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PNNL-19904 Rev. 5

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory Potential Impact Categories for Radiological Air Emission Monitoring

JM Barnett

September 2018

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Richland, Washington 99352

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1.0 PNNL Potential Impact Categories

In 2002, the United States (U.S.) Environmental Protection Agency amended 40 Code of Federal Regulations (CFR) 61 Subpart H and 40 CFR 61 Appendix B Method 114 to include requirements from American National Standards Institute/Health Physics Society (ANSI/HPS) N13.1-1999 *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities* for major emission points. Additionally, the Washington State Department of Health amended the Washington Administrative Code (WAC) 246-247 *Radiation Protection—Air Emissions* to include ANSI/HPS N13.1-1999 requirements for major and minor emission points when new permitting actions are approved. A result of the amended regulations is the requirement to prepare a written technical basis for the radiological air emission sampling and monitoring program. The technical basis must address the

- sampling objective,
- graded approach for meeting the objectives,
- relevant building operating conditions and airborne contaminants, and
- action levels that signal changing conditions of significance (section 4 of the standard).

A key component of the technical basis is the Potential Impact Category (PIC) assigned to an emission unit. The PIC assignments for the Pacific Northwest National Laboratory (PNNL) integrated laboratory emission units are presented herein. ANSI/HPS N13.1-1999 was reaffirmed in 2011 as ANSI/HPS N13.1-2011.

ANSI/HPS N13.1-1999 uses PICs to define a graded approach to sampling for airborne radioactive materials. The PICs used for illustrative purposes in the standard are based on potential "dose consequences that may occur assuming effluent attenuation or filtration devices present in the effluent stream have no effect" (ANSI/HPS N13.1-1999). This is comparable to the definition for Potential-To-Emit (PTE) used in radiological air emission regulations. The highest PIC suggested by the standard has potential consequences greater than 0.5 of an allowable limit. Table 1.1 illustrates the ANSI N13.1-1999 PIC ranges for an allowable limit of 10 millirem per year (mrem/yr).

Table 1.1. ANSI/HPS N13.1-1999 Potential Impact Category Example Criteria

PIC	Operating Range – PTE (mrem/yr)	Monitoring and Sample Analysis
1	> 5	Continuous sampling for a record of emissions and in-line, real-time monitoring with alarm capability; consideration of separate accident monitoring system.
2	> 0.1 and ≤ 5	Continuous sampling for record of emissions, with retrospective, offline periodic analysis.
3	> 0.001 and ≤ 0.1	Periodic confirmatory sampling and offline analysis.
4	≤ 0.001	Annual administrative review of building uses to confirm absence of radioactive materials in forms and quantities not conforming to prescribed specifications and limits.

PNNL has adopted the suggested PIC definitions provided in ANSI/HPS N13.1-1999, as applied to the federal and state standards of 10 mrem/year.[1, 2] Following the graded approach advocated in ANSI/HPS N13.1-1999, PNNL has defined an additional PIC category (PIC 5), as applied to a group of materials used site-wide, with PTE criteria orders of magnitude below that of PIC 4 to allow for appropriate and efficient permitting and management of radioactive materials with inconsequential contributions to potential offsite dose (Table 1.2). The PIC 5 category is employed to classify a site-wide use of materials that have either been released from radiological control according to the PNNL How Do I? (HDI) Work Control "Radiological – General" or have been determined to be Administratively Controlled Radioactive Materials or Non-dispersible Radioactive Materials according to RCP-3.1.01, Radiological Work Planning.[3] When applicable, PNNL will permit PIC 5 items as a group for air emission purposes to allow for flexibility in the research and development environment by allowing site-wide use of these low-risk items.[4] Site-wide PIC 5 utilization does not preclude the use of the materials in PIC 4 or higher permitted locations. Similarly, an emission unit associated with a building or other well defined location (e.g., land area, or pond) with a PTE of less than the PIC 5 threshold of 1E-6 mrem/yr is still assigned as a PIC 4.

Although PTEs for each emission unit are calculated annually using actual inventory, the PTE used for assigning PICs is the permitted PTE, which is based on maximum estimated inventory and throughput for permitted activities. For example, the 331 Building EP-331-01-V emission unit is permitted for a PTE > 0.1 mrem/year and is considered a major emission unit. Therefore, this emission unit is considered PIC 2 instead of PIC 3 until it is downgraded to minor status. The PNNL-defined PIC categories are identified in Table 1.2.

PNNL has adopted the graded approach outlined in the standard and applied it to the PNNL PICs because the rigor of some of the requirements in the standard depend on the PIC category. Table 1.3 shows the PNNL emission units and identifies the PIC assigned to each based on the PNNL criteria in Table 1.2. Table 1.4 identifies the differences in sampling system requirements for the different PIC categories, as described in ANSI/HPS N13.1-1999.

New emission units and permitting actions will follow the guidance in Table 1.2. For existing emission units, a change to the PIC monitoring and sampling analysis requirements requires a permit modification and regulatory approval. For example, an emission unit going from a PIC 3 to a PIC 4 category will be considered for an "annual administrative review" in lieu of sampling during future permitting actions after regulatory approval (ANSI/HPS N13.1-1999).

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[1] Emissions of radionuclides to the ambient air from U.S. Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr. (40 CFR 61 Subpart H, 61.92)

[2] Emissions of radionuclides in the air shall not cause a maximum effective dose equivalent of more than 10 mrem/yr to the whole body to any member of the public. (WAC 173-480-040)

[3] Note that PIC 5 only applies to materials that were brought under radiological control and subsequently released; materials where radiological control was never required are not included in PTE calculations.

[4] The PNNL Start Clean Stay Clean Program may be considered in determining use locations for PIC 5 materials.

Table 1.2. PNNL Potential Impact Categories

PIC	Operating Range – PTE (mrem/yr)	Monitoring and Sample Analysis
1	> 5	Continuous sampling for a record of emissions and in-line, real-time monitoring with alarm capability; consideration of separate accident monitoring system.
2	> 0.1 and ≤ 5	Continuous sampling for record of emissions, with retrospective, offline periodic analysis.
3	> 0.001 and ≤ 0.1	Periodic confirmatory sampling and offline analysis.
4	≤ 0.001 and non-PIC 5	Annual administrative review of emission unit uses to confirm absence of radioactive materials in forms and quantities not conforming to prescribed specifications and limits.
5	≤ 1E-6	Applied to a group of materials used site-wide. As defined, this category is a subgroup under PIC 4 allowing for a graded approach for managing radioactive materials with little to no emission potential. Administrative control through the following steps: 1) The item is classified by Radiation Protection to be released from radiological control (e.g., volumetrically released liquids[1]) or is determined by Radiation Protection to be Administratively Controlled Material or Non-dispersible Radioactive Material; 2) Radiation Protection administers the classification programs with input from the Effluent Management and Waste Operations Groups; and 3) Radiation Protection maintains a record of these items and a periodic evaluation is performed on the processes.

[1] The PTE calculated for 1 L of solution using volumetric release limits and worst case isotopes from each radionuclide group was less than 5E-9 mrem/yr. Therefore, hundreds of these items would not exceed a PTE of 1E-6.

Table 1.3. PNNL Emission Unit Potential Impact Categories[2]

Building	Emission Unit(s)	PTE mrem/yr	ANSI N13.1 PIC	PNNL PIC	Emission Rate Determination
318	J-318	6.80E-4	4	**4**	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring. Fugitive emissions.
325	EP-325-01-S	4.1E+2	1	**1**	Continuous sampling and monitoring.
331	EP-331-01-V	3.86	2	**2**	Continuous sampling.
	EP-331-09-S	9.93E-4	4	**4**	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring.
3410	EP-3410-01-S	3.66	2	**2**	Continuous sampling.
3420	EP-3420-01-S	3.70	2	**2**	Continuous sampling Radionuclide emissions determined using 40 CFR 61
	EP-3420-02-S	3.2E-4	4	**4**	Appendix D calculations in lieu of monitoring.
3425	J-3425	2.70E-4	4	**4**	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring. Fugitive emissions.
3430	EP-3430-01-S	4.20	2	**2**	Continuous sampling
	EP-3430-02-S	3.24E-4	4	**4**	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring.
	EP-3430-1606P-S EP-3430-1608P-S EP-3430-1610P-S EP-3430-1612P-S EP-3430-1614P-S	7.40E-8 (ea)	4 (ea)	**4** (ea)	Perchloric acid hood emission units; PTE is per emission unit. Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring.
361	J-361	9.0E-4	4	**4**	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring. Fugitive Emissions.
LSL II	EP-LSLII-01-V EP-LSLII-02-V	1.97E-4 (ea)	4 (ea)	**4** (ea)	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring.
MSL	J-MSL	9.23E-4	4	**4**	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring. Fugitive emissions from Sequim-Marine Sciences Laboratory.

[2] Hanford Site-Wide NOCs are not included in the PNNL PIC category listing as they are covered by the Hanford Site integrating contractors for PIC categorization.

Building	Emission Unit(s)	PTE mrem/yr	ANSI N13.1 PIC	PNNL PIC	Emission Rate Determination
RTL-520	EP-RTL-10-V EP-RTL-11-V		4 (ea)	**4** (ea)	Radionuclide emissions determined using 40 CFR 61 Appendix D calculations in lieu of monitoring.
RTL-530	J-RTL530	4.36E-4	4	**4**	Radionuclide emissions determined based on smears and using 40 CFR 61 Appendix D calculations. Fugitive emissions.
RTL Complex	J-RTL Complex	2.00E-4	4	**4**	Radionuclide emissions determined based on surveys and using 40 CFR 61 Appendix D calculations. Fugitive emissions.
PIC 5	Facilities Restoration	8.40E-7	4	**5**	Records.
	Non-dispersible Radioactive Material (NDRM)	6.60E-8	4	**5**	Records.
	Low-Level Sources	1.00E-6	4	**5**	Records.
	Volumetrically Released Radiological Material (VRRM)	9.40E-7	4	**5**	Records.

Table 1.4. Sampling System Requirements Based on PIC

PIC	Sampling Site	Sample Nozzle	Stack Flow	Sample Flow	CAMS
1	Must meet acceptance criteria for uniform velocity, tracer gas, and aerosol mixing & lack of cyclonic flow.	Aerosol transmission ratio within range of 0.8–1.3 for 10 µm (or greater) particles. This depends on stack & sample velocity, so this ratio required over a range of values if these vary. Aspiration ration of 0.8–1.5. Aspiration ratio is related to transmission ratio.	Must continuously measure.	Shall be varied in proportion to stack flow in order to permit an accurate assessment of the quantities of any releases. A controller (continuous control) shall be used to maintain the ratio of the sample flow rate and effluent flow rate within ± 20% of a predetermined value.	Required, but may be operated at a fixed flow rate. However, ratio of sample flow to stack flow should not vary by more than ± 25%.
2	Must meet acceptance criteria for uniform velocity, tracer gas, and aerosol mixing & lack of cyclonic flow.	For new or major modified emission units (after 9/2002), aerosol transmission ratio within range of 0.8–1.3 for 10 µm (or greater) particles. This depends on stack & sample velocity, so this ratio required over a range of values if these vary. Aspiration ration of 0.8– .5. Aspiration ratio is related to transmission ratio.	Must continuously measure if flow rate varies by > 20% over year.	May be varied or may be held constant. Continuous control if the sample flow rate can vary by more than ± 20% over the sample period.	Not required.
3	Must meet acceptance criteria for uniform velocity, tracer gas, and aerosol mixing & lack of cyclonic flow.		Only periodic measurements required.	May be varied or may be held constant. Continuous control if the flow rate can vary by more than ± 20% over the sample period.	Not required.
4	No requirements to sample or monitor per ANSI/HPS N13.1-1999, Table 2: “Annual administrative review of facility uses to confirm absence of radioactive materials in forms and quantities not conforming to prescribed specifications and limits.” A registered emission unit associated with a building or other well defined location (e.g., land area, or pond) with a PTE of less than the PIC 5 threshold of 1E-6 mrem/yr is still assigned as a PIC 4.				
5	Applied to a group of materials used site-wide. As defined by PNNL, this category is a subgroup under PIC 4 allowing for a graded approach for managing radioactive materials with little to no emission potential. Administrative control through the following steps: 1) The item is classified by Radiation Protection to be released from radiological control or is determined by Radiation Protection to be Administratively Controlled Material or Non-dispersible Radioactive Material; 2) Radiation Protection administers the classification programs with input from the Effluent Management and Waste Operations groups; 3) Radiation Protection maintains a record of these items and a periodic evaluation is performed on the processes.				

2.0 References

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