
# Using Preventative Radiological Nuclear Detection Equipment for Consequence Management Missions

## Operational Job Aids

2017 First Edition

Homeland Security
Science and Technology

NUSTL
NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA



RNRR-T-G-3

# Foreword

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory organized within the U.S. Department of Homeland Security Science and Technology Directorate's First Responders Group. Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of state and local first responders to address the homeland security mission. The laboratory provides first responders with the necessary services, products and tools to prevent, protect against, mitigate, respond to and recover from homeland security threats and events.

NUSTL uniquely provides independent technology evaluations and assessments for first responders, thereby enabling informed acquisition and deployment decisions, and helping to ensure that responders have the best technology available to use in homeland security missions. NUSTL's Radiological/Nuclear Response and Recovery (RNRR) Research & Development (R&D) portfolio improves the first responder community's ability to respond and recover from radiological incidents through R&D advancements in knowledge, technology, policy and procedures.

Visit the NUSTL website at https://www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory, or contact NUSTL@hq.dhs.gov for more information.

# List of Acronyms

| | |
|---|---|
| Bq | Becquerel |
| Ci | Curie |
| CM | Consequence management |
| cpm | counts per minute |
| cps | counts per second |
| dpm | disintegrations per minute |
| ER-PRD | Extended Range Personal Radiation Detector |
| FRMAC | Federal Radiological Monitoring and Assessment Center |
| m | milli ($10^{-3}$) |
| mR/hr | milliroentgen per hour |
| NUSTL | National Urban Security Technology Laboratory |
| p | pico ($10^{-12}$) |
| PERD | Personal Emergency Radiation Detectors |
| PRD | Personal Radiation Detector |
| PRND | Preventive radiological/nuclear detection |
| R | Roentgen |
| RAP | Radiological Assistance Program |
| RIID | Radio-Isotope Identification Device |
| RPM | Radiation Portal Monitor |
| SPRD | Spectroscopic Personal Radiation Detector |
| Sv | Sievert |
| VM | Vehicle Mounted |
| µ | micro |

# Table of Contents

# Introduction

This operator aid book briefly describes procedures for the use of first responder preventive radiological/nuclear detection (PRND) equipment in a consequence management (CM) response to a radiological material release to the environment. The PRND mission is to detect and interdict radiological/nuclear materials outside of regulatory control before they can be misused. Many state and local agencies have purchased equipment for the PRND mission that could be used as a force multiplier in a CM response. The operator aids provide state and local agencies with guidance on how to effectively use the PRND equipment during a CM response.

The usefulness of PRND equipment during a CM response was categorized into the following operational categories: Exposure Rate (both Exposure Rate Monitoring and Radiation Survey), Integrated Dose (Worker Exposure Monitoring), Contamination Screening (for both person and objects) and Isotope Identification. By using appropriate PRND equipment for each operational category, the first responder will provide critical information to other radiological emergency response organizations.

It is imperative that the responding agency determine, in advance, the capabilities of their PRND equipment and the applicability of the PRND equipment to the CM operational categories. The operational aids provide some guidance on instrument applicability to each of the CM operational categories.

# RadResponder: The National Tool for Collecting and Sharing Critical Radiological Data

As part of the Nuclear/Radiological Incident Annex to the Response and Recovery Federal Interagency Operations Plan, the RadResponder Network is the National Standard and Whole Community solution for the management of radiological data. The Network is the product of collaboration among the Federal Emergency Management Agency (FEMA), Department of Energy (DOE) / National Nuclear Security Administration (NNSA) and the Environmental Protection Agency (EPA), and can be used by responders to bridge the mission gap between PRND and CM.

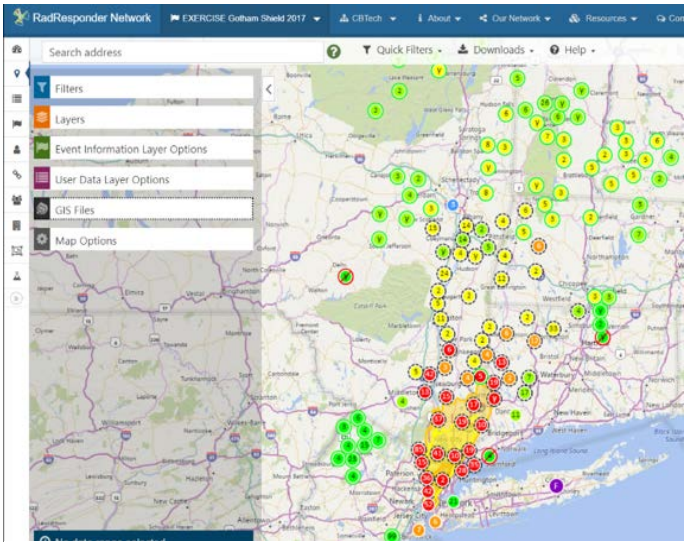

RadResponder Shared Event Space with modeling & data

RadResponder is now provided free to all federal, state, local, tribal and territorial response organizations, allowing users to uniformly establish a flexible, efficient and networked approach to the management of radiological data. RadResponder can be accessed on smartphones and tablets (iOS, Android, Windows), and via the web (www.radresponder.net), allowing it to be seamlessly and rapidly employed at all levels of government during a radiological or nuclear emergency response.

The Network also provides tools to manage personnel, equipment and field teams, which helps to maintain data quality standards. The RadResponder mapping utility allows for the geospatial display of real-time data, responder locations, modeling, user geographic information system (GIS) files, fixed sensors, facilities and sampling locations. GIS file exports ensure RadResponder is interoperable with other geospatial situational awareness tools.

## Partnerships and Data Management

Partnership functions within the Network provide flexibility for organizations to manage with whom and under what circumstances radiological data is shared.




Event Map with clustered data and Modeling

Events can be managed in RadResponder to allow multiple jurisdictions to collect and share radiological data and event information. RadResponder also incorporates atmospheric dispersion modeling into events, allowing for rapid display of plume models to support operational planning and decision making. Additionally, via the RadResponder Application Program Interface, organizations and equipment manufacturers can integrate their Bluetooth equipment and live data feeds into the system to provide real-time monitoring and situational awareness.

**To sign up for an account, go to:**
www.radresponder.net/app/index#account/request
For more information, contact the RadResponder Team at:
support@radresponder.net

Action Needed

# Information Needed Before Event

## 1. Understand the Capabilities of your PRND Equipment

Make/Model: _____

**Type (circle one):** PRD, SPRD, ER-PRD, RIID, Backpack

Fill in this table with information about your instrument:

| Key Capability | Comment |
|---|---|
| Operational Range:<br>*What is the maximum exposure rate it can measure?* | |
| Over-range Indication:<br>*How will you know if you are in a radiation field outside of its operational range?* | |
| Display (quantity/unit):<br>*What are the exposure or dose rate units: mR/h or mrem/h, etc.?* | |
| Accumulated Dose:<br>*Is it capable of measuring and storing the accumulated dose? (yes/no)* | |
| Alarm Setting(s):<br>*Exposure Rate and/or*<br>*Accumulated Exposure or Dose* | |
| Able to detect 1 µCi of Cs-137? *(yes/no)* | |
| Able to detect 20 µCi of Cs-137? *(yes/no)* | |
| Nuclide identification *(yes/no)* | |

# Information Needed Before Event

## 2. Compare the Capabilities of your PRND Equipment to the CM Mission Categories Requirements

The next four pages are to assist in determining if your PRND equipment would be applicable to different CM missions. Two tables are provided per page to assist in this determination. Not all PRND equipment will meet all the requirements of the CM mission.

It is extremely advantageous to determine the applicability of your PRND equipment before the event occurs. This will improve worker health and safety, assist in mission planning, and provide useful data to assist in protective action decisions.

The tables use the following acronyms:

- **Personal Radiation Detector (PRD)**
- **Spectroscopic Personal Radiation Detector (SPRD)**
- **Extended Range Personal Radiation Detector (ER-PRD)**
- **Personal Emergency Radiation Detectors (PERD)**
- **Radio-Isotope Identification Device (RIID)**
- **Human-Portable Detector (Backpack)**
- **Vehicle Mounted (VM)**

The tables will reference the Cold, Hot and Dangerous zones. The zones and definitions are as follows:

| |
|---|
| **Cold Zone ≤ 10 mR/hr** |
| **Hot Zone > 10 mR/hr and < 10,000 mR/hr** |
| **Dangerous Zone ≥ 10,000 mR/hr** |

## Exposure Rate

If your equipment meets the following criteria, it may be used for ***Exposure Rate Monitoring***:

| System Requirements for Exposure Rate Monitoring | | | |
|---|---|---|---|
| **Function** | **Cold Zone** | **Hot Zone** | **Dangerous Zone** |
| Operational Range | (✓) 0.1 – 10 mR/hr<br>(-) 0.1 – 2 mR/hr | (✓) 1 – 10,000 mR/hr | (✓) 1 – 999,000 mR/hr<br>(-) 1 – 100,000 mR/hr |
| Exposure Rate Alarm Type | (✓) Audible/visible<br>(-) other | (✓) Audible/visible | (✓) Audible/visible |
| Over-range Indication | (✓) Audible/visible<br>(-) other | (✓) Audible/visible | (✓) Audible/visible |
| Display | (✓) Exposure or dose rate<br>(-) Other | (✓) Exposure or dose rate | (✓) Exposure or dose rate |
| *A check mark (✓) denotes the optimal capability, whereas a dash (-) denotes a marginal capability. | | | |

| Exposure Rate Monitoring | PRD & SPRD | ER-PRD | PERD | RIID | Backpack & VM |
|---|---|---|---|---|---|
| Cold Zone | ■ | ■ | ■ | O | O |
| Hot Zone | ⦸ | O<br>■ if H | ■ | ⦸ | ⦸ |
| Dangerous Zone | ⦸ | ⦸<br>■ if G, H | ■ | ⦸ | ⦸ |

Summary Table Legend:
■ Appropriate for the mission
O Marginal, meets minimum requirement
⦸ Insufficient for the mission

Key Notes:
G: Instruments with capability for very high range (up to 999 R hr-1) functionality.
H: Instruments with loud audible and vibration alarm.

## Radiation Survey

# If your equipment meets the following criteria, it may be used for performing *Radiation Surveys*:

| System Requirements for Radiation Survey | | |
|---|---|---|
| **Function** | **Cold Zone** | **Hot Zone** |
| Operational Range | (✓) 0.005 – 10 mR/hr<br>(-) 0.005 – 2 mR/hr | (✓) 1 – 10,000 mR/hr |
| Exposure Rate Alarm Type | Not required | (✓) Audible/visible |
| Over-range Indication | Not required | (✓) Audible/visible |
| Display | (✓) Exposure or dose rate | (✓) Exposure or dose rate |
| *A check mark (✓) denotes the optimal capability, whereas a dash (-) denotes a marginal capability. | | |

| Radiation Survey | PRD & SPRD | ER-PRD | PERD | RIID | Backpack & VM |
|---|---|---|---|---|---|
| Cold Zone | O<br>■ if C | ■ | O<br>■ if B | ■ | ■ |
| Hot Zone | ⦸ | ■ | ■ | ⦸ | ⦸<br>■ if F |

Summary Table Legend:
- ■ Appropriate for the mission
- O Marginal, meets minimum requirement
- ⦸ Insufficient for the mission

Key Notes:
B: Instruments with capability for low range (down to 0.1 mR hr-1) exposure monitoring.
C: Instruments that readout in exposure or dose rate and do not automatically adjust for background.
F: Instruments with capability for high range (up to 10 R/h) functionality.

## Integrated Dose

**If your equipment meets the following criteria, it may be used for *Worker Exposure Monitoring*:**

| System Requirements for Worker Exposure Monitoring | | | |
|---|---|---|---|
| **Function** | **Cold Zone** | **Hot Zone** | **Dangerous Zone** |
| Operational Range | (✓) 1 – 10 mR/hr | (✓) 1 – 10,000 mR/hr<br>(-) 1- 1000 mR/h | (✓) 1 – 999,000 mR/hr |
| Integrated Exposure / Dose Range | (✓) 1 – 100,000 mR or mrem | (✓) 1 – 100,000 mR or mrem | (✓) 1 – 999,000 mR or mrem |
| Alarm Type: Exposure Rate and/or Integrated Dose | Not required | (✓) Audible/visible<br>(-) No audio | (✓) Audible/visible |
| Over-range Indication | Not required | (✓) Audible/visible<br>(-) No audio | (✓) Audible/visible |
| *A check mark (✓) denotes the optimal capability, whereas a dash (-) denotes a marginal capability. | | | |

| Worker Exposure Monitoring | PRD & SPRD | ER-PRD | PERD | RIID |
|---|---|---|---|---|
| Cold Zone | ⦸<br>■ if A | ⦸<br>■ if A | ■ | ⦸<br>O if A |
| Hot Zone | ⦸ | ⦸<br>■ if A, H | ■ | ⦸ |
| Dangerous Zone | ⦸ | ⦸<br>■ if A, H | ■ | ⦸ |

Summary Table Legend:
■ Appropriate for the mission
O Marginal, meets minimum requirement
⦸ Insufficient for the mission

Key Notes:
A: Instruments with capability to track accumulated exposure or dose.
H: Instruments with loud audible and vibration alarm.

## Contamination Screening

**If your equipment meets the following criteria, it may be used for *Contamination Screening*:**

| System Requirements for Contamination Screening | |
|---|---|
| **Screening Function** | **Cold Zone** |
| Whole Body Frisk | (✓) 1 µCi Cs-137 |
| Highly Contaminated Individuals | (✓) 20 µCi Cs-137 |
| Objects | (✓) 1 µCi Cs-137 |
| *A check mark (✓) denotes the optimal capability at scan speeds and distances as outlined in the respective CM procedure in Section 2 of this operator aid. | |

| Contamination Screening | PRD & SPRD | ER-PRD | PERD | RIID | Backpack & VM | Radiation Portal Monitors |
|---|---|---|---|---|---|---|
| Cold Zone | ■ | ■ | ○<br>■ if B | ■ | ■ | ■ |

Summary Table Legend:
- ■ Appropriate for the mission
- ○ Marginal, meets minimum requirement
- ⦸ Insufficient for the mission

Key Notes:
B: Instruments with capability for low range (down to 0.1 mR $hr^{-1}$) exposure monitoring.

# Information Needed Before Event

## 3. Assign the CM Mission Capabilities to your PRND Equipment

Make/Model: _____

| CM Missions | Zone |
|---|---|
| ❑ Exposure rate | ❑ Cold |
| | ❑ Hot |
| | ❑ Dangerous |
| ❑ Radiation survey | ❑ Cold |
| | ❑ Hot |
| ❑ Worker dose | ❑ Cold |
| | ❑ Hot |
| | ❑ Dangerous |
| ❑ Contamination screening | ❑ Cold |
| ❑ Nuclide identification | ❑ Cold |

# Consequence Management Procedures

# Using PRND Equipment

The following job aids assume that the responder is familiar with the operation of their PRND equipment. The job aids highlight specific techniques to ensure the data collected is useful for radiological data assessment.

The initial step before all missions is to ensure that the PRND equipment is ready to use prior to responding.

- **Check the equipment according to local procedures (battery checks, visual inspection, etc.).**
- **Review any local job aids.**
- **Note at what level audible/visual alarms are set. Be aware that many default alarms are set to respond to very low levels of radioactivity, whereas a CM response will have higher levels of radioactivity.**

# Consequence Management Procedures

## Using PRND Equipment

**Exposure Rate Monitoring**

**Proper procedures need to be in place to warn a worker when they may be approaching a Hot Zone or Dangerous area. When a dose/exposure rate turn back level has been established, PRND equipment will be issued to either each individual worker or group of workers should equipment be limited.**

| | |
|---|---|
| Cold Zone | ≤ 10 mR/hr |
| Hot Zone | > 10 mR/hr < 10,000 mR/hr |
| Dangerous Zone | ≥ 10,000 mR/hr |

My turn back exposure rate is: _____

**Start**

**Appropriate PRND:** PRD, SPRD, ER-PRD, PERD, RIID, Backpacks, Vehicle Mounted

**Step 1**

**For optimal exposure monitoring:**

- ❑ Wear the PRND equipment where it is visible, preferably between the waist and neck.
- ❑ If it is highly likely that the responder will become contaminated during the shift, wrap the PRND equipment in plastic and secure it to the body.

**Frequently check the PRND equipment.**

- ❑ Check your exposure rate during operations and as you progress toward the release point. Compare exposure rate to your turn back level.

**Depending on the noise levels in the area, audible alarms may not be heard.**

**Step 2**

**If warranted, communicate your location to command when crossing into another zone** (Cold Zone ≤ 10 mR/hr, Hot Zone > 10 mR/hr and < 10,000 mR/hr, or Dangerous Zone ≥ 10,000 mR/hr or 10 R/hr). Reporting locations of the zones will help with further mission planning.

**Step 3**

**Observe turn back limits and severely limit the time in the Dangerous Zone.**

**NOTE:** Depending on the alarm set point, the PRND equipment may alarm at levels that do not correspond to the exposure rates of the zone boundaries. Check the display for the exposure rate values and units.

# NOTES

# Consequence Management Procedures Using PRND Equipment

## Radiation Survey

Radiation surveys can be performed in both the Cold and Hot Zone. Surveys should NOT be taken in the dangerous radiation zone. Radiation survey results are important data to pass onto radiological emergency response assets.

| | |
|---|---|
| Cold Zone | ≤10 mR/hr |
| Hot Zone | > 10 mR/hr <10,000 mR/hr |
| Dangerous Zone | ≥10,000 mR/hr |

My turn back exposure rate is: _____

## Start

**Appropriate PRND:** PRD, SPRD, ER-PRD, PERD, RIID, Backpacks, Vehicle Mounted

**Step 1** **Ensure that the equipment is ready for use prior to entering the work area.**

- ❑ Bring supplies to capture data (examples: GPS, laptop, cell phone, paper/pen, etc.).

**Step 2** **To take a radiation survey:**

- ❑ Hold the PRND equipment approximately 1 meter (~3 feet) above the ground.
- ❑ Find an undisturbed area (preferably a flat, non-plowed field, away from major landscape changes like ditches or roads, and not under overhead obstructions like trees or overpasses).
- ❑ Let the detector stabilize for at least 10 seconds.
- ❑ Record the value and units.
- ❑ Record the average value over the survey time. If the average is not easily calculated, then record the maximum value.
- ❑ Ensure that the proper units are recorded to distinguish between commonly mistaken units (examples: mR/hr and µR/hr or mrem/hr and µrem/hr).
- ❑ Record the location of the survey.
- ❑ GPS coordinates are preferred, but street intersections would be acceptable.
- ❑ Record your name, agency and PRND equipment make/model.

**Step 3** **Repeat Step 2 at different locations.**

**Step 4** **Send the survey results** (with the value, units, location, PRND equipment make/model, surveyor name and agency) to incident command or follow local procedures for reporting.

Ensure that you are paying attention to your integrated dose.

# NOTES

# Where Should I Perform Radiation Surveys?

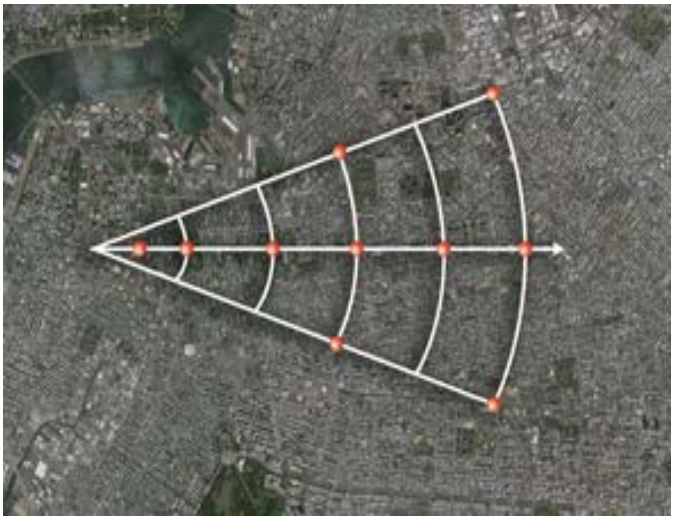
The **Ten Point Monitoring Strategy** is a standardized methodology for quickly gathering required radiological monitoring information after a potential release. Use of those 10 points would quickly verify the initial plume projection and allow follow on detailed monitoring to be performed.

To execute the Ten Point Monitoring Strategy, the initial responders should gather radiological monitoring data for 10 points in the downwind direction. If the downwind direction is not known, survey in all directions around the release point until the direction of deposition is determined.

Conditions or local terrain may prevent access to some of the 10 points. If that occurs, responders should collect as many of the 10 points as possible. The spacing between the points may vary depending on the severity of the incident.

RAP or the Consequence Management Home Team can help initial responders select 10 locations. An example of the Ten Point Monitoring Strategy is provided in the following figure.

**General guidance on the 10 point locations:**



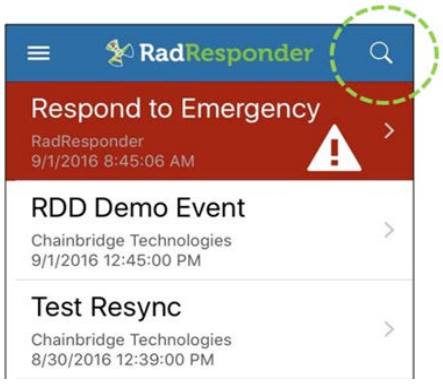
- ❑ One point directly downwind from the release point and as close as possible to the release that is safe for responders.
- ❑ 0.5, 1, 1.5, 2 and 2.5 miles directly downwind.
- ❑ 1.5 and 2.5 miles downwind at 22.5 degrees on both sides of plume centerline.
- ❑ Scale distances as necessary.

# Collecting Radiation Surveys Using the RadResponder Mobile App

*The RadResponder Network can facilitate the collection and sharing of survey data from a variety of equipment to include PRDs. To enter data into the Network, perform the following steps:*

1. Open the app and log in.


2. Tap an event to select, or use the magnifying glass to search for an event for which you do not yet have access.

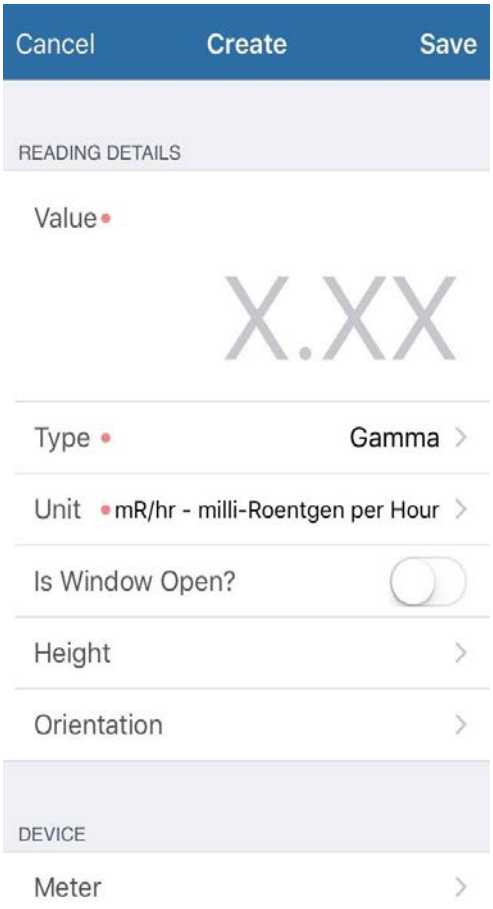



3. You will be taken to the "Record Data" screen for that event. Tap "Surveys."


4. To record a new survey, tap "Create" in the top right of your screen.


5. Tap each field to select an option. Red dots indicate a required field. Make sure to scroll down to access all fields.

*Select your field team to filter the lists of meters and probes by equipment assigned to your team.*

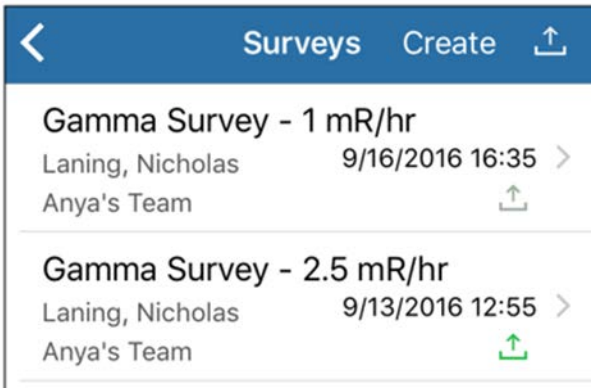



6. Tap "Save."

   *If you have a Wi-Fi/data connection, your data will automatically be uploaded to the RadResponder site. If not, they will be saved locally to your mobile device and will be uploaded automatically when you regain connectivity.*

7. After your record is saved, a new Create Survey form will open automatically, with some information pre-filled. Repeat steps 5-6, OR

8. Click Cancel to view a list of saved Survey records for that event. The app will automatically upload locally cached records once a connection is detected.




= already uploaded to the site

= not uploaded (saved locally)

# Consequence Management Procedures Using PRND Equipment

**Worker Exposure Monitoring**

Tracking accumulated exposure or dose is more meaningful than tracking an exposure or dose rate because emergency dose limits are established for accumulated exposure or dose.

5 rem Occupational exposures
10 rem Critical infrastructure
25 rem Lifesaving measures
>25 rem Protecting large populations

*EPA 2017*

My turn back exposure rate is: _____

**Start**

Appropriate PRND: PRD, SPRD, ER-PRD, PERD, RIID

**Step 1** **For optimal integrated dose/exposure monitoring:**

- ❑ Wear the PRND equipment where it is visible, preferably between the waist and neck. If it is highly likely that the responder will become contaminated during the shift, wrap the PRND equipment in plastic and secure it to the body.
- ❑ Frequently check the PRND display for the exposure value and unit.
- ❑ Compare your exposure to the exposure turn back level.
- ❑ Depending on the noise levels in the area, audible alarms may not be heard.

**NOTE:** Depending on the alarm set point, the PRND equipment may alarm at levels that do not correspond to the exposure rates of the zone boundaries.

**Step 2** **Observe accumulated dose/exposure turn back limits.**

- ❑ Default emergency worker guidelines exist at 5000, 10,000 or 25,000 mrem, and are based on the urgency of activities and knowledge of the risks involved.

**Step 3** **Be aware of the amount of accumulated dose/exposure acquired on the way to the work location.** What accumulated dose/exposure was acquired on the way into the work location will most likely occur on the way out of the work location. Take this into account when working with turn back limits.

**Step 4** **Follow local procedures to record/report the accumulated dose/exposure of the team to the health and safety officer/group when the work shift has ended.**

# Consequence Management Procedures Using PRND Equipment

## Contamination Screening for Highly Contaminated Individuals

This procedure will focus on screening of highly contaminated individuals who are a priority for decontamination and follow up medical evaluation. The goal of the screening is to be able to identify 20 µCi of Cs-137 on skin.

**Contamination Screening Goal**

20 µCi Cs-137 for fixed plus loose contamination

**Start**

Appropriate PRND: PRD, SPRD, Backpack

**Step 1** **Verify screening levels at which further action is required.**

**Step 2** **Set up a contamination screening location in an area that is close to background levels of contamination.**

- ❑ The goal is to find a screening location in an area with no or very little contamination so the environment will not interfere with the screening.

**Step 3** **Perform targeted screening for highly contaminated individuals in a group (reception line).**

**NOTE:** Setting audible alarms is undesirable in public monitoring due to the stress the alarm could cause.

- ❑ Walk slowly past individuals no faster than 12 inches per second with the PRD at 12 inches from the individuals, OR
- ❑ Screen the individual 12 inches away from the most probable contaminated parts of the body (no faster than 12 inches per second), OR
- ❑ Have individuals walk slowly (no faster than 12 inches per second) past a backpack.

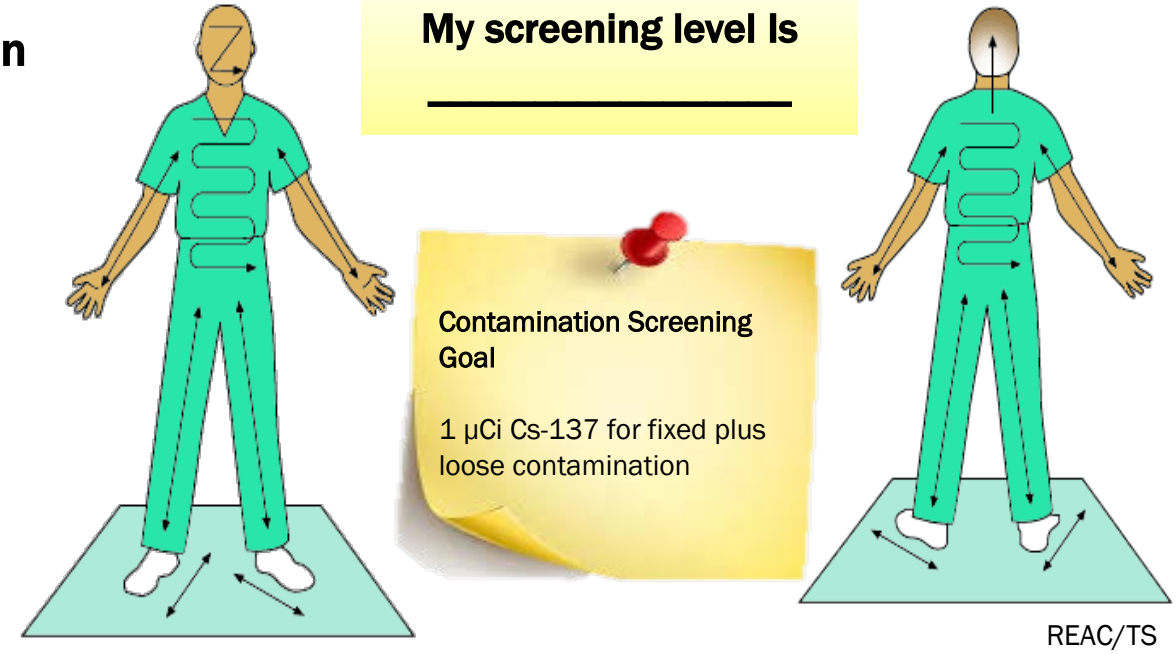
**NOTE:** The alarm function will respond quicker than the numerical values on the display.

**Step 4** **If the PRD alarms or screening levels are exceeded, then:**

- ❑ Locate the contaminated individual and follow local guidance.
- ❑ Possible options are to remove outer layer of clothing and perform a detailed frisk (see next job aid for details), OR
- ❑ Refer the person to a Community Response Center, or similar setting, for more rigorous screening and/or decontamination.

# Contamination Screening – Whole Body Frisk

**My screening level is** _____



**Contamination Screening Goal**

1 µCi Cs-137 for fixed plus loose contamination

REAC/TS

## Appropriate PRND: PRD, SPRD

1

- Verify screening levels at which further action is required.
  - Set up a contamination screening location in an area that is close to background levels of contamination.

2

- Position person to be scanned:
  - Standing upright on a clean pad;
  - Feet spread slightly; and
  - Arms extended from body, palms up, fingers extended from the hand.

3

- To frisk personnel or objects for release or additional decontamination:
  - Avoid contacting the person or object with the instrument. If possible, place the PRD in a plastic bag.
  - Focus screening on most probable contaminated parts of the body starting at the top of the head working downward (head, hands, knees and feet).
  - Screen the individual 2 inches away from the most probable contaminated parts of the body at a speed of around 6 inches per second.

4

- Quicker screening times may be warranted if there are large crowds.
  - Screen the individual 2 inches away from the most probable contaminated parts of the body at a speed of around 6-12 inches per second.
  - Reliably detecting contaminated individuals starts to decrease when scanning at speeds quicker than 12 inches per second.

# Consequence Management Procedures Using PRND Equipment

## Contamination Screening for Objects

This procedure will focus mainly on the screening of objects out of the contaminated area. The goal of the screening is to be able to identify 1 µCi (loose plus fixed) of Cs-137 on objects.

The screening level is: _____

**Contamination Screening Goal**

1 µCi Cs-137 for fixed plus loose contamination

## Start

**Appropriate PRND:** PRD, SPRD, ER-PRD, PERD, RIID, Backpack, Vehicle Mounted, RPM

**Step 1** **Verify screening levels at which further action is required.**

**Step 2** **Set up a contamination screening location that is in an area that is close to background levels of contamination.** The goal is to find a screening location in an area with no or very little contamination so the environment will not interfere with the screening.

**Step 3** **To perform contamination screening with PRD:**

- ❑ Avoid touching the object.
- ❑ Focus screening on most probable contaminated parts of the object.
- ❑ Screen the object 2 inches away from the most probable contaminated parts of the object at a speed of around 6-12 inches per second.
- ❑ Quicker screening times may be warranted if there are multiple large objects (i.e., vehicles). Screen the object 2 inches away from the most probable contaminated parts of the object at a speed of around 12-24 inches per second.

**Step 4** **To perform contamination screening with a backpack, vehicle mounted detector or portal monitor:**

- ❑ Follow manufacturer's instructions in setup and use.
- ❑ Do not allow the object to touch the detectors.
- ❑ Direct the object slowly through the portal, or by the vehicle mounted detector or backpack.
- ❑ Alternatively, walk closely around the object with a backpack.

**NOTE:** Quicker screening times may be warranted if there are multiple large objects (i.e., vehicles). If the screening levels are exceeded, then follow local guidance (decontamination, hold for decay, disposal as radioactive waste, etc.).


# NOTES

# Consequence Management Procedures Using PRND Equipment

## Isotope Identification

Identifying which radionuclides were dispersed after a radiological incident is one of the most crucial steps in radiological emergency response. This is done using PRND equipment with spectroscopic capabilities. Typically, these PRND equipment are useful in the Cold Zone where exposure rates are less than 2 mR/hr.


## Start

| | |
|---|---|
| **Step 1** | **Bring supplies to capture data** (examples: GPS, laptop, cell phone, paper/pen, USB, etc.). |
| **Step 2** | **Take a radiation survey.**<br>❑ See the operator aid "Radiation Survey" on page 19 for details. |
| **Step 3** | **To survey for nuclide identification:**<br>❑ Find an undisturbed area (preferably a flat, non-plowed field, away from major landscape changes like ditches or roads, and not under overhead obstructions like trees or overpasses).<br>❑ Allow PRND equipment to collect enough data to generate a spectrum (at least 1 minute or until the set time of PRND equipment is complete).<br>❑ If radionuclides were identified, record the identified nuclide, the confidence percentage (if available) and the estimated activity of the nuclide (if available).<br>❑ Save the spectrum (if available).<br>❑ Record the location of the survey.<br>❑ GPS coordinates are preferred, but street intersections would be acceptable. |
| **Step 4** | **Repeat Step 3 at different locations.** |
| **Step 5** | **Send the survey results** (identified nuclides, the saved spectrum, the location, the PRND equipment make/model, the radiation survey results and your name) to incident command or follow local procedures for reporting. |

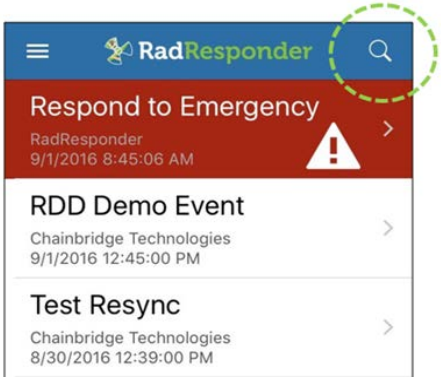

# NOTES

# Isotopic Identification Using the RadResponder Mobile App

The RadResponder Network can be used to facilitate the collection and sharing of isotopic identification. To enter spectroscopic data, perform the following steps:

1. Open the app and log in.


2. Tap an event to select, or use the magnifying glass to search for an event for which you do not yet have access.

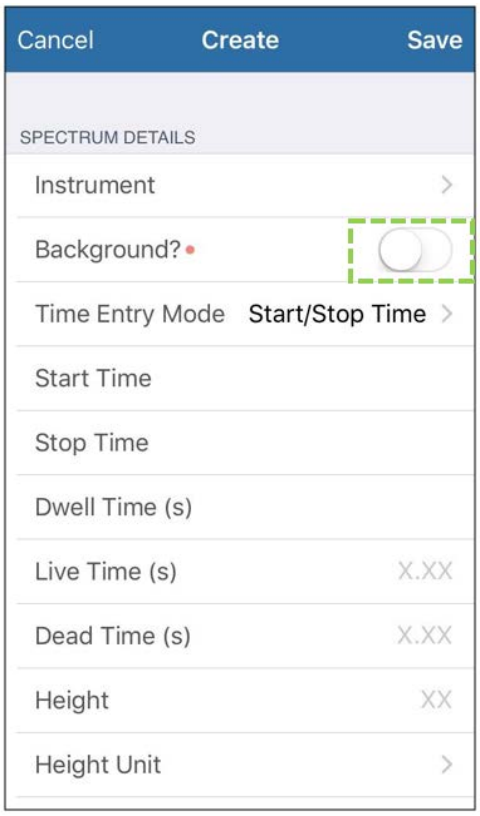



3. You will be taken to the "Record Data" screen for that event. Tap "Spectra."


4. To record a new spectrum, tap "Create" in the top right of your screen.


5. Tap each field to select an option. **Red dots indicate a required field.** Make sure to scroll down to access all fields.

*Turning background on (green) indicates that this is a background record.*




6. Tap "Save."
   *If you have a Wi-Fi/data connection, your data will automatically be uploaded to the RadResponder site. If not, they will be saved locally to your mobile device and will be uploaded automatically when you regain connectivity.*

7. After your record is saved, a new Create Spectra form will open automatically, with some information pre-filled. Repeat steps 5-6, OR…

8. Click Cancel to view a list of saved Spectra records for that event. The app will automatically upload locally cached records once a connection is detected.


= already uploaded to the site

= not uploaded (saved locally)

# References and Information

This section contains contact information for federal radiological emergency assets and radiation health and safety concepts. This is intended to serve as a quick reference for responders and for quick mission planning.

# Contact Information for RAP Assistance

NNSA's Radiological Assistance Program (RAP) is the nation's premier first-response resource in assessing an emergency situation and advising decision-makers on further steps to take to evaluate and minimize the hazards of a radiological incident. RAP provides resources (trained personnel and equipment) to evaluate, assess, advise, isotopically identify, search for and assist in the mitigation of actual or perceived nuclear or radiological hazards. The RAP is implemented on a regional basis, with coordination between the emergency response elements of state, local and federal agencies. Regional coordination is intended to provide a timely response capability.

## RAP Regions


| RAP Region | 24-Hour Telephone for Assistance |
|---|---|
| 0 | (301) 817-3301 |
| 1 | (631) 344-2200 |
| 2 | (865) 576-1005 |
| 3 | (803) 725-3333 |
| 4 | (505) 845-4667 |
| 5 | (630) 252-4800 |
| 6 | (208) 526-1515 |
| 7 | (925) 422-8951 |
| 8 | (509) 373-3800 |

**The Radiological Assistance Program can be reached at any time by contacting the DOE Watch Office 24-hour Number: (202) 586-8100**

# Contact Information for FRMAC Assistance

The Federal Radiological Monitoring and Assessment Center (FRMAC) is a federal asset available upon request by the Department of Homeland Security and state and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency organization with representation from the National Nuclear Security Administration (NNSA), the Department of Defense, the Environmental Protection Agency, the Department of Health and Human Services, Federal Bureau of Investigations and other federal agencies. NNSA has the responsibility to maintain the operational readiness and to deploy the FRMAC upon request.

Radiological emergency response professionals within the Department of Energy's national laboratories support the Consequence Management Home Team (CMHT), Consequence Management Response Team (CMRT), Radiological Assistance Program (RAP), National Atmospheric Release Advisory Center (NARAC), Aerial Measuring System (AMS) and the Radiation Emergency Assistance Center/Training Site (REAC/TS). These teams supplement the FRMAC to provide:

- Atmospheric transport modeling;
- Radiation monitoring;
- Radiological analysis and data assessments; and
- Medical advice for radiation injuries.

In support of field operations, the FRMAC provides geographic information systems, communications, mechanical, electrical, logistics and administrative support. The size of the FRMAC is tailored to the incident.

**First responder data for consequence management incidents (i.e., where wide spread radioactive contamination has occurred) should be given to the Consequence Management Home Team (CMHT) as soon as possible. CMHT can be activated upon request through the DOE Watch Office 24-hour Number: (202) 586-8100.**

**When the CMHT is activated, send data via the following:**
**cmht@nnsa.doe.gov**

**Or share via:**

RadResponder Network

# Health and Safety Information: Stay Times

**Safety**

**Exposure rates or total doses in the shaded areas exceed guidance levels and are to be used only when critical or lifesaving actions are warranted. This table is for gamma only – if airborne alpha or beta are present, appropriate respiratory protection must be used.**

| *EPA May 2017<br>**Exposure rates** | **Up to 5,000 mrem limit for emergency operations** | **Up to 10,000 mrem when lower dose not practicable, only for protecting valuable property or infrastructure** | **Up to 25,000 mrem when lower dose not practicable, only for lifesaving or protecting large populations** |
|---|---|---|---|
| 100 mR/hr | 50 hours | 100 hours | 250 hours |
| 1000 mR/hr | 5 hours | 10 hours | 25 hours |
| 5000 mR/hr | 1 hour | 2 hours | 5 hours |
| 10,000 mR/hr | 30 min | 1 hour | 2.5 hours |
| 25,000 mR/hr | 12 min | 24 min | 1 hour |
| 50,000 mR/hr | 6 min | 12 min | 30 min |
| 100,000 mR/hr | 3 min | 6 min | 15 min |

| **Zone Definitions per NCRP Report 165** |
|---|
| Cold Zone ≤ 10 mR/hr |
| Hot Zone > 10 mR/hr and < 10,000 mR/hr |
| Dangerous Zone ≥ 10,000 mR/hr |

# When Acute Whole Body Radiation Doses Become Dangerous

Safety

**The four stages of Acute Radiation Sickness (starting around 100 rad or 100,000 mR)**

**Prodromal Stage**: Nausea, vomiting, anorexia and diarrhea. Occurring from minutes to days after exposure.

**Latent Stage:** Patient can look and feel well for hours up to weeks.

**Manifest Stage:** Symptoms depend on specific syndrome and last from a few hours to months.

**Recovery or Death:** Most patients who do not recover will die within several months of exposure. Recovery can take weeks to years.

| Dose (Rad)* | Exposure (mR) | Potential Biological Effects |
|---|---|---|
| 1,000 | 1,000,000 mR | Death due to central nervous system damage within hours. |
| ≥ 800 | ≥ 800,000 mR | Neurovascular Syndrome: death occurs within 3 days. |
| ≥ 600 | ≥ 600,000 mR | Gastrointestinal (GI) Syndrome: survival is extremely unlikely with this syndrome. Destructive and irreparable changes in the GI tract and bone marrow. Death usually occurs within 2 weeks. |
| 350 | 350,000 mR | No treatment: death within 60 days for 50% of exposed population (with treatment, up to 800 Rad). |
| 300 | 300,000 mR | Female sterility. |
| 200 | 200,000 mR | Male sterility. |
| ≥ 100 | ≥ 100,000 mR | Hematopoietic Syndrome: begin symptoms of acute radiation sickness. Medical attention required at this dose level or greater. |
| 25 | 25,000 mR | Detectable blood changes. |
| 15 | 15,000 mR | Temporary decreased sperm count. |

***EPA May 2017**

# Expanded EPA Dose Guidance



| EPA Emergency Responder Dose Guidance | | |
|---|---|---|
| Dose Limit[a] (mrem*) | Activity | Condition |
| 5,000 | All | None |
| 10,000 | Protecting valuable property | Voluntary; lower dose not practicable |
| 25,000 | Lifesaving or protection of large populations | Voluntary; lower dose not practicable |
| >25,000 | Lifesaving or protection of large populations | **Only on a voluntary basis to persons fully aware of the risks involved** |

**[a] Total effective dose equivalent (TEDE), which is the sum of the external effective dose equivalent and the committed effective dose equivalent, to non-pregnant adults from exposure and intake during an emergency situation. These limits apply to all doses from an incident, except those received in unrestricted areas as members of the public. These are assumed to be once in a lifetime doses.**
*** For x and gamma radiation, mrad ~ mrem ~ mR.**

**Exceeding the administrative control level requires concurrence of the senior EPA official onsite, the Incident Commander, the Health and Safety Officer, or the Radiation Safety Officer.**

## Conversions

**Instruments may read out in different units. Here are some helpful conversions.**

1 R ≈ 1 rad ≈ 1 rem

1 R = 1000 mR = 1,000,000 µR

1 mR = 1000 µR

100 rad = 1 Gy

100 rem = 1 Sv

1 mSv = 100 mrem

1 cpm = 60 cps

1000 cpm = 60,000 cps

1 Bq = 60 dpm

1 pCi = 2.22 dpm

1 µCi = 37,000 Bq = 2,220,000 dpm

1 Ci = 1,000,000 µCi

# Dose Accumulations

Starting dose amount: _____

Ending dose amount: _____

Date and time of shift: _____

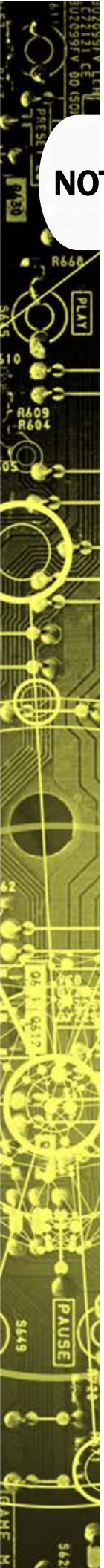
Formula for dose accumulation:

Ending dose – Starting dose = Dose accumulated

**Add accumulated doses from each operational period to determine your total dose.**

**Dose accumulation example form**

| Name | Date/Time In | Date/Time Out | Starting Dose | Ending Dose | Respirator (Y/N) |
|---|---|---|---|---|---|
| John Doe | 9/5/2017 0800 | 9/5/2017 1700 | 0 mrem | 50 mrem | Y- SCBA |
| John Doe | 9/6/2017 0800 | 9/6/2017 1700 | 0 mrem | 25 mrem | N |
| TOTAL DOSE | | | | 75 mrem | |




# NOTES