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BIOENVIRONMENTAL ENGINEERING

Nuclear Enterprise

QUALIFICATION TRAINING PACKAGE

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TABLE OF CONTENTS

STS Line Item 6.8.1: Recommend countermeasures.

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.
Prerequisites:	4.9.2.11.2 Gamma Spec QTP
Training References:	• Medical Management of Radiological Casualties, Fourth Edition, July 2013
Additional Supporting References:	• Radiation Emergency Medical Management Website, www.remm.nlm.gov • DOD 3150.08-M, Nuclear Weapon Accident Response Procedures (NARP) Internet Supplement, http://www.acq.osd.mil/ncbdp/narp/index.htm
CDC Reference:	4B051
Training Support Material:	• One scenario included in the notes section
Specific Techniques:	Conduct tabletop training and evaluation of researching, identifying, and recommending medical countermeasures for radiological casualties.
Criterion Objective:	Given a scenario and references, research, identify, and recommend medical countermeasures to medical providers and/or the incident commander (IC) after a radiological incident, successfully completing all checklist items with limited trainer assistance on only the hardest parts.

Notes:

The abovementioned references are great resources for determining medical countermeasures for internally deposited radioactive material. Trainee should be able to identify when medical countermeasures are beneficial and which countermeasures should be used (using the references) for which radioisotopes.

Scenario:

1. A terrorist attack occurred at an Air Force Academy sporting event. Witness statements identify there was a large explosion in the middle of a crowded grandstand. There were immediate casualties, and when the responding fire department arrived and proceeded to rescue the wounded, their EPDs began to alarm. They were showing a dose rate of 10 mrem/hr. They immediately called Bio to respond. The trainee, as the Bio Team Lead, has responded and reported to the IC. At this time, the Bio Team Lead can ask any questions and/or use any available equipment to conduct any reconnaissance required.
    a. If trainee asks to use the SAM-940 to identify the isotope, the dirty bomb contained a substantial amount of cobalt-60.
    b. If trainee asks, the patients were decontaminated by disrobing and gross decontamination on scene prior to transport to the medical facility.
    c. Based on above information, the trainee should recommend countermeasures which could include the preferred method, Diethylentriamene Pentaacetate (DTPA), or any of the following: Ethylenediaminetetraacetic Acid (EDTA), Succimer (DMSA), or N-acetyl cysteine (NAC).

TASK STEPS

1. Determine radioisotope of concern based on the scenario and reconnaissance.[1]

2. Recommend decontamination of the patient.[2]

3. Determine appropriate medical countermeasures.[3]

LOCAL REQUIREMENTS:

NOTES:

1. Medical countermeasures are based on specific isotopes. This step must be accomplished prior to any recommendations being made. Typically, this can be done with minimal risk to personnel as the SAM-940 requires a very small gamma signature to identify isotopes.

2. This is the second most important step as treating a patient who is still contaminated risks the health of the providers as well as spreads contamination through the medical facility. Removing clothing, shoes, and washing the patients hair and head, removes 95 percent of the contamination.

3. Trainee should use Table 5 of the *Medical Management of Radiological Casualties* reference or the Patient Management section of the Radiation Emergency Medical Management website to determine specific treatment based on the isotope of concern.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.8.1 Recommend countermeasures.

1. What is the first step in recommending countermeasures and why?

2. What is the best method of decontamination for radiological casualties?

3. Match the medical countermeasure below with the isotope of concern it can treat. (some may be used more than once)

Americium-241 ______	a. Potassium Iodide
Cobalt-60 _________	b. DTPA
Iodine __________	c. DMSA
Plutonium ________	d. Prussian Blue
Uranium ________	e. Bicarbonate
Cesium __________	f. Beer (or other diuretic)
Potassium ________	
Cadmium ________	
Lead __________	
Sodium _________	

PERFORMANCE CHECKLIST

STS Line Item 6.8.1 Recommend countermeasures.

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.

DID THE TRAINEE…		YES	NO
1. Determine radioisotope of concern based on the scenario and reconnaissance?			
2. Recommend decontamination of the patient?			
3. Determine appropriate medical countermeasures?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. What is the first step in recommending countermeasures and why?

   A: Determining the isotope of concern because each type of medical countermeasure is isotope specific.

   (Source: Medical Management of Radiological Casualties, 4th Edition)

2. What is the best method of decontamination for radiological casualties?

   A: Removing all clothing and shoes may remove up to 90% of radiological contamination.

   (Source: DOD 3150.08-M Nuclear Weapon Accident Response Procedures (NARP) Internet Supplement)

3. Match the medical countermeasure below with the isotope of concern it can treat. (some may be used more than once)

	a. Potassium Iodide
Cobalt-60 __B_______	b. DTPA
Iodine ____A______	c. DMSA
Plutonium __B______	d. Prussian Blue
Uranium ____E____	e. Bicarbonate
Cesium ____D______	f. Beer (or other diuretic)
Potassium __F______	
Cadmium __C______	
Lead ____C______	
Sodium ___F______	

(Source: Medical Management of Radiological Casualties, 4th Edition)

STS Line Item 6.10.1: Convert units of radiation.

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.
Prerequisites:	Training Module 3.2.2 Perform conversion of units using dimensional analysis
Training References:	• Bioenvironmental Engineer's Guide to Ionizing Radiation, AFIOH, October 2005, Chapter 4 "Units of Ionizing Radiation Quantification, Activity, and Half-Life"
Additional Supporting References:	• N/A
CDC Refer*ence:*	4B051
Training Support Material:	N/A
Specific Techniques:	Conduct hands-on training and evaluation.
Criterion Objective:	Given calculator, access to references, and scenario, convert units of radiation as required with NO trainer guidance.

Notes:

*The purpose of this training is to ensure trainee can convert units of radiation as necessary to adequately use in health risk communication. Typically, this includes converting from exposure readings (roentgen/gray) to dose equivalent readings (rem/sievert). Conversion from CPM to DPM is also required in many situations; however, that is closed out in QTP 4.9.2.10.1, and will not be covered here.

Trainee will be given a scenario and must extract the appropriate information to convert units.

TASK STEPS

1. Convert units of activity (Curie to Becquerel, Becquerel to Curie).[1]
2. Convert units of exposure and dose equivalent between SI and conventional units.[2]
3. Convert between units of exposure and dose equivalent using quality factors.[3]

LOCAL REQUIREMENTS:

NOTES:

1. 1 becquerel (Bq) is equal to 1 disintegration per second (dps). 1 Curie (Ci) is equal to 3.7×10^{10} Bq. To convert from Ci to Bq, simply multiply by $3.7\text{x}10^{10}$. To convert from Bq to Ci, divide by $3.7\text{x}10^{10}$.

Example:

0.15 Ci x $3.7\text{x}10^{10}$ Bq/Ci = 5.55 $\text{x}10^{9}$ Bq

15,200 Bq / $3.7\text{x}10^{10}$ Bq/Ci = 4.1 x 10^{-7}Ci = 0.41μCi

2. 1 Gray (Gy) = 100 rad. 1 Sievert (Sv) = 100 roentgen equivalent man (rem).

Example:

3.7 Gy x 100 rad/Gy = 3,700 rad

9784 rad / 100 rad/Gy = 97.84 Gy

84 Sv x 100 rem/Sv = 8,400 rem

451 rem / 100rem/Sv = 4.51 Sv

3. Dose equivalent quality factors are found in the BE Guide to Ionizing Radiation Table 4-1. Use these quality factors when converting between exposure and dose equivalent for both SI and conventional units. Multiply exposure readings by the appropriate Q factor to obtain dose equivalent, divide dose equivalent by appropriate Q factor to obtain exposure reading.

Radiation	Q Factor
X, γ, or β	1
A, fission fragments, heavy particles	20
Neutron (unknown energy)	10
High Energy Protons	10

TRAINEE REVIEW QUESTIONS

STS Line Item 6.10.1: Convert units of radiation.

1. Convert the following activity levels either from SI to conventional or conventional to SI as appropriate.

    a. 1.7 Ci

    b. 18 µCi

    c. 2.5 MBq

    d. 37 kBq

2. You are part of a joint force responding to a nuclear incident with foreign nationals, Mr. Schulte and Mr. Lawver reported readings of 1.5 mR/hr . The host nation expects all readings to be in SI units. What number should you report?

3. In response to your previous report, the host nation has requested that your team halts their entry if exposure readings exceed 20 mGy/hr. What number should you inform your team to stop at if their equipment reads in R/hr?

4. A radiation worker has received 14 gray exposure following a mishap handling Po-210. In order to enter this information into DOEHRS, readings must be in conventional units for dose equivalent. What is CMSgt Patrick's equivalent exposure? (note, Po-210 emits alpha radiation)

PERFORMANCE CHECKLIST

STS Line Item 6.10.1: Convert units of radiation.

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed

DID THE TRAINEE…		YES	NO
1. Convert units of activity (Curie to Becquerel, Becquerel to Curie).			
2. Convert units of exposure and dose equivalent between SI and conventional units.			
3. Convert between units of exposure and dose equivalent using quality factors			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. Convert the following activity levels either from SI to conventional or conventional to SI as appropriate.

a. 1.7 Ci

A: 1.7 Ci x 3.7 x 10^{10} Bq/Ci = *6.29 x 10^{10}Bq*

b. 18 µCi

A: 18 µCi x 3.7 x 10^{10} Bq/Ci = *666,000Bq or 6.66 x 10^{5}Bq*

c. 2.5 MBq

A: 2,500,000Bq / 3.7x10^{10}Bq/Ci = *6.75x10^{-5}Ci or 67.5 µCi*

d. 37 kBq

A: 37,000Bq / 3.7x10^{10}Bq/Ci = *1x10^{-6}Ci or 1 µCi*

(Source: Bioenvironmental Engineer's Guide to Ionizing Radiation, AFIOH, October 2005, Chapter 4 "Units of Ionizing Radiation Quantification, Activity, and Half-Life")

2. You are part of a joint force responding to a nuclear incident with foreign nationals, Mr. Schulte and Mr. Lawver reported readings of 1.5 mR/hr. The host nation expects all readings to be in SI units. What number should you report?

A: 1.5 mR/hr / 100R/Gy = *0.015 mGy/hr*

(Source: Bioenvironmental Engineer's Guide to Ionizing Radiation, AFIOH, October 2005, Chapter 4 "Units of Ionizing Radiation Quantification, Activity, and Half-Life")

3. In response to your previous report, the host nation has requested that your team halts their entry if exposure readings exceed 20 mGy/hr. What number should you inform your team to stop at if their equipment reads in R/hr?

A: 20 mGy/hr = 0.00002 Gy/hr x 100R/Gy = 0.002 R/hr = 2mR/hr

(Source: Bioenvironmental Engineer's Guide to Ionizing Radiation, AFIOH, October 2005, Chapter 4 "Units of Ionizing Radiation Quantification, Activity, and Half-Life")

4. A radiation worker has received 14 gray exposure following a mishap handling Po-210. In order to enter this information into DOEHRS, readings must be in conventional units for dose equivalent. What is CMSgt Patrick's equivalent exposure? (note, Po-210 emits alpha radiation)

A: 14Gy x 100rad/Gy = 1400 rad

1400 rad x 20 (Q factor for alpha) = 28,000rem

(Source: Bioenvironmental Engineer's Guide to Ionizing Radiation, AFIOH, October 2005, Chapter 4 "Units of Ionizing Radiation Quantification, Activity, and Half-Life")

STS Line Item 6.13: Calculate stay times.

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed
Prerequisites:	QTP 3.2.2 Perform conversion of units using dimensional analysis
Training References:	Bioenvironmental Engineer's Guide to Radiological Emergencies, November 2011
Additional Supporting References:	N/A
CDC Reference:	4B051
Training Support Material:	N/A
Specific Techniques:	Conduct hands-on training and evaluation.
Criterion Objective:	Given calculator, BE Guide to Radiological Emergencies, and scenario, calculate stay times with no trainer guidance.

Notes: *The purpose of this training is to ensure trainee can determine allowable stay times in areas with varying levels of radiation. Trainee will be required to convert units of radiation if necessary. Utilize tables in paragraphs under the "7.4 Stay times" chapter of the BE Guide to Radiological Emergencies to determine stay times.

Table 7-3: Quick reference for 5R exposure limit, isotope unknown
Table 7-4: Alpha surface activity, no respirator
Table 7-5: Beta/Gamma surface activity, no respirator
Table 7-6: Alpha activity in air, no respirator
Table 7-7: Gamma rate, no respirator
Table 7-8: Apha surface activity, with respirator
Table 7-9: Beta/Gamma surface activity, with respirator
Table 7-10: Air activity, with respirator
Table 7-11: Gamma rate, with respirator

Trainee will be given a scenario and must extract the appropriate information to determine allowable times.

TASK STEPS

1. Utilize BE Guide to Radiological Emergencies to determine allowable stay time.

LOCAL REQUIREMENTS:

NOTES:

1. The calculation "Dose = Rate x Time" has been a staple of the BE career field, and can be used for point sources. In the case of a radiation dispersal device, nuclear detonation, or other radiation emergencies such as a nuclear power plant emergency it is necessary to use the tables issued by the Department of Energy (DoE) utilizing surface contamination activity, radioisotope of concern, and allowable dose.

The tables issued by the DoE are used in the 2009 BE Guide to Radiological Emergencies.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.13: Calculate stay times.

5. Following the detonation of an IED, initial modeling predicts ground contamination at 2,220,000dpm/100cm^2 alpha in the area surrounding the incident. Emergency responders in this area will be supplied appropriate PPE (respirators, anti-contamination clothing). Based on the information provided, how long do you estimate they can stay in the area without exceeding 1 rem exposure?

6. Following an incident at a local nuclear power plant, RADeCO measurements show an airborne alpha activity of 222dpm/m^3. The installation commander has decided to evacuate the base and is asking for a maximum stay time to evacuate personnel with an exposure no greater than 1 rem. How long does the commander have to evacuate the base? (note, this is a stateside base and includes base housing)

7. A weapons tech maintaining a nuclear warhead has breached the containment system and leaked Pu-239. Gamma readings in the room where he was working are 100 mR/hr. The teams tasked to clean up the material may receive no more than 1 rem of exposure per entry per day and will be wearing level C suits (suit, boots, gloves, FF respirator, hood). How long may each team stay in the area?

PERFORMANCE CHECKLIST

STS Line Item 6.13: Calculate stay times.

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed

DID THE TRAINEE…		YES	NO
1. Utilize BE Guide to Radiological Emergencies to determine allowable stay time?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. Following the detonation of an IED, initial modeling predicts ground contamination at 2,220,000dpm/100cm^2 alpha in the area surrounding the incident. Emergency responders in this area will be supplied appropriate PPE (respirators, anti-contamination clothing). Based on the information provided, how long do you estimate they can stay in the area without exceeding 1 rem exposure?

   A: *435 hours*

   (Source: Bioenvironmental Engineer's Guide to Radiological Emergencies, November 2011, Table 7-4)

8. Following an incident at a local nuclear power plant, RADeCO measurements show an airborne alpha activity of 222dpm/m^3. The installation commander has decided to evacuate the base and is asking for a maximum stay time to evacuate personnel with an exposure no greater than 1 rem. How long does the commander have to evacuate the base? (note, this is a stateside base and includes base housing)

   A: 16 hours

   (Source: Bioenvironmental Engineer's Guide to Radiological Emergencies, November 2011, Table 7-6)

9. A weapons tech maintaining a nuclear warhead has breached the containment system and leaked Pu-239. Gamma readings in the room where he was working are 100 mR/hr. The teams tasked to clean up the material may receive no more than 1 rem of exposure per entry per day and will be wearing level C suits (suit, boots, gloves, FF respirator, hood). How long may each team stay in the area?

   A: 0.0069hrs x 4 (correction factor for Pu-239) = 0.0276 hrs = 1m 39s per team per day.

   (Source: Bioenvironmental Engineer's Guide to Radiological Emergencies, November 2011, Table 7-11)

STS Line Item 6.14: Measure nuclear radiation intensity and dose.

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.
Prerequisites:	Accomplish in conjunction with Training Modules 6.15.1, 6.15.2, 6.15.3, 6.15.4, and 6.15.5
Training References:	Equipment Manuals
Additional Supporting References:	Base-specific equipment checklists
CDC Reference:	4B051
Training Support Material:	• Equipment User's Manual. • Required radiation detection equipment • Radioactive source
Specific Techniques:	Conduct hands-on evaluation of radiation detection equipment operation.
Criterion Objective:	Given any piece of radiation detection equipment and a radioactive source, demonstrate how to measure radiation intensity and/or dose, successfully completing all checklist items with NO trainer assistance.

Notes:

*The intent of this QTP is to ensure trainees have the ability to pick up any piece of radiation detection equipment and correctly operate the equipment to measure intensity and/or dose. This is a critical skill of all BE technicians.

Trainer should select a radioactive source and a piece of equipment capable of detecting/measuring the source strength and/or dose rate. From there, the trainee is expected to locate any checklists needed/required and correctly operate the given equipment properly.

TASK STEPS

1. Prepare the equipment prior to operation.[1]
2. Identify measurement capabilities.[2]
3. Demonstrate proper equipment techniques to measure desired readings.

LOCAL REQUIREMENTS:

NOTES:

1. Ensure the equipment provided is configured properly to detect and measure the given source (i.e. correct probe attached, correct mode of operation, etc.) Pre-operation checks, function checks, pre-calibration/bump checks, and battery checks must be completed prior to source monitoring.

2. Identify to the trainer the measurement capabilities of the selected equipment.
   - What type(s) of radiation will it detect?
   - Will it measure dose?
   - Will it measure dose rate?
   - Will it measure activity?

PERFORMANCE CHECKLIST

STS Line Item 6.14: Measure nuclear radiation intensity and dose.

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.

DID THE TRAINEE…		YES	NO
1. Prepare the equipment prior to operation?			
2. Identify measurement capabilities?			
3. Demonstrate proper equipment techniques to measure desired readings?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

STS Line Item 6.15.1: Calibrate and operate ADM-300 kit (or equivalent).

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed
Prerequisites:	None
Training References:	• Equipment User's Manual. • *Final Guidance Document For Use Of The Canberra ADM-300 Multifunction Survey Meter*, January 2008, Air Force Institute of Operational Health (now USAFSAM). • Consultative Letter, IOH-SD-BR-SR-2006-0037, *ADM-300 "E" Kit (Cs-137/Th-232 Check Sources) Certification,* Air Force Institute of Operational Health (now USAFSAM).
Additional Supporting References:	• *Fundamentals of Industrial Hygiene*, 6th edition. • *Basic Radiation Protection Technology*, *6th* Edition. • IOH-SD-BR-SR-2005-0004, *Bioenvironmental Engineer's Guide to Ionizing Radiation*, October 2005, Air Force Institute of Operational Health (now USAFSAM).
CDC Reference:	4B051
Training Support Material:	• Equipment User's Manual. • ADM-300. • Alpha probe (AP-100). • Beta probe (BP-100). • X-ray probe (XP-100). • ADM-300 Kit E, Test/Verification Kit (including check sources).
Specific Techniques:	Conduct hands-on training and evaluation of calibration and operation of equipment with verification of steps.
Criterion Objective:	Given an ADM-300 meter with probes, perform field checks on the meter using each probe and demonstrate how to operate the meter successfully completing all checklist items with NO trainer assistance.

Notes:
*****The ADM-300 meter is calibrated each year, most likely, through your Precision Measurement Equipment Laboratory (PMEL). Proper instrument response is verified by performing a pre-operational check before and after each mission and every 180 days. This QTP outlines the steps for performing a pre-operational check and how to operate the ADM-300 survey meter alone and with external probes. Your Air Force purchased ADM-300 survey meter will should come equipped with three probes:

1. The alpha probe (AP-100) for alpha monitoring.
2. The beta probe (BP-100) for beta monitoring.
3. The x-ray probe (XP-100) designed specifically for plutonium-239 detection (17 keV window) such as in broken arrows or nuclear incidents.

The ADM-300 Kit E, Test/Verification Kit, contains two radioactive check sources (thorium 232 and cesium 137). Using the check sources the trainer can set up a training environment in a controlled area having the trainee locate and measure the energy from each source. You must maintain proper control of these sources as you use them to check the meter response and return the kit and sources to the secure storage area when finished.

TASK STEPS

USER PRE-OPERATIONAL CHECK OF THE ADM-300 METER WITHOUT A PROBE:

1. Remove cesium-137 check source from the TS-100 test source container.
2. Insert the cesium-137 check source into the test source container, facing upward, in the circular insert.
3. Turn the ADM-300 meter ON (in an area away from the source – at least six feet) and verify that "*Rate*" is displayed.
4. Place the ADM-300 meter on the test source container.
5. Allow rate reading to stabilize for 20 seconds.
6. Note the rate reading.
7. Confirm that the displayed rate reading is within the upper and lower check source values listed for the current year[1].
8. If the meter readings are not within the upper and lower values, repeat steps 1-7[2].
9. Turn ADM-300 meter OFF and return cesium-137 to the TS-100 container.

USER PRE-OPERATIONAL CHECK OF THE ADM-300 METER WITH THE ALPHA PROBE (AP-100):

1. Remove thorium-232 check source from the TS-100 test source container.
2. With the ADM-300 meter turned OFF, attach the alpha probe to the meter[3].
3. Turn the ADM-300 meter on[4].
4. Lay the thorium-232 check source in position on the alpha probe window with the thorium-232 facing the window.
5. Allow rate reading to stabilize for 20 seconds.
6. Note the rate reading.
7. Confirm that the displayed rate reading is within the upper and lower check source values for the current year[1].
8. If the meter readings are not within the upper and lower values, repeat steps 1-7[2].
9. Turn ADM-300 meter OFF, replace the alpha probe's protective cover, disconnect the alpha probe from the survey meter, and return the thorium-232 source to the TS-100 container.

USER PRE-OPERATIONAL CHECK OF THE ADM-300 METER WITH THE BETA PROBE (BP-100):

1. Remove cesium-137 check source from the TS-100 test source container.
2. Place the cesium-137 check source into the test source container, facing upward, in the circular insert.
3. With the ADM-300 meter turned OFF, attach the beta probe to the meter[3].
4. Turn the ADM-300 meter on[5].
5. Allow rate reading to stabilize for 20 seconds.
6. Note the rate reading.
7. Confirm that the displayed rate reading is within the upper and lower check source values for the current year[1].
8. If the meter readings are not within the upper and lower values, repeat steps 1-7[2].
9. Turn ADM-300 meter OFF, disconnect the beta probe, and return the cesium-137 source to the TS-100 container.

USER PRE-OPERATIONAL CHECK OF THE ADM-300 WITH THE X-RAY PROBE (XP-100):

1. Remove thorium-232 check source from the TS-100 test source container.
2. Place the thorium-232 check source on a flat surface with the circle facing upwards.
3. With the ADM-300 meter turned OFF, attach the x-ray probe to the meter[3].
4. Turn the ADM-300 meter on[6].
5. Place the probe on the test source, center of the circle, with the probe face flat against the source.
6. Allow rate reading to stabilize for 20 seconds.
7. Note the rate reading.
8. Confirm that the displayed rate reading is within the upper and lower check source values for the current year[1].

9. If the meter readings are not within the upper and lower values, repeat steps 1-8[2].
10. Turn the ADM-300 meter OFF, disconnect the x-ray probe, and return the thorium-232 source to the TS-100 container.

OPERATE THE ADM-300 METER:

(The following steps are standard any time the ADM-300 is operated regardless of configuration.)

1. Perform a battery check.
2. Visually check meter and probe for tears, holes, cracks, and missing or broken pins.
3. Determine the appropriate for the type of radiation being measured[7].
4. Perform a user pre-operational check appropriate to the type of radiation being measured.
5. Select the desired mode of measurement (*rate* or *scalar*) [8].
6. Measure background radiation well away from the area/surface to be monitored.

Measuring gamma radiation without a probe:

1. Close the beta window[9].
2. Determine the sample location[10].
3. Position the meter holding it at a consistent angle[11].
4. Note the rate reading.
5. Subtract the background value from the reading.

Measuring gamma and beta radiation without a probe:

1. Open the beta window[9].
2. Determine the sample location[10].
3. Position the meter holding it at a consistent angle[12].
4. Record the rate reading.
5. Close the beta window.
6. Note the rate reading.
7. Compare the two readings[11].

Measuring alpha radiation with the alpha probe (AP-100):

1. Remove cover from the alpha probe.
2. Determine the sample location[10].
3. Position the meter holding it at a consistent angle[13].
4. Note the rate reading.
5. Subtract the background value from the reading.

Measuring beta radiation with the beta probe (BP-100):

1. Determine the sample location[10].
2. Position the meter holding it at a consistent angle[14].
3. Note the rate reading.
4. Subtract the background value from the reading.

Measuring x-ray radiation with the x-ray probe (XP-100):

1. Determine the sample location[8].
2. Position the meter holding it at a consistent angle[15].
3. Note the rate reading.
4. Subtract the background value from the reading.

LOCAL REQUIREMENTS:

NOTES:

1. Recall that radioisotopes release energy as they decay in an effort to reach a stable state; therefore, source strength will decrease over time. Upper and lower source strength values are listed on the test source containers in progressive calendar year groups. You will need to locate the upper and lower values that correspond to the current year. Meter readings must be within the upper and lower values to be considered acceptable. If the meter reading is not within the range, repeat the steps.
   - During calibration/verification using an alpha probe, if the thorium-232 source is expired ensure the readings are ±20 percent of the acceptable values identified inside the lid of the TS-100 container.
   - During calibration/verification using a beta probe, if the cesium-137 source is expired multiply the last acceptable values on the inside lid of the TS-100 container by 0.933 for the set of acceptable limits for the next three years.
   - During calibration/verification using an x-ray probe, if the thorium-232 is expired ensure the readings are ±20 percent of the acceptable values identified inside the lid of the TS-100 container.

   AP-100 and XP-100: No decay is required for the thorium-232 check source due to its long half-life. Upon receipt from calibration, each alpha probe and x-ray probe detector should be placed against the thorium-232 source per the manufacturer's response check instructions. The will calculate acceptable response values for those probes at that time. Acceptable values are ±20 percent. To calculate this value, multiply the source activity by 0.8 for the lower acceptable value and multiply the source activity by 1.2 for the upper acceptable value. Document each detector specific acceptable response values with calibration records and with the detector.

2. If the meter reading fails twice to fall within these values, do not use the meter and return it to the manufacturer for maintenance.

3. Each external probe is configured such that during power-up of the survey meter, the type of prove is recognized electronically by the survey meter. The ADM-300 meter provides power to operate the probe. External probes are connected to the survey meter through the 7-pin connector on the back panel while the ADM-300 meter is turned OFF. The survey meter MUST be turned OFF before connecting the external probe. After connection, when the survey meter is turned ON, the meter automatically gets all the necessary configuration and calibration data from the probe. Since each probe contains its own calibration information, any probe can be used with any ADM-300 meter and maintain its calibration.

4. Turn the survey meter power ON. The unit displays "Please Wait" then "Alpha Probe" and units of measure. The unit automatically begins to measure alpha radiation. If *"Alpha Probe"* does not appear on the display automatically, press and release the *INC* key on the meter until it does. Three units of alpha measurement are available:
   - .000 cpm (counts per minute).
   - .000 µCi/MxM (micro-Curie per square meter).
   - .000 DPM/CMxCM (disintegrations per minute per 100 square centimeters).

5. Turn the survey meter power ON. The unit displays "Please Wait" then "Beta Probe" then displays units of measurement. The unit automatically begins to measure Beta radiation. If the *"Beta Probe"* does not appear on the display automatically, press and release the *INC* key on the meter until it does.

6. Turn the survey meter power ON. The unit displays "Please Wait" then "X-RAY Probe" and units of measure.

7. When measuring gamma radiation, no probe is used. When measuring alpha, beta, or x-ray, select the probe appropriate for the type of radiation being measured and attach it to the meter (when the meter is turned OFF).

8. The ADM-300 meter has the option of collecting the measurement in *rate* or *scalar* (integrate) modes. Due to fluctuations in meter response while in rate mode, it is easier to make quantitative measurements in the scalar mode when using an alpha or beta probe.

9. When monitoring for beta radiation, use extreme care to protect the beta window when the beta window cover is open as sharp objects can rupture the beta window.

10. Where you collect readings will depend upon the situation (i.e., type of survey, type of radiation, source strength, extent of contamination, etc.). Be aware of your position at all times. Position yourself so you obtain useful readings, but without overexposing yourself. See IOH-SD-BR-SR-2005-0004, *Bioenvironmental Engineer's Guide to Ionizing Radiation*, October 2005, Air Force Institute of Operational Health (now USAFSAM), for specific measurement techniques.

11. The ADM-300 meter, with the shutter closed, should be held parallel to the surface, using a slow and steady sweeping motion. It will detect gamma radiation from several meters away from a source.

12. In this configuration, the meter can *detect*, <u>not measure</u>, beta radiation; the meter will not provide accurate dose rate readings. If the reading with the beta window open is greater than the reading with the window closed, beta radiation is present.

13. Recall that alpha radiation travels only centimeters. Therefore, the probe will need to be as close as possible to the source for an accurate reading, approximately $1/8^{th}$ to $1/16^{th}$ of an inch away from the surface being monitored. The alpha probe should be held parallel to the surface, using a slow and steady sweeping motion.

14. The beta probe should be held parallel to the surface, using a slow and steady sweeping motion, a few centimeters from the suspected contamination in order for the probe to detect it.

15. The x-ray probe is directional and should be held vertically to the surface, using a slow and steady sweeping motion, approximately $1/8^{th}$ of an inch away from the surface being monitored.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.15.1: Calibrate and operate ADM-300 kit (or equivalent).

1. What must be accomplished prior to calibration to ensure that the ADM-300 readings are accurate?
2. Which operating mode must the ADM-300 be in to enable the switching of probes and why?
3. The alpha probe in kit A has a light leak, is it possible to utilize another probe from a different kit, if so why?
4. After placing the meter or probe against a check source, what must you do before recording the meter reading?

PERFORMANCE CHECKLIST

STS Line Item 6.15.1: Calibrate and operate ADM-300 kit (or equivalent).

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.

DID THE TRAINEE…		YES	NO
USER PRE-OPERATIONAL CHECK OF THE ADM-300 METER WITHOUT A PROBE			
1. Remove cesium-137 check source from the TS-100 test source container?			
2. Insert the cesium-137 check source into the test source container, facing upward, in the circular insert?			
3. Turn the ADM-300 meter ON (in an area away from the source – at least six feet) and verify that "*Rate*" is displayed?			
4. Place the ADM-300 meter on the test source container?			
5. Allow rate reading to stabilize for 20 seconds?			
6. Note the rate reading?			
7. Confirm that the displayed rate reading is within the upper and lower check source values listed for the current year?			
8. If the meter readings are not within the upper and lower values, repeat steps 1-7?			
9. Turn ADM-300 meter OFF and return cesium-137 to the TS-100 container?			
USER PRE-OPERATIONAL CHECK OF THE ADM-300 METER WITH THE ALPHA PROBE (AP-100)			
1. Remove thorium-232 check source from the TS-100 test source container?			
2. With the ADM-300 meter turned OFF, attach the alpha probe to the meter?			
3. Turn the ADM-300 meter on?			
4. Lay the thorium-232 check source in position on the alpha probe window with the thorium-232 facing the window?			
5. Allow rate reading to stabilize for 20 seconds?			
6. Note the rate reading?			

7. Confirm that the displayed rate reading is within the upper and lower check source values for the current year?			
8. If the meter readings are not within the upper and lower values, repeat steps 1-7?			
9. Turn ADM-300 meter OFF, replace the alpha probe's protective cover, disconnect the alpha probe from the survey meter, and return the thorium-232 source to the TS-100 container?			
USER PRE-OPERATIONAL CHECK OF THE ADM-300 METER WITH THE BETA PROBE (BP-100)			
1. Remove cesium-137 check source from the TS-100 test source container?			
2. Place the cesium-137 check source into the test source container, facing upward, in the circular insert?			
3. With the ADM-300 meter turned OFF, attach the beta probe to the meter?			
4. Turn the ADM-300 meter on?			
5. Allow rate reading to stabilize for 20 seconds?			
6. Note the rate reading?			
7. Confirm that the displayed rate reading is within the upper and lower check source values for the current year?			
8. If the meter readings are not within the upper and lower values, repeat steps 1-7?			
9. Turn ADM-300 meter OFF, disconnect the beta probe, and return the cesium-137 source to the TS-100 container?			
USER PRE-OPERATIONAL CHECK OF THE ADM-300 WITH THE X-RAY PROBE (XP-100)			
1. Remove thorium-232 check source from the TS-100 test source container?.			
2. Place the thorium-232 check source on a flat surface with the circle facing upwards?			
3. With the ADM-300 meter turned OFF, attach the x-ray probe to the meter?			
4. Turn the ADM-300 meter on[6?]			
5. Place the probe on the test source, center of the circle, with the probe face flat against the source?			
6. Allow rate reading to stabilize for 20 seconds?			
7. Note the rate reading?			
8. Confirm that the displayed rate reading is within the upper and lower check source values for the current year?			
9. If the meter readings are not within the upper and lower values, repeat steps 1-8?			
10. Turn the ADM-300 meter OFF, disconnect the x-ray probe, and return the thorium-232 source to the TS-100 container?			
OPERATE THE ADM-300 METER			

1. Perform a battery check?			
2. Visually check meter and probe for tears, holes, cracks, and missing or broken pins?			
3. Determine the appropriate for the type of radiation being measured?			
4. Perform a user pre-operational check appropriate to the type of radiation being measured?			
5. Select the desired mode of measurement (*rate* or *scalar*)?			
6. Measure background radiation well away from the area/surface to be monitored?			
Measuring gamma radiation without a probe			
1. Close the beta window?			
2. Determine the sample location?			
3. Position the meter holding it at a consistent angle?			
4. Note the rate reading?			
5. Subtract the background value from the reading?			
Measuring gamma and beta radiation without a probe			
1. Open the beta window?			
2. Determine the sample location?			
3. Position the meter holding it at a consistent angle?			
4. Record the rate reading?			
5. Close the beta window?			
6. Note the rate reading?			
7. Compare the two readings?			
Measuring alpha radiation with the alpha probe (AP-100)			
1. Remove cover from the alpha probe?			
2. Determine the sample location?			
3. Position the meter holding it at a consistent angle?			
4. Note the rate reading?			

5. Subtract the background value from the reading?			
Measuring beta radiation with the beta probe (BP-100)			
1. Determine the sample location?			
2. Position the meter holding it at a consistent angle?			
3. Note the rate reading?			
4. Subtract the background value from the reading?			
Measuring x-ray radiation with the x-ray probe (XP-100)			
1. Determine the sample location?			
2. Position the meter holding it at a consistent angle?			
3. Note the rate reading?			
4. Subtract the background value from the reading?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. What must be accomplished prior to calibration to ensure that the ADM-300 readings are accurate?

   A: Locate the upper and lower values that correspond to the current year. Meter readings must be within the upper and lower values to be considered acceptable.

   (Source: *Final Guidance Document For Use Of The Canberra ADM-300 Multifunction Survey Meter,* January 2008, Air Force Institute of Operational Health (now USAFSAM), pg. 24, Checklist 4.4)

2. Which operating mode must the ADM-300 be in to enable the switching of probes and why?

   A: Off, ADM-300 does not support hot swap of probes.

   (Source: Equipment User's Manual)

3. The alpha probe in kit A has a light leak, is it possible to utilize another probe from a different kit, if so why?

   A: Yes, all probes are independently calibrated and can be utilized with different ADM-300 meters.

   (Source: Equipment User's Manual)

4. After placing the meter or probe against a check source, what must you do before recording the meter reading?

   A: Allow the rate reading to stabilize for 20 seconds.

   (Source: *Final Guidance Document For Use Of The Canberra ADM-300 Multifunction Survey Meter,* January 2008, Air Force Institute of Operational Health (now USAFSAM), pg. 24, Checklist 4.4)

STS Line Item 6.15.2: Ion Chamber (i.e. Victoreen 451P)

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.
Prerequisites:	None
Training References:	Victoreen® 451P Ion Chamber Survey Meter Operators Manual
Additional Supporting References:	• Final Guidance Document for Use of the Victoreen 451P Ion Chamber Survey Meter, January 2007
CDC Reference:	4B051
Training Support Material:	• Equipment User's Manual. • Victoreen 451P survey meter. • Cesium-137 check source.
Specific Techniques:	Conduct hands-on training and evaluation of calibration and operation of equipment with verification of steps.
Criterion Objective:	Given a Victoreen survey meter and a cesium-137 check source, demonstrate how to perform a pre-operational check and how to operate the survey meter successfully completing all checklist items with NO trainer assistance.

Notes:

***This QTP was written based on Victoreen Model 451P as this is the survey meter listed on the allowance standard. If your flight has another version of a Victoreen survey meter then modifications to the QTP can be made under the LOCAL REQUIREMENTS area. Any Victoreen survey meter your flight has is calibrated each year, likely through the Precision Measurement Equipment Laboratory (PMEL) at your installation. Proper instrument response should be verified before each use. This is referred to as a pre-operational check. This TRAINING MODULE outlines the steps for performing a pre-operational check and steps on how to operate the survey meter. To perform a pre-operational check, you will need a cesium-137 check source. The check source can be found in the ADM-300 Test/Verification Kit. Anytime check sources are involved, you must maintain proper control of the source at all times and secure the source once your check is completed.

The 451P is an air-filled ionization chamber with an electrically conductive inner wall and central anode and a relatively low applied voltage. When primary ion pairs are formed in the air volume, from x-ray or gamma radiation interactions in the chamber wall, the central anode collects the electrons and a small current is generated. This in turn is measured by the electrometer circuit and displayed digitally. The 451P is designed to provide an accurate measurement of absorbed dose to air which, through appropriate conversion factors, can be related to dose to tissue. Common readout units are milliroentgens and roentgen per hour (mR/hr and R/hr).

It must be noted that: (1) performing a pre-operational check on a Victoreen survey meter is consider *best practice* – <u>not a requirement</u>, and (2) a check is required on each Victoreen immediately after annual calibration with PMEL to establish a baseline dose rate to compare future pre-operational check values. The decision whether or not to perform a pre-operational check prior to each use rests with your flight leadership.

TASK STEPS

1. Perform pre-operational check of the Victoreen 451p survey meter:[1] 2. Properly demonstrate the ability to determine and select the desired mode of operation on the Victoreen 451p: [2] 3. Properly operate the Victoreen 451p survey meter:[3]

LOCAL REQUIREMENTS:

NOTES:

1. When the 451P survey meter is first turned on, it runs through a functional self-test procedure. During this self-test, the firmware version of the unit is displayed. If the unit passes the self-test, it will go into the normal operating mode. The bar graph and digital display will show a reading that decreases as the instrument stabilizes. The initial reading usually starts in the 5 R/h range and decreases through the lower ranges to a reading of less the 50 µR/h within 120 seconds. When the only elements remaining in the display are those necessary for normal operation, you can begin the measurement process. If the unit fails the self-test, it will remain locked and the unit should be returned to the manufacturer for corrective action.

- The warm-up time for the 451P that has been OFF 12 or more hours is about 4 minutes for readings less than 20µR/h in a 10 µR/h or less background.

- The same cesium-137 check source should be used every time a pre-operational check is performed to ensure accuracy of results.

- The pre-operational check reading should be within ± 10 percent of the baseline value established immediately following the return of the survey meter from its annual calibration with PMEL. This baseline reading and the serial number of the check source used should be documented and retained to ensure availability of readings for future operational checks.

2. When turned on, the 451P defaults to the DOSE RATE mode. This mode is typically used when monitoring for industrial scatter surveys as well as emergency response when monitoring for external radiation exposures. The dose rate mode should only be used when there is no need for remote monitoring.

- INTEGRATE mode is accessed by pressing the mode button one time. This mode is activated 30 seconds after the 451 is initially turned on. In the integrate mode, the 451P accumulates total dose that the 451P has absorbed. The INTEGRATE mode is most commonly used to monitor medical scatter surveys. Due to the low power, and typically shielded rooms within the medical facility, it is very difficult to get a response using dose rate or freeze modes. Therefore, the common practice is to continue taking medical x-ray shots until the 451P registers a dose in the integrate mode. These numbers are then

- The FREEZE mode can be accessed by pressing and holding the mode button prior to pressing the power button. The mode button must be held down until the only word showing on the 451P display is the word FREEZE. Once turned on, the FREEZE mode will display the current dose rate, and the maximum dose rate measured by the meter will be displayed as a single line in the bar graph under the dose rate. It is important to note the FREEZE mode will register false readings during the meter self-test when first powered on. To reset the FREEZE bar, press mode to switch to DOSE RATE mode, wait for the readings to steady around the background, then press mode again to reenter the FREEZE mode. This mode is best used whenever remote monitoring is required. For example, if readings need to be taken inside a hangar, and dose rate measurements are uncertain, it is best to use FREEZE mode to ensure BE personnel are not exposed to elevated dose rates. This ensures ALARA principles are followed.

3. Proper operation of the Victoreen requires the operator to power on the unit, allow it to warm up for at least 4 minutes and perform a pre-operational check (if required by your base) to ensure accurate response to a radioactive source.

- Where you collect readings will depend upon the situation (i.e., type of survey, type of radiation, source strength, extent of contamination, etc.). Where you collect readings should be pre-determined and outlined in the sampling strategy. Be aware of your position at all times. Position yourself so you can obtain useful readings, but without overexposing yourself.

- Position of the meter also depends upon the sampling situation. When measuring radiation in air, hold the meter by the handle and extend your arm pointing the meter in the direction of the suspected source. When surveying radioactive materials for shipment, external radiation is monitored 10 centimeters (cm) from the surface of the package. Additionally, radiation levels cannot exceed 10 mR/hr at 10 cm from any point on the external surface of an unpackaged material.

- If decontamination is required, the survey meter can be cleaned by wiping with a damp cloth using any commercially available cleaning or decontaminating agent. Do not immerse the survey meter, it is not waterproof, liquid could damage the circuits.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.15.2: Ion Chamber (i.e. Victoreen 451P)

1. You have been tasked by your flight commander to conduct a scatter survey of an NDI shoot on the flight line. The survey will be conducted at night in an aircraft hangar. Your commander has asked you to establish dose rate readings for the area outside the hangar (previous surveys have shown this area well below the 2 mrem/hr), the operators position (a lead lined trailer inside the hangar), and an entry door that is unable to be secured during NDI shoots (located inside the hangar leading to some restrooms). Determine which mode of operation should be used for each location .
2. What mode of operation is utilized when conducting medical and dental scatter surveys? Why?

PERFORMANCE CHECKLIST

STS Line Item 6.15.2: Ion Chamber (i.e. Victoreen 451P)

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.

DID THE TRAINEE…		YES	NO
1. Perform pre-operational check of the Victoreen 451p survey meter?			
2. Properly demonstrate the ability to determine and select the desired MODE of operation on the Victoreen 451P?			
3. Properly operate the Victoreen 451P survey meter?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. You have been tasked by your flight commander to conduct a scatter survey of an NDI shoot on the flight line. The survey will be conducted at night in an aircraft hangar. Your commander has asked you to establish dose rate readings for the area outside the hangar (previous surveys have shown this area well below the 2 mrem/hr), the operators position (a lead lined trailer inside the hangar), and an entry door that is unable to be secured during NDI shoots (located inside the hangar leading to some restrooms). Determine which mode of operation should be used for each location.

   A: Locations outside the hangar – Dose Rate Mode

   Operators Position – Dose Rate Mode

   Entry Door – Freeze Mode

   (Source: 4B051 CDC)

2. What mode of operation is utilized when conducting medical and dental scatter surveys? Why?

   A: Integrate Mode – Due to the short duration of medical x-rays, the dose rate mode does not respond fast enough for accurate readings and typical scatter surveys do not have enough power to generate scatter readings significantly above background readings. The integrate mode allows BEs to accumulate dose over multiple shots and utilize calculations to estimate the annual exposures.

(Source: 4B051 CDC)

STS Line Item 6.15.3: Calibrate and operate RADēCO (or equivalent).

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed
Prerequisites:	QTP 4..2.11.3 Geiger-Mueller (i.e. ADM-300)
Training References:	• Final Guidance Document for the use of the RADēCO H-809VII Variable Flow Sampler July 2007 • IOH-SD-BR-CL-2006-0017 "Minimum Air Sample Volume for the RADeCO High Volume Air Sampler Model H-809 VII," 7 Feb 06 • IOH-SD-BR-CL-2005-0081 "Alpha Correction Factor for New BE Air Sampling Equip - RADēCO Model H-809 VII," 21 Sep 05 • RADeCO USAF High Volume Air Sampling Kit, education resource from RADeCO inc, from ESOH Service Center website
Additional Supporting References:	• N/A
CDC Reference:	4B051
Training Support Material:	• RADēCO Variable Flow Sampler, Calibrator, Filter Adaptor, Filters, Tripod and generator.
Specific Techniques:	Conduct hands-on training and evaluation.
Criterion Objective:	Given a RADēCO, ADM-300, and associated supplies, collect and analyze a sample for airborne radioactive material successfully completing all checklist items with NO trainer guidance.

Notes:

*The purpose of this training is to become proficient in using the RADēCO high volume air sampler in to collect samples for radioanalytical analysis. Calibration of the RADēCO is not covered in this training.

The final guidance document for the RADēCO provides step by step instructions for setting up and using the RADēCO. The trainee should have access to this document at all times during training and evaluation, as should the guidance document for determining the minimum sample volume to be collected.

Any training or use involving the RADēCO should be conducted outdoors using the generator, as this is the environment it would be used in, and trainees should be familiar with operation of the generator used by your shop as well as the RADēCO.

TASK STEPS

Determine radiation hazards 1. Determine sample locations following a radiological incident where airborne contamination is suspected.[1] 2. Determine required volume, flow rate, and collection time for a representative sample using appropriate guidance document.[2] 3. Set flow rate by using calibrator and sample media of the same type used in the sample.[3] 4. Set up sampler on tripod, ~5 feet above ground and ~2 building heights away from nearby structures.[4] 5. Collect background of sample paper using ADM-300 Alpha probe and 1 minute scaler.[5] 6. Run sample for appropriate amount of time.[6] 7. Without removing sample paper, survey using the ADM-300 Alpha probe and 1 minute scaler.[7]

LOCAL REQUIREMENTS:

NOTES:

1. Sample locations should include: several locations downwind of incident, filter facing into the wind, 5-6 feet off the ground, and at least 2 building heights away from nearest structure. For example, if setting up near a 20' building, the sampler should be placed no closer than 40' from the building. One RADēCO should also be set up several hundred feet upwind of the incident to obtain background measurements.

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2. Sample volume collected is dependant on local conditions. If dust loading is a concern at your base, or sampling following a radiation dispersal device, $100ft^3$ should be collected, if not, $1000ft^3$ is the recommended sample volume. At a 20 cfm flow rate, this equates to 5 minutes for $100ft^3$ or 50 minutes for $1000ft^3$.

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3. Compare rotometer reading at 20 cfm to calibrator reading. Rotometer should be accurate within 5%. If not, adjust using "RADēCO USAF High Volume Air Sampling Kit" found on the ESOH Service Center website. Always use a generator when and allow RADēCO to warm up at least 5 minutes prior to performing this check.

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4. RADēCO will be set up on the tripod at full height (~5ft), and adjusted to be level. Filter will face into the wind for all downwind samples (towards the incident), and 2 building heights away from nearest building. Start generator prior to plugging in the RADēCO.

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5. Ensure all surfaces, and filter holder are free of contamination and use ADM-300 with AP-100 to collect background on filter paper (using 1 minute scaler). Record background reading.

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6. Collect sample at 20cfm for appropriate amount of time for your base/incident; 5 minutes for high dust/RDD, 50 minutes standard.

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7. When sampler stops running (and no sooner) collect survey reading without removing filter holder (1 minute scaler).

TRAINEE REVIEW QUESTIONS

STS Line Item 6.15.3: Calibrate and operate RADēCO (or equivalent).

10. Following a radiological dispersal device incident, what is the recommended sample volume?
11. How long must the RADēCO warm up prior to performing a field check and setting the flow rate?
12. What is the primary power source for calibrating and operating the RADēCO?

PERFORMANCE CHECKLIST

STS Line Item 6.15.3: Calibrate and operate RADēCO (or equivalent).

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed

DID THE TRAINEE…		YES	NO
DETERMINE RADIATION HAZARDS			
1. Determine sample locations following a radiological incident where airborne contamination is suspected?			
2. Determine required volume, flow rate, and collection time for a representative sample using appropriate guidance document?			
3. Set flow rate by using calibrator and sample media of the same type used in the sample?			
4. Set up sampler on tripod, ~5 feet above ground and ~2 building heights away from nearby structures?			
5. Collect background of sample paper using ADM-300 Alpha probe and 1 minute scaler?			
6. Run sample for appropriate amount of time?			
7. Without removing sample paper, survey using the ADM-300 Alpha probe and 1 minute scaler?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. Following a radiological dispersal device incident, what is the recommended sample volume?

   A: 100ft^3

   (Source: OH-SD-BR-CL-2006-0017 "Minimum Air Sample Volume for the RADeCO High Volume Air Sampler Model H-809 VII," 7 Feb 06, paragraph 4.e.)

2. How long must the RADeCO warm up prior to performing a field check and setting the flow rate?

   A: 5 minute.

   (Source: RADeCO USAF High Volume Air Sampling Kit, education resource from RADeCO inc, from ESOH Service Center website, “Calibration”)

3. What is the primary power source for calibrating and operating the RADeCO?

   A: Generator to be used during incidents.

   (Source: 4B051 CDC)

STS Line Item 6.15.4: Gamma Spec (i.e. SAM-940)

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed
Prerequisites:	None
Training References:	• Berkeley Nucleonics Corporation, (2007). *Instruction Manual Model 940.* • Berkeley Nucleonics Corporation, (n.d). *Introduction to SAM 940 & Real Time Spectroscopy* • Berkeley Nucleonics Corporation, (n.d) *Real-Time Radionuclide Identification*
Additional Supporting References:	• *Berkeley Nucleonics Corporation, (2011). Addendum 1.01 to SAM 940 Instruction Manual*
CDC Reference:	4B051
Training Support Material:	• SAM 940 • Cesium-137 check source.
Specific Techniques:	Conduct hands-on training and evaluation of calibration and operation of equipment with verification of steps.
Criterion Objective:	Given a SAM 940 with probe and a Cs-137 source, calibrate and demonstrate how to operate the meter successfully completing all checklist items with no trainer assistance.

Notes:
***** The SAM 940 is a hand-held radiological surveillance and measurement system that detects and identifies multiple radio-nuclides. The SAM 940 is light weight (less than 4.5 lbs.) and relatively compact. The SAM 940s external probe contains a 2x2 sodium iodide (NaI) crystal. The external probe must be connected with the supplied cable. It will detect photon emissions (gamma and x-ray) with energies between 18 keV and 3 MeV. It supports USAF radiation related emergency responses (industrial accidents, radiation dispersal devices, improvised nuclear devices, or nuclear warfare) by real-time identification of unknown radionuclides. The SAM 940 should not be used as a primary radiation hazard search tool, but in support of assessing health hazards. That is, the SAM 940 would be used when other instruments such as the ADM-300, Victoreen 451P, or EPDs indicate the presence of a radiological hazard. The SAM 940 identifies and measures the intensity of isotopes, determines risk scenarios and allows personnel to perform appropriate standard operating procedures immediately.

Unlike some other radiation meters such as the ADM-300 and Victoreen, the SAM 940 is course calibrated by the user. This QTP outlines the steps for performing the course calibration and how to operate the instrument. To calibrate the instrument you'll need a cesium-137 source, such as used to field check ADM 300 survey meter. You must maintain proper control of the radioactive source as you use it to calibrate the instrument and secure the source when finished.

The SAM 940 also has the ability to communicate with a computer through the use of Quantitative Analysis Software which is available on the ESOH Service Center website.

TASK STEPS

CALIBRATION, BACKGROUND AND OPERATION OF THE SAM 940

1. Turn on the meter[1]
2. Press "enter" when prompted
3. Select the "administrator" user-mode and press enter
4. Press the menu key to open the menu
5. Press the over button and highlight the cog wheel, which is "field settings"
6. Scroll down and highlight the "course calibrate with Cs-137"
7. Press enter, move the Cs-137 source next to the detector when prompted[2]
8. Press enter to begin calibration[2]
9. Upon completion of calibration, the SAM 940 will return to the "field settings" screen
10. Press the "back" button or select "exit" and press enter to return to the dial screen
11. Remove check source.[3]
12. Highlight "background" by utilizing the directional pad and press enter
13. Ensure there are no sources located next to the SAM 940, then press enter
14. When background is complete it will return to the dial mode screen
15. Position the meter close enough to begin identification[45]
16. Highlight the "identify" function and press enter
17. The SAM-940 will present a "results" screen when finished identifying

LOCAL REQUIREMENTS:

NOTES:

1. The instrument will automatically begin a self-test when turned on, and the status will be indicated on the screen.

2. The SAM 940 will indicate on the display screen when you should place the calibration source on the probe and will start a 60 second count down. Place the check source in the middle of the 2 x 2 detector (probe) window. Make sure there are no other significant radiation sources nearby that could interfere.

3. Once the calibration is complete, you will have the opportunity to take a "background" sample to establish a baseline for natural radiation. ***Do not skip this step*** because the SAM automatically subtracts natural background and may function improperly without a background sample. The background adjustment takes 1 minute. The Cs-137 source should be at least 10 feet from the SAM when conducting the background reading.

4. Hold the SAM 940 in front of you so you can read the display. Take readings by placing the sample as close as possible to the detector window. The sensitive direction is broadside to the back of the unit.

5. The SAM automatically begins detection in the default search mode (Dial) after acquiring a background reading. There are four search modes of operation:

- **Dial Search:** The main purpose of the *Dial* screen is to provide a quick visual indication, similar to that given by a handheld dose meter or Geiger counter, showing the amount of radioactivity being measured. When the dial pointer is in the gray area, there is little radioactivity present most of the counts are coming from either cosmic rays or naturally occurring sources such as potassium-40. Once the pointer moves up into the green area (on either the gamma dial or, if present, on the neutron dial), there is an indication of some unusual activity. Within the green area, an **Identify** operation should be started. Finally, if the pointer moves into the red area, the activity is too high for a correct identification. It is *strongly advised that you move back from the radioactive source*, if at all possible, before attempting to identify it.

- **Finder Mode:** The *Finder* screen shows a similar type of count-rate-based information. However, it is displayed as part of a bar graph that continually moves to the left at 10 steps every second. The full chart displayed on the screen represents approximately the last 20 seconds. This mode can be extremely helpful when you are walking through an area looking for a radioactive source. This is giving you cold/warmer/hot feedback as you move, so that you can localize the source effectively. Once you have narrowed in on the source, you should do an **Identify** operation. The low area shown on the screen corresponds to the gray area on the *Dial*; the ID area matches the green portion; and the high area matches the red portion. **Identify** will be most effective when the top of the rolling chart is falling within the ID area.

- **Bars Mode:** The *Bars* screen provides a very different sort of information, organized around *what* is present rather than on *how much*. The numbers at the top right still indicate the count and dose rates, but the individual bars indicate the different radioisotopes that are thought to be present. The symbol and name of the isotope are listed to its left. Above each bar is a class indication. Each bar shows an estimated dose rate attributable to that particular isotope.

- **Spectrum Mode:** The *Spectrum* screen is designed for users with a Health Physics background to see the data collection and statistics in real time. Certain changes in the spectrum shape, such as that produced by beta particle interactions, can be interpreted by the trained eye, even when it cannot be identified by the automated algorithms. This screen provides a dynamic display for this particular set of users.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.15.4: Gamma Spec (i.e. SAM-940)

1. Why is recalibration of the SAM 940 important, and when should it be completed?
2. What user mode do you select to access all the search modes in the SAM 940 and what are the available search modes?
3. If you want the SAM 940 to analyze isotopes, which mode of operation should you select?
4. When would you perform a background and why is it important?

PERFORMANCE CHECKLIST

STS Line Item 6.15.4: Gamma Spec (i.e. SAM-940)

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed

DID THE TRAINEE…		YES	NO
1. Turn on the meter?			
2. Press "enter" when prompted?			
3. Select the "administrator" user-mode and press enter?			
4. Press the menu key to open the menu?			
5. Press the over button and highlight the cog wheel, which is "field settings"?			
6. Scroll down and highlight the "course calibrate with Cs-137?			
7. Press enter; move the Cs-137 source next to the detector when prompted?			
8. Press enter to begin calibration[2]?			
9. Upon completion of calibration, the SAM 940 will return to the "field settings" screen?			
10. Press the "back" button or select "exit" and press enter to return to the dial screen?			
11. Remove check source?			
12. Highlight "background" by utilizing the directional pad and press enter?			
13. Ensure there are no sources located next to the SAM 940, then press enter?			
14. When background is complete it will return to the dial mode screen?			
15. Position the meter close enough to begin identification?			
16. Highlight the "identify" function and press enter?			
17. The SAM-940 will present a "results" screen when finished identifying?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. Why is recalibration of the SAM 940 important, and when should it be completed?

   A: The recalibration procedure automatically adjusts hardware parameters (for example, high voltage and amplifier gain) to obtain an accurate system energy calibration. It should be accomplished after calibration and when the unit subject to severe temperature change

   (Source: SAM-940 User Manual)

2. What user mode do you select to access all the search modes in the SAM 940 and what are the available search modes?

   A: Administrator (dial, finder, spectrum, bars)

   (Source: SAM-940 User Manual)

3. If you want the SAM 940 to analyze isotopes, which mode of operation should you select?

   A: Identify

(Source: SAM-940 User Manual)

4. When would you perform a background and why is it important?

   A: To ensure accurate results, it is very important to take frequent background spectra in the actual monitoring location. The background is the point of reference against which readings are measured, and corrects for ambient radioactivity or background from cosmic rays in the area of the detector. The ambient background spectrum is stored and then subtracted from all other spectra on a channel-by-channel basis before they are analyzed.

   (Source: SAM-940 User Manual)

STS Line Item 6.15.5: Operate EPD (or equivalent).

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.
Prerequisites:	Electronic Personal Dosimeter (EPD), Web-Based Training.
Training References:	• Equipment User's Manual. • *Final Guidance Document for Use of the EPD Mk2 and EPD N2 Electronic Personal Dosimeters, Mar 2008*
Additional Supporting References:	• IOH-SD-BR-SR-2005-0004, *Bioenvironmental Engineer's Guide to Ionizing Radiation*, October 2005, Air Force Institute of Operational Health (now USAFSAM).
CDC Reference:	4B051
Training Support Material:	• Equipment User's Manual. • Electronic Personal Dosimeter (EPD).
Specific Techniques:	Conduct hands-on training and evaluation of calibration and operation of equipment with verification of steps.
Criterion Objective:	Given an Electronic Personal Dosimeter (EPD), perform a pre-operational check on the EPD and demonstrate how to operate the dosimeter successfully completing all checklist items with NO trainer assistance.

Notes:
* Electronic Personnel Dosimeters (EPDs) have been issued to the Bioenvironmental Engineering Flight (BEF) as part of the Home Station Response Allowance Standard also referred to as the 886H Allowance Standard. Each BEF has been issued, at minimum, four model Mk2s and two N2s EPDs. EPDs serve as alternative or supplemental equipment to TLDs during radiological monitoring. One of the greatest advantages of the EPD is that it detects and records real-time doses and dose-rates of ionizing radiation for first responders and routine occupation personnel. By using the EasyEPD2 software, personnel are able to take the information, display it on a computer, and put it into a graph showing when the user received a specific dose and the length of time of the exposure. Using an infrared (IR) communication link, the EasyEPD2 software program:

- Reads data from the EPD.
- Displays it on a computer/laptop.
- Writes threshold points and other parameters to the EPD.
- Displays dose rate and exposure rate.

The EasyEPD2 software can operate on any computer with the Microsoft Windows™ operating system. However, there must be an external IR reader connected to the computer/laptop.

The EPD Mk2 detects/responds to both beta and photon radiation. The EPD N2 detects/responds to photon and neutron radiation. Results of the EPD Mk2 and N2 are real-time quantitative exposures, and should be compared to applicable exposure guidelines (situation dependent) in support of health risk assessments (HRAs).

TASK STEPS

OPERATING AN EPD:

(The following steps are standard any time an EPD is operated regardless of model: Mk2 or N2.)

1. Inspect the EPD to ensure there is no physical damage and no *Default* display showing on the LCD.
2. Verify the EPD's calibration is current[1].
3. Confirm that the EPD has the appropriate mounting device attached[2].
4. Conduct a successful confidence test[3].
5. Verify the EPD has been programmed properly[4].
6. Issue the EPD to user[5].
7. Instruct the user how to properly wear the EPD, its purpose, and what to do in the event the alarm sounds[6].
8. Ensure the user correctly attaches EPD to their body properly ensuring the dosimeter is not covered by protective clothing.
9. De-issue the EPD from user when work is complete[7].

LOCAL REQUIREMENTS:

NOTES:

1. Each dosimeter should be calibrated and routinely maintained by the USAFSAM Radiation Dosimetry Laboratory. Additional calibration is not needed.

2. The mounting device is the lanyard or belt-clip which is attached to the dosimeter so it can be attached to the body.

3. Monitor the initialization sequence by checking that an '8888' appears on the display for about three seconds. Then the dosimeter should check the status of its own software and run a confidence test. If the confidence test is successful, the ***default display*** should appear – the EPD Mk2 shows Hp(10) for deep-dose exposure and the EPD N2 shows HpG (for gamma/x-rays). Once the default display appears, the dosimeter is now in operation.

4. Open the EasyEPD2 program on the PC or laptop – you must have an infrared (IR) adapter to communicate with both the N2 and the Mk2. Place the dosimeter with button facing, and within range of the IR adapter. Once in range, the *Dose and Alarms* screen will automatically pop-up. Manually input the user name and SSN (recommended practice is to use the user's SSN without the dashes). Continue by manually inputting the *Dose Alarm Thresholds* and *Rate Alarm Thresholds*. *Final Guidance Document For Use Of The EPD® Mk2 and EPD® N2 Electronic Personal Dosimeters,* March 2007, Air Force Institute of Operational Health (now USAFSAM), Tables 2-6 and 2-7 contain recommended settings (alarm set points) based on the situation. Be aware of the units sieverts versus rem and micro versus milli. Once thresholds and personnel data are established, click the *Write to EPD®* button in the tool bar (second yellow button from the left). Now you are ready to issue the dosimeter to the user.

5. The EasyEPD2 software does not keep a record of who had what EPD and what dose was received. Therefore, a Utilization Log must be maintained by the issuing organization. It is recommended that a spreadsheet or database program be used to keep the data organized and secure. For each EPD issue and subsequent de-issue, the following information must be recorded:

- Serial number of the EPD (located on the back of the EPD).
- User's name, SSN, gender, and date of birth.
- The time the EPD was issued and the time it was de-issued (returned).
- The dose the person received while wearing the EPD.

The dose values will be displayed on the Dose and Alarms window when the EPD is placed in front of the IR reader during de-issue. Be sure to record the numbers in the Dose column and not the numbers in the Total dose column. If there are not enough EPDs for all individuals on a team, then issue one EPD per team. Issue it to the worker who is likely to receive the highest dose – the team leader or the one working closest to the ionizing radiation source.

6. For most operating conditions, it is recommended that the EPD be worn on the front torso area, outside of any personal protective equipment (PPE), with the push-button control facing outwards (away from the user's body). By wearing the dosimeter on the exterior of the PPE, the user has the ability to read the LCD display, see the visual alarm LED, and manually operate the dosimeter. The dosimeter can be placed inside a clear, sealable plastic bag to minimize/prevent contamination of the unit; however, this affects the measured dose of beta radiation. In the event that the alarm sounds, the user is instructed to evacuate the area immediately.

7. After use, the EPD should be downloaded to record dose and dose-rate. Use the IR communication link of the EPD for this. When the EPD is placed in front of the IR reader the dose values are automatically displayed on the *Dose and Alarms* windows. This information should be recorded and sent to USAFSAM Radiation Dosimetry Laboratory for inclusion into the individual's Longitudinal Exposure Record (LER).

PERFORMANCE CHECKLIST

STS Line Item 6.15.5: Operate EPD (or equivalent).

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.

DID THE TRAINEE…		YES	NO
1. Properly inspect the EPD to ensure there is no physical damage and no *Default* display showing on the LCD?			
2. Verify the EPD's calibration is current?			
3. Confirm that the EPD has the appropriate mounting device attached?			
4. Conduct a successful confidence test?			
5. Verify the EPD has been programmed properly?			
6. Properly issue the EPD to user?			
7. Adequately instruct the user how to properly wear the EPD, its purpose, and what to do in the event the alarm sounds?			
8. Properly attach the EPD to the user's body ensuring the dosimeter is not covered by protective clothing?			
9. De-issue the EPD from user when work is complete?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

STS Line Item 6.17: Develop sampling analysis strategy (Air, water, soil, vegetation sampling strategies)

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.
Prerequisites:	None
Training References:	*BE Guide to Radiological Emergencies*, February 2013 (Can be found on the ESOH Service Center) Laboratory Sampling Guide, 11 May 2012
Additional Supporting References:	DOD 3150.08-M "Nuclear Weapon Accident Response Procedures" (NARP) Internet Supplement
CDC Reference:	4B051
Training Support Material:	Scenario below
Specific Techniques:	Conduct table top training and evaluation of developing radiation sampling strategy during radiological response operations.
Criterion Objective:	Given references, a scenario, and a site picture, develop a comprehensive sampling strategy, to include air, water, soil, and vegetation sampling as required, successfully completing all checklist items with limited trainer assistance on only the hardest parts.

Notes:

The intent of this QTP is to ensure trainees have the ability to evaluate a scenario and develop a sound comprehensive sampling strategy to determine the extent of contamination and health risk to affected populations.

The resources included, the *BE Guide to Radiological Emergencies* as well as the Laboratory Sampling Guide, 11 May 2012, provide a substantial guide to developing the strategy, prompting all applicable questions and advising on sampling requirements (Figure 9-1, page 119 of BE Guide and Section 3.4 and 3.5, pages 61-71 of the Sampling Guide). The trainee can use the Laboratory Sampling Guide, 11 May 2012 reference to determine quantity for each sample, or they can reference that they would contact the ESOH Service Center for verification of how much material the lab requires for analysis.

In addition, the trainee should specify that with each type of sample (vegetation, foodstuffs, soil, drinking water, etc.) a field blank should also be collected from a clean area near the site to send in for analysis (Laboratory Sampling Guide, 11 May 2012 page 85).

During development of sampling strategy, ESOH Service Center can typically be utilized as reachback support.

TASK STEPS

1. Identify sampling requirements[1]
2. Determine sampling action level[2]
3. Determine the type of analysis required.[3]
4. Collect the sample.[4]
5. Submit the sample to the lab[5]

LOCAL REQUIREMENTS:

NOTES:

1. Trainee should identify areas of concern that require sampling following a radioactive incident. Sampling sites may include vegetation, surface water, food stuffs, dead animals, etc.

2. Determine level of contamination which would induce future actions. This should be based on baseline contamination levels as well as the isotope of concern. Typically action levels are determined by your flight commander and/or Incident Commander. Generally accepted practice is anything greater than twice background readings require further action.

3. The type of analysis can be determined by contacting the ESOH Service Center or by referencing section 4.4 and 4.5 of the Laboratory Sampling Guide, 11 May 2012 on pages 90-95.

4. Trainee should research collection methods on pages 99-112 of the Laboratory Sampling Guide, 11 May 2012. The sample collection method should match the sample requirements identified in both step 1 and step 3.

5. Explain the process of submitting the samples to the laboratory as well as any accompanying documentation and additional samples required.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.17: Develop sampling analysis strategy (Air, water, soil, vegetation sampling strategies)

1. For the following questions, refer to the scenario below.

Outside your base's front gate, a terrorist detonated a dirty bomb containing Strontium-90. The bomb was detonated inside a park area. The park includes a small pond, many trees, and lots of different wildlife. The local fire department asked for your help in evaluating the contamination levels as well as the hazards of the area.

a. What is the purpose of sampling in this situation?

b. What is the action level for your scenario?

c. What type of analysis is required for your scenario?

d. What method should be used to collect your pond water sample?

e. Describe the process of submitting the samples to the laboratory.

PERFORMANCE CHECKLIST

STS Line Item 6.17: Develop sampling analysis strategy (Air, water, soil, vegetation sampling strategies)

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step by step procedures for doing the task.

DID THE TRAINEE…		YES	NO
1. Identify sampling requirements?			
2. Determine sampling action level?			
3. Determine the type of analysis required?			
4. Collect the sample?			
5. Submit the sample to the lab?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. For the following questions, refer to the scenario below.

Outside your base's front gate, a terrorist detonated a dirty bomb containing Strontium-90. The bomb was detonated inside a park area. The park includes a small pond, many trees, and lots of different wildlife. The local fire department asked for your help in evaluating the contamination levels as well as the hazards of the area.

a. What is the purpose of sampling in this situation?

A: Environmental Assessment

(Source: Laboratory Sampling Guide, 11 May 2012)

b. What is the action level for your scenario?

A: Determined by IC/Flight Commander. Generally accepted practice is anything over twice background.

(Source: See note #2 above in this QTP)

c. What type of analysis is required for your scenario?

A: Gross Beta Counting

(Source: Laboratory Sampling Guide, 11 May 2012)

d. What method should be used to collect your pond water sample?

A: Soil – double bagged in large zip-lock bags, at least 100 grams
Pond - These bodies of water experience less mixing and have a greater tendency to stratify than streams and rivers. As a result, a larger number of samples will be required. In a small impoundment or pond, a single vertical composite at the deepest point may be satisfactory. A minimum of 2 liters with the entire sample in a single container.

Vegetation – minimum of 3 liters of densely packed sample and should be double plastic bagged or packed in a 1 gallon wide mouth plastic jar with screw cap.

(Source: Laboratory Sampling Guide, 11 May 2012)

e. Describe the process of submitting the samples to the laboratory.

A: All samples must be submitted along with a chain of custody and be accompanied by field blanks. They should be preserved according to the Laboratory Sampling Guide, 11 May 2012 and shipped to the Radioanalytical Lab. All samples should be screened with the ADM-300 and the Victoreen prior to sample shipment. Coordination should also be made with the Radioanalytical Lab to ensure they are aware of the pending samples.

(Source: Laboratory Sampling Guide, 11 May 2012)

STS Line Item 6.20: Recommend decontamination procedures (personnel, equipment, vehicles, aircraft, buildings).

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs assistance only on hardest parts. Can determine step-by-step procedures for doing the task.
Prerequisites:	Training Modules 6.15.1 through 6.15.5
Training References:	DoDM 3150.08, August 22, 2013 DoD 3150.8-M NARP Internet Supplement_Rev1.122211
Additional Supporting References:	http://www.acq.osd.mil/ncbdp/narp/pdf/NARP_InternetSupplement_010512.pdf
CDC Reference:	4B051
Training Support Material:	
Specific Techniques:	
Criterion Objective:	Given scenarios of potentially contaminated items, recommend proper decontamination procedures successfully completing all task steps with limited trainer assistance.

Notes:

Trainer will need to choose items and contamination levels for trainee to use in order to recommend decontamination.

TASK STEPS

1. Set up Contamination Control Station (CSS) for personnel and vehicles IAW NARP.

PERSONNEL

2. Check all personnel without life-threatening injuries with ADM-300 for contamination.[1]
3. Wash exposed areas of contaminated personnel and resurvey.

EQUIPMENT AND VEHICLES

4. Check all equipment and vehicles for contamination.
5. Remove contamination from equipment with wipe or damp cloth and resurvey.
6. Utilize LRS vehicle decontamination line and resurvey.

BUILDING

7. Using an ADM-300, survey any building that is deemed critical and needs to be cleared for contamination.
8. Mark all areas that you find contamination and clean with wet mopping.
9. Any building deemed not critical within the contamination area should be left evacuated.
10. Make special considerations for medical treatment facilities which could be contaminated by patients.

AIRCRAFT

11. Survey exterior and interior to determine contamination levels.
12. Determine isotope, if possible.[2]
13. Wash exterior contamination with water and detergent and resurvey.
14. Mark areas of interior contamination and work with maintenance to determine cleaning procedures.

LOCAL REQUIREMENTS:

NOTES:

1. Strip outermost layers of clothes and perform life saving measures on critical causalities before performing decontamination.

2. Short half-life isotopes should be allowed to decay.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.20: Recommend decontamination procedures (personnel, equipment, vehicles, aircraft, buildings).

1. Which personnel receive decontamination and process through the CCS? All personnel without life threatening injuries.
2. What items are removed before crossing the hotline into the CCS?
3. Which vehicles are a priority for decontamination after the initial response?

PERFORMANCE CHECKLIST

STS Line Item 6.20: Recommend decontamination procedures (personnel, equipment, vehicles, aircraft, buildings).

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs assistance only on hardest parts. Can determine step-by-step procedures for doing the task.

DID THE TRAINEE…		YES	NO
1. Set up Contamination Control Station (CSS) for personnel and vehicles IAW NARP?			
PERSONNEL			
2. Check all personnel without life-threatening injuries with ADM-300 for contamination?			
3. Wash exposed areas of contaminated personnel and resurvey?			
EQUIPMENT AND VEHICLES			
4. Check all equipment and vehicles for contamination?			
5. Remove contamination from equipment with wipe or damp cloth and resurvey?			
6. Utilize LRS vehicle decontamination line and resurvey?			
BUILDING			
7. Using an ADM-300, survey any building that is deemed critical and needs to be cleared for contamination?			
8. Mark all areas that you find contamination and clean with wet mopping?			
9. Any building deemed not critical within the contamination area should be left evacuated?			
10. Make special considerations for medical treatment facilities which could be contaminated by patients?			
AIRCRAFT			
11. Survey exterior and interior to determine contamination levels?			
12. Determine isotope, if possible?			
13. Wash exterior contamination with water and detergent and resurvey?			

14. Mark areas of interior contamination and work with maintenance to determine cleaning procedures?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. Which personnel receive decontamination and process through the CCS?

A: All personnel without life threatening injuries.

(Source: DoDM 3150.08 (NARP) page 34 – 35 and DoD 3150.8-M NARP Internet Supplement_Rev1.122211 Personnel Contamination Control)

2. What items are removed before crossing the hotline into the CCS?

A: Boot covers, contaminated items, and equipment

(Source: DoD 3150.8-M NARP Internet Supplement_Rev1.122211 Figure 1 Personnel CCS)

3. Which vehicles are a priority for decontamination after the initial response?

A: Priority should be for decontamination of fire trucks and ambulances.

(Source: DoD 3150.8-M NARP Internet Supplement_Rev1.122211 page 117)

STS Line Item 6.25: Evaluate personnel exposure/risk assessment.

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs assistance only on hardest parts. Can determine step-by-step procedures for doing the task.
Prerequisites:	Training Module - 4.9.2.11.1 Ion Chamber Training Module - 4.9.2.11.3 Geiger Mueller Training Module - 4.9.2.11.4 EPD (MK-2 N-2)
Training References:	DoDM 3150.08, August 22, 2013 DoD 3150.8-M NARP Internet Supplement_Rev1.122211
Additional Supporting References:	http://www.acq.osd.mil/ncbdp/narp/pdf/NARP_InternetSupplement_010512.pdf Medical Consequences of Radiological and Nuclear weapons Medical Management of Radiological Casualties AFMAN48-146 Chapter 4 OEH Risk Communication.
CDC Reference:	4B051
Training Support Material:	
Specific Techniques:	
Criterion Objective:	Give a list of exposures, determine degree of hazard and perform effective risk communication successfully completing all checklist items with trainer assistance on only the hardest parts.

Notes:

Trainer will need to use scenario or develop their own.

Scenario: There has been a partial detonation and members need to conduct operations on scene. Below is the dose rate in certain areas and the operations that need to occur. Determine health risk and brief commander on possible outcomes.

Dose rate average	Operation and time
1 Gy/Hr	Survey area around exterior of blast to look for casualties. Approximately 2 hours.
50 cGy/Hr	Survey perimeter to determine hotspots/ground truth. 3 hours.
3 Gy/Hr	Enter center of blast to remove casualties in critical status. 1 hour.

TASK STEPS

1. Determine exposure group.[1]
2. Measure dose rate in area, if possible, or estimate dose rate from available intelligence.[2]
3. Determine average dose rate for group or area.
4. Calculate total dose based on exposure duration or estimated dose for future exposures.[3]
5. Determine overall health risks at associated dose.
6. Effectively communicate risk to target audience.[4]

LOCAL REQUIREMENTS:

NOTES:

1. Determine missions and assigned personnel for predicative exposures or identify similar exposure groups for post exposure determinations.
2. Member should be able to choose proper equipment to measure dose rate.
3. Dose = Dose Rate x Time
4. Effective risk communication should be target to appropriate audiences IE. Communication to commanders should be worded differently from workers.

TRAINEE REVIEW QUESTIONS

STS Line Item 6.25: Evaluate personnel exposure/risk assessment.

1. What are the two ways ionizing radiation damages cells?
2. What health effects will you see at 2 Gy?
3. What are the stages of acute radiation syndrome (ARS)?
4. What range of exposure makes death a significant ARS concern?
5. What is the lowest level of observable change?

PERFORMANCE CHECKLIST

STS Line Item 6.25: Evaluate personnel exposure/risk assessment.

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs assistance only on hardest parts. Can determine step-by-step procedures for doing the task.

DID THE TRAINEE…		YES	NO
1. Determine exposure group?			
2. Measure dose rate in area, if possible, or estimate dose rate from available intelligence?			
3. Determine average dose rate for group or area?			
4. Calculate total dose based on exposure duration or estimated dose for future exposures?			
5. Determine overall health risks at associated dose?			
6. Effectively communicate risk to target audience?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. What are the two ways ionizing radiation damages cells?

   A: Direct and indirect.

   (Source: 4B051 CDC)

2. What health effects will you see at 2 Gy?

   A: Answers can vary, depending on the reference used:

   Fatigue, weakness, bleeding, epilation (or) Lymphocyte depression, Nausea and vomiting within hours, few if any deaths.

   (Source: 4B051 CDC or *Medical Consequences of Radiological and Nuclear Weapons*)

3. What are the stages of acute radiation syndrome (ARS)?

   A: Prodromal, Latent, Manifest, Recovery.

   (Source: 4B051 CDC)

4. What range of exposure makes death a significant ARS concern?

   A: Answers can vary, depending on the reference used:
   4-6 Gy (20-70 % death) (or) 3.5-4 Gy (50% death within 60 days if untreated)

   (Source: 4B051 CDCor *Medical Consequences of Radiological and Nuclear Weapons*)

5. What is the lowest level of observable change?

   A: Answers can vary, depending on the reference used:
   0.25 – 1 Gy some blood changes can be seen (or) 50 cGy Minor Lymphocyte depression

   (Source: 4B051 CDC or *Medical Consequences of Radiological and Nuclear Weapons*)

STS Line Item 6.25.1: Document exposure in OEHSA.

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed
Prerequisites:	Training Module 6.25.2 - Document exposures in DOEHRS (IR)
Training References:	*Occupational and Environmental Health Site Assessment (OEHSA) Documentation and Data Management Technical Guide*. USAFSAM. 2011. DOEHRS Student Guide/User Manual, Version 2.0.15.0
Additional Supporting References:	None
CDC Reference:	4B051
Training Support Material:	• Computer with DOEHRS Access
Specific Techniques:	Conduct hands-on training and evaluation on documenting exposure in OEHSA
Criterion Objective:	Given a DOEHRS exposure report, successfully document an exposure in an OEHSA survey successfully completing all checklist items with NO trainer assistance.

Notes:

This QTP will be accomplished after 6.25.2 Document Exposure in DOEHRS, as the OEHSA Tech guide specifies using DOEHRS as the primary means of documenting exposures.

TASK STEPS

1. Determine if incident is over.[1]
2. Determine if exposure still exists.
3. Determine if exposure pathway exists.
4. Determine if there is a population at risk
5. Document chronic exposure determination in DOEHRS

LOCAL REQUIREMENTS:

NOTES:

1. Determination of when incident is over is an assessment of whether or not the acute exposure has ended and a chronic exposure has begun (e.g., for a chemical spill that leaks into the ground water, the spill and initial cleanup would be part of the incident but use of the ground water would create a chronic exposure that needs to be assessed.)

PERFORMANCE CHECKLIST

STS Line Item 6.25.1: Document exposure in OEHSA.

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed

DID THE TRAINEE…		YES	NO
1. Determine if incident is over?			
2. Determine if exposure still exists?			
3. Determine if exposure pathway exists?			
4. .Determine if there is a population at risk?			
5. Document chronic exposure determination in DOEHRS?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

STS Line Item 6.25.2: Document exposure in DOEHRS (IR).

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed
Prerequisites:	Access to and familiarity with DOEHRS
Training References:	DOEHRS Student Guide/User Manual, Version 2.0.15.0
Additional Supporting References:	None
CDC Reference:	4B051
Training Support Material:	• Computer with DOEHRS Access • After Action Report
Specific Techniques:	Conduct hands-on training and evaluation on documenting exposure in DOEHRS
Criterion Objective:	Given an after action report, successfully document exposures in DOEHRS and complete all checklist items with no trainer assistance.

Notes:

Trainer will provide an after action report for the trainee to enter into DOEHRS.

TASK STEPS

6. Name the incident.
7. Correctly label the incident type and provide an incident type description.
8. Properly document the start and stop date/time.
9. Indicate how the incident occurred.
10. Write a brief summary of incident.
11. List other key units involved.
12. List the correct exposure routes.
13. Note if any signs and symptoms/effects were reported.
14. Provide any general acute health effects observed.
15. Document if odors were noticed.
16. Create a summary of events (timeline).
17. Document whether decontamination was performed on people.
18. Document if medical treatment was sought.
19. Estimate overall number of people exposed.
20. Document field monitoring and detector results, to include who performed monitoring and list of detectors/equipment used.
21. Document if samples were collected.
22. Document PPE used and what was available.
23. Summarize decontamination used for people and equipment and the effectiveness of decontamination.
24. List any medical countermeasures used.
25. Include any overall remarks.

LOCAL REQUIREMENTS:

NOTES:

TRAINEE REVIEW QUESTIONS

STS Line Item 6.25.2: Document exposure in DOEHRS (IR).

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1. Why are exposures documented in DOEHRS?
2. A chlorine tanker crashes outside of the base gate exposing Security Forces to chlorine. How would you classify how the incident occurred?

PERFORMANCE CHECKLIST

STS Line Item 6.25.2: Document exposure in DOEHRS (IR).

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed

DID THE TRAINEE…		YES	NO
1. Name the incident?			
2. Correctly label the incident type and provide a incident type description?			
3. Properly document the start and stop date/time?			
4. Indicate how the incident occurred?			
5. Write a brief summary of incident?			
6. List other key units involved?			
7. List the correct exposure routes?			
8. Note if any signs and symptoms/effects were reported?			
9. Provide any general acute health effects observed?			
10. Document if odors were noticed?			
11. Create a summary of events (timeline)?			
12. Document whether decontamination was performed on people?			
13. Document if medical treatment was sought?			
14. Estimate overall number of people exposed?			
15. Document field monitoring and detector results, to include who performed monitoring and list of detectors/equipment used?			
16. Document if samples were collected?			
17. Document PPE used and what was available?			
18. Summarize decontamination used for people and equipment and the effectiveness of decontamination?			

19. List any medical countermeasures used?			
20. Include any overall remarks?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. Why are exposures documented in DOEHRS?

   A: AFI 48-145, *Occupational and Environmental Health Program,* prescribes the use of an AF-approved OEH Management Information System (OEH-MIS) to standardize and enhance data entry, management, and reporting. The Defense Occupational and Environmental Health Readiness System (DOEHRS) is the DoD approved OEH-MIS used to manage and archive OEH exposure data. The AF uses DOEHRS to manage longitudinal exposure recordkeeping and reporting.

   (Source: AFI 48-145, *Occupational and Environmental Health Program*)

2. A chlorine tanker crashes outside of the base gate exposing Security Forces to chlorine. How would you classify how the incident occurred?

   A: Accidental release

   (Source: DOEHRS Student Guide/User Manual Version 2.0.15.0, pg 40-1.)