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From: Dwight Shearer, P.E.
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Re: *Westmoreland Sanitary Landfill LLC*
Plan Approval Application No. PA-65-00767C
Westmoreland Sanitary Landfill LLC
Rostraver Township, Westmoreland County

The Southwest Region Air Quality (SW AQ) program is reviewing a plan approval application from Westmoreland Sanitary Landfill LLC (WSL) to install an evaporator, which would evaporate landfill leachate. Analyses of leachate samples has identified radionuclides in the landfill leachate, and the evaporation of leachate has the potential to emit radionuclides into the atmosphere. Therefore, SW AQ reached out to the Bureau of Radiation Protection (BRP) to review and provide input on the radiation related aspects of the proposed evaporator emissions.

It is my understanding that Radium-226 (Ra-226) and Radium-228 (Ra-228) are the main radionuclides of concern in the landfill leachate proposed for evaporation. It should be made clear that in this context that these radionuclides fall into a category known as Technologically Enhanced Naturally Occurring Radioactive Material or (TENORM). Currently, the DEP's Radiation Protection Program does not regulate TENORM pursuant to the statutes it administers.

It is also my understanding that WSL is proposing that the raw leachate undergo a pre-treatment process, specifically hydrocarbon removal and filtration. The applicant has stated that in the evaporator itself is a mist eliminator, which is an air cleaning device. The applicant has proposed that the mist eliminator has a control efficiency of 99% for total dissolved solids present in the leachate in the evaporator. The mist eliminator is proposed to control dissolved solids including radionuclides. The evaporator is proposed to operate at temperatures of 600 to 1000 °F. Radium is in a solid phase below 1285 °F and will remain a solid at temperatures at which the evaporator is proposed to operate. The radionuclides are expected to be dissolved solids in the leachate.

Is Evaporating the TENORM Leachate from WSL safe for the Environment and to Humans?

Standards for protection of humans and environment from ionizing radiation are set forth in 10 CFR Part 20 ("Part 20"). The practices and procedures set forth in Part 20 are generally accepted by radiation protection professionals for evaluating the potential danger from ionizing radiation, even for activities, like the proposed evaporator, that are not conducted under licenses issued by the Nuclear Regulatory Commission (NRC) or an agreement state. Since the Commonwealth is an agreement state with the NRC, the proposed evaporator will not require a license from the Department.

Appendix B to Part 20 generally contains criteria for evaluating the safety to humans and environment from emissions or discharges of radionuclides, and specifically contains "Effluent" criteria for use in assessing and controlling the dose to the public of radionuclides emitted from a facility. Appendix B Table 2 lists isotope specific values for effluent releases to air and water. *See* 10 CFR § 20.1302 (b)(2)(i) ("The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table 2 of Appendix B to part 20")

The air effluent criteria from Table 2 of Appendix B for Ra-226 and Ra-226 are as follows:

Ra-226 = 9.0×10^{-13} μCi/mL (9.0×10^{-4} pCi/L)

Ra-228 = 2.0×10^{-12} μCi/mL (2.0×10^{-3} pCi/L)

When multiple radionuclides are being emitted in an effluent, the "Rule of Unity" is used to determine the safety of the emissions. That means summation of the radionuclide concentraion emitted to the atmosphere for inhalation divided by the respective Table 2 value must be equal to or less than 1.0 A summation of one or less would correspond to a safe dose of radiation.

See Appendix B (heading "Table 1 Occupational").

Expressed in mathematical form:

$1.0 \geq \sum (Ci/E1) + (C2/E2) + (C3/E3) \ldots.$

Cx = Concertation of emitted isotope in the atmosphere at the site boundary

Ex = Effluent criteria value for isotope from Appendix B, Table 2.

WSL conducted dispersion modeling for the evaporator as part of its plan approval application for contaminates to be emitted to the atmosphere from the evaporator, including radionuclides. DEP Air Quality's Modeling Section has reviewed the modeling and found it to be acceptable. *See* Memorandum dated December 17, 2021 from Daniel J. Roble to Melissa L. Jativa

(Modeling Memo). The modeling was performed for emission of 1 g/s of each radionuclide, which I understand that this is a common convention in air dispersion modeling. The actual atmospheric concentration is determined by multiplying the concentration determined from modeling by the actual concentration of that contaminant, because the relationship is linear.

The maximum atmospheric concentration based on the assumed 1.0 g/s emission is 315.79747 ug/m^3. This concentration is from a location 61.0 meters from the stack in the northwest direction and is located within WSL's site-controlled boundaries.

I will conservatively use the application's stack emission rates for Ra-226 and Ra-228 to evaluate the Rule of Unity. Using stack emission rates is conservative because no person would inhale stack emissions directly and atmospheric concentrations of Ra-226 and Ra-228 will be lower than the stack emission rate. I understand the maximum stack emission rate of Ra-226 and Ra-228 from WSL's Plan Approval application (assuming 99% removal of radionuclides by the mist eliminator) to be:

Ra-226 $= 1.2 \times 10^{-5}$ pCi/L

Ra-228 $= 5.61 \times 10^{-6}$ pCi/L

Applying the Rule of Unity to these values yields the following:

$((1.2 \times 10^{-5}$ pCi/L)/$(9.0 \times 10^{-4}$ pCi/L)) + $((5.61 \times 10^{-6}$ pCi/L)/$(2.0 \times 10^{-3}$ pCi/L)

$0.013 + 0.003 = 0.016 \leq 1.0$

Thus, the Rule of Unity is satisfied, and the evaporator radionuclide emissions would be within standards protective of humans and the environment.

Is the Proposed Radionuclide Monitoring Plan Appropriate?

An air monitoring plan for radionuclides relies heavily on dispersion modeling. These models predict areas of higher concentrations and the modeling results are used to determine the location and the number of air monitor stations. WSL's contractor performed an air dispersion model which DEP Air Quality's Modeling Section has reviewed and found it to be acceptable. *See* Memorandum dated December 17, 2021from Daniel J. Roble to Melissa L. Jativa (Modeling Memo).

I understand that WSL has proposed to establish five (5) continuous running air monitoring stations/locations with particulate filter samples being collected weekly. WSL also, proposes to have 6 passive radiation detectors (TLD/OSL) collected quarterly. Each of the, five air monitoring stations will have a passive TLD/OSL along with a sixth being placed at the site office.

According, to plan the locations cover the three most prevalent wind directions indicated by the model. The three predominant wind directions as shown by meteorological data: northwest, north-northeast and southeast. The monitoring station locations, which represent the areas of highest modeled concentrations, are all located within WSL's site-controlled boundaries. The modeling did indicate an area of concentration outside the site boundary; however, the concentration is a factor of three (3) less than then the maximum concentration predicted by the model.

The Plan indicates that the applicant will compile the data into a monthly format and submit those results to DEP on a quarterly basis and will include the continuous monitor analysis and TLD/OSL analyses.

The steps in which applicant took to determine the locations, and number of monitoring stations, the frequency of monitoring and the types of monitoring devices to be used are the same steps that the Bureau of Radiation Protection would expect from a fully licensed radioactive materials user that would be operating an evaporator. Thus, the radionuclide monitoring plan as currently proposed is adequate to monitor airborne radionuclides emitted from the proposed evaporator.

Conclusion

WSL's leachate that contains TENORM can be evaporated through the proposed process and still be within the safe discharge limits established by the NRC and adopted by the Commonwealth through agreement status, and generally accepted by radiation professionals. The monitoring plan as proposed is also acceptable as means to detect radiation and stop operations, if needed. Therefore, it is my recommendation that the proposed operation and monitoring of the evaporator would be protective of public health from a radiation protection perspective.