

Part 7: Regulatory Issues and Quality Control

Part 1: Current NRC Regulations Related to Radiation Safety

1. Secretarial space, hallways, and certain other areas of a department must qualify as an UNRESTRICTED AREA. Which ONE of the following 10 readings is the maximum acceptable in an unrestricted area?

1 mRem/hr	1 mRem in 1 hour
2 mRem/hr	2 mRem in 1 hour
5 mRem/hr	5 mRem in 1 hour
10 mRem/hr	10 mRem in 1 hour
20 mRem/hr	20 mRem in 1 hour

2. What is the regulation regarding posting of radiation safety rules?

- General Radiation Safety rules (no smoking, eating, drinking, etc), must be posted in each laboratory in which radioactive materials are used.
- State/NRC regulations and telephone numbers must be posted conspicuously in each Nuclear Medicine Laboratory.
- Both are required
- Neither is required

3. A female technologist enters your office and announces to you that she is pregnant and gives you the estimated date of conception (the 2 required pieces of information). Is she legally considered a "DECLARED PREGNANT WORKER"?

4. What are the dose limits to the embryo/fetus for a woman who meets the requirements of a declared pregnant worker?

- Dose to the embryo/fetus over entire period of gestation (9 mos.) is 0.05 rem
- Dose to the embryo/fetus over entire period of gestation (9 mos.) is 0.5 rem
- Dose to the embryo/fetus over entire period of gestation (9 mos.) is 5.0 rem
- None of the above

5. For an **occupationally exposed individual** for one year, the maximum permissible whole body dose, the extremity dose, internal organ dose, and the dose to the lens of the eye are, respectively,

- 5 Rem, 50 Rem, 50 Rem, and 15 Rem
- 5 Rem, 50 Rem, 15 Rem, and 50 Rem
- 5 Rem, 15 Rem, 50 Rem, and 50 Rem
- 15 Rem, 50 Rem, 5 Rem, and 15 Rem

6. If you have accumulated 2,000 mRem at your current institution as of June 15 and are planning to change jobs, you will be permitted 5,000 additional mRem for the remainder of the calendar year at your new facility. True/False?

7. How often MUST an employer inform his radiation workers of their radiation exposure levels?

- a. weekly
- b. monthly
- c. quarterly
- d. annually

8. Your technologist performed requisite QC testing on your dose calibrator at 7:00 AM this morning. If the Tech is called in to perform a stat lung scan at 12:15 tomorrow morning, the elapsed time will be 17 hours and 15 minutes. Since <24 hrs have elapsed, is the Tech required to repeat the QC testing on the dose calibrator? If yes, which test(s) must be repeated?

9. The NRC or State Inspector blows a puff of smoke under the closed door in the room in which Xe-133 ventilation studies are performed. What is the purpose of this test, what should happen to the puff of smoke, and is the test still mandatory?

- a. The smoke should be blown back into the hallway as positive pressure is required in a room in which ventilation studies are being performed.
- b. The smoke should flow under the door and into the room as positive pressure is required in a room in which ventilation studies are being performed.
- c. The smoke should be blown back into the hallway as negative pressure is required in a room in which ventilation studies are being performed.
- d. The smoke should flow under the door and into the room as negative pressure is required in a room in which ventilation studies are being performed.

10. One of the policies that helps to minimize radiation dose to Nuclear Medicine Technologists is called the ALARA Policy. For what does the acronym stand?

11. The Radiation Safety Program and the ALARA Policy must be reviewed periodically. Whose job is it to do so, and how often must it be done?

- a. RSO, semiannually
- b. RSO, annually
- c. Director of Radiology, semi-annually
- d. Director of Radiology, annually
- e. Director of Nuclear Medicine, semi-annually
- f. Director of Nuclear Medicine, annually

12. One is permitted to designate one sink in the laboratory as a "HOT SINK" for disposal of low-activity radioactive waste. The **institutional** limit is

- a. 10 Ci per year for all isotopes
- b. 1 Ci per year for all isotopes
- c. 100 mCi per year for all isotopes
- d. There is no legal limit

13. All administered doses must be within ____% of the prescribed dose

- a. 5
- b. 10
- c. 15
- d. 20

14. A male patient's prescribed dose of Tl-201 chloride for a cardiac study was 3 mCi. The technologist inadvertently administered 5 mCi, a 67% overdose. Testicular dose (critical organ in males) was 15 R, kidney dose was 5.1 R, and whole body dose was 2 R. Was this a reportable or a recordable event?

15. A patient was treated with I-131 NaI for hyperthyroidism. The actual dose was 17 mCi; the prescribed dose was 10 mCi. Was this a reportable or recordable event?

16. You administered a 150 mCi therapeutic dose of I-131 to a patient with thyroid cancer. Which of the following is required by law for the person performing the dose administration?

- a. thyroid count at 24-72 hr post admin time
- b. 24-72 hr urine sample must be counted
- c. Both of the above
- d. Neither of the above

17. The three most significant sources of our background radiation include:

- a. Cosmic rays
- b. Flying in aircraft
- c. Global fallout
- d. Internal Radioactivity
- e. Nuclear Power Plants
- f. Radon and other terrestrial sources

18. According to the NRC, an adult is defined as a person ____ or more years of age

- a. 15
- b. 18
- c. 21
- d. 25

19. A radiation area and a high radiation area are, respectively, areas in which an individual could receive a dose of ____ and ____ mRem in 1 hour at a distance of 30 cm from the source

- a. 1, 5
- b. 5, 10
- c. 1, 50
- d. 5, 100

20. Respectively, what are the LD⁵⁰ and LD¹⁰⁰ whole body doses in humans?
- 50, 100
 - 200, 380
 - 350, 550
 - 1,000, 3000
21. An individual **must be** monitored for radiation dose with a film badge if his dose is likely to exceed _____% of the MPD
- 5
 - 10
 - 25
 - 50
22. Hospitals have a _____ license
- Specific
 - General
 - Broad
 - Unlimited
23. A GM Survey of your lab and a wipe test must be performed _____ and _____, respectively.
- Daily and daily
 - Daily and weekly
 - Weekly and daily
 - Weekly and weekly
24. How often must one perform leak-testing on sealed source? What are several examples of sealed sources?
25. How would you define an Agreement State? Is your state an agreement state or an NRC state? Which may be more restrictive than the other, an NRC State or an Agreement State?
26. Who is the licensee?
- Director of Nuclear Medicine
 - Director of Radiology
 - Directors of Nuclear Medicine & Radiology
 - The institution
 - Each individual user of radioactivity
27. Both hand monitoring and treadmill monitoring are **required** on a(n) _____ basis
- Hourly
 - Twice daily
 - Daily
 - Weekly

28. Which of the following must be trained in Radiation Safety on an annual basis?

- a. Nuc Med Techs
- b. All Authorized Users
- c. Loading Dock personnel who deliver radioactive materials
- d. Housekeeping
- e. Security officers accompanying a person delivering radioactive materials.

29. The NRC Inspector has completed his inspection and it is 5 PM. Only you and the inspector remain in the department, and you both have your coats on, ready to leave for the day. The inspector walks over to the Hot Lab door, opens it, looks around, and begins writing a note on his pad. Has he discovered a citable offense?

30. Regarding the rules for opening packages: which of the following packages must be wipe-tested for surface contamination? (read all possible answers)

- a. a package containing a vial of Xe-133 gas
- b. a package containing a vial of Tl-201 chloride
- c. a box containing a Mo-Tc generator
- d. an ammo can from a central pharmacy containing several unit doses of Tc-99m MDP
- e. all of the above except Xe-133 gas

31. What data must be recorded in the INCOMING PACKAGE LOGBOOK?

32. Which of the following is/are **acceptable** methods of waste disposal?

- a. Transfer to licensed person/company
- b. Decay in storage
- c. Release as effluents within authorized limits
- d. All of the above
- e. None of the above

Part 2: Hot Lab Regulations

1. Within what limits must the expected and measured readings on a dose calibrator be?

- a. 5%
- b. 10%
- c. 15%
- d. 20%

2. How often must a dose calibrator be checked for **accuracy** and how is the test performed?

- a. Daily
- b. Monthly
- c. Quarterly
- d. Annually
- e. Never

3. Is the following accuracy test a “Pass” or a “Fail”?

Standard	Energy (keV)	expected value (mCi)	measured value (mCi)
Co-57	122	2.48	2.51
Cs-137	662	3.38	3.29
Co-60	1,332	1.55	1.52

4. How often must a dose calibrator be checked for **constancy** and how is the test performed?

- a. Daily
- b. Monthly
- c. Quarterly
- d. Annually
- e. Never

5. Is the following constancy test a “Pass” or a “Fail”?

Isotope Setting	<u>Reading (μCi)</u>				
	Mon	Tues	Wed	Thu	Fri
Cs-137	123	124	122	126	124
Ga-67	223	224	222	226	224
Tl-201	163	164	162	166	164
Tc-99m	243	244	242	246	244
I-131	313	314	312	316	314
I-123	193	194	192	196	194
In-111	283	284	282	286	284
Xe-133	433	434	432	436	434

6. How often must a dose calibrator be checked for **linearity** and how is the test performed?

- a. Daily
- b. Monthly
- c. Quarterly
- d. Annually
- e. Never

7. Is the following linearity test a "Pass" or a "Fail"?

Elapsed time (hr)	expected value	measured value
0	300	300
1	267	242
2	238	201
3	212	135
6 (1 HL)	150	92
12 (2 HL)	75	36.4
24 (4 HL)	18.75	7.5

8. How often must a dose calibrator be checked for **geometry** and how is the test performed?

- a. Daily
- b. Monthly
- c. Quarterly
- d. Annually
- e. At Installation

9. Is this geometry test a "Pass" or a "Fail"?

Sample Volume	Activity (mCi)
0.5 ml	25.5
1.0	25.3
2.0	25.0
3.0	24.8
4.0	24.7
5.0	24.5
6.0	24.4

10. Which of the following is an example of a radionuclide impurity?

- a. Mo-99 in the generator eluate
- b. I-123 Iodide in a preparation of I-123 mIBG
- c. Aluminum ion breakthrough
- d. Hydrolyzed reduced Tc in a preparation of Tc-99m MDP

11. Which of the following is/are examples of a radiochemical impurity?

- a. Mo-99 in the generator eluate
- b. I-123 Iodide in a preparation of I-123 mIBG
- c. Aluminum ion breakthrough
- d. Hydrolyzed reduced Tc in a preparation of Tc-99m MDP

12. Which of the following is an example of a chemical impurity?

- a. Mo-99 in the generator eluate
- b. I-123 Iodide in a preparation of I-123 mIBG
- c. Aluminum ion breakthrough
- d. Hydrolyzed reduced Tc in a preparation of Tc-99m MDP

13. Match the following test methods with the category of impurity

Radionuclidic	Thin Layer Chromatography
Radiochemical	Dose Calibrator or Multichannel Analyzer
Chemical	Colorimetric

14. What is upper limit of Mo-99 breakthrough in a generator eluate and how is test performed?

- a. 0.15 $\mu\text{Ci Mo/mCi Tc}$ at time of elution
- b. 0.15 $\mu\text{Ci Mo/mCi Tc}$ at time of administration
- c. 10 ppm
- d. Not a mandatory test for generators

15. What is the upper limit of Al^{3+} breakthrough in a generator eluate and how is the test performed?

- a. 1 ppm
- b. 5 ppm
- c. 10 ppm
- d. 20 ppm

16. Which of the following radiochemical impurities will result in the appearance of liver and spleen on bone scans performed following injection of Tc-99m MDP?

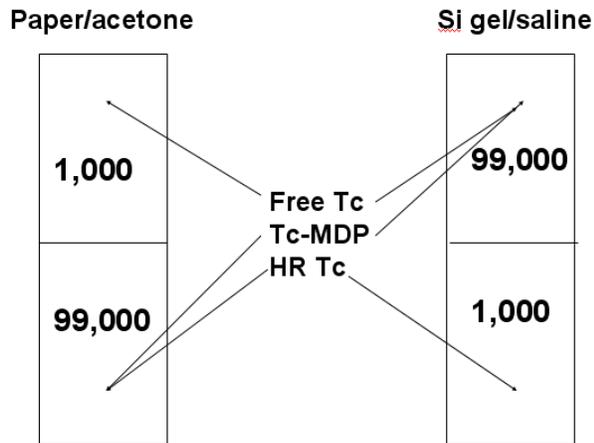
- a. Free Tc Chemical form: pertechnetate, TcO_4^-
- b. Hydrolyzed Reduced Tc: Chemical form is probably $\text{TcO}(\text{OH})_2 \cdot \text{H}_2\text{O}$, a hydrated Tc-oxide
- c. Free iodine in preparations of I-123 mIBG
- d. stereochemical impurities in $^{99\text{m}}\text{Tc HMPAO}$

17. Why don't we test for the presence of HR Tc in Tc-99m MAA?

- a. It's never present, so we don't need to test for it
- b. HR Tc is not radioactive and doesn't interfere with scans
- c. Even if it is present in significant quantities, it has no effect on the lung scan
- d. There is no simple way to test for HR Tc in preparations of Tc-99m MAA

18. The diagram below shows count rates and the migration pattern of Tc-MDP, free Tc, and HR TC on chromatography strips. What is the Radiochemical Purity of the product?

Migration Patterns of Tc-MDP



18. What are the release criteria in an Agreement State and in an NRC state for patients treated with high-dose therapy for thyroid Ca with I-131 NaI?

- 5 mR/hr at 1 m from chest
- 5 mR/hr at 10 cm from chest
- 7 mR/hr at 1 m from chest
- 7 mR/hr at 10 cm from chest
- None of the above

19. A patient was treated with I-131 NaI for thyroid cancer. Which signs must be on the door to the room in which he was treated?

- a. Caution: Radioactive Materials
- b. Caution: Radiation Area
- c. Caution: Airborne Radioactivity Area
- d. None of the above
- e. Signage for I-131 Therapy