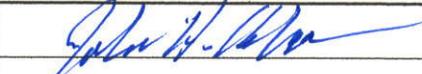
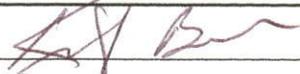


Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.02
RADIATION SAFETY TRAINING

1.0 OBJECTIVE

To define general and specific radiation safety training requirements for employees at the Clean Harbors Deer Trail (CHDT) facility or other temporary job sites to ensure that workers can safely work with radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers who may be exposed to radioactive materials brought onsite. Additional radiation safety training beyond the scope of this procedure may be prescribed by the CHDT Radiation Safety Officer (RSO) as necessary.

3.0 POLICY

All workers who may potentially be exposed to radioactive materials at the CHDT landfill or other job sites shall attend an General Employee Radiation Protection Training course and refresher training each year, and demonstrate competence by scoring at least 70% on a series of tests administered or directed by the CHDT RSO or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 RADIATION SAFETY TRAINING PROCEDURE

5.1 Criteria for Determining Radiation Safety Training Requirements

Training requirements are based on job descriptions and types of areas that workers are required to access to perform their assigned duties. Training may be adjusted to be commensurate with the individual's job category, assigned duties, and previous training and experience. All CHDT workers who may be exposed to radioactive materials as part of their routine employment shall be part of the General Employee Radiation Protection Training program. The following factors shall be considered to determine the appropriate level of knowledge and training for individual CHDT workers:

- The individual's job assignment (i.e., activities in or near the weight station, waste sampling and analysis operations, waste treatment facility when radioactive materials could be present, and disposal cell operations),
- The nature of the radiation hazards that could be present (dependent on waste form, type of treatment if any, and disposal configuration), and

- The type and complexity of any protective actions that the individual might be expected to execute (i.e., the need to limit the duration of an activity, provide temporary shielding, or observe special procedures for some types of radioactive materials). Note that workers in the CHDT landfill are required to wear personal protective equipment (PPE) and respiratory protection under the Resource Conservation and Recovery Act (RCRA) Permit.

5.2 Training Requirements for Radiation Workers

General employees whose job assignments indicate the potential for exposure to radioactive materials shall receive the General Employee Radiation Protection Training prior to conducting those assignments. The CHDT RSO is responsible for ensuring that all workers receive the appropriate training before conducting their assigned duties.

5.3 Training for Site Visitors or Contractors

Visitors or contractors who work with radioactive materials at the CHDT landfill or who enter areas restricted because of the presence of radioactive materials shall complete the first part of the three-part training session required of CHDT employees. All other visitors shall be escorted by trained CHDT staff.

5.4 Evaluating the Adequacy of Current Training for Individual Workers

The CHDT RSO shall:

- Ensure that all new hires who will work with radioactive materials receive the General Employee Radiation Protection Training followed by annual refresher courses.
- Periodically check the training records and determine current levels of Radiation Protection Training for individual workers and their training expiration dates to ensure that workers are adequately trained.
- Compare the individual's current training to the required training, especially in cases where workers change job assignments.
- Ensure that special periodic retraining occurs in the event of changes to CHDT policies, procedures, and practices that affect radioactive material disposal.

5.5 Training Records

Records certifying completion of each part of the required training shall be maintained as part of the CHDT records retention program and within each individual worker's employment file, as required by SOP 15.RPP.3, *Worker Radiation Protection Records*.

6.0 TRAINING SYLLABUS

Radiation safety training for CHDT workers will be commensurate with their responsibilities. The first part of the CHDT General Employee Radiation Protection Training program shall cover the topics listed in Section 6.1 (Radiation Safety Basics). The first part is required for all workers performing activities with radioactive materials. Additional training in site operations and SOPs, and the application and use of radiation survey instruments (topics listed in Section 6.2) comprise the remainder of the program that may be required based on the job responsibilities of the employee.

6.1 Radiation Safety Basics

- Radioactivity and Radioactive Decay
 - Alpha Emission
 - Beta Emission
 - Gamma-Rays
 - X-Rays
 - Half-Life
 - Units of Radioactivity
- Naturally Occurring Radioactivity
 - Cosmic Radiation
 - Cosmogenic Radioactivity
 - Radionuclides in the Earth
 - Summary of Natural Background Radiation
- Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced NORM (TENORM)
 - Decay Chains and Radionuclides
 - Sources
 - Waste Forms
- Biological Effects of Radiation
 - Acute Effects
 - Chronic Effects
 - Dose Equivalent: The Rem
 - Relative effects of radiation exposure versus other risks
- Basic Radiation Protection Criteria
 - Time, Distance, and Shielding for External Radiation
 - Inhalation Protection
 - Fetal Protection
- Radiation Protection Guidelines and Standards
 - Philosophy of Radiation Protection
 - Occupational Limits
 - General Public Limits
 - ALARA

- Posting

6.2 Applied Radiation Protection and Site-Specific Issues

- Site-Specific Instrumentation Use
 - General Radiation Survey Equipment
 - Dose Rate Meters
 - Geiger Mueller (GM) Survey Equipment
 - Alpha/Beta Smear Sample Counter
 - Air Monitoring
 - Gate Monitor
- Waste Acceptance
 - CHDT Regulations and Permit Conditions
 - CHDT Waste Acceptance Criteria
- Posting
- CHDT Individual Dosimetry Program
- Radiation Records

7.0 REFERENCES

None.

ATTACHMENT A – Quiz and Answers

CLEAN HARBORS DEER TRAIL LLC
QUIZ ON PART 1:
BASIC RADIATION PROTECTION TRAINING

Name: _____ **Date:** _____

1. Alpha radiation is:

- a. the nucleus of a helium atom
- b. an electron
- c. electromagnetic radiation
- d. none of the above

2. Beta radiation is:

- a. the nucleus of a helium atom
- b. an electron
- c. electromagnetic radiation
- d. none of the above

3. Gamma radiation is:

- a. the nucleus of a helium atom
- b. an electron
- c. electromagnetic radiation
- d. none of the above

4. Alpha radiation can penetrate 1/8 inch of steel.

True False

5. Beta radiation can penetrate 1/8 inch of steel.

True False

6. Gamma radiation can penetrate 1/8 inch of steel.

True False

- 7. A series of different barriers was placed between a radioactive source and a G-M counter to determine the types of radiation emitted. The results are shown below. Which type or types of radiation were emitted?**

EXPERIMENT	COUNT RATE in counts per minute
Background	30
No barrier	2,000
Thin paper	1,500
¼ inch of Aluminum	1,500

- a. alpha and beta particles
- b. alpha particles and gamma rays
- c. gamma rays only
- d. beta particles and gamma rays

8. Ionizing radiation:

- a. creates ions in matter
- b. can create acute effects
- c. can cause cancer
- d. all of the above

9. X-rays:

- a. consist of energy and are similar to gamma rays
- b. have an atomic mass of 6
- c. come from the nucleus of an atom
- d. move at the speed of sound

10. The experimental data below show the amount of radioactivity from a radioactive source as measured by a G-M tube and counter over a time period of 8 hours. What is the half-life of the radioactive source?

Time in hours	0	2	4	6	8
Counts per minute (cpm)	600	450	300	225	150

- a. 2 hours
- b. 4 hours
- c. 6 hours
- d. 8 hours

11. Activity is:

- a. radioactive decays per time
- b. heat loss per unit time
- c. associated with alpha radiation only
- d. measured in rads

12. Radiation dose is:

- a. heat absorbed per unit time
- b. energy absorbed per unit mass
- c. different for each type of radiation
- d. different for natural versus man-made sources

13. Radiation dose is measured in units of:

- a. kilograms (kg)
- b. rad (R)
- c. centimeters (cm)
- d. volts (v)

14. Dose equivalent accounts for:

- a. different quantities of radioactive material
- b. biological damage caused by different types of radiation
- c. biological damage caused by natural versus man-made radiation
- d. different age groups in an exposed population

15. The unit of radiation dose equivalent is:

- a. rad (R)
- b. electron volts (eV)
- c. rem
- d. picocuries

16. Sources of background radiation include:

- a. cosmic rays from outer space
- b. radiation from materials in the earth
- c. radiation from materials taken into the body through breathing and eating or drinking
- d. all of the above

17. Background radiation doses are:

- a. constant around the world
- b. of less consequence than man-made radiation
- c. vary with location and lifestyle
- d. only associated with gamma radiation

18. NORM stands for:

- a. Normal Ordinary Radioactive Material
- b. Naturally Occurring Radioactive Material
- c. Neutral Operating Radioactive Material
- d. Negative Oriented Radiation in Man

19. TENORM stands for:

- a. Thermally Excited NORM
- b. Technically Elegant NORM
- c. Technologically Enhanced NORM
- d. Telephone Emitted NORM

20. NORM/TENORM radionuclides:

- a. include uranium and its decay products
- b. include thorium and its decay products
- c. include a natural form of radioactive potassium
- d. all of the above

21. Radon-222 is:

- a. an inert, radioactive gas produced by the decay of radium
- b. considered to be a heavy metal
- c. has a half-life of over a million years
- d. is a greater hazard outdoors than indoors

22. The decay products of Radon-222:

- a. cause no observable health effects
- b. emit energetic alpha particles
- c. have half-lives > a million years
- d. are not found in nature

23. Cigarette smokers receive a higher lung dose from Radon-222 decay products than non-smokers.

True False

24. Background doses in the U.S., including the dose from Radon, is about 300 mrem/year.

True False

25. The background dose in Denver is less than the U.S. average.

True False

26. Several NORM and TENORM radionuclides have half-lives in excess of a million years.

True False

27. NORM radionuclides can be found in ceramic products.

True False

28. TENORM radionuclides include man-made radionuclides.

True False

29. TENORM waste can include which of the following:

- i. oil field pipe scale
- ii. feedlot waste
- iii. drinking water purification waste
- iv. mining residuals
- v. household waste

- a. i, ii, and v
- b. i, iii, and iv
- c. ii, iii, and iv
- d. all of the above

30. Ionizing radiation can damage DNA in a cell, which can cause cancer or other effects.

True False

31. Humans suffer millions of DNA breaks a day from all sources, most of which are repaired.

True False

32. The most affected cells to radiation damage are:

- a. rapidly dividing cells (bone marrow, fetus)
- b. slowly dividing cells (brain, nerves)

33. Activity is recorded in units of:

- a. the rad (100 ergs of energy per gram of material)
- b. the Curie (Ci) or picocurie
- c. the rem (= rad x a quality factor)
- d. the ton (2,000 pounds)

34. The maximum allowed dose to a worker in a nuclear facility is:

- a. 2 rem
- b. 4 rem
- c. 5 rem
- d. 8 rem

35. Annual doses to Deer Trail workers will be maintained at:

- a. 5 rem
- b. 4 rem
- c. 2 rem
- d. 100 mrem

36. ALARA stands for As Low As Reasonably Achievable.

True False

37. The Deer Trail annual worker radiation dose ALARA goal is:

- a. 1 rem
- b. 100 mrem
- c. 25 mrem
- d. 5 mrem

38. There are no observable effects for radiation doses less than 10 rem.

True False

39. The observable effect for radiation exposures in excess of 600 rem is death.

True False

40. Delayed effects can include:

- a. cataracts
- b. birth defects when the fetus is exposed
- c. cancer
- d. all of the above

41. Some data indicate that low doses of radiation may be beneficial.

True False

42. Although there is considerable discussion among scientists, radiation protection standards and limits are set assuming that even the smallest dose has some increased risk of health effect.

True False

43. Radiation produces cancer in every exposed person.

True False

44. The fundamental principal of radiation protection is to reduce exposures through:

- a. width, height, and length
- b. volume, mass, and temperature
- c. time, distance, and shielding
- d. knowledge, common sense, and procedures

45. The person charged with responsibility for maintaining and enforcing the Deer Trail radiation safety program is:

- a. the General Manager
- b. the Radiation Safety Officer
- c. the Environmental Compliance Officer
- d. all employees

46. Significant elements of the Deer Trail Radiation Protection Program Include which of the following:

- i. radiation surveys
- ii. protective clothing
- iii. overtime
- iv. environmental monitoring
- v. medical insurance

- a. i, iii, and v.
- b. i, ii, and iv
- c. ii, iii, and iv
- d. iii, iv, and v

47. Under the Deer Trail License, the facility can legally dispose all forms of radioactive waste.

True False

48. Colorado is an Agreement State with the U.S. Nuclear Regulatory Commission.

True False

CLEAN HARBORS DEER TRAIL LLC
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 (Correct answers are shown in **Bold** text)

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 - b. an electron
 - c. electromagnetic radiation
 - d. none of the above

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 - d. none of the above

- a. alpha and beta particles
- b. **alpha particles and gamma rays**
- c. gamma rays only
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3. Gamma radiation is:
- a. the nucleus of a helium atom
 - b. an electron
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 - d. none of the above

8. Ionizing radiation:
- a. creates ions in matter
 - b. can create acute effects
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 - d. **all of the above**

4. Alpha radiation can penetrate 1/8 inch of steel.

True **False**

9. X-rays:
- a. **consist of energy and are similar to gamma rays**
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