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New Gamma-Ray Buildup Factor Data for Point Kernel Calculations: ANS-6.4.3 Standard Reference Data

D. K. Trubey

Radiation Shielding Information Center

RADIATION SHIELDING INFORMATION CENTER

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
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ABSTRACT

An American Nuclear Society Standards Committee Working Group, identified as ANS-6.4.3, has developed a set of evaluated gamma-ray isotropic point-source buildup factors and attenuation coefficients for a standard reference data base. The largely unpublished set of buildup factors calculated with the moments method has been evaluated by recalculating key values with Monte Carlo, integral transport, and discrete ordinates methods. Additional buildup factor data were obtained from PALLAS code results. Attention has been given to frequently-neglected processes such as bremsstrahlung and the effect of introducing a tissue phantom behind the shield. The proposed draft standard, provided as an appendix, contains data for a source energy range from 15 keV to 15 MeV and for 23 elements and 3 mixtures (water, air, and concrete). The buildup factor data are also represented as coefficients for the G-P fitting function. Tables giving correction factors for multiple scattering in tissue are also provided.

INTRODUCTION

Since the 1979 accident at Three Mile Island, it has become increasingly apparent that a comprehensive and reliable set of gamma-ray attenuation data would be very useful to engineers involved in postaccident analysis and control. At Three Mile Island, for example, the on-site engineers were asked on day two or three to assist in the evaluation of the activity of ^{133}Xe in the waste gas decay tanks (WGDT).[1] Xenon-133

emits several low-energy gamma rays, the most important at 80 keV. Dose rates had been measured by health physicists in the WGDT room, and U.S. Nuclear Regulatory Commission (NRC) personnel needed to know the activity of the ^{133}Xe in the tanks that caused those dose rates in order to estimate the dose rates to the offsite populations when the ^{133}Xe was vented. However, to determine the activity in the tanks, they needed gamma-ray attenuation data that would predict the penetration of the ^{133}Xe gamma rays through the tank walls.

Another need for such data occurred about 60 days after the accident when gamma-ray dose rates and energy spectra were measured outside the 3.8-cm-thick steel containment equipment hatch. The gamma rays were due to noble gases inside the containment vessel, and if gamma-ray attenuation data describing the penetration of the noble gas gamma rays through the steel had been available, the activity of the noble gases within the containment vessel could have been determined. Again, the offsite dose rates resulting from a purging of the noble gases from the containment vessel could have been readily determined.

Presently, under the "Lessons Learned from TMI" programs[2] instituted by NRC, plants must monitor releases from steam dump valves. Given the design constraints, attenuation data for low-energy gamma rays would be useful here also.

The above TMI incidents have only served to emphasize the need for such data. Over the years, the Radiation Shielding Information Center at Oak Ridge National Laboratory (ORNL) has had numerous requests for similar data, but no reliable and comprehensive compilations have been available to satisfy the requests. As a result, shielding calculations in the nuclear industry have continued to rely on point-kernel methods incorporating interpolated or unpublished buildup factors. Various computations of attenuation data exist, but most of the data used by engineers are data calculated with the moments method by Goldstein and Wilkins and published in 1954.[3] The Goldstein-Wilkins document, undoubtedly the most cited reference in shielding literature, has been a *de facto* standard for more than 30 years, but it lacks low-energy data and data for many needed materials.

Following the TMI accident, it was suggested to the relevant standards subcommittee of the American Nuclear Society (ANS) that the subcommittee assume responsibility for obtaining and/or generating a set of gamma-ray isotropic point-source buildup factors and attenuation coefficients for various engineering materials, evaluating them, and publishing them as a standard reference data base. ANS is a standards-writing organization member of the American National Standards Institute (ANSI), and the subcommittee to which the proposal was addressed was the Radiation Protection and Shielding Subcommittee (ANS-6) set up by the ANS Standards Committee. ANS-6 is charged with the responsibility for developing standards for radiation protection and shield design, providing shielding information to other standards-working groups, and developing standard reference shielding data and test problems. As is the case for all standards, the subcommittee's purpose in developing standards is to set forth acceptable practices, procedures, dimensions, material properties, specifications, etc. that have been agreed upon by rep-

resentatives of a broad segment of the subject activity. Ideally, because of the standardization process, a standard is a high-quality, highly reliable, comprehensive summary of the state of the art.

Thus, in response to the above suggestion, the chairman of Subcommittee ANS-6.4, Shielding Materials, led an organizational meeting in early 1980 to initiate an effort to develop an appropriate and comprehensive standard. Later, the author was appointed chairman of a new working group, designated as Working Group ANS-6.4.3, and members with special expertise were recruited from the following institutions: Bettis Atomic Power Laboratory, GA Technologies, Inc., Los Alamos National Laboratory, Pennsylvania State University, Indira Gandhi Centre for Atomic Research (India), and Tokyo Institute of Technology (Japan). (Additional organizational details are included in Appendix I.)

CHARTER OF WORKING GROUP ANS-6.4.3

After the first meeting of Working Group ANS-6.4.3 in November 1980, a charter was approved by the ANS Standards Steering Committee at its February 1981 meeting. The scope reads as follows:

This standard presents evaluated gamma-ray elemental attenuation coefficients and pure-material buildup factors for selected engineering materials for use in shielding calculations of structures at power plants and other nuclear facilities. The data cover the energy range 0.01–10 MeV and up to 20 mean free paths. These data are intended to be standard reference data for use in radiation analyses employing point-kernel methods.

Notification was subsequently received, in May 1982, that the charter had also been approved by the ANSI Nuclear Standards Management Board.

ACTIVITIES OF WORKING GROUP ANS-6.4.3

Before Working Group ANS-6.4.3 was organized, a data base of buildup factors and absorption coefficients based on moments method calculations was already in existence at the National Bureau of Standards (NBS) for a number of materials: $_{4}$Be, $_{5}$B, $_{6}$C, $_{7}$N, $_{8}$O, $_{11}$Na, $_{12}$Mg, $_{13}$Al, $_{14}$Si, $_{15}$P, $_{16}$S, $_{18}$Ar, $_{19}$K, $_{20}$Ca, $_{26}$Fe, $_{29}$Cu, $_{42}$Mo, $_{82}$Pb, $_{92}$U, water, air, and concrete.

Though the NBS data base is comprehensive, only the results for concrete, air, water, and iron have been published,[4] and thus most of the data are not yet generally available. Also, some outstanding questions concerning the data base needed to be resolved. For example, the moments method calculations did not take into account coherent scattering or bremsstrahlung, and the importance of these effects needed to be determined. In addition, there was an unknown uncertainty arising from the reconstructions of the moments.

With the large NBS data base available, it was decided that the first effort of the Working Group ANS-6.4.3 should concentrate on validating the buildup factors included in the data base for water, lead, and iron, at the same time investigating the importance of the neglected effects. The validation effort consisted of recalculations of the buildup factors for these materials by Monte Carlo, integral transport, and discrete ordinates methods. The Monte Carlo calculations, employing the MCNP code,[5] were carried out at Los Alamos National Laboratory (LANL). The integral transport calculations were done at the Indira Gandhi Centre for Atomic Research in India with the ASFIT code,[6] and the discrete ordinates-integral transport calculations were performed at Japan Atomic Energy Research Institute with the PALLAS code.[7]

TECHNICAL ISSUES ADDRESSED

Effect of Coherent Scattering

As noted above, the moments method calculations do not account for coherent scattering. Our own Monte Carlo calculations tend to confirm statements in the literature that coherent scattering can be neglected for most shielding calculations with the proviso that the total attenuation coefficient used in the calculations does not include it. Several MCNP calculations were performed to evaluate the effect of neglecting coherent scattering. These preliminary calculations were exploratory in nature, but indicated that the effect of neglecting coherent scattering could be as great as 40% for the dose at 20 mfp in the case of a 100-keV source in iron. More definitive Monte Carlo calculations have recently been reported by Hirayama and Trubey.[8] The results for water, iron, and lead have been recast for Table 1 as correction factors. These arise due to the neglect of both coherent and bound-electron incoherent scattering in most transport calculations. These corrections are the ratio of a "pseudo" buildup factor (coherent, bound) to the "true" buildup factor (without coherent, free electron) and apply to distances in mean free paths using attenuation coefficient without coherent scattering. The pseudo buildup factor[8] differs from the true buildup factor because of an inconsistency in the cross sections used for the scattered and uncollided doses. It can be observed that these corrections can either increase or decrease the dose as calculated from the standard buildup factors.

Tables of the total attenuation coefficients for 35 elements and three mixtures are provided in the draft standard. Values are given in one table for the attenuation coefficient which includes coherent and incoherent (bound-electron Compton) scattering. Values are given in another table for the attenuation coefficient without coherent scattering and uses the free-electron Compton collision cross section. This is consistent with use of similar cross sections based on Ref. 9 generally used in the transport calculations. The tables were produced with the help of the Berger XCOM code and data library.[10] The free-electron Compton cross section values were obtained from Ref. 11. It should be noted that the effects of including coherent and incoherent (bound-electron) scattering tend to cancel; it is best to include or neglect both effects rather than one or the other in a transport calculation.

Table 1

Coherent-Incoherent Correction Factors

Water

Depth(mfp)	40 keV	60 keV	80 keV	100 keV	200 keV
0.5	1.00	0.99	1.00	1.01	1.00
1.0	1.00	1.00	1.00	1.00	1.01
2.0	1.03	1.01	1.02	1.01	1.00
3.0	1.04	1.02	1.03	1.02	1.02
4.0	1.03	1.01	1.03	1.05	1.05
5.0	1.09	1.07	1.06	1.03	1.04
6.0	1.07	1.08	1.06	1.06	1.03
7.0	1.08	1.13	1.09	1.09	1.06
8.0	1.10	1.13	1.11	1.13	1.11
9.0	1.22	1.17	1.12	0.98	1.14
10.	1.16	1.28	1.05	1.07	1.13

Iron

Depth(mfp)	40 keV	60 keV	100 keV	200 keV
0.5	1.00	1.02	0.99	1.00
1.0	1.01	1.01	1.01	1.01
2.0	0.99	1.01	1.01	1.03
3.0	0.98	1.00	1.01	1.04
4.0	0.97	1.00	1.03	1.04
5.0	0.94	0.98	1.04	1.08
6.0	0.93	0.98	1.02	1.08
7.0	0.92	0.97	1.01	1.10
8.0	0.87	0.95	1.04	1.13
9.0	0.82	0.88	1.00	1.13
10.	0.82	0.89	0.98	1.15

Lead

Depth (mfp)	40 keV	60 keV	80 keV	100 keV	150 keV	200 keV
0.5	1.00	1.01	1.01	1.01	1.00	1.01
1.0	1.00	1.01	1.01	1.01	1.01	1.02
2.0	1.00	0.99	0.99	1.01	1.01	1.02
3.0	0.97	0.96	0.96	1.02	1.00	1.00
4.0	0.94	0.94	0.93	1.02	0.99	1.00
5.0	0.91	0.90	0.89	1.00	0.97	0.98
6.0	0.89	0.87	0.87	0.99	0.97	0.96
7.0	0.86	0.82	0.83	1.00	0.94	0.96
8.0	0.82	0.80	0.76	0.98	0.94	0.93
9.0	0.77	0.75	0.70	0.98	0.89	0.97
10.	0.72	0.71	0.66	0.99	0.91	0.91

Effect of Secondary Sources

The Goldstein-Wilkins data do not include secondary sources such as annihilation, fluorescence, and bremsstrahlung. ASFIT calculations[12] confirm the importance of all three sources in general, although of varying importance for different materials and source energies.

The NBS moments method data do not include bremsstrahlung, but ASFIT and PALLAS calculations do. Such data are important for high-Z materials and for the higher source energies. Typical results of the PALLAS code are given in Table 2.[13]

Table 2. Bremsstrahlung effect on exposure buildup factor for a point isotropic source in lead

Distance (mfp)	Energy (MeV)			
	4	8	10	15
10	5.46	4.97	4.7	4.3
	5.80	8.97	13.8	32.8
20	15.4	30.0	40	81
	16.1	53.6	128	783
40	61.5	817	2620	34,800
	63.7	1310	7510	300,000

Upper entry: No bremsstrahlung; lower entry: bremsstrahlung included. Data of Tekeuchi and Tanaka, PALLAS Code.

Selection of Response Function

There is no universally recognized standard response function for the determination of buildup factors. Traditionally, the response medium has been air, which implies exposure as the endpoint, and hence exposure buildup factors are frequently found in the literature. It would be better if the endpoint were dose equivalent in a reasonably realistic geometry, which implies a tissue phantom geometry. An ANSI standard issued in 1977[14] gives guidance for the estimation of dose equivalent in tissue when one knows the spectrum impinging upon the tissue phantom. This is not logically applicable to the point-kernel method, however, since it is based on a knowledge of the source spectrum rather than the impinging spectrum, and the buildup factor used is derived from an infinite-medium calculation.

On the other hand, the estimated dose for radiation protection purposes should include the effect of multiple scattering in tissue (as the ANSI standard does), rather than in an infinite medium of shielding material alone. In the case of a water shield, the effect of replacing some of the water with tissue is not great, but in the case of a lead shield, the effect is quite large. For a source energy of 0.2 MeV, the lead correction factor for radiation protection purposes is as large as 1.45.[15] This correction factor, and similar correction factors for other cases can be deduced from the ratio of the column 4 values to the column 1 values shown in Table 3. The table shows buildup factors in slab geometry for an infinite medium of lead (column 1), a finite slab of lead (column 2), and lead-tissue sequence (columns 3 and 4). The buildup factor given in column 4 is the maximum in the tissue.

Recently, more extensive calculations by Gopinath, Subbaiah, and Trubey have been published.[16] Their correction factors for eight materials are given in the ANS-6.4.3 standard as Table 7.

Table 3. Plane collimated buildup factors for lead[a]

E (MeV)	Thickness (mfp)	Buildup factor[b] 1	2	3	4
0.05	1	1.02	1.01	1.69	1.74
	2	1.02	1.01	1.70	1.75
	5	1.03	1.02	1.71	1.84
	10	1.03	1.03	1.71	1.77
	20	1.04	1.04	1.74	1.78
0.20	1	1.23	1.16	1.74	1.76
	2	1.26	1.20	1.80	1.83
	5	1.36	1.29	1.94	1.98
	10	1.51	1.41	2.14	2.16
	20	1.81	1.64	2.47	2.48
1.0	1	1.38	1.36	1.53	1.53
	2	1.65	1.63	1.84	1.84
	5	2.29	2.24	2.56	2.56
	10	3.06	3.01	3.46	3.46
	20	4.18	4.09	4.75	4.75
3.0	1	1.49	1.40	1.51	1.51
	2	1.85	1.76	1.89	1.89
	5	2.95	2.78	3.05	3.05
	10	4.80	4.56	5.03	5.03
	20	8.68	8.15	9.16	9.16

[a]From Ref. 15.

[b]1 = infinite medium; 2 = finite medium, 3 = interface; and 4 = corrected (tissue maximum).

Another problem in selecting a response function is that there is no standard composition or geometry for tissue. Because of the lack of standardization, Hubbell[17] has given energy deposition coefficients for several tissues reported by the ICRP and ICRU.

In view of the above problems, Working Group ANS-6.4.3 provides exposure and energy absorption buildup factor data only.

Source of Buildup Factor Data

All of the data selected for the compilation were computed by codes which use point values in the energy variable, thus eliminating one source of uncertainty associated with multigroup codes. They also used an accurate algorithm for the Klein-Nishina cross section, eliminating another source of error inherent in

codes which use a Legendre expansion. The codes used were ADJMOM-I (moments method), ASFIT (discrete ordinates-integral transport), and PALLAS (discrete ordinates-integral transport).

The code ADJMOM-I, written by Simmons,[18] was used to calculate adjoint moments of the energy fluence at a plane isotropic detector in an infinite medium. These were then converted to moments for a point isotropic detector by a simple transformation. The distributions constructed from these moments can be interpreted as the importance of the l'th Legendre harmonic of photons of energy E at a distance r from a point isotropic detector contributing to the dose at that detector. For l = 0, this reduces to the importance of photons from an isotropic source to an isotropic detector. With appropriate normalization, the moments for l = 0 should be exactly the same as those obtained by an ordinary moments calculation for a point isotropic source.

The ASFIT code implements a semianalytical technique for the solution of the transport equation in one-dimensional finite systems. The method is applicable to multiregion, multivelocity systems with arbitrary degree of anisotropy. The transport equation is written in the form of coupled integral equations separating spatial and energy-angle transmission. The space and energy-angle transmission kernels are evaluated analytically. The numerical part of the method consists of a fast-converging iterative technique used for solution of the integral equations. The code employs a nodal structure in space with quadratic interpolation of sources to evaluate the spatial integral in the flux computation. This method is known to give results with very high accuracy.

ASFIT employs a nodal structure in the wave-length (energy) domain. The collision integral to obtain the scattered source density is evaluated using linear interpolation of fluxes and cross sections between the nodes.

The other relevant feature of the code is that it explicitly takes into account the generation and transport of annihilation, bremsstrahlung, and fluorescence radiations.

It should be mentioned that the values computed by the ASFIT code are for a plane isotropic source, and these are subsequently converted to the point isotropic source case, using the relation

$$B^{pt}(x) = B^{pl}(x) - x\exp(x)E_1(x)\frac{d}{dx}B^{pl}(x) , \tag{1}$$

where $B^{pt}(x)$ is the point source buildup factor, and $B^{pl}(x)$ is the plane source buildup factor.

The PALLAS-PL, SP-BR computer code solves the energy- and angular-dependent Boltzmann transport equation with general anisotropic scattering in plane and spherical geometries. Principal applications are to neutron and gamma-ray transport problems in the forward mode. The code is particularly designed for and suited to the solution of radiation shielding problems with an external source.

The code is based on a method of direct integration of the transport equation in which the equation is solved by integrating along a flight path of radiation in the direction of motion at each discrete-ordinate

angle. The specific features of this method are that (1) the radiation flux is calculated at each energy mesh without using any conventional iterative techniques as is used widely in the S_n method for obtaining the flux in each energy group, and (2) the scattering calculations are made directly using the differential scattering cross section for neutrons and the Klein-Nishina formula for gamma rays. Thus, a Legendre polynomial expansion approximation as used widely in the S_n method is not applied to the calculation of radiation scattering. As a result, PALLAS can provide always positive and physically meaningful angular and scalar fluxes. In addition, (3) no supplementary difference equations are required to obtain a solution to the flux, which frees users from making a choice of such modes as "diamond difference", "step function", and "weighted difference" equations. By virtue of no usage of average flux, PALLAS can be applied to even such problems as violently varied angular and spatial flux distributions.

The majority of the data selected for the standard are from the NBS moments method calculations. The materials are Be, B, C, N, O, Na, Mg, Al, Si, P, S, Ar, K, Ca, Fe, Cu, water, air, and concrete. Data for the remaining materials were taken from more recent PALLAS calculations.[13,19] The materials are Mo, Sn, La, Gd, W, Pb, and U. ASFIT calculations were used generally for comparison purposes. The low-energy (0.03 – 0.3 MeV) values for Be were taken from Ref. 20 which compared results from three codes, PALLAS, ANISN,[21] and EGS4.[22]

Fitting Functions

Although some analysts prefer to use data tables directly in computer calculations, others prefer parameterized forms. Over the years a number of functional forms have been used to parameterize attenuation data, in particular, the Taylor and Berger forms. For the usual Taylor form and for the Berger form, accuracy is a problem for low-Z materials and low energies. It is now clear that the best available form is the geometric progression (G-P) form.[23-25]

This formula can accurately reproduce the data over the full range of energy and atomic number within a few percent. For example, the maximum deviation to 40 mean free paths of water for the the exposure buildup factor is 3%. In Table 4, "Max. dev." is the maximum deviation from the moments method results for $0 \leqslant x \leqslant 40$ mfp. The maximum occurs at X_{max}. Table 4 shows the standard deviation in the last column. The G-P function is:

$$\begin{aligned} B(E,x) &= 1 + (b-1)\,(K^x-1)/(K-1) \quad \text{for } K \neq 1 \\ &= 1 + (b-1)x \qquad\qquad\qquad\quad \text{for } K = 1 \,, \end{aligned} \tag{2}$$

$$K(x) = cx^a + d \cdot \frac{\tanh(x/X_k - 2) - \tanh(-2)}{1 - \tanh(-2)}] \,, \tag{3}$$

where x is the source-detector distance in mean free paths (mfp), b is the value of the buildup factor at 1 mfp, and K is the multiplication per mfp. Equation (2) represents the dependence of K on x; a, c, d, and X_k are fitting parameters which depend on source energy.

The G-P fitting function has been implemented in the CCC-493/QAD-CGGP and CCC-494/G33-GP codes[26-27] available from RSIC at Oak Ridge National Laboratory. Fitting function parameters and attenuation coefficient data for 22 materials and 2 response functions are utilized in the form of data files. This will allow easy modification as the new data becomes available. If these data are incorporated in other codes, it is recommended that the same format be used so that revised data can be easily incorporated. The two FORTRAN 77 codes have been tested at RSIC on CRAY X-MP, IBM 3033, Data General Eclipse MV/4000, and IBM PC computers.

Table 4. G-P Coefficients for Water

Water Kerma								
E(MeV)	b	c	a	X_K	d	Max. dev.(%)	X_{max}	St. dev.(%)
0.015	1.188	0.464	0.172	14.00	-0.0829	1.37	0.5	0.508
0.020	1.449	0.532	0.152	14.61	-0.0764	1.91	0.5	0.730
0.030	2.411	0.741	0.084	14.62	-0.0452	2.29	0.5	1.065
0.040	3.587	1.114	-0.018	12.48	0.0013	0.68	0.5	0.248
0.050	4.554	1.457	-0.084	13.69	0.0341	1.47	35.0	0.977
0.060	5.018	1.735	-0.127	13.70	0.0676	2.37	35.0	1.564
0.080	5.030	2.054	-0.167	13.84	0.0763	3.00	35.0	1.982
0.100	4.627	2.207	-0.184	13.27	0.0799	2.98	10.0	1.885
0.150	3.888	2.206	-0.180	14.27	0.0738	2.37	0.5	1.478
0.200	3.462	2.132	-0.173	14.51	0.0750	2.36	0.5	1.335
0.300	2.897	2.008	-0.162	14.18	0.0641	2.40	35.0	1.412
0.400	2.646	1.874	-0.148	14.16	0.0591	2.41	35.0	1.377
0.500	2.499	1.749	-0.132	14.36	0.0517	2.00	1.0	1.195
0.600	2.383	1.662	-0.121	14.19	0.0482	1.97	35.0	1.224
0.800	2.223	1.524	-0.101	14.31	0.0403	1.97	1.0	1.078
1.000	2.106	1.436	-0.088	14.19	0.0367	1.68	0.5	0.970
1.500	1.948	1.265	-0.057	14.98	0.0245	1.51	0.5	0.616
2.000	1.843	1.169	-0.038	14.22	0.0157	1.61	0.5	0.551
3.000	1.716	1.050	-0.011	13.63	0.0027	0.97	0.5	0.314
4.000	1.633	0.979	0.007	14.23	-0.0060	0.65	0.5	0.252
5.000	1.571	0.928	0.022	13.20	-0.0157	0.62	4.0	0.336
6.000	1.521	0.893	0.033	11.92	-0.0208	1.87	1.0	0.636
8.000	1.432	0.873	0.038	11.56	-0.0204	0.59	3.0	0.355
10.000	1.378	0.849	0.045	14.34	-0.0280	0.98	0.5	0.574
15.000	1.280	0.829	0.052	14.85	-0.0367	1.23	3.0	0.688

Table 4. Continued

Air kerma (exposure)								
E(MeV)	b	c	a	X_K	d	Max. dev.(%)	X_{max}	St. dev.(%)
0.015	1.182	0.463	0.175	14.23	-0.0908	1.69	0.5	0.634
0.020	1.427	0.549	0.143	14.86	-0.0707	2.31	0.5	0.780
0.030	2.335	0.736	0.087	13.28	-0.0419	2.34	0.5	1.180
0.040	3.477	1.117	-0.019	11.67	0.0026	0.89	0.5	0.298
0.050	4.461	1.457	-0.084	13.62	0.0341	1.26	10.0	0.850
0.060	4.983	1.730	-0.126	13.64	0.0561	2.22	10.0	1.563
0.080	5.059	2.059	-0.168	13.67	0.0770	2.94	35.0	1.946
0.100	4.663	2.221	-0.186	13.33	0.0826	3.02	10.0	1.925
0.150	3.897	2.242	-0.185	14.19	0.0777	2.55	15.0	1.584
0.200	3.478	2.154	-0.176	14.50	0.0774	2.50	0.5	1.492
0.300	2.920	2.022	-0.164	14.21	0.0655	2.46	1.0	1.471
0.400	2.660	1.882	-0.149	14.24	0.0595	2.17	35.0	1.372
0.500	2.500	1.766	-0.135	14.33	0.0546	2.46	1.0	1.380
0.600	2.377	1.679	-0.124	14.23	0.0503	2.02	1.0	1.265
0.800	2.212	1.544	-0.105	14.36	0.0437	1.97	0.5	1.186
1.000	2.103	1.441	-0.089	14.22	0.0378	1.55	0.5	0.895
1.500	1.939	1.269	-0.058	14.52	0.0246	1.91	0.5	0.757
2.000	1.839	1.173	-0.039	14.07	0.0161	1.45	0.5	0.522
3.000	1.710	1.056	-0.013	11.82	0.0047	0.70	0.5	0.239
4.000	1.621	0.989	0.004	13.45	-0.0041	0.55	1.0	0.211
5.000	1.554	0.939	0.018	13.55	-0.0122	0.51	30.0	0.333
6.000	1.507	0.903	0.029	16.13	-0.0272	0.85	25.0	0.475
8.000	1.422	0.879	0.035	13.36	-0.0191	0.89	0.5	0.445
10.000	1.362	0.859	0.042	13.37	-0.0247	0.90	0.5	0.453
15.000	1.267	0.843	0.047	15.08	-0.0336	1.02	1.0	0.604

In the present draft of the standard, only G-P fitting function data are provided. It is expected that Taylor coefficients will become available in the next draft for at least part of the energy domain.

In summary, modern buildup factor data are now available across the whole range of atomic number and source energies, and an accurate fitting function is available to reproduce these data in point kernel calculations on computers of all sizes.

ACKNOWLEDGMENTS

The present status of this project is the result of a great deal of effort by a number of people dedicated to compiling the best possible data base to serve as standard reference data. The author would particularly acknowledge Charlie Eisenhauer who provided the original data base and who has spent much time analyzing and comparing various results; John Hubbell, who provided guidance in the cross section area; Kal Shure and Joe Wallace for their checking of data and contribution of Taylor coefficients.

We acknowledge with deep gratitude the vital contributions of Yoshiko Harima, Shun-ichi Tanaka, Yukio Sakamoto, Hideo Hirayama, and their co-workers in Japan. Dr. Harima used the G-P method to improve the moments method data, performed many hours of critical analysis, and led the efforts to provide the G-P coefficients. Dr. Tanaka improved the PALLAS code in several respects to help assure accurate and reliable results. Dr. Sakamoto helped develop the G-P equations, developed the code to produce the G-P coefficients, determined the G-P parameters, and developed interpolation algorithms for use in codes which evaluate the buildup factor. Drs. Sakamoto and Tanaka performed many PALLAS calculations to provide the data base from molybdenum to uranium. Drs. Harima and Hirayama and their co-workers investigated the effect of coherent and incoherent (bound-electron) scattering on the buildup factor and investigated transport in low-Z materials for low energies.

We also acknowledge with deep gratitude the vital efforts of D. V. Gopinath, K. V. Sabbaiah, and co-workers in India who made important calculations to compare with moments data, investigated the effect of secondary radiations, such as bremsstrahlung and fluorescence radiation, and investigated the effect of the shield-tissue interface.

The author would also like to thank the other members of the working group: Tony Foderaro, Shiaw-Der Su, and W. L. (Buck) Thompson, who made key contributions.

In addition, the author wishes to acknowledge the support of the Nuclear Regulatory Commission (NRC) through the Technical Data Management Center at ORNL. William E. Kreger played a key role at NRC in support of this project when it was started.

The acknowledgments are not listed in order of importance; all these efforts were necessary to achieve what we believe to be a reliable state-of-the-art compilation of standard reference data. It would not have been possible without the framework of a standards-development type of effort in which many people contribute, and there is sufficient time to thoroughly validate the data. It has been a truly international cooperative effort.

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APPENDIX I

APPENDIX I

The American Nuclear Society Standards Steering Committee is chaired by John H. Crowley, United Engineers and Constructors, Inc., who also represents the society on the Nuclear Standards Management Board of ANSI. Marilyn D. Weber is the Committee Administrative Secretary and ANS Standards Manager.

Subcommittee ANS-6, Radiation Protection and Shielding, is chaired by D. K. Trubey. E. Normand, of Boeing, chairs ANS-6.4, Materials.

Working Group ANS-6.4.3 is chaired by D. K. Trubey. Group members are:

C. M. Eisenhauer, National Bureau of Standards, Washington, D. C.,

A. Foderaro, Pennsylvania State University, State College, Penn.,

D. V. Gopinath, Indira Gandhi Centre for Atomic Research, Kalpakkam, India,

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APPENDIX II

Draft of ANSI/ANS-6.4.3

ANSI/ANS-6.4.3
Draft 2, Rev. 3
July 1988

DRAFT

CAUTION NOTICE: This standard is being prepared or reviewed and has not been approved by ANSI. It is subject to revision or withdrawal before issue.

DRAFT

AMERICAN NATIONAL STANDARD

Gamma-Ray Attenuation Coefficients and Buildup Factors for Engineering Materials

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FOREWORD

(This foreword is not a part of American National Standard Gamma-Ray Attenuation Coefficients and Buildup Factor for Engineering Materials, ANSI/ANS-6.4.3.)

It came to the attention of Subcommittee ANS-6, Radiation Protection and Shielding, of the American Nuclear Society Standards Committee following the 1979 Three-Mile Island accident that gamma-ray attenuation data for several needed materials, especially for the lower energies, was lacking. It was also known by the subcommittee that data available in the literature are not always in good agreement. Therefore, it was felt by the subcommittee that an evaluated standard reference data set would be useful to engineers involved in radiation accident response as well as for routine shield design.

During 1980, the Working Group ANS-6.4, charged with the oversight of standards on shielding materials, organized a meeting to consider developing the needed standard. At this meeting the first scope was drafted and a decision made that a new working group, later designated ANS-6.4.3, be formed to develop the proposed standard. Following this meeting, a chairman was found and members with special expertise and experience were recruited.

Early in the work, the group decided that the best set of available buildup factors were those computed at the National Bureau of Standards, only a fraction of which had been published. These covered a broad energy range and covered the range of materials needed from atomic number 4 (Be) to 92 (U). Before accepting the data, however, the group undertook a validation process by making Monte Carlo and other transport theory calculations and comparing with reported values in the literature. During the validation process many changes were made, and data for additional materials were obtained from calculations performed in Japan and India.

In view of the fact that there are several standard gamma-ray response functions and the whole subject is under review by ICRP, ANS-6.1.1, and others, the group decided to present exposure and energy absorption buildup factors.

It was recognized by the working group that most use of buildup factors are for point kernel calculations which assume radiation leakage from a shield and energy absorption in a phantom. This configuration is a significant departure from the infinite medium which is assumed when determining the buildup factors, especially in the case of a heavy-element shield such as lead. Therefore, a table of correction factors are presented to provide a means of taking this into account.

The attenuation and energy absorption coefficients were relatively easy to obtain; they were obtained from published and unpublished data of the NBS Photon Cross Section Center, a unit of the National Standard Reference Data System.

The membership of Working Group ANS-6.4.3 is as follows:

D. K. Trubey, Chairman, Oak Ridge National Laboratory
C. M. Eisenhauer, National Bureau of Standards
A. Foderaro, Pennsylvania State University
D. V. Gopinath, Indira Gandhi Centre for Atomic Research, India
Y. Harima, Tokyo Institute of Technology, Japan
J. H. Hubbell, National Bureau of Standards
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Gamma-Ray Attenuation Coefficients and Buildup Factors
for Engineering Materials

1. Scope

This standard presents evaluated gamma-ray elemental attenuation coefficients and single-material buildup factors for selected engineering materials for use in shielding calculations of structures in power plants and other nuclear facilities. The data cover the energy range 0.015-15 MeV and up to 40 mean free paths. These data are intended to be standard reference data for use in radiation analyses employing point-kernel methods.

2. Definitions

Attenuation coefficient. Of a substance, for a parallel beam of specified radiation: the quantitity μ, in the expression $\mu\, dx$ for the fraction removed by attenuation in passing through a thin layer of thickness dx of that substance. It is a function of the energy of the radiation. As dx is expressed in terms of length, mass per unit area, moles or atoms per unit area, μ, is called the linear, mass, molar, or atomic attenuation coefficient respectively.

Energy absorption coefficient. Of a substance, for a parallel beam of specified radiation: the quantity μ_{en} in the expression $\mu_{en}\, dx$ for the fraction absorbed in passing through a thin layer of thickness dx of that substance. It is a function of energy of the radiation. As dx is expressed in terms of length, mass per unit area, moles per unit area, or atoms per unit area, μ_{en} is called the linear, mass, molar, or atomic absorption coefficient.

Note: It is that part of the attenuation coefficient resulting from energy absorption only, and is equal to the product of the energy transfer coefficient and $1 - g$, where g is the fraction of the energy of secondary charged particles that is lost to bremsstrahlung in the material.

Buildup factor. In the passage of radiation through a medium, the ratio of the total value of a specified radiation quantity at any point to the contribution to that value from radiation reaching the point without having undergone a collision.

Buildup factor, exposure, B_D. A photon buildup factor in which the quantity of interest is exposure. The energy response function is that of absorption in air.

Buildup factor, energy absorption, B_A. A photon buildup factor in which the quantity of interest is the absorbed or deposited energy in the shield medium. The energy response function is that of absorption in the material.

Correction factor, shield-tissue interface. A correction factor to be applied to the basic infinite-medium exposure buildup factor to correct for the scattering in a tissue phantom after emerging from a shield.

Fitting function, Taylor. A buildup factor function of distance from the source in the form:

$$B(E,x) = A_1 \exp(-a_1 x) + A_2 \exp(-a_2 x)$$

where x is the distance from the source in mean free paths and parameters A_1, a_1, *and* a_2 are functions of the attenuating medium and the source energy, E. The fourth parameter, A_2, is constrained to equal $1 - A_1$.

Fitting function, G-P. A buildup factor function of distance from the source in the form:

$$B(E,x) = 1 + (b-1)(K^x - 1)/(K-1) \qquad \text{for } K \neq 1 \text{ and}$$

$$B(E,x) = 1 + (b-1)x \qquad \text{for } K = 1. \tag{1}$$

$$K(E,x) = cx^a + d\,[\tanh(x/X_k - 2) - \tanh(-2)]/[1 - \tanh(-2)], \tag{2}$$

where x is the distance from the source in mean free paths, b is the value of the buildup factor at 1 mfp, and K is the multiplication per mfp. Equation (2) represents the dependence of K on x; a, c, d, and X_k are fitting parameters which depend on the attenuating medium and source energy, E.

3. Sources of Data

3.1. The mass attenuation coefficients and energy absorption coefficients were taken from evaluations of the Photon Cross Section Center at the National Bureau of Standards. The most recently published compilations are given in Ref. 1 and 2. Additional data were provided in the data library of Martin Berger[3] and combined with the Compton free-electron cross section to provide the cross sections without coherent scattering.

3.2. The primary source of buildup factor data was the series of moments method calculations carried out at the National Bureau of Standards (NBS) described in Ref. 4 and 5. The data for concrete, iron, water, and air are taken from those references. Most of the remainder (Be, B, C, N, O, Na, Mg, Al, Si, P, S, Ar, K, Ca, Cu) were unpublished data determined in a similar manner at NBS. Additional validation was accomplished by making calculations using the MCNP Monte Carlo code[6] and the ASFIT discrete ordinates-integral transport theory code.[7–8] The moments method results do not include the effect of bremsstrahlung generation and transport.

Reconstruction of the flux density from the moments sometimes results in spurious oscillation. The G-P fitting function parameters were carefully analyzed, and buildup factors values which did not permit reasonable interpolation were replaced. In addition, the low-energy (0.03 – 0.3 MeV) values for Be were taken from Ref. 9 which compared results from three codes, PALLAS, ANISN[10] and EGS4.[11]

3.3. Buildup factor values for Mo, Sn, La, Gd, W, Pb, and U were determined with the discrete ordinates-integral transport theory PALLAS code[12–15] and validated by comparison with results of the ASFIT code and with G-P fitting function analysis to assure smooth interpolation. Both PALLAS and ASFIT treat the Klein-Nishina scattering cross section accurately and include all secondary radiations, including bremsstrahlung.

3.4. The G-P fitting function coefficients were determined at Japan Atomic Energy Research Laboratory and Tokyo Institute of Technology. The G-P fitting function[16] reproduces the basic buildup factor over the whole range energy, atomic number, and shield thickness within a few per cent and is the fitting function of choice for point kernel calculations.

3.5. The Taylor fitting function coefficients were determined at Bettis Atomic Power Laboratory (not available for present draft).

3.6 In evaluating the energy deposition in tissue exposed to gamma radiation, it should be noted that the radiation field itself may be altered by the presence of the tissue. In particular, the spectrum at the shield-tissue interface can quite different from that of an infinite shield medium due to the backscattering of the tissue. Furthermore, the maximum radiation dose to the tissue may not be located at its surface but somewhere inside, due to the buildup of degraded photons by multiple scattering within the tissue. The buildup factors presented in the tables are for an infinite medium of shielding material, and must be corrected, if more realistic dose values are to be obtained for radiation protection purposes.

Calculations have been performed at the Indira Gandhi Centre for Atomic Research which allow such corrections to be made.[17] These calculations determine the dose and buildup factor at a shield-tissue interface and within the tissue near the interface. The source is a plane parallel beam (1 photon cm^{-2} s^{-1}) normally incident on the shield. The calculation took into account the scattering in both the shield and tissue phantom in slab geometry and determined the peak energy deposition in the tissue. The factors, shown in Table 7, are independent of shield thickness and source angular distribution to a satisfactory degree.

4. Applications of this Standard in Practice

4.1. Coherent scattering was neglected in computing the buildup factor for the data presented in this standard, and therefore the attenuation coefficient (without coherent) should be used to determine the number of mean free paths at the source energy. It should be recognized that neglecting coherent scattering and assuming free-electron Compton scattering can result in an error in the buildup factor of more that 20% for energies below about 20 keV and shield thicknesses near 10 mfp.[18]

4.2. For radiation protection purposes, in point kernel calculations of massive shields, the shield-tissue interface correction factors of Table 7 should be applied to account for scattering in a tissue phantom following the shield. The last column in the table gives the correction factor that should be applied to the infinite medium exposure buildup factor to obtain the corrected dose. The energy absorption coefficient (Table 2) should be used to determine the tissue dose from the uncollided flux density. These corrections are necessary for high-Z materials below about 0.5 MeV. For shield materials not given in the table, interpolations in Z are necessary.

4.3. For high-Z materials, the buildup factors near shell edges can become very large due to the non-continuous nature of the cross sections. This can be observed, for example, in the values for lead in the region near 0.1 MeV. Discussions of this phenomenon are contained in Ref. 19. For point kernel calculations, it is recommended that the source energies not be placed near shell edges. If it is desired to use buildup factors near shell edges, additional data are available in Ref. 14 and 15 at energies more closely spaced in the energy region of the edges.

4.4. The buildup factor, attenuation coefficient, and absorption coefficient compilation are available in computer-readable form from the Radiation Shielding Information Center at Oak Ridge National Laboratory as DLC-129/ANS643.[20] The package includes a Fortran program (Daniel) to reproduce a table of buildup factors. The program includes routines to implement the G-P technology for interpolating in energy and Z and extrapolating in thickness.

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Table 1a
Photon Mass Attenuation Coefficients (cm^2/g)
(without coherent scattering)

E(MeV)	$_1H$	$_3Li$	$_4Be$	$_5B$	$_6C$	$_7N$	$_8O$
0.010	3.854E−01	3.028E−01	5.941E−01	1.182E+00	2.268E+00	3.736E+00	5.760E+00
0.015	3.765E−01	1.985E−01	2.782E−01	4.407E−01	7.477E−01	1.157E+00	1.731E+00
0.020	3.695E−01	1.740E−01	2.073E−01	2.746E−01	4.036E−01	5.668E−01	7.985E−01
0.030	3.571E−01	1.589E−01	1.705E−01	1.930E−01	2.368E−01	2.808E−01	3.440E−01
0.040	3.458E−01	1.519E−01	1.588E−01	1.714E−01	1.960E−01	2.133E−01	2.382E−01
0.050	3.355E−01	1.467E−01	1.520E−01	1.612E−01	1.793E−01	1.876E−01	1.998E−01
0.060	3.261E−01	1.424E−01	1.469E−01	1.546E−01	1.698E−01	1.744E−01	1.811E−01
0.080	3.091E−01	1.348E−01	1.387E−01	1.451E−01	1.578E−01	1.596E−01	1.623E−01
0.100	2.944E−01	1.283E−01	1.319E−01	1.377E−01	1.493E−01	1.502E−01	1.515E−01
0.150	2.651E−01	1.155E−01	1.186E−01	1.237E−01	1.337E−01	1.340E−01	1.344E−01
0.200	2.429E−01	1.058E−01	1.087E−01	1.133E−01	1.224E−01	1.226E−01	1.228E−01
0.300	2.113E−01	9.204E−02	9.452E−02	9.851E−02	1.064E−01	1.065E−01	1.066E−01
0.400	1.893E−01	8.246E−02	8.468E−02	8.825E−02	9.531E−02	9.537E−02	9.543E−02
0.500	1.729E−01	7.530E−02	7.733E−02	8.058E−02	8.704E−02	8.708E−02	8.713E−02
0.600	1.599E−01	6.968E−02	7.155E−02	7.457E−02	8.054E−02	8.057E−02	8.062E−02
0.800	1.405E−01	6.119E−02	6.284E−02	6.549E−02	7.073E−02	7.076E−02	7.080E−02
1.000	1.263E−01	5.502E−02	5.650E−02	5.888E−02	6.360E−02	6.362E−02	6.366E−02
1.500	1.027E−01	4.475E−02	4.597E−02	4.792E−02	5.176E−02	5.180E−02	5.184E−02
2.000	8.770E−02	3.829E−02	3.937E−02	4.108E−02	4.442E−02	4.449E−02	4.457E−02
3.000	6.922E−02	3.042E−02	3.137E−02	3.283E−02	3.561E−02	3.578E−02	3.595E−02
4.000	5.807E−02	2.572E−02	2.663E−02	2.798E−02	3.047E−02	3.073E−02	3.100E−02
5.000	5.049E−02	2.257E−02	2.347E−02	2.477E−02	2.708E−02	2.742E−02	2.777E−02
6.000	4.498E−02	2.030E−02	2.121E−02	2.248E−02	2.469E−02	2.510E−02	2.552E−02
8.000	3.746E−02	1.725E−02	1.819E−02	1.945E−02	2.154E−02	2.209E−02	2.263E−02
10.00	3.254E−02	1.529E−02	1.627E−02	1.755E−02	1.960E−02	2.024E−02	2.089E−02
15.00	2.539E−02	1.252E−02	1.360E−02	1.495E−02	1.698E−02	1.782E−02	1.866E−02
20.00	2.153E−02	1.109E−02	1.226E−02	1.369E−02	1.575E−02	1.673E−02	1.770E−02
30.00	1.748E−02	9.686E−03	1.100E−02	1.255E−02	1.472E−02	1.588E−02	1.706E−02

Table 1a
Photon Mass Attenuation Coefficients (cm^2/g)
(without coherent scattering)

E(MeV)	$_{11}Na$	$_{12}Mg$	$_{13}Al$	$_{14}Si$	$_{15}P$	$_{16}S$	$_{17}Cl$
0.010	1.521E+01	2.062E+01	2.574E+01	3.334E+01	3.979E+01	4.950E+01	5.659E+01
0.015	4.498E+00	6.124E+00	7.697E+00	1.004E+01	1.207E+01	1.514E+01	1.746E+01
0.020	1.934E+00	2.617E+00	3.279E+00	4.275E+00	5.150E+00	6.476E+00	7.493E+00
0.030	6.575E−01	8.560E−01	1.046E+00	1.340E+00	1.595E+00	1.993E+00	2.299E+00
0.040	3.595E−01	4.432E−01	5.183E−01	6.425E−01	7.458E−01	9.144E−01	1.039E+00
0.050	2.555E−01	2.993E−01	3.347E−01	3.993E−01	4.490E−01	5.358E−01	5.960E−01
0.060	2.091E−01	2.357E−01	2.540E−01	2.927E−01	3.188E−01	3.701E−01	4.018E−01
0.080	1.694E−01	1.827E−01	1.879E−01	2.065E−01	2.146E−01	2.380E−01	2.476E−01
0.100	1.518E−01	1.605E−01	1.614E−01	1.729E−01	1.749E−01	1.886E−01	1.906E−01
0.150	1.305E−01	1.357E−01	1.337E−01	1.400E−01	1.379E−01	1.445E−01	1.415E−01
0.200	1.182E−01	1.224E−01	1.200E−01	1.248E−01	1.220E−01	1.267E−01	1.228E−01
0.300	1.022E−01	1.056E−01	1.032E−01	1.069E−01	1.041E−01	1.076E−01	1.037E−01
0.400	9.141E−02	9.438E−02	9.217E−02	9.544E−02	9.282E−02	9.578E−02	9.217E−02
0.500	8.343E−02	8.612E−02	8.407E−02	8.703E−02	8.460E−02	8.725E−02	8.391E−02
0.600	7.718E−02	7.966E−02	7.776E−02	8.048E−02	7.822E−02	8.065E−02	7.754E−02
0.800	6.776E−02	6.993E−02	6.826E−02	7.063E−02	6.864E−02	7.075E−02	6.801E−02
1.000	6.093E−02	6.287E−02	6.136E−02	6.350E−02	6.170E−02	6.359E−02	6.112E−02
1.500	4.965E−02	5.125E−02	5.003E−02	5.178E−02	5.032E−02	5.188E−02	4.987E−02
2.000	4.281E−02	4.423E−02	4.322E−02	4.477E−02	4.355E−02	4.494E−02	4.324E−02
3.000	3.484E−02	3.611E−02	3.539E−02	3.677E−02	3.587E−02	3.713E−02	3.583E−02
4.000	3.037E−02	3.159E−02	3.107E−02	3.239E−02	3.171E−02	3.293E−02	3.188E−02
5.000	2.753E−02	2.873E−02	2.836E−02	2.967E−02	2.915E−02	3.037E−02	2.950E−02
6.000	2.559E−02	2.681E−02	2.655E−02	2.787E−02	2.747E−02	2.872E−02	2.798E−02
8.000	2.319E−02	2.445E−02	2.437E−02	2.574E−02	2.552E−02	2.683E−02	2.628E−02
10.00	2.181E−02	2.313E−02	2.318E−02	2.461E−02	2.452E−02	2.590E−02	2.549E−02
15.00	2.022E−02	2.168E−02	2.194E−02	2.352E−02	2.364E−02	2.517E−02	2.496E−02
20.00	1.970E−02	2.127E−02	2.168E−02	2.338E−02	2.363E−02	2.529E−02	2.520E−02
30.00	1.962E−02	2.138E−02	2.196E−02	2.385E−02	2.426E−02	2.613E−02	2.617E−02

Table 1a
Photon Mass Attenuation Coefficients (cm^2/g)
(without coherent scattering)

E(MeV)	$_{18}Ar$	$_{19}K$	$_{20}Ca$	$_{24}Cr$	$_{25}Mn$	$_{26}Fe$	$_{28}Ni$
0.010	6.249E+01	7.832E+01	9.260E+01	1.378E+02	1.503E+02	1.696E+02	2.077E+02
0.015	1.944E+01	2.457E+01	2.929E+01	4.512E+01	4.965E+01	5.641E+01	7.003E+01
0.020	8.374E+00	1.063E+01	1.273E+01	1.998E+01	2.210E+01	2.522E+01	3.167E+01
0.030	2.565E+00	3.258E+00	3.909E+00	6.221E+00	6.917E+00	7.930E+00	1.005E+01
0.040	1.148E+00	1.447E+00	1.726E+00	2.725E+00	3.032E+00	3.478E+00	4.422E+00
0.050	6.470E−01	8.041E−01	9.487E−01	1.462E+00	1.621E+00	1.855E+00	2.354E+00
0.060	4.274E−01	5.220E−01	6.068E−01	8.999E−01	9.919E−01	1.131E+00	1.424E+00
0.080	2.531E−01	2.982E−01	3.354E−01	4.523E−01	4.903E−01	5.510E−01	6.786E−01
0.100	1.894E−01	2.169E−01	2.374E−01	2.916E−01	3.101E−01	3.426E−01	4.096E−01
0.150	1.358E−01	1.501E−01	1.583E−01	1.673E−01	1.716E−01	1.830E−01	2.049E−01
0.200	1.166E−01	1.272E−01	1.324E−01	1.312E−01	1.321E−01	1.383E−01	1.491E−01
0.300	9.778E−02	1.059E−01	1.093E−01	1.037E−01	1.031E−01	1.064E−01	1.113E−01
0.400	8.676E−02	9.376E−02	9.651E−02	9.043E−02	8.953E−02	9.203E−02	9.532E−02
0.500	7.893E−02	8.524E−02	8.765E−02	8.171E−02	8.077E−02	8.287E−02	8.548E−02
0.600	7.291E−02	7.870E−02	8.089E−02	7.523E−02	7.430E−02	7.616E−02	7.840E−02
0.800	6.393E−02	6.898E−02	7.088E−02	6.576E−02	6.490E−02	6.648E−02	6.831E−02
1.000	5.745E−02	6.198E−02	6.367E−02	5.902E−02	5.823E−02	5.962E−02	6.121E−02
1.500	4.688E−02	5.059E−02	5.197E−02	4.820E−02	4.755E−02	4.869E−02	4.998E−02
2.000	4.069E−02	4.395E−02	4.519E−02	4.206E−02	4.154E−02	4.257E−02	4.377E−02
3.000	3.381E−02	3.662E−02	3.777E−02	3.555E−02	3.520E−02	3.617E−02	3.740E−02
4.000	3.018E−02	3.280E−02	3.393E−02	3.233E−02	3.211E−02	3.309E−02	3.441E−02
5.000	2.802E−02	3.054E−02	3.169E−02	3.055E−02	3.043E−02	3.144E−02	3.287E−02
6.000	2.666E−02	2.914E−02	3.033E−02	2.955E−02	2.950E−02	3.056E−02	3.209E−02
8.000	2.517E−02	2.766E−02	2.892E−02	2.869E−02	2.875E−02	2.990E−02	3.163E−02
10.00	2.451E−02	2.704E−02	2.839E−02	2.854E−02	2.871E−02	2.994E−02	3.185E−02
15.00	2.418E−02	2.686E−02	2.838E−02	2.920E−02	2.951E−02	3.092E−02	3.320E−02
20.00	2.453E−02	2.737E−02	2.903E−02	3.026E−02	3.068E−02	3.223E−02	3.476E−02
30.00	2.561E−02	2.870E−02	3.058E−02	3.236E−02	3.290E−02	3.469E−02	3.759E−02

Table 1a
Photon Mass Attenuation Coefficients (cm^2/g)
(without coherent scattering)

E(MeV)	$_{29}Cu$	$_{40}Zr$	$_{41}Nb$	$_{42}Mo$	$_{48}Cd$	$_{50}Sn$	$_{56}Ba$
0.010	2.146E+02	7.213E+01	7.828E+01	8.359E+01	1.219E+02	1.359E+02	1.832E+02
0.015	7.325E+01	2.335E+01	2.539E+01	2.717E+01	4.017E+01	4.499E+01	6.163E+01
0.020	3.325E+01	7.153E+01	7.620E+01	7.862E+01	1.809E+01	2.030E+01	2.808E+01
0.030	1.062E+01	2.438E+01	2.616E+01	2.759E+01	3.704E+01	4.058E+01	9.167E+00
0.040	4.679E+00	1.108E+01	1.192E+01	1.261E+01	1.738E+01	1.902E+01	2.410E+01
0.050	2.489E+00	5.966E+00	6.426E+00	6.814E+00	9.503E+00	1.041E+01	1.346E+01
0.060	1.503E+00	3.593E+00	3.874E+00	4.110E+00	5.776E+00	6.354E+00	8.264E+00
0.080	7.097E−01	1.631E+00	1.758E+00	1.864E+00	2.631E+00	2.902E+00	3.813E+00
0.100	4.232E−01	9.058E−01	9.736E−01	1.031E+00	1.444E+00	1.592E+00	2.095E+00
0.150	2.054E−01	3.510E−01	3.728E−01	3.902E−01	5.214E−01	5.690E−01	7.351E−01
0.200	1.466E−01	2.075E−01	2.174E−01	2.247E−01	2.819E−01	3.027E−01	3.769E−01
0.300	1.077E−01	1.244E−01	1.280E−01	1.299E−01	1.471E−01	1.532E−01	1.764E−01
0.400	9.173E−02	9.769E−02	9.958E−02	1.001E−01	1.072E−01	1.095E−01	1.193E−01
0.500	8.207E−02	8.421E−02	8.546E−02	8.553E−02	8.881E−02	8.979E−02	9.451E−02
0.600	7.519E−02	7.565E−02	7.659E−02	7.647E−02	7.804E−02	7.839E−02	8.080E−02
0.800	6.544E−02	6.463E−02	6.528E−02	6.501E−02	6.521E−02	6.506E−02	6.555E−02
1.000	5.861E−02	5.741E−02	5.793E−02	5.762E−02	5.733E−02	5.701E−02	5.680E−02
1.500	4.786E−02	4.669E−02	4.708E−02	4.680E−02	4.630E−02	4.594E−02	4.538E−02
2.000	4.195E−02	4.129E−02	4.166E−02	4.144E−02	4.115E−02	4.087E−02	4.047E−02
3.000	3.594E−02	3.636E−02	3.677E−02	3.666E−02	3.687E−02	3.675E−02	3.677E−02
4.000	3.315E−02	3.447E−02	3.494E−02	3.491E−02	3.553E−02	3.555E−02	3.590E−02
5.000	3.175E−02	3.381E−02	3.433E−02	3.436E−02	3.533E−02	3.545E−02	3.607E−02
6.000	3.107E−02	3.373E−02	3.430E−02	3.438E−02	3.561E−02	3.581E−02	3.665E−02
8.000	3.073E−02	3.441E−02	3.507E−02	3.523E−02	3.690E−02	3.722E−02	3.842E−02
10.00	3.103E−02	3.553E−02	3.628E−02	3.649E−02	3.852E−02	3.895E−02	4.041E−02
15.00	3.247E−02	3.855E−02	3.944E−02	3.977E−02	4.253E−02	4.315E−02	4.518E−02
20.00	3.408E−02	4.122E−02	4.224E−02	4.264E−02	4.587E−02	4.662E−02	4.902E−02
30.00	3.693E−02	4.555E−02	4.674E−02	4.724E−02	5.111E−02	5.202E−02	5.489E−02

Table 1a
Photon Mass Attenuation Coefficients (cm^2/g)
(without coherent scattering)

E(MeV)	$_{57}La$	$_{64}Gd$	$_{72}Hf$	$_{74}W$	$_{82}Pb$	$_{90}Th$	$_{92}U$
0.010	1.939E+02	2.659E+02	2.259E+02	9.256E+01	1.258E+02	1.636E+02	1.737E+02
0.015	6.545E+01	9.115E+01	1.263E+02	1.361E+02	1.083E+02	5.787E+01	6.162E+01
0.020	2.985E+01	4.205E+01	5.899E+01	6.376E+01	8.411E+01	9.114E+01	6.845E+01
0.030	9.763E+00	1.393E+01	1.988E+01	2.158E+01	2.900E+01	3.743E+01	3.976E+01
0.040	2.530E+01	6.334E+00	9.112E+00	9.921E+00	1.349E+01	1.766E+01	1.881E+01
0.050	1.413E+01	3.449E+00	4.978E+00	5.426E+00	7.426E+00	9.814E+00	1.048E+01
0.060	8.706E+00	1.145E+01	3.048E+00	3.323E+00	4.562E+00	6.065E+00	6.489E+00
0.080	4.021E+00	5.385E+00	7.120E+00	7.567E+00	2.136E+00	2.851E+00	3.057E+00
0.100	2.211E+00	2.983E+00	3.996E+00	4.273E+00	5.355E+00	1.606E+00	1.722E+00
0.150	7.747E−01	1.040E+00	1.402E+00	1.503E+00	1.921E+00	2.362E+00	2.476E+00
0.200	3.952E−01	5.182E−01	6.899E−01	7.383E−01	9.432E−01	1.169E+00	1.230E+00
0.300	1.829E−01	2.247E−01	2.850E−01	3.023E−01	3.772E−01	4.633E−01	4.873E−01
0.400	1.226E−01	1.424E−01	1.716E−01	1.801E−01	2.172E−01	2.611E−01	2.735E−01
0.500	9.659E−02	1.078E−01	1.248E−01	1.297E−01	1.515E−01	1.778E−01	1.854E−01
0.600	8.227E−02	8.945E−02	1.004E−01	1.036E−01	1.179E−01	1.352E−01	1.404E−01
0.800	6.647E−02	7.008E−02	7.571E−02	7.741E−02	8.474E−02	9.387E−02	9.663E−02
1.000	5.748E−02	5.961E−02	6.304E−02	6.407E−02	6.848E−02	7.402E−02	7.574E−02
1.500	4.584E−02	4.687E−02	4.855E−02	4.906E−02	5.107E−02	5.358E−02	5.440E−02
2.000	4.090E−02	4.189E−02	4.336E−02	4.379E−02	4.542E−02	4.733E−02	4.794E−02
3.000	3.722E−02	3.846E−02	4.007E−02	4.050E−02	4.204E−02	4.360E−02	4.408E−02
4.000	3.638E−02	3.792E−02	3.977E−02	4.024E−02	4.181E−02	4.327E−02	4.370E−02
5.000	3.659E−02	3.838E−02	4.044E−02	4.095E−02	4.262E−02	4.408E−02	4.450E−02
6.000	3.722E−02	3.923E−02	4.149E−02	4.205E−02	4.384E−02	4.533E−02	4.573E−02
8.000	3.905E−02	4.144E−02	4.406E−02	4.469E−02	4.671E−02	4.832E−02	4.873E−02
10.00	4.112E−02	4.383E−02	4.676E−02	4.745E−02	4.969E−02	5.146E−02	5.191E−02
15.00	4.602E−02	4.943E−02	5.300E−02	5.383E−02	5.656E−02	5.869E−02	5.925E−02
20.00	4.996E−02	5.384E−02	5.796E−02	5.892E−02	6.205E−02	6.446E−02	6.511E−02
30.00	5.599E−02	6.057E−02	6.541E−02	6.653E−02	7.022E−02	7.315E−02	7.390E−02

Table 1a
Photon Mass Attenuation Coefficients (cm^2/g)
(without coherent scattering)

E(MeV)	Air	Water	Concrete
0.010	4.962E+00	5.159E+00	2.617E+01
0.015	1.525E+00	1.579E+00	8.075E+00
0.020	7.210E−01	7.505E−01	3.510E+00
0.030	3.249E−01	3.455E−01	1.142E+00
0.040	2.311E−01	2.502E−01	5.683E−01
0.050	1.963E−01	2.150E−01	3.650E−01
0.060	1.792E−01	1.973E−01	2.746E−01
0.080	1.614E−01	1.787E−01	2.002E−01
0.100	1.510E−01	1.675E−01	1.703E−01
0.150	1.341E−01	1.490E−01	1.397E−01
0.200	1.226E−01	1.362E−01	1.250E−01
0.300	1.064E−01	1.183E−01	1.073E−01
0.400	9.527E−02	1.059E−01	9.575E−02
0.500	8.699E−02	9.673E−02	8.733E−02
0.600	8.048E−02	8.949E−02	8.076E−02
0.800	7.068E−02	7.860E−02	7.089E−02
1.000	6.355E−02	7.067E−02	6.373E−02
1.500	5.175E−02	5.753E−02	5.193E−02
2.000	4.446E−02	4.940E−02	4.480E−02
3.000	3.579E−02	3.967E−02	3.652E−02
4.000	3.079E−02	3.403E−02	3.189E−02
5.000	2.751E−02	3.031E−02	2.895E−02
6.000	2.522E−02	2.770E−02	2.695E−02
8.000	2.225E−02	2.429E−02	2.450E−02
10.00	2.045E−02	2.219E−02	2.311E−02
15.00	1.810E−02	1.941E−02	2.153E−02
20.00	1.706E−02	1.813E−02	2.105E−02
30.00	1.628E−02	1.711E−02	2.105E−02

Table 1b
Photon Mass Attenuation Coefficients (cm^2/g)
(with coherent scattering)

E(MeV)	$_1H$	$_3Li$	$_4Be$	$_5B$	$_6C$	$_7N$	$_8O$
0.010	3.854E−01	3.396E−01	6.466E−01	1.255E+00	2.373E+00	3.879E+00	5.953E+00
0.015	3.765E−01	2.175E−01	3.070E−01	4.827E−01	8.074E−01	1.236E+00	1.836E+00
0.020	3.695E−01	1.855E−01	2.251E−01	3.014E−01	4.420E−01	6.179E−01	8.653E−01
0.030	3.570E−01	1.644E−01	1.792E−01	2.064E−01	2.562E−01	3.066E−01	3.779E−01
0.040	3.458E−01	1.551E−01	1.640E−01	1.794E−01	2.076E−01	2.287E−01	2.585E−01
0.050	3.355E−01	1.488E−01	1.554E−01	1.665E−01	1.871E−01	1.980E−01	2.132E−01
0.060	3.260E−01	1.438E−01	1.493E−01	1.584E−01	1.753E−01	1.817E−01	1.907E−01
0.080	3.091E−01	1.356E−01	1.401E−01	1.472E−01	1.610E−01	1.639E−01	1.679E−01
0.100	2.944E−01	1.289E−01	1.328E−01	1.391E−01	1.514E−01	1.529E−01	1.551E−01
0.150	2.651E−01	1.158E−01	1.190E−01	1.244E−01	1.347E−01	1.353E−01	1.361E−01
0.200	2.429E−01	1.060E−01	1.089E−01	1.136E−01	1.230E−01	1.233E−01	1.237E−01
0.300	2.112E−01	9.210E−02	9.463E−02	9.864E−02	1.066E−01	1.068E−01	1.070E−01
0.400	1.893E−01	8.249E−02	8.471E−02	8.836E−02	9.547E−02	9.557E−02	9.566E−02
0.500	1.729E−01	7.532E−02	7.739E−02	8.066E−02	8.715E−02	8.719E−02	8.729E−02
0.600	1.599E−01	6.968E−02	7.155E−02	7.461E−02	8.058E−02	8.063E−02	8.070E−02
0.800	1.405E−01	6.121E−02	6.286E−02	6.550E−02	7.076E−02	7.081E−02	7.087E−02
1.000	1.263E−01	5.503E−02	5.652E−02	5.891E−02	6.362E−02	6.364E−02	6.371E−02
1.500	1.027E−01	4.476E−02	4.597E−02	4.792E−02	5.179E−02	5.180E−02	5.185E−02
2.000	8.770E−02	3.830E−02	3.938E−02	4.109E−02	4.442E−02	4.450E−02	4.459E−02
3.000	6.922E−02	3.043E−02	3.138E−02	3.285E−02	3.562E−02	3.579E−02	3.597E−02
4.000	5.807E−02	2.572E−02	2.663E−02	2.799E−02	3.047E−02	3.074E−02	3.100E−02
5.000	5.049E−02	2.257E−02	2.347E−02	2.477E−02	2.708E−02	2.742E−02	2.777E−02
6.000	4.498E−02	2.030E−02	2.121E−02	2.248E−02	2.469E−02	2.510E−02	2.552E−02
8.000	3.746E−02	1.725E−02	1.819E−02	1.945E−02	2.154E−02	2.209E−02	2.263E−02
10.00	3.254E−02	1.529E−02	1.627E−02	1.755E−02	1.959E−02	2.024E−02	2.089E−02
15.00	2.539E−02	1.252E−02	1.361E−02	1.495E−02	1.698E−02	1.782E−02	1.866E−02
20.00	2.153E−02	1.109E−02	1.227E−02	1.368E−02	1.575E−02	1.673E−02	1.770E−02
30.00	1.748E−02	9.687E−03	1.100E−02	1.255E−02	1.472E−02	1.588E−02	1.706E−02

Table 1b
Photon Mass Attenuation Coefficients (cm^2/g)
(with coherent scattering)

E(MeV)	$_{11}Na$	$_{12}Mg$	$_{13}Al$	$_{14}Si$	$_{15}P$	$_{16}S$	$_{17}Cl$
0.010	1.557E+01	2.106E+01	2.621E+01	3.388E+01	4.036E+01	5.013E+01	5.725E+01
0.015	4.694E+00	6.357E+00	7.955E+00	1.034E+01	1.239E+01	1.550E+01	1.784E+01
0.020	2.057E+00	2.763E+00	3.442E+00	4.463E+00	5.354E+00	6.710E+00	7.740E+00
0.030	7.198E−01	9.304E−01	1.128E+00	1.436E+00	1.700E+00	2.113E+00	2.426E+00
0.040	3.969E−01	4.880E−01	5.684E−01	7.010E−01	8.095E−01	9.874E−01	1.117E+00
0.050	2.804E−01	3.292E−01	3.681E−01	4.385E−01	4.918E−01	5.850E−01	6.483E−01
0.060	2.268E−01	2.570E−01	2.778E−01	3.206E−01	3.494E−01	4.053E−01	4.394E−01
0.080	1.796E−01	1.951E−01	2.018E−01	2.228E−01	2.324E−01	2.586E−01	2.696E−01
0.100	1.585E−01	1.686E−01	1.704E−01	1.835E−01	1.865E−01	2.020E−01	2.050E−01
0.150	1.335E−01	1.394E−01	1.378E−01	1.448E−01	1.432E−01	1.506E−01	1.480E−01
0.200	1.199E−01	1.245E−01	1.223E−01	1.275E−01	1.250E−01	1.302E−01	1.266E−01
0.300	1.029E−01	1.065E−01	1.042E−01	1.082E−01	1.055E−01	1.091E−01	1.054E−01
0.400	9.185E−02	9.492E−02	9.276E−02	9.614E−02	9.359E−02	9.667E−02	9.311E−02
0.500	8.372E−02	8.647E−02	8.445E−02	8.748E−02	8.511E−02	8.783E−02	8.453E−02
0.600	7.736E−02	7.988E−02	7.802E−02	8.077E−02	7.854E−02	8.104E−02	7.795E−02
0.800	6.788E−02	7.008E−02	6.841E−02	7.082E−02	6.884E−02	7.100E−02	6.826E−02
1.000	6.100E−02	6.296E−02	6.146E−02	6.361E−02	6.182E−02	6.374E−02	6.128E−02
1.500	4.968E−02	5.129E−02	5.006E−02	5.183E−02	5.039E−02	5.194E−02	4.994E−02
2.000	4.282E−02	4.426E−02	4.324E−02	4.480E−02	4.358E−02	4.498E−02	4.328E−02
3.000	3.488E−02	3.613E−02	3.541E−02	3.678E−02	3.590E−02	3.716E−02	3.585E−02
4.000	3.037E−02	3.159E−02	3.106E−02	3.240E−02	3.172E−02	3.294E−02	3.188E−02
5.000	2.753E−02	2.873E−02	2.836E−02	2.967E−02	2.915E−02	3.037E−02	2.950E−02
6.000	2.559E−02	2.681E−02	2.655E−02	2.788E−02	2.747E−02	2.872E−02	2.798E−02
8.000	2.319E−02	2.445E−02	2.437E−02	2.574E−02	2.552E−02	2.683E−02	2.628E−02
10.00	2.181E−02	2.313E−02	2.318E−02	2.462E−02	2.452E−02	2.590E−02	2.549E−02
15.00	2.022E−02	2.168E−02	2.195E−02	2.352E−02	2.364E−02	2.517E−02	2.496E−02
20.00	1.970E−02	2.127E−02	2.168E−02	2.338E−02	2.363E−02	2.529E−02	2.520E−02
30.00	1.963E−02	2.138E−02	2.196E−02	2.385E−02	2.426E−02	2.613E−02	2.618E−02

Table 1b
Photon Mass Attenuation Coefficients (cm^2/g)
(with coherent scattering)

E(MeV)	$_{18}Ar$	$_{19}K$	$_{20}Ca$	$_{24}Cr$	$_{25}Mn$	$_{26}Fe$	$_{28}Ni$
0.010	6.315E+01	7.907E+01	9.340E+01	1.387E+02	1.514E+02	1.707E+02	2.090E+02
0.015	1.983E+01	2.502E+01	2.979E+01	4.572E+01	5.027E+01	5.708E+01	7.081E+01
0.020	8.630E+00	1.093E+01	1.306E+01	2.038E+01	2.252E+01	2.568E+01	3.220E+01
0.030	2.696E+00	3.412E+00	4.079E+00	6.434E+00	7.141E+00	8.176E+00	1.034E+01
0.040	1.228E+00	1.541E+00	1.830E+00	2.856E+00	3.169E+00	3.629E+00	4.600E+00
0.050	7.012E−01	8.678E−01	1.019E+00	1.551E+00	1.714E+00	1.957E+00	2.474E+00
0.060	4.664E−01	5.678E−01	6.578E−01	9.640E−01	1.060E+00	1.205E+00	1.511E+00
0.080	2.760E−01	3.251E−01	3.655E−01	4.904E−01	5.306E−01	5.952E−01	7.305E−01
0.100	2.043E−01	2.345E−01	2.571E−01	3.166E−01	3.366E−01	3.717E−01	4.439E−01
0.150	1.427E−01	1.582E−01	1.674E−01	1.788E−01	1.838E−01	1.964E−01	2.208E−01
0.200	1.205E−01	1.319E−01	1.376E−01	1.378E−01	1.391E−01	1.460E−01	1.582E−01
0.300	9.953E−02	1.080E−01	1.116E−01	1.067E−01	1.062E−01	1.099E−01	1.154E−01
0.400	8.776E−02	9.495E−02	9.782E−02	9.213E−02	9.133E−02	9.400E−02	9.764E−02
0.500	7.958E−02	8.600E−02	8.851E−02	8.281E−02	8.192E−02	8.415E−02	8.698E−02
0.600	7.335E−02	7.922E−02	8.147E−02	7.598E−02	7.509E−02	7.704E−02	7.944E−02
0.800	6.419E−02	6.928E−02	7.121E−02	6.620E−02	6.537E−02	6.699E−02	6.891E−02
1.000	5.762E−02	6.216E−02	6.388E−02	5.930E−02	5.852E−02	5.995E−02	6.160E−02
1.500	4.695E−02	5.068E−02	5.206E−02	4.832E−02	4.769E−02	4.883E−02	5.015E−02
2.000	4.074E−02	4.399E−02	4.524E−02	4.213E−02	4.162E−02	4.265E−02	4.387E−02
3.000	3.384E−02	3.666E−02	3.780E−02	3.559E−02	3.524E−02	3.621E−02	3.745E−02
4.000	3.019E−02	3.282E−02	3.395E−02	3.235E−02	3.213E−02	3.312E−02	3.444E−02
5.000	2.802E−02	3.054E−02	3.170E−02	3.057E−02	3.045E−02	3.146E−02	3.289E−02
6.000	2.667E−02	2.915E−02	3.034E−02	2.956E−02	2.952E−02	3.057E−02	3.210E−02
8.000	2.517E−02	2.766E−02	2.892E−02	2.869E−02	2.875E−02	2.991E−02	3.164E−02
10.00	2.451E−02	2.704E−02	2.839E−02	2.855E−02	2.871E−02	2.994E−02	3.185E−02
15.00	2.419E−02	2.687E−02	2.838E−02	2.920E−02	2.951E−02	3.092E−02	3.320E−02
20.00	2.453E−02	2.737E−02	2.903E−02	3.026E−02	3.068E−02	3.224E−02	3.476E−02
30.00	2.561E−02	2.870E−02	3.059E−02	3.237E−02	3.290E−02	3.469E−02	3.759E−02

Table 1b
Photon Mass Attenuation Coefficients (cm^2/g)
(with coherent scattering)

E(MeV)	$_{29}Cu$	$_{40}Zr$	$_{41}Nb$	$_{42}Mo$	$_{48}Cd$	$_{50}Sn$	$_{56}Ba$
0.010	2.160E+02	7.418E+01	8.040E+01	8.575E+01	1.244E+02	1.384E+02	1.860E+02
0.015	7.405E+01	2.462E+01	2.672E+01	2.854E+01	4.178E+01	4.665E+01	6.346E+01
0.020	3.380E+01	7.238E+01	7.709E+01	7.954E+01	1.920E+01	2.146E+01	2.937E+01
0.030	1.091E+01	2.485E+01	2.665E+01	2.810E+01	3.765E+01	4.122E+01	9.903E+00
0.040	4.862E+00	1.139E+01	1.223E+01	1.294E+01	1.778E+01	1.943E+01	2.457E+01
0.050	2.613E+00	6.174E+00	6.644E+00	7.040E+00	9.778E+00	1.070E+01	1.379E+01
0.060	1.593E+00	3.744E+00	4.032E+00	4.274E+00	5.977E+00	6.566E+00	8.510E+00
0.080	7.630E−01	1.721E+00	1.852E+00	1.962E+00	2.751E+00	3.029E+00	3.963E+00
0.100	4.585E−01	9.657E−01	1.036E+00	1.096E+00	1.524E+00	1.677E+00	2.195E+00
0.150	2.217E−01	3.790E−01	4.023E−01	4.208E−01	5.593E−01	6.092E−01	7.826E−01
0.200	1.559E−01	2.237E−01	2.344E−01	2.423E−01	3.039E−01	3.260E−01	4.045E−01
0.300	1.119E−01	1.318E−01	1.357E−01	1.379E−01	1.571E−01	1.639E−01	1.891E−01
0.400	9.413E−02	1.018E−01	1.040E−01	1.047E−01	1.129E−01	1.156E−01	1.265E−01
0.500	8.362E−02	8.693E−02	8.832E−02	8.848E−02	9.250E−02	9.375E−02	9.923E−02
0.600	7.625E−02	7.756E−02	7.858E−02	7.851E−02	8.065E−02	8.115E−02	8.410E−02
0.800	6.605E−02	6.571E−02	6.642E−02	6.619E−02	6.670E−02	6.663E−02	6.744E−02
1.000	5.901E−02	5.810E−02	5.866E−02	5.837E−02	5.826E−02	5.801E−02	5.802E−02
1.500	4.803E−02	4.700E−02	4.741E−02	4.713E−02	4.673E−02	4.639E−02	4.592E−02
2.000	4.205E−02	4.147E−02	4.185E−02	4.163E−02	4.139E−02	4.113E−02	4.078E−02
3.000	3.599E−02	3.644E−02	3.686E−02	3.675E−02	3.698E−02	3.687E−02	3.692E−02
4.000	3.318E−02	3.452E−02	3.498E−02	3.496E−02	3.559E−02	3.562E−02	3.598E−02
5.000	3.177E−02	3.384E−02	3.436E−02	3.439E−02	3.536E−02	3.549E−02	3.611E−02
6.000	3.108E−02	3.374E−02	3.432E−02	3.440E−02	3.563E−02	3.584E−02	3.669E−02
8.000	3.074E−02	3.441E−02	3.508E−02	3.523E−02	3.691E−02	3.724E−02	3.844E−02
10.00	3.103E−02	3.554E−02	3.628E−02	3.650E−02	3.853E−02	3.896E−02	4.042E−02
15.00	3.247E−02	3.855E−02	3.945E−02	3.978E−02	4.253E−02	4.316E−02	4.518E−02
20.00	3.408E−02	4.122E−02	4.224E−02	4.264E−02	4.588E−02	4.662E−02	4.902E−02
30.00	3.694E−02	4.555E−02	4.675E−02	4.724E−02	5.111E−02	5.203E−02	5.489E−02

Table 1b
Photon Mass Attenuation Coefficients (cm^2/g)
(with coherent scattering)

E(MeV)	$_{57}La$	$_{64}Gd$	$_{72}Hf$	$_{74}W$	$_{82}Pb$	$_{90}Th$	$_{92}U$
0.010	1.967E+02	2.693E+02	2.301E+02	9.690E+01	1.306E+02	1.689E+02	1.791E+02
0.015	6.732E+01	9.335E+01	1.289E+02	1.389E+02	1.116E+02	6.142E+01	6.526E+01
0.020	3.118E+01	4.361E+01	6.087E+01	6.572E+01	8.637E+01	9.367E+01	7.106E+01
0.030	1.052E+01	1.484E+01	2.098E+01	2.273E+01	3.032E+01	3.891E+01	4.128E+01
0.040	2.579E+01	6.920E+00	9.827E+00	1.067E+01	1.436E+01	1.865E+01	1.983E+01
0.050	1.447E+01	3.859E+00	5.478E+00	5.950E+00	8.041E+00	1.052E+01	1.121E+01
0.060	8.961E+00	1.175E+01	3.420E+00	3.713E+00	5.020E+00	6.591E+00	7.033E+00
0.080	4.177E+00	5.573E+00	7.350E+00	7.809E+00	2.419E+00	3.177E+00	3.395E+00
0.100	2.315E+00	3.109E+00	4.153E+00	4.437E+00	5.549E+00	1.830E+00	1.954E+00
0.150	8.240E−01	1.100E+00	1.477E+00	1.581E+00	2.014E+00	2.472E+00	2.591E+00
0.200	4.239E−01	5.535E−01	7.338E−01	7.844E−01	9.986E−01	1.234E+00	1.298E+00
0.300	1.961E−01	2.410E−01	3.055E−01	3.238E−01	4.032E−01	4.940E−01	5.192E−01
0.400	1.301E−01	1.518E−01	1.834E−01	1.925E−01	2.323E−01	2.789E−01	2.922E−01
0.500	1.015E−01	1.139E−01	1.324E−01	1.378E−01	1.614E−01	1.895E−01	1.976E−01
0.600	8.570E−02	9.371E−02	1.058E−01	1.093E−01	1.248E−01	1.435E−01	1.490E−01
0.800	6.843E−02	7.252E−02	7.879E−02	8.066E−02	8.870E−02	9.862E−02	1.016E−01
1.000	5.876E−02	6.120E−02	6.502E−02	6.618E−02	7.102E−02	7.709E−02	7.894E−02
1.500	4.640E−02	4.759E−02	4.944E−02	5.000E−02	5.222E−02	5.498E−02	5.586E−02
2.000	4.122E−02	4.228E−02	4.388E−02	4.433E−02	4.606E−02	4.812E−02	4.877E−02
3.000	3.737E−02	3.865E−02	4.030E−02	4.075E−02	4.234E−02	4.396E−02	4.446E−02
4.000	3.646E−02	3.802E−02	3.989E−02	4.038E−02	4.197E−02	4.347E−02	4.391E−02
5.000	3.664E−02	3.844E−02	4.052E−02	4.103E−02	4.272E−02	4.421E−02	4.463E−02
6.000	3.726E−02	3.928E−02	4.155E−02	4.210E−02	4.391E−02	4.542E−02	4.583E−02
8.000	3.907E−02	4.147E−02	4.409E−02	4.472E−02	4.675E−02	4.836E−02	4.879E−02
10.00	4.113E−02	4.384E−02	4.677E−02	4.747E−02	4.972E−02	5.149E−02	5.194E−02
15.00	4.603E−02	4.943E−02	5.301E−02	5.384E−02	5.658E−02	5.871E−02	5.926E−02
20.00	4.996E−02	5.385E−02	5.796E−02	5.893E−02	6.205E−02	6.447E−02	6.511E−02
30.00	5.599E−02	6.057E−02	6.542E−02	6.653E−02	7.022E−02	7.315E−02	7.390E−02

Table 1b
Photon Mass Attenuation Coefficients (cm^2/g)
(with coherent scattering)

E(MeV)	Air	Water	NBS Concrete
0.010	5.123E+00	5.330E+00	2.656E+01
0.015	1.615E+00	1.673E+00	8.297E+00
0.020	7.784E−01	8.098E−01	3.651E+00
0.030	3.539E−01	3.756E−01	1.214E+00
0.040	2.485E−01	2.683E−01	6.122E−01
0.050	2.080E−01	2.269E−01	3.944E−01
0.060	1.875E−01	2.058E−01	2.957E−01
0.080	1.663E−01	1.837E−01	2.125E−01
0.100	1.541E−01	1.707E−01	1.783E−01
0.150	1.356E−01	1.505E−01	1.434E−01
0.200	1.234E−01	1.370E−01	1.270E−01
0.300	1.068E−01	1.187E−01	1.082E−01
0.400	9.549E−02	1.061E−01	9.628E−02
0.500	8.712E−02	9.687E−02	8.768E−02
0.600	8.055E−02	8.956E−02	8.098E−02
0.800	7.074E−02	7.866E−02	7.103E−02
1.000	6.358E−02	7.071E−02	6.382E−02
1.500	5.175E−02	5.754E−02	5.197E−02
2.000	4.447E−02	4.941E−02	4.482E−02
3.000	3.581E−02	3.969E−02	3.654E−02
4.000	3.079E−02	3.403E−02	3.189E−02
5.000	2.751E−02	3.031E−02	2.895E−02
6.000	2.522E−02	2.770E−02	2.696E−02
8.000	2.225E−02	2.429E−02	2.450E−02
10.00	2.045E−02	2.219E−02	2.311E−02
15.00	1.810E−02	1.941E−02	2.153E−02
20.00	1.706E−02	1.813E−02	2.105E−02
30.00	1.628E−02	1.711E−02	2.105E−02

Table 2

Energy Absorption Coefficients (cm^2/g)

E(MeV)	$_1H$	$_4Be$	$_5B$	$_6C$	$_7N$	$_8O$
0.010	9.849E−3	4.023E−1	9.616E−1	2.003E+0	3.446E+0	5.449E+0
0.015	1.102E−2	1.083E−1	2.581E−1	5.425E−1	9.422E−1	1.508E+0
0.020	1.355E−2	4.549E−2	1.038E−1	2.159E−1	3.753E−1	6.026E−1
0.030	1.864E−2	1.839E−2	3.389E−2	6.411E−2	1.069E−1	1.688E−1
0.040	2.315E−2	1.415E−2	2.039E−2	3.265E−2	4.934E−2	7.369E−2
0.050	2.709E−2	1.390E−2	1.716E−2	2.360E−2	3.161E−2	4.337E−2
0.060	3.053E−2	1.462E−2	1.669E−2	2.078E−2	2.517E−2	3.165E−2
0.080	3.620E−2	1.656E−2	1.781E−2	2.029E−2	2.200E−2	2.452E−2
0.100	4.063E−2	1.835E−2	1.938E−2	2.144E−2	2.225E−2	2.347E−2
0.150	4.813E−2	2.157E−2	2.255E−2	2.448E−2	2.470E−2	2.504E−2
0.200	5.255E−2	2.352E−2	2.454E−2	2.655E−2	2.664E−2	2.678E−2
0.300	5.695E−2	2.548E−2	2.655E−2	2.869E−2	2.872E−2	2.877E−2
0.400	5.860E−2	2.620E−2	2.731E−2	2.949E−2	2.951E−2	2.954E−2
0.500	5.899E−2	2.638E−2	2.748E−2	2.967E−2	2.969E−2	2.971E−2
0.600	5.875E−2	2.627E−2	2.737E−2	2.955E−2	2.956E−2	2.957E−2
0.800	5.739E−2	2.565E−2	2.672E−2	2.885E−2	2.885E−2	2.886E−2
1.000	5.555E−2	2.482E−2	2.585E−2	2.791E−2	2.791E−2	2.791E−2
1.500	5.074E−2	2.267E−2	2.361E−2	2.548E−2	2.548E−2	2.548E−2
2.000	4.649E−2	2.081E−2	2.169E−2	2.343E−2	2.345E−2	2.346E−2
3.000	3.992E−2	1.803E−2	1.886E−2	2.045E−2	2.054E−2	2.062E−2
4.000	3.523E−2	1.613E−2	1.695E−2	1.847E−2	1.863E−2	1.879E−2
5.000	3.173E−2	1.477E−2	1.559E−2	1.707E−2	1.731E−2	1.754E−2
6.000	2.904E−2	1.374E−2	1.459E−2	1.605E−2	1.636E−2	1.665E−2
8.000	2.515E−2	1.232E−2	1.320E−2	1.467E−2	1.509E−2	1.549E−2
10.00	2.247E−2	1.137E−2	1.230E−2	1.379E−2	1.431E−2	1.480E−2
15.00	1.837E−2	1.002E−2	1.104E−2	1.259E−2	1.328E−2	1.392E−2
20.00	1.606E−2	9.317E−3	1.042E−2	1.203E−2	1.284E−2	1.358E−2

Table 2

Mass Energy Absorption Coefficients (cm^2/g)

E(MeV)	$_{11}Na$	$_{12}Mg$	$_{13}Al$	$_{14}Si$	$_{15}P$	$_{16}S$
0.010	1.473E+1	2.001E+1	2.495E+1	3.245E+1	3.865E+1	4.790E+1
0.015	4.244E+0	5.817E+0	7.377E+0	9.663E−2	1.162E+1	1.459E+1
0.020	1.728E+0	2.393E+0	3.056E+0	4.014E+0	4.865E+0	6.156E+0
0.030	4.850E−1	6.757E−1	8.646E−1	1.150E+0	1.404E+0	1.789E+0
0.040	2.000E−1	2.775E−1	3.556E−1	4.730E−1	5.779E−1	7.379E−1
0.050	1.048E−1	1.432E−1	1.816E−1	2.405E−1	2.939E−1	3.734E−1
0.060	6.542E−2	8.715E−2	1.087E−1	1.417E−1	1.716E−1	2.184E−1
0.080	3.730E−2	4.631E−2	5.464E−2	6.840E−2	8.024E−2	9.924E−2
0.100	2.917E−2	3.392E−2	3.773E−2	4.488E−2	5.041E−2	6.024E−2
0.150	2.576E−2	2.762E−2	2.823E−2	3.082E−2	3.183E−2	3.510E−2
0.200	2.635E−2	2.760E−2	2.745E−2	2.905E−2	2.899E−2	3.082E−2
0.300	2.772E−2	2.872E−2	2.817E−2	2.933E−2	2.872E−2	2.987E−2
0.400	2.833E−2	2.928E−2	2.863E−2	2.970E−2	2.895E−2	2.994E−2
0.500	2.845E−2	2.938E−2	2.870E−2	2.973E−2	2.892E−2	2.986E−2
0.600	2.830E−2	2.921E−2	2.851E−2	2.952E−2	2.870E−2	2.961E−2
0.800	2.759E−2	2.847E−2	2.778E−2	2.874E−2	2.792E−2	2.878E−2
1.000	2.667E−2	2.751E−2	2.684E−2	2.776E−2	2.696E−2	2.778E−2
1.500	2.434E−2	2.509E−2	2.447E−2	2.531E−2	2.458E−2	2.531E−2
2.000	2.245E−2	2.317E−2	2.261E−2	2.340E−2	2.273E−2	2.343E−2
3.000	1.992E−2	2.062E−2	2.018E−2	2.095E−2	2.042E−2	2.112E−2
4.000	1.838E−2	1.910E−2	1.877E−2	1.956E−2	1.915E−2	1.988E−2
5.000	1.738E−2	1.814E−2	1.790E−2	1.873E−2	1.840E−2	1.918E−2
6.000	1.672E−2	1.752E−2	1.735E−2	1.822E−2	1.797E−2	1.879E−2
8.000	1.592E−2	1.678E−2	1.674E−2	1.769E−2	1.755E−2	1.846E−2
10.00	1.549E−2	1.643E−2	1.645E−2	1.748E−2	1.742E−2	1.841E−2
15.00	1.505E−2	1.610E−2	1.626E−2	1.741E−2	1.747E−2	1.858E−2
20.00	1.500E−2	1.612E−2	1.637E−2	1.760E−2	1.774E−2	1.892E−2

Table 2
Mass Energy Absorption Coefficients (cm^2/g)

E(MeV)	$_{18}Ar$	$_{19}K$	$_{20}Ca$	$_{26}Fe$	$_{29}Cu$	$_{42}Mo$
0.010	6.036E+1	7.399E+1	8.626E+1	1.367E+2	1.514E+2	8.062E+1
0.015	1.865E+1	2.350E+1	2.773E+1	4.895E+1	5.853E+1	2.624E+1
0.020	7.979E+0	1.012E+1	1.207E+1	2.257E+1	2.810E+1	7.749E+1
0.030	2.353E+0	3.012E+0	3.637E+0	7.237E+0	9.382E+0	1.679E+1
0.040	9.817E+0	1.260E+0	1.525E+0	3.146E+0	4.173E+0	8.823E+0
0.050	4.976E−1	6.408E−1	7.755E−1	1.630E+0	2.196E+0	5.106E+0
0.060	2.880E−1	3.696E−1	4.481E−1	9.538E−1	1.290E+0	3.194E+0
0.080	1.271E−1	1.617E−1	1.944E−1	4.093E−1	5.593E−1	1.487E+0
0.100	7.308E−2	9.115E−2	1.080E−1	2.181E−1	2.952E−1	8.114E−1
0.150	3.698E−2	4.346E−2	4.864E−2	7.970E−2	1.030E−1	2.716E−1
0.200	2.998E−2	3.380E−2	3.641E−2	4.840E−2	5.811E−2	1.327E−1
0.300	2.760E−2	3.019E−2	3.151E−2	3.374E−2	3.636E−2	5.987E−2
0.400	2.730E−2	2.963E−2	3.064E−2	3.050E−2	3.135E−2	4.154E−2
0.500	2.710E−2	2.932E−2	3.022E−2	2.922E−2	2.943E−2	3.468E−2
0.600	2.681E−2	2.897E−2	2.981E−2	2.843E−2	2.835E−2	3.125E−2
0.800	2.601E−2	2.807E−2	2.885E−2	2.718E−2	2.686E−2	2.775E−2
1.000	2.508E−2	2.705E−2	2.779E−2	2.604E−2	2.563E−2	2.573E−2
1.500	2.284E−2	2.462E−2	2.528E−2	2.358E−2	2.313E−2	2.261E−2
2.000	2.117E−2	2.283E−2	2.346E−2	2.195E−2	2.156E−2	2.112E−2
3.000	1.919E−2	2.077E−2	2.139E−2	2.036E−2	2.016E−2	2.038E−2
4.000	1.821E−2	1.977E−2	2.044E−2	1.984E−2	1.981E−2	2.073E−2
5.000	1.770E−2	1.929E−2	2.001E−2	1.976E−2	1.991E−2	2.140E−2
6.000	1.745E−2	1.908E−2	1.985E−2	1.991E−2	2.019E−2	2.214E−2
8.000	1.733E−2	1.904E−2	1.989E−2	2.043E−2	2.092E−2	2.366E−2
10.00	1.742E−2	1.921E−2	2.014E−2	2.100E−2	2.165E−2	2.490E−2
15.00	1.778E−2	1.970E−2	2.073E−2	2.202E−2	2.286E−2	2.689E−2
20.00	1.822E−2	2.024E−2	2.135E−2	2.289E−2	2.384E−2	2.821E−2

Table 2
Energy Absorption Coefficients (cm^2/g)

E(MeV)	$_{50}Sn$	$_{53}I$	$_{74}W$	$_{82}Pb$	$_{92}U$
0.010	1.293E+2	1.510E+2	9.242E+1	1.256E+2	1.735E+2
0.015	4.313E+1	5.102E+1	1.177E+2	8.939E+1	6.148E+1
0.020	1.946E+1	2.313E+1	5.732E+1	6.923E+1	5.586E+1
0.030	1.516E+1	7.473E+0	1.998E+1	2.550E+1	3.293E+1
0.040	9.989E+0	9.960E+0	9.289E+0	1.221E+1	1.632E+1
0.050	6.410E+0	6.761E+0	5.100E+0	6.796E+0	9.303E+0
0.060	4.264E+0	4.620E+0	3.095E+0	4.177E+0	5.830E+0
0.080	2.124E+0	2.373E+0	3.164E+0	1.936E+0	2.767E+0
0.100	1.200E+0	1.363E+0	2.254E+0	2.229E+0	1.541E+0
0.150	4.170E−1	4.817E−1	9.833E−1	1.135E+0	1.218E+0
0.200	2.015E−1	2.330E−1	5.133E−1	6.229E−1	7.352E−1
0.300	8.292E−2	9.436E−2	2.056E−1	2.581E−1	3.250E−1
0.400	5.209E−2	5.739E−2	1.146E−1	1.439E−1	1.847E−1
0.500	4.028E−2	4.327E−2	7.722E−2	9.564E−2	1.226E−1
0.600	3.455E−2	3.637E−2	5.882E−2	7.132E−2	9.025E−2
0.800	2.900E−2	2.983E−2	4.151E−2	4.838E−2	5.917E−2
1.000	2.611E−2	2.657E−2	3.360E−2	3.787E−2	4.473E−2
1.500	2.232E−2	2.243E−2	2.528E−2	2.714E−2	3.022E−2
2.000	2.079E−2	2.085E−2	2.286E−2	2.407E−2	2.612E−2
3.000	2.035E−2	2.050E−2	2.253E−2	2.351E−2	2.493E−2
4.000	2.102E−2	2.127E−2	2.368E−2	2.463E−2	2.585E−2
5.000	2.195E−2	2.229E−2	2.503E−2	2.600E−2	2.711E−2
6.000	2.288E−2	2.329E−2	2.631E−2	2.730E−2	2.835E−2
8.000	2.469E−2	2.521E−2	2.853E−2	2.948E−2	3.034E−2
10.00	2.610E−2	2.669E−2	3.021E−2	3.114E−2	3.190E−2
15.00	2.835E−2	2.902E−2	3.272E−2	3.353E−2	3.399E−2
20.00	2.971E−2	3.039E−2	3.379E−2	3.440E−2	3.465E−2

Table 2
Mass Energy Absorption Coefficients (cm^2/g)

E(MeV)	Air	Water	Concrete	ICRP Tiss.	ICRU Tiss.	St. Man
0.010	4.640E+0	4.840E+0	2.467E+1	4.403E+0	4.464E+0	5.730E+0
0.015	1.300E+0	1.340E+0	7.582E+0	1.231E+0	1.235E+0	1.654E+0
0.020	5.255E−1	5.367E−1	3.217E+0	4.962E−1	4.942E−1	6.791E−1
0.030	1.501E−1	1.520E−1	9.454E−1	1.422E−1	1.404E−2	1.969E−1
0.040	6.694E−2	6.803E−2	3.959E−1	6.448E−2	6.339E−2	8.719E−2
0.050	4.031E−2	4.155E−2	2.048E−1	3.990E−2	3.922E−2	5.128E−2
0.060	3.004E−2	3.152E−2	1.230E−1	3.061E−2	3.016E−2	3.702E−2
0.080	2.393E−2	2.583E−2	6.154E−2	2.540E−2	2.517E−2	2.796E−2
0.100	2.318E−2	2.539E−2	4.180E−2	2.511E−2	2.495E−2	2.633E−2
0.150	2.494E−2	2.762E−2	3.014E−2	2.741E−2	2.731E−2	2.767E−2
0.200	2.672E−2	2.966E−2	2.887E−2	2.945E−2	2.936E−2	2.949E−2
0.300	2.872E−2	3.192E−2	2.937E−2	3.170E−2	3.161E−2	3.162E−2
0.400	2.949E−2	3.279E−2	2.980E−2	3.256E−2	3.247E−2	3.245E−2
0.500	2.966E−2	3.299E−2	2.984E−2	3.275E−2	3.267E−2	3.264E−2
0.600	2.953E−2	3.284E−2	2.964E−2	3.265E−2	3.252E−2	3.249E−2
0.800	2.882E−2	3.205E−2	2.887E−2	3.183E−2	3.175E−2	3.171E−2
1.000	2.787E−2	3.100E−2	2.790E−2	3.079E−2	3.071E−2	3.067E−2
1.500	2.545E−2	2.831E−2	2.544E−2	2.811E−2	2.804E−2	2.800E−2
2.000	2.342E−2	2.604E−2	2.348E−2	2.585E−2	2.579E−2	2.576E−2
3.000	2.054E−2	2.278E−2	2.086E−2	2.259E−2	2.255E−2	2.253E−2
4.000	1.866E−2	2.063E−2	1.929E−2	2.043E−2	2.041E−2	2.039E−2
5.000	1.737E−2	1.917E−2	1.828E−2	1.892E−2	1.892E−2	1.890E−2
6.000	1.644E−2	1.804E−2	1.760E−2	1.781E−2	1.782E−2	1.781E−2
8.000	1.521E−2	1.657E−2	1.680E−2	1.632E−2	1.637E−2	1.635E−2
10.00	1.446E−2	1.566E−2	1.639E−2	1.538E−2	1.545E−2	1.544E−2
15.00	1.349E−2	1.442E−2	1.596E−2	1.410E−2	1.421E−2	1.419E−2
20.00	1.308E−2	1.386E−2	1.591E−2	1.350E−2	1.364E−2	1.362E−2

Table 3
Exposure Buildup Factors
Beryllium

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.17	1.28	1.25	1.29	1.31	1.35	1.38	1.43	1.41
1.0	1.31	1.46	1.49	1.59	1.65	1.74	1.85	2.01	2.05
2.0	1.56	1.76	1.91	2.13	2.27	2.50	2.83	3.41	3.89
3.0	1.78	2.07	2.28	2.61	2.84	3.22	3.81	4.96	6.12
4.0	1.99	2.37	2.64	3.07	3.39	3.91	4.77	6.58	8.56
5.0	2.19	2.65	2.99	3.53	3.94	4.61	5.75	8.25	1.11E1
6.0	2.39	2.93	3.33	3.98	4.48	5.30	6.73	9.97	1.39E1
7.0	2.58	3.20	3.66	4.43	5.01	6.00	7.73	1.17E1	1.68E1
8.0	2.76	3.46	3.99	4.86	5.54	6.69	8.73	1.36E1	1.98E1
10.0	3.12	3.97	4.62	5.72	6.59	8.07	1.08E1	1.74E1	2.63E1
15.0	3.95	5.19	6.13	7.79	9.14	1.15E1	1.60E1	2.77E1	4.46E1
20.0	4.72	6.33	7.56	9.78	1.16E1	1.49E1	2.13E1	3.87E1	6.52E1
25.0	5.45	7.43	8.93	1.17E1	1.41E1	1.83E1	2.67E1	5.04E1	8.77E1
30.0	6.17	8.48	1.03E1	1.36E1	1.64E1	2.16E1	3.21E1	6.27E1	1.12E2
35.0	6.99	9.43	1.16E1	1.55E1	1.88E1	2.49E1	3.77E1	7.57E1	1.37E2
40.0	7.80	1.03E1	1.28E1	1.72E1	2.10E1	2.82E1	4.33E1	8.92E1	1.63E2

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.44	1.52	1.57	1.61	1.80	1.79	2.07	2.19	2.83
1.0	2.17	2.36	2.51	2.65	3.20	3.35	4.27	4.84	7.06
2.0	4.73	5.36	6.25	6.95	8.61	1.01E1	1.46E1	1.79E1	2.86E1
3.0	8.49	1.02E1	1.31E1	1.54E1	1.86E1	2.45E1	3.90E1	5.01E1	8.29E1
4.0	1.31E1	1.68E1	2.33E1	2.89E1	3.72E1	5.12E1	8.78E1	1.17E2	1.98E2
5.0	1.84E1	2.48E1	3.71E1	4.80E1	6.59E1	9.48E1	1.74E2	2.42E2	4.16E2
6.0	2.43E1	3.42E1	5.43E1	7.33E1	1.06E2	1.59E2	3.11E2	4.50E2	7.87E2
7.0	3.08E1	4.49E1	7.49E1	1.05E2	1.59E2	2.50E2	5.23E2	7.86E2	1.40E3
8.0	3.78E1	5.68E1	9.89E1	1.43E2	2.25E2	3.72E2	8.27E2	1.29E3	2.34E3
10.0	5.35E1	8.40E1	1.57E2	2.40E2	4.04E2	7.25E2	1.81E3	3.04E3	5.75E3
15.0	1.02E2	1.73E2	3.65E2	6.09E2	1.17E3	2.55E3	8.02E3	1.60E4	3.37E4
20.0	1.62E2	2.92E2	6.68E2	1.19E3	2.48E3	6.26E3	2.37E4	5.48E4	1.29E5
25.0	2.31E2	4.36E2	1.07E3	2.02E3	4.47E3	1.26E4	5.55E4	1.45E5	3.79E5
30.0	3.08E2	6.04E2	1.56E3	3.09E3	7.29E3	2.22E4	1.12E5	3.24E5	9.35E5
35.0	3.89E2	7.93E2	2.20E3	4.40E3	1.11E4	3.66E4	2.06E5	6.54E5	2.07E6
40.0	4.73E2	9.98E2	2.80E3	6.00E3	1.60E4	5.69E4	3.58E5	1.23E6	4.23E6

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	3.21	3.63	3.72	3.54	3.05	2.30	1.83
1.0	8.32	9.53	9.50	8.47	6.41	3.83	2.55
2.0	3.43E1	3.81E1	3.60E1	2.90E1	1.83E1	7.76	3.94
3.0	9.92E1	1.06E2	9.60E1	7.16E1	3.94E1	1.30E1	5.40
4.0	2.36E2	2.45E2	2.13E2	1.49E2	7.28E1	1.95E1	6.93
5.0	4.94E2	4.97E2	4.18E2	2.76E2	1.22E2	2.74E1	8.52
6.0	9.31E2	9.13E2	7.45E2	4.69E2	1.91E2	3.68E1	1.01E1
7.0	1.65E3	1.59E3	1.26E3	7.59E2	2.84E2	4.77E1	1.18E1
8.0	2.77E3	2.61E3	2.03E3	1.17E3	4.07E2	6.00E1	1.35E1
10.0	6.86E3	6.24E3	4.65E3	2.50E3	7.60E2	8.97E1	1.70E1
15.0	4.13E4	3.55E4	2.44E4	1.13E4	2.61E3	1.95E2	2.65E1
20.0	1.63E5	1.36E5	8.79E4	3.65E4	6.68E3	3.55E2	3.71E1
25.0	5.00E5	4.09E5	2.51E5	9.47E4	1.43E4	5.80E2	4.89E1
30.0	1.28E6	1.04E6	6.13E5	2.14E5	2.71E4	8.88E2	6.25E1
35.0	2.95E6	2.38E6	1.36E6	4.41E5	4.79E4	1.30E3	7.80E1
40.0	6.25E6	5.03E6	2.78E6	8.47E5	7.97E4	1.83E3	9.56E1

Table 3
Exposure Buildup Factors

Boron

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.16	1.21	1.23	1.28	1.30	1.33	1.36	1.41	1.44
1.0	1.30	1.39	1.44	1.55	1.60	1.68	1.78	1.92	2.03
2.0	1.53	1.72	1.85	2.05	2.18	2.37	2.64	3.10	3.50
3.0	1.75	2.03	2.22	2.51	2.71	3.03	3.50	4.38	5.22
4.0	1.95	2.31	2.57	2.96	3.24	3.68	4.37	5.72	7.10
5.0	2.15	2.59	2.91	3.40	3.76	4.33	5.24	7.11	9.12
6.0	2.35	2.87	3.24	3.84	4.27	4.98	6.13	8.56	1.13E1
7.0	2.54	3.14	3.57	4.27	4.78	5.63	7.04	1.01E1	1.35E1
8.0	2.72	3.40	3.89	4.69	5.29	6.28	7.95	1.16E1	1.59E1
10.0	3.09	3.92	4.52	5.53	6.30	7.58	9.80	1.48E1	2.10E1
15.0	3.94	5.15	6.04	7.57	8.77	1.08E1	1.45E1	2.35E1	3.53E1
20.0	4.75	6.33	7.49	9.54	1.12E1	1.41E1	1.94E1	3.28E1	5.13E1
25.0	5.52	7.48	8.89	1.15E1	1.36E1	1.73E1	2.43E1	4.27E1	6.89E1
30.0	6.26	8.63	1.02E1	1.34E1	1.59E1	2.05E1	2.93E1	5.29E1	8.83E1
35.0	6.98	9.80	1.15E1	1.52E1	1.83E1	2.37E1	3.44E1	6.36E1	1.10E2
40.0	7.74	1.10E1	1.26E1	1.70E1	2.05E1	2.68E1	3.94E1	7.59E1	1.33E2

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.48	1.50	1.59	1.62	1.68	1.75	2.02	2.69	3.53
1.0	2.18	2.26	2.45	2.59	2.78	3.00	3.84	5.94	8.26
2.0	4.20	4.67	5.44	6.01	6.87	8.55	1.14E1	1.87E1	2.64E1
3.0	6.92	8.17	9.87	1.18E1	1.43E1	1.83E1	2.72E1	4.42E1	6.34E1
4.0	1.01E1	1.26E1	1.68E1	2.03E1	2.58E1	3.52E1	5.60E1	8.97E1	1.24E2
5.0	1.38E1	1.78E1	2.53E1	3.16E1	4.20E1	6.08E1	1.03E2	1.65E2	2.27E2
6.0	1.79E1	2.38E1	3.53E1	4.57E1	6.34E1	9.67E1	1.73E2	2.82E2	3.93E2
7.0	2.23E1	3.05E1	4.70E1	6.28E1	9.04E1	1.44E2	2.74E2	4.56E2	6.46E2
8.0	2.71E1	3.80E1	6.05E1	8.29E1	1.23E2	2.06E2	4.12E2	7.04E2	1.01E3
10.0	3.78E1	5.51E1	9.30E1	1.33E2	2.09E2	3.75E2	8.26E2	1.51E3	2.21E3
15.0	7.07E1	1.11E2	2.07E2	3.18E2	5.54E2	1.15E3	3.08E3	6.46E3	9.91E3
20.0	1.11E2	1.83E2	3.70E2	6.01E2	1.13E3	2.61E3	8.17E3	1.86E4	3.11E4
25.0	1.58E2	2.72E2	5.83E2	9.92E2	1.99E3	5.00E3	1.79E4	4.35E4	8.05E4
30.0	2.10E2	3.74E2	8.50E2	1.48E3	3.13E3	8.63E3	3.45E4	9.29E4	1.84E5
35.0	2.68E2	4.88E2	1.17E3	2.02E3	4.43E3	1.38E4	6.08E4	1.86E5	3.90E5
40.0	3.31E2	6.11E2	1.55E3	2.42E3	5.37E3	2.09E4	9.93E4	3.35E5	7.78E5

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	3.40	3.64	3.63	3.28	2.58	1.88	1.43
1.0	8.09	8.58	8.25	6.91	4.65	2.65	1.73
2.0	2.68E1	2.68E1	2.43E1	1.83E1	1.03E1	4.14	2.24
3.0	6.33E1	6.34E1	5.42E1	3.73E1	1.81E1	5.70	2.67
4.0	1.35E2	1.29E2	1.05E2	6.68E1	2.81E1	7.32	3.06
5.0	2.55E2	2.35E2	1.83E2	1.08E2	4.04E1	8.99	3.41
6.0	4.43E2	3.93E2	2.95E2	1.64E2	5.50E1	1.07E1	3.74
7.0	7.20E2	6.19E2	4.50E2	2.36E2	7.20E1	1.24E1	4.05
8.0	1.11E3	9.30E2	6.55E2	3.28E2	9.16E1	1.42E1	4.35
10.0	2.39E3	1.89E3	1.26E3	5.79E2	1.38E2	1.79E1	4.91
15.0	1.06E4	7.64E3	4.59E3	1.76E3	3.08E2	2.79E1	6.17
20.0	3.31E4	2.25E4	1.24E4	4.15E3	5.66E2	3.92E1	7.32
25.0	8.51E4	5.50E4	2.85E4	8.47E3	9.37E2	5.21E1	8.40
30.0	1.93E5	1.20E5	5.87E4	1.58E4	1.45E3	6.68E1	9.42
35.0	4.01E5	2.40E5	1.12E5	2.75E4	2.13E3	8.33E1	1.04E1
40.0	7.83E5	4.51E5	2.02E5	4.59E4	3.02E3	1.01E2	1.12E1

Table 3
Exposure Buildup Factors

Carbon

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.16	1.20	1.23	1.27	1.29	1.32	1.35	1.40	1.43
1.0	1.29	1.38	1.45	1.54	1.58	1.66	1.75	1.88	1.98
2.0	1.51	1.70	1.83	2.01	2.13	2.31	2.56	2.96	3.30
3.0	1.72	2.00	2.19	2.47	2.65	2.94	3.37	4.12	4.80
4.0	1.93	2.28	2.53	2.91	3.16	3.57	4.19	5.34	6.45
5.0	2.13	2.56	2.87	3.35	3.67	4.20	5.03	6.62	8.21
6.0	2.33	2.84	3.21	3.78	4.18	4.84	5.88	7.96	1.01E1
7.0	2.52	3.11	3.54	4.21	4.69	5.47	6.75	9.34	1.21E1
8.0	2.71	3.37	3.86	4.64	5.19	6.11	7.63	1.08E1	1.41E1
10.0	3.08	3.89	4.50	5.49	6.18	7.38	9.41	1.38E1	1.85E1
15.0	3.98	5.14	6.05	7.56	8.64	1.06E1	1.40E1	2.19E1	3.09E1
20.0	4.83	6.34	7.55	9.60	1.11E1	1.37E1	1.87E1	3.06E1	4.48E1
25.0	5.66	7.50	8.99	1.16E1	1.35E1	1.69E1	2.35E1	3.99E1	5.98E1
30.0	6.46	8.65	1.03E1	1.36E1	1.58E1	2.01E1	2.84E1	4.96E1	7.59E1
35.0	7.20	9.86	1.14E1	1.56E1	1.82E1	2.33E1	3.33E1	5.97E1	9.26E1
40.0	7.85	1.12E1	1.23E1	1.75E1	2.04E1	2.63E1	3.82E1	7.02E1	1.10E2

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.48	1.52	1.63	1.66	1.71	1.80	1.99	2.19	2.73
1.0	2.13	2.25	2.54	2.66	2.84	3.15	3.75	4.38	5.90
2.0	3.91	4.34	4.90	5.39	6.20	7.61	9.76	1.22E1	1.72E1
3.0	6.19	7.18	8.89	1.01E1	1.20E1	1.45E1	2.14E1	2.80E1	3.93E1
4.0	8.84	1.07E1	1.39E1	1.65E1	2.03E1	2.68E1	4.08E1	5.49E1	7.79E1
5.0	1.18E1	1.47E1	2.00E1	2.46E1	3.16E1	4.40E1	7.02E1	9.69E1	1.38E2
6.0	1.52E1	1.94E1	2.74E1	3.45E1	4.58E1	6.67E1	1.12E2	1.58E2	2.27E2
7.0	1.88E1	2.45E1	3.60E1	4.64E1	6.33E1	9.56E1	1.68E2	2.44E2	3.50E2
8.0	2.27E1	3.02E1	4.57E1	6.02E1	8.43E1	1.32E2	2.42E2	3.58E2	5.17E2
10.0	3.15E1	4.32E1	6.91E1	9.42E1	1.38E2	2.28E2	4.53E2	6.98E2	1.02E3
15.0	5.83E1	8.46E1	1.50E2	2.20E2	3.47E2	6.46E2	1.50E3	2.53E3	3.82E3
20.0	9.11E1	1.38E2	2.65E2	4.10E2	6.89E2	1.40E3	3.69E3	6.74E3	1.06E4
25.0	1.29E2	2.02E2	4.16E2	6.76E2	1.19E3	2.62E3	7.68E3	1.50E4	2.45E4
30.0	1.73E2	2.77E2	6.01E2	1.03E3	1.86E3	4.43E3	1.43E4	2.98E4	5.07E4
35.0	2.20E2	3.61E2	7.80E2	1.48E3	2.67E3	7.02E3	2.43E4	5.42E4	9.68E4
40.0	2.72E2	4.54E2	1.00E3	2.04E3	3.54E3	1.06E4	4.20E4	9.19E4	1.74E5

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	3.08	3.34	3.25	2.75	2.22	1.49	1.25
1.0	6.77	7.21	6.71	5.17	3.49	1.87	1.39
2.0	1.95E1	1.97E1	1.69E1	1.21E1	6.30	2.56	1.60
3.0	4.39E1	4.16E1	3.43E1	2.18E1	9.44	3.13	1.77
4.0	8.55E1	7.68E1	5.94E1	3.44E1	1.29E1	3.63	1.91
5.0	1.49E2	1.28E2	9.37E1	5.00E1	1.65E1	4.11	2.03
6.0	2.41E2	1.97E2	1.38E2	6.87E1	2.04E1	4.57	2.13
7.0	3.66E2	2.90E2	1.95E2	9.08E1	2.44E1	5.00	2.23
8.0	5.34E2	4.08E2	2.65E2	1.16E2	2.87E1	5.42	2.32
10.0	1.03E3	7.42E2	4.52E2	1.79E2	3.80E1	6.23	2.48
15.0	3.72E3	2.41E3	1.29E3	4.14E2	6.54E1	8.15	2.81
20.0	1.01E4	6.01E3	2.93E3	7.92E2	9.96E1	9.99	3.08
25.0	2.30E4	1.29E4	5.80E3	1.36E3	1.41E2	1.18E1	3.31
30.0	4.70E4	2.52E4	1.05E4	2.16E3	1.91E2	1.36E1	3.51
35.0	8.92E4	4.60E4	1.79E4	3.25E3	2.49E2	1.53E1	3.68
40.0	1.60E5	8.01E4	2.90E4	4.72E3	3.17E2	1.68E1	3.82

Table 3
Exposure Buildup Factors

Nitrogen

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.16	1.20	1.23	1.28	1.29	1.31	1.34	1.39	1.42
1.0	1.28	1.38	1.43	1.53	1.57	1.64	1.72	1.84	1.94
2.0	1.50	1.69	1.81	1.99	2.10	2.27	2.49	2.86	3.15
3.0	1.71	1.98	2.16	2.43	2.61	2.88	3.27	3.94	4.53
4.0	1.91	2.27	2.51	2.87	3.12	3.50	4.06	5.08	6.04
5.0	2.11	2.55	2.85	3.31	3.62	4.12	4.87	6.28	7.66
6.0	2.31	2.82	3.18	3.74	4.13	4.74	5.70	7.54	9.39
7.0	2.51	3.10	3.52	4.17	4.63	5.37	6.54	8.84	1.12E1
8.0	2.70	3.37	3.85	4.60	5.14	6.00	7.39	1.02E1	1.31E1
10.0	3.09	3.91	4.50	5.44	6.14	7.27	9.12	1.30E1	1.73E1
15.0	4.02	5.22	6.08	7.53	8.63	1.04E1	1.36E1	2.05E1	2.88E1
20.0	4.93	6.50	7.63	9.59	1.11E1	1.36E1	1.82E1	2.86E1	4.18E1
25.0	5.82	7.76	9.13	1.16E1	1.36E1	1.69E1	2.29E1	3.72E1	5.60E1
30.0	6.68	9.00	1.06E1	1.36E1	1.60E1	2.01E1	2.77E1	4.62E1	7.12E1
35.0	7.48	1.02E1	1.24E1	1.57E1	1.84E1	2.33E1	3.25E1	5.54E1	8.74E1
40.0	8.19	1.14E1	1.41E1	1.79E1	2.08E1	2.64E1	3.73E1	6.49E1	1.05E2

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.48	1.51	1.57	1.61	1.67	1.76	1.86	2.09	2.60
1.0	2.05	2.20	2.36	2.48	2.64	2.90	3.29	3.87	5.21
2.0	3.71	4.07	4.63	5.06	5.66	6.60	8.40	1.02E1	1.34E1
3.0	5.69	6.51	7.81	8.81	1.03E1	1.26E1	1.71E1	2.14E1	2.77E1
4.0	7.98	9.44	1.18E1	1.37E1	1.66E1	2.12E1	3.03E1	3.88E1	5.01E1
5.0	1.06E1	1.28E1	1.67E1	1.99E1	2.48E1	3.29E1	4.91E1	6.38E1	8.20E1
6.0	1.34E1	1.67E1	2.24E1	2.73E1	3.48E1	4.79E1	7.43E1	9.81E1	1.25E2
7.0	1.66E1	2.10E1	2.89E1	3.59E1	4.70E1	6.66E1	1.07E2	1.43E2	1.82E2
8.0	2.00E1	2.57E1	3.63E1	4.58E1	6.13E1	8.93E1	1.48E2	2.01E2	2.54E2
10.0	2.75E1	3.65E1	5.38E1	6.99E1	9.70E1	1.48E2	2.61E2	3.63E2	4.53E2
15.0	5.04E1	7.11E1	1.14E2	1.57E2	2.34E2	3.95E2	7.85E2	1.15E3	1.42E3
20.0	7.83E1	1.16E2	1.98E2	2.86E2	4.53E2	8.29E2	1.82E3	2.81E3	3.47E3
25.0	1.11E2	1.70E2	3.06E2	4.60E2	7.66E2	1.51E3	3.63E3	5.86E3	7.27E3
30.0	1.47E2.	2.33E2	4.37E2	6.80E2	1.19E3	2.49E3	6.51E3	1.11E4	1.39E4
35.0	1.87E2	3.04E2	5.93E2	9.50E2	1.72E3	3.83E3	1.07E4	1.95E4	2.47E4
40.0	2.30E2	3.83E2	7.72E2	1.27E3	2.39E3	5.60E3	1.61E4	3.26E4	4.18E4

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.62	2.75	2.70	2.37	1.89	1.34	1.16
1.0	5.28	5.39	4.98	3.92	2.63	1.55	1.24
2.0	1.44E1	1.35E1	1.12E1	7.56	3.98	1.87	1.35
3.0	2.94E1	2.55E1	1.96E1	1.18E1	5.29	2.14	1.43
4.0	5.16E1	4.19E1	3.02E1	1.66E1	6.58	2.36	1.50
5.0	8.23E1	6.30E1	4.31E1	2.20E1	7.85	2.56	1.56
6.0	1.23E2	8.93E1	5.83E1	2.78E1	9.09	2.74	1.61
7.0	1.74E2	1.21E2	7.59E1	3.40E1	1.03E1	2.91	1.66
8.0	2.39E2	1.59E2	9.61E1	4.08E1	1.16E1	3.06	1.70
10.0	4.14E2	2.57E2	1.45E2	5.57E1	1.41E1	3.35	1.77
15.0	1.22E3	6.55E2	3.23E2	1.02E2	2.07E1	3.97	1.91
20.0	2.83E3	1.36E3	6.02E2	1.63E2	2.78E1	4.52	2.02
25.0	5.74E3	2.52E3	1.01E3	2.39E2	3.55E1	5.01	2.11
30.0	1.06E4	4.28E3	1.59E3	3.31E2	4.35E1	5.46	2.19
35.0	1.80E4	6.87E3	2.36E3	4.41E2	5.14E1	5.85	2.26
40.0	2.84E4	1.05E4	3.38E3	5.69E2	5.88E1	6.17	2.30

Table 3
Exposure Buildup Factors

Oxygen

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.23	1.27	1.29	1.31	1.34	1.38	1.41
1.0	1.28	1.37	1.43	1.52	1.56	1.63	1.71	1.83	1.91
2.0	1.49	1.68	1.80	1.97	2.08	2.25	2.46	2.80	3.07
3.0	1.69	1.97	2.15	2.42	2.59	2.85	3.22	3.84	4.38
4.0	1.90	2.25	2.49	2.85	3.09	3.46	4.00	4.95	5.80
5.0	2.10	2.54	2.84	3.29	3.60	4.08	4.80	6.11	7.34
6.0	2.30	2.82	3.18	3.72	4.10	4.70	5.61	7.33	8.98
7.0	2.50	3.10	3.51	4.16	4.61	5.33	6.44	8.59	1.07E1
8.0	2.70	3.37	3.85	4.59	5.12	5.96	7.28	9.90	1.26E1
10.0	3.10	3.93	4.51	5.45	6.13	7.22	9.00	1.26E1	1.65E1
15.0	4.07	5.29	6.15	7.59	8.66	1.04E1	1.34E1	2.00E1	2.74E1
20.0	5.04	6.63	7.76	9.71	1.12E1	1.37E1	1.80E1	2.80E1	3.97E1
25.0	6.00	7.97	9.35	1.18E1	1.37E1	1.69E1	2.27E1	3.64E1	5.32E1
30.0	6.94	9.29	1.09E1	1.38E1	1.62E1	2.02E1	2.75E1	4.52E1	6.76E1
35.0	7.83	1.06E1	1.26E1	1.56E1	1.88E1	2.35E1	3.23E1	5.44E1	8.30E1
40.0	8.62	1.19E1	1.44E1	1.72E1	2.13E1	2.67E1	3.71E1	6.37E1	9.90E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.49	1.56	1.60	1.66	1.74	1.90	2.18	2.34
1.0	2.07	2.15	2.32	2.43	2.59	2.82	3.26	3.83	4.39
2.0	3.58	3.91	4.41	4.79	5.32	6.11	7.59	8.97	1.09E1
3.0	5.41	6.13	7.23	8.08	9.28	1.11E1	1.45E1	1.74E1	2.10E1
4.0	7.51	8.76	1.07E1	1.23E1	1.45E1	1.80E1	2.44E1	2.97E1	3.53E1
5.0	9.88	1.18E1	1.49E1	1.74E1	2.12E1	2.71E1	3.79E1	4.66E1	5.43E1
6.0	1.25E1	1.52E1	1.98E1	2.36E1	2.92E1	3.84E1	5.53E1	6.87E1	7.87E1
7.0	1.54E1	1.91E1	2.54E1	3.07E1	3.88E1	5.23E1	7.73E1	9.66E1	1.09E2
8.0	1.85E1	2.33E1	3.17E1	3.89E1	5.01E1	6.89E1	1.04E2	1.31E2	1.46E2
10.0	2.54E1	3.29E1	4.66E1	5.86E1	7.78E1	1.11E2	1.76E2	2.25E2	2.44E2
15.0	4.62E1	6.35E1	9.73E1	1.29E2	1.83E2	2.85E2	4.93E2	6.49E2	6.73E2
20.0	7.16E1	1.03E2	1.68E2	2.32E2	3.48E2	5.81E2	1.09E3	1.48E3	1.49E3
25.0	1.01E2	1.50E2	2.58E2	3.70E2	5.81E2	1.04E3	2.10E3	2.94E3	2.89E3
30.0	1.34E2	2.05E2	3.67E2	5.44E2	8.92E2	1.68E3	3.66E3	5.31E3	5.13E3
35.0	1.70E2	2.68E2	4.97E2	7.55E2	1.29E3	2.56E3	5.95E3	8.95E3	8.54E3
40.0	2.09E2	3.37E2	6.45E2	1.00E3	1.77E3	3.69E3	9.14E3	1.44E4	1.35E4

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.49	2.53	2.40	2.10	1.63	1.24	1.11
1.0	4.69	4.56	4.03	3.14	2.00	1.36	1.15
2.0	1.13E1	9.92	7.92	5.23	2.89	1.54	1.22
3.0	2.11E1	1.70E1	1.25E1	7.40	3.53	1.68	1.27
4.0	3.42E1	2.57E1	1.78E1	9.61	4.13	1.80	1.31
5.0	5.11E1	3.60E1	2.36E1	1.19E1	4.69	1.90	1.34
6.0	7.20E1	4.80E1	3.00E1	1.42E1	5.23	1.99	1.37
7.0	9.73E1	6.18E1	3.71E1	1.66E1	5.75	2.07	1.39
8.0	1.27E2	7.75E1	4.48E1	1.90E1	6.25	2.14	1.42
10.0	2.04E2	1.15E2	6.21E1	2.41E1	7.22	2.27	1.45
15.0	5.19E2	2.50E2	1.18E2	3.82E1	9.56	2.55	1.53
20.0	1.08E3	4.60E2	1.94E2	5.43E1	1.18E1	2.77	1.58
25.0	1.98E3	7.63E2	2.93E2	7.23E1	1.41E1	2.96	1.63
30.0	3.36E3	1.18E3	4.16E2	9.21E1	1.64E1	3.13	1.67
35.0	5.36E3	1.74E3	5.67E2	1.14E2	1.85E1	3.27	1.70
40.0	8.14E3	2.46E3	7.48E2	1.39E2	2.04E1	3.37	1.72

Table 3
Exposure Buildup Factors

Sodium

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.22	1.26	1.28	1.31	1.33	1.37	1.40
1.0	1.26	1.36	1.42	1.50	1.54	1.61	1.69	1.79	1.87
2.0	1.47	1.65	1.78	1.95	2.05	2.21	2.41	2.70	2.93
3.0	1.67	1.94	2.12	2.39	2.55	2.80	3.14	3.67	4.12
4.0	1.87	2.23	2.47	2.83	3.06	3.41	3.90	4.70	5.42
5.0	2.08	2.52	2.82	3.27	3.56	4.02	4.68	5.79	6.84
6.0	2.29	2.82	3.18	3.72	4.08	4.65	5.48	6.92	8.34
7.0	2.50	3.11	3.54	4.17	4.60	5.28	6.30	8.10	9.94
8.0	2.72	3.41	3.89	4.63	5.12	5.93	7.14	9.31	1.16E1
10.0	3.16	4.01	4.62	5.54	6.17	7.23	8.85	1.18E1	1.52E1
15.0	4.32	5.56	6.45	7.88	8.85	1.06E1	1.33E1	1.86E1	2.52E1
20.0	5.54	7.14	8.32	1.03E1	1.16E1	1.40E1	1.80E1	2.59E1	3.65E1
25.0	6.81	8.77	1.02E1	1.27E1	1.43E1	1.75E1	2.29E1	3.35E1	4.89E1
30.0	8.12	1.04E1	1.21E1	1.51E1	1.70E1	2.11E1	2.79E1	4.16E1	6.21E1
35.0	9.41	1.21E1	1.41E1	1.79E1	1.94E1	2.47E1	3.30E1	4.98E1	7.61E1
40.0	1.06E1	1.40E1	1.60E1	2.12E1	2.16E1	2.84E1	3.81E1	5.82E1	9.07E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.46	1.49	1.54	1.58	1.63	1.71	1.84	1.94	2.08
1.0	2.01	2.10	2.24	2.33	2.46	2.64	2.94	3.16	3.37
2.0	3.35	3.62	4.01	4.30	4.66	5.17	5.94	6.42	6.53
3.0	4.94	5.49	6.29	6.85	7.61	8.62	1.00E1	1.08E1	1.04E1
4.0	6.77	7.68	9.05	1.00E1	1.13E1	1.30E1	1.53E1	1.63E1	1.50E1
5.0	8.82	1.02E1	1.23E1	1.38E1	1.58E1	1.85E1	2.18E1	2.30E1	2.02E1
6.0	1.11E1	1.30E1	1.61E1	1.82E1	2.12E1	2.51E1	2.98E1	3.11E1	2.62E1
7.0	1.36E1	1.62E1	2.04E1	2.32E1	2.74E1	3.29E1	3.93E1	4.07E1	3.30E1
8.0	1.63E1	1.97E1	2.52E1	2.90E1	3.47E1	4.21E1	5.04E1	5.18E1	4.07E1
10.0	2.22E1	2.76E1	3.65E1	4.27E1	5.22E1	6.48E1	7.83E1	7.95E1	5.87E1
15.0	4.02E1	5.25E1	7.47E1	9.04E1	1.16E2	1.52E2	1.88E2	1.87E2	1.22E2
20.0	6.20E1	8.43E1	1.27E2	1.58E2	2.14E2	2.93E2	3.73E2	3.65E2	2.15E2
25.0	8.72E1	1.23E2	1.95E2	2.47E2	3.48E2	5.00E2	6.55E2	6.36E2	3.44E2
30.0	1.15E2	1.67E2	2.77E2	3.58E2	5.24E2	7.83E2	1.06E3	1.02E3	5.14E2
35.0	1.47E2	2.17E2	3.73E2	4.92E2	7.43E2	1.15E3	1.61E3	1.55E3	7.31E2
40.0	1.80E2	2.72E2	4.85E2	6.48E2	1.01E3	1.59E3	2.33E3	2.25E3	1.00E3

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.09	1.97	1.80	1.41	1.26	1.09	1.04
1.0	3.29	2.84	2.42	1.78	1.39	1.12	1.05
2.0	5.97	4.51	3.44	2.38	1.58	1.17	1.07
3.0	8.97	6.17	4.38	2.79	1.73	1.21	1.09
4.0	1.23E1	7.85	5.28	3.15	1.85	1.24	1.10
5.0	1.59E1	9.56	6.14	3.48	1.95	1.26	1.11
6.0	1.99E1	1.13E1	6.98	3.79	2.04	1.28	1.11
7.0	2.42E1	1.31E1	7.81	4.08	2.12	1.30	1.12
8.0	2.89E1	1.49E1	8.62	4.35	2.20	1.31	1.13
10.0	3.93E1	1.88E1	1.03E1	4.87	2.33	1.34	1.14
15.0	7.21E1	2.95E1	1.44E1	6.05	2.62	1.40	1.16
20.0	1.15E2	4.17E1	1.85E1	7.11	2.85	1.43	1.17
25.0	1.69E2	5.51E1	2.28E1	8.08	3.05	1.47	1.18
30.0	2.35E2	6.97E1	2.72E1	8.97	3.22	1.49	1.19
35.0	3.12E2	8.58E1	3.16E1	9.75	3.37	1.51	1.20
40.0	4.02E2	1.05E2	3.59E1	1.04E1	3.47	1.53	1.21

Table 3
Exposure Buildup Factors

Magnesium

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.22	1.26	1.28	1.31	1.33	1.37	1.40
1.0	1.26	1.36	1.42	1.49	1.54	1.61	1.68	1.78	1.86
2.0	1.46	1.65	1.77	1.94	2.05	2.20	2.39	2.68	2.90
3.0	1.66	1.93	2.12	2.38	2.55	2.79	3.12	3.65	4.07
4.0	1.86	2.22	2.47	2.82	3.05	3.39	3.88	4.68	5.35
5.0	2.07	2.52	2.82	3.27	3.56	4.01	4.66	5.77	6.74
6.0	2.29	2.82	3.18	3.72	4.08	4.64	5.46	6.91	8.22
7.0	2.51	3.12	3.54	4.18	4.61	5.28	6.28	8.10	9.79
8.0	2.73	3.43	3.91	4.64	5.14	5.92	7.12	9.33	1.14E1
10.0	3.19	4.05	4.65	5.57	6.22	7.24	8.84	1.19E1	1.49E1
15.0	4.41	5.67	6.54	7.96	8.98	1.06E1	1.33E1	1.89E1	2.48E1
20.0	5.73	7.36	8.49	1.04E1	1.18E1	1.41E1	1.80E1	2.65E1	3.59E1
25.0	7.13	9.11	1.05E1	1.29E1	1.47E1	1.77E1	2.29E1	3.46E1	4.81E1
30.0	8.60	1.09E1	1.25E1	1.55E1	1.76E1	2.13E1	2.79E1	4.31E1	6.11E1
35.0	1.01E1	1.28E1	1.46E1	1.82E1	2.13E1	2.50E1	3.30E1	5.19E1	7.49E1
40.0	1.15E1	1.49E1	1.66E1	2.13E1	2.56E1	2.88E1	3.82E1	6.10E1	8.93E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.45	1.49	1.54	1.58	1.63	1.69	1.81	1.90	1.99
1.0	2.00	2.09	2.21	2.31	2.42	2.59	2.84	3.01	3.10
2.0	3.30	3.56	3.92	4.18	4.51	4.94	5.54	5.83	5.61
3.0	4.85	5.35	6.08	6.58	7.24	8.07	9.09	9.41	8.51
4.0	6.62	7.45	8.67	9.53	1.06E1	1.20E1	1.36E1	1.38E1	1.18E1
5.0	8.60	9.87	1.17E1	1.30E1	1.47E1	1.68E1	1.90E1	1.90E1	1.55E1
6.0	1.08E1	1.26E1	1.52E1	1.71E1	1.96E1	2.26E1	2.55E1	2.52E1	1.95E1
7.0	1.32E1	1.56E1	1.92E1	2.19E1	2.53E1	2.94E1	3.32E1	3.23E1	2.41E1
8.0	1.58E1	1.89E1	2.37E1	2.72E1	3.18E1	3.73E1	4.21E1	4.04E1	2.90E1
10.0	2.16E1	2.65E1	3.42E1	3.99E1	4.75E1	5.68E1	6.42E1	6.02E1	4.04E1
15.0	3.88E1	5.01E1	6.90E1	8.39E1	1.04E2	1.30E2	1.49E2	1.33E2	7.78E1
20.0	5.98E1	8.03E1	1.16E2	1.47E2	1.89E2	2.47E2	2.87E2	2.47E2	1.29E2
25.0	8.40E1	1.16E2	1.76E2	2.29E2	3.06E2	4.14E2	4.92E2	4.12E2	1.96E2
30.0	1.11E2	1.58E2	2.49E2	3.31E2	4.57E2	6.42E2	7.80E2	6.37E2	2.79E2
35.0	1.41E2	2.06E2	3.34E2	4.54E2	6.45E2	9.36E2	1.16E3	9.30E2	3.80E2
40.0	1.73E2	2.58E2	4.30E2	5.98E2	8.71E2	1.31E3	1.66E3	1.30E3	4.99E2

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.98	1.83	1.67	1.38	1.20	1.06	1.03
1.0	2.95	2.49	2.13	1.62	1.29	1.09	1.04
2.0	4.95	3.65	2.80	1.99	1.42	1.12	1.05
3.0	7.07	4.74	3.39	2.27	1.52	1.15	1.06
4.0	9.30	5.80	3.95	2.49	1.60	1.17	1.07
5.0	1.17E1	6.84	4.48	2.70	1.67	1.19	1.08
6.0	1.42E1	7.87	4.97	2.89	1.73	1.20	1.09
7.0	1.68E1	8.91	5.44	3.06	1.78	1.22	1.09
8.0	1.96E1	9.96	5.90	3.22	1.83	1.23	1.10
10.0	2.57E1	1.21E1	6.80	3.52	1.92	1.25	1.10
15.0	4.35E1	1.76E1	8.95	4.18	2.09	1.28	1.12
20.0	6.52E1	2.34E1	1.09E1	4.73	2.23	1.31	1.13
25.0	9.07E1	2.95E1	1.30E1	5.22	2.34	1.33	1.14
30.0	1.20E2	3.56E1	1.53E1	5.66	2.44	1.35	1.14
35.0	1.53E2	4.15E1	1.75E1	6.03	2.52	1.36	1.15
40.0	1.90E2	4.67E1	1.97E1	6.30	2.57	1.37	1.15

Table 3
Exposure Buildup Factors

Aluminum

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.19	1.22	1.26	1.28	1.32	1.33	1.37	1.40
1.0	1.26	1.35	1.41	1.49	1.54	1.62	1.68	1.78	1.85
2.0	1.45	1.64	1.76	1.94	2.04	2.19	2.38	2.66	2.88
3.0	1.65	1.93	2.11	2.37	2.54	2.78	3.11	3.62	4.02
4.0	1.86	2.22	2.46	2.81	3.04	3.38	3.86	4.64	5.28
5.0	2.07	2.52	2.82	3.26	3.55	3.99	4.64	5.72	6.64
6.0	2.28	2.83	3.18	3.72	4.08	4.61	5.44	6.86	8.10
7.0	2.51	3.14	3.55	4.19	4.61	5.24	6.26	8.05	9.64
8.0	2.74	3.46	3.92	4.66	5.14	5.88	7.10	9.28	1.13E1
10.0	3.21	4.12	4.68	5.61	6.23	7.18	8.83	1.19E1	1.47E1
15.0	4.49	5.87	6.64	8.09	9.03	1.05E1	1.34E1	1.89E1	2.44E1
20.0	5.90	7.74	8.68	1.07E1	1.19E1	1.40E1	1.81E1	2.66E1	3.53E1
25.0	7.42	9.74	1.08E1	1.33E1	1.49E1	1.75E1	2.30E1	3.49E1	4.72E1
30.0	9.02	1.18E1	1.30E1	1.60E1	1.80E1	2.10E1	2.81E1	4.36E1	6.00E1
35.0	1.07E1	1.41E1	1.52E1	1.89E1	2.15E1	2.47E1	3.33E1	5.27E1	7.35E1
40.0	1.24E1	1.66E1	1.74E1	2.21E1	2.55E1	2.86E1	3.85E1	6.20E1	8.77E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.45	1.48	1.53	1.57	1.62	1.68	1.79	1.86	1.91
1.0	1.99	2.07	2.19	2.28	2.39	2.54	2.75	2.88	2.86
2.0	3.26	3.50	3.84	4.07	4.37	4.74	5.18	5.32	4.87
3.0	4.76	5.23	5.89	6.35	6.92	7.60	8.29	8.30	7.07
4.0	6.48	7.26	8.36	9.14	1.01E1	1.12E1	1.21E1	1.18E1	9.47
5.0	8.41	9.59	1.13E1	1.24E1	1.39E1	1.55E1	1.67E1	1.60E1	1.21E1
6.0	1.05E1	1.22E1	1.46E1	1.63E1	1.83E1	2.06E1	2.21E1	2.07E1	1.49E1
7.0	1.29E1	1.51E1	1.83E1	2.07E1	2.35E1	2.66E1	2.84E1	2.62E1	1.80E1
8.0	1.54E1	1.83E1	2.26E1	2.57E1	2.95E1	3.35E1	3.57E1	3.23E1	2.13E1
10.0	2.10E1	2.56E1	3.24E1	3.76E1	4.38E1	5.04E1	5.34E1	4.69E1	2.87E1
15.0	3.77E1	4.84E1	6.48E1	7.86E1	9.51E1	1.13E2	1.19E2	9.81E1	5.17E1
20.0	5.79E1	7.75E1	1.09E2	1.37E2	1.71E2	2.10E2	2.23E2	1.74E2	8.11E1
25.0	8.13E1	1.13E2	1.64E2	2.13E2	2.75E2	3.48E2	3.73E2	2.78E2	1.17E2
30.0	1.07E2	1.53E2	2.29E2	3.07E2	4.09E2	5.32E2	5.77E2	4.15E2	1.59E2
35.0	1.36E2	1.99E2	3.06E2	4.21E2	5.74E2	7.68E2	8.44E2	5.87E2	2.08E2
40.0	1.67E2	2.50E2	3.94E2	5.54E2	7.73E2	1.06E3	1.18E3	7.98E2	2.65E2

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.87	1.71	1.41	1.31	1.16	1.05	1.02
1.0	2.66	2.22	1.77	1.48	1.22	1.07	1.03
2.0	4.17	3.04	2.36	1.74	1.32	1.09	1.04
3.0	5.68	3.77	2.77	1.93	1.39	1.11	1.05
4.0	7.22	4.47	3.12	2.08	1.45	1.13	1.06
5.0	8.80	5.15	3.45	2.22	1.49	1.14	1.06
6.0	1.04E1	5.81	3.77	2.34	1.53	1.15	1.06
7.0	1.21E1	6.45	4.06	2.45	1.57	1.16	1.07
8.0	1.39E1	7.08	4.34	2.55	1.60	1.17	1.07
10.0	1.75E1	8.33	4.88	2.74	1.66	1.18	1.08
15.0	2.77E1	1.14E1	6.10	3.14	1.77	1.21	1.09
20.0	3.93E1	1.45E1	7.20	3.46	1.86	1.23	1.10
25.0	5.21E1	1.75E1	8.22	3.74	1.94	1.25	1.10
30.0	6.60E1	2.09E1	9.16	3.98	2.00	1.26	1.11
35.0	8.07E1	2.47E1	1.00E1	4.18	2.05	1.27	1.11
40.0	9.99E1	2.90E1	1.07E1	4.32	2.08	1.28	1.11

Table 3
Exposure Buildup Factors

Silicon

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.19	1.22	1.26	1.28	1.30	1.33	1.37	1.39
1.0	1.26	1.35	1.41	1.49	1.53	1.60	1.67	1.77	1.84
2.0	1.45	1.64	1.76	1.93	2.03	2.18	2.37	2.65	2.85
3.0	1.64	1.92	2.10	2.37	2.53	2.77	3.09	3.59	3.98
4.0	1.85	2.21	2.46	2.81	3.04	3.38	3.84	4.60	5.22
5.0	2.07	2.51	2.82	3.27	3.56	4.00	4.62	5.67	6.56
6.0	2.29	2.82	3.19	3.73	4.09	4.64	5.42	6.79	8.00
7.0	2.52	3.14	3.56	4.20	4.63	5.28	6.24	7.95	9.52
8.0	2.75	3.46	3.94	4.68	5.17	5.94	7.08	9.17	1.11E1
10.0	3.25	4.13	4.72	5.66	6.29	7.29	8.81	1.17E1	1.45E1
15.0	4.63	5.89	6.76	8.22	9.18	1.08E1	1.34E1	1.86E1	2.41E1
20.0	6.19	7.80	8.91	1.09E1	1.22E1	1.45E1	1.82E1	2.61E1	3.49E1
25.0	7.93	9.84	1.11E1	1.37E1	1.53E1	1.83E1	2.32E1	3.41E1	4.67E1
30.0	9.83	1.20E1	1.35E1	1.65E1	1.85E1	2.21E1	2.83E1	4.26E1	5.94E1
35.0	1.18E1	1.43E1	1.58E1	1.95E1	2.20E1	2.57E1	3.36E1	5.14E1	7.28E1
40.0	1.44E1	1.68E1	1.83E1	2.24E1	2.62E1	2.91E1	3.90E1	6.04E1	8.69E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.45	1.48	1.53	1.56	1.61	1.67	1.76	1.82	1.84
1.0	1.97	2.06	2.17	2.25	2.36	2.49	2.67	2.74	2.65
2.0	3.22	3.44	3.76	3.98	4.24	4.55	4.87	4.87	4.27
3.0	4.68	5.12	5.74	6.15	6.64	7.19	7.61	7.38	5.97
4.0	6.36	7.09	8.10	8.78	9.58	1.04E1	1.09E1	1.03E1	7.78
5.0	8.24	9.34	1.09E1	1.19E1	1.31E1	1.43E1	1.48E1	1.36E1	9.70
6.0	1.03E1	1.19E1	1.40E1	1.55E1	1.72E1	1.89E1	1.94E1	1.74E1	1.18E1
7.0	1.26E1	1.47E1	1.76E1	1.96E1	2.20E1	2.43E1	2.46E1	2.16E1	1.39E1
8.0	1.50E1	1.78E1	2.17E1	2.43E1	2.74E1	3.04E1	3.06E1	2.63E1	1.62E1
10.0	2.04E1	2.47E1	3.10E1	3.53E1	4.04E1	4.53E1	4.50E1	3.71E1	2.12E1
15.0	3.66E1	4.65E1	6.19E1	7.30E1	8.66E1	9.96E1	9.70E1	7.38E1	3.59E1
20.0	5.62E1	7.42E1	1.04E2	1.26E2	1.54E2	1.82E2	1.76E2	1.25E2	5.35E1
25.0	7.87E1	1.07E2	1.56E2	1.95E2	2.46E2	2.98E2	2.86E2	1.93E2	7.39E1
30.0	1.04E2	1.46E2	2.19E2	2.80E2	3.63E2	4.51E2	4.33E2	2.77E2	9.68E1
35.0	1.32E2	1.89E2	2.93E2	3.82E2	5.07E2	6.45E2	6.21E2	3.80E2	1.22E2
40.0	1.61E2	2.36E2	3.77E2	5.01E2	6.80E2	8.83E2	8.54E2	5.03E2	1.49E2

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.78	1.54	1.37	1.26	1.13	1.04	1.02
1.0	2.43	1.84	1.65	1.39	1.18	1.05	1.02
2.0	3.58	2.61	2.05	1.57	1.25	1.07	1.03
3.0	4.69	3.13	2.34	1.71	1.30	1.09	1.04
4.0	5.80	3.60	2.59	1.82	1.35	1.10	1.04
5.0	6.91	4.06	2.82	1.92	1.38	1.11	1.05
6.0	8.02	4.50	3.03	2.00	1.41	1.12	1.05
7.0	9.15	4.92	3.23	2.08	1.44	1.13	1.05
8.0	1.03E1	5.32	3.41	2.15	1.46	1.13	1.06
10.0	1.27E1	6.11	3.76	2.28	1.50	1.14	1.06
15.0	1.89E1	7.98	4.52	2.55	1.59	1.16	1.07
20.0	2.56E1	9.72	5.17	2.76	1.65	1.18	1.08
25.0	3.27E1	1.14E1	5.76	2.93	1.70	1.19	1.08
30.0	4.00E1	1.30E1	6.29	3.08	1.74	1.20	1.08
35.0	4.71E1	1.44E1	6.75	3.20	1.78	1.21	1.09
40.0	5.37E1	1.57E1	7.10	3.28	1.80	1.21	1.09

Table 3
Exposure Buildup Factors

Phosphorus

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.19	1.22	1.26	1.28	1.30	1.33	1.36	1.39
1.0	1.26	1.35	1.41	1.49	1.53	1.60	1.67	1.77	1.83
2.0	1.45	1.63	1.76	1.93	2.03	2.18	2.37	2.63	2.83
3.0	1.64	1.91	2.10	2.36	2.53	2.77	3.08	3.57	3.94
4.0	1.85	2.21	2.45	2.81	3.03	3.37	3.83	4.57	5.16
5.0	2.06	2.51	2.82	3.26	3.56	3.99	4.60	5.62	6.49
6.0	2.29	2.83	3.19	3.73	4.09	4.63	5.41	6.74	7.90
7.0	2.52	3.15	3.58	4.21	4.63	5.28	6.23	7.90	9.40
8.0	2.77	3.48	3.97	4.69	5.19	5.95	7.07	9.10	1.10E1
10.0	3.29	4.17	4.77	5.69	6.32	7.31	8.81	1.16E1	1.43E1
15.0	4.76	6.03	6.91	8.30	9.29	1.09E1	1.34E1	1.85E1	2.38E1
20.0	6.47	8.07	9.19	1.10E1	1.24E1	1.46E1	1.83E1	2.60E1	3.44E1
25.0	8.43	1.03E1	1.16E1	1.39E1	1.56E1	1.85E1	2.34E1	3.40E1	4.60E1
30.0	1.06E1	1.26E1	1.41E1	1.69E1	1.90E1	2.23E1	2.86E1	4.25E1	5.86E1
35.0	1.30E1	1.52E1	1.68E1	2.00E1	2.26E1	2.60E1	3.40E1	5.13E1	7.18E1
40.0	1.63E1	1.81E1	1.95E1	2.30E1	2.66E1	2.94E1	3.95E1	6.03E1	8.57E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.44	1.48	1.52	1.56	1.60	1.66	1.74	1.78	1.78
1.0	1.96	2.04	2.15	2.23	2.33	2.44	2.59	2.62	2.47
2.0	3.18	3.40	3.69	3.89	4.13	4.39	4.59	4.49	3.78
3.0	4.61	5.03	5.59	5.96	6.39	6.83	7.02	6.62	5.11
4.0	6.25	6.93	7.86	8.46	9.15	9.80	9.91	9.03	6.50
5.0	8.09	9.11	1.05E1	1.14E1	1.24E1	1.33E1	1.33E1	1.17E1	7.93
6.0	1.01E1	1.16E1	1.35E1	1.48E1	1.63E1	1.75E1	1.72E1	1.48E1	9.43
7.0	1.23E1	1.43E1	1.70E1	1.87E1	2.07E1	2.23E1	2.16E1	1.81E1	1.10E1
8.0	1.47E1	1.73E1	2.08E1	2.31E1	2.57E1	2.78E1	2.66E1	2.18E1	1.26E1
10.0	2.00E1	2.40E1	2.97E1	3.34E1	3.76E1	4.10E1	3.85E1	3.01E1	1.61E1
15.0	3.58E1	4.50E1	5.89E1	6.85E1	7.96E1	8.83E1	8.01E1	5.70E1	2.56E1
20.0	5.49E1	7.16E1	9.81E1	1.17E2	1.40E2	1.59E2	1.41E2	9.29E1	3.65E1
25.0	7.68E1	1.03E2	1.47E2	1.81E2	2.22E2	2.56E2	2.24E2	1.38E2	4.84E1
30.0	1.01E2	1.40E2	2.06E2	2.59E2	3.26E2	3.84E2	3.32E2	1.93E2	6.12E1
35.0	1.28E2	1.82E2	2.75E2	3.52E2	4.53E2	5.43E2	4.67E2	2.58E2	7.43E1
40.0	1.58E2	2.27E2	3.53E2	4.60E2	6.05E2	7.36E2	6.32E2	3.34E2	8.72E1

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.70	1.44	1.34	1.22	1.10	1.03	1.01
1.0	2.24	1.75	1.54	1.31	1.14	1.04	1.02
2.0	3.13	2.27	1.83	1.46	1.20	1.06	1.03
3.0	3.95	2.66	2.05	1.56	1.24	1.07	1.03
4.0	4.76	3.01	2.23	1.64	1.27	1.08	1.03
5.0	5.56	3.33	2.40	1.72	1.30	1.09	1.04
6.0	6.35	3.63	2.54	1.78	1.32	1.10	1.04
7.0	7.14	3.92	2.68	1.84	1.34	1.10	1.04
8.0	7.92	4.19	2.81	1.89	1.36	1.11	1.05
10.0	9.49	4.71	3.05	1.98	1.39	1.11	1.05
15.0	1.35E1	5.90	3.55	2.17	1.45	1.13	1.06
20.0	1.75E1	6.97	3.98	2.31	1.50	1.14	1.06
25.0	2.17E1	7.96	4.35	2.43	1.54	1.15	1.06
30.0	2.64E1	8.87	4.67	2.53	1.57	1.16	1.07
35.0	3.16E1	9.68	4.94	2.61	1.59	1.16	1.07
40.0	3.75E1	1.04E1	5.14	2.66	1.61	1.17	1.07

Table 3
Exposure Buildup Factors

Sulphur

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.19	1.22	1.26	1.28	1.30	1.33	1.36	1.39
1.0	1.25	1.35	1.41	1.49	1.53	1.59	1.67	1.76	1.83
2.0	1.44	1.63	1.75	1.92	2.02	2.17	2.36	2.62	2.81
3.0	1.63	1.91	2.09	2.36	2.52	2.76	3.07	3.54	3.90
4.0	1.84	2.20	2.45	2.80	3.03	3.36	3.82	4.53	5.11
5.0	2.06	2.51	2.82	3.27	3.55	3.99	4.59	5.58	6.42
6.0	2.29	2.83	3.20	3.74	4.09	4.63	5.39	6.69	7.81
7.0	2.53	3.16	3.59	4.23	4.65	5.29	6.22	7.84	9.29
8.0	2.78	3.50	3.99	4.72	5.21	5.96	7.07	9.03	1.08E1
10.0	3.33	4.21	4.82	5.74	6.37	7.34	8.81	1.15E1	1.42E1
15.0	4.89	6.16	7.04	8.44	9.41	1.10E1	1.35E1	1.84E1	2.35E1
20.0	6.77	8.34	9.45	1.13E1	1.26E1	1.48E1	1.84E1	2.58E1	3.40E1
25.0	8.97	1.07E1	1.20E1	1.44E1	1.60E1	1.88E1	2.35E1	3.38E1	4.55E1
30.0	1.15E1	1.33E1	1.47E1	1.75E1	1.95E1	2.28E1	2.89E1	4.23E1	5.79E1
35.0	1.44E1	1.61E1	1.76E1	2.08E1	2.32E1	2.77E1	3.44E1	5.10E1	7.10E1
40.0	1.82E1	1.93E1	2.06E1	2.42E1	2.73E1	3.33E1	4.01E1	6.01E1	8.47E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.44	1.47	1.52	1.55	1.59	1.65	1.72	1.75	1.71
1.0	1.95	2.03	2.13	2.21	2.30	2.40	2.51	2.51	2.31
2.0	3.14	3.35	3.63	3.81	4.02	4.23	4.33	4.14	3.38
3.0	4.55	4.94	5.46	5.79	6.16	6.49	6.50	5.96	4.44
4.0	6.15	6.79	7.64	8.17	8.75	9.22	9.03	7.97	5.52
5.0	7.94	8.91	1.02E1	1.10E1	1.18E1	1.24E1	1.19E1	1.02E1	6.63
6.0	9.93	1.13E1	1.31E1	1.42E1	1.54E1	1.62E1	1.53E1	1.26E1	7.76
7.0	1.21E1	1.39E1	1.64E1	1.79E1	1.95E1	2.05E1	1.90E1	1.53E1	8.91
8.0	1.44E1	1.68E1	2.00E1	2.20E1	2.41E1	2.54E1	2.32E1	1.81E1	1.01E1
10.0	1.96E1	2.33E1	2.85E1	3.17E1	3.51E1	3.71E1	3.30E1	2.45E1	1.25E1
15.0	3.49E1	4.36E1	5.62E1	6.45E1	7.33E1	7.83E1	6.64E1	4.43E1	1.91E1
20.0	5.35E1	6.92E1	9.33E1	1.10E2	1.28E2	1.39E2	1.14E2	6.93E1	2.61E1
25.0	7.48E1	9.98E1	1.40E2	1.68E2	2.01E2	2.20E2	1.76E2	9.97E1	3.36E1
30.0	9.87E1	1.35E2	1.95E2	2.40E2	2.92E2	3.25E2	2.56E2	1.35E2	4.17E1
35.0	1.25E2	1.75E2	2.60E2	3.25E2	4.04E2	4.56E2	3.52E2	1.75E2	5.07E1
40.0	1.53E2	2.18E2	3.33E2	4.24E2	5.36E2	6.14E2	4.69E2	2.20E2	6.05E1

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.58	1.39	1.29	1.18	1.08	1.03	1.01
1.0	1.91	1.64	1.44	1.26	1.12	1.04	1.02
2.0	2.78	2.03	1.67	1.37	1.16	1.05	1.02
3.0	3.42	2.33	1.84	1.45	1.19	1.06	1.03
4.0	4.02	2.58	1.97	1.51	1.22	1.07	1.03
5.0	4.61	2.81	2.09	1.57	1.24	1.07	1.03
6.0	5.19	3.03	2.20	1.61	1.26	1.08	1.03
7.0	5.75	3.24	2.30	1.66	1.27	1.08	1.04
8.0	6.31	3.43	2.40	1.70	1.29	1.09	1.04
10.0	7.41	3.79	2.56	1.76	1.31	1.09	1.04
15.0	1.01E1	4.60	2.92	1.90	1.36	1.10	1.05
20.0	1.27E1	5.29	3.20	2.00	1.39	1.11	1.05
25.0	1.53E1	5.91	3.45	2.09	1.42	1.12	1.05
30.0	1.79E1	6.48	3.66	2.16	1.44	1.13	1.05
35.0	2.03E1	6.97	3.83	2.22	1.46	1.13	1.06
40.0	2.26E1	7.36	3.95	2.25	1.47	1.13	1.06

Table 3
Exposure Buildup Factors

Argon

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.19	1.22	1.26	1.28	1.30	1.33	1.36	1.38
1.0	1.25	1.35	1.41	1.48	1.53	1.59	1.67	1.75	1.81
2.0	1.43	1.62	1.74	1.91	2.02	2.16	2.34	2.59	2.77
3.0	1.62	1.90	2.08	2.35	2.51	2.74	3.05	3.50	3.84
4.0	1.83	2.20	2.44	2.80	3.02	3.35	3.79	4.48	5.01
5.0	2.05	2.51	2.82	3.26	3.55	3.98	4.56	5.51	6.28
6.0	2.29	2.84	3.21	3.75	4.10	4.62	5.37	6.60	7.64
7.0	2.55	3.18	3.61	4.25	4.67	5.29	6.19	7.74	9.08
8.0	2.82	3.54	4.03	4.76	5.24	5.98	7.05	8.92	1.06E1
10.0	3.41	4.30	4.91	5.83	6.44	7.39	8.81	1.14E1	1.38E1
15.0	5.19	6.45	7.32	8.71	9.64	1.11E1	1.35E1	1.82E1	2.29E1
20.0	7.46	8.94	1.00E1	1.18E1	1.31E1	1.51E1	1.86E1	2.57E1	3.31E1
25.0	1.03E1	1.18E1	1.29E1	1.52E1	1.67E1	1.93E1	2.39E1	3.37E1	4.43E1
30.0	1.37E1	1.49E1	1.61E1	1.88E1	2.06E1	2.37E1	2.94E1	4.22E1	5.63E1
35.0	1.78E1	1.84E1	1.95E1	2.25E1	2.45E1	2.85E1	3.52E1	5.10E1	6.91E1
40.0	2.32E1	2.25E1	2.32E1	2.64E1	2.86E1	3.41E1	4.11E1	6.02E1	8.25E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.43	1.46	1.51	1.54	1.58	1.62	1.67	1.62	1.52
1.0	1.93	2.00	2.10	2.16	2.24	2.31	2.37	2.25	1.96
2.0	3.08	3.26	3.50	3.65	3.81	3.94	3.88	3.55	2.77
3.0	4.42	4.77	5.21	5.48	5.74	5.90	5.60	4.93	3.47
4.0	5.96	6.53	7.24	7.65	8.04	8.21	7.56	6.37	4.14
5.0	7.68	8.52	9.58	1.02E1	1.07E1	1.09E1	9.77	7.88	4.81
6.0	9.57	1.08E1	1.23E1	1.31E1	1.38E1	1.40E1	1.22E1	9.47	5.47
7.0	1.16E1	1.32E1	1.53E1	1.64E1	1.74E1	1.75E1	1.50E1	1.11E1	6.13
8.0	1.39E1	1.59E1	1.86E1	2.01E1	2.14E1	2.15E1	1.79E1	1.29E1	6.79
10.0	1.87E1	2.20E1	2.62E1	2.86E1	3.07E1	3.07E1	2.47E1	1.67E1	8.09
15.0	3.33E1	4.09E1	5.11E1	5.72E1	6.23E1	6.19E1	4.65E1	2.77E1	1.13E1
20.0	5.09E1	6.46E1	8.41E1	9.61E1	1.07E2	1.06E2	7.52E1	4.09E1	1.45E1
25.0	7.11E1	9.28E1	1.25E2	1.46E2	1.64E2	1.63E2	1.11E2	5.55E1	1.77E1
30.0	9.37E1	1.25E2	1.74E2	2.06E2	2.36E2	2.35E2	1.55E2	7.07E1	2.08E1
35.0	1.18E2	1.62E2	2.30E2	2.77E2	3.23E2	3.22E2	2.06E2	8.67E1	2.38E1
40.0	1.45E2	2.02E2	2.94E2	3.60E2	4.24E2	4.25E2	2.65E2	1.05E2	2.66E1

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.44	1.30	1.22	1.13	1.06	1.02	1.01
1.0	1.74	1.46	1.31	1.18	1.08	1.03	1.01
2.0	2.25	1.70	1.45	1.25	1.11	1.03	1.01
3.0	2.66	1.88	1.56	1.30	1.13	1.04	1.02
4.0	3.02	2.04	1.64	1.34	1.15	1.05	1.02
5.0	3.37	2.17	1.71	1.38	1.16	1.05	1.02
6.0	3.69	2.30	1.78	1.41	1.17	1.05	1.02
7.0	4.01	2.41	1.84	1.43	1.18	1.06	1.02
8.0	4.31	2.52	1.89	1.46	1.19	1.06	1.03
10.0	4.89	2.71	1.98	1.50	1.21	1.06	1.03
15.0	6.22	3.13	2.18	1.58	1.24	1.07	1.03
20.0	7.43	3.46	2.32	1.64	1.26	1.08	1.03
25.0	8.56	3.75	2.45	1.68	1.28	1.08	1.04
30.0	9.63	4.01	2.55	1.73	1.29	1.09	1.04
35.0	1.06E1	4.22	2.64	1.76	1.30	1.09	1.04
40.0	1.15E1	4.38	2.69	1.77	1.31	1.09	1.04

Table 3
Exposure Buildup Factors

Potassium

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.14	1.19	1.22	1.26	1.27	1.30	1.32	1.36	1.38
1.0	1.25	1.34	1.40	1.48	1.53	1.59	1.68	1.75	1.80
2.0	1.43	1.62	1.74	1.91	2.01	2.16	2.33	2.58	2.75
3.0	1.62	1.89	2.08	2.34	2.50	2.74	3.04	3.48	3.80
4.0	1.83	2.19	2.44	2.79	3.02	3.34	3.78	4.45	4.96
5.0	2.05	2.51	2.82	3.26	3.55	3.97	4.55	5.47	6.22
6.0	2.29	2.84	3.21	3.75	4.10	4.63	5.35	6.55	7.56
7.0	2.55	3.20	3.63	4.26	4.67	5.30	6.18	7.68	8.98
8.0	2.83	3.56	4.05	4.78	5.26	5.99	7.04	8.86	1.05E1
10.0	3.45	4.35	4.96	5.87	6.48	7.43	8.82	1.13E1	1.37E1
15.0	5.36	6.61	7.47	8.83	9.76	1.13E1	1.36E1	1.81E1	2.26E1
20.0	7.86	9.28	1.03E1	1.21E1	1.33E1	1.54E1	1.87E1	2.55E1	3.27E1
25.0	1.11E1	1.24E1	1.35E1	1.56E1	1.71E1	1.97E1	2.41E1	3.35E1	4.37E1
30.0	1.51E1	1.59E1	1.69E1	1.94E1	2.11E1	2.43E1	2.97E1	4.20E1	5.56E1
35.0	2.00E1	1.98E1	2.06E1	2.33E1	2.53E1	2.92E1	3.56E1	5.08E1	6.83E1
40.0	2.65E1	2.44E1	2.47E1	2.75E1	2.96E1	3.47E1	4.19E1	6.00E1	8.15E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.43	1.46	1.50	1.53	1.57	1.61	1.59	1.58	1.50
1.0	1.92	1.99	2.08	2.14	2.21	2.27	2.25	2.16	1.87
2.0	3.05	3.22	3.45	3.58	3.72	3.80	3.67	3.32	2.52
3.0	4.37	4.69	5.10	5.33	5.55	5.63	5.22	4.46	3.10
4.0	5.87	6.40	7.05	7.41	7.72	7.76	6.95	5.66	3.64
5.0	7.55	8.34	9.30	9.82	1.03E1	1.02E1	8.88	6.92	4.17
6.0	9.40	1.05E1	1.19E1	1.26E1	1.32E1	1.30E1	1.10E1	8.24	4.69
7.0	1.14E1	1.29E1	1.47E1	1.57E1	1.64E1	1.62E1	1.33E1	9.62	5.19
8.0	1.36E1	1.55E1	1.79E1	1.92E1	2.01E1	1.97E1	1.59E1	1.11E1	5.69
10.0	1.83E1	2.14E1	2.52E1	2.72E1	2.87E1	2.79E1	2.15E1	1.41E1	6.67
15.0	3.25E1	3.96E1	4.88E1	5.38E1	5.75E1	5.52E1	3.92E1	2.24E1	9.01
20.0	4.96E1	6.24E1	7.99E1	8.99E1	9.74E1	9.26E1	6.17E1	3.18E1	1.12E1
25.0	6.92E1	8.95E1	1.18E2	1.35E2	1.49E2	1.41E2	8.91E1	4.20E1	1.34E1
30.0	9.11E1	1.21E2	1.64E2	1.91E2	2.12E2	2.00E2	1.21E2	5.31E1	1.55E1
35.0	1.15E2	1.56E2	2.17E2	2.56E2	2.88E2	2.70E2	1.58E2	6.47E1	1.74E1
40.0	1.41E2	1.94E2	2.77E2	3.31E2	3.76E2	3.52E2	2.00E2	7.66E1	1.92E1

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.40	1.26	1.19	1.11	1.05	1.02	1.01
1.0	1.65	1.40	1.27	1.15	1.07	1.02	1.01
2.0	2.05	1.59	1.38	1.21	1.09	1.03	1.01
3.0	2.38	1.74	1.47	1.25	1.11	1.04	1.02
4.0	2.67	1.86	1.53	1.29	1.13	1.04	1.02
5.0	2.94	1.97	1.59	1.31	1.14	1.04	1.02
6.0	3.19	2.06	1.64	1.34	1.15	1.05	1.02
7.0	3.43	2.15	1.69	1.36	1.16	1.05	1.02
8.0	3.66	2.24	1.73	1.38	1.16	1.05	1.02
10.0	4.09	2.38	1.81	1.41	1.18	1.05	1.02
15.0	5.06	2.69	1.96	1.48	1.20	1.06	1.03
20.0	5.91	2.94	2.07	1.52	1.22	1.07	1.03
25.0	6.69	3.15	2.17	1.56	1.23	1.07	1.03
30.0	7.42	3.33	2.25	1.59	1.24	1.07	1.03
35.0	8.07	3.48	2.31	1.62	1.25	1.08	1.03
40.0	8.61	3.59	2.35	1.63	1.26	1.08	1.04

Table 3
Exposure Buildup Factors

Calcium

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.14	1.19	1.22	1.26	1.27	1.30	1.32	1.36	1.38
1.0	1.25	1.34	1.40	1.48	1.52	1.59	1.65	1.74	1.80
2.0	1.43	1.61	1.73	1.90	2.01	2.15	2.32	2.57	2.73
3.0	1.62	1.89	2.07	2.33	2.50	2.73	3.03	3.46	3.77
4.0	1.82	2.19	2.44	2.79	3.01	3.34	3.76	4.42	4.91
5.0	2.05	2.51	2.82	3.26	3.55	3.97	4.53	5.44	6.15
6.0	2.30	2.85	3.22	3.76	4.11	4.62	5.34	6.51	7.48
7.0	2.56	3.21	3.64	4.27	4.68	5.30	6.17	7.63	8.88
8.0	2.85	3.58	4.08	4.80	5.28	6.00	7.03	8.80	1.03E1
10.0	3.49	4.40	5.01	5.92	6.52	7.45	8.81	1.13E1	1.35E1
15.0	5.53	6.77	7.62	8.97	9.88	1.14E1	1.36E1	1.80E1	2.23E1
20.0	8.31	9.64	1.06E1	1.24E1	1.36E1	1.56E1	1.88E1	2.54E1	3.22E1
25.0	1.20E1	1.30E1	1.40E1	1.61E1	1.75E1	2.00E1	2.42E1	3.34E1	4.31E1
30.0	1.67E1	1.69E1	1.78E1	2.00E1	2.17E1	2.48E1	2.98E1	4.18E1	5.49E1
35.0	2.27E1	2.14E1	2.19E1	2.43E1	2.61E1	2.98E1	3.54E1	5.07E1	6.73E1
40.0	3.06E1	2.66E1	2.65E1	2.88E1	3.07E1	3.53E1	4.07E1	5.99E1	8.03E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.43	1.46	1.50	1.52	1.56	1.58	1.60	1.57	1.46
1.0	1.91	1.97	2.06	2.12	2.18	2.22	2.20	2.08	1.77
2.0	3.02	3.18	3.39	3.51	3.62	3.67	3.47	3.08	2.31
3.0	4.31	4.61	4.98	5.19	5.36	5.36	4.86	4.07	2.79
4.0	5.78	6.28	6.86	7.17	7.40	7.33	6.39	5.08	3.22
5.0	7.42	8.16	9.02	9.47	9.78	9.59	8.06	6.12	3.64
6.0	9.23	1.03E1	1.15E1	1.21E1	1.25E1	1.21E1	9.90	7.20	4.04
7.0	1.12E1	1.26E1	1.42E1	1.51E1	1.55E1	1.50E1	1.19E1	8.31	4.43
8.0	1.33E1	1.51E1	1.72E1	1.83E1	1.89E1	1.81E1	1.40E1	9.45	4.81
10.0	1.80E1	2.08E1	2.41E1	2.59E1	2.68E1	2.54E1	1.87E1	1.18E1	5.54
15.0	3.18E1	3.83E1	4.64E1	5.08E1	5.29E1	4.90E1	3.29E1	1.81E1	7.24
20.0	4.84E1	6.02E1	7.54E1	8.43E1	8.86E1	8.06E1	5.05E1	2.50E1	8.81
25.0	6.75E1	8.61E1	1.11E2	1.26E2	1.34E2	1.21E2	7.12E1	3.22E1	1.03E1
30.0	8.87E1	1.16E2	1.54E2	1.77E2	1.90E2	1.69E2	9.50E1	3.98E1	1.17E1
35.0	1.12E2	1.49E2	2.02E2	2.37E2	2.56E2	2.26E2	1.22E2	4.77E1	1.30E1
40.0	1.37E2	1.86E2	2.57E2	3.06E2	3.32E2	2.92E2	1.51E2	5.56E1	1.41E1

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.36	1.23	1.16	1.09	1.04	1.01	1.01
1.0	1.57	1.34	1.23	1.13	1.06	1.02	1.01
2.0	1.90	1.49	1.32	1.18	1.08	1.02	1.01
3.0	2.16	1.61	1.39	1.21	1.09	1.03	1.01
4.0	2.39	1.71	1.44	1.24	1.11	1.03	1.01
5.0	2.61	1.79	1.49	1.26	1.12	1.04	1.02
6.0	2.81	1.87	1.53	1.28	1.12	1.04	1.02
7.0	2.99	1.94	1.57	1.30	1.13	1.04	1.02
8.0	3.17	2.00	1.60	1.31	1.14	1.04	1.02
10.0	3.49	2.12	1.66	1.34	1.15	1.05	1.02
15.0	4.21	2.35	1.77	1.39	1.17	1.05	1.02
20.0	4.82	2.54	1.86	1.43	1.18	1.06	1.03
25.0	5.38	2.69	1.93	1.46	1.19	1.06	1.03
30.0	5.88	2.82	1.99	1.48	1.20	1.06	1.03
35.0	6.32	2.93	2.04	1.50	1.21	1.07	1.03
40.0	6.68	3.00	2.07	1.51	1.22	1.07	1.03

Table 3
Exposure Buildup Factors

Iron

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.14	1.19	1.22	1.25	1.27	1.30	1.32	1.35	1.37
1.0	1.24	1.33	1.39	1.47	1.51	1.57	1.64	1.71	1.76
2.0	1.41	1.59	1.71	1.87	1.97	2.12	2.28	2.49	2.62
3.0	1.59	1.86	2.04	2.30	2.46	2.68	2.96	3.34	3.59
4.0	1.80	2.16	2.41	2.76	2.98	3.29	3.68	4.25	4.65
5.0	2.04	2.50	2.81	3.25	3.53	3.93	4.45	5.22	5.79
6.0	2.31	2.87	3.24	3.78	4.11	4.60	5.25	6.25	7.01
7.0	2.61	3.27	3.71	4.33	4.73	5.31	6.09	7.33	8.30
8.0	2.95	3.71	4.20	4.92	5.38	6.05	6.96	8.45	9.65
10.0	3.77	4.69	5.30	6.18	6.75	7.60	8.80	1.08E1	1.25E1
15.0	6.80	7.88	8.64	9.85	1.07E1	1.19E1	1.38E1	1.74E1	2.06E1
20.0	1.18E1	1.23E1	1.29E1	1.42E1	1.52E1	1.68E1	1.94E1	2.46E1	2.97E1
25.0	2.00E1	1.81E1	1.82E1	1.93E1	2.03E1	2.21E1	2.54E1	3.25E1	3.97E1
30.0	3.28E1	2.57E1	2.45E1	2.51E1	2.59E1	2.79E1	3.17E1	4.09E1	5.04E1
35.0	5.26E1	3.53E1	3.20E1	3.15E1	3.20E1	3.40E1	3.84E1	4.98E1	6.18E1
40.0	8.28E1	4.76E1	4.09E1	3.88E1	3.88E1	4.06E1	4.55E1	5.91E1	7.38E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.41	1.43	1.46	1.48	1.50	1.51	1.47	1.40	1.26
1.0	1.85	1.90	1.96	1.99	2.01	1.99	1.86	1.68	1.40
2.0	2.85	2.96	3.07	3.12	3.12	3.00	2.59	2.15	1.61
3.0	4.00	4.20	4.39	4.44	4.40	4.12	3.33	2.59	1.78
4.0	5.30	5.62	5.90	5.96	5.86	5.34	4.08	3.00	1.94
5.0	6.74	7.21	7.61	7.68	7.48	6.66	4.85	3.39	2.07
6.0	8.31	8.96	9.51	9.58	9.27	8.08	5.64	3.77	2.20
7.0	1.00E1	1.09E1	1.16E1	1.17E1	1.12E1	9.59	6.44	4.13	2.31
8.0	1.18E1	1.30E1	1.39E1	1.40E1	1.33E1	1.12E1	7.25	4.49	2.41
10.0	1.58E1	1.75E1	1.90E1	1.91E1	1.81E1	1.47E1	8.90	5.17	2.61
15.0	2.75E1	3.14E1	3.48E1	3.51E1	3.26E1	2.47E1	1.32E1	6.75	3.01
20.0	4.13E1	4.85E1	5.48E1	5.54E1	5.08E1	3.64E1	1.76E1	8.21	3.33
25.0	5.70E1	6.84E1	7.88E1	7.99E1	7.25E1	4.96E1	2.22E1	9.58	3.61
30.0	7.45E1	9.10E1	1.07E2	1.08E2	9.77E1	6.43E1	2.69E1	1.09E1	3.86
35.0	9.35E1	1.16E2	1.38E2	1.41E2	1.26E2	8.03E1	3.17E1	1.21E1	4.07
40.0	1.14E2	1.44E2	1.73E2	1.77E2	1.58E2	9.74E1	3.64E1	1.32E1	4.23

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.19	1.11	1.07	1.04	1.02	1.01	1.00
1.0	1.27	1.15	1.10	1.06	1.03	1.01	1.00
2.0	1.39	1.21	1.14	1.08	1.04	1.01	1.01
3.0	1.49	1.25	1.16	1.09	1.04	1.02	1.01
4.0	1.57	1.29	1.18	1.10	1.05	1.02	1.01
5.0	1.64	1.32	1.20	1.11	1.05	1.02	1.01
6.0	1.70	1.34	1.22	1.12	1.06	1.02	1.01
7.0	1.75	1.37	1.23	1.13	1.06	1.02	1.01
8.0	1.81	1.39	1.24	1.13	1.06	1.02	1.01
10.0	1.90	1.42	1.26	1.14	1.07	1.02	1.01
15.0	2.08	1.49	1.30	1.16	1.07	1.03	1.01
20.0	2.22	1.54	1.33	1.17	1.08	1.03	1.01
25.0	2.34	1.58	1.35	1.18	1.08	1.03	1.01
30.0	2.45	1.62	1.37	1.19	1.09	1.03	1.01
35.0	2.53	1.64	1.38	1.20	1.09	1.03	1.01
40.0	2.59	1.66	1.39	1.21	1.09	1.04	1.01

Table 3
Exposure Buildup Factors

Copper

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.14	1.19	1.22	1.25	1.27	1.30	1.32	1.35	1.36
1.0	1.24	1.33	1.39	1.46	1.51	1.57	1.63	1.70	1.74
2.0	1.40	1.58	1.70	1.86	1.96	2.10	2.26	2.46	2.57
3.0	1.58	1.85	2.03	2.28	2.44	2.66	2.93	3.28	3.51
4.0	1.79	2.15	2.39	2.74	2.96	3.26	3.64	4.17	4.52
5.0	2.03	2.49	2.80	3.23	3.52	3.91	4.40	5.11	5.62
6.0	2.31	2.87	3.24	3.77	4.12	4.60	5.20	6.11	6.79
7.0	2.64	3.29	3.73	4.34	4.75	5.32	6.04	7.15	8.02
8.0	3.01	3.75	4.25	4.95	5.42	6.08	6.92	8.24	9.32
10.0	3.94	4.82	5.43	6.27	6.88	7.70	8.77	1.05E1	1.21E1
15.0	7.66	8.46	9.16	1.02E1	1.11E1	1.23E1	1.39E1	1.69E1	1.98E1
20.0	1.46E1	1.38E1	1.42E1	1.51E1	1.61E1	1.76E1	1.96E1	2.39E1	2.85E1
25.0	2.72E1	2.14E1	2.06E1	2.08E1	2.20E1	2.36E1	2.59E1	3.16E1	3.81E1
30.0	4.95E1	3.18E1	2.88E1	2.74E1	2.86E1	3.02E1	3.26E1	3.98E1	4.83E1
35.0	8.79E1	4.58E1	3.88E1	3.51E1	3.59E1	3.74E1	3.97E1	4.84E1	5.92E1
40.0	1.53E2	6.46E1	5.11E1	4.38E1	4.42E1	4.52E1	4.73E1	5.75E1	7.08E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.40	1.42	1.45	1.46	1.47	1.47	1.41	1.33	1.20
1.0	1.82	1.86	1.91	1.93	1.93	1.88	1.71	1.53	1.29
2.0	2.76	2.85	2.93	2.94	2.90	2.72	2.27	1.87	1.43
3.0	3.85	4.01	4.12	4.12	4.00	3.62	2.81	2.17	1.55
4.0	5.07	5.31	5.47	5.44	5.21	4.57	3.34	2.45	1.65
5.0	6.41	6.77	6.97	6.91	6.54	5.57	3.87	2.70	1.73
6.0	7.86	8.36	8.63	8.52	7.98	6.62	4.38	2.94	1.81
7.0	9.43	1.01E1	1.04E1	1.03E1	9.53	7.70	4.90	3.16	1.88
8.0	1.11E1	1.20E1	1.24E1	1.22E1	1.12E1	8.83	5.40	3.38	1.94
10.0	1.47E1	1.61E1	1.67E1	1.64E1	1.48E1	1.12E1	6.40	3.78	2.06
15.0	2.53E1	2.83E1	2.98E1	2.90E1	2.54E1	1.76E1	8.84	4.67	2.29
20.0	3.77E1	4.32E1	4.59E1	4.46E1	3.82E1	2.47E1	1.12E1	5.45	2.47
25.0	5.17E1	6.04E1	6.48E1	6.30E1	5.30E1	3.23E1	1.35E1	6.15	2.62
30.0	6.71E1	7.98E1	8.64E1	8.41E1	6.96E1	4.04E1	1.58E1	6.79	2.75
35.0	8.39E1	1.01E2	1.11E2	1.08E2	8.79E1	4.89E1	1.80E1	7.38	2.86
40.0	1.02E2	1.25E2	1.37E2	1.34E2	1.08E2	5.78E1	2.01E1	7.88	2.94

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.14	1.08	1.05	1.03	1.01	1.01	1.00		
1.0	1.19	1.11	1.07	1.04	1.02	1.01	1.00		
2.0	1.27	1.15	1.10	1.06	1.03	1.01	1.00		
3.0	1.34	1.18	1.12	1.07	1.03	1.01	1.00		
4.0	1.39	1.20	1.13	1.07	1.04	1.01	1.01		
5.0	1.44	1.22	1.14	1.08	1.04	1.01	1.01		
6.0	1.48	1.24	1.15	1.08	1.04	1.01	1.01		
7.0	1.51	1.25	1.16	1.09	1.04	1.02	1.01		
8.0	1.55	1.27	1.17	1.09	1.04	1.02	1.01		
10.0	1.60	1.29	1.18	1.10	1.05	1.02	1.01		
15.0	1.71	1.33	1.21	1.11	1.05	1.02	1.01		
20.0	1.80	1.37	1.23	1.12	1.06	1.02	1.01		
25.0	1.87	1.39	1.24	1.13	1.06	1.02	1.01		
30.0	1.92	1.41	1.25	1.14	1.06	1.02	1.01		
35.0	1.97	1.43	1.26	1.14	1.07	1.02	1.01		
40.0	2.00	1.44	1.27	1.15	1.07	1.03	1.01		

Table 3
Exposure Buildup Factors

Molybdenum

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.33	1.32	1.32	1.32	1.32	1.29	1.29	1.29	1.30
1.0	1.64	1.58	1.57	1.57	1.57	1.54	1.58	1.62	1.64
2.0	2.21	2.02	1.98	2.01	2.04	2.04	2.18	2.34	2.37
3.0	2.89	2.49	2.41	2.45	2.51	2.54	2.78	3.07	3.15
4.0	3.73	3.04	2.90	2.93	3.03	3.09	3.40	3.82	3.94
5.0	4.79	3.68	3.45	3.49	3.61	3.69	4.09	4.61	4.75
6.0	6.12	4.44	4.10	4.12	4.27	4.37	4.84	5.47	5.65
7.0	7.78	5.32	4.83	4.82	4.99	5.11	5.65	6.39	6.58
8.0	9.84	6.34	5.65	5.59	5.78	5.91	6.50	7.36	7.51
10.0	1.56E1	8.88	7.64	7.38	7.57	7.67	8.36	9.43	9.49
15.0	4.63E1	1.94E1	1.51E1	1.35E1	1.34E1	1.31E1	1.38E1	1.54E1	1.50E1
20.0	1.31E2	3.98E1	2.77E1	2.22E1	2.11E1	1.99E1	2.00E1	2.20E1	2.09E1
25.0	3.54E2	7.77E1	4.78E1	3.41E1	3.10E1	2.80E1	2.68E1	2.92E1	2.70E1
30.0	9.24E2	1.46E2	7.88E1	4.97E1	4.31E1	3.72E1	3.41E1	3.67E1	3.32E1
35.0	2.35E3	2.65E2	1.25E2	6.95E1	5.76E1	4.75E1	4.17E1	4.45E1	3.93E1
40.0	5.83E3	4.69E2	1.94E2	9.42E1	7.45E1	5.87E1	4.96E1	5.25E1	4.55E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.36	1.37	1.37	1.37	1.35	1.30	1.20	1.18	1.08
1.0	1.75	1.76	1.75	1.73	1.66	1.54	1.34	1.25	1.11
2.0	2.54	2.55	2.50	2.41	2.23	1.95	1.54	1.35	1.15
3.0	3.38	3.37	3.28	3.09	2.78	2.31	1.71	1.43	1.18
4.0	4.21	4.18	4.04	3.74	3.28	2.62	1.84	1.51	1.20
5.0	5.07	4.99	4.81	4.38	3.76	2.91	1.96	1.58	1.23
6.0	6.04	5.91	5.68	5.10	4.29	3.21	2.07	1.64	1.25
7.0	7.03	6.84	6.56	5.81	4.80	3.50	2.18	1.69	1.27
8.0	8.02	7.77	7.45	6.52	5.30	3.77	2.28	1.74	1.29
10.0	1.02E1	9.72	9.33	7.99	6.32	4.31	2.46	1.83	1.32
15.0	1.62E1	1.52E1	1.47E1	1.20E1	8.95	5.64	2.89	2.00	1.37
20.0	2.29E1	2.11E1	2.07E1	1.63E1	1.16E1	6.88	3.26	2.12	1.41
25.0	3.01E1	2.72E1	2.72E1	2.08E1	1.42E1	8.01	3.58	2.22	1.44
30.0	3.75E1	3.35E1	3.40E1	2.54E1	1.67E1	9.04	3.86	2.31	1.47
35.0	4.52E1	4.00E1	4.11E1	3.00E1	1.91E1	9.99	4.11	2.39	1.49
40.0	5.29E1	4.64E1	4.82E1	3.46E1	2.15E1	1.09E1	4.33	2.46	1.51

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.05	1.02	2.66	2.82	2.45	1.01	1.00
1.0	1.07	1.03	3.06	3.83	3.76	1.01	1.01
2.0	1.09	1.04	3.12	4.83	6.59	1.02	1.01
3.0	1.10	1.05	3.06	5.23	1.03E1	1.02	1.01
4.0	1.12	1.06	3.02	5.42	1.58E1	1.02	1.01
5.0	1.13	1.07	3.02	5.53	2.43E1	1.02	1.01
6.0	1.14	1.07	3.02	5.57	3.72E1	1.03	1.01
7.0	1.15	1.08	3.01	5.58	5.70E1	1.03	1.01
8.0	1.16	1.08	3.02	5.61	8.57E1	1.03	1.01
10.0	1.18	1.09	3.01	5.62	1.87E2	1.03	1.02
15.0	1.21	1.11	3.00	5.63	1.62E3	1.04	1.02
20.0	1.24	1.12	3.02	5.69	1.77E4	1.05	1.02
25.0	1.25	1.13	3.04	5.72	2.24E5	1.05	1.02
30.0	1.27	1.14	3.06	5.74	3.04E6	1.06	1.03
35.0	1.28	1.14	3.07	5.73	4.25E7	1.06	1.03
40.0	1.29	1.15	3.09	5.72	6.02E8	1.06	1.03

Table 3
Exposure Buildup Factors

Tin

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.33	1.32	1.32	1.32	1.31	1.27	1.28	1.28	1.29
1.0	1.65	1.57	1.55	1.54	1.54	1.50	1.53	1.57	1.61
2.0	2.27	2.03	1.96	1.95	1.97	1.94	2.06	2.20	2.28
3.0	3.05	2.55	2.40	2.39	2.42	2.40	2.61	2.83	2.98
4.0	4.08	3.17	2.92	2.88	2.93	2.91	3.19	3.48	3.69
5.0	5.43	3.94	3.53	3.44	3.50	3.49	3.82	4.17	4.42
6.0	7.21	4.86	4.24	4.10	4.16	4.14	4.53	4.92	5.22
7.0	9.51	5.96	5.07	4.84	4.89	4.85	5.29	5.72	6.04
8.0	1.25E1	7.28	6.02	5.67	5.70	5.62	6.10	6.55	6.87
10.0	2.14E1	1.07E1	8.39	7.65	7.57	7.35	7.86	8.33	8.60
15.0	7.81E1	2.69E1	1.81E1	1.49E1	1.39E1	1.28E1	1.31E1	1.34E1	1.34E1
20.0	2.71E2	6.35E1	3.66E1	2.64E1	2.30E1	1.99E1	1.93E1	1.90E1	1.84E1
25.0	8.98E2	1.43E2	6.98E1	4.38E1	3.53E1	2.86E1	2.63E1	2.50E1	2.36E1
30.0	2.88E3	3.11E2	1.28E2	6.90E1	5.14E1	3.89E1	3.40E1	3.13E1	2.88E1
35.0	8.97E3	6.57E2	2.26E2	1.05E2	7.20E1	5.07E1	4.22E1	3.78E1	3.40E1
40.0	2.73E4	1.35E3	3.89E2	1.54E2	9.74E1	6.41E1	5.07E1	4.45E1	3.91E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.33	1.34	1.33	1.31	1.29	1.23	1.14	1.06	1.09
1.0	1.68	1.68	1.65	1.61	1.53	1.41	1.23	1.11	1.12
2.0	2.37	2.35	2.26	2.14	1.96	1.69	1.36	1.17	1.14
3.0	3.09	3.04	2.86	2.66	2.34	1.92	1.47	1.23	1.16
4.0	3.79	3.70	3.43	3.14	2.68	2.12	1.55	1.27	1.18
5.0	4.50	4.37	4.00	3.62	2.99	2.30	1.62	1.31	1.20
6.0	5.29	5.11	4.62	4.13	3.33	2.49	1.68	1.34	1.21
7.0	6.09	5.86	5.23	4.63	3.65	2.66	1.75	1.37	1.22
8.0	6.88	6.60	5.84	5.13	3.95	2.82	1.80	1.40	1.23
10.0	8.54	8.14	7.09	6.15	4.56	3.14	1.91	1.45	1.25
15.0	1.31E1	1.24E1	1.04E1	8.83	6.03	3.87	2.14	1.54	1.28
20.0	1.79E1	1.68E1	1.39E1	1.16E1	7.40	4.52	2.33	1.60	1.31
25.0	2.29E1	2.14E1	1.74E1	1.43E1	8.66	5.08	2.49	1.65	1.33
30.0	2.79E1	2.59E1	2.09E1	1.69E1	9.84	5.57	2.63	1.70	1.34
35.0	3.29E1	3.06E1	2.43E1	1.96E1	1.10E1	6.01	2.75	1.73	1.35
40.0	3.79E1	3.51E1	2.77E1	2.21E1	1.20E1	6.39	2.86	1.77	1.37

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.69	2.25	2.40	2.28	1.86	1.00	1.00
1.0	1.79	2.83	3.40	3.50	2.86	1.01	1.00
2.0	1.79	3.28	4.91	6.39	5.98	1.01	1.00
3.0	1.79	3.38	6.12	1.06E1	1.24E1	1.01	1.01
4.0	1.80	3.38	7.29	1.75E1	2.66E1	1.01	1.01
5.0	1.81	3.37	8.54	2.91E1	5.86E1	1.01	1.01
6.0	1.83	3.35	9.86	4.84E1	1.30E2	1.01	1.01
7.0	1.84	3.32	1.14E1	7.99E1	2.66E2	1.02	1.01
8.0	1.85	3.31	1.33E1	1.28E2	5.49E2	1.02	1.01
10.0	1.86	3.28	1.80E1	3.28E2	2.39E3	1.02	1.01
15.0	1.90	3.23	4.27E1	4.15E3	9.92E4	1.02	1.01
20.0	1.92	3.20	1.36E2	6.41E4	4.43E6	1.03	1.01
25.0	1.95	3.19	4.81E2	1.13E6	2.08E8	1.03	1.01
30.0	1.96	3.20	1.80E3	2.13E7	1.02E10	1.03	1.02
35.0	1.98	3.20	6.96E3	4.17E8	5.19E11	1.03	1.02
40.0	2.00	3.21	2.73E4	8.30E9	2.73E13	1.04	1.02

Table 3
Exposure Buildup Factors

Lanthanum

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.34	1.32	1.32	1.31	1.31	1.26	1.27	1.27	1.27
1.0	1.66	1.58	1.54	1.53	1.52	1.47	1.50	1.54	1.58
2.0	2.31	2.04	1.95	1.92	1.93	1.88	2.00	2.12	2.18
3.0	3.16	2.60	2.41	2.35	2.37	2.32	2.51	2.69	2.81
4.0	4.32	3.29	2.96	2.84	2.87	2.82	3.06	3.29	3.44
5.0	5.90	4.15	3.62	3.42	3.45	3.38	3.66	3.92	4.08
6.0	8.02	5.21	4.40	4.08	4.11	4.02	4.33	4.61	4.78
7.0	1.09E1	6.51	5.32	4.84	4.86	4.72	5.05	5.33	5.49
8.0	1.47E1	8.10	6.41	5.71	5.71	5.50	5.83	6.08	6.19
10.0	2.66E1	1.24E1	9.20	7.81	7.69	7.27	7.52	7.69	7.68
15.0	1.11E2	3.44E1	2.15E1	1.58E1	1.48E1	1.31E1	1.26E1	1.22E1	1.17E1
20.0	4.39E2	8.99E1	4.71E1	2.94E1	2.57E1	2.11E1	1.88E1	1.72E1	1.58E1
25.0	1.66E3	2.25E2	9.83E1	5.13E1	4.16E1	3.14E1	2.58E1	2.25E1	1.99E1
30.0	6.09E3	5.44E2	1.97E2	8.51E1	6.39E1	4.42E1	3.36E1	2.81E1	2.40E1
35.0	2.17E4	1.28E3	3.82E2	1.36E2	9.44E1	5.96E1	4.20E1	3.39E1	2.81E1
40.0	7.53E4	2.91E3	7.20E2	2.10E2	1.35E2	7.79E1	5.10E1	3.98E1	3.21E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.31	1.30	1.29	1.27	1.24	1.19	1.13	1.06	1.39
1.0	1.62	1.60	1.56	1.51	1.43	1.32	1.20	1.09	1.47
2.0	2.22	2.16	2.04	1.92	1.74	1.52	1.29	1.14	1.48
3.0	2.84	2.72	2.50	2.30	2.02	1.68	1.36	1.17	1.49
4.0	3.43	3.25	2.93	2.64	2.25	1.81	1.42	1.20	1.50
5.0	4.03	3.77	3.34	2.97	2.46	1.94	1.46	1.23	1.51
6.0	4.69	4.35	3.79	3.31	2.68	2.06	1.51	1.25	1.52
7.0	5.35	4.92	4.22	3.64	2.89	2.17	1.55	1.27	1.53
8.0	6.00	5.47	4.64	3.95	3.08	2.27	1.59	1.29	1.54
10.0	7.36	6.61	5.50	4.59	3.46	2.47	1.65	1.32	1.56
15.0	1.10E1	9.59	7.67	6.16	4.34	2.91	1.80	1.38	1.59
20.0	1.48E1	1.26E1	9.80	7.63	5.11	3.29	1.92	1.42	1.61
25.0	1.86E1	1.55E1	1.19E1	9.02	5.79	3.61	2.02	1.45	1.62
30.0	2.24E1	1.84E1	1.38E1	1.03E1	6.40	3.88	2.10	1.47	1.64
35.0	2.61E1	2.13E1	1.57E1	1.16E1	6.97	4.11	2.17	1.50	1.65
40.0	2.98E1	2.40E1	1.76E1	1.27E1	7.48	4.31	2.24	1.52	1.66

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.69	2.02	2.05	1.86	1.01	1.00	1.00
1.0	2.00	2.85	3.08	2.85	1.01	1.00	1.00
2.0	2.21	4.36	5.64	5.89	1.02	1.01	1.00
3.0	2.25	5.96	9.60	1.20E1	1.02	1.01	1.00
4.0	2.25	7.92	1.64E1	2.53E1	1.02	1.01	1.00
5.0	2.24	1.05E1	2.85E1	5.49E1	1.03	1.01	1.00
6.0	2.23	1.38E1	4.95E1	1.19E2	1.03	1.01	1.00
7.0	2.22	1.84E1	8.56E1	2.41E2	1.03	1.01	1.01
8.0	2.22	2.44E1	1.41E2	4.89E2	1.03	1.01	1.01
10.0	2.21	4.33E1	3.96E2	2.06E3	1.04	1.01	1.01
15.0	2.20	2.16E2	6.16E3	8.01E4	1.04	1.02	1.01
20.0	2.20	1.41E3	1.15E5	3.38E6	1.05	1.02	1.01
25.0	2.21	1.04E4	2.42E6	1.51E8	1.06	1.02	1.01
30.0	2.22	8.00E4	5.43E7	7.08E9	1.06	1.02	1.01
35.0	2.23	6.27E5	1.26E9	3.45E11	1.06	1.02	1.01
40.0	2.24	4.96E6	2.98E10	1.74E13	1.07	1.02	1.01

Table 3
Exposure Buildup Factors

Gadolinium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.34	1.32	1.31	1.30	1.29	1.25	1.25	1.25	1.26
1.0	1.67	1.57	1.53	1.50	1.49	1.43	1.46	1.50	1.53
2.0	2.35	2.05	1.93	1.88	1.87	1.81	1.91	2.02	2.06
3.0	3.28	2.65	2.41	2.30	2.29	2.21	2.38	2.52	2.60
4.0	4.58	3.39	2.97	2.78	2.77	2.67	2.88	3.04	3.12
5.0	6.36	4.33	3.65	3.34	3.32	3.20	3.43	3.59	3.66
6.0	8.79	5.50	4.46	3.99	3.95	3.79	4.04	4.18	4.23
7.0	1.21E1	6.96	5.43	4.73	4.67	4.45	4.70	4.79	4.81
8.0	1.67E1	8.76	6.58	5.59	5.45	5.18	5.41	5.43	5.38
10.0	3.12E1	1.38E1	9.56	7.69	7.40	6.85	6.96	6.77	6.56
15.0	1.42E2	4.06E1	2.31E1	1.59E1	1.44E1	1.25E1	1.16E1	1.05E1	9.64
20.0	6.13E2	1.13E2	5.29E1	3.04E1	2.55E1	2.03E1	1.73E1	1.45E1	1.27E1
25.0	2.54E3	3.04E2	1.15E2	5.49E1	4.23E1	3.07E1	2.39E1	1.86E1	1.58E1
30.0	1.02E4	7.85E2	2.43E2	9.43E1	6.66E1	4.40E1	3.13E1	2.30E1	1.87E1
35.0	3.94E4	1.97E3	4.94E2	1.56E2	1.01E2	6.05E1	3.94E1	2.74E1	2.16E1
40.0	1.50E5	4.83E3	9.80E2	2.51E2	1.48E2	8.05E1	4.81E1	3.19E1	2.44E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.27	1.27	1.24	1.22	1.19	1.15	1.11	1.14	1.41
1.0	1.54	1.52	1.46	1.41	1.34	1.24	1.16	1.17	1.60
2.0	2.04	1.97	1.83	1.72	1.56	1.38	1.23	1.20	1.75
3.0	2.54	2.39	2.17	1.99	1.75	1.49	1.27	1.23	1.79
4.0	3.00	2.79	2.47	2.22	1.90	1.58	1.31	1.25	1.80
5.0	3.47	3.17	2.77	2.45	2.04	1.66	1.34	1.27	1.81
6.0	3.97	3.58	3.07	2.67	2.18	1.74	1.37	1.29	1.81
7.0	4.47	3.97	3.36	2.89	2.31	1.81	1.40	1.30	1.81
8.0	4.95	4.35	3.63	3.09	2.43	1.88	1.42	1.32	1.81
10.0	5.95	5.11	4.19	3.50	2.66	2.00	1.47	1.34	1.80
15.0	8.49	6.99	5.52	4.44	3.17	2.28	1.56	1.38	1.80
20.0	1.10E1	8.77	6.76	5.28	3.60	2.50	1.63	1.41	1.81
25.0	1.35E1	1.04E1	7.89	6.03	3.96	2.68	1.70	1.44	1.81
30.0	1.58E1	1.20E1	8.93	6.72	4.28	2.84	1.75	1.46	1.82
35.0	1.82E1	1.35E1	9.91	7.35	4.57	2.97	1.80	1.47	1.83
40.0	2.04E1	1.49E1	1.08E1	7.93	4.83	3.08	1.84	1.49	1.84

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.64	1.81	1.02	1.01	1.01	1.00	1.00
1.0	2.12	2.65	1.03	1.02	1.01	1.00	1.00
2.0	2.90	4.87	1.04	1.02	1.01	1.00	1.00
3.0	3.61	8.58	1.05	1.03	1.01	1.01	1.00
4.0	4.37	1.54E1	1.06	1.03	1.02	1.01	1.00
5.0	5.27	2.84E1	1.06	1.04	1.02	1.01	1.00
6.0	6.33	5.25E1	1.07	1.04	1.02	1.01	1.00
7.0	7.69	9.49E1	1.08	1.04	1.02	1.01	1.00
8.0	9.45	1.66E2	1.08	1.05	1.02	1.01	1.00
10.0	1.42E1	5.30E2	1.09	1.05	1.02	1.01	1.00
15.0	4.84E1	1.10E4	1.11	1.06	1.03	1.01	1.01
20.0	2.11E2	2.66E5	1.13	1.07	1.04	1.01	1.01
25.0	1.04E3	7.14E6	1.14	1.08	1.04	1.01	1.01
30.0	5.31E3	2.04E8	1.15	1.09	1.04	1.01	1.01
35.0	2.79E4	6.01E9	1.16	1.09	1.04	1.02	1.01
40.0	1.49E5	1.81E11	1.17	1.10	1.05	1.02	1.01

Table 3
Exposure Buildup Factors
Tungsten

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.30	1.27	1.26	1.25	1.24	1.22	1.23	1.23	1.23
1.0	1.62	1.51	1.46	1.43	1.42	1.38	1.41	1.44	1.47
2.0	2.27	1.97	1.85	1.77	1.75	1.71	1.80	1.88	1.90
3.0	3.22	2.56	2.30	2.15	2.13	2.07	2.21	2.30	2.32
4.0	4.55	3.32	2.84	2.59	2.55	2.48	2.64	2.73	2.73
5.0	6.41	4.28	3.50	3.10	3.04	2.94	3.12	3.18	3.14
6.0	9.01	5.49	4.29	3.70	3.60	3.47	3.64	3.65	3.57
7.0	1.26E1	7.04	5.25	4.39	4.24	4.05	4.20	4.14	3.99
8.0	1.77E1	8.99	6.40	5.19	4.97	4.70	4.80	4.63	4.41
10.0	3.44E1	1.46E1	9.44	7.17	6.71	6.19	6.11	5.67	5.24
15.0	1.72E2	4.66E1	2.39E1	1.52E1	1.32E1	1.12E1	1.00E1	8.43	7.33
20.0	8.23E2	1.43E2	5.79E1	3.01E1	2.38E1	1.84E1	1.48E1	1.13E1	9.31
25.0	3.77E3	4.20E2	1.35E2	5.68E1	4.05E1	2.81E1	2.02E1	1.43E1	1.12E1
30.0	1.67E4	1.20E3	3.03E2	1.03E2	6.57E1	4.09E1	2.64E1	1.74E1	1.30E1
35.0	7.21E4	3.32E3	6.62E2	1.79E2	1.03E2	5.71E1	3.32E1	2.04E1	1.47E1
40.0	3.04E5	9.00E3	1.41E3	3.04E2	1.56E2	7.73E1	4.05E1	2.34E1	1.63E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.23	1.22	1.19	1.17	1.14	1.11	1.12	1.19	1.44
1.0	1.45	1.41	1.35	1.30	1.24	1.17	1.16	1.26	1.82
2.0	1.83	1.74	1.61	1.51	1.39	1.26	1.20	1.31	2.53
3.0	2.19	2.04	1.83	1.68	1.51	1.33	1.23	1.33	3.34
4.0	2.51	2.31	2.03	1.83	1.60	1.38	1.25	1.34	4.40
5.0	2.83	2.56	2.21	1.96	1.69	1.42	1.27	1.35	5.85
6.0	3.15	2.82	2.39	2.09	1.77	1.46	1.29	1.35	7.87
7.0	3.47	3.07	2.57	2.21	1.85	1.49	1.30	1.36	1.08E1
8.0	3.77	3.30	2.73	2.33	1.92	1.53	1.32	1.37	1.48E1
10.0	4.37	3.76	3.04	2.55	2.05	1.58	1.35	1.38	2.82E1
15.0	5.79	4.82	3.75	3.02	2.33	1.70	1.40	1.41	1.76E2
20.0	7.09	5.76	4.37	3.43	2.55	1.79	1.44	1.43	1.38E3
25.0	8.28	6.59	4.91	3.77	2.74	1.86	1.48	1.45	1.19E4
30.0	9.39	7.36	5.39	4.07	2.90	1.93	1.51	1.46	1.06E5
35.0	1.04E1	8.07	5.83	4.34	3.04	1.98	1.53	1.47	9.63E5
40.0	1.14E1	8.73	6.22	4.58	3.16	2.04	1.56	1.48	8.84E6

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.61	1.02	1.01	1.01	1.00	1.00	1.00
1.0	2.24	1.03	1.02	1.01	1.01	1.00	1.00
2.0	3.91	1.04	1.03	1.02	1.01	1.00	1.00
3.0	6.74	1.05	1.03	1.02	1.01	1.00	1.00
4.0	1.20E1	1.05	1.04	1.02	1.01	1.00	1.00
5.0	2.21E1	1.06	1.04	1.02	1.01	1.00	1.00
6.0	4.10E1	1.07	1.04	1.02	1.01	1.00	1.00
7.0	7.50E1	1.07	1.05	1.03	1.01	1.00	1.00
8.0	1.33E2	1.08	1.05	1.03	1.01	1.01	1.00
10.0	4.31E2	1.09	1.06	1.03	1.02	1.01	1.00
15.0	9.39E3	1.11	1.07	1.04	1.02	1.01	1.00
20.0	2.37E5	1.12	1.08	1.05	1.02	1.01	1.00
25.0	6.51E6	1.14	1.09	1.05	1.02	1.01	1.00
30.0	1.89E8	1.15	1.09	1.05	1.03	1.01	1.01
35.0	5.63E9	1.16	1.10	1.06	1.03	1.01	1.01
40.0	1.70E11	1.17	1.11	1.06	1.03	1.01	1.01

Table 3
Exposure Buildup Factors

Lead

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.32	1.29	1.27	1.26	1.25	1.25	1.24	1.21	1.19
1.0	1.62	1.51	1.46	1.42	1.40	1.41	1.41	1.39	1.37
2.0	2.26	1.97	1.82	1.74	1.71	1.74	1.77	1.76	1.73
3.0	3.16	2.54	2.26	2.10	2.06	2.11	2.13	2.12	2.05
4.0	4.43	3.26	2.78	2.51	2.45	2.49	2.51	2.47	2.34
5.0	6.21	4.17	3.40	2.98	2.89	2.92	2.91	2.83	2.63
6.0	8.69	5.32	4.15	3.52	3.39	3.40	3.34	3.20	2.92
7.0	1.21E1	6.78	5.05	4.14	3.96	3.92	3.81	3.58	3.21
8.0	1.69E1	8.60	6.13	4.86	4.61	4.50	4.30	3.97	3.50
10.0	3.28E1	1.38E1	8.97	6.64	6.14	5.80	5.37	4.76	4.05
15.0	1.64E2	4.28E1	2.24E1	1.37E1	1.18E1	1.01E1	8.43	6.80	5.35
20.0	7.83E2	1.28E2	5.36E1	2.66E1	2.10E1	1.61E1	1.20E1	8.89	6.56
25.0	3.61E3	3.69E2	1.24E2	4.94E1	3.53E1	2.42E1	1.61E1	1.10E1	7.70
30.0	1.61E4	1.03E3	2.78E2	8.83E1	5.70E1	3.46E1	2.06E1	1.31E1	8.78
35.0	7.03E4	2.82E3	6.10E2	1.53E2	8.89E1	4.77E1	2.56E1	1.52E1	9.81
40.0	3.00E5	7.51E3	1.31E3	2.59E2	1.35E2	6.37E1	3.10E1	1.73E1	1.08E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.16	1.14	1.12	1.09	1.07	1.08	1.14	1.25	1.52
1.0	1.31	1.28	1.22	1.18	1.13	1.12	1.19	1.41	2.05
2.0	1.61	1.53	1.41	1.32	1.23	1.19	1.23	1.60	3.44
3.0	1.87	1.74	1.57	1.44	1.31	1.24	1.25	1.72	5.72
4.0	2.10	1.91	1.69	1.53	1.37	1.28	1.26	1.82	9.90
5.0	2.32	2.08	1.80	1.61	1.42	1.31	1.28	1.90	1.77E1
6.0	2.54	2.24	1.90	1.69	1.47	1.34	1.29	1.96	3.22E1
7.0	2.75	2.39	2.00	1.77	1.52	1.37	1.31	2.03	5.83E1
8.0	2.96	2.54	2.10	1.85	1.56	1.39	1.31	2.11	1.02E2
10.0	3.37	2.83	2.28	1.98	1.64	1.43	1.34	2.27	3.20E2
15.0	4.30	3.44	2.65	2.27	1.79	1.51	1.37	2.77	6.55E3
20.0	5.17	4.00	2.97	2.52	1.92	1.57	1.40	3.36	1.55E5
25.0	6.00	4.49	3.24	2.74	2.04	1.62	1.42	4.26	4.01E6
30.0	6.80	4.94	3.50	2.94	2.15	1.65	1.44	5.71	1.09E8
35.0	7.53	5.35	3.74	3.13	2.25	1.69	1.45	8.13	3.02E9
40.0	8.21	5.74	3.97	3.31	2.33	1.72	1.47	1.22E1	8.51E10

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.02	1.01	1.01	1.01	1.00		
1.0	1.03	1.02	1.01	1.01	1.00		
2.0	1.05	1.03	1.02	1.01	1.00		
3.0	1.06	1.03	1.02	1.01	1.01		
4.0	1.08	1.04	1.02	1.01	1.01		
5.0	1.09	1.04	1.03	1.02	1.01		
6.0	1.09	1.05	1.03	1.02	1.01		
7.0	1.10	1.05	1.03	1.02	1.01		
8.0	1.11	1.06	1.04	1.02	1.01		
10.0	1.12	1.06	1.04	1.02	1.01		
15.0	1.15	1.08	1.05	1.03	1.01		
20.0	1.17	1.09	1.06	1.03	1.02		
25.0	1.18	1.10	1.07	1.04	1.02		
30.0	1.20	1.10	1.08	1.04	1.02		
35.0	1.21	1.11	1.08	1.04	1.02		
40.0	1.22	1.12	1.09	1.04	1.02		

Table 3
Exposure Buildup Factors

Uranium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.31	1.27	1.25	1.25	1.23	1.21	1.21	1.19	1.16
1.0	1.60	1.48	1.42	1.39	1.37	1.35	1.36	1.35	1.31
2.0	2.21	1.92	1.77	1.66	1.63	1.63	1.66	1.66	1.61
3.0	3.07	2.46	2.17	1.97	1.93	1.94	1.97	1.96	1.86
4.0	4.27	3.14	2.65	2.32	2.25	2.26	2.29	2.25	2.09
5.0	5.94	3.98	3.21	2.72	2.62	2.61	2.63	2.54	2.31
6.0	8.24	5.04	3.87	3.17	3.03	3.00	2.99	2.84	2.53
7.0	1.14E1	6.36	4.66	3.69	3.49	3.43	3.38	3.15	2.74
8.0	1.59E1	8.01	5.60	4.28	4.01	3.90	3.79	3.45	2.95
10.0	3.02E1	1.26E1	8.03	5.71	5.22	4.94	4.66	4.08	3.36
15.0	1.46E2	3.76E1	1.90E1	1.12E1	9.56	8.28	7.12	5.66	4.34
20.0	6.77E2	1.09E2	4.35E1	2.09E1	1.64E1	1.28E1	9.93	7.24	5.25
25.0	3.04E3	3.03E2	9.63E1	3.76E1	2.69E1	1.87E1	1.30E1	8.82	6.11
30.0	1.33E4	8.24E2	2.08E2	6.52E1	4.25E1	2.62E1	1.64E1	1.04E1	6.96
35.0	5.67E4	2.19E3	4.38E2	1.10E2	6.50E1	3.54E1	1.99E1	1.20E1	7.91
40.0	2.37E5	5.69E3	9.07E2	1.82E2	9.70E1	4.66E1	2.36E1	1.35E1	8.85

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.14	1.12	1.10	1.09	1.08	1.10	1.21	1.36	1.04
1.0	1.27	1.23	1.18	1.15	1.13	1.14	1.33	1.68	1.06
2.0	1.50	1.43	1.32	1.26	1.21	1.19	1.47	2.35	1.07
3.0	1.69	1.58	1.43	1.34	1.26	1.22	1.55	3.20	1.09
4.0	1.86	1.71	1.52	1.41	1.31	1.25	1.60	4.41	1.10
5.0	2.03	1.83	1.60	1.47	1.35	1.28	1.64	6.25	1.11
6.0	2.19	1.95	1.68	1.52	1.38	1.30	1.68	9.01	1.12
7.0	2.34	2.06	1.76	1.57	1.42	1.32	1.70	1.34E1	1.13
8.0	2.49	2.17	1.84	1.62	1.45	1.34	1.73	1.95E1	1.14
10.0	2.77	2.37	1.98	1.72	1.51	1.36	1.77	4.23E1	1.16
15.0	3.38	2.78	2.25	1.90	1.62	1.42	1.87	3.69E2	1.19
20.0	3.94	3.15	2.48	2.06	1.72	1.46	1.94	3.90E3	1.21
25.0	4.46	3.46	2.68	2.20	1.81	1.49	1.99	4.47E4	1.22
30.0	4.94	3.74	2.85	2.32	1.89	1.52	2.02	5.29E5	1.23
35.0	5.39	4.01	3.00	2.44	1.96	1.54	2.06	6.35E6	1.25
40.0	5.79	4.26	3.16	2.55	2.03	1.56	2.10	7.71E7	1.26

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.02	1.01	1.01	1.00	1.00		
1.0	1.02	1.01	1.01	1.01	1.00		
2.0	1.03	1.02	1.01	1.01	1.00		
3.0	1.04	1.02	1.02	1.01	1.00		
4.0	1.05	1.03	1.02	1.01	1.01		
5.0	1.06	1.03	1.02	1.01	1.01		
6.0	1.06	1.03	1.02	1.01	1.01		
7.0	1.07	1.03	1.02	1.01	1.01		
8.0	1.07	1.04	1.02	1.01	1.01		
10.0	1.08	1.04	1.03	1.02	1.01		
15.0	1.10	1.05	1.03	1.02	1.01		
20.0	1.11	1.06	1.04	1.02	1.01		
25.0	1.13	1.07	1.04	1.03	1.01		
30.0	1.14	1.07	1.05	1.03	1.01		
35.0	1.15	1.08	1.05	1.03	1.01		
40.0	1.15	1.08	1.05	1.03	1.02		

Table 3
Exposure Buildup Factors

Water

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.23	1.27	1.28	1.31	1.34	1.38	1.41
1.0	1.28	1.37	1.43	1.51	1.56	1.63	1.71	1.83	1.92
2.0	1.49	1.68	1.80	1.97	2.08	2.24	2.46	2.81	3.10
3.0	1.70	1.97	2.15	2.41	2.58	2.85	3.23	3.87	4.43
4.0	1.90	2.25	2.49	2.84	3.08	3.46	4.00	4.98	5.88
5.0	2.10	2.53	2.82	3.27	3.58	4.07	4.80	6.15	7.44
6.0	2.30	2.80	3.15	3.70	4.08	4.68	5.61	7.38	9.11
7.0	2.49	3.07	3.48	4.12	4.58	5.30	6.43	8.65	10.9
8.0	2.68	3.34	3.80	4.54	5.07	5.92	7.27	9.97	12.7
10.0	3.05	3.86	4.44	5.37	6.05	7.16	8.97	12.7	16.7
15.0	3.96	5.14	5.99	7.41	8.49	10.3	13.3	20.1	27.8
20.0	4.84	6.38	7.49	9.42	10.9	13.4	17.8	28.0	40.4
25.0	5.69	7.59	8.96	11.4	13.3	16.5	22.4	36.5	54.0
30.0	6.51	8.78	10.4	13.3	15.7	19.7	27.1	45.2	68.7
35.0	7.26	9.96	11.9	15.0	18.0	22.8	31.8	54.4	84.3
40.0	7.91	11.2	13.4	16.4	20.4	25.9	36.5	63.7	101.

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.50	1.56	1.60	1.66	1.75	1.92	2.07	2.37
1.0	2.08	2.17	2.33	2.44	2.61	2.85	3.42	3.89	4.55
2.0	3.62	3.96	4.49	4.88	5.44	6.30	8.31	9.49	1.18E1
3.0	5.50	6.26	7.44	8.35	9.66	1.17E1	1.60E1	1.90E1	2.38E1
4.0	7.68	9.00	1.12E1	1.28E1	1.53E1	1.93E1	2.70E1	3.33E1	4.13E1
5.0	1.01E1	1.22E1	1.56E1	1.84E1	2.25E1	2.94E1	4.22E1	5.34E1	6.52E1
6.0	1.28E1	1.58E1	2.08E1	2.50E1	3.14E1	4.21E1	6.25E1	8.01E1	9.67E1
7.0	1.58E1	1.98E1	2.67E1	3.27E1	4.19E1	5.78E1	8.85E1	1.15E2	1.37E2
8.0	1.90E1	2.42E1	3.35E1	4.15E1	5.43E1	7.68E1	1.21E2	1.58E2	1.87E2
10.0	2.61E1	3.42E1	4.93E1	6.29E1	8.50E1	1.26E2	2.08E2	2.77E2	3.21E2
15.0	4.77E1	6.63E1	1.04E2	1.39E2	2.02E2	3.27E2	6.00E2	8.34E2	9.38E2
20.0	7.40E1	1.08E2	1.79E2	2.52E2	3.87E2	6.76E2	1.35E3	1.96E3	2.17E3
25.0	1.04E2	1.57E2	2.76E2	4.03E2	6.49E2	1.22E3	2.67E3	3.98E3	4.36E3
30.0	1.39E2	2.15E2	3.95E2	5.94E2	9.99E2	1.99E3	4.81E3	7.32E3	7.97E3
35.0	1.77E2	2.81E2	5.34E2	8.28E2	1.44E3	3.04E3	8.17E3	1.25E4	1.35E4
40.0	2.18E2	3.53E2	6.95E2	1.11E3	1.99E3	4.41E3	1.33E4	2.03E4	2.11E4

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.55	2.62	2.52	2.22	1.77	1.28	1.13
1.0	4.95	4.90	4.42	3.47	2.35	1.43	1.18
2.0	1.26E1	1.14E1	9.25	6.18	3.32	1.67	1.27
3.0	2.45E1	2.04E1	1.53E1	9.14	4.21	1.86	1.33
4.0	4.11E1	3.20E1	2.26E1	1.23E1	5.07	2.02	1.38
5.0	6.33E1	4.64E1	3.10E1	1.57E1	5.89	2.16	1.43
6.0	9.14E1	6.36E1	4.05E1	1.92E1	6.68	2.28	1.46
7.0	1.26E2	8.39E1	5.13E1	2.29E1	7.45	2.39	1.50
8.0	1.69E2	1.07E2	6.32E1	2.68E1	8.20	2.50	1.53
10.0	2.81E2	1.65E2	9.09E1	3.51E1	9.69	2.68	1.58
15.0	7.62E2	3.86E2	1.85E2	5.92E1	1.35E1	3.08	1.68
20.0	1.66E3	7.51E2	3.23E2	8.85E1	1.72E1	3.42	1.75
25.0	3.20E3	1.31E3	5.11E2	1.23E2	2.12E1	3.71	1.82
30.0	5.63E3	2.11E3	7.59E2	1.63E2	2.57E1	3.97	1.87
35.0	9.30E3	3.24E3	1.08E3	2.08E2	3.07E1	4.19	1.91
40.0	1.46E4	4.74E3	1.47E3	2.59E2	3.63E1	4.36	1.94

Table 3
Exposure Buildup Factors

Air

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.23	1.27	1.29	1.31	1.34	1.38	1.42
1.0	1.28	1.37	1.43	1.52	1.57	1.63	1.71	1.83	1.92
2.0	1.49	1.68	1.80	1.97	2.09	2.25	2.46	2.81	3.09
3.0	1.70	1.97	2.15	2.41	2.60	2.85	3.22	3.86	4.42
4.0	1.90	2.26	2.50	2.85	3.11	3.46	4.00	4.96	5.86
5.0	2.11	2.54	2.84	3.28	3.61	4.07	4.79	6.13	7.42
6.0	2.30	2.82	3.17	3.71	4.12	4.69	5.60	7.35	9.08
7.0	2.50	3.10	3.51	4.14	4.62	5.31	6.43	8.61	10.8
8.0	2.70	3.37	3.84	4.57	5.12	5.94	7.26	9.92	12.7
10.0	3.08	3.92	4.49	5.42	6.13	7.19	8.97	12.6	16.7
15.0	4.03	5.25	6.08	7.51	8.63	10.3	13.4	20.0	27.7
20.0	4.96	6.55	7.64	9.58	11.1	13.5	17.9	27.9	40.2
25.0	5.87	7.84	9.17	11.6	13.6	16.7	22.5	36.2	53.9
30.0	6.75	9.11	10.7	13.6	16.1	19.9	27.2	45.0	68.5
35.0	7.58	10.4	12.3	15.4	18.5	23.1	32.0	54.0	84.0
40.0	8.31	11.6	14.1	16.9	21.0	26.3	36.7	63.2	100.

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.50	1.56	1.60	1.66	1.75	1.90	2.16	2.35
1.0	2.08	2.17	2.33	2.44	2.59	2.83	3.28	3.83	4.46
2.0	3.60	3.94	4.46	4.84	5.37	6.20	7.74	9.21	1.14E1
3.0	5.46	6.19	7.34	8.21	9.45	1.14E1	1.50E1	1.82E1	2.25E1
4.0	7.60	8.88	1.09E1	1.26E1	1.49E1	1.87E1	2.56E1	3.15E1	3.84E1
5.0	1.00E1	1.20E1	1.53E1	1.79E1	2.18E1	2.82E1	4.00E1	4.99E1	5.99E1
6.0	1.27E1	1.55E1	2.03E1	2.42E1	3.02E1	4.02E1	5.89E1	7.42E1	8.78E1
7.0	1.56E1	1.94E1	2.60E1	3.16E1	4.02E1	5.49E1	8.28E1	1.05E2	1.23E2
8.0	1.88E1	2.37E1	3.25E1	4.01E1	5.20E1	7.27E1	1.12E2	1.44E2	1.66E2
10.0	2.58E1	3.35E1	4.79E1	6.06E1	8.11E1	1.18E2	1.92E2	2.49E2	2.82E2
15.0	4.70E1	6.49E1	1.00E2	1.34E2	1.91E2	3.04E2	5.45E2	7.35E2	8.00E2
20.0	7.28E1	1.05E2	1.73E2	2.41E2	3.65E2	6.24E2	1.22E3	1.70E3	1.81E3
25.0	1.03E2	1.54E2	2.66E2	3.85E2	6.11E2	1.12E3	2.36E3	3.41E3	3.57E3
30.0	1.36E2	2.10E2	3.79E2	5.67E2	9.38E2	1.82E3	4.15E3	6.21E3	6.43E3
35.0	1.73E2	2.74E2	5.12E2	7.88E2	1.35E3	2.77E3	6.77E3	1.05E4	1.06E4
40.0	2.12E2	3.45E2	6.65E2	1.05E3	1.87E3	4.01E3	1.05E4	1.70E4	1.57E4

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.52	2.58	2.48	2.20	1.76	1.27	1.12
1.0	4.83	4.76	4.28	3.38	2.31	1.41	1.17
2.0	1.20E1	1.08E1	8.72	5.85	3.19	1.62	1.25
3.0	2.29E1	1.89E1	1.41E1	8.47	3.99	1.79	1.31
4.0	3.79E1	2.91E1	2.05E1	1.12E1	4.75	1.93	1.36
5.0	5.74E1	4.15E1	2.76E1	1.41E1	5.46	2.04	1.39
6.0	8.20E1	5.61E1	3.57E1	1.70E1	6.14	2.15	1.43
7.0	1.12E2	7.32E1	4.46E1	2.01E1	6.79	2.25	1.46
8.0	1.48E2	9.27E1	5.44E1	2.33E1	7.43	2.34	1.48
10.0	2.42E2	1.40E2	7.68E1	3.00E1	8.69	2.50	1.53
15.0	6.36E2	3.16E2	1.51E2	4.90E1	1.18E1	2.83	1.62
20.0	1.35E3	5.96E2	2.56E2	7.14E1	1.48E1	3.11	1.68
25.0	2.54E3	1.01E3	3.95E2	9.72E1	1.80E1	3.35	1.74
30.0	4.39E3	1.60E3	5.74E2	1.26E2	2.15E1	3.56	1.78
35.0	7.14E3	2.41E3	7.98E2	1.59E2	2.54E1	3.74	1.82
40.0	1.11E4	3.48E3	1.07E3	1.95E2	2.97E1	3.88	1.85

Table 3
Exposure Buildup Factors

Concrete

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.19	1.22	1.26	1.27	1.31	1.33	1.37	1.39
1.0	1.26	1.35	1.41	1.49	1.53	1.61	1.67	1.77	1.85
2.0	1.46	1.64	1.76	1.93	2.04	2.18	2.38	2.65	2.86
3.0	1.66	1.93	2.11	2.37	2.53	2.77	3.09	3.60	4.00
4.0	1.86	2.22	2.45	2.80	3.03	3.37	3.84	4.61	5.25
5.0	2.07	2.51	2.81	3.25	3.54	3.98	4.61	5.68	6.60
6.0	2.28	2.80	3.16	3.69	4.05	4.60	5.40	6.80	8.05
7.0	2.50	3.10	3.51	4.14	4.57	5.23	6.20	7.97	9.58
8.0	2.71	3.40	3.87	4.60	5.09	5.86	7.03	9.18	1.12E1
10.0	3.16	4.01	4.59	5.52	6.15	7.15	8.71	1.17E1	1.46E1
15.0	4.34	5.57	6.43	7.86	8.85	1.05E1	1.31E1	1.86E1	2.42E1
20.0	5.59	7.19	8.31	1.02E1	1.16E1	1.39E1	1.77E1	2.60E1	3.50E1
25.0	6.91	8.86	1.02E1	1.27E1	1.44E1	1.74E1	2.25E1	3.39E1	4.69E1
30.0	8.27	1.06E1	1.22E1	1.52E1	1.73E1	2.09E1	2.74E1	4.22E1	5.96E1
35.0	9.63	1.23E1	1.41E1	1.78E1	2.05E1	2.46E1	3.24E1	5.09E1	7.30E1
40.0	10.9	1.45E1	1.62E1	2.05E1	2.48E1	2.84E1	3.74E1	5.98E1	8.71E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.45	1.48	1.53	1.57	1.61	1.68	1.78	1.84	1.89
1.0	1.98	2.06	2.18	2.27	2.37	2.52	2.72	2.82	2.78
2.0	3.24	3.47	3.80	4.03	4.31	4.66	5.05	5.13	4.63
3.0	4.72	5.18	5.82	6.26	6.80	7.42	8.00	7.92	6.63
4.0	6.42	7.18	8.25	8.97	9.85	1.08E1	1.16E1	1.12E1	8.80
5.0	8.33	9.47	1.11E1	1.22E1	1.35E1	1.50E1	1.59E1	1.50E1	1.11E1
6.0	1.04E1	1.20E1	1.43E1	1.59E1	1.78E1	1.99E1	2.09E1	1.93E1	1.36E1
7.0	1.27E1	1.49E1	1.80E1	2.02E1	2.28E1	2.56E1	2.67E1	2.42E1	1.63E1
8.0	1.52E1	1.81E1	2.22E1	2.50E1	2.85E1	3.22E1	3.34E1	2.97E1	1.92E1
10.0	2.07E1	2.51E1	3.18E1	3.64E1	4.21E1	4.82E1	4.96E1	4.27E1	2.56E1
15.0	3.72E1	4.74E1	6.36E1	7.56E1	9.07E1	1.07E2	1.09E2	8.76E1	4.49E1
20.0	5.71E1	7.57E1	1.07E2	1.31E2	1.62E2	1.98E2	2.01E2	1.53E2	6.91E1
25.0	8.01E1	1.10E2	1.61E2	2.03E2	2.59E2	3.26E2	3.31E2	2.40E2	9.79E1
30.0	1.06E2	1.49E2	2.26E2	2.92E2	3.83E2	4.97E2	5.07E2	3.53E2	1.31E2
35.0	1.34E2	1.93E2	3.02E2	3.99E2	5.36E2	7.16E2	7.34E2	4.94E2	1.70E2
40.0	1.64E2	2.42E2	3.89E2	5.23E2	7.19E2	9.85E2	1.02E3	6.64E2	2.14E2

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.84	1.68	1.42	1.30	1.15	1.05	1.02
1.0	2.58	2.15	1.74	1.46	1.21	1.07	1.03
2.0	3.96	2.89	2.26	1.69	1.30	1.09	1.04
3.0	5.31	3.54	2.63	1.87	1.37	1.11	1.05
4.0	6.69	4.17	2.95	2.01	1.43	1.13	1.05
5.0	8.09	4.77	3.25	2.14	1.47	1.14	1.06
6.0	9.52	5.34	3.53	2.25	1.51	1.15	1.06
7.0	1.10E1	5.90	3.79	2.35	1.54	1.16	1.07
8.0	1.25E1	6.44	4.04	2.45	1.57	1.17	1.07
10.0	1.57E1	7.52	4.51	2.62	1.63	1.18	1.08
15.0	2.43E1	1.02E1	5.57	2.98	1.74	1.21	1.09
20.0	3.38E1	1.27E1	6.52	3.27	1.82	1.22	1.10
25.0	4.43E1	1.52E1	7.38	3.51	1.89	1.24	1.10
30.0	5.54E1	1.82E1	8.18	3.73	1.94	1.25	1.11
35.0	6.68E1	2.19E1	8.87	3.91	1.99	1.26	1.11
40.0	7.81E1	2.65E1	9.44	4.03	2.02	1.27	1.11

Table 4
Energy Absorption Buildup Factors

Beryllium

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.18	1.22	1.24	1.28	1.29	1.31	1.34	1.38	1.41
1.0	1.32	1.41	1.46	1.54	1.58	1.64	1.71	1.82	1.91
2.0	1.58	1.76	1.87	2.02	2.13	2.27	2.47	2.81	3.10
3.0	1.81	2.07	2.24	2.48	2.65	2.89	3.24	3.88	4.46
4.0	2.03	2.37	2.59	2.92	3.16	3.50	4.02	5.01	5.95
5.0	2.24	2.66	2.94	3.36	3.67	4.11	4.82	6.19	7.55
6.0	2.45	2.94	3.27	3.78	4.17	4.72	5.62	7.41	9.26
7.0	2.65	3.22	3.60	4.20	4.66	5.33	6.44	8.69	1.11E1
8.0	2.84	3.49	3.92	4.61	5.15	5.94	7.26	1.00E1	1.30E1
10.0	3.22	4.01	4.55	5.43	6.12	7.15	8.93	1.27E1	1.70E1
15.0	4.09	5.24	6.04	7.39	8.47	1.02E1	1.32E1	2.00E1	2.83E1
20.0	4.90	6.41	7.46	9.28	1.08E1	1.31E1	1.75E1	2.79E1	4.11E1
25.0	5.67	7.53	8.81	1.11E1	1.30E1	1.61E1	2.19E1	3.62E1	5.50E1
30.0	6.39	8.61	1.01E1	1.29E1	1.52E1	1.91E1	2.64E1	4.48E1	6.99E1
35.0	7.10	9.65	1.17E1	1.47E1	1.74E1	2.20E1	3.09E1	5.37E1	8.55E1
40.0	7.80	1.07E1	1.28E1	1.64E1	1.95E1	2.48E1	3.53E1	6.28E1	1.01E2

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.46	1.49	1.54	1.58	1.65	1.66	1.82	1.84	2.07
1.0	2.05	2.13	2.25	2.37	2.50	2.69	3.10	3.23	3.86
2.0	3.58	3.89	4.34	4.71	5.28	6.02	7.48	8.16	1.05E1
3.0	5.52	6.25	7.35	8.24	9.36	1.14E1	1.52E1	1.73E1	2.36E1
4.0	7.79	9.16	1.14E1	1.31E1	1.56E1	1.95E1	2.76E1	3.29E1	4.72E1
5.0	1.04E1	1.26E1	1.64E1	1.94E1	2.40E1	3.09E1	4.67E1	5.82E1	8.72E1
6.0	1.32E1	1.65E1	2.23E1	2.71E1	3.50E1	4.62E1	7.43E1	9.65E1	1.50E2
7.0	1.64E1	2.08E1	2.91E1	3.65E1	4.86E1	6.65E1	1.13E2	1.54E2	2.48E2
8.0	1.97E1	2.56E1	3.69E1	4.74E1	6.52E1	9.19E1	1.66E2	2.35E2	3.93E2
10.0	2.73E1	3.67E1	5.56E1	7.43E1	1.08E2	1.61E2	3.26E2	5.00E2	8.90E2
15.0	5.01E1	7.19E1	1.20E2	1.73E2	2.81E2	4.89E2	1.24E3	2.28E3	4.66E3
20.0	7.79E1	1.18E2	2.12E2	3.23E2	5.67E2	1.12E3	3.42E3	7.26E3	1.69E4
25.0	1.10E2	1.73E2	3.30E2	5.30E2	9.90E2	2.15E3	7.68E3	1.85E4	4.81E4
30.0	1.47E2	2.37E2	4.78E2	7.91E2	1.58E3	3.69E3	1.51E4	4.02E4	1.16E5
35.0	1.86E2	3.09E2	6.54E2	1.11E3	2.35E3	5.94E3	2.73E4	7.99E4	2.54E5
40.0	2.29E2	3.86E2	8.62E2	1.50E3	3.36E3	9.06E3	4.85E4	1.47E5	5.13E5

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.19	2.36	2.50	2.69	2.79	2.31	1.86
1.0	4.19	4.71	5.12	5.61	5.60	3.83	2.62
2.0	1.19E1	1.40E1	1.54E1	1.67E1	1.52E1	7.71	4.08
3.0	2.74E1	3.29E1	3.63E1	3.83E1	3.18E1	1.28E1	5.60
4.0	5.60E1	6.79E1	7.40E1	7.57E1	5.77E1	1.92E1	7.21
5.0	1.05E2	1.28E2	1.38E2	1.36E2	9.56E1	2.69E1	8.87
6.0	1.84E2	2.22E2	2.36E2	2.26E2	1.47E2	3.60E1	1.06E1
7.0	3.07E2	3.70E2	3.87E2	3.58E2	2.18E2	4.65E1	1.23E1
8.0	4.92E2	5.90E2	6.07E2	5.44E2	3.10E2	5.85E1	1.41E1
10.0	1.14E3	1.35E3	1.35E3	1.14E3	5.73E2	8.72E1	1.78E1
15.0	6.24E3	7.18E3	6.72E3	5.00E3	1.94E3	1.89E2	2.77E1
20.0	2.36E4	2.66E4	2.36E4	1.58E4	4.94E3	3.43E2	3.87E1
25.0	7.04E4	7.84E4	6.65E4	4.07E4	1.05E4	5.61E2	5.11E1
30.0	1.78E5	1.97E5	1.61E5	9.11E4	1.99E4	8.58E2	6.50E1
35.0	4.04E5	4.48E5	3.54E5	1.87E5	3.51E4	1.25E3	8.05E1
40.0	8.47E5	9.40E5	7.22E5	3.58E5	5.82E4	1.76E3	9.74E1

Table 4
Energy Absorption Buildup Factors

Boron

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.17	1.21	1.24	1.28	1.29	1.31	1.34	1.38	1.41
1.0	1.31	1.40	1.45	1.53	1.58	1.63	1.71	1.82	1.91
2.0	1.55	1.73	1.85	2.01	2.12	2.26	2.47	2.81	3.10
3.0	1.77	2.04	2.21	2.46	2.64	2.88	3.24	3.87	4.45
4.0	1.99	2.34	2.56	2.90	3.14	3.49	4.02	4.99	5.92
5.0	2.20	2.62	2.90	3.33	3.65	4.10	4.81	6.17	7.51
6.0	2.40	2.90	3.24	3.76	4.15	4.71	5.62	7.39	9.20
7.0	2.60	3.18	3.57	4.18	4.65	5.33	6.44	8.66	1.10E1
8.0	2.79	3.45	3.90	4.60	5.14	5.94	7.26	9.98	1.29E1
10.0	3.17	3.98	4.53	5.42	6.12	7.16	8.94	1.27E1	1.69E1
15.0	4.06	5.24	6.05	7.42	8.52	1.02E1	1.32E1	2.00E1	2.81E1
20.0	4.90	6.44	7.51	9.35	1.09E1	1.33E1	1.76E1	2.79E1	4.08E1
25.0	5.70	7.60	8.91	1.12E1	1.32E1	1.63E1	2.21E1	3.62E1	5.46E1
30.0	6.45	8.73	1.03E1	1.31E1	1.55E1	1.93E1	2.66E1	4.48E1	6.94E1
35.0	7.15	9.83	1.18E1	1.49E1	1.77E1	2.23E1	3.12E1	5.38E1	8.51E1
40.0	7.86	1.09E1	1.37E1	1.68E1	1.99E1	2.52E1	3.57E1	6.30E1	1.02E2

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.46	1.51	1.58	1.59	1.61	1.67	1.99	2.14	2.08
1.0	2.05	2.16	2.38	2.43	2.54	2.72	3.47	3.89	4.04
2.0	3.59	3.91	4.40	4.79	5.21	6.12	7.55	8.90	1.13E1
3.0	5.51	6.24	7.38	8.21	9.45	1.12E1	1.47E1	1.79E1	2.46E1
4.0	7.74	9.08	1.13E1	1.30E1	1.55E1	1.94E1	2.72E1	3.40E1	4.85E1
5.0	1.03E1	1.24E1	1.60E1	1.90E1	2.34E1	3.10E1	4.61E1	6.00E1	8.73E1
6.0	1.31E1	1.62E1	2.16E1	2.63E1	3.36E1	4.64E1	7.30E1	9.70E1	1.46E2
7.0	1.61E1	2.04E1	2.81E1	3.49E1	4.60E1	6.61E1	1.10E2	1.50E2	2.32E2
8.0	1.94E1	2.50E1	3.55E1	4.50E1	6.08E1	9.08E1	1.59E2	2.20E2	3.53E2
10.0	2.67E1	3.56E1	5.30E1	6.94E1	9.85E1	1.57E2	3.02E2	4.40E2	7.38E2
15.0	4.90E1	6.95E1	1.13E2	1.58E2	2.46E2	4.50E2	1.05E3	1.70E3	3.16E3
20.0	7.61E1	1.13E2	1.98E2	2.91E2	4.87E2	9.84E2	2.68E3	4.70E3	9.70E3
25.0	1.08E2	1.67E2	3.07E2	4.72E2	8.37E2	1.85E3	5.73E3	1.10E4	2.45E4
30.0	1.43E2	2.28E2	4.41E2	7.04E2	1.31E3	3.15E3	1.09E4	2.20E4	5.44E4
35.0	1.82E2	2.99E2	6.00E2	9.93E2	1.92E3	5.01E3	1.93E4	4.20E4	1.10E5
40.0	2.23E2	3.76E2	7.86E2	1.34E3	2.66E3	7.59E3	3.21E4	7.10E4	2.10E5

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.27	2.57	2.76	2.74	2.61	1.91	1.45
1.0	4.57	5.34	5.73	5.44	4.67	2.71	1.75
2.0	1.30E1	1.52E1	1.58E1	1.44E1	1.03E1	4.26	2.28
3.0	2.88E1	3.32E1	3.35E1	2.91E1	1.78E1	5.88	2.72
4.0	5.70E1	6.44E1	6.30E1	5.11E1	2.75E1	7.55	3.11
5.0	1.03E2	1.13E2	1.07E2	8.18E1	3.93E1	9.27	3.47
6.0	1.72E2	1.85E2	1.70E2	1.23E2	5.34E1	1.10E1	3.81
7.0	2.72E2	2.87E2	2.56E2	1.76E2	6.97E1	1.28E1	4.13
8.0	4.12E2	4.25E2	3.70E2	2.42E2	8.84E1	1.46E1	4.43
10.0	8.57E2	8.50E2	7.05E2	4.25E2	1.33E2	1.84E1	5.00
15.0	3.65E3	3.34E3	2.51E3	1.28E3	2.95E2	2.88E1	6.29
20.0	1.12E4	9.69E3	6.75E3	3.00E3	5.41E2	4.05E1	7.46
25.0	2.84E4	2.35E4	1.54E4	6.10E3	8.94E2	5.38E1	8.56
30.0	6.37E4	5.09E4	3.15E4	1.13E4	1.38E3	6.85E1	9.60
35.0	1.31E5	1.02E5	6.00E4	1.95E4	2.03E3	8.40E1	1.06E1
40.0	2.51E5	1.91E5	1.08E5	3.21E4	2.87E3	9.96E1	1.14E1

Table 4
Energy Absorption Buildup Factors

Carbon

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.16	1.21	1.23	1.29	1.29	1.31	1.34	1.38	1.41
1.0	1.29	1.39	1.44	1.54	1.57	1.63	1.71	1.82	1.92
2.0	1.52	1.71	1.83	1.99	2.11	2.26	2.47	2.81	3.11
3.0	1.74	2.01	2.18	2.44	2.62	2.87	3.23	3.87	4.45
4.0	1.95	2.30	2.53	2.88	3.13	3.48	4.01	4.98	5.91
5.0	2.16	2.59	2.87	3.31	3.63	4.09	4.80	6.16	7.49
6.0	2.36	2.87	3.21	3.74	4.14	4.70	5.61	7.39	9.16
7.0	2.55	3.14	3.54	4.17	4.64	5.32	6.44	8.66	1.09E1
8.0	2.75	3.41	3.87	4.59	5.13	5.94	7.27	9.98	1.28E1
10.0	3.13	3.94	4.51	5.43	6.12	7.17	8.96	1.27E1	1.67E1
15.0	4.04	5.21	6.06	7.48	8.55	1.03E1	1.33E1	2.02E1	2.78E1
20.0	4.92	6.43	7.56	9.50	1.09E1	1.33E1	1.78E1	2.82E1	4.01E1
25.0	5.77	7.62	9.01	1.15E1	1.33E1	1.64E1	2.23E1	3.67E1	5.36E1
30.0	6.58	8.78	1.05E1	1.34E1	1.57E1	1.95E1	2.70E1	4.56E1	6.80E1
35.0	7.32	9.92	1.20E1	1.54E1	1.80E1	2.26E1	3.16E1	5.48E1	8.32E1
40.0	7.97	1.10E1	1.37E1	1.76E1	2.03E1	2.56E1	3.63E1	6.43E1	9.94E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.45	1.50	1.60	1.61	1.66	1.70	1.82	1.94	2.22
1.0	2.05	2.16	2.40	2.46	2.63	2.80	3.17	3.52	4.31
2.0	3.59	3.93	4.49	4.71	5.38	6.04	7.59	8.92	1.15E1
3.0	5.48	6.24	7.42	8.24	9.60	1.15E1	1.51E1	1.83E1	2.43E1
4.0	7.68	9.02	1.11E1	1.28E1	1.54E1	1.94E1	2.69E1	3.39E1	4.58E1
5.0	1.02E1	1.22E1	1.57E1	1.85E1	2.29E1	3.02E1	4.43E1	5.73E1	7.87E1
6.0	1.29E1	1.59E1	2.11E1	2.55E1	3.24E1	4.43E1	6.83E1	9.07E1	1.26E2
7.0	1.59E1	1.99E1	2.73E1	3.37E1	4.39E1	6.21E1	1.00E2	1.36E2	1.91E2
8.0	1.91E1	2.44E1	3.44E1	4.32E1	5.76E1	8.41E1	1.41E2	1.97E2	2.79E2
10.0	2.64E1	3.46E1	5.11E1	6.64E1	9.20E1	1.42E2	2.57E2	3.73E2	5.39E2
15.0	4.83E1	6.68E1	1.09E2	1.51E2	2.25E2	3.87E2	8.18E2	1.31E3	1.97E3
20.0	7.51E1	1.08E2	1.90E2	2.78E2	4.38E2	8.25E2	1.97E3	3.41E3	5.38E3
25.0	1.06E2	1.58E2	2.96E2	4.51E2	7.51E2	1.52E3	4.04E3	7.52E3	1.24E4
30.0	1.41E2	2.15E2	4.28E2	6.64E2	1.19E3	2.53E3	7.43E3	1.48E4	2.54E4
35.0	1.80E2	2.80E2	5.89E2	9.70E2	1.77E3	3.90E3	1.27E4	2.70E4	4.84E4
40.0	2.22E2	3.51E2	7.78E2	1.37E3	2.54E3	5.90E3	2.04E4	4.64E4	8.70E4

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.43	2.69	2.82	2.68	2.33	1.49	1.26
1.0	4.86	5.42	5.58	4.99	3.71	1.90	1.40
2.0	1.30E1	1.41E1	1.37E1	1.15E1	6.76	2.62	1.61
3.0	2.75E1	2.88E1	2.72E1	2.07E1	1.02E1	3.20	1.78
4.0	5.15E1	5.20E1	4.68E1	3.27E1	1.39E1	3.73	1.92
5.0	8.77E1	8.53E1	7.33E1	4.74E1	1.78E1	4.22	2.04
6.0	1.39E2	1.31E2	1.08E2	6.52E1	2.20E1	4.69	2.15
7.0	2.09E2	1.90E2	1.51E2	8.61E1	2.64E1	5.14	2.25
8.0	3.02E2	2.67E2	2.05E2	1.10E2	3.11E1	5.57	2.33
10.0	5.73E2	4.81E2	3.49E2	1.70E2	4.12E1	6.40	2.50
15.0	2.04E3	1.55E3	9.92E2	3.92E2	7.09E1	8.37	2.83
20.0	5.45E3	3.84E3	2.24E3	7.49E2	1.08E2	1.03E1	3.10
25.0	1.24E4	8.23E3	4.43E3	1.28E3	1.53E2	1.21E1	3.33
30.0	2.52E4	1.60E4	8.02E3	2.04E3	2.07E2	1.40E1	3.54
35.0	4.77E4	2.92E4	1.36E4	3.08E3	2.70E2	1.57E1	3.71
40.0	8.55E4	5.08E4	2.21E4	4.46E3	3.43E2	1.73E1	3.84

Table 4
Energy Absorption Buildup Factors

Nitrogen

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.16	1.20	1.23	1.25	1.29	1.31	1.34	1.38	1.41
1.0	1.28	1.38	1.43	1.50	1.57	1.63	1.71	1.83	1.92
2.0	1.50	1.69	1.81	1.97	2.10	2.25	2.46	2.81	3.09
3.0	1.71	1.98	2.16	2.42	2.61	2.86	3.23	3.86	4.42
4.0	1.92	2.27	2.51	2.86	3.11	3.46	4.00	4.97	5.88
5.0	2.12	2.56	2.85	3.29	3.62	4.08	4.80	6.14	7.44
6.0	2.32	2.83	3.18	3.72	4.12	4.70	5.61	7.36	9.12
7.0	2.51	3.11	3.52	4.15	4.63	5.32	6.43	8.63	1.09E1
8.0	2.71	3.38	3.84	4.57	5.13	5.94	7.27	9.94	1.27E1
10.0	3.09	3.92	4.49	5.42	6.13	7.19	8.97	1.27E1	1.67E1
15.0	4.03	5.24	6.08	7.49	8.62	1.03E1	1.33E1	2.00E1	2.79E1
20.0	4.95	6.53	7.63	9.54	1.11E1	1.35E1	1.79E1	2.79E1	4.04E1
25.0	5.84	7.80	9.14	1.16E1	1.35E1	1.67E1	2.25E1	3.62E1	5.41E1
30.0	6.71	9.05	1.06E1	1.35E1	1.60E1	1.98E1	2.72E1	4.49E1	6.88E1
35.0	7.51	1.03E1	1.22E1	1.54E1	1.84E1	2.30E1	3.19E1	5.40E1	8.44E1
40.0	8.21	1.15E1	1.40E1	1.70E1	2.08E1	2.61E1	3.66E1	6.32E1	1.01E2

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.50	1.56	1.60	1.65	1.73	1.90	2.01	2.41
1.0	2.07	2.16	2.32	2.42	2.57	2.80	3.29	3.81	4.66
2.0	3.60	3.93	4.45	4.82	5.35	6.15	7.96	9.13	1.17E1
3.0	5.47	6.21	7.37	8.23	9.49	1.14E1	1.55E1	1.84E1	2.36E1
4.0	7.64	8.94	1.10E1	1.27E1	1.51E1	1.90E1	2.65E1	3.28E1	4.21E1
5.0	1.01E1	1.21E1	1.55E1	1.82E1	2.23E1	2.90E1	4.19E1	5.34E1	6.83E1
6.0	1.28E1	1.57E1	2.07E1	2.48E1	3.11E1	4.19E1	6.27E1	8.14E1	1.04E2
7.0	1.57E1	1.96E1	2.66E1	3.25E1	4.17E1	5.79E1	8.97E1	1.18E2	1.50E2
8.0	1.89E1	2.40E1	3.33E1	4.13E1	5.42E1	7.72E1	1.24E2	1.65E2	2.08E2
10.0	2.60E1	3.41E1	4.91E1	6.28E1	8.53E1	1.27E2	2.17E2	2.96E2	3.70E2
15.0	4.76E1	6.60E1	1.03E2	1.40E2	2.04E2	3.35E2	6.43E2	9.28E2	1.15E3
20.0	7.38E1	1.07E2	1.79E2	2.53E2	3.92E2	6.99E2	1.48E3	2.25E3	2.80E3
25.0	1.04E2	1.57E2	2.75E2	4.06E2	6.61E2	1.27E3	2.96E3	4.68E3	5.86E3
30.0	1.38E2	2.15E2	3.94E2	6.00E2	1.02E3	2.08E3	5.40E3	8.79E3	1.12E4
35.0	1.76E2	2.80E2	5.33E2	8.36E2	1.48E3	3.19E3	9.25E3	1.53E4	1.98E4
40.0	2.18E2	3.53E2	6.93E2	1.11E3	2.05E3	4.66E3	1.52E4	2.52E4	3.36E4

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.47	2.63	2.65	2.39	1.94	1.35	1.16
1.0	4.80	5.05	4.83	3.96	2.73	1.56	1.24
2.0	1.26E1	1.24E1	1.08E1	7.63	4.15	1.90	1.35
3.0	2.54E1	2.33E1	1.88E1	1.19E1	5.54	2.16	1.44
4.0	4.42E1	3.81E1	2.90E1	1.68E1	6.90	2.39	1.51
5.0	7.01E1	5.72E1	4.13E1	2.22E1	8.23	2.59	1.57
6.0	1.04E2	8.09E1	5.58E1	2.80E1	9.54	2.77	1.62
7.0	1.47E2	1.10E2	7.26E1	3.43E1	1.08E1	2.94	1.67
8.0	2.02E2	1.44E2	9.18E1	4.12E1	1.21E1	3.10	1.71
10.0	3.48E2	2.32E2	1.38E2	5.62E1	1.48E1	3.39	1.78
15.0	1.02E3	5.90E2	3.08E2	1.03E2	2.17E1	4.02	1.92
20.0	2.36E3	1.23E3	5.74E2	1.64E2	2.92E1	4.57	2.03
25.0	4.78E3	2.26E3	9.65E2	2.41E2	3.72E1	5.07	2.12
30.0	8.78E3	3.85E3	1.51E3	3.34E2	4.57E1	5.52	2.20
35.0	1.49E4	6.17E3	2.25E3	4.45E2	5.42E1	5.92	2.27
40.0	2.35E4	9.43E3	3.22E3	5.75E2	6.23E1	6.24	2.31

Table 4
Energy Absorption Buildup Factors

Oxygen

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.22	1.27	1.29	1.31	1.34	1.38	1.42
1.0	1.27	1.37	1.42	1.51	1.56	1.63	1.71	1.83	1.92
2.0	1.48	1.67	1.79	1.96	2.09	2.24	2.46	2.81	3.10
3.0	1.68	1.96	2.14	2.40	2.59	2.85	3.22	3.85	4.42
4.0	1.88	2.24	2.48	2.84	3.10	3.45	3.99	4.96	5.86
5.0	2.08	2.52	2.82	3.27	3.60	4.07	4.79	6.13	7.42
6.0	2.28	2.80	3.16	3.70	4.11	4.69	5.60	7.35	9.08
7.0	2.48	3.08	3.49	4.13	4.62	5.31	6.43	8.62	1.08E1
8.0	2.67	3.36	3.82	4.56	5.12	5.94	7.27	9.94	1.27E1
10.0	3.06	3.90	4.48	5.42	6.14	7.20	8.98	1.27E1	1.67E1
15.0	4.03	5.25	6.10	7.53	8.67	1.04E1	1.34E1	2.01E1	2.77E1
20.0	4.98	6.59	7.70	9.64	1.12E1	1.36E1	1.80E1	2.81E1	4.02E1
25.0	5.93	7.91	9.27	1.17E1	1.37E1	1.69E1	2.26E1	3.65E1	5.39E1
30.0	6.86	9.23	1.09E1	1.37E1	1.62E1	2.01E1	2.74E1	4.54E1	6.85E1
35.0	7.73	1.05E1	1.25E1	1.55E1	1.88E1	2.34E1	3.22E1	5.46E1	8.40E1
40.0	8.51	1.18E1	1.44E1	1.71E1	2.13E1	2.66E1	3.70E1	6.40E1	1.00E2

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.50	1.56	1.60	1.66	1.75	1.91	2.17	2.38
1.0	2.08	2.17	2.33	2.44	2.60	2.84	3.30	3.86	4.52
2.0	3.60	3.94	4.46	4.84	5.38	6.22	7.78	9.25	1.14E1
3.0	5.46	6.19	7.34	8.21	9.45	1.14E1	1.50E1	1.81E1	2.22E1
4.0	7.60	8.87	1.09E1	1.25E1	1.49E1	1.86E1	2.54E1	3.12E1	3.75E1
5.0	1.00E1	1.20E1	1.52E1	1.78E1	2.17E1	2.80E1	3.96E1	4.91E1	5.78E1
6.0	1.27E1	1.54E1	2.02E1	2.41E1	3.00E1	3.99E1	5.80E1	7.25E1	8.40E1
7.0	1.56E1	1.93E1	2.59E1	3.15E1	4.00E1	5.44E1	8.13E1	1.02E2	1.17E2
8.0	1.87E1	2.37E1	3.24E1	3.99E1	5.16E1	7.18E1	1.10E2	1.39E2	1.57E2
10.0	2.57E1	3.34E1	4.77E1	6.02E1	8.03E1	1.16E2	1.86E2	2.39E2	2.62E2
15.0	4.69E1	6.46E1	9.97E1	1.33E2	1.89E2	2.98E2	5.23E2	6.93E2	7.24E2
20.0	7.27E1	1.05E2	1.72E2	2.39E2	3.60E2	6.10E2	1.16E3	1.59E3	1.60E3
25.0	1.02E2	1.53E2	2.64E2	3.81E2	6.03E2	1.09E3	2.24E3	3.15E3	3.12E3
30.0	1.36E2	2.09E2	3.77E2	5.61E2	9.26E2	1.77E3	3.91E3	5.69E3	5.55E3
35.0	1.72E2	2.73E2	5.10E2	7.80E2	1.34E3	2.69E3	6.35E3	9.60E3	9.23E3
40.0	2.11E2	3.43E2	6.63E2	1.04E3	1.84E3	3.89E3	9.77E3	1.54E4	1.46E4

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.54	2.58	2.44	2.14	1.71	1.24	1.11
1.0	4.84	4.69	4.14	3.22	2.20	1.37	1.16
2.0	1.18E1	1.03E1	8.19	5.40	2.96	1.55	1.22
3.0	2.22E1	1.77E1	1.30E1	7.65	3.63	1.69	1.27
4.0	3.62E1	2.68E1	1.84E1	9.95	4.26	1.81	1.31
5.0	5.42E1	3.77E1	2.45E1	1.23E1	4.86	1.91	1.34
6.0	7.66E1	5.04E1	3.13E1	1.47E1	5.42	2.00	1.37
7.0	1.04E2	6.49E1	3.86E1	1.72E1	5.95	2.08	1.40
8.0	1.36E2	8.15E1	4.66E1	1.97E1	6.46	2.16	1.42
10.0	2.18E2	1.21E2	6.47E1	2.50E1	7.46	2.29	1.46
15.0	5.56E2	2.64E2	1.23E2	3.96E1	9.90	2.57	1.53
20.0	1.16E3	4.84E2	2.02E2	5.63E1	1.22E1	2.79	1.59
25.0	2.13E3	8.04E2	3.05E2	7.51E1	1.46E1	2.98	1.63
30.0	3.61E3	1.25E3	4.35E2	9.57E1	1.75E1	3.15	1.67
35.0	5.76E3	1.83E3	5.92E2	1.18E2	2.11E1	3.29	1.70
40.0	8.76E3	2.60E3	7.81E2	1.44E2	2.57E1	3.39	1.73

Table 4
Energy Absorption Buildup Factors

Sodium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.14	1.18	1.21	1.26	1.29	1.31	1.34	1.39	1.42
1.0	1.24	1.34	1.40	1.49	1.56	1.62	1.71	1.84	1.92
2.0	1.43	1.62	1.75	1.93	2.06	2.22	2.45	2.81	3.08
3.0	1.62	1.89	2.08	2.36	2.55	2.82	3.20	3.85	4.37
4.0	1.81	2.17	2.41	2.78	3.05	3.42	3.98	4.94	5.79
5.0	2.00	2.44	2.75	3.22	3.56	4.04	4.77	6.09	7.31
6.0	2.20	2.72	3.09	3.65	4.07	4.67	5.60	7.30	8.95
7.0	2.39	3.00	3.43	4.09	4.59	5.30	6.43	8.55	1.07E1
8.0	2.60	3.29	3.77	4.54	5.11	5.95	7.29	9.84	1.25E1
10.0	3.01	3.86	4.46	5.43	6.16	7.26	9.05	1.25E1	1.64E1
15.0	4.08	5.32	6.22	7.70	8.82	1.06E1	1.36E1	1.97E1	2.73E1
20.0	5.20	6.83	8.01	1.00E1	1.15E1	1.41E1	1.84E1	2.75E1	3.96E1
25.0	6.38	8.37	9.82	1.24E1	1.43E1	1.76E1	2.34E1	3.56E1	5.30E1
30.0	7.59	9.94	1.17E1	1.46E1	1.70E1	2.11E1	2.85E1	4.41E1	6.74E1
35.0	8.80	1.15E1	1.37E1	1.67E1	1.99E1	2.48E1	3.37E1	5.29E1	8.26E1
40.0	9.96	1.31E1	1.60E1	1.85E1	2.30E1	2.83E1	3.90E1	6.19E1	9.84E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.48	1.52	1.58	1.63	1.70	1.81	2.03	2.22	2.51
1.0	2.09	2.20	2.37	2.51	2.68	2.97	3.54	3.99	4.47
2.0	3.59	3.94	4.47	4.90	5.45	6.34	7.94	9.04	9.42
3.0	5.38	6.09	7.20	8.09	9.25	1.11E1	1.42E1	1.60E1	1.56E1
4.0	7.44	8.64	1.05E1	1.20E1	1.41E1	1.73E1	2.23E1	2.49E1	2.28E1
5.0	9.75	1.16E1	1.45E1	1.68E1	2.00E1	2.50E1	3.26E1	3.59E1	3.13E1
6.0	1.23E1	1.49E1	1.91E1	2.24E1	2.71E1	3.44E1	4.51E1	4.92E1	4.09E1
7.0	1.51E1	1.86E1	2.43E1	2.89E1	3.55E1	4.56E1	6.01E1	6.50E1	5.19E1
8.0	1.82E1	2.26E1	3.02E1	3.62E1	4.51E1	5.87E1	7.78E1	8.35E1	6.42E1
10.0	2.49E1	3.19E1	4.41E1	5.39E1	6.87E1	9.16E1	1.23E2	1.30E2	9.32E1
15.0	4.53E1	6.12E1	9.14E1	1.16E2	1.56E2	2.20E2	3.02E2	3.11E2	1.96E2
20.0	7.01E1	9.87E1	1.57E2	2.04E2	2.90E2	4.29E2	6.06E2	6.15E2	3.48E2
25.0	9.88E1	1.44E2	2.41E2	3.22E2	4.76E2	7.38E2	1.07E3	1.08E3	5.60E2
30.0	1.31E2	1.96E2	3.44E2	4.68E2	7.20E2	1.17E3	1.75E3	1.75E3	8.41E2
35.0	1.66E2	2.55E2	4.65E2	6.44E2	1.03E3	1.73E3	2.67E3	2.66E3	1.20E3
40.0	2.05E2	3.21E2	6.06E2	8.51E2	1.40E3	2.44E3	3.90E3	3.86E3	1.64E3

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.46	2.14	1.88	1.48	1.27	1.09	1.04
1.0	4.14	3.19	2.56	1.85	1.40	1.12	1.05
2.0	7.99	5.20	3.69	2.46	1.60	1.17	1.07
3.0	1.23E1	7.20	4.72	2.88	1.75	1.21	1.09
4.0	1.71E1	9.20	5.70	3.25	1.87	1.24	1.10
5.0	2.23E1	1.12E1	6.64	3.59	1.97	1.26	1.11
6.0	2.80E1	1.33E1	7.55	3.91	2.06	1.28	1.12
7.0	3.42E1	1.54E1	8.45	4.21	2.14	1.30	1.12
8.0	4.09E1	1.76E1	9.34	4.49	2.22	1.32	1.13
10.0	5.59E1	2.22E1	1.11E1	5.03	2.36	1.34	1.14
15.0	1.03E2	3.49E1	1.56E1	6.25	2.64	1.40	1.16
20.0	1.66E2	4.93E1	2.01E1	7.33	2.88	1.44	1.17
25.0	2.44E2	6.53E1	2.47E1	8.34	3.08	1.47	1.18
30.0	3.40E2	8.28E1	2.92E1	9.25	3.25	1.50	1.19
35.0	4.52E2	1.02E2	3.34E1	1.01E1	3.40	1.52	1.20
40.0	5.82E2	1.22E2	3.70E1	1.07E1	3.50	1.53	1.21

Table 4
Energy Absorption Buildup Factors

Magnesium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.13	1.18	1.21	1.25	1.31	1.31	1.34	1.39	1.42
1.0	1.24	1.33	1.39	1.48	1.57	1.62	1.70	1.83	1.93
2.0	1.42	1.61	1.73	1.92	2.04	2.21	2.44	2.80	3.09
3.0	1.60	1.87	2.06	2.34	2.54	2.81	3.19	3.83	4.38
4.0	1.78	2.14	2.39	2.77	3.04	3.41	3.97	4.93	5.79
5.0	1.98	2.42	2.73	3.20	3.55	4.03	4.77	6.09	7.32
6.0	2.17	2.70	3.06	3.63	4.06	4.66	5.59	7.31	8.95
7.0	2.37	2.98	3.41	4.08	4.58	5.30	6.43	8.58	1.07E1
8.0	2.57	3.27	3.75	4.52	5.11	5.94	7.29	9.90	1.25E1
10.0	2.99	3.85	4.45	5.43	6.17	7.26	9.06	1.27E1	1.64E1
15.0	4.10	5.36	6.24	7.73	8.90	1.06E1	1.37E1	2.01E1	2.73E1
20.0	5.29	6.94	8.08	1.01E1	1.17E1	1.41E1	1.85E1	2.82E1	3.96E1
25.0	6.56	8.57	9.96	1.25E1	1.46E1	1.77E1	2.35E1	3.69E1	5.30E1
30.0	7.90	1.03E1	1.19E1	1.48E1	1.75E1	2.13E1	2.87E1	4.60E1	6.75E1
35.0	9.25	1.20E1	1.40E1	1.70E1	2.04E1	2.50E1	3.39E1	5.54E1	8.28E1
40.0	1.06E1	1.37E1	1.65E1	1.88E1	2.36E1	2.87E1	3.91E1	6.51E1	9.87E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.48	1.53	1.59	1.64	1.71	1.83	2.06	2.27	2.47
1.0	2.10	2.21	2.39	2.52	2.71	3.01	3.59	4.05	4.25
2.0	3.60	3.95	4.49	4.89	5.46	6.35	7.86	8.84	8.41
3.0	5.38	6.08	7.17	8.00	9.16	1.09E1	1.37E1	1.51E1	1.32E1
4.0	7.41	8.59	1.04E1	1.18E1	1.38E1	1.68E1	2.11E1	2.28E1	1.87E1
5.0	9.71	1.15E1	1.43E1	1.64E1	1.95E1	2.40E1	3.02E1	3.20E1	2.47E1
6.0	1.22E1	1.47E1	1.87E1	2.18E1	2.62E1	3.27E1	4.12E1	4.29E1	3.15E1
7.0	1.50E1	1.83E1	2.38E1	2.81E1	3.41E1	4.30E1	5.42E1	5.56E1	3.90E1
8.0	1.80E1	2.23E1	2.95E1	3.52E1	4.32E1	5.50E1	6.94E1	7.02E1	4.73E1
10.0	2.47E1	3.14E1	4.29E1	5.21E1	6.54E1	8.49E1	1.07E2	1.06E2	6.63E1
15.0	4.48E1	6.01E1	8.78E1	1.11E2	1.47E2	1.99E2	2.55E2	2.39E2	1.29E2
20.0	6.93E1	9.68E1	1.49E2	1.96E2	2.70E2	3.83E2	4.98E2	4.49E2	2.16E2
25.0	9.76E1	1.41E2	2.28E2	3.09E2	4.39E2	6.49E2	8.64E2	7.55E2	3.30E2
30.0	1.29E2	1.92E2	3.22E2	4.49E2	6.60E2	1.01E3	1.38E3	1.18E3	4.72E2
35.0	1.64E2	2.50E2	4.33E2	6.18E2	9.37E2	1.49E3	2.07E3	1.73E3	6.43E2
40.0	2.02E2	3.14E2	5.60E2	8.17E2	1.27E3	2.09E3	2.96E3	2.41E3	8.46E2

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.36	1.99	1.74	1.39	1.20	1.06	1.03
1.0	3.77	2.79	2.24	1.64	1.30	1.09	1.04
2.0	6.73	4.19	2.99	2.04	1.43	1.13	1.05
3.0	9.83	5.50	3.64	2.32	1.53	1.15	1.06
4.0	1.31E1	6.75	4.24	2.56	1.61	1.17	1.07
5.0	1.65E1	7.98	4.81	2.77	1.68	1.19	1.08
6.0	2.01E1	9.20	5.34	2.96	1.74	1.20	1.09
7.0	2.40E1	1.04E1	5.85	3.14	1.79	1.22	1.09
8.0	2.80E1	1.17E1	6.34	3.30	1.84	1.23	1.10
10.0	3.68E1	1.42E1	7.31	3.61	1.93	1.25	1.10
15.0	6.28E1	2.07E1	9.62	4.28	2.10	1.28	1.12
20.0	9.44E1	2.75E1	1.18E1	4.85	2.24	1.31	1.13
25.0	1.32E2	3.46E1	1.39E1	5.35	2.36	1.33	1.14
30.0	1.74E2	4.19E1	1.62E1	5.80	2.45	1.35	1.14
35.0	2.22E2	4.98E1	1.86E1	6.17	2.53	1.36	1.15
40.0	2.75E2	5.94E1	2.10E1	6.45	2.59	1.37	1.15

Table 4
Energy Absorption Buildup Factors

Aluminum

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.13	1.18	1.21	1.25	1.28	1.31	1.34	1.39	1.42
1.0	1.23	1.32	1.39	1.48	1.57	1.62	1.70	1.83	1.93
2.0	1.41	1.59	1.72	1.91	2.03	2.21	2.43	2.79	3.09
3.0	1.58	1.85	2.05	2.33	2.53	2.80	3.18	3.82	4.37
4.0	1.76	2.12	2.37	2.75	3.03	3.40	3.95	4.92	5.78
5.0	1.95	2.40	2.71	3.18	3.53	4.02	4.75	6.08	7.30
6.0	2.15	2.68	3.04	3.62	4.04	4.64	5.57	7.30	8.92
7.0	2.35	2.97	3.39	4.06	4.56	5.28	6.42	8.57	1.06E1
8.0	2.55	3.26	3.74	4.51	5.09	5.92	7.28	9.90	1.25E1
10.0	2.97	3.86	4.44	5.43	6.16	7.22	9.05	1.27E1	1.63E1
15.0	4.11	5.45	6.27	7.79	8.91	1.06E1	1.37E1	2.03E1	2.72E1
20.0	5.36	7.15	8.18	1.03E1	1.18E1	1.40E1	1.86E1	2.85E1	3.94E1
25.0	6.71	8.96	1.01E1	1.28E1	1.47E1	1.75E1	2.36E1	3.74E1	5.27E1
30.0	8.15	1.09E1	1.22E1	1.52E1	1.76E1	2.11E1	2.88E1	4.68E1	6.71E1
35.0	9.63	1.28E1	1.42E1	1.75E1	2.06E1	2.48E1	3.41E1	5.66E1	8.23E1
40.0	1.11E1	1.48E1	1.62E1	1.95E1	2.33E1	2.84E1	3.94E1	6.66E1	9.82E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.49	1.53	1.60	1.75	1.76	1.85	2.10	2.36	2.43
1.0	2.10	2.22	2.41	2.57	2.77	3.06	3.64	4.12	4.00
2.0	3.59	3.94	4.49	4.87	5.46	6.35	7.76	8.50	7.44
3.0	5.35	6.04	7.14	7.91	9.06	1.08E1	1.32E1	1.40E1	1.12E1
4.0	7.37	8.51	1.03E1	1.16E1	1.35E1	1.63E1	1.98E1	2.05E1	1.52E1
5.0	9.64	1.13E1	1.41E1	1.61E1	1.90E1	2.30E1	2.79E1	2.82E1	1.96E1
6.0	1.21E1	1.46E1	1.84E1	2.13E1	2.54E1	3.11E1	3.75E1	3.71E1	2.44E1
7.0	1.49E1	1.81E1	2.33E1	2.73E1	3.29E1	4.06E1	4.88E1	4.73E1	2.96E1
8.0	1.79E1	2.21E1	2.89E1	3.42E1	4.15E1	5.17E1	6.18E1	5.88E1	3.52E1
10.0	2.45E1	3.10E1	4.18E1	5.05E1	6.25E1	7.88E1	9.39E1	8.63E1	4.77E1
15.0	4.43E1	5.92E1	8.49E1	1.07E2	1.39E2	1.81E2	2.15E2	1.84E2	8.67E1
20.0	6.84E1	9.54E1	1.43E2	1.89E2	2.53E2	3.42E2	4.07E2	3.31E2	1.37E2
25.0	9.62E1	1.39E2	2.17E2	2.96E2	4.10E2	5.72E2	6.88E2	5.34E2	1.98E2
30.0	1.27E2	1.90E2	3.06E2	4.30E2	6.14E2	8.82E2	1.07E3	8.01E2	2.71E2
35.0	1.62E2	2.47E2	4.10E2	5.91E2	8.67E2	1.28E3	1.58E3	1.14E3	3.56E2
40.0	1.99E2	3.10E2	5.29E2	7.80E2	1.17E3	1.78E3	2.22E3	1.56E3	4.51E2

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.24	1.85	1.61	1.33	1.16	1.05	1.02
1.0	3.41	2.46	1.90	1.50	1.23	1.07	1.03
2.0	5.66	3.44	2.52	1.77	1.32	1.10	1.04
3.0	7.87	4.31	2.94	1.97	1.39	1.12	1.05
4.0	1.01E1	5.13	3.32	2.12	1.45	1.13	1.05
5.0	1.24E1	5.91	3.68	2.26	1.50	1.14	1.06
6.0	1.47E1	6.67	4.01	2.38	1.54	1.15	1.06
7.0	1.71E1	7.41	4.33	2.50	1.57	1.16	1.07
8.0	1.96E1	8.14	4.63	2.60	1.61	1.17	1.07
10.0	2.49E1	9.59	5.20	2.79	1.67	1.18	1.08
15.0	3.96E1	1.32E1	6.50	3.20	1.78	1.21	1.09
20.0	5.62E1	1.67E1	7.67	3.53	1.87	1.23	1.10
25.0	7.47E1	2.02E1	8.75	3.81	1.94	1.25	1.10
30.0	9.48E1	2.35E1	9.76	4.06	2.00	1.26	1.11
35.0	1.17E2	2.65E1	1.06E1	4.25	2.05	1.27	1.11
40.0	1.40E2	2.89E1	1.13E1	4.39	2.08	1.28	1.11

Table 4
Energy Absorption Buildup Factors

Silicon

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.12	1.17	1.20	1.24	1.29	1.30	1.34	1.39	1.42
1.0	1.22	1.32	1.38	1.47	1.55	1.61	1.70	1.83	1.93
2.0	1.39	1.58	1.71	1.90	2.03	2.20	2.44	2.80	3.08
3.0	1.57	1.84	2.03	2.31	2.51	2.79	3.18	3.82	4.36
4.0	1.75	2.10	2.35	2.73	3.01	3.39	3.96	4.91	5.76
5.0	1.93	2.38	2.68	3.16	3.52	4.01	4.76	6.07	7.27
6.0	2.13	2.66	3.02	3.60	4.04	4.65	5.58	7.29	8.89
7.0	2.33	2.94	3.37	4.05	4.56	5.29	6.43	8.56	1.06E1
8.0	2.54	3.23	3.72	4.51	5.10	5.95	7.30	9.87	1.24E1
10.0	2.97	3.84	4.44	5.44	6.19	7.30	9.09	1.26E1	1.63E1
15.0	4.17	5.44	6.32	7.86	9.02	1.08E1	1.38E1	2.01E1	2.71E1
20.0	5.52	7.16	8.30	1.04E1	1.20E1	1.45E1	1.88E1	2.83E1	3.93E1
25.0	7.04	9.00	1.04E1	1.30E1	1.50E1	1.82E1	2.39E1	3.70E1	5.27E1
30.0	8.69	1.09E1	1.25E1	1.56E1	1.81E1	2.21E1	2.93E1	4.62E1	6.71E1
35.0	1.04E1	1.30E1	1.49E1	1.80E1	2.10E1	2.61E1	3.47E1	5.58E1	8.24E1
40.0	1.23E1	1.52E1	1.79E1	2.02E1	2.37E1	3.01E1	4.02E1	6.55E1	9.83E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.49	1.53	1.61	1.66	1.74	1.87	2.13	2.34	2.35
1.0	2.11	2.23	2.41	2.56	2.76	3.09	3.67	4.03	3.73
2.0	3.59	3.94	4.48	4.88	5.45	6.32	7.62	8.09	6.53
3.0	5.33	6.01	7.07	7.85	8.94	1.05E1	1.26E1	1.29E1	9.42
4.0	7.33	8.44	1.02E1	1.15E1	1.32E1	1.57E1	1.86E1	1.84E1	1.24E1
5.0	9.57	1.12E1	1.38E1	1.58E1	1.84E1	2.20E1	2.58E1	2.48E1	1.56E1
6.0	1.21E1	1.44E1	1.81E1	2.08E1	2.45E1	2.95E1	3.42E1	3.20E1	1.91E1
7.0	1.48E1	1.79E1	2.29E1	2.66E1	3.17E1	3.83E1	4.40E1	4.01E1	2.27E1
8.0	1.77E1	2.17E1	2.82E1	3.32E1	3.98E1	4.85E1	5.52E1	4.92E1	2.65E1
10.0	2.42E1	3.05E1	4.08E1	4.87E1	5.95E1	7.32E1	8.22E1	7.04E1	3.49E1
15.0	4.37E1	5.80E1	8.28E1	1.03E2	1.30E2	1.65E2	1.81E2	1.42E2	5.96E1
20.0	6.74E1	9.31E1	1.40E2	1.79E2	2.35E2	3.07E2	3.34E2	2.44E2	8.93E1
25.0	9.47E1	1.35E2	2.12E2	2.79E2	3.78E2	5.07E2	5.49E2	3.79E2	1.24E2
30.0	1.25E2	1.84E2	2.99E2	4.03E2	5.62E2	7.74E2	8.38E2	5.49E2	1.63E2
35.0	1.59E2	2.39E2	4.01E2	5.52E2	7.89E2	1.11E3	1.21E3	7.57E2	2.06E2
40.0	1.95E2	3.00E2	5.17E2	7.26E2	1.06E3	1.53E3	1.68E3	1.00E3	2.53E2

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.12	1.73	1.37	1.27	1.13	1.04	1.02
1.0	3.08	2.21	1.68	1.40	1.18	1.05	1.02
2.0	4.79	2.91	2.16	1.59	1.25	1.07	1.03
3.0	6.39	3.51	2.47	1.74	1.31	1.09	1.04
4.0	7.95	4.07	2.73	1.85	1.35	1.10	1.04
5.0	9.50	4.60	2.97	1.94	1.38	1.11	1.05
6.0	1.11E1	5.09	3.19	2.03	1.41	1.12	1.05
7.0	1.26E1	5.56	3.40	2.11	1.44	1.13	1.05
8.0	1.43E1	6.02	3.59	2.18	1.46	1.13	1.06
10.0	1.76E1	6.92	3.96	2.31	1.51	1.14	1.06
15.0	2.63E1	9.04	4.76	2.58	1.59	1.16	1.07
20.0	3.57E1	1.10E1	5.44	2.79	1.65	1.18	1.07
25.0	4.56E1	1.29E1	6.06	2.97	1.70	1.19	1.08
30.0	5.61E1	1.49E1	6.62	3.12	1.75	1.20	1.08
35.0	6.70E1	1.70E1	7.09	3.24	1.78	1.21	1.09
40.0	7.84E1	1.90E1	7.44	3.32	1.80	1.21	1.09

Table 4
Energy Absorption Buildup Factors

Phosphorus

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.12	1.17	1.20	1.24	1.29	1.30	1.34	1.39	1.43
1.0	1.22	1.31	1.38	1.47	1.54	1.61	1.70	1.83	1.93
2.0	1.38	1.57	1.70	1.89	2.02	2.19	2.43	2.79	3.08
3.0	1.55	1.82	2.01	2.30	2.50	2.78	3.18	3.82	4.35
4.0	1.73	2.09	2.33	2.72	3.00	3.38	3.95	4.91	5.74
5.0	1.91	2.36	2.67	3.15	3.51	4.00	4.75	6.06	7.24
6.0	2.11	2.64	3.01	3.59	4.02	4.64	5.58	7.28	8.86
7.0	2.31	2.93	3.36	4.04	4.55	5.29	6.43	8.55	1.06E1
8.0	2.52	3.22	3.71	4.50	5.09	5.95	7.30	9.86	1.24E1
10.0	2.96	3.83	4.45	5.44	6.20	7.31	9.10	1.26E1	1.62E1
15.0	4.22	5.49	6.39	7.89	9.08	1.09E1	1.39E1	2.01E1	2.70E1
20.0	5.67	7.31	8.47	1.05E1	1.21E1	1.46E1	1.89E1	2.83E1	3.92E1
25.0	7.33	9.27	1.06E1	1.32E1	1.53E1	1.84E1	2.41E1	3.71E1	5.25E1
30.0	9.20	1.14E1	1.30E1	1.59E1	1.84E1	2.24E1	2.96E1	4.64E1	6.68E1
35.0	1.12E1	1.37E1	1.56E1	1.84E1	2.14E1	2.65E1	3.52E1	5.60E1	8.20E1
40.0	1.35E1	1.61E1	1.90E1	2.06E1	2.42E1	3.06E1	4.08E1	6.59E1	9.78E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.49	1.54	1.61	1.67	1.75	1.89	2.19	2.35	2.28
1.0	2.11	2.23	2.43	2.57	2.78	3.11	3.72	3.96	3.48
2.0	3.58	3.93	4.47	4.88	5.44	6.28	7.44	7.64	5.76
3.0	5.31	5.98	7.02	7.78	8.83	1.03E1	1.20E1	1.18E1	8.00
4.0	7.29	8.38	1.01E1	1.13E1	1.30E1	1.52E1	1.74E1	1.65E1	1.03E1
5.0	9.51	1.11E1	1.36E1	1.55E1	1.79E1	2.11E1	2.38E1	2.18E1	1.26E1
6.0	1.20E1	1.42E1	1.78E1	2.03E1	2.38E1	2.81E1	3.12E1	2.77E1	1.51E1
7.0	1.46E1	1.77E1	2.24E1	2.59E1	3.05E1	3.62E1	3.96E1	3.42E1	1.77E1
8.0	1.76E1	2.15E1	2.77E1	3.22E1	3.82E1	4.55E1	4.93E1	4.14E1	2.04E1
10.0	2.40E1	3.00E1	3.98E1	4.72E1	5.68E1	6.81E1	7.22E1	5.78E1	2.60E1
15.0	4.33E1	5.71E1	8.03E1	9.85E1	1.23E2	1.50E2	1.54E2	1.11E2	4.19E1
20.0	6.67E1	9.14E1	1.35E2	1.71E2	2.20E2	2.75E2	2.75E2	1.84E2	5.99E1
25.0	9.37E1	1.33E2	2.04E2	2.65E2	3.50E2	4.49E2	4.41E2	2.75E2	7.97E1
30.0	1.24E2	1.80E2	2.88E2	3.81E2	5.18E2	6.77E2	6.59E2	3.87E2	1.01E2
35.0	1.57E2	2.34E2	3.85E2	5.21E2	7.24E2	9.65E2	9.32E2	5.18E2	1.24E2
40.0	1.93E2	2.93E2	4.95E2	6.83E2	9.72E2	1.31E3	1.27E3	6.70E2	1.48E2

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.01	1.64	1.36	1.22	1.10	1.03	1.01
1.0	2.79	2.02	1.57	1.32	1.14	1.04	1.02
2.0	4.08	2.51	1.91	1.47	1.20	1.06	1.03
3.0	5.25	2.94	2.14	1.58	1.24	1.07	1.03
4.0	6.37	3.34	2.33	1.66	1.27	1.08	1.03
5.0	7.45	3.70	2.50	1.73	1.30	1.09	1.04
6.0	8.52	4.04	2.65	1.80	1.32	1.09	1.04
7.0	9.59	4.36	2.80	1.85	1.34	1.10	1.04
8.0	1.07E1	4.66	2.93	1.91	1.36	1.11	1.05
10.0	1.28E1	5.24	3.18	2.00	1.39	1.11	1.05
15.0	1.82E1	6.58	3.70	2.19	1.46	1.13	1.06
20.0	2.38E1	7.72	4.14	2.33	1.50	1.14	1.06
25.0	2.94E1	8.89	4.52	2.46	1.54	1.15	1.06
30.0	3.51E1	1.02E1	4.86	2.56	1.57	1.16	1.07
35.0	4.10E1	1.14E1	5.14	2.64	1.59	1.16	1.07
40.0	4.76E1	1.26E1	5.33	2.69	1.61	1.17	1.07

Table 4
Energy Absorption Buildup Factors
Sulphur

	Energy (MeV)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.12	1.17	1.20	1.24	1.28	1.30	1.34	1.39	1.43
1.0	1.21	1.31	1.37	1.46	1.54	1.61	1.70	1.83	1.94
2.0	1.38	1.56	1.69	1.88	2.01	2.19	2.43	2.79	3.07
3.0	1.54	1.81	2.00	2.29	2.49	2.77	3.17	3.81	4.34
4.0	1.71	2.07	2.32	2.70	2.99	3.37	3.94	4.90	5.72
5.0	1.90	2.34	2.65	3.13	3.49	3.99	4.74	6.05	7.22
6.0	2.09	2.62	2.99	3.58	4.01	4.63	5.57	7.27	8.83
7.0	2.29	2.91	3.34	4.03	4.55	5.28	6.43	8.53	1.05E1
8.0	2.51	3.21	3.70	4.50	5.09	5.95	7.31	9.85	1.23E1
10.0	2.96	3.83	4.45	5.45	6.21	7.32	9.12	1.26E1	1.61E1
15.0	4.27	5.54	6.44	7.97	9.16	1.09E1	1.39E1	2.01E1	2.69E1
20.0	5.83	7.45	8.61	1.07E1	1.23E1	1.47E1	1.90E1	2.84E1	3.90E1
25.0	7.65	9.54	1.09E1	1.35E1	1.55E1	1.87E1	2.44E1	3.72E1	5.23E1
30.0	9.74	1.18E1	1.34E1	1.63E1	1.88E1	2.28E1	2.99E1	4.65E1	6.66E1
35.0	1.21E1	1.43E1	1.62E1	1.89E1	2.20E1	2.70E1	3.56E1	5.61E1	8.18E1
40.0	1.47E1	1.71E1	1.92E1	2.13E1	2.49E1	3.14E1	4.14E1	6.60E1	9.75E1

	Energy (MeV)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.50	1.54	1.62	1.68	1.80	1.92	2.20	2.34	2.19
1.0	2.12	2.24	2.44	2.59	2.84	3.14	3.69	3.86	3.21
2.0	3.58	3.93	4.46	4.86	5.42	6.22	7.22	7.15	5.04
3.0	5.29	5.95	6.96	7.70	8.70	1.01E1	1.14E1	1.07E1	6.79
4.0	7.24	8.31	9.94	1.11E1	1.27E1	1.47E1	1.62E1	1.47E1	8.52
5.0	9.44	1.10E1	1.34E1	1.52E1	1.74E1	2.02E1	2.19E1	1.90E1	1.03E1
6.0	1.19E1	1.41E1	1.74E1	1.99E1	2.30E1	2.67E1	2.83E1	2.38E1	1.21E1
7.0	1.45E1	1.75E1	2.20E1	2.52E1	2.94E1	3.42E1	3.56E1	2.90E1	1.39E1
8.0	1.74E1	2.12E1	2.71E1	3.13E1	3.67E1	4.27E1	4.38E1	3.46E1	1.58E1
10.0	2.37E1	2.96E1	3.89E1	4.56E1	5.42E1	6.33E1	6.32E1	4.73E1	1.98E1
15.0	4.28E1	5.61E1	7.81E1	9.46E1	1.16E2	1.37E2	1.30E2	8.67E1	3.02E1
20.0	6.59E1	8.96E1	1.31E2	1.63E2	2.05E2	2.46E2	2.25E2	1.37E2	4.16E1
25.0	9.24E1	1.30E2	1.97E2	2.52E2	3.24E2	3.95E2	3.53E2	1.99E2	5.35E1
30.0	1.22E2	1.76E2	2.77E2	3.61E2	4.75E2	5.88E2	5.15E2	2.71E2	6.60E1
35.0	1.55E2	2.29E2	3.70E2	4.92E2	6.60E2	8.30E2	7.14E2	3.53E2	7.90E1
40.0	1.90E2	2.86E2	4.76E2	6.43E2	8.81E2	1.13E3	9.53E2	4.45E2	9.23E1

	Energy (MeV)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.91	1.50	1.31	1.19	1.08	1.03	1.01
1.0	2.55	1.66	1.48	1.27	1.12	1.04	1.02
2.0	3.54	2.23	1.72	1.38	1.16	1.05	1.02
3.0	4.41	2.55	1.90	1.46	1.19	1.06	1.02
4.0	5.24	2.83	2.04	1.52	1.22	1.07	1.03
5.0	6.02	3.09	2.17	1.58	1.24	1.07	1.03
6.0	6.78	3.33	2.28	1.63	1.26	1.08	1.03
7.0	7.53	3.56	2.38	1.67	1.27	1.08	1.03
8.0	8.26	3.77	2.48	1.71	1.29	1.08	1.04
10.0	9.72	4.17	2.65	1.78	1.31	1.09	1.04
15.0	1.33E1	5.04	3.02	1.91	1.36	1.10	1.04
20.0	1.67E1	5.80	3.31	2.02	1.39	1.11	1.05
25.0	2.01E1	6.49	3.56	2.11	1.42	1.12	1.05
30.0	2.34E1	7.10	3.78	2.18	1.44	1.13	1.05
35.0	2.68E1	7.62	3.95	2.23	1.46	1.13	1.06
40.0	3.10E1	8.01	4.07	2.26	1.47	1.13	1.06

Table 4
Energy Absorption Buildup Factors

Argon

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.11	1.16	1.19	1.23	1.26	1.31	1.34	1.39	1.43
1.0	1.20	1.30	1.36	1.45	1.51	1.61	1.70	1.84	1.94
2.0	1.36	1.54	1.67	1.86	1.99	2.18	2.42	2.78	3.07
3.0	1.51	1.78	1.97	2.26	2.47	2.75	3.16	3.80	4.32
4.0	1.68	2.03	2.28	2.67	2.96	3.35	3.93	4.88	5.69
5.0	1.86	2.30	2.61	3.10	3.47	3.97	4.73	6.03	7.17
6.0	2.06	2.58	2.96	3.55	3.99	4.61	5.56	7.24	8.76
7.0	2.26	2.88	3.31	4.01	4.53	5.27	6.42	8.51	1.05E1
8.0	2.48	3.18	3.68	4.48	5.09	5.95	7.31	9.83	1.22E1
10.0	2.96	3.83	4.45	5.47	6.24	7.35	9.15	1.26E1	1.60E1
15.0	4.39	5.66	6.56	8.11	9.29	1.11E1	1.40E1	2.02E1	2.66E1
20.0	6.19	7.77	8.92	1.10E1	1.26E1	1.50E1	1.93E1	2.85E1	3.87E1
25.0	8.43	1.02E1	1.15E1	1.41E1	1.62E1	1.92E1	2.48E1	3.74E1	5.18E1
30.0	1.11E1	1.28E1	1.43E1	1.72E1	1.99E1	2.35E1	3.06E1	4.69E1	6.60E1
35.0	1.44E1	1.58E1	1.76E1	2.02E1	2.30E1	2.80E1	3.65E1	5.67E1	8.10E1
40.0	1.81E1	1.89E1	2.17E1	2.40E1	2.62E1	3.28E1	4.25E1	6.69E1	9.66E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.50	1.55	1.64	1.71	1.80	1.97	2.23	1.62	2.02
1.0	2.12	2.25	2.46	2.61	2.84	3.19	3.62	2.25	2.75
2.0	3.57	3.91	4.44	4.83	5.36	6.08	6.69	3.55	3.93
3.0	5.24	5.88	6.84	7.53	8.43	9.55	1.01E1	4.93	5.01
4.0	7.16	8.17	9.69	1.08E1	1.21E1	1.37E1	1.40E1	6.37	6.04
5.0	9.31	1.08E1	1.30E1	1.46E1	1.65E1	1.85E1	1.83E1	7.88	7.05
6.0	1.17E1	1.37E1	1.68E1	1.89E1	2.15E1	2.40E1	2.32E1	9.47	8.05
7.0	1.43E1	1.70E1	2.11E1	2.39E1	2.73E1	3.04E1	2.86E1	1.11E1	9.04
8.0	1.71E1	2.06E1	2.59E1	2.95E1	3.38E1	3.75E1	3.46E1	1.29E1	1.00E1
10.0	2.33E1	2.87E1	3.70E1	4.27E1	4.92E1	5.44E1	4.82E1	1.67E1	1.20E1
15.0	4.18E1	5.40E1	7.33E1	8.68E1	1.02E2	1.12E2	9.24E1	2.77E1	1.68E1
20.0	6.42E1	8.60E1	1.22E2	1.48E2	1.77E2	1.95E2	1.51E2	4.09E1	2.16E1
25.0	8.99E1	1.24E2	1.82E2	2.26E2	2.76E2	3.04E2	2.25E2	5.55E1	2.64E1
30.0	1.19E2	1.68E2	2.55E2	3.21E2	3.99E2	4.41E2	3.15E2	7.07E1	3.10E1
35.0	1.50E2	2.18E2	3.39E2	4.34E2	5.47E2	6.07E2	4.20E2	8.67E1	3.58E1
40.0	1.84E2	2.72E2	4.34E2	5.65E2	7.22E2	8.04E2	5.41E2	1.05E2	4.11E1

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.73	1.33	1.23	1.13	1.06	1.02	1.01
1.0	2.17	1.52	1.34	1.18	1.08	1.02	1.01
2.0	2.75	1.82	1.49	1.25	1.11	1.03	1.01
3.0	3.26	2.02	1.59	1.31	1.13	1.04	1.02
4.0	3.73	2.18	1.68	1.35	1.15	1.05	1.02
5.0	4.17	2.33	1.75	1.38	1.16	1.05	1.02
6.0	4.58	2.46	1.82	1.41	1.17	1.05	1.02
7.0	4.97	2.58	1.88	1.44	1.18	1.06	1.02
8.0	5.34	2.70	1.93	1.46	1.19	1.06	1.03
10.0	6.07	2.91	2.03	1.50	1.21	1.06	1.03
15.0	7.72	3.35	2.23	1.58	1.24	1.07	1.03
20.0	9.21	3.70	2.38	1.64	1.26	1.08	1.03
25.0	1.07E1	4.02	2.50	1.69	1.28	1.08	1.04
30.0	1.21E1	4.29	2.61	1.73	1.29	1.09	1.04
35.0	1.36E1	4.50	2.69	1.76	1.30	1.09	1.04
40.0	1.50E1	4.65	2.74	1.78	1.31	1.09	1.04

Table 4
Energy Absorption Buildup Factors

Potassium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.11	1.16	1.19	1.23	1.26	1.31	1.34	1.39	1.43
1.0	1.20	1.29	1.35	1.45	1.51	1.61	1.70	1.84	1.94
2.0	1.35	1.53	1.66	1.85	1.98	2.17	2.42	2.78	3.06
3.0	1.50	1.77	1.96	2.25	2.46	2.74	3.15	3.79	4.31
4.0	1.67	2.02	2.27	2.66	2.95	3.34	3.92	4.87	5.67
5.0	1.85	2.29	2.60	3.09	3.45	3.96	4.72	6.02	7.15
6.0	2.04	2.57	2.94	3.54	3.98	4.61	5.56	7.23	8.73
7.0	2.25	2.86	3.30	4.00	4.52	5.27	6.42	8.50	1.04E1
8.0	2.47	3.17	3.67	4.48	5.08	5.95	7.31	9.81	1.22E1
10.0	2.96	3.83	4.46	5.47	6.25	7.37	9.16	1.26E1	1.59E1
15.0	4.45	5.72	6.63	8.17	9.36	1.12E1	1.41E1	2.02E1	2.65E1
20.0	6.40	7.96	9.10	1.12E1	1.28E1	1.52E1	1.94E1	2.85E1	3.85E1
25.0	8.88	1.05E1	1.18E1	1.44E1	1.64E1	1.95E1	2.51E1	3.74E1	5.16E1
30.0	1.20E1	1.34E1	1.48E1	1.76E1	1.95E1	2.40E1	3.09E1	4.69E1	6.57E1
35.0	1.58E1	1.67E1	1.84E1	2.08E1	2.28E1	2.87E1	3.70E1	5.68E1	8.06E1
40.0	2.04E1	2.02E1	2.29E1	2.50E1	2.66E1	3.39E1	4.32E1	6.70E1	9.62E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.51	1.56	1.65	1.72	1.82	1.99	2.23	2.26	1.94
1.0	2.13	2.26	2.47	2.63	2.85	3.19	3.57	3.45	2.55
2.0	3.56	3.90	4.43	4.81	5.32	5.99	6.40	5.69	3.50
3.0	5.22	5.85	6.78	7.44	8.29	9.27	9.48	7.91	4.35
4.0	7.12	8.10	9.57	1.06E1	1.18E1	1.31E1	1.29E1	1.02E1	5.16
5.0	9.24	1.07E1	1.28E1	1.43E1	1.60E1	1.76E1	1.67E1	1.26E1	5.94
6.0	1.16E1	1.36E1	1.65E1	1.85E1	2.08E1	2.27E1	2.10E1	1.51E1	6.69
7.0	1.42E1	1.68E1	2.07E1	2.33E1	2.62E1	2.86E1	2.56E1	1.77E1	7.42
8.0	1.69E1	2.03E1	2.53E1	2.87E1	3.24E1	3.51E1	3.07E1	2.05E1	8.15
10.0	2.30E1	2.83E1	3.60E1	4.12E1	4.68E1	5.03E1	4.21E1	2.62E1	9.57
15.0	4.12E1	5.30E1	7.10E1	8.31E1	9.58E1	1.02E2	7.80E1	4.23E1	1.30E1
20.0	6.32E1	8.41E1	1.17E2	1.40E2	1.64E2	1.73E2	1.24E2	6.03E1	1.62E1
25.0	8.85E1	1.21E2	1.75E2	2.13E2	2.54E2	2.66E2	1.81E2	8.00E1	1.93E1
30.0	1.17E2	1.64E2	2.44E2	3.02E2	3.64E2	3.80E2	2.48E2	1.01E2	2.22E1
35.0	1.48E2	2.12E2	3.24E2	4.07E2	4.96E2	5.17E2	3.24E2	1.24E2	2.58E1
40.0	1.81E2	2.65E2	4.14E2	5.27E2	6.51E2	6.77E2	4.10E2	1.47E2	2.92E1

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.66	1.30	1.20	1.11	1.05	1.02	1.01
1.0	2.02	1.45	1.29	1.16	1.07	1.02	1.01
2.0	2.47	1.68	1.41	1.21	1.09	1.03	1.01
3.0	2.86	1.84	1.50	1.26	1.11	1.03	1.01
4.0	3.22	1.97	1.56	1.29	1.13	1.04	1.02
5.0	3.56	2.08	1.62	1.32	1.14	1.04	1.02
6.0	3.87	2.18	1.68	1.34	1.15	1.04	1.02
7.0	4.16	2.28	1.72	1.36	1.15	1.05	1.02
8.0	4.43	2.37	1.77	1.38	1.16	1.05	1.02
10.0	4.96	2.52	1.84	1.42	1.18	1.05	1.02
15.0	6.14	2.85	1.99	1.48	1.20	1.06	1.03
20.0	7.14	3.11	2.11	1.53	1.22	1.07	1.03
25.0	8.15	3.33	2.21	1.57	1.23	1.07	1.03
30.0	9.28	3.52	2.29	1.60	1.24	1.07	1.03
35.0	1.03E1	3.67	2.35	1.62	1.25	1.08	1.03
40.0	1.14E1	3.76	2.38	1.63	1.26	1.08	1.03

Table 4
Energy Absorption Buildup Factors
Calcium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.11	1.16	1.19	1.23	1.27	1.31	1.34	1.39	1.43
1.0	1.19	1.29	1.35	1.44	1.52	1.61	1.70	1.84	1.94
2.0	1.34	1.52	1.65	1.84	1.98	2.16	2.41	2.78	3.06
3.0	1.49	1.76	1.94	2.24	2.45	2.73	3.14	3.79	4.29
4.0	1.66	2.00	2.25	2.65	2.93	3.33	3.91	4.86	5.65
5.0	1.83	2.27	2.58	3.07	3.44	3.95	4.71	6.01	7.12
6.0	2.03	2.55	2.93	3.52	3.97	4.60	5.55	7.21	8.69
7.0	2.24	2.85	3.29	3.99	4.52	5.27	6.42	8.48	1.04E1
8.0	2.46	3.16	3.67	4.47	5.08	5.95	7.31	9.79	1.21E1
10.0	2.96	3.84	4.46	5.48	6.26	7.38	9.17	1.26E1	1.59E1
15.0	4.53	5.80	6.70	8.24	9.44	1.12E1	1.42E1	2.01E1	2.64E1
20.0	6.64	8.15	9.29	1.13E1	1.29E1	1.54E1	1.96E1	2.85E1	3.83E1
25.0	9.40	1.09E1	1.22E1	1.47E1	1.67E1	1.98E1	2.53E1	3.75E1	5.13E1
30.0	1.30E1	1.41E1	1.54E1	1.81E1	2.05E1	2.44E1	3.12E1	4.70E1	6.53E1
35.0	1.75E1	1.77E1	1.93E1	2.15E1	2.43E1	2.93E1	3.74E1	5.70E1	8.01E1
40.0	2.33E1	2.17E1	2.41E1	2.59E1	2.78E1	3.50E1	4.37E1	6.72E1	9.56E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.51	1.57	1.66	1.73	1.83	2.00	2.24	2.22	1.67
1.0	2.13	2.26	2.47	2.63	2.87	3.19	3.50	3.29	2.20
2.0	3.55	3.89	4.41	4.78	5.28	5.88	6.09	5.23	3.13
3.0	5.20	5.81	6.72	7.34	8.14	8.99	8.84	7.09	3.80
4.0	7.07	8.03	9.44	1.04E1	1.15E1	1.26E1	1.19E1	8.99	4.43
5.0	9.17	1.06E1	1.26E1	1.39E1	1.55E1	1.67E1	1.52E1	1.09E1	5.03
6.0	1.15E1	1.34E1	1.62E1	1.80E1	2.00E1	2.15E1	1.88E1	1.30E1	5.59
7.0	1.40E1	1.66E1	2.02E1	2.26E1	2.52E1	2.68E1	2.28E1	1.50E1	6.14
8.0	1.67E1	2.00E1	2.47E1	2.78E1	3.09E1	3.27E1	2.71E1	1.72E1	6.67
10.0	2.28E1	2.78E1	3.50E1	3.97E1	4.44E1	4.64E1	3.65E1	2.16E1	7.70
15.0	4.07E1	5.18E1	6.84E1	7.94E1	8.96E1	9.15E1	6.54E1	3.35E1	1.01E1
20.0	6.23E1	8.21E1	1.13E2	1.33E2	1.52E2	1.53E2	1.01E2	4.63E1	1.23E1
25.0	8.72E1	1.18E2	1.67E2	2.02E2	2.32E2	2.30E2	1.44E2	5.99E1	1.44E1
30.0	1.15E2	1.60E2	2.32E2	2.85E2	3.30E2	3.25E2	1.93E2	7.41E1	1.62E1
35.0	1.45E2	2.06E2	3.06E2	3.82E2	4.47E2	4.37E2	2.48E2	8.89E1	1.77E1
40.0	1.78E2	2.57E2	3.90E2	4.94E2	5.83E2	5.66E2	3.09E2	1.04E2	1.87E1

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.43	1.26	1.17	1.09	1.04	1.01	1.01
1.0	1.74	1.38	1.24	1.13	1.06	1.02	1.01
2.0	2.25	1.57	1.34	1.18	1.08	1.02	1.01
3.0	2.54	1.69	1.41	1.21	1.09	1.03	1.01
4.0	2.82	1.80	1.46	1.24	1.10	1.03	1.01
5.0	3.08	1.89	1.51	1.26	1.11	1.04	1.02
6.0	3.32	1.97	1.55	1.28	1.12	1.04	1.02
7.0	3.54	2.04	1.59	1.30	1.13	1.04	1.02
8.0	3.74	2.11	1.62	1.32	1.14	1.04	1.02
10.0	4.13	2.23	1.68	1.34	1.15	1.05	1.02
15.0	4.98	2.47	1.80	1.40	1.17	1.05	1.02
20.0	5.70	2.66	1.89	1.43	1.18	1.06	1.02
25.0	6.36	2.82	1.96	1.46	1.19	1.06	1.03
30.0	6.95	2.96	2.02	1.49	1.20	1.06	1.03
35.0	7.43	3.07	2.06	1.51	1.21	1.06	1.03
40.0	7.78	3.13	2.09	1.52	1.21	1.07	1.03

Table 4
Energy Absorption Buildup Factors

Iron

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.10	1.15	1.18	1.22	1.26	1.31	1.35	1.40	1.45
1.0	1.18	1.27	1.33	1.42	1.49	1.59	1.70	1.84	1.95
2.0	1.31	1.48	1.60	1.79	1.93	2.12	2.39	2.76	3.03
3.0	1.44	1.69	1.88	2.17	2.39	2.68	3.10	3.74	4.23
4.0	1.59	1.93	2.17	2.57	2.86	3.27	3.86	4.80	5.54
5.0	1.76	2.19	2.50	2.99	3.37	3.89	4.66	5.93	6.95
6.0	1.96	2.47	2.85	3.45	3.91	4.55	5.51	7.12	8.47
7.0	2.17	2.78	3.22	3.93	4.47	5.23	6.39	8.37	1.01E1
8.0	2.42	3.12	3.62	4.44	5.07	5.95	7.30	9.67	1.18E1
10.0	2.99	3.87	4.50	5.54	6.33	7.46	9.23	1.24E1	1.53E1
15.0	5.06	6.29	7.18	8.72	9.92	1.17E1	1.45E1	2.00E1	2.54E1
20.0	8.44	9.59	1.06E1	1.25E1	1.41E1	1.64E1	2.04E1	2.85E1	3.68E1
25.0	1.38E1	1.40E1	1.48E1	1.69E1	1.87E1	2.16E1	2.67E1	3.77E1	4.92E1
30.0	2.22E1	1.96E1	1.98E1	2.17E1	2.37E1	2.70E1	3.33E1	4.74E1	6.26E1
35.0	3.50E1	2.67E1	2.56E1	2.68E1	2.89E1	3.25E1	4.04E1	5.77E1	7.68E1
40.0	5.41E1	3.54E1	3.24E1	3.21E1	3.40E1	3.79E1	4.78E1	6.84E1	9.16E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.53	1.60	1.71	1.79	1.91	2.07	2.13	1.93	1.38
1.0	2.14	2.28	2.50	2.66	2.86	3.08	2.94	2.46	1.60
2.0	3.50	3.81	4.27	4.57	4.90	5.09	4.34	3.22	1.94
3.0	5.04	5.57	6.30	6.75	7.17	7.23	5.72	3.93	2.13
4.0	6.79	7.60	8.65	9.25	9.75	9.58	7.14	4.60	2.31
5.0	8.74	9.88	1.13E1	1.21E1	1.27E1	1.21E1	8.58	5.23	2.48
6.0	1.09E1	1.24E1	1.43E1	1.53E1	1.59E1	1.49E1	1.00E1	5.84	2.63
7.0	1.32E1	1.52E1	1.77E1	1.88E1	1.94E1	1.79E1	1.15E1	6.42	2.77
8.0	1.57E1	1.82E1	2.13E1	2.27E1	2.33E1	2.10E1	1.31E1	6.98	2.90
10.0	2.11E1	2.49E1	2.94E1	3.14E1	3.19E1	2.78E1	1.61E1	8.07	3.13
15.0	3.71E1	4.53E1	5.50E1	5.88E1	5.86E1	4.76E1	2.42E1	1.06E1	3.61
20.0	5.62E1	7.04E1	8.74E1	9.39E1	9.23E1	7.08E1	3.25E1	1.29E1	4.00
25.0	7.79E1	9.98E1	1.27E2	1.36E2	1.33E2	9.72E1	4.10E1	1.50E1	4.34
30.0	1.02E2	1.33E2	1.72E2	1.86E2	1.80E2	1.26E2	4.98E1	1.69E1	4.63
35.0	1.28E2	1.70E2	2.23E2	2.42E2	2.33E2	1.58E2	5.88E1	1.94E1	4.85
40.0	1.56E2	2.11E2	2.80E2	3.05E2	2.92E2	1.92E2	6.81E1	2.17E1	4.98

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.23	1.12	1.08	1.04	1.02	1.01	1.00
1.0	1.34	1.17	1.10	1.06	1.03	1.01	1.00
2.0	1.51	1.23	1.14	1.08	1.03	1.01	1.01
3.0	1.61	1.28	1.17	1.09	1.04	1.01	1.01
4.0	1.70	1.31	1.19	1.10	1.05	1.02	1.01
5.0	1.78	1.34	1.21	1.11	1.05	1.02	1.01
6.0	1.84	1.37	1.22	1.12	1.05	1.02	1.01
7.0	1.91	1.39	1.23	1.12	1.06	1.02	1.01
8.0	1.96	1.41	1.24	1.13	1.06	1.02	1.01
10.0	2.06	1.45	1.26	1.14	1.06	1.02	1.01
15.0	2.26	1.52	1.30	1.16	1.07	1.02	1.01
20.0	2.41	1.57	1.33	1.17	1.08	1.03	1.01
25.0	2.54	1.61	1.35	1.18	1.08	1.03	1.01
30.0	2.65	1.65	1.37	1.19	1.09	1.03	1.01
35.0	2.73	1.67	1.38	1.20	1.09	1.03	1.01
40.0	2.77	1.68	1.39	1.20	1.09	1.03	1.01

Table 4
Energy Absorption Buildup Factors

Copper

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.09	1.14	1.17	1.22	1.25	1.30	1.36	1.41	1.46
1.0	1.17	1.26	1.32	1.41	1.48	1.58	1.70	1.85	1.95
2.0	1.30	1.46	1.58	1.77	1.91	2.10	2.37	2.75	3.01
3.0	1.42	1.67	1.85	2.14	2.35	2.65	3.08	3.72	4.19
4.0	1.57	1.90	2.14	2.53	2.82	3.23	3.83	4.76	5.47
5.0	1.74	2.15	2.46	2.95	3.33	3.86	4.63	5.88	6.85
6.0	1.93	2.44	2.81	3.41	3.87	4.52	5.48	7.05	8.33
7.0	2.15	2.75	3.19	3.90	4.45	5.22	6.36	8.28	9.89
8.0	2.40	3.10	3.60	4.42	5.06	5.95	7.29	9.57	1.15E1
10.0	3.02	3.89	4.52	5.55	6.38	7.52	9.24	1.23E1	1.50E1
15.0	5.43	6.55	7.43	8.90	1.02E1	1.20E1	1.47E1	1.98E1	2.49E1
20.0	9.84	1.04E1	1.13E1	1.30E1	1.48E1	1.71E1	2.07E1	2.81E1	3.59E1
25.0	1.77E1	1.59E1	1.63E1	1.79E1	2.00E1	2.29E1	2.73E1	3.72E1	4.81E1
30.0	3.14E1	2.33E1	2.25E1	2.34E1	2.58E1	2.90E1	3.44E1	4.69E1	6.12E1
35.0	5.47E1	3.32E1	3.01E1	2.94E1	3.19E1	3.54E1	4.20E1	5.70E1	7.50E1
40.0	9.35E1	4.61E1	3.92E1	3.58E1	3.81E1	4.17E1	5.02E1	6.76E1	8.95E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.55	1.62	1.74	1.82	1.95	2.09	2.03	1.78	1.21
1.0	2.15	2.29	2.51	2.65	2.84	2.97	2.65	2.14	1.38
2.0	3.47	3.76	4.18	4.42	4.65	4.63	3.62	2.61	1.64
3.0	4.96	5.44	6.08	6.40	6.64	6.37	4.58	3.05	1.77
4.0	6.65	7.36	8.24	8.65	8.85	8.21	5.54	3.47	1.88
5.0	8.51	9.50	1.07E1	1.12E1	1.13E1	1.02E1	6.47	3.86	1.98
6.0	1.05E1	1.19E1	1.34E1	1.40E1	1.39E1	1.22E1	7.38	4.21	2.07
7.0	1.27E1	1.44E1	1.63E1	1.70E1	1.68E1	1.43E1	8.28	4.53	2.15
8.0	1.51E1	1.72E1	1.95E1	2.03E1	1.99E1	1.65E1	9.17	4.85	2.23
10.0	2.02E1	2.34E1	2.66E1	2.76E1	2.66E1	2.11E1	1.09E1	5.44	2.36
15.0	3.50E1	4.18E1	4.83E1	4.98E1	4.65E1	3.38E1	1.52E1	6.73	2.62
20.0	5.26E1	6.43E1	7.52E1	7.74E1	7.06E1	4.76E1	1.93E1	7.85	2.83
25.0	7.24E1	9.04E1	1.07E2	1.10E2	9.84E1	6.26E1	2.33E1	8.90	3.00
30.0	9.43E1	1.20E2	1.43E2	1.47E2	1.30E2	7.85E1	2.71E1	9.91	3.15
35.0	1.18E2	1.52E2	1.84E2	1.89E2	1.64E2	9.53E1	3.13E1	1.08E1	3.25
40.0	1.43E2	1.88E2	2.28E2	2.35E2	2.02E2	1.13E2	3.45E1	1.16E1	3.31

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.18	1.09	1.05	1.03	1.01	1.00	1.00
1.0	1.24	1.12	1.07	1.04	1.02	1.01	1.00
2.0	1.35	1.16	1.10	1.05	1.02	1.01	1.00
3.0	1.42	1.19	1.12	1.06	1.03	1.01	1.00
4.0	1.47	1.22	1.13	1.07	1.03	1.01	1.01
5.0	1.52	1.24	1.14	1.08	1.04	1.01	1.01
6.0	1.57	1.25	1.15	1.08	1.04	1.01	1.01
7.0	1.60	1.27	1.16	1.09	1.04	1.01	1.01
8.0	1.64	1.28	1.17	1.09	1.04	1.01	1.01
10.0	1.70	1.30	1.18	1.10	1.05	1.02	1.01
15.0	1.81	1.35	1.21	1.11	1.05	1.02	1.01
20.0	1.90	1.38	1.23	1.12	1.06	1.02	1.01
25.0	1.97	1.41	1.24	1.13	1.06	1.02	1.01
30.0	2.03	1.43	1.25	1.14	1.06	1.02	1.01
35.0	2.08	1.44	1.26	1.14	1.06	1.02	1.01
40.0	2.10	1.45	1.27	1.14	1.07	1.02	1.01

Table 4
Energy Absorption Buildup Factors

Molybdenum

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.25	1.27	1.33	1.37	1.40	1.34	1.38	1.42	1.44
1.0	1.47	1.48	1.55	1.62	1.67	1.62	1.72	1.86	1.91
2.0	1.84	1.81	1.89	2.00	2.12	2.11	2.38	2.80	2.88
3.0	2.25	2.14	2.21	2.38	2.55	2.57	3.02	3.72	3.93
4.0	2.76	2.52	2.59	2.79	3.03	3.08	3.68	4.64	4.98
5.0	3.39	2.97	3.02	3.26	3.57	3.64	4.40	5.61	6.05
6.0	4.18	3.49	3.51	3.80	4.18	4.28	5.20	6.69	7.24
7.0	5.16	4.11	4.08	4.41	4.85	4.98	6.05	7.82	8.47
8.0	6.38	4.81	4.77	5.07	5.59	5.73	6.96	9.02	9.69
10.0	9.72	6.56	6.23	6.60	7.25	7.40	8.94	1.16E1	1.23E1
15.0	2.75E1	1.38E1	1.19E1	1.18E1	1.26E1	1.26E1	1.48E1	1.91E1	1.96E1
20.0	7.59E1	2.76E1	2.14E1	1.92E1	1.99E1	1.90E1	2.15E1	2.75E1	2.75E1
25.0	2.03E2	5.30E1	3.65E1	2.93E1	2.90E1	2.66E1	2.88E1	3.65E1	3.56E1
30.0	5.27E2	9.83E1	5.97E1	4.24E1	4.02E1	3.53E1	3.66E1	4.59E1	4.38E1
35.0	1.33E3	1.78E2	9.44E1	5.92E1	5.36E1	4.51E1	4.49E1	5.58E1	5.21E1
40.0	3.30E3	3.13E2	1.45E2	7.99E1	6.93E1	5.57E1	5.34E1	6.59E1	6.03E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.66	1.76	1.86	1.92	1.94	1.82	1.48	1.33	1.13
1.0	2.28	2.43	2.57	2.62	2.58	2.30	1.71	1.42	1.16
2.0	3.48	3.69	3.86	3.84	3.62	3.01	2.00	1.53	1.19
3.0	4.73	4.99	5.18	5.04	4.60	3.61	2.23	1.63	1.22
4.0	5.95	6.23	6.43	6.14	5.46	4.11	2.41	1.72	1.25
5.0	7.18	7.48	7.68	7.21	6.27	4.56	2.55	1.80	1.28
6.0	8.61	8.91	9.13	8.44	7.19	5.05	2.71	1.88	1.30
7.0	1.01E1	1.04E1	1.06E1	9.66	8.08	5.51	2.85	1.94	1.32
8.0	1.15E1	1.18E1	1.20E1	1.08E1	8.92	5.93	2.97	2.00	1.34
10.0	1.46E1	1.48E1	1.51E1	1.33E1	1.07E1	6.78	3.21	2.10	1.37
15.0	2.35E1	2.32E1	2.40E1	2.02E1	1.52E1	8.89	3.76	2.31	1.43
20.0	3.35E1	3.25E1	3.41E1	2.75E1	1.97E1	1.09E1	4.25	2.45	1.47
25.0	4.41E1	4.21E1	4.49E1	3.52E1	2.41E1	1.27E1	4.67	2.57	1.51
30.0	5.51E1	5.20E1	5.62E1	4.30E1	2.85E1	1.43E1	5.03	2.67	1.53
35.0	6.66E1	6.21E1	6.81E1	5.09E1	3.27E1	1.59E1	5.36	2.77	1.56
40.0	7.81E1	7.22E1	8.02E1	5.88E1	3.68E1	1.72E1	5.65	2.85	1.58

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.07	1.02	1.31	1.31	1.29	1.01	1.00
1.0	1.09	1.03	1.38	1.49	1.55	1.01	1.01
2.0	1.10	1.04	1.40	1.66	2.11	1.02	1.01
3.0	1.12	1.05	1.40	1.73	2.84	1.02	1.01
4.0	1.13	1.06	1.39	1.77	3.93	1.02	1.01
5.0	1.15	1.07	1.40	1.79	5.61	1.02	1.01
6.0	1.16	1.08	1.40	1.80	8.16	1.03	1.01
7.0	1.17	1.08	1.40	1.80	1.21E1	1.03	1.01
8.0	1.18	1.09	1.40	1.81	1.78E1	1.03	1.01
10.0	1.20	1.09	1.41	1.82	3.80E1	1.03	1.02
15.0	1.23	1.11	1.41	1.82	3.26E2	1.04	1.02
20.0	1.26	1.12	1.42	1.84	3.60E3	1.05	1.02
25.0	1.27	1.13	1.43	1.84	4.58E4	1.05	1.02
30.0	1.29	1.14	1.44	1.85	6.21E5	1.06	1.03
35.0	1.30	1.15	1.44	1.85	8.69E6	1.06	1.03
40.0	1.31	1.15	1.45	1.85	1.23E8	1.06	1.03

Table 4
Energy Absorption Buildup Factors

Tin

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.27	1.30	1.35	1.39	1.42	1.34	1.38	1.42	1.46
1.0	1.49	1.52	1.56	1.62	1.67	1.58	1.69	1.82	1.93
2.0	1.87	1.85	1.89	1.98	2.07	2.00	2.27	2.65	2.89
3.0	2.32	2.21	2.22	2.34	2.48	2.42	2.84	3.45	3.89
4.0	2.91	2.65	2.62	2.76	2.95	2.89	3.45	4.26	4.88
5.0	3.68	3.18	3.08	3.24	3.48	3.42	4.12	5.12	5.89
6.0	4.68	3.82	3.63	3.80	4.09	4.02	4.87	6.06	7.01
7.0	5.98	4.59	4.26	4.43	4.77	4.68	5.68	7.06	8.16
8.0	7.66	5.50	4.99	5.14	5.52	5.39	6.54	8.10	9.30
10.0	1.26E1	7.87	6.79	6.83	7.25	7.00	8.43	1.04E1	1.17E1
15.0	4.38E1	1.89E1	1.41E1	1.30E1	1.31E1	1.21E1	1.41E1	1.68E1	1.84E1
20.0	1.49E2	4.35E1	2.79E1	2.27E1	2.15E1	1.87E1	2.08E1	2.39E1	2.55E1
25.0	4.89E2	9.67E1	5.25E1	3.72E1	3.28E1	2.68E1	2.83E1	3.16E1	3.28E1
30.0	1.56E3	2.08E2	9.52E1	5.83E1	4.77E1	3.63E1	3.65E1	3.96E1	4.01E1
35.0	4.84E3	4.38E2	1.68E2	8.80E1	6.66E1	4.73E1	4.53E1	4.79E1	4.75E1
40.0	1.47E4	8.97E2	2.87E2	1.29E2	8.99E1	5.97E1	5.46E1	5.65E1	5.47E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.67	1.75	1.81	1.80	1.77	1.61	1.32	1.11	1.10
1.0	2.25	2.35	2.41	2.35	2.24	1.93	1.46	1.17	1.12
2.0	3.36	3.47	3.47	3.29	2.97	2.37	1.63	1.26	1.15
3.0	4.49	4.60	4.51	4.17	3.62	2.74	1.76	1.32	1.18
4.0	5.55	5.66	5.45	4.96	4.16	3.02	1.86	1.38	1.19
5.0	6.62	7.71	6.37	5.72	4.66	3.28	1.94	1.42	1.21
6.0	7.84	7.92	7.42	6.58	5.21	3.55	2.02	1.46	1.22
7.0	9.08	9.12	8.44	7.41	5.72	3.81	2.10	1.49	1.24
8.0	1.03E1	1.03E1	9.43	8.21	6.20	4.03	2.16	1.52	1.25
10.0	1.28E1	1.27E1	1.15E1	9.88	7.17	4.49	2.29	1.58	1.26
15.0	1.99E1	1.95E1	1.71E1	1.43E1	9.53	5.55	2.56	1.68	1.30
20.0	2.73E1	2.67E1	2.28E1	1.88E1	1.17E1	6.50	2.80	1.75	1.32
25.0	3.50E1	3.41E1	2.87E1	2.32E1	1.38E1	7.32	3.00	1.81	1.34
30.0	4.28E1	4.15E1	3.44E1	2.76E1	1.56E1	8.03	3.16	1.85	1.36
35.0	5.06E1	4.90E1	4.02E1	3.20E1	1.74E1	8.66	3.31	1.89	1.37
40.0	5.83E1	5.63E1	4.58E1	3.62E1	1.91E1	9.22	3.44	1.93	1.38

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.35	1.38	1.38	1.36	1.35	1.00	1.00
1.0	1.40	1.56	1.64	1.70	1.76	1.01	1.00
2.0	1.41	1.70	2.05	2.51	3.04	1.01	1.00
3.0	1.42	1.73	2.37	3.69	5.66	1.01	1.01
4.0	1.43	1.74	2.69	5.62	1.15E1	1.01	1.01
5.0	1.44	1.74	3.02	8.87	2.46E1	1.01	1.01
6.0	1.45	1.74	3.38	1.43E1	5.38E1	1.01	1.01
7.0	1.46	1.73	3.80	2.32E1	1.10E2	1.02	1.01
8.0	1.46	1.73	4.33	3.66E1	2.26E2	1.02	1.01
10.0	1.48	1.72	5.59	9.32E1	9.82E2	1.02	1.01
15.0	1.50	1.71	1.26E1	1.18E3	4.09E4	1.02	1.01
20.0	1.52	1.71	3.78E1	1.84E4	1.83E6	1.03	1.01
25.0	1.54	1.71	1.32E2	3.24E5	8.65E7	1.03	1.01
30.0	1.55	1.72	4.93E2	6.13E6	4.25E9	1.03	1.02
35.0	1.57	1.72	1.90E3	1.20E8	2.17E11	1.03	1.02
40.0	1.58	1.73	7.47E3	2.39E9	1.14E13	1.04	1.02

Table 4
Energy Absorption Buildup Factors

Lanthanum

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.28	1.31	1.36	1.41	1.44	1.36	1.41	1.44	1.48
1.0	1.50	1.52	1.56	1.63	1.67	1.59	1.70	1.83	1.95
2.0	1.90	1.85	1.87	1.96	2.05	1.98	2.24	2.63	2.86
3.0	2.38	2.23	2.21	2.32	2.45	2.38	2.79	3.39	3.80
4.0	3.03	2.69	2.62	2.73	2.91	2.85	3.38	4.15	4.70
5.0	3.91	3.27	3.11	3.22	3.45	3.37	4.03	4.97	5.62
6.0	5.08	3.98	3.69	3.78	4.06	3.97	4.76	5.86	5.64
7.0	6.65	4.85	4.38	4.43	4.76	4.64	5.55	6.80	7.68
8.0	8.73	5.91	5.18	5.16	5.53	5.37	6.39	7.79	8.69
10.0	1.52E1	8.76	7.22	6.93	7.37	7.04	8.25	9.89	1.08E1
15.0	6.04E1	2.31E1	1.62E1	1.37E1	1.39E1	1.26E1	1.39E1	1.59E1	1.67E1
20.0	2.35E2	5.89E1	3.46E1	2.50E1	2.39E1	2.01E1	2.06E1	2.25E1	2.27E1
25.0	8.83E2	1.46E2	7.12E1	4.31E1	3.85E1	2.98E1	2.84E1	2.95E1	2.88E1
30.0	3.22E3	3.49E2	1.41E2	7.10E1	5.89E1	4.18E1	3.70E1	3.69E1	3.48E1
35.0	1.14E4	8.15E2	2.73E2	1.13E2	8.67E1	5.64E1	4.63E1	4.46E1	4.07E1
40.0	3.96E4	1.86E3	5.12E2	1.74E2	1.24E2	7.37E1	5.62E1	5.25E1	4.65E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.64	1.70	1.72	1.78	1.72	1.58	1.41	1.13	1.38
1.0	2.17	2.23	2.22	2.25	2.10	1.82	1.51	1.17	1.46
2.0	3.13	3.18	3.05	3.00	2.65	2.14	1.64	1.23	1.48
3.0	4.09	4.10	3.82	3.67	3.11	2.39	1.74	1.27	1.49
4.0	4.99	4.93	4.51	4.23	3.48	2.59	1.81	1.31	1.50
5.0	5.89	5.75	5.16	4.76	3.82	2.76	1.86	1.34	1.51
6.0	6.91	6.68	5.89	5.35	4.19	2.94	1.92	1.36	1.52
7.0	7.92	7.59	6.58	5.90	4.52	3.10	1.98	1.38	1.53
8.0	8.91	8.46	7.25	6.42	4.82	3.25	2.02	1.40	1.54
10.0	1.10E1	1.03E1	8.63	7.48	5.42	3.53	2.11	1.44	1.55
15.0	1.66E1	1.50E1	1.21E1	1.01E1	6.83	4.18	2.29	1.50	1.58
20.0	2.24E1	1.99E1	1.56E1	1.26E1	8.07	4.74	2.45	1.54	1.61
25.0	2.82E1	2.46E1	1.89E1	1.49E1	9.15	5.20	2.58	1.58	1.62
30.0	3.41E1	2.92E1	2.21E1	1.71E1	1.01E1	5.59	2.69	1.61	1.64
35.0	3.99E1	3.37E1	2.52E1	1.92E1	1.10E1	5.93	2.79	1.63	1.65
40.0	4.56E1	3.81E1	2.81E1	2.11E1	1.19E1	6.23	2.87	1.66	1.66

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.41	1.41	1.40	1.40	1.01	1.00	1.00
1.0	1.60	1.74	1.80	1.86	1.01	1.00	1.00
2.0	1.73	2.34	2.78	3.27	1.02	1.01	1.00
3.0	1.75	2.97	4.29	6.11	1.02	1.01	1.00
4.0	1.76	3.75	6.90	1.23E1	1.02	1.01	1.00
5.0	1.76	4.76	1.15E1	2.60E1	1.03	1.01	1.00
6.0	1.75	6.08	1.96E1	5.59E1	1.03	1.01	1.00
7.0	1.75	7.91	3.34E1	1.12E2	1.03	1.01	1.01
8.0	1.75	1.03E1	5.45E1	2.28E2	1.03	1.01	1.01
10.0	1.74	1.78E1	1.52E2	9.59E2	1.04	1.01	1.01
15.0	1.74	8.63E1	2.36E3	3.72E4	1.04	1.02	1.01
20.0	1.75	5.60E2	4.41E4	1.57E6	1.05	1.02	1.01
25.0	1.75	4.12E3	9.27E5	7.03E7	1.06	1.02	1.01
30.0	1.77	3.17E4	2.08E7	3.30E9	1.06	1.02	1.01
35.0	1.78	2.48E5	4.83E8	1.61E11	1.06	1.02	1.01
40.0	1.78	1.97E6	1.14E10	8.08E12	1.07	1.02	1.01

Table 4
Energy Absorption Buildup Factors

Gadolinium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.30	1.33	1.37	1.42	1.45	1.37	1.42	1.45	1.48
1.0	1.52	1.54	1.57	1.63	1.67	1.57	1.68	1.81	1.92
2.0	1.93	1.88	1.88	1.94	2.03	1.92	2.17	2.53	2.74
3.0	2.46	2.28	2.23	2.30	2.41	2.29	2.67	3.20	3.55
4.0	3.18	2.79	2.65	2.71	2.86	2.73	3.22	3.88	4.32
5.0	4.17	3.42	3.16	3.18	3.38	3.22	3.82	4.60	5.10
6.0	5.51	4.21	3.76	3.74	3.97	3.78	4.49	5.38	5.95
7.0	7.33	5.18	4.48	4.38	4.64	4.41	5.22	6.20	6.81
8.0	9.79	6.38	5.33	5.11	5.40	5.10	6.00	7.05	7.64
10.0	1.76E1	9.68	7.52	6.89	7.20	6.69	7.71	8.83	9.37
15.0	7.67E1	2.72E1	1.74E1	1.38E1	1.37E1	1.20E1	1.29E1	1.38E1	1.39E1
20.0	3.26E2	7.41E1	3.88E1	2.60E1	2.41E1	1.94E1	1.92E1	1.92E1	1.85E1
25.0	1.34E3	1.96E2	8.35E1	4.63E1	3.96E1	2.93E1	2.65E1	2.48E1	2.30E1
30.0	5.33E3	5.04E2	1.74E2	7.91E1	6.21E1	4.18E1	3.47E1	3.06E1	2.74E1
35.0	2.07E4	1.26E3	3.53E2	1.31E2	9.38E1	5.75E1	4.38E1	3.66E1	3.16E1
40.0	7.82E4	3.08E3	6.98E2	2.09E2	1.37E2	7.64E1	5.35E1	4.26E1	3.57E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.59	1.63	1.60	1.67	1.60	1.49	1.40	1.37	1.44
1.0	2.05	2.07	1.99	2.03	1.88	1.65	1.47	1.42	1.64
2.0	2.86	2.82	2.61	2.57	2.26	1.87	1.56	1.46	1.80
3.0	3.63	3.51	3.16	3.03	2.56	2.04	1.63	1.49	1.84
4.0	4.33	4.12	3.62	3.40	2.80	2.16	1.67	1.52	1.85
5.0	5.02	4.70	4.06	3.75	3.01	2.27	1.71	1.55	1.86
6.0	5.80	5.35	4.53	4.13	3.23	2.39	1.75	1.57	1.86
7.0	6.55	5.96	4.98	4.47	3.43	2.49	1.79	1.59	1.85
8.0	7.28	6.55	5.40	4.79	3.61	2.58	1.82	1.60	1.85
10.0	8.78	7.73	6.25	5.44	3.96	2.75	1.87	1.63	1.85
15.0	1.27E1	1.07E1	8.30	6.94	4.74	3.14	2.00	1.69	1.85
20.0	1.65E1	1.34E1	1.02E1	8.29	5.39	3.45	2.09	1.73	1.85
25.0	2.02E1	1.60E1	1.19E1	9.48	5.94	3.71	2.18	1.76	1.86
30.0	2.39E1	1.85E1	1.35E1	1.06E1	6.42	3.93	2.25	1.78	1.87
35.0	2.74E1	2.08E1	1.50E1	1.16E1	6.86	4.11	2.31	1.80	1.88
40.0	3.08E1	2.30E1	1.64E1	1.25E1	7.25	4.27	2.36	1.82	1.89

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.44	1.43	1.02	1.01	1.01	1.00	1.00
1.0	1.77	1.87	1.03	1.02	1.01	1.00	1.00
2.0	2.31	3.03	1.04	1.02	1.01	1.00	1.00
3.0	2.79	4.97	1.05	1.03	1.01	1.01	1.00
4.0	3.31	8.53	1.06	1.03	1.02	1.01	1.00
5.0	3.91	1.53E1	1.07	1.04	1.02	1.01	1.00
6.0	4.61	2.78E1	1.07	1.04	1.02	1.01	1.00
7.0	5.50	4.97E1	1.08	1.04	1.02	1.01	1.00
8.0	6.67	8.66E1	1.09	1.05	1.02	1.01	1.00
10.0	9.74	2.73E2	1.10	1.05	1.02	1.01	1.00
15.0	3.20E1	5.58E3	1.12	1.06	1.03	1.01	1.01
20.0	1.38E2	1.34E5	1.13	1.07	1.04	1.01	1.01
25.0	6.70E2	3.57E6	1.15	1.08	1.04	1.01	1.01
30.0	3.43E3	1.01E8	1.16	1.09	1.04	1.01	1.01
35.0	1.80E4	2.98E9	1.17	1.09	1.04	1.02	1.01
40.0	9.60E4	8.95E10	1.18	1.10	1.05	1.02	1.01

Table 4
Energy Absorption Buildup Factors

Tungsten

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.28	1.31	1.35	1.40	1.42	1.38	1.43	1.45	1.47
1.0	1.51	1.51	1.53	1.58	1.60	1.54	1.64	1.77	1.87
2.0	1.91	1.84	1.82	1.87	1.91	1.84	2.07	2.39	2.55
3.0	2.45	2.24	2.16	2.20	2.25	2.18	2.52	2.96	3.20
4.0	3.21	2.76	2.58	2.58	2.64	2.57	3.01	3.53	3.79
5.0	4.25	3.41	3.07	3.03	3.08	3.02	3.54	4.13	4.39
6.0	5.70	4.23	3.66	3.55	3.60	3.53	4.13	4.77	5.04
7.0	7.71	5.26	4.38	4.15	4.18	4.09	4.76	5.43	5.66
8.0	1.05E1	6.56	5.23	4.83	4.84	4.71	5.43	6.11	6.28
10.0	1.96E1	1.02E1	7.47	6.54	6.42	6.15	6.91	7.52	7.51
15.0	9.40E1	3.11E1	1.80E1	1.34E1	1.23E1	1.10E1	1.14E1	1.13E1	1.06E1
20.0	4.42E2	9.31E1	4.25E1	2.60E1	2.18E1	1.79E1	1.67E1	1.53E1	1.36E1
25.0	2.01E3	2.71E2	9.74E1	4.85E1	3.67E1	2.72E1	2.29E1	1.94E1	1.64E1
30.0	8.87E3	7.69E2	2.17E2	8.69E1	5.91E1	3.94E1	2.99E1	2.35E1	1.90E1
35.0	3.82E4	2.13E3	4.73E2	1.51E2	9.21E1	5.50E1	3.76E1	2.77E1	2.16E1
40.0	1.61E5	5.74E3	1.01E3	2.56E2	1.39E2	7.44E1	4.59E1	3.18E1	2.40E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.52	1.57	1.49	1.55	1.50	1.44	1.45	1.45	1.47
1.0	1.89	1.93	1.77	1.80	1.68	1.55	1.52	1.62	1.86
2.0	2.48	2.48	2.19	2.10	1.86	1.63	1.49	1.61	2.46
3.0	3.03	2.97	2.53	2.31	1.98	1.65	1.42	1.47	3.02
4.0	3.50	3.38	2.81	2.52	2.11	1.72	1.44	1.45	3.87
5.0	3.95	3.76	3.08	2.71	2.22	1.78	1.47	1.45	5.00
6.0	4.45	4.18	3.35	2.91	2.34	1.84	1.49	1.46	6.51
7.0	4.91	4.56	3.60	3.08	2.44	1.90	1.51	1.47	8.82
8.0	5.36	4.92	3.83	3.24	2.54	1.95	1.53	1.47	1.19E1
10.0	6.23	5.63	4.29	3.56	2.71	2.04	1.56	1.49	2.28E1
15.0	8.34	7.28	5.33	4.26	3.09	2.24	1.63	1.51	1.48E2
20.0	1.03E1	8.73	6.24	4.85	3.39	2.40	1.68	1.54	1.18E3
25.0	1.20E1	1.00E1	7.02	5.34	3.64	2.52	1.73	1.55	1.02E4
30.0	1.36E1	1.12E1	7.71	5.78	3.85	2.62	1.76	1.57	9.01E4
35.0	1.52E1	1.23E1	8.34	6.17	4.04	2.71	1.80	1.58	8.23E5
40.0	1.66E1	1.33E1	8.91	6.52	4.21	2.78	1.83	1.59	7.53E6

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.47	1.02	1.01	1.01	1.00	1.00	1.00
1.0	1.95	1.03	1.02	1.01	1.01	1.00	1.00
2.0	3.07	1.04	1.03	1.02	1.01	1.00	1.00
3.0	4.90	1.05	1.03	1.02	1.01	1.00	1.00
4.0	8.47	1.06	1.04	1.02	1.01	1.00	1.00
5.0	1.50E1	1.06	1.04	1.02	1.01	1.00	1.00
6.0	2.65E1	1.07	1.04	1.02	1.01	1.00	1.00
7.0	4.74E1	1.08	1.05	1.03	1.01	1.00	1.00
8.0	8.42E1	1.08	1.05	1.03	1.01	1.01	1.00
10.0	2.75E2	1.09	1.06	1.03	1.02	1.01	1.00
15.0	6.04E3	1.11	1.07	1.04	1.02	1.01	1.00
20.0	1.52E5	1.13	1.08	1.05	1.02	1.01	1.00
25.0	4.16E6	1.14	1.09	1.05	1.02	1.01	1.00
30.0	1.20E8	1.15	1.10	1.05	1.03	1.01	1.01
35.0	3.57E9	1.16	1.10	1.06	1.03	1.01	1.01
40.0	1.08E11	1.17	1.11	1.06	1.03	1.01	1.01

Table 4
Energy Absorption Buildup Factors

Lead

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.32	1.36	1.39	1.44	1.47	1.51	1.43	1.42	1.37
1.0	1.53	1.54	1.55	1.59	1.62	1.69	1.63	1.69	1.66
2.0	1.91	1.86	1.83	1.87	1.92	2.03	2.01	2.20	2.19
3.0	2.43	2.26	2.16	2.19	2.26	2.42	2.43	2.70	2.67
4.0	3.16	2.77	2.56	2.55	2.64	2.84	2.85	3.17	3.08
5.0	4.17	3.41	3.04	2.97	3.07	3.30	3.31	3.64	3.49
6.0	5.56	4.20	3.61	3.45	3.56	3.81	3.80	4.13	3.89
7.0	7.48	5.21	4.30	4.00	4.12	4.37	4.33	4.65	4.31
8.0	1.01E1	6.45	5.12	4.64	4.75	4.99	4.89	5.17	4.72
10.0	1.89E1	9.95	7.25	6.19	6.24	6.40	6.11	6.23	5.50
15.0	9.01E1	2.94E1	1.72E1	1.23E1	1.17E1	1.10E1	9.69	9.00	7.36
20.0	4.23E2	8.59E1	4.02E1	2.35E1	2.06E1	1.75E1	1.39E1	1.18E1	9.06
25.0	1.94E3	2.45E2	9.17E1	4.32E1	3.44E1	2.61E1	1.86E1	1.46E1	1.07E1
30.0	8.63E3	6.82E2	2.04E2	7.66E1	5.52E1	3.73E1	2.38E1	1.75E1	1.22E1
35.0	3.75E4	1.85E3	4.45E2	1.32E2	8.58E1	5.13E1	2.95E1	2.03E1	1.36E1
40.0	1.60E5	4.94E3	9.52E2	2.22E2	1.30E2	6.84E1	3.54E1	2.31E1	1.50E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.32	1.30	1.25	1.20	1.15	1.40	1.46	1.48	1.48
1.0	1.58	1.52	1.42	1.32	1.23	1.48	1.60	1.78	1.98
2.0	2.06	1.93	1.71	1.55	1.38	1.58	1.67	2.13	3.28
3.0	2.47	2.26	1.94	1.72	1.49	1.66	1.69	2.33	5.38
4.0	2.80	2.51	2.11	1.84	1.57	1.72	1.71	2.48	9.19
5.0	3.12	2.75	2.27	1.95	1.63	1.77	1.73	2.60	1.62E1
6.0	3.43	2.97	2.41	2.05	1.69	1.81	1.75	2.70	2.91E1
7.0	3.74	3.20	2.55	2.16	1.75	1.85	1.76	2.80	5.22E1
8.0	4.05	3.42	2.68	2.26	1.81	1.89	1.78	2.91	8.98E1
10.0	4.64	3.83	2.93	2.44	1.90	1.94	1.80	3.14	2.77E2
15.0	5.99	4.70	3.44	2.81	2.10	2.06	1.85	3.89	5.35E3
20.0	7.24	5.49	3.87	3.14	2.26	2.14	1.89	4.78	1.22E5
25.0	8.44	6.19	4.23	3.43	2.40	2.20	1.92	6.13	3.06E6
30.0	9.57	6.82	4.57	3.69	2.54	2.26	1.95	8.32	8.17E7
35.0	1.06E1	7.40	4.89	3.93	2.66	2.31	1.97	1.19E1	2.25E9
40.0	1.16E1	7.95	5.20	4.15	2.76	2.36	1.99	1.81E1	6.30E10

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.03	1.02	1.01	1.01	1.00		
1.0	1.04	1.02	1.01	1.01	1.00		
2.0	1.06	1.03	1.02	1.01	1.01		
3.0	1.08	1.04	1.02	1.01	1.01		
4.0	1.09	1.04	1.03	1.01	1.01		
5.0	1.10	1.04	1.03	1.02	1.01		
6.0	1.11	1.05	1.03	1.02	1.01		
7.0	1.11	1.05	1.03	1.02	1.01		
8.0	1.12	1.06	1.04	1.02	1.01		
10.0	1.14	1.06	1.04	1.02	1.01		
15.0	1.16	1.08	1.05	1.03	1.01		
20.0	1.18	1.09	1.06	1.03	1.02		
25.0	1.20	1.10	1.07	1.04	1.02		
30.0	1.21	1.11	1.08	1.04	1.02		
35.0	1.22	1.11	1.08	1.04	1.02		
40.0	1.24	1.12	1.09	1.04	1.02		

Table 4
Energy Absorption Buildup Factors

Uranium

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.33	1.36	1.40	1.44	1.46	1.48	1.49	1.46	1.38
1.0	1.53	1.54	1.55	1.58	1.61	1.62	1.68	1.70	1.63
2.0	1.91	1.86	1.83	1.82	1.86	1.92	2.03	2.15	2.10
3.0	2.42	2.26	2.15	2.10	2.15	2.25	2.41	2.57	2.49
4.0	3.13	2.76	2.54	2.41	2.47	2.61	2.80	2.97	2.83
5.0	4.10	3.38	2.99	2.77	2.83	2.99	3.21	3.37	3.14
6.0	5.43	4.14	3.52	3.18	3.23	3.41	3.65	3.79	3.46
7.0	7.25	5.09	4.14	3.65	3.69	3.88	4.12	4.23	3.78
8.0	9.76	6.27	4.89	4.17	4.20	4.38	4.61	4.66	4.10
10.0	1.79E1	9.53	6.80	5.45	5.39	5.51	5.67	5.53	4.70
15.0	8.26E1	2.71E1	1.54E1	1.03E1	9.64	9.14	8.67	7.76	6.13
20.0	3.77E2	7.64E1	3.42E1	1.89E1	1.63E1	1.40E1	1.21E1	9.98	7.47
25.0	1.68E3	2.11E2	7.47E1	3.35E1	2.65E1	2.04E1	1.59E1	1.22E1	8.72
30.0	7.32E3	5.70E2	1.60E2	5.76E1	4.16E1	2.85E1	1.99E1	1.44E1	9.96
35.0	3.12E4	1.51E3	3.35E2	9.67E1	6.33E1	3.84E1	2.43E1	1.66E1	1.13E1
40.0	1.30E5	3.92E3	6.92E2	1.59E2	9.41E1	5.05E1	2.88E1	1.88E1	1.27E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.35	1.35	1.34	1.35	1.38	1.43	1.48	1.49	1.06
1.0	1.58	1.55	1.48	1.46	1.45	1.54	1.76	1.92	1.08
2.0	1.99	1.90	1.73	1.64	1.58	1.61	2.06	2.82	1.09
3.0	2.29	2.14	1.90	1.77	1.66	1.66	2.21	3.91	1.11
4.0	2.55	2.34	2.03	1.87	1.73	1.70	2.29	5.45	1.12
5.0	2.80	2.53	2.16	1.96	1.79	1.73	2.36	7.71	1.13
6.0	3.04	2.71	2.28	2.04	1.84	1.77	2.40	1.10E1	1.14
7.0	3.28	2.88	2.40	2.12	1.89	1.79	2.44	1.61E1	1.16
8.0	3.51	3.04	2.52	2.19	1.94	1.82	2.47	2.32E1	1.16
10.0	3.93	3.35	2.73	2.33	2.02	1.86	2.54	4.87E1	1.18
15.0	4.85	3.97	3.13	2.59	2.18	1.94	2.68	3.92E2	1.21
20.0	5.69	4.52	3.47	2.82	2.32	1.99	2.80	3.98E3	1.23
25.0	6.45	4.98	3.75	3.02	2.44	2.04	2.86	4.47E4	1.24
30.0	7.18	5.40	4.00	3.19	2.55	2.08	2.92	5.23E5	1.26
35.0	7.83	5.78	4.22	3.35	2.65	2.11	2.98	6.25E6	1.27
40.0	8.43	6.16	4.43	3.51	2.74	2.15	3.04	7.54E7	1.28

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	1.02	1.01	1.01	1.00	1.00		
1.0	1.03	1.01	1.01	1.01	1.00		
2.0	1.04	1.02	1.01	1.01	1.00		
3.0	1.05	1.02	1.02	1.01	1.00		
4.0	1.06	1.03	1.02	1.01	1.01		
5.0	1.06	1.03	1.02	1.01	1.01		
6.0	1.07	1.03	1.02	1.01	1.01		
7.0	1.07	1.04	1.02	1.01	1.01		
8.0	1.08	1.04	1.03	1.01	1.01		
10.0	1.09	1.04	1.03	1.02	1.01		
15.0	1.11	1.05	1.03	1.02	1.01		
20.0	1.12	1.06	1.04	1.02	1.01		
25.0	1.13	1.07	1.04	1.03	1.01		
30.0	1.14	1.07	1.05	1.03	1.01		
35.0	1.15	1.08	1.05	1.03	1.01		
40.0	1.16	1.08	1.05	1.03	1.02		

Table 4
Energy Absorption Buildup Factors

Water

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.16	1.21	1.23	1.27	1.29	1.31	1.34	1.38	1.42
1.0	1.29	1.38	1.44	1.55	1.57	1.63	1.71	1.83	1.93
2.0	1.51	1.70	1.82	1.98	2.10	2.26	2.47	2.82	3.11
3.0	1.72	2.00	2.17	2.43	2.62	2.87	3.24	3.87	4.44
4.0	1.93	2.29	2.52	2.87	3.12	3.48	4.01	4.99	5.90
5.0	2.14	2.57	2.86	3.31	3.63	4.09	4.81	6.16	7.47
6.0	2.34	2.85	3.20	3.74	4.14	4.71	5.62	7.38	9.14
7.0	2.53	3.13	3.53	4.16	4.64	5.33	6.45	8.66	10.9
8.0	2.73	3.40	3.86	4.59	5.14	5.95	7.28	9.97	12.8
10.0	3.11	3.94	4.51	5.43	6.14	7.20	8.98	12.7	16.8
15.0	4.04	5.24	6.08	7.49	8.62	10.3	13.4	20.1	27.9
20.0	4.93	6.51	7.61	9.52	11.1	13.5	17.8	28.0	40.4
25.0	5.81	7.75	9.10	11.5	13.5	16.6	22.4	36.4	54.1
30.0	6.64	8.97	10.6	13.5	15.9	19.8	27.1	45.2	68.8
35.0	7.42	10.2	12.2	15.5	18.3	23.0	31.8	54.3	84.4
40.0	8.09	11.3	14.1	17.9	20.7	26.1	36.5	63.6	101.

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.51	1.56	1.61	1.66	1.75	1.92	2.07	2.36
1.0	2.08	2.18	2.34	2.45	2.60	2.84	3.42	3.91	4.52
2.0	3.62	3.96	4.48	4.87	5.42	6.25	8.22	9.36	1.17E1
3.0	5.50	6.24	7.40	8.29	9.56	1.15E1	1.57E1	1.86E1	2.35E1
4.0	7.66	8.96	1.11E1	1.27E1	1.51E1	1.90E1	2.64E1	3.25E1	4.06E1
5.0	1.01E1	1.21E1	1.54E1	1.81E1	2.22E1	2.88E1	4.13E1	5.20E1	6.40E1
6.0	1.28E1	1.56E1	2.06E1	2.46E1	3.08E1	4.12E1	6.10E1	7.79E1	9.48E1
7.0	1.57E1	1.96E1	2.64E1	3.22E1	4.11E1	5.65E1	8.62E1	1.11E2	1.34E2
8.0	1.89E1	2.40E1	3.30E1	4.08E1	5.32E1	7.50E1	1.18E2	1.53E2	1.83E2
10.0	2.60E1	3.39E1	4.87E1	6.18E1	8.32E1	1.22E2	2.02E2	2.68E2	3.14E2
15.0	4.74E1	6.56E1	1.02E2	1.37E2	1.97E2	3.18E2	5.82E2	8.05E2	9.17E2
20.0	7.35E1	1.06E2	1.76E2	2.47E2	3.77E2	6.56E2	1.31E3	1.89E3	2.12E3
25.0	1.04E2	1.56E2	2.72E2	3.95E2	6.32E2	1.18E3	2.58E3	3.84E3	4.26E3
30.0	1.38E2	2.13E2	3.88E2	5.82E2	9.72E2	1.93E3	4.64E3	7.05E3	7.78E3
35.0	1.75E2	2.77E2	5.25E2	8.09E2	1.40E3	2.95E3	7.89E3	1.21E4	1.31E4
40.0	2.14E2	3.49E2	6.83E2	1.08E3	1.94E3	4.28E3	1.28E4	1.96E4	2.03E4

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.54	2.63	2.55	2.27	1.81	1.29	1.13
1.0	4.93	4.94	4.51	3.58	2.43	1.45	1.19
2.0	1.25E1	1.15E1	9.49	6.41	3.46	1.70	1.28
3.0	2.43E1	2.06E1	1.57E1	9.50	4.41	1.89	1.34
4.0	4.08E1	3.24E1	2.32E1	1.28E1	5.32	2.05	1.40
5.0	6.27E1	4.69E1	3.18E1	1.63E1	6.18	2.19	1.44
6.0	9.06E1	6.43E1	4.16E1	1.99E1	7.01	2.31	1.48
7.0	1.25E2	8.48E1	5.26E1	2.38E1	7.81	2.43	1.51
8.0	1.67E2	1.09E2	6.49E1	2.78E1	8.61	2.53	1.54
10.0	2.78E2	1.67E2	9.33E1	3.65E1	1.02E1	2.72	1.59
15.0	7.54E2	3.90E2	1.90E2	6.16E1	1.41E1	3.13	1.69
20.0	1.65E3	7.58E2	3.31E2	9.21E1	1.81E1	3.47	1.77
25.0	3.16E3	1.32E3	5.25E2	1.28E2	2.23E1	3.76	1.83
30.0	5.56E3	2.14E3	7.79E2	1.69E2	2.67E1	4.03	1.88
35.0	9.19E3	3.27E3	1.10E3	2.16E2	3.13E1	4.25	1.93
40.0	1.45E4	4.82E3	1.51E3	2.69E2	3.59E1	4.43	1.96

Table 4
Energy Absorption Buildup Factors

Air

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.15	1.20	1.23	1.27	1.29	1.31	1.34	1.38	1.42
1.0	1.28	1.37	1.43	1.52	1.57	1.63	1.71	1.83	1.92
2.0	1.49	1.68	1.80	1.97	2.09	2.25	2.46	2.81	3.09
3.0	1.70	1.97	2.15	2.41	2.60	2.85	3.22	3.86	4.42
4.0	1.90	2.26	2.50	2.85	3.11	3.46	4.00	4.96	5.86
5.0	2.11	2.54	2.84	3.28	3.61	4.07	4.79	6.13	7.42
6.0	2.30	2.82	3.17	3.71	4.12	4.69	5.60	7.35	9.08
7.0	2.50	3.10	3.51	4.14	4.62	5.31	6.43	8.61	10.8
8.0	2.70	3.37	3.84	4.57	5.12	5.94	7.26	9.92	12.7
10.0	3.08	3.92	4.49	5.42	6.13	7.19	8.97	12.6	16.7
15.0	4.03	5.25	6.08	7.51	8.63	10.3	13.4	20.0	27.7
20.0	4.96	6.55	7.64	9.58	11.1	13.5	17.9	27.9	40.2
25.0	5.87	7.84	9.17	11.6	13.6	16.7	22.5	36.2	53.9
30.0	6.75	9.11	10.7	13.6	16.1	19.9	27.2	45.0	68.5
35.0	7.58	10.4	12.3	15.4	18.5	23.1	32.0	54.0	84.0
40.0	8.31	11.6	14.1	16.9	21.0	26.3	36.7	63.2	100.

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.47	1.50	1.56	1.60	1.66	1.75	1.90	2.16	2.35
1.0	2.08	2.17	2.33	2.44	2.59	2.83	3.28	3.83	4.46
2.0	3.60	3.94	4.46	4.84	5.37	6.20	7.74	9.21	1.14E1
3.0	5.46	6.19	7.34	8.21	9.45	1.14E1	1.50E1	1.82E1	2.25E1
4.0	7.60	8.88	1.09E1	1.26E1	1.49E1	1.87E1	2.56E1	3.15E1	3.84E1
5.0	1.00E1	1.20E1	1.53E1	1.79E1	2.18E1	2.82E1	4.00E1	4.99E1	5.99E1
6.0	1.27E1	1.55E1	2.03E1	2.42E1	3.02E1	4.02E1	5.89E1	7.42E1	8.78E1
7.0	1.56E1	1.94E1	2.60E1	3.16E1	4.02E1	5.49E1	8.28E1	1.05E2	1.23E2
8.0	1.88E1	2.37E1	3.25E1	4.01E1	5.20E1	7.27E1	1.12E2	1.44E2	1.66E2
10.0	2.58E1	3.35E1	4.79E1	6.06E1	8.11E1	1.18E2	1.92E2	2.49E2	2.82E2
15.0	4.70E1	6.49E1	1.00E2	1.34E2	1.91E2	3.04E2	5.45E2	7.35E2	8.00E2
20.0	7.28E1	1.05E2	1.73E2	2.41E2	3.65E2	6.24E2	1.22E3	1.70E3	1.81E3
25.0	1.03E2	1.54E2	2.66E2	3.85E2	6.11E2	1.12E3	2.36E3	3.41E3	3.57E3
30.0	1.36E2	2.10E2	3.79E2	5.67E2	9.38E2	1.82E3	4.15E3	6.21E3	6.43E3
35.0	1.73E2	2.74E2	5.12E2	7.88E2	1.35E3	2.77E3	6.77E3	1.05E4	1.06E4
40.0	2.12E2	3.45E2	6.65E2	1.05E3	1.87E3	4.01E3	1.05E4	1.70E4	1.57E4

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.52	2.58	2.48	2.20	1.76	1.27	1.12
1.0	4.83	4.76	4.28	3.38	2.31	1.41	1.17
2.0	1.20E1	1.08E1	8.72	5.85	3.19	1.62	1.25
3.0	2.29E1	1.89E1	1.41E1	8.47	3.99	1.79	1.31
4.0	3.79E1	2.91E1	2.05E1	1.12E1	4.75	1.93	1.36
5.0	5.74E1	4.15E1	2.76E1	1.41E1	5.46	2.04	1.39
6.0	8.20E1	5.61E1	3.57E1	1.70E1	6.14	2.15	1.43
7.0	1.12E2	7.32E1	4.46E1	2.01E1	6.79	2.25	1.46
8.0	1.48E2	9.27E1	5.44E1	2.33E1	7.43	2.34	1.48
10.0	2.42E2	1.40E2	7.68E1	3.00E1	8.69	2.50	1.53
15.0	6.36E2	3.16E2	1.51E2	4.90E1	1.18E1	2.83	1.62
20.0	1.35E3	5.96E2	2.56E2	7.14E1	1.48E1	3.11	1.68
25.0	2.54E3	1.01E3	3.95E2	9.72E1	1.80E1	3.35	1.74
30.0	4.39E3	1.60E3	5.74E2	1.26E2	2.15E1	3.56	1.78
35.0	7.14E3	2.41E3	7.98E2	1.59E2	2.54E1	3.74	1.82
40.0	1.11E4	3.48E3	1.07E3	1.95E2	2.97E1	3.88	1.85

Table 4
Energy Absorption Buildup Factors

Concrete

	Energy (Mev)								
R(mfp)	15	10	8	6	5	4	3	2	1.5
0.5	1.13	1.18	1.21	1.25	1.32	1.31	1.34	1.39	1.42
1.0	1.24	1.34	1.40	1.48	1.57	1.62	1.70	1.83	1.93
2.0	1.42	1.61	1.74	1.92	2.05	2.22	2.44	2.80	3.08
3.0	1.61	1.88	2.07	2.35	2.54	2.81	3.19	3.82	4.36
4.0	1.80	2.16	2.40	2.77	3.04	3.41	3.96	4.92	5.77
5.0	1.99	2.43	2.73	3.20	3.55	4.03	4.76	6.07	7.28
6.0	2.18	2.71	3.07	3.64	4.06	4.66	5.58	7.28	8.90
7.0	2.38	2.99	3.41	4.08	4.58	5.29	6.42	8.55	1.06E1
8.0	2.58	3.28	3.76	4.52	5.10	5.94	7.27	9.86	1.24E1
10.0	3.00	3.85	4.45	5.42	6.16	7.24	9.02	1.26E1	1.63E1
15.0	4.08	5.33	6.21	7.70	8.86	1.06E1	1.36E1	2.00E1	2.71E1
20.0	5.23	6.86	8.00	1.00E1	1.16E1	1.41E1	1.84E1	2.81E1	3.93E1
25.0	6.45	8.45	9.83	1.24E1	1.44E1	1.76E1	2.33E1	3.67E1	5.26E1
30.0	7.71	1.01E1	1.17E1	1.47E1	1.73E1	2.12E1	2.84E1	4.57E1	6.70E1
35.0	8.97	1.17E1	1.37E1	1.68E1	2.02E1	2.48E1	3.36E1	5.50E1	8.21E1
40.0	10.2	1.34E1	1.60E1	1.86E1	2.39E1	2.85E1	3.88E1	6.46E1	9.80E1

	Energy (Mev)								
R(mfp)	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1
0.5	1.49	1.53	1.60	1.66	1.73	1.86	2.11	2.32	2.39
1.0	2.11	2.22	2.41	2.55	2.74	3.06	3.65	4.04	3.89
2.0	3.59	3.94	4.48	4.89	5.46	6.32	7.69	8.29	7.06
3.0	5.35	6.03	7.10	7.89	9.00	1.06E1	1.29E1	1.35E1	1.04E1
4.0	7.35	8.48	1.03E1	1.16E1	1.34E1	1.60E1	1.93E1	1.96E1	1.41E1
5.0	9.61	1.13E1	1.40E1	1.60E1	1.87E1	2.25E1	2.70E1	2.67E1	1.79E1
6.0	1.21E1	1.45E1	1.82E1	2.11E1	2.50E1	3.03E1	3.60E1	3.48E1	2.21E1
7.0	1.48E1	1.80E1	2.31E1	2.70E1	3.23E1	3.95E1	4.66E1	4.40E1	2.66E1
8.0	1.78E1	2.19E1	2.86E1	3.37E1	4.07E1	5.01E1	5.88E1	5.45E1	3.15E1
10.0	2.43E1	3.07E1	4.13E1	4.96E1	6.09E1	7.62E1	8.85E1	7.91E1	4.21E1
15.0	4.40E1	5.85E1	8.40E1	1.05E2	1.34E2	1.74E2	1.99E2	1.65E2	7.47E1
20.0	6.79E1	9.41E1	1.42E2	1.83E2	2.43E2	3.26E2	3.72E2	2.92E2	1.16E2
25.0	9.55E1	1.37E2	2.16E2	2.86E2	3.92E2	5.43E2	6.20E2	4.63E2	1.65E2
30.0	1.26E2	1.86E2	3.05E2	4.14E2	5.83E2	8.34E2	9.58E2	6.86E2	2.22E2
35.0	1.60E2	2.42E2	4.08E2	5.67E2	8.20E2	1.21E3	1.40E3	9.63E2	2.86E2
40.0	1.97E2	3.03E2	5.27E2	7.47E2	1.10E3	1.67E3	1.94E3	1.30E3	3.58E2

	Energy (Mev)						
R(mfp)	0.08	0.06	0.05	0.04	0.03	0.02	0.015
0.5	2.19	1.68	1.48	1.31	1.15	1.05	1.02
1.0	3.27	2.25	1.83	1.47	1.22	1.07	1.03
2.0	5.30	3.25	2.40	1.72	1.31	1.09	1.04
3.0	7.26	4.02	2.78	1.90	1.38	1.11	1.05
4.0	9.21	4.74	3.12	2.04	1.43	1.13	1.05
5.0	1.12E1	5.43	3.43	2.17	1.47	1.14	1.06
6.0	1.32E1	6.08	3.73	2.28	1.51	1.15	1.06
7.0	1.53E1	6.72	4.01	2.39	1.55	1.16	1.07
8.0	1.74E1	7.35	4.27	2.48	1.58	1.17	1.07
10.0	2.19E1	8.59	4.77	2.66	1.63	1.18	1.08
15.0	3.41E1	1.16E1	5.89	3.02	1.74	1.21	1.09
20.0	4.76E1	1.45E1	6.88	3.31	1.82	1.22	1.09
25.0	6.24E1	1.74E1	7.80	3.57	1.89	1.24	1.10
30.0	7.83E1	2.00E1	8.64	3.79	1.95	1.25	1.11
35.0	9.53E1	2.23E1	9.36	3.96	1.99	1.27	1.11
40.0	1.13E2	2.39E1	9.93	4.08	2.02	1.27	1.11

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Beryllium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	2.597	0.964	0.020	12.81	−0.0195	2.76%	0.5	1.234%
0.020	3.819	1.501	−0.086	16.20	0.0274	2.77%	0.5	0.869%
0.030	5.682	2.348	−0.190	14.96	0.0674	1.84%	15.0	1.153%
0.040	5.706	2.771	−0.222	14.91	0.0771	2.04%	15.0	1.289%
0.050	5.186	2.923	−0.229	15.43	0.0747	2.00%	15.0	1.126%
0.060	4.750	2.950	−0.227	16.03	0.0689	2.03%	0.5	0.971%
0.080	4.196	2.877	−0.217	17.74	0.0596	2.75%	0.5	1.034%
0.100	3.842	2.783	−0.210	19.63	0.0630	2.56%	0.5	1.019%
0.150	3.212	2.600	−0.199	19.35	0.0582	1.58%	0.5	0.660%
0.200	3.098	2.416	−0.189	17.56	0.0573	1.71%	0.5	0.625%
0.300	2.722	2.183	−0.175	15.88	0.0592	1.47%	15.0	0.807%
0.400	2.519	2.060	−0.168	15.38	0.0640	2.88%	0.5	1.251%
0.500	2.395	1.912	−0.154	14.75	0.0605	2.20%	15.0	1.160%
0.600	2.287	1.810	−0.144	14.46	0.0619	2.26%	15.0	1.300%
0.800	2.159	1.632	−0.121	13.99	0.0528	1.74%	25.0	1.176%
1.000	2.081	1.491	−0.099	14.06	0.0439	1.51%	1.0	1.016%
1.500	1.933	1.296	−0.065	13.59	0.0291	1.49%	0.5	0.758%
2.000	1.837	1.182	−0.042	13.81	0.0193	1.30%	0.5	0.622%
3.000	1.712	1.060	−0.015	13.20	0.0073	0.74%	0.5	0.298%
4.000	1.639	0.978	0.006	13.80	−0.0039	0.89%	0.5	0.316%
5.000	1.575	0.941	0.015	13.97	−0.0071	0.39%	2.0	0.196%
6.000	1.535	0.897	0.028	13.94	−0.0143	0.49%	25.0	0.304%
8.000	1.455	0.869	0.036	10.77	−0.0140	0.58%	30.0	0.287%
10.000	1.405	0.842	0.044	13.44	−0.0218	0.64%	35.0	0.371%
15.000	1.313	0.818	0.051	13.60	−0.0256	1.21%	0.5	0.474%

G-P Exposure Buildup Factor Coefficients

Beryllium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	2.527	0.957	0.023	12.01	−0.0216	3.01%	0.5	1.237%
0.020	3.834	1.517	−0.089	16.27	0.0300	2.25%	0.5	0.788%
0.030	6.543	2.464	−0.204	14.71	0.0774	2.52%	25.0	1.471%
0.040	8.672	3.150	−0.260	14.20	0.1068	3.59%	10.0	2.348%
0.050	9.770	3.613	−0.292	14.02	0.1238	4.49%	10.0	2.847%
0.060	9.823	3.916	−0.311	13.93	0.1334	4.85%	10.0	3.133%
0.080	8.582	4.200	−0.328	14.01	0.1398	4.98%	25.0	3.145%
0.100	7.303	4.252	−0.333	14.11	0.1406	4.64%	25.0	2.996%
0.150	4.983	4.136	−0.331	14.43	0.1391	4.28%	35.0	2.596%
0.200	4.396	3.877	−0.323	14.44	0.1425	4.45%	35.0	2.612%
0.300	3.448	3.442	−0.304	14.20	0.1422	4.80%	25.0	2.833%
0.400	3.218	3.046	−0.280	14.18	0.1370	4.37%	15.0	2.652%
0.500	2.793	2.934	−0.281	13.44	0.1494	5.92%	35.0	3.826%
0.600	2.654	2.672	−0.261	13.20	0.1435	5.82%	10.0	3.747%
0.800	2.505	2.225	−0.215	13.24	0.1211	6.14%	1.0	3.848%
1.000	2.330	1.997	−0.190	12.98	0.1115	7.37%	1.0	4.366%
1.500	2.150	1.549	−0.122	13.00	0.0757	6.41%	0.5	3.260%
2.000	2.061	1.284	−0.069	13.26	0.0434	4.27%	0.5	1.857%
3.000	1.863	1.087	−0.024	13.06	0.0168	2.95%	0.5	1.072%
4.000	1.740	0.986	0.002	9.42	0.0022	1.59%	0.5	0.593%
5.000	1.641	0.932	0.017	17.21	−0.0085	1.30%	0.5	0.487%
6.000	1.584	0.886	0.031	14.51	−0.0159	0.96%	0.5	0.450%
8.000	1.480	0.851	0.041	14.63	−0.0207	0.69%	25.0	0.393%
10.000	1.437	0.772	0.071	14.24	−0.0469	3.49%	0.5	1.311%
15.000	1.306	0.802	0.057	12.34	−0.0247	0.83%	35.0	0.445%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Boron

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.752	0.678	0.097	15.02	−0.0473	2.16%	0.5	0.813%
0.020	2.694	0.953	0.023	15.10	−0.0242	2.59%	0.5	1.018%
0.030	4.721	1.627	−0.110	14.85	0.0449	1.31%	15.0	0.705%
0.040	5.549	2.219	−0.182	14.33	0.0778	2.46%	35.0	1.455%
0.050	5.727	2.489	−0.204	14.75	0.0837	2.43%	15.0	1.228%
0.060	5.340	2.667	−0.218	14.84	0.0878	2.40%	15.0	1.140%
0.080	4.566	2.791	−0.226	14.99	0.0860	2.05%	15.0	1.065%
0.100	4.037	2.781	−0.224	15.38	0.0818	1.92%	15.0	0.989%
0.150	3.648	2.431	−0.189	17.16	0.0543	7.34%	3.0	3.542%
0.200	3.253	2.328	−0.183	17.94	0.0629	6.91%	3.0	3.361%
0.300	2.723	2.212	−0.183	15.15	0.0714	2.54%	3.0	1.109%
0.400	2.533	2.027	−0.167	14.34	0.0653	2.02%	15.0	1.129%
0.500	2.430	1.860	−0.148	14.53	0.0607	2.02%	15.0	1.062%
0.600	2.358	1.720	−0.129	14.73	0.0510	2.14%	2.0	1.067%
0.800	2.186	1.588	−0.113	14.15	0.0485	1.86%	25.0	1.030%
1.000	2.086	1.475	−0.096	13.96	0.0419	1.76%	1.0	1.118%
1.500	1.935	1.285	−0.062	14.35	0.0279	1.65%	0.5	0.798%
2.000	1.833	1.183	−0.042	14.13	0.0192	1.16%	0.5	0.572%
3.000	1.715	1.054	−0.013	12.91	0.0054	0.90%	0.5	0.292%
4.000	1.630	0.986	0.004	14.96	−0.0035	0.48%	0.5	0.186%
5.000	1.571	0.938	0.017	13.83	−0.0100	0.57%	1.0	0.233%
6.000	1.525	0.903	0.027	13.17	−0.0144	0.75%	0.5	0.329%
8.000	1.451	0.856	0.043	11.15	−0.0230	0.59%	20.0	0.316%
10.000	1.389	0.856	0.040	14.51	−0.0208	0.79%	1.0	0.395%
15.000	1.295	0.834	0.047	14.05	−0.0265	1.25%	0.5	0.516%

G-P Exposure Buildup Factor Coefficients
Boron

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.728	0.683	0.095	15.02	−0.0460	1.78%	0.5	0.740%
0.020	2.629	0.959	0.021	13.74	−0.0179	2.87%	0.5	1.125%
0.030	4.699	1.665	−0.117	14.48	0.0497	1.44%	35.0	0.854%
0.040	6.906	2.243	−0.184	14.61	0.0788	2.32%	35.0	1.257%
0.050	8.247	2.657	−0.223	14.47	0.0972	2.83%	25.0	1.611%
0.060	8.580	2.947	−0.247	14.36	0.1080	3.27%	15.0	1.842%
0.080	8.089	3.170	−0.262	14.66	0.1119	2.83%	15.0	1.645%
0.100	8.262	2.951	−0.238	16.05	0.0956	1.77%	3.0	1.043%
0.150	5.943	3.081	−0.256	15.38	0.1057	0.00%	0.0	0.000%
0.200	3.927	3.222	−0.279	14.14	0.1225	3.73%	15.0	2.159%
0.300	3.156	2.928	−0.265	13.98	0.1270	5.20%	1.0	2.668%
0.400	2.862	2.630	−0.245	12.58	0.1109	3.08%	10.0	2.092%
0.500	2.679	2.375	−0.222	12.68	0.1043	3.44%	1.0	2.261%
0.600	2.547	2.161	−0.198	13.69	0.1020	4.06%	10.0	2.710%
0.800	2.359	1.894	−0.167	13.38	0.0876	4.38%	1.0	2.824%
1.000	2.258	1.674	−0.135	13.53	0.0718	3.65%	0.5	2.392%
1.500	2.075	1.372	−0.083	13.78	0.0470	3.29%	0.5	1.539%
2.000	1.955	1.213	−0.050	14.44	0.0278	2.86%	0.5	1.202%
3.000	1.785	1.069	−0.018	12.74	0.0106	1.82%	0.5	0.638%
4.000	1.684	0.978	0.006	17.12	−0.0045	1.07%	0.5	0.342%
5.000	1.599	0.933	0.018	14.95	−0.0099	0.70%	2.0	0.275%
6.000	1.541	0.904	0.026	14.92	−0.0142	0.58%	1.0	0.260%
8.000	1.447	0.873	0.035	14.16	−0.0200	0.75%	35.0	0.332%
10.000	1.383	0.853	0.041	13.43	−0.0179	0.79%	0.5	0.369%
15.000	1.286	0.830	0.048	14.00	−0.0243	1.08%	1.0	0.469%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Carbon

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.398	0.526	0.153	14.42	−0.0777	1.92%	0.5	0.819%
0.020	1.900	0.739	0.076	16.46	−0.0363	0.74%	25.0	0.327%
0.030	3.725	1.153	−0.027	12.57	0.0085	0.96%	0.5	0.373%
0.040	5.068	1.735	−0.127	14.10	0.0554	1.91%	15.0	1.207%
0.050	5.594	2.066	−0.164	14.48	0.0692	2.68%	2.0	1.395%
0.060	5.424	2.287	−0.186	14.66	0.0790	2.17%	25.0	1.300%
0.080	4.862	2.488	−0.204	14.81	0.0832	2.38%	15.0	1.307%
0.100	4.305	2.548	−0.209	14.88	0.0834	2.34%	15.0	1.197%
0.150	3.523	2.491	−0.205	14.96	0.0796	1.90%	15.0	1.028%
0.200	3.173	2.365	−0.196	14.77	0.0757	1.95%	15.0	0.989%
0.300	2.797	2.129	−0.175	14.96	0.0694	2.62%	35.0	1.397%
0.400	2.629	1.925	−0.153	14.84	0.0631	1.64%	35.0	0.904%
0.500	2.456	1.801	−0.138	16.05	0.0618	2.75%	2.0	1.200%
0.600	2.399	1.663	−0.119	14.98	0.0457	1.15%	2.0	0.650%
0.800	2.198	1.563	−0.109	14.09	0.0461	1.76%	1.0	1.105%
1.000	2.087	1.461	−0.093	14.20	0.0406	2.31%	0.5	1.149%
1.500	1.941	1.275	−0.060	14.29	0.0266	1.92%	0.5	0.809%
2.000	1.843	1.167	−0.037	14.53	0.0143	1.63%	0.5	0.596%
3.000	1.715	1.050	−0.011	14.52	0.0027	0.93%	0.5	0.285%
4.000	1.626	0.990	0.003	12.82	−0.0020	0.57%	2.0	0.262%
5.000	1.564	0.947	0.014	15.05	−0.0068	0.49%	5.0	0.271%
6.000	1.519	0.900	0.030	12.35	−0.0186	1.73%	0.5	0.607%
8.000	1.430	0.884	0.033	12.11	−0.0158	0.69%	1.0	0.359%
10.000	1.378	0.859	0.040	14.32	−0.0221	1.03%	0.5	0.500%
15.000	1.283	0.838	0.047	15.91	−0.0324	0.96%	0.5	0.512%

G-P Exposure Buildup Factor Coefficients
Carbon

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.386	0.539	0.146	14.31	−0.0718	1.81%	0.5	0.692%
0.020	1.877	0.732	0.079	16.57	−0.0395	0.77%	0.5	0.411%
0.030	3.511	1.153	−0.027	12.82	0.0087	0.84%	2.0	0.399%
0.040	5.260	1.745	−0.129	13.91	0.0571	2.28%	35.0	1.397%
0.050	6.706	2.108	−0.170	14.34	0.0735	2.96%	2.0	1.506%
0.060	7.209	2.383	−0.198	14.53	0.0878	2.66%	15.0	1.551%
0.080	6.765	2.691	−0.227	14.44	0.0998	3.28%	15.0	1.834%
0.100	5.890	2.824	−0.239	14.40	0.1046	3.32%	15.0	1.784%
0.150	4.381	2.866	−0.246	14.14	0.1067	3.22%	15.0	1.856%
0.200	3.750	2.698	−0.233	15.08	0.1060	4.12%	35.0	2.212%
0.300	3.147	2.413	−0.211	14.41	0.0944	4.33%	3.0	1.973%
0.400	2.843	2.197	−0.192	13.47	0.0805	3.04%	2.0	1.664%
0.500	2.657	2.011	−0.171	14.19	0.0795	4.22%	2.0	1.885%
0.600	2.543	1.851	−0.151	13.60	0.0610	4.40%	2.0	1.971%
0.800	2.312	1.691	−0.133	13.80	0.0643	2.76%	1.0	1.814%
1.000	2.192	1.544	−0.110	13.78	0.0533	2.91%	1.0	1.654%
1.500	2.011	1.311	−0.069	13.69	0.0332	2.47%	0.5	1.140%
2.000	1.898	1.192	−0.044	13.99	0.0206	1.85%	0.5	0.739%
3.000	1.752	1.058	−0.014	11.98	0.0060	1.47%	0.5	0.468%
4.000	1.653	0.986	0.004	25.64	−0.0080	0.60%	0.5	0.302%
5.000	1.575	0.939	0.017	14.50	−0.0109	0.85%	35.0	0.313%
6.000	1.525	0.908	0.026	14.36	−0.0149	0.97%	1.0	0.380%
8.000	1.440	0.868	0.038	17.08	−0.0351	0.69%	1.0	0.402%
10.000	1.373	0.855	0.042	12.35	−0.0208	0.63%	4.0	0.351%
15.000	1.276	0.841	0.046	15.27	−0.0296	1.29%	0.5	0.614%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Nitrogen

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.236	0.485	0.163	14.57	−0.0784	1.52%	0.5	0.646%
0.020	1.559	0.578	0.134	14.90	−0.0661	1.93%	0.5	0.753%
0.030	2.712	0.843	0.052	16.05	−0.0373	2.05%	0.5	0.809%
0.040	3.984	1.272	−0.051	13.80	0.0170	0.82%	5.0	0.457%
0.050	4.894	1.630	−0.111	13.96	0.0473	1.78%	10.0	1.095%
0.060	5.144	1.919	−0.151	13.77	0.0689	2.96%	35.0	1.732%
0.080	4.913	2.225	−0.186	13.43	0.0824	2.80%	25.0	1.867%
0.100	4.661	2.248	−0.183	14.48	0.0770	2.62%	15.0	1.454%
0.150	3.749	2.299	−0.189	14.41	0.0764	2.64%	35.0	1.472%
0.200	3.365	2.195	−0.179	14.80	0.0761	2.28%	1.0	1.188%
0.300	2.841	2.056	−0.168	14.21	0.0668	2.53%	25.0	1.404%
0.400	2.620	1.898	−0.151	14.21	0.0602	2.10%	35.0	1.282%
0.500	2.462	1.785	−0.138	14.12	0.0555	1.96%	35.0	1.206%
0.600	2.363	1.680	−0.124	14.24	0.0499	1.85%	1.0	1.167%
0.800	2.202	1.544	−0.105	14.20	0.0434	1.94%	1.0	1.138%
1.000	2.108	1.429	−0.086	14.72	0.0355	1.84%	1.0	0.949%
1.500	1.931	1.277	−0.060	14.38	0.0261	1.58%	0.5	0.725%
2.000	1.835	1.176	−0.040	13.95	0.0172	1.28%	0.5	0.490%
3.000	1.708	1.057	−0.013	12.50	0.0042	0.62%	0.5	0.262%
4.000	1.629	0.980	0.007	14.32	−0.0070	0.49%	0.5	0.227%
5.000	1.567	0.931	0.021	13.51	−0.0148	0.68%	25.0	0.353%
6.000	1.495	0.935	0.018	17.14	−0.0156	0.65%	30.0	0.274%
8.000	1.430	0.869	0.040	12.04	−0.0237	0.68%	3.0	0.329%
10.000	1.364	0.870	0.038	14.33	−0.0223	1.16%	1.0	0.507%
15.000	1.272	0.839	0.049	15.00	−0.0355	1.46%	0.5	0.645%

G-P Exposure Buildup Factor Coefficients
Nitrogen

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.234	0.475	0.171	14.27	−0.0858	1.56%	0.5	0.677%
0.020	1.543	0.586	0.130	15.00	−0.0632	1.97%	0.5	0.762%
0.030	2.621	0.842	0.053	15.71	−0.0398	1.97%	0.5	0.831%
0.040	3.945	1.279	−0.053	13.58	0.0191	0.86%	25.0	0.490%
0.050	5.039	1.640	−0.113	13.85	0.0489	1.60%	25.0	1.099%
0.060	5.510	1.937	−0.154	13.68	0.0714	2.81%	0.5	1.892%
0.080	5.432	2.283	−0.194	13.30	0.0892	3.31%	35.0	2.192%
0.100	5.208	2.311	−0.191	14.39	0.0825	2.88%	15.0	1.572%
0.150	3.970	2.453	−0.209	14.11	0.0943	3.41%	35.0	1.982%
0.200	3.395	2.408	−0.208	13.32	0.0891	3.19%	1.0	2.001%
0.300	2.962	2.142	−0.180	14.06	0.0755	2.66%	25.0	1.645%
0.400	2.700	1.976	−0.163	14.05	0.0690	2.47%	35.0	1.626%
0.500	2.538	1.835	−0.146	14.13	0.0612	2.34%	1.0	1.499%
0.600	2.406	1.737	−0.134	14.11	0.0572	2.16%	10.0	1.434%
0.800	2.241	1.580	−0.112	14.03	0.0484	1.86%	1.0	1.326%
1.000	2.123	1.474	−0.096	13.97	0.0426	3.56%	1.0	1.417%
1.500	1.968	1.270	−0.058	14.81	0.0246	2.13%	0.5	0.806%
2.000	1.858	1.176	−0.040	13.95	0.0175	1.34%	0.5	0.575%
3.000	1.718	1.061	−0.014	13.95	0.0047	0.96%	0.5	0.343%
4.000	1.631	0.989	0.004	15.65	−0.0044	0.58%	2.0	0.275%
5.000	1.562	0.940	0.018	13.58	−0.0128	0.51%	1.0	0.260%
6.000	1.517	0.901	0.030	12.46	−0.0186	1.05%	0.5	0.488%
8.000	1.423	0.887	0.033	11.67	−0.0159	0.89%	0.5	0.463%
10.000	1.361	0.873	0.037	14.21	−0.0221	1.38%	1.0	0.521%
15.000	1.271	0.841	0.048	15.04	−0.0339	1.51%	0.5	0.710%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Oxygen

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.154	0.425	0.198	13.15	−0.1036	1.28%	0.5	0.538%
0.020	1.361	0.502	0.164	14.47	−0.0845	1.91%	0.5	0.784%
0.030	2.173	0.657	0.116	11.54	−0.0467	2.95%	0.5	1.256%
0.040	3.219	0.990	0.012	13.23	−0.0133	1.19%	0.5	0.385%
0.050	4.168	1.313	−0.058	13.41	0.0204	1.01%	35.0	0.610%
0.060	4.739	1.577	−0.103	13.67	0.0436	1.93%	35.0	1.215%
0.080	4.943	1.912	−0.150	13.71	0.0674	2.85%	10.0	1.865%
0.100	4.628	2.082	−0.170	13.71	0.0770	2.93%	35.0	1.926%
0.150	3.921	2.118	−0.170	14.40	0.0691	2.53%	15.0	1.465%
0.200	3.365	2.126	−0.174	13.98	0.0714	2.58%	35.0	1.568%
0.300	2.901	1.974	−0.158	14.10	0.0623	2.37%	25.0	1.462%
0.400	2.650	1.846	−0.144	14.09	0.0569	1.92%	1.0	1.303%
0.500	2.479	1.746	−0.132	14.28	0.0526	1.86%	10.0	1.206%
0.600	2.367	1.656	−0.120	14.31	0.0476	1.59%	35.0	1.135%
0.800	2.214	1.519	−0.100	14.38	0.0396	2.23%	0.5	1.137%
1.000	2.104	1.427	−0.086	14.20	0.0347	1.69%	0.5	0.882%
1.500	1.943	1.261	−0.056	14.31	0.0223	1.38%	0.5	0.614%
2.000	1.839	1.167	−0.037	14.62	0.0144	1.49%	0.5	0.468%
3.000	1.710	1.052	−0.011	14.36	0.0018	0.73%	0.5	0.241%
4.000	1.621	0.986	0.006	12.97	−0.0070	0.55%	1.0	0.251%
5.000	1.556	0.942	0.018	13.28	−0.0128	0.58%	35.0	0.345%
6.000	1.506	0.906	0.029	15.08	−0.0259	0.90%	3.0	0.509%
8.000	1.411	0.896	0.031	12.33	−0.0166	0.64%	0.5	0.329%
10.000	1.356	0.867	0.041	13.90	−0.0273	1.20%	0.5	0.588%
15.000	1.259	0.848	0.048	14.75	−0.0365	1.23%	0.5	0.696%

G-P Exposure Buildup Factor Coefficients
Oxygen

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.153	0.432	0.189	14.49	−0.0965	1.38%	0.5	0.519%
0.020	1.355	0.505	0.162	14.65	−0.0825	2.23%	0.5	0.804%
0.030	2.054	0.718	0.086	16.37	−0.0456	3.17%	0.5	1.147%
0.040	3.137	0.990	0.012	13.45	−0.0134	1.27%	0.5	0.412%
0.050	4.063	1.305	−0.056	13.54	0.0184	0.97%	4.0	0.590%
0.060	4.610	1.562	−0.100	13.75	0.0412	1.73%	0.5	1.177%
0.080	4.783	1.887	−0.146	13.73	0.0643	2.71%	35.0	1.754%
0.100	4.492	2.043	−0.164	13.85	0.0718	2.61%	25.0	1.781%
0.150	3.877	2.069	−0.163	14.48	0.0637	2.50%	2.0	1.380%
0.200	3.320	2.090	−0.169	14.03	0.0678	2.38%	25.0	1.446%
0.300	2.870	1.948	−0.154	14.20	0.0595	2.32%	25.0	1.344%
0.400	2.629	1.828	−0.141	14.19	0.0546	1.85%	10.0	1.165%
0.500	2.475	1.723	−0.128	14.20	0.0488	1.85%	1.0	1.146%
0.600	2.362	1.635	−0.116	14.32	0.0439	1.81%	1.0	1.056%
0.800	2.185	1.532	−0.103	14.24	0.0427	1.95%	0.5	1.174%
1.000	2.098	1.418	−0.084	14.35	0.0333	1.58%	0.5	0.829%
1.500	1.929	1.265	−0.057	14.45	0.0235	1.61%	0.5	0.633%
2.000	1.837	1.164	−0.036	15.40	0.0137	1.45%	0.5	0.483%
3.000	1.711	1.052	−0.011	12.88	0.0020	0.77%	0.5	0.247%
4.000	1.624	0.990	0.004	20.49	−0.0070	0.55%	4.0	0.297%
5.000	1.553	0.947	0.016	14.42	−0.0111	0.70%	0.5	0.379%
6.000	1.505	0.917	0.025	15.64	−0.0229	0.99%	1.0	0.467%
8.000	1.417	0.891	0.033	12.30	−0.0194	1.16%	0.5	0.467%
10.000	1.358	0.872	0.039	13.99	−0.0252	1.14%	0.5	0.542%
15.000	1.265	0.842	0.050	15.03	−0.0387	1.19%	3.0	0.728%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Sodium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.051	0.409	0.197	11.44	−0.0913	0.78%	0.5	0.267%
0.020	1.121	0.410	0.202	14.55	−0.1108	1.31%	0.5	0.464%
0.030	1.401	0.472	0.180	14.69	−0.0944	2.07%	0.5	0.757%
0.040	1.849	0.629	0.114	16.17	−0.0596	1.35%	2.0	0.566%
0.050	2.535	0.737	0.088	14.98	−0.0626	2.26%	0.5	1.051%
0.060	3.171	0.922	0.033	14.39	−0.0303	1.23%	0.5	0.557%
0.080	4.169	1.220	−0.038	11.66	0.0065	1.44%	0.5	0.567%
0.100	4.509	1.444	−0.079	13.36	0.0260	2.39%	0.5	1.110%
0.150	4.045	1.730	−0.124	13.53	0.0491	2.84%	0.5	1.686%
0.200	3.614	1.784	−0.131	13.78	0.0503	2.97%	0.5	1.587%
0.300	3.024	1.769	−0.130	13.87	0.0478	2.03%	10.0	1.397%
0.400	2.721	1.702	−0.122	14.15	0.0440	1.80%	10.0	1.206%
0.500	2.538	1.635	−0.114	14.25	0.0410	1.84%	0.5	1.065%
0.600	2.402	1.569	−0.104	14.56	0.0366	1.89%	0.5	0.958%
0.800	2.227	1.469	−0.090	14.86	0.0327	1.66%	0.5	0.833%
1.000	2.112	1.387	−0.077	14.85	0.0282	1.57%	0.5	0.697%
1.500	1.936	1.253	−0.054	14.28	0.0205	1.22%	0.5	0.505%
2.000	1.845	1.154	−0.034	14.75	0.0125	1.07%	0.5	0.379%
3.000	1.706	1.050	−0.009	10.63	−0.0012	0.61%	0.5	0.215%
4.000	1.614	0.983	0.009	13.16	−0.0120	0.63%	35.0	0.323%
5.000	1.542	0.946	0.019	12.67	−0.0150	1.15%	1.0	0.589%
6.000	1.479	0.929	0.024	15.97	−0.0271	1.20%	0.5	0.536%
8.000	1.388	0.903	0.033	12.28	−0.0233	0.86%	1.0	0.472%
10.000	1.324	0.894	0.036	13.93	−0.0286	1.19%	1.0	0.619%
15.000	1.225	0.892	0.038	14.72	−0.0327	2.07%	0.5	0.768%

G-P Exposure Buildup Factor Coefficients
Sodium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.052	0.379	0.223	11.69	−0.1146	0.66%	0.5	0.279%
0.020	1.122	0.398	0.212	13.54	−0.1140	1.20%	0.5	0.432%
0.030	1.388	0.480	0.176	14.60	−0.0921	1.99%	0.5	0.765%
0.040	1.779	0.662	0.099	16.41	−0.0479	2.05%	2.0	0.747%
0.050	2.394	0.740	0.087	14.31	−0.0552	2.23%	0.5	1.153%
0.060	2.836	0.910	0.038	13.27	−0.0339	1.23%	0.5	0.609%
0.080	3.300	1.183	−0.028	13.57	−0.0025	0.30%	1.0	0.141%
0.100	3.388	1.368	−0.062	14.35	0.0115	0.83%	4.0	0.394%
0.150	3.190	1.575	−0.095	14.71	0.0260	0.95%	1.0	0.621%
0.200	2.968	1.627	−0.103	14.63	0.0281	0.95%	1.0	0.550%
0.300	2.658	1.633	−0.106	14.12	0.0279	0.73%	25.0	0.485%
0.400	2.481	1.587	−0.101	15.09	0.0285	0.98%	15.0	0.559%
0.500	2.350	1.548	−0.098	14.86	0.0307	1.02%	25.0	0.542%
0.600	2.253	1.498	−0.090	15.42	0.0264	0.89%	0.5	0.496%
0.800	2.117	1.421	−0.080	15.18	0.0250	0.89%	25.0	0.464%
1.000	2.023	1.356	−0.070	15.70	0.0234	0.65%	1.0	0.346%
1.500	1.879	1.234	−0.049	15.21	0.0168	0.91%	0.5	0.331%
2.000	1.795	1.154	−0.034	14.43	0.0122	0.80%	0.5	0.332%
3.000	1.684	1.056	−0.011	10.47	0.0009	0.50%	0.5	0.214%
4.000	1.606	0.992	0.006	12.86	−0.0089	0.54%	3.0	0.326%
5.000	1.536	0.956	0.016	15.20	−0.0205	0.70%	25.0	0.383%
6.000	1.494	0.914	0.031	11.38	−0.0247	0.54%	8.0	0.345%
8.000	1.406	0.902	0.033	13.53	−0.0260	0.99%	1.0	0.657%
10.000	1.347	0.876	0.043	13.19	−0.0335	1.62%	0.5	0.735%
15.000	1.263	0.823	0.064	14.35	−0.0562	1.79%	3.0	1.064%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Magnesium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.037	0.401	0.211	13.33	−0.1332	0.65%	0.5	0.330%
0.020	1.087	0.426	0.185	14.50	−0.0945	0.57%	0.5	0.331%
0.030	1.294	0.445	0.191	14.26	−0.1008	1.58%	0.5	0.655%
0.040	1.644	0.557	0.142	15.31	−0.0745	0.97%	0.5	0.517%
0.050	2.216	0.623	0.130	13.60	−0.0692	2.70%	0.5	1.395%
0.060	2.778	0.780	0.077	13.14	−0.0522	1.71%	0.5	0.904%
0.080	3.778	1.058	−0.001	14.35	−0.0150	0.44%	15.0	0.239%
0.100	4.260	1.285	−0.049	12.62	0.0081	1.79%	0.5	0.731%
0.150	4.099	1.591	−0.103	13.28	0.0364	3.22%	0.5	1.461%
0.200	3.649	1.684	−0.116	13.69	0.0411	3.24%	0.5	1.540%
0.300	3.056	1.704	−0.120	14.17	0.0423	2.23%	0.5	1.327%
0.400	2.751	1.649	−0.113	14.51	0.0377	2.32%	0.5	1.119%
0.500	2.552	1.597	−0.107	14.44	0.0365	1.92%	0.5	0.976%
0.600	2.416	1.544	−0.100	14.58	0.0343	1.84%	0.5	0.876%
0.800	2.238	1.449	−0.086	14.82	0.0299	1.48%	0.5	0.749%
1.000	2.115	1.378	−0.075	15.12	0.0268	1.74%	0.5	0.705%
1.500	1.940	1.249	−0.053	14.51	0.0202	1.38%	0.5	0.497%
2.000	1.834	1.165	−0.036	14.42	0.0130	0.65%	2.0	0.304%
3.000	1.696	1.061	−0.012	14.79	0.0004	0.48%	2.0	0.180%
4.000	1.607	0.992	0.006	14.46	−0.0093	0.80%	1.0	0.345%
5.000	1.549	0.922	0.029	13.02	−0.0274	2.18%	0.5	0.917%
6.000	1.474	0.929	0.025	15.42	−0.0285	0.79%	3.0	0.519%
8.000	1.380	0.909	0.032	11.96	−0.0231	1.19%	0.5	0.522%
10.000	1.309	0.918	0.029	14.57	−0.0249	1.82%	0.5	0.754%
15.000	1.231	0.844	0.058	14.16	−0.0516	1.77%	4.0	0.970%

G-P Exposure Buildup Factor Coefficients
Magnesium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.037	0.401	0.211	13.33	−0.1332	0.65%	0.5	0.330%
0.020	1.085	0.439	0.178	14.34	−0.0910	0.72%	0.5	0.379%
0.030	1.288	0.449	0.189	14.38	−0.1020	1.92%	0.5	0.756%
0.040	1.617	0.557	0.143	15.17	−0.0757	1.39%	0.5	0.632%
0.050	2.099	0.633	0.125	14.15	−0.0657	2.77%	0.5	1.542%
0.060	2.467	0.794	0.071	14.91	−0.0563	2.47%	0.5	1.088%
0.080	2.950	1.039	0.005	13.70	−0.0201	0.72%	10.0	0.454%
0.100	3.102	1.229	−0.035	12.29	−0.0037	0.49%	6.0	0.202%
0.150	3.032	1.454	−0.075	15.08	0.0138	0.73%	1.0	0.314%
0.200	2.856	1.537	−0.088	15.99	0.0200	0.78%	4.0	0.411%
0.300	2.599	1.564	−0.094	15.96	0.0228	0.89%	15.0	0.373%
0.400	2.437	1.541	−0.093	15.45	0.0236	0.70%	1.0	0.332%
0.500	2.315	1.505	−0.089	16.00	0.0236	0.64%	15.0	0.284%
0.600	2.221	1.473	−0.086	15.28	0.0246	0.69%	35.0	0.291%
0.800	2.100	1.401	−0.076	15.64	0.0233	0.48%	1.0	0.247%
1.000	2.004	1.350	−0.069	15.69	0.0235	0.70%	15.0	0.330%
1.500	1.867	1.233	−0.049	14.52	0.0168	0.51%	0.5	0.292%
2.000	1.787	1.155	−0.033	16.11	0.0108	0.52%	0.5	0.248%
3.000	1.674	1.064	0.013	16.49	−0.0022	0.36%	1.0	0.150%
4.000	1.598	0.997	0.005	13.02	−0.0091	0.80%	0.5	0.382%
5.000	1.538	0.941	0.024	10.17	−0.0216	0.51%	30.0	0.338%
6.000	1.484	0.934	0.024	12.01	−0.0192	1.02%	0.5	0.447%
8.000	1.405	0.902	0.034	13.85	−0.0285	1.06%	1.0	0.684%
10.000	1.342	0.886	0.041	13.09	−0.0332	1.88%	0.5	0.828%
15.000	1.253	0.847	0.057	14.24	−0.0511	1.69%	4.0	1.093%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Aluminum

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.029	0.364	0.240	14.12	−0.1704	0.46%	25.0	0.236%
0.020	1.072	0.349	0.241	14.25	−0.1280	0.33%	8.0	0.168%
0.030	1.226	0.415	0.206	14.06	−0.1131	1.61%	0.5	0.690%
0.040	1.504	0.492	0.172	14.83	−0.0948	1.99%	0.5	0.750%
0.050	1.935	0.570	0.148	14.64	−0.0888	4.07%	0.5	1.411%
0.060	2.436	0.683	0.109	14.74	−0.0784	2.72%	0.5	1.314%
0.080	3.399	0.926	0.033	14.11	−0.0328	0.89%	35.0	0.541%
0.100	3.991	1.148	−0.020	13.53	−0.0085	0.84%	2.0	0.401%
0.150	4.141	1.441	−0.076	14.24	0.0185	1.99%	0.5	0.779%
0.200	3.690	1.585	−0.100	14.16	0.0316	3.23%	0.5	1.309%
0.300	3.101	1.636	−0.109	14.26	0.0349	2.83%	0.5	1.263%
0.400	2.791	1.593	−0.103	14.76	0.0306	1.05%	3.0	0.656%
0.500	2.609	1.528	−0.093	15.47	0.0249	2.47%	0.5	0.832%
0.600	2.428	1.521	−0.096	14.79	0.0322	1.73%	0.5	0.750%
0.800	2.237	1.439	−0.084	14.68	0.0284	1.53%	0.5	0.642%
1.000	2.119	1.368	−0.073	15.07	0.0257	1.26%	0.5	0.531%
1.500	1.940	1.245	−0.052	14.72	0.0196	1.41%	0.5	0.527%
2.000	1.835	1.160	−0.034	14.89	0.0107	0.69%	0.5	0.237%
3.000	1.694	1.059	−0.011	10.74	−0.0011	0.35%	1.0	0.179%
4.000	1.605	0.992	0.006	12.74	−0.0087	0.93%	1.0	0.444%
5.000	1.533	0.945	0.021	14.17	−0.0223	2.36%	1.0	0.782%
6.000	1.464	0.936	0.024	15.05	−0.0290	1.08%	1.0	0.525%
8.000	1.374	0.913	0.031	14.15	−0.0269	1.47%	0.5	0.721%
10.000	1.308	0.904	0.036	14.30	−0.0322	1.79%	0.5	0.797%
15.000	1.228	0.833	0.064	14.20	−0.0587	2.12%	3.0	1.186%

G-P Exposure Buildup Factor Coefficients
Aluminum

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.029	0.394	0.206	15.51	−0.1388	0.45%	6.0	0.223%
0.020	1.067	0.384	0.220	13.81	−0.1204	0.71%	0.5	0.312%
0.030	1.223	0.422	0.198	15.10	−0.1042	1.83%	0.5	0.635%
0.040	1.480	0.503	0.166	14.78	−0.0893	1.72%	0.5	0.697%
0.050	1.765	0.666	0.099	16.34	−0.0493	2.10%	2.0	0.722%
0.060	2.189	0.697	0.104	12.90	−0.0580	3.00%	0.5	1.356%
0.080	2.640	0.924	0.035	12.99	−0.0351	1.54%	0.5	0.666%
0.100	2.847	1.110	−0.009	12.98	−0.0187	0.63%	0.5	0.413%
0.150	2.877	1.357	−0.058	21.73	0.0071	0.48%	4.0	0.243%
0.200	2.762	1.455	−0.074	17.02	0.0114	0.44%	1.0	0.196%
0.300	2.546	1.510	−0.085	16.22	0.0172	0.48%	4.0	0.215%
0.400	2.403	1.498	−0.085	16.45	0.0189	0.54%	1.0	0.237%
0.500	2.287	1.474	−0.083	16.41	0.0194	0.31%	1.0	0.181%
0.600	2.197	1.448	−0.081	17.03	0.0227	0.67%	15.0	0.293%
0.800	2.080	1.384	−0.072	16.24	0.0202	0.64%	0.5	0.283%
1.000	1.994	1.336	−0.066	15.85	0.0215	0.60%	6.0	0.282%
1.500	1.855	1.230	−0.048	16.01	0.0171	0.45%	15.0	0.226%
2.000	1.781	1.153	−0.032	15.32	0.0091	0.32%	0.5	0.142%
3.000	1.673	1.057	−0.010	10.79	−0.0025	0.42%	1.0	0.202%
4.000	1.607	0.974	0.013	12.22	−0.0164	1.05%	0.5	0.498%
5.000	1.529	0.957	0.018	10.90	−0.0157	0.92%	0.5	0.413%
6.000	1.481	0.933	0.026	12.33	−0.0239	1.13%	0.5	0.524%
8.000	1.396	0.917	0.030	13.88	−0.0262	1.37%	0.5	0.677%
10.000	1.334	0.902	0.038	13.03	−0.0332	1.48%	0.5	0.719%
15.000	1.244	0.869	0.050	14.91	−0.0476	1.97%	0.5	1.098%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Silicon

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.022	0.415	0.190	11.16	−0.0775	0.62%	0.5	0.288%
0.020	1.051	0.426	0.179	17.64	−0.1078	0.81%	0.5	0.298%
0.030	1.180	0.395	0.215	14.40	−0.1170	1.44%	0.5	0.588%
0.040	1.401	0.455	0.189	14.61	−0.1049	1.91%	0.5	0.760%
0.050	1.677	0.604	0.119	16.85	−0.0604	1.81%	2.0	0.694%
0.060	2.178	0.604	0.139	13.56	−0.0780	3.08%	0.5	1.521%
0.080	3.059	0.820	0.064	13.99	−0.0488	1.41%	10.0	0.887%
0.100	3.712	1.027	0.009	13.77	−0.0262	0.87%	4.0	0.514%
0.150	4.043	1.348	−0.060	13.94	0.0100	2.24%	0.5	0.798%
0.200	3.678	1.506	−0.087	14.36	0.0243	2.46%	0.5	1.120%
0.300	3.110	1.582	−0.100	14.45	0.0290	2.49%	0.5	1.051%
0.400	2.781	1.571	−0.100	14.57	0.0299	2.02%	0.5	0.870%
0.500	2.570	1.541	−0.097	14.87	0.0301	1.65%	0.5	0.785%
0.600	2.433	1.497	−0.091	15.01	0.0283	1.45%	0.5	0.706%
0.800	2.242	1.424	−0.081	15.08	0.0267	1.81%	0.5	0.622%
1.000	2.124	1.358	−0.071	14.98	0.0243	1.49%	0.5	0.521%
1.500	1.941	1.241	−0.051	14.38	0.0185	1.48%	0.5	0.479%
2.000	1.838	1.155	−0.033	14.32	0.0100	0.83%	0.5	0.305%
3.000	1.699	1.051	−0.008	11.58	−0.0039	0.43%	2.0	0.221%
4.000	1.596	0.998	0.006	12.80	−0.0112	0.87%	1.0	0.375%
5.000	1.528	0.948	0.021	14.62	−0.0256	1.67%	0.5	0.794%
6.000	1.456	0.944	0.022	15.19	−0.0273	0.95%	1.0	0.553%
8.000	1.367	0.907	0.036	11.95	−0.0307	0.94%	1.0	0.533%
10.000	1.298	0.916	0.033	13.35	−0.0293	1.67%	1.0	0.751%
15.000	1.202	0.913	0.037	14.31	−0.0360	1.48%	1.0	0.713%

G-P Exposure Buildup Factor Coefficients
Silicon

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.023	0.349	0.262	11.98	−0.1791	0.50%	0.5	0.266%
0.020	1.051	0.426	0.179	17.64	−0.1078	0.81%	0.5	0.298%
0.030	1.179	0.395	0.216	13.99	−0.1163	1.50%	0.5	0.591%
0.040	1.385	0.460	0.188	14.33	−0.1065	1.95%	0.5	0.788%
0.050	1.640	0.579	0.135	15.12	−0.0715	0.94%	4.0	0.582%
0.060	1.894	0.702	0.092	15.29	−0.0516	3.02%	0.5	1.219%
0.080	2.400	0.838	0.058	14.66	−0.0505	2.36%	0.5	1.133%
0.100	2.627	1.018	0.012	13.65	−0.0298	1.54%	0.5	0.805%
0.150	2.733	1.273	−0.042	10.39	−0.0062	0.66%	0.5	0.237%
0.200	2.676	1.375	−0.058	7.72	−0.0052	0.70%	30.0	0.322%
0.300	2.483	1.469	−0.078	16.89	0.0136	0.57%	0.5	0.225%
0.400	2.355	1.473	−0.081	15.82	0.0161	0.50%	35.0	0.226%
0.500	2.252	1.455	−0.080	16.30	0.0182	0.44%	40.0	0.155%
0.600	2.177	1.424	−0.076	18.67	0.0215	0.41%	5.0	0.215%
0.800	2.053	1.385	−0.073	15.28	0.0211	0.44%	35.0	0.203%
1.000	1.980	1.323	−0.063	15.81	0.0184	0.51%	1.0	0.192%
1.500	1.842	1.230	−0.048	15.12	0.0161	0.43%	35.0	0.227%
2.000	1.771	1.155	−0.033	14.57	0.0100	0.45%	40.0	0.167%
3.000	1.669	1.058	−0.010	10.43	−0.0026	0.40%	4.0	0.174%
4.000	1.585	1.011	0.002	15.91	−0.0125	0.94%	1.0	0.351%
5.000	1.522	0.967	0.016	11.03	−0.0170	1.26%	0.5	0.414%
6.000	1.474	0.953	0.019	14.09	−0.0190	1.54%	0.5	0.637%
8.000	1.389	0.930	0.027	13.47	−0.0249	1.73%	0.5	0.758%
10.000	1.331	0.908	0.036	13.36	−0.0319	1.64%	0.5	0.829%
15.000	1.236	0.887	0.047	13.39	−0.0432	2.39%	0.5	0.993%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Phosphorus

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.018	0.398	0.212	12.01	−0.1279	0.52%	4.0	0.286%
0.020	1.041	0.411	0.194	13.58	−0.0962	0.59%	8.0	0.244%
0.030	1.141	0.390	0.219	13.87	−0.1228	0.97%	0.5	0.390%
0.040	1.321	0.439	0.194	14.66	−0.1070	1.79%	0.5	0.702%
0.050	1.573	0.525	0.156	15.24	−0.0836	1.49%	0.5	0.645%
0.060	1.984	0.535	0.168	13.70	−0.0873	3.52%	0.5	1.820%
0.080	2.767	0.726	0.096	13.52	−0.0655	2.06%	0.5	1.165%
0.100	3.452	0.924	0.036	13.69	−0.0410	1.27%	35.0	0.836%
0.150	3.949	1.255	−0.042	20.00	0.0000	1.28%	0.5	0.523%
0.200	3.711	1.410	−0.069	16.17	0.0124	1.52%	0.5	0.589%
0.300	3.132	1.528	−0.091	14.16	0.0233	2.48%	0.5	0.942%
0.400	2.805	1.527	−0.092	15.23	0.0252	2.47%	0.5	0.853%
0.500	2.590	1.504	−0.090	15.30	0.0253	1.91%	0.5	0.734%
0.600	2.443	1.475	−0.087	14.94	0.0257	1.92%	0.5	0.654%
0.800	2.245	1.410	−0.078	15.21	0.0241	1.35%	0.5	0.535%
1.000	2.115	1.358	−0.071	15.01	0.0242	1.22%	0.5	0.522%
1.500	1.943	1.234	−0.049	14.99	0.0169	0.89%	0.5	0.361%
2.000	1.837	1.155	−0.033	13.92	0.0100	0.79%	0.5	0.281%
3.000	1.693	1.056	−0.009	11.30	−0.0040	0.43%	25.0	0.228%
4.000	1.596	0.994	0.008	12.63	−0.0141	0.87%	1.0	0.444%
5.000	1.524	0.948	0.022	14.53	−0.0280	1.82%	0.5	0.755%
6.000	1.452	0.946	0.022	15.59	−0.0289	1.22%	1.0	0.580%
8.000	1.361	0.911	0.036	11.74	−0.0309	1.38%	1.0	0.691%
10.000	1.298	0.903	0.039	13.70	−0.0358	1.38%	0.5	0.798%
15.000	1.193	0.930	0.033	14.49	−0.0333	2.21%	1.0	0.866%

G-P Exposure Buildup Factor Coefficients
Phosphorus

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.018	0.398	0.212	12.01	−0.1279	0.52%	4.0	0.286%
0.020	1.041	0.432	0.175	13.83	−0.0771	0.45%	0.5	0.249%
0.030	1.141	0.394	0.213	14.41	−0.1150	0.99%	0.5	0.372%
0.040	1.314	0.439	0.195	14.43	−0.1084	2.14%	0.5	0.811%
0.050	1.533	0.520	0.162	14.69	−0.0901	1.72%	0.5	0.773%
0.060	1.751	0.633	0.117	14.78	−0.0635	0.99%	0.5	0.582%
0.080	2.204	0.757	0.084	12.94	−0.0516	2.79%	0.5	1.399%
0.100	2.434	0.940	0.031	14.07	−0.0402	2.70%	0.5	1.169%
0.150	2.611	1.198	−0.027	11.68	−0.0137	0.82%	0.5	0.496%
0.200	2.590	1.319	−0.048	9.03	−0.0088	0.68%	3.0	0.383%
0.300	2.431	1.433	−0.072	19.17	0.0125	1.06%	0.5	0.328%
0.400	2.325	1.440	−0.075	17.17	0.0139	0.39%	0.5	0.246%
0.500	2.224	1.433	−0.076	16.31	0.0157	0.70%	0.5	0.250%
0.600	2.147	1.416	−0.075	16.44	0.0180	0.30%	6.0	0.153%
0.800	2.035	1.375	−0.071	15.64	0.0205	0.67%	0.5	0.226%
1.000	1.959	1.323	−0.063	17.02	0.0204	0.37%	15.0	0.165%
1.500	1.834	1.226	−0.047	15.36	0.0155	0.37%	10.0	0.184%
2.000	1.763	1.156	−0.033	14.97	0.0099	0.40%	0.5	0.190%
3.000	1.664	1.059	−0.010	13.40	−0.0030	0.36%	1.0	0.231%
4.000	1.590	1.003	0.005	15.05	−0.0156	0.74%	4.0	0.419%
5.000	1.521	0.968	0.016	11.99	−0.0176	1.30%	0.5	0.503%
6.000	1.470	0.958	0.018	14.30	−0.0190	1.73%	0.5	0.742%
8.000	1.389	0.928	0.029	13.67	−0.0279	1.71%	0.5	0.840%
10.000	1.330	0.907	0.038	13.34	−0.0349	1.67%	0.5	0.890%
15.000	1.235	0.879	0.053	13.06	−0.0508	2.40%	0.5	1.027%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Sulphur

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.016	0.294	0.302	11.36	−0.1627	0.51%	8.0	0.286%
0.020	1.040	0.303	0.264	28.62	−0.5075	0.43%	2.0	0.214%
0.030	1.115	0.387	0.215	13.89	−0.1155	0.73%	3.0	0.396%
0.040	1.267	0.405	0.213	14.75	−0.1239	1.86%	0.5	0.734%
0.050	1.476	0.480	0.178	14.71	−0.0989	1.66%	0.5	0.731%
0.060	1.733	0.578	0.136	15.24	−0.0744	5.01%	0.5	1.779%
0.080	2.529	0.648	0.126	13.15	−0.0819	2.43%	0.5	1.373%
0.100	3.177	0.841	0.060	13.60	−0.0536	1.97%	0.5	1.137%
0.150	3.835	1.165	−0.023	12.88	−0.0107	0.90%	2.0	0.425%
0.200	3.680	1.339	−0.056	19.72	0.0054	1.34%	0.5	0.539%
0.300	3.151	1.473	−0.081	16.17	0.0191	1.91%	0.5	0.735%
0.400	2.840	1.475	−0.082	16.92	0.0191	1.00%	0.5	0.325%
0.500	2.599	1.477	−0.085	15.49	0.0223	1.79%	0.5	0.589%
0.600	2.444	1.455	−0.083	15.62	0.0234	1.50%	0.5	0.531%
0.800	2.252	1.395	−0.075	15.38	0.0225	1.68%	0.5	0.512%
1.000	2.130	1.336	−0.066	15.62	0.0209	1.18%	0.5	0.394%
1.500	1.938	1.234	−0.049	14.81	0.0167	0.73%	0.5	0.325%
2.000	1.840	1.146	−0.030	15.78	0.0070	0.97%	0.5	0.304%
3.000	1.691	1.059	−0.010	11.88	−0.0022	0.53%	1.0	0.253%
4.000	1.591	0.998	0.007	13.09	−0.0130	1.18%	1.0	0.447%
5.000	1.513	0.962	0.018	14.66	−0.0251	1.75%	1.0	0.774%
6.000	1.444	0.953	0.021	15.16	−0.0294	1.17%	0.5	0.599%
8.000	1.351	0.931	0.029	13.09	−0.0258	1.71%	0.5	0.777%
10.000	1.291	0.908	0.039	13.43	−0.0369	1.71%	0.5	0.851%
15.000	1.190	0.922	0.038	14.24	−0.0391	2.00%	0.5	0.902%

G-P Exposure Buildup Factor Coefficients
Sulphur

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.017	0.293	0.325	10.44	−0.2521	0.43%	6.0	0.245%
0.020	1.039	0.340	0.228	27.88	−0.3834	0.52%	8.0	0.264%
0.030	1.115	0.387	0.215	13.89	−0.1155	0.73%	3.0	0.396%
0.040	1.257	0.418	0.204	14.60	−0.1126	1.66%	0.5	0.686%
0.050	1.440	0.487	0.176	14.61	−0.0988	1.89%	0.5	0.786%
0.060	1.635	0.576	0.140	14.63	−0.0781	1.54%	0.5	0.786%
0.080	1.965	0.763	0.074	14.91	−0.0445	3.72%	0.5	1.329%
0.100	2.276	0.868	0.051	12.99	−0.0441	2.56%	0.5	1.275%
0.150	2.492	1.133	−0.014	12.60	−0.0196	1.66%	0.5	0.723%
0.200	2.500	1.269	−0.039	10.97	−0.0123	1.14%	0.5	0.506%
0.300	2.407	1.364	−0.056	7.84	−0.0099	0.66%	35.0	0.375%
0.400	2.285	1.417	−0.071	20.45	0.0155	0.70%	0.5	0.306%
0.500	2.201	1.415	−0.073	16.28	0.0148	0.58%	0.5	0.318%
0.600	2.135	1.392	−0.070	18.06	0.0158	0.44%	3.0	0.269%
0.800	2.029	1.353	−0.066	16.59	0.0166	0.28%	3.0	0.156%
1.000	1.951	1.313	−0.061	15.85	0.0173	0.32%	40.0	0.175%
1.500	1.832	1.215	−0.044	16.11	0.0131	0.34%	8.0	0.158%
2.000	1.761	1.149	−0.031	15.18	0.0082	0.39%	0.5	0.167%
3.000	1.660	1.059	−0.009	10.21	−0.0054	0.60%	1.0	0.248%
4.000	1.587	0.995	0.010	10.20	−0.0171	0.54%	4.0	0.300%
5.000	1.515	0.979	0.013	12.27	−0.0161	1.61%	0.5	0.605%
6.000	1.468	0.957	0.020	13.46	−0.0224	1.80%	0.5	0.742%
8.000	1.388	0.927	0.031	13.43	−0.0316	1.74%	0.5	0.901%
10.000	1.325	0.919	0.035	13.72	−0.0335	1.94%	0.5	0.975%
15.000	1.228	0.898	0.048	13.24	−0.0471	2.78%	0.5	1.079%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Argon

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.009	0.495	0.141	29.38	−0.2851	0.46%	0.5	0.285%
0.020	1.022	0.465	0.151	30.59	−0.3021	0.65%	0.5	0.280%
0.030	1.081	0.344	0.252	13.45	−0.1508	0.69%	0.5	0.281%
0.040	1.180	0.397	0.211	14.36	−0.1139	1.46%	0.5	0.537%
0.050	1.337	0.420	0.209	14.32	−0.1214	1.60%	0.5	0.747%
0.060	1.522	0.509	0.162	15.42	−0.0887	1.37%	0.5	0.643%
0.080	2.134	0.540	0.170	13.50	−0.1007	3.47%	0.5	1.811%
0.100	2.716	0.699	0.107	13.30	−0.0760	3.45%	0.5	1.602%
0.150	3.558	1.007	0.014	13.47	−0.0308	1.24%	4.0	0.814%
0.200	3.599	1.199	−0.027	12.18	−0.0147	0.78%	5.0	0.488%
0.300	3.161	1.378	−0.064	21.31	0.0125	1.16%	2.0	0.439%
0.400	2.829	1.426	−0.074	16.70	0.0152	1.22%	0.5	0.441%
0.500	2.615	1.424	−0.075	17.17	0.0174	0.93%	0.5	0.343%
0.600	2.456	1.410	−0.074	17.12	0.0183	1.00%	0.5	0.354%
0.800	2.248	1.375	−0.071	15.67	0.0202	1.08%	0.5	0.374%
1.000	2.118	1.334	−0.066	14.93	0.0208	0.83%	35.0	0.387%
1.500	1.943	1.222	−0.046	15.07	0.0146	0.99%	0.5	0.330%
2.000	1.831	1.154	−0.032	15.62	0.0088	0.60%	0.5	0.251%
3.000	1.692	1.052	−0.007	12.91	−0.0061	0.47%	1.0	0.263%
4.000	1.592	0.985	0.013	12.56	−0.0204	1.12%	1.0	0.631%
5.000	1.501	0.970	0.017	15.63	−0.0287	0.94%	10.0	0.518%
6.000	1.437	0.944	0.027	13.04	−0.0330	0.94%	4.0	0.566%
8.000	1.342	0.924	0.035	12.28	−0.0338	1.32%	1.0	0.730%
10.000	1.280	0.911	0.041	13.91	−0.0434	1.54%	1.0	0.980%
15.000	1.176	0.948	0.033	14.53	−0.0363	2.00%	1.0	0.964%

G-P Exposure Buildup Factor Coefficients
Argon

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.009	0.495	0.141	29.38	−0.2851	0.46%	0.5	0.285%
0.020	1.027	0.318	0.252	18.88	−0.1913	0.70%	2.0	0.291%
0.030	1.081	0.344	0.252	13.45	−0.1508	0.69%	0.5	0.281%
0.040	1.179	0.392	0.216	14.54	−0.1227	1.48%	0.5	0.661%
0.050	1.313	0.433	0.202	14.23	−0.1149	2.13%	0.5	0.866%
0.060	1.456	0.508	0.168	14.35	−0.0942	2.10%	0.5	0.898%
0.080	1.737	0.655	0.111	14.39	−0.0625	1.78%	0.5	0.821%
0.100	1.950	0.814	0.059	14.51	−0.0408	1.04%	0.5	0.663%
0.150	2.255	1.040	0.004	13.40	−0.0244	0.38%	2.0	0.170%
0.200	2.347	1.175	−0.021	12.06	−0.0193	1.56%	0.5	0.858%
0.300	2.299	1.312	−0.048	9.01	−0.0105	1.23%	0.5	0.433%
0.400	2.234	1.342	−0.054	8.27	−0.0092	0.89%	0.5	0.466%
0.500	2.145	1.378	−0.066	22.25	0.0179	1.29%	0.5	0.425%
0.600	2.088	1.369	−0.066	18.91	0.0152	0.98%	0.5	0.385%
0.800	1.994	1.341	−0.064	16.54	0.0166	0.42%	3.0	0.230%
1.000	1.925	1.303	−0.059	16.03	0.0166	0.46%	35.0	0.239%
1.500	1.814	1.211	−0.043	16.27	0.0125	0.33%	0.5	0.162%
2.000	1.749	1.147	−0.030	15.16	0.0065	0.40%	40.0	0.134%
3.000	1.657	1.052	−0.006	11.62	−0.0089	0.78%	1.0	0.355%
4.000	1.579	1.005	0.007	10.97	−0.0144	0.69%	1.0	0.405%
5.000	1.513	0.978	0.015	13.38	−0.0213	1.67%	0.5	0.742%
6.000	1.461	0.966	0.019	13.70	−0.0235	2.12%	0.5	0.812%
8.000	1.380	0.938	0.030	13.39	−0.0333	2.13%	0.5	1.040%
10.000	1.321	0.919	0.039	13.42	−0.0414	2.15%	1.0	1.040%
15.000	1.244	0.842	0.072	13.87	−0.0710	3.00%	3.0	1.737%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Potassium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.010	0.224	0.422	12.99	−0.4354	0.47%	3.0	0.220%
0.020	1.023	0.248	0.365	12.39	−0.2533	0.45%	7.0	0.270%
0.030	1.069	0.351	0.244	12.59	−0.1388	0.70%	2.0	0.323%
0.040	1.157	0.362	0.238	14.60	−0.1453	1.15%	2.0	0.490%
0.050	1.289	0.400	0.218	14.85	−0.1282	1.48%	0.5	0.706%
0.060	1.451	0.466	0.185	14.80	−0.1055	1.93%	0.5	0.782%
0.080	1.986	0.488	0.197	11.86	−0.0951	3.81%	0.5	1.918%
0.100	2.532	0.625	0.140	11.98	−0.0947	3.41%	0.5	1.565%
0.150	3.411	0.935	0.033	13.43	−0.0406	1.49%	35.0	1.021%
0.200	3.529	1.139	−0.014	12.77	−0.0218	1.21%	10.0	0.727%
0.300	3.188	1.309	−0.048	9.23	−0.0099	1.08%	0.5	0.393%
0.400	2.840	1.389	−0.067	20.01	0.0139	0.77%	0.5	0.336%
0.500	2.627	1.397	−0.070	17.55	0.0148	0.92%	0.5	0.282%
0.600	2.456	1.397	−0.072	16.30	0.0173	0.88%	2.0	0.322%
0.800	2.264	1.352	−0.066	16.77	0.0175	1.11%	0.5	0.306%
1.000	2.128	1.313	−0.061	15.50	0.0170	0.64%	0.5	0.276%
1.500	1.939	1.222	−0.046	14.93	0.0143	0.86%	0.5	0.296%
2.000	1.835	1.147	−0.030	16.46	0.0074	0.79%	0.5	0.243%
3.000	1.685	1.057	−0.008	12.35	−0.0057	0.88%	1.0	0.337%
4.000	1.589	0.983	0.015	11.87	−0.0235	1.30%	1.0	0.713%
5.000	1.501	0.956	0.024	12.99	−0.0361	0.86%	10.0	0.452%
6.000	1.432	0.945	0.028	12.78	−0.0350	1.24%	1.0	0.562%
8.000	1.334	0.934	0.033	12.11	−0.0332	1.61%	0.5	0.715%
10.000	1.283	0.890	0.050	13.89	−0.0525	1.73%	4.0	1.093%
15.000	1.175	0.934	0.040	14.39	−0.0436	2.08%	1.0	0.985%

G-P Exposure Buildup Factor Coefficients
Potassium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.012	0.130	0.620	11.39	−0.6162	0.43%	2.0	0.219%
0.020	1.024	0.289	0.289	12.38	−0.1453	0.41%	6.0	0.269%
0.030	1.067	0.384	0.215	12.44	−0.1141	0.71%	0.5	0.326%
0.040	1.151	0.382	0.222	13.92	−0.1229	1.26%	0.5	0.554%
0.050	1.269	0.408	0.217	14.20	−0.1274	1.77%	0.5	0.778%
0.060	1.392	0.483	0.178	14.36	−0.0988	1.82%	0.5	0.803%
0.080	1.644	0.609	0.129	14.32	−0.0742	2.23%	0.5	1.020%
0.100	1.853	0.757	0.077	14.33	−0.0502	2.55%	0.5	1.021%
0.150	2.146	1.005	0.010	13.70	−0.0216	0.96%	4.0	0.617%
0.200	2.235	1.166	−0.022	11.91	−0.0143	0.67%	1.0	0.438%
0.300	2.253	1.282	−0.043	10.15	−0.0111	1.68%	0.5	0.591%
0.400	2.211	1.315	−0.049	8.86	−0.0109	0.89%	3.0	0.461%
0.500	2.122	1.361	−0.063	20.95	0.0137	1.19%	0.5	0.485%
0.600	2.070	1.353	−0.063	18.25	0.0123	0.74%	0.5	0.402%
0.800	1.979	1.328	−0.061	16.89	0.0137	0.71%	0.5	0.313%
1.000	1.914	1.294	−0.057	15.83	0.0146	0.54%	40.0	0.245%
1.500	1.804	1.214	−0.044	15.26	0.0131	0.45%	35.0	0.203%
2.000	1.744	1.144	−0.029	16.51	0.0061	0.34%	1.0	0.157%
3.000	1.658	1.047	−0.004	11.27	−0.0108	1.31%	1.0	0.488%
4.000	1.579	1.002	0.009	11.56	−0.0183	0.78%	0.5	0.492%
5.000	1.508	0.986	0.013	13.41	−0.0200	1.44%	1.0	0.683%
6.000	1.463	0.958	0.023	13.42	−0.0288	1.99%	0.5	0.865%
8.000	1.382	0.931	0.034	13.47	−0.0389	2.00%	0.5	0.978%
10.000	1.316	0.927	0.038	13.53	−0.0427	2.35%	0.5	1.085%
15.000	1.218	0.920	0.047	13.48	−0.0518	2.56%	1.0	1.163%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Calcium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.007	0.585	0.034	9.72	0.1113	0.60%	0.5	0.296%
0.020	1.017	0.370	0.247	11.26	−0.1771	0.44%	2.0	0.257%
0.030	1.056	0.363	0.237	12.80	−0.1459	0.53%	35.0	0.356%
0.040	1.127	0.380	0.222	13.84	−0.1211	0.84%	0.5	0.458%
0.050	1.240	0.389	0.225	14.22	−0.1325	1.52%	0.5	0.601%
0.060	1.382	0.450	0.190	14.77	−0.1058	2.01%	0.5	0.802%
0.080	1.741	0.573	0.136	15.85	−0.0738	1.90%	2.0	0.750%
0.100	2.203	0.685	0.099	15.97	−0.0680	1.43%	2.0	0.670%
0.150	3.245	0.871	0.051	13.42	−0.0502	2.20%	0.5	1.297%
0.200	3.471	1.072	0.002	12.89	−0.0317	1.53%	3.0	0.998%
0.300	3.172	1.273	−0.042	10.25	−0.0103	0.79%	5.0	0.415%
0.400	2.848	1.356	−0.061	27.24	0.0185	0.84%	4.0	0.469%
0.500	2.615	1.380	−0.067	17.03	0.0123	0.78%	2.0	0.381%
0.600	2.477	1.364	−0.065	21.16	0.0171	0.79%	0.5	0.282%
0.800	2.258	1.346	−0.065	16.21	0.0164	0.34%	2.0	0.207%
1.000	2.129	1.304	−0.059	16.33	0.0164	0.75%	0.5	0.251%
1.500	1.936	1.222	−0.046	15.60	0.0151	0.76%	0.5	0.289%
2.000	1.834	1.144	−0.029	17.20	0.0068	0.78%	0.5	0.279%
3.000	1.687	1.050	−0.005	11.95	−0.0099	0.76%	1.0	0.346%
4.000	1.589	0.978	0.017	12.17	−0.0250	1.30%	1.0	0.683%
5.000	1.498	0.963	0.021	14.58	−0.0317	1.45%	1.0	0.830%
6.000	1.429	0.944	0.029	12.99	−0.0361	0.97%	20.0	0.615%
8.000	1.330	0.932	0.035	12.38	−0.0364	1.77%	0.5	0.854%
10.000	1.274	0.903	0.047	13.91	−0.0513	1.84%	4.0	1.136%
15.000	1.167	0.957	0.034	14.47	−0.0375	2.26%	0.5	0.966%

G-P Exposure Buildup Factor Coefficients
Calcium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.007	0.596	0.021	7.03	0.1290	0.60%	0.5	0.287%
0.020	1.016	0.441	0.180	10.89	−0.0845	0.39%	1.0	0.262%
0.030	1.057	0.372	0.226	11.52	−0.1182	0.64%	3.0	0.277%
0.040	1.129	0.364	0.234	14.07	−0.1357	0.66%	3.0	0.344%
0.050	1.226	0.405	0.213	14.14	−0.1172	1.55%	0.5	0.669%
0.060	1.335	0.456	0.192	14.25	−0.1107	2.01%	0.5	0.871%
0.080	1.564	0.574	0.142	14.35	−0.0801	2.38%	0.5	1.070%
0.100	1.760	0.708	0.093	14.30	−0.0580	2.82%	0.5	1.112%
0.150	2.062	0.949	0.024	13.69	−0.0280	1.90%	0.5	0.795%
0.200	2.175	1.118	−0.012	12.58	−0.0188	1.88%	0.5	0.799%
0.300	2.204	1.257	−0.039	10.26	−0.0113	1.04%	0.5	0.521%
0.400	2.172	1.299	−0.047	9.76	−0.0090	1.09%	0.5	0.558%
0.500	2.128	1.304	−0.048	8.71	−0.0108	1.16%	2.0	0.562%
0.600	2.058	1.333	−0.059	23.64	0.0150	1.03%	3.0	0.523%
0.800	1.963	1.322	−0.060	18.99	0.0166	1.17%	0.5	0.369%
1.000	1.904	1.289	−0.056	17.12	0.0159	0.77%	0.5	0.307%
1.500	1.796	1.210	−0.043	15.77	0.0128	0.33%	8.0	0.167%
2.000	1.737	1.148	−0.030	17.57	0.0079	0.45%	0.5	0.224%
3.000	1.640	1.070	−0.011	13.24	−0.0067	0.66%	40.0	0.317%
4.000	1.574	1.009	0.007	12.05	−0.0167	1.03%	0.5	0.579%
5.000	1.508	0.983	0.015	13.21	−0.0231	1.12%	0.5	0.665%
6.000	1.459	0.962	0.023	13.19	−0.0303	2.17%	0.5	0.918%
8.000	1.376	0.943	0.031	13.52	−0.0363	2.31%	0.5	1.091%
10.000	1.313	0.934	0.037	13.60	−0.0424	2.51%	0.5	1.147%
15.000	1.219	0.916	0.050	13.91	−0.0551	2.48%	1.0	1.277%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Iron

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.004	1.561	−0.554	5.60	0.3524	0.40%	1.0	0.129%
0.020	1.010	0.258	0.319	18.22	−0.2950	0.49%	3.0	0.247%
0.030	1.027	0.318	0.252	18.88	−0.1913	0.70%	2.0	0.291%
0.040	1.058	0.331	0.248	13.93	−0.1315	0.38%	35.0	0.249%
0.050	1.105	0.344	0.243	14.40	−0.1356	1.09%	0.5	0.383%
0.060	1.167	0.372	0.229	14.70	−0.1365	1.18%	0.5	0.530%
0.080	1.340	0.442	0.191	15.11	−0.1085	1.66%	0.5	0.685%
0.100	1.600	0.484	0.178	15.00	−0.1050	1.40%	3.0	0.880%
0.150	2.422	0.584	0.151	14.99	−0.1187	5.48%	0.5	2.542%
0.200	2.887	0.788	0.080	13.12	−0.0720	5.51%	0.5	2.306%
0.300	3.035	1.034	0.010	12.47	−0.0359	2.86%	0.5	1.456%
0.400	2.823	1.164	−0.020	11.68	−0.0210	1.90%	0.5	0.962%
0.500	2.626	1.225	−0.034	10.32	−0.0132	1.28%	0.5	0.685%
0.600	2.486	1.241	−0.038	10.26	−0.0113	1.01%	20.0	0.612%
0.800	2.277	1.241	−0.039	8.31	−0.0126	0.63%	40.0	0.404%
1.000	2.130	1.256	−0.049	18.40	0.0121	0.73%	4.0	0.343%
1.500	1.938	1.193	−0.039	15.35	0.0096	0.62%	1.0	0.280%
2.000	1.827	1.135	−0.026	25.39	0.0074	0.71%	1.0	0.238%
3.000	1.684	1.035	0.002	12.45	−0.0184	0.94%	1.0	0.587%
4.000	1.565	0.996	0.014	13.95	−0.0296	2.03%	0.5	0.976%
5.000	1.476	0.969	0.024	14.14	−0.0384	1.66%	4.0	0.981%
6.000	1.394	0.977	0.023	14.33	−0.0380	1.83%	1.0	0.919%
8.000	1.299	0.958	0.033	14.00	−0.0446	2.38%	0.5	1.123%
10.000	1.235	0.958	0.037	14.27	−0.0483	2.76%	1.0	1.262%
15.000	1.148	0.955	0.047	14.63	−0.0535	2.71%	1.0	1.268%

G-P Exposure Buildup Factor Coefficients
Iron

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.004	1.561	−0.554	5.60	0.3524	0.40%	1.0	0.129%
0.020	1.012	0.130	0.620	11.39	−0.6162	0.43%	2.0	0.219%
0.030	1.028	0.374	0.190	29.34	−0.3170	0.65%	3.0	0.281%
0.040	1.058	0.336	0.248	11.65	−0.1188	0.50%	7.0	0.238%
0.050	1.099	0.366	0.232	14.01	−0.1354	0.65%	3.0	0.343%
0.060	1.148	0.405	0.208	14.17	−0.1142	1.53%	0.5	0.577%
0.080	1.267	0.470	0.180	14.48	−0.0974	2.32%	0.5	0.892%
0.100	1.389	0.557	0.144	14.11	−0.0791	2.58%	0.5	1.040%
0.150	1.660	0.743	0.079	14.12	−0.0476	2.93%	0.5	1.143%
0.200	1.839	0.911	0.034	13.23	−0.0334	2.60%	0.5	1.169%
0.300	1.973	1.095	−0.009	11.86	−0.0183	2.34%	0.5	0.955%
0.400	1.992	1.187	−0.027	10.72	−0.0140	1.84%	0.5	0.777%
0.500	1.967	1.240	−0.039	8.34	−0.0074	1.74%	0.5	0.660%
0.600	1.947	1.247	−0.040	8.20	−0.0096	1.09%	0.5	0.512%
0.800	1.906	1.233	−0.038	7.93	−0.0110	1.15%	2.0	0.516%
1.000	1.841	1.250	−0.048	19.49	0.0140	1.16%	0.5	0.400%
1.500	1.750	1.197	−0.040	15.90	0.0110	1.05%	0.5	0.318%
2.000	1.712	1.123	−0.021	7.97	−0.0057	0.42%	0.5	0.250%
3.000	1.627	1.059	−0.005	11.99	−0.0132	0.85%	0.5	0.507%
4.000	1.553	1.026	0.005	12.93	−0.0191	1.93%	0.5	0.791%
5.000	1.483	1.009	0.012	13.12	−0.0258	2.24%	0.5	0.939%
6.000	1.442	0.980	0.023	13.37	−0.0355	2.16%	0.5	1.120%
8.000	1.354	0.974	0.029	13.65	−0.0424	3.36%	0.5	1.370%
10.000	1.297	0.949	0.042	13.97	−0.0561	3.23%	0.5	1.500%
15.000	1.199	0.957	0.049	14.37	−0.0594	3.38%	0.5	1.553%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Copper

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.001	2.044	−0.310	11.15	0.2519	0.46%	3.0	0.175%
0.020	1.006	0.230	0.442	12.61	−0.5099	0.49%	10.0	0.234%
0.030	1.017	0.370	0.247	11.26	−0.1771	0.44%	2.0	0.257%
0.040	1.038	0.392	0.197	25.45	−0.2886	0.58%	0.5	0.283%
0.050	1.071	0.353	0.243	12.89	−0.1407	0.39%	0.5	0.163%
0.060	1.121	0.340	0.250	14.53	−0.1501	1.02%	0.5	0.446%
0.080	1.246	0.395	0.217	14.39	−0.1226	2.08%	0.5	0.792%
0.100	1.381	0.539	0.133	19.42	−0.0874	2.07%	2.0	0.680%
0.150	2.120	0.472	0.208	13.51	−0.1372	5.43%	0.5	2.600%
0.200	2.603	0.671	0.120	13.45	−0.0928	6.52%	0.5	2.781%
0.300	2.926	0.921	0.039	12.80	−0.0495	4.82%	0.5	2.001%
0.400	2.795	1.070	0.002	12.19	−0.0331	3.45%	0.5	1.529%
0.500	2.612	1.158	−0.020	11.56	−0.0190	2.55%	0.5	1.093%
0.600	2.479	1.191	−0.028	10.74	−0.0147	2.09%	0.5	0.878%
0.800	2.270	1.210	−0.033	8.79	−0.0131	1.16%	0.5	0.587%
1.000	2.129	1.211	−0.036	7.13	−0.0090	1.03%	0.5	0.444%
1.500	1.952	1.149	−0.025	8.18	−0.0085	0.56%	2.0	0.300%
2.000	1.835	1.113	−0.019	9.49	−0.0052	0.81%	1.0	0.328%
3.000	1.673	1.041	0.001	12.27	−0.0174	1.97%	0.5	0.834%
4.000	1.542	1.016	0.010	14.08	−0.0286	2.41%	1.0	1.046%
5.000	1.451	0.993	0.019	14.15	−0.0372	1.96%	1.0	1.015%
6.000	1.381	0.984	0.023	14.30	−0.0395	2.29%	0.5	1.076%
8.000	1.289	0.959	0.036	14.05	−0.0494	2.35%	1.0	1.217%
10.000	1.226	0.958	0.041	14.33	−0.0536	2.70%	1.0	1.258%
15.000	1.142	0.944	0.057	14.81	−0.0634	2.39%	1.0	1.209%

G-P Exposure Buildup Factor Coefficients
Copper

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.001	2.044	−0.310	11.15	0.2519	0.46%	3.0	0.175%
0.020	1.009	0.103	0.764	10.78	−1.0613	0.48%	7.0	0.243%
0.030	1.020	0.359	0.205	12.00	−0.0510	0.37%	8.0	0.247%
0.040	1.042	0.330	0.239	14.45	−0.0962	0.38%	4.0	0.215%
0.050	1.071	0.353	0.243	12.89	−0.1407	0.39%	0.5	0.163%
0.060	1.109	0.364	0.237	13.54	−0.1349	0.92%	0.5	0.410%
0.080	1.189	0.446	0.192	13.97	−0.1094	2.08%	0.5	0.748%
0.100	1.287	0.507	0.165	13.89	−0.0924	2.37%	0.5	0.921%
0.150	1.518	0.675	0.100	13.99	−0.0555	3.10%	0.5	1.109%
0.200	1.695	0.835	0.052	13.62	−0.0364	3.10%	0.5	1.163%
0.300	1.865	1.023	0.005	12.51	−0.0197	2.69%	0.5	1.004%
0.400	1.908	1.135	−0.018	11.46	−0.0137	2.16%	0.5	0.862%
0.500	1.909	1.189	−0.029	9.92	−0.0106	1.88%	0.5	0.773%
0.600	1.889	1.216	−0.035	8.53	−0.0091	2.06%	0.5	0.661%
0.800	1.847	1.226	−0.037	7.03	−0.0118	1.46%	0.5	0.517%
1.000	1.816	1.204	−0.034	7.47	−0.0114	0.95%	0.5	0.434%
1.500	1.733	1.185	−0.037	18.36	0.0106	0.84%	0.5	0.302%
2.000	1.695	1.121	−0.021	8.90	−0.0042	1.01%	0.5	0.349%
3.000	1.617	1.059	−0.004	12.21	−0.0146	1.22%	0.5	0.608%
4.000	1.546	1.022	0.009	12.92	−0.0258	2.16%	0.5	0.976%
5.000	1.479	1.008	0.015	13.26	−0.0310	2.39%	0.5	1.105%
6.000	1.428	0.995	0.021	13.23	−0.0371	2.80%	0.5	1.201%
8.000	1.353	0.960	0.038	13.50	−0.0547	3.32%	0.5	1.576%
10.000	1.289	0.962	0.042	13.91	−0.0577	3.62%	0.5	1.627%
15.000	1.191	0.969	0.052	14.48	−0.0640	3.95%	1.0	1.757%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Molybdenum

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.005	0.347	0.282	13.56	−0.1759	0.1%	10	0.04%
0.020	1.011	0.365	0.261	14.32	−0.1599	0.1%	0.5	0.05%
0.030	1.511	1.111	0.103	28.91	−0.1158	4.3%	8	2.41%
0.040	1.486	0.349	0.064	29.63	−0.0674	0.4%	15	0.18%
0.050	1.380	0.053	−0.090	9.94	0.1063	0.4%	4	0.23%
0.060	1.028	0.505	0.150	13.57	−0.0706	0.1%	0.5	0.07%
0.080	1.085	0.240	0.379	13.14	−0.2715	0.9%	0.5	0.50%
0.100	1.156	0.252	0.363	13.03	−0.2549	1.8%	0.5	0.85%
0.150	1.422	0.291	0.330	12.85	−0.2300	3.5%	0.5	1.69%
0.200	1.709	0.389	0.248	14.25	−0.1467	2.2%	0.5	1.00%
0.300	2.294	0.527	0.182	14.13	−0.1276	2.9%	0.5	1.41%
0.400	2.555	0.675	0.119	13.99	−0.0919	3.5%	0.5	1.62%
0.500	2.594	0.774	0.085	13.93	−0.0750	3.1%	0.5	1.48%
0.600	2.549	0.847	0.063	13.82	−0.0655	2.5%	0.5	1.34%
0.800	2.408	0.908	0.040	13.62	−0.0467	2.1%	0.5	1.03%
1.00	2.263	0.958	0.026	13.62	−0.0389	1.5%	5	0.75%
1.50	1.906	1.079	−0.012	12.97	−0.0095	0.7%	3	0.34%
2.00	1.860	1.032	0.006	13.22	−0.0281	1.6%	2	0.73%
3.00	1.690	0.950	0.035	13.30	−0.0570	2.0%	0.5	1.40%
4.00	1.563	0.900	0.057	13.51	−0.0796	3.3%	0.5	2.06%
5.00	1.596	0.819	0.090	13.79	−0.1087	5.6%	0.5	2.86%
6.00	1.545	0.784	0.107	13.97	−0.1249	5.5%	0.5	3.02%
8.00	1.465	0.805	0.105	14.27	−0.1188	5.9%	0.5	2.98%
10.00	1.411	0.863	0.091	14.31	0.1056	4.9%	1	2.59%
15.00	1.404	0.984	0.072	14.18	−0.0947	4.7%	1	2.44%

G-P Exposure Buildup Factor Coefficients

Molybdenum

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.005	0.377	0.249	15.04	−0.1493	0.1%	0.5	0.04%
0.020	1.011	0.376	0.250	14.35	−0.1476	0.1%	10	0.06%
0.030	3.621	1.090	0.110	36.26	−0.3084	5.8%	0.5	3.41%
0.040	3.839	0.345	0.050	30.30	−0.0921	0.8%	15	0.40%
0.050	2.981	0.038	−0.226	16.53	0.0483	2.6%	1	1.04%
0.060	1.025	0.556	0.123	14.26	−0.0506	0.1%	0.5	0.07%
0.080	1.065	0.341	0.275	13.17	−0.1833	0.8%	0.5	0.39%
0.100	1.108	0.373	0.250	13.00	−0.1638	1.4%	0.5	0.62%
0.150	1.241	0.462	0.192	12.98	−0.1125	2.4%	0.5	1.05%
0.200	1.334	0.582	0.136	14.63	−0.0734	0.6%	25	0.38%
0.300	1.533	0.733	0.084	14.45	−0.0549	1.0%	35	0.49%
0.400	1.654	0.856	0.047	14.13	−0.0369	1.0%	5	0.49%
0.500	1.716	0.940	0.025	14.30	−0.0275	1.0%	5	0.44%
0.600	1.747	0.997	0.012	14.14	−0.0237	1.0%	5	0.39%
0.800	1.757	1.032	0.000	13.85	−0.0143	0.8%	5	0.37%
1.00	1.743	1.061	−0.006	13.68	−0.0129	0.9%	5	0.39%
1.50	1.649	1.117	−0.023	12.45	−0.0005	1.2%	0.5	0.44%
2.00	1.628	1.097	−0.013	12.41	−0.0128	1.3%	2	0.61%
3.00	1.566	1.042	0.006	12.98	−0.0329	1.2%	35	0.81%
4.00	1.509	1.003	0.023	13.32	−0.0502	2.4%	0.5	1.40%
5.00	1.524	0.940	0.047	13.63	−0.0713	3.9%	0.5	1.99%
6.00	1.517	0.901	0.064	13.82	−0.0869	4.2%	0.5	2.27%
8.00	1.496	0.904	0.070	14.12	−0.0891	4.9%	0.5	2.37%
10.00	1.510	0.936	0.067	14.16	−0.0860	4.5%	0.5	2.37%
15.00	1.567	1.081	0.044	13.97	−0.0699	4.4%	1	2.12%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Tin

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.003	0.405	0.215	26.26	−0.3092	0.1%	4	0.04%
0.020	1.006	0.381	0.252	13.99	−0.1592	0.1%	15	0.03%
0.030	1.787	1.859	0.042	11.10	−0.0316	11.3%	3	4.82%
0.040	1.691	1.229	0.096	29.62	−0.1824	6.3%	3	3.78%
0.050	1.636	0.496	0.276	16.81	−0.2316	1.9%	20	0.91%
0.060	1.566	0.258	−0.080	21.22	0.0579	0.5%	0.5	0.27%
0.080	1.393	0.033	0.741	14.35	−0.2278	0.5%	3	0.24%
0.100	1.123	0.245	0.342	12.99	−0.2053	1.1%	0.5	0.44%
0.150	1.170	0.504	0.152	13.45	−0.0750	0.9%	0.5	0.40%
0.200	1.456	0.356	0.263	14.22	−0.1497	1.7%	0.5	0.75%
0.300	1.924	0.460	0.213	14.10	−0.1426	2.5%	0.5	1.25%
0.400	2.224	0.589	0.151	13.88	−0.1057	3.5%	0.5	1.51%
0.500	2.337	0.702	0.110	13.90	−0.0892	3.3%	0.5	1.60%
0.600	2.391	0.769	0.085	13.78	−0.0736	3.1%	0.5	1.44%
0.800	2.332	0.852	0.057	13.76	−0.0574	2.7%	0.5	1.23%
1.00	2.236	0.901	0.041	13.52	−0.0463	1.6%	5	0.95%
1.50	1.929	1.030	0.001	13.25	−0.0179	0.9%	5	0.36%
2.00	1.814	0.981	0.021	13.33	−0.0392	1.5%	35	0.86%
3.00	1.643	0.933	0.043	13.32	−0.0665	3.7%	0.5	1.85%
4.00	1.517	0.891	0.063	13.52	−0.0873	5.1%	0.5	2.52%
5.00	1.575	0.814	0.096	13.88	−0.1167	7.8%	0.5	3.42%
6.00	1.568	0.732	0.136	14.03	−0.1584	5.7%	0.5	3.70%
8.00	1.469	0.807	0.112	14.26	−0.1297	7.2%	0.5	3.38%
10.00	1.435	0.895	0.088	14.80	−0.1043	5.8%	0.5	3.32%
15.00	1.398	1.055	0.064	14.06	−0.0929	6.0%	1	2.81%

G-P Exposure Buildup Factor Coefficients

Tin

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.003	0.382	0.234	28.06	−0.4056	0.15	4	0.04%
0.020	1.006	0.377	0.255	14.12	−0.1620	0.1%	10	0.03%
0.030	2.901	1.854	0.044	9.47	−0.0403	11.5%	3	4.87%
0.040	3.472	1.233	0.094	27.06	−0.1217	8.2%	3	4.12%
0.050	3.386	0.491	0.279	16.78	−0.2340	2.3%	0.5	1.18%
0.060	2.848	0.236	−0.030	5.00	−0.0542	0.6%	40	0.38%
0.080	1.765	0.018	0.810	15.18	−0.1613	1.1%	1	0.35%
0.100	1.117	0.229	0.366	13.11	−0.2253	1.0%	0.5	0.46%
0.150	1.104	0.640	0.091	13.89	−0.0357	0.3%	3	0.15%
0.200	1.229	0.543	0.149	14.61	−0.0779	0.6%	35	0.32%
0.300	1.405	0.659	0.109	14.33	−0.0678	0.9%	35	0.49%
0.400	1.525	0.780	0.067	14.18	−0.0432	1.0%	35	0.49%
0.500	1.601	0.877	0.042	13.86	−0.0357	1.0%	5	0.49%
0.600	1.643	0.929	0.027	13.89	−0.0286	0.8%	5	0.40%
0.800	1.670	0.994	0.009	13.88	−0.0182	0.9%	5	0.38%
1.00	1.674	1.021	0.002	13.56	−0.0151	0.9%	0.5	0.37%
1.50	1.612	1.085	−0.015	12.40	−0.0057	0.9%	2	0.36%
2.000	1.567	1.073	−0.007	12.77	−0.0162	1.3%	2	0.49%
3.000	1.506	1.058	0.003	13.05	−0.0314	2.0%	0.5	0.97%
4.000	1.459	1.018	0.021	13.31	−0.0504	3.4%	0.5	1.58%
5.000	1.480	0.970	0.041	13.72	−0.0672	5.1%	0.5	2.19%
6.000	1.486	0.924	0.062	13.89	−0.0870	5.1%	0.5	2.44%
8.000	1.478	0.945	0.063	14.24	−0.0840	5.5%	0.5	2.49%
10.000	1.509	0.987	0.061	14.01	−0.0850	4.8%	0.5	2.49%
15.000	1.573	1.170	0.033	13.84	−0.0640	4.8%	1	2.25%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Lanthanum

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.002	0.351	0.272	14.37	−0.1700	0.1%	6	0.02%
0.020	1.004	0.385	0.242	15.44	−0.1504	0.1%	5	0.03%
0.030	1.012	0.371	0.256	14.48	−0.1601	0.1%	4	0.08%
0.040	1.907	1.787	0.050	11.12	−0.0373	12.1%	3	5.13%
0.050	1.768	1.347	0.080	33.49	−0.1719	6.4%	20	3.96%
0.060	1.694	0.794	0.175	16.64	−0.1387	2.4%	1	1.27%
0.070	1.699	0.288	0.358	26.36	−0.3037	3.7%	0.5	1.73%
0.080	1.604	0.214	−0.058	14.49	0.0680	0.4%	1	0.16%
0.100	1.450	0.043	0.646	14.35	−0.1780	0.6%	1	0.24%
0.150	1.170	0.338	0.259	12.95	−0.1506	1.4%	0.5	0.60%
0.200	1.524	0.216	0.390	14.02	−0.2232	2.3%	0.5	1.02%
0.300	1.820	0.369	0.269	14.03	−0.1785	3.2%	0.5	1.35%
0.400	2.094	0.488	0.199	13.77	−0.1338	3.4%	0.5	1.55%
0.500	2.235	0.599	0.149	13.87	−0.1084	3.9%	0.5	1.68%
0.600	2.202	0.690	0.112	13.78	−0.0874	3.0%	0.5	1.46%
0.800	2.212	0.786	0.077	13.61	−0.0670	2.9%	0.5	1.35%
1.00	2.143	0.854	0.055	13.58	−0.0542	2.2%	0.5	1.14%
1.50	1.937	0.977	0.015	13.37	−0.0258	1.2%	5	0.50%
2.00	1.822	0.942	0.033	13.34	−0.0477	1.6%	0.5	1.09%
3.00	1.647	0.899	0.056	13.34	−0.0789	5.1%	0.5	2.30%
4.00	1.513	0.873	0.073	13.60	−0.0989	6.6%	0.5	3.00%
5.00	1.574	0.797	0.107	13.96	−0.1293	8.8%	0.5	3.80%
6.00	1.518	0.788	0.115	14.12	−0.1361	9.1%	0.5	3.85%
8.00	1.404	0.924	0.073	14.62	−0.0883	10.9%	0.5	4.13%
10.00	1.422	0.919	0.089	14.18	−0.1121	7.3%	0.5	3.36%
15.00	1.400	1.096	0.061	13.99	−0.0938	6.9%	1	3.10%

G-P Exposure Buildup Factor Coefficients

Lanthanum

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.002	0.351	0.272	14.37	−0.1700	0.1%	6	0.02%
0.020	1.004	0.385	0.242	15.44	−0.1504	0.1%	5	0.03%
0.030	1.012	0.367	0.263	13.73	−0.1674	0.1%	0.5	0.06%
0.040	2.900	1.811	0.046	11.12	−0.0333	11.8%	3	5.15%
0.050	3.178	1.269	0.100	18.88	−0.1095	12.8%	40	6.98%
0.060	2.786	0.778	0.182	16.42	−0.1492	2.7%	4	1.57%
0.070	2.381	0.305	0.340	24.83	−0.2257	4.1%	0.5	2.25%
0.080	2.014	0.216	−0.123	16.23	0.0673	0.7%	1	0.32%
0.100	1.455	0.040	0.661	14.48	−0.1748	0.7%	1	0.25%
0.150	1.089	0.537	0.135	13.64	−0.0636	0.8%	0.5	0.29%
0.200	1.197	0.452	0.195	14.41	−0.1048	1.1%	0.5	0.45%
0.300	1.310	0.619	0.121	14.43	−0.0711	0.8%	0.5	0.45%
0.400	1.426	0.709	0.089	13.99	−0.0526	0.8%	35	0.47%
0.500	1.500	0.805	0.060	14.09	−0.0407	0.8%	5	0.49%
0.600	1.547	0.868	0.042	13.95	−0.0331	0.9%	5	0.45%
0.800	1.592	0.942	0.021	13.82	−0.0224	0.9%	5	0.43%
1.00	1.608	0.990	0.009	13.65	−0.0172	0.9%	5	0.40%
1.50	1.574	1.053	−0.008	12.66	−0.0081	0.7%	0.5	0.32%
2.00	1.536	1.053	−0.002	12.93	−0.0187	0.9%	2	0.49%
3.00	1.481	1.051	0.006	13.03	−0.0342	2.3%	0.5	1.09%
4.00	1.431	1.026	0.022	13.38	−0.0535	3.7%	0.5	1.72%
5.00	1.466	0.966	0.047	13.73	−0.0749	5.2%	0.5	2.33%
6.00	1.467	0.938	0.061	13.94	−0.0871	5.5%	0.5	2.49%
8.00	1.468	0.974	0.060	14.13	−0.0838	5.9%	0.5	2.56%
10.00	1.493	1.055	0.047	13.98	−0.0734	5.7%	0.5	2.54%
15.00	1.581	1.220	0.029	13.69	−0.0637	4.9%	1	2.35%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Gadolinium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.001	0.623	0.099	11.85	−0.0272	0.1%	4.0	0.03%
0.020	1.003	0.304	0.321	14.04	−0.2144	0.0%	4.0	0.02%
0.030	1.008	0.370	0.262	14.04	−0.1718	0.1%	3.0	0.06%
0.040	1.017	0.393	0.238	14.15	−0.1412	0.2%	0.5	0.10%
0.050	1.030	0.408	0.228	13.76	−0.1346	0.4%	0.5	0.17%
0.060	1.903	1.408	0.085	18.32	−0.0988	15.2%	40.	7.47%
0.080	1.739	0.609	0.235	16.12	−0.2033	2.2%	35.	1.23%
0.100	1.648	0.242	−0.006	19.35	0.0590	0.4%	0.5	0.17%
0.150	1.433	0.076	0.629	13.32	−0.3336	1.5%	2	0.75%
0.200	1.488	0.148	0.479	13.91	−0.2602	2.2%	0.5	0.96%
0.300	1.664	0.303	0.316	14.00	−0.2044	2.8%	0.5	1.25%
0.400	1.883	0.408	0.242	13.70	−0.1576	3.0%	0.5	1.40%
0.500	2.022	0.516	0.186	13.77	−0.1282	3.6%	0.5	1.60%
0.600	1.975	0.625	0.134	13.80	−0.0948	3.0%	0.5	1.38%
0.800	2.054	0.709	0.101	13.64	−0.0763	2.8%	0.5	1.34%
1.00	2.025	0.790	0.074	14.55	−0.0629	2.6%	0.5	1.28%
1.50	1.899	0.912	0.033	13.36	−0.0360	1.2%	5	0.72%
2.00	1.795	0.889	0.049	13.34	−0.0585	2.5%	0.5	1.35%
3.00	1.625	0.866	0.068	13.44	−0.0887	6.3%	0.5	2.67%
4.00	1.490	0.854	0.081	13.71	−0.1057	8.0%	0.5	3.34%
5.00	1.616	0.713	0.145	14.15	−0.1708	7.7%	0.5	4.29%
6.00	1.482	0.828	0.100	14.26	−0.1177	11.6%	0.5	4.23%
8.00	1.466	0.820	0.116	14.21	−0.1362	9.0%	0.5	3.85%
10.00	1.433	0.938	0.087	14.14	−0.1117	8.2%	0.5	3.54%
15.00	1.415	1.120	0.060	13.92	−0.0949	7.0	0.5	3.26%

G-P Exposure Buildup Factor Coefficients
Gadolinium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.001	0.673	0.069	23.28	0.0179	0.1%	7.0	0.03%
0.020	1.003	0.304	0.321	14.04	−0.2144	0.0%	4.0	0.02%
0.030	1.008	0.380	0.252	14.05	−0.1597	0.1%	0.5	0.05%
0.040	1.017	0.393	0.238	14.15	−0.1412	0.2%	0.5	0.10%
0.050	1.029	0.419	0.220	13.78	−0.1281	0.4%	0.5	0.17%
0.060	2.651	1.449	0.076	19.01	−0.0762	10.5%	40.	6.14%
0.080	2.066	0.621	0.230	16.01	−0.1998	2.4%	1.0	1.40%
0.100	1.607	0.246	−0.005	19.62	0.0612	0.3%	0.5	0.18%
0.150	1.175	0.182	0.427	13.11	−0.2640	1.2%	2	0.60%
0.200	1.160	0.389	0.232	14.05	−0.1256	1.1%	0.5	0.46%
0.300	1.235	0.576	0.136	14.60	−0.0779	0.8%	0.5	0.43%
0.400	1.328	0.658	0.104	13.96	−0.0569	0.7%	25	0.43%
0.500	1.399	0.749	0.075	14.07	−0.0448	0.7%	15	0.48%
0.600	1.450	0.806	0.058	13.74	−0.0379	0.8%	35	0.44%
0.800	1.507	0.875	0.037	13.71	−0.0272	0.9%	5	0.43%
1.00	1.533	0.935	0.022	13.53	−0.0218	0.9%	5	0.44%
1.50	1.524	1.009	0.002	13.00	−0.0122	0.8%	5	0.31%
2.00	1.496	1.016	0.007	13.01	−0.0237	1.0%	35.	0.54%
3.00	1.444	1.038	0.010	13.33	−0.0365	2.5%	0.5	1.13%
4.00	1.392	1.036	0.020	13.47	−0.0510	4.2%	0.5	1.73%
5.00	1.438	0.967	0.048	13.80	−0.0749	5.4%	0.5	2.27%
6.00	1.443	0.949	0.059	14.02	−0.0835	5.6%	0.5	2.43%
8.00	1.457	0.995	0.056	14.08	−0.0790	5.9%	0.5	2.48%
10.00	1.503	1.074	0.046	13.91	−0.0738	5.2%	0.5	2.42%
15.00	1.590	1.269	0.022	13.68	−0.0562	4.8%	1.0	2.25%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Tungsten

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.001	0.277	0.342	19.18	−0.3351	0.1%	3.	0.03%
0.020	1.002	0.258	0.394	13.12	−0.3192	0.0%	4.	0.02%
0.030	1.004	0.554	0.136	15.36	−0.0677	0.2%	0.5	0.06%
0.040	1.011	0.346	0.279	14.35	−0.1832	0.1%	8.	0.06%
0.050	1.018	0.407	0.230	13.80	−0.1384	0.3%	0.5	0.11%
0.060	1.029	0.415	0.224	13.44	−0.1325	0.5%	0.5	0.18%
0.080	1.956	1.461	0.073	27.21	−0.1584	17.9%	40	6.37%
0.100	1.809	0.852	0.164	16.39	−0.1348	2.6%	1.	1.54%
0.150	1.613	0.124	0.194	8.36	0.0659	0.5%	0.5	0.27%
0.200	1.528	0.073	0.634	13.97	−0.2997	1.2%	2	0.61%
0.300	1.563	0.204	0.395	13.29	−0.2179	2.4%	0.5	1.04%
0.400	1.683	0.327	0.294	13.68	−0.1857	2.9%	0.5	1.29%
0.500	1.802	0.416	0.237	13.74	−0.1550	3.0%	0.5	1.43%
0.600	1.759	0.534	0.171	13.78	−0.1124	2.9%	0.5	1.28%
0.800	1.910	0.607	0.139	13.57	−0.0952	2.9%	0.5	1.40%
1.00	1.869	0.689	0.106	13.54	−0.0760	2.2%	0.5	1.27%
1.50	1.840	0.818	0.061	13.42	−0.0512	1.7%	0.5	1.02%
2.00	1.748	0.827	0.068	13.39	−0.0694	4.0%	0.5	1.72%
3.00	1.582	0.840	0.076	13.53	−0.0922	8.2%	0.5	3.01%
4.00	1.460	0.828	0.091	13.78	−0.1126	9.5%	0.5	3.67%
5.00	1.509	0.756	0.126	14.11	−0.1441	9.9%	0.5	4.02%
6.00	1.480	0.768	0.127	14.27	−0.1441	9.7%	0.5	3.95%
8.00	1.431	0.839	0.112	14.28	−0.1304	8.9%	0.5	3.71%
10.00	1.481	0.844	0.128	14.12	−0.1624	7.0%	3.	4.40%
15.00	1.396	1.164	0.054	13.90	−0.0885	7.3%	1.	3.17%

G-P Exposure Buildup Factor Coefficients

Tungsten

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.001	0.277	0.342	19.18	−0.3351	0.1%	3.	0.03%
0.020	1.002	0.258	0.394	13.12	−0.3192	0.0%	4.	0.02%
0.030	1.005	0.408	0.224	14.86	−0.1299	0.1%	0.5	0.03%
0.040	1.011	0.346	0.279	14.35	−0.1832	0.1%	8.	0.06%
0.050	1.017	0.432	0.213	13.80	−0.1254	0.2%	0.5	0.10%
0.060	1.026	0.448	0.203	13.55	−0.1178	0.3%	0.5	0.15%
0.080	2.054	1.649	0.034	12.02	0.0348	8.8%	0.5	3.70%
0.100	1.755	0.894	0.152	16.07	−0.1271	3.4%	1.	1.78%
0.150	1.257	0.152	0.335	15.57	−0.0722	0.3%	0.5	0.15%
0.200	1.155	0.253	0.340	13.68	−0.1903	1.1%	0.5	0.47%
0.300	1.169	0.497	0.162	13.63	−0.0757	0.8%	0.5	0.33%
0.400	1.234	0.611	0.118	14.19	−0.0609	0.6%	0.5	0.37%
0.500	1.294	0.681	0.094	14.19	−0.0502	0.7%	1	0.42%
0.600	1.339	0.743	0.074	14.08	−0.0417	0.8%	1	0.43%
0.800	1.405	0.799	0.057	13.63	−0.0340	0.7%	5	0.43%
1.00	1.443	0.849	0.043	13.54	−0.0282	0.8%	5	0.44%
1.50	1.456	0.948	0.016	13.24	−0.0168	0.7%	1	0.36%
2.00	1.435	0.985	0.013	13.24	−0.0234	1.0%	0.5	0.57%
3.00	1.392	1.028	0.012	13.29	−0.0362	2.8%	0.5	1.11%
4.00	1.346	1.039	0.019	13.73	−0.0470	4.3%	0.5	1.68%
5.00	1.365	1.010	0.035	13.97	−0.0597	4.8%	0.5	1.92%
6.00	1.395	0.953	0.060	14.15	−0.0823	4.0%	0.5	2.13%
8.00	1.416	1.024	0.050	14.34	−0.0707	4.3%	0.5	2.12%
10.00	1.442	1.156	0.028	14.05	−0.0537	4.6%	0.5	1.97%
15.00	1.544	1.332	0.013	13.57	−0.0464	4.4%	1.	1.87%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Lead

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.03	1.003	0.506	0.167	14.21	−0.0950	0.1%	0.5	0.04%
0.04	1.007	0.414	0.227	13.71	−0.1370	0.1%	5	0.05%
0.05	1.013	0.368	0.273	13.99	−0.1844	0.2%	0.5	0.07%
0.06	1.020	0.413	0.226	13.73	−0.1353	0.2%	0.5	0.10%
0.08	1.044	0.403	0.227	13.24	−0.1318	0.6%	0.5	0.25%
0.10	2.014	1.393	0.083	20.93	−0.0912	10.0%	3	5.32%
0.15	1.783	0.318	0.310	26.45	−0.1233	2.8%	0.5	1.29%
0.20	1.588	0.097	0.441	14.49	−0.1076	0.8%	1	0.27%
0.30	1.494	0.183	0.421	12.80	−0.2485	2.4%	0.5	1.20%
0.40	1.237	0.552	0.134	15.25	−0.0504	1.0%	0.5	0.43%
0.50	1.332	0.590	0.127	14.62	−0.0572	0.9%	1	0.52%
0.60	1.424	0.621	0.113	13.77	−0.0478	0.7%	0.5	0.42%
0.80	1.533	0.682	0.094	14.43	−0.0455	0.9%	10	0.53%
1.00	1.589	0.744	0.076	14.76	−0.0406	0.8%	10	0.53%
1.50	1.656	0.778	0.069	13.61	−0.0452	1.4%	0.5	0.73%
2.00	1.670	0.785	0.079	13.58	−0.0696	4.2%	0.5	1.66%
3.00	1.575	0.778	0.096	13.78	−0.1032	8.4%	0.5	3.06%
4.00	1.612	0.706	0.137	14.11	−0.1471	11.3%	0.5	4.14%
5.00	1.530	0.722	0.139	14.19	−0.1526	12.1%	0.5	4.36%
6.00	1.497	0.721	0.145	14.37	−0.1578	11.5%	0.5	4.26%
8.00	1.443	0.808	0.123	14.30	−0.1385	10.9%	0.5	4.15%
10.00	1.424	0.940	0.090	14.20	−0.1121	10.4%	0.5	3.92%
15.00	1.404	1.124	0.065	13.91	−0.0991	9.2%	0.5	3.79%

G-P Exposure Buildup Factor Coefficients

Lead

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.03	1.003	0.396	0.248	14.56	−0.1696	0.1%	5	0.04%
0.04	1.007	0.438	0.204	14.26	−0.1093	0.1%	3	0.05%
0.05	1.012	0.405	0.244	14.18	−0.1624	0.1%	0.5	0.00%
0.06	1.017	0.487	0.180	13.37	−0.1037	0.3%	0.5	0.11%
0.08	1.033	0.523	0.153	13.30	−0.0777	0.4%	0.5	0.17%
0.10	2.037	1.432	0.079	18.37	−0.0935	10.5%	40	5.97%
0.15	1.408	0.362	0.281	21.46	−0.0964	1.2%	0.5	0.66%
0.20	1.184	0.190	0.381	13.27	−0.1868	0.5%	3	0.26%
0.30	1.122	0.533	0.137	13.69	−0.0612	0.8%	0.5	0.32%
0.40	1.135	0.670	0.085	19.56	−0.0325	0.5%	0.5	0.26%
0.50	1.179	0.725	0.072	14.89	−0.0244	0.7%	3	0.36%
0.60	1.228	0.744	0.064	14.47	−0.0184	0.9%	3	0.40%
0.80	1.283	0.800	0.050	15.20	−0.0191	0.9%	0.5	0.43%
1.00	1.318	0.860	0.035	16.49	−0.0154	0.7%	3	0.38%
1.50	1.375	0.891	0.029	13.29	−0.0168	0.5%	2	0.35%
2.00	1.388	0.939	0.024	13.33	−0.0266	1.0%	0.5	0.51%
3.00	1.385	0.960	0.029	13.48	−0.0421	3.6%	0.5	1.31%
4.00	1.378	0.954	0.042	14.04	−0.0603	4.6%	0.5	1.72%
5.00	1.361	0.956	0.051	13.95	−0.0709	5.3%	0.5	2.06%
6.00	1.377	0.941	0.062	14.14	−0.0795	5.3%	0.5	2.15%
8.00	1.424	0.968	0.068	13.98	−0.0874	4.2%	0.5	2.35%
10.00	1.448	1.121	0.036	13.98	−0.0599	5.5%	0.5	2.20%
15.00	1.548	1.287	0.024	13.50	−0.0571	4.7%	0.5	2.21%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients

Uranium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.03	1.003	0.270	0.357	14.60	−0.2551	0.1%	3	0.04%
0.04	1.005	0.448	0.191	19.76	−0.1466	0.1%	0.5	0.05%
0.05	1.009	0.379	0.255	13.55	−0.1651	0.1%	0.5	0.07%
0.06	1.013	0.446	0.202	13.86	−0.1161	0.3%	0.5	0.10%
0.08	1.028	0.417	0.220	13.29	−0.1242	0.4%	0.5	0.18%
0.10	1.076	0.248	0.367	13.01	−0.2542	0.9%	2	0.51%
0.15	1.858	1.007	0.129	17.25	−0.0990	3.4%	0.5	1.93%
0.20	1.759	0.336	0.183	15.97	−0.0460	0.8%	20	0.35%
0.30	1.539	0.121	0.494	13.05	−0.2398	1.4%	2	0.70%
0.40	1.474	0.217	0.392	13.47	−0.2187	2.9%	0.5	1.27%
0.50	1.469	0.346	0.274	13.50	−0.1558	3.2%	0.5	1.19%
0.60	1.487	0.450	0.209	13.34	−0.1284	2.9%	0.5	1.20%
0.80	1.558	0.547	0.155	13.52	−0.0864	1.8%	0.5	0.88%
1.00	1.578	0.641	0.114	14.32	−0.0605	1.8%	0.5	0.86%
1.50	1.639	0.680	0.107	13.23	−0.0624	1.7%	0.5	0.90%
2.00	1.674	0.698	0.113	13.58	−0.0938	5.6%	0.5	2.13%
3.00	1.624	0.681	0.135	13.81	−0.1336	9.5%	0.5	3.49%
4.00	1.554	0.677	0.147	14.11	−0.1506	11.1%	0.5	4.01%
5.00	1.506	0.669	0.159	14.38	−0.1641	11.8%	0.5	4.34%
6.00	1.479	0.677	0.161	14.46	−0.1666	11.7%	0.5	4.38%
8.00	1.449	0.783	0.129	14.39	−0.1393	11.2%	0.5	4.10%
10.00	1.435	0.915	0.096	14.23	−0.1155	10.0%	0.5	3.79%
15.00	1.411	1.096	0.071	13.88	−0.1035	9.6%	0.5	3.87%

G-P Exposure Buildup Factor Coefficients

Uranium

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.03	1.003	0.275	0.355	14.80	−0.2744	0.1%	3	0.04%
0.04	1.005	0.448	0.191	19.76	−0.1466	0.1%	0.5	0.05%
0.05	1.008	0.451	0.199	14.63	−0.1175	0.1%	0.5	0.05%
0.06	1.012	0.457	0.198	13.92	−0.1168	0.2%	0.5	0.08%
0.08	1.021	0.550	0.139	13.56	−0.0621	0.4%	0.5	0.12%
0.10	1.053	0.362	0.270	12.21	−0.1943	0.7%	1	0.38%
0.15	1.606	1.080	0.112	16.63	−0.0875	4.4%	1	2.02%
0.20	1.329	0.369	0.197	14.10	−0.0755	0.4%	20	0.18%
0.30	1.138	0.358	0.242	13.01	−0.1319	0.9%	0.5	0.44%
0.40	1.129	0.556	0.136	14.89	−0.0530	0.5%	0.5	0.29%
0.50	1.149	0.660	0.094	14.55	−0.0343	0.5%	2	0.25%
0.60	1.177	0.724	0.073	13.34	−0.0304	0.8%	10	0.40%
0.80	1.235	0.746	0.067	13.79	−0.0264	0.6%	2	0.32%
1.00	1.271	0.796	0.053	15.45	−0.0219	0.7%	0.5	0.37%
1.50	1.317	0.849	0.041	12.50	−0.0154	1.0%	2	0.42%
2.00	1.341	0.911	0.030	13.96	−0.0258	1.2%	0.5	0.61%
3.00	1.335	0.948	0.031	13.63	−0.0436	3.3%	0.5	1.27%
4.00	1.317	0.963	0.036	14.07	−0.0506	4.1%	0.5	1.52%
5.00	1.338	0.889	0.071	14.10	−0.0838	4.4%	0.5	2.33%
6.00	1.335	0.930	0.062	14.27	−0.0740	6.2%	0.5	2.26%
8.00	1.376	1.009	0.050	14.37	−0.0633	4.9%	0.5	1.90%
10.00	1.429	1.111	0.036	14.05	−0.0565	4.7%	0.5	1.91%
15.00	1.526	1.285	0.022	13.61	−0.0515	4.8%	0.5	2.17%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Water

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.188	0.464	0.172	14.00	−0.0829	1.37%	0.5	0.508%
0.020	1.449	0.532	0.152	14.61	−0.0764	1.91%	0.5	0.730%
0.030	2.411	0.741	0.084	14.62	−0.0452	2.29%	0.5	1.065%
0.040	3.587	1.114	−0.018	12.48	0.0013	0.68%	0.5	0.248%
0.050	4.554	1.457	−0.084	13.69	0.0341	1.47%	35.0	0.977%
0.060	5.018	1.735	−0.127	13.70	0.0676	2.37%	35.0	1.564%
0.080	5.030	2.054	−0.167	13.84	0.0763	3.00%	35.0	1.982%
0.100	4.627	2.207	−0.184	13.27	0.0799	2.98%	10.0	1.885%
0.150	3.888	2.206	−0.180	14.27	0.0738	2.37%	0.5	1.478%
0.200	3.462	2.132	−0.173	14.51	0.0750	2.36%	0.5	1.335%
0.300	2.897	2.008	−0.162	14.18	0.0641	2.40%	35.0	1.412%
0.400	2.646	1.874	−0.148	14.16	0.0591	2.41%	35.0	1.377%
0.500	2.499	1.749	−0.132	14.36	0.0517	2.00%	1.0	1.195%
0.600	2.383	1.662	−0.121	14.19	0.0482	1.97%	35.0	1.224%
0.800	2.223	1.524	−0.101	14.31	0.0403	1.97%	1.0	1.078%
1.000	2.106	1.436	−0.088	14.19	0.0367	1.68%	0.5	0.970%
1.500	1.948	1.265	−0.057	14.98	0.0245	1.51%	0.5	0.616%
2.000	1.843	1.169	−0.038	14.22	0.0157	1.61%	0.5	0.551%
3.000	1.716	1.050	−0.011	13.63	0.0027	0.97%	0.5	0.314%
4.000	1.633	0.979	0.007	14.23	−0.0060	0.65%	0.5	0.252%
5.000	1.571	0.928	0.022	13.20	−0.0157	0.62%	4.0	0.336%
6.000	1.521	0.893	0.033	11.92	−0.0208	1.87%	1.0	0.636%
8.000	1.432	0.873	0.038	11.56	−0.0204	0.59%	3.0	0.355%
10.000	1.378	0.849	0.045	14.34	−0.0280	0.98%	0.5	0.574%
15.000	1.280	0.829	0.052	14.85	−0.0367	1.23%	3.0	0.688%

G-P Exposure Buildup Factor Coefficients
Water

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.182	0.463	0.175	14.23	−0.0908	1.69%	0.5	0.634%
0.020	1.427	0.549	0.143	14.86	−0.0707	2.31%	0.5	0.780%
0.030	2.335	0.736	0.087	13.28	−0.0419	2.34%	0.5	1.180%
0.040	3.477	1.117	−0.019	11.67	0.0026	0.89%	0.5	0.298%
0.050	4.461	1.457	−0.084	13.62	0.0341	1.26%	10.0	0.850%
0.060	4.983	1.730	−0.126	13.64	0.0561	2.22%	10.0	1.563%
0.080	5.059	2.059	−0.168	13.67	0.0770	2.94%	35.0	1.946%
0.100	4.663	2.221	−0.186	13.33	0.0826	3.02%	10.0	1.925%
0.150	3.897	2.242	−0.185	14.19	0.0777	2.55%	15.0	1.584%
0.200	3.478	2.154	−0.176	14.50	0.0774	2.50%	0.5	1.492%
0.300	2.920	2.022	−0.164	14.21	0.0655	2.46%	1.0	1.471%
0.400	2.660	1.882	−0.149	14.24	0.0595	2.17%	35.0	1.372%
0.500	2.500	1.766	−0.135	14.33	0.0546	2.46%	1.0	1.380%
0.600	2.377	1.679	−0.124	14.23	0.0503	2.02%	1.0	1.265%
0.800	2.212	1.544	−0.105	14.36	0.0437	1.97%	0.5	1.186%
1.000	2.103	1.441	−0.089	14.22	0.0378	1.55%	0.5	0.895%
1.500	1.939	1.269	−0.058	14.52	0.0246	1.91%	0.5	0.757%
2.000	1.839	1.173	−0.039	14.07	0.0161	1.45%	0.5	0.522%
3.000	1.710	1.056	−0.013	11.82	0.0047	0.70%	0.5	0.239%
4.000	1.621	0.989	0.004	13.45	−0.0041	0.55%	1.0	0.211%
5.000	1.554	0.939	0.018	13.55	−0.0122	0.51%	30.0	0.333%
6.000	1.507	0.903	0.029	16.13	−0.0272	0.85%	25.0	0.475%
8.000	1.422	0.879	0.035	13.36	−0.0191	0.89%	0.5	0.445%
10.000	1.362	0.859	0.042	13.37	−0.0247	0.90%	0.5	0.453%
15.000	1.267	0.843	0.047	15.08	−0.0336	1.02%	1.0	0.604%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Air

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.170	0.459	0.175	13.73	−0.0862	1.45%	0.5	0.512%
0.020	1.407	0.512	0.161	14.40	−0.0819	2.15%	0.5	0.830%
0.030	2.292	0.693	0.102	13.34	−0.0484	2.48%	0.5	1.240%
0.040	3.390	1.052	−0.004	19.76	−0.0068	0.95%	0.5	0.383%
0.050	4.322	1.383	−0.071	13.51	0.0270	1.19%	4.0	0.782%
0.060	4.837	1.653	−0.115	13.66	0.0511	2.37%	0.5	1.422%
0.080	4.929	1.983	−0.159	13.74	0.0730	2.73%	10.0	1.909%
0.100	4.580	2.146	−0.178	12.83	0.0759	2.69%	1.0	1.733%
0.150	3.894	2.148	−0.173	14.46	0.0698	2.51%	35.0	1.506%
0.200	3.345	2.147	−0.176	14.08	0.0719	2.51%	35.0	1.540%
0.300	2.887	1.990	−0.160	14.13	0.0633	2.29%	25.0	1.450%
0.400	2.635	1.860	−0.146	14.24	0.0583	2.17%	35.0	1.377%
0.500	2.496	1.736	−0.130	14.32	0.0505	2.30%	1.0	1.267%
0.600	2.371	1.656	−0.120	14.27	0.0472	1.80%	25.0	1.198%
0.800	2.207	1.532	−0.103	14.12	0.0425	1.92%	0.5	1.131%
1.000	2.102	1.428	−0.086	14.35	0.0344	1.63%	0.5	0.858%
1.500	1.939	1.265	−0.057	14.24	0.0232	1.22%	0.5	0.610%
2.000	1.835	1.173	−0.039	14.07	0.0161	1.31%	0.5	0.534%
3.000	1.712	1.051	−0.011	13.67	0.0024	0.81%	0.5	0.254%
4.000	1.627	0.983	0.006	13.51	−0.0051	0.44%	5.0	0.257%
5.000	1.558	0.943	0.017	13.82	−0.0117	0.76%	1.0	0.371%
6.000	1.505	0.915	0.025	16.37	−0.0231	0.99%	1.0	0.513%
8.000	1.418	0.891	0.032	12.06	−0.0167	1.12%	0.5	0.418%
10.000	1.358	0.875	0.037	14.01	−0.0226	1.16%	0.5	0.547%
15.000	1.267	0.844	0.048	14.55	−0.0344	1.08%	4.0	0.651%

Table 5.1
G-P Energy Absorption Buildup Factor Coefficients
Concrete

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.028	0.429	0.174	27.56	−0.2976	0.58%	4.0	0.282%
0.020	1.067	0.396	0.204	13.32	−0.0960	0.74%	0.5	0.414%
0.030	1.220	0.403	0.212	14.44	−0.1160	1.01%	0.5	0.558%
0.040	1.472	0.489	0.172	14.92	−0.0943	1.94%	0.5	0.766%
0.050	1.826	0.602	0.127	15.51	−0.0687	1.30%	2.0	0.638%
0.060	2.249	0.723	0.087	16.62	−0.0622	1.30%	2.0	0.563%
0.080	3.263	0.885	0.045	14.03	−0.0402	1.15%	10.0	0.700%
0.100	3.867	1.101	−0.009	13.91	−0.0161	0.80%	2.0	0.367%
0.150	4.066	1.413	−0.072	13.89	0.0174	2.67%	0.5	1.007%
0.200	3.682	1.552	−0.095	13.73	0.0285	2.96%	0.5	1.182%
0.300	3.090	1.617	−0.106	14.23	0.0331	2.21%	0.5	1.085%
0.400	2.774	1.593	−0.104	14.36	0.0323	2.22%	0.5	1.000%
0.500	2.572	1.552	−0.099	14.76	0.0315	1.61%	0.5	0.799%
0.600	2.433	1.507	−0.093	14.78	0.0296	1.99%	0.5	0.833%
0.800	2.243	1.429	−0.082	14.85	0.0270	1.79%	0.5	0.687%
1.000	2.124	1.359	−0.071	15.31	0.0243	1.48%	0.5	0.563%
1.500	1.934	1.249	−0.053	14.53	0.0201	1.18%	0.5	0.497%
2.000	1.834	1.161	−0.035	13.88	0.0117	0.75%	2.0	0.332%
3.000	1.701	1.051	−0.009	10.11	−0.0021	0.42%	0.5	0.180%
4.000	1.613	0.981	0.010	12.99	−0.0133	0.64%	4.0	0.331%
5.000	1.551	0.919	0.030	11.99	−0.0263	2.82%	0.5	0.979%
6.000	1.475	0.930	0.024	15.87	−0.0273	0.80%	10.0	0.475%
8.000	1.383	0.909	0.031	12.43	−0.0218	1.21%	1.0	0.573%
10.000	1.320	0.902	0.033	14.83	−0.0258	1.49%	1.0	0.710%
15.000	1.229	0.866	0.048	15.03	−0.0426	1.25%	10.0	0.806%

G-P Exposure Buildup Factor Coefficients
Concrete

E(MeV)	b	c	a	X_k	d	Max. Dev.	X_{max}	St. Dev.
0.015	1.029	0.364	0.240	14.12	−0.1704	0.46%	25.0	0.236%
0.020	1.067	0.389	0.214	12.68	−0.1126	0.72%	0.5	0.359%
0.030	1.212	0.421	0.201	14.12	−0.1079	1.56%	0.5	0.610%
0.040	1.455	0.493	0.171	14.53	−0.0925	2.01%	0.5	0.831%
0.050	1.737	0.628	0.115	15.82	−0.0600	0.97%	2.0	0.499%
0.060	2.125	0.664	0.118	11.90	−0.0615	2.90%	0.5	1.389%
0.080	2.557	0.895	0.042	14.37	−0.0413	1.86%	0.5	0.958%
0.100	2.766	1.069	0.001	12.64	−0.0251	1.14%	35.0	0.623%
0.150	2.824	1.315	−0.049	8.66	−0.0048	0.36%	30.0	0.175%
0.200	2.716	1.430	−0.070	18.52	0.0108	0.50%	0.5	0.164%
0.300	2.522	1.492	−0.082	16.59	0.0161	0.49%	40.0	0.246%
0.400	2.372	1.494	−0.085	15.96	0.0194	0.40%	25.0	0.195%
0.500	2.271	1.466	−0.082	16.25	0.0195	0.28%	15.0	0.163%
0.600	2.192	1.434	−0.078	17.02	0.0199	0.55%	1.0	0.242%
0.800	2.066	1.386	−0.073	15.07	0.0202	0.68%	35.0	0.296%
1.000	1.982	1.332	−0.065	15.38	0.0193	0.46%	35.0	0.189%
1.500	1.848	1.227	−0.047	16.41	0.0160	0.64%	0.5	0.317%
2.000	1.775	1.154	−0.033	14.35	0.0100	0.64%	40.0	0.194%
3.000	1.671	1.054	−0.010	10.47	−0.0008	0.31%	3.0	0.152%
4.000	1.597	0.988	0.008	12.53	−0.0115	0.81%	1.0	0.433%
5.000	1.527	0.951	0.020	9.99	−0.0184	0.71%	40.0	0.352%
6.000	1.478	0.940	0.021	13.11	−0.0163	1.30%	0.5	0.560%
8.000	1.395	0.917	0.028	13.45	−0.0213	1.42%	0.5	0.604%
10.000	1.334	0.901	0.035	12.56	−0.0267	1.48%	0.5	0.623%
15.000	1.260	0.823	0.065	14.28	−0.0581	1.96%	3.0	1.151%

Table 6
Elemental Compositions of NBS Concrete and Air

NBS Concrete	
Element	Weight Fraction
Hydrogen	0.0056
Oxygen	0.4983
Sodium	0.0171
Magnesium	0.0024
Aluminum	0.0456
Silicon	0.3158
Sulfur	0.0012
Potassium	0.0192
Calcium	0.0826
Iron	0.0122
Sum	1.000

Air	
Element	Weight Fraction
Carbon	0.00014
Nitrogen	0.75519
Oxygen	0.23179
Argon	0.01288
Sum	1.00000

Table 7

Correction Factors for Aluminium Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	0.0	3.325E−9	3.325E−9	2.574	3.329	3.329	1.29
0.06	0.0	3.948E−9	3.948E−9	3.498	4.479	4.479	1.28
0.08	0.0	5.948E−9	5.948E−9	5.386	6.589	6.589	1.22
0.10	0.0	8.573E−9	8.573E−9	6.896	8.105	8.105	1.17
0.15	0.0	1.632E−8	1.632E−8	8.885	9.952	9.952	1.12
0.20	0.0	2.379E−8	2.379E−8	9.390	10.26	10.26	1.09
0.30	0.0	3.601E−8	3.601E−8	9.184	9.757	9.757	1.06
0.40	0.0	4.570E−8	4.570E−8	8.680	9.096	9.096	1.05
0.50	0.0	5.327E−8	5.327E−8	8.137	8.454	8.454	1.04
0.60	0.0	5.996E−8	5.996E−8	7.663	7.916	7.916	1.03
0.80	0.0	6.931E−8	6.391E−9	6.928	7.105	7.105	1.02
1.00	0.0	7.684E−8	7.684E−8	6.389	6.523	6.523	1.02
1.50	0.0	9.138E−8	9.138E−8	5.502	5.578	5.578	1.01
2.00	0.0	1.006E−7	1.006E−7	4.967	5.012	5.012	1.01
3.00	0.0	1.122E−7	1.127E−7	4.253	4.263	4.263	1.00

Correction Factors for Iron Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	0.5	1.760E−9	1.824E−9	1.148	1.774	1.838	1.60
0.06	1.0	1.704E−9	1.794E−9	1.237	1.954	2.057	1.66
0.08	1.0	2.018E−9	2.119E−9	1.488	2.274	2.378	1.60
0.10	1.0	2.749E−9	2.837E−9	1.828	2.628	2.712	1.48
0.15	0.5	6.101E−9	6.144E−9	2.870	3.723	3.749	1.31
0.20	0.0	1.093E−8	1.093E−8	3.858	4.709	4.709	1.22
0.30	0.0	1.965E−8	1.965E−8	5.112	5.854	5.854	1.15
0.40	0.0	2.870E−8	2.870E−8	5.641	6.267	6.267	1.11
0.50	0.0	3.662E−8	3.662E−8	5.827	6.347	6.347	1.09
0.60	0.0	4.335E−8	4.335E−8	5.839	6.281	6.281	1.08
0.80	0.0	5.391E−8	5.391E−8	5.667	6.001	6.001	1.06
1.00	0.0	6.222E−8	6.222E−8	5.449	5.753	5.753	1.06
1.50	0.0	8.416E−8	8.416E−8	4.982	5.153	5.153	1.03
2.00	0.0	9.559E−8	9.559E−8	4.665	4.771	4.771	1.02
3.00	0.0	1.120E−7	1.102E−7	4.152	4.191	4.191	1.01

E = source energy (MeV),
X_m = depth in tissue where maximum dose occurs (cm),
D_{int} = dose rate at the interface ($cGy/h \cdot cm^2 \cdot s$),
D_{max} = dose rate maximum in tissue ($cGy/h \cdot cm^2 \cdot s$),
B_∞ = infinite medium buildup factor for plane parallel source,
B_{int} = interface buildup factor for plane parallel source,
B_c = corrected buildup factor,
C = correction factor (B_c/B_∞).

Table 7

Correction Factors for Tin Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	0.0	5.390E−9	5.390E−9	4.817	5.296	5.296	1.09
0.06	0.0	3.013E−9	3.013E−9	2.912	3.365	3.365	1.15
0.08	0.0	2.130E−9	2.130E−9	1.763	2.341	2.341	1.32
0.10	0.0	2.118E−9	2.118E−9	1.415	1.991	1.991	1.40
0.15	1.0	2.942E−9	3.083E−9	1.275	1.800	1.886	1.48
0.20	1.0	4.635E−9	4.772E−9	1.509	2.003	2.062	1.36
0.30	1.0	9.405E−9	9.521E−9	2.076	2.555	2.570	1.23
0.40	0.5	1.567E−8	1.568E−8	2.625	3.098	3.098	1.18
0.50	0.0	2.233E−8	2.233E−8	3.063	3.519	3.519	1.14
0.60	0.0	2.854E−8	2.854E−8	3.337	3.762	3.792	1.12
0.80	0.0	4.004E−8	4.004E−8	3.687	4.056	4.056	1.10
1.00	0.0	4.971E−8	4.971E−8	3.835	4.161	4.161	1.08
1.50	0.0	6.816E−8	6.816E−8	3.957	4.176	4.176	1.05
2.00	0.0	8.286E−8	8.286E−8	3.977	4.138	4.138	1.04
3.00	0.0	1.003E−7	1.003E−7	3.738	3.816	3.816	1.02

Table 7

Correction Factors for Tungsten Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	1.0	1.627E−9	1.695E−7	1.041	1.639	1.707	1.64
0.06	1.0	1.506E−9	1.607E−9	1.064	1.727	1.842	1.73
0.08	0.0	1.006E−8	1.006E−8	7.519	10.94	10.94	1.46
0.10	0.5	4.295E−9	4.320E−9	2.761	3.943	3.966	1.44
0.15	1.0	2.992E−9	3.067E−9	1.294	1.896	1.851	1.43
0.20	1.0	3.875E−9	3.984E−9	1.233	1.665	1.712	1.39
0.30	1.0	6.465E−9	6.559E−9	1.370	1.743	1.768	1.29
0.40	1.0	9.885E−9	9.965E−9	1.607	1.952	1.967	1.22
0.50	1.0	1.367E−8	1.371E−8	1.845	2.154	2.157	1.17
0.60	0.5	1.791E−8	1.793E−8	2.063	2.360	2.361	1.14
0.80	0.0	2.647E−8	2.647E−8	2.487	2.682	2.682	1.08
1.00	0.0	3.447E−8	3.447E−8	2.633	2.886	2.886	1.10
1.50	0.0	5.205E−8	5.205E−8	2.988	3.189	3.189	1.07
2.00	0.0	6.669E−8	6.669E−8	3.192	3.332	3.332	1.04
3.00	0.0	8.504E−8	8.504E−8	3.168	3.237	3.237	1.02

Table 7

Correction Factors for Lead Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	1.0	1.613E−9	1.684E−9	1.030	1.625	1.696	1.65
0.06	1.0	1.480E−9	1.581E−9	1.046	1.691	1.806	1.72
0.08	1.0	1.552E−9	1.669E−9	1.089	1.746	1.877	1.72
0.10	0.5	1.005E−8	1.008E−8	6.475	9.406	9.434	1.46
0.15	1.0	3.389E−9	3.442E−9	1.540	2.078	2.110	1.37
0.20	1.0	3.796E−9	3.886E−9	1.252	1.660	1.699	1.36
0.30	1.0	5.970E−9	6.080E−9	1.300	1.640	1.670	1.29
0.40	1.0	8.796E−9	8.877E−9	1.459	1.765	1.781	1.22
0.50	1.0	1.198E−8	1.202E−8	1.635	1.921	1.927	1.18
0.60	0.5	1.547E−8	1.549E−8	1.801	2.071	2.073	1.15
0.80	0.5	2.251E−8	2.253E−8	2.079	2.326	2.236	1.12
1.00	0.0	2.953E−8	2.953E−8	2.296	2.525	2.525	1.10
1.50	0.0	4.627E−8	4.627E−8	2.656	2.835	2.835	1.07
2.00	0.0	6.022E−8	6.002E−8	2.883	3.011	3.011	1.04
3.00	0.0	7.805E−8	7.805E−8	2.906	2.971	2.971	1.02

Table 7

Correction Factors for Water Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	0.0	1.198E−8	1.198E−8	12.32	11.77	11.77	0.95
0.06	0.0	1.400E−8	1.400E−8	16.71	15.52	15.52	0.95
0.08	0.0	1.757E−8	1.757E−8	19.53	18.86	18.86	0.96
0.10	0.0	2.074E−8	2.074E−8	19.47	18.92	18.92	0.97
0.15	0.0	2.929E−8	2.929E−8	17.61	17.27	17.27	0.98
0.20	0.0	3.658E−8	3.658E−8	15.58	15.35	15.35	0.98
0.30	0.0	4.712E−8	4.712E−8	12.64	12.52	12.52	0.99
0.40	0.0	5.546E−8	5.546E−8	10.96	10.88	10.88	0.99
0.50	0.0	6.185E−8	6.185E−8	9.760	9.703	9.703	0.99
0.60	0.0	6.735E−8	6.735E−8	8.911	8.866	8.866	0.99
0.80	0.0	7.565E−8	7.656E−8	7.730	7.699	7.699	0.99
1.00	0.0	8.738E−8	8.738E−8	6.976	6.952	6.952	0.99
1.50	0.0	9.512E−8	9.512E−8	5.806	5.791	5.791	1.00
2.00	0.0	1.029E−7	1.027E−7	5.129	5.118	5.118	1.00
3.00	0.0	1.125E−7	1.125E−7	4.276	4.268	4.268	1.00

Table 7

Correction Factors for Concrete Medium

E	X_m	D_{int}	D_{max}	B_∞	B_{int}	B_c	C
0.05	0.0	2.854E−9	2.854E−9	2.224	2.869	2.869	1.29
0.06	0.0	3.275E−9	3.275E−9	2.922	3.761	3.761	1.29
0.08	0.0	4.884E−9	4.884E−9	4.445	5.523	5.523	1.24
0.10	0.0	7.196E−9	7.196E−9	5.752	6.881	6.881	1.20
0.15	0.0	1.446E−8	1.446E−8	7.703	8.778	8.778	1.14
0.20	0.0	2.159E−8	2.159E−8	8.327	9.244	9.244	1.11
0.30	0.0	3.329E−8	3.329E−8	8.277	8.917	8.917	1.08
0.40	0.0	4.238E−8	4.238E−8	7.841	8.325	8.325	1.06
0.50	0.0	4.961E−8	4.961E−8	7.388	7.774	7.774	1.05
0.60	0.0	5.549E−8	5.549E−8	6.960	7.323	7.323	1.05
0.80	0.0	6.412E−8	6.412E−8	6.243	6.475	6.475	1.04
1.00	0.0	7.064E−8	7.064E−8	5.715	5.899	5.899	1.03
1.50	0.0	8.025E−8	8.025E−8	4.793	4.907	4.907	1.02
2.00	0.0	8.580E−8	8.580E−8	4.205	4.286	4.286	1.02
3.00	0.0	9.233E−8	9.233E−8	3.473	3.515	3.515	1.01

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