University at Buffalo
The State University of New York

Environment, Health & Safety Services

June 5, 2014

Docket 50-57
License R-77

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555 -0001

Dear Sir or Madam:

This submission is in follow up to our submission, dated May 22, 2014, detailing supplemental information and data to address comments provided by ORISE and the N.R.C. regarding building release surveys performed at the University at Buffalo's Buffalo Materials Research Center to prepare the building for demolition.

A conference call was held on June 2, 2014 during which several items were identified that required further clarification.

Attached is a letter and data from the University's Decommissioning Management Contractor, Enercon to Mr. Dave Vasbinder detailing supplemental information addressing those items that were identified.

We have also provided courtesy copies of this information to our Project Manager, Ted Smith and Region 1 Inspector, Steve Hammann as well as to ORISE.

If you have any questions or wish further information, please contact me at (716) 829-3301 or dvasbind@buffalo.edu.

Sincerely,

David R. Vasbinder
Director, Buffalo Materials Research Center

Cc: Ted Smith, U.S.N.R.C. Project Manager
Steve Hammann, NRC Region 1
Nick Altic, ORISE

A020
NRR

ENERCON

Excellence—Every project. Every day.

June 5, 2014
GEW-P14-008

Mr. Dave Vasbinder
Associate Director, Environment, Health, and Safety Services BMRC
The State University of New York
University at Buffalo
220 Winspear Avenue
Buffalo, NY 14215-1034

Re: Response to June 2, 2014 Comments

Mr. Vasbinder;

This letter provides discussion of the technical issues addressed in our discussion June 2, 2014 with NRC and ORISE. Each of the key items identified as requiring clarification are addressed in the following sections.

Selection of Release Criteria

For this project, the surface release criteria for building materials were based on the use of Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors" Table 1. This table provides average and maximum values for surface measurements and removable contamination limits. These criteria are acceptable for unrestricted release of buildings, materials, and equipment. The criteria were stated in the NRC approved decommissioning plan.

Since the average limits provided in Reg Guide 1.86 were followed, the concept of using a developed area factor following MARSSIM for elevated measurement comparison of individual survey measurements that exceed the DCGL value is not directly applicable. Reg Guide 1.86 Table 1 average values were selected as a conservative measure and to eliminate the need to derive site-specific DCGLs and area factors.

Statistical Analysis of Survey Units

Three survey units were assessed during scans and surveys using the release criteria of 1,000 dpm/100cm^2 because SR-90 was the radionuclide of concern in that survey unit. The remainder of the survey units used the average release criteria of 5,000 dpm/100cm^2.

The survey package units using 1,000 dpm/100cm^2 as the average release limit were RBC-200-1, RBC-201-1, and ADM-000-5. Two of these survey package units have individual readings that exceed 1,000 dpm/100cm^2 (two measurements for RBC-200-1 and four measurements for ADM-000-5). The third survey unit (RBC-201-1) had no individual reading that exceeded 1,000 dpm/100cm^2. None of these six locations exceed the maximum surface concentration level of 3,000 dpm/100cm^2 in Table 1 of Reg Guide 1.86 for Sr-90.

For the six locations with measurements above 1,000 dpm/100cm^2, the areas were determined during the survey to be less that 1-meter square using the process described in this letter. The average concentration limit for these survey units was less than 1,000 dpm/100cm^2. No reading exceeded the maximum concentration limit of 3,000 dpm/100cm^2. Thus, these survey units met the levels established in the NRC approved decommissioning plan.

At the request of NRC and ORISE, statistical analysis for RBC-200-1 and ADM-000-5 was completed based on the Sign Test and submitted for review. Use of the Sign Test is appropriate under MARSSIM because the radionuclide in question (Sr-90) is not present in the background. Statistical analysis documentation added to each survey package unit and provided to NRC and ORISE showed that the survey units passed the Sign Test. Each of these statistical analyses included a note that the Sign Test was based on an assumed area factor of 2.

Technical clarification and justification has been requested to support this assumption as stated on the statistical summary sheet. Since Reg Guide 1.86 release criteria were selected rather than calculating site-specific DCGLs, area factors were not calculated. Supporting justification for as the assumption that an area factor of 2 is a conservative selection for the Sign Test comparison is as follows:

1. Radionuclide-specific area factors are published in NUREG-1505 Table 8.2 (see Attachment 1) for indoor building surfaces. The 1-meter square area factor for Sr-90 is 35.7. This published area factor for Sr-90 is much higher than the very conservatively selected assumed factor of 2 used in the Sign Test.

2. As a further demonstration that the assumed area factor value of 2 used in the Sign Test is extremely conservative, area factor calculations for Sr-90 have been made using the NRC's DandD code. This code is widely recognized as extremely conservative. The results in the table below provide area factors for Sr-90 for various area sizes. The factor for a 1-meter square area is 10. This calculated value is much higher than the very conservatively selected factor of 2 used in the Sign Test. Supporting code output reports for these analyses are provided in Attachment 2.

Table 1 – Area Factors for Sr-90

Size of Area above Release Limit (square meters)	Area Factor
125	1
10	1
5	2
3	3.3
1	10

<u>Assessment of Areas Exceeding the Investigation Limit</u>

NRC and ORISE have requested a description of the evaluation process for the individual survey measurements that exceeded the investigation limit.

As part of the survey process, an investigation limit was administratively selected to ensure that areas exceeding a specified value were appropriately evaluated regardless of whether the area exceeded the average release limit. For the BMRC surveys, this value was selected to be 75% of the average release limit. Thus, survey units with an average release limit of 5,000 dpm/100cm^2 had an investigation limit of 3,750 dpm/100cm^2, while survey units with an average release limit of 1,000 dpm/100cm^2 had an investigation limit of 750 dpm/100cm^2.

Areas identified during the survey with having activity greater than the investigation limits were evaluated using the following process:

- A 1-meter square area at the location of the reading exceeding the investigation limit was re-scanned. The purpose of the re-scan was to determine if any area exceeded the average release limit.

- If the re-scan confirmed a reading exceeded the maximum release limit, the area was remediated and re-scanned.

- If the re-scan confirmed a reading exceeded the average release limit and the area was less than 1-meter square, a direct one-minute measurement was taken at the location of the highest activity and recorded, then survey activities were continued.

- If the re-scan confirmed a reading exceeded the investigation limit but not the release limit within the 1-meter square area, a direct one-minute measurement was taken at the location of the highest activity and recorded, then survey activities were continued.

Attachment 3 provides a summary table of survey data collected for the 29 BMRC survey units. Overall, only 14 survey points exceeded the investigation limit in the combined data from all survey units.

Of these 14 measurements, six measurements are those values that exceeded the average release limit in survey units RBC-200-1 and ADM-000-5 but are below the maximum release limit. These six measurements were part of the Sign Test evaluations (two measurements for RBC-200-1 and four measurement for ADM-000-5) requested by and provided to NRC and ORISE.

An additional two measurements in survey unit RBN-000-1 were reported, but noted in the comments section that the measurements were part of a structurally significant location that will be removed and disposed as low-level radioactive waste (LLRW) during demolition. These two measurements are included in the total of 14.

The remaining six locations were evaluated using the investigation process described above. No readings above the average release limit were found at these locations.

<u>Assessment of Number of Sampling Points</u>

NRC and ORISE requested confirmation that the number of sampling points met the requirements for building release for demolition. Each survey unit was individually evaluated for the number of sampling points prior to starting the field survey. The "General Instructions" section identified the number of static measurements for that specific survey unit based on statistical assessment. Maps were prepared for each survey area using the Visual Sample Plan. These maps were provided to the staff during the data collection process. Measurement locations were recorded during the survey process, and were provided in the survey unit package documentation.

Following the MARSSIM protocol, an additional 10% allowance was included for quality control along with an additional 20% allowance to account for any inaccessibility issues, data collection issues, or unanticipated issues with data collection. This information is provided in Attachment 3.

Conclusions

In summary, none of the survey data exceeded the maximum release limit. Only 14 survey points exceeded the investigation limit of 75% of the average release limit.

Of these 14 survey points, six points each less than 1-meter square exceeded the average release limit but were less than the maximum release limit. The two survey units with these six data points passed the average release limit. No points exceeded the maximum release limit of Reg Guide 1.86 stated in the NRC approved decommissioning plan. The two survey units were proven to pass the Sign Test using an extremely conservative area factor assumption.

Two of the 14 points represented a known activated structural component that will be removed and disposed as LLRW during demolition.

The remaining six points exceeding the investigation limit were assessed to confirm that no material exceeded the average release limit.

In concurrence with the Reg Guide 1.86 criteria, no measurement of the surface reading was averaged over more than 1-meter square. In concurrence with Reg Guide 1.86 criteria, no measurement of the maximum surface reading was greater than 100 cm^2 since no measurement exceeded the maximum value.

Three survey units had less actual survey points than planned. During planning, each survey unit was designed with an excess number of survey points beyond the MARSSIM requirements. The actual number of survey points for these survey units, although less than planned, was still confirmed to meet the MARSSIM requirements.

We continue to believe that the building has met the release criteria in the FSS plan, the decommissioning plan, and the methodology specified in MARSSIM. Accordingly, the building demolition needs to be initiated, and NRC approval to proceed is required.

Sincerely,

Gerald E. Williams

Gerald E. Williams, P.E.
Manager, Environmental Services Group

Frank Brown

Frank Brown
Project Manager

Attachments

cc: Robert Weller

Table 8.2 Example Indoor Area Factors

Nuclide	36 m^2	25 m^2	16 m^2	9 m^2	4 m^2	1 m^2
Co-60	1.0	1.2	1.6	2.5	5.5	22.7
Cs-137	1.0	1.2	1.7	2.6	5.7	23.5
H-3	1.0	1.4	2.3	4.0	9.0	36.0
Ni-63	1.0	1.4	2.3	4.0	9.0	36.0
Pu-239	1.0	1.4	2.3	4.0	9.0	36.0
Ra-226	1.0	1.4	2.1	3.6	8.0	32.2
Sr-90	1.0	1.4	2.2	4.0	8.9	35.7
Th-232	1.0	1.4	2.3	4.0	9.0	36.0
U-235	1.0	1.4	2.2	4.0	9.0	35.8
Zn-65	1.0	1.2	1.6	2.5	5.4	22.3

DandD Building Occupancy Scenario

DandD Version: 2.1.0
Run Date/Time: 6/2/2014 12:32:13 PM
Site Name: Sr-90 AF Calcs
Description: Calculation of Sr-90 Area Factors
FileName:C:\Users\ajnardi\Documents\DandD\Sr-90 Area Factors.mcd

Options:

Implicit progeny doses NOT included with explicit parent doses
Nuclide concentrations are distributed among all progeny
Number of simulations: 100
Seed for Random Generation: 8718721
Averages used for behavioral type parameters

External Pathway is ON
Inhalation Pathway is ON
Secondary Ingestion Pathway is ON

Initial Activities:

Nuclide	Area of Contamination (m^2)	Distribution
90Sr	125	CONSTANT(dpm/100 cm**2)
Justification for concentration: Sr-90 Unit Value		Value 1.00E+00

Chain Data:

Number of chains: 1

Chain No. 1: **90Sr**
Nuclides in chain: 2

Nuclide	Chain Position	Half Life	First Parent	Fractional Yield	Second Parent	Fractional Yield	Ingestion CEDE Factor (Sv/Bq)	Inhalation CEDE Factor (Sv/Bq)	Surface Dose Rate Factor ((Sv/d)/(Bq/m^2))	15 cm Dose Rate Factor ((Sv/d)/(Bq/m^3))
90Sr	1	1.06E+04					3.85E-08	3.51E-07	2.46E-14	3.21E-16
90Y	2	2.67E+00	1	1	0	0	2.91E-09	2.28E-09	4.60E-13	1.03E-14

Initial Concentrations:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	1.00E+00
90Y	0.00E+00

Model Parameters:

General Parameters:

Parameter Name	Description	Distribution
To:Time In Building	The time in the building during the occupancy period	CONSTANT(hr/week)
Default value used		Value 4.50E+01
Tto:Occupancy Period	The duration of the occupancy exposure period	CONSTANT(days)
Default value used		Value 3.65E+02
Vo:Breathing Rate	The average volumetric breathing rate during building occupancy for an 8-hour work day	CONSTANT(m**3/hr)
Default value used		Value 1.40E+00
RFo*:Resuspension Factor	Effective resuspension factor during the occupancy period = RFo * Fl	DERIVED(1/m)
Default value used		
GO*:Ingestion Rate	Effective secondary ingestion transfer rate of removable surface activity from building surfaces to the mouth during building occupancy = GO * Fl	DERIVED(m**2/hr)
Default value used		
Tstart:Start Time	The start time of the scenario in days	CONSTANT(days)
Default value used		Value 0.00E+00
Tend:End Time	The ending time of the scenario in days	CONSTANT(days)
Default value used		Value 3.65E+02
dt:Time Step Size	The time step size	CONSTANT(days)
Default value used		Value 3.65E+02
Pstep:Print Step Size	The time steps for the history file. Doses will be written to the history file every n time steps	CONSTANT(none)
Default value used		Value 1.00E+00
AOExt:External Exposure Area	Minimum surface area to which occupant is exposed via external radiation during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AOInh:Inhalation Exposure Area	Minimum surface area to which occupant is exposed via inhalation during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AOIng:Secondary Ingestion Exposure Area	Minimum surface area to which occupant is exposed via secondary ingestion during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AO:Exposure Area	Minimum surface area to which occupant is exposed during the occupancy period	DERIVED(m**2)
Default value used		
Fl:Loose Fraction	Fraction of surface contamination available for resuspension and ingestion	CONSTANT(none)
Default value used		Value 1.00E-01
Rfo:Loose Resuspension Factor	Resuspension factor for loose contamination	CONTINUOUS LOGARITHMIC(1/m)
Default value used		Value / Probability 9.12E-06 / 0.00E+00 1.10E-04 / 7.67E-01 1.46E-04 / 9.09E-01 1.62E-04 / 9.50E-01 1.85E-04 / 9.90E-01 1.90E-04 / 1.00E+00

GO:Loose Ingestion Rate	The secondary ingestion transfer rate of loose removable surface activity from building surfaces to the mouth during building occupancy	CONSTANT(m**2/hr)
Default value used		Value 1.10E-04

Correlation Coefficients:

None

Summary Results:

90.00% of the 100 calculated TEDE values are < 2.88E-03 mrem/year .
The 95 % Confidence Interval for the 0.9 quantile value of TEDE is 2.59E-03 to 3.26E-03 mrem/year

Detailed Results:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Concentration at Time of Peak Dose:

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	9.88E-01
90Y	9.78E-01

Pathway Dose from All Nuclides (mrem)

All Pathways Dose	External	Inhalation	Secondary Ingestion
3.26E-03	7.70E-06	3.07E-03	1.75E-04

Radionuclide Dose through All Active Pathways (mrem)

Nuclide	All Pathways Dose
90Sr	3.22E-03
90Y	3.91E-05
All Nuclides	3.26E-03

Dose from Each Nuclide through Each Active Pathway (mrem)

Nuclide	External	Inhalation	Secondary Ingestion
90Sr	3.95E-07	3.05E-03	1.63E-04
90Y	7.31E-06	1.96E-05	1.22E-05

DandD Building Occupancy Scenario

DandD Version: 2.1.0
Run Date/Time: 6/2/2014 12:25:31 PM
Site Name: Sr-90 AF Calcs
Description: Calculation of Sr-90 Area Factors
FileName:C:\Users\ajnardi\Documents\DandD\Sr-90 Area Factors.mcd

Options:

Implicit progeny doses NOT included with explicit parent doses
Nuclide concentrations are distributed among all progeny
Number of simulations: 100
Seed for Random Generation: 8718721
Averages used for behavioral type parameters

External Pathway is ON
Inhalation Pathway is ON
Secondary Ingestion Pathway is ON

Initial Activities:

Nuclide	Area of Contamination (m^2)	Distribution
90Sr	10	CONSTANT(dpm/100 cm**2)
Justification for concentration: Sr-90 Unit Value		Value 1.00E+00

Chain Data:

Number of chains: 1

Chain No. 1: 90Sr
Nuclides in chain: 2

Nuclide	Chain Position	Half Life	First Parent	Fractional Yield	Second Parent	Fractional Yield	Ingestion CEDE Factor (Sv/Bq)	Inhalation CEDE Factor (Sv/Bq)	Surface Dose Rate Factor ((Sv/d)/(Bq/m^2))	15 cm Dose Rate Factor ((Sv/d)/(Bq/m^3))
90Sr	1	1.06E+04					3.85E-08	3.51E-07	2.46E-14	3.21E-16
90Y	2	2.67E+00	1	1	0	0	2.91E-09	2.28E-09	4.60E-13	1.03E-14

Initial Concentrations:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	1.00E+00
90Y	0.00E+00

Model Parameters:

General Parameters:

Parameter Name	Description	Distribution
To:Time In Building	The time in the building during the occupancy period	CONSTANT(hr/week)
Default value used		Value 4.50E+01
Tto:Occupancy Period	The duration of the occupancy exposure period	CONSTANT(days)
Default value used		Value 3.65E+02
Vo:Breathing Rate	The average volumetric breathing rate during building occupancy for an 8-hour work day	CONSTANT(m**3/hr)
Default value used		Value 1.40E+00
RFo*:Resuspension Factor	Effective resuspension factor during the occupancy period = RFo * Fl	DERIVED(1/m)
Default value used		
GO*:Ingestion Rate	Effective secondary ingestion transfer rate of removable surface activity from building surfaces to the mouth during building occupancy = GO * Fl	DERIVED(m**2/hr)
Default value used		
Tstart:Start Time	The start time of the scenario in days	CONSTANT(days)
Default value used		Value 0.00E+00
Tend:End Time	The ending time of the scenario in days	CONSTANT(days)
Default value used		Value 3.65E+02
dt:Time Step Size	The time step size	CONSTANT(days)
Default value used		Value 3.65E+02
Pstep:Print Step Size	The time steps for the history file. Doses will be written to the history file every n time steps	CONSTANT(none)
Default value used		Value 1.00E+00
AOExt:External Exposure Area	Minimum surface area to which occupant is exposed via external radiation during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AOInh:Inhalation Exposure Area	Minimum surface area to which occupant is exposed via inhalation during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AOIng:Secondary Ingestion Exposure Area	Minimum surface area to which occupant is exposed via secondary ingestion during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AO:Exposure Area	Minimum surface area to which occupant is exposed during the occupancy period	DERIVED(m**2)
Default value used		
Fl:Loose Fraction	Fraction of surface contamination available for resuspension and ingestion	CONSTANT(none)
Default value used		Value 1.00E-01
Rfo:Loose Resuspension Factor	Resuspension factor for loose contamination	CONTINUOUS LOGARITHMIC(1/m)
Default value used		Value / Probability 9.12E-06 / 0.00E+00 1.10E-04 / 7.67E-01 1.46E-04 / 9.09E-01 1.62E-04 / 9.50E-01 1.85E-04 / 9.90E-01 1.90E-04 / 1.00E+00

GO:Loose Ingestion Rate	The secondary ingestion transfer rate of loose removable surface activity from building surfaces to the mouth during building occupancy	CONSTANT(m**2/hr)
Default value used		Value 1.10E-04

Correlation Coefficients:

None

Summary Results:

90.00% of the 100 calculated TEDE values are < 2.88E-03 mrem/year .
The 95 % Confidence Interval for the 0.9 quantile value of TEDE is 2.59E-03 **to** 3.26E-03 **mrem/year**

Detailed Results:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Concentration at Time of Peak Dose:

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	9.88E-01
90Y	9.78E-01

Pathway Dose from All Nuclides (mrem)

All Pathways Dose	External	Inhalation	Secondary Ingestion
3.26E-03	7.70E-06	3.07E-03	1.75E-04

Radionuclide Dose through All Active Pathways (mrem)

Nuclide	All Pathways Dose
90Sr	3.22E-03
90Y	3.91E-05
All Nuclides	3.26E-03

Dose from Each Nuclide through Each Active Pathway (mrem)

Nuclide	External	Inhalation	Secondary Ingestion
90Sr	3.95E-07	3.05E-03	1.63E-04
90Y	7.31E-06	1.96E-05	1.22E-05

DandD Building Occupancy Scenario

DandD Version: 2.1.0
Run Date/Time: 6/2/2014 12:28:47 PM
Site Name: Sr-90 AF Calcs
Description: Calculation of Sr-90 Area Factors
FileName:C:\Users\ajnardi\Documents\DandD\Sr-90 Area Factors.mcd

Options:

Implicit progeny doses NOT included with explicit parent doses
Nuclide concentrations are distributed among all progeny
Number of simulations: 100
Seed for Random Generation: 8718721
Averages used for behavioral type parameters

External Pathway is ON
Inhalation Pathway is ON
Secondary Ingestion Pathway is ON

Initial Activities:

Nuclide	Area of Contamination (m^2)	Distribution
90Sr	5	CONSTANT(dpm/100 cm**2)
Justification for concentration: Sr-90 Unit Value		Value 1.00E+00

Chain Data:

Number of chains: 1

Chain No. 1: **90Sr**
Nuclides in chain: 2

Nuclide	Chain Position	Half Life	First Parent	Fractional Yield	Second Parent	Fractional Yield	Ingestion CEDE Factor (Sv/Bq)	Inhalation CEDE Factor (Sv/Bq)	Surface Dose Rate Factor ((Sv/d)/(Bq/m^2))	15 cm Dose Rate Factor ((Sv/d)/(Bq/m^3))
90Sr	1	1.06E+04					3.85E-08	3.51E-07	2.46E-14	3.21E-16
90Y	2	2.67E+00	1	1	0	0	2.91E-09	2.28E-09	4.60E-13	1.03E-14

Initial Concentrations:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	5.00E-01
90Y	0.00E+00

Model Parameters:

General Parameters:

Parameter Name	Description	Distribution	
To:Time In Building	The time in the building during the occupancy period	CONSTANT(hr/week)	
Default value used		Value	4.50E+01
Tto:Occupancy Period	The duration of the occupancy exposure period	CONSTANT(days)	
Default value used		Value	3.65E+02
Vo:Breathing Rate	The average volumetric breathing rate during building occupancy for an 8-hour work day	CONSTANT(m**3/hr)	
Default value used		Value	1.40E+00
RFo*:Resuspension Factor	Effective resuspension factor during the occupancy period = RFo * Fl	DERIVED(1/m)	
Default value used			
GO*:Ingestion Rate	Effective secondary ingestion transfer rate of removable surface activity from building surfaces to the mouth during building occupancy = GO * Fl	DERIVED(m**2/hr)	
Default value used			
Tstart:Start Time	The start time of the scenario in days	CONSTANT(days)	
Default value used		Value	0.00E+00
Tend:End Time	The ending time of the scenario in days	CONSTANT(days)	
Default value used		Value	3.65E+02
dt:Time Step Size	The time step size	CONSTANT(days)	
Default value used		Value	3.65E+02
Pstep:Print Step Size	The time steps for the history file. Doses will be written to the history file every n time steps	CONSTANT(none)	
Default value used		Value	1.00E+00
AOExt:External Exposure Area	Minimum surface area to which occupant is exposed via external radiation during occupancy period	CONSTANT(m**2)	
Default value used		Value	1.00E+01
AOInh:Inhalation Exposure Area	Minimum surface area to which occupant is exposed via inhalation during occupancy period	CONSTANT(m**2)	
Default value used		Value	1.00E+01
AOIng:Secondary Ingestion Exposure Area	Minimum surface area to which occupant is exposed via secondary ingestion during occupancy period	CONSTANT(m**2)	
Default value used		Value	1.00E+01
AO:Exposure Area	Minimum surface area to which occupant is exposed during the occupancy period	DERIVED(m**2)	
Default value used			
Fl:Loose Fraction	Fraction of surface contamination available for resuspension and ingestion	CONSTANT(none)	
Default value used		Value	1.00E-01
Rfo:Loose Resuspension Factor	Resuspension factor for loose contamination	CONTINUOUS LOGARITHMIC(1/m)	
Default value used		Value	Probability
		9.12E-06	0.00E+00
		1.10E-04	7.67E-01
		1.46E-04	9.09E-01
		1.62E-04	9.50E-01
		1.85E-04	9.90E-01
		1.90E-04	1.00E+00

GO:Loose Ingestion Rate	The secondary ingestion transfer rate of loose removable surface activity from building surfaces to the mouth during building occupancy	CONSTANT(m**2/hr)
Default value used		Value 1.10E-04

Correlation Coefficients:

None

Summary Results:

90.00% of the 100 calculated TEDE values are < 1.44E-03 mrem/year .
The 95 % Confidence Interval for the 0.9 **quantile value of TEDE is** 1.29E-03 **to** 1.63E-03 **mrem/year**

Detailed Results:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Concentration at Time of Peak Dose:

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	4.94E-01
90Y	4.89E-01

Pathway Dose from All Nuclides (mrem)

All Pathways Dose	External	Inhalation	Secondary Ingestion
1.63E-03	3.85E-06	1.54E-03	8.77E-05

Radionuclide Dose through All Active Pathways (mrem)

Nuclide	All Pathways Dose
90Sr	1.61E-03
90Y	1.96E-05
All Nuclides	1.63E-03

Dose from Each Nuclide through Each Active Pathway (mrem)

Nuclide	External	Inhalation	Secondary Ingestion
90Sr	1.97E-07	1.53E-03	8.16E-05
90Y	3.65E-06	9.81E-06	6.10E-06

DandD Building Occupancy Scenario

DandD Version: 2.1.0
Run Date/Time: 6/2/2014 12:30:07 PM
Site Name: Sr-90 AF Calcs
Description: Calculation of Sr-90 Area Factors
FileName:C:\Users\ajnardi\Documents\DandD\Sr-90 Area Factors.mcd

Options:

Implicit progeny doses NOT included with explicit parent doses
Nuclide concentrations are distributed among all progeny
Number of simulations: 100
Seed for Random Generation: 8718721
Averages used for behavioral type parameters

External Pathway is ON
Inhalation Pathway is ON
Secondary Ingestion Pathway is ON

Initial Activities:

Nuclide	Area of Contamination (m^2)	Distribution
90Sr	3	CONSTANT(dpm/100 cm**2)
Justification for concentration: Sr-90 Unit Value		Value 1.00E+00

Chain Data:

Number of chains: **1**

Chain No. 1: **90Sr**
Nuclides in chain: **2**

Nuclide	Chain Position	Half Life	First Parent	Fractional Yield	Second Parent	Fractional Yield	Ingestion CEDE Factor (Sv/Bq)	Inhalation CEDE Factor (Sv/Bq)	Surface Dose Rate Factor ((Sv/d)/(Bq/m^2))	15 cm Dose Rate Factor ((Sv/d)/(Bq/m^3))
90Sr	1	1.06E+04					3.85E-08	3.51E-07	2.46E-14	3.21E-16
90Y	2	2.67E+00	1	1	0	0	2.91E-09	2.28E-09	4.60E-13	1.03E-14

Initial Concentrations:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	3.00E-01
90Y	0.00E+00

Model Parameters:

General Parameters:

Parameter Name	Description	Distribution
To:Time In Building	The time in the building during the occupancy period	CONSTANT(hr/week)
Default value used		Value 4.50E+01
Tto:Occupancy Period	The duration of the occupancy exposure period	CONSTANT(days)
Default value used		Value 3.65E+02
Vo:Breathing Rate	The average volumetric breathing rate during building occupancy for an 8-hour work day	CONSTANT(m**3/hr)
Default value used		Value 1.40E+00
RFo*:Resuspension Factor	Effective resuspension factor during the occupancy period = RFo * Fl	DERIVED(1/m)
Default value used		
GO*:Ingestion Rate	Effective secondary ingestion transfer rate of removable surface activity from building surfaces to the mouth during building occupancy = GO * Fl	DERIVED(m**2/hr)
Default value used		
Tstart:Start Time	The start time of the scenario in days	CONSTANT(days)
Default value used		Value 0.00E+00
Tend:End Time	The ending time of the scenario in days	CONSTANT(days)
Default value used		Value 3.65E+02
dt:Time Step Size	The time step size	CONSTANT(days)
Default value used		Value 3.65E+02
Pstep:Print Step Size	The time steps for the history file. Doses will be written to the history file every n time steps	CONSTANT(none)
Default value used		Value 1.00E+00
AOExt:External Exposure Area	Minimum surface area to which occupant is exposed via external radiation during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AOInh:Inhalation Exposure Area	Minimum surface area to which occupant is exposed via inhalation during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AOIng:Secondary Ingestion Exposure Area	Minimum surface area to which occupant is exposed via secondary ingestion during occupancy period	CONSTANT(m**2)
Default value used		Value 1.00E+01
AO:Exposure Area	Minimum surface area to which occupant is exposed during the occupancy period	DERIVED(m**2)
Default value used		
Fl:Loose Fraction	Fraction of surface contamination available for resuspension and ingestion	CONSTANT(none)
Default value used		Value 1.00E-01
Rfo:Loose Resuspension Factor	Resuspension factor for loose contamination	CONTINUOUS LOGARITHMIC(1/m)
Default value used		Value / Probability 9.12E-06 / 0.00E+00 1.10E-04 / 7.67E-01 1.46E-04 / 9.09E-01 1.62E-04 / 9.50E-01 1.85E-04 / 9.90E-01 1.90E-04 / 1.00E+00

GO:Loose Ingestion Rate	The secondary ingestion transfer rate of loose removable surface activity from building surfaces to the mouth during building occupancy	CONSTANT(m**2/hr)
Default value used		Value 1.10E-04

Correlation Coefficients:

None

Summary Results:

90.00% **of the** 100 **calculated TEDE values are** < 8.64E-04 **mrem/year .**
The 95 % Confidence Interval for the 0.9 **quantile value of TEDE is** 7.76E-04 **to** 9.77E-04 **mrem/year**

Detailed Results:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Concentration at Time of Peak Dose:

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	2.96E-01
90Y	2.93E-01

Pathway Dose from All Nuclides (mrem)

All Pathways Dose	External	Inhalation	Secondary Ingestion
9.77E-04	2.31E-06	9.22E-04	5.26E-05

Radionuclide Dose through All Active Pathways (mrem)

Nuclide	All Pathways Dose
90Sr	9.65E-04
90Y	1.17E-05
All Nuclides	9.77E-04

Dose from Each Nuclide through Each Active Pathway (mrem)

Nuclide	External	Inhalation	Secondary Ingestion
90Sr	1.18E-07	9.16E-04	4.90E-05
90Y	2.19E-06	5.89E-06	3.66E-06

DandD Building Occupancy Scenario

DandD Version: 2.1.0
Run Date/Time: 6/2/2014 12:31:14 PM
Site Name: Sr-90 AF Calcs
Description: Calculation of Sr-90 Area Factors
FileName:C:\Users\ajnardi\Documents\DandD\Sr-90 Area Factors.mcd

Options:

Implicit progeny doses NOT included with explicit parent doses
Nuclide concentrations are distributed among all progeny
Number of simulations: 100
Seed for Random Generation: 8718721
Averages used for behavioral type parameters

External Pathway is ON
Inhalation Pathway is ON
Secondary Ingestion Pathway is ON

Initial Activities:

Nuclide	Area of Contamination (m^2)	Distribution
90Sr	1	CONSTANT(dpm/100 cm**2)
Justification for concentration: Sr-90 Unit Value		Value 1.00E+00

Chain Data:

Number of chains: 1

Chain No. 1: **90Sr**
Nuclides in chain: 2

Nuclide	Chain Position	Half Life	First Parent	Fractional Yield	Second Parent	Fractional Yield	Ingestion CEDE Factor (Sv/Bq)	Inhalation CEDE Factor (Sv/Bq)	Surface Dose Rate Factor ((Sv/d)/(Bq/m^2))	15 cm Dose Rate Factor ((Sv/d)/(Bq/m^3))
90Sr	1	1.06E+04					3.85E-08	3.51E-07	2.46E-14	3.21E-16
90Y	2	2.67E+00	1	1	0	0	2.91E-09	2.28E-09	4.60E-13	1.03E-14

Initial Concentrations:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	1.00E-01
90Y	0.00E+00

Model Parameters:

General Parameters:

Parameter Name	Description	Distribution	
To:Time In Building	The time in the building during the occupancy period	CONSTANT(hr/week)	
Default value used		Value	4.50E+01
Tto:Occupancy Period	The duration of the occupancy exposure period	CONSTANT(days)	
Default value used		Value	3.65E+02
Vo:Breathing Rate	The average volumetric breathing rate during building occupancy for an 8-hour work day	CONSTANT(m**3/hr)	
Default value used		Value	1.40E+00
RFo*:Resuspension Factor	Effective resuspension factor during the occupancy period = RFo * Fl	DERIVED(1/m)	
Default value used			
GO*:Ingestion Rate	Effective secondary ingestion transfer rate of removable surface activity from building surfaces to the mouth during building occupancy = GO * Fl	DERIVED(m**2/hr)	
Default value used			
Tstart:Start Time	The start time of the scenario in days	CONSTANT(days)	
Default value used		Value	0.00E+00
Tend:End Time	The ending time of the scenario in days	CONSTANT(days)	
Default value used		Value	3.65E+02
dt:Time Step Size	The time step size	CONSTANT(days)	
Default value used		Value	3.65E+02
Pstep:Print Step Size	The time steps for the history file. Doses will be written to the history file every n time steps	CONSTANT(none)	
Default value used		Value	1.00E+00
AOExt:External Exposure Area	Minimum surface area to which occupant is exposed via external radiation during occupancy period	CONSTANT(m**2)	
Default value used		Value	1.00E+01
AOInh:Inhalation Exposure Area	Minimum surface area to which occupant is exposed via inhalation during occupancy period	CONSTANT(m**2)	
Default value used		Value	1.00E+01
AOIng:Secondary Ingestion Exposure Area	Minimum surface area to which occupant is exposed via secondary ingestion during occupancy period	CONSTANT(m**2)	
Default value used		Value	1.00E+01
AO:Exposure Area	Minimum surface area to which occupant is exposed during the occupancy period	DERIVED(m**2)	
Default value used			
Fl:Loose Fraction	Fraction of surface contamination available for resuspension and ingestion	CONSTANT(none)	
Default value used		Value	1.00E-01
Rfo:Loose Resuspension Factor	Resuspension factor for loose contamination	CONTINUOUS LOGARITHMIC(1/m)	
Default value used		Value	Probability
		9.12E-06	0.00E+00
		1.10E-04	7.67E-01
		1.46E-04	9.09E-01
		1.62E-04	9.50E-01
		1.85E-04	9.90E-01
		1.90E-04	1.00E+00

GO:Loose Ingestion Rate	The secondary ingestion transfer rate of loose removable surface activity from building surfaces to the mouth during building occupancy	CONSTANT(m**2/hr)
Default value used		Value 1.10E-04

Correlation Coefficients:

None

Summary Results:

90.00% of the 100 calculated **TEDE values are** < 2.88E-04 **mrem/year .**
The 95 % Confidence Interval for the 0.9 **quantile value of TEDE is** 2.59E-04 **to** 3.26E-04 **mrem/year**

Detailed Results:

Note: All reported values are the upper bound of the symmetric 95% confidence interval for the 0.9 quantile value

Concentration at Time of Peak Dose:

Nuclide	Surface Concentration (dpm/100 cm**2)
90Sr	9.88E-02
90Y	9.78E-02

Pathway Dose from All Nuclides (mrem)

All Pathways Dose	External	Inhalation	Secondary Ingestion
3.26E-04	7.70E-07	3.07E-04	1.75E-05

Radionuclide Dose through All Active Pathways (mrem)

Nuclide	All Pathways Dose
90Sr	3.22E-04
90Y	3.91E-06
All Nuclides	3.26E-04

Dose from Each Nuclide through Each Active Pathway (mrem)

Nuclide	External	Inhalation	Secondary Ingestion
90Sr	3.95E-08	3.05E-04	1.63E-05
90Y	7.31E-07	1.96E-06	1.22E-06

Survey Package Identification	Planned Number of Survey Points	Actual Number of Survey Points	Survey Points Exceeding the Investigation Level	Survey Point Exceeding the Average Release Level
RCD-001	15	15	0	0
RCD-002	15	15	0	0
RGD-001	15	15	0	0
RGD-002	15	15	0	0
RND-001	19	19	0	0
RND-002	16	16	0	0
ADM-10K-001	23	23	0	0
ADM-BR-001	20	20	0	0
ADM-100	14	14	0	0
ADM-115	14	14	0	0
ADM-1K-001	14	14	0	0
RBC-201	14	14	0	0
ADM-000-4	14	14	0	0
ADM-000-5	28	28	2	4 (1)
ADM-001-1	14	14	0	0
ADM-001-2	14	14	0	0
ADM-201	14	14	0	0
RBC-200-1	14	14	2	2 (2)
RBC-201-1	14	14	2	0
RBE-401	14	13	0	0
RBG-101	14	14	0	0
RBN-000-1	14	11	0	2 (3)
RBN-001	14	14	0	0
RBN-001-1	14	11	0	0
ADM-200	14	14	0	0
ADM-101	14	14	0	0
RBR-301	14	14	0	0
ADM-301	14	14	0	0
ADM-401	14	14	0	0

Notes:

(1) Four points each less than 1-meter square exceed the average release limit but not the maximum release limit specified in Reg Guide 1.86 Table 1. The survey unit passes the Sign Test.
(2) Two points each less than 1-meter square exceed the average release limit but not the maximum release limit specified in Reg Guide 1.86 Table 1. The survey unit passes the Sign Test.
(3) Two points exceed the average release limit. The location is part of a recognized activated structural component to be removed during demolition and disposed as LLRW.