Use of Preventive Radiological/Nuclear Detection Equipment for Consequence Management

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DOE/NNSA

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PRND and CM Missions

- **Preventive Radiological Nuclear Detection (PRND) :** Detect, locate, and identify radioactive material out of regulatory control.

- **Consequence Management (CM):** Ensure public health and safety against unnecessary exposure to radiation or radioactive fallout as a result of an accidental or deliberate radiological or nuclear release.

Background

- PRND mission supported by significant planning, equipping, and training
- A catastrophic radiological release will overwhelm even the best response plans and infrastructure
- Sophisticated PRND technology can be applied to the CM mission
- Federal project recently completed to support using PRND technology in a CM response

DHS S&T Project Components

- PRND Equipment Categorization identifies PRND that may have an application in CM and their characteristics
- Mission Analysis describes CM mission areas that are appropriate for PRND (exposure control, dose monitoring, radiation survey, contamination survey)
- ConOps provide additional detail on the use of the equipment for the mission areas identified
- Job Aids provide guidance by instrument model on the mission areas and on instrument functions
- Data Management will integrate with RadResponder
- Training developed for just-in-time refresher on use of instruments
- Standards revisions will provide guidance for future PRND system development

Detection Components of CM Mission

- Worker exposure control
- Worker dose monitoring
- Contamination screening for persons and objects
- Radiation survey
- Isotope identification

PRND vs. CM Missions

PRND capabilities that matter for CM:

- Dose rate measurements
- Energy range
- Audible alarm
- Exposure integration
- Visible readout

Problems using PRND for CM:

- Failure at elevated radiation fields
- Quantitative measurements needed
- Energy-dependent responses
- Alpha and beta insensitivity

PRND Equipment

PRND Category	Defining Characteristic	CM Mission Applicability
Personal Radiation Detector (PRD)	Sensitive, detection near background, alarming, N42.32, most common PRND	Environmental and personal contamination screening in Cold Zone
Spectroscopic Personal Radiation Detector (SPRD)	Sensitive, detection near background, alarming, N42.48, isotopic ID	Environmental and personal contamination screening in cold zone, isotopic ID
Extended Range Personal Radiation Detector (ER-PERD)	Sensitive, detection near background, alarming, extended range to 10 R/hr or more	Cold and Hot Zone survey and responder exposure control
Personal Emergency Radiation Detectors (PERD)	High range, alarming, operates at >10 R/hr, N42.49A, harsh environments	Detection and entry into Hot Zone, exposure control, possible dose monitoring
Radioisotope Identification Device (RIID)	Sensitive, detection near background, isotope ID, N42.34	Isotope ID for public safety, environmental and contamination surveys
Human-Portable Backpack	Very sensitive, large volume detector, N42.43	Environmental and personal contamination screening in Cold Zone
Vehicle-Mounted Detection System	Extremely sensitive, large volume detector, N42.43	Environmental and personal contamination surveys in Cold Zone
Radiation Portal Monitors	Fixed or transportable, screening for people vehicles or other objects, N42.35, FEMA-REP-21	Personal/object contamination surveys

CM Mission Areas and Instrument Applicability – Cold Zone

	Mission	Personal Radiation Detector (PRD & SPRD)	Extended Range Personal Radiation Detector (ER-PRD)	Personal Emergency Radiation Detectors (PERD) & Monitors	Electronic Personal Dosimeter (EPD)[E]	Radio-Isotope Identification Device (RIID)	Hand-Held Survey Meter (Low Range)	Hand-Held Survey Meter (High Range)	Human-Portable Detector (Backpack) &Vehicle Mounted	Radiation Portal Monitors (RPM)
Cold Zone (< 10 mR/h)	Worker Exposure Control	●	●	●	●	○	○	○	○	⦸
	Worker Dose Monitoring	⦸ ● if A	⦸ ● if A	●	●	⦸ ○ if A	⦸ ○ if A	⦸ ○ if A	⦸	⦸
	Person/Object External Contamination Detection (β/γ)	●	●	○ ● if B	○	●	●	○	●	●
	Radiation Survey (Cold Zone Only)	○ ● if C	●	○ ● if B	⦸	●	●	○	●	⦸
	Isotope Identification[3]	⦸ ● if D (SPRD)	⦸ ● if D	⦸	⦸	●	⦸	⦸	⦸ ● if D	⦸ ● if D

● Appropriate for the mission,
○ Marginal, meets minimum requirement,
⦸ Insufficient for the mission

A: Instruments with capability to track accumulated exposure or dose.
B: Instruments with capability for low range (down to 0.1 mR/h) exposure monitoring.
C: Instruments that readout in exposure or dose rate and do not automatically adjust for background.
D: Instruments with capability for energy spectroscopic analysis

E: dosimeter with capability for read out in the field
F: Instruments with capability for high range (up to 10 R/h) functionality.
G: Instruments with capability for very high range (up to 999 R/h) functionality
H: Instruments with loud audible and vibration alarm

CM Mission Areas and Instrument Applicability – Hot Zone, DRZ

	Mission	Personal Radiation Detector (PRD & SPRD)	Extended Range Personal Radiation Detector (ER-PRD)	Personal Emergency Radiation Detectors (PERD) & Monitors	Alarming Electronic Personal Dosimeter (EPD)	Radio-Isotope Identification Device (RIID)	Hand-Held Survey Meter (Low Range)	Hand-Held Survey Meter (High Range)	Human-Portable Detector (Backpack) &Vehicle Mounted	Radiation Portal Monitors (RPM)
Hot Zone (>10 mR/h)	Worker Exposure Control	⦸	○ ● if H	●	○ ● if H	⦸	⦸	○	⦸	⦸
	Worker Dose Monitoring	⦸	⦸ ● if A, H	●	○ ● if H	⦸	⦸	⦸ ○ if A	⦸	⦸
	Radiation Survey (Hot Zone Only)	⦸	●	●	⦸	⦸	⦸	●	⦸ ● if F	⦸
DRZ (>10 R/h)	Worker Exposure Control	⦸	⦸ ● if G, H	●	○ ● if G, H	⦸	⦸	○	⦸	⦸
	Worker Dose Monitoring	⦸	⦸ ● if A, H	●	○ ● if G, H	⦸	⦸	⦸ ○ if A	⦸	⦸

● Appropriate for the mission,
○ Marginal, meets minimum requirement,
⦸ Insufficient for the mission

A: Instruments with capability to track accumulated exposure or dose.
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D: Instruments with capability for energy spectroscopic analysis

E: dosimeter with capability for read out in the field
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G: Instruments with capability for very high range (up to 999 R/h) functionality
H: Instruments with loud audible and vibration alarm

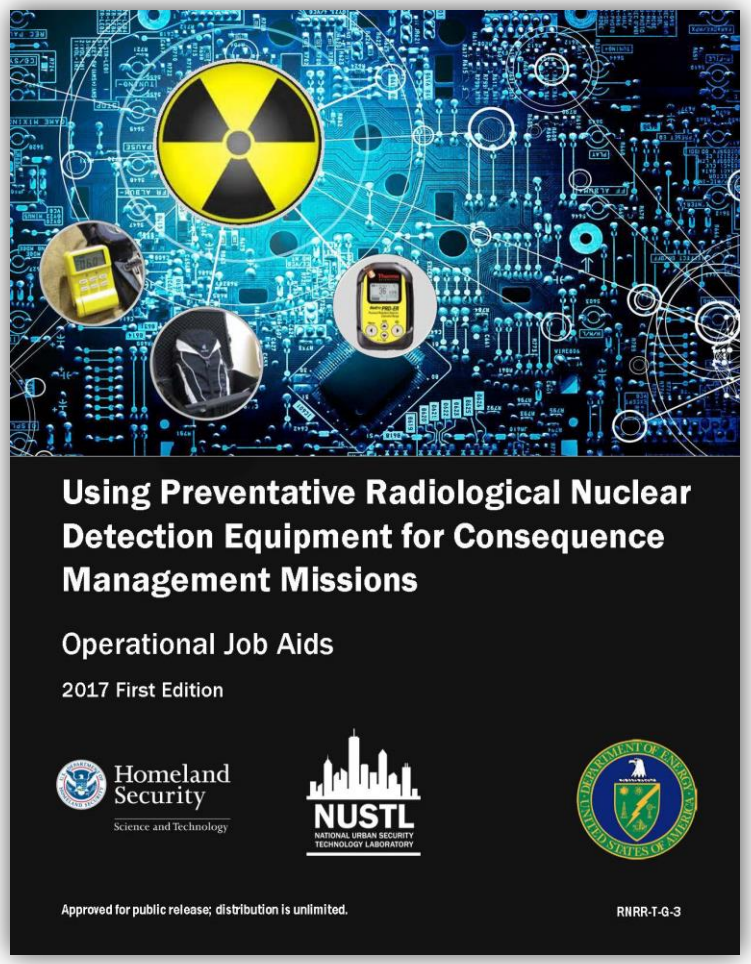
Concepts of Operations

- Outlined general procedures for using PRND for each mission
- Scientifically validate developed CONOPS through laboratory and field testing

Operational Job Aids

- Summarizes appropriate missions by equipment category
- General guidelines for use in each mission area
- Available online:

  https://www.dhs.gov/publication/st-frg-using-preventative-radiological-nuclear-detection-equipment-consequence



Information Needed Before Event

Action Needed

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: *What is the maximum exposure rate it can measure?*	
Over-range Indication: *How will you know if you are in a radiation field outside of its operational range?*	
Display (quantity/unit): *What are the exposure or dose rate units: mR/h or mrem/h, etc.?*	
Accumulated Dose: *Is it capable of measuring and storing the accumulated dose? (yes/no)*	
Alarm Setting(s): *Exposure Rate and/or 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)*	

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 (-) 0.1 – 2 mR/hr	(✓) 1 – 10,000 mR/hr	(✓) 1 – 999,000 mR/hr (-) 1 – 100,000 mR/hr
Exposure Rate Alarm Type	(✓) Audible/visible (-) other	(✓) Audible/visible	(✓) Audible/visible
Over-range Indication	(✓) Audible/visible (-) other	(✓) Audible/visible	(✓) Audible/visible
Display	(✓) Exposure or dose rate (-) 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	■	■	■	○	○
Hot Zone	⦸	○ ■ if H	■	⦸	⦸
Dangerous Zone	⦸	⦸ ■ if G, H	■	⦸	⦸

Summary Table Legend:
■ Appropriate for the mission
○ 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

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, Backpack, 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.

Where Should I Perform Radiation Surveys?

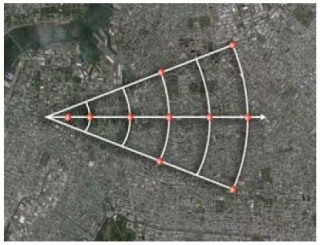
The **Ten Point Monitoring Strategy** is a standardized methodology for quickly gathering required radiological monitoring information after a potential release. Use of those 10 points would quickly verify the initial plume projection and allow follow on detailed monitoring to be performed.

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.

Contamination Screening

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.

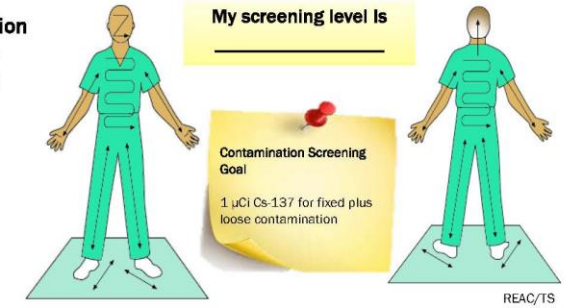
NOTE: The alarm function will respond quicker than the numerical values on the display.

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 _____



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.

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

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

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 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

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	

Equipment-Specific Job Aids

- Canberra UltraRadiac Plus
- RAE Systems GammaRAE IIR
- BNC NucALERT 951
- D-Tect MiniRad-D
- Polimaster PM1703MO-1
- Polimaster PM1703GN
- Thermo Radeye PRD
- Thermo Radeye PRD-ER
- Thermo Radeye SPRD
- Thermo Radeye G
- STE Pager
- STE Pager S

Thermo Radeye PRD-ER: Consequence Management

	Cold Zone < 10 mR/h	Hot Zone > 10 mR/h < 10,000 mR/h	Dangerous Radiation Zone > 10,000 mR/h	Notes
Worker Exposure Control	■	■	⊘	Consider setting Dose and Dose Rate alarms (see back)
Worker Dose Monitoring	■	■	⊘	**Zero Dose** or **Record instrument dose** before beginning and at end of operation
Radiation Survey	■	■	*	
Person/Object Contamination Detection (γ)	■	*	*	Device should alarm for 1 µCi of Cs 137 if scanning 12" per sec at 2" from surface

■ Appropriate ○ Marginal, meets minimum requirement ⊘ Insufficient *This activity not appropriate for this zone

DRAFT September 2017, contact dmamc1@hq.dhs.govt for an electronic copy of job aid LLNL-TR-000000

Lawrence Livermore National Laboratory developed this DRAFT Job Aid for the Department of Homeland Security's National Urban Science and Technology Laboratory "First Responder Use of Preventive Radiological/Nuclear Detection (PRND) Equipment During Consequence Management Operations" project. For more information, contact Benjamin Stevenson <Benjamin.Stevenson@hq.dhs.gov> or Brooke Buddemeier <buddemeier1@llnl.gov>

Cold Zone: This is the area outside of the Hot Zone. There may be some contamination and elevated radiation in this area, but it is below the levels indicated for controlled access. e.g. a Hot Line. For a large incident, the Cold Zone may include areas where protective actions are in place, such as agricultural embargo. There may also be a response agency defined Warm Zone as a transition area between Hot and Cold Zones.
Hot Zone: The NCRP* identifies the Hot Zone boundary by exposure rate or surface contamination levels, > 10 mR/h.
Dangerous Radiation Zone: The NCRP defines a Dangerous Radiation Zone (DRZ) where exposure rate exceeds 10 R/h (10,000 mR/h), within which, actions taken should be restricted to time-sensitive, mission-critical activities, such as lifesaving.

Worker Exposure Control – For photon energies most likely to be encountered in an emergency, the capability to warn the user he/she was approaching or have entered the Hot Zone or the Dangerous Radiation Zone.
Worker Dose Monitoring – The capability to measure integrated exposure or dose and alarm when predetermined levels are exceeded.
Radiation Survey – Instruments that have the capability to display exposure or dose rate can be used to warn the approach to or establish the boundary of a radiation hazard zone or project accumulated dose.
Person/Object External Contamination Detection (γ) – The capability to determine if the contamination on a person or object exceeds predetermined criteria. For this mission, sensitivity is important. The device should be able to detect low levels of contamination on a person or object. In a large-scale event, initial screening levels 1 µCi of Cs-137 spot contamination are considered acceptable. Equipment that could effective 0.1 mR/h could also be used for higher contamination levels, but this would be considered marginal. Testing a Brookhaven National Laboratories, demonstrated that many PRDs could be used to detect 1 µCi of Cs-137 spot contamination at a distance of 2 inches from the surface of clothing, skin, or object and move it at a speed of 12 inches s^{-1}. The Job Aids of the tested equipment will list the appropriate survey height and speed useful for finding 1 µCi of Cs-137 as demonstrated through testing. Untested equipment will list presumed survey height and speed based on how closely the equipment matches tested equipment's sensitivity and specifications.

*National Council on Radiation Protection and Measurement. (2011), "Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers". Report No. 165, ISBN 978-0-9823843-3-6, December 31, 2010.

Thermo Radeye PRD-ER: Consequence Management

Alarm Indication
- Alarm 1: LED slowly blinking, 2-frequency alarm tone
- Alarm 2: LED quick blinking, continuous alarm tone
- NBR-Alarm: LED quick blinking, two frequency alarm tone
- Dose Alarm: LED constantly on, continuous alarm tone, vibrator slow

Display
- Pressing the up arrow/dose key shows current dose rate (on 1st click) and the accumulated dose on 2nd click.

Setting Alarms
- The menu options **Alarm Cnt Rate, Alarm Dose Rate, Alarm Dose**, and **Alarm Level** allow the alarm thresholds to be modified. Changing the value is effected by pressing the left (Change) button if the corresponding "Alarm" is selected.
- To increment the number, press the up/down arrow keys. To go on to the next digit or to quit the edit mode menu use right/left arrow keys. Press Exit key when done.

Recommended Settings	Alarm 2 (High)	Alarm 1 (Low)
Dose	50 R	4.5 R
Dose Rate	10 R/h[1]	10 mR/h

1. *The maximum measurable dose rate of this model is 10,000 mR/hr*

DRAFT September 2017, contact dmamc1@hq.dhs.govt for an electronic copy of job aid

Emergency workers operate under reference values and guidelines rather than regulatory dose limits while working in an emergency exposure situation. Default alarm set points are provided that correlate to national and international reference values and guidelines for emergency response. It is expected that many agencies will have alternate alarm set points defined by internal policy and the Job Aids are being provided in an editable PowerPoint format so that they may change the Job Aids to match their policies.

Exposure Rate Alarms:
- Low Level 10 mR/h (0.01 R/h) is used to identify the ***hot line*** (ASTM), ***outer perimeter*** , or 0.01 R/h boundary of the Hot Zone or Low Radiation Zone
- High level 10 R/h represents the boundary to the Dangerous Radiation Zone or Dangerous Fallout Zone

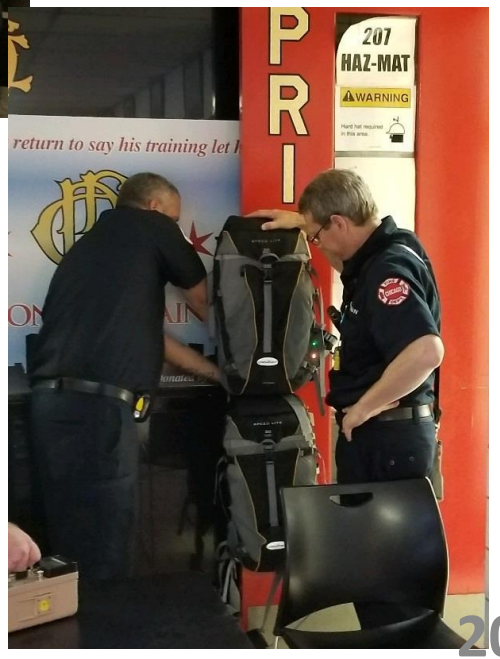
Total Exposure Alarms:
- The 4.5 R low level alarm is **~90% of the 5 rem** standard dose limit for **non-emergency** activities (OSHA, NRC, and DOE). 90% was the chosen alarm level to provide opportunity for the responder to leave the exposure area without exceeding the 5 rem limit. Even in emergency situations, exceeding the 5 rem guideline should only be done when critical, time sensitive missions are required and all appropriate actions are taken to reduce dose.
- The 50 R high level alarm is from the National Council of Radiation Protection and Measurement Report # 165 which states: "When the cumulative absorbed dose to an emergency responder reaches 50 rad (0.5 Gy), a decision be made on whether or not to withdraw the emergency responder from the hot zone. NCRP considers the 50 rad (0.5 Gy) cumulative absorbed dose a decision dose, not a dose limit."

References:

- ASTM E2601-15, Standard Practice for Radiological Emergency Response, http://www.astm.org/cgi-bin/resolver.cgi?E2601, ASTM International, West Conshohocken, PA, 2008, www.astm.org
- Executive Office of the President Homeland Security Council Interagency Policy Coordination subcommittee for Preparedness and Response to Radiological and Nuclear Threats, Planning Guidance for Response to a Nuclear Detonation (June 2010). Office of Science and Technology Policy, available at www.ostp.gov
- CRCPD Publication 06-6, Handbook for Responding to a Radiological Dispersal Device: First Responders Guide – The First 12 Hours, Conference of Radiation Control Program Directors, September 2006, www.crcpd.org
- 29 CFR Part 1910.1096 (Ionizing Radiation) for OSHA's occupational limit. Under the OSHA Ionizing Radiation standard, the annual occupational limit for whole body radiation exposure for adults (age ≥18 years) is 5 rem (50 mSv)

Training

Material developed and piloted during 3 DOE just-in-time training events with local responders



Standards

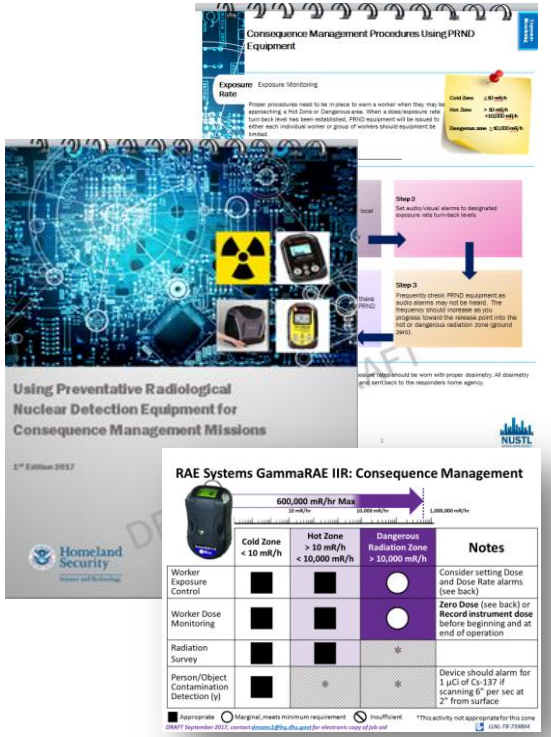
- Identify and document next generation PRND equipment standards for CM missions
- ANSI N42.60 will address training and testing criteria associated with CM scenarios and the use of PRND
- Revise existing ANSI standards over time

Future Work

- Validate instrument-specific job aids
- Continue to add data logging capability in RadResponder
- Conduct additional training
- Codify in response plans
- Socialize through journal articles, websites, and conferences
  - Materials are on CMWeb
  - Make materials available on RadResponder

Plan to Use Your Preventive Radiological Nuclear Detection Equipment During a Response

- PRND equipment may be utilized for “right of boom” response/consequence management tasks
  - Person/object contamination screening
  - Responder exposure monitoring and control
  - Area radiation surveys
  - Isotope identification
- A specific model’s detection and alarm capabilities determine how the instrument may be used *effectively* and *safely*
- ConOps, Job Aids and Training are available for responders
- Contact your regional Department of Energy or Department of Homeland Security (CWMD or FEMA CBRN) representatives for additional information



Force multiplier for the public health and safety mission