REVISED NYC DOHMH Guidance for Hospital Area Radiation Detection (ARD) and Response Protocols Date of Revision: July 2012[1]

Symbol = Significant revision or new information since 2009 Guidance document

OVERVIEW:

This revised guidance document is the result of projects completed by the Brookhaven National Laboratory in 2011-2012 including site visits at 43 NYC hospitals and drills at 13 to evaluate hospitals' capability to detect radiation on incoming patients to the emergency department. Several new recommendations and clarifications have been created and hospital emergency management staff, security, and radiation control personnel should review these recommendations and revise their own plan accordingly.

The Ludlum Model 375-10 Area Radiation Detectors (ARD) are located at fixed points of entry and egress of emergency departments and, for some hospitals, at other entry points to detect the presence of radioactive contamination of persons or items entering or leaving the facility. The ARDs can detect gamma radiation (no detection of beta or alpha radiation) at dose rates consistent with medical procedures and above, but are not sensitive enough to detect much lower levels of radiation that might occur if a person only had surface contamination. **Importantly, sensitivity of the detectors are ample to alert hospital staff if there are patients that are highly contaminated or if a dangerous amount of contamination or hot particle, such as an embedded fragment, are present.** Administration and radiation safety personnel must be aware of the limitations of the equipment and should train their staff in a realistic context, e.g. only highly contaminated persons will be identified.

NEW RECOMMENDATIONS FOR RESPONSE PLANNING

SELECTING HOSPITAL SPECIFIC RESPONSE STRATEGY:

Hospitals may choose the operational strategy of when the ARDs are turned on that best suits their needs:

- 24/7 Strategy: Hospital chooses to have ARDs on continuously. This strategy will identify the occasional nuclear medicine patient and has the advantage of maintaining situational awareness and exercising the response procedure. The disadvantage is the additional administrative burden of staff responding to non-emergency alarms.
- Response Only Strategy: Hospital chooses to have ARDs turned on during announced or suspicious incidents. The advantage of strategy of using the ARD only in a declared emergency condition will be to effectively protect the staff and the hospital, and eliminate/minimize response to non-emergency alarms. The disadvantage is that response personnel will have less operational experience with the equipment and protocols.

[1] For questions about this document send inquiries to phprep@health.nyc.gov

SELECTING HOSPITAL SPECIFIC ALARM LEVELS:

The Ludlum Model 375-10 Area Radiation Detectors (ARD) have the capability to report two levels of alarm. There is no need for hospitals to have more than one alarm level for the purpose of these detectors.

- Both the low and high alarm setpoint should be the same value.
- A choice to set the alarm to a level 5-10 times above background (~100 µR/hr) or higher does not degrade safety.
- Or, correlating the alarm setpoint to a known source and source-to-detector distance would couple the actual detection level to alarm enunciation does not degrade safety

MOUNTING ARDS ON WALLS:

Within the practical constraints of the room architecture and cost, an evaluation should be made to relocate the ARD to a height 3-4 feet above the floor. Consider placement such that the pedestrian pathways and transit times (distance and time) optimize the detection capability of the ARD. Covering the units with a clear plastic box to prevent tampering would be a best practice.

INCREASING ALARM RECOGNITION WITH STROBE LIGHT:

Installation of a latching strobe light would facilitate alarm recognition by Security or Hospital staff and ensure a reaction. Often it was observed that the ARD was positioned in a location where a momentary alarm is likely to be missed. This can occur because the audible alarm is not very loud, the security guard may be away from the post performing their duties, or there may be background noise masking the enunciator.

DECISION POINT FOR RESPONSE SIMPLIFIED:

The decision strategy needed after verbal screening has been simplified to No Concern or High Concern, where the High Concern conditions require outside intervention and notification. (See page 6 for revised Initial Patient/Visitor Encounter Screening Plan Components and page 9 for the revised screening form.)

ROUTINE FUNCTIONAL TESTING OF ARDS:

To ensure that the ARDs are functioning properly and to verify the alarm set points, periodic operability checks should be conducted and recorded. This is especially important for hospitals choosing to only turn on the ARDs in response to an event. The RSO should be consulted to establish a routine test of basic functionality. Establishing an expectation value with a known source is a good practice and would facilitate trending. Continued routine calibration and maintenance should also be conducted at hospitals of the radiation detection equipment.

TRAINING OF STAFF:

Provision of training is necessary to qualify new personnel due to routine turnover of staff and refresh incumbents. Response to a radiation alarm is a perishable skill especially due to the fact that this function is not a typical duty for medical personnel. DOHMH has provided a series of modules, http://www.nyc.gov/html/doh/html/bhpp/bhpp-train-cbrne-rad.shtml**.** A new, condensed training is in development to enable hospitals to train easily on a regular basis. Training will become available in early 2013.

SUMMARY OF STEPS FOR CREATING / REVISING RADIATION DETECTION PLAN:

The following steps are a quick summary of what should be including in a creating or revising a radiation detection and response plan:

1. Select best operational strategy based on hospital needs (see comments below):
   - 24/7, or
   - Response Only Strategy

2. Determine location and mounting of ARDs (see comments below)

3. Determine one alarm set point and have ARD alarm readjusted if necessary (see details below)

4. Determine method(s) of alarm

5. Determine who will be responsible for monitoring alarms (nursing, security, radiation safety, other)

6. Determine who will be responsible for responding to alarms? (nursing, security, radiation safety, other)

7. Determine what action steps hospital staff take in response to an alarm and radiation contamination control.

8. Determine frequency of maintenance, calibration, and functionality checks of equipment.

9. Determine staff training for protocol on at least an annual or biannual basis to maintain awareness of the appropriate response to a confirmed alarm.

10. Identify radioisotopes used in institution. For a list of common medical isotopes, please see **Appendix I.** Even a unit appropriately modified to ignore lower energies will occasionally alarm for patients who may have had a large dose or very recent procedure. Staff must be prepared to differentiate these patients from those who have no justifiable reason for setting off the alarm.

11. Determine and plan for obtaining radiation expertise, (RSO, health physics, etc.) after hours and weekend to support hospital staff respond to an ARD alarm,

How to Use this Guidance Document to Create or Revise a Detection Protocol:

Given the potential implications of delayed recognition of a patient with unknown radioactive contamination, this guidance document provides a format for hospitals to use in creating their own Radiation Detection and Response Protocols/Plan. These protocols should be considered living documents (i.e., ones that evolve as needed to fit the needs and culture of each hospital) and be updated on a yearly basis and as new information and technology are developed.

The following are the four recommended components that should be included in each hospital plan and revised ARD Response Protocol components:

1.) Radiation Detector Monitoring Methodology
2.) Initial Patient/Visitor Encounter/Screening
3.) Radiation Control Measures and Response
4.) Notification

Please note that the NOTIFICATION PROCEDURES outlined in this document are uniform requirements to be adopted and followed by all hospitals. They are standardized by necessity since they generally involve outside agencies that must conform their actions to hospital practices.

This document does not address the decontamination or management of radioactively contaminated patients. That material is available from multiple text books and on-line resources such as, Radiation Emergency Assistance Center and Training Site (REAC/TS) web site http://orise.orau.gov/reacts/. REAC/TS is a 24/7 organization that can provide emergency medical consultation for incidents involving radiation.

In each section, the DOHMH provides suggested text and/or examples. Sections that the DOHMH considers critical to an effective response protocol for patients who may have radioactive contamination of urgent public health concern are highlighted in **bold** text. If appropriate for your facility, the text and/or examples can be incorporated directly into your hospital protocol.

Plan Component 1. Radiation Detection Monitor Methodology:

1. Response strategy:

- *24/7, or*
- *Response Only Strategy*

2. Location of Detectors:
List location of hospital entrances where detectors are installed. The Brookhaven National Laboratory site visit recommendations should be reviewed to assist hospitals in determining optimal locations where detectors should be installed at hospital entrances/exits.

2. Method of Alarm:
Determine whether alarm will function using one or more of the following methods:

- *Visible alarm (latching strobe light recommended)*
- *Audible alarm*
- *Remote alarm unit (located in triage room, radiation safety office, security station, etc.)*
- *Hardwire link to Ethernet*

3. Other Automatic or Facility functions activated by the alarm:
Describe any automatic/mechanical/engineered functions that are trigged by the alarm, if applicable. Such as, "ED Interior Doors will automatic lock," or "Security cameras are immediately activated," etc.

4. Responsibility for Detection Monitoring
List hospital staff titles that are responsible for monitoring alarm annunciation.

b. Initial Alarm Response:
List hospital staff title(s) that will be responsible for initial response to detector alarms, including who will administer the patient/visitor questionnaire. NYPD strongly encourages hospitals to involve hospital security as primary responders to alarms.

c. Hospital response actions once alarm has been verified
List hospital staff title(s) and main function(s) after an alarm has been verified as a potential cause of concern or highly suspicious event.

Plan Component 2. Initial Patient/Visitor Encounter Screening Plan Components:

Patients who have life or limb threatening conditions should not have their treatment or evaluation delayed because a radiation area detector alarms upon their arrival. Those patients should receive immediate medical attention, and the following steps may occur simultaneously to their medical evaluation. An example of such a patient is one complaining of severe chest pain with an acute myocardial infarction status post Technetium stress test. Radiation monitoring equipment, although desirable, *is not required* to begin lifesaving procedures.

1. Steps that will immediately occur once alarm has been recognized.
Outline initial actions, including radiation safety measures (e.g., "Responding staff will bring the Ludlum 2241 Survey Meter and follow instructions for turning on meter," and/or "Security will turn on electronic personal dosimeters before encountering patient."). *Hospital staff should make sure that no patient or person identified by the alarm should be left alone nor locked into a room, such as an isolation room.*

2. Verbal screening of patient or visitor:
The following questions should be asked of patient/visitor identified as being responsible source for the alarm:

- *Have you received any form of radiation treatment or diagnostic testing in the past 30 days?*
  - *Procedures include:*
    - *nuclear medicine test or radionuclide therapy*
    - *radiation treatment for cancer*
    - *nuclear or radiopharmaceutical ingestion or injection*
    - *cardiac stress test or heart study*
    - *radioactive "seeds" implant*
    - *thyroid test or treatment*
  - *If yes, specify procedure type, location of procedure, and date of procedure. Provide appropriate documentation.*[2]
- *Are you presently carrying any radioactive materials for work-related purposes or other licensed activities?*
- *Where do you work? Does it involve any radioactive materials (Researcher, nuclear energy worker, radiographer, etc.)?*
- *Have you been involved in an explosion or industrial accident involving chemicals?*

3. Based on the response to the above screening, patients/visitors may be placed into one of two categories:

- **NO IMMEDIATE CONCERN: Known Medical Source of Radioactive Contamination. Patient safe to proceed.**[3]
- **HIGH LEVEL OF CONCERN: Radioactive material present and no history of medical procedure, or unable to ascertain source, or suspicious in nature. May also be due to occupation OR unable to determine due to patient/visitor not able or willing to answer. Further advance radiation screening required. Initiate notification procedure.**[4]

[2] Hospital and medical professionals are encouraged to advise patients to carry documentation of procedures for 30 day period.
[3] NYPD terminology for this level of alarm is "innocent" or "identified".
[4] NYPD terminology for this level of alarm may be "hostile" if source unable to be ascertained.

Plan Component 3. Radiation Control Measures and Response Plan Components:

If the patient/visitor is placed in the following screening:

1. **NO IMMEDIATE CONCERN:**
   - Patient/visitor may proceed into the emergency department
   - *List how incident will be documented on chart.*

2. **HIGH LEVEL OF CONCERN**
   - These patients require further screening and evaluation prior to moving into the emergency department***, unless the person's medical condition is critical (life or limb saving),*** if so, then the following steps should be conducted while resuscitating or treating the patient.
   - Outline where patient may be placed and appropriate radiation safety measures until further scope of contamination is determined for both critical and non-critical patients.
   - These patients should have a complete and documented radiation survey, also known as "frisking" (See Appendix IV Sample Procedure for Ambulatory Radiation Monitoring) to determine locations of contamination.
   - If elevated readings are found, all outer clothing should be removed from the person, bagged separately, and the person placed on clean sheets if on a stretcher. A repeat survey is necessary to confirm if the radiological status of the patient.
   - List what hospital title(s) with advanced radiation training would be notified to respond to determine:
     - Potential source of radiation
     - External or internal contamination, and protocol to determine difference
     - List how advanced survey will be documented
     - Further Radiation Control steps if necessary
   - **If unable to classify as No Immediate Concern then person is of HIGH LEVEL OF CONCERN and immediate notification of NYPD is required by contacting 911.**
   - **Notification of NYC DOHMH Office of Radiological Health during the day or NYC Poison Control Center after hours to notify DOHMH of a potential radiological incident is also required.**
   - If external contamination is present begin hospital decontamination procedures and hospital hazardous materials procedures.
   - If the patient's medical condition is suspected to be related to radiation exposure, medical staff may contact NYC PCC for further assistance or the Radiation Emergency Assistance Center and Training Site (REAC/TS) for further assistance.

Plan Component 4. Notification for HIGH LEVEL OF CONCERN ALARMS

Immediate notification to NYPD is required
FIRST notification is always to NYPD and must be made IMMEDIATELY
New York City Police Department **911**

- Give operator all available information related to the alarm, person(s) involved and the conditions leading to a determination that the alarm is of HIGH LEVEL (NOTE: NYPD terminology for this level of alarm is a HOSTILE ALARM)

Additional Notification of External Agencies
Timely notification must be made to the following agencies:

DOHMH

Office of Radiological Health (Business hours)	212-676-1552
Poison Control Center (after 5:00pm and on weekends)	212-764-7667

Internal Notification
Identify staff needed for effective response (indicate 24 hour contact information)
1. Administration
2. Radiation Safety Office
3. Security
4. Other

Radiation Emergency Assistance Center and Training Site (REAC/TS): If assistance is required for medical management of a radiation incident, call: 865-576-1005

Appendix I REVISED Sample Patient/Visitor Screening Form

Question	Y	N	UTO*	If YES:	Comment
1. Did you recently have any nuclear medicine test or radionuclide therapy?				Where, when?	
2. Are you being treated for cancer with any radioactive substances?				What kind, where, when?	
3. Have you ingested or been injected with any nuclear or radiopharmaceuticals?				Where, with what agent?	
4. Have you had a recent cardiac (heart) study?				Where, when?	
5. Have you had any radioactive seeds implanted?				Where, when?	
6. Have you had recent thyroid test or thyroid treatment?				Where, when?	
7. Does your work involve any radioactive materials?				Where? What materials? Why?	
8. Are you carrying any radioactive materials or substances?				What? Licensed?	
9. Have you been involved in an explosion or industrial accident involving chemicals?				Incident details:	

* **UTO:** Unable to Obtain

Patient/Visitor Categorization of Level of Concern:

_____ **No Immediate Concern:**

- Alarm indicates radiation present
- YES to any #1-6 above and procedure done within past 30 days and
- No to #7 – 9
- Patient/visitor may proceed

_____ **High Level of Concern:**

- Alarm indicates radiation present
- NO to all or Unable to Obtain, or
- Yes to #7, 8, or 9
- Contact Radiation Safety Officer (or designee) to complete advanced survey and initiate Notification Protocol
- Initiate notification protocols

_____ _____ _____am/pm
Person Notified Title Time Notified

Response: None Required_____ Otherwise please document actions taken:
_____
_____
_____
_____

Final Disposition of Person: _____
(if person needs to be advanced survey, see page 3)
Form Completed by: _____

_____ _____
Name Title

_____ _____am/pm ____/____/____
Signature Time Date

Appendix II Common Medical Isotopes

Isotopes

Over 140 radioactive sources, out of a list of over 3000 total known isotopes, are used in medical settings. All medical isotopes are easily detected and sub-microCuris amounts are commonly detected in hospital waste. Half-life is indicated in parenthesis.

ISOTPES USED FOR DIAGNOSITCS

- **Technetium (Tc-99m) (6 hr)** By far the most common, used to image the skeleton and heart muscle in particular, but also for brain, thyroid, lungs (perfusion and ventilation), liver, spleen, kidney (structure and filtration rate), gall bladder, bone marrow, salivary and lacrimal glands, heart blood pool, infection and numerous specialized medical studies.
- **Thallium (Tl-201) (3 d)**
- **Gallium (Ga-67) (3.2 d)**
- **Iodine (I-123) (13 h)**
- **Indium (In-111m) (67 h)**
- **Xenon (Xe-133) (5 d):** Used for pulmonary (lung) ventilation studies. Xenon is a gas - exhaled almost immediately after use.

IOSTOPES USED FOR TREATMENT

- **Strontium (Sr-89) (50d)** - rare use for pain. Effective in reducing the pain of prostate and bone cancer. Beta emitter.
- **Iodine (I-131) (8 d)** - common use for thyroid treatment and growing use for immunotherapy. The largest amount likely to be seen in patients outside the hospital. Widely used in treating thyroid cancer and in imaging the thyroid; also in diagnosis of abnormal liver function, renal (kidney) blood flow and urinary tract obstruction. A strong gamma emitter, but used for beta therapy.
- **Iodine-125 (60 d):** Used in cancer brachytherapy (prostate and brain), also diagnostically to evaluate the filtration rate of kidneys and to diagnose deep vein thrombosis in the leg. It is also widely used in radioimmuno-assays to show the presence of hormones in tiny quantities. Used for permanent implants (e.g. prostate). Difficult to detect with Geiger because it is low energy.
- **Iridium (Ir-192) - (74 d):** Supplied in wire form for use as an internal radiotherapy source for cancer treatment (used then removed). Used for temporary implants - patients not discharged with implant.
- **Ytterbium (Yb-169)** - used for permanent implants (e.g. prostate). Difficult to detect with Geiger because it is low energy
- **Cesium (Cs 137)** - used for temporary implants - patients not discharged
- **Phosphorus (P-32**) (14 d) - used primarily for lab research. Was used for Rx but archaic. Used in the treatment of polycythemia vera (excess red blood cells). Not usually detected internally because it is a beta. Easier to detect externally

OTHER LESS COMMON ISOTOPES USED IN MEDICINE:

- **Molybdenum-99 (66 h):** Used as the 'parent' in a generator to produce technetium-99m.

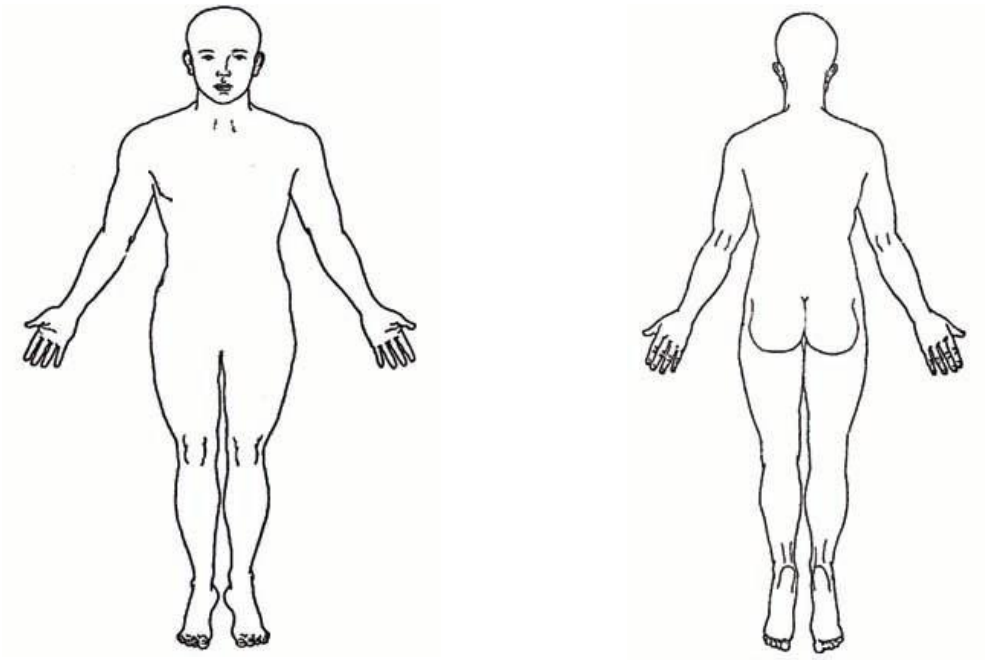
- **Bismuth-213 (46 min):** Used for TAT.
- **Chromium-51 (28 d):** Used to label red blood cells and quantify gastro-intestinal protein loss.
- **Cobalt-60 (5.3 yr):** Formerly used for external beam radiotherapy.
- **Copper-64 (13 h):** Used to study genetic diseases affecting copper metabolism, such as Wilson's and Menke's diseases.
- **Dysprosium-165 (2 h):** Used as an aggregated hydroxide for synovectomy treatment of arthritis.
- **Erbium-169 (9.4 d):** Use for relieving arthritis pain in synovial joints.
- **Holmium-166 (26 h):** Being developed for diagnosis and treatment of liver tumors.
- **Iron-59 (46 d):** Used in studies of iron metabolism in the spleen.
- **Lutetium-177 (6.7 d):** Lu-177 is increasingly important as it emits just enough gamma for imaging while the beta radiation does the therapy on small (e.g. endocrine) tumors. Its half-life is long enough to allow sophisticated preparation for use.
- **Palladium-103 (17 d):** Used to make brachytherapy permanent implant seeds for early stage prostate cancer.
- **Potassium-42 (12 h):** Used for the determination of exchangeable potassium in coronary blood flow.
- **Rhenium-186 (3.8 d):** Used for pain relief in bone cancer. Beta emitter with weak gamma for imaging.
- **Rhenium-188 (17 h):** Used to beta irradiate coronary arteries from an angioplasty balloon.
- **Samarium-153 (47 h):** Sm-153 is very effective in relieving the pain of secondary cancers lodged in the bone, sold as Quadramet. Also very effective for prostate and breast cancer. Beta emitter.
- **Selenium-75 (120 d):** Used in the form of seleno-methionine to study the production of digestive enzymes.
- **Sodium-24 (15 h):** For studies of electrolytes within the body.
- **Ytterbium-169 (32 d):** Used for cerebrospinal fluid studies in the brain.
- **Ytterbium-177 (1.9 h):** Progenitor of Lu-177.
- **Yttrium-90 (64 h):** Used for cancer brachytherapy and as silicate colloid for the relieving the pain of arthritis in larger synovial joints. Pure beta emitter.
- Radioisotopes of cesium, gold and ruthenium are also used in brachytherapy.

Appendix III Sample Advanced Survey Form

Name of Patient or Visitor: _____ Date_____ Time of Survey_____

Patient/visitor placed in designated evaluation area ___Y / N____
Survey patient with clothing on and without clothing
Mark contamination on the diagram below:

Front Measurements:
1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____
9._____
10. _____
Comments:



Back Measurements:
1._____
2._____
3._____
4._____
5._____
6._____
7,_____
8._____
9._____
10._____
Comments:

For areas positive for contamination, complete a wipe test to determine if contamination is present externally.
External Contamination Present Yes_____ No _____ Unable to Determine _____
Internal Contamination Present or Suspected Yes _____ No _____ Unable to Determine _____

Name of person completing survey: _____
Instrument Type: _____ Number: _____ Calibration Date of Instrument_____

Appendix IV Sample Procedure for Ambulatory Radiation Monitoring

Adapted from REAC/TS http://orise.orau.gov/reacts/guide/detect.htm

Using a Typical Geiger-Mueller (GM) Counter to Survey

Preparing the Meter:

1. Position the Geiger counter with the meter away from you. Locate and open the battery compartment.
2. Put the batteries in the meter using proper orientation (up/down).
3. Close and latch the battery compartment.
4. Check the batteries using the "range" switch, On switch, or "bat" button; the method depends on the type of instrument. The meter needle should move to area on scale marked battery if an analog survey meter is used indicating the batteries are good or the display should indicate information. If the batteries are not good, find a flashlight or other source of 2 D-cells and put them in the meter -- check these batteries also.
5. Turn the "F/S" switch to "S" (Slow).
6. Turn the "audio" switch to "OFF."
7. Connect the pancake probe (Ludlum) or use the probe that is wired to the meter.
8. Turn the meter on (Ratemeter setting for Ludlum 2241).

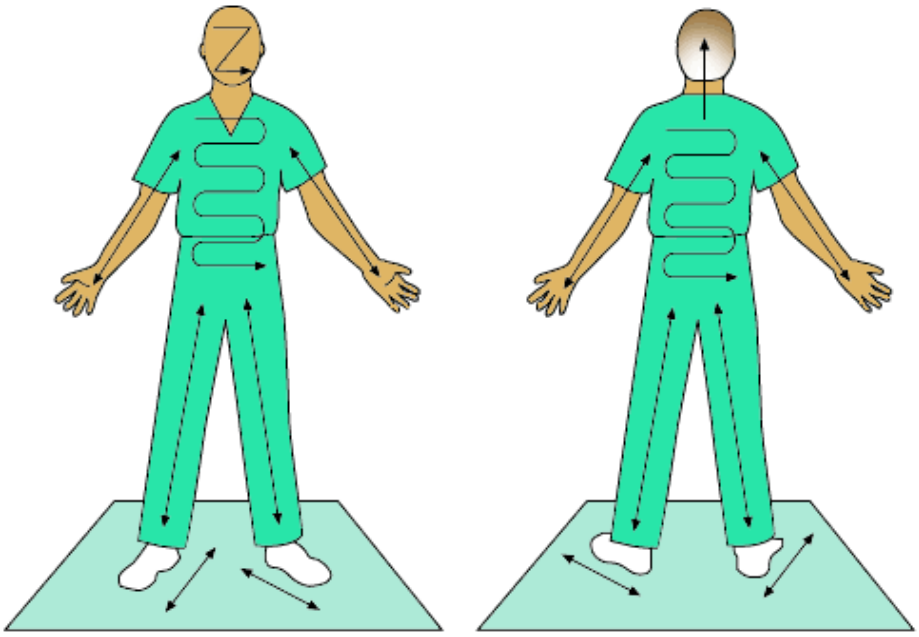
Measure Background Radiation:

1. Remove the probe cover if one is in place.
2. Measure the background radiation for 60 seconds: write down the reading. Since background radiation varies with time, it may be desirable to make several counts and average the results. Record the reading.
3. Expect a reading of 40-200 counts/min or a reading of approximately 2 - 15 μR/hr.
4. Record background reading.

Conducting the Survey of an Ambulatory Person

1. Have the person stand on a clean pad.
2. Instruct the person to stand straight, feet spread slightly, arms extended with palms up and fingers straight out.
3. Holding the probe approximately 1/2 to 1 inch from the person's skin, systematically survey the entire body from head to toe on all sides.
4. Pay particular attention to hands, face and feet.
5. Monitor both hands and arms; then repeat with hands and arms turned over.
6. Starting at the top of the head, cover the entire body, monitoring carefully the forehead, nose, mouth, neckline, torso, knees, and ankles.
7. Have the subject turn around, and repeat the survey on the back of the body.
8. Monitor the soles of the feet.
9. Move the probe slowly (about 1 inch per second).
10. Do not let the probe touch anything.
11. Try to maintain a constant distance.
12. Note that some GM instruments cannot detect alpha radiation and some low-energy beta radiation. Because alpha radiation is non-penetrating, it cannot be detected through even a thin film of water, blood, dirt, clothing, or through probe cover.
13. *An increase in count rate or exposure rate above background indicates the presence of radiation.*

14. Document time and radiation measurements.
15. In general, areas that register more than twice the previously determined background level are considered contaminated. For accidents involving alpha emitters, if the reading is less than twice the background radiation level, the person is not contaminated to a medically significant degree. If the accident circumstances indicate that an alpha emitter (such as plutonium) or low energy beta emitter could be a contaminant, a health physicist should always be consulted.



Ending the radiation survey:

1. Switch off the meter.
2. Replace the cap on the meter probe.
3. Disconnect the probe (Ludlum) if removable.
4. Take the batteries out.
5. Put the Geiger counter back in its case.

APPENDIX V

ADVANCED OPERATION CHECKLIST
Ludlum Survey Meter 2241 or 2241-2RK

Prepare for Operation

____ Inspect that all components are present, not damaged.
____ Install batteries.
____ Attach cable and selected probe to instrument.
____ Set Aud toggle switch to On or Off as desired.
____ Set F/S toggle switch to F or S as desired. Slow is recommended for ARD alarm response.
____ Set Det toggle switch to Det 1 for pancake probe or Det 2 for gamma probe.
____ Power On. Set Mode switch to Ratemeter.
____ Check meter functions.
- ____ Check display increases and decreases as probe is moved closer to and away from check source.
- ____ Check that reset button clears display when pressed.
- ____ Check that light button lights display when pressed.
- ____ Check Aud toggle switch. Chirp is audible when On and not heard when Off.

Perform Normal Operation

____ Check dose rate. Default reading on display.
____ Use chirp function. Enable or disable with Aud toggle switch.
____ Turn on backlight. Press Light button.
____ Use gamma probe.
- ____ Verify that Det toggle switch is set to Det 2.
- ____ Hold probe in front at waist height, move probe side to side.

____ Change probe.
- ____ Power Off. Set Mode switch to Off.
- ____ Disconnect probe from cable.
- ____ Connect new probe to cable.
- ____ Verify that Det toggle switch is in correct position for probe type.
- ____ Power On. Set Mode switch to Ratemeter.

ADVANCED OPERATION CHECKLIST

Ludlum Survey Meter 2241 or 2241-2RK

(continued)

Perform Normal Operation (* advanced procedures)

____ Use pancake probe.
____ Verify Det toggle switch is set to Det 1.
____ Remove protective cover from probe face.
____ Hold probe face near to target material, move slowly over surface.
____ Reset alarm. Press Reset button 1x (Alert) or 2x (Alarm).
____ * Use scalar mode
____ Attach probe as desired.
____ Set Det switch to appropriate setting for selected probe.
____ Set Mode switch to Scalar.
____ Press handle button to start count; display shows count in small digits.
____ Press handle button to reset scalar alarm and restart count.
____ * Set meter parameters (using internal switchboard)
____ Set Detector toggle switch as needed (select position to adjust).
____ Set Mode switch to Ratemeter.
____ Open instrument case.
____ Set switchboard function switch to desired position (refer to attached list of settings and operator's manual).
____ Press ENTER, display flashes right digit of current setting.
____ Press UP to change character value.
____ Press LEFT to advance to next character.
____ Press ENTER to accept setting.
____ Repeat for each function switch setting as needed.
____ Close instrument case.

Shut Down

____ Power Off. Set Mode switch to Off.
____ Remove batteries.
____ Disassemble cable and probe from meter.
____ Store components in carry case.

ADVANCED OPERATION CHECKLIST

Ludlum Survey Meter 2241 or 2241-2RK

(continued)

Settings for function switch on internal switchboard.

Position 0. Normal operation.

Position 1. Dead time: 0 to 9999.

Position 2. Calibration constant, 0.001 to 280 x 109.

Position 3. Display units: R/h, Sv/h, C/time base (position 4).

Position 4. Time base: cps, cpm.

Position 5. Audio divide by: 0 (1/1), 1 (1/10), 2 (1/100), 3 (1/1000).

Position 6. Response time: 0 (variable) or 1 to 199 (fixed)

Position 7. Ratemeter Alarm/Alert set point: 1 to 999 R/h, 1 to 999 kcpm, 1 to 100 kcps.

Position 8. Scalar alarm/count time set point: 1 to 999,999 counts, 1 to 9999 seconds.

Position 9. Not Used.

Position A. Not Used.

Position B. LCD backlight time (seconds): 5, 30, 60, 90, 180, 240.

Position C. Minimum display set point (after pressing Reset button): Several options of 0.00, 00.0, or 000 with each set of units.

Position D. RS-232 data dump rate, on/off while connected.

Position E. RS-232 parameter setup: Accepts string of parameters for RS-232 while connected.

Position F. Baud rate for RS-232: 150, 300, 600, 1200, 2400, 4800, 9600.