ECF-200W-18-0072
Revision 0

200 West Pump and Treat Radiological Air Emissions

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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APPROVED
By Julia Raymer at 1:21 pm, Oct 31, 2019

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ENVIRONMENTAL CALCULATION COVER PAGE

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200 West Pump and Treat Radiological Air Emissions. Updating the radiological air emissions for constituents at the 200W Pump and Treat.

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SECTION 2 - Completed by Preparer

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ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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SECTION 4 - Document Review and Approval

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SECTION 5 - Applicable if Calculation is a Risk Assessment or Uses an Environmental Model

Prior to Initiating Modeling:

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Terms

2WPT	200 West Pump-and-Treat
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
ECF	environmental calculation file
EPA	U.S. Environmental Protection Agency
IX	ion exchange
MEI	maximally exposed individual
O&M	operations and maintenance
P&T	pump and treat
PTE	potential-to-emit
RAWP	Removal Action Work Plan
ROD	record of decision
TEDE	total effective dose equivalent

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1 Purpose

This environmental calculation file (ECF) supports the ongoing operation of the 200 West Pump and Treat (2WPT) tasked with treating contaminated ground water underneath the Hanford Site. The 2WPT is regulated under EPA et al., 2008, *Record of Decision, Hanford 200 Area, 200-ZP-1 Superfund Site, Benton County Washington*, (hereinafter called the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA] 200-ZP-1 Record of Decision [ROD]. This ECF supports DOE/RL-2008-78, *200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan*, and DOE/RL-2009-124, *200 West Pump and Treat Operations and Maintenance Plan* (hereinafter called the Operations and Maintenance [O&M] Plan). Groundwater plumes treated at 2WPT contain both non-radioactive and radioactive contaminants of concern (COCs) including iodine-129, technetium-99, tritium and uranium.

This calculation document summarizes the assumptions, inputs, and methodology to update the potential-to-emit (PTE) from the radionuclide airborne emissions and the total effective dose equivalent (TEDE) to the offsite maximally exposed individual (MEI). Per the definition of PTE within WAC 246-247-030(21), "Radiation Protection—Air Emissions," "Definitions," this calculation assumes a worst-case emission rate based on a bounding source term, if no abatement technology existed. These results will be used to continue to support and update the PTE values and Air Monitoring Plan language within Appendix C of the O&M Plan.

2 Background

The applicable or relevant and appropriate requirements (ARARs; provided in Appendix A of the CERCLA 200-ZP-1 ROD approved in September 2008) support the language within the Removal Action Work Plan (RAWP). The RAWP, originally approved in July 2009, delineates how the remedial action is to be completed and how compliance with the ARARs will be achieved. The O&M Plan, most recently revised in 2016, is the operational implementation of the 2WPT and contains Appendix C, "Air Monitoring Plan for the 200 West Pump and Treat." The Air Monitoring Plan establishes how the radiological ARARs are implemented based on the results of this ECF for the 2WPT.

Revision 0 of the O&M Plan was approved by the U.S. Department of Energy and the U.S. Environmental Protection Agency (EPA) in 2010, which included the original Air Monitoring Plan PTE calculations. Since the startup of the 2WPT, DOE/RL-2006-29, *Calculating Potential-to-Emit Radiological Releases and Doses*, has been revised with updated site-wide dose factor information. This calculation is an update to the PTE calculations for the 2WPT.

3 Methodology

1. Sum the concentrations of influent to the main treatment facility for each COC.
2. Determine the annual possession quantity for each COC.
3. Determine the unabated release rate for each COC.
4. Calculate the TEDE for each COC.
5. Sum the unabated release rates for all COCs.

4 Assumptions and Inputs

- Radiological constituents have not been significantly altered since the latest version of SGW-59108, *Integrated Mass Balance for Introduction of UP-1 Waste Stream to the 200 West Pump and Treat*

Facility (formerly 382519-CALC-050; hereinafter called the Integrated Mass Balance), was issued. Constituent levels have been declining across the pump and treat (P&T) system. Values have been maintained, as is, out of conservatism.

- Concentration inputs are from sample values taken during development of the Integrated Mass Balance. Values have diminished since the calculation was finalized but the values are used out of conservatism.
- The use of DOE/RL-2006-29 appropriate for estimating the prospective TEDE to the MEI as it is based on the EPA approved computer model CAP-88 –PC Version 4.
- A release fraction of 1.00E+00 is conservatively used for iodine-129 as a gas, although its removal in the treatment system is as a particulate.
- Tritium is also conservatively considered as a gas for dose calculation.
- The organic compound dose release factor is used for tritium because it is the most conservative dose release factor of all the offsite MEI location factors for tritium.
- A release fraction of 1.00E-03 is used for technetium-99 and uranium.
- The unabated annual possession quantity for the 200 West P&T is conservatively calculated by applying the maximum design flow for the entire facility to each constituent for a period of one year operating at 24 hours a day, 365 days a yr. Annual pump rate is 2,500 gpm.

Table 1. COCs and Offsite MEI Location

Constituent	Offsite MEI Dose Release Factor [a] (mrem/yr per Ci/yr)
Tritium (H-3) [b]	2.77 E-05
Technetium-99	2.21 E-02
Iodine-129	1.35 E-01
Uranium [c]	6.51 E-01

a. Values from DOE/RL-2006-29, *Calculating Potential-to-Emit Radiological Releases and Doses*, Table 4.5 for less than 40 m.

b. Organic compounds value.

c. As U-232+D. The +D indicated the isotope does include parent and decay products.

COC = contaminant of concern

MEI = maximally exposed individual

5 Calculations

Step 1)

Sum the concentrations of influent to the main treatment facility for each COC.

The technetium-99 concentration is obtained by summing the concentration of influent to the technetium-99 ion exchange (IX) treatment unit and the concentration of untreated groundwater to the main treatment facility:

14,700 pCi/L + 175 pCi/L = 14,875 pCi/L

Repeat for each COC:

The iodine-129 concentration is obtained by summing the concentrations of raw groundwater influent to the technetium-99 IX unit, uranium IX unit and untreated groundwater to the main treatment facility:

1.3 pCi/L + 0.825 pCi/L + 0.054 pCi/L = 2.18 pCi/L

The tritium concentration is obtained from the combined (radiological and biological buildings) influent to the main treatment facility:

(9,250 pCi/L)

The uranium concentration is obtained from summing the concentrations of untreated groundwater influent to the uranium IX unit, technetium-99 IX unit, and untreated groundwater influent to the main treatment facility:

570 pCi/L + 3.96 pCi/L + 3.47 pCi/L = 577.43 pCi/L

Step 2)

Determine the annual possession quantity for each COC.

The (technetium-99 concentration) x (annual pump rate) = annual possession quantity:

$$\left(14{,}875\frac{pCi}{L}\right) x \left(3.7854\frac{L}{gal}\right) x\ (2{,}500\ gpm) x \left(1{,}440\frac{min}{day}\right) x \left(365\frac{days}{yr}\right) x \left(E-12\frac{Ci}{pCi}\right) = 7.40\ E+01\ Ci/yr$$

Repeat for each COC.

The (iodine-129 concentration) x (annual pump rate) = annual possession quantity:

$$(2.18\ pCi/L)\ x\ (3.7854\ L/gal)\ x\ (2{,}500\ gpm)\ x\ (1{,}440\ min/day)\ x\ (365\ days/yr)\ x\ (E-12\ Ci/pCi) = 1.08\ E-02\ Ci/yr$$

The (tritium concentration) x (annual pump rate) = annual possession quantity

$$\left(9{,}250\frac{pCi}{L}\right) x \left(3.7854\frac{L}{gal}\right) x\ (2{,}500\ gpm) x \left(1{,}440\frac{min}{day}\right) x \left(365\frac{days}{yr}\right) x \left(E-12\frac{Ci}{pCi}\right) = 4.60\ E+01\ Ci/yr$$

The (uranium concentration) x (annual pump rate) = annual possession quantity

$$\left(577.43\frac{pCi}{L}\right) x \left(3.7854\frac{L}{gal}\right) x\ (2{,}500\ gpm) X \left(1{,}440\frac{min}{day}\right) x \left(365\frac{day}{yr}\right) x \left(E-12\frac{Ci}{pCi}\right) = 2.87E+00\ Ci/yr$$

Step 3)

Determine the unabated release rate for each COC.

The (technetium-99 annual possession quantity) x (release fraction) = unabated release rate:

$$\left(7.40\ E+01\frac{Ci}{yr}\right) x\ (1\ E-03) = 7.40\ E-02\ Ci/yr$$

Repeat for each COC.

The (iodine-129 annual possession quantity) x (release fraction) = unabated release rate:

$$(1.08\ E-02\ Ci/yr)\ x\ (1) = 1.08\ E-02\ Ci/yr$$

The (tritium annual possession quantity) x (annual pump rates) = unabated release rate:

$$(4.6\ 0E+01\ Ci/yr)\ x\ (1) = 4.60\ E+01\ Ci/yr$$

The (uranium possession quantity) x (annual pump rates) = unabated release rate:

$$(2.87E+00\ Ci/yr)\ x\ (1\ E-03) = 2.87\ E-03\ Ci/yr$$

Step 4)

Calculate annual TEDE for each COC.

The annual TEDE to the maximally exposed individual is conservatively determined by multiplying the unabated release rate for each representative radiological constituent by the applicable unit dose conversion factors from DOE/RL-2006-29:

- Technetium-99: (7.40 E-02 Ci/yr) x (2.21 E-02 mrem/Ci) = 1.64 E-03 mrem/yr
- Iodine-129: (1.08 E-02 Ci/yr) x (1.35 E-01 mrem/Ci) = 1.46 E-03 mrem/yr
- Tritium: (4.60 E+01 Ci/yr) x (2.77 E-05 mrem/Ci) = 1.27 E-03 mrem/yr
- Uranium (as U-232): (2.87 E-03 Ci/yr) x (6.51 E-01 mrem/Ci) = 1.87 E-03 mrem/yr

Step 5)

Sum the TEDE for all COCs.

(1.64 E-03 mrem/yr) + (1.46 E-03 mrem/yr) + (1.27 E-03 mrem/yr) + (1.87 E-03 mrem/yr) = **6.24 E-03 mrem/yr**

6 Results

The TEDE for the 2WPT stack is 6.24E-03 mrem/year to the offsite MEI. The MEI is located 22 km to the southeast.

7 References

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