ECF-100HR3-19-0115
Revision 0

New Source Review for the 100-HX and 100-DX Pump and Treat Facilities in the 100-HR-3 Operable Unit

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 Lynn M. Ayers at 3:49 pm, Nov 14, 2019

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ENVIRONMENTAL CALCULATION COVER PAGE

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New Source Review for the 100-HX and 100-DX Pump and Treat Facilities in the 100-HR-3 Operable Unit. Provides a bounding calculation for radiological and non-radiological emissions for these facilities.

Qualifications Summary

Preparer(s):

Name: Sean Sexton

Degree, Major, Institution, Year: B.A. Geology, Central Washington University, 2007
M.S. Environmental Science, WSU Tri-Cities, 2018

Professional Licenses: N/A

Brief Narrative of Experience: Over 10 years of environmental support at Hanford, including 3 years as the Environmental Compliance Officer for the Soil & Groundwater Remediation Project.

Checker(s):

Name: Nick Wood

Degree, Major, Institution, Year: B.S. Environmental Science, Washington State University, 2019

Professional Licenses: N/A

Brief Narrative of Experience: 1 year of environmental support at SGRP.

Senior Reviewer(s):

Name: Frank Carleo

Degree, Major, Institution, Year: B.S. Environmental Science, Washington State University, 2015

Professional Licenses: N/A

Brief Narrative of Experience: Mr. Carleo has a decade of experience in the radiological and environmental field developing/implementing/reviewing environmental calculations and associated documentation needed to permit and ensure compliance for clean-up work at the Hanford Site. In his role as the Clean Air Act SME he is the expert for CHPRC in these matters.

SECTION 2 - Completed by Preparer

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ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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SECTION 4 - Document Review and Approval

Preparer(s):			
Sean Sexton	SGRP ECO		10/31/19
Print First and Last Name	*Position*	*Signature*	*Date*
Checker(s):			
Nick Wood	SGRP Env. Scientist		10/31/19
Print First and Last Name	*Position*	*Signature*	*Date*
Senior Reviewer(s):			
Frank Carleo	EPSP Air SME		10/31/19
Print First and Last Name	*Position*	*Signature*	*Date*
Responsible Manager(s):			
Randal Fox	SGRP Env. Director		10/31/19
Print First and Last Name	*Position*	*Signature*	*Date*

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

Prior to Initiating Modeling:

Required training for modelers completed:
Integration Lead:

N/A		
Print First and Last Name	*Signature*	*Date*

Safety Software Approved:
Integration Lead:

N/A		
Print First and Last Name	*Signature*	*Date*

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Risk/Modeling Integration Manager:

N/A		
Print First and Last Name	*Signature*	*Date*

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Terms

COC	contaminant of concern
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
gpm	gallons per minute
IX	ion exchange
MEI	maximally exposed individual
OU	operable unit
ROD	record of decision
TEDE	total effective dose equivalent

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1 Purpose

The purpose of this environmental calculation is to document the air emissions calculations for contaminants of concern (COCs) documented for the 100-HR-3 Operable Unit (OU) record of decision (ROD) in EPA et al., 2018, *Record of Decision Hanford 100 Area Superfund Site 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, 100-HR-3 Operable Units July 2018* (hereafter known as the 100-D/H ROD).

This calculation focuses on the COCs listed in the 100-D/H ROD for the 100-HR-3 groundwater OU, because of the active remediation of groundwater. The COCs for 100-HR-3 OU are Strontium-90, chromium (total and hexavalent) and nitrate. These calculations are being performed in accordance with the applicable requirements of WAC 173-400, "General Regulations for Air Pollution Sources," WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides," and WAC 246-247, "Radiation Protection—Air Emissions," which are listed as applicable, relevant and appropriate requirements (ARARs) in the 100-D/H ROD. The assumptions and operating conditions found within this calculation are considered to be bounding conditions of the remedial actions performed at the 100-HR-3 OU.

2 Background

There are currently two active pump and treat facilities operating in the 100-HR-3 groundwater OU, the 100-HX and 100-DX facilities. The 100-HX and 100-DX facilities treat 100-HR-3 COCs through a series of ion exchange (IX) vessels, with a predominant focus on hexavalent chromium treatment. Under the current remediation strategy using IX vessels, there are no anticipated air emissions at these facilities.

Remedial actions in the 100-HR-3 OU are being performed under the authority of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and is therefore not subject to permitting. ARARs for the remedial actions have been designated in the 100-D/H ROD, and to meet the substantive requirements of the *Washington Administrative Code* (WAC) regulations listed as ARARs, this calculation shows the air emissions calculations (radiological and non-radiological) for Strontium-90 (Sr-90) and nitrate emissions. Total chromium and hexavalent chromium are not evaluated as toxic air pollutants under operating conditions of the 100-HX and 100-DX facilities. Hexavalent chromium as a volatile at pump and treat facilities has been previously evaluated in SGW-62363, *Hexavalent Chromium Treatment at the 200 West Pump and Treat*.

These emissions are calculated under a worst-case scenario in order to be bounding for the current remedial actions. Changes to, or additional, remedial or removal actions will require further evaluation under the requirements of the substantive ARARs. The results of this calculation are presented in the Remedial Design/Remedial Action Work Plan for the 100-D/H ROD.

3 Assumptions

For both radiological and non-radiological equations:

- Maximum potential flow through the 100-HX facility (1200 gallons per minute [gpm]) and 100-DX facility (900 gpm) was used for bounding condition.

For the radiological potential to emit (PTE) calculation:

- Sr-90 release factor value of 1.90E-03 from DOE/RL-2006-29, *Calculating Potential-to-Emit Radiological Releases and Doses*, Table 4.3, includes daughter products.

- Sr-90 release factor value of 1.90E-03 from DOE/RL-2006-29, Table 4.3, is for a release from 100-K Area at less than 40 meters in height, because there is no value for the 100-H or 100-D Areas.
- Highest detected Sr-90 value in groundwater from calendar year 2017 through September 2019 for 100-HX (199-H4-63) and 100-DX (199-D8-68) was used as a bounding condition.
- A release fraction of E-03 is used for Sr-90.

For the toxic air pollutant (TAP) calculation:

- Chromium and hexavalent chromium are not released as stated in the background section above.
- All nitrate is released as nitrogen oxides.

4 Methodology

1. Determine the maximum flow rate of groundwater through the 100-HX and 100-DX facilities.
2. Determine the maximum concentration for each considered COC from extraction wells at each facility.

4.1 Radiological COCs

DOE/RL-2006-29 is used to calculate the unabated release potential for radiological constituents. As such, Method 1, which is prescribed in 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Appendix D, "Methods for Estimating Radionuclide Emissions," and in WAC 246-247-030, "Definitions" is used. Method 1 states, "Multiply the annual possession quantity of each radionuclide by the release fraction for that radionuclide," depending on its physical state. The following release fractions are used:

- 1 for gases
- 10^{-3} (E-03) for liquids or particulate solids
- 10^{-6} (E-06) for solids

A release fraction of E-03 is used for Sr-90. The unabated annual possession quantity for the 100-HX and 100-DX facilities is conservatively calculated by applying the maximum facility flow rate to each constituent for a period of one year operating 24 hours a day, 365 days a year.

3. Calculate the annual possession quantity for Sr-90 at the 100-HX and 100-DX facilities.
4. Calculate the unabated release rate for Sr-90 at 100-HX and 100-DX.
5. Calculate the annual total effective dose equivalent (TEDE) for Sr-90 from the 100-HX and 100-DX facility and document for nearest maximally exposed individual (MEI).

4.2 Non-radiological COCs

6. Calculate the annual release of nitrous oxides (in ton/year) for 100-HX and 100-DX.

5 Calculation

Step 1) Determine maximum flow rate of groundwater for the 100-HX and 100-DX facilities.

Maximum flow rate through the 100-HX facility is up to 1200 gpm. Maximum flow rate through the 100-DX facility is up to 900 gpm.

Step 2) Determine the maximum concentration for each considered COC from extraction wells at each facility.

Table 1. Maximum Groundwater Concentration by Facility Extraction Well

Well Name	Facility	Result
199-H4-12C	100-HX	Total Chromium 132 µg/L
699-97-61	100-DX	Total Chromium 106 µg/L
199-D8-97	100-DX	Nitrate 7,770 µg/L
199-H4-74	100-HX	Nitrate 7,290 µg/L
199-H4-63	100-HX	Sr-90 15.1 pCi/L
199-D8-68	100-DX	Sr-90 5.86 pCi/L

Step 3) Calculate the annual possession quantity for Sr-90 at the 100-HX and 100-DX facilities.

Sr-90 (100-HX):

$$\frac{15.1\ pCi}{L} \times \frac{3.7854\ L}{gal} \times \frac{1200\ gal}{min} \times \frac{1440\ min}{day} \times \frac{365\ day}{year} \times \frac{1E-12\ Ci}{pCi} = \mathbf{3.61\ E-2\ \frac{Ci}{year}}$$

Sr-90 (100-DX):

$$\frac{5.86\ pCi}{L} \times \frac{3.7854\ L}{gal} \times \frac{900\ gal}{min} \times \frac{1440\ min}{day} \times \frac{365\ day}{year} \times \frac{1E-12\ Ci}{pCi} = \mathbf{1.05\ E-2\ \frac{Ci}{year}}$$

Step 4) Calculate the unabated release rate for Sr-90 at the 100-HX and 100-DX.

Sr-90 annual possession quantity X release fraction = unabated release rate

100-HX:

$$3.61\ E-2\ \frac{Ci}{year} \times E-03 = \mathbf{3.61\ E-5\ \frac{Ci}{year}}$$

100-DX:

$$1.05\ E-2\ \frac{Ci}{year} \times E-03 = \mathbf{1.05\ E-5\ \frac{Ci}{year}}$$

Step 5) Calculate the annual total effective dose equivalent (TEDE) for Sr-90 from the 100-HX and 100DX facility and document for nearest maximally exposed individual (MEI).

Unabated release rate (Ci/yr) x unit conversion (mrem/Ci) = TEDE

100-HX:

$$3.61\ E-5\ \frac{Ci}{year} \times 1.90\ E-01\ \frac{mrem}{Ci} = \mathbf{6.86\ E-6\ \frac{mrem}{year}}$$

100-DX:

$$1.05\ E-5\ \frac{Ci}{year} \times 1.90\ E-01\ \frac{mrem}{Ci} = \mathbf{2.00\ E-6\ \frac{mrem}{year}}$$

Step 6) Calculate the annual release of nitrous oxides (in ton/year) for 100-HX and 100-DX.

For 100-HX:

$$\frac{1200\ gal}{min} \times \frac{3.7854\ L}{gal} \times \frac{7{,}290\ \mu g}{L} \times \frac{1440\ min}{day} \times \frac{365\ day}{year} \times \frac{ton}{9.072\ E+11\ \mu g} = \mathbf{19.2\ \frac{ton}{year}}$$

For 100-DX:

$$\frac{900\ gal}{min} \times \frac{3.7854\ L}{gal} \times \frac{7{,}770\ \mu g}{L} \times \frac{1440\ min}{day} \times \frac{365\ day}{year} \times \frac{ton}{9.072\ E+11\ \mu g} = \mathbf{15.3\ \frac{ton}{year}}$$

6 Results

For Sr-90, the exposure to the nearest offsite MEI to 100-HX, approximately 12,500 m to the east-southeast, is calculated to be 6.86 E-6 mrem/year. The calculated exposure to the nearest offsite MEI to 100-DX, approximately 16,500 m to the east, is 2.00 E-6 mrem/year. These values are both well below the 10 mrem/year offsite MEI exposure limit found in WAC 173-480-040, “Ambient Standard.”

Nitrous oxide (nitrate) emissions from the 100-HX facility are calculated to a maximal value of 19.2 tons/year. The nitrous oxide emissions from the 100-DX facility are calculated to a maximal value of 15.3 tons/year. These criteria pollutant calculations are prospective calculations used to bound emissions from the 100-HX and 100-DX facilities as a worst case scenario. The threshold limit for the Hanford Site is 40 ton/year for nitrous oxides. The calculations presented here indicate that even a conservative prospective calculation remains under the threshold limits within WAC 173-400-030(30), “Definitions.”

7 References

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