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Our ref: HEM-10-89
Date: September 15, 2010

Subject: Additional Responses to Questions on Decommissioning Plan Chapter 5, Dose Modeling (License No. SNM-00033, Docket No. 070-00036)

References:

1) NRC (J. J. Hayes) letter to Westinghouse (E. K. Hackmann), dated July 12, 2010, (Accession # ML101760058) "Westinghouse Hematite Decommission Plan Review Requests for Additional Information"

2) Westinghouse (E. K. Hackmann) letter to NRC Document Control Desk, HEM-10-85, dated August 11, 2010, "Response to Request for Additional Information Concerning Hematite Decommissioning Plan: Chapter 5, Dose Modeling (License No. SNM-00033, Docket No. 070-00036)."

Reference 1 issued NRC Requests for Additional Information (RAI) concerning Hematite Decommissioning Plan Chapter 5, Dose Modeling. Reference 2 submitted most of the responses to those RAIs. Westinghouse Electric Company LLC submits 4 of the remaining 7 responses herein (specifically, those for questions 7, 11, 15 and part of 10). The final remaining 3 responses (specifically, those for questions 2, 3, 9, and the remainder of 10) will be submitted as soon as possible.

Attachment 1 provides responses and an explanation of anticipated changes to the Decommissioning Plan (DP) resulting from the responses. Attachments 2 through 5 provide information referred to in Attachment 1. The Enclosure provides RESRAD-BUILD files referred to in the response to RAI HDP-C5-Q10. The actual changes to the DP will be provided under separate cover.

Please contact Mark Michelsen, Acting Licensing Manager of my staff at (314) 810-3376 should you have questions or need any additional information.

Sincerely,

E. Kurt Hackmann
Director, Hematite Decommissioning Project

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Attachments:
1) Additional Decommissioning Plan Chapter 5 Responses to NRC Questions 7, 11, 10 (partial) and 15
2) PHPAIDA Files - Building 230 Roll Door Open
3) PHPAIDA Files - Building 230 Roll Door Closed
4) RESRAD-BUILD Files - Large Warehouse Occupancy
5) RESRAD-BUILD Files - Large Warehouse Occupancy - Th-232+C

Enclosure: The following files are enclosed:

HEMATITE - Small Office AF - $1m^2$.pdf
HEMATITE - Small Office AF - $4m^2$.pdf
HEMATITE - Small Office AF - $6.5m^2$.pdf
HEMATITE - Small Office AF - Th-232+C - $1m^2$.pdf
HEMATITE - Small Office AF - Th-232+C - $4m^2$.pdf
HEMATITE - Small Office AF - Th-232+C - $6.5m^2$.pdf

cc: J. J. Hayes, NRC/FSME/DWMEP/DURLD
J. W. Smetanka, Westinghouse, w/o attachments & enclosure
J. E. Tapp, NRC Region III/DNMS/MCID, w/o attachments & enclosure

ATTACHMENT 1

Additional Decommissioning Plan Chapter 5 Responses to NRC Questions 7, 11, 10 (partial) and 15

Westinghouse Electric Company LLC,
Hematite Decommissioning Project

Docket No. 070-00036

Additional Decommissioning Plan Chapter 5 Responses to NRC Questions 7, 11, 10 (partial) and 15

The following reiterates the NRC requests for additional information (RAI) of letter dated July 12, 2010, followed by the Westinghouse Electric Company LLC (Westinghouse) response for each RAI. Some of the responses will result in changes, as noted, to the Decommissioning Plan (DP; Hematite Decommissioning Plan, DO-08-004, Revision 0.0). The changes to the DP will be provided under separate cover, and will be denoted by vertical lines in the right margin of the document.

These RAI responses are organized in the same manner as the NRC's RAIs concerning DP Chapter 5. For each RAI, the NRC's Comment, Basis and Path Forward is reiterated followed by the Westinghouse Response. Westinghouse letter dated August 11, 2010 (HEM-10-85) answered most of the NRC's July 12, 2010 RAIs. Of the 7 remaining unanswered RAIs of the NRC July 12, 2010 letter, responses to 4 are included below (numbers 7, 11, 15 and part of 10). The final 3 RAIs (numbers 2, 3, 9 and the remainder of 10) will be answered under separate correspondence.

2. (HDP-C5-Q2) This response will be provided under separate correspondence.

3. (HDP-C5-Q3) This response will be provided under separate correspondence.

7. (HDP-C5-Q7) Comment: The Kds of Ac-277, Np-237, and Th-232 are determined to be sensitive parameters as described in Section 5.3.4.4, and therefore, should be treated conservatively.

   Basis: NUREG-1757 Vol 2, Appendix I states that sensitive parameters should be treated conservatively by applying the 25th or 75th percentile of the distribution unless site-specific data is available. Section I.6.4.2 states, "...for the physical parameters, the licensee should use site-specific information for the physical parameters addressing geohydrologic and meteorologic conditions. The level of justification for the parameter values should be based on sensitivity analyses. Alternatively, sensitivity analyses may be used to support the use of default distributions or representative values."

   The DP, Section 5.3.4.4, describes that these Kds values are based on soil type as opposed to the 25th or 75th quantile of a generic distribution. For example, the 25th percentile of the distribution for Np-237 Kd in NUREG-6697 is 3.75 cm^3/g. This value is deemed to be inconsistent with the silty clay soil type in the contaminated and unsaturated zones. The value chosen for the contaminated and unsaturated zone Kd is 25 cm^3/g, which is the mean of literature values corresponding to clay, and the saturated zone value is the mean of literature values corresponding to sand, or 5 cm^3/g. The mean value taken from literature samples for a specific soil type does not constitute a site-specific Kd. Furthermore, it is unclear why the recommendations for the neptunium and americium Kds provided in Reference 5-6 were not followed in the DP. Reference 5-6 suggests using a value of 2 cm^3/g for neptunium, and a value of 1000 cm^3/g for americium Kd. In acknowledging that the

value of 2 cm^3/g is conservative, Reference 5-6, p. 44 also states "...if the calculated DCGL based on this conservative Kd is significantly smaller than in situ Np levels and will require significant clean-up efforts, site-specific laboratory measurements may be warranted." However, it is not evident that WEC has pursued laboratory measurements for neptunium Kds. This is a similar case for americium.

The representative value for the soil type should be adequately conservative, and should consider the uncertainty in the literature estimates for that soil type. For example, the 25th percentile of the literature PDF for Np-237 in silt is 11 cm^3/g. Knowledge of site soil type can be used to inform the choice for the representative Kd, either by applying a narrower distribution or a conservative representative value for distribution of that soil type. Alternatively, if the licensee wishes to use site-specific Kd values, the values should be determined through taking samples and using laboratory analysis.

Path Forward: Demonstrate that the values used for the Kds of Ac-277, Np-237, and Th-232 for the contaminated and saturated zones are sufficiently conservative through sensitivity analysis. Alternatively, obtain site-specific data to measure site-specific Kds for these radionuclides through laboratory analysis. If new Kds are chosen for these radionuclides, adjust the DCGLs in Chapter 5 and Chapter 14 accordingly.

Westinghouse Response:

For conservatism, Westinghouse will adjust the Kd values for sensitive and insensitive parameters to be consistent with NUREG-1757 guidance (with the exception of Np-237 for the contaminated and unsaturated zones, as explained below); i.e., sensitive parameters will utilize either the 25th or 75th percentile of the NUREG/CR-6697 PDF as applicable. Insensitive parameters will utilize the 50th percentile. The revised Kd values are given in the table below:

Revised Kd Values for Sensitive and Insensitive Parameters

Radionuclide	Former Kd (cm^3/g)	Revised Kd (cm^3/g)	Percentile Utilized (per NUREG/CR-6697 PDF)
Th-232	3300	67,500	75th percentile for both contaminated and unsaturated zones
Th-232	3200	5884	50th percentile for saturated zone (insensitive parameter)
Ac-227	450	92	25th percentile for saturated zone
Ac-227	1500	825	50th percentile for contaminated and unsaturated zones (insensitive parameter)
Np-237	5	17	50th percentile for saturated zone (insensitive parameter)

Kd values in DP Table 5-6 will be revised to include the values described above, and the DCGLs in DP Chapter 5 and 14 will be adjusted using these new Kd values.

Regarding Np-237, Westinghouse concurs with NRC's statement in the basis for their comment that "knowledge of site soil type can be used to inform the choice for the representative Kd, either by applying a narrower distribution or a conservative representative value for distribution of that soil type." Westinghouse believes that conservative representative values have been selected based on extensive knowledge of existing site soil types. Hematite soils in the contaminated and unsaturated zones are described as silty clay, with typical clay contents of greater than 25%. In each case, a mean value for the appropriate soil type was selected. Where Hematite's soil was a mixture of two types, the value from the more conservative soil type was selected. NUREG/CR-6697 considers the compilation of Kd values by Thibault et al.(1990) to be comprehensive. Westinghouse selected conservative mean Kd values from the Thibault report as listed in NUREG-6697 Table 3.9-2, and shown below:

Selected Mean Kd Values

Isotope	Zone	Soil Type	Sand Mean	Loam Mean	**HDP**	Clay Mean
Np-297	Contaminated	Silty Clay	5	25	**25**	55
Np-297	Unsaturated	Silty Clay	5	25	**25**	55
Np-297	Saturated	Sand	5	25	**5**	55

To further support the DP selections for Np-237, Westinghouse evaluated Neptunium Kd data from Thibault et al (Table B-21) for loam and clay samples representative of Hematite's soil type. Samples from sand and organics were excluded. The resultant data was fit to a lognormal distribution with a geometric mean of 96.5 and geometric standard deviation (GSD) of 2.17. Based on these distribution parameters, the 25th percentile value was calculated as 57 cm^3/g, supporting Westinghouse's conservative Kd choice of 25 cm^3/g for the contaminated and unsaturated zone. A table containing the sample values from this data set used is shown below.

Excerpts from Table B-21 of Thibault Report - Applicable Kd Values

Page	**Line**	**Kd**	**Page**	**Line**	**Kd**
1	1	35	2	18	35
1	2	95	2	19	95
1	7	41	2	22	1.27
1	8	117	2	23	20.2
1	11	52	2	24	41
1	12	81	2	25	117
1	51	320			

The wording in Hematite Decommission Plan Chapter 5 will be revised as follows. The last paragraph of section 5.3.4.4 will be revised to read:

Three of the sensitive parameters including the Kd of Np-237 in the unsaturated zone, Depth of Soil Mixing Layer, and Depth of Roots were assigned values based on specific justification as opposed to the 25th or 75th quantile.

Chapter 5 sections 5.3.4.4.1 for Ac-227, and 5.3.4.4.3 for Thorium 232 will be deleted.

9. (HDP-C5-Q9) This response will be provided under separate correspondence.

10. (HDP-C5-Q10) Comment: More information is necessary to review the Area Factors for the Soil as described in Section 5.3.7, and for Building DCGLs as described in Section 5.4.5.

    Basis: The RESRAD files used to calculate the $DCGL_{EMC}$ for buildings and soil are not included in the DP. These files are required to verify that the inputs and outputs to RESRAD are correct. Also, area factors are not defined for the DEEP layer. If the UNIFORM area factors will apply for all areas of elevated activity at depths below 1.5 m, this should be clearly stated. The footnote on Table 14-12 indicates that the length parallel to the aquifer was determined for each Area Size by determining the diameter of a circle with the area of the CZ, and multiplying by a factor of 343/291, where 343 is the diameter of a circle with area 99,539 and 291 is the length applied for the contaminated zone. The reason for multiplying by this factor is unclear.

    Path Forward: Provide the RESRAD Summary Files for determining the $DCGL_{EMC}$ for buildings and soil. Explain the rationale behind the ratio used in calculating the length parallel to the aquifer. Verify which area factors will be applied for depths greater than 1.5 m.

    Westinghouse Response:

    The RESRAD-BUILD Summary Report files are enclosed with the accompanying transmittal letter. Table 1 provides a list of those filenames. The RESRAD Summary Reports will be provided under separate correspondence since their content is dependent upon the response to RAI 2 (HDP-C5-Q2).

Table 1
RESRAD-BUILD Small Office Summary Report Filename Matrix

Radionuclides	Elevated Measurement Area (m^2)		
	6.5	4	1
U-234, U-235+D, U-238+D, Tc-99, Np-237+D, Pu-239/240, Am-241	HEMATITE - Small Office AF - 6.5 m².pdf	HEMATITE - Small Office AF - 4 m².pdf	HEMATITE - Small Office AF - 1 m².pdf
Th-232+C	HEMATITE - Small Office AF - Th-232+C - 6.5 m².pdf	HEMATITE - Small Office AF - Th-232+C - 4 m².pdf	HEMATITE - Small Office AF - Th-232+C - 1 m².pdf

The footnote on DP Table 14-12 is an artifact of the draft Decommissioning Plan which is incorrect. The errant footnote will be removed since it summarized a method which was not actually used to derive the area factors provided in DP Table 14-12 and DP Table 5-13. In lieu of using the method of the errant footnote, the length parallel to the aquifer was established at 291 meters for the contaminated area of the site as a whole (153,375 square meters), and estimated at 41 meters for the Radium-226 Area (1,292). The Radium-226 Area value was estimated as the diameter of the 1,292 m^2 contaminated area (DP Table 5-6). That is, the length parallel to the aquifer parameter was not modified during the calculation of area factors as the errant footnote stated.

Area factors for depths greater than 1.5 m will be impacted by the response to RAI 9 (HDP-C5-Q9) concerning DEEP DCGLs. Therefore, the portion of this response concerning the application of area factors will be provided under separate correspondence along with the response to RAI 9.

11. (HDP-C5-Q11) Comment: The source term in RESRAD is solely from contaminated soil. Contamination has been found in the upper aquitard, a region below the contaminated soil, as stated in the DP in Table 4-28. This contamination would serve as an additional source term if it reaches the lower aquifer. The cumulative impact of both source terms on the soil DCGLs should be considered.

    Basis: As stated in NUREG-1757, the potential radiation dose that could result from groundwater contamination should be accounted for when demonstrating compliance with the dose limit of 0.25 mSv/yr. Section 5.3.8 states that very low, insignificant concentrations of Tc-99 are potentially present in site groundwater. Section 5.3.8 does not make any statements about the levels of U-234 in the groundwater. These current measured values in Table 4-28 of the DP for Tc-99 are 13.4 pCi/L in the sand/gravel aquifer and 48.9 pCi/L in the bedrock aquifer. For U-234, the measured values are 6.8 pCi/L and 12.4 pCi/L. The current measured groundwater concentrations do not adequately capture the leachate source

term in the upper aquitard that could potentially contaminate the groundwater in the lower aquifer. Table 4-28 displays measured concentration values of 7,900 pCi/L of U-234 in leachate at an unknown screen depth, and 6,400 pCi/L of Tc-99 in the overburden hybrid. Note that these concentrations are not accounted for in the contaminated soil source term either.

When estimating the groundwater dose, it is important to use the maximum groundwater concentration projected within 1,000 years as input to the groundwater contamination. The maximum projected groundwater concentration should be used for dose estimation instead of the maximum measured groundwater concentration unless there is sufficient evidence to demonstrate that the groundwater concentrations would decline over time from their current measured values after the release of the facility. Section 5.3.8 states "Groundwater doses will be calculated by multiplying the groundwater concentration identified, if any, for a given ROC by the corresponding DSRGW listed in Table 5-14." However, it is not clear how the groundwater concentrations may change in the next 1,000 years resulting from the leachate migration. The migration of volatile organic compounds offsite suggests the presence of fast pathways through which radionuclides could also travel. The potential dose from this source term should be combined with the dose from the soil and accounted for in the determination of the soil DCGLs.

Path Forward: Estimate the peak dose contribution from the source term contamination currently present in the leachate for Tc-99 and U-234 if it were to reach the groundwater over the 1,000 year period of performance. Estimate the dose when groundwater source term is cumulatively considered with the soil contamination source term, and adjust the soil DCGLs as necessary. Alternatively, provide sufficient evidence to demonstrate that the groundwater concentrations would decline over time from their current values after the release of the facility.

Westinghouse Response:

The following provides the evidence that groundwater contamination does not exist at the current time, and that any migration over time is accounted for in the RESRAD model. The leachate overburden results in Table 4-28 apply to wells screened in the contaminated material. The leachate is the pore space water of the clay overburden. As described in Reference 5-7 there is essentially no vertical flow in the overburden towards the sand/gravel aquifer. In addition, the recharge rates in the immediate vicinity of a well after a water sample is collected are very low.

The radionuclides in the leachate (pore space water) are directly associated with the contaminated soil in the immediate vicinity of the water sample and not likely associated with migration below the contaminated zone. Most importantly, the leachate (pore space water) source term will be removed during the remediation of the contaminated soil in the burial pits.

The potential for radionuclide migration through the unsaturated zone, post remediation, after backfill, is accounted for in the RESRAD model by the unsaturated zone water transport. Additional consideration of the existing leachate (pore space water) in the dose assessment is not considered necessary.

Regarding the comment on positive uranium in groundwater as reported in Table 4-28, the uranium concentrations were statistically evaluated and determined to be consistent with natural uranium. This was stated in Section 4.5.4 as follows:

> *There were also positive uranium results in the samples from the sand/gravel and bedrock aquifers. The positive uranium results were evaluated and found to be indistinguishable from background which was expected given the relative low mobility of uranium compared to technetium.*

Therefore, consideration of the positive uranium results in the determination of the modified DCGLs was not considered necessary.

15. (HDP-C5-Q15) Comment: The value used for the building exchange rate in RESARAD-BUILD is inconsistent with the value described for this parameter in the text of the DP. In addition, information on the current building exchange rates is not provided in the DP.

Basis: Section 5.4.3.2 of the DP identifies the building exchange rate as a sensitive parameter with a negative correlation to dose and that the 25th percentile of the distribution for this parameter from NUREG-6697 was therefore used for this parameter. However, in Table 5-16, the value used for this parameter corresponds to the 75th percentile value. Also, more information is needed about the building exchange rates observed for the buildings that will remain at the time of license termination. Although the usage and configuration of these buildings may change in the future, the air exchange rates currently observed in these buildings provides useful information about the expected range of air exchange rates that may exist in the future.

Path Forward: Provide a revised analysis that uses the correct value (i.e., the 25th percentile instead of the 75th percentile) for the building exchange rate. Provide information about the current air exchange rates in the buildings that will remain at the time of license termination.

Westinghouse Response:

The information on air exchange rates follows the paragraph immediately below concerning the exchange rate percentile.

The text in the "Justification" column of Table 5-16 for the "Air Flow Building Exchange Rate" incorrectly indicates this value is the 75th percentile. Actually, the value listed in DP Table 5-16 correctly represents the 25th percentile, and not the 75th percentile. Following the process described in the Westinghouse response to HDP-C5-Q13, the 25th

percentile was verified to be equal to 0.83/hr. This value was used in the calculation of the DCGL, and therefore a revised analysis is not necessary. The "Justification" provided in DP Table 5-16 for the "Air Flow Building Exchange Rate" will be corrected to properly indicate that the 25th percentile was used.

The buildings that may remain at the time of license termination include Buildings 110, 230, 231, and potentially Buildings 115 and the Sanitary Water Treatment Shed. The current, and expected future building exchange rates are provided in the following table for Buildings 110 and Building 230.

Buildings 110 and 230 Air Exchange Information

Room	Floor Area (ft^2)	Room Volume (ft^3)	Fan Rating (cfm)	Air Exchange per Hour
Building 110				
Lobby	1,735	17,357	2,000	6.9
Offices	13,906	135,248	5,600	2.5
Men's Rm	495	3,960	200	3.0
Women's Rm	487	3,896	200	3.1
Building 230				
Open Space	34,226	902,926	14,000	0.9
N Mezzanine	5,570	72,410	10,000	8.3
S Mezzanine	3,823	49,699	5,000	6.0
Warehouse	16,269	504,339	14,000	1.7
Computer Rm	208	2,704	1,600	35.5
Gad Rm Office	1,054	13,702	3,000	13.1
Operations	4,101	53,313	6,000	6.8
Men/Women	1,435	18,655	500	1.6
Men's Rm	481	6,253	565	5.4

As shown in DP Table 5-18, the building exchange rate was determined to be negatively correlated to dose, and as described above the 25th percentile of 0.83/hr was selected. Since the actual air exchange rates provided in the table above for Buildings 110 and Building 230 are greater than the modeled value, the DCGL values are considered acceptable for as-left conditions at license termination.

Buildings 231, 115 and the Sanitary Water Treatment Shed currently do not have an installed ventilation system. These buildings do not have a history of radioactive material handling, but were identified as impacted due to: the identification of a small number of hand tools within Building 231 that showed fixed contamination levels in excess of the current operational release criteria; the planned use of Building 115 for evaluation of specific contaminated waste items during decommissioning; and the presence of low

concentrations of radioactivity in waste water processed through the piping associated with the Sanitary Water Treatment Shed.

In consideration of the absence of a ventilation system within these buildings, Building 231 was selected as the basis for an estimate of natural air circulation that would occur during future use. Building 231 was selected since it is the largest of the three buildings, and contains the largest amount of floor surface area. This estimate was prepared using the PHPAIDA On-Line Natural Ventilation, Mixed Mode and Air Infiltration Rate Calculation Algorithm (http://phpaida.veetech.org.uk/phpaida.php). Building 231 dimensional and site meteorological data are provided in the table below:

Building 231 and Meteorological Information

Parameter	Value		Comment
Building Dimensions			
Length	100 ft	30.5 m	
Width	60 ft	18.3 m	
Footprint	6,000 ft^2	557.4 m^2	
Ceiling Height	23 ft	7.0 m	(8 m peak)
Volume	138,000 ft^3	3,907.7 m^3	
Building Openings			
Louvers Area (each)	16 ft^2	14,864.5 cm^2	4 ft × 4ft (2 on windward side, 1 on leeward side)
Louvers Height	4 ft	1.2 m	
Personnel Doors Area	23.9 ft^2	22,203.8 cm^2	3 ft 4 in × 7 ft 2 in Open 8 hr each working (2000 hr/yr) Closed remaining time (6760 hr / yr)
Personnel Doors Height	7 ft 2 in	2.2 m	
Overhead Doors	320 ft^2	297,289.7 cm^2	16 ft × 20 ft
Meteorological Data			
Average Wind Speed	4.3 m/sec		DP Table 5-6
Average Annual Temperature	53.7 °F	12.1 °C	DP Reference 5-13 (accessed 10/31/2008): http://www.idcide.com/weather/mo/festus.htm

For the building openings provided above, the effective open area of louvers without the motive force provided by a fan was conservatively assumed to be 10 percent, and only one of the four overhead doors was assumed to be open during working hours. Also, the indoor temperature was set equal to the outdoor temperature (average annual temperature) based on the absence of a ventilation system.

The input values to the PHPAIDA calculator are listed in the table above, Building 231 and Meteorological Information. The PHPAIDA calculator was used to evaluate a Rural setting, with the side with two louvers set to Flow Path 1, the side with one louver set to Flow Path 2, and the side with the roll up door set to Flow Path 4. The air exchange rate was estimated to be 0.28/hr with the rollup door open (2000 hr/yr) and 0.13 with the door

closed (6760 hr/yr). The resultant weighted average ventilation rate is 0.16/hr. The PHPAIDA model input and output files are included as Attachments 2 and 3 of the accompanying transmittal letter.

In order to determine if the proposed DCGL for the Small Office scenario are bounding when compared to those based on the natural ventilation rate, building-specific DCGL values were derived for Building 231. In consideration of the historical use of these buildings, the source was limited to the floor surface. This is reasonable since the characterization survey data reported in the Hematite Radiological Characterization Report obtained from the floor surfaces show that radioactivity levels within all three of these buildings are within the range of background levels. Based on usage, the floor surfaces are most likely to show residual radioactivity if any was present. The following deviations from the assumptions used for the proposed DCGL adopted for site wide use were used in this example:

Assumptions for Proposed DCGL for Site Wide Use

Parameter	Code	Default	Value	Units	Justification
Air Flow – Building Exchange Rate	LAMBDAT	0.8	0.1	hr^{-1}	Natural ventilation air infiltration rate.
Source Number (Sources)	NS	1	1	unitless	The number of sources or surfaces was defined to include only the floor.

The calculated building-specific DCGL and the proposed DCGL for the Small Office scenario are provided for comparison in the table below:

Comparison of Building-Specific DCGL and Small Office Proposed DCGL

Radionuclide	Building 231 – Specific DSR (mrem per dpm/100 cm^2)	Building 231 – Specific DCGL (dpm/100 cm^2)	DP Small Office Proposed DCGL (dpm/100 cm^2)
U-234	5.40E-04	46,296	20,000
U-235 + D	6.22E-04	40,187	19,000
U-238 + D	5.10E-04	49,020	21,000
Tc-99	5.97E-07	41,876,047	13,000,000
Th-232 + C	9.88E-03	2,530	1,200
Np-237 + D	3.52E-03	7,102	2,700
Pu-239/240	2.68E-03	9,328	3,500
Am-241	2.78E-03	8,993	3,400

The DCGL values calculated using building-specific parameters in this example are based on reasonably conservative assumptions, and are bounded by the proposed DCGL

for the Small Office scenario provided in the DP. The associated RESRAD-BUILD output files for this model are provided in Attachments 4 and 5 of the accompanying transmittal letter. Therefore Westinghouse believes the use of the proposed DCGL are adequately protective, especially in consideration of the expected low levels of residual radioactivity within these three buildings.

ATTACHMENT 2

PHPAIDA Files - Building 230 Roll Door Open

(2 pages follow; referred to in response to RAI HDP-C5-Q15)

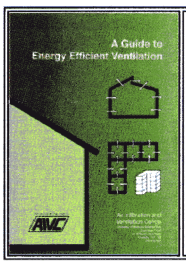
Simulation Results

Windspeed Met Station (m/s)	Windspeed at Bdg Ht (m/s)	Ext Temp (Deg C)	Int Temp (Deg C)	Building Ht (m)	Buiding Vol (m3)
4.30	2.53	12.00	12.00	8.00	3907.30

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
Area (cm2)	2972.00	0.00	1486.00	22308.00	0.00	0.00	0.00	0.00	0.00
Ext Pr (Pa)	0.81	-1.01	-1.01	-1.01	0.81	-1.01	-1.01	-1.01	-1.21
Airflow (L/s)	305.44	0.00	-19.08	-286.36	0.00	0.00	0.00	0.00	0.00

Total Ventilation Rate (L/s)	Mechanical Supply Rate (L/s)	Mechanical Extract Rate (L/s)	Inflow Through Openings (L/s)	Outflow Through Openings (L/s)
305.44	0.00	0.00	305.44	-305.43

Internal Pressure (Pa)	Flow Balance (L/s)	Air Change Rate (ac/h)
-0.98	0.00986552	0.28



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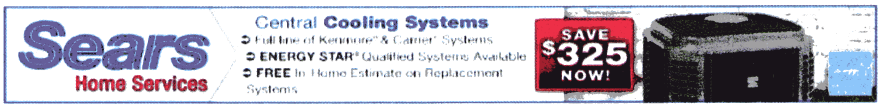

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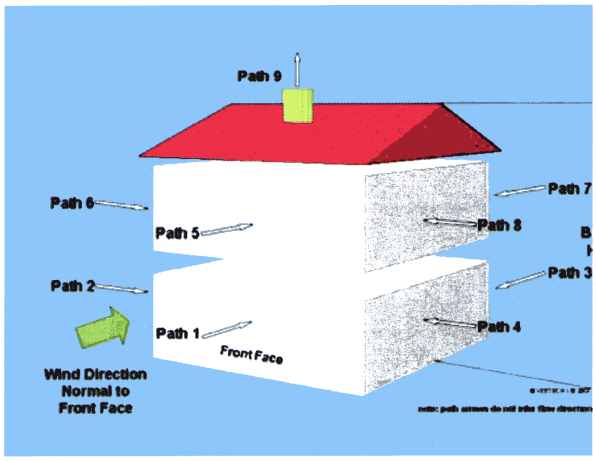
PHPAIDA - The On-Line Natural Ventilation, Mixed Mode and Air Infiltration Rate Calculation Algorithm (Combined Stack, Wind and Mechanical Ventilation)

Click Here for Tutorial

Click here for ventilation rate calculations based on steady state CO2 concentration

Written by Martin Liddament



For full details order the Guide to Energy Efficient Ventilation

PHPAIDA Input Form

Location of Building:

City ○ Urban ◉ Rural ○ Open Countryside ○

Building Details:

Building Height (m) 8
Top Ceiling Height (m) 7
Building Volume (m3) 3907.3

Section 1: Natural Ventilation through User Defined Openings

Flow Path 1:	height (m) 5	area (cm2) 2972
Flow Path 2:	height (m)	area (cm2)
Flow Path 3:	height (m) 5	area (cm2) 1486
Flow Path 4:	height (m) 1.5	area (cm2) 22308
Flow Path 5:	height (m)	area (cm2)
Flow Path 6:	height (m)	area (cm2)
Flow Path 7:	height (m)	area (cm2)
Flow Path 8:	height (m)	area (cm2)
Flow Path 9:	height (m)	area (cm2)

Section 2: Mechanical Ventilation

Mechanical Extract Ventilation Rate (L/s)
Mechanical Supply Ventilation Rate (L/s)

Instructions: Enter data as indicated. Section 1 can be used in 'stand alone' mode (i.e. without data input to Sections 2 and 3). The maximum number of flow paths is nine and the minimum is two. Unused flow paths do not require data to be inserted.
Section 2 must be used in conjuntion with either Section 1 and/or 3. Leave blank for natural ventilation (Section 1) or air infiltration only (Section 3) calculations. For balanced mechanical systems data are needed for both supply and extract ventilation. CAUTION: Always check that any installed fan can overcome the internal pressure generated by the fan as well as any pressure drop through ducting. The internal pressure is given in the output. Internal pressures of greater than 1000 Pa result in an error condition since it is unrealistic for intended applications. If high internal pressure occurs, the rate of mechanical ventilation is not compatible with the size of openings needed to relieve this pressure. Either reduce the mechanical ventilation rate or increase the size of openings.
Section 3 can be used in 'stand alone' mode to calculate the natural infiltration rate for given airtightness (air changes at 50Pa) and

Section 3: Air Infiltration

Air Change Rate at 50 Pa (air change/hour)

Climate Data:

Outdoor Temperature (Deg C) 12

Indoor Temperature (Deg C) 12

Met Office (10m) Windspeed m/s 4.3

send

weather conditions. It can be combined with Section 1 and/or Section 2 to determine how air leakage influences the overall ventilation rate of purpose provided openings and mechanical ventilation.
When data entry completed click send. Edit and repeat process as required.
Output: Flow rate and flow direction through each purpose provided path; whole building ventilation rate and air change rate; average internal pressure; air infiltration rate.
Limitations: Purpose provided openings are based on orifice type openings (Cd=0.61); single zone well mixed; volumetric flow; uniform wind pressure coefficient on each face. The flow exponent is 0.5 for purpuse provided openings and 0.66 for infiltration openings. Opening area should never exceed the cross-sectional area of any connecting ducting.
Exclusions: For approximate guidance only. The suitability of this algorithm for any particular application is neither implied or guaranteed.

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ATTACHMENT 3

PHPAIDA Files - Building 230 Roll Door Closed

(2 pages follow; referred to in response to RAI HDP-C5-Q15)

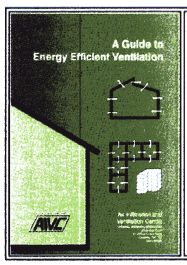
Simulation Results

Windspeed Met Station (m/s)	Windspeed at Bdg Ht (m/s)	Ext Temp (Deg C)	Int Temp (Deg C)	Building Ht (m)	Buiding Vol (m3)
4.30	2.53	12.00	12.00	8.00	3907.30

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
Area (cm2)	2972.00	0.00	1486.00	0.00	0.00	0.00	0.00	0.00	0.00
Ext Pr (Pa)	0.81	-1.01	-1.01	-1.01	0.81	-1.01	-1.01	-1.01	-1.21
Airflow (L/s)	137.67	0.00	-137.66	0.00	0.00	0.00	0.00	0.00	0.00

Total Ventilation Rate (L/s)	Mechanical Supply Rate (L/s)	Mechanical Extract Rate (L/s)	Inflow Through Openings (L/s)	Outflow Through Openings (L/s)
137.67	0.00	0.00	137.67	-137.66

Internal Pressure (Pa)	Flow Balance (L/s)	Air Change Rate (ac/h)
0.44	0.00761613	0.13

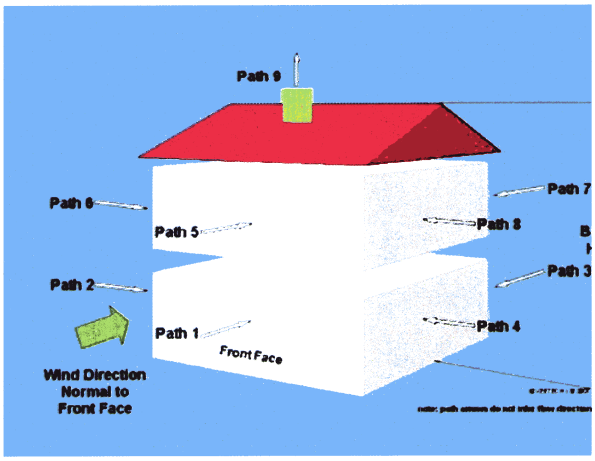


Ventilation Energy and Environmental Technology
from VEETECH Ltd. Updated 9th January 2008

PHPAIDA - The On-Line Natural Ventilation, Mixed Mode and Air Infiltration Rate Calculation Algorithm (Combined Stack, Wind and Mechanical Ventilation)
Click Here for Tutorial

Click here for ventilation rate calculations based on steady state CO2 concentration

Written by Martin Liddament



For full details order the Guide to Energy Efficient Ventilation

PHPAIDA Input Form

Location of Building:

City ○ Urban ◉ Rural ○ Open Countryside ○

Building Details:

Building Height (m) 8
Top Ceiling Height (m) 7
Building Volume (m3) 3907.3

Section 1: Natural Ventilation through User Defined Openings

Flow Path 1:	height (m) 5	area (cm2) 2972
Flow Path 2:	height (m)	area (cm2)
Flow Path 3:	height (m) 5	area (cm2) 1486
Flow Path 4:	height (m)	area (cm2)
Flow Path 5:	height (m)	area (cm2)
Flow Path 6:	height (m)	area (cm2)
Flow Path 7:	height (m)	area (cm2)
Flow Path 8:	height (m)	area (cm2)
Flow Path 9:	height (m)	area (cm2)

Section 2: Mechanical Ventilation

Mechanical Extract Ventilation Rate (L/s)
Mechanical Supply Ventilation Rate (L/s)

Instructions: Enter data as indicated. Section 1 can be used in 'stand alone' mode (i.e. without data input to Sections 2 and 3). The maximum number of flow paths is nine and the minimum is two. Unused flow paths do not require data to be inserted.
Section 2 must be used in conjuntion with either Section 1 and/or 3. Leave blank for natural ventilation (Section 1) or air infiltration only (Section 3) calculations. For balanced mechanical systems data are needed for both supply and extract ventilation. CAUTION: Always check that any installed fan can overcome the internal pressure generated by the fan as well as any pressure drop through ducting. The internal pressure is given in the output. Internal pressures of greater than 1000 Pa result in an error condition since it is unrealistic for intended applications. If high internal pressure occurs, the rate of mechanical ventilation is not compatible with the size of openings needed to relieve this pressure. Either reduce the mechanical ventilation rate or increase the size of openings.
Section 3 can be used in 'stand alone' mode to calculate the natural infiltration rate for given airtightness (air changes at 50Pa) and

Section 3: Air Infiltration

Air Change Rate at 50 Pa (air change/hour)

Climate Data:

Outdoor Temperature (Deg C) 12

Indoor Temperature (Deg C) 12

Met Office (10m) Windspeed m/s 4.3

send

weather conditions. It can be combined with Section 1 and/or Section 2 to determine how air leakage influences the overall ventilation rate of purpose provided openings and mechanical ventilation.
When data entry completed click send. Edit and repeat process as required.
Output: Flow rate and flow direction through each purpose provided path; whole building ventilation rate and air change rate; average internal pressure; air infiltration rate.
Limitations: Purpose provided openings are based on orifice type openings (Cd=0.61); single zone well mixed; volumetric flow; uniform wind pressure coefficient on each face. The flow exponent is 0.5 for purpuse provided openings and 0.66 for infiltration openings. Opening area should never exceed the cross-sectional area of any connecting ducting.
Exclusions: For approximate guidance only. The suitability of this algorithm for any particular application is neither implied or guaranteed.

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ATTACHMENT 4

RESRAD-BUILD Files - Large Warehouse Occupancy

(17 pages follow; referred to in response to RAI HDP-C5-Q15)

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters..... 2
Building Information..... 3
Source Information..... 4
For time = 0.00E+00 yr
Time Specific Parameters..... 5
Receptor-Source Dose Summary..... 6
Dose by Pathway Detail..... 7
Dose by Nuclide Detail..... 8
For time = 1.00E+00 yr
Time Specific Parameters..... 9
Receptor-Source Dose Summary..... 10
Dose by Pathway Detail..... 11
Dose by Nuclide Detail..... 12
For time = 3.00E+01 yr
Time Specific Parameters..... 13
Receptor-Source Dose Summary..... 14
Dose by Pathway Detail..... 15
Dose by Nuclide Detail..... 16
Full Summary..... 17

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

:ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	9.000	15.100	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

Building Information

Building Air Exchange Rate: 1.00E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                            <=Q01: 3.97E+02
 H1:   7.300       *           Room  1          *      Q10 :  3.97E+02
                   *   LAMBDA: 1.00E-01         *
Area 544.000       *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

Source Information

ɔurce: 1

Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00[m]

Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z

Pathway ::

Direct Ingestion Rate: 6.140E-08 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/(dpm/m3)]
AM-241	1.000E+02	1.640E-03	2.000E-01	4.304E-05
PU-240	1.000E+02	1.595E-03	1.932E-01	2.499E-07
PU-239	1.000E+02	1.595E-03	1.932E-01	2.231E-07
NP-237	1.000E+02	2.002E-03	2.432E-01	5.461E-04
U-238	1.000E+02	1.210E-04	5.317E-02	7.191E-05
U-236	0.000E+00	1.212E-04	5.631E-02	2.636E-07
U-235	1.000E+02	1.204E-04	5.541E-02	4.063E-04
U-234	1.000E+02	1.275E-04	5.946E-02	4.014E-07
U-233	0.000E+00	1.302E-04	6.081E-02	8.576E-07
PA-231	0.000E+00	4.775E-03	5.766E-01	9.049E-05
TH-232	0.000E+00	1.230E-03	7.387E-01	4.588E-07
TH-230	0.000E+00	2.468E-04	1.468E-01	9.155E-07
TH-229	0.000E+00	1.814E-03	9.768E-01	7.842E-04
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
AC-227	0.000E+00	6.665E-03	3.029E+00	9.734E-04
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
RA-226	0.000E+00	5.950E-04	3.871E-03	4.663E-03
PB-210	0.000E+00	2.422E-03	6.214E-03	4.698E-06
TC-99	1.000E+02	6.577E-07	3.748E-06	8.523E-08

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 0.00000000E+00 years

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

Source Information

ɔurce: 1
Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00 [m]
Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z
Pathway ::
Direct Ingestion Rate: 6.140E-08 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	1.000E+02
PU-240	1.000E+02
PU-239	1.000E+02
NP-237	1.000E+02
U-238	1.000E+02
U-236	0.000E+00
U-235	1.000E+02
U-234	1.000E+02
U-233	0.000E+00
PA-231	0.000E+00
TH-232	0.000E+00
TH-230	0.000E+00
TH-229	0.000E+00
TH-228	0.000E+00
AC-227	0.000E+00
RA-228	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00
TC-99	1.000E+02

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	1.33E-02	1.33E-02
›tal	1.33E-02	1.33E-02

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.32E-04	1.04E-08	6.44E-10	7.37E-03	1.94E-18	5.63E-03
Total	3.32E-04	1.04E-08	6.44E-10	7.37E-03	1.94E-18	5.63E-03

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	2.78E-03	2.78E-03
IP-237	5.70E-10	5.70E-10
I-233	1.30E-16	1.30E-16
'H-229	4.93E-20	4.93E-20
'U-240	2.68E-03	2.68E-03
I-236	7.58E-12	7.58E-12
'H-232	1.56E-21	1.56E-21
ı-228		
'H-228	1.13E-24	1.13E-24
'U-239	2.68E-03	2.68E-03
I-235	3.06E-13	3.06E-13
'A-231	2.78E-17	2.78E-17
ıC-227	7.60E-19	7.60E-19
IP-237	3.52E-03	3.52E-03
I-233	1.20E-09	1.20E-09
'H-229	6.09E-13	6.09E-13
I-238	5.10E-04	5.10E-04
I-234	7.63E-10	7.63E-10
'H-230	5.43E-15	5.43E-15
'A-226	7.42E-19	7.42E-19
'B-210	5.51E-21	5.51E-21
I-235	6.22E-04	6.22E-04
'A-231	8.48E-08	8.48E-08
ıC-227	3.08E-09	3.08E-09
I-234	5.40E-04	5.40E-04
'H-230	5.76E-09	5.76E-09
'A-226	1.05E-12	1.05E-12
'B-210	9.70E-15	9.70E-15
'C-99	5.97E-07	5.97E-07

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 1.00000000 years

Assessment for Time: 2
Time =1.00E+00 yr

Source Information

ɔurce: 1
Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00 [m]
Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z
Pathway ::
Direct Ingestion Rate: 6.140E-08 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 9.816E-02
Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	9.964E+01
PU-240	9.979E+01
PU-239	9.979E+01
NP-237	9.980E+01
U-238	9.980E+01
U-236	2.956E-06
U-235	9.980E+01
U-234	9.980E+01
U-233	4.351E-04
PA-231	2.109E-03
TH-232	7.266E-17
TH-230	8.984E-04
TH-229	2.054E-08
TH-228	2.409E-19
AC-227	3.317E-05
RA-228	2.834E-18
RA-226	1.946E-07
PB-210	2.000E-09
TC-99	9.980E+01

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	1.32E-02	1.32E-02
›tal	1.32E-02	1.32E-02

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.31E-04	1.04E-08	6.44E-10	7.36E-03	1.36E-17	5.52E-03
Total	3.31E-04	1.04E-08	6.44E-10	7.36E-03	1.36E-17	5.52E-03

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	2.75E-03	2.75E-03
IP-237	1.69E-09	1.69E-09
I-233	9.05E-16	9.05E-16
'H-229	7.36E-19	7.36E-19
'U-240	2.65E-03	2.65E-03
I-236	2.26E-11	2.26E-11
'H-232	1.09E-20	1.09E-20
ı-228		
'H-228	3.22E-23	3.22E-23
'U-239	2.65E-03	2.65E-03
I-235	9.15E-13	9.15E-13
'A-231	1.93E-16	1.93E-16
ıC-227	1.13E-17	1.13E-17
IP-237	3.49E-03	3.49E-03
I-233	3.60E-09	3.60E-09
'H-229	4.25E-12	4.25E-12
I-238	5.08E-04	5.08E-04
I-234	2.28E-09	2.28E-09
'H-230	3.79E-14	3.79E-14
‹A-226	1.11E-17	1.11E-17
'B-210	1.67E-19	1.67E-19
I-235	6.20E-04	6.20E-04
'A-231	2.52E-07	2.52E-07
ıC-227	2.13E-08	2.13E-08
I-234	5.38E-04	5.38E-04
'H-230	1.72E-08	1.72E-08
‹A-226	7.30E-12	7.30E-12
'B-210	1.42E-13	1.42E-13
'C-99	5.87E-07	5.87E-07

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 30.0000000 years

Assessment for Time: 3
Time =3.00E+01 yr

Source Information

ɔurce: 1
Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00 [m]
Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z
Pathway ::
Direct Ingestion Rate: 6.140E-08 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 4.138E-02
Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	8.947E+01
PU-240	9.359E+01
PU-239	9.380E+01
NP-237	9.388E+01
U-238	9.388E+01
U-236	8.330E-05
U-235	9.388E+01
U-234	9.388E+01
U-233	1.228E-02
PA-231	5.950E-02
TH-232	6.146E-14
TH-230	2.535E-02
TH-229	1.738E-05
TH-228	2.936E-14
AC-227	2.116E-02
RA-228	3.662E-14
RA-226	1.640E-04
PB-210	4.105E-05
TC-99	9.388E+01

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	9.74E-03	9.74E-03
›tal	9.74E-03	9.74E-03

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.11E-04	1.04E-08	6.43E-10	7.30E-03	5.37E-15	2.13E-03
Total	3.11E-04	1.04E-08	6.43E-10	7.30E-03	5.37E-15	2.13E-03

.tle : Large Warehouse - Occupancy - HDP-C5-Q15
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse.bld
'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

luclide	Receptor 1	Total
ıM-241	1.90E-03	1.90E-03
IP-237	2.46E-08	2.46E-08
I-233	3.16E-13	3.16E-13
'H-229	4.96E-15	4.96E-15
'U-240	1.90E-03	1.90E-03
I-236	4.08E-10	4.08E-10
'H-232	3.94E-18	3.94E-18
ı-228		
'H-228	6.75E-19	6.75E-19
'U-239	1.90E-03	1.90E-03
I-235	1.67E-11	1.67E-11
'A-231	5.53E-14	5.53E-14
ıC-227	6.10E-14	6.10E-14
IP-237	2.55E-03	2.55E-03
I-233	6.50E-08	6.50E-08
'H-229	1.53E-09	1.53E-09
I-238	4.50E-04	4.50E-04
I-234	4.13E-08	4.13E-08
'H-230	1.37E-11	1.37E-11
ıA-226	6.56E-14	6.56E-14
'B-210	8.00E-15	8.00E-15
I-235	5.56E-04	5.56E-04
'A-231	3.68E-06	3.68E-06
ıC-227	5.67E-06	5.67E-06
I-234	4.78E-04	4.78E-04
'H-230	3.18E-07	3.18E-07
ıA-226	2.28E-09	2.28E-09
'B-210	3.55E-10	3.55E-10
'C-99	2.76E-07	2.76E-07

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
1.33E-02	1.32E-02	9.74E-03

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
1.33E-02	1.32E-02	9.74E-03

ATTACHMENT 5

RESRAD-BUILD Files - Large Warehouse Occupancy - Th-232+C

(17 pages follow; referred to in response to RAI HDP-C5-Q15)

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RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

ɛceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	9.000	15.100	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

Building Information

Building Air Exchange Rate: 1.00E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                           <=Q01: 3.97E+02
 H1:   7.300       *           Room  1          *      Q10 :  3.97E+02
                   *   LAMBDA: 1.00E-01         *
Area 544.000       *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

Source Information

ɔurce: 1

Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00[m]

Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z

Pathway ::

Direct Ingestion Rate: 6.140E-08 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/(dpm/m3)]
TH-232	1.000E+02	1.230E-03	7.387E-01	4.588E-07
TH-228	1.000E+02	3.642E-04	1.556E-01	4.224E-03
RA-228	1.000E+02	6.496E-04	2.287E-03	2.515E-03

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 0.00000000E+00 years

```
==========================================
==========================================
==      Assessment for Time:  1         ==
==            Time =0.00E+00 yr         ==
==========================================
==========================================
```

========= Source Information =========

ɔurce: 1

Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00 [m]

Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z

Pathway ::

Direct Ingestion Rate: 6.140E-08 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	1.000E+02
TH-228	1.000E+02
RA-228	1.000E+02

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	9.88E-03	9.88E-03
›tal	9.88E-03	9.88E-03

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.57E-03	4.13E-08	3.87E-09	6.55E-03	4.05E-08	1.76E-03
Total	1.57E-03	4.13E-08	3.87E-09	6.55E-03	4.05E-08	1.76E-03

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
'H-232	6.42E-03	6.42E-03
ı-228		
'H-228	1.49E-05	1.49E-05
I-228		
'H-228	1.93E-03	1.93E-03
ı-228		
'H-228	3.56E-04	3.56E-04

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 1.00000000 years

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

======== Source Information ========

ɔurce: 1

Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00 [m]

Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z

Pathway ::

Direct Ingestion Rate: 6.140E-08 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.980E+01
TH-228	9.980E+01
RA-228	9.980E+01

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	9.84E-03	9.84E-03
›tal	9.84E-03	9.84E-03

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.57E-03	4.13E-08	3.87E-09	6.55E-03	4.05E-08	1.72E-03
Total	1.57E-03	4.13E-08	3.87E-09	6.55E-03	4.05E-08	1.72E-03

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
'H-232	6.40E-03	6.40E-03
ı-228		
'H-228	9.10E-05	9.10E-05
I-228		
'H-228	1.34E-03	1.34E-03
ı-228		
'H-228	8.63E-04	8.63E-04

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 30.0000000 years

```
==========================================
==========================================
===       Assessment for Time:  3        ===
===             Time =3.00E+01 yr        ===
==========================================
==========================================
```

======= Source Information =======

ɔurce: 1

Location:: Room : 1 x: 9.00 y: 15.10 z: 0.00 [m]

Geometry:: Type: Area Length[m]:1.80E+01 Width[m]:3.02E+01 Direction: z

Pathway ::

Direct Ingestion Rate: 6.140E-08 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	9.388E+01
	TH-228	9.388E+01
	RA-228	9.388E+01

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	8.70E-03	8.70E-03
›tal	8.70E-03	8.70E-03

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.48E-03	4.13E-08	3.87E-09	6.55E-03	4.05E-08	6.72E-04
Total	1.48E-03	4.13E-08	3.87E-09	6.55E-03	4.05E-08	6.72E-04

.tle : Large Warehouse - Occupancy - Th-232+C -
ıput File : C:\RESRAD_Family\BUILD\HDP-C5-Q15 - Large Warehouse - Th-232+C.bld
'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Nuclide	Receptor 1	Total
'H-232	5.82E-03	5.82E-03
ı-228		
'H-228	1.99E-03	1.99E-03
I-228		
'H-228	3.24E-08	3.24E-08
ı-228		
'H-228	7.83E-05	7.83E-05

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
9.88E-03	9.84E-03	8.70E-03

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
9.88E-03	9.84E-03	8.70E-03

Enclosure

The following files are enclosed:

HEMATITE - Small Office AF - 1m^2.pdf
HEMATITE - Small Office AF - 4m^2.pdf
HEMATITE - Small Office AF - 6.5m^2.pdf
HEMATITE - Small Office AF - Th-232+C - 1m^2.pdf
HEMATITE - Small Office AF - Th-232+C - 4m^2.pdf
HEMATITE - Small Office AF - Th-232+C - 6.5m^2.pdf

.tle : Small Office - Occupancy AF
ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

* Report for 1 m² Area Factor Calculation *

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For time = 1.00E+00 yr
Time Specific Parameters..... 9
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Dose by Pathway Detail..... 11
Dose by Nuclide Detail..... 12
For time = 3.00E+01 yr
Time Specific Parameters..... 13
Receptor-Source Dose Summary..... 14
Dose by Pathway Detail..... 15
Dose by Nuclide Detail..... 16
Full Summary..... 17

* Report for 1 m² Area Factor Calculation *

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

:ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.200	1.400	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

* Report for 1 m² Area Factor Calculation *

Building Information

Building Air Exchange Rate: 8.30E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                           <=Q01: 1.33E+01
 H1:    2.400      *           Room  1          *      Q10 :  1.33E+01
                   *   LAMBDA: 8.30E-01         *
Area    6.700      *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

* Report for 1 m² Area Factor Calculation *

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00[m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/ (dpm/m3)]
AM-241	1.000E+02	1.640E-03	2.000E-01	4.304E-05
PU-240	1.000E+02	1.595E-03	1.932E-01	2.499E-07
PU-239	1.000E+02	1.595E-03	1.932E-01	2.231E-07
NP-237	1.000E+02	2.002E-03	2.432E-01	5.461E-04
U-238	1.000E+02	1.210E-04	5.317E-02	7.191E-05
U-236	0.000E+00	1.212E-04	5.631E-02	2.636E-07
U-235	1.000E+02	1.204E-04	5.541E-02	4.063E-04
U-234	1.000E+02	1.275E-04	5.946E-02	4.014E-07
U-233	0.000E+00	1.302E-04	6.081E-02	8.576E-07
PA-231	0.000E+00	4.775E-03	5.766E-01	9.049E-05
TH-232	0.000E+00	1.230E-03	7.387E-01	4.588E-07
TH-230	0.000E+00	2.468E-04	1.468E-01	9.155E-07
TH-229	0.000E+00	1.814E-03	9.768E-01	7.842E-04
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
AC-227	0.000E+00	6.665E-03	3.029E+00	9.734E-04
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
RA-226	0.000E+00	5.950E-04	3.871E-03	4.663E-03
PB-210	0.000E+00	2.422E-03	6.214E-03	4.698E-06
TC-99	1.000E+02	6.577E-07	3.748E-06	8.523E-08

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Assessment for Time: 1

Time =0.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	1.000E+02
PU-240	1.000E+02
PU-239	1.000E+02
NP-237	1.000E+02
U-238	1.000E+02
U-236	0.000E+00
U-235	1.000E+02
U-234	1.000E+02
U-233	0.000E+00
PA-231	0.000E+00
TH-232	0.000E+00
TH-230	0.000E+00
TH-229	0.000E+00
TH-228	0.000E+00
AC-227	0.000E+00
RA-228	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00
TC-99	1.000E+02

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	9.18E-04	9.18E-04
›tal	9.18E-04	9.18E-04

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.86E-05	1.32E-10	3.52E-11	4.03E-04	8.50E-21	4.96E-04
Total	1.86E-05	1.32E-10	3.52E-11	4.03E-04	8.50E-21	4.96E-04

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	1.95E-04	1.95E-04
IP-237	3.97E-11	3.97E-11
I-233	7.90E-18	7.90E-18
'H-229	2.95E-21	2.95E-21
'U-240	1.88E-04	1.88E-04
I-236	4.62E-13	4.62E-13
'H-232	9.30E-23	9.30E-23
ı-228		
'H-228	6.77E-26	6.77E-26
'U-239	1.88E-04	1.88E-04
I-235	1.84E-14	1.84E-14
'A-231	1.95E-18	1.95E-18
ıC-227	4.64E-20	4.64E-20
IP-237	2.45E-04	2.45E-04
I-233	7.32E-11	7.32E-11
'H-229	3.65E-14	3.65E-14
I-238	3.11E-05	3.11E-05
I-234	4.65E-11	4.65E-11
'H-230	3.24E-16	3.24E-16
ıA-226	4.78E-20	4.78E-20
'B-210	4.81E-22	4.81E-22
I-235	3.73E-05	3.73E-05
'A-231	5.95E-09	5.95E-09
ıC-227	1.88E-10	1.88E-10
I-234	3.29E-05	3.29E-05
'H-230	3.44E-10	3.44E-10
ıA-226	6.75E-14	6.75E-14
'B-210	8.46E-16	8.46E-16
'C-99	4.97E-08	4.97E-08

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Assessment for Time: 2

Time =1.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	9.964E+01
PU-240	9.979E+01
PU-239	9.979E+01
NP-237	9.980E+01
U-238	9.980E+01
U-236	2.956E-06
U-235	9.980E+01
U-234	9.980E+01
U-233	4.351E-04
PA-231	2.109E-03
TH-232	7.266E-17
TH-230	8.984E-04
TH-229	2.054E-08
TH-228	2.409E-19
AC-227	3.317E-05
RA-228	2.834E-18
RA-226	1.946E-07
PB-210	2.000E-09
TC-99	9.980E+01

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
;ceptor 1	9.07E-04	9.07E-04
›tal	9.07E-04	9.07E-04

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.86E-05	1.32E-10	3.52E-11	4.03E-04	5.95E-20	4.86E-04
Total	1.86E-05	1.32E-10	3.52E-11	4.03E-04	5.95E-20	4.86E-04

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

luclide	Receptor 1	Total
ıM-241	1.93E-04	1.93E-04
IP-237	1.18E-10	1.18E-10
I-233	5.50E-17	5.50E-17
'H-229	4.41E-20	4.41E-20
'U-240	1.86E-04	1.86E-04
I-236	1.38E-12	1.38E-12
'H-232	6.48E-22	6.48E-22
ı-228		
'H-228	1.93E-24	1.93E-24
'U-239	1.86E-04	1.86E-04
I-235	5.48E-14	5.48E-14
'A-231	1.35E-17	1.35E-17
ıC-227	6.87E-19	6.87E-19
IP-237	2.42E-04	2.42E-04
I-233	2.19E-10	2.19E-10
'H-229	2.54E-13	2.54E-13
I-238	3.09E-05	3.09E-05
I-234	1.39E-10	1.39E-10
'H-230	2.26E-15	2.26E-15
ıA-226	7.11E-19	7.11E-19
'B-210	1.45E-20	1.45E-20
I-235	3.71E-05	3.71E-05
'A-231	1.77E-08	1.77E-08
ıC-227	1.30E-09	1.30E-09
I-234	3.27E-05	3.27E-05
'H-230	1.03E-09	1.03E-09
ıA-226	4.69E-13	4.69E-13
'B-210	1.24E-14	1.24E-14
'C-99	4.87E-08	4.87E-08

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Assessment for Time: 3

Time =3.00E+01 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	8.947E+01
PU-240	9.359E+01
PU-239	9.380E+01
NP-237	9.388E+01
U-238	9.388E+01
U-236	8.330E-05
U-235	9.388E+01
U-234	9.388E+01
U-233	1.228E-02
PA-231	5.950E-02
TH-232	6.146E-14
TH-230	2.535E-02
TH-229	1.738E-05
TH-228	2.936E-14
AC-227	2.116E-02
RA-228	3.662E-14
RA-226	1.640E-04
PB-210	4.105E-05
TC-99	9.388E+01

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	6.05E-04	6.05E-04
›tal	6.05E-04	6.05E-04

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.74E-05	1.31E-10	3.52E-11	3.99E-04	2.36E-17	1.88E-04
Total	1.74E-05	1.31E-10	3.52E-11	3.99E-04	2.36E-17	1.88E-04

.tle : Small Office - Occupancy AF

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	1.20E-04	1.20E-04
IP-237	1.54E-09	1.54E-09
I-233	1.81E-14	1.81E-14
'H-229	2.83E-16	2.83E-16
'U-240	1.20E-04	1.20E-04
I-236	2.35E-11	2.35E-11
'H-232	2.24E-19	2.24E-19
ı-228		
'H-228	3.90E-20	3.90E-20
'U-239	1.20E-04	1.20E-04
I-235	9.53E-13	9.53E-13
'A-231	3.49E-15	3.49E-15
ıC-227	3.52E-15	3.52E-15
IP-237	1.59E-04	1.59E-04
I-233	3.73E-09	3.73E-09
'H-229	8.69E-11	8.69E-11
I-238	2.59E-05	2.59E-05
I-234	2.37E-09	2.37E-09
'H-230	7.81E-13	7.81E-13
ıA-226	3.91E-15	3.91E-15
'B-210	6.87E-16	6.87E-16
I-235	3.18E-05	3.18E-05
'A-231	2.32E-07	2.32E-07
ıC-227	3.27E-07	3.27E-07
I-234	2.75E-05	2.75E-05
'H-230	1.81E-08	1.81E-08
ıA-226	1.36E-10	1.36E-10
'B-210	3.05E-11	3.05E-11
'C-99	2.15E-08	2.15E-08

* Report for 1 m² Area Factor Calculation *

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
9.18E-04	9.07E-04	6.05E-04

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
9.18E-04	9.07E-04	6.05E-04

.tle : Small Office - Occupancy AF
ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

* Report for 4 m² Area Factor Calculation *

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* Report for 4 m² Area Factor Calculation *

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.200	1.400	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

* Report for 4 m² Area Factor Calculation *

Building Information

Building Air Exchange Rate: 8.30E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                  ******************************
                  *                            *
                  *                            *
                  *                           <=Q01: 1.33E+01
 H1:   2.400      *           Room  1          *      Q10 :  1.33E+01
                  *   LAMBDA: 8.30E-01         *
Area   6.700      *                            *
                  *                            *
                  ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

* Report for 4 m² Area Factor Calculation *

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00[m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/(dpm/m3)]
AM-241	1.000E+02	1.640E-03	2.000E-01	4.304E-05
PU-240	1.000E+02	1.595E-03	1.932E-01	2.499E-07
PU-239	1.000E+02	1.595E-03	1.932E-01	2.231E-07
NP-237	1.000E+02	2.002E-03	2.432E-01	5.461E-04
U-238	1.000E+02	1.210E-04	5.317E-02	7.191E-05
U-236	0.000E+00	1.212E-04	5.631E-02	2.636E-07
U-235	1.000E+02	1.204E-04	5.541E-02	4.063E-04
U-234	1.000E+02	1.275E-04	5.946E-02	4.014E-07
U-233	0.000E+00	1.302E-04	6.081E-02	8.576E-07
PA-231	0.000E+00	4.775E-03	5.766E-01	9.049E-05
TH-232	0.000E+00	1.230E-03	7.387E-01	4.588E-07
TH-230	0.000E+00	2.468E-04	1.468E-01	9.155E-07
TH-229	0.000E+00	1.814E-03	9.768E-01	7.842E-04
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
AC-227	0.000E+00	6.665E-03	3.029E+00	9.734E-04
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
RA-226	0.000E+00	5.950E-04	3.871E-03	4.663E-03
PB-210	0.000E+00	2.422E-03	6.214E-03	4.698E-06
TC-99	1.000E+02	6.577E-07	3.748E-06	8.523E-08

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Assessment for Time: 1

Time =0.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	1.000E+02
PU-240	1.000E+02
PU-239	1.000E+02
NP-237	1.000E+02
U-238	1.000E+02
U-236	0.000E+00
U-235	1.000E+02
U-234	1.000E+02
U-233	0.000E+00
PA-231	0.000E+00
TH-232	0.000E+00
TH-230	0.000E+00
TH-229	0.000E+00
TH-228	0.000E+00
AC-227	0.000E+00
RA-228	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00
TC-99	1.000E+02

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	3.65E-03	3.65E-03
›tal	3.65E-03	3.65E-03

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.52E-05	5.27E-10	1.41E-10	1.61E-03	3.40E-20	1.98E-03
Total	5.52E-05	5.27E-10	1.41E-10	1.61E-03	3.40E-20	1.98E-03

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	7.79E-04	7.79E-04
IP-237	1.57E-10	1.57E-10
I-233	3.16E-17	3.16E-17
'H-229	1.17E-20	1.17E-20
'U-240	7.52E-04	7.52E-04
I-236	1.84E-12	1.84E-12
'H-232	3.72E-22	3.72E-22
ı-228		
'H-228	2.45E-25	2.45E-25
'U-239	7.52E-04	7.52E-04
I-235	7.00E-14	7.00E-14
'A-231	7.80E-18	7.80E-18
ıC-227	1.85E-19	1.85E-19
IP-237	9.72E-04	9.72E-04
I-233	2.93E-10	2.93E-10
'H-229	1.45E-13	1.45E-13
I-238	1.23E-04	1.23E-04
I-234	1.86E-10	1.86E-10
'H-230	1.30E-15	1.30E-15
;A-226	1.62E-19	1.62E-19
'B-210	1.92E-21	1.92E-21
I-235	1.42E-04	1.42E-04
'A-231	2.38E-08	2.38E-08
ıC-227	7.51E-10	7.51E-10
I-234	1.32E-04	1.32E-04
'H-230	1.37E-09	1.37E-09
;A-226	2.29E-13	2.29E-13
'B-210	3.38E-15	3.38E-15
'C-99	1.96E-07	1.96E-07

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Assessment for Time: 2

Time =1.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	9.964E+01
PU-240	9.979E+01
PU-239	9.979E+01
NP-237	9.980E+01
U-238	9.980E+01
U-236	2.956E-06
U-235	9.980E+01
U-234	9.980E+01
U-233	4.351E-04
PA-231	2.109E-03
TH-232	7.266E-17
TH-230	8.984E-04
TH-229	2.054E-08
TH-228	2.409E-19
AC-227	3.317E-05
RA-228	2.834E-18
RA-226	1.946E-07
PB-210	2.000E-09
TC-99	9.980E+01

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
;ceptor 1	3.61E-03	3.61E-03
›tal	3.61E-03	3.61E-03

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.51E-05	5.27E-10	1.41E-10	1.61E-03	2.38E-19	1.94E-03
Total	5.51E-05	5.27E-10	1.41E-10	1.61E-03	2.38E-19	1.94E-03

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	7.69E-04	7.69E-04
IP-237	4.66E-10	4.66E-10
I-233	2.20E-16	2.20E-16
'H-229	1.75E-19	1.75E-19
'U-240	7.43E-04	7.43E-04
I-236	5.51E-12	5.51E-12
'H-232	2.59E-21	2.59E-21
ı-228		
'H-228	6.96E-24	6.96E-24
'U-239	7.43E-04	7.43E-04
I-235	2.09E-13	2.09E-13
'A-231	5.40E-17	5.40E-17
ıC-227	2.74E-18	2.74E-18
IP-237	9.60E-04	9.60E-04
I-233	8.74E-10	8.74E-10
'H-229	1.01E-12	1.01E-12
I-238	1.22E-04	1.22E-04
I-234	5.55E-10	5.55E-10
'H-230	9.04E-15	9.04E-15
ıA-226	2.41E-18	2.41E-18
'B-210	5.81E-20	5.81E-20
I-235	1.42E-04	1.42E-04
'A-231	7.05E-08	7.05E-08
ıC-227	5.18E-09	5.18E-09
I-234	1.31E-04	1.31E-04
'H-230	4.11E-09	4.11E-09
ıA-226	1.59E-12	1.59E-12
'B-210	4.96E-14	4.96E-14
'C-99	1.92E-07	1.92E-07

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Assessment for Time: 3

Time =3.00E+01 yr

Source Information

›urce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	8.947E+01
PU-240	9.359E+01
PU-239	9.380E+01
NP-237	9.388E+01
U-238	9.388E+01
U-236	8.330E-05
U-235	9.388E+01
U-234	9.388E+01
U-233	1.228E-02
PA-231	5.950E-02
TH-232	6.146E-14
TH-230	2.535E-02
TH-229	1.738E-05
TH-228	2.936E-14
AC-227	2.116E-02
RA-228	3.662E-14
RA-226	1.640E-04
PB-210	4.105E-05
TC-99	9.388E+01

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
ɜceptor 1	2.40E-03	2.40E-03
›tal	2.40E-03	2.40E-03

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.17E-05	5.25E-10	1.41E-10	1.60E-03	9.45E-17	7.51E-04
Total	5.17E-05	5.25E-10	1.41E-10	1.60E-03	9.45E-17	7.51E-04

.tle : Small Office - Occupancy AF

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	4.77E-04	4.77E-04
IP-237	6.07E-09	6.07E-09
I-233	7.25E-14	7.25E-14
'H-229	1.12E-15	1.12E-15
'U-240	4.79E-04	4.79E-04
I-236	9.38E-11	9.38E-11
'H-232	8.96E-19	8.96E-19
ı-228		
'H-228	1.40E-19	1.40E-19
'U-239	4.80E-04	4.80E-04
I-235	3.62E-12	3.62E-12
'A-231	1.39E-14	1.39E-14
ıC-227	1.40E-14	1.40E-14
IP-237	6.29E-04	6.29E-04
I-233	1.49E-08	1.49E-08
'H-229	3.45E-10	3.45E-10
I-238	1.02E-04	1.02E-04
I-234	9.47E-09	9.47E-09
'H-230	3.12E-12	3.12E-12
ıA-226	1.25E-14	1.25E-14
'B-210	2.75E-15	2.75E-15
I-235	1.21E-04	1.21E-04
'A-231	9.28E-07	9.28E-07
ıC-227	1.30E-06	1.30E-06
I-234	1.10E-04	1.10E-04
'H-230	7.24E-08	7.24E-08
ıA-226	4.35E-10	4.35E-10
'B-210	1.22E-10	1.22E-10
'C-99	8.33E-08	8.33E-08

* Report for 4 m² Area Factor Calculation *

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
3.65E-03	3.61E-03	2.40E-03

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
3.65E-03	3.61E-03	2.40E-03

* Report for 6.5 m² Area Factor Calculation *

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Time Specific Parameters..... 9
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Dose by Pathway Detail..... 11
Dose by Nuclide Detail..... 12
For time = 3.00E+01 yr
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* Report for 6.5 m² Area Factor Calculation *

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

›ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.200	1.400	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

* Report for 6.5 m² Area Factor Calculation *

Building Information

Building Air Exchange Rate: 8.30E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                           <=Q01: 1.33E+01
 H1:   2.400       *           Room  1          *      Q10 :  1.33E+01
                   *   LAMBDA: 8.30E-01         *
Area   6.700       *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

* Report for 6.5 m² Area Factor Calculation *

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00[m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/(dpm/m3)]
AM-241	1.000E+02	1.640E-03	2.000E-01	4.304E-05
PU-240	1.000E+02	1.595E-03	1.932E-01	2.499E-07
PU-239	1.000E+02	1.595E-03	1.932E-01	2.231E-07
NP-237	1.000E+02	2.002E-03	2.432E-01	5.461E-04
U-238	1.000E+02	1.210E-04	5.317E-02	7.191E-05
U-236	0.000E+00	1.212E-04	5.631E-02	2.636E-07
U-235	1.000E+02	1.204E-04	5.541E-02	4.063E-04
U-234	1.000E+02	1.275E-04	5.946E-02	4.014E-07
U-233	0.000E+00	1.302E-04	6.081E-02	8.576E-07
PA-231	0.000E+00	4.775E-03	5.766E-01	9.049E-05
TH-232	0.000E+00	1.230E-03	7.387E-01	4.588E-07
TH-230	0.000E+00	2.468E-04	1.468E-01	9.155E-07
TH-229	0.000E+00	1.814E-03	9.768E-01	7.842E-04
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
AC-227	0.000E+00	6.665E-03	3.029E+00	9.734E-04
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
RA-226	0.000E+00	5.950E-04	3.871E-03	4.663E-03
PB-210	0.000E+00	2.422E-03	6.214E-03	4.698E-06
TC-99	1.000E+02	6.577E-07	3.748E-06	8.523E-08

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

```
==========================================
==========================================
==      Assessment for Time:  1         ==
==            Time =0.00E+00 yr         ==
==========================================
==========================================
```

======= Source Information =======

›urce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	1.000E+02
PU-240	1.000E+02
PU-239	1.000E+02
NP-237	1.000E+02
U-238	1.000E+02
U-236	0.000E+00
U-235	1.000E+02
U-234	1.000E+02
U-233	0.000E+00
PA-231	0.000E+00
TH-232	0.000E+00
TH-230	0.000E+00
TH-229	0.000E+00
TH-228	0.000E+00
AC-227	0.000E+00
RA-228	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00
TC-99	1.000E+02

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	5.92E-03	5.92E-03
›tal	5.92E-03	5.92E-03

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.53E-05	8.57E-10	2.29E-10	2.62E-03	5.53E-20	3.22E-03
Total	7.53E-05	8.57E-10	2.29E-10	2.62E-03	5.53E-20	3.22E-03

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	1.27E-03	1.27E-03
IP-237	2.54E-10	2.54E-10
I-233	5.13E-17	5.13E-17
'H-229	1.90E-20	1.90E-20
'U-240	1.22E-03	1.22E-03
I-236	3.00E-12	3.00E-12
'H-232	6.04E-22	6.04E-22
ı-228		
'H-228	3.78E-25	3.78E-25
'U-239	1.22E-03	1.22E-03
I-235	1.11E-13	1.11E-13
'A-231	1.27E-17	1.27E-17
ıC-227	3.00E-19	3.00E-19
IP-237	1.57E-03	1.57E-03
I-233	4.76E-10	4.76E-10
'H-229	2.35E-13	2.35E-13
I-238	1.99E-04	1.99E-04
I-234	3.02E-10	3.02E-10
'H-230	2.11E-15	2.11E-15
ıA-226	2.41E-19	2.41E-19
'B-210	3.12E-21	3.12E-21
I-235	2.26E-04	2.26E-04
'A-231	3.86E-08	3.86E-08
ıC-227	1.22E-09	1.22E-09
I-234	2.14E-04	2.14E-04
'H-230	2.23E-09	2.23E-09
ıA-226	3.41E-13	3.41E-13
'B-210	5.50E-15	5.50E-15
'C-99	3.16E-07	3.16E-07

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Assessment for Time: 2

Time =1.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	9.964E+01
PU-240	9.979E+01
PU-239	9.979E+01
NP-237	9.980E+01
U-238	9.980E+01
U-236	2.956E-06
U-235	9.980E+01
U-234	9.980E+01
U-233	4.351E-04
PA-231	2.109E-03
TH-232	7.266E-17
TH-230	8.984E-04
TH-229	2.054E-08
TH-228	2.409E-19
AC-227	3.317E-05
RA-228	2.834E-18
RA-226	1.946E-07
PB-210	2.000E-09
TC-99	9.980E+01

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	5.85E-03	5.85E-03
›tal	5.85E-03	5.85E-03

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.51E-05	8.57E-10	2.29E-10	2.62E-03	3.87E-19	3.16E-03
Total	7.51E-05	8.57E-10	2.29E-10	2.62E-03	3.87E-19	3.16E-03

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	1.25E-03	1.25E-03
IP-237	7.54E-10	7.54E-10
I-233	3.57E-16	3.57E-16
'H-229	2.84E-19	2.84E-19
'U-240	1.21E-03	1.21E-03
I-236	8.94E-12	8.94E-12
'H-232	4.21E-21	4.21E-21
ı-228		
'H-228	1.08E-23	1.08E-23
'U-239	1.21E-03	1.21E-03
I-235	3.32E-13	3.32E-13
'A-231	8.77E-17	8.77E-17
ıC-227	4.45E-18	4.45E-18
IP-237	1.55E-03	1.55E-03
I-233	1.42E-09	1.42E-09
'H-229	1.64E-12	1.64E-12
I-238	1.98E-04	1.98E-04
I-234	9.01E-10	9.01E-10
'H-230	1.47E-14	1.47E-14
'A-226	3.58E-18	3.58E-18
'B-210	9.44E-20	9.44E-20
I-235	2.25E-04	2.25E-04
'A-231	1.15E-07	1.15E-07
ıC-227	8.41E-09	8.41E-09
I-234	2.12E-04	2.12E-04
'H-230	6.67E-09	6.67E-09
'A-226	2.37E-12	2.37E-12
'B-210	8.05E-14	8.05E-14
'C-99	3.10E-07	3.10E-07

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Assessment for Time: 3

Time =3.00E+01 yr

Source Information

›urce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
AM-241	8.947E+01
PU-240	9.359E+01
PU-239	9.380E+01
NP-237	9.388E+01
U-238	9.388E+01
U-236	8.330E-05
U-235	9.388E+01
U-234	9.388E+01
U-233	1.228E-02
PA-231	5.950E-02
TH-232	6.146E-14
TH-230	2.535E-02
TH-229	1.738E-05
TH-228	2.936E-14
AC-227	2.116E-02
RA-228	3.662E-14
RA-226	1.640E-04
PB-210	4.105E-05
TC-99	9.388E+01

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	3.89E-03	3.89E-03
›tal	3.89E-03	3.89E-03

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.04E-05	8.54E-10	2.29E-10	2.60E-03	1.53E-16	1.22E-03
Total	7.04E-05	8.54E-10	2.29E-10	2.60E-03	1.53E-16	1.22E-03

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
ıM-241	7.73E-04	7.73E-04
IP-237	9.80E-09	9.80E-09
I-233	1.18E-13	1.18E-13
'H-229	1.82E-15	1.82E-15
'U-240	7.79E-04	7.79E-04
I-236	1.52E-10	1.52E-10
'H-232	1.46E-18	1.46E-18
ı-228		
'H-228	2.15E-19	2.15E-19
'U-239	7.80E-04	7.80E-04
I-235	5.74E-12	5.74E-12
'A-231	2.26E-14	2.26E-14
ıC-227	2.28E-14	2.28E-14
IP-237	1.02E-03	1.02E-03
I-233	2.42E-08	2.42E-08
'H-229	5.60E-10	5.60E-10
I-238	1.65E-04	1.65E-04
I-234	1.54E-08	1.54E-08
'H-230	5.07E-12	5.07E-12
ıA-226	1.80E-14	1.80E-14
'B-210	4.46E-15	4.46E-15
I-235	1.91E-04	1.91E-04
'A-231	1.51E-06	1.51E-06
ıC-227	2.12E-06	2.12E-06
I-234	1.78E-04	1.78E-04
'H-230	1.18E-07	1.18E-07
ıA-226	6.26E-10	6.26E-10
'B-210	1.98E-10	1.98E-10
'C-99	1.33E-07	1.33E-07

.tle : Small Office - Occupancy AF

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF.bld

ıll Summary

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
5.92E-03	5.85E-03	3.89E-03

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
5.92E-03	5.85E-03	3.89E-03

.tle : Small Office - Occupancy AF - Th-232+C
ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

* Report for 1 m² Area Factor Calculation *

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* Report for 1 m² Area Factor Calculation *

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

:ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.200	1.400	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

* Report for 1 m² Area Factor Calculation *

Building Information

Building Air Exchange Rate: 8.30E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                           <=Q01: 1.33E+01
 H1:   2.400       *           Room  1          *      Q10 :  1.33E+01
                   *   LAMBDA: 8.30E-01         *
Area   6.700       *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00[m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/ (dpm/m3)]
TH-232	1.000E+02	1.230E-03	7.387E-01	4.588E-07
TH-228	1.000E+02	3.642E-04	1.556E-01	4.224E-03
RA-228	1.000E+02	6.496E-04	2.287E-03	2.515E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

```
==========================================
==========================================
===      Assessment for Time:  1        ===
===            Time =0.00E+00 yr        ===
==========================================
==========================================
```

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	1.000E+02
TH-228	1.000E+02
RA-228	1.000E+02

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	6.02E-04	6.02E-04
›tal	6.02E-04	6.02E-04

.tle : Small Office - Occupancy AF - Th-232+C

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

* Report for 1 m² Area Factor Calculation *

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.64E-05	5.28E-10	2.18E-10	3.61E-04	4.43E-10	1.55E-04
Total	8.64E-05	5.28E-10	2.18E-10	3.61E-04	4.43E-10	1.55E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
'H-232	3.83E-04	3.83E-04
ı-228		
'H-228	8.92E-07	8.92E-07
I-228		
'H-228	1.16E-04	1.16E-04
ı-228		
'H-228	2.13E-05	2.13E-05

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Assessment for Time: 2

Time =1.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.980E+01
TH-228	9.980E+01
RA-228	9.980E+01

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	5.98E-04	5.98E-04
›tal	5.98E-04	5.98E-04

.tle : Small Office - Occupancy AF - Th-232+C

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

* Report for 1 m² Area Factor Calculation *

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.62E-05	5.28E-10	2.18E-10	3.61E-04	4.43E-10	1.51E-04
Total	8.62E-05	5.28E-10	2.18E-10	3.61E-04	4.43E-10	1.51E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
'H-232	3.82E-04	3.82E-04
ı-228		
'H-228	5.45E-06	5.45E-06
I-228		
'H-228	8.01E-05	8.01E-05
ı-228		
'H-228	5.17E-05	5.17E-05

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

```
==========================================
==========================================
==      Assessment for Time:  3         ==
==            Time =3.00E+01 yr         ==
==========================================
==========================================
```

======== Source Information ========

›urce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:1.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.388E+01
TH-228	9.388E+01
RA-228	9.388E+01

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	5.01E-04	5.01E-04
›tal	5.01E-04	5.01E-04

.tle : Small Office - Occupancy AF - Th-232+C

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

* Report for 1 m² Area Factor Calculation *

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.11E-05	5.28E-10	2.18E-10	3.61E-04	4.43E-10	5.92E-05
Total	8.11E-05	5.28E-10	2.18E-10	3.61E-04	4.43E-10	5.92E-05

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 1 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Nuclide	Receptor 1	Total
'H-232	3.31E-04	3.31E-04
ı-228		
'H-228	1.15E-04	1.15E-04
I-228		
'H-228	1.87E-09	1.87E-09
ı-228		
'H-228	4.52E-06	4.52E-06

* Report for 1 m² Area Factor Calculation *

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
6.02E-04	5.98E-04	5.01E-04

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
6.02E-04	5.98E-04	5.01E-04

.tle : Small Office - Occupancy AF - Th-232+C
ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

* Report for 4 m² Area Factor Calculation *

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Time Specific Parameters..... 5
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For time = 1.00E+00 yr
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Dose by Pathway Detail..... 11
Dose by Nuclide Detail..... 12
For time = 3.00E+01 yr
Time Specific Parameters..... 13
Receptor-Source Dose Summary..... 14
Dose by Pathway Detail..... 15
Dose by Nuclide Detail..... 16
Full Summary..... 17

* Report for 4 m² Area Factor Calculation *

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

:ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.200	1.400	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

* Report for 4 m² Area Factor Calculation *

Building Information

Building Air Exchange Rate: 8.30E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                           <=Q01: 1.33E+01
 H1:   2.400       *           Room  1          *      Q10 :  1.33E+01
                   *   LAMBDA: 8.30E-01         *
Area   6.700       *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

* Report for 4 m² Area Factor Calculation *

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00[m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/ (dpm/m3)]
TH-232	1.000E+02	1.230E-03	7.387E-01	4.588E-07
TH-228	1.000E+02	3.642E-04	1.556E-01	4.224E-03
RA-228	1.000E+02	6.496E-04	2.287E-03	2.515E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

```
==========================================
==========================================
===      Assessment for Time:  1        ===
===            Time =0.00E+00 yr        ===
==========================================
==========================================
```

======== Source Information ========

›urce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	1.000E+02
TH-228	1.000E+02
RA-228	1.000E+02

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
;ceptor 1	2.32E-03	2.32E-03
›tal	2.32E-03	2.32E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.57E-04	2.11E-09	8.73E-10	1.44E-03	1.77E-09	6.18E-04
Total	2.57E-04	2.11E-09	8.73E-10	1.44E-03	1.77E-09	6.18E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
'H-232	1.53E-03	1.53E-03
ı-228		
'H-228	3.23E-06	3.23E-06
I-228		
'H-228	4.18E-04	4.18E-04
ı-228		
'H-228	7.72E-05	7.72E-05

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Assessment for Time: 2

Time =1.00E+00 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.980E+01
TH-228	9.980E+01
RA-228	9.980E+01

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	2.31E-03	2.31E-03
›tal	2.31E-03	2.31E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.56E-04	2.11E-09	8.73E-10	1.44E-03	1.77E-09	6.06E-04
Total	2.56E-04	2.11E-09	8.73E-10	1.44E-03	1.77E-09	6.06E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Nuclide	Receptor 1	Total
'H-232	1.53E-03	1.53E-03
ı-228		
'H-228	1.97E-05	1.97E-05
I-228		
'H-228	2.89E-04	2.89E-04
ı-228		
'H-228	1.87E-04	1.87E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Assessment for Time: 3

Time =3.00E+01 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:4.00E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.388E+01
TH-228	9.388E+01
RA-228	9.388E+01

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	1.92E-03	1.92E-03
›tal	1.92E-03	1.92E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.41E-04	2.11E-09	8.73E-10	1.44E-03	1.77E-09	2.37E-04
Total	2.41E-04	2.11E-09	8.73E-10	1.44E-03	1.77E-09	2.37E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 4 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Nuclide	Receptor 1	Total
'H-232	1.32E-03	1.32E-03
ı-228		
'H-228	4.11E-04	4.11E-04
I-228		
'H-228	6.70E-09	6.70E-09
ı-228		
'H-228	1.62E-05	1.62E-05

* Report for 4 m² Area Factor Calculation *

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
2.32E-03	2.31E-03	1.92E-03

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
2.32E-03	2.31E-03	1.92E-03

* Report for 6.5 m² Area Factor Calculation *

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For time = 1.00E+00 yr
Time Specific Parameters..... 9
Receptor-Source Dose Summary..... 10
Dose by Pathway Detail..... 11
Dose by Nuclide Detail..... 12
For time = 3.00E+01 yr
Time Specific Parameters..... 13
Receptor-Source Dose Summary..... 14
Dose by Pathway Detail..... 15
Dose by Nuclide Detail..... 16
Full Summary..... 17

* Report for 6.5 m² Area Factor Calculation *

RESRAD-BUILD Input Parameters

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.652500E+02 days
Fraction Inside : 2.700000E-01

Receptor Information

:ceptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.200	1.400	1.000	1.000	3.36E+01	1.10E-04

Receptor-Source Shielding Relationship

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

* Report for 6.5 m² Area Factor Calculation *

Building Information

Building Air Exchange Rate: 8.30E-01 1/hr

```
 Height[m]          Air Exchanges [m3/hr]
 Area [m2]
                   ******************************
                   *                            *
                   *                            *
                   *                           <=Q01: 1.33E+01
 H1:   2.400       *           Room  1          *      Q10 :  1.33E+01
                   *   LAMBDA: 8.30E-01         *
Area   6.700       *                            *
                   *                            *
                   ******************************
```

Deposition velocity: 8.07E-05 [m/s] Resuspension Rate: 5.73E-08 [1/s]

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00[m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Radon Release Fraction: 0.000E+00

Contamination::

Nuclide	Concentration [dpm/m2]	Dose Conversion Factor (Library: FGR 11) Ingestion [mrem/dpm]	Inhalation [mrem/dpm]	Submersion [mrem/yr/ (dpm/m3)]
TH-232	1.000E+02	1.230E-03	7.387E-01	4.588E-07
TH-228	1.000E+02	3.642E-04	1.556E-01	4.224E-03
RA-228	1.000E+02	6.496E-04	2.287E-03	2.515E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

```
==========================================
==========================================
===      Assessment for Time:  1        ===
===            Time =0.00E+00 yr        ===
==========================================
==========================================
```

========= Source Information =========

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 1.000E-01

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	1.000E+02
TH-228	1.000E+02
RA-228	1.000E+02

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	3.70E-03	3.70E-03
›tal	3.70E-03	3.70E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.50E-04	3.43E-09	1.42E-09	2.35E-03	2.88E-09	1.01E-03
Total	3.50E-04	3.43E-09	1.42E-09	2.35E-03	2.88E-09	1.01E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Iuclide	Receptor 1	Total
'H-232	2.49E-03	2.49E-03
ı-228		
'H-228	4.99E-06	4.99E-06
I-228		
'H-228	6.46E-04	6.46E-04
ı-228		
'H-228	1.19E-04	1.19E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

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

======== Source Information ========

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 9.816E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.980E+01
TH-228	9.980E+01
RA-228	9.980E+01

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
:ceptor 1	3.68E-03	3.68E-03
›tal	3.68E-03	3.68E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.50E-04	3.43E-09	1.42E-09	2.35E-03	2.88E-09	9.84E-04
Total	3.50E-04	3.43E-09	1.42E-09	2.35E-03	2.88E-09	9.84E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Nuclide	Receptor 1	Total
'H-232	2.48E-03	2.48E-03
ı-228		
'H-228	3.04E-05	3.04E-05
I-228		
'H-228	4.47E-04	4.47E-04
ı-228		
'H-228	2.89E-04	2.89E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Assessment for Time: 3

Time =3.00E+01 yr

Source Information

ɔurce: 1

Location:: Room : 1 x: 1.20 y: 1.40 z: 0.00 [m]

Geometry:: Type: Area Area:6.50E+00 [m2] Direction: z

Pathway ::

Direct Ingestion Rate: 2.940E-06 [1/hr]

Fraction released to air: 7.000E-02

Removable fraction: 4.138E-02

Time to Remove: 1.792E+04 [day]

Contamination::

Nuclide	Concentration [dpm/m2]
TH-232	9.388E+01
TH-228	9.388E+01
RA-228	9.388E+01

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Total
›ceptor 1	3.06E-03	3.06E-03
›tal	3.06E-03	3.06E-03

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

ırce: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.29E-04	3.43E-09	1.42E-09	2.35E-03	2.88E-09	3.84E-04
Total	3.29E-04	3.43E-09	1.42E-09	2.35E-03	2.88E-09	3.84E-04

.tle : Small Office - Occupancy AF - Th-232+C

* Report for 6.5 m² Area Factor Calculation *

ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld

'aluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

ırce: 1

Nuclide	Receptor 1	Total
'H-232	2.15E-03	2.15E-03
ı-228		
'H-228	6.32E-04	6.32E-04
I-228		
'H-228	1.03E-08	1.03E-08
ı-228		
'H-228	2.49E-05	2.49E-05

.tle : Small Office - Occupancy AF - Th-232+C
ıput File : C:\RESRAD_Family\BUILD\HEMATITE - Small Office AF - Th-232+C.bld
ıll Summary

* Report for 6.5 m² Area Factor Calculation *

RESRAD-BUILD Dose (Time) Tables

Receptor Dose Received for the Exposure Duration

(mrem)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
3.70E-03	3.68E-03	3.06E-03

Receptor Dose/Yr Averaged Over Exposure Duration

(mrem/yr)

Evaluation Time [yr]		
0.00E+00	1.00E+00	3.00E+01
3.70E-03	3.68E-03	3.06E-03