Cleanup Standards

David Andrews, 16 Nov 2017

Radiological

Non-Radiological

Eight Definitions from NRC Regulations 10 CFR § 20.1003

- *Unrestricted area* means an area, access to which is neither limited nor controlled by the licensee.
- *Residual radioactivity* means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR part 20.

Eight Definitions from NRC Regulations 10 CFR § 20.1003

- *Background radiation* means radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. "*Background radiation*" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.
- *Total Effective Dose Equivalent* (TEDE) means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Eight Definitions from NRC Regulations 10 CFR § 20.1003

- *Critical Group* means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.
- *ALARA* (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Eight Definitions from NRC Regulations 10 CFR § 20.1003

- *Decommission* means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits—
  (1) Release of the property for unrestricted use and termination of the license; or
  (2) Release of the property under restricted conditions and termination of the license.

- *Distinguishable from background* means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

Radiological criteria for unrestricted use

10 CFR § 20.1402 A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

State of Vermont Dept of Health Rule
Part 5, Chapter 3, Subchapter 1, Section 5-305 Standards

State of Vermont Title 18: Health
Chapter 32: Ionizing and Nonionizing Radiation Control

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INVESTIGATION AND REMEDIATION OF CONTAMINATED PROPERTIES RULE

STATE OF VERMONT
AGENCY OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WASTE MANAGEMENT AND PREVENTION DIVISION

Final Adopted Rule
Effective July 27, 2017

Purpose

This rule is intended to protect public health and the environment by establishing procedures and requirements for conducting investigations and corrective actions at properties where a release of hazardous materials has occurred. This includes procedures for identifying hazardous material contamination to environmental media including soil, groundwater, surface water, and air, as well as requirements for source treatment, removal, or containment, long term monitoring and institutional controls.

Environmental Media Standards

§ 35-APX-A1. SOIL SCREENING VALUES

§ 35-APX-A2. VAPOR INTRUSION VALUES

§ 35-APX-A3. SEDIMENT VALUES

Appendix A - § 35-APX-A1 - Soil Screening Values
(see notes at end of table)

		EPA Regional Screening Levels (TR=1E-06, HQ=1.0)		Vermont Screening Levels (TR=1E-06, HQ=1.0)	VT DEC Background Soil Concentrations	
Analyte	CAS Number	Resident Soil (mg/kg)	Industrial Soil (mg/kg)	Resident Soil (mg/kg)	Rural (mg/kg)	Urban (mg/kg)
Acephate	30560-19-1	62	260			
Acetaldehyde	75-07-0	11	49			
Acetochlor	34256-82-1		16,000	1,270		
Acetone	67-64-1		670,000	39,900		
Acetone Cyanohydrin	75-86-5	2,800,000	12,000,000			
Acetonitrile	75-05-8	810	3,400			
Acetophenone	98-86-2	7,800	120,000			
Acetylaminofluorene, 2-	53-96-3	0.14	0.6			
Acrolein	107-02-8	0.14	0.6			
Acrylamide	79-06-1	0.24	4.6			
Acrylic Acid	79-10-7	99	420			
Acrylonitrile	107-13-1	0.25	1.1			
Adiponitrile	111-69-3	8,500,000	36,000,000			

Recommended Sediment Quality Guidelines for the Protection of Aquatic Biota in Freshwater Ecosystems			
Analyte	**TEC**	**PEC**	**Notes**
Metals (in mg/kg - ppm DW)			
Arsenic	9.79	33	1,2
Cadmium	0.99	4.98	1,2
Chromium	43.4	111	1,2
Copper	31.6	149	1,2
Lead	35.8	128	1,2
Mercury	0.18	1.06	1,2,4
Nickel	22.7	48.6	1,2
Zinc	121	459	1,2
Polycyclic Aromatic Hydrocarbons (in µg/kg - ppb DW)			
Anthracene	57.2	845	1,3
Fluorene	77.4	536	1,3
Naphthalene	176	561	1,3
Phenanthrene	204	1,170	1,3
Benz(a)anthracene	108	1,050	1,3

Appendix A - § 35-APX-A2. Vapor Intrusion Values
(see notes at end of table)

		EPA Regional Air Screening Levels (TR=1E-06, HQ=1.0)		Vermont Air Screening Levels (TR=1E-06, HQ=1.0)		Vapor Intrusion Screening Values - Sub-slab Soil Gas		Vapor Intrusion Screening Values - Groundwater	
Analyte	CAS Number	Resident Air (µg/m3)	Industrial Air (µg/m3)	Resident Air (µg/m3)	Industrial Air (µg/m3)	Residential (µg/m3)	Industrial (µg/m3)	Residential (µg/L)	Industrial (µg/L)
Acetaldehyde	75-07-0	1.3	5.6			43	190	670	2,900
Acetone	67-64-1	32,000	140,000			1,100,000	4,500,000	35,000,000	150,000,000
Acetone Cyanohydrin	75-86-5	2.1	8.8						
Acetonitrile	75-05-8	63	260			2,100	8,800	69,000	290,000
Acetylaminofluorene, 2-	53-96-3	0.0022	0.0094						
Acrolein	107-02-8	0.021	0.088			0.7	2.9	6.4	27
Acrylamide	79-06-1	0.01	0.12						
Acrylic Acid	79-10-7	1.0	4.4			35	150	150,000	630,000
Acrylonitrile	107-13-1	0.041	0.18			1.4	6.0	12	54
Adiponitrile	111-69-3	6.3	26						
Aldrin	309-00-2	0.00057	0.0025			0.019	0.083	0.92	4.0
Allyl Alcohol	107-18-6	0.1	0.44			3.5	15	980	4,100
Allyl Chloride	107-05-1	0.47	2			16	68	1.6	7.0
Aluminum	7429-90-5	5.2	22						
Aminobiphenyl, 4-	92-67-1	0.00047	0.002						
Ammonia	7664-41-7	100	440			3,500	15,000	210,000	890,000
Amyl Alcohol, tert-	75-85-4	3.1	13			100	440	11,000	45,000
Aniline	62-53-3	1	4.4						
Antimony Trioxide	1309-64-4	0.21	0.88						
Arsenic, Inorganic	7440-38-2	0.00065	0.0029						
Arsine	7784-42-1	0.052	0.22						
Auramine	492-80-8	0.011	0.049						
Azinphos-methyl	86-50-0	10	44						
Azobenzene	103-33-3	0.091	0.4			3.0	13	160	720

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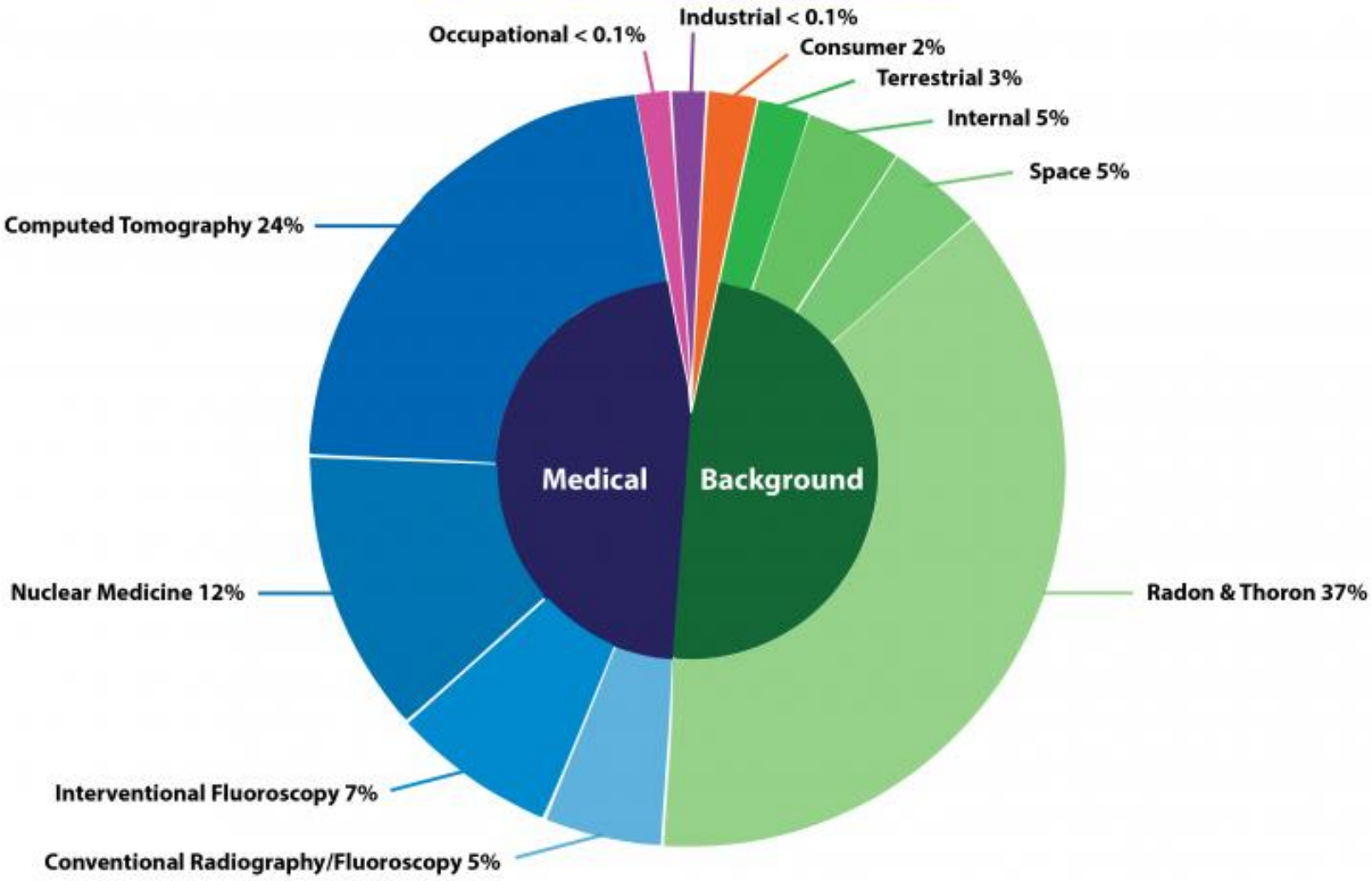
  - 10 CFR § 20.1403 sets the criteria for license termination under restricted conditions
- In the IROC Rule, we have standards for industrial, commercial, and residential
  - There are no commercial standards in IROC

Sources of Radiation Exposure



Average Annual Radiation Dose

Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/ Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
Units mrem (United States) mSv (International)	228 mrem 2.28 mSv	147 mrem 1.47 mSv	77 mrem 0.77 mSv	43 mrem 0.43 mSv	33 mrem 0.33 mSv	33 mrem 0.33mSv	29 mrem 0.29 mSv	21 mrem 0.21 mSv	13 mrem 0.13 mSv	0.5 mrem 0.005 mSv	0.3 mrem 0.003 mSv

(Source: National Council on Radiation Protection & Measurements, Report No. 160)