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Terms

CF	conversion factor
COC	contaminant of concern
DOE	U. S. Department of Energy
ECF	environmental calculation file
MAR	material-at-risk
MEI	maximally exposed individual
NESHAP	National Emission Standards for Hazardous Air Pollutants
PTE	potential-to-emit
PUREX	Plutonium Uranium Extraction
UNH	uranyl nitrate hexahydrate
UO_3	uranium trioxide

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1 Introduction

This environmental calculation file (ECF) provides air emission estimates for the removal action at the 203A Acid Storage Area (203A Area) located within the Plutonium Uranium Extraction (PUREX) Complex (Figure 1). The ECF 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). This ECF also documents the determination of criteria and toxic air emissions resulting from the removal action.

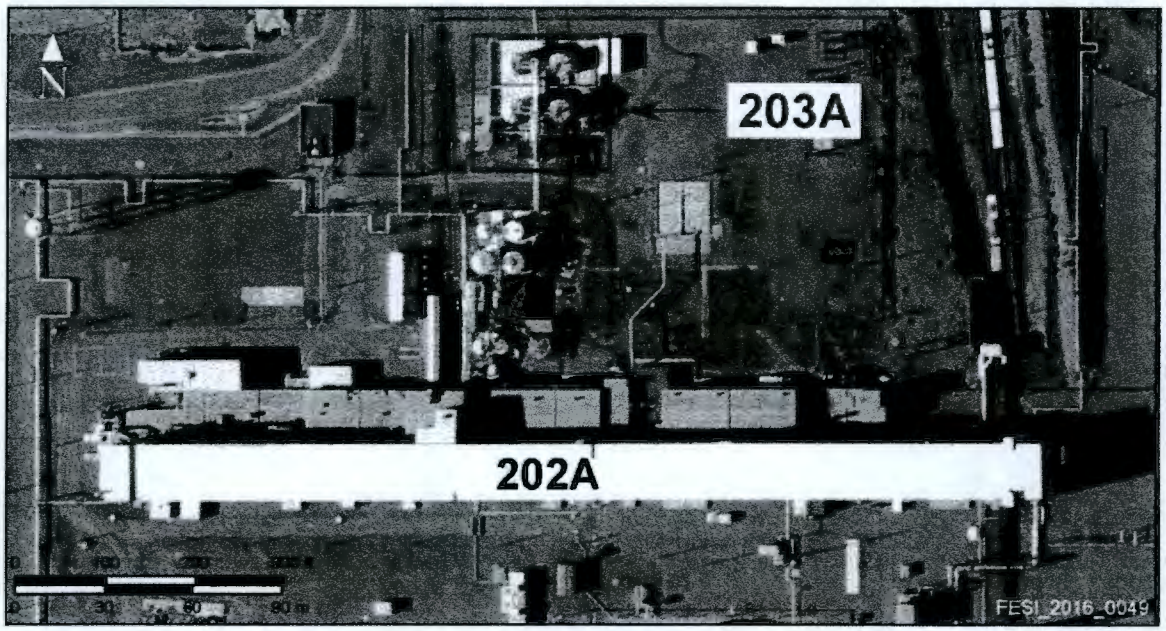

Figure 1. 203A Area within the PUREX Complex

This ECF supports DOE/RL-2016-47, *Removal Action Work Plan for the PUREX Complex Tier 2 Buildings/Structures*, which implements the demolition of the 203A Area 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 203A Acid Storage Area is located in the 200 East Area north of the 202A Building (PUREX) (Figure 1). The 203A Area was constructed in 1954 and consists of a pump house, loading dock, and secondary containment area that houses nine tanks (Figure 2). During operations, the 203A Area was used to facilitate the storage and shipment of uranyl nitrate hexahydrate (UNH) and nitric acid between PUREX and the Uranium Trioxide (UO_3) Plant. UNH was produced in the final uranium extraction cycle at PUREX and concentrated through evaporation. Once concentrated, UNH was pumped through pipelines to 203A for storage in tanks TK-P1, TK-P2, TK-P3, and TK-P4. UNH was then shipped by tanker-trailer from the 203A storage tanks to the UO_3 Plant in the 200 West Area for further concentration and to recover nitric acid. The recovered nitric acid was shipped back to tanks TK-P13, TK-P14, and TK-P15 for storage, and the UNH waste solutions were shipped back to tank TK-P6 for further concentration. Condensate from this concentration process was stored in tank TK-P5.

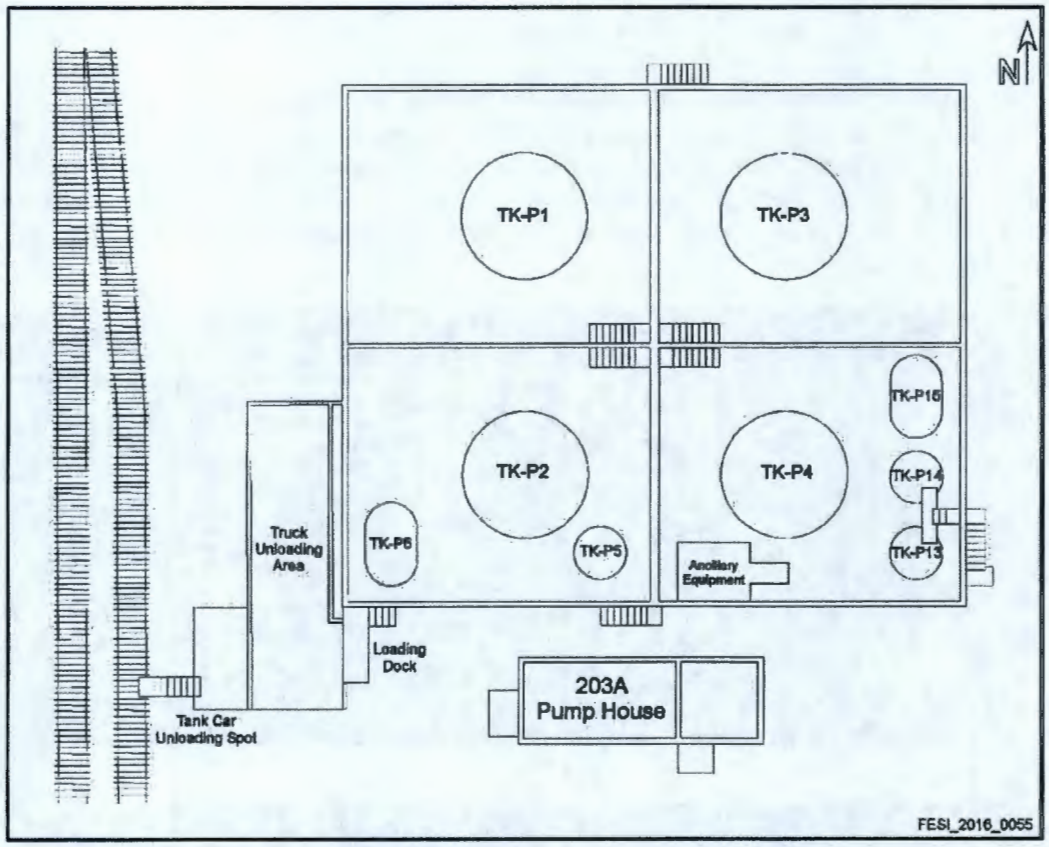

Figure 2. 203A Area

The PUREX Complex began deactivation activities following a final facility closure order from the U.S. Department of Energy (DOE) in December 1992. Between 1992 and 1998, work was conducted to place the PUREX Complex in a safe configuration. The remaining UNH at the 203A Area was shipped to the UO_3 Plant for final processing between April and June 1993 (WHC-SP-1147, *PUREX/UO_3 Facilities Deactivation Lessons Learned History*). Once processed, the recovered nitric acid was returned to the 203A Area for storage. In early 1994, the remaining nitric acid was sold to a fuel reprocessing facility in Sellafield, England per Section 8.4 of WHC-SP-1147. Prior to shipment, the contents of 203A Area tanks TK-P2 and TK-P4 were sampled to demonstrate adherence with the conformance criteria of the contract between Westinghouse Hanford Company and British Nuclear Fuels Limited. The sampling results (letter 9555104, "Shipment of Plutonium Uranium Extraction Facility Nitric Acid to the United Kingdom, Sample Results for Nitric Acid from Tanks TK-P2/MS and TK-P4") are provided in Appendix A. Shipments of nitric acid from 203A Area were completed in November 1995.

Following removal of UNH and nitric acid from the 203A Area, all tanks were flushed in 1996 with only a minimum heel remaining (HNF-SD-CP-HIE-004, *PUREX Deactivated End-State Hazard Analysis*; DOE/RL-95-78, *PUREX Facility Preclosure Work Plan*, contains additional tank flushing information). The Resource Conservation and Recovery Act clean closure of tank TK-P4 is addressed in DOE/RL-2015-72, *Closure Plan for the PUREX Tanks TK-P4 and TK-40*. The 203A Area was isolated from the PUREX Canyon through blanking transfer lines, and all site utility services were disconnected at the end of deactivation (WHC-SD-WM-TPP-049, *203-A Facility Deactivation Project Plan*). The sample results and remaining heel volumes for all 203A Area tanks are provided in Section 3.1.

As described in DOE/RL-2016-47, removal actions for the 203A Area included the removal or demolition of all tanks; demolition of the secondary containment structures, pump house, and truck unloading dock; excavation of underlying soils; and disposition of demolition waste. Appropriate sampling and stabilization activities will be conducted. The remaining hazards associated with the 203A Area include chemical solutions, fixed surface radioactive contamination, and asbestos insulation.

3 Radiological Air Emission Calculations

Radiological release potential exists at the 203A Area. The state implementing regulation, "Radiation Protection—Air Emissions" (WAC 246-247), addresses potential radioactive airborne emissions from point, fugitive, or diffuse sources that require monitoring. Potential radiological releases from the 203A Area removal action would be considered diffuse and fugitive emissions. The monitoring system for all site activities is detailed in DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*. Near-facility ambient air monitoring stations N969, N970, N985, and N977 surround the PUREX Complex and are planned to be utilized for monitoring during removal action (Figure 3).

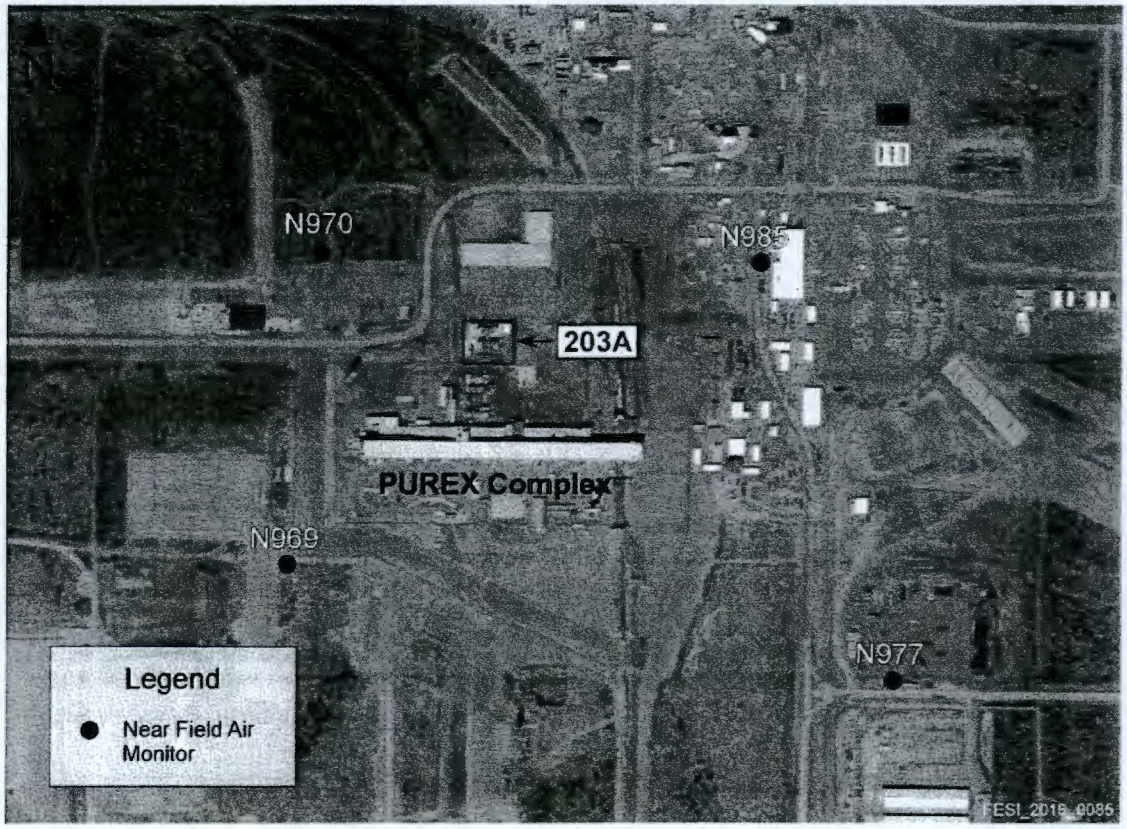

Figure 3. Near Field Air Monitor Locations for the 203A Area

The methodology used to estimate the PTE is based upon the guidance document DOE-RL-2006-29, *Calculating Potential-to-Emit Radiological Releases and Doses*. Airborne emissions control and monitoring requirements for radiological air emissions will be identified as needed based on the calculated value of the potential emissions and resultant public exposure.

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 203A Area removal action are described in this section. The assumptions and inputs used in this ECF are obtained from past facility descriptions and deactivation documentation.

1. Samples of nitric acid from tanks TK-P2 and TK-P4 were collected in 1995, prior to acid removal and shipment to Sellafield, England. The sample results, originally from letter 9555104 and provided in Appendix A, are summarized in Table 1. These sample results indicate that tank TK-P4 contains a higher total inventory than tank TK-P2. The remaining 203A Area tanks are conservatively assumed to contain the same radiological contaminants and concentrations as tank TK-P4. The concentrations and tank heel volumes are used to calculate the total radiological inventory for each tank.

Table 1. 203A Area Tank Heel Volumes and Radiological Concentrations

203A Tank Number	Tank Heel[a] (gal)	Total Plutonium (Pu-239/240)[b,c] (µCi/L)	Uranium-235[b] (µCi/L)	Total Uranium (U-238)[b,d] (µCi/L)	Total Beta[b] (Cs-137)[e] (µCi/L)
TK-P1	459	1.40E-02	9.00E-03	1.14E-02	1.87E+01
TK-P2	308	1.07E-02	1.78E-01	4.39E+00	6.31E+00
TK-P3	371	1.40E-02	9.00E-03	1.14E-02	1.87E+01
TK-P4	303				
TK-P5	109				
TK-P6	109				
TK-P13	55				
TK-P14	55				
TK-P15	303				

a. HNF-SD-CP-HIE-004, *PUREX Deactivated End-State Hazard Analysis*, page E-21.

b. Letter No. 9555104, "Shipment of Plutonium Uranium Extraction Facility Nitric Acid to the United Kingdom, Sample Results for Nitric Acid from Tanks TK-P2/MS and TK-P4."

c. Presented total plutonium (Pu-239/240) sample results converted from g/L to µCi/L using specific activity conversion factor of Pu-239/240, per 10 CFR 71, Table A-1—"A_1 and A_2 Values for Radionuclides." Conversion factor = 6.2E+04 µCi/g.

d. Presented total uranium sample results were converted from g/L to µCi/L using the specific activity conversion factor of U-238, per 10 CFR 71, Table A-1. Conversion factor = 3.40E-01 µCi/g.

e. Total beta conservatively assumed to be Cs-137 due to higher total dose factor when compared to Sr-90 per DOE/RL-2006-29, Rev. 2, Table 4.4.

2. The 1996 post-flush heel volumes for each tank are provided in Table 1. These volumes are assumed to remain upon initiation of the removal action.

3. The 203A Area secondary containment structure, pump house, loading dock, and underlying soils are assumed contaminated from operations. The radiological inventory for these structures and the underlying soils is conservatively assumed to contain a radiological inventory equal to that of the 203A Area tanks.

4. The radiological constituents of concern are total plutonium (assumed Pu-239/240), total beta (assumed Cs-137), U-235, and total uranium (assumed U-238).

5. Total plutonium is assumed to be Pu-239/240 due to highest total dose-per-unit-release factor (dose factor) of plutonium isotopes. Total beta is conservatively assumed to be Cs-137 due to higher total dose factor when compared to Sr-90. Dose factor values per DOE/RL-2006-29, Rev. 2, Table 4.4.

6. It is assumed that the entire material-at-risk (MAR) is available for release within 1 year.

7. The radiological constituents of concern are particulate solids; therefore, a release fraction of 1.0E-03 is used, in accordance with WAC 246-247-030, "Definitions," and 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" (NESHAP), Appendix D, "Methods for Estimating Radionuclide Emissions."

8. Dose-per-unit-release factors were taken from DOE/RL-2006-29, Rev. 2, Table 4.4, assuming an effective release height of less than 40 m (131 ft) within the 200 East Area. 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, Rev. 2. Dose factor values are provided in Section 3.4.

3.2 Methodology

Potential radionuclide air emission estimates are determined using the Method 1: Annual Possession Quantity process as described in DOE/RL-2006-29, Rev. 2.

Sample results taken prior to flushing activities are used to calculate MAR, which is the assumed quantity of contamination present. MAR is calculated by multiplying the pre-flush concentrations by the remaining heel volumes for each tank, per Section 3.1, Item 1. The MAR for 203A Area secondary containment, pump house, unloading dock, and underlying soils is calculated as the sum of the MAR values for all 203A Area tanks. The MAR is used to calculate the PTE, which is an estimate of the radionuclides that could potentially be emitted during the 203A Area 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. Section 3.4 provides the air emissions calculations for Pu-239/240, U-235, U-238, and Cs-137 for each tank and structure covered under the proposed removal action.

3.2.1 Material-at-Risk

The MAR is measured as total inventory in curies. Two methods are used to calculate the MAR at the 203A Area: MAR_T is used to calculate the total inventory of each constituent in 203A Area tanks, and MAR_S is used to calculate the total inventory within the 203A Area secondary containment structure, pump house, loading dock, and underlying soils. MAR_T is calculated as follows:

1. Convert the radiological sample results from microcuries per liter (μCi/L) to microcuries per gallon (μCi/gal) by multiplying the sample results by the conversion factor (CF) of 1 gal = 3.785 L. This converts sample results from μCi/L to μCi/gal.

2. Multiply the sample results (μCi/gal) from Step 1 by the remaining heel volume (gal) for each tank. This eliminates the volume unit, resulting in a tank-specific inventory (μCi) for each constituent.

3. Convert the results of Step 2 from microcuries to curies. The CF for converting microcuries to curies is 1 Ci = 1,000,000 μCi. MAR_T is calculated using Equation 1:

$$MAR_T\ (Ci) = Inventory\left(\frac{\mu Ci}{L}\right) \times \left(\frac{3.785\ L}{1\ gal}\right) \times \mathrm{V}\ (gal) \times \left(\frac{1\ Ci}{1.0\mathrm{E}{+}06\ \mu\mathrm{Ci}}\right) \quad (1)$$

where:

MAR_T = 203A Area tanks
V = volume of tank heel

Assumed equal to the total inventory of the 203A Area tanks, MAR_S is calculated as the sum of inventories (Ci) for each constituent as calculated using Equation 1. MAR_S is calculated using Equation 2:

$$MAR_S\ (Ci) = \sum_{TK-1}^{TK-15} MAR_T\ (Ci) \quad (2)$$

where:

MAR_S = 203A Area secondary containment, pump house, loading dock, and underlying soils

3.2.2 Potential-to-Emit

The maximum PTE in a calendar year is calculated by multiplying the MAR value by a release fraction in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAP; 40 CFR 61, Appendix D). Because it is assumed that the entire MAR is available for release within a 1 year period, as described in Section 3.1, Item 6, 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 7. PTE is calculated using Equation 3:

$$\mathrm{PTE}\left(\frac{Ci}{yr}\right) = \mathrm{MAR}\left(\frac{Ci}{yr}\right) \times 1.0\mathrm{E}\text{-}03 \quad (3)$$

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 (calculated using Equation 3) by the dose-per-unit-release factors described in Section 3.1, Item 8. The potential onsite dose for the MEI for a single isotope is performed using Equation 4:

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

Similarly, the offsite dose to the MEI for a single isotope is performed using Equation 5:

$$\text{Offsite Dose}\left(\frac{mrem}{yr}\right) = \mathrm{PTE}\left(\frac{Ci}{yr}\right) \times \text{Offsite Dose Factor}\left(\frac{mrem}{yr} \div \frac{Ci}{yr}\right) \quad (5)$$

3.3 Software Applications

Microsoft® Excel® 2016 was used to perform the calculations in Chapter 6. Excel is a site licensed client software.

3.4 Calculations

Table 2 provides the potential air emission calculations for 203A Area radiological constituents of concern (Pu-239/240, U-235, U-238, and Cs-137). These calculations follow the methodology described in Section 3.2 using the assumptions and inputs stated in Section 3.1. Table 2 also 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 4.15E-05 mrem/yr; the potential dose to the offsite MEI is 6.60E-05 mrem/yr.

3.5 Results

Potential radionuclide air emission estimates were calculated for the 203A Area removal action described in DOE/RL-2016-47. The resulting onsite and offsite MEI are as follows:

- The potential unabated dose to the onsite MEI is 4.15E-05 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 6.60E-05 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.

As determined by the above calculations, the effective dose equivalent to the MEI emission values for the 203A Area, are well below the national emission standard for DOE facility emissions of radionuclides to the ambient air (40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities"). The emission values are also well within compliance with WAC 246-221-060, "Radiation Protection Standards," "Dose Limits for Individual Members of the Public," which requires that Hanford Site operations not result in a dose to an individual member of the public in excess of 10 mrem/yr.

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Table 2. PTE Calculation for the 203A Acid Storage Area

A	B	C	D	E	F	G	H	I	J
Radionuclide	Pre-Flush Concentration[a] (pCi/L)	Volume[b] (gal)	MAR[c] (Ci)	Release Fraction[d]	PTE[e] (Ci/yr)	Dose Factor[f] (mrem/yr per Ci/yr)		Unabated Dose to MEI (mrem/yr)	
						Onsite MEI	Offsite MEI	Onsite MEI[g]	Offsite MEI[h]
Tank TK-P1[i]									
Plutonium-239/240[k]	1.40E-02	459.0	2.43E-05	1.00E-03	2.43E-08	3.28E+00	2.78E+00	7.99E-08	6.77E-08
Uranium-235	9.00E-03	459.0	1.56E-05	1.00E-03	1.56E-08	2.27E-01	2.05E-01	3.55E-09	3.21E-09
Uranium-238[l]	1.14E-02	459.0	1.98E-05	1.00E-03	1.98E-08	2.00E-01	1.81E-01	3.97E-09	3.59E-09
Total beta (Cs-137)	1.87E+01	459.0	3.25E-02	1.00E-03	3.25E-05	1.46E-01	2.40E-01	4.74E-06	7.80E-06
Tank TK-P2									
Plutonium-239/240[k]	1.07E-02	308.0	1.24E-05	1.00E-03	1.24E-08	3.28E+00	2.78E+00	4.08E-08	3.46E-08
Uranium-235	1.78E-01	308.0	2.08E-04	1.00E-03	2.08E-07	2.27E-01	2.05E-01	4.71E-08	4.25E-08
Uranium-238[l]	4.39E+00	308.0	5.11E-03	1.00E-03	5.11E-06	2.00E-01	1.81E-01	1.02E-06	9.26E-07
Total beta (Cs-137)	6.31E+00	308.0	7.36E-03	1.00E-03	7.36E-06	1.46E-01	2.40E-01	1.07E-06	1.77E-06
Tank TK-P3[i]									
Plutonium-239/240[k]	1.40E-02	371.0	1.97E-05	1.00E-03	1.97E-08	3.28E+00	2.78E+00	6.45E-08	5.47E-08
Uranium-235	9.00E-03	371.0	1.26E-05	1.00E-03	1.26E-08	2.27E-01	2.05E-01	2.87E-09	2.59E-09
Uranium-238[l]	1.14E-02	371.0	1.60E-05	1.00E-03	1.60E-08	2.00E-01	1.81E-01	3.21E-09	2.90E-09
Total beta (Cs-137)	1.87E+01	371.0	2.63E-02	1.00E-03	2.63E-05	1.46E-01	2.40E-01	3.83E-06	6.30E-06
Tank TK-P4									
Plutonium-239/240[k]	1.40E-02	303.0	1.61E-05	1.00E-03	1.61E-08	3.28E+00	2.78E+00	5.27E-08	4.47E-08
Uranium-235	9.00E-03	303.0	1.03E-05	1.00E-03	1.03E-08	2.27E-01	2.05E-01	2.34E-09	2.12E-09
Uranium-238[l]	1.14E-02	303.0	1.31E-05	1.00E-03	1.31E-08	2.00E-01	1.81E-01	2.62E-09	2.37E-09
Total beta (Cs-137)	1.87E+01	303.0	2.14E-02	1.00E-03	2.14E-05	1.46E-01	2.40E-01	3.13E-06	5.15E-06

Table 2. PTE Calculation for the 203A Acid Storage Area

A	B	C	D	E	F	G	H	I	J
Radionuclide	Pre-Flush Concentration[a] (µCi/L)	Volume[b] (gal)	MAR[c] (Ci)	Release Fraction[d]	PTE[e] (Ci/yr)	Dose Factor[f] (mrem/yr per Ci/yr)		Unabated Dose to MEI (mrem/yr)	
						Onsite MEI	Offsite MEI	Onsite MEI[h]	Offsite MEI[h]
Tank TK-P5[i]									
Plutonium-239/240[k]	1.40E-02	109.0	5.78E-06	1.00E-03	5.78E-09	3.28E+00	2.78E+00	1.90E-08	1.61E-08
Uranium-235	9.00E-03	109.0	3.71E-06	1.00E-03	3.71E-09	2.27E-01	2.05E-01	8.43E-10	7.61E-10
Uranium-238[l]	1.14E-02	109.0	4.71E-06	1.00E-03	4.71E-09	2.00E-01	1.81E-01	9.43E-10	8.53E-10
Total beta (Cs-137)	1.87E+01	109.0	7.72E-03	1.00E-03	7.72E-06	1.46E-01	2.40E-01	1.13E-06	1.85E-06
Tank TK-P6[i]									
Plutonium-239/240[k]	1.40E-02	109.0	5.78E-06	1.00E-03	5.78E-09	3.28E+00	2.78E+00	1.90E-08	1.61E-08
Uranium-235	9.00E-03	109.0	3.71E-06	1.00E-03	3.71E-09	2.27E-01	2.05E-01	8.43E-10	7.61E-10
Uranium-238[l]	1.14E-02	109.0	4.71E-06	1.00E-03	4.71E-09	2.00E-01	1.81E-01	9.43E-10	8.53E-10
Total beta (Cs-137)	1.87E+01	109.0	7.72E-03	1.00E-03	7.72E-06	1.46E-01	2.40E-01	1.13E-06	1.85E-06
Tank TK-P13[i]									
Plutonium-239/240[k]	1.40E-02	55.0	2.92E-06	1.00E-03	2.92E-09	3.28E+00	2.78E+00	9.57E-09	8.11E-09
Uranium-235	9.00E-03	55.0	1.87E-06	1.00E-03	1.87E-09	2.27E-01	2.05E-01	4.25E-10	3.84E-10
Uranium-238[l]	1.14E-02	55.0	2.38E-06	1.00E-03	2.38E-09	2.00E-01	1.81E-01	4.76E-10	4.30E-10
Total beta (Cs-137)	1.87E+01	55.0	3.89E-03	1.00E-03	3.89E-06	1.46E-01	2.40E-01	5.68E-07	9.34E-07
Tank TK-P14[i]									
Plutonium-239/240[k]	1.40E-02	55.0	2.92E-06	1.00E-03	2.92E-09	3.28E+00	2.78E+00	9.57E-09	8.11E-09
Uranium-235	9.00E-03	55.0	1.87E-06	1.00E-03	1.87E-09	2.27E-01	2.05E-01	4.25E-10	3.84E-10
Uranium-238[l]	1.14E-02	55.0	2.38E-06	1.00E-03	2.38E-09	2.00E-01	1.81E-01	4.76E-10	4.30E-10
Total beta (Cs-137)	1.87E+01	55.0	3.89E-03	1.00E-03	3.89E-06	1.46E-01	2.40E-01	5.68E-07	9.34E-07

Table 2. PTE Calculation for the 203A Acid Storage Area

A	B	C	D	E	F	G	H	I	J
Radionuclide	Pre-Flush Concentration[a] (µCi/L)	Volume[b] (gal)	MAR[c] (Ci)	Release Fraction[d]	PTE[e] (Ci/yr)	Dose Factor[f] (mrem/yr per Ci/yr)		Unabated Dose to MEI (mrem/yr)	
						Onsite MEI	Offsite MEI	Onsite MEI[g]	Offsite MEI[h]
Tank TK-P15[i]									
Plutonium-239/240[k]	1.40E-02	303.0	1.61E-05	1.00E-03	1.61E-08	3.28E+00	2.78E+00	5.27E-08	4.47E-08
Uranium-235	9.00E-03	303.0	1.03E-05	1.00E-03	1.03E-08	2.27E-01	2.05E-01	2.34E-09	2.12E-09
Uranium-238[l]	1.14E-02	303.0	1.31E-05	1.00E-03	1.31E-08	2.00E-01	1.81E-01	2.62E-09	2.37E-09
Total beta (Cs-137)	1.87E+01	303.0	2.14E-02	1.00E-03	2.14E-05	1.46E-01	2.40E-01	3.13E-06	5.15E-06
203A Secondary Containment, Pump House, Unloading Dock, and Underlying Soils[j]									
Plutonium-239/240[k]			1.06E-04	1.00E-03	1.06E-07	3.28E+00	2.78E+00	3.48E-07	2.95E-07
Uranium-235			2.68E-04	1.00E-03	2.68E-07	2.27E-01	2.05E-01	6.08E-08	5.49E-08
Uranium-238[l]			5.19E-03	1.00E-03	5.19E-06	2.00E-01	1.81E-01	1.04E-06	9.39E-07
Total beta (Cs-137)			1.32E-01	1.00E-03	1.32E-04	1.46E-01	2.40E-01	1.93E-05	3.17E-05
							Total (mrem/yr)	**4.15E-05**	**6.60E-05**

a. Sample Results from Letter No. 9555104, "Shipment of Plutonium Uranium Extraction Facility Nitric Acid to the United Kingdom, Sample Results for Nitric Acid from Tanks TK-P2/MS and TK-P4."

b. Volumes from HNF-SD-CP-HIE-004, *PUREX Deactivated End-State Hazard Analysis*, page E-21.

c. MAR is calculated as follows: Column B × CF1 (3.785 L/gal) × Column C × CF2 (1 Ci/1,000,000 µCi) = Column D; Section 3.2.1, Equations 1 and 2.

d. Release fraction 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."

e. PTE (Ci/yr) = MAR (Column D) × Release Fraction (Column E); Section 3.2.2, Equation 3.

f. Dose factors were obtained from DOE/RL-2006-29, *Calculating Potential-to-emit Radiological Releases and Doses*, Rev. 2 (Table 4.4), with an effective release height of less than 40 m (131 ft).

g. Onsite MEI dose is calculated as follows: Column F × Column G = Column I; Section 3.2.3, Equation 4.

h. Offsite MEI dose is calculated as follows: Column F × Column H = Column J; Section 3.2.3, Equation 5.

i. Assumed to contain the same radiological contaminants and concentrations as tank TK-P4.

j. MAR values associated with 203A Area secondary containment, pump house, unloading dock, and underlying soils are equal to the sum of MAR values for all tanks for each contaminant; Section 3.2.1, Equation 2.

k. Presented total plutonium (Pu-239/240) sample results were converted from g/L to µCi/L using specific activity conversion factor of Pu-239/240 per 10 CFR 71. Conversion factor = 6.2E+04 µCi/g.

l. Presented total uranium(U-238) sample results were converted from g/L to µCi/L using specific activity conversion factor of U-238 per 10 CFR 71, Table A-1. Conversion factor = 3.40E-01 µCi/g.

4 Criteria/Toxic Air Determination

This section documents the determination of criteria/toxic air emissions resulting from the removal action at the 203A Area. This determination supports DOE/RL-2016-47 and subsequent fieldwork packages. The primary nonradioactive emissions resulting from this removal action will be fugitive particulate matter. Requirements established under WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," regulate emissions criteria and toxic air pollutants. 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 fugitive emissions resulting from materials handling, demolition, or other operations if criteria and toxic emissions are expected.

During deactivation in the 1990s, tanks were emptied of residual chemicals and then flushed until the rinsate was verified to have a pH greater than 2 but less than 12.5 (i.e., no longer exhibited the dangerous waste characteristic of corrosivity). Water and caustic solutions of sodium and potassium hydroxides were used to flush all tanks but TK-P5 and TK-P6 (water only flush; memo 17530-96-028, "Completion of the PUREX Deactivation End Points Associated with Flushing/Draining of the 203-A Vessels"). It was assumed that each flush reduced the concentration in a vessel by $10^{(n+1)}$ for one to three flushes (HNF-SD-CP-HIE-004). The rinsate and tank heels were removed to the extent possible utilizing existing piping and equipment.

The chemical contaminants of concern (COCs) for the 203A Area are UNH, nitric acid, sodium hydroxide, potassium hydroxide, and asbestos (DOE/RL-2016-47). The COCs were identified using process knowledge, deactivation activities, and construction materials. The chemical contaminants were compared to WAC 173-460-150, "Table of ASIL, SQER and de Minimis Emission Values," to identify regulated contaminants. Of the COCs, asbestos, nitric acid, and sodium hydroxide are regulated. Table 3 lists the regulated COCs with their de minimis emission values.

Table 3. de Minimis Emission Values for 203A Area Chemicals

Name	Chemical Abstracts Service Number	De Minimis Emission*
Asbestos	1332-21-4	1.53E-04 lb/yr
Nitric acid	7697-37-2	9.42E-03 lb/hr
Sodium hydroxide	1310-73-2	8.76E-04 lb/hr

*Values from WAC 173-460-150, "Table of ASIL, SQER and de Minimis Emission Values."

Toxic air requirements associated with asbestos containing materials at the 203A Area will be addressed in accordance with applicable NESHAP requirements. An asbestos inspection will be performed by an *Asbestos Hazard Emergency Response Act of 1986*-certified building inspector and necessary abatement performed.

Toxic air emissions from nitric acid and sodium hydroxide are not expected. Sodium hydroxide was used to neutralize the nitric acid in the tanks. Post-flushing pH tests indicate that the acid was neutralized. Therefore, nitric acid and sodium hydroxide are not expected to remain in the tanks at levels that would contribute to toxic air emissions. In addition, any remaining liquid heels will be solidified prior to tank removals, eliminating the potential for emission.

5 References

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Appendix A

Sample Results for Nitric Acid from Tanks TK-P2/MS and TK-P4
(excerpt from Letter 9555104)

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SAMPLE RESULTS FOR NITRIC ACID FROM TANKS TK-P2/MS AND TK-P4

Constituent	Conformance Criteria	Tk-P2/MS	Tk-P4
* Acidity	>6M, <13M	8.51 M	11.1 M
Plutonium	<2.0E^{-5} G/L	1.72E^{-7} G/L	2.26E^{-7} G/L
* Uranium	<80 G/L	12.9 G/L	3.36E^{-2} G/L
Organic Carbon	<2000 uG C/mL	370 uG C/mL	55 uG C/mL
* Total Beta	<50 uCi/L	6.31 uCi/L	18.7 uCi/L
* Total Alpha	<25 uCi/L	2.15E^{-3} uCi/L	7.6E^{-2} uCi/L
Americium^{241}	<1E^{-4} uCi/mL	<3.07E^{-5} uCi/mL	<2.5E^{-5} uCi/mL
Neptunium^{237}	<1E^{-4} uCi/mL	<3.95E^{-5} uCi/mL	<2.9E^{-5} uCi/mL
* Uranium^{235}	<0.95% w/wU	1.78E^{-1} uCi/L	<9.0E^{-3} uCi/L
* Fluoride	<400 uG/mL	<161 uG/mL	<257 uG/mL
Chloride	<800 uG/mL	720 uG/mL	<344 uG/mL
Phosphate	<4000 uG/mL	<1550 uG/mL	<662 uG/mL
Sulphate	<4000 uG/mL	<1760 uG/mL	<753 uG/mL
Iron	<100 uG/mL	67.6 uG/mL	80.3 uG/mL
Sodium	<50 uG/mL	<10.1 uG/mL	4.29 uG/mL
Potassium	<50 uG/mL	<30.3 uG/mL	2.2E^{-1} uG/mL
Arsenic	<3E^{-2} uG/mL	<2.5E^{-2} uG/mL	2.5E^{-2} uG/mL
Selenium	<7E^{-2} uG/mL	<2.5E^{-2} uG/mL	<2.5E^{-2} uG/mL
Mercury	<100 uG/L	18.3 uG/L	53.0 uG/mL
Calcium	<30 uG/mL	14.3 uG/mL	2.09 uG/mL
Chromium	<40 uG/mL	19.9 uG/mL	20.8 uG/mL
Nickel	<20 uG/mL	8.28 uG/mL	11.1 uG/mL
Magnesium	BNFL	<10.1 uG/mL	<1.0E^{-1} uG/mL
Phosphorus	<60 uG/mL	35.2 uG/mL	22.0 uG/mL
SpG	NA	1.27	1.30

* Analytes of special interest to NII.

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Environmental Calculation Review Checklist

Calculation Title: Radiological and Toxic Air Emission for 203A Acid Storage Area
Calculation Number: ECF-Hanford-17-40
Revision: 0
Preparer: John Young
Checker: Carolyn Ervin

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: Carolyn Ervin CEErvin 8/21/2017
Print/Signature/Date

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