138 4.4	I 133 4.1	BR 89 3.9	I 136 3.8
1.0 SEC.	I 134 20.8	I 132 10.0	I 135 9.7	I 136 7.0	I 137 6.8	BR 8A	4.8	I 133 4.3	I 138 4.2	I 136 4.0	BR 87 3.9
2.0 SEC.	I 134 21.0	I 132 10.4	I 135 10.1	I 136 7.2	I 137 6.8	BR 86	4.7	I 133 4.4	I 136 4.1	BR 87 4.0	I 138 3.9
5.0 SEC.	I 134 21.2	I 132 11.2	I 135 10.9	I 136 7.6	I 137 6.8	I 133 4.4	BR 88 4.5	I 136 4.2	BR 87 4.2	BR 86 3.5	I 138 3.5
10.0 SEC.	I 134 22.0	I 132 12.0	I 135 11.7	I 136 7.8	I 137 6.3	I 133 5.1	BR 87 4.2	I 136 4.2	BR 86 3.9	BR 86 3.5	I 138 3.5
20.0 SEC.	I 134 27.2	I 132 13.1	I 135 12.8	I 136 7.9	I 133 5.6	I 137 5.2	BR 87 4.1	I 136 4.0	BR 86 3.4	BR 86 2.7	I 138 2.7
40.0 SEC.	I 134 31.1	I 132 15.0	I 135 14.7	I 136 7.0	I 133 6.5	BR 87 3.2	I 136 3.0	BR 86 2.7	BR 86 2.4	I 137 2.0	I 138 2.0
60.0 SEC.	I 134 32.0	I 132 15.5	I 135 15.1	I 136 7.1	I 133 6.7	BR 87 2.9	BR 86 2.7	I 136 2.6	BR 86 2.4	I 137 2.0	I 138 2.0
100.0 SEC.	I 134 34.6	I 132 16.8	I 135 16.5	I 133 7.2	I 136 5.2	BR 84 2.9	I 131 2.0	BR 87 2.0	I 136 1.6	BR 86 1.4	I 137 1.4
3.3 MIN.	I 134 37.6	I 132 18.5	I 135 18.2	I 133 8.0	RO 84 3.1	I 136 2.5	I 131 2.2	BR 87 2.0	I 136 1.6	CS 136 1.4	I 137 1.4
6.3 MIN.	I 134 38.7	I 132 19.8	I 135 19.8	I 133 8.8	BR 84 3.1	I 131 2.4	LA 142 1.4	I 136 1.4	CS 136 1.4	BR 89 1.4	I 137 1.4
16.7 MIN.	I 134 37.4	I 135 21.0	I 137 20.5	I 133 9.4	HR 84 2.8	I 131 2.6	LA 142 1.4	I 136 1.4	CS 136 1.4	SR 92 1.4	I 137 1.4
33.3 MIN.	I 134 34.2	I 135 23.1	I 132 21.4	I 133 10.6	I 131 2.0	BR 84 2.2	LA 140 1.4	I 136 1.4	CS 136 1.4	SR 92 1.4	I 137 1.4
60.0 MIN.	I 134 28.8	I 135 26.2	I 132 22.3	I 133 12.6	I 131 3.5	BR 84 1.5	LA 140 1.4	I 136 1.4	SR 92 1.4	XE 135 1.4	I 137 1.4
1.4 HR.	I 135 28.7	I 135 24.2	I 132 22.6	I 133 15.9	I 131 3.0	LA 140 1.0	BR 84 1.0	LA 142 1.4	I 136 1.4	SR 92 1.4	I 137 1.4
2.8 HR.	I 135 35.3	I 132 25.8	I 133 18.9	I 134 11.6	I 131 5.0	LA 140 1.4	I 144 1.4	XE 135 1.4	LA 142 1.4	SR 92 1.4	I 137 1.4
5.6 HR.	I 135 39.4	I 133 25.8	I 132 18.9	I 131 8.3	XE 135 3.2	LA 140 2.1	I 134 2.0	ZR 95 1.9	NR 97 1.9	SR 91 1.4	I 137 1.4
12.0 HR.	I 133 33.7	I 135 12.3	I 131 15.1	XE 135 6.3	I 132 5.2	LA 140 3.4	ZR 95 1.0	NR 97 1.9	SR 91 1.4	I 137 1.4	I 137 1.4
13.9 HR.	I 133 35.1	I 135 24.4	I 131 14.4	XE 135 6.9	I 132 4.3	LA 140 3.8	ZR 95 1.1	NR 97 1.9	SR 91 1.4	I 137 1.4	I 137 1.4
1.0 DAYS	I 133 38.3	I 131 21.2	I 135 15.5	XE 135 7.4	LA 140 5.8	I 132 3.4	ZR 95 1.7	NR 97 1.9	SR 91 1.4	I 137 1.4	I 137 1.4
1.2 DAYS	I 133 38.2	I 131 21.7	I 135 11.8	XE 135 6.4	LA 140 6.5	I 132 3.7	ZR 95 2.0	NR 97 1.9	SR 91 1.4	I 137 1.4	I 137 1.4
2.3 DAYS	I 131 38.5	I 133 27.2	LA 140 11.0	I 132 5.1	ZR 95 3.5	NR 95 3.2	XE 133 2.4	XE 135 2.2	RU 103 1.2	I 137 1.4	I 137 1.4
4.0 DAYS	I 131 40.1	LA 140 15.7	I 133 10.4	I 132 5.2	ZR 95 5.0	NR 95 4.6	XE 133 3.6	RU 103 1.7	BA 140 1.4	TE 132 1.4	I 137 1.4
5.8 DAYS	I 131 52.3	LA 140 18.0	ZR 95 6.1	NR 95 6.0	I 132 4.1	XE 133 3.8	I 133 3.1	RU 103 1.7	CE 141 1.4	I 137 1.4	I 137 1.4
10.0 DAYS	I 131 50.7	LA 140 20.2	NR 95 6.3	ZR 95 6.2	XE 133 3.3	RU 103 2.7	I 132 2.5	HA 140 1.8	CE 141 1.4	ND 147 1.4	I 137 1.4
11.8 DAYS	I 131 49.2	LA 140 20.7	NR 95 9.3	ZR 95 6.9	XE 133 3.0	RU 103 2.9	I 132 2.0	RA 100 1.8	CE 141 1.4	ND 147 1.4	I 137 1.4
23.1 DAYS	I 131 35.0	LA 140 21.3	NR 95 17.7	ZR 95 15.3	RU 103 4.6	BA 140 1.8	XE 133 1.3	CF 141 1.2	I 132 1.3	ND 147 1.4	I 137 1.4
30.6 DAYS	I 131 26.3	NR 95 25.6	LA 140 19.9	ZR 95 19.3	RU 103 5.6	BA 140 1.7	CE 141 1.4	XE 133 1.4	PH 144 1.4	CE 144 1.4	I 137 1.4
57.9 DAYS	NR 95 43.8	ZR 95 30.1	LA 140 9.3	RU 103 7.2	I 131 5.0	CE 141 1.6	HA 140 1.6	PT 144 1.6	CE 144 1.6	CE 144 1.6	I 137 1.4
60.0 DAYS	NR 95 44.9	ZR 95 30.5	LA 140 8.5	RU 103 7.2	I 131 4.3	CE 141 1.6	PR 140 1.6	HA 140 1.6	CE 144 1.6	BA 140 1.6	I 137 1.4
115.7 DAYS	NR 95 47.9	ZR 95 32.3	RU 103 5.2	PR 140 1.1	CE 141 1.2	CE 141 1.2	LA 140 1.9	HA 140 1.8	RM 106 1.5	Y 91 1.1	I 137 1.4
150.0 DAYS	NR 95 50.7	ZR 95 31.4	RU 103 4.0	PR 140 1.7	CE 141 1.5	RM 106 1.7	CF 141 1.6	LA 140 1.8	Y 91 1.1	SB 125 1.1	I 137 1.4
231.5 DAYS	NR 95 60.4	ZR 95 29.3	PR 140 3.0	CF 141 2.8	RU 103 2.4	RM 106 1.3	CF 141 1.3	SR 125 1.4	Y 91 1.1	PH 144 1.1	I 137 1.4
1.0 YRS.	NR 95 55.0	ZR 95 25.1	PR 140 7.7	CF 141 7.7	RU 103 3.5	RU 103 7.7	SR 125 4.4	PR 144 2.2	SA 123 1.1	Y 91 1.1	I 137 1.4

Source: (water), 200 d, Power = 1 watt, Pure U-235

Table A.12

GREATEST CONTRIBUTORS TO REF. DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LNCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	RR RA 10.4 I	136 7.4 I	RR RO 7.4 I	134 7.1 I	137 7.1 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I
1.0 SEC.	RR BA 10.9 I	136 8.0 I	134 7.1 I	137 7.1 I	RR A9 6.4 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I
2.0 SEC.	RR RA 11.1 I	136 8.4 I	134 7.2 I	137 7.3 I	RR A7 7.2 I	RR A9 6.3 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I	RR A7 6.3 I
5.0 SEC.	RR BA 11.0 I	134 9.4 I	134 8.4 I	RR A7 7.8 I	137 7.6 I	RR A7 7.6 I	RR A7 7.6 I	RR A7 7.6 I	RR A7 7.6 I	RR A7 7.6 I
10.0 SEC.	I 134 10.7 I	136 10.2 I	RR RA 10.1 I	RR A7 8.0 I	137 7.6 I	RR A7 7.6 I	RR A7 7.6 I	RR A7 7.6 I	RR A7 7.6 I	RR A7 7.6 I
20.0 SEC.	I 134 12.5 I	136 11.1 I	RR A7 8.7 I	RR A7 7.7 I	136 8.9 I	RR A7 7.7 I	RR A7 7.7 I	RR A7 7.7 I	RR A7 7.7 I	RR A7 7.7 I
50.0 SEC.	I 134 16.0 I	136 11.1 I	133 8.7 I	RR A7 7.7 I	135 7.7 I	RR A7 7.7 I	RR A7 7.7 I	RR A7 7.7 I	RR A7 7.7 I	RR A7 7.7 I
60.0 SEC.	I 134 16.5 I	136 17.0 I	133 9.2 I	135 8.1 I	RR A7 7.2 I	RR A7 7.2 I	RR A7 7.2 I	RR A7 7.2 I	RR A7 7.2 I	RR A7 7.2 I
100.0 SEC.	I 134 19.1 I	133 15.0 I	135 9.6 I	134 9.2 I	132 8.5 I	RR A7 5.2 I	RR A7 5.2 I	RR A7 5.2 I	RR A7 5.2 I	RR A7 5.2 I
3.1 MIN.	I 134 24.0 I	133 15.4 I	135 11.8 I	132 10.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I
6.3 MIN.	I 134 27.2 I	133 16.1 I	135 14.1 I	132 12.2 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I
10.7 MIN.	I 134 27.0 I	133 17.8 I	135 15.4 I	132 13.0 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I	RR A4 5.4 I
33.3 MIN.	I 140 24.0 I	133 20.1 I	135 17.0 I	132 13.7 I	RR A4 5.3 I	RR A4 5.3 I	RR A4 5.3 I	RR A4 5.3 I	RR A4 5.3 I	RR A4 5.3 I
60.0 MIN.	I 133 23.2 I	134 20.6 I	135 19.0 I	132 14.0 I	I 131 4.4 I	RR A4 2.8 I	RR A4 2.8 I	RR A4 2.8 I	RR A4 2.8 I	RR A4 2.8 I
1.4 HR.	I 133 25.5 I	135 20.3 I	134 16.9 I	132 15.0 I	I 131 4.4 I	RR A4 1.9 I	RR A4 1.9 I	RR A4 1.9 I	RR A4 1.9 I	RR A4 1.9 I
2.8 HR.	I 133 31.5 I	135 22.9 I	132 12.0 I	134 7.0 I	131 6.3 I	RR A4 3.9 I	RR A4 3.9 I	RR A4 3.9 I	RR A4 3.9 I	RR A4 3.9 I
5.6 HR.	I 133 37.1 I	135 22.1 I	131 8.2 I	135 7.0 I	132 7.1 I	RR A4 1.8 I	RR A4 1.8 I	RR A4 1.8 I	RR A4 1.8 I	RR A4 1.8 I
12.0 HR.	I 133 41.4 I	135 15.4 I	135 13.2 I	131 11.0 I	132 2.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
13.9 HR.	I 133 41.4 I	135 13.9 I	135 13.9 I	131 11.7 I	132 1.7 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
1.0 DAYS	I 133 42.1 I	131 16.0 I	135 13.8 I	135 6.0 I	LA 140 2.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
1.7 DAYS	I 133 41.5 I	131 17.4 I	135 12.8 I	135 5.0 I	LA 140 2.4 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
2.3 DAYS	I 133 40.1 I	131 20.2 I	135 4.9 I	RR A4 4.1 I	LA 140 4.2 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
4.0 DAYS	I 131 38.8 I	133 12.0 I	135 7.4 I	RR A4 6.1 I	LA 140 6.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
5.8 DAYS	I 131 41.4 I	133 8.0 I	RR A4 7.9 I	LA 140 7.0 I	RR A4 6.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
10.0 DAYS	I 131 38.9 I	RR A4 9.1 I	RR A4 8.0 I	RR A4 8.1 I	LA 140 7.6 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
11.6 DAYS	I 131 37.3 I	RR A4 11.1 I	RR A4 9.9 I	RR A4 8.6 I	LA 140 7.7 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
23.1 DAYS	I 131 23.5 I	RR A4 10.5 I	RR A4 16.3 I	RR A4 12.7 I	LA 140 7.0 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
30.0 DAYS	RR A4 20.4 I	RR A4 18.0 I	131 16.4 I	RR A4 14.5 I	LA 140 6.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
57.9 DAYS	RR A4 12.6 I	RR A4 21.3 I	RR A4 17.1 I	RR A4 17.1 I	RR A4 5.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
60.0 DAYS	RR A4 13.1 I	RR A4 23.3 I	RR A4 17.1 I	RR A4 17.1 I	RR A4 5.1 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
115.7 DAYS	RR A4 17.2 I	RR A4 16.6 I	RR A4 13.2 I	RR A4 10.6 I	RR A4 4.6 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
150.0 DAYS	RR A4 15.9 I	RR A4 16.2 I	RR A4 10.4 I	RR A4 10.4 I	RR A4 4.0 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
231.5 DAYS	RR A4 16.6 I	RR A4 16.2 I	RR A4 5.2 I	RR A4 10.6 I	RR A4 5.0 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I
1.0 YRS.	RR A4 14.8 I	RR A4 16.6 I	RR A4 4.9 I	RR A4 4.9 I	RR A4 3.0 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I	RR A4 1.5 I

Source 1 (water). 200 d. Power = 1 watt, Pure ^{137}Cs

Table A.13

GREATEST CONTRIBUTIONS TO DAMPED OSCILLATION POWER (PERCENT OF TOTAL)

TIME AFTER LOCAL	1	2	3	4	5	6	7	8	9	10
0.0 SEC	I 134 10.7 AR	AO 11.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
1.0 SEC	I 134 11.1 AR	AO 11.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
2.0 SEC	I 134 11.1 AR	AO 11.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
5.0 SEC	I 134 12.1 AR	AO 11.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
10.0 SEC	I 134 12.1 AR	AO 11.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
20.0 SEC	I 134 13.5 AR	AO 12.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
50.0 SEC	I 134 15.2 AR	AO 12.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
100.0 SEC	I 134 15.2 AR	AO 12.5 AD	01 0.1 AR	0F 5.0 AE	1.2 8.1 AE	1.0 5.5 AE	130 5.2 I	132 5.2 I	135 5.0 I	136 3.6
3.0 MIN	I 134 16.0 AR	AO 13.6 AF	134 12.7 AR	00 1.0 I	132 6.2 I	135 6.0 I	133 3.5 AR	87 3.4 AF	135 3.0 I	136 2.5
4.3 MIN	I 134 16.0 AR	AO 13.6 AF	134 12.7 AR	00 1.0 I	132 6.2 I	135 6.0 I	133 3.5 AR	87 3.4 AF	135 3.0 I	136 2.5
10.7 MIN	I 134 16.0 AR	AO 13.6 AF	134 12.7 AR	00 1.0 I	132 6.2 I	135 6.0 I	133 3.5 AR	87 3.4 AF	135 3.0 I	136 2.5
33.3 MIN	AR 19.6 I	134 17.0 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
60.0 MIN	AR 20.8 I	134 18.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
1.0 HR	AR 22.8 I	134 19.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
2.0 HR	I 135 23.6 AR	AR 19.6 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
5.0 HR	I 135 23.6 AR	AR 19.6 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
12.0 HR	I 135 24.9 I	134 23.1 AE	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
13.0 HR	I 135 26.8 I	134 22.1 AE	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
1.0 DAYS	I 135 27.5 AE	134 19.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
1.0 DAYS	I 135 33.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
2.3 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
4.7 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
5.0 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
10.0 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
11.0 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
23.1 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
30.0 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
57.0 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
100.0 DAYS	I 135 35.0 AE	134 20.7 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
115.7 DAYS	AR 66.0 AR	120 0.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
150.0 DAYS	AR 66.0 AR	120 0.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
215.0 DAYS	AR 66.0 AR	120 0.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1
1.0 YRS.	AR 66.0 AR	120 0.1 I	134 12.7 I	132 12.2 I	134 6.2 CS	138 7.2 I	133 5.0 AR	87 4.3 AE	135 3.0 AR	89 3.1

Source: J. A. P. Equilibrium Power = 1 watt, Pure U-235

Table A.14

GREATEST CONTRIBUTORS TO BETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LHR	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	137 14.0	130 11.0	80 11.2	80 7.1	02 0.9	134 5.1	02 4.6	87 4.2	140 4.0	136 3.4
0.0 SEC.	137 14.0	130 11.0	80 11.2	80 7.1	02 0.9	134 5.1	87 4.6	140 4.0	136 3.5	134 3.4
2.0 SEC.	137 15.1	130 11.0	80 10.4	80 7.7	07 7.2	134 5.5	87 4.5	140 4.0	136 3.6	134 3.5
5.0 SEC.	137 16.2	130 12.1	80 8.8	80 8.3	04 7.3	134 5.9	87 4.9	134 3.8	136 3.6	140 3.7
10.0 SEC.	137 17.5	130 12.1	80 9.0	80 7.2	01 6.5	134 6.5	87 5.4	134 4.2	136 4.0	135 3.7
20.0 SEC.	137 19.2	130 11.7	80 9.0	80 7.2	01 6.5	87 6.5	134 4.7	136 4.2	135 3.9	133 3.1
40.0 SEC.	137 21.5	80 10.4	138 8.5	87 7.0	07 7.3	134 5.6	87 4.7	136 4.2	136 3.5	133 3.2
60.0 SEC.	137 21.0	80 10.5	138 8.8	87 7.0	07 7.3	134 5.6	87 4.7	136 4.2	136 3.5	133 3.2
100.0 SEC.	137 22.6	80 11.0	138 9.0	87 7.1	134 6.7	134 5.3	139 4.3	133 3.7	135 3.2	136 3.1
3.3 MIN.	137 21.2	138 11.0	87 10.1	80 8.4	134 6.4	134 5.3	133 6.4	135 5.5	132 4.7	138 3.9
8.3 MIN.	87 12.7	138 11.0	137 10.5	134 9.5	08 8.4	134 5.2	133 6.2	135 5.7	132 4.3	138 4.3
16.7 MIN.	88 15.8	87 13.3	130 9.7	135 9.2	134 8.3	133 7.3	133 6.4	135 5.5	132 4.7	138 4.3
33.3 MIN.	88 24.8	87 12.2	136 9.4	138 8.9	134 7.5	133 6.4	133 5.7	132 4.6	138 4.0	138 3.9
60.0 MIN.	88 31.5	136 10.4	87 10.6	138 7.9	134 6.9	133 6.1	133 5.7	132 4.6	138 4.0	138 3.6
1.0 HR.	88 31.5	136 11.4	87 9.5	133 8.1	134 6.4	133 5.6	133 5.3	132 4.4	138 4.0	138 3.6
2.0 HR.	88 34.6	136 15.1	133 10.1	133 8.1	134 6.4	133 5.6	133 5.3	132 4.4	138 4.0	138 3.6
5.0 HR.	88 27.3	136 20.4	133 15.2	135 6.2	134 6.5	133 4.9	131 3.3	130 2.9	138 4.0	138 3.6
12.0 HR.	136 26.0	133 22.5	133 15.0	134 10.2	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
13.0 HR.	136 27.1	133 23.8	133 17.5	135 10.7	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
1.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
1.2 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
2.3 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
4.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
5.8 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
10.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
11.6 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
23.1 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
30.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
47.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
60.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
115.7 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
150.0 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
211.5 DAYS	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6
1.0 YRS.	133 20.6	133 26.3	136 22.5	131 11.4	134 6.4	131 4.0	130 3.3	130 2.9	138 4.0	138 3.6

Source: Z (air), Eq. (14), Power = 1 watt, Pure U-235

Table A.15

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LNCA	1	2	3	4	5	6	7	8	9	10
0 SEC.	I 134 10.7	KR A9 10.5	KR 00 9.0	KR 08 8.6	XE 13A 8.1	XE 140 5.5	XE 139 5.2	I 132 5.2	I 135 5.0	I 130 3.0
1.0 SFC.	I 134 11.1	KR A9 10.8	KR 00 9.1	KR 08 8.8	XE 13A 8.4	XE 140 5.4	I 132 5.4	XE 139 5.3	I 135 5.2	I 130 3.7
2.0 SFC.	I 134 11.4	KR A9 11.1	KR 00 9.2	KR 08 9.0	XE 13A 8.6	I 132 5.5	XE 139 5.4	I 135 5.3	XF 140 5.3	I 130 3.8
5.0 SFC.	I 134 12.0	KR A9 11.5	KR 00 9.7	KR 08 9.0	XF 139 9.1	I 132 5.8	I 135 5.6	XF 139 5.4	XE 140 4.8	I 130 3.9
10.0 SFC.	I 134 12.6	KR A9 11.9	KR 00 10.2	XF 138 9.5	KR 00 8.6	I 132 6.1	I 135 5.9	XF 140 5.2	I 130 4.0	XF 140 3.9
20.0 SEC.	I 134 13.5	KR A9 12.3	KR A9 10.9	XE 13A 10.1	KR 00 7.4	I 132 6.5	I 135 6.1	XE 139 4.7	I 130 3.9	I 133 2.8
50.0 SFC.	I 134 15.2	KR A9 12.5	KR 08 12.3	XE 13A 11.1	I 132 7.3	I 135 7.2	KR 00 4.4	I 130 6.4	XE 139 3.2	I 133 3.2
40.0 SFC.	I 134 15.8	KR A9 12.7	KR A9 12.4	XE 13A 11.4	I 132 7.6	I 135 7.4	KR 00 3.7	I 130 6.2	I 133 3.2	KR 07 3.2
100.0 SFC.	I 134 16.9	KR A9 13.8	XE 13A 12.0	KR 00 11.7	I 132 8.2	I 135 8.1	I 133 3.5	KR 07 3.5	XE 135 3.0	I 130 2.5
3.3 MIN.	I 134 18.6	KR A9 15.4	XE 13A 12.5	I 132 9.2	KR 00 9.1	I 135 9.0	I 133 4.0	KR 07 3.8	XF 135 3.0	RB 90 2.1
8.3 MIN.	I 134 20.3	KR A9 17.2	XE 13A 13.2	I 132 10.2	I 135 10.2	I 133 4.5	CS 13A 4.4	KR 07 4.2	XE 135 3.0	RB 80 3.5
16.7 MIN.	I 134 19.7	KR A9 18.3	I 135 11.1	I 132 10.4	XF 138 8.2	CS 130 7.2	I 133 5.0	KR 07 4.3	XE 135 4.2	RB 90 3.1
33.3 MIN.	KR 08 19.4	I 134 17.9	I 135 12.2	I 132 11.2	CS 13A 9.4	I 133 5.6	XE 135 4.7	KR 08 4.5	KR 07 4.2	XE 138 4.1
46.0 MIN.	KR 08 20.8	I 134 15.1	I 135 13.9	I 132 11.7	CS 13A 8.5	I 133 6.0	RB 08 4.2	XE 135 5.6	KR 07 3.9	KR 05 2.1
1.4 HR.	KR A9 21.7	I 135 15.4	I 130 12.7	I 132 12.0	I 133 7.5	RB 08 7.0	CS 138 6.6	XE 135 6.3	KR 07 3.6	KR 05 2.2
2.8 HR.	KR A9 22.6	I 135 16.4	I 132 13.6	I 133 10.5	XF 135 6.7	RB 08 7.7	I 134 6.3	XE 133 3.1	I 131 3.1	KR 05 2.7
5.6 HR.	I 135 23.8	KR A9 18.6	I 133 15.6	XE 135 12.5	I 132 8.2	RB 08 6.3	XF 133 5.0	I 131 5.0	KR 05 2.8	I 130 1.1
12.0 HR.	I 133 24.9	I 135 21.9	XE 135 17.5	XE 133 9.8	I 131 9.7	KR 08 7.4	NR 08 2.5	I 132 2.3	KR 05 2.1	KR 07 .1
13.9 HR.	I 133 26.0	I 135 22.5	XE 135 18.0	XF 133 11.2	I 131 11.0	KR 08 5.4	NR 08 1.8	NR 05 1.8	I 132 1.5	KR 07 .1
1.0 DAYS	I 133 12.5	XE 133 18.3	I 131 18.0	XF 135 16.3	I 135 13.1	KR 08 .7	NR 05 .6	RB 08 .3	I 132 .1	SR 91 .0
1.2 DAYS	I 133 35.0	XE 133 20.8	I 131 20.5	XF 135 16.7	I 135 10.2	NR 05 .0	KR 08 .3	NR 08 .1	I 132 .0	SR 91 .0
2.3 DAYS	I 131 35.1	XF 133 35.0	I 131 24.8	XF 135 4.0	I 135 .0	NR 05 .0	KR 08 .0	LA 140 .0	I 130 .0	SR 91 .0
4.0 DAYS	I 131 46.0	XF 133 43.9	I 133 9.8	XE 135 .3	I 135 .0	LA 140 .0	KR 05 .0	HA 140 .0	I 130 .0	SR 91 .0
5.6 DAYS	I 131 51.1	XE 133 45.8	I 133 3.0	XE 135 .0	LA 140 .0	KR 05 .0	BA 140 .0	I 135 .0	I 130 .0	CE 141 .0
10.0 DAYS	I 131 56.7	XF 133 43.1	I 133 .2	LA 140 .0	RA 140 .0	HA 140 .0	XF 135 .0	CE 141 .0	Y 91 .0	2R 95 .0
11.6 DAYS	I 131 58.4	XF 133 41.5	I 133 .1	KR 05 .0	LA 140 .0	HA 140 .0	CE 141 .0	Y 91 .0	XF 135 .0	2R 95 .0
23.1 DAYS	I 131 60.9	XF 133 30.0	KR 05 .1	LA 140 .0	HA 140 .0	CE 141 .0	I 133 .0	Y 91 .0	2R 95 .0	I 129 .0
30.0 DAYS	I 131 75.9	XF 133 24.0	KR 05 .1	LA 140 .0	HA 140 .0	CE 141 .0	Y 91 .0	2R 95 .0	I 129 .0	NR 95 .0
57.9 DAYS	I 131 80.2	XE 133 8.2	KR 05 1.5	LA 140 .1	HA 140 .0	CE 141 .0	Y 91 .0	I 129 .0	2R 95 .0	NR 95 .0
60.0 DAYS	I 131 90.5	XE 133 7.5	NR 05 1.9	LA 140 .0	HA 140 .0	CE 141 .0	Y 91 .0	I 129 .0	2R 95 .0	NR 95 .0
115.7 DAYS	KR 05 71.0	I 131 28.5	LA 140 .2	XF 133 .2	BA 140 .0	CE 141 .0	Y 91 .0	I 129 .0	NR 95 .0	2R 95 .0
150.0 DAYS	KR 05 91.9	I 131 2.1	LA 140 .1	HA 140 .0	Y 91 .0	CE 141 .0	XF 133 .0	I 129 .0	NR 95 .0	2R 95 .0
231.5 DAYS	KR 05 100.0	I 131 .0	Y 91 .0	LA 140 .0	CE 141 .0	I 129 .0	NR 95 .0	Y 90 .0	2R 95 .0	BA 140 .0
1.0 YRS.	KR 05 100.0	I 129 .0	Y 91 .0	Y 90 .0	NR 95 .0	CE 141 .0	2R 95 .0	PR 140 .0	CE 141 .0	CS 135 .0

Source 2 (air), 200 d, Power = 1 watt, Pure U-235

Table A.16

GREATEST CONTRIBUTORS TO BETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LCCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	XF 137 14.0	XF 139 11.4	KR 91 11.2	KR A9 7.2	KD 90 6.9	XF 138 5.1	KR 92 4.6	KR A7 4.2	XE 140 4.0	I 136 3.4
1.0 SEC.	XF 137 14.6	XF 139 11.7	KR 91 10.4	KR A9 7.5	KD 90 7.1	XF 138 5.3	KR A7 4.6	XE 140 4.0	I 136 3.5	I 134 3.4
2.0 SEC.	XF 137 15.1	XF 139 12.0	KR 91 10.4	KR A9 7.7	KD 90 7.2	XF 138 5.3	KR A7 4.6	XE 140 4.0	I 136 3.6	I 134 3.5
5.0 SEC.	XF 137 16.3	XF 139 12.3	KD 91 8.9	KR A9 8.3	KD 90 7.3	XF 138 6.0	KR A7 4.9	I 134 3.8	I 136 3.8	KE 140 3.7
10.0 SEC.	XF 137 17.6	XF 139 12.4	KD 90 8.9	KR 90 7.2	KD 91 6.5	XF 138 6.5	KR A7 5.4	I 134 4.2	I 136 4.4	KE 125 5.3
20.0 SEC.	XF 137 19.3	XF 139 11.7	KR 89 9.6	XF 138 7.2	KD 90 6.5	KR 87 6.0	I 134 4.7	I 136 4.1	XE 135 3.7	KR 91 3.3
40.0 SEC.	XF 137 21.6	KR 89 10.5	XE 138 8.6	XE 139 8.5	KR 87 7.3	I 134 5.7	XE 135 4.4	KR 90 4.2	I 136 3.9	I 133 3.1
60.0 SEC.	XF 137 22.0	KR 89 10.6	XE 138 8.9	KR 87 7.6	XE 139 7.5	I 134 5.9	XE 135 4.6	I 136 3.8	KR 90 3.5	I 133 3.2
100.0 SEC.	XF 137 22.5	KR 89 10.5	XF 138 9.4	KR 87 8.7	I 134 6.7	XE 135 5.3	XE 139 4.3	I 133 3.7	I 135 3.2	I 136 3.1
3.3 MIN.	XE 137 20.4	XF 138 11.1	KR 87 10.5	KR 89 8.0	I 134 6.0	XE 135 6.5	I 133 4.5	I 135 3.9	I 132 3.5	HB 88 2.9
8.3 MIN.	KR 87 12.8	XF 138 11.1	XF 137 10.6	I 134 9.6	KR 88 8.3	XF 135 8.3	I 133 5.7	I 135 5.0	I 132 4.3	CS 138 4.3
16.7 MIN.	RB 88 15.9	KR 87 13.4	I 134 9.8	XE 135 9.3	XE 138 8.4	CS 138 7.3	I 133 6.5	I 135 5.8	I 132 4.7	KR 85 3.9
33.3 MIN.	KR 88 24.7	KR 87 12.3	XF 135 9.9	CS 138 8.0	I 134 8.0	I 133 6.0	I 135 5.8	I 132 4.0	KR 85 4.0	XE 138 4.0
60.0 MIN.	KR 88 31.3	XF 135 10.8	KR 87 10.7	CS 138 7.5	I 133 7.5	I 134 6.0	I 135 6.1	I 132 4.5	KR 85 4.2	KR 88 3.8
1.4 HR.	KR 88 33.4	XF 135 11.7	KR 87 9.6	I 133 8.2	I 135 6.5	CS 138 5.6	I 134 5.3	I 132 4.4	KR 85 4.3	XE 138 4.2
2.6 HR.	KR 88 35.2	XF 135 15.1	I 133 10.8	I 135 7.8	KR 87 6.2	XE 133 5.8	KR 85 4.9	I 132 4.0	KR 88 3.8	I 134 2.5
5.8 HR.	KR 88 28.0	XE 135 21.2	I 133 15.6	I 135 9.2	XE 133 9.0	KR 85 5.0	I 131 3.4	KR 88 3.0	I 132 2.7	KR 87 2.2
12.0 HR.	XF 135 28.2	I 133 23.7	XF 133 16.7	RB 88 10.7	I 135 8.8	I 131 6.3	KR 85 7.5	KR 88 1.1	I 132 7.7	KR 85 2.2
13.9 HR.	XF 135 28.7	I 133 25.2	XE 133 18.8	I 135 8.2	RB 88 7.6	I 131 7.1	KR 85 2.9	KR 88 1.8	I 132 5.8	KR 85 2.2
1.0 DAYS	XE 133 29.0	I 133 28.7	XF 135 24.5	I 131 10.9	I 135 4.5	HB 88 1.0	KR 85 1.0	KR 85 1.3	KR 88 1.1	I 132 0.0
1.2 DAYS	XF 133 32.0	I 133 28.7	XF 135 21.7	I 131 12.2	I 135 3.4	KR 85 0.0	KR 88 0.0	KR 85 0.0	KR 88 0.0	I 132 0.0
2.3 DAYS	XF 133 32.5	I 133 20.7	XF 131 20.0	XE 135 5.7	KR 85 7.1	I 135 3.3	KR 85 0.0	SR 89 0.0	LA 140 0.0	BA 140 0.0
4.0 DAYS	XF 133 64.7	I 131 25.8	I 133 8.0	KD 85 1.0	XE 135 0.0	SR 89 0.0	I 135 0.0	LA 140 0.0	BA 140 0.0	Y 91 0.0
5.8 DAYS	XF 133 67.5	I 131 28.7	I 133 2.5	KR 85 1.3	XF 135 0.0	SR 89 0.0	LA 140 0.0	HA 140 0.0	Y 91 0.0	I 135 0.0
10.0 DAYS	XF 133 65.1	I 131 32.6	KR 85 2.1	I 133 0.1	SR 89 0.0	LA 140 0.0	HA 140 0.0	Y 91 0.0	CS 137 0.0	Y 90 0.0
11.6 DAYS	XF 133 61.4	I 131 33.9	KR 85 2.6	I 133 0.0	SR 89 0.0	LA 140 0.0	BA 140 0.0	Y 91 0.0	CS 137 0.0	Y 90 0.0
23.1 DAYS	XE 133 68.3	I 131 42.9	KR 85 8.7	SR 89 1.1	LA 140 0.0	BA 140 0.0	Y 91 0.0	CS 137 0.0	Y 90 0.0	CE 141 0.0
30.0 DAYS	I 131 45.4	XF 133 37.7	KR 85 16.7	SR 89 2.1	LA 140 0.0	Y 91 0.0	HA 140 0.0	CS 137 0.0	Y 90 0.0	CE 141 0.0
37.0 DAYS	KR 85 76.1	I 131 18.8	XF 133 4.5	SR 89 0.6	Y 91 0.0	LA 140 0.0	BA 140 0.0	CS 137 0.0	Y 90 0.0	CF 141 0.0
60.0 DAYS	KR 85 79.5	I 131 16.0	XE 133 3.5	SR 89 0.6	Y 91 0.0	LA 140 0.0	BA 140 0.0	CS 137 0.0	Y 90 0.0	SR 90 0.0
115.7 DAYS	KR 85 99.5	SR 89 0.3	I 131 2.2	Y 91 0.0	CS 137 0.0	Y 90 0.0	LA 140 0.0	SR 90 0.0	BA 140 0.0	Y 91 0.0
150.0 DAYS	KR 85 99.8	SR 89 0.2	I 131 0.0	Y 91 0.0	CS 137 0.0	Y 90 0.0	SR 90 0.0	LA 140 0.0	CE 141 0.0	HA 140 0.0
231.5 DAYS	KR 85 99.9	SR 89 0.1	CS 137 0.0	Y 91 0.0	Y 90 0.0	SR 90 0.0	CF 141 0.0	I 131 0.0	I 129 0.0	CS 135 0.0
1.0 YRS.	KR 85 100.0	SR 89 0.0	CS 137 0.0	Y 90 0.0	Y 91 0.0	SR 90 0.0	I 129 0.0	CS 135 0.0	PR 144 0.0	CE 141 0.0

Source 2 (air), 200 d, Power = 1 watt, Pure U-235

Table A.17

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LCCA	1	2	3	4	5	6	7	8	9	10
0 SEC.	I 134 20.1	I 132 14.0	I 135 13.6	I 136 9.9	I 137 9.7	I 138 6.5	I 133 6.0	I 136 5.6	I 139 2.7	I 131 1.6
1.0 SFC.	I 134 20.8	I 132 14.3	I 135 13.9	I 136 10.0	I 137 9.7	I 133 6.1	I 138 6.0	I 136 5.7	I 139 2.1	I 131 1.7
2.0 SEC.	I 134 20.0	I 132 14.6	I 135 14.2	I 136 10.1	I 137 9.6	I 133 6.2	I 138 5.7	I 138 5.5	I 131 1.7	I 139 1.6
5.0 SEC.	I 134 13.6	I 132 15.2	I 135 14.8	I 136 10.3	I 137 9.2	I 133 6.5	I 138 5.7	I 138 4.2	I 131 1.6	I 139 1.7
10.0 SEC.	I 134 13.0	I 132 15.9	I 135 15.4	I 136 10.3	I 137 8.3	I 133 6.8	I 138 5.6	I 138 2.6	I 131 1.6	I 139 1.2
20.0 SEC.	I 134 34.8	I 132 16.8	I 135 16.3	I 136 10.0	I 133 7.2	I 137 6.7	I 136 5.1	I 131 2.0	I 138 1.1	I 139 1.1
50.0 SEC.	I 134 38.1	I 132 18.4	I 135 17.9	I 136 8.6	I 133 7.9	I 136 3.6	I 137 3.1	I 131 2.1	XE 137	I 138 0.0
60.0 SEC.	I 134 38.8	I 132 18.8	I 135 18.3	I 136 8.1	I 133 8.1	I 136 3.2	I 137 2.4	I 131 2.2	XE 137	I 138 0.0
100.0 SFC.	I 134 40.8	I 132 19.9	I 135 19.4	I 136 8.6	I 136 8.1	I 131 2.3	I 136 1.9	I 137 0.8	XE 137	I 138 0.0
3.3 MIN.	I 134 42.9	I 132 21.1	I 135 20.8	I 133 9.2	I 136 2.9	I 131 2.5	I 136 0.5	XE 137	I 137 0.1	XE 138 0.0
8.3 MIN.	I 134 43.0	I 132 22.1	I 135 22.1	I 133 9.8	I 131 2.7	I 136 0.2	XE 137	0.0	XE 138	0.0
16.7 MIN.	I 134 41.1	I 135 23.1	I 132 22.5	I 133 10.4	I 131 2.4	XE 135	0.0	CS 138	0.0	I 136 0.0
33.3 MIN.	I 134 36.9	I 135 25.1	I 132 23.1	I 133 11.5	I 131 3.2	XE 135	0.0	XE 138	0.0	I 130 0.0
60.0 MIN.	I 134 30.5	I 135 28.2	I 132 23.8	I 133 13.3	I 131 3.7	XE 135	0.0	CS 138	0.0	XE 138 0.0
1.0 HR.	I 135 30.7	I 134 25.5	I 132 24.0	I 133 14.9	I 131 4.2	XE 135	0.0	CS 138	0.0	I 130 0.0
2.0 HR.	I 135 37.8	I 132 22.4	I 131 20.3	I 134 12.1	I 131 6.0	XE 135	1.5	XE 133	0.0	I 129 0.0
5.6 HR.	I 135 42.7	I 131 28.0	I 132 14.6	I 131 9.0	XE 135	3.5	I 134 2.0	XE 133	0.0	I 129 0.0
12.0 HR.	I 135 37.9	I 135 36.4	I 131 14.7	XE 135	7.1	I 132 3.5	XE 133	3.1	I 134 0.0	I 129 0.0
13.9 HR.	I 133 39.8	I 135 33.4	I 131 16.4	XE 135	7.8	I 132 2.2	XE 133	0.0	I 134 0.0	I 130 0.0
1.0 DAYS	I 133 45.9	I 131 25.5	I 135 18.6	XE 135	8.8	XF 133	1.0	I 132 0.2	I 129 0.0	I 130 0.0
1.2 DAYS	I 133 46.8	I 131 29.0	I 135 14.4	XF 135	6.5	XE 133	1.3	I 132 0.1	I 129 0.0	I 130 0.0
2.3 DAYS	I 131 53.9	I 131 34.0	XE 133	3.4	XE 135	3.1	I 135 1.6	I 129 0.0	I 130 0.0	I 132 0.0
4.0 DAYS	I 131 77.6	I 131 38.4	XE 133	5.6	XE 135	3.3	I 135 0.0	I 129 0.0	I 130 0.0	I 134 0.0
5.8 DAYS	I 131 80.2	XF 133	6.5	I 131 5.2	I 129 0.0	XE 135	0.0	I 135 0.0	I 130 0.0	I 134 0.0
10.0 DAYS	I 131 93.5	XE 133	6.1	I 133 3.3	I 129 0.0	LA 140	0.0	XE 135	0.0	HA 140 0.0
11.6 DAYS	I 131 94.0	XE 133	5.8	I 133 3.1	I 129 0.0	LA 140	0.0	HA 140	0.0	CE 141 0.0
23.1 DAYS	I 131 96.1	XF 133	3.7	I 129 0.2	LA 140	0.0	I 133 0.0	HA 140	0.0	CF 141 0.0
30.0 DAYS	I 131 96.9	XE 133	2.7	I 129 0.4	LA 140	0.0	HA 140	0.0	CF 141	0.0
57.9 DAYS	I 131 94.7	I 129 4.8	XF 133	0.8	LA 140	0.0	HA 140	0.0	CF 141	0.0
80.0 DAYS	I 131 93.9	I 129 5.4	XF 133	0.7	LA 140	0.0	HA 140	0.0	CF 141	0.0
115.7 DAYS	I 129 87.8	I 131 12.4	XE 133	0.0	LA 140	0.0	HA 140	0.0	CF 141	0.0
150.0 DAYS	I 129 99.3	I 131 7.7	XF 133	0.0	LA 140	0.0	CF 141	0.0	BA 140	0.0
231.4 DAYS	I 129 100.0	I 131 0.0	CF 141	0.0	LA 140	0.0	CS 135	0.0	HA 140	0.0
1.0 YRS.	I 129 100.0	CS 135	0.0	CE 141	0.0	I 131 0.0	LA 140	0.0	PR 144	0.0

Source 2 (plate out), Equilibrium, Power = 1 watt. Pure U-235

Table A.18

GREATEST CONTRIBUTORS TO RETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	I 136 16.6	I 134 16.0	I 137 15.0	I 136 11.7	I 138 10.6	I 133 8.6	I 135 7.6	I 132 6.8	I 139 4.0	I 131 1.6
1.0 SEC.	I 136 17.1	I 134 16.6	I 137 15.1	I 136 12.0	I 138 9.8	I 133 8.9	I 135 7.9	I 132 7.0	I 139 3.1	I 131 1.7
2.0 SEC.	I 136 17.5	I 134 17.0	I 137 15.1	I 136 12.1	I 138 9.2	I 133 8.1	I 135 8.1	I 132 7.2	I 139 2.4	I 131 1.7
5.0 SEC.	I 134 18.1	I 136 18.1	I 137 14.8	I 136 12.4	I 133 9.8	I 135 8.6	I 132 7.7	I 138 7.0	I 131 1.8	I 139 1.1
10.0 SEC.	I 134 19.5	I 136 18.7	I 137 13.8	I 136 12.4	I 133 10.5	I 135 9.3	I 132 8.3	I 138 4.4	I 131 1.9	I 139 1.7
20.0 SEC.	I 134 21.5	I 136 19.0	I 136 11.8	I 133 11.6	I 137 11.5	I 135 10.2	I 132 9.1	I 131 2.2	I 138 1.7	I 139 1.1
40.0 SEC.	I 134 25.4	I 136 17.4	I 133 13.8	I 135 12.2	I 132 10.8	I 136 9.2	I 137 8.9	I 131 2.6	I 137 2.2	I 139 1.2
60.0 SEC.	I 134 26.5	I 136 16.9	I 133 14.4	I 135 12.7	I 132 11.3	I 136 8.3	I 137 4.6	I 131 2.7	I 137 2.4	I 139 1.2
100.0 SEC.	I 134 29.8	I 133 16.3	I 135 14.4	I 136 13.7	I 132 12.8	I 136 5.3	I 131 3.0	I 137 2.8	I 137 1.7	I 139 1.1
3.3 MIN.	I 134 34.2	I 133 19.1	I 135 16.8	I 132 14.8	I 136 7.0	I 131 3.6	I 137 2.9	I 136 1.5	I 137 1.1	I 139 1.0
8.3 MIN.	I 134 36.6	I 133 21.7	I 135 19.0	I 132 16.5	I 131 4.1	I 137 1.2	I 136 1.7	I 137 1.1	I 138 0.8	I 139 0.8
16.7 MIN.	I 134 35.0	I 133 23.1	I 135 20.0	I 132 16.9	I 131 4.3	I 137 1.3	I 137 1.3	I 138 0.8	I 139 0.8	I 139 0.8
33.3 MIN.	I 134 30.9	I 133 25.2	I 135 21.4	I 132 17.1	I 131 4.8	I 137 1.7	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8
60.0 MIN.	I 133 28.2	I 134 24.8	I 135 23.2	I 132 17.0	I 131 5.4	I 137 1.3	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8
1.4 HR.	I 133 30.7	I 135 24.5	I 134 20.1	I 132 16.6	I 131 5.9	I 137 1.5	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8
2.8 HR.	I 133 37.7	I 135 27.3	I 132 14.0	I 134 8.6	I 131 7.6	I 137 1.5	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8
5.6 HR.	I 133 44.8	I 135 26.5	I 131 9.8	I 137 9.5	I 132 7.9	I 134 1.2	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8
12.0 HR.	I 133 49.9	I 135 18.6	I 135 15.9	I 131 13.2	I 132 1.5	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
13.9 HR.	I 133 50.6	I 135 16.8	I 135 16.4	I 131 14.2	I 132 1.1	I 138 0.8	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
1.0 DAYS	I 133 52.5	I 131 19.9	I 135 17.2	I 135 8.2	I 137 2.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
1.2 DAYS	I 133 52.6	I 131 22.3	I 135 16.2	I 135 8.3	I 137 2.6	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
2.3 DAYS	I 133 41.8	I 131 42.4	I 133 7.1	I 135 6.5	I 137 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
4.0 DAYS	I 131 66.1	I 133 20.5	I 135 12.6	I 135 6.5	I 137 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
5.6 DAYS	I 131 78.0	I 133 15.0	I 133 6.8	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
10.0 DAYS	I 131 80.8	I 133 14.6	I 133 7.4	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
11.6 DAYS	I 131 85.7	I 133 13.9	I 133 7.2	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
23.1 DAYS	I 131 90.3	I 133 9.0	I 133 7.7	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
30.0 DAYS	I 131 91.9	I 133 6.8	I 133 1.3	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
37.9 DAYS	I 131 86.8	I 133 11.4	I 133 1.8	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
60.0 DAYS	I 131 82.8	I 133 15.7	I 133 1.6	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
115.7 DAYS	I 129 95.4	I 131 4.2	I 133 0.8	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
150.0 DAYS	I 129 99.8	I 131 2.2	I 133 0.8	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
231.5 DAYS	I 129 100.0	I 133 0.8	I 131 0.8	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8
1.0 YRS.	I 129 100.0	I 133 0.8	I 131 0.8	I 137 1.2	I 135 1.1	I 132 1.1	I 139 0.8	I 139 0.8	I 139 0.8	I 139 0.8

Source 2 (plate out), Equilibrium, Power = 1 watt, Pure U-235

Table A.19

GREATEST CONTRIBUTIONS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	1 134 29.1	1 132 14.8	1 135 15.6	1 136 9.0	1 137 9.7	1 138 6.5	1 133 6.0	1 136 5.6	1 139 2.7	1 131 1.8
1.0 SEC.	1 134 29.8	1 132 14.3	1 135 15.9	1 136 10.0	1 137 9.7	1 133 6.1	1 138 6.0	1 136 5.7	1 139 2.1	1 131 1.7
2.0 SEC.	1 134 30.4	1 132 14.4	1 135 16.2	1 136 10.1	1 137 9.6	1 133 6.2	1 136 5.7	1 138 5.5	1 131 1.7	1 139 1.6
5.0 SEC.	1 134 31.6	1 132 15.2	1 135 16.8	1 136 10.3	1 137 9.2	1 133 6.5	1 136 5.1	1 138 4.2	1 131 1.6	1 139 .7
10.0 SEC.	1 134 33.0	1 132 15.9	1 135 15.4	1 136 10.3	1 137 8.3	1 133 6.8	1 136 5.6	1 138 2.6	1 131 1.8	1 139 .2
20.0 SEC.	1 134 34.8	1 132 16.8	1 135 16.3	1 136 10.0	1 137 7.2	1 137 6.7	1 136 5.1	1 131 2.0	1 138 .9	1 139 .1
40.0 SEC.	1 134 36.1	1 132 18.4	1 135 17.9	1 136 8.6	1 137 7.9	1 136 3.6	1 137 3.1	1 131 2.1	1 138 .1	1 139 .0
60.0 SEC.	1 134 38.8	1 132 18.8	1 135 18.3	1 136 8.1	1 137 8.1	1 136 3.2	1 137 2.4	1 131 2.2	1 138 .1	1 139 .0
180.0 SEC.	1 134 40.8	1 132 19.9	1 135 19.4	1 136 8.6	1 136 8.1	1 131 2.3	1 136 1.9	1 137 .8	1 138 .1	1 139 .0
5.3 MIN.	1 134 42.9	1 132 21.1	1 135 20.8	1 136 9.2	1 136 2.9	1 131 2.5	1 136 .5	1 137 .1	1 137 .1	1 138 .0
8.3 MIN.	1 134 43.0	1 132 22.1	1 135 22.1	1 136 9.6	1 131 2.7	1 136 .2	1 137 .0	1 136 .0	1 138 .0	1 139 .0
16.7 MIN.	1 134 41.3	1 135 23.1	1 132 22.5	1 136 10.4	1 131 2.8	1 136 .1	1 137 .0	1 138 .0	1 137 .0	1 136 .0
33.3 MIN.	1 134 36.9	1 135 25.1	1 132 23.1	1 136 11.5	1 131 3.2	1 136 .2	1 138 .0	1 137 .0	1 138 .0	1 139 .0
60.0 MIN.	1 134 30.5	1 135 28.2	1 132 23.8	1 136 13.3	1 131 3.7	1 136 .4	1 138 .0	1 137 .0	1 138 .0	1 139 .0
1.4 HR.	1 135 30.7	1 134 25.5	1 132 24.0	1 136 14.9	1 131 4.2	1 136 .6	1 138 .0	1 137 .0	1 138 .0	1 139 .0
2.8 HR.	1 135 27.8	1 132 22.4	1 133 20.3	1 134 12.1	1 131 6.0	1 136 1.5	1 138 .0	1 137 .0	1 138 .0	1 139 .0
5.6 HR.	1 135 46.7	1 133 28.0	1 132 14.6	1 131 4.1	1 136 3.5	1 134 2.0	1 137 .1	1 138 .0	1 139 .0	1 139 .0
12.0 HR.	1 133 57.9	1 135 36.0	1 131 16.7	1 136 7.1	1 132 3.5	1 133 .3	1 134 .0	1 138 .0	1 139 .0	1 139 .0
13.9 HR.	1 133 59.8	1 135 33.4	1 131 16.4	1 136 7.8	1 132 2.2	1 133 .4	1 134 .0	1 138 .0	1 139 .0	1 139 .0
1.0 DAYS	1 133 45.9	1 131 26.5	1 135 18.6	1 136 8.5	1 133 1.0	1 132 .2	1 130 .0	1 134 .0	1 138 .0	1 139 .0
1.2 DAYS	1 133 46.8	1 131 29.0	1 135 14.4	1 136 8.5	1 133 1.3	1 132 .1	1 130 .0	1 134 .0	1 138 .0	1 139 .0
2.3 DAYS	1 131 53.9	1 133 34.0	1 135 3.4	1 136 3.1	1 135 1.6	1 130 .0	1 132 .0	1 134 .0	1 138 .0	1 139 .0
4.0 DAYS	1 131 77.6	1 133 36.5	1 135 5.6	1 136 .3	1 135 .0	1 130 .0	1 134 .0	1 138 .0	1 139 .0	1 139 .0
5.8 DAYS	1 131 86.3	1 133 6.5	1 135 5.2	1 136 .1	1 135 .0	1 130 .0	1 134 .0	1 138 .0	1 139 .0	1 139 .0
10.0 DAYS	1 131 93.6	1 133 6.1	1 133 .3	1 134 .0	1 136 .0	1 130 .0	1 134 .0	1 138 .0	1 139 .0	1 139 .0
11.6 DAYS	1 131 94.1	1 133 5.8	1 133 .1	1 134 .0	1 136 .0	1 130 .0	1 134 .0	1 138 .0	1 139 .0	1 139 .0
23.1 DAYS	1 131 96.3	1 133 5.1	1 134 .0	1 133 .0	1 136 .0	1 129 .0	1 134 .0	1 138 .0	1 139 .0	1 139 .0
30.0 DAYS	1 131 97.3	1 133 2.7	1 134 .0	1 134 .0	1 129 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0
57.9 DAYS	1 131 99.2	1 133 .7	1 134 .0	1 134 .0	1 129 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0
60.0 DAYS	1 131 99.3	1 133 .7	1 134 .0	1 134 .0	1 129 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0
115.7 DAYS	1 131 99.0	1 133 .1	1 134 .0	1 129 .0	1 134 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0
180.0 DAYS	1 131 100.0	1 129 .0	1 134 .0	1 129 .0	1 134 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0
231.5 DAYS	1 131 80.0	1 129 10.9	1 134 .0	1 129 .0	1 133 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0
1.0 YRS.	1 129 99.0	1 135 .0	1 134 .0	1 131 .0	1 134 .0	1 134 .0	1 133 .0	1 138 .0	1 139 .0	1 139 .0

Source 2 (plate out), 250 d. Power .1 watt. Fuel U-235

Table A.20

GREATEST CONTRIBUTIONS TO BETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LINES	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	1 134 16.6	1 134 16.0	1 137 15.0	1 134 11.7	1 134 10.6	1 133 8.0	1 135 7.6	1 132 6.8	1 130 4.0	1 131 1.6
1.0 SEC.	1 134 17.1	1 134 16.6	1 137 15.1	1 134 12.0	1 134 9.8	1 133 8.9	1 135 7.9	1 132 7.0	1 130 3.1	1 131 1.7
2.0 SEC.	1 134 17.5	1 134 17.0	1 137 15.1	1 134 12.1	1 133 9.2	1 134 8.1	1 135 7.2	1 132 7.2	1 130 2.4	1 131 1.7
5.0 SEC.	1 134 18.1	1 134 18.1	1 137 14.8	1 134 12.4	1 133 9.8	1 135 8.6	1 132 7.7	1 131 7.0	1 131 1.8	1 130 1.1
10.0 SEC.	1 134 19.5	1 134 18.7	1 137 13.8	1 134 12.4	1 133 10.5	1 135 9.5	1 132 8.3	1 131 8.4	1 131 1.9	1 130 1.1
20.0 SEC.	1 134 21.5	1 134 19.0	1 134 11.8	1 133 11.6	1 137 11.5	1 135 10.2	1 132 9.1	1 131 2.2	1 134 1.7	1 130 1.1
50.0 SEC.	1 134 25.4	1 134 17.8	1 133 13.8	1 135 12.2	1 132 10.8	1 134 9.2	1 137 5.9	1 131 2.6	1 137 2.2	1 130 1.0
100.0 SEC.	1 134 26.5	1 134 18.0	1 133 14.4	1 135 12.7	1 132 11.4	1 134 8.1	1 137 4.6	1 131 2.7	1 137 2.4	1 130 1.0
100.0 SEC.	1 134 29.8	1 133 16.3	1 134 10.4	1 136 13.7	1 142 12.8	1 134 5.5	1 131 3.0	1 137 2.8	1 137 1.7	1 130 1.1
3.0 MIN.	1 134 34.2	1 133 19.1	1 135 16.8	1 132 14.8	1 134 7.0	1 131 3.2	1 137 2.6	1 136 1.5	1 137 1.1	1 130 1.0
10.0 MIN.	1 134 36.2	1 133 21.7	1 135 19.0	1 132 16.5	1 131 4.1	1 137 1.2	1 136 1.7	1 136 1.1	1 136 0.9	1 130 1.0
10.0 MIN.	1 134 35.0	1 133 21.1	1 135 20.0	1 132 16.9	1 131 4.3	1 137 1.3	1 136 1.5	1 136 1.1	1 136 0.9	1 130 1.0
33.3 MIN.	1 134 30.9	1 133 25.2	1 135 21.4	1 132 17.1	1 131 4.0	1 137 1.3	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
60.0 MIN.	1 133 28.2	1 134 20.8	1 135 23.2	1 132 17.0	1 131 5.4	1 137 1.3	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
1.0 HR.	1 133 30.7	1 135 24.5	1 134 20.1	1 132 16.6	1 131 6.0	1 137 1.3	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
2.0 HR.	1 133 37.7	1 135 27.7	1 132 14.0	1 134 8.6	1 131 7.6	1 137 1.3	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
5.0 HR.	1 133 44.8	1 135 28.5	1 131 9.8	1 137 9.5	1 132 7.0	1 134 1.2	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
10.0 HR.	1 133 49.9	1 135 18.8	1 135 15.9	1 131 13.2	1 132 1.5	1 137 1.3	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
15.0 HR.	1 133 50.8	1 135 16.8	1 135 16.4	1 131 14.2	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
1.0 DAYS	1 133 52.5	1 131 19.0	1 135 17.2	1 135 8.2	1 137 2.1	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
1.2 DAYS	1 133 52.6	1 131 22.3	1 135 16.2	1 135 8.3	1 137 2.6	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
2.3 DAYS	1 133 43.8	1 131 20.4	1 135 7.1	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
4.0 DAYS	1 133 46.2	1 131 20.5	1 135 12.7	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
5.0 DAYS	1 133 78.2	1 133 15.0	1 135 8.8	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
10.0 DAYS	1 133 85.0	1 133 14.6	1 135 4.4	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
11.0 DAYS	1 133 85.0	1 133 14.0	1 135 4.1	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
23.1 DAYS	1 133 80.9	1 133 9.1	1 134 1.0	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
10.0 DAYS	1 133 83.1	1 133 8.9	1 134 1.0	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
57.0 DAYS	1 133 87.0	1 133 2.1	1 137 1.3	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
40.0 DAYS	1 133 88.1	1 133 1.9	1 137 1.3	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
115.7 DAYS	1 133 88.8	1 133 1.2	1 137 1.3	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
150.0 DAYS	1 133 88.7	1 133 1.1	1 137 1.3	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
211.5 DAYS	1 133 88.7	1 133 1.1	1 137 1.3	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0
1.0 YRS.	1 133 88.7	1 133 1.1	1 137 1.3	1 137 1.3	1 137 1.3	1 132 1.5	1 136 1.3	1 136 1.1	1 136 0.9	1 130 1.0

Source 2 (plate out), 200 d, Power = 1 watt, Pure U-235

Table A.21

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LCCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	I 134 21.7	I 132 10.4	I 135 10.1	I 136 7.4	I 137 7.3	HR 8A 5.2	I 13A 4.4	I 133 4.5	BR 8Q 4.2	I 136 4.2
1.0 SEC.	I 134 22.8	I 132 11.0	I 135 10.7	I 136 7.7	I 137 7.4	HR 8A 5.2	I 13A 4.7	I 13A 4.6	I 136 4.4	BR 8Q 4.3
2.0 SEC.	I 134 23.7	I 132 11.4	I 135 11.1	I 136 7.9	I 137 7.5	HR 8A 5.2	I 13A 4.9	I 136 4.5	HR 87 4.4	I 138 4.3
5.0 SEC.	I 134 25.0	I 132 12.2	I 135 11.9	I 136 8.3	I 137 7.4	I 133 5.2	HR 8A 4.9	I 136 4.6	HR 87 4.6	BR 86 3.8
10.0 SEC.	I 134 27.3	I 132 13.1	I 135 12.8	I 136 8.5	I 137 6.9	I 133 5.6	HR 87 4.6	I 136 4.6	BR 88 4.2	BR 86 3.8
20.0 SEC.	I 134 28.8	I 132 14.3	I 135 14.0	I 136 8.6	I 137 6.1	I 137 5.7	BR 87 4.5	I 136 4.3	BR 86 3.7	BR 88 3.0
50.0 SEC.	I 134 34.0	I 132 16.4	I 135 16.0	I 136 7.7	I 133 7.0	HR 87 3.5	I 136 3.2	HR 86 2.9	BR 84 2.9	I 137 2.8
100.0 SEC.	I 134 34.9	I 132 16.9	I 135 16.5	I 136 7.3	I 133 7.3	HR 87 3.2	BR 84 3.0	I 136 2.9	BR 86 2.6	I 137 2.2
100.0 SEC.	I 134 37.7	I 132 18.3	I 135 17.9	I 133 7.9	I 136 5.7	HR 84 3.2	I 131 2.1	HR 87 2.1	I 136 1.8	BR 86 1.7
3.3 MIN.	I 134 40.7	I 132 20.1	I 135 19.7	I 133 8.7	HR 84 3.4	I 136 2.7	I 131 2.4	HR 87 1.7	BR 86 1.5	I 136 1.5
8.3 MIN.	I 134 41.5	I 132 21.3	I 135 21.3	I 133 9.4	HR 84 3.3	I 131 2.6	I 136 2.2	HR 87 1.0	HR 87 0.8	HR 87 0.8
16.7 MIN.	I 134 36.8	I 135 22.4	I 132 21.8	I 131 10.0	HR 84 2.9	I 131 2.8	HR 87 1.1	HR 87 0.8	HR 89 0.8	HR 88 0.8
33.3 MIN.	I 134 36.0	I 135 24.5	I 132 22.6	I 131 11.2	I 131 5.1	HR 84 2.3	HR 87 1.1	HR 87 0.8	HR 88 0.8	HR 88 0.8
60.0 MIN.	I 134 30.0	I 135 27.7	I 132 23.4	I 131 13.1	I 131 3.7	HR 84 1.5	HR 87 1.1	HR 87 0.8	HR 88 0.8	HR 88 0.8
1.4 HR.	I 135 30.4	I 134 25.2	I 132 23.7	I 131 14.8	I 131 4.2	HR 84 1.1	HR 87 1.1	HR 87 0.8	HR 88 0.8	HR 88 0.8
2.8 HR.	I 135 37.6	I 132 22.1	I 131 20.2	I 134 12.0	I 131 6.0	HR 87 1.5	HR 84 1.1	HR 87 0.8	HR 88 0.8	HR 88 0.8
5.6 HR.	I 135 42.7	I 133 28.0	I 132 14.0	I 131 4.0	HR 87 1.5	HR 84 2.0	HR 87 1.1	HR 88 0.8	HR 88 0.8	HR 88 0.8
12.0 HR.	I 133 37.9	I 135 36.4	I 131 14.7	HR 87 1.1	I 132 3.5	HR 87 1.3	I 134 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
13.0 HR.	I 133 30.4	I 135 33.4	I 131 16.4	HR 87 1.1	I 132 2.2	HR 87 1.3	I 130 0.8	HR 88 0.8	I 134 0.8	HR 88 0.8
1.0 DAYS	I 133 45.9	I 131 25.5	I 131 18.6	HR 87 1.1	HR 87 1.3	I 130 0.8	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
1.2 DAYS	I 133 46.7	I 131 20.0	I 135 14.4	HR 87 1.1	HR 87 1.3	I 130 0.8	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
2.3 DAYS	I 131 53.9	I 133 38.0	HR 87 1.1	I 135 1.6	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
4.0 DAYS	I 131 77.5	I 133 16.4	HR 87 1.1	I 135 0.8	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
5.8 DAYS	I 131 88.2	HR 87 1.1	I 133 5.2	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8	HR 88 0.8
10.0 DAYS	I 131 93.5	HR 87 1.1	I 133 5.1	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8	HR 88 0.8
11.6 DAYS	I 131 94.0	HR 87 1.1	I 133 5.1	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8	HR 88 0.8
23.1 DAYS	I 131 96.1	HR 87 1.1	I 133 3.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8	HR 88 0.8
37.0 DAYS	I 131 96.0	HR 87 1.1	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8	HR 88 0.8
50.0 DAYS	I 131 94.7	I 129 4.6	HR 87 1.1	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
100.0 DAYS	I 131 93.9	I 129 5.4	HR 87 1.1	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
115.7 DAYS	I 129 87.0	I 131 12.4	HR 87 1.1	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
150.0 DAYS	I 129 94.3	I 131 7.7	HR 87 1.1	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
231.5 DAYS	I 129 100.0	I 131 0.8	HR 87 1.1	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8
1.0 YRS.	I 129 100.0	HR 87 1.1	I 131 0.8	I 133 2.7	I 129 0.8	HR 87 1.1	I 130 0.8	HR 88 0.8	I 130 0.8	HR 88 0.8

Source ? (water), Equilibrium, Power = 1 watt, Pure U-235

Table A.22

GREATEST CONTRIBUTORS TO RETA DECAV POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	RR BR 12.1	I 136 9.6	HQ BR 8.5	I 134 8.2	I 137 7.7	HQ BR 7.3	RR BR 7.1	I 136 6.0	I 138 5.4	BR BR 4.8
1.0 SEC.	RR BR 12.6	I 136 9.2	I 136 9.0	I 137 8.2	RR BR 7.9	I 136 7.9	I 136 6.5	I 138 5.3	RR BR 5.0	I 133 4.8
2.0 SEC.	RR BR 12.8	I 136 9.1	I 136 9.5	I 137 8.5	RR BR 7.3	I 136 7.3	I 136 6.8	I 133 5.1	I 138 5.1	I 135 4.5
5.0 SEC.	RR BR 12.8	I 136 10.4	I 136 10.4	RR BR 9.1	I 137 8.9	I 136 7.4	I 133 5.8	RR BR 5.2	I 135 5.2	I 132 4.6
10.0 SEC.	I 134 12.4	I 136 11.9	RR BR 11.8	RR BR 9.8	I 137 8.8	I 136 7.9	I 133 6.7	I 135 5.9	I 132 5.5	RR BR 3.5
20.0 SEC.	I 134 14.7	I 136 13.0	RR BR 10.2	RR BR 9.0	I 136 8.1	I 133 7.9	I 137 7.9	I 135 7.0	I 132 6.2	RR BR 3.6
50.0 SEC.	I 134 19.1	I 136 13.2	I 133 10.3	RR BR 9.2	I 135 9.1	I 132 8.1	I 136 6.9	I 137 4.8	RR BR 4.8	RR BR 3.9
AR.0 SEC.	I 136 26.2	I 136 12.9	I 133 11.0	I 135 9.7	RR BR 8.7	I 132 8.6	I 136 6.3	RR BR 4.8	RR BR 3.9	I 137 3.5
100.0 SEC.	I 136 25.9	I 133 11.1	I 135 11.4	I 136 11.0	I 132 10.2	RR BR 8.3	RR BR 6.3	I 136 4.8	RR BR 4.0	I 131 2.6
5.0 MIN.	I 134 20.3	I 133 16.4	I 135 14.0	I 132 12.7	RR BR 8.0	I 136 8.0	RR BR 5.3	I 131 7.0	RR BR 2.3	RR BR 2.3
10.0 MIN.	I 134 22.9	I 133 19.8	I 135 17.1	I 132 16.8	RR BR 7.0	I 131 5.7	RR BR 4.2	RR BR 1.1	RR BR 1.1	I 131 1.1
15.0 MIN.	I 134 22.2	I 133 21.2	I 135 18.4	I 132 15.5	RR BR 6.4	I 131 4.0	RR BR 3.3	RR BR 1.2	RR BR 1.2	RR BR 1.2
33.3 MIN.	I 134 26.9	I 133 23.5	I 135 20.0	I 132 15.9	RR BR 5.0	I 131 4.4	RR BR 3.1	RR BR 1.2	RR BR 1.2	RR BR 1.2
40.0 MIN.	I 133 26.0	I 134 23.6	I 135 22.1	I 132 16.2	I 131 5.1	RR BR 3.2	RR BR 1.3	RR BR 1.3	RR BR 1.3	RR BR 1.3
1.0 HR.	I 133 29.6	I 135 23.8	I 134 19.3	I 132 16.0	I 131 5.7	RR BR 2.2	RR BR 1.9	RR BR 1.3	RR BR 1.3	RR BR 1.3
2.0 HR.	I 133 37.0	I 135 26.8	I 132 13.8	I 130 8.5	I 131 7.5	RR BR 4.5	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
5.0 HR.	I 133 44.0	I 135 26.3	I 131 9.7	RR BR 13.5	I 132 7.8	I 134 1.2	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
12.0 HR.	I 133 49.8	I 135 18.5	RR BR 15.9	I 131 13.2	I 132 1.5	RR BR 1.3	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
13.0 HR.	I 133 50.5	RR BR 16.8	I 135 16.4	I 131 14.2	RR BR 1.3	I 132 1.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
1.0 DAYS	I 133 52.5	I 131 19.0	RR BR 17.2	I 135 16.2	RR BR 1.3	I 132 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
1.2 DAYS	I 133 52.6	I 131 22.3	RR BR 16.2	I 135 16.3	RR BR 1.3	I 129 2.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
2.3 DAYS	I 133 43.7	I 131 42.4	RR BR 13.1	RR BR 13.5	I 129 7.1	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
4.0 DAYS	I 131 44.1	I 133 20.5	RR BR 12.4	RR BR 13.5	I 129 6.1	I 131 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
5.4 DAYS	I 131 74.0	RR BR 13.5	I 133 6.8	I 129 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
10.0 DAYS	I 131 84.8	RR BR 13.4	I 133 4.1	I 129 2.2	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
11.4 DAYS	I 131 85.7	RR BR 13.3	I 129 2.2	I 133 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
23.1 DAYS	I 131 90.3	RR BR 13.3	I 129 2.2	I 133 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
30.0 DAYS	I 131 91.0	RR BR 13.3	I 129 2.2	I 133 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
47.0 DAYS	I 131 91.0	RR BR 13.3	I 129 2.2	I 133 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
AR.0 DAYS	I 131 92.7	I 129 15.6	RR BR 13.1	RR BR 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
115.7 DAYS	I 129 95.8	I 131 4.1	RR BR 13.1	RR BR 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
150.0 DAYS	I 129 99.7	I 131 2.0	RR BR 13.1	RR BR 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
211.5 DAYS	I 129 100.0	RR BR 1.1	RR BR 13.1	RR BR 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1
1.0 YRS.	I 129 100.0	RR BR 1.1	RR BR 13.1	RR BR 1.1	RR BR 1.1	I 135 0.0	RR BR 1.1	RR BR 1.1	RR BR 1.1	RR BR 1.1

Source 2 (water), Equilibrium, Power = 1 watt, Pure U-235

Table A.23

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10							
0 SEC.	1 134 21.7	1 132 10.4	1 135 10.1	1 136 7.4	1 137 7.3	RR RR	5.2	1 138 4.9	1 133 4.5	RR RR	4.2	1 136 4.2					
1.0 SEC.	1 134 22.8	1 132 11.0	1 135 10.7	1 136 7.7	1 137 7.4	RR RR	5.2	1 133 4.7	1 130 4.6	1 136 4.4	RR RR	4.3					
2.0 SEC.	1 134 23.7	1 132 11.4	1 134 11.1	1 136 7.9	1 137 7.5	RR RR	5.2	1 133 4.9	1 136 4.5	RR RR	4.4	1 136 4.5					
5.0 SEC.	1 134 25.4	1 132 12.2	1 135 11.9	1 136 8.3	1 137 7.6	1 133 5.2	RR RR	4.9	1 136 4.6	RR RR	4.6	RR RR	4.6				
10.0 SEC.	1 134 27.3	1 132 13.1	1 135 12.8	1 136 8.5	1 137 6.9	1 133 5.6	RR RR	4.6	1 136 4.6	RR RR	4.6	RR RR	4.6				
20.0 SEC.	1 134 29.8	1 132 14.3	1 135 14.0	1 136 8.6	1 133 6.1	1 137 5.7	RR RR	4.5	1 136 4.3	RR RR	4.3	RR RR	4.3				
50.0 SEC.	1 134 30.2	1 132 16.4	1 135 16.0	1 136 7.7	1 133 7.0	RR RR	3.5	1 136 3.2	RR RR	2.9	RR RR	2.9	RR RR	2.9			
100.0 SEC.	1 134 31.7	1 132 18.3	1 135 17.9	1 136 7.4	1 133 7.3	RR RR	3.2	RR RR	3.0	1 136 2.9	RR RR	2.6	RR RR	2.6			
3.3 MIN.	1 134 40.7	1 132 20.1	1 135 19.7	1 133 8.7	RR RR	3.4	1 136 2.7	1 131 2.4	RR RR	2.1	RR RR	1.8	RR RR	1.7			
8.3 MIN.	1 134 41.5	1 132 21.3	1 135 21.3	1 133 9.4	RR RR	3.3	1 131 2.6	1 136 2.2	RR RR	2.0	RR RR	1.5	RR RR	1.5			
16.7 MIN.	1 134 39.8	1 135 22.4	1 132 21.8	1 133 10.0	RR RR	2.9	1 131 2.8	RR RR	1.1	RR RR	0.9	RR RR	0.8	RR RR	0.8		
33.3 MIN.	1 134 36.0	1 135 24.5	1 132 22.6	1 133 11.2	1 131 5.1	RR RR	2.3	RR RR	1.2	RR RR	0.8	RR RR	0.7	RR RR	0.7		
60.0 MIN.	1 134 36.0	1 135 27.7	1 132 23.4	1 133 13.1	1 131 3.7	RR RR	1.5	RR RR	0.4	RR RR	0.3	RR RR	0.3	RR RR	0.3		
1.0 HR.	1 134 30.4	1 134 25.2	1 132 23.7	1 133 14.8	1 131 4.2	RR RR	1.1	RR RR	0.6	RR RR	0.4	RR RR	0.3	RR RR	0.3		
2.0 HR.	1 134 37.6	1 132 22.3	1 133 20.2	1 134 12.1	1 131 6.0	RR RR	1.5	RR RR	0.2	RR RR	0.1	RR RR	0.1	RR RR	0.1		
5.6 HR.	1 135 42.7	1 133 28.0	1 132 14.6	1 131 9.0	RR RR	3.5	1 134 2.0	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0		
12.0 HR.	1 133 37.9	1 135 16.4	1 131 14.7	RR RR	1.1	RR RR	0.3	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0		
13.9 HR.	1 133 39.8	1 135 13.4	1 131 10.4	RR RR	0.8	RR RR	0.2	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0		
1.0 DAYS	1 133 45.9	1 131 25.5	1 135 18.6	RR RR	0.8	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0		
1.2 DAYS	1 133 46.8	1 131 24.0	1 135 14.4	RR RR	0.5	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0		
2.3 DAYS	1 131 53.9	1 133 38.0	RR RR	0.5	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	
4.0 DAYS	1 131 77.6	1 133 19.5	RR RR	0.5	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	
5.8 DAYS	1 131 88.3	RR RR	0.5	RR RR	0.2	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
10.0 DAYS	1 131 93.6	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
11.6 DAYS	1 131 94.1	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
23.1 DAYS	1 131 96.3	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
30.0 DAYS	1 131 97.1	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
57.9 DAYS	1 131 98.2	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
100.0 DAYS	1 131 98.3	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
115.7 DAYS	1 131 98.4	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
150.0 DAYS	1 131 98.4	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
281.5 DAYS	1 131 72.5	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0
1.0 YRS.	1 129 66.7	RR RR	0.1	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0	RR RR	0.0

Source 2 (water), 200 d, Power = 1 watt, Pure U-235

Table A.24

GREATEST CONTRIBUTORS TO BETA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LCCA	1	2	3	4	5	6	7	8	9	10
0.0 SEC.	BR 88 12.8	I 136 8.6	HR 89 8.5	I 134 8.2	I 137 7.7	BR 87 7.3	BR 90 7.1	I 136 6.0	I 138 5.4	BR 86 4.6
1.0 SEC.	BR 88 12.8	I 136 9.2	I 131 9.0	I 137 8.2	HR 89 8.0	HR 87 7.9	I 136 6.5	I 138 5.3	BR 90 5.0	I 133 4.8
2.0 SEC.	BR 88 12.8	I 136 9.8	I 134 9.5	I 137 6.5	HR 87 8.3	HR 89 7.3	I 136 6.8	I 133 5.1	I 138 5.1	I 135 4.5
5.0 SEC.	BR 88 12.8	I 134 10.0	HR 87 9.1	I 137 8.9	I 136 7.4	I 133 5.8	BR 89 5.2	I 135 5.2	I 132 4.6	
10.0 SEC.	I 134 12.4	I 136 11.9	HR 88 11.8	HR 87 9.8	I 137 8.8	I 136 7.9	I 133 6.7	I 135 5.9	I 132 5.3	BR 86 3.5
20.0 SEC.	I 134 14.7	I 136 13.0	HR 87 10.2	BR 88 9.0	I 136 8.1	I 133 7.9	I 137 7.9	I 135 7.0	I 132 6.2	HR 86 3.6
50.0 SEC.	I 134 19.1	I 136 13.2	I 133 10.4	HR 87 9.2	I 135 9.1	I 132 8.1	I 136 6.9	I 137 4.4	BR 84 4.4	HR 86 3.9
80.0 SEC.	I 134 20.2	I 136 12.9	I 133 11.0	I 135 9.7	HR 87 8.6	I 132 8.6	I 136 6.3	HR 84 4.6	BR 85 3.9	I 137 3.5
100.0 SEC.	I 134 23.0	I 133 13.1	I 135 11.5	I 136 11.0	I 132 10.2	BR 87 6.3	BR 84 5.4	I 136 4.2	HR 85 4.0	I 131 2.4
3.4 MIN.	I 134 20.3	I 133 16.4	I 135 14.4	I 132 12.7	HR 84 6.6	I 136 6.0	BR 85 3.3	I 131 3.0	BR 87 2.3	XE 137 2.3
8.3 MIN.	I 134 32.0	I 133 19.6	I 135 17.1	I 132 10.9	BR 84 7.0	I 131 3.7	HR 85 1.2	BR 83 1.1	XE 137 1.1	I 136 .6
16.7 MIN.	I 134 32.2	I 133 21.2	I 135 18.4	I 132 15.5	HR 84 6.4	I 131 4.0	BR 83 1.2	XE 135 .3	XE 137 .3	HR 87 .2
33.3 MIN.	I 134 28.0	I 133 23.5	I 135 20.0	I 132 15.9	HR 84 5.0	I 131 4.4	HR 83 1.2	XE 135 .6	HR 87 .2	BR 86 .0
80.0 MIN.	I 133 26.9	I 134 23.6	I 135 22.1	I 132 16.2	I 131 5.1	HR 84 3.2	XE 135 1.3	HR 83 1.3	HR 87 .2	BR 88 .1
1.4 HR.	I 133 29.6	I 135 23.6	I 134 19.3	I 132 16.0	I 131 5.7	BR 84 2.2	XE 135 1.9	HR 83 1.3	HR 87 .2	HR 88 .1
2.8 HR.	I 133 37.1	I 135 26.6	I 132 13.6	I 134 6.5	I 131 7.5	XE 135 4.5	BR 83 1.1	HR 84 .5	XE 133 .1	HR 87 .1
5.6 HR.	I 133 46.4	I 135 26.3	I 131 9.7	XE 135 9.4	I 132 7.8	I 134 1.2	BR 81 .7	XE 133 .3	HR 88 .0	HR 87 .0
12.0 HR.	I 133 40.8	I 135 18.4	XF 135 15.9	I 131 13.7	I 132 1.5	XE 133 .9	HR 83 .1	HR 85 .0	HR 86 .0	I 134 .0
13.9 HR.	I 133 50.5	XF 135 16.8	I 135 16.4	I 131 14.2	XF 133 1.0	I 132 .9	HR 83 .1	HR 85 .0	HR 86 .0	I 134 .0
1.0 DAYS	I 133 52.5	I 131 19.9	XF 135 17.2	I 135 8.2	XE 133 2.1	I 132 .1	HR 83 .0	HR 85 .0	HR 86 .0	I 130 .0
1.2 DAYS	I 133 52.6	I 131 22.3	XE 135 16.2	I 135 6.3	XF 133 2.6	I 132 .0	HR 83 .0	HR 85 .0	I 130 .0	HR 82 .0
2.3 DAYS	I 133 41.4	I 131 42.4	XF 133 7.1	XF 135 .0	I 135 .7	HR 82 .0	I 130 .3	HR 85 .0	HR 86 .0	I 132 .0
4.0 DAYS	I 131 66.2	I 133 20.5	XF 133 12.7	XF 135 .6	I 135 .0	HR 82 .0	SR 89 .0	I 130 .0	LA 140 .0	BA 140 .0
5.4 DAYS	I 131 78.2	XF 133 15.0	I 133 6.8	XF 135 .0	HR 82 .0	I 135 .0	SR 89 .0	LA 140 .0	HR 85 .0	
10.0 DAYS	I 131 85.0	XE 133 14.6	I 133 .4	SR 89 .0	HR 82 .0	XE 135 .0	LA 140 .0	HR 85 .0	BA 140 .0	Y 91 .0
11.6 DAYS	I 131 85.9	XE 133 14.0	I 131 .1	SR 89 .0	HR 82 .0	LA 140 .0	HR 85 .0	Y 91 .0	CS 137 .0	
23.1 DAYS	I 131 91.9	XE 133 9.1	SR 89 .0	HR 85 .0	Y 91 .0	LA 140 .0	CS 137 .0	BA 140 .0	Y 90 .0	
30.0 DAYS	I 131 91.1	XF 133 6.9	SR 89 .0	HR 85 .0	Y 91 .0	CS 137 .0	LA 140 .0	Y 90 .0	HA 140 .0	I 129 .0
57.9 DAYS	I 131 97.9	XF 133 2.1	SR 89 .0	HR 85 .0	Y 91 .0	CS 137 .0	LA 140 .0	Y 90 .0	HA 140 .0	I 129 .0
80.0 DAYS	I 131 98.1	XF 133 1.9	SR 89 .0	HR 85 .0	Y 91 .0	CS 137 .0	LA 140 .0	Y 90 .0	HA 140 .0	I 129 .0
115.7 DAYS	I 131 98.6	SR 89 1.4	XE 133 .2	HR 85 .1	CS 137 .1	Y 91 .0	Y 90 .0	I 129 .0	SR 40 .0	LA 140 .0
150.0 DAYS	I 131 85.8	SR 89 10.3	HR 85 2.3	CS 137 1.0	Y 91 .4	Y 90 .2	I 129 .1	SR 40 .1	XE 133 .0	CS 135 .0
211.5 DAYS	SR 89 48.5	HR 85 11.4	CS 137 13.6	Y 90 2.1	Y 91 1.9	I 131 1.1	I 129 .1	SR 40 .4	CS 135 .1	CF 141 .0
1.0 YRS.	HR 85 54.6	CS 137 24.0	SR 89 14.5	Y 90 3.7	I 129 1.5	SR 90 .8	Y 91 .7	CS 135 .2	CF 141 .0	I 131 .0

Source 2 (water), 200 d, Power = 1 watt, Pure U-235

Table A.25
GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10																								
0 SEC	I 134 3.3 RR 01 2.6 CS 13A 2.5 LA 142 2.5 LA 140 2.3 RR 90 2.1 CS 140 2.1 RR 89 1.8 LA 144 1.7 KR 89 1.6	I 130 3.5 RR 01 2.8 CS 13A 2.7 LA 142 2.7 LA 140 2.5 RB 90 2.3 CS 140 2.2 RR 89 2.0 LA 144 1.9 KR 89 1.7	I 130 3.7 RR 01 2.9 CS 13A 2.8 LA 142 2.8 LA 140 2.6 RB 90 2.3 CS 140 2.3 RR 89 2.1 LA 144 1.9 KR 89 1.6	I 134 4.0 RR 01 3.1 CS 13A 3.1 LA 142 3.0 LA 140 2.8 RB 90 2.5 CS 140 2.5 RR 89 2.2 LA 144 2.0 KR 89 1.9	I 134 4.3 CS 13A 3.3 LA 142 3.3 RR 91 3.2 LA 140 3.0 RB 90 2.7 CS 140 2.6 RB 89 2.4 LA 144 2.1 I 132 2.0	I 134 4.7 CS 13A 3.6 LA 142 3.6 LA 140 3.3 RR 91 3.2 RR 89 2.9 RR 89 2.6 CS 140 2.6 I 132 2.2 I 135 2.2	I 134 5.0 CS 13A 4.2 LA 142 4.2 LA 140 3.8 RR 90 3.2 RR 89 3.0 RR 91 2.6 I 132 2.6 I 135 2.5 CS 140 2.3	I 134 5.6 CS 13A 4.3 LA 142 4.3 LA 140 4.0 RR 90 3.2 RR 89 3.1 I 132 2.7 I 135 2.6 RR 91 2.4 SR 93 2.3	I 134 6.2 CS 13A 4.8 LA 142 4.8 LA 140 4.0 RB 89 3.4 RB 90 3.1 I 132 3.0 I 135 2.9 SR 92 2.5 KR 88 2.5	I 130 7.2 LA 142 5.5 CS 13A 5.5 LA 140 5.1 RB 89 3.9 I 132 3.5 I 135 3.3 SR 92 2.9 KR 88 2.9 RR 90 2.4	I 130 8.5 LA 142 6.5 CS 13A 6.4 LA 140 6.1 I 132 4.2 I 135 4.0 RB 89 4.0 SR 92 3.4 KR 88 3.4 TE+133 2.3	I 134 9.6 LA 142 7.3 LA 140 7.1 CS 13A 6.9 I 132 4.8 I 135 4.6 KR 88 3.8 SR 92 3.8 RB 89 3.3 NB 95 2.5	I 134 10.7 LA 140 8.5 LA 142 8.0 CS 13A 6.6 I 132 5.8 I 135 5.3 KR 88 4.2 SR 92 4.2 NB 95 3.0 ZR 95 2.9	I 134 11.0 LA 140 10.0 LA 142 8.1 I 132 7.1 I 135 6.2 CS 13A 5.0 KR 88 4.6 SR 92 4.6 NB 95 4.0 CS 138 3.6	I 140 11.8 I 134 10.3 I 132 7.7 I 135 7.7 KR 88 4.6 SR 92 4.7 RR 95 4.2 ZR 95 4.3 NB 97 4.2	I 140 15.0 I 132 10.4 I 134 8.1 NB 95 5.5 LA 142 5.4 ZR 95 5.3 KR 88 4.4 SR 92 4.3 NB 97 4.2	I 140 19.9 I 132 13.2 I 134 7.4 NB 95 7.1 ZR 95 6.8 I 133 4.9 RR 97 4.9 SR 91 3.9 KR 88 2.9 SR 92 2.7	I 140 24.8 I 132 15.7 RR 95 8.8 ZR 95 8.5 I 133 5.0 NB 97 4.7 I 135 4.7 SR 91 3.1 RU 103 2.7 CE 143 2.5	I 140 25.8 I 132 16.0 RR 95 9.2 ZR 95 8.8 I 133 4.9 NB 97 4.6 I 135 4.0 RU 103 2.8 SR 91 2.8 CE 143 2.5	I 140 29.5 I 132 16.9 RR 95 10.6 ZR 95 10.1 I 133 4.9 NB 97 3.5 RU 103 3.2 NB 97 2.6 I 131 2.2	I 140 30.6 I 132 16.0 RR 95 11.0 ZR 95 10.4 I 133 3.7 RU 103 3.3 NB 97 3.1 RA 140 2.9 I 131 2.2 CE 143 2.2	I 140 35.3 I 132 15.7 RR 95 13.1 ZR 95 12.3 RU 103 3.9 RA 140 3.2 I 131 2.4 TE 132 1.8 I 133 1.7 MD 99 1.7	I 140 38.3 RR 95 15.1 ZR 95 13.9 I 132 12.7 RU 103 4.6 RA 140 3.4 I 131 2.4 TE 132 1.5 MD 99 1.5 NE 133 1.2	I 140 39.5 RR 95 16.9 ZR 95 15.3 I 132 9.7 RU 103 4.8 RA 140 3.4 I 131 2.4 CE 141 1.3 TE 132 1.1 NE 133 1.1	I 140 39.2 RR 95 20.7 ZR 95 18.1 RU 103 5.4 I 132 9.9 RA 140 3.4 I 131 2.0 CE 141 1.4 TE 133 1.0 PR 144 1.7	I 140 38.4 RR 95 22.0 ZR 95 18.9 RU 103 5.6 I 132 7.3 BA 140 3.3 I 131 1.9 CE 141 1.5 PR 144 1.7 TE 133 1.7	RR 95 10.4 LA 140 29.4 ZR 95 24.0 RU 103 6.6 RA 140 2.5 CE 141 1.7 PR 144 1.0 I 131 1.0 CE 144 1.0 RM 106 1.5	RR 95 34.7 ZR 95 26.1 LA 140 23.8 RU 103 6.9 RA 140 2.0 CE 141 1.7 PR 144 1.2 CE 144 1.1 I 131 1.0 RM 106 1.6	RR 95 47.0 ZR 95 30.8 LA 140 8.3 RU 103 6.6 PR 144 1.7 CE 141 1.6 CE 141 1.5 RM 106 1.6 BA 140 1.7 EU 152 1.2	RR 95 47.6 ZR 95 30.7 LA 140 7.6 RU 103 6.6 PR 144 1.8 CE 144 1.7 CE 141 1.4 RM 106 1.6 BA 140 1.6 EU 152 1.2	RR 95 55.5 ZR 95 30.4 RU 103 6.4 PR 144 2.8 CE 144 2.6 RM 106 1.4 CE 141 1.8 LA 140 1.7 EU 152 1.3 SB 125 1.3	RR 95 56.3 ZR 95 29.1 PR 144 3.5 RU 103 3.1 CE 142 3.3 RM 106 1.8 CE 141 1.5 EU 152 1.4 SB 125 1.4 SR 126 1.3	RR 95 53.8 ZR 95 25.6 PR 144 6.0 CE 144 5.6 RM 106 3.1 RU 103 1.7 EU 152 1.8 SB 125 1.7 SR 126 1.7 ZR 93 1.6	RR 95 18.5 ZR 95 18.0 PR 144 12.5 CE 144 11.6 RM 106 7.1 EU 152 2.3 SR 126 2.0 SR 125 1.9 ZR 93 1.8 SB 126 1.8

Source 7 (All Fission Products), Equilibrium, Power = 1 watt, Pure U-235

GREATEST CONTRIBUTORS TO H₂TA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCAL	1	2	3	4	5	6	7	8	9	10
0.0 SFC.	RR 02 2.6	Y 0A 2.2	CS 100 1.4	XE 137 1.7	CS 139 1.7	Y 05 1.7	Y 04 1.7	Y 07 1.7	NR 90 1.7	SR 95 1.6
1.0 SFC.	RR 02 2.5	Y 0A 2.0	CS 100 1.0	XE 137 1.4	CS 139 1.9	Y 05 1.9	Y 04 1.9	NR 98 1.6	SR 95 1.8	XE 139 1.5
2.0 SFC.	Y 0A 2.6	RA 02 2.4	CS 139 2.0	XE 137 2.0	CS 140 2.0	Y 05 2.0	Y 04 2.0	NR 98 1.9	SR 95 1.8	XE 139 1.6
5.0 SFC.	Y 0A 2.8	CS 139 2.2	XF 137 2.2	Y 05 2.2	CS 140 2.2	Y 04 2.2	NR 98 2.0	SR 95 1.8	SR 92 1.7	
10.0 SEC.	Y 0A 3.1	CS 139 2.5	Y 05 2.4	XF 137 2.4	Y 04 2.4	CS 140 2.5	NR 98 2.0	Y 02 1.9	CS 138 1.6	SR 95 1.8
20.0 SFC.	Y 0A 3.3	CS 139 2.8	Y 05 2.4	XF 137 2.7	CS 140 2.5	Y 02 2.2	CS 138 2.0	NR 90 1.9	NR 90 1.9	
40.0 SFC.	Y 0A 3.4	CS 139 3.3	Y 04 3.3	Y 05 3.2	XF 137 3.0	Y 02 2.6	CS 138 2.5	CS 140 2.3	PB 88 2.2	Y 01 2.2
60.0 SFC.	Y 0A 3.4	CS 139 3.4	CS 139 3.4	Y 05 3.1	XE 137 3.1	Y 02 3.0	CS 138 2.6	RR 88 2.3	Y 01 2.3	RR 90 2.1
100.0 SFC.	Y 0A 3.7	CS 139 3.6	Y 05 3.4	Y 05 3.1	XF 137 3.1	Y 01 3.0	CS 138 2.7	RR 88 2.6	Y 01 2.6	RR 90 2.4
3.3 MTN.	Y 0A 2.2	CS 139 3.4	Y 05 3.4	Y 02 3.5	CS 138 3.1	Y 01 3.4	NR 88 1.9	PR 104 2.6	XE 137 2.2	LA 141 2.4
8.3 MTN.	Y 02 4.4	Y 04 0.3	CS 114 4.0	Y 01 3.6	RR 88 3.7	PR 144 4.4	Y 05 3.4	CS 150 4.2	LA 141 2.9	HA 139 3.4
16.7 MTN.	Y 02 5.1	Y 03 4.4	NR 88 4.4	CS 138 4.4	PR 144 4.1	Y 04 3.8	LA 141 3.4	HA 139 5.2	Y 00 3.2	LA 142 3.2
33.3 MTN.	Y 02 6.0	Y 03 5.2	RR 88 5.0	PR 144 4.9	CS 138 4.4	Y 00 4.6	LA 141 4.0	Y 00 3.9	BA 139 3.5	LA 142 3.5
60.0 MTN.	Y 02 7.2	Y 03 6.0	PR 144 5.8	RR 88 5.4	Y 00 4.6	LA 141 4.4	ZP 97 3.4	LA 142 3.0	BA 135 3.4	I 134 3.3
1.4 HR.	Y 02 7.7	Y 03 6.4	PR 144 6.3	RR 88 5.4	Y 00 5.1	LA 141 4.5	ZP 97 3.7	Y 01 3.3	SP 91 3.2	LA 142 3.1
2.8 HR.	Y 02 8.4	PR 144 7.6	Y 03 7.0	Y 00 6.1	RR 88 4.7	LA 141 4.5	ZP 97 4.1	Y 01 4.0	LA 140 3.6	SR 91 3.5
5.6 HR.	PR 144 8.2	Y 00 7.6	Y 00 7.4	Y 03 7.0	Y 01 5.6	ZP 97 4.5	LA 140 4.4	SR 90 3.8	SR 91 3.5	I 133 3.2
12.0 HR.	PR 144 11.8	Y 00 9.4	Y 01 6.1	Y 03 5.8	LA 140 5.9	ZP 97 4.8	Y 02 3.6	NR 90 3.7	Y 02 3.6	I 132 3.5
13.9 HR.	PR 144 12.4	Y 00 9.9	Y 01 6.4	LA 140 5.9	Y 03 5.7	SR 89 5.0	ZP 97 4.3	NR 90 3.7	I 132 3.6	PA 142 3.5
1.0 DAYS	PR 144 14.6	Y 00 11.7	Y 01 7.4	LA 140 6.0	SP 89 5.9	PR 143 4.1	I 132 3.9	NR 90 3.9	BA 140 3.6	ZP 97 3.7
1.2 DAYS	PR 144 15.3	Y 00 12.2	Y 01 7.9	LA 140 6.2	SP 89 6.2	PR 143 4.2	I 132 4.0	NR 90 3.9	BA 140 3.7	CE 103 3.5
2.1 DAYS	PR 144 18.0	Y 00 14.4	Y 01 9.2	LA 140 6.2	SP 89 7.2	PR 143 4.8	BA 140 4.1	I 132 3.7	NR 90 3.5	SR 90 3.1
4.0 DAYS	PR 144 19.8	Y 00 16.6	Y 01 10.0	LA 140 6.5	SP 89 7.8	PR 143 5.0	BA 140 4.1	SR 90 3.6	CS 137 4.2	I 132 2.8
5.4 DAYS	PR 144 21.0	Y 00 17.0	Y 01 10.4	LA 140 6.4	SP 89 8.1	PR 143 4.9	BA 140 4.0	SR 90 3.6	CS 137 3.4	CE 141 2.6
10.0 DAYS	PR 144 22.9	Y 00 16.8	Y 01 11.0	SP 89 8.4	LA 140 7.4	PR 143 4.4	SP 90 4.0	CS 137 3.7	RA 140 3.5	CE 141 2.6
11.6 DAYS	PR 144 23.5	Y 00 19.3	Y 01 11.1	SP 89 8.5	LA 140 7.0	NR 143 4.2	SP 90 4.1	CS 137 3.6	HA 140 3.3	CE 141 2.4
21.6 DAYS	PR 144 26.5	Y 00 22.4	Y 01 11.2	SP 89 8.4	SP 90 5.1	CS 137 4.4	LA			
30.0 DAYS	PR 144 27.5	Y 00 22.4	Y 01 11.2	SP 89 8.4	SP 90 5.1	CS 137 4.4	LA			
37.9 DAYS	PR 144 28.5	Y 00 22.4	Y 01 11.2	SP 89 8.4	SP 90 5.1	CS 137 4.4	LA			
57.9 DAYS	PR 144 30.9	Y 00 26.2	Y 01 9.2	SP 89						
60.0 DAYS	PR 144 30.9	Y 00 26.5	Y 01 9.2	SP 89						
115.7 DAYS	Y 00 34.1	PR 144 32.4	SP 90 7.2	CS 137 6.6	Y 01 5.7	SR 89 3.8	HA 104 2.6	CF 140 2.1	ZP 95 1.4	NR 95 0.9
150.0 DAYS	Y 00 36.8	PR 144 32.2	SP 90 7.8	CS 157 7.1	Y 01 4.1	HM 108 2.9	SR 89 2.6	CE 144 2.1	ZP 95 1.0	PH 147 0.9
231.5 DAYS	Y 00 01.8	PR 144 30.2	SP 89 8.9	CS 137 6.3	RM 106 2.8	CF 144 2.0	Y 01 1.8	SP 90 1.0	PH 147 0.9	KR 85 0.5
1.0 YRS.	Y 00 07.7	PR 144 25.1	SP 90 10.1	CS 137 9.5	RM 106 2.5	CE 144 1.7	PH 147 1.0	KR 85 0.6	Y 01 0.4	CS 135 0.5

Source 7 (All Fission Products), Equilibrium, Power = 1 watt, Pure U-235

Table A.27

GREATEST CONTRIBUTORS TO GAMMA DECAY POWER (PERCENT OF TOTAL)

TIME AFTER LOCA	1	2	3	4	5	6	7	8	9	10																								
0 SEC.	I 134 3,3 RB 91 2,6 CS 13A 2,5 LA 142 2,5 LA 140 2,3 RB 90 2,1 CS 140 2,1 RB 89 1,8 LA 144 1,7 KR 89 1,6	I 134 3,5 RB 91 2,8 CS 13A 2,7 LA 142 2,7 LA 140 2,5 RB 90 2,3 CS 140 2,2 RB 89 2,0 LA 144 1,9 KR 89 1,7	I 134 3,7 RB 91 2,9 CS 13A 2,9 LA 142 2,8 LA 140 2,6 RB 90 2,4 CS 140 2,3 RB 89 2,1 LA 144 1,9 KR 89 1,6	I 134 4,0 RB 91 3,1 CS 13A 3,1 LA 142 3,1 LA 140 2,8 RB 90 2,5 CS 140 2,5 RB 89 2,2 LA 144 2,0 KR 89 1,9	I 134 4,3 CS 13A 3,3 LA 142 3,3 RB 91 3,2 LA 140 3,0 RB 90 2,7 CS 140 2,6 RB 89 2,4 LA 144 2,1 I 132 2,1	I 134 4,7 CS 13A 3,6 LA 142 3,6 LA 140 3,3 RB 91 3,2 RB 90 2,7 CS 140 2,6 I 132 2,0 I 135 2,2	I 134 5,3 CS 13A 4,2 LA 142 4,2 LA 140 3,9 RB 90 3,2 RB 89 3,1 RB 91 2,6 I 132 2,0 I 135 2,3	I 134 5,7 CS 13A 4,6 LA 142 4,6 LA 140 4,0 RB 90 3,2 RB 89 3,2 I 132 2,7 I 135 2,6 RB 91 2,4 SR 93 2,3	I 134 6,3 CS 13A 4,8 LA 142 4,8 LA 140 4,4 RB 90 3,5 RB 90 3,1 I 132 3,0 I 135 2,9 SR 92 2,5 KR 88 2,5	I 134 7,2 LA 142 5,6 CS 13A 5,6 LA 140 5,1 RB 89 3,9 I 132 3,5 I 135 3,4 SR 92 2,9 KR 88 2,9 RB 90 2,4	I 134 8,6 LA 142 6,6 CS 13A 6,5 LA 140 6,1 I 132 4,2 I 135 4,0 RB 89 4,0 SR 92 3,4 KR 88 3,4 TE+133 2,3	I 134 9,7 LA 142 7,4 LA 140 7,1 CS 13A 7,0 I 132 4,9 I 135 4,6 KR 88 3,8 SR 92 3,8 RB 89 3,5 TE+133 2,4	I 134 10,9 LA 140 8,0 LA 142 8,1 CS 13A 8,2 I 132 5,9 I 135 5,4 KR 88 4,5 SR 92 4,3 ZR 95 2,6 I 133 2,5	I 134 11,2 LA 140 10,6 LA 142 8,3 I 132 7,2 I 135 6,3 CS 13A 5,1 KR 88 4,7 SR 92 4,7 ZR 95 3,2 I 133 3,0	LA 140 12,0 I 134 10,5 I 132 8,1 LA 142 7,9 I 135 6,9 KR 88 4,6 SR 92 4,8 CS 13A 3,7 ZR 95 3,6 NB 97 3,4	LA 140 15,8 I 132 10,7 I 135 7,8 I 134 8,2 LA 142 5,6 ZR 95 4,7 KR 88 4,5 SR 92 4,4 NB 97 3,0 I 133 4,3	LA 140 20,5 I 132 13,6 I 135 7,6 ZR 95 6,1 NB 97 5,0 I 133 5,1 NB 97 5,1 SR 91 4,0 KR 88 3,0 SR 92 2,8	LA 140 25,8 I 132 16,3 ZR 95 7,7 NB 95 7,0 I 133 5,2 NB 97 4,9 I 135 4,9 SR 91 3,2 RU 103 2,7 CE 143 2,6	LA 140 26,9 I 132 16,7 ZR 95 8,0 NB 95 7,3 I 133 5,1 NB 97 4,7 I 135 4,1 SR 91 2,9 CE 143 2,6	LA 140 30,9 I 132 17,7 ZR 95 9,3 NB 95 8,5 I 133 4,2 NB 97 3,6 RU 103 3,3 HA 140 2,9 CE 143 2,4 I 131 2,3	LA 140 32,1 I 132 17,7 ZR 95 9,6 NB 95 8,8 I 133 3,9 RU 103 3,4 NB 97 3,2 HA 140 3,0 I 131 2,4 CE 143 2,3	LA 140 37,3 I 132 16,6 ZR 95 11,4 NB 95 10,6 RU 103 4,0 BA 140 3,4 I 131 2,6 TE 132 1,9 I 133 1,8 MO 99 1,8	LA 140 40,8 I 132 13,6 ZR 95 13,1 NB 95 12,4 RU 103 4,5 BA 140 3,6 I 131 2,6 TE 132 1,6 MO 99 1,4 KE 133 1,3	LA 140 42,4 ZR 95 14,5 NB 95 14,1 I 132 10,5 RU 103 5,0 BA 140 3,7 I 131 2,5 CE 141 1,4 TE 132 1,2 KE 133 1,2	LA 140 42,7 NB 95 17,6 ZR 95 17,3 RU 103 5,7 I 132 5,3 BA 140 3,7 I 131 2,2 CE 141 1,9 KE 133 1,0	LA 140 42,1 NB 95 18,9 ZR 95 18,2 RU 103 6,0 I 132 4,1 BA 140 3,6 I 131 2,1 CE 141 1,8 KE 133 1,0	LA 140 53,1 NB 95 27,5 ZR 95 23,7 RU 103 7,2 BA 140 2,8 CE 141 1,8 I 131 1,1 I 132 1,5 ND 147 1,5	NB 95 32,0 LA 140 27,1 ZR 95 26,2 RU 103 7,2 BA 140 2,3 CE 141 1,9 I 131 1,7 PR 144 1,5 CE 140 1,5 ND 147 1,3	NB 95 46,1 ZR 95 31,7 LA 140 9,7 RU 103 7,6 CE 141 1,7 BA 140 1,6 PR 144 1,6 CE 144 1,7 RM 106 1,3 I 131 1,1	NB 95 46,9 ZR 95 31,9 LA 140 8,9 RU 103 7,5 CE 141 1,7 PR 144 1,6 BA 140 1,6 CE 144 1,8 RM 106 1,3 Y 91 1,1	NB 95 57,5 ZR 95 32,3 RU 103 5,2 PR 144 1,3 CF 144 1,2 CE 141 1,6 LA 140 1,6 RM 106 1,5 Y 91 1,1 BA 140 1,1	NB 95 59,7 ZR 95 31,4 RU 103 4,0 PR 144 1,7 CE 144 1,5 NH 106 1,7 CE 141 1,6 LA 140 1,2 Y 91 1,1 SB 125 1,1	NB 95 60,9 ZR 95 29,3 PR 144 3,0 CE 144 2,8 RU 103 2,1 RM 106 1,3 CE 141 2,2 SB 125 1,1 Y 91 1,1 PR+144 1,1	NB 95 55,0 ZR 95 25,1 PR 144 7,7 CE 140 7,1 RM 106 3,5 RU 103 7,7 SB 125 1,1 Y 91 1,1

Source 7 (All Fission Products), 200 d, Power = 1 watt, Pure U-235

GREATEST CONTRIBUTORS TO BETA DECAY POWER (PERCENT OF TOTAL)

[illegible]

Source 7 (All Fission Products), 200 d, Power = 1 watt, Pure U-235

APPENDIX B. SELECTED CUMULATIVE RADIATION SPECTRA

Sources 1, 2, and 7, Power = 1 Watt, Pure U-235

Equilibrium - All Daughters Included

Table B.2

SOURCE 1 (AIR), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION BETA ENERGY BELOW GIVEN ENERGY

-----COOLING TIMES-----											
GROUP	E(MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	6.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	3.00000+01	5.0780+02	7.9264+02	1.4068+01	4.3018+01	6.0079+01	8.6309+01	8.4163+01	5.6662+01	4.2503+01	4.1968+01
2	6.00000+01	1.2211+01	1.8544+01	3.0753+01	7.1108+01	8.5009+01	9.8156+01	9.9683+01	9.8818+01	9.8301+01	9.8323+01
3	9.00000+01	1.9226+01	2.7934+01	4.1102+01	8.4751+01	9.6476+01	9.9575+01	9.9985+01	9.9973+01	9.9974+01	9.9999+01
4	1.20000+00	2.6972+01	3.6233+01	4.7836+01	8.7874+01	9.8837+01	9.9993+01	9.9992+01	9.9995+01	9.9995+01	1.0000+00
5	1.50000+00	3.6001+01	4.5916+01	5.4306+01	8.6923+01	9.9029+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
6	1.80000+00	4.5828+01	5.6030+01	6.1072+01	8.9972+01	9.9127+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
7	2.10000+00	5.5569+01	6.5696+01	6.7747+01	9.1105+01	9.9227+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
8	2.40000+00	6.0544+01	7.4282+01	7.3905+01	9.2296+01	9.9329+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
9	2.70000+00	7.2658+01	8.1729+01	7.9385+01	9.3534+01	9.9363+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
10	3.00000+00	7.9932+01	8.7967+01	8.4203+01	9.4799+01	9.9546+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
11	3.30000+00	8.6065+01	9.2785+01	8.8355+01	9.6033+01	9.9653+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
12	3.60000+00	9.0829+01	9.6095+01	9.1861+01	9.7179+01	9.9753+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
13	3.90000+00	9.4229+01	9.8070+01	9.4785+01	9.8184+01	9.9841+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
14	4.20000+00	9.6485+01	9.9877+01	9.7101+01	9.8990+01	9.9912+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
15	4.50000+00	9.7931+01	9.9534+01	9.8727+01	9.9556+01	9.9961+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
16	4.80000+00	9.8903+01	9.9772+01	9.9646+01	9.9877+01	9.9989+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
17	5.10000+00	9.9518+01	9.9890+01	9.9974+01	9.9991+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
18	5.40000+00	9.9851+01	9.9957+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
19	5.70000+00	9.9979+01	9.9987+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
20	6.00000+00	1.0000+00	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
21	6.30000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	6.60000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	6.90000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	7.20000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	7.50000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Table B.3

SOURCE 1 (PLATE OUT), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION GAMMA ENERGY BELOW GIVEN ENERGY

COOLING TIMES

GROUP	E(MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	1.500000E+01	3.0605E+03	2.9426E+03	3.2540E+03	2.2166E+02	2.7915E+02	2.2496E+02	2.2010E+02	1.6782E+02	1.6332E+02	6.1821E+03
2	3.000000E+01	1.9078E+02	1.6805E+02	1.4565E+02	7.9333E+02	9.3008E+02	4.7667E+02	3.7990E+02	2.4541E+02	1.7506E+02	6.3088E+03
3	5.000000E+01	6.2150E+02	5.4000E+02	5.1000E+02	1.7910E+01	4.1001E+01	3.2828E+01	2.9125E+01	1.2065E+01	3.0959E+02	7.0201E+03
4	6.000000E+01	1.8234E+01	1.0904E+01	1.0603E+01	4.4866E+01	5.2424E+01	4.3766E+01	3.6556E+01	1.9470E+01	8.6770E+02	1.3154E+04
5	7.500000E+01	7.5000E+01	5.5904E+01	5.5904E+01	4.6994E+01	5.2424E+01	4.3766E+01	3.6556E+01	1.9470E+01	8.6770E+02	1.3154E+04
6	9.000000E+01	4.9060E+01	5.2557E+01	5.4000E+01	4.6994E+01	7.6432E+01	8.0113E+01	8.0148E+01	6.6342E+01	5.5023E+01	4.8721E+01
7	1.650000E+02	5.5218E+01	5.8571E+01	6.7179E+01	6.8266E+01	7.8055E+01	8.2492E+01	8.1351E+01	6.7012E+01	5.5265E+01	8.8747E+01
8	1.200000E+02	6.2630E+01	6.6700E+01	7.2694E+01	7.4550E+01	8.1686E+01	8.2611E+01	8.4826E+01	6.7036E+01	5.2678E+01	9.6827E+01
9	1.350000E+02	7.7407E+01	7.8061E+01	8.0652E+01	8.4004E+01	8.7384E+01	8.3125E+01	8.1971E+01	6.7105E+01	5.3357E+01	9.8833E+01
10	1.500000E+02	8.2142E+01	8.3062E+01	8.4135E+01	8.7214E+01	8.8947E+01	8.3869E+01	8.1841E+01	6.7221E+01	5.5181E+01	9.0080E+01
11	1.650000E+02	8.4701E+01	8.5764E+01	8.8948E+01	9.2067E+01	9.5925E+01	8.6499E+01	8.6578E+01	6.8820E+01	5.9135E+01	9.4080E+01
12	1.800000E+02	8.9087E+01	9.0617E+01	9.3577E+01	9.6785E+01	9.8974E+01	8.8015E+01	8.8582E+01	6.8262E+01	5.9138E+01	9.4080E+01
13	2.000000E+02	9.2826E+01	9.5220E+01	9.7200E+01	9.9200E+01	9.9200E+01	8.9220E+01	8.9220E+01	6.9220E+01	5.9138E+01	9.4080E+01
14	2.100000E+02	9.2203E+01	9.3828E+01	9.6370E+01	9.9604E+01	9.9604E+01	8.9604E+01	8.9604E+01	6.9604E+01	5.9143E+01	9.4080E+01
15	2.500000E+02	9.2864E+01	9.5066E+01	9.7707E+01	9.9670E+01	9.9513E+01	8.9312E+01	8.9200E+01	6.9258E+01	5.9076E+01	9.4993E+01
16	2.400000E+02	9.4578E+01	9.5815E+01	9.9061E+01	9.9766E+01	9.9649E+01	8.9727E+01	8.9126E+01	6.9495E+01	5.9810E+01	9.4997E+01
17	2.550000E+02	9.6131E+01	9.7119E+01	9.9604E+01	9.9847E+01	9.9849E+01	8.9777E+01	8.9974E+01	6.9826E+01	5.9944E+01	9.4999E+01
18	2.700000E+02	9.7617E+01	9.8214E+01	9.9764E+01	9.9884E+01	9.9884E+01	8.9777E+01	8.9974E+01	6.9826E+01	5.9944E+01	9.4999E+01
19	2.850000E+02	9.7812E+01	9.8387E+01	9.9706E+01	9.9899E+01	9.9899E+01	8.9777E+01	8.9974E+01	6.9826E+01	5.9944E+01	1.0000E+00
20	3.000000E+02	9.8580E+01	9.8907E+01	9.9858E+01	9.9905E+01	9.9907E+01	8.9944E+01	8.9993E+01	6.9995E+01	5.9999E+01	1.0000E+00
21	3.150000E+02	9.8611E+01	9.8911E+01	9.9861E+01	9.9905E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
22	3.300000E+02	9.8706E+01	9.9036E+01	9.9910E+01	9.9994E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
23	3.450000E+02	9.8947E+01	9.9247E+01	9.9942E+01	9.9999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
24	3.600000E+02	9.9273E+01	9.9579E+01	9.9952E+01	9.9999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
25	3.750000E+02	9.9377E+01	9.9556E+01	9.9992E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
26	3.900000E+02	9.9450E+01	9.9600E+01	9.9996E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
27	4.050000E+02	9.9453E+01	9.9606E+01	9.9999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
28	4.200000E+02	9.9459E+01	9.9760E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
29	4.350000E+02	9.9464E+01	9.9870E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
30	4.500000E+02	9.9469E+01	9.9922E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
31	4.650000E+02	9.9476E+01	9.9958E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
32	4.800000E+02	9.9481E+01	9.9959E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
33	4.950000E+02	9.9484E+01	9.9960E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
34	5.100000E+02	9.9483E+01	9.9966E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
35	5.250000E+02	9.9483E+01	9.9965E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
36	5.400000E+02	9.9480E+01	9.9967E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
37	5.550000E+02	9.9481E+01	9.9968E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
38	5.700000E+02	9.9480E+01	9.9968E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
39	5.850000E+02	9.9482E+01	9.9969E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
40	6.000000E+02	9.9483E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

Table B.4

SOURCE 1 (PLATE OUT), EQUILIBRIUM, 1 MATT, PURE U-235

FRACTION BETA ENERGY BELOW GIVEN ENERGY

GROUP	E(MEV)	COOLING TIMES									
		SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	3.00000+01	6.7910+02	8.5064+02	1.4418+01	2.2263+01	2.5575+01	3.3924+01	3.2043+01	2.5358+01	2.1133+01	2.0222+01
2	6.00000+01	2.0935+01	2.5947+01	4.1046+01	5.4481+01	5.7073+01	5.8211+01	5.3137+01	4.0889+01	3.5821+01	3.2357+01
3	9.00000+01	1.6288+01	4.4188+01	6.4289+01	7.8665+01	7.9321+01	7.2466+01	6.6270+01	5.4710+01	4.8819+01	4.3111+01
4	1.20000+00	4.8200+01	5.7877+01	8.1291+01	8.9373+01	8.0494+01	6.2660+01	7.7584+01	6.8619+01	6.3228+01	5.7835+01
5	1.50000+00	5.7314+01	6.7261+01	8.9096+01	9.3609+01	8.3572+01	6.9155+01	8.5786+01	7.9758+01	7.6038+01	7.3248+01
6	1.80000+00	6.5337+01	7.4793+01	9.4037+01	9.6156+01	8.6393+01	6.3883+01	9.1924+01	8.4868+01	8.6660+01	8.6390+01
7	2.10000+00	7.2515+01	8.0924+01	9.6968+01	9.8024+01	8.8727+01	6.7099+01	9.6155+01	9.4527+01	9.3614+01	9.4337+01
8	2.40000+00	7.8831+01	8.5829+01	9.8407+01	9.9133+01	9.0377+01	6.8867+01	9.8497+01	9.7860+01	9.7505+01	9.7815+01
9	2.70000+00	8.4614+01	8.9928+01	9.9139+01	9.9713+01	9.0803+01	6.9754+01	9.9673+01	9.9533+01	9.9453+01	9.9501+01
10	3.00000+00	8.9136+01	9.3294+01	9.9568+01	9.9914+01	9.0971+01	6.9966+01	9.9954+01	9.9935+01	9.9923+01	9.9923+01
11	3.30000+00	9.2828+01	9.5877+01	9.9799+01	9.9988+01	9.0906+01	6.9906+01	9.9905+01	9.9903+01	9.9902+01	9.9902+01
12	3.60000+00	9.5439+01	9.7658+01	9.9998+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
13	3.90000+00	9.7143+01	9.8770+01	9.9939+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
14	4.20000+00	9.8172+01	9.9199+01	9.9976+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
15	4.50000+00	9.8762+01	9.9717+01	9.9992+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
16	4.80000+00	9.9125+01	9.9874+01	9.9998+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
17	5.10000+00	9.9364+01	9.9941+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
18	5.40000+00	9.9546+01	9.9979+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
19	5.70000+00	9.9689+01	9.9991+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
20	6.00000+00	9.9800+01	9.9998+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
21	6.30000+00	9.9882+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	6.60000+00	9.9940+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	6.90000+00	9.9977+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	7.20000+00	9.9995+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	7.50000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Table B.5

SOURCE 1 (WATER), EQUILIBRIUM, 1 MATT, PURE U-235

FRACTION GAMMA ENERGY BELOW GIVEN ENERGY

-----COOLING TIMES-----											
GROUP	E(MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	8.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	1.50000+00	1.9739+03	2.0260+03	2.5376+03	2.2294+02	2.6973+02	2.3077+02	2.3039+02	1.8358+02	1.6217+02	8.1821+03
2	1.80000+00	1.4847+02	1.2669+02	1.2594+02	1.3294+02	1.4101+01	5.2037+02	5.2037+02	1.7588+02	1.7588+02	8.3088+03
3	4.50000+00	5.5000+00	4.6717+01	5.2555+02	1.3323+01	5.3871+01	5.3389+01	4.2020+01	1.9245+01	4.4202+01	1.0000+00
4	6.00000+01	1.3162+01	1.3752+01	1.9524+01	8.8460+01	5.9246+01	5.5608+01	4.7946+01	2.5979+01	9.4815+02	1.3150+02
5	7.50000+00	2.2195+01	2.3764+01	3.1814+01	6.6351+01	8.6745+01	7.2178+01	6.6723+01	5.3071+01	4.8085+01	9.1247+01
6	9.00000+00	4.5321+01	5.0113+01	5.7713+01	5.6346+01	7.7610+01	8.5941+01	8.0818+01	8.7700+01	9.5087+01	8.8721+01
7	1.05000+00	4.9936+01	5.5288+01	6.4280+01	6.7386+01	7.9357+01	8.6993+01	8.5739+01	8.8302+01	9.5326+01	8.6747+01
8	1.20000+00	5.6726+01	6.3111+01	7.2713+01	7.4471+01	9.2952+01	9.7261+01	9.5825+01	8.8324+01	9.5348+01	8.8027+01
9	1.35000+00	7.0762+01	7.6218+01	8.0786+01	8.8448+01	9.8608+01	8.8151+01	8.5412+01	8.6386+01	9.3417+01	9.8835+01
10	1.50000+00	7.8619+01	8.4703+01	8.5944+01	8.8270+01	1.1310+01	9.8608+01	8.6119+01	8.6401+01	9.5576+01	9.9068+01
11	1.65000+00	8.2310+01	8.3801+01	8.3466+01	9.1131+01	1.1310+01	9.9002+01	9.7101+01	9.9002+01	9.9002+01	1.0000+00
12	1.80000+00	8.6199+01	8.8562+01	9.5154+01	9.9909+01	9.9279+01	9.9016+01	8.8911+01	9.8919+01	9.9149+01	9.9085+01
13	1.95000+00	8.8581+01	9.1055+01	9.7275+01	9.9347+01	9.9577+01	9.9082+01	9.8946+01	9.8942+01	9.9150+01	9.9088+01
14	2.10000+00	8.9742+01	9.2120+01	9.8099+01	9.9758+01	9.9674+01	9.9180+01	9.8993+01	9.8948+01	9.9154+01	9.9089+01
15	2.25000+00	9.0160+01	9.2585+01	9.8412+01	9.9816+01	9.9733+01	9.9312+01	9.9175+01	9.9321+01	9.9749+01	9.9930+01
16	2.40000+00	9.1968+01	9.3916+01	9.8675+01	9.9866+01	9.9791+01	9.9451+01	9.9332+01	9.9455+01	9.9815+01	9.9997+01
17	2.55000+00	9.3533+01	9.5334+01	9.9302+01	9.9902+01	9.9909+01	9.9980+01	9.9980+01	9.9983+01	9.9994+01	9.9999+01
18	2.70000+00	9.5140+01	9.6475+01	9.9407+01	9.9959+01	9.9994+01	9.9980+01	9.9980+01	9.9983+01	9.9994+01	9.9999+01
19	2.85000+00	9.6091+01	9.7871+01	9.9461+01	9.9964+01	9.9984+01	9.9980+01	9.9980+01	9.9983+01	9.9994+01	1.0000+00
20	3.00000+00	9.6847+01	9.7608+01	9.9467+01	9.9967+01	9.9986+01	9.9980+01	9.9980+01	9.9983+01	9.9994+01	1.0000+00
21	3.15000+00	9.7006+01	9.7781+01	9.9577+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	3.30000+00	9.7127+01	9.7819+01	9.9606+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	3.45000+00	9.7379+01	9.8189+01	9.9742+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	3.60000+00	9.7534+01	9.8315+01	9.9747+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	3.75000+00	9.7580+01	9.8358+01	9.9768+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
26	3.90000+00	9.7616+01	9.8382+01	9.9770+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
27	4.05000+00	9.7637+01	9.8422+01	9.9990+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
28	4.20000+00	9.7653+01	9.8622+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
29	4.35000+00	9.7669+01	9.8722+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
30	4.50000+00	9.7685+01	9.8822+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
31	4.65000+00	9.7701+01	9.8922+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
32	4.80000+00	9.7717+01	9.9042+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
33	4.95000+00	9.7733+01	9.9162+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
34	5.10000+00	9.7749+01	9.9282+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
35	5.25000+00	9.7765+01	9.9402+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
36	5.40000+00	9.7781+01	9.9522+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
37	5.55000+00	9.7797+01	9.9642+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
38	5.70000+00	9.7813+01	9.9762+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
39	5.85000+00	9.7829+01	9.9882+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
40	6.00000+00	9.7845+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Table B.6

SOURCE 1 (WATER), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION BETA ENERGY BELOW GIVEN ENERGY

-----COOLING TIMES-----												
GROUP	E(MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	6.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.	
1	3.00000+01	5.6149-02	7.2982-02	1.6299+01	2.3006+01	2.6695+01	3.9309+01	3.7573+01	2.6996+01	2.3262+01	2.0222+01	
2	6.00000+01	1.8060+01	2.3142+01	4.2030+01	5.7958+01	6.1065+01	6.6054+01	6.0978+01	4.3590+01	3.5892+01	3.2357+01	
3	9.00000+01	3.1905+01	4.0154+01	6.7945+01	8.3242+01	8.6100+01	7.8509+01	7.1936+01	5.0783+01	4.8835+01	4.3111+01	
4	1.20000+02	4.3045+01	5.2865+01	8.2727+01	9.3164+01	9.3220+01	8.6800+01	8.1354+01	7.0750+01	6.3363+01	5.7635+01	
5	1.50000+02	5.2613+01	6.2160+01	8.9876+01	9.5802+01	9.5917+01	9.1749+01	8.8176+01	8.0685+01	7.6135+01	7.3266+01	
6	1.80000+02	6.0160+01	6.9781+01	9.6228+01	9.7620+01	9.7714+01	9.5346+01	9.3243+01	8.9013+01	8.6517+01	8.6390+01	
7	2.10000+02	6.7663+01	7.6150+01	9.6766+01	9.8749+01	9.8907+01	9.6802+01	9.4777+01	9.3640+01	9.3640+01	9.4337+01	
8	2.40000+02	7.3738+01	8.1216+01	9.8004+01	9.9466+01	9.9574+01	9.9138+01	9.8750+01	9.7956+01	9.7515+01	9.7815+01	
9	2.70000+02	7.9264+01	8.5490+01	9.8718+01	9.9820+01	9.9901+01	9.9812+01	9.9728+01	9.9554+01	9.9456+01	9.9501+01	
10	3.00000+02	8.4161+01	8.9202+01	9.9202+01	9.9944+01	9.9981+01	9.9974+01	9.9962+01	9.9938+01	9.9923+01	9.9923+01	
11	3.30000+02	8.8240+01	9.2273+01	9.9511+01	9.9988+01	9.9997+01	9.9997+01	9.9996+01	9.9993+01	9.9992+01	9.9992+01	
12	3.60000+02	9.1553+01	9.4636+01	9.9756+01	9.9998+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
13	3.90000+02	9.4027+01	9.6366+01	9.9888+01	9.9999+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
14	4.20000+02	9.5857+01	9.7597+01	9.9946+01	9.9999+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
15	4.50000+02	9.7189+01	9.8448+01	9.9933+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
16	4.80000+02	9.8173+01	9.9044+01	9.9998+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
17	5.10000+02	9.8887+01	9.9458+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
18	5.40000+02	9.9379+01	9.9731+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
19	5.70000+02	9.9675+01	9.9881+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
20	6.00000+02	9.9828+01	9.9947+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
21	6.30000+02	9.9904+01	9.9976+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
22	6.60000+02	9.9957+01	9.9990+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
23	6.90000+02	9.9986+01	9.9998+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
24	7.20000+02	9.9997+01	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	
25	7.50000+02	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00

Figure B.1

SOURCE 1 (AIR), EQUILIBRIUM, 1 WATT, PURE U-235

Figure B.2

Figure B.3

Figure B.4

Figure B.5

Figure B.6

COMING TIMES											
GROUP	(MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	6.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	1.90000+01	1.5470-02	1.5060-02	3.3255-02	8.8042-02	1.2260-01	2.1038-01	2.0506-01	9.8672-02	2.0138-02	7.0862-03
2	3.00000+01	2.5217-02	7.5000-02	2.8505-02	2.8505-02	1.5180-01	5.5303-01	2.9112-01	1.1510-01	2.5190-01	7.1750-02
3	5.00000+01	1.2400-01	1.1622-01	1.3755-01	3.5711-01	4.9678-01	7.6375-01	8.6694-01	8.2310-01	5.3581-01	7.1750-02
4	6.00000+01	2.1540-01	1.0661-01	2.2113-01	5.7771-01	7.4810-01	8.7408-01	8.7833-01	8.6581-01	9.0161-01	9.952-02
5	7.50000+01	2.6757-01	2.5102-01	2.8179-01	6.1147-01	7.9199-01	9.7686-01	9.9942-01	9.9584-01	9.9921-01	1.0000+00
6	9.00000+01	3.8715-01	3.6345-01	4.4513-01	6.5884-01	8.2830-01	9.8810-01	9.9961-01	9.9943-01	9.9931-01	1.0000+00
7	1.05000+00	4.1765-01	4.4903-01	4.8350-01	6.7880-01	8.3370-01	8.8813-01	9.9978-01	9.9965-01	9.9934-01	1.0000+00
8	1.20000+00	5.0479-01	4.9032-01	5.3886-01	7.3518-01	8.7229-01	9.8840-01	9.9966-01	9.9965-01	9.9934-01	1.0000+00
9	1.35000+00	5.8765-01	5.5742-01	6.5758-01	8.1842-01	9.3640-01	9.9966-01	9.9964-01	9.9965-01	9.9934-01	1.0000+00
10	1.50000+00	6.8786-01	6.5005-01	6.5657-01	8.4849-01	9.5900-01	9.9966-01	9.9961-01	9.9965-01	9.9934-01	1.0000+00
11	1.65000+00	7.9520-01	7.4220-01	7.8220-01	9.8220-01	9.5005-01	9.9992-01	9.9990-01	9.9992-01	9.9934-01	1.0000+00
12	1.80000+00	7.4039-01	7.0385-01	7.1311-01	9.1831-01	9.8690-01	9.9990-01	9.9990-01	9.9990-01	9.9934-01	1.0000+00
13	1.95000+00	7.5886-01	7.2532-01	7.3316-01	9.3131-01	9.9220-01	9.9990-01	9.9990-01	9.9990-01	9.9934-01	1.0000+00
14	2.10000+00	8.1669-01	7.6900-01	8.1221-01	9.4732-01	9.9443-01	9.9990-01	9.9990-01	9.9990-01	9.9934-01	1.0000+00
15	2.25000+00	8.4442-01	8.2300-01	8.6650-01	9.6213-01	9.9600-01	9.9990-01	9.9990-01	9.9990-01	9.9934-01	1.0000+00
16	2.40000+00	9.0620-01	8.9369-01	9.5470-01	9.9419-01	9.9941-01	1.0000+00	9.9990-01	9.9990-01	9.9977-01	1.0000+00
17	2.55000+00	9.2543-01	9.0649-01	9.5976-01	9.9508-01	9.9950-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
18	2.70000+00	9.4448-01	9.3024-01	9.9334-01	9.9821-01	9.9981-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
19	2.85000+00	9.5841-01	9.4607-01	9.9431-01	9.9957-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
20	3.00000+00	9.7095-01	9.4812-01	9.9486-01	9.9957-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
21	3.15000+00	9.7612-01	9.5366-01	9.9613-01	9.9903-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	3.30000+00	9.7831-01	9.5602-01	9.9710-01	9.9948-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	3.45000+00	9.8453-01	9.6652-01	9.9853-01	9.9949-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	3.60000+00	9.8692-01	9.7529-01	9.9924-01	9.9974-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	3.75000+00	9.9255-01	9.7884-01	9.9931-01	9.9975-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
26	3.90000+00	9.9408-01	9.8243-01	9.9932-01	9.9975-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
27	4.05000+00	9.9561-01	9.8637-01	9.9942-01	9.9977-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
28	4.20000+00	9.9626-01	9.8790-01	9.9947-01	9.9977-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
29	4.35000+00	9.9717-01	9.9292-01	9.9946-01	9.9977-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
30	4.50000+00	9.9802-01	9.9749-01	9.9946-01	9.9977-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
31	4.65000+00	9.9901-01	9.9870-01	9.9948-01	9.9978-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
32	4.80000+00	1.0000+00	9.9882-01	9.9946-01	9.9998-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
33	4.95000+00	1.0000+00	9.9883-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
34	5.10000+00	1.0000+00	9.9904-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
35	5.25000+00	1.0000+00	9.9962-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
36	5.40000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
37	5.55000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
38	5.70000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
39	5.85000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
40	6.00000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Table B.8

SOURCE 2 (AIR), EQUILIBRIUM, 1 WATT, PUMP U-235

FRACTION BETA ENERGY BELOW GIVEN ENERGY

-----COOLING TIMES-----												
GROUP	E (MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.	
1	3.00000+01	5.5653-02	8.4361-02	1.5518+01	3.8944-01	5.2124+01	7.6977-01	7.3148+01	4.6A20-01	4.2217-01	4.1968-01	
2	6.00000+01	1.6096+01	2.0741+01	3.4730+01	7.057A-01	8.17A2-01	9.7189+01	9.9410+01	9.8601-01	9.8323-01	9.8323-01	
3	9.00000+01	2.2076+01	3.1114+01	4.7457+01	8.672A-01	9.5726-01	9.4371-01	9.99A5+01	9.99A9+01	9.9901-01	1.0000+00	
4	1.20000+00	3.0119-01	4.0323-01	5.5007+01	9.0864-01	9.9090-01	9.9940-01	9.9999+01	9.999A+01	9.9998+01	1.0000+00	
5	1.50000+00	3.89A3-01	4.9674-01	6.1192+01	9.1794-01	9.9291-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
6	1.80000+00	4.8461-01	5.9197-01	6.7248+01	9.2A01-01	9.9371-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
7	2.10000+00	5.7804+01	6.8194+01	7.3007+01	9.3447-01	9.9445+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
8	2.40000+00	6.839A+01	7.6127+01	7.8191+01	9.4325+01	9.9519+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
9	2.70000+00	7.4116+01	8.3009+01	8.2772-01	9.5237-01	9.9596+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
10	3.00000+00	8.1120+01	8.8A80+01	8.8758+01	9.6168+01	9.9676+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
11	3.30000+00	8.6958+01	9.3311+01	9.0269+01	9.707A-01	9.9751+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
12	3.60000+00	9.1467+01	9.6381+01	9.319A+01	9.7922-01	9.9873+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
13	3.90000+00	9.4665+01	9.8714+01	9.5602+01	9.8A62-01	9.9A86+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
14	4.20000+00	9.6772+01	9.9152+01	9.757A+01	9.9258+01	9.9617+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
15	4.50000+00	9.8111+01	9.9578+01	9.8936+01	9.9673+01	9.9972+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
16	4.80000+00	9.9001+01	9.9766+01	9.9705+01	9.9909+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
17	5.10000+00	9.9561+01	9.9905+01	9.997A+01	9.9993+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
18	5.40000+00	9.9806+01	9.9992+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
19	5.70000+00	9.99A1+01	9.999A+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
20	6.00000+00	1.0000+00	9.999A+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
21	6.30000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
22	6.60000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
23	6.90000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
24	7.20000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	
25	7.50000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	

Table B.9

SOURCE 2 (PLATE OUT), EQUILIBRIUM, 1 nATT, PURE U-235

FRACTION GAMMA ENERGY BELOW GIVEN ENERGY

GROUP	E(MEV)	SHUTDOWN	COOLING TIMES								
			60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.3 DAYS	60.0 DAYS	1.0 YRS.
1	1.500000+01	1.3058+03	1.3290+03	1.8005+03	2.2476+02	3.0536+02	2.465+02	2.6378+02	1.4308+02	7.7074+03	1.5405+05
2	3.000000+01	1.7540+02	1.6119+02	1.4118+02	1.1180+02	1.2236+01	1.1371+01	1.0701+01	1.0304+01	7.7074+03	4.1566+06
3	4.500000+01	5.7870+01	5.4350+01	5.3360+02	2.2137+01	2.2236+01	2.0111+01	1.8268+01	1.6201+01	4.5000+01	4.5000+01
4	6.000000+01	1.4890+01	1.4938+01	2.0050+01	5.3099+01	6.9307+01	6.4135+01	6.4914+01	6.4722+01	6.4621+01	4.5000+01
5	7.500000+01	2.4415+01	2.5375+01	3.1959+01	6.3793+01	7.7478+01	7.7095+01	7.9952+01	1.0000+00	1.0000+00	1.0000+00
6	9.000000+01	5.1580+01	5.5031+01	5.8440+01	5.7503+01	7.9348+01	8.5511+01	9.9976+01	1.0000+00	1.0000+00	1.0000+00
7	1.050000+02	5.6148+01	5.9906+01	6.1837+01	6.2425+01	8.0614+01	8.5514+01	9.9976+01	1.0000+00	1.0000+00	1.0000+00
8	1.200000+02	6.4393+01	6.8980+01	7.3911+01	7.6246+01	8.4917+01	8.9674+01	9.9978+01	1.0000+00	1.0000+00	1.0000+00
9	1.350000+02	8.1307+01	8.1644+01	8.2530+01	8.6181+01	9.3039+01	9.9968+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00
10	1.500000+02	9.4931+01	8.5623+01	8.7441+01	8.9647+01	9.7380+01	9.9967+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00
11	1.650000+02	9.6861+01	8.7613+01	8.7157+01	8.9507+01	9.5181+01	9.9990+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00
12	1.800000+02	9.1718+01	8.2991+01	8.6524+01	9.0197+01	9.9600+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00
13	1.950000+02	9.3721+01	8.5181+01	8.8455+01	9.3544+01	9.9811+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
14	2.100000+02	9.4660+01	8.6067+01	8.9219+01	9.0985+01	9.9998+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
15	2.250000+02	9.4268+01	8.6247+01	8.9411+01	9.0985+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
16	2.400000+02	9.6532+01	9.7453+01	9.9561+01	9.9997+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
17	2.550000+02	9.8633+01	9.8663+01	9.9972+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
18	2.700000+02	9.9238+01	9.9492+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
19	2.850000+02	9.9238+01	9.9494+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
20	3.000000+02	1.0000+00	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
21	3.150000+02	1.0000+00	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	3.300000+02	1.0000+00	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	3.450000+02	1.0000+00	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	3.600000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	3.750000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
26	3.900000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
27	4.050000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
28	4.200000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
29	4.350000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
30	4.500000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
31	4.650000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
32	4.800000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
33	4.950000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
34	5.100000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
35	5.250000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
36	5.400000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
37	5.550000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
38	5.700000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
39	5.850000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
40	6.000000+02	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Table B.10

SOURCE 2 (PLATE OUT), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION BETA ENERGY BELOW GIVEN ENERGY

GROUP	E(MEV)	-----COOLING TIMES-----									
		SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	3.00000E-01	7.6604E-02	9.1091E-02	1.5014E-01	2.4169E-01	2.8622E-01	5.6429E-01	6.4925E-01	6.1113E-01	5.8477E-01	6.4088E-01
2	6.00000E-01	2.4800E-01	2.9505E-01	4.5870E-01	6.3385E-01	6.7932E-01	9.1005E-01	9.9761E-01	9.9905E-01	9.9898E-01	9.9595E-01
3	9.00000E-01	4.2782E-01	5.0409E-01	7.0181E-01	9.0392E-01	9.2321E-01	9.7711E-01	9.9961E-01	1.0000E+00	1.0000E+00	9.9958E-01
4	1.20000E+00	5.5186E-01	6.4117E-01	8.9084E-01	9.9068E-01	9.9641E-01	9.9968E-01	9.9999E-01	1.0000E+00	1.0000E+00	1.0000E+00
5	1.50000E+00	6.3420E-01	7.2333E-01	9.5164E-01	9.9752E-01	9.9951E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
6	1.80000E+00	7.0359E-01	7.8506E-01	9.8278E-01	9.9949E-01	9.9988E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
7	2.10000E+00	7.6604E-01	8.3525E-01	9.9695E-01	9.9998E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
8	2.40000E+00	8.2151E-01	8.7574E-01	9.9990E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
9	2.70000E+00	8.7204E-01	9.1137E-01	9.9999E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
10	3.00000E+00	9.1587E-01	9.4192E-01	9.9999E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
11	3.30000E+00	9.4989E-01	9.6547E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
12	3.60000E+00	9.7314E-01	9.8180E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
13	3.90000E+00	9.8728E-01	9.9108E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
14	4.20000E+00	9.9489E-01	9.9829E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
15	4.50000E+00	9.9822E-01	9.9988E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
16	4.80000E+00	9.9944E-01	9.9958E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
17	5.10000E+00	9.9972E-01	9.9979E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
18	5.40000E+00	9.9987E-01	9.9990E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
19	5.70000E+00	9.9996E-01	9.9997E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
20	6.00000E+00	9.9999E-01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
21	6.30000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
22	6.60000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
23	6.90000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
24	7.20000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
25	7.50000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

Table B.11

SOURCE 2 (WATER), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION GAMMA ENERGY BELOW GIVEN ENERGY

[illegible]

Table B.12

SOURCE 2 (WATER), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION BETA ENERGY BELOW GIVEN ENERGY

GROUP	E (MEV)	-----COOLING TIMES-----									
		SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	3.00000+00	5.6710-02	7.3059-02	1.0563-01	2.4167-01	2.8671-01	5.0429-01	6.4925-01	6.1112-01	5.8469-01	4.1384-01
2	6.00000+01	1.8970-01	2.3999-01	4.0538-01	6.3379-01	6.7932-01	9.1005-01	9.4763-01	9.9904-01	9.9888-01	8.4028-01
3	9.00000+01	3.3348-01	4.1707-01	7.2092-01	9.0361-01	9.2323-01	9.7733-01	9.9461-01	9.9999-01	9.9995-01	9.2028-01
4	1.20000+00	4.4509-01	5.4375-01	8.6761-01	9.9028-01	9.9640-01	9.9999-01	9.9999-01	1.0000+00	9.9999-01	9.7207-01
5	1.50000+00	5.3140-01	6.3103-01	9.2952-01	9.9771-01	9.9952-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	9.9033-01
6	1.80000+00	6.0923-01	7.0285-01	9.6309-01	9.9934-01	9.9987-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	9.9695-01
7	2.10000+00	6.7910-01	7.8266-01	9.8041-01	9.9989-01	9.9999-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	9.9978-01
8	2.40000+00	7.3908-01	8.1031-01	9.8691-01	9.9992-01	9.9999-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
9	2.70000+00	7.9233-01	8.5126-01	9.9038-01	9.9994-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
10	3.00000+00	8.4043-01	8.8784-01	9.9341-01	9.9995-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
11	3.30000+00	8.8156-01	9.1858-01	9.9542-01	9.9997-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
12	3.60000+00	9.1646-01	9.4256-01	9.9778-01	9.9997-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
13	3.90000+00	9.3971-01	9.6045-01	9.9901-01	9.9998-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
14	4.20000+00	9.5865-01	9.7149-01	9.9971-01	9.9999-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
15	4.50000+00	9.7251-01	9.8203-01	9.9997-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
16	4.80000+00	9.8276-01	9.8922-01	9.9999-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
17	5.10000+00	9.9010-01	9.9382-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
18	5.40000+00	9.9504-01	9.9691-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
19	5.70000+00	9.9782-01	9.9885-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
20	6.00000+00	9.9900-01	9.9939-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
21	6.30000+00	9.9951-01	9.9977-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	6.60000+00	9.9981-01	9.9990-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	6.90000+00	9.9999-01	9.9999-01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	7.20000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	7.50000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Figure B.7

Figure B.8

Figure B.9

SOURCE 2 (P.O.), EQUILIBRIUM, 1 WATT, PURE U-235

Figure B.10

Figure B.11

Figure B.12

Table B.13

SOURCE 7 (ALL F.P.), EQUILIBRIUM, 1 WATT?, PURE U-235

FRACTION GAMMA ENERGY BELOW GIVEN ENERGY

COOLING TIMES

GROUP	E(MEV)	SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	1.50000E+01	1.130E+02	1.06E+02	1.08E+02	2.68E+02	2.76E+02	2.507E+02	2.2127E+02	1.954E+02	1.6651E+02	4.1812E+03
2	3.00000E+01	8.517E+02	4.310E+02	4.99E+02	8.64E+02	8.340E+02	4.1900E+02	2.9425E+02	2.137E+02	1.7137E+02	8.3078E+03
3	4.00000E+01	8.612E+02	4.601E+02	4.129E+02	1.009E+03	9.839E+02	7.4200E+02	2.9416E+02	3.5290E+02	2.0661E+02	7.0191E+03
4	6.00000E+01	1.136E+03	1.618E+02	1.245E+03	2.245E+03	2.177E+03	1.8350E+03	1.6404E+03	1.1749E+03	7.538E+02	1.3301E+02
5	1.50000E+01	7.736E+02	7.736E+02	3.610E+02	8.55E+02	3.94E+02	3.94E+02	3.94E+02	4.118E+02	4.118E+02	1.0000E+00
6	9.00000E+01	3.981E+02	4.009E+01	5.2574E+01	6.9283E+01	7.1255E+01	8.4521E+01	1.875E+01	8.722E+01	9.490E+01	8.8721E+01
7	1.05000E+00	4.6471E+01	4.9678E+01	5.9495E+01	7.3194E+01	7.4795E+01	7.1945E+01	7.35E+01	8.5477E+01	9.5205E+01	8.879E+01
8	1.20000E+00	5.3120E+01	5.6011E+01	6.3001E+01	7.5694E+01	7.5681E+01	7.2365E+01	7.5737E+01	8.5504E+01	9.5277E+01	9.8827E+01
9	1.35000E+00	5.958E+01	5.958E+01	6.6165E+01	7.7589E+01	7.6997E+01	7.2692E+01	7.3862E+01	8.5581E+01	9.529E+01	9.8833E+01
10	1.50000E+00	6.7893E+01	6.8272E+01	7.4911E+01	8.0017E+01	7.8663E+01	7.3581E+01	7.265E+01	8.5711E+01	9.5681E+01	9.906E+01
11	1.65000E+00	7.3407E+01	7.4085E+01	8.3639E+01	9.5975E+01	9.7300E+01	7.7712E+01	7.7895E+01	9.6681E+01	9.6124E+01	9.9080E+01
12	1.80000E+00	7.7536E+01	7.7536E+01	8.6129E+01	9.5959E+01	9.7912E+01	7.7912E+01	7.7912E+01	9.8833E+01	9.9127E+01	9.9080E+01
13	9.50000E+00	8.871E+01	7.589E+01	9.767E+01	9.8103E+01	9.7882E+01	9.800E+01	9.800E+01	9.900E+01	9.900E+01	9.908E+01
14	2.10000E+00	8.1189E+01	8.2181E+01	9.022E+01	9.810E+01	9.810E+01	9.810E+01	9.810E+01	9.8694E+01	9.9152E+01	9.9089E+01
15	2.25000E+00	8.3031E+01	8.5194E+01	9.442E+01	9.8553E+01	9.8715E+01	9.8401E+01	9.8470E+01	9.9171E+01	9.9763E+01	9.9093E+01
16	2.40000E+00	8.6544E+01	8.6009E+01	9.5601E+01	9.9078E+01	9.9004E+01	9.8734E+01	9.8781E+01	9.9324E+01	9.960E+01	9.9997E+01
17	2.55000E+00	8.836E+01	8.7689E+01	9.7680E+01	9.9494E+01	9.9494E+01	9.9494E+01	9.9494E+01	9.9994E+01	9.9994E+01	9.9999E+01
18	2.70000E+00	9.0939E+01	9.210E+01	9.8355E+01	9.9939E+01	9.9969E+01	9.9962E+01	9.9961E+01	9.9979E+01	9.9994E+01	9.9999E+01
19	2.85000E+00	9.2178E+01	9.3102E+01	9.8587E+01	9.945E+01	9.9970E+01	9.9962E+01	9.9963E+01	9.9988E+01	9.9994E+01	1.0000E+00
20	3.00000E+00	9.2975E+01	9.373E+01	9.8939E+01	9.949E+01	9.9992E+01	9.9992E+01	9.9992E+01	9.9995E+01	9.9995E+01	1.0000E+00
21	3.15000E+00	9.381E+01	9.426E+01	9.9193E+01	9.992E+01	9.999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
22	3.30000E+00	9.376E+01	9.4581E+01	9.9337E+01	9.9988E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
23	3.45000E+00	9.4917E+01	9.5678E+01	9.9572E+01	9.9981E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
24	3.60000E+00	9.636E+01	9.671E+01	9.968E+01	9.9993E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
25	3.75000E+00	9.6874E+01	9.735E+01	9.986E+01	9.9997E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
26	3.90000E+00	9.7187E+01	9.759E+01	9.9913E+01	9.9998E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
27	4.05000E+00	9.736E+01	9.7783E+01	9.9982E+01	9.9998E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
28	4.20000E+00	9.8441E+01	9.890E+01	9.9987E+01	9.9998E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
29	4.35000E+00	9.8591E+01	9.884E+01	9.9987E+01	9.9998E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
30	5.00000E+00	9.934E+01	9.940E+01	9.999E+01	9.999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
31	4.85000E+00	9.954E+01	9.972E+01	9.998E+01	9.999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
32	4.80000E+00	9.9549E+01	9.9735E+01	9.9999E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
33	4.85000E+00	9.9575E+01	9.9735E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
34	5.10000E+00	9.9614E+01	9.977E+01	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
35	5.25000E+00	9.9739E+01	9.986E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
36	5.0E+00	9.9809E+01	9.9925E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
37	5.5000E+00	9.9877E+01	9.998E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
38	5.7000E+00	9.994E+01	9.999E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
39	5.8500E+00	9.9951E+01	9.999E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.000E+00	1.0000E+00	1.0000E+00
40	6.00000E+00	9.996E+01	9.999E+01	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	9.999E+00	1.0000E+00	1.0000E+00

Table B.14

SOURCE 7 (ALL F.P.), EQUILIBRIUM, 1 WATT, PURE U-235

FRACTION RETA ENERGY BELOW GIVEN ENERGY

GROUP	E (MEV)	COOLING TIMES									
		SHUTDOWN	60.0 SEC.	60.0 MIN.	12.0 HR.	1.0 DAYS	4.0 DAYS	10.0 DAYS	30.0 DAYS	60.0 DAYS	1.0 YRS.
1	3.00000+01	5.2876+02	7.3212+02	1.3287+01	2.0472+01	2.3201+01	2.5541+01	2.4884+01	2.3751+01	2.3054+01	2.0343+01
2	6.00000+01	1.3966+01	1.8818+01	3.0179+01	4.1544+01	4.4725+01	4.5120+01	4.2593+01	3.8265+01	3.5571+01	3.2725+01
3	9.00000+01	2.4283+01	3.1819+01	4.7379+01	6.0746+01	6.3878+01	6.2293+01	5.8653+01	5.2700+01	4.8583+01	4.3428+01
4	1.20000+00	3.4804+01	4.4242+01	6.1469+01	7.4238+01	7.7269+01	7.5683+01	7.2518+01	6.7227+01	6.3203+01	5.7871+01
5	1.40000+00	4.5080+01	5.5542+01	7.2482+01	8.3236+01	8.5874+01	8.4770+01	8.2572+01	7.8860+01	7.4821+01	7.3395+01
6	1.60000+00	5.4894+01	6.5675+01	8.1257+01	9.9913+01	9.2042+01	9.1810+01	9.0094+01	8.7975+01	8.4451+01	8.0466+01
7	2.10000+00	6.3772+01	7.4126+01	9.1145+01	9.8565+01	9.8167+01	9.5927+01	9.5286+01	9.4264+01	9.3609+01	9.0369+01
8	2.40000+00	7.1557+01	8.0942+01	9.1148+01	9.7402+01	9.8402+01	9.8409+01	9.8157+01	9.7765+01	9.7503+01	9.7827+01
9	2.70000+00	7.8256+01	8.6400+01	9.4842+01	9.8921+01	9.8633+01	9.8654+01	9.9594+01	9.9512+01	9.9453+01	9.9503+01
10	3.00000+00	8.3459+01	9.0692+01	9.6650+01	9.9496+01	9.9917+01	9.9952+01	9.9944+01	9.9932+01	9.9923+01	9.9923+01
11	3.30000+00	8.8368+01	9.3999+01	9.7856+01	9.9743+01	9.9977+01	9.9995+01	9.9994+01	9.9993+01	9.9992+01	9.9992+01
12	3.60000+00	9.1773+01	9.6553+01	9.8625+01	9.9842+01	9.9990+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
13	3.90000+00	9.4206+01	9.7888+01	9.9163+01	9.9898+01	9.9994+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
14	4.20000+00	9.5871+01	9.8797+01	9.9555+01	9.9944+01	9.9996+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
15	4.50000+00	9.7019+01	9.9116+01	9.9810+01	9.9975+01	9.9998+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
16	4.80000+00	9.7866+01	9.9637+01	9.9948+01	9.9993+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
17	5.10000+00	9.8500+01	9.9824+01	9.9996+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
18	5.40000+00	9.8947+01	9.9921+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
19	5.70000+00	9.9308+01	9.9966+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
20	6.00000+00	9.9557+01	9.9990+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
21	6.30000+00	9.9740+01	9.9996+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
22	6.60000+00	9.9869+01	9.9999+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
23	6.90000+00	9.9949+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
24	7.20000+00	9.9988+01	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00
25	7.50000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00	1.0000+00

Figure B.13

Figure B.14