YMP	Scientific Analysis/Calculation Error Resolution Document *Complete only applicable items.*	QA: QA Page 1 of 7

1. Document Number:	2. Revision/Addendum:	3. ERD:
ANL-MGR-MD-000005	REV 04	01

4 Title:	5. No. of Pages Attached:
Characteristics of the Receptor for the Biosphere Model	6

6. Description of and Justification for Change (Identify affected pages, applicable CRs and TBVs):

I Background Information Summary

This ERD is prepared as a part of the resolution of CR 12947. This CR raised two issues concerning *Characteristics of the Receptor for the Biosphere Model* (ANL-MGR-MD-000005 REV04) (BSC 2005 [DIRS 172827]) that are addressed in this ERD for this document.

Issue 1: Section 5.2 of *Characteristics of the Receptor for the Biosphere Model* (ANL-MGR-MD-000005 REV04) (BSC 2005 [DIRS 172827]) presents an assumption regarding the proportion of the population of Amargosa Valley that is considered to be "local outdoor workers" for the purposes of developing dose coefficients for the biosphere model.

One of the comments to be addressed as part of Corrective Action 12947-004, comment #333, was that the assumption made in Section 5.2 needed "more discussion and proof of concept." The particular part of the assumption that was questioned is: "Because motor vehicle operators and others working in the transportation industry spend most of their time in enclosed cabs, they would not be exposed to substantial amounts of contaminated soil, and they are not considered local outdoor workers." The commenter noted that this assumption "...assumes that the vehicles have closed air cycle A/C and would use this all year round. If this is a FEMA recommendation and survey of the vehicles in the Amargosa Valley shows that vehicles have A/C and that the RMEI does not drive with his window down, then the assumption is valid."

(continued on next page)

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9. Originator	Laura Price		3/23/09
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To address this comment, the assumption will be further supported by noting that motor vehicle operators and those in the transportation industry would be expected to drive primarily on paved roads, and thus would not be part of the "local outdoor workers" population group. By definition, "local outdoor workers" engage in activities that resuspend soil, such as driving on unpaved roads, plowing, or riding motorbikes (page 6-7 of the same report); therefore, those who drive on paved roads would not be considered to be part of the "local outdoor workers" population group.

Issue 2: Tables 6-24 and 6-25 of *Characteristics of the Receptor for the Biosphere Model* (ANL-MGR-MD-000005 REV04) (BSC 2005 [DIRS 172827]) give Dose Coefficients for Inhalation and Ingestion of Radionuclides of Interest from Federal Guidance Report No. 11 and Dose Coefficients for Inhalation and Ingestion of Radionuclides of Interest from ICRP Publications 72, respectively. The tables list inhalation and ingestion dose coefficients for the primary radionuclides modeled in the performance assessment, as well as the short-lived daughter products associated with each primary radionuclide. Some of the short-lived daughter products do not have inhalation and ingestion dose coefficients, as is explained in footnotes to each table: "The contribution from the short-lived decay products resulting from the decay of a longer-lived parent radionuclide in the human body is included together with the parent radionuclide dose coefficient."

One of the comments to be addressed as part of Corrective Action 12947-004, comment # 351, noted that the last two lines of Table 6-25 were replicates of the previous two lines in the table, and should be deleted. In developing the response to this comment, it was noted that this is also true of Table 6-24.

The last two lines of each table show Thallium-207 and Polonium-211 as being short-lived decay products of Actinium-227. However, these last two lines appear to simply be a repeat of the previous two lines in the table. That is, the last four lines of the table list Thallium-207, Polonium-211, Thallium-207, and Polonium-211, in that order, as the short-lived decay products of Actinium-227. This is in error, and the last two lines of each table need to be deleted. In addition, as this table is reproduced as Table 1 in DTN: MO0503SPADCESR.000, Table 1 in this DTN was revised in a similar fashion. This will not affect input to the TSPA, as dose coefficients for both Thallium-207 and Polonium-211 are included in the dose coefficients for Actinium-227, as shown in Tables 6-24 and 6-25. The dose coefficients for Actinium-227 do not change as a result of deleting the last two lines in these two tables.

II Software and Changes to Inputs and Outputs

No new input sources or software are used in this ERD. Output DTN: MO0503SPADCESR.000 was modified by deleting the last two lines of Table 1 of that DTN. This change will not affect input to the TSPA, as deleting the last two lines of Table 1 of DTN: MO0503SPADCESR.000 did not affect the inhalation and ingestion dose coefficients for Actinium-227, which include the dose effects of inhaling and ingesting Thallium-207 and Polonium-211.

III Identification of Impacts

The resolution of Issue 1 will have no impact on this document or any other documents, as it will simply strengthen the basis for an assumption made in this document. The assumption itself is not changed, nor is the model given in this document changed as a result of strengthening the basis for this assumption.

Correcting the typographic errors in this document to resolve Issue 2 will not affect the conclusion of this document as deleting the last two lines of Tables 6-24 and 6-25 does not change the inhalation dose coefficient or ingestion dose coefficient for Actinium-227, which include the dose effects of inhaling and ingesting Thallium-207 and Polonium-211.

Correcting the typographic errors in this document to resolve Issue 2 does not affect downstream documents. The following controlled documents are shown in DIRS as citing *Characteristics of the Receptor for the Biosphere Model* (ANL-MGR-MD-000005 REV04). Each of these documents was checked, and it was determined that correcting the typographic errors in this document to resolve Issue 2 will not impact these documents.

- *Site-Specific Input Files for use with GENII Version 2* (000-00C-MGR0-02500-000-00A)
- *IED Surface Facility and Environment* (100-IED-WHS0-00201-000-00D)
- *Evaluation of the Need for Charcoal Adsorbers* (100-PSA-WHS0-00100-000 Rev. 00A)
- *Inhalation Exposure Input Parameters for the Biosphere Model* (ANL-MGR-MD-000001 Rev. 04)
- *Soil-Related Input Parameters for the Biosphere Model* (ANL-NBS-MD-000009 Rev. 03)
- *Radionuclide Screening* (ANL-WIS-MD-000006 Rev. 02)
- *Features, Events, and Processes for the Total System Performance Assessment: Analyses* (ANL-WIS-MD-000027 Rev. 00)
- *Atmospheric Dispersal and Deposition of Tephra from a Potential Volcanic Eruption at Yucca Mountain, Nevada* (MDL-MGR-GS-000002 Rev. 03)
- *Redistribution of Tephra and Waste by Geomorphic Processes Following a Potential Volcanic Eruption at Yucca Mountain, Nevada* (MDL-MGR-GS-000006 Rev. 00)
- *Biosphere Model Report* (MDL-MGR-MD-000001 Rev. 02)
- *Total System Performance Assessment Model/Analysis for the License Application – Volume I* (MDL-WIS-PA-000005 Rev. 00)
- *TSPA Information Package for the Draft SEIS* (TDR-WIS-PA-000014 Rev. 00)
- *Yucca Mountain Repository General Information*, Section 5 (DOE/RW-0573, Rev.0)
- *Yucca Mountain Repository Safety Analysis Report*, Sections 1.8, 2.3.10, and 2.4 (DOE/RW-0573, Rev. 0)

In addition, correcting the typographic error in Table 1 of DTN: MO0503SPADCESR.000 to resolve Issue 2 did not affect controlled documents that cite this DTN. This DTN is cited by *Biosphere Model Report* (MDL-MGR-MD-000001 REV02) (SNL 2007 [DIRS 177399]) and *Site-Specific Input Files for use with GENII Version 2* (000-00C-MGR0-02500-000-00A) (BSC 2007 [DIRS 177751]).

Biosphere Model Report cites DTN: MO0503SPADCESR.000 as a source for values given in Tables 6.6-3, Tables 6.11-8 through 6.11-11, and Tables 6.12-2 through 6.12-4 of *Biosphere Model Report*. However, the DIRS report for *Biosphere Model Report* (LLR.20080328.0005) notes that the only information from DTN: MO0503SPADCESR.000 that is used as direct input to these tables is the dose coefficient for inhalation of Rn-222. Therefore, deleting the last two lines in Table 1 of DTN: MO0503SPADCESR.000, which lists Thallium-207 and Polonium-211 and which are erroneously repeated from the previous two lines, did not affect *Biosphere Model Report*.

Site-Specific Input Files for use with GENII Version 2 (000-00C-MGR0-02500-000-00A) (BSC 2007 [DIRS 177751]) does not use the information from DTN: MO0503SPADCESR.000 in its calculations. Section 4.1.5 of that report states that, with respect to DTN: MO0503SPADCESR.000, "That DTN is not used in this document, because the dose coefficients with the decay products considered in the Biosphere Model and the PCSA are treated differently." Therefore, correcting the typographic errors in this DTN did not affect *Site-Specific Input Files for use with GENII Version 2*.

Changed pages are attached as pages 5, 6, and 7. Inserted text is underlined. Deleted text is ~~struck through~~.

Test Site. It is much less likely that ash would be deposited at more distant population and employment centers to the south (Pahrump), east (Las Vegas), and west (Beatty).

Over time, some ash initially deposited at or near Yucca Mountain would be washed into the Amargosa Valley via Fortymile Wash. Ash may also be redistributed into the upper reaches of the Amargosa River near Beatty, Nevada, via Beatty Wash and other drainages that flow west from Yucca Mountain. Because they are outside the watersheds where substantial amounts of ash would be deposited initially, large amounts of ash probably would not be redistributed into Las Vegas and Pahrump.

For the volcanic ash exposure scenario, it is assumed that, on average, people who commute to work less than 35 minutes (one way) remain in the contaminated area. Within 35 minutes, a person living in northern Amargosa Valley could travel to work sites in the Amargosa Valley, Beatty, and much of the Nevada Test Site. They probably could not travel to Pahrump or to other employment centers in Clark County (e.g., Indian Springs, Las Vegas) in only 35 minutes.

The minimum value of the distribution of the proportion of the population classified as commuters is calculated as the average minus two standard errors (in contrast to ± one standard error for other population groups) to account for uncertainty in the distribution of ash and the travel time required to leave contaminated areas (Section 6.3.1).

5.2 PROPORTION OF POPULATION–LOCAL OUTDOOR WORKERS

For both exposure scenarios, all residents working in agriculture, 25 percent of those working in construction, 10 percent of those working in the utilities industry, and 10 percent of miners are classified as local outdoor workers who spend their working hours outdoors in the potentially contaminated area. To account for uncertainty in the distribution of ash, the upper bound of the distribution of local outdoor workers is calculated as two times the standard error of the mean. All other distribution tails for both scenarios are calculated as one times the standard error of the mean.

This assumption is based on information from the Bureau of the Census (2002 [DIRS 159728], Table P49) on the number of people working in various industries (Table 6-4). The population group "local outdoor workers" includes people who work outdoors and disturb (and therefore resuspend) contaminated soil. Because motor vehicle operators and others working in the transportation industry spend most of their time in enclosed cabs and would be expected to drive on paved roads, they would not be exposed to substantial amounts of contaminated soil, and they are not considered local outdoor workers.

All residents of the Amargosa Valley who work in agriculture, forestry, or fisheries are assumed to work outdoors in that valley.

Many people in the construction and utilities industries also work outdoors. However, because many workers in Amargosa Valley have a long travel time to work (e.g., 20 percent had a travel time to work of more than 35 minutes in 2000; Table 6-3), and because there are few industries in Amargosa Valley that require construction and utility workers (Rasmuson 2004 [DIRS 169506]), it is likely that only a few of these people work in the Amargosa Valley and conduct soil-disturbing activities. To account for these local workers, 25 percent of construction

Correction to page 5-2 of ANL-MGR-MD-000005 REV04

Table 6-24. Dose Coefficients for Inhalation and Ingestion of Radionuclides of Interest from Federal Guidance Report No. 11 (Continued)

Primary Radionuclide	Short-lived Decay Product	Dose Coefficients (Sv/Bq)	
		Inhalation	Ingestion
Uranium Series (4n + 2)			
Plutonium-242		1.11E-04	9.08E-07
Uranium-238		3.20E-05	6.88E-08
	Thorium-234	9.47E-09	3.69E-09
	Protactinium-234m	–[b]	–[b]
	Protactinium-234	2.20E-10	5.84E-10
Plutonium-238		1.06E-04	8.65E-07
Uranium-234		3.58E-05	7.66E-08
Thorium-230		8.80E-05	1.48E-07
Radium-226		2.32E-06	3.58E-07
	Radon-222	–[b]	–[b]
	Polonium-218	–[b]	–[b]
	Lead-214	2.11E-09	1.69E-10
	Astatine-218	–[b]	–[b]
	Bismuth-214	1.78E-09	7.64E-11
	Polonium-214	–[b]	–[b]
	Thallium-210	–[b]	–[b]
Lead-210		3.67E-06	1.45E-06
	Bismuth-210	5.29E-08	1.73E-09
	Polonium-210	2.54E-06	5.14E-07
Actinium Series (4n + 3)			
Americium-243		1.19E-04	9.79E-07
	Neptunium-239	6.78E-10	8.82E-10
Plutonium-239		1.16E-04	9.56E-07
Uranium-235		3.32E-05	7.19E-08
	Thorium-231	2.37E-10	3.65E-10
Protactinium-231		3.47E-04	2.86E-06
Actinium-227		1.81E-03	3.80E-06
	Thorium-227	4.37E-06	1.03E-08
	Francium-223	1.68E-09	2.33E-09
	Radium-223	2.12E-06	1.78E-07
	Radon-219	–[b]	–[b]
	Polonium-215	–[b]	–[b]
	Lead-211	2.35E-09	1.42E-10
	Bismuth-211	–[b]	–[b]
	Thallium-207	–[b]	–[b]
	Polonium-211	–[b]	–[b]
	~~Thallium-207~~	~~–[b]~~	~~–[b]~~
	~~Polonium-211~~	~~–[b]~~	~~–[b]~~

Source: Eckerman et al. 1988 [DIRS 101069], Tables 2.1 and 2.2.

1 Sv = 100 rem; 1 Ci = 3.7×10^{10} Bq.

[a] Two values of dose coefficient for ^{90}Sr are given in the source document: one for $SrTiO_3$ and one for all other compounds. Because $SrTiO_3$ is not a common compound and is unlikely to be present in the biosphere, the value for all other compounds was used (Rittmann 1993 [DIRS 107744], p. 6).

[b] Eckerman et al. 1988 [DIRS 101069] does not include dose coefficients for these short-lived radionuclides. The contribution from the short-lived decay products resulting from the decay of a longer-lived parent radionuclide in the human body is included together with the parent radionuclide dose coefficient. For radon, the short-lived decay products are included in the dose coefficient for the parent radionuclide, as described in Section 6.5.4.

Correction to page 6-62 of ANL-MGR-MD-000005 REV04

Table 6-25. Dose Coefficients for Inhalation and Ingestion of Radionuclides of Interest from ICRP Publications 72 (Continued)

Primary Radionuclide	Short-lived Decay Product	Dose Coefficients (Sv/Bq)	
		Inhalation	Ingestion
Uranium Series (4n + 2)			
Plutonium-242		1.1E-04	2.4E-07
Uranium-238		8.0E-06	4.5E-08
	Thorium-234	7.7E-09	3.4E-09
	Protactinium-234m	–[a]	–[a]
	Protactinium-234	4.0E-10	5.1E-10
Plutonium-238		1.1E-04	2.3E-07
Uranium-234		9.4E-06	4.9E-08
Thorium-230		1.0E-04	2.1E-07
Radium-226		9.5E-06	2.8E-07
	Radon-222	–[a]	–[a]
	Polonium-218	–[a]	–[a]
	Lead-214	1.5E-08	1.4E-10
	Astatine-218	–[a]	–[a]
	Bismuth-214	1.4E-08	1.1E-10
	Polonium-214	–[a]	–[a]
	Thallium-210	–[a]	–[a]
Lead-210		5.6E-06	6.9E-07
	Bismuth-210	9.3E-08	1.3E-09
	Polonium-210	4.3E-06	1.2E-06
Actinium Series (4n + 3)			
Americium-243		9.6E-05	2.0E-07
	Neptunium-239	1.0E-9	8.0E-10
Plutonium-239		1.2E-04	2.5E-07
Uranium-235		8.5E-06	4.7E-08
	Thorium-231	3.3E-10	3.4E-10
Protactinium-231		1.4E-04	7.1E-07
Actinium-227		5.5E-04	1.1E-06
	Thorium-227	1.0E-05	8.8E-09
	Francium-223	8.9E-10	2.4E-09
	Radium-223	8.7E-06	1.0E-07
	Radon-219	–[a]	–[a]
	Polonium-215	–[a]	–[a]
	Lead-211	1.2E-08	1.8E-10
	Bismuth-211	–[a]	–[a]
	Thallium-207	–[a]	–[a]
	Polonium-211	–[a]	–[a]
	~~Thallium-207~~	~~–[a]~~	~~–[a]~~
	~~Polonium-211~~	~~–[a]~~	~~–[a]~~

Source: ICRP 1996 [DIRS 152446], Tables A.1 and A.2.

1 Sv = 100 rem; 1 Ci = 3.7×10^{10} Bq.

[a] ICRP 1996 [DIRS 152446] does not include dose coefficients for the short-lived radionuclides. The contribution from the short-lived decay products resulting from the decay of a longer-lived parent radionuclide in the human body is included together with the dose coefficient for the parent radionuclide. For radon and radon decay products dose coefficients are calculated separately, as described in Section 6.5.4.

Correction to page 6-64 of ANL-MGR-MD-000005 REV04