OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
CALCULATION COVER SHEET

1. QA: QA
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2. Calculation Title

Biosphere Dose Conversion Factor Percentiles for Radionuclides Identified as being Potential Contributors to Dose after Ten Thousand Years

3. Document Identifier (including Revision Number)

CAL-NBS-PA-000001 REV 00

4. Total Attachments	5. Attachment Numbers – Number of pages in each
1	I – 1

	Print Name	Signature	Date
6. Originator	A. J. Smith	A P Smith	09 Nov 2000
7. Checker	J. Matties	J. Matt	11/9/00
8. Lead	M. Sauer	Jerry Ahlheish for M. Sauer	11.9.00

9. Remarks

Revision History

10. Revision No.	11. Description of Revision
Rev 00	Initial Issue

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TABLES

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1. PURPOSE

Two previous Analysis and Modeling Reports (AMRs) Civilian Radioactive Waste Management Systems Management and Operating Contractor (CRWMS M&O 2000a and CRWMS M&O 2000b) provided abstractions of the biosphere dose conversion factors (BDCFs) for those radionuclides determined (CRWMS M&O 1999a) to be of potential importance for the initial ten thousand years after closure of the repository. To continue predictions of dose beyond ten thousand years requires abstractions of the BDCFs for those additional radionuclides defined in CRWMS M&O 1999b to be of potential importance in this time domain. The radionuclides for which BDCFs were generated (CRWMS M&O 2000c) to address the time period out to a million years are ^{210}Pb, ^{226}Ra, ^{230}Th, ^{231}Pa, and ^{242}Pu.

The abstraction to be used in this calculation for providing as input to the Total System Performance Assessment (TSPA) code is the definition of the percentile points, at intervals of 5%, of the set of stochastic BDCF data for each radionuclide generated and reported in CRWMS M&O 2000c. Being based directly on the stochastic data the approach captures the uncertainty in the BDCF distributions.

This activity is associated with performance assessment and was conducted in accordance with the Technical Work Plan for the Biosphere activities titled *Technical Work Plan for Biosphere Modeling And Expert Support* (CRWMS M&O 2000d). This calculation was developed in accordance with AP-3.12Q/Rev. 0/ICN 3.

2. METHOD

The input data used was generated by a previous calculation (CRWMS M&O 2000c) and consisted of tabular data generated as discussed in that calculation. Each row of data represented the sequence of stochastic parametric input and output of the BDCF generation code. These data were obtained from Technical Database Management System (TDMS) by reference to the appropriate Data Tracking Number (DTN) given in Section 5 of this report. These BDCF data for each radionuclide comprised of 130 data points. To facilitate integration into the TSPA code these data were abstracted into an empirical statistical distribution defined by the minimum BDCF values, the BDCF percentile points of 5%, 10%, and continuing increments of 5% to 95%, and the maximum BDCF value. Each of these data points were obtained from the raw stochastic data by use of the available functions in the Excel code (details provided in sections 4 and 5).

The control the electronic management of data was accomplished in accordance with the methods specified in the TWP (CRWMS M&O 2000d).

3. ASSUMPTIONS

No assumptions were needed to perform the calculation reported here.

4. USE OF COMPUTER SOFTWARE AND MODELS

No models were used or developed in this analysis. The only software used was a commercially available spreadsheet (Microsoft® Excel 97 SR-2). This spreadsheet was used as an aid in calculation; no routines, macros, or other applications were developed and used. Use of this off-the-shelf commercial software is documented in this report in sufficient detail to allow the results to be reproduced by an independent entity without recourse to the originator. The spreadsheet used is documented in Section 5.

The input data used in this calculation were generated by a previous calculation (CRWMS M&O 2000c) by use of the GENII-S code (Leigh, 1993). It should be emphasized that for the calculation documented here, no use was made of the GENII-S code.

5. CALCULATION

5.1. INPUT DATA

The generation of the input data used in this calculation was reported in CRWMS M&O 2000c and developed in accordance with AP-3.12Q, *Calculations*. Specifically the data used was that reported for the radionuclides identified as being of potential importance to dose calculations in TSPA; these radionuclides were ^{210}Pb, ^{226}Ra, ^{230}Th, ^{231}Pa, and ^{242}Pu. The raw BDCF data as generated by the GENII-S code (Leigh, 1993) were retrieved from the TDMS. These unqualified data had the dataset description *Critical Group BDCF (1 Million Year Radionuclides)* with a DTN of MO0002SPACRI02.002 and TBV-4889. The actual output BDCF data within the cited DTN are in file with name *critical group outputfiles.ZIP*. This compressed ZIP file contains the GENII-S output files for both the million year radionuclides and the radionuclides of potential importance for the early time disruptive event scenario. The data associated with the latter radionuclides is not addressed in this calculation. Table 1 gives the file names used for each radionuclide that had BDCF data processed in this calculation.

For the BDCF abstractions reported in CRWMS M&O 2000a, stochastic BDCF data were provided for six periods of irrigation prior to the evaluation of the BDCFs. The periods of irrigation were derived from leaching factors and radioactive decay rate to provide approximately equally spaced mean BDCF values over the period of time required for soil build-up effects. The BDCF data evaluated in CRWMS M&O 2000c and provided to the TDMS only considered the fourth period (see page 6 and Table 2 of CRWMS M&O 2000c). Thus, the data provided for this calculation gave no information on whether radionuclide build-up in soils resulting from prolonged irrigation was of any concern. The lack of consideration of BDCF time evolution negated any need to fit statistical distributions to the input data as further processing could be undertaken. Thus the percentile approach was all that was required for TSPA input.

The values for the period of prior irrigation in the calculation of the BDCFs in CRWMS M&O 2000c are provided in Table 2.

Table 1. File Name of Location of BDCF Data in the TDMS

Radionuclide	BDCF Data File Name
^{210}Pb	1bpb210.rst
^{226}Ra	1bra226.rst
^{230}Th	1bth230.rst
^{231}Pa	1bpa231.rst
^{242}Pu	1bpu242.rst

Table 2. Prior Irrigation Time Periods used in GENII-S to Generate BDCFs

Radionuclide	^{210}Pb	^{226}Ra	^{230}Th	^{231}Pa	^{242}Pu
Irrigation Period (years)	21	513	3270	7	563

The data in each file defined in Table 1 has the same format once they have been "un-zipped". The files are DOS text files. The first ten lines provide detail of that particular calculation. This information is followed by the parametric values selected stochastically from the predefined (CRWMS M&O 2000c) input distributions by the GENII-S code and the corresponding output values. Each row corresponds to an individual GENII-S realization. Each GENII-S output file contains details from 130 realizations. To facilitate viewing, the output file consists of five columns. Each of the five columns has two rows of header information followed by a blank line, the 130 rows of data, and two additional blank lines. This sequence of 135 rows of five columns is repeated until all the information output by GENII-S captured. The only column of interest for this abstraction effort is the last column labeled *Annual EDE* (Effective Dose Equivalent). This *Annual EDE* column contains the individual BDCF realizations for the particular radionuclide considered in that GENII-S calculation.

When the files are opened using Excel accepting the defaults for the input, the file header information are in cells A1:D7 and the BDCF data (with title *Annual EDE*) required are in cells E1371:E:1503. To avoid multiple massive spreadsheets, rows 10 to 1370 were deleted (highlighting the complete set of row to be deleted and using "Delete..." from the "Edit" pull down menu – if the "Delete" key is used the contents of the highlighted cells are deleted but the rows, now empty, remain). The format of the data remaining is shown in Table 3 for file 1BPU242. Although not used in the calculation, columns A:D were not deleted as this operation would have necessitated moving the header information.

A new blank spreadsheet was opened and saved in standard Excel format with the name "Million Year Rns for Dave 08May00". The spreadsheet containing the data from file 1BPU242 with format "txt" was moved into the "xls" spreadsheet using the "Move or Copy Sheet ..."

command in the "Edit" pull down menu and indicating the file to which it had to be moved, i.e., "Million Year Rns for Dave 08May00". This process given above was repeated for each of the other data files, 1BTH230, 1BRA226, 1BPA210, and 1BPB210.

Table 3. Detail of Spreadsheet Layout after Data Manipulations (Importation of all Data and Deletion of Redundant Data)

	A	B	C	D	E
1	Pu-242, Case 1B	[Mean ingestion	consumption r	ate]	
2					
3					
4	INPUT FILE NAME	1BPU242.INP			
5	RUN ON 01/09/0	0 AT 14:	2:20		
6					
7	Stat. Committed	Dose Summary (re	m)		
8					
9					
10	Inhalation	Ingestion	Internal	External	Annual
11	EDE	EDE	EDE	Dose	EDE
12					
13	3.89E-05	4.34E-03	4.38E-03	3.17E-08	4.38E-03
14	2.55E-05	6.13E-03	6.15E-03	2.14E-08	6.15E-03
15	1.09E-04	4.38E-03	4.49E-03	2.87E-08	4.49E-03
16	3.12E-05	4.03E-03	4.06E-03	2.75E-08	4.06E-03
17	8.09E-05	3.84E-03	3.92E-03	3.02E-08	3.92E-03
18	9.31E-06	4.07E-03	4.08E-03	2.71E-08	4.08E-03
...	.....	.....	.....	.....	.....
143	1.62E-05	5.46E-03	5.48E-03	3.14E-08	5.48E-03

DTN: MO0002SPACRI02.002

5.2. SPREADSHEET CODE

The Excel spreadsheet code used for this application was restricted to using the simple built-in instructions available to the version of the software used, i.e., Microsoft® Excel 97 SR-2. The only instructions used were "copy by direct reference" (value in new cell at location of cursor = + value in specified cell on specified worksheet), and the Excel functions "MAX", "MIN", and "PERCENTILE". It should be emphasized that the spreadsheet performed no arithmetic operations on any of the data. As identified in AP-SV.1Q, *Software Management*, the built-in standard deviation functions, as all other built-in functions, in Microsoft Excel does not require further qualification or validation of the results, as long as the user does not modify it by developing their own series of coding or formula implementation.

The work was performed in a spreadsheet named "Million Year Rns for Dave 08May00.xls". The spreadsheet was run on the DELL Power Edge with U. S. DOE/YMP bar code number 112375 at the M&O Summerlin offices located in Las Vegas, NV.

A new sheet was inserted into the spreadsheet. This sheet was given the name "Working". The first operation was to consolidate the appropriate BDCF data for each radionuclide into a range in sheet "Working". The instructions to perform this operation are shown in Table 4.

Table 4. Spreadsheet Instructions used to Consolidate Required BDCF Data onto a Single Sheet

3	C	D	E	F	G
4	Th230	Ra226	Pa231	Pb210	Pu242
5					
6	=+'1BTH230'!E14	=+'1BRA226'!E14	=+'1BPA231'!E14	=+'1BPB210'!E14	=+'1BPU242'!E14
7	=+'1BTH230'!E15	=+'1BRA226'!E15	=+'1BPA231'!E15	=+'1BPB210'!E15	=+'1BPU242'!E15
8	=+'1BTH230'!E16	=+'1BRA226'!E16	=+'1BPA231'!E16	=+'1BPB210'!E16	=+'1BPU242'!E16
9	=+'1BTH230'!E17	=+'1BRA226'!E17	=+'1BPA231'!E17	=+'1BPB210'!E17	=+'1BPU242'!E17
10	=+'1BTH230'!E18	=+'1BRA226'!E18	=+'1BPA231'!E18	=+'1BPB210'!E18	=+'1BPU242'!E18
11	=+'1BTH230'!E19	=+'1BRA226'!E19	=+'1BPA231'!E19	=+'1BPB210'!E19	=+'1BPU242'!E19
12	=+'1BTH230'!E20	=+'1BRA226'!E20	=+'1BPA231'!E20	=+'1BPB210'!E20	=+'1BPU242'!E20
13	=+'1BTH230'!E21	=+'1BRA226'!E21	=+'1BPA231'!E21	=+'1BPB210'!E21	=+'1BPU242'!E21
14	=+'1BTH230'!E22	=+'1BRA226'!E22	=+'1BPA231'!E22	=+'1BPB210'!E22	=+'1BPU242'!E22
...	.....	.....	.....	.....	.....
135	=+'1BTH230'!E143	=+'1BRA226'!E143	=+'1BPA231'!E143	=+'1BPB210'!E143	=+'1BPU242'!E143

Having consolidated the stochastic BDCF data into a single block of cells, the required minimum, various percentiles, and the maximum values of the BDCFs for each radionuclide was generated using the standard functions available from within Excel. The instructions used to perform these operations are shown in Table 5.

The MAX and MIN functions are self-explanatory and each has a single argument of the range of cells containing the values over which the function is to be evaluated. The PERCENTILE function is used to generate the required percentiles from each data set. The PERCENTILE function requires two arguments. The first is value of the required percentile. These required percentile values, starting at 0.05 through 0.95 at increments of 0.05 are in cells J7:J25. The second argument is the range in which stochastic BDCF data are located. These data are in cells C6:G135 where sequential columns contains the appropriate data for the radionuclide identified in row 4 of Table 4.

Table 5. Spreadsheet Instructions used to Generate the Minimum, Maximum, and Defined Percentiles for Each Radionuclide of Interest.

	J	K	L	M	N	O
2		BDCF Percentiles (rem/year per pCi/lt)				
3		Th230	Ra226	Pa231	Pb210	Pu242
4						
5						
6	Min	=+MIN(C6:C135)	=+MIN(D6:D135)	Columns **M**, **N**, and **O** are repeats of column **L** with all reference to column **D** replaced with **E**, **F** and **G** respectively		
7	0.05	=PERCENTILE(C$6:C$135,$J7)	=PERCENTILE(D$6:D$135,$J7)			
8	0.1	=PERCENTILE(C$6:C$135,$J8)	=PERCENTILE(D$6:D$135,$J8)			
9	0.15	=PERCENTILE(C$6:C$135,$J9)	=PERCENTILE(D$6:D$135,$J9)			
10	0.2	=PERCENTILE(C$6:C$135,$J10)	=PERCENTILE(D$6:D$135,$J10)			
11	0.25	=PERCENTILE(C$6:C$135,$J11)	=PERCENTILE(D$6:D$135,$J11)			
12	0.3	=PERCENTILE(C$6:C$135,$J12)	=PERCENTILE(D$6:D$135,$J12)			
13	0.35	=PERCENTILE(C$6:C$135,$J13)	=PERCENTILE(D$6:D$135,$J13)			
...	.....	.....	.....			
21	0.75	=PERCENTILE(C$6:C$135,$J21)	=PERCENTILE(D$6:D$135,$J21)			
22	0.8	=PERCENTILE(C$6:C$135,$J22)	=PERCENTILE(D$6:D$135,$J22)			
23	0.85	=PERCENTILE(C$6:C$135,$J23)	=PERCENTILE(D$6:D$135,$J23)			
24	0.9	=PERCENTILE(C$6:C$135,$J24)	=PERCENTILE(D$6:D$135,$J24)			
25	0.95	=PERCENTILE(C$6:C$135,$J25)	=PERCENTILE(D$6:D$135,$J25)			
26	Max	=+MAX(C6:C135)	=+MAX(D6:D135)			

6. RESULTS

6.1. CONSOLIDATED INPUT DATA

Once the data from DTN MO0002SPACRI02.002 had been imported into the spreadsheet and consolidated onto the worksheet titled "Working" by the instructions given in Table 4 of Section 5.2, the resulting BDCF data are shown in Table 6. This accuracy of this built-in copy by address reference instruction in Excel could be confirmed by visual inspection.

Table 6. Consolidated BDCFs

Th230	Ra226	Pa231	Pb210	Pu242
1.13E-02	8.15E-03	1.32E-02	6.93E-03	4.38E-03
8.18E-03	6.36E-03	1.92E-02	9.86E-03	6.15E-03
6.95E-02	4.66E-02	1.32E-02	8.73E-03	4.49E-03
1.20E-01	8.07E-02	1.19E-02	9.78E-03	4.06E-03
3.23E-02	2.22E-02	1.15E-02	6.74E-03	3.92E-03
1.03E-02	7.55E-03	1.24E-02	6.51E-03	4.08E-03
1.75E-02	1.21E-02	1.20E-02	6.51E-03	3.98E-03
4.00E-02	2.76E-02	1.19E-02	7.14E-03	3.97E-03
4.28E-02	2.97E-02	1.38E-02	8.23E-03	4.46E-03
4.12E-02	2.83E-02	1.65E-02	9.50E-03	5.49E-03

Table 6. Consolidated BDCFs (continued)

Th230	Ra226	Pa231	Pb210	Pu242
2.86E-02	1.97E-02	1.37E-02	7.82E-03	4.44E-03
6.86E-03	5.26E-03	1.54E-02	7.91E-03	5.04E-03
1.02E-02	7.30E-03	1.13E-02	5.92E-03	3.69E-03
8.93E-03	6.51E-03	1.18E-02	6.14E-03	3.84E-03
6.65E-03	4.98E-03	1.17E-02	6.00E-03	3.86E-03
2.24E-02	1.57E-02	1.55E-02	8.45E-03	5.05E-03
9.73E-03	7.00E-03	1.31E-02	6.79E-03	4.40E-03
1.65E-02	1.14E-02	1.56E-02	8.30E-03	5.21E-03
1.18E-02	8.44E-03	1.25E-02	6.62E-03	4.10E-03
6.85E-03	5.19E-03	1.19E-02	6.12E-03	3.91E-03
8.12E-03	6.08E-03	1.27E-02	6.56E-03	4.10E-03
3.75E-02	2.56E-02	1.20E-02	7.12E-03	3.99E-03
1.33E-02	9.31E-03	9.92E-03	5.36E-03	3.34E-03
2.42E-02	1.66E-02	1.19E-02	6.69E-03	3.90E-03
8.83E-03	6.58E-03	1.39E-02	7.21E-03	4.54E-03
1.97E-02	1.37E-02	1.26E-02	6.94E-03	4.13E-03
9.54E-03	7.05E-03	1.31E-02	6.84E-03	4.28E-03
5.78E-03	4.41E-03	1.20E-02	6.14E-03	3.92E-03
2.78E-02	1.91E-02	1.19E-02	6.70E-03	3.98E-03
9.24E-03	6.66E-03	1.14E-02	5.96E-03	3.81E-03
1.44E-02	1.06E-02	1.71E-02	9.09E-03	5.53E-03
7.07E-03	5.33E-03	1.25E-02	6.44E-03	4.08E-03
1.25E-02	8.99E-03	1.41E-02	7.43E-03	4.66E-03
1.47E-02	1.06E-02	1.44E-02	7.70E-03	4.70E-03
1.66E-02	1.20E-02	1.66E-02	8.87E-03	5.34E-03
8.19E-03	6.16E-03	1.37E-02	7.07E-03	4.52E-03
1.41E-02	9.95E-03	1.31E-02	6.97E-03	4.35E-03
1.68E-02	1.18E-02	1.26E-02	6.70E-03	4.21E-03
9.76E-02	6.57E-02	1.42E-02	1.01E-02	4.77E-03
1.99E-02	1.37E-02	1.31E-02	7.12E-03	4.42E-03
9.77E-03	7.21E-03	1.24E-02	6.59E-03	4.09E-03
6.22E-02	4.21E-02	1.41E-02	9.05E-03	4.66E-03
2.32E-02	1.65E-02	1.73E-02	9.46E-03	5.60E-03
1.37E-02	9.62E-03	1.49E-02	7.87E-03	4.97E-03
3.82E-02	2.65E-02	1.19E-02	7.09E-03	4.01E-03
2.92E-02	2.03E-02	1.11E-02	6.43E-03	3.68E-03
1.10E-02	7.87E-03	1.15E-02	6.10E-03	3.81E-03
9.43E-03	6.84E-03	1.22E-02	6.36E-03	4.01E-03
1.73E-01	1.16E-01	1.17E-02	1.13E-02	4.10E-03
1.42E-02	1.01E-02	1.33E-02	7.06E-03	4.41E-03
1.98E-02	1.38E-02	1.19E-02	6.49E-03	4.03E-03
2.14E-02	1.51E-02	1.26E-02	6.99E-03	4.17E-03
1.59E-02	1.10E-02	1.19E-02	6.37E-03	4.03E-03
3.07E-02	2.13E-02	1.24E-02	7.15E-03	4.05E-03

Table 6. Consolidated BDCFs (continued)

Th230	Ra226	Pa231	Pb210	Pu242
5.16E-02	3.49E-02	1.76E-02	1.04E-02	5.79E-03
1.98E-02	1.39E-02	1.29E-02	7.00E-03	4.26E-03
1.64E-02	1.15E-02	1.17E-02	6.31E-03	3.87E-03
1.59E-02	1.14E-02	1.60E-02	8.53E-03	5.14E-03
2.69E-02	1.87E-02	1.09E-02	6.35E-03	3.62E-03
1.28E-01	8.68E-02	1.53E-02	1.16E-02	5.12E-03
8.76E-03	6.60E-03	1.42E-02	7.40E-03	4.66E-03
4.89E-02	3.35E-02	1.50E-02	9.09E-03	4.95E-03
7.12E-03	5.07E-03	1.71E-02	8.81E-03	5.71E-03
6.14E-03	4.62E-03	1.09E-02	5.56E-03	3.59E-03
2.72E-02	1.84E-02	1.24E-02	7.01E-03	4.27E-03
9.56E-03	6.98E-03	1.14E-02	5.93E-03	3.80E-03
1.17E-02	9.14E-03	2.47E-02	1.28E-02	7.90E-03
9.59E-03	7.01E-03	1.43E-02	7.39E-03	4.74E-03
1.00E-02	7.56E-03	1.84E-02	9.62E-03	6.02E-03
1.79E-02	1.25E-02	1.24E-02	6.77E-03	4.11E-03
1.04E-02	7.66E-03	1.27E-02	6.65E-03	4.11E-03
1.16E-02	8.57E-03	1.67E-02	8.73E-03	5.46E-03
8.62E-02	5.87E-02	1.45E-02	9.99E-03	4.83E-03
6.48E-03	4.95E-03	1.27E-02	6.53E-03	4.16E-03
5.56E-03	4.17E-03	1.23E-02	6.26E-03	4.07E-03
7.13E-03	5.14E-03	1.20E-02	6.15E-03	3.97E-03
1.47E-02	1.05E-02	1.44E-02	7.64E-03	4.69E-03
1.07E-02	7.61E-03	1.13E-02	5.92E-03	3.73E-03
9.92E-03	7.38E-03	1.45E-02	7.61E-03	4.68E-03
1.79E-02	1.24E-02	1.10E-02	5.96E-03	3.69E-03
1.39E-02	1.01E-02	1.50E-02	8.00E-03	4.93E-03
3.61E-02	2.52E-02	2.05E-02	1.12E-02	6.57E-03
7.37E-03	5.43E-03	1.17E-02	6.03E-03	3.83E-03
1.13E-02	8.08E-03	1.20E-02	6.33E-03	4.01E-03
6.70E-03	5.26E-03	1.61E-02	8.28E-03	5.21E-03
2.78E-02	1.89E-02	1.40E-02	7.85E-03	4.66E-03
2.16E-02	1.50E-02	1.28E-02	7.11E-03	4.28E-03
1.10E-02	8.03E-03	1.22E-02	6.48E-03	3.98E-03
2.81E-02	1.95E-02	1.37E-02	7.76E-03	4.51E-03
8.73E-03	6.59E-03	1.40E-02	7.30E-03	4.54E-03
1.89E-02	1.38E-02	2.03E-02	1.08E-02	6.51E-03
2.07E-02	1.43E-02	1.21E-02	6.64E-03	4.03E-03
1.19E-02	8.64E-03	1.37E-02	7.22E-03	4.49E-03
2.19E-02	1.46E-02	1.13E-02	6.23E-03	3.93E-03
1.21E-02	8.64E-03	1.21E-02	6.40E-03	4.02E-03
2.65E-02	1.81E-02	1.56E-02	8.61E-03	5.07E-03
5.83E-02	4.00E-02	1.66E-02	1.01E-02	5.46E-03
6.27E-02	4.23E-02	9.07E-03	6.44E-03	3.07E-03

Table 6. Consolidated BDCFs (continued)

Th230	Ra226	Pa231	Pb210	Pu242
8.43E-03	6.20E-03	1.16E-02	6.02E-03	3.77E-03
2.90E-02	1.99E-02	1.34E-02	7.53E-03	4.47E-03
2.37E-02	1.67E-02	1.51E-02	8.36E-03	4.89E-03
3.72E-02	2.58E-02	1.37E-02	7.99E-03	4.52E-03
5.92E-03	4.52E-03	1.32E-02	6.84E-03	4.37E-03
5.51E-02	3.74E-02	1.56E-02	9.57E-03	5.08E-03
1.95E-02	1.35E-02	1.13E-02	6.23E-03	3.74E-03
2.50E-02	1.74E-02	1.65E-02	9.06E-03	5.36E-03
1.75E-02	1.26E-02	1.67E-02	8.92E-03	5.39E-03
1.44E-02	1.02E-02	1.20E-02	6.41E-03	3.98E-03
4.42E-02	3.00E-02	1.41E-02	8.46E-03	4.61E-03
7.63E-03	5.69E-03	1.17E-02	6.03E-03	3.85E-03
1.15E-02	8.04E-03	1.16E-02	6.12E-03	3.92E-03
6.73E-03	5.06E-03	1.17E-02	5.95E-03	3.87E-03
8.04E-03	6.10E-03	1.73E-02	8.88E-03	5.65E-03
5.25E-03	4.28E-03	1.65E-02	8.47E-03	5.33E-03
7.95E-03	5.94E-03	1.33E-02	6.92E-03	4.34E-03
8.46E-03	6.31E-03	1.35E-02	7.02E-03	4.47E-03
1.50E-02	1.08E-02	1.43E-02	7.70E-03	4.63E-03
1.09E-02	7.81E-03	1.35E-02	7.07E-03	4.51E-03
7.75E-03	5.87E-03	1.64E-02	8.43E-03	5.37E-03
3.54E-02	2.37E-02	1.32E-02	7.73E-03	4.35E-03
2.76E-02	1.93E-02	1.76E-02	9.66E-03	5.79E-03
2.74E-02	1.91E-02	1.51E-02	8.44E-03	4.92E-03
8.08E-03	5.87E-03	1.33E-02	6.90E-03	4.38E-03
7.59E-03	5.63E-03	1.56E-02	7.98E-03	5.15E-03
1.99E-02	1.37E-02	1.11E-02	6.14E-03	3.65E-03
1.13E-02	8.24E-03	1.21E-02	6.39E-03	3.93E-03
1.69E-02	1.19E-02	1.29E-02	6.89E-03	4.28E-03
1.35E-02	9.60E-03	1.36E-02	7.20E-03	4.47E-03
1.32E-02	9.32E-03	1.23E-02	6.52E-03	4.06E-03
8.07E-02	5.49E-02	1.66E-02	1.09E-02	5.48E-03

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6.2. DERIVED DATA

The data given in Table 6 was subjected to the instructions presented in Table 5 in Section 5.2 and loaded onto worksheet "Working". The results provided by Excel are shown in Table 7. Table 7was constructed directly by using the "copy" and "paste" capabilities of the clipboard in the Windows operating system to take the data directly from the Excel spreadsheet and place it into a WORD table which became Table 7. As the desired number of row and column appeared in Table 7, it integrity of the Windows operating system ensured that the data were correctly transcribed from the spreadsheet to the Table 7 in this document. These data were submitted to

the TDMS and were allocated DTN:MO0006SPABDC01.007 with TDIF:310766. Being based on unqualified input data, the resultant data are unqualified. These data are to be used to support TSPA-SR. This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the Document Input Reference System database.

Table 7. Minimum, Maximum, and Required Percentile Points of BDCF Data

	BDCF Percentiles (rem/year per pCi/lt)				
	Th230	Ra226	Pa231	Pb210	Pu242
Min	5.245E-03	4.166E-03	9.066E-03	5.363E-03	3.073E-03
5.0%	6.673E-03	5.018E-03	1.118E-02	5.961E-03	3.688E-03
10.0%	7.127E-03	5.325E-03	1.148E-02	6.116E-03	3.814E-03
15.0%	8.052E-03	5.991E-03	1.170E-02	6.231E-03	3.881E-03
20.0%	8.676E-03	6.479E-03	1.187E-02	6.365E-03	3.932E-03
25.0%	9.541E-03	6.987E-03	1.196E-02	6.451E-03	3.983E-03
30.0%	1.012E-02	7.498E-03	1.209E-02	6.548E-03	4.027E-03
35.0%	1.106E-02	8.031E-03	1.237E-02	6.696E-03	4.078E-03
40.0%	1.176E-02	8.614E-03	1.256E-02	6.870E-03	4.112E-03
45.0%	1.354E-02	9.598E-03	1.282E-02	6.990E-03	4.267E-03
50.0%	1.456E-02	1.055E-02	1.317E-02	7.081E-03	4.364E-03
55.0%	1.645E-02	1.146E-02	1.330E-02	7.201E-03	4.440E-03
60.0%	1.791E-02	1.253E-02	1.373E-02	7.474E-03	4.498E-03
65.0%	1.985E-02	1.380E-02	1.403E-02	7.755E-03	4.604E-03
70.0%	2.267E-02	1.599E-02	1.431E-02	7.994E-03	4.683E-03
75.0%	2.715E-02	1.860E-02	1.500E-02	8.438E-03	4.913E-03
80.0%	2.872E-02	1.973E-02	1.552E-02	8.729E-03	5.076E-03
85.0%	3.679E-02	2.544E-02	1.630E-02	9.059E-03	5.289E-03
90.0%	4.471E-02	3.037E-02	1.665E-02	9.626E-03	5.464E-03
95.0%	6.645E-02	4.468E-02	1.748E-02	1.031E-02	5.750E-03
Max	1.734E-01	1.161E-01	2.469E-02	1.276E-02	7.897E-03

DTN:MO0006SPABDC01.007

7. REFERENCES

7.1. DOCUMENTS CITED

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7.2. CODES, STANDARDS, REGULATIONS, AND PROCEDURES

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7.3. SOURCE DATA

MO0002SPACRI02.002. Critical Group BDCF (1 Million Year Radionuclides). Submittal date: 02/17/2000. Submit to RPC URN-0591.

8. ATTACHMENTS

There is one attachment to this document. This attachment is a list of acronyms and abbreviations.

ATTACHMENT I ACRONYMS AND ABBREVIATIONS

AMR	Analysis and Modeling Reports
BDCF	Biosphere Dose Conversion Factor
CRWMS M&O	Civilian Radioactive Waste Management Systems Management and Operating Contractor
DTN	Data Tracking Number
EDE	Effective Dose Equivalent
lt	Liter
M&O	Management and Operating
^{M}E	The isotope of atomic mass M of element represented by the chemical symbol E
OCRWM	Office of Civilian Radioactive Waste Management
Pa	Protactinium
Pb	Lead
pCi	Pico-Curie
Pu	Plutonium
Ra	Radium
rem	Roentgen equivalent man
SR	Site Recommendation
TDIF	Technical Data Information Form
TDMS	Technical Database Management System
Th	Thorium
TSPA	Total System Performance Assessment
TSPA-SR	Total System Performance Assessment - Site Recommendation
TWP	Technical Work Plan
U.S. DOE/YMP	United States Department of Energy/Yucca Mountain Project