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ENVIRONMENTAL CALCULATION COVER PAGE

Section 1: Completed by the Responsible Manager

Project: KBO&PR

Date: 8/21/2017

Calculation Title & Description: Radiological and Toxic Air Emissions for the 215C Gas Preparation Building

RELEASE / ISSUE

DATE: Sep 27, 2017 HANFORD RELEASE

Section 2: Completed by Preparer

Calculation No.: ECF-HANFORD-17-0035 **Revision No.:** 0

Revision History

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APPROVED
By Julia Raymer at 1:13 pm, Sep 25, 2017

Approved for Public Release; Further Dissemination Unlimited

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Contents

1 Introduction **1**

2 Background **1**

3 Radiological Air Emission Calculations **2**

3.1 Assumptions and Inputs 3

3.2 Methodology 4

3.2.1 Material-at-Risk 5

3.2.2 Potential-to-Emit 5

3.2.3 Dose to the Maximally Exposed Individual 5

3.3 Software Applications 6

3.4 Calculations 6

3.5 Results 6

4 Criteria/Toxic Air Determination **7**

5 References **8**

Appendix

A Radiological Survey Report RC-1200248 ..... **A-i**

Figures

Figure 1. 215C Building within the 200 East Area 1

Figure 2. 215C Building 2

Figure 3. Near-Field Air Monitoring Locations for the 215C Building 3

Table

Table 1. PTE Calculation for the 215C Gas Preparation Building 7

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Terms

β	beta ray
γ	gamma ray
CF	Conversion factor
ECF	environmental calculation file
MAR	material-at-risk
MEI	maximally exposed individual
NESHAP	National Emission Standards for Hazardous Air
NTCRA	non-time-critical removal action
PTE	potential-to-emit

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1 Introduction

This environmental calculation file (ECF) provides radiological air emission estimates and a criteria/toxic air determination for the non-time-critical removal action (NTCRA) at the 215C Gas Preparation Building (hereinafter referred to as the 215C Building), The 215C Building is located within the Hot Semiworks Complex in the 200 East Area (Figure 1). This document summarizes the assumptions, inputs, and methodology used to calculate the potential-to-emit (PTE) radionuclide airborne emissions and potential dose to the maximally exposed individual (MEI) associated with the removal action.

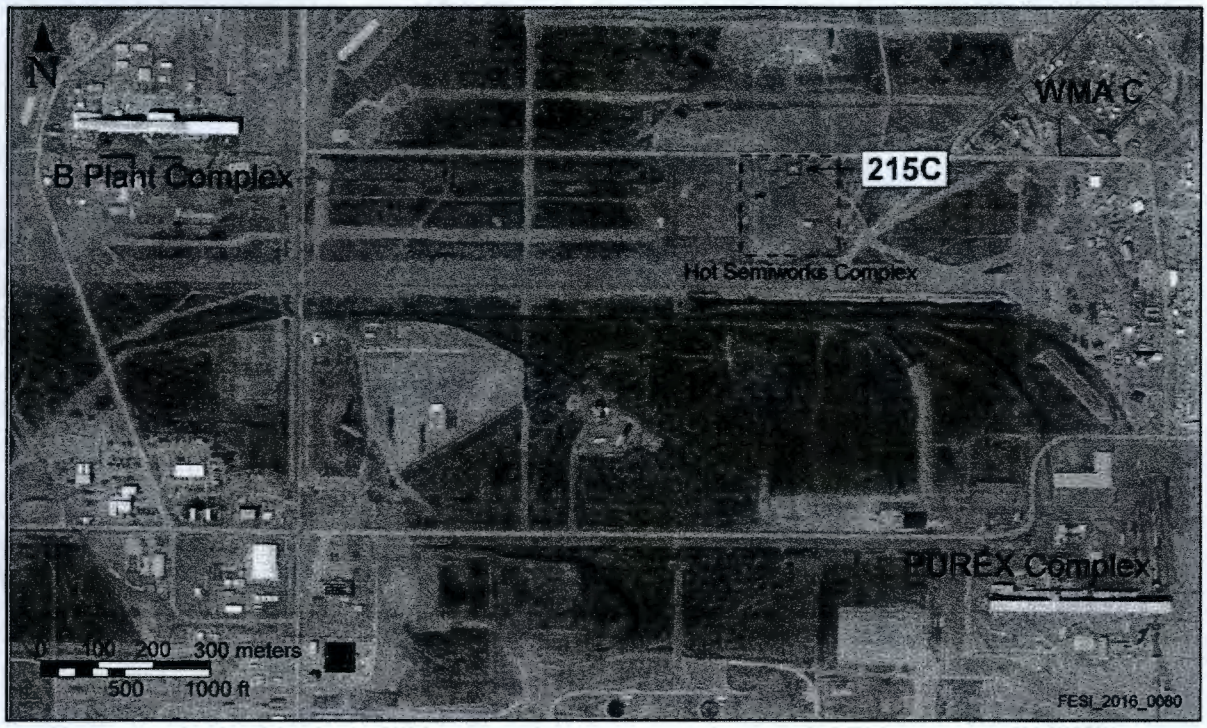

Figure 1. 215C Building within the 200 East Area

This ECF supports DOE/RL-2016-50, *Removal Action Work Plan for the 200 East Tier 2 Miscellaneous Buildings/Structures*, Draft A, which implements the demolition of the 215C Building in accordance with DOE/RL-2010-102, *Action Memorandum for Decontamination, Deactivation, Decommissioning, and Demolition (D4) Activities for 200 East Tier 2 Buildings/Structures*.

2 Background

The 215C Building (Figure 2) is a 10.7 m (35 ft) long by 6.4 m (21 ft) wide by 4 m (13 ft) high single-level concrete structure. The building consists of two rooms and was used to store equipment, compressors, and inert gas cylinders. An open shed with a sloping roof is attached to the south side of the building and provided storage for gas cylinders. The 215C Building was decommissioned and decontaminated in 1985 and is a Tier 2 building that is slated for final disposition. A radiological contamination survey was last conducted at the 215C Building in May 2012 as part of ongoing surveillance and maintenance operations.

Figure 2. 215C Building

Removal actions for the 215C Building are described in DOE/RL-2016-50, Draft A, and include demolition of the building to slab-on-grade and disposition of demolition waste. The remaining hazards associated with the 215C Building include fixed radioactive contamination and asbestos-containing material. Radiological surveys performed in May 2012 are documented in Radiological Survey Report RC-1200248, which is provided in Appendix A. Based on the survey report, the only areas of the 215C Building to have fixed contamination are in the smaller of the two rooms within the building. Additional information about the 215C Building radiological survey results is in Section 3.1.

3 Radiological Air Emission Calculations

The methodology used to estimate the PTE is based on the guidance document DOE/RL-2006-29, *Calculating Potential to Emit Radiological Releases and Doses*. Radiological airborne emissions control and monitoring requirements will be identified, as needed, based on the calculated value of the potential emissions and resultant public exposure. This information will be provided in field work packages, as appropriate.

Radiological release potential exists at the 215C Building. The applicable state requirements in WAC 246-247, "Radiation Protection—Air Emissions," address potential radioactive airborne emissions from point sources and from fugitive or diffuse sources and require monitoring of such sources. Potential radiological releases from the 215C Building removal action would be considered fugitive emissions and

would be monitored by the existing Hanford Site Environmental Monitoring Program, which serves as the monitoring system for all site activities as described in DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*. Near-facility ambient air monitoring stations N019, N970, N973, and N976 that surround the Hot Semiworks Complex area are planned to be used for monitoring during the removal action (Figure 3).

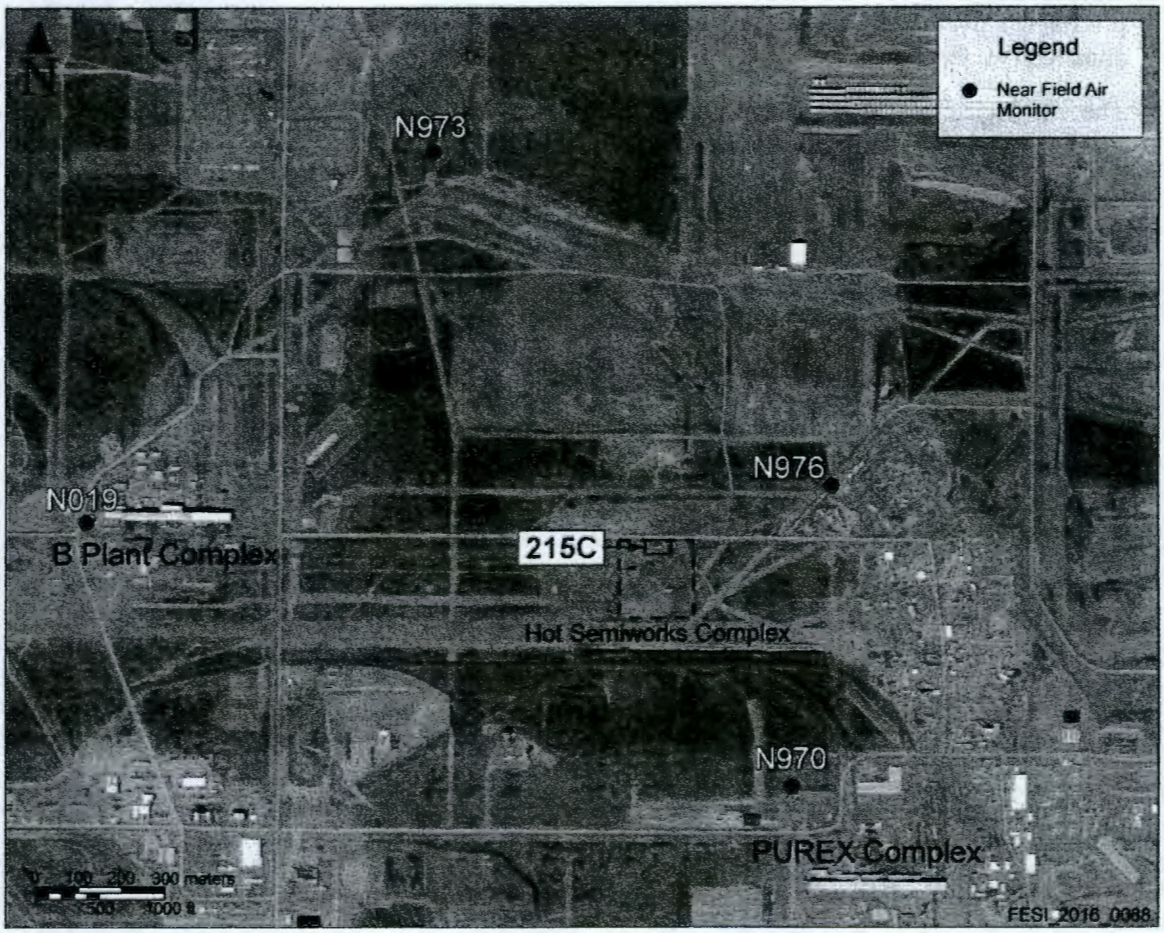

Figure 3. Near-Field Air Monitoring Locations for the 215C Building

3.1 Assumptions and Inputs

The assumptions and inputs used to calculate PTE and the onsite/offsite dose to the MEI values associated with the 215C Building removal action are described in this section. The assumptions and inputs obtained from site features, physical parameters, and data from radiological survey reports include the following:

1. A radiological survey was conducted at the 215C Building in May 2012. Radiological Survey Report RC-1200248 (Appendix A) contains measurable levels of total beta (β)/gamma (γ) contamination.

2. Radiological Survey Report RC-1200248 (Appendix A) identifies fixed contamination at three discrete locations on the floor within a small room within the 215C Building. This small room is isolated from the rest of the 215C Building by a 20 cm (8 in.) concrete wall and can only be entered

through an exterior door. The entire floor area of this small room (8.3 m^2 [88.9 ft^2]) is assumed to be contaminated. The entirety of this surface area is used as the contaminated area in the calculation.

3. Radiological Survey Report RC-1200248 (Appendix A) included three survey points, one with an area of 929 cm^2 (1 ft^2) and two with areas of 100 cm^2 (0.1 ft^2) each. All points surveyed were on the floor. The highest total contamination measurement was 1,890,000 disintegrations per minute (dpm) per 100 cm^2 $\beta\gamma$. For conservative purposes, the highest contamination measurement of 1,890,000 dpm/100 cm^2 $\beta\gamma$ is used.
4. The radiological constituent of concern at the 215C Building is Sr-90, based on building history and Hot Semiworks Complex process knowledge.
5. To account for any additional unexpected contamination at the 215C Building, material-at-risk (MAR) is conservatively multiplied by 10.
6. A potential release height of less than 40 m (131 ft) within the 200 East Area is assumed. Dose consequence can be calculated in accordance with DOE/RL-2006-29.
7. It is assumed that the entire MAR, in a particulate form, is available for release within a 1-year period
8. The radionuclides of concern are particulate solids; therefore, a release fraction of 1.0E-03 is used, in accordance with WAC 246 247 030(21)(a), "Definitions," and 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" (NESHAP), Appendix D, "Methods for Estimating Radionuclide Emissions."
9. The dose factors used for this ECF were taken from DOE/RL-2006-29, Table 4.4, with an effective release height of less than 40 m (131 ft). The dose-per-unit-release factors include the parent isotope and its radioactive decay products (+D), in accordance with Section 3.2.3 of DOE/RL-2006-29. Dose factor values are provided in Section 3.4.

3.2 Methodology

Potential radionuclide air emission estimates were determined using Method 1: Annual Possession Quantity methodology as described in DOE/RL-2006-29.

Building radiological reports and process knowledge are used to estimate MAR, which is the assumed quantity of contamination present. MAR is used to calculate PTE, which is an estimate of the radionuclides that could potentially be emitted during the 215C Building removal action. The PTE and dose factors from DOE/RL-2006-29, are used to determine onsite and offsite doses to the MEI.

The calculation is outlined in the following steps:

1. Calculate the MAR (Section 3.2.1).
2. Determine PTE (Section 3.2.2).
3. Calculate onsite and offsite doses to the MEI (Section 3.2.3).

The following sections provide detailed descriptions of each step, as well as example calculations. Section 3.4 provides the air emissions calculations.

3.2.1 Material-at-Risk

MAR is measured as total activity in curies. MAR is calculated as follows:

1. Convert the estimated contaminated surface area to square centimeters, as shown in Equation 1. The conversion factor (CF) for converting square meters to square centimeters is 1 m^2 = 10,000 cm^2.

2. Multiply the highest radiological contamination survey readings (Sr-90 assumed) for total contamination dpm/100 cm^2 by the assumed contaminated surface area (cm^2) from Step 1. This will eliminate the area units from the measured value.

3. Convert the result of the previous step from dpm to curies. The CF for converting dpm to curies is 1 Ci = 2.22E+12 dpm.

4. For the purposes of this calculation, survey data is conservatively multiplied by 10 to account for any additional unexpected contamination, as specified in Section 3.1, Item 5:

$$\text{MAR}\ (Ci) = \text{A}\ (m^2) \times \left(\frac{10{,}000\ cm^2}{1\ m^2}\right) \times \left(\frac{1\ dpm}{100\ cm^2}\right) \times \left(\frac{1\ Ci}{2.22\text{E}{+}12 dpm}\right) \times 10 \quad (1)$$

3.2.2 Potential-to-Emit

The maximum PTE in a calendar year is calculated using the MAR and a release fraction, in accordance with NESHAP (40 CFR 61, Appendix D). Since it is assumed that the entire MAR is available for release within a 1-year period, as described in Section 3.1, Item 7, Ci/yr is used for MAR units in PTE and MEI dose calculations. The MAR, assumed to be in particulate form, is multiplied by a unitless release fraction of 1.0E-03, as described in Section 3.1, Item 8. Equation 2 shows this process:

$$\text{PTE}\ \left(\frac{Ci}{yr}\right) = \text{MAR}\ \left(\frac{Ci}{yr}\right) \times 1.0\text{E-}03 \quad (2)$$

3.2.3 Dose to the Maximally Exposed Individual

The potential total onsite and offsite dose to the MEI are determined by multiplying the PTE, as determined using Equation 2, by the dose-per-unit-release factors, as described in Section 3.1, Item 9. Calculating the onsite dose to the MEI for a single isotope is performed using Equation 3:

$$\text{Onsite Dose}\ \left(\frac{mrem}{yr}\right) = \text{PTE}\ \left(\frac{Ci}{yr}\right) \times \text{Onsite Dose Factor}\ \left(\frac{mrem}{yr} \div \frac{Ci}{yr}\right) \quad (3)$$

Similarly, the offsite dose to the MEI for a single isotope is performed using Equation 4:

$$\text{Offsite Dose}\ \left(\frac{mrem}{yr}\right) = \text{PTE}\ \left(\frac{Ci}{yr}\right) \times \text{Offsite Dose Factor}\ \left(\frac{mrem}{yr} \div \frac{Ci}{yr}\right) \quad (4)$$

3.3 Software Applications

Microsoft® Excel® 2016 was used to perform the calculations in Section 3.4. Excel is a "Site Licensed Client Software" and is exempt from formal control requirements of PRC-PRO-IRM-309, *Controlled Software Management*.

3.4 Calculations

Table 1 provides calculations of potential air emissions for the 215C Building demolition. These calculations follow the methodology described in Section 3.2, using the assumptions and inputs stated in Section 3.1. The potential dose to the onsite MEI is 2.8E-07 mrem/yr. The potential dose to the offsite MEI is 1.36E-06 mrem/yr.

3.5 Results

Potential radionuclide air emission estimates were calculated for the 215C Building removal action described in DOE/RL-2016-50, Draft A. The resulting onsite and offsite MEI are as follows:

- The potential dose equivalent to the onsite MEI is 2.8E-07 mrem/yr. The onsite MEI is located at Energy Northwest. The distance from the 200 East Area emission zone to Energy Northwest is assumed to be 16.7 km (10.4 mi) east-southeast.
- The potential dose equivalent to the offsite MEI is 1.36E-06 mrem/yr. The offsite MEI is located at the Hanford Site boundary. The distance from the 200 East Area emission zone to the Hanford Site boundary is 19.4 km (12.1 mi) east-southeast.

The potential effective dose equivalent to the MEI emission values for the 215C Building, as determined by these calculations, are well below 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." They are also well within compliance with WAC 246-221-060, "Radiation Protection Standards," "Dose Limits for Individual Members of the Public," which requires that operations not result in a total effective dose equivalent to individual members of the public in excess of 10 mrem/yr.

® Microsoft and Excel are registered trademarks of Microsoft Corporation, Redmond, Washington.

Table 1. PTE Calculation for the 215C Gas Preparation Building

A	B	C	D	E	F	G	H	I
					Dose Factor[e] (mrem/yr per Ci/yr)		Dose (mrem/yr)	
Radionuclide	Surface Area[a] (m^2)	Highest Contamination[b] (dpm/100 cm^2)	MAR[c] (Ci)	PTE[d] (Ci/yr)	Onsite MEI	Offsite MEI	Onsite MEI[f]	Offsite MEI[g]
Sr-90	8.3	1.89E+06	7.07E-03	7.07E-06	3.96E-02	1.93E-01	2.80E-07	1.36E-06
						Total	**2.80E-07**	**1.36E-06**

a. Surface area is equal to the entire floor area of a small room within the 215C Building, as specified in Section 3.1, Item 2.

b. Highest contamination value was obtained from Radiological Survey Report RC-1200248 (Appendix A).

c. MAR is calculated: **Column B × CF1 × Column C × CF2 × Conservatism Multiplier = Column D**

- CF1 1 m^2 = 10,000 cm^2
- CF2 1 Ci = 2.22E+12 dpm
- Conservatism Multiplier = 10 (as specified in Section 3.1, Item 5)

d. PTE is calculated: **Column D × Release Fraction = Column E**

- Release Fraction = 1.0E-03 (as specified in Section 3.1, Item 8)

e. Dose factors were obtained from DOE/RL-2006-29, *Calculating Potential-to-emit Radiological Releases and Doses* (Table 4.4), with an effective release height of less than 40 m (131 ft).

f. Onsite MEI dose is calculated: **Column E × Column F = Column H**

g. Offsite MEI dose is calculated: **Column E × Column G = Column I**

4 Criteria/Toxic Air Determination

This chapter documents the determination of criteria/toxic air emissions resulting from the NTCRA at the 215C Building. This determination supports DOE/RL-2016-50, Draft A, and subsequent field work packages. Under WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," requirements are established for the evaluation of emissions of criteria/toxic air pollutants and implementation of controls. In accordance with WAC 173-400-040, "General Standards for Maximum Emissions," reasonable precautions must be taken to prevent the release of air contaminants associated with point sources and fugitive emissions or resulting from excavation, materials handling, or other operations if criteria/toxic emissions are expected.

Review of records and historical documents indicates that no hazardous chemicals, carcinogens, or explosives were handled at the 215C Building. In addition, all material and equipment from within and around the building was removed during decommissioning and decontamination in 1985. Therefore, toxic air emissions resulting from the removal action at the 215C Building are not expected. Appropriate control of fugitive dust will be performed during demolition activities.

Toxic air requirements associated with asbestos-containing materials at the 215C Building will be addressed in accordance with NESHAP. An asbestos inspection will be performed by an Asbestos Hazard Emergency Response Act certified building inspector.

5 References

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol8/xml/CFR-2010-title40-vol8-part61.xml.

Appendix D, "Methods for Estimating Radionuclide Emissions."

Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities."

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WAC 173-400-040, "General Regulations for Air Pollution Sources," "General Standards for Maximum Emissions," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-400-040.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460.

WAC 246-221-060, "Radiation Protection Standards," "Dose Limits for Individual Members of the Public," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=246-221-060.

WAC 246-247, "Radiation Protection—Air Emissions," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=246-247.

247-030, "Definitions."

Appendix A

Radiological Survey Report
RC-1200248

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CH2M HILL PLATEAU REMEDIATION COMPANY RADIOLOGICAL SURVEY REPORT (Submitted for Approval)	RSR No. RC-1200248	Page 1 of 6

Date	Start/Stop Time	Area/Location	RWP/Rev.
5/15/2012	0900 / 1045	200E / 218C / Southern most / West Entrance	RC-12-001 Rev 2

Purpose of Survey:

- [ ] Material Release
  - Number: N/A
  - Released to: N/A
- [ ] Ram Shipment: N/A
- [ ] Required Task: N/A
- [x] Job Coverage: sw-12-02254
- [ ] Verification survey β = <D
  <D=No increase in audible count rate

N/A	Inches/Sec.	N/A	Inches Away
N/A	Count Time (Sec.)	N/A	% Surveyed
N/A	# of Static Counts	N/A	Square Feet

- [ ] Verification survey βγ = <D
  <D=No increase in audible count rate

N/A	Inches/Sec.	N/A	Inches Away
N/A	Count Time (Sec.)	N/A	% Surveyed
N/A	# of Static Counts	N/A	Square Feet

- [ ] Other:
  N/A

Description of Work / Comments:

Identify and verify fixed contamination on 3 spots found in 218C with Radioactive Stickers on floor.

Comments: For the purposes of distinction this survey reflects the numbers of FCA's at 218C as 1,2 and 3. See map for exact location. For future reference these FCA's will be labled as 218C-12-001 as they are all behind one door in a small room and within a few feet of each other.
FCA #1 just inside door opening up against the west wall of the building is approximatly 1 square foot in size.
FCA #2 is towards the middle of the room and almost directly under a light that hangs from the ceiling. It is approximatly 100cmsq or the size of a 2360 probe.
FCA#3 is in the southeast corner of the room on the floor and is also approximatly 100cmsq/probe size. By size this survey is reflecsive of the area reading direct contamination, not the white fixative area. None of the three had any removable contamination. All three have stickers visible from 1991 and also have had a white fixative applied that is visible after pushing dirt away with masslin mop.
Personnel (RCT,HCO) ACED in under RC-12-001 Rev 2 in case any removable contamination was found for this task.

Dose Rate Measurements

Note*: F = Field (≥30cm) C = Contact(≤1 cm)

No.	Description	Dist. (cm) Note*	WO mR/hr	WC mR/hr	CF Non-Penetrating	CF Penetrating	Neutron Dose mrem/hr	Shallow Dose mrem/hr	Deep Dose mrem/hr
D1	FCA closest to door (#1)	C	0.7	0.2	2	1	N/A	1.2	0.2
D2	FCA closest to door	F	<0.1	<0.1	2	1	N/A	<0.1	<0.1
D3	FCA middle of room (#2)	C	<0.1	<0.1	2	1	N/A	<0.1	<0.1
D4	FCA SE corner of room (#3)	C	<0.1	<0.1	2	1	N/A	<0.1	<0.1

Contamination Measurements

† Manually Calculated by RCT

		Background cpm		Direct Gross cpm/100 cm²		Total dpm/100 cm²		Correction Factor		Removable				
											Gross (cpm)		dpm/100 cm²	
No.	Description	βγ	α	βγ	α	βγ	α	βγ	α	Type	βγ	α	βγ	α
C1	FCA #1	300	0	189000	0	1890000†	<100†	10	10	Smear	300	0	<1000†	<20†

Date Submitted: 05/15/2012 16:34:00

A-6004-663-SS (Rev. 4)

A-1

CH2M HILL PLATEAU REMEDIATION COMPANY RADIOLOGICAL SURVEY REPORT (Submitted for Approval)	RSR No. RC-1200248	Page 2 of 6

Contamination Measurements (Continued)

† Manually Calculated by RCT

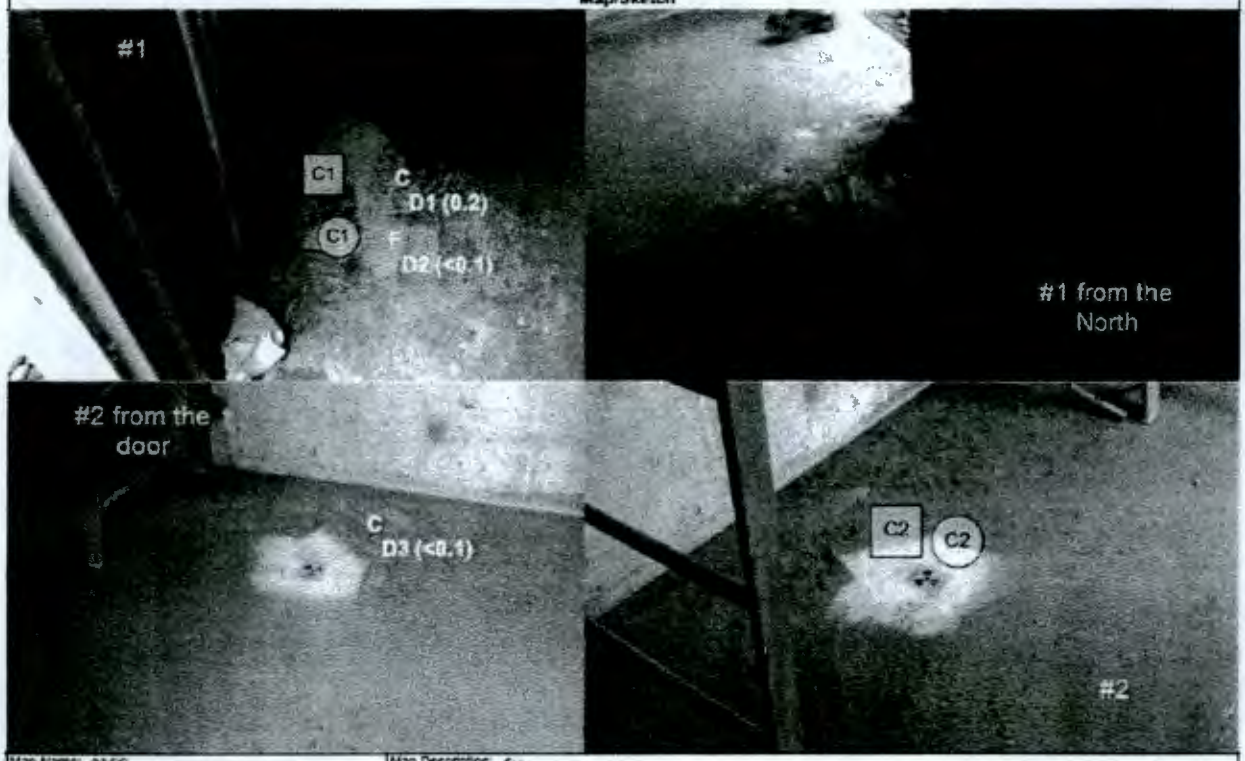
		Background cpm		Direct Gross cpm/100 cm²		Total dpm/100 cm²		Correction Factor		Removable				
											Gross (cpm)		dpm/100 cm²	
No.	Description	βγ	α	βγ	α	βγ	α	βγ	α	Type	βγ	α	βγ	α
C2	FCA #2	300	0	4000	0	40000†	<100†	10	10	Smear	300	0	<1000†	<20†
C3	FCA #3	300	0	5000	0	50000†	<100†	10	10	Smear	300	0	<1000†	<20†

Date Submitted: 05/15/2012 16:34:00

A-6004-663-SS (Rev. 4)

CH2M HILL PLATEAU REMEDIATION COMPANY RADIOLOGICAL SURVEY REPORT (Submitted for Approval)	RSR No. RC-1200245	Page 3 of 6

Map/Sketch



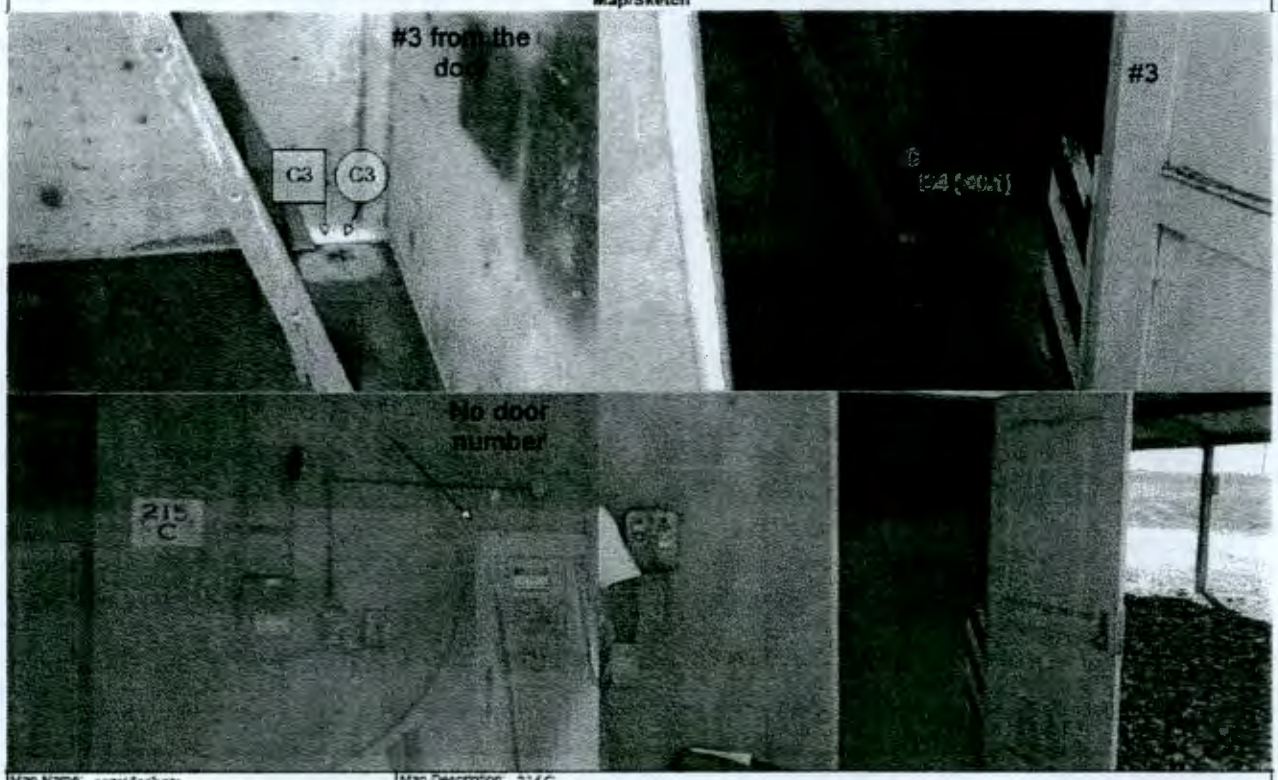
Map Name: 215C	Map Description: Sca									
Legend	Direct Measurement	Air Sample	Smear	LAW	Neutron Dose Rate	Transferability	Field	Contact	Other Distance	Other Measurement
	----------(designation inside)---------- Radiological Area Boundary								Note: Dose Rates in mrem/hr unless otherwise noted.	

Date Submitted: 05/15/2012 16:34:00

A-6004-663-SS (Rev. 4)

CH2M HILL PLATEAU REMEDIATION COMPANY RADIOLOGICAL SURVEY REPORT (Submitted for Approval)	RSR No. . RC-1200246	Page 4 of 6

Map/Sketch



Map Name: outsideshots | Map Description: 215C

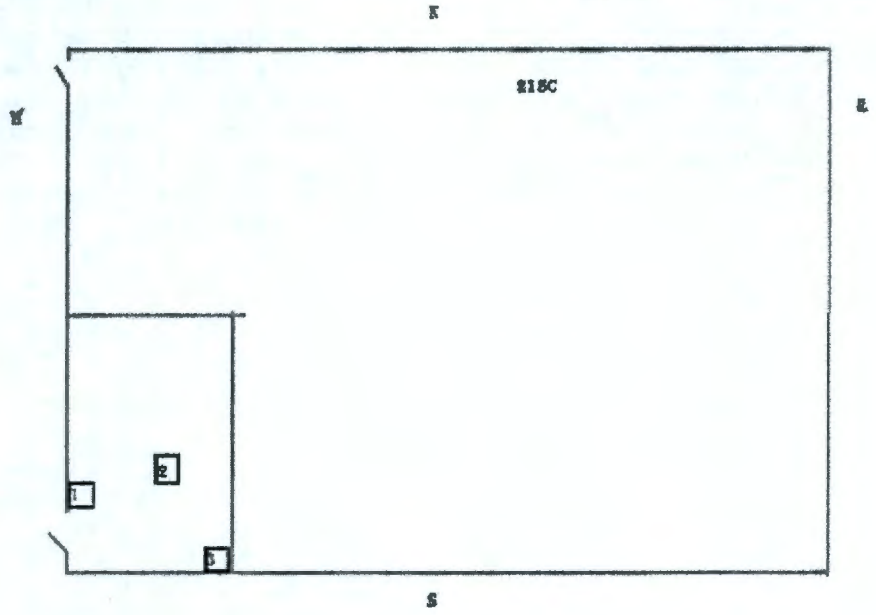
Legend	Direct Measurement	Air Sample	Smear	LAW	Neutron Dose Rate	Transferability	Field	Contact	Other Distance	Other Measurement
	----------(designation inside)---------- Radiological Area Boundary								Note: Dose Rates in mrem/hr unless otherwise noted.	

Date Submitted: 05/15/2012 16:34:00

A-6004-663-SS (Rev. 4)

CH2M HILL PLATEAU REMEDIATION COMPANY RADIOLOGICAL SURVEY REPORT (Submitted for Approval)	RSR No. RC-1200248	Page 5 of 6

Map/Sketch



Map Name: 215C	Map Description: overhead									
Legend	# Direct Measurement	Air Sample	Smear	L# LAW	Neutron Dose Rate	T# Transferability	F# Field	C# Contact	D# Other Distance	Other Measurement
	----------(designation inside)---------- Radiological Area Boundary							Note: Dose Rates in mrem/hr unless otherwise noted.		

Date Submitted: 05/15/2012 16:34:00

A-6004-663-SS (Rev. 4)

CH2M HILL PLATEAU REMEDIATION COMPANY RADIOLOGICAL SURVEY REPORT (Submitted for Approval)	RSR No. RC-1200246	Page 6 of 6

Instruments

Instrument Type	Bar Code No.	Probe Bar Code No.	Efficiency (Used)
Ludlum 2360/43-93	SCLL6-0259	DTLLP-0265	0.10
cp	ICEB2-0263	N/A	1

Unless stated otherwise in the "Comments" section, contamination levels for C-14, Fe-55, Ni-59, Ni-63, Se-79, Tc-99, Pd-107, and Nu-155 are ≤ 10 times the b-g contamination levels shown above (see CHPRC-00073, Table 2-2).

History

2012-05-15 16:03:20 - Rowan, Clay - Submitted
2012-05-15 16:22:30 - Rowan, Clay - UnSubmitted: add tech smear locations
2012-05-15 16:24:52 - Rowan, Clay - Submitted: added tech smear locations

RC-1200248 Electronically Approved On 5/15/2012 By:

User: ROWAN, ADAM (H0030573)
Title: Contributor
Date: Tuesday, May 15, 2012, 4:34 PM Pacific Standard Time
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User: WILLIAMS, RAYMOND (H0048344)
Title: Reviewer
Date: Tuesday, May 15, 2012, 4:42 PM Pacific Standard Time
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Environmental Calculation Review Checklist

Calculation Title: Radiological and Toxic Air Emissions for 215C Gas Preparation Building
Calculation Number: ECF-Hanford-17-0035
Revision: 0
Preparer: John Young
Checker: Kira Murray

Items to Verify	Yes	No	N/A	Comments
1) Are the following elements clearly described? a) Purpose b) Calculation approach c) Assumptions d) Inputs e) Equations used f) Results/conclusions g) References	☒	☐	☐	
2) Are necessary assumptions explicitly stated and supported?	☒	☐	☐	
3) Are data files identified in the document?	☒	☐	☐	
4) Are table lookups correct?	☒	☐	☐	
5) Is data used in the calculation explicitly stated in the document?	☒	☐	☐	
6) Was data checked for consistency with the original source information?	☒	☐	☐	
7) Were mathematical derivations checked, including dimensional consistency of results?	☒	☐	☐	
8) Was the data input into the spreadsheet correctly?	☒	☐	☐	
9) Was the calculation performed to verify it is free of errors?	☒	☐	☐	

I verify that all numbers have been checked and that comments have been addressed appropriately.

Checker: Kira Murray KIRA MURRAY 8/21/17
Print/Signature/Date

Preparer: John Young 8/21/2017
Print/Signature/Date