Appendix D –

EDF-3124-0006, *Determination of Wind-Blown Dust During Construction Activities*

Document ID: EDF-3124-0006
Revision ID: 1
Effective Date: July 21, 2015

Engineering Design File

Determination of Wind-Blown Dust During Construction Activities

Portage Project No.: 3124
Project Title: NWMI Environmental Report

Portage

TEM-9002
09/29/09
Rev. 0

ENGINEERING DESIGN FILE

1. Portage Project No.: 3124 2. Project/Task: NWMI Environmental Report

3. DCN #

4. Title: Determination of Wind-Blown Dust During Construction Activities

5. NPH PC or SDC: N/A

6. SSC Safety Category: N/A

7. Summary: This EDF documents the methods used and the results of the windborne dust generated during the construction phase of the Northwest Medical Isotopes, LLC (NWMI) Radioisotope Production Facility project.

8. Distribution: (Portage, Inc.)

9. Review (R) and Approval (A) Signatures:
(Identify minimum reviews and approvals. Additional reviews/approvals may be added.)

	R/A	Printed Name/ Organization	Signature	Date
Author/Design Agent	A	Gary McManus		7/21/15
Independent Review	R	Dave Thorne		7/21/15
Independent Review	R			
Project Manager	R/A	John Beller		7/21/15

Registered Professional Engineer's Stamp (if required) ☒ N/A

Introduction and Purpose

The purpose if the analysis is to determine the amount of dust produced during construction of the Northwest Medical Isotopes, LLC (NWMI) Radioisotope Production Facility from wind erosion. Wind erosion could occur during the construction period at areas that have experienced disturbance, either temporary or permanent. These areas include grubbed areas, building pads, roadways, rights-of-way for power lines, trenched areas, laydown yards, and construction material stockpiles.

Approach

Aggregate material surfaces are characterized by the finite availability of erodible material (mass/area), referred to as the erosion potential. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential. However, each time a surface is disturbed, its erosion potential is restored. Emissions generated by wind erosion are dependent on the frequency of the disturbance.

A disturbance is defined as an action that results in the exposure of fresh surface material. On a stockpile, this would occur whenever aggregate material is either added or removed from the old surface. A disturbance of an exposed area may also result from the turning of surface material to a depth exceeding the size of the largest pieces of material present.

The emission factor for wind-generated particulate emissions from mixtures of erodible and non-erodible surface material subject to disturbance may be expressed in units of grams (g)/square meter (m^2) per year, as shown in the following equation from U.S. Environmental Protection Agency, AP-42, *Compilation of Air Pollutant Emission Factors*, Section 13.2.5 (updated 2006):

Equation 1

$$\text{Emission factor} = k \sum_{i=1}^{N} P_i$$

where

k = Particle size multiplier, varies with aerodynamic particle size as follows: 0.5 for <10 μm, 0.075 for <2.5 micrometer (μm) (see Attachment 1).

N = Number of disturbances per year

Pi = Erosion potential corresponding to the observed (or probable) "fastest mile" of wind for the period (i) between disturbances, g/m^2

In calculating emission factors, each area of an erodible surface that is subject to a different frequency of disturbance is treated separately. For a surface disturbed daily, N = 365 per year, and for a surface disturbance once every 6 months, N = 2 per year.

The erosion potential functions for a dry, exposed surface are from AP-42, Section 13.2.5. The erosion potential function (P) for a dry, exposed surface is calculated in Equation 2.

Equation 2

$$P = 58 (u^* - u_t^*)^2 + 25 (u^* - u_t^*)$$

P = 0 for $u^* \leq u_t^*$

where

u^* = Friction velocity (meters [m]/second [s])

u_t = Threshold friction velocity (m/s)

The routinely measured meteorological variable that best reflects the magnitude of wind gusts is the fastest mile (u+). To convert the fastest mile of wind (u+) from a reference anemometer height of 10 m to the equivalent friction velocity (u*), the logarithmic wind speed profile may be used to yield the following equation (AP-42, Section 13.2.5).

Equation 3

$$u^* = 0.053\ u_{10}^+$$

where:

u_{10}^+ = Fastest mile of reference anemometer for period between disturbances (m/s)

Assumptions

- A typical roughness height of 0.5 centimeters (cm) for open terrain. Equation 3 is restricted to large relatively flat piles or exposed areas with little penetration into the surface wind layer.
- In the absence of field data for estimating the threshold friction velocity (u_t), a value of 1.02 m/s is obtained from AP-42, Table 13.2.5-2 (see Attachment 1). This is the threshold wind velocity for overburden.
- The surface area is assumed to be 14,163 m^2 (3.5 acres) and exposed for a period of 3 months after beginning of grading. The surface area is allowed to erode by the maximum 2-minute wind speed observed in five years of weather data (January 1, 2007 through December 31, 2011). This assumes that the entire area is eroded based on its erosion potential for N=1 disturbances, and no other disturbances are assumed to occur during the period.
- Wind data was obtained from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center wind data for station GHCND:USW00003945 – Columbia Regional Airport, Missouri (http://www.ncdc.noaa.gov/cdo-web/search) for the fastest 2-minute wind speed for the period of January 1, 2007 through December 31, 2011. During this period, the highest record sustained wind speed was 24.1 m/s (53.9 miles [mi]/hour [hr]) using a reference anemometer height of 10 m.

Calculations

Equation 3 is used to convert the fastest mile value of 24.1 m/s (53.9 mi/hr) to an equivalent friction velocity.

$U^* = 0.053(24.1)$

$= 1.28$ m/s

This value exceeds the threshold friction velocity ($u_t = 1.02$ m/s) from AP-42, Table 13.2.5-2 (see Attachment 1), so erosion would occur.

The PM-10 and PM-2.5 emissions generated by the erosion event are calculated using Equation 2.

$P = 58(1.28 - 1.02)^2 + 25(1.28 - 1.02)$

$= 3.92 + 6.50$

$= 10.4\ g/m^2$

The PM-10 emissions for the construction period are estimated using Equation 1:

$E_{10} = 0.5*(14{,}163\ m^2)\ (10.4\ g/m^2)$

$= 7.38E+04$ g

$= 160$ lb (0.082 t)

The PM-2.5 emissions for the construction period are estimated using Equation 1:

$E_{2.5}$ = 0.075*(14,163 m^2) (10.4 g/m^2)

= 1.10E+04 g

= 24 lb (0.012 t)

References

AP-42, *Compilation of Air Pollutant Emission Factors*, Volume 1, *Stationary Point and Area Sources*, Fifth Edition, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C., January 1995.

Attachment 1

Aerosol Particle Size Multipliers (k)

Aerodynamic Particle Size Multipliers for Equation 1

30 µm	<15 µm	<10 µm	<2.5 µm
1.0	0.6	0.5	0.075

Source: Section 13.2.5 (updated 2006) of EPA AP-42, *Compilation of Air Pollutant Emission Factors*, Volume 1, *Stationary Point and Area Sources*, Fifth Edition, U.S. Environmental Protection Agency, Office of Air and Radiation, January 1995.

Table 13.2.5-2 (Metric Units), Threshold Friction Velocities

Material	Threshold friction velocity (m/s)	Roughness height (cm)	Threshold wind velocity at 10 m (m/s)	
			zo = Act	zo = 0.5 cm
Overburden[a]	1.02	0.3	21	19
Scoria (roadbed material)[a]	1.3	0.3	27	25
Ground coal (surrounding coal pile)[a]	0.55	0.01	16	10
Uncrusted coal pile[a]	1.12	0.3	23	21
Scraper tracks on coal pile (lightly crusted)[a]	0.62	0.06	15	12
Fine coal dust on concrete pad[b]	0.54	0.2	11	10

[a] Western surface coal mine (Axtell and Cowherd, 1984).
[b] Eastern power plant (Muleski, 1985).

References

Axtell, K., and C. Cowherd, Jr., "Improved Emission Factors for Fugitive Dust from Surface," *Coal Mining Sources*, EPA-600/7-84-048, U. S. Environmental Protection Agency, Cincinnati, Ohio, March 1984.

EPA AP-42, *Compilation of Air Pollutant Emission Factors*, Volume 1, *Stationary Point and Area Sources*, Fifth Edition, U.S. Environmental Protection Agency, Office of Air and Radiation, January 1995.

Muleski, G. E., "Coal Yard Wind Erosion Measurement," Midwest Research Institute, Kansas City, Missouri, March 1985.