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ENVIRONMENTAL CALCULATION COVER PAGE

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Terms

ECF	environmental calculation file
MAR	material-at-risk
MEI	maximally exposed individual
NESHAP	National Emission Standards for Hazardous Air Pollutants
NTCRA	non-time-critical removal action
PTE	potential-to-emit

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1 Purpose and Scope

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 276C Solvent Handling Facility (hereinafter referred to as the 276C Building) 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. 276C 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 demolition of the 276C 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 276C Building (Figure 2) was a storage and treatment facility for the solvents used in the 201C Process Building. The 276C Building is a four-story structure, extending approximately 14 m (46 ft) abovegrade, with a total floor area of 213.5 m^2 (2,300 ft^2). Equipment used for solvent treatment was located on the first floor, with the chemical addition tanks on the second-floor mezzanine. The storage tanks for clean solvents were on the third and fourth floors. The heating, ventilation, and air conditioning system was located on the second floor, and a power control room was attached to the south side of the building.

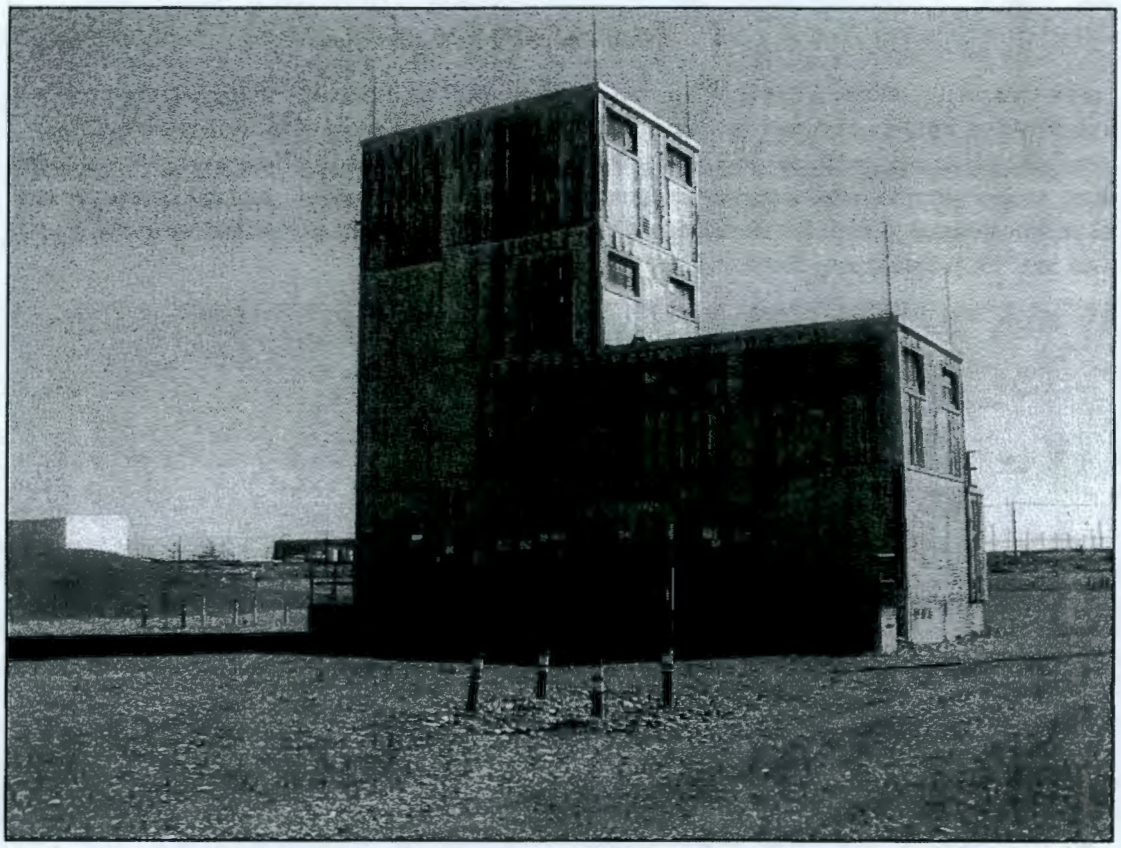

Figure 2. 276C Building

In 1982, it was estimated that the 276C Building contained approximately 1 Ci of plutonium and 10 Ci of total beta (SD-DD-FL-001, *Rockwell Retired Contaminated Facility Listing and Description*) during operations. In 1984, the 276C Building was decommissioned. All radioactively contaminated equipment within the building was removed and all exposed surfaces were decontaminated.

In 2000, the assumption was made that 10% of the original inventory was still present within the 276C Building (BHI-01173, *Auditable Safety Analysis for Surveillance and Maintenance of the 241-CX Tank System*). The bounding inventory of 0.1 Ci alpha (assumed to be plutonium-239/240 [Pu-239/240]) and 1.0 Ci beta (assumed to be strontium-90 [Sr-90]) were assumed to remain as surface contamination within the facility.

Removal actions for the 276C Building (described in DOE/RL-2016-50) include demolition of the building to slab-on-grade and disposition of demolition waste. The remaining hazards associated with the 276C Building include fixed radioactive contamination, asbestos-containing material, and significant biological waste from bird nesting.

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*. Radiololgical 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 276C Building. The state implementing regulation WAC 246-247, "Radiation Protection—Air Emissions," addresses potential radioactive airborne emissions from point sources and from fugitive or diffuse sources, requiring monitoring of such sources. Potential radiological releases from the 276C Building removal action would be considered diffuse and fugitive emissions. The Hanford Site Environmental Monitoring Program, which serves as the monitoring system for all site activities, is described in detail 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 will be used for monitoring during removal action (Figure 3).

Figure 3. Near-Field Air Monitoring Locations for the 276C Building

3.1 Assumptions and Inputs

This section describes the assumptions and inputs used to calculate PTE and the onsite/offsite dose to the MEI values associated with the 276C Building removal action. The assumptions and inputs are obtained from past facility descriptions and safety analysis reports. No radioactive survey reports are available for this facility.

1. The radiological constituents of concern at the 276C Building are Pu-239/240 and Sr-90, based on building history and Hot Semiworks Complex process knowledge.

2. Radiological inventory estimates for the 276C Building are based on information found in BHI-01173. To account for any additional unexpected contamination at the 276C Building, the 1982 radiological inventory estimate of 1 Ci Pu-239/240 and 10 Ci Sr-90 is used in this ECF.
3. A potential release height of less than 40 m (131 ft) within the 200 East Area is assumed. Dose consequence will be calculated in accordance with DOE/RL-2006-29.
4. It is assumed that the entire material-at-risk (MAR) is available, in a particulate form, for release within a 1-year period.
5. 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."
6. 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 the Method 1: Annual Possession Quantity methodology as described in DOE/RL-2006-29.

Historical inventory estimates and process knowledge are used to estimate the MAR, which is the assumed quantity of contamination present. The MAR is used to calculate the PTE, which is an estimate of the radionuclides that could potentially be emitted during the 276C Building removal action. The PTE and dose factors 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 offsite and onsite doses to the MEI (Section 3.2.3).

The following sections provide detailed descriptions of each step, as well as example calculations using the estimated inventory for Pu-239/240. Section 3.4 provides the air emissions calculations for Pu-239/240 and Sr-90.

3.2.1 Material-at-Risk

The MAR is measured as total activity in curies. For this ECF, the estimated inventory (Ci), as specified in Section 3.1, Item 2, is used as the MAR.

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 4, Ci/yr is used for MAR units in PTE and MEI

dose calculations. The MAR is multiplied by a unitless release fraction of 1.0E-03, as described in Section 3.1. Item 5. Equation 1 shows this calculation:

$$\text{PTE}\left(\frac{Ci}{yr}\right) = \text{MAR}\left(\frac{Ci}{yr}\right) \times 1.0\text{E-03} \tag{1}$$

3.2.3 Dose to the Maximally Exposed Individual

The potential total onsite and offsite doses to the MEI are determined by multiplying the PTE, as determined using Equation 1, by the dose-per-unit-release factors, as described in Section 3.1, Item 6. The potential onsite dose for the MEI for a single isotope is performed using Equation 2:

$$\text{Onsite Dose}\left(\frac{mrem}{yr}\right) = \text{PTE}\left(\frac{Ci}{yr}\right) \times \text{Onsite Dose Factor}\left(\frac{mrem}{yr} \div \frac{Ci}{yr}\right) \tag{2}$$

Similarly, the offsite dose to the MEI for a single isotope is performed using Equation 3:

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

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 the potential air emission calculations for the 276C Building radiological constituents of concern (Pu-239/240 and Sr-90). These calculations follow the methodology described in Section 3.2, using the assumptions and inputs stated in Section 3.1. Table 1 provides the total potential dose for onsite and offsite MEI by using the sum of potential air emissions for all radiological constituents of concern. The potential dose to the onsite MEI is 3.68E-03 mrem/yr. The potential dose to the offsite MEI is 4.71E-03 mrem/yr.

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Table 1. PTE Calculation for the 276C Solvent Handling Facility

A	B	C	D	E	F	G	H
				Dose Factor[d] (mrem/yr per Ci/yr)		Unabated Dose (mrem/yr)	
Radionuclide	**Estimated Inventory[a] (Ci)**	**MAR[b] (Ci)**	**PTE[c] (Ci/yr)**	**Onsite MEI**	**Offsite MEI**	**Onsite MEI[f]**	**Offsite MEI[g]**
Pu-239/240	1.00E-00	1.00E+00	1.00E-03	3.28E+00	2.78E+00	3.28E-03	2.78E-03
Sr-90	1.00E+01	1.00E+01	1.00E-02	3.96E-02	1.93E-01	3.96E-04	1.93E-03
					Total	**3.68E-03**	**4.71E-03**

a. Estimated inventory values were obtained from BHI-01173, *Auditable Safety Analysis for Surveillance and Maintenance of the 241-CX Tank System.*

b. MAR is equal to Estimated Inventory: **Column B = Column C**

c. PTE is calculated: **Column C × Release Fraction = Column D**

- Release Fraction = 10^{-3} (as specified in Section 3.1, Item 5)

d. 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).

e. Onsite MEI dose is calculated: **Column D × Column E = Column G.**

f. Offsite MEI dose is calculated: **Column D × Column F = Column H.**

3.5 Results

Potential radionuclide air emission estimates were calculated for the 276C Building removal action described in DOE/RL-2016-50. The resulting onsite and offsite MEI are as follows:

- The potential unabated dose to the onsite MEI is 3.68E-03 mrem/yr. The onsite MEI is located at Energy Northwest. The distance from the 200 East Area emission zone to Energy Northwest is 16.7 km (10.4 mi) east-southeast.
- The potential unabated dose to the offsite MEI is 4.71 E-03 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 effective dose equivalent to the MEI emission values for the 276C 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 the Hanford Site operations not result in a dose to an individual member of the public in excess of 10 mrem/yr.

4 Criteria/Toxic Air Determination

This chapter documents the determination of criteria/toxic air emissions resulting from the NTCRA at the 276C Solvent Handling Facility. This determination supports DOE/RL-2016-50 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.

A review of records and historical documents indicate that all of the tanks have been removed from the building. None of the solvents that were used in the building are expected to be present. If any chemicals remain in the building, they are likely in the form of residues. Therefore, toxic air emissions resulting from the removal action at the 276C 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 276C Building will be addressed in accordance with NESHAP. An asbestos inspection will be performed by an *Asbestos Hazard Emergency Response Act of 1986* certified building inspector.

5 References

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Environmental Calculation Review Checklist

Calculation Title: Radiological and Toxic Air Emissions for 276C Building
Calculation Number: ECF-Hanford-17-0036
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