



**DEPARTMENT OF THE AIR FORCE**  
AIR FORCE INSTITUTE FOR OPERATIONAL HEALTH (AFMO)  
BROOKS CITY-BASE TEXAS

26 May 2006

MEMORANDUM FOR 377 AMDS/SGPB  
1501 SAN PEDRO STREET SE BLDG 589  
KIRTLAND AFB NM 87117

FROM: AFIOH/SDR  
2350 Gillingham Drive  
Brooks City-Base TX 78235-5111

SUBJECT: Consultative Letter, IOH-SD-BR-CL-2006-0040, Radiological Assessment of the Release Surveys of Building 20358, National Atomic Museum, by Sandia National Laboratories, Kirtland AFB, Albuquerque, NM

1. The Air Force Institute for Operational Health, Radiation Surveillance Division, Health Physics Consulting Branch (AFIOH/SDRH), performed an assessment of the radiological release surveys of Building 20358, National Atomic Museum, by Sandia National Laboratories (SNL) on behalf of the U.S. Department of Energy's National Nuclear Security Agency (DOE/NNSA), at Kirtland AFB, Albuquerque, NM. As part of this assessment, a confirmatory survey was performed by 377 AMDS personnel under the direction of AFIOH/SDRH (George Cicotte) on March 14-16, 2006. The purpose of the assessment and survey was to confirm the results of the survey performed in preparation for release of the former museum to the Air Force. Based on the results of the assessment and survey, it was determined that the survey conducted by SNL was sufficient to identify elevated levels of residual radioactivity in Building 20358, in order to perform a dose assessment for release for unrestricted use of the building.

**2. Background:**

a. In Feb-Mar 05, DOE-NNSA in Albuquerque, NM, contacted 377 AMDS with the results of a series of surveys and assessments, concluding that the former location of the National Atomic Museum, Building 20358 on Kirtland AFB, was suitable for release for unrestricted use and was ready for disposition and transfer back to Air Force custody. The Institute for Operational Health (AFIOH/SDRH), the Radiation Safety Officer for 377 AMDS, and AFMOA/SGPR (USAF Radioisotope Committee) all reviewed the results of those surveys and assessments. Several comments and a request to re-address identified data gaps were sent in writing to DOE/NNSA in Jul 2005.

b. In negotiation of the resolution of the comments as noted above, a teleconference was conducted between DOE and USAF stakeholders on 21 Oct 2005. As a result of the teleconference, it was concluded that based on the results of confirmatory surveys by AFIOH/SDRH, and additional clarification of some other details, the previously-performed

surveys would be considered adequate for release for unrestricted use. The extent of the survey was to be determined by AFMOA/SGPR, with the methodology and survey oversight by AFIOH/SDRH.

c. On 14-16 Mar 06, George Cicotte from AFIOH/SDRH provided oversight of a confirmatory radiological survey as approved by AFMOA/SGPR, with survey conduct by personnel from 377 AMDS/SGPB. The following personnel from 377 AMDS/SGPB performed the survey:

B. Murren, Capt, USAF

F. Nunley, TSgt, USAF

C. Willett, A1C, USAF

### **3. Survey Equipment:**

- Ludlum Model 2360 (serial number 168043 with 43-37 probe serial number PR117138, calibration due date 6 Mar 2007)
- Bicon Surveyor M (serial number A809P with PGM probe serial number B870H, calibration due date 30 Dec 2006)

### **4. Findings:**

a. Physical Description: Building 20358 consists of a two-story building, with a “High Bay,” several single story rooms, and a partial second story. The second story was not within the scope of this survey, as it was inaccessible from within the building and was not used for the museum. Part of the purpose of the confirmatory survey was to ensure that areas carpeted after use of the rooms for the museum were free of detectable residual radioactivity once the carpet was removed. The survey of areas of the main floor not covered by carpet was also verified.

b. Hazards: The radiological contaminant of most concern consisted of radium from aircraft dials. In one of the rooms (about 5% of the planned survey area) where carpets were to have been removed in preparation for the confirmatory survey, asbestos-vinyl tiles were found to have degraded such that carpet removal was halted, and this area was excluded from the survey on the agreement with AFMOA staff that 95% of the planned confirmatory survey was adequate.

c. Radiation Survey Plan: The confirmatory survey plan called for removal of the carpets, 100% scan of the areas thus uncovered, and 10% scan of the other floor areas within Building 20358. In addition, static readings were taken in areas where only 10% scans were performed, and included floor drain openings in areas where radioactive materials may have been present. Background readings were to be taken outside Building 20358, and at two other buildings of similar construction and approximate date of construction.

d. Radiation Survey Results: With the exception of the areas not surveyed due to the presence of carpets as noted above, the plan was completed. No areas of significant elevated radioactivity were observed. Maps of the areas surveyed are shown in Atch 1. Results of individual readings, background, and other relevant information are contained in atch 2. Calibration records for the radiation survey instruments used are contained in Atch 3.

e. Radiological Assessment: An assessment using RESRAD Build Version 3.3 (August, 2005) and the associated technical basis<sup>1</sup> with primarily default inputs was performed. The default resuspension factor was revised<sup>2</sup> by a factor of 10 (lower resuspension) consistent with NUREG 1549. The resulting dose estimate, at the highest detected level for a 100 m<sup>2</sup> area, was indicated to be about 2.2 mrem per year. The calculated detection limit L<sub>d</sub>, being greater than the observed net count rate, was used for conservatism.

## 5. Recommendations

a. The results of the confirmatory survey, consistent with the surveys conducted for DOE/NNSA, indicate that Building 20358 is suitable for release for unrestricted use.

c. The combined surveys conducted for DOE/NNSA should be considered confirmed as acceptable for verification that there is no residual radioactive material sufficient to create an exposure in excess of values acceptable to AFMOA/SGPR.

6. If you have any comments or questions regarding this consultation, please contact Mr George Cicotte at 210-536-6007 (DSN 240-6007), or email to [george.cicotte@brooks.af.mil](mailto:george.cicotte@brooks.af.mil).

//signed//

SCOTT M. NICHELSON, Lt Col, USAF, BSC, CHP, CIH  
Chief, Radiation Surveillance Division

cc:  
AFMSA/SPGR  
ASC/TMTC

Atchs:

1. Survey Maps
2. Survey Details
3. Instrument Calibration Records
4. Dose Assessment [Computer Program] Printouts

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<sup>1</sup> NUREG/CR-6755: Technical Basis for Calculating Radiation Doses for the Building Occupancy Scenario Using the Probabilistic RESRAD-BUILD 3.0 Code. February 2002. Argonne National Laboratory, Argonne, IL

<sup>2</sup> NUREG-1549: Decision Methods for Dose Assessment to Comply With Radiological Criteria for License Termination [NUREG/CR-5512 - Residual Radioactive Contamination From Decommissioning Parameter Analysis, April 2001]

Attachment 1  
Survey Maps

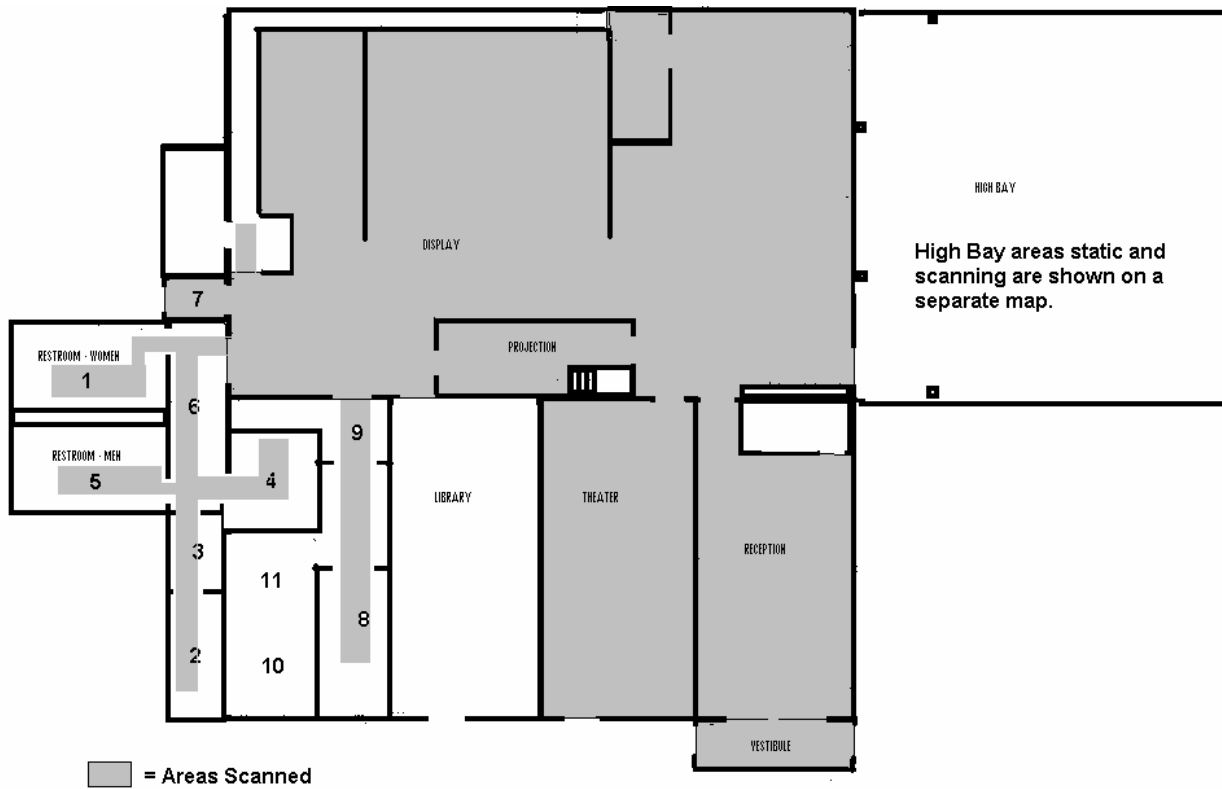


Figure 1 – Rooms

Note: The areas shown as shaded, where the entire room is shaded, are those areas that were carpeted, from which the carpet was removed. The room shown as “Library” is the room from which the carpet was only partially removed, and which could not be surveyed.

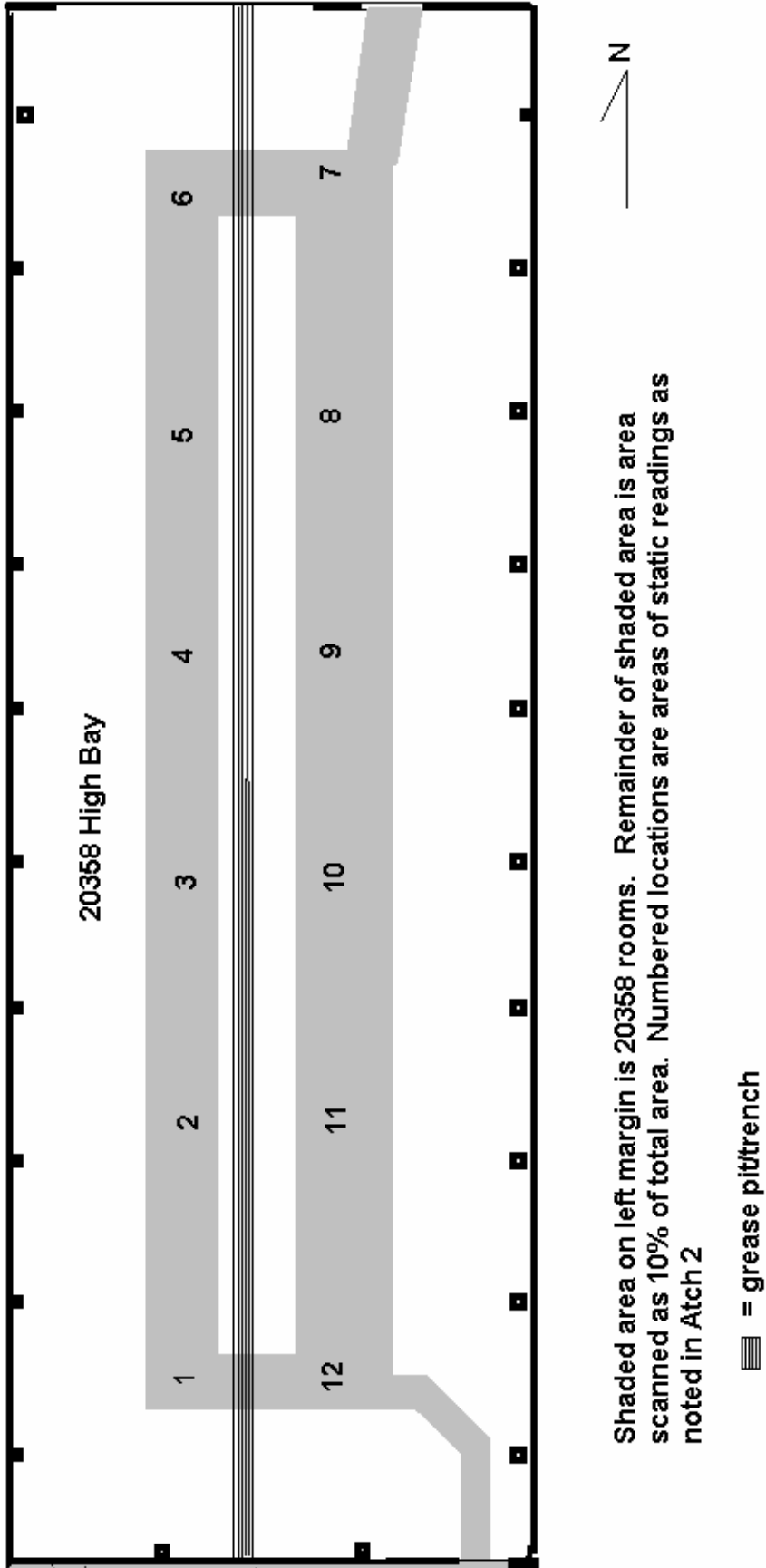


Figure 2 – Building  
20358 High Bay

## Attachment 2 Survey Details

Static and scanning surveys were divided into the High Bay, and the areas other than the High Bay (Rooms). Alpha background 42 cpm, beta background 1414 cpm.

### High Bay – Static Readings

Location	DOE Delineator	Gross Rate (cpm)		Net Rate (cpm)		Net Activity (dpm/100 cm <sup>2</sup> )	
		Alpha	Beta	Alpha	Beta	Alpha	Beta
1	unknown	35	936	0	0	≤64	≤148
2	unknown	39	1254	0	0	≤64	≤148
3	unknown	32	943	0	0	≤64	≤148
4	unknown	36	1021	0	0	≤64	≤148
5	31	46	989	4	0	40	≤148
6	33	38	957	0	0	≤64	≤148
7	38	45	877	3	0	30	≤148
8	121	30	1539	0	125	≤64	520
9	128	33	1339	0	0	≤64	≤148
10	106	41	1558	0	144	≤64	600
11	128	46	1300	4	0	40	≤148

### Rooms – Static Readings

Location	DOE Delineator	Gross Rate (cpm)		Net Rate (cpm)		Net Activity (dpm/100 cm <sup>2</sup> )	
		Alpha	Beta	Alpha	Beta	Alpha	Beta
1	112	32	914	0	0	≤64	≤148
2	105	22	870	0	0	≤64	≤148
3	366	23	905	0	0	≤64	≤148
4	510	28	932	0	0	≤64	≤148
5	685	24	916	0	0	≤64	≤148
6	831	27	941	0	0	≤64	≤148
7	794	34	916	0	0	≤64	≤148
8	650	26	935	0	0	≤64	≤148
9	500	30	938	0	0	≤64	≤148
10	350	14	874	0	0	≤64	≤148
11	193	31	937	0	0	≤64	≤148
12	83	37	841	0	0	≤64	≤148

### Notes:

1. Static readings were obtained on 03/15/06. Background readings were obtained before/after the survey. Background selected for calculating net count rate was the lower of the two, obtained at end of survey (see next page).
2. MDC calculated from equations 6-6 and 6-7 of NUREG 1575 (2000). The constant C was calculated to be 2 dpm/100 cm<sup>2</sup>-count for alpha, and 0.83 dpm/100 cm<sup>2</sup>-count for beta.
3. Standard deviation calculated from equation 6-16 of NUREG 1575 (2000). For zero net counts, these values for  $\sigma_n$  are 1 for alpha, and 12 for beta.

Attachment 2  
Survey Details

Instrument Quality Assurance (14-15 Mar 2006)

Date	Time	Reading	Duration (minutes)	Gross Counts		Net Count Rate (cpm)		Eff.	
				Alpha	Beta	Alpha	Beta	Alpha	Beta
03/14/06	14:00	Bkgd <sup>1</sup>	10	387	13527	39	1353	NA	
03/14/06	17:00	Bkgd <sup>2</sup>	10	348	12799	35	1280		
03/14/06	19:30	Bkgd <sup>2</sup>	10	449	18273	45	1827		
03/15/06	07:30	Bkgd <sup>1</sup>	10	520	15428	52	1543		
03/15/06	16:00	Bkgd <sup>1</sup>	10	418	14142	42	1414		
03/15/06	14:10	Source test <sup>3</sup>	0.5	900824	NA	1801606	NA	0.10	NA
03/15/06	14:18	Source test <sup>4</sup>	1	NA	9223	NA	9223	NA	0.24

Note: "NA" means Not Applicable.

<sup>1</sup> Background obtained outside Building 20358 on unsealed concrete

<sup>2</sup> Background obtained on similar material in buildings of similar date, ceramic tile floor in Building 20228, "Rio Grande Lounge" and concrete at the bowling alley, building 20333.

<sup>3</sup> Pu-239 test standard, P5612, #KAFB 67-114, 15.8 uCi on 31 Oct 1965. Source test count was for 0.5 minutes and one half of the source was covered to provide 100% attenuation of half the alpha emissions because total counts for a 1 minute count exceeded the maximum readout on the instrument.

<sup>4</sup> Cs-137 test standard, #KAFB 65-148, 78,000 dpm on 1 Jan 1965, accounting for half-life, beta-gamma count rate approximately 38,000 dpm

Attachment 3  
Instrument Calibration Records

**Certificate of Calibration**

**Ratemeter Certificate of Calibration**



Environmental Restoration Group, Inc.  
8809 Washington St. NE, Suite 150  
Albuquerque, NM 87113  
(505) 298-4224

Manufacturer: Ludlum Model: 2360 Serial No.: 168043

All Ranges Calibrated Electronically; Ludlum Pulser Generator S.N.  97743  201932

Reset  Audio  Mechanical  Battery

High Voltage 500v  1000v  1500v

Instrument found within tolerance (+/- 10%) Yes  No

Internal Calibration Date Reset

Alpha Threshold Setting: 100 mV

Beta Threshold Setting: 4 mV Beta Window: 40 mV

Reference Setting	Ratemeter	Instrument "As found reading"	
400 Kcpm	<u>400 Kcpm</u>	<u>+/- 10%</u>	
100 Kcpm	<u>100 Kcpm</u>		
40 Kcpm	<u>40 Kcpm</u>		
10 Kcpm	<u>10 Kcpm</u>		
4 Kcpm	<u>4 Kcpm</u>		
1 Kcpm	<u>1 Kcpm</u>		
400 cpm	<u>400cpm</u>		
100 cpm	<u>100cpm</u>		
Reference Setting	Integrated Counts (1-minute count)		Instrument "As found reading"
400 Kcpm	<u>39882.5</u>		<u>+/- 10%</u>
40 Kcpm	<u>39886</u>		
4 Kcpm	<u>3988</u>		
400 cpm	<u>398</u>		

The calibration system conforms to the requirements of ANSI N323-1997

Calibrated By: [Signature]

Calibration Date: 3-6-06

Calibration Due: 3-6-07

Reviewed By: [Signature]

Date: 3/13/06

Attachment 3  
Instrument Calibration Records

Certificate of Calibration

Voltage Plateau Form



Environmental Restoration Group, Inc.  
8809 Washington St. NE, Suite 150  
Albuquerque, NM 87113  
(505) 298-4224

Detector Mfg.: Ludlum Model: 43-37 Serial No.: PR117138  
Counter Mfg.: Ludlum Model: 2360 Serial No.: 168043

Temp.: 70 °F Rel. Humidity: 33 % Bar. Pressure: 30.09 in. of Hg

Alpha Threshold Setting: 100 mV

Beta Threshold Setting: 4 mV Beta Window: 40 mV

Cable Length:  39 inch,  5 foot,  Other: \_\_\_\_\_

Alpha Source:  Th230 @ 13,500 dpm sn: 4098-03  Other: \_\_\_\_\_

Beta Source:  Tc99 @ 18,100 dpm sn: 4099-03  Other: \_\_\_\_\_

Geometry / Distance to source: SIG

Count Time: 1 minute(s)

High Voltage	Alpha Source Counts		Beta Source Counts		Background Counts	
	Alpha	Beta	Alpha	Beta	Alpha	Beta
1400	20	1120	1	159	2	16
1500	790	981	11	1844	4	216
→ 1600	1643	1642	8	3988	3	738
1700	2183	1962	446	3852	71	1455

The calibration system conforms to the requirements of ANSI N323-1997

Recommended Operating Voltage: 1600 volts

Calibrated By: [Signature]

Calibration Date: 3-6-06

Calibration Due: 3-6-07

Reviewed By: [Signature]

Date: 3/13/06







Attachment 4  
Dose Assessment [Computer Program] Printouts

\*\* RESRAD-BUILD Dose Program Output, Version 3.3 05/01/06 12:45:10 Page: 3 \*\*  
Title : Default Case for RESRAD-BUILD  
Input File : site1.bld

íííííííííí Building Information íííííííííí

Building Air Exchange Rate: 8.00E-01 1/hr

Height[m]	Area [m2]	Air Exchanges [m3/hr]
		*****
		* * *
		* * * <=Q01: 7.20E+01
H1: 2.500		* Room 1 * Q10 : 7.20E+01
		* LAMBDA: 8.00E-01 * *
Area 36.000		* * *
		*****

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 5.00E-08 [1/s]

## Attachment 4 Dose Assessment [Computer Program] Printouts

\*\* RESRAD-BUILD Dose Program Output, Version 3.3 05/01/06 12:45:10 Page: 4 \*\*  
 Title : Default Case for RESRAD-BUILD  
 Input File : sitel.bld

### iiiiiiii Source Information iiiiiiii

Source: 1  
 Location:: Room : 1 x: 0.00 y: 0.00 z: 0.00[m]  
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01  
 Direction: x  
 Pathway ::  
 Direct Ingestion Rate: 0.000E+00 [1/hr]  
 Fraction released to air: 1.000E-01  
 Removable fraction: 5.000E-01  
 Time to Remove: 3.650E+02 [day]  
 Radon Release Fraction: 1.000E-01

### Contamination:

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 13 Morbidity)		
		Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/ (dpm/m3)]
RA-226	4.000E+03	5.950E-04	3.871E-03	4.663E-03
PB-210	0.000E+00	2.422E-03	6.214E-03	4.698E-06

Attachment 4  
Dose Assessment [Computer Program] Printouts

\*\* RESRAD-BUILD Dose Program Output, Version 3.3 05/01/06 12:45:10 Page: 5 \*\*  
Title : Default Case for RESRAD-BUILD  
Input File : sitel.bld  
Evaluation Time: 0.00000000E+00 years

```

iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
fff      Assessment for Time: 1      fff
fff      Time =0.00E+00 yr          fff
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii

```

iiiiiiii Source Information iiii

Source: 1  
Location:: Room : 1 x: 0.00 y: 0.00 z: 0.00 [m]  
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01  
Direction: x  
Pathway ::  
Direct Ingestion Rate: 0.000E+00 [1/hr]  
Fraction released to air: 1.000E-01  
Removable fraction: 5.000E-01  
Time to Remove: 3.650E+02 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	RA-226	4.000E+03
	PB-210	0.000E+00







## Attachment 4 Dose Assessment [Computer Program] Printouts

\*\* RESRAD-BUILD Dose Program Output, Version 3.3 05/01/06 12:45:10 Page: 9 \*\*  
 Title : Default Case for RESRAD-BUILD  
 Input File : sitel.bld  
 Evaluation Time: 1.00000000 years

```

iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
fff      Assessment for Time: 2      fff
fff      Time =1.00E+00 yr          fff
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
  
```

iiiiiiii Source Information iiiiiiii

Source: 1  
 Location:: Room : 1 x: 0.00 y: 0.00 z: 0.00 [m]  
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01  
 Direction: x  
 Pathway ::  
 Direct Ingestion Rate: 0.000E+00 [1/hr]  
 Fraction released to air: 1.000E-01  
 Removable fraction: 0.000E+00  
 Time to Remove: 3.650E+02 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	RA-226	1.999E+03
	PB-210	6.120E+01







Attachment 4  
Dose Assessment [Computer Program] Printouts

\*\* RESRAD-BUILD Dose Program Output, Version 3.3 05/01/06 12:45:10 Page: 13 \*\*  
Title : Default Case for RESRAD-BUILD  
Input File : site1.bld  
Full Summary

```
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
fff                                     fff
fff      RESRAD-BUILD Dose (Time) Tables      fff
fff                                     fff
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii
```

Receptor Dose Received for the Exposure Duration  
iii  
(mrem)

	Evaluation Time [yr]	
	0.00E+00	1.00E+00
	AAAAAAAA	AAAAAAAA
1	2.17E+00	3.60E-02

Receptor Dose/Yr Averaged Over Exposure Duration  
iii  
(mrem/yr)

	Evaluation Time [yr]	
	0.00E+00	1.00E+00
	AAAAAAAA	AAAAAAAA
1	2.17E+00	3.60E-02