# Radioactive Material Exemptions

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Radioactive Materials Division

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# 1.0 Introduction

This guide explains and clarifies the criteria by which radioactive materials can be exempted from the standard disposal requirements for radioactive wastes in the State of Texas. If the radioactive materials meet the criteria in the regulations, the material is exempt by rule, not by decision of TCEQ.

Despite its radioactive content, exempt materials do not need to be sent to a facility that is licensed for radioactive waste disposal [Title 30, Texas Administrative Code (30 TAC), Subsection 336.5(c)]. The disposal of exempt material is not subject to further regulation by TCEQ concerning its radioactive content, though the material will still be regulated as a solid waste. If it does not meet the exemption criteria, then it must be disposed of in the manner stipulated in 30 TAC Section 336.211, as appropriate to the type of licensed material.

Before accepting exempt materials, a disposal facility may require a letter from TCEQ stating that the waste meets the exemption criteria found in the regulations and is thereby exempt from other regulations concerning radioactive-waste disposal. This statement from TCEQ is called an *exemption concurrence*. Hazardous-waste disposal facilities regulated by TCEQ have a condition in their permit requiring them to obtain an exemption concurrence before disposing of exempt materials. Please note that even if a waste shipment is determined to be exempt, the landfill operator retains the right to reject it.

This guide focuses on the disposal of exempt material in TCEQ-regulated disposal facilities: the agencies in Texas that have authority over exempt materials, what materials are exempt, TCEQ's regulations over exempt materials, and what documentation and analysis are required to determine whether the material meets the exemption requirements.

This guide summarizes TCEQ's rules and regulations concerning exempt materials to assist waste generators and disposal facilities. The rules in the Texas Administrative Code should always be reviewed. The rules will form the ultimate basis for granting an exemption concurrence. If any wording of this guide conflicts with the rules, then the rules take precedence.

# 2.0 Regulatory Basis

## 2.1 State Agencies that Regulate Radioactive Material

Three state agencies regulate radioactive material in Texas: TCEQ, Texas Department of State Health Services (DSHS), and Railroad Commission of Texas (RRC).

- DSHS has authority for possession, receipt, use, handling, transfer, transport, and storage of radioactive material.
- RRC has authority over Naturally Occurring Radioactive Material (NORM) waste generated as a result of the exploration and production of oil and gas.
- TCEQ has authority over uranium and thorium mining, the disposal of low-level radioactive waste (LLRW), disposal of by-product waste, disposal of certain NORM waste, and the commercial processing and storage of radioactive waste. This authority does not extend to oil and gas NORM waste.

Exemptions are conducted by TCEQ under 30 TAC Section 336.5. Most exemption concurrences are granted under 30 TAC Subsection 336.5(c), which exempts waste from licensing requirements under Texas Health and Safety Code (THSC), Subsection 401.106(a), thus authorizing TCEQ to use the exemption rules from the DSHS which are found in Title 25 Texas Administrative Code (25 TAC) Subsections 289.251(d), 251(e), and 259(d).

## 2.2 Additional Regulatory Considerations

Texas does not allow dilution to be used to lower the waste disposal classification [30 TAC Section 336.229]. TCEQ will not grant an exemption concurrence to any waste that was diluted so that it would meet the exemption criteria. Waste that has been diluted due to stabilization, mixing, or treatment will be subject to the disposal regulations according to its pre-dilution concentration.

Additionally, whenever exemption limits are stated in the regulations using the activity units *Curie* and *Becquerel*, the Becquerel values are to be used. In such cases, the Becquerel value is the legal limit, while the Curie value is also stated in the rule since the Curie is the most widely used activity unit in the United States. The Curie value in the rule is only an approximation of the Becquerel unit due to rounding.

Items or material containing radioactive material that are regulated under a general license by DSHS [see 25 TAC Subsections 289.251(f) and 289.259(f)], Nuclear Regulatory Commission (NRC), or another Agreement State are not exempt. For example, tritium exit signs are authorized for use in Texas by a general license issued by DSHS in rule; but would be classified as LLRW if disposed.

The rule 30 TAC Subsection 336.1(f)(3) states that no person shall dispose of radioactive material other than low-level radioactive waste, except for diffuse NORM waste having concentrations of less than 2,000 pCi/g radium-226 or radium-228. This rule pertains to phosphogypsum waste and is not a rule to exempt waste containing radioactive material from the standard disposal requirements for radioactive waste.

# 3.0 Naturally Occurring Radioactive Material (NORM)

## 3.1 Regulatory Definitions

NORM is defined in 25 TAC Subsection 289.259(c)(4) as naturally occurring radioactive material not regulated under the Atomic Energy Act which has had its radionuclide concentrations increased by, or as a result of, human practices. NORM does not include the natural radioactivity of rocks, soils, or other naturally occurring radioactive substances but instead refers to material which has had its radioactivity altered to a higher concentration by controllable practices (or by past human practices). The term technically enhanced NORM (TENORM) is also used for this definition by some other states but does not appear in Texas regulations.

DSHS and TCEQ have slightly different definitions of NORM in their rules. DSHS' definition is used for exemption concurrences since the NORM exemption rules are mostly contained in the DSHS regulations. TCEQ's definition can be found at 30 TAC Section 336.2 and it excludes material that is exempted under DSHS rules.

# 3.2 Small Quantities of Radium or NORM in Soil or Other Media

NORM waste is exempt for purposes of disposal under 25 TAC Subsection 289.259(d)(1) if it contains, or is contaminated at, the following concentrations in soil or other media:

- 30 picocuries per gram (pCi/g) or less of radium-226 or radium-228 provided the radon emanation rate is less than 20 picocuries per square meter per second (pCi/m$^2$/sec),
- 5 pCi/g or less of radium-226 or radium-228 in which the radon emanation rate is equal to or greater than 20 pCi/m$^2$/sec; or
- 150 pCi/g or less of any other NORM radionuclide.

Radium-226 and radium-228 are considered separately, so both isotopes can be up to the limit (30 or 5 pCi/g) and still be exempt. Typically, Ra-226 is present in larger quantities than Ra-228.

*Other media* is defined in 25 TAC Subsection 289.259(c)(5) as "any volumetric material other than soils or liquids (for example: sludge, scale, slag, etcetera)."

The radon-emanation rate specified above does not apply to:

- known NORM types for which the radon-emanation fraction has been documented to be low, e.g., oil-production scales and sludges;
- soil or other media in which the known volume of NORM would be too low to produce a radon-emanation rate of 20 pCi/m$^2$/s (as demonstrated by calculation); or
- soil or other media that has been displaced from its natural location and is to be disposed of in a (permitted) disposal site for hazardous material.

This 30 pCi/g rule [25 TAC Subsection 289.259(d)(1)] is not applicable to pipe or other equipment as a means of determining exemption unless the scale inside the pipe is sampled and the concentrations are measured.

# 3.3 Building, Construction, Industrial Processing, and Other NORM

Material used for building construction, industrial processing, sand blasting, metal casings, or other NORM in which the radionuclide content has not been concentrated to higher levels than found in its natural state is exempt. This exemption includes any products or materials and the recycling of equipment or containers used to produce, contain, or transport those products or materials [25 TAC Subsection 289.259(d)(5)].

The following materials commonly contain NORM at relatively high concentrations but have not been concentrated to higher levels than those found in their natural state and are therefore exempt (unless contaminated by another radioactive source):

- Refractory bricks: NORM in furnace brick is not concentrated during use.
- Zirconium oxide (zircon, zirconia, zirconium): commonly used as a blasting agent and is not concentrated during use.
- Monazite sand containing thorium-232 and its daughters.
- Alumina, used for ceramic insulators in electrical equipment.

# 3.4 Recycled Contaminated Objects

Materials and equipment in the recycling process contaminated with NORM scale or residue are exempt if the maximum radiation exposure level, including the background radiation level, does not exceed 50 microroentgens per hour (µR/hr) at any accessible point [25 TAC Subsection 289.259(d)(2)].

Recycling is defined in this context as "a process by which materials that have served their useful purpose are collected, separated, or processed and returned to use in the form of raw materials in the production of new products" [25 TAC Subsection 289.259(c)(8)]. Recycling does not include the reuse of an oil pipe after cleaning.

# 3.5 Oil and Gas Products and Processing

Pipe (tubulars) and other downhole or surface equipment used in oil production contaminated with NORM scale or residue are exempt if the maximum radiation exposure level, including the background radiation level, does not exceed 50 µR/hr at any accessible point [25 TAC Subsection 289.259(d)(3)]. Unlike other exemption rules that apply to both gas and oil, this rule applies only to oil production.

Natural gas, natural-gas products, crude oil, and crude-oil products containing NORM are exempt [25 TAC Subsection 289.259(d)(7)]. However, the processing and manufacturing of natural-gas and crude-oil products containing NORM are subject to general license requirements by the DSHS. Possession of produced waters from crude oil and natural gas production is exempt if the produced waters are reinjected into a well approved by the agency having jurisdiction or if the produced waters are discharged under the authority of the appropriate agency [25 TAC Subsection 289.259(d)(8)].

# 3.6 Phosphate Industry

The wholesale and retail commercial distribution (including custom blending), possession, and use of the following products and materials, or the recycling of equipment or containers used to produce, contain, or transport them, are exempt [25 TAC Subsection 289.259(d)(6)]:

- Phosphate and potash fertilizer. (Note that the manufacture of phosphate and potash fertilizer is subject to general license requirements under DSHS rules),
- Phosphogypsum for agricultural uses, if such commercial distribution and uses meet the requirements of Title 40, Code of Federal Regulations (40 CFR), Section 61.204, and
- Materials used for building construction if the materials contain NORM that has not been concentrated to higher levels than found in its natural state.

# 3.7 Potassium and By-Products from Fossil-Fuel Combustion

The following products and materials and the recycling of equipment or containers used to produce, contain, or transport them, are exempt [25 TAC Subsection 289.259(d)(5)]:

- Potassium and potassium compounds that have not been isotopically enriched in the radionuclide K-40,
- By-products from fossil-fuel combustion (bottom ash, fly ash, and by-products of flue-gas emission control), and

- Material used for building construction, industrial processing, sand blasting, metal casings, or other NORM in which the radionuclide content has not been concentrated to higher levels than found in its natural state. (See Section 3.3 of this publication.)

# 4.0 Source Material

Even though uranium and thorium occur naturally, by statute and rule they are defined as source material and not as NORM. Source material is defined as uranium or thorium, or any combination thereof, in any physical or chemical form [30 TAC Subsection 336.2(125)]. Source material does not include special nuclear material (defined in 25 TAC Subsection 289.201(b)(101)]). The 30 pCi/g radium and 150 pCi/g other NORM exemption rule (see Section 3.2 of this publication) does not apply to source material waste.

# 4.1 Weight Percent of 0.05

Any chemical mixture, compound, solution, or alloy of source material is exempt if the source material is by weight less than 0.05% of the mixture, compound, solution, or alloy [25 TAC Subsection 289.251(d)(1)]. This rule does not include waste that has been classified as by-product material as defined in 30 TAC Subsection 336.2(20)(B) ("tailings or wastes produced by or resulting from the extraction or concentration of uranium or thorium from ore processed primarily for its source material content") since the equivalent NRC rule 10 CFR Section 40.13, which the State of Texas is required to be compatible with, excludes by-product material. As explained in section 4.2, unrefined and unprocessed ore containing source material may be exempt at concentrations higher than 0.05% by weight.

The levels of activity per unit mass that corresponds to 0.05% by weight for different source material isotopes are shown in Table 1.

If radium and other daughters are at (or are reaching) secular equilibrium with the uranium or thorium (the parent isotopes), then the activity of the daughter is not considered for determining the exemption status of the material. Secular equilibrium is when the daughter's activity becomes equal (and remains equal) with the parent activity (before equilibrium, the daughter's activity is less). The daughter radionuclides are covered under the exemption of the uranium or thorium parent. For example, if the material contains 100 pCi/g uranium-238 (under 0.05% by weight) and 90 pCi/g radium-226, it is still exempt even though the radium exceeds 30 pCi/g (see Section 3.2 of this publication).

Table 1. Specific-Activity Values for 0.05 Weight Percent of Source Material

| Isotope | Specific Activity | Material | Specific activity |
|---|---|---|---|
| thorium-232 | 54.9 pCi/g | natural thorium | 110 pCi/g of total Thorium[a] |
| uranium-238 | 167.5 pCi/g | natural uranium | 340 pCi/g of total Uranium[b] |
| uranium-235 | 1,078 pCi/g | depleted uranium | 199 pCi/g of total Uranium[c] |

[a] Th-232 is in secular equilibrium with its daughter Th-228 (both isotopes are at equal activity level).
[b] By activity, 48.8% U-234 (daughter of U-238), 2.4% U-235, and 48.8% U-238 (IAEA, 2010).
[c] Typically, by activity, 15.2% U-234, 1.1% U-235, and 83.7% U-238 (IAEA, 2010).

# 4.2 Unrefined or Unprocessed Ore

Unrefined and unprocessed ore containing source material are exempt provided that the ore has not been refined or processed [25 TAC Subsection 289.251(d)(2)]. This exemption does not

apply to the mining of ore containing source material for the extraction of source material (known as *source recovery*), which requires a specific license from TCEQ or RRC.

## 4.3 Rare-Earth Elements with Source Material

Rare-earth metals and compounds, mixtures, and products containing no more than 0.25% by weight of thorium, uranium, or any combination of these are exempt [25 TAC Subsection 289.251(d)(3)(A)(vi)]. Rare-earth metals include the elements scandium, yttrium, and the 15 lanthanides (also referred to as lanthanoids) with atomic numbers 57–71: lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium.

## 4.4 Specific Items Containing Source Material

Specific items containing source material are exempt if they do not exceed specified activities that are defined in rule. Some of these items include, but are not limited to, incandescent gas mantles, vacuum tubes, welding rods, finished aircraft-engine parts, glazed ceramic tableware, and piezoelectric ceramics. Uranium, either natural or depleted, can be exempt if used as shielding constituting part of any shipping container or if contained in counterweights installed in aircraft, rockets, projectiles, and missiles. The criteria for these items can be found in 25 TAC Subsection 289.251(d)(3).

# 5.0 Radioactive Material Exemptions

## 5.1 Exempt Concentrations of Radionuclides

Rule 25 TAC Subsection 289.251(e)(1) exempts materials (solid, liquid, or gaseous) containing radioactive material other than source material which have radionuclide concentrations that do not exceed those listed in 25 TAC Subsection 289.251(l)(1). Rule 25 TAC Subsection 289.251(e)(2) grants exemptions for materials (solid, liquid, or gaseous) containing radioactive material, other than source material, which have individual quantities of radionuclides that do not exceed those listed in 25 TAC Subsection 289.251(l)(2). The sum-of-fractions rule applies if more than one radionuclide is present

If a radionuclide decays to a radioactive daughter, the value in these tables for the parent radionuclide includes the daughter activity. The activity of the daughter, as long as it is not greater than the activity of the parent, is not considered in the determination of whether the material is exempt.

Please note that in most disposal situations, restrictions (such as moisture being below a certain percentage) at landfills and disposal facilities would rule out the disposal of liquid and gaseous wastes, even though values are given for liquid and gaseous concentrations in 25 TAC Subsections 289.251(l)(1) and (l)(2). These exemption rules were written for use, as well as disposal, of those materials.

This exemption only applies to waste in which radioactive or by-product[1] material was introduced into the waste in accordance with a specific or general license (only a specific license for by-product material) of the NRC or Agreement State.

1 See Appendix A of this publication for definition.

## 5.2 Smoke Detector

Ionization-chamber smoke detectors containing no more than 1 µCi of Am-241 per detector in the form of a foil and designed to protect life and property from fire are exempt [25 TAC Subsection 289.251(e)(3)(A)(i)(IX)].

## 5.3 Specific Items

Specific items, which incorporate radioactivity for functional purposes, are exempt if they do not exceed specified activities or other requirements that are defined in the rule 25 TAC Subsection 289.251(e)(3). Some of these specific items include, but are not limited to, timepieces, electron tubes, radioactive sources in instruments, gauges, gas and aerosol detectors, and self-luminous products.

## 5.4 Emission-control dust from electric arc furnaces

Emission-control dust and other material from electric-arc furnaces or foundries contaminated as a result of inadvertent melting of cesium-137 or americium-241 sources may be exempted for disposal in a hazardous-waste disposal facility if all of the conditions in 25 TAC Subsection 289.202(ff)(2) are met. This exemption requires approval from either TCEQ or DSHS. DSHS is the appropriate agency if the generator of the material holds a DSHS license. TCEQ is the appropriate agency in all other instances.

## 5.5 Sewer Discharge from Medical Use of Radioactive Material

Rule 25 TAC Subsection 289.202(gg)(2) concerns "excreta from individuals undergoing medical diagnosis or therapy with radioactive material" that is discharged into the sewer. Human excreta that are flushed from a toilet into the sewer is exempt if it contains radioactive material as a result of an individual having undergone medical diagnosis or therapy using radioactive material. Isotopes used in medical procedures where the radioactive material is brought into the body typically have half-life values less than 90 days.

## 5.6 Radioactive Tracers Used in the Exploration, Development or Production of Oil or Gas or Geothermal Resources

In accordance with 30 TAC Section 336.227, radioactive tracer waste generated in the exploration, development or production of oil or gas or geothermal resources is exempt if disposed in the following manner:

- In an on-site disposal pit that is permitted by the RRC for the disposal of oil and gas waste and is covered by at least two feet of clean soil or
- A Class II injection well permitted by the RRC for the disposal of oil and gas waste if the permit specifically authorizes the disposal of radioactive tracers.

Additional criteria that must be met for the radioactive tracers to be exempt are described in 30 TAC Section 336.227. Since the isotopes must have a half-life of 120 days or less, they may also

qualify for the exemption under the 300-Day Rule 30 TAC Subsection 336.225(c) (see Section 5.8 of this publication).

# 5.7 Disposal of Hydrogen-3, Carbon-14, and Iodine-125 in Specific Media

In accordance with 30 TAC Section 336.225, a licensee may dispose of the following licensed material as if it were not radioactive. However, it cannot be disposed in a manner that would permit its use either as food for humans or animals. The activity requirements are described below:

- Activity of 0.05 µCi (1.85 kBq), or less, of hydrogen-3, carbon-14, or iodine-125 per gram of medium used for liquid scintillation counting or in vitro clinical or in vitro laboratory testing.
- animal tissue containing 0.05 µCi (1.85 kBq), or less, of hydrogen-3, carbon-14, or iodine-125 per gram, averaged over the weight of the entire animal.

To qualify for this disposal exemption, the licensee must:

- perform surveys adequate to assure that the specified limits are not exceeded [30 TAC Subsection 336.225(e)(1)];
- remove or otherwise obliterate or obscure all labels, tags, or other markings which would indicate that the material or contents are radioactive [30 TAC Subsection 336.225(e)(2)]; and
- maintain records in accordance with 30 TAC Sections 336.338 and Subsection 336.225(f).

# 5.8 The 300-Day Rule

A licensee may, if approved by the appropriate licensing authority (either DSHS or TCEQ), dispose of licensed material listed in 30 TAC 336.365, Appendix H in a Type I municipal solid-waste facility or, if appropriate, a hazardous waste disposal facility, under the provisions stated in 30 TAC Subsection 336.225(c). The sum-of-fractions rule applies if more than one radionuclide is present. The rule is referred to as the “300-day” rule since the isotopes identified in 30 TAC 336.365, Appendix H have a half-life less than or equal to 300 days. The licensed material disposed under this rule must not exceed the specified concentration and annual activity limits in 30 TAC Section 336.365, Appendix H. Additional requirements are described in 30 TAC Subsections 336.225(d) through 225(g) which include, but is not limited to, surveys, obscuring labels, record keeping, and submitting procedures to the appropriate agency.

# 5.9 Decay in Storage

Decay in storage is authorized in 30 TAC Subsection 336.211(a)(3) “according to law.” This authorization is mainly used by medical institutions, licensed by DSHS, for short-lived radionuclides—with half-lives less than 120 days—used in nuclear medicine, such as metastable technetium-99, xenon-133, and fluorine-18.

# 6.0 Obtaining an Exemption Concurrence

To request an exemption concurrence, send a signed letter with the appropriate documentation to TCEQ, Radioactive Materials Division, MC 233, TCEQ, P.O. Box 13087, Austin TX 78711-3087. Please mark on the envelope that an exemption is being requested. The request can also be scanned and electronically submitted to the Radioactive Materials Division at radmat@tceq.texas.gov.

If the waste is to be disposed at a hazardous waste disposal facility, the disposal facility will request the exemption concurrence on behalf of the waste generator. Otherwise, the waste generator or waste broker will typically request the exemption concurrence letter.

Please include the following information in the exemption-concurrence request:

- the waste-generator identification
- the volume of waste
- the physical form of the waste
- a sampling protocol and sampling data
- characterization
- the device manufacturer's name and device model number (if appropriate)
- any other information that may help in making the exemption determination

TCEQ typically needs up to two weeks to review an exemption request. If the agency requires additional information, staff will contact the requester by letter, e-mail, or phone. There is no fee for an exemption-concurrence request.

An exemption concurrence can only be granted for a material or item if documentation shows that it meets the exemption criteria. Documentation includes one or more of process knowledge, radiochemical analysis of the sample, radiation surveys of the item or material, or NRC analysis documenting that it meets the exemption criteria, provided that the criteria are also in the Texas Administrative Code. Sample results must be current. If additional volume is being added to an exemption concurrence request, then new sampling results for that additional volume must be provided.

## 6.1 Process Knowledge

Many items identified in the exemption rules have been manufactured with specific radioactive content so that those items would satisfy the exemption limits. Such items can be exempted without radiochemical analysis if it can be documented that they were manufactured to contain a radioactive content at or below the exemption limits. Some examples of such items or documentation include:

- a smoke detector which has a sticker attached verifying that it contains 1 µCi or less of americium-241
- company literature
- a Material Safety Data Sheet
- items used by the U.S. armed forces that are built according to military specifications and listed by a national part number in the Technical Bulletin (Army, 1998) as exempt.

Clearly defined manufacturing processes that use NORM material can be exempted using process knowledge [under 25 TAC Subsections 289.259(d)(5)(A), (5)(C), and (6)(C)] if it can be documented that the process does not concentrate the naturally occurring radionuclides according to the appropriate regulation.

# 6.2 Radiochemical Analysis

## *6.2.1 National Environmental Laboratory Accreditation Conference (NELAC)*

Analytical data from samples measured by a laboratory can only be accepted if the laboratory is NELAC accredited by the Texas Laboratory Accreditation Program operated by TCEQ or the data are exempt from the NELAC-accreditation requirement under criteria described in 30 TAC Section 25.6.

## *6.2.2 Averaging and Homogeneity*

It is important that any sample data submitted to TCEQ accurately represent the average activity level of the waste volume. If homogeneity cannot be guaranteed, then four to five samples are required for every 20 cubic yards ($yd^3$). The maximum volume of material over which averaging may be performed is 20 $yd^3$. No single measurement made to calculate an average volumetric or surface-activity contamination can exceed 10 times the exemption criteria.

A total of fewer than four to five samples per 20 $yd^3$ may be accepted if additional data are included such as the studies of contaminated soil from an environmental remediation project which had been sampled extensively during the characterization or remediation stage. Other examples include the use of an *in situ* object-counting system (ISOCS) and screening surveys of soil or debris with the intent of on-site segregation into waste types.

Each waste container is considered as a separate waste volume. Two container waste volumes cannot be averaged together to determine if the activity is below the exemption limit. For example, two containers, one at 34 pCi/g Ra-226 and the other at 20 pCi/g Ra-226 cannot be averaged to yield a result of 27 pCi/g Ra-226 and thereby exempt both containers. Only the container at 20 pCi/g Ra-226 would be exempt.

- Biased collection of samples is also acceptable to determine if the maximum concentrations are below the exemption levels. This would allow fewer samples to be collected and analyzed for a heterogeneous waste. Biased collection to sample the maximum contamination levels could include, but not limited to: Areas with the highest radiation exposure field or contamination (fixed or removable)
- Visible impacts such as discoloration due to spills or contamination, or
- Higher chemical contamination detected by non-radiological screening (which would be indicative of radioactive contamination).

## *6.2.3 Measurement of Daughters to Determine Parent Radionuclide Activity*

Some radiochemical analyses are difficult to perform, given the isotope and the material. These analyses may require alternative testing methodologies. For example, analysis of thorium in metal is a difficult measurement to perform since iron in the sample interferes with measuring the thorium. However, the daughters of the parent nuclide may be measured to determine the parent radionuclide concentration. This methodology can be accepted only if equilibrium has been reached (daughter activity equals parent activity) or if the ratio of daughter activity to

parent activity (if equilibrium has not yet been reached) can be calculated from the elapsed time since the item was processed or manufactured.

## 6.3 Surface Contaminated Waste

Volumetric measurements of surface-contaminated waste (averaging the activity on the surface over the mass of the piece of debris)—such as fixed contamination on concrete rubble—for disposal exemption concurrences are allowed, case by case, if the procedures in ANSI/HPS N13.12-1999 are closely followed. Contaminated distinct items or equipment, if they are to be disposed of, do not need to meet the surface-contamination release limits in 30 TAC Section 336.364, Appendix G. TCEQ will not accept a calculation that averages the activity on the surface of a piece of debris and the entire mass of material in a container containing non-contaminated rubble or other waste. *Radiological Assessments for Clearance of Materials from Nuclear Facilities* (NRC, 2003: section 3.8) contains a methodology relating specific activities ($Bq/cm^2$) to specific areal activity (Bq/g), including the mass-to-surface-ratio conversion factors for various steel components of nuclear power plants.

## 6.4 Radiation Survey

Radiation surveys (wipes or exposure rates) are sometimes required to determine if exemption requirements are met. Rules regarding appropriate use of radiation-survey instruments can be found at 25 TAC Subsection 289.259(e).

## 6.5 NRC Analysis

A letter from the NRC documenting its analysis and conclusion that a specific waste volume or stream meets the exemption requirements may be accepted by TCEQ to grant an exemption concurrence in Texas, provided that the rule in the Code of Federal Regulations used by the NRC to exempt the material is also in the Texas Administrative Code.

# 7.0 References

American National Standards Institute–Health Physics Society. 1999. *Surface and Volume Radioactivity Standards for Clearance. ANSI/HPS N13.12-1999.* McLean, VA: Health Physics Society.

Army. Department of, Headquarters. 1998. Identification of Radioactive Items in the Army. Technical Bulletin 43-0116. Washington.

International Atomic Energy Agency. 2022. *Feature: Depleted Uranium, Questions and Answers*. Vienna.

NRC. 2003. *Radiological Assessments for Clearance of Materials from Nuclear Facilities.* NUREG-1640. Washington.

# Appendix A: Definitions

**Agreement State**: Any state with which the NRC has entered into an effective agreement under 274b of the Atomic Energy Act of 1954, as amended. An agreement state regulates radioactive material within its boundaries except for federal sites and nuclear power plants.

**By-Product Material:** Defined in 30 TAC Subsection 336.2(20)(B) in regard to source material as "the tailings or wastes produced by or resulting from the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including

discrete surface wastes resulting from uranium solution extraction processes, and other tailings having similar radiological characteristics." It excludes underground ore bodies depleted by these solution-extraction processes.

**Exempt Material**: Radioactive material that is exempt from the radioactive-material regulations and can therefore be used or disposed of without consideration of its radioactive content.

**Exemption Concurrence**: A letter from the appropriate regulatory agency stating that a specific radioactive material or object meets the exemption criteria stipulated in the Texas Administrative Code and is therefore exempt from the radioactive material regulations.

**Licensed Material**: Radioactive material received, possessed, used, or transferred under a general or specific license issued by the agency [25 TAC Subsection 289.201(b)(53)].

**Naturally Occurring Radioactive Material (NORM)**: Naturally occurring materials not regulated under the Atomic Energy Act whose radionuclide concentrations have been increased by or as a result of human practices. NORM does not include the natural radioactivity of rocks or soils, or background radiation, but instead refers to materials whose radioactivity is concentrated by controllable practices (or by past human practices). NORM does not include source, by-product, or special nuclear material [25 TAC Subsection 289.259(c)(4)].

**Special Nuclear Material:** Either (1) plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that NRC, in accordance with the provisions of the Atomic Energy Act of 1954, section 51 as amended, determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material [25 TAC Subsection 289.201(b)(101)].

**Sum-of-Fractions Rule**: Equation used to determine if a mixture of radionuclides exceeds a regulatory limit when each radionuclide has a different activity limit. The rule is shown in Equation A-1 but can be described as the requirement that the sum of the ratios of the radionuclide concentrations over its regulatory limit is less than or equal to one.

Eqn. A-1 $$Ratio = \sum_{i=1}^{N} \frac{C_i}{R_i} \leq 1.0$$

*C* is the measured concentration or activity of radioisotope i.

*R* is the regulatory limit for the concentration or activity of radioisotope i.

*N* is the total number of radioisotopes in the waste.

**Tritium:** A hydrogen isotope with one proton and two neutrons. It is commonly referred as tritium (T) instead of hydrogen-3 (H-3).