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DEMONSTRATING COMPLIANCE WITH THE PUBLIC DOSE LIMITS IN PART 380

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The New York State Department of Environmental Conservation's (DEC) 6 NYCRR Part 380 regulations, *"Rules and Regulations for Prevention and Control of Environmental Pollution by Radioactive Materials,"* apply to the release of radioactive materials into the environment. Certain categories of radioactive emissions require a Part 380 Radiation Control Permit. When you apply for a permit, you must be able to demonstrate that the emissions you propose will comply with the dose limits in Part 380. This guidance describes how **facilities applying for a permit to emit radioactive materials to the air** can make that demonstration. This guide is a supplement to the *Application Guide for Radiation Control Permits for the Emissions of Radioactive Material in Effluents to Air*, and expands the discussion appearing in Section D, Item 8 of the guide.

Dose Limits to Members of the Public

Part 380 establishes radiation dose limits for individual members of the public from the release of radioactive material to the environment (Section 380-5.1). These limits are 100 millirem per year total effective dose equivalent and an external dose rate of 2 millirem in any hour. For radioactive emissions, a 10 millirem dose constraint must also be met. In addition, doses must be maintained as low as reasonably achievable (ALARA).

Part 380 also requires facilities that release radioactive materials to perform surveys to demonstrate compliance with the dose limits (see Subpart 380-6). "Survey" is broadly defined as an evaluation of the radiological conditions present. It includes measurements or calculations performed to estimate concentrations and quantities of radioactive material in effluents. The regulations require surveys to assess compliance in unrestricted areas in the environment. The results are used as the basis for demonstrating that operations are conducted in such a way that public dose limits are not exceeded.

Demonstrating Compliance with the Public Dose Limits

Part 380 requires that compliance with the public dose limits be demonstrated by one of two methods (see Section 380-5.2). When you apply for a permit to emit radioactive materials to the air, you must use one of these two methods to demonstrate that doses resulting from your proposed radioactive emissions will comply with the public dose limits.

The simplest method for demonstrating compliance is described in paragraph 380-5.2(b)(2) and is referred to here as "Method 1." A radioactive release will comply if the radionuclide concentration in the effluent (at the emission point) is less than the effluent concentration value listed in the tables (Column 1, Table II of Section 380-11.7), and if the external dose rate limit is met. You should try this method first and use it whenever possible.

If your radioactive emissions exceed the effluent concentration values in the tables (at the emission point), you must use the method outlined in paragraph 380-5.2(b)(1) to demonstrate compliance. This method is referred to here as "Method 2," and it is a dose assessment.

Your Part 380 permit application must clearly indicate which of these two methods you have used to demonstrate compliance with the public dose limits. (See Section 380-5.2 of the regulations and Section D, Item 8 of the *"Application Guidelines for Radiation Control Permits for Emissions of Radioactive Material in Effluents to Air.")*

1. **METHOD 1 - paragraph 380-5.2(b)(2)**

Use this method when the average annual effluent concentration at the emission point is less than the concentration value listed in Table II, Column 1 of Section 380-11.7. When using Method 1, the emission point (i.e., stack) is conservatively considered as the nearest unrestricted area in the environment.

Fill out the attached **Effluent Calculation Worksheet** (see page 4) for each emission point to be listed on the permit. As long as you can demonstrate that the radionuclide concentration in the effluent is less than the Table II value (or, if more than one nuclide is present, the sum-of-ratios does not exceed unity) and that the external exposure rate limit will not be exceeded, then you have demonstrated that the public dose limits are met. If Method 1 can be used to demonstrate compliance, a dose assessment is not necessary, and you can end here.

2. **METHOD 2 - paragraph 380-5.2(b)(1)**

Use this method when the average annual effluent concentration at the emission point is greater than the concentration values in Table II, Column 1 of Section 380-11.7. First, fill out the attached **Effluent Calculation Worksheet** (see page 4) to show that emissions will exceed Table II values and that Method 2 must be used. When using Method 2, the permit application must demonstrate by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose does not exceed the annual 100 millirem dose limit or the 10 millirem dose constraint. You must provide all calculations and cite all references used. The Method 2 dose assessment can be broken down into two steps. If the public dose limits are met at Step 1, there is no need to proceed to Step 2.

STEP 1

In Step 1, the emission point is conservatively assumed to be the nearest unrestricted area in the environment (i.e., the nearest location that could be occupied by a member of the public). You can calculate the dose to a member of the public at the emission point, as follows:

a) Determine the average annual concentration of each radionuclide in the effluent at the emission point (i.e., at the end of the stack).

b) Calculate the annual intake of each radionuclide (or exposure to a noble gas cloud) by a member of the public from the average annual concentration of the effluent at the stack.

c) Calculate the committed effective dose equivalent (CEDE) delivered from the intake of each radionuclide (or the effective dose equivalent from exposure to a noble gas cloud) by applying appropriate dose conversion factors. Useful references include: *ICRP 30 & 60, NCRP 91 & 119, EPA Federal Guidance Report 11.*

d) Determine the external dose rate at the nearest unrestricted area in the environment. The external dose rate includes shine from the facility as well as cloud shine from gamma-emitters present in the effluent. You can determine the external dose rate by taking a measurement with an appropriate survey instrument. Alternatively, if no gamma-emitters or high-energy particles are present on site, you can submit a detailed explanation of why the external dose rate in the environment due to facility operations is negligible.

e) Add the doses calculated in steps c) and d) above to calculate the total effective dose equivalent (TEDE). If your dose assessment demonstrates that public dose limits and the 10 millirem dose constraint are not exceeded, you can end here.

STEP 2

In Step 2, the radionuclide concentration is estimated at the nearest location occupied by the public that will be maximally exposed to the effluent plume. Therefore, you must estimate the atmospheric dispersion of radioactive materials in the effluent after exiting the stack. The receptor location could be an air intake on the same building as the emission point, or an air intake on an adjacent building, depending on meteorological and emission point characteristics which will affect plume dispersion.

You are welcome to contact DEC Radiation Control Permit Section staff to discuss the assumptions and parameters you are planning to use before performing this calculation. You will then calculate a dose assessment for a member of the public resulting from exposure to the concentration of radioactive material you have estimated will be present at the nearest location occupied by a member of the public, as follows:

a) Determine the average annual concentration of each radionuclide in the effluent at the emission point (i.e., at the end of the stack).

b) Calculate the radionuclide concentration in the effluent at the nearest location occupied by the public. You can use an atmospheric dispersion model (e.g., Gaussian, Building Wake, Puff, Particle-in-Cell, etc.) to determine effluent concentration at that location. If you do, you must identify the model selected and provide the site-specific or default meteorological input data you used. Useful references include:

Workbook of Atmospheric Dispersion Estimates, Turner, 1994;
Meteorology & Atomic Energy, Slade, 1969;
Environmental Radioactivity, Eisenbud, 1987.

c) Calculate the annual intake of each radionuclide (or exposure to a noble gas cloud) by a member of the public present at that location.

d) Calculate the committed effective dose equivalent (CEDE) delivered from the intake of each radionuclide(or the effective dose equivalent from exposure to a noble gas cloud) by applying appropriate dose conversion factors. Useful references include: *ICRP 30 & 60, NCRP 91 & 119, EPA Federal Guidance Report 11.*

e) Determine the external dose rate at the nearest unrestricted area in the environment. The external dose rate includes shine from the facility (e.g., due to the presence of large sealed sources) as well as cloud shine from gamma-emitters present in the effluent. You can determine the external dose rate by taking a measurement with an appropriate survey instrument. Alternatively, if no gamma-emitters or high-energy particles are present on site, you can submit a detailed explanation of why the external dose rate in the environment due to facility operations is negligible.

f) Add the doses calculated in steps d) and e) above to calculate the total effective dose equivalent (TEDE). In order for the proposed level of radionuclide emissions to be approved, the results of the dose assessment must demonstrate that public dose limits and the 10 millirem dose constraint are not exceeded.

If you use a computer modeling program to perform the dose assessment, the code must be appropriate for the situation, and you must provide all specific and default input data. (Codes usually incorporate a dispersion model and dose conversion factors.) For further guidance on how to perform a dose assessment to demonstrate compliance with the public dose limits in Part 380, please review the supplementary guidance document, “Review of Atmospheric Transport and Dispersion Models Used for Dose Assessment.”

Questions

Copies of the Part 380 regulations and Part 380 permit application guidelines are available from DEC's Radiation Control Permit Section. For questions regarding the regulations or how to prepare a Part 380 permit application, contact the Radiation Control Permit Section at (518) 402-9625 or the address appearing at the top of this document.

EFFLUENT CALCULATION WORKSHEET

Facility Name _____ **Emission Point** _____

		A	B	C	
	Radionuclides & forms	_____	_____	_____	
		as _____	as _____	as _____	
1.	Yearly activity handled/produced	_____	_____	_____	µCi/yr
2.	Release fraction (decimal or %)	_____	_____	_____	
3.	Yearly activity released before treatment A_{before} = µCi/yr handled * decimal release fraction	_____	_____	_____	µCi/yr
4.	Removal efficiency of effluent treatment system (if used) for each radionuclide & form (decimal or %)	_____	_____	_____	
5.	Yearly activity released after treatment $A_{after} = A_{before}$ * decimal removal efficiency [NOTE: these estimated yearly activity discharge totals will be used in establishing annual activity discharge limits as a permit condition]	_____	_____	_____	µCi/yr
6.	Exhaust system flow rate (F) cfm [specify if minimum or operating flow rate]	_____	_____	_____	cfm
7.	Yearly effluent volume (V) = F * 1.49 E+10 min/yr * ml/cf	_____	_____	_____	ml/yr
8.	Annual average effluent concentration (C) = A_{after} / V	_____	_____	_____	µCi/ml
9.	Table II (T) concentrations from Section 380-11.7, Column 1	_____	_____	_____	µCi/ml
10.	Ratio of annual average concentration divided by Table II concentration value (R) = C / T	_____	_____	_____	

11. For multiple radionuclides: Sum-of-Ratios

    $R_A + R_B + R_C$ = _____ + _____ + _____ = _____

12. For single radionuclide: is the R value in #10 above less than 1 ? _____ yes _____ no

    If yes, then public dose limits have been met.

13. For multiple radionuclides: is the sum of the R values in #11 above less than 1 ? _____ yes _____ no

    If no, Method 2 must be used to demonstrate compliance with public dose limits. Therefore, the applicant must submit a dose assessment.

Note: lines 1 and 2 above must be completed if using the mass balance method to survey discharges.