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Standard Practice for Radiological Emergency Response[1]

This standard is issued under the fixed designation E2601; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

One of the legacies of the Oklahoma City bombing and the attacks of September 11, 2001 is recognition that terrorists use weapons of mass destruction (WMD). This awareness has changed the philosophy of emergency response across disciplines. Incident response is still based on accepted procedures and safe work practices developed over the years, but the new mission must include concerns that are specific to an intentional release of hazardous materials designed to kill or injure and cause destruction of property. This standard practice provides guidance for responding to incidents where radioactive materials might be used with that intent. The standard also applies guidance for general radiological emergency response. The purpose of the guidance is to save lives, minimize radiation dose, and move members of the public out of perceived danger areas.

This standard practice provides decision making considerations that jurisdictions can use to respond to incidents that involve radioactive materials. The standard practice provides a consistent set of practices that can be incorporated into the development, planning, training, and implementation of guidelines for radiological emergency response. The standard practice does not incorporate long-term recovery or mitigation considerations, nor does it include provisions for improvised nuclear device[2] (INDs) detonations or nuclear power plant (NPP) accidents. Jurisdictions using the standard practice shall incorporate their own procedures for notification and requests for assistance from specialized radiological response assets.

The following are key concepts associated with this standard practice:

The standard practice applies to the emergency phase of an event (0 to 24 h or until specialized resources arrive on scene if they are requested).

It adheres to a risk-based response; this means the guidance presented is intended to be coupled with the authority having jurisdiction's (AHJ's) understanding of local vulnerability and capability when developing its plans and guidance documents on the subject.

It is compliant with the National Incident Management System (NIMS) and uses Incident Command System (ICS) common terminology. Full compliance with NIMS is recognized as an essential part of emergency response planning. In developing this standard practice, every effort was made to ensure that all communications between organizational elements during an incident are presented in plain language according to NIMS 2007. In keeping with this NIMS requirement, key definitions and terms, using plain English, are incorporated.

It is not intended for large-scale nuclear scenarios (for example, IND), which may quickly exhaust the capabilities of local emergency responders.

The standard practice is not intended to prepare communities for nuclear power plant accidents. The state of preparedness for communities in close proximity to nuclear power plants far exceeds the minimum requirements and capabilities described in this standard practice.

TRACEM (Thermal, Radiological, Asphyxiant, Chemical, Etiological, Mechanical) issues were considered throughout. While response to radiological hazards is the focus of this standard practice, responders must consider all hazards during a response; it is possible that non-radiological hazards may present a greater danger at an incident.

The standard practice does not address airborne contamination levels of radioactive materials exposure. Equipment to determine this potential hazard is not widely available in emergency responder communities. Respiratory protection is required for emergency responders until a complete hazard identification assessment is complete.

1. Scope

1.1 This practice provides decision-making considerations for response to incidents that involve radioactive materials. It provides information and guidance for what to include in response planning, and what activities to conduct during a response. The scope of this standard practice does not explicitly consider response to INDs or nuclear power plant accidents.[3] It does not expressly address emergency response to contamination of food or water supplies.

1.2 This practice applies to those emergency response agencies that have a role in the response to a radiological incident, excluding an IND incident. It should be used in emergency services response such as law enforcement, fire department, and emergency medical response actions.

1.3 This practice assumes that implementation begins with the recognition of a radiological incident and ends when emergency response actions cease or the response is assumed by specialized regional, state, or federal response teams.

1.4 AHJs using this practice will identify hazards, develop a plan, acquire and track equipment, and provide training consistent with the descriptions provided in Section 6. AHJs not able to meet the requirements should refer to the United States (US) Department of Transportation (DOT) Emergency Response Guidebook (ERG) for guidance on how to manage radiological incidents (DOT, current version). This standard practice provides additional guidance and is not intended to replace the ERG, rather to supplement it (see Annex A1[4]).

1.5 *This standard practice does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard practice to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *Referenced Standards and Documents:*

ANSI N42.33 American National Standard for Portable Radiation Detection Instrumentation for Homeland Security[5]

ANSI N42.32 American National Standard Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security[5]

ANSI N42.49A American National Standard for Performance Criteria for Alarming Electronic Personal Emergency Radiation Detectors (PERDs) for Exposure Control[5]

CDC 2007 Population Monitoring in Radiation Emergencies: A Guide for State and Local Public Health Planners[6]

CRCPD 2006 Radiological Dispersal Device (RDD)—First Responder's Guide, the First 12 Hours[7]

CTOS 2014 WMD Definitions for Use in the DHS Course Materials Developed by CTOS[8]

29 CFR 1910 Occupational Safety and Health Standards[9]

49 CFR 173 Shippers General Requirements for Shipments and Packages[9]

DOT, current version, Emergency Response Guidelines (ERG)[10]

EPA 400-R-92-001 Manual of Protective Action Guides and Protective Actions for Nuclear Incidents[11]

EPA PAG Manual Protective Actions Guides and Planning Guidance for Radiological Incidents, 2013 (Draft for Interim Use and Public Comment)[11]

EPA-402-F-07-008 Communicating Radiation Risks, Office of Radiation and Indoor Air[11]

FEMA 2008 Application of Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents[12]

Homeland Security Act of 2002 [13]

IAEA 2006 Manual for First Responders to a Radiological Emergency[14]

ICRP Publication 96 Protecting People against Radiation Exposure in the Event of a Radiological Attack, 96[15]

NCRP Commentary No. 19 Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism[16]

NCRP Report No. 138 Management of Terrorist Events Involving Radioactive Material[16]

NCRP Report No. 116 Limitation of Exposure to Ionizing Radiation[16]

NCRP Report No. 165 Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers[16]

NFPA 472 Standard for Professional Competence of Responders to Hazardous Materials Incidents[17]

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[1] This practice is under the jurisdiction of ASTM Committee E54 on Homeland Security Applications and is the direct responsibility of Subcommittee E54.01 on CBRNE Detection and CBRN Protection.

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[2] An improvised nuclear device is defined as follows: A device incorporating fissile materials designed or constructed outside of an official government agency and that has, or appears to have, or is claimed to have the capability to produce a nuclear explosion. It also may be a nuclear weapon that is no longer in the custody of competent authority or custodian, or has been modified from its designated firing sequence, or it may have been assembled from illegally obtained nuclear weapons components or special nuclear materials.

[3] Local response to nuclear facilities incidents should follow nuclear facility plans, especially in accordance to ingestion pathway zone actions, such as distribution of potassium iodine.

[4] Annex A1 material is labeled to complement the standard practice section numbers and can be found at the end of the standard before the appendices. The annex provides additional information for responder consideration.

[5] Available from http://standards.ieee.org/getN42/.

[6] For access to document, go to http://www.bt.cdc.gov/radiation/pdf/population-monitoring-guide.pdf.

[7] For access to document, go to http://www.crcpd.org/publications.asp#RDD.

[8] For access to document, go to www.ctosnnsa.org.

[9] For access to document, go to www.access.gpo.gov.

[10] Available from http://hazmat.dot.gov/pubs/erg/gydebook.htm.

[11] Available from www.epa.gov.

[12] Available from http://edocket.access.gpo.gov/2008/E8-17645.htm.

[13] For access to document, go to http://www.whitehouse.gov/deptofhomeland/bill/hsl-bill.pdf.

[14] For access to document, go to http://www-pub.iaea.org/MTCD/publications/PDF/EPR_FirstResponder_web.pdf.

[15] For access to description and site for ordering, go to http://www.elsevier.com/wps/find/bookdescription (cws_home/707248/description#description).

[16] Available from www.ncrponline.org.

[17] Available from www.nfpa.org.

NIMS 2007 Draft revised NIMS for interim use[18]
NRF 2008 [19]
NIST 2006a Results of Test and Evaluation of Commercially Available Survey Meters for the Department of Homeland Security—Round 2[20]
NIST 2006b Results of Test and Evaluation of Commercially Available Personal Radiation Detectors (PRDs) and Radiation Pagers for the Department of Homeland Security—Round 2[20]
NIST 2005a Results of Test and Evaluation of Commercially Available Survey Meters for the Department of Homeland Security[20]
NIST 2005b Results of Test and Evaluation of Commercially Available Personal Radiation Detectors (PRDs) and Radiation Pagers for the Department of Homeland Security[20]
NUREG-0654/FEMA-REP-1, Rev. 1 Addenda Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, Final Report[21]
NUREG-0654/FEMA-REP-1 Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants[21]

3. Terminology

3.1 *Definitions:*

3.1.1 *authority having jurisdiction (AHJ)*—the organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure. **NFPA 472**

3.1.2 *ALARA (as low as reasonably achievable)*—a principle of radiation protection philosophy that requires that exposures to ionizing radiation should be kept as low as reasonably achievable, economic and social factors being taken into account; the ALARA principle is satisfied when the expenditure of further resources would be unwarranted by the reduction in exposure that would be achieved. **NCRP Report No. 165**

3.1.3 *committed effective dose equivalent (CEDE)*— committed effective dose equivalent is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.

3.1.4 *decision points*—predefined exposure rates or doses at which a decision-maker must determine a path forward to maximize responder safety and public protection.

3.1.5 *decontamination*—(*1*) the removal of radionuclide contaminants from surfaces (for example, skin) by cleaning and washing (NCRP Report No. 165); (*2*) the physical or chemical process of reducing and preventing the spread of contaminants from people, animals, the environment, or equipment involved at hazardous materials/weapons of mass destruction (WMD) incidents (2013 Edition NFPA 472 3.3.17).

3.1.6 *defensive operation(s)*—emergency response measures taken from a safe distance (for example, outside the hot zone) to prevent or limit radiation exposure or the spread of hazardous material; life-safety operations are not a concern if defensive operations are the only operations supporting the response.

3.1.7 *dose*—radiation absorbed by an individual's body; general term used to denote mean absorbed dose, equivalent dose, effective dose, or effective equivalent dose, and to denote dose received or committed dose; see Total Effective Dose Equivalent (TEDE). **CRCPD 2006**

3.1.8 *dosimeter*—a small portable instrument (such as a film badge, thermoluminescent dosimeter, or pocket dosimeter) used to measure and record the total accumulated personal dose of ionizing radiation. **U.S. NRC Glossary**

3.1.9 *emergency decontamination*—the physical process of immediately reducing contamination of individuals in potentially life-threatening situations with or without the formal establishment of a decontamination corridor. A goal of emergency decontamination is reducing dose to a lower level; however it may not be possible to completely eliminate contamination.

3.1.10 *emergency operations center (EOC)*—the physical location at which the coordination of information and resources to support incident management activities normally takes place. An EOC may be a temporary facility or in a permanently established location in a jurisdiction. **NIMS 2007**

3.1.11 *emergency responder*—emergency response providers include federal, state, and local government, fire, law enforcement, emergency medical, and related personnel, agencies, and authorities. **Homeland Security Act of 2002**

3.1.12 *emergency response*—the performance of actions to mitigate the consequences of an emergency for human health and safety, quality of life, the environment and property. It may also provide a basis for the resumption of normal social and economic activity. **IAEA 2006**

3.1.13 *evacuation*—organized, phased, and supervised withdrawal, dispersal, or removal of civilians from dangerous or potentially dangerous areas, and their reception and care in safe areas. **NIMS 2007**

3.1.14 *high exposure rate*—exposure rate beyond which emergency response is not recommended for rescue operations unless the incident commander (IC) determines it can be carefully controlled for a short duration for priority operations such as life-saving, and the emergency responder is informed of the hazards and consents to performing the operation(s); the recommendation of this standard practice is for a high exposure rate less than or equal to 100 R/h (1 Sv/h). For the purposes of this standard practice, the term "high dose rate" is equivalent to "high exposure rate."

3.1.15 *hot zone*—the control zone immediately surrounding a hazardous materials incident, which extends far enough to prevent adverse effects from hazardous materials releases to personnel outside the zone. **NFPA 472**

3.1.16 *hot line*—the line of demarcation that may become a decision point to control the hot zone; for a radiological response, the hot line shall correspond to a previously established exposure rate (for example, the low exposure rate) or

[18] For access to document, go to www.fema.gov.
[19] For access to document, go to www.dhs.gov.
[20] For permission to access document, go to https://www.rkb.us/.
[21] For access to document, go to www.nrc.gov.

contamination level above which personnel shall be trained and protected appropriately by personal protective equipment (PPE) to operate. The location of the hot line may not be determined based on radiation exposure rate or contamination level if a higher hazard associated with the incident presents greater risk.

3.1.17 *improvised nuclear device (IND)*—a device incorporating fissile materials designed or constructed outside of an official government agency and that has, or appears to have, or is claimed to have the capability to produce a nuclear explosion. It also may be a nuclear weapon that is no longer in the custody of competent authority or custodian, or has been modified from its designated firing sequence, or it may have been assembled from illegally obtained nuclear weapons components or special nuclear materials. **CTOS 2014**

3.1.18 *incident commander (IC)*—the individual responsible for all incident activities, including the development of strategies and tactics and the ordering and release of resources. The IC has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site **NIMS 2007**

3.1.19 *jurisdiction*—a range or sphere of authority. Public agencies have jurisdiction at an incident within their area of responsibility. Jurisdictional authority at an incident can be political, geographic (for example, city, county, tribal, state, or federal boundary lines) or functional (for example, law enforcement, public health). **NIMS 2007**

3.1.20 *low exposure rate*—the radiation exposure rate that marks the hot line if the radiation exposure hazard poses the greatest risk at an incident. It is recommended that the low exposure rate not exceed 10 mR/h (milliR/h) (0.1 mSv/h (milliSv/h)) at 1 m (3.3 ft) from the object or at 1 m (3.3 ft) above the ground or surface. For the purposes of this standard practice, the term "low dose rate" is equivalent to "low exposure rate."

3.1.21 *multiagency coordination system (MACS)*— a system that provides the architecture to support coordination for incident prioritization, critical resource allocation, communications systems integration, and information coordination. The elements of the MACS include facilities, equipment, personnel, procedures, and communications. An EOC is a commonly used element. These systems assist agencies and organizations responding to an incident. **NIMS 2007**

3.1.22 *offensive operation(s)*—emergency response measures taken to reduce or minimize exposure from hazardous circumstances and materials to responders and civilians (for example, operations required within the hot zone); life-safety operations are top priority in offensive operations however evidence preservation shall be considered.

3.1.23 *orphan source*—a radioactive source that is not under regulatory control, either because it has never been under regulatory control, or because it has been abandoned, lost, misplaced, stolen, or transferred without proper authorization. **ICRP Publication 96**

3.1.24 *personal emergency radiation detector (PERD)*—an alarming electronic radiation measurement instrument used to manage exposure by alerting the emergency responders when they are exposed to gamma radiation. The instrument provides rapid and clear indication of the level of radiation exposure (dose) or exposure rate (dose rate), or both, and readily recognizable alarms. The alarms are both audible and visual, and distinguishable between exposure rate and exposure. **COTS 2014**

3.1.25 *personal protective equipment (PPE)*—the equipment provided to shield or isolate a person from hazards (TRACEM) that can be encountered at hazardous materials/WMD incidents. **NFPA 472**

3.1.26 *personal radiation detector (PRD)*—a pocket-sized detection instrument worn by an operator to detect the presence of radiological/nuclear material in a limited area in the vicinity of the operator. PRDs detect small increases in gamma radiation above background levels and alert the operator. Some models have additional capabilities to measure gamma radiation exposure rate levels, measure the accumulated gamma radiation dose, or a limited capability to detect neutron radiation, or combinations thereof. **CTOS 2014**

3.1.27 *preventive radiological/nuclear detection (PRND) or Radiological/Nuclear Detection (RND)*—capability to detect, illicit radiological/nuclear materials and radiological/nuclear WMDs at the points of manufacture, transportation, and use, and to identify the nature of material through adjudication or resolution of the detection alarm. This does not include actions taken to respond to the consequences of the release of radiological/nuclear materials (such as response to the detonation of a Radiological Dispersal Device). Also called Preventative Radiological/Nuclear Detection (PRND) **CTOS 2014**

3.1.28 *radiological dispersal device (RDD)*—any device that intentionally spreads radioactive material across an area with the intent to cause harm, without a nuclear explosion occurring. An RDD that uses explosives for spreading or dispersing radioactive material is called an "explosive RDD." The term "dirty bomb" is used by media, government, and others as a well-known, non-technical term for an explosive RDD. Non-explosive RDDs could spread radioactive material using common items such as pressurized containers, fans, building air-handling systems, sprayers, crop dusters, or even spreading by hand. **CTOS 2014**

3.1.29 *radiation exposure device (RED)*—a device intended to cause harm by exposing people to radiation without spreading radioactive material. An example of a RED is unshielded or partially shielded radioactive material placed in any type of container and in a location capable of causing a radiation exposure to one or more individuals. Also called a "Radiological Exposure Device (RED)." **CTOS 2014**

3.1.30 *rem*—a unit of biological/risk equivalent dose; not all radiation produces the same biological effect, even for the same amount of absorbed dose; rem relates the absorbed dose in human tissue to the effective biological damage of the radiation. For the purpose of this standard practice, the 1 rem of dose is equal to 10 mSv.

3.1.31 *roentgen (R)*—a unit of exposure to ionizing radiation. It is the primary standard of measurement used in the emergency responder community in the United States. For the purpose of this standard practice, 1 R of exposure is equal to 1 rem and 10 mSv of dose to the human body.

1000 micro-roentgen (microR or uR) = 1 milli-roentgen (mR)
1000 milli-roentgen (mR) = 1 roentgen (R), thus
1 000 000 microR = 1 roentgen (R)

3.1.31.1 *Discussion*—To improve clarity in communications, the unit roentgen may be spoken as "R" instead of pronouncing "roentgen." The SI prefix "micro" (one millionth) may be written as a lower case "u" or the phrase "micro" instead of the lower case Greek letter mu (μ) and may be spoken as either "micro" or "U." Similarly, the SI prefix "milli" (one thousandth) may be written as either "milli" or "m" and spoken as either "milli" or "M." For example, the value of 25 μR may be written as "25 uR" or "25 microR" and pronounced as "25 U-R" or "25 micro-R." Likewise, the value of 2 mR could be spoken as "2 M-R" or "2 milli-R."

3.1.32 *roentgen per hour (R/h)*—a unit used to express exposure per unit of time (exposure rate). For the purpose of this standard practice, the roentgen unit of exposure is assumed to be equivalent to the sievert unit of dose and "1 R = 10 mSv" will be applied as the basis for comparison of traditional and SI units. For the purpose of this standard practice, the term "dose rate" is equivalent to "exposure rate."

3.1.33 *secondary threats*—any object or person(s) designed to cause harm to persons responding to an incident (emergency responders) or to increase the number of civilian casualties. Secondary threats are normally designed to cause harm after persons have responded to the scene.

3.1.34 *shelter in place*—taking shelter inside a structure and remaining there until the danger passes. Sheltering in-place is used when evacuating the public would cause greater risk than staying where they are, or when an evacuation cannot be performed.

3.1.35 *technical decontamination*—the process designed to remove hazardous contaminants from responders and their equipment and victims. It is intended to minimize the spread of contamination and ensure responder safety. Technical decontamination is normally established in support of emergency responder entry operations at a hazardous materials incident, with the scope and level of technical decontamination based upon the type and properties of the contaminants involved. In non life-threatening contamination incidents, technical decontamination can also be used on victims of the initial release. **NFPA 472**

3.1.36 *termination*—termination in the context of this standard practice is the end of life safety operations, investigative work, and assurance of protective measure implementation. This will include documentation of hazards present and conditions found.

3.1.37 *TRACEM*—the acronym for additional hazards which may be found at any incident; derived from thermal, radiological, asphyxiant, chemical, etiological, and mechanical harms.

3.1.38 *total effective dose equivalent (TEDE)— for the purpose of this standard practice*, TEDE is the sum of the dose to the body from external radiation plus the total eventual risk equivalent dose from intakes of radionuclides. Note that where the term "dose" is used in this document, it is understood to be used as a synonym of TEDE.

3.1.39 *transport index*—the dimensionless number (rounded up to the next tenth) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined by multiplying the maximum radiation level in millisieverts (mSv) per hour at 1 m (3.3 ft) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour (mrem/h) at 1 m (3.3 ft)). **49 CFR 173.403**

3.1.40 *weapon of mass destruction (WMD)*—defined in U.S. law (18 USC §2332a) as a weapon meeting one or more of the following four categories: (*1*) any "destructive device" (such as explosives, incendiary material, or poison gas in a bomb, grenade, rocket, missile, or mine); (*2*) any weapon that is designed or intended to cause death or serious bodily injury through the release, dissemination, or impact of toxic or poisonous chemicals, or their precursors; (*3*) any weapon involving a biological agent, toxin, or vector; (*4*) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life.

3.1.40.1 *Discussion*—WMD is often referred to by the collection of categories that make up the set of weapons: chemical, biological, radiological, nuclear, and explosive (CBRNE). These are weapons that have a relatively large-scale impact on people, property, or infrastruction, or combinations thereof. **CTOS 2014**

3.2 *Acronyms:*

3.2.1 *ABIS*—Arson Bombing Investigative Services

3.2.2 *AHJ*—Authority Having Jurisdiction

3.2.3 *ALARA*—As Low as Reasonably Achievable

3.2.4 *ANSI*—American National Standards Institute

3.2.5 *ATF*—Bureau of Alcohol, Tobacco and Firearms

3.2.6 *CBRN*—Chemical, Biological, Radiological, Nuclear

3.2.7 *CBRNE*—Chemical, Biological, Radiological, Nuclear, and Explosive

3.2.8 *CDC*—Centers for Disease Control and Prevention

3.2.9 *CEDE*—Committed Effective Dose Equivalent

3.2.10 *CFR*—Code of Federal Regulations

3.2.11 *CIA*—Criminal Investigative Analysis

3.2.12 *CIRG*—Critical Incident Response Group

3.2.13 *CRCPD*—Conference of Radiation Control Program Directors

3.2.14 *CTOS*—CTOS Center for Radiological/Nuclear Training at the Nevada National Security Site

3.2.15 *DCO*—Dosimetry Control Officer

3.2.16 *DHS*—Department of Homeland Security

3.2.17 *DOT*—Department of Transportation

3.2.18 *ECO*—Exposure Control Officer

3.2.19 *EOC*—Emergency Operations Center

3.2.20 *EPA*—Environmental Protection Agency

3.2.21 *ERG*—Emergency Response Guidebook

3.2.22 *FBI*—Federal Bureau of Investigation

3.2.23 *FEMA*—Federal Emergency Management Agency

3.2.24 *GM*—Geiger-Mueller

3.2.25 *IAEA*—International Atomic Energy Agency

3.2.26 *IC*—Incident Commander

3.2.27 *ICP*—Incident Command Post

3.2.28 *ICRP*—International Commission on Radiation Protection

3.2.29 *ICS*—Incident Command System

3.2.30 *IND*—Improvised Nuclear Device

3.2.31 *JTTF*—Joint Terrorism Task Force

3.2.32 *MACS*—Multiagency Coordination System

3.2.33 *MIPT*—Memorial Institute for the Prevention of Terrorism

3.2.34 *NCAVC*—National Center for Analysis of Violent Crime

3.2.35 *NCRP*—National Council on Radiation Protection and Measurements

3.2.36 *NFPA*—National Fire Protection Association

3.2.37 *NIMS*—National Incident Management System

3.2.38 *NIST*—National Institute of Standards and Technology

3.2.39 *NPP*—Nuclear Power Plant

3.2.40 *NRF*—National Response Framework

3.2.41 *OSHA*—Occupational Safety and Health Administration

3.2.42 *PAGs*—Protective Action Guidelines

3.2.43 *PPE*—Personal Protective Equipment

3.2.44 *PERD*—Personal Emergency Radiation Detector

3.2.45 *PRDs*—Personal Radiation Detector

3.2.46 *PRND/RND*—Preventive Radiological/Nuclear Detection or Radiological/Nuclear Detection

3.2.47 *R*—Roentgen

3.2.48 *R/h*—Roentgen per hour

3.2.49 *RDD*—Radiological Dispersal Device

3.2.50 *RED*—Radiation Exposure Device

3.2.51 *SI*—International System of Units

3.2.52 *SOIC*—Strategic Operation Information Center

3.2.53 *TDS*—Time, Distance, and Shielding

3.2.54 *TEDE*—Total Effective Dose Equivalent

3.2.55 *TI*—Transport Index

3.2.56 *TIS*—Terrorist Information System

3.2.57 *TKB*—Terrorism Knowledge Base

3.2.58 *TRACEM*—Thermal, Radiological, Asphyxiant, Chemical, Etiological, Mechanical

3.2.59 *TTIC*—Terrorist Threat Integration Center

3.2.60 *UN*—United Nations

3.2.61 *US*—United States

3.2.62 *WMD*—Weapon of Mass Destruction

4. Summary of Practices

4.1 This standard practice is based on existing resources and experience related to the development of radiological emergency response guidelines. This experience base is translated into a standard practice to guide responder agencies toward the goal of building operational guidelines for the emergency phase of radiological response. The standard practice is intended to enhance the ability, knowledge, and understanding of personnel, agencies, or departments that are responsible for responding to a radiological incident.

4.2 This standard practice shall be incorporated as a reference in Emergency Operation Centers (EOCs), emergency operation plans, and multiagency coordination systems (MACS) to assist in policy formulation and development of strategic objectives consistent with the objectives and needs of the Incident Commander (IC) throughout the incident. In incidents encompassing multiple agencies, multiple victims, and damage to environment and infrastructure the EOC and/or MACS would be operating at least at the local level. It is imperative that representatives at the EOC and/or MACS be aware of and understand the standard practice, and operate in concert with emergency response communities that adopt the standard practice .

5. Significance and Use

5.1 It is essential for response agency personnel to plan, develop, implement, and train on standardized guidelines that encompass policy, strategy, operations, and tactical decisions prior to responding to a radiological incident. Use of this standard practice is recommended for all levels of the response structure.

5.2 Documents developed from this standard practice should be referenced and revised as necessary and reviewed on a two-year cycle. The review should consider new and updated requirements and guidance, technologies, and other information or equipment that might have a significant impact on the management and outcome of radiological incidents.

6. Prerequisites for Radiological Emergency Response

6.1 AHJs over a radiological response are responsible for providing the planning, resources, training, and safety necessary to implement standardized procedures.

6.2 *Planning*—AHJs shall determine the specific requirements and planning elements for a response plan. The plan, and the documents that have significant impact on it or those that flow from it, shall be revised as necessary, in accordance with 5.2. The important elements of a plan include the following:

6.2.1 Type of response:

6.2.1.1 Radioactive materials are contained, the source is legitimate, and does not presently pose an exposure risk to human health or the environment or

6.2.1.2 Radioactive materials have been released or have the potential to be released or present an exposure hazard, or both, where radiation exposures or contamination, or both, are above typical background levels or implementation of protective action measures, or both, may be necessary.

6.2.2 Distinction between defensive and offensive operations:

6.2.2.1 Defensive operations plan will include (see Annex A1):

(1) Notification details.

(2) Definition of radiological hot zone: if the radiological hazard controls determination of the hot line, the maximum exposure rate for the hot line is recommended to be less than or equal to 10 mR/h (0.1 mSv/h) at 1 m (3.3 ft); if radioactive material contamination is prevalent on scene, Annex A1 provides additional information regarding hot zone considerations (NFPA 472 3.3.15 Control Zones, NCRP Commentary No. 19; NCRP Report No. 165; CRCPD 2006; IAEA 2006; see Annex A1; see Appendix X1 and Appendix X2).

(3) For incidents where contamination has been identified, a scalable approach should be used for decontamination response (see Annex A1).

6.2.2.2 Offensive operations: In addition to the considerations summarized above for defensive operations a plan will include:

(1) Responder exposure rate decision points (Note: Exposures should always be minimized based upon ALARA (see Table X5.1) and are not considered absolute action levels but rather are incident management guidelines):

(a) The exposure rate, above which it is recommended operational personnel should be trained and protected by PPE, is less than or equal to 10 mR/h (0.1 mSv/h) at 1 m (3.3 ft) (that is, the same value given to the hot line exposure rate if radiation exposure controls placement of the hot line location).

(b) The high exposure rate decision point is recommended not to exceed 100 R/h (1 Sv/h) when reasonably achievable; above 100 R/h (1 Sv/h) the IC shall only commit informed, consenting responders to short duration life-saving activities (see Annex A1; see Appendix X2 and Appendix X3).

(2) Recommendations for decision points and corresponding criteria for managing dose as follows (see Annex A1):

(a) NCRP does not recommend a dose limit for emergency responders performing time-sensitive, mission critical activities such as lifesaving. Instead, decision points should be established by the incident commander based upon operational awareness and mission priorities. This recommendation is consistent with existing national and international guidance reviewed which identifies the conditions and activities in which higher levels of dose may be warranted. In all cases, appropriate measures should always be taken to keep doses to individual emergency responders as low as reasonably achievable (the ALARA principle), given the situation and response objectives. This can be accomplished by minimizing the time spent in hazardous areas, wearing appropriate personal protective equipment (PPE), staff rotation, and establishing dose and dose-rate decision points.[22]

(b) There are a number of resources available that can be used to establish recommendations and criteria for managing emergency responder doses. The recently published *Planning Guidance for Protection and Recovery Following RDD and IND Incidents* (DHS, 2008) modifies previously issued guidance from the U.S. Environmental Protection Agency (EPA, 1992) by providing a description of justification for approaching or exceeding 50 rad (0.5 Gy) to a large portion of the body in a short time (an early exposure). Both NCRP (1993) and the Conference of Radiation Control Program Directors (CRCPD, 2006) recommend a 50 rad (0.5 Gy) decision dose to evaluate whether or not to remove personnel from continuing lifesaving operations. IAEA (2006) recommends 100 rem (1 Sv) personal dose equivalent (at 10 mm) for lifesaving efforts and ICRP (2005) places no cap on lifesaving. In all cases, emergency responders should be made fully aware of the risks of both early and late (cancer) health effects from such large doses. (NCRP 165)

(c) The following dose values are provided to help guide the incident commander when determining applicable decision points, considering the response situation using the ALARA principle:

(a) Less than or equal to 5 rem (0.05 Sv), all occupational activities.

(b) 10 rem (0.1 Sv), protecting valuable property necessary for public welfare.

(c) 25 rem (0.25 Sv), lifesaving or protection of large populations.

(d) 50 rem (0.5 Sv) decision point for lifesaving activities in catastrophic incidents.

6.3 *Resources*—The AHJ shall conduct equipment and resource needs assessments to determine the agency's requirements for radiation detection equipment, monitoring equipment, dosimetry, and specialized personal protective equipment (PPE). Instruments shall be calibrated and maintained in accordance with applicable and relevant society standards, including the recommended maintenance frequency.

6.3.1 The AHJ, based on the equipment and resource assessment, shall develop a response profile that details equipment requirements and the AHJ shall acquire the equipment that is necessary.

6.3.2 Minimum equipment prerequisites per team:

6.3.2.1 Contamination measuring instrument(s): the instrument, or combination of instruments, shall be able to detect alpha, beta, and gamma radiation, and shall have sensitivity equivalent to or greater than a pancake Geiger-Mueller (GM) instrument (see Annex A1).

6.3.2.2 Exposure rate instrument(s): an instrument or combination of instruments able to measure a range of exposure rate from 0.005 mR/h to 10 mR/h (0.05 uSv/h (microSv/h) to 0.1 mSv/h) for Preventive Radiological/Nuclear Detection (PRND) activities (such as search and interdiction of illicit material) and 0.1 mR/h to more than 100 R/h, possibly up to 1000 R/h (1 uSv/h to more than 1 Sv/h, possibly 10 Sv/h) for establishing the hot line and operating within the hot zone (see Annex A1).

6.3.2.3 Dosimetry devices: a dosimeter or personal emergency radiation detector (PERD) able to measure the highest level of penetrating radiation (gamma radiation and neutron

[22] NCRP 165 recommended decision dose approach.

radiation) team members are expected to receive; one dosimeter per team member is recommended, although it is recognized that resources may only allow one dosimeter per team; it is recommended that the dosimeter have a programmable alarming function (ANSI N42.49A and Annex A1).

6.3.2.4 PPE: select PPE based on hazard assessment.

6.4 *Training*—Personnel who have a responsibility for a radiological response shall have the level of training that will enable them to perform work tasks safely. The training shall include proper use of equipment and guidelines developed by the AHJ. Employees shall use hazard risk assessments to institute a safe working environment. The minimum level of training for responders shall be the current version of:

6.4.1 NIMS ICS,

6.4.2 Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 (q) and General Duty Clause,

6.4.3 Any federal, state, local, or tribal regulatory requirements that apply, and

6.4.4 NFPA 472.

6.4.4.1 Chapter 5. Core Competencies.

6.4.4.2 Chapter 6. Mission Specific Competencies (for example, minimum PPE, monitoring, and detection).

6.5 *Safety*—Safety considerations by the AHJ are paramount to the success of the operation. The following safety issues will be considered in planning activities:

6.5.1 Ensure the proper equipment has been assembled and maintained for the mission.

6.5.2 Monitor strategic command operations and ensure use of self-protection concepts.

6.5.2.1 ALARA principles, which include time, distance, and shielding (see Annex A1, see Appendix X4).

6.5.2.2 Determine the feasibility of life safety operations based upon elapsed time, geographic distance from source, dose, exposure rate, stay times, and difficulty of life-saving operations (see Annex A1).

6.5.3 Develop site plans and document them as defined in 29 CFR 1910.120 (q) using dose reports, dose report with associated injury report, and personnel dosimeter logs (see Annex A1, see Appendix X5 and Appendix X6).

7. Radiological Emergency Response

7.1 The following sections establish a guide for safe radiological emergency response. They include the minimum requirements for analyzing, planning for, implementing, evaluating, and terminating the response.

7.2 *Analyze the Response*—The AHJ shall provide the emergency responder with the training and resources to recognize a radiological hazard, determine the scope of the problem, and predict the potential outcome of actions taken. Appendix X7 provides an example template for recording incident scene analysis.

7.2.1 Assess the scene and evaluate the possibility of a radiological hazard using the following on-scene indicators:

7.2.1.1 *Occupancies or Locations*—Responders shall be aware of establishments in their jurisdiction that may have radioactive materials present, in advance of a response (see Annex A1).

7.2.1.2 *Containers or Radioactive Material Packages*—Responders shall be able to identify the various types of radioactive material packages and the risks associated with the material typically found in each package type (see Annex A1).

7.2.1.3 *Natural Sources Including Building Materials*—Responders shall have the knowledge to recognize that naturally occurring sources may have an effect on radiological survey instrument readings. Responders shall identify building materials that have naturally occurring radioactive components and are likely to produce increased levels of background radiation (see Annex A1).

7.2.1.4 *Shipping Documents*—Responders shall use the information found on radioactive material shipping documents for risk assessment and response planning (see Annex A1).

7.2.1.5 *Signs and Symptoms*—Responders shall understand and recognize the signs, symptoms, and potential health effects of radiation exposure (see Annex A1).

7.2.1.6 *Intelligence Information*—Responders shall use information obtained from local, state or federal law enforcement and radiation authority agencies (see Annex A1).

7.2.1.7 *Monitoring and Detection Information*—Responders shall understand that initial indications of a radiological hazard will likely result from the use of their radiological instruments.

7.2.2 Efforts to determine accidental or intentional release shall be made from the onset of response. Exercise caution until such a time that the AHJ determines the release is accidental. This caution shall not hinder life safety response in any way, but shall increase situational awareness. Use the following information to determine if the release is accidental or intentional:

7.2.2.1 *Accidental*—Accidental releases of radioactive material can occur at a wide variety of locations including transit locations as a result of transportation accidents. The responder shall be able to assess the radiological emergency and determine whether it is accidental. Initial response actions prior to accidental or intentional release determination shall include investigating the potential for intentional release. Consultation with proper authorities, including radiation authorities, shall be a part of the assessment regarding accidental versus intentional release. Proper safety precautions and evidence preservation shall be considered. The following are examples of potentially accidental radiological hazards:

(1) Release at a facility such as a medical, research, construction, or industrial site (see Annex A1).

(2) Release in transport (see Annex A1).

(3) Breach in package (see Annex A1).

(4) Inappropriate packaging for the material (see Annex A1).

(5) Readings above a package Transport Index label (see Annex A1).

(6) Package containing radioactive material that is involved in a fire (see Annex A1).

(7) Orphan source (see Annex A1).

(8) Malfunctioning radiography source; this may occur at a site where radioactive materials are not normally found (see Annex A1).

7.2.2.2 *Intentional*—Intentional releases of radioactive material can occur anywhere as a result of a malicious or criminal act. A situation that appears to be an accidental release could indeed be an intentional act. Responders shall assess the radiological emergency to determine whether the cause appears suspicious. Additional concerns of an intentional release are hazards of a secondary device and crime scene/evidence preservation. Examples of intentional radiological releases include:

(1) Explosive Radiological dispersal devices (RDD) (see Annex A1).

(2) Radiation exposure devices (RED) (see Annex A1).

(3) Non-explosive RDDs and other deliberate acts of radioactive material release or radiation exposure (see Annex A1).

7.2.3 Determine the scope of the response:

7.2.3.1 Collect hazard information from various resources:

(1) Human sources (for example, witnesses, victims, subject matter experts (for example, radiation authorities), responsible party).

(2) Reference materials (for example, databases, written materials, modeling data).

7.2.3.2 Recognize and identify additional hazards (TRACEM).

7.2.3.3 Identify environmental conditions that have the potential to affect the response including geography, rural and urban environments, topography, and atmospheric/weather considerations.

7.2.3.4 Survey for radiation and contamination and monitor surroundings (see Annex A1; see Appendix X7).

7.2.4 Predict the potential outcomes: The IC interprets the information and predicts the likely outcomes of alternative response actions, including potential harm, through the use of scene analysis and situational awareness.

7.3 *Planning the Response:*

7.3.1 Based on analysis of the situation, develop an incident action plan (IAP) with available personnel and equipment, knowledge of the emergency response plan and the standard operating guidelines of the AHJ consistent with NIMS and ICS. It is important for this IAP to reflect ALARA principles (recognizing the potential immediate and long term health effects associated with radiation exposure – see Table A1.3 Medical Aspects of Radiation Injury). As part of a Risk Benefit Analysis, it is the responsibility of all response personnel to ensure actions are commensurate with potential benefits – managing all risks based upon ALARA and utilizing actionable decision points. Describe actions according to the following for both accidental and intentional incident (for intentional situation, additional considerations are presented in 7.3.4):

7.3.1.1 Self-protection concepts including ALARA principles: time, distance, shielding (see Annex A1).

7.3.1.2 Required resources (see 6.3):

(1) Equipment including contamination monitoring instrument, exposure rate instrument, and dosimeter.

(2) PPE.

7.3.1.3 Life safety operations: Rescue operations for life safety purposes shall be based on considerations incorporating the feasibility of responders to carry out missions, potential health effects, time required to complete rescue operations, and an evaluation of all hazards (TRACEM) on-scene. Specific decision points considered in a radiological event for life safety operations shall include the calculation of dose for both responders and victims. AHJs shall implement procedures for continuous evaluation of the need for and effectiveness of rescue operations (see Annex A1).

7.3.1.4 Emergency decontamination plan for contaminated victim(s): Decontamination operations shall include plans and provisions for prompt removal of contaminants from victims. Emergency decontamination plans shall incorporate processes to immediately reduce contamination of affected individuals in the absence of an established (formal) decontamination corridor (see Annex A1).

7.3.1.5 Technical decontamination plan: Decontamination operations shall include plans and provisions for implementation and operation of a formal decontamination corridor. PPE or specialized equipment will be utilized in the decontamination corridor by adequately trained response personnel. Plans shall incorporate specific processes for removal of contaminants. AHJs shall continually evaluate decontamination operations and be prepared to adjust for changes in hazard potentials and environmental conditions. Plans developed by AHJs should implement procedures allowing for immediate decontamination of victims and responders. If follow-up screening identifies further contamination on victims or responders, wet decontamination procedures may be necessary to reduce contamination to acceptable levels. When developing technical decontamination plans, AHJs shall include consideration of:

(1) Emergency responder(s) (see Annex A1).

(2) Contaminated victim(s) (see Annex A1).

(3) Equipment processing (see Annex A1).

(4) Evidence processing (see Annex A1).

7.3.2 Establish the following, and where appropriate define:

7.3.2.1 Type of radiological consideration:

(1) Radioactive material contained, the source is legitimate, and does not presently pose an exposure or contamination risk to humans or the environment, or

(2) Radioactive material has been released or has the potential to be released and it presents an exposure and/or contamination hazard situation and/or implementation of protective action measures may be necessary. If applicable:

(a) Differentiate between defensive and offensive operations.

(b) If possible determine whether incident is accidental or intentional; if intentional, monitor for secondary threats.

7.3.2.2 Decision points for defensive operations:

(1) Hot line: not to exceed 10 mR/h (0.1 mSv/h) at 1 m (3.3 ft) above the ground and minimal contamination when reasonably achievable. It is important to recognize that the hot line is not to be determined precisely. For example, a boundary line approximating 10 mR/h (0.1 mSv/h) at 1 m (3.3 ft) can be established for an instrument reading between 5 mR/h (0.05 mSv/h) and 20 mR/h (0.2 mSv/h) measured at waist height above the ground. These readings are essentially equivalent from the standpoint of health risk and operational flexibility. Where practical, the hot line zone should be established to match physical boundaries (such as streets and fences) that are close to the radiation levels identified above.

(2) It may not be practical to precisely survey map the entire perimeter of the hot line (hot zone outer boundary). The location of hot line can be established based on a limited number of survey locations be estimating the boundary line in areas where radiological surveys have not been performed yet. The hot line can be adjusted as new measurements become available.

(3) Locate incident command post (ICP), personnel, equipment, and decontamination operations in an area where there is no contamination and where it is unlikely to become contaminated during the response (for example, through windborne resuspension, etc.); if contamination is present, recommendations are provided in Annex A16.2.2.1*(2)*.

7.3.2.3 Decision points for offensive operations:

(1) Dose (see Annex A16.2.2.2*(2)*.):

(a) Less than or equal to 5 rem (0.05 Sv), all occupational activities.

(b) 10 rem (0.1 Sv), protecting valuable property necessary for public welfare.

(c) 25 rem (0.25 Sv), lifesaving or protection of large populations.

(d) 50 rem (0.5 Sv) for lifesaving activities in catastrophic incidents; the dose is recommended not to exceed 50 rem (0.5 Sv) when reasonably achievable.

(2) Hot line: not to exceed 10 mR/h (0.1 mSv/h) at 1 m (3.3 ft) when reasonably achievable.

(3) Dangerous Radiation Zone: not to exceed 10 R/h (0.1 Sv/h) when reasonably achievable. Exposure and contamination levels within the dangerous radiation zone have the potential to cause early health effects if doses to people are not controlled and thus actions taken within this area should be restricted to time-sensitive, mission-critical activities such as lifesaving.

(4) High exposure rate: not to exceed 100 R/h (1 Sv/h) when reasonably achievable.

7.3.3 Describe actions to be taken based on the on-scene hazard analysis and AHJ's emergency response plans and procedures for the following:

7.3.3.1 Notification: appropriate notifications shall be made to emergency response and regulatory agencies in accordance with AHJ plans.

7.3.3.2 Request specialized resources and/or equipment (for example, subject matter experts, medical, law enforcement, fire service, and state/local/federal radiation, environmental, and health professionals).

7.3.3.3 Protective action considerations shall include: evacuation (EPA PAG Manual; DOT ERG, current version); shelter-in-place (EPA PAG Manual; DOT ERG, current version); scene control (DOT ERG, current version).

7.3.3.4 Documentation: shall be in accordance with statutory requirements (for example, local, state, federal, etc.) and AHJ's established plans.

7.3.4 Additional actions for initial response to an undetermined release and an intentional release are as follows:

7.3.4.1 Security provided by law enforcement including: security for a crime scene, secure area for command post, staging area, safe refuge area.

7.3.4.2 Awareness of secondary threat.

7.3.4.3 Preservation of evidence.

7.3.4.4 Investigation.

7.4 *Implementing the Planned Response:*

7.4.1 Implement the response to favorably change the outcome of a radiological incident consistent with emergency response plans and operating guidelines of the AHJ.

7.4.1.1 Given scenarios involving an accidental release of radioactive materials, the emergency responder shall describe the actions to be implemented based on 7.3.3 in the AHJ's response plans and operating guidelines.

7.4.1.2 Given scenarios involving an intentional release of radioactive materials, the emergency responder shall describe the actions they would implement in addition to 7.3.3 and 7.3.4 as noted in the AHJ's response plans and operating guidelines.

7.5 *Evaluating Progress:*

7.5.1 Evaluate and document the effect of actions implemented during a radiological incident, consistent with the response plan and the operating guidelines of the AHJ. If necessary, adjust the response plan to better achieve desired goals. The emergency responder shall evaluate the effectiveness of the actions taken in accomplishing response objectives in the following scenarios:

7.5.1.1 Actions taken in response to an accidental release of radioactive material, based on the actions identified in 7.3.3.

7.5.1.2 Actions taken in response to an intentional release of radioactive material, based on actions identified in 7.3.3 and 7.3.4.

7.6 *Terminating the Emergency Phase of the Response:*

7.6.1 During any radiological incident the emergency responder shall participate in the termination process including documentation of the incident, which is consistent with the emergency response plan and the operating guidelines of the AHJ. Orderly turnover of authority is key to terminating the emergency phase of the response. There will likely be a decontamination effort subsequent to the emergency phase.

ANNEX

(Mandatory Information)

A1. ADDITIONAL INFORMATION FOR RESPONDER USE

A1.1 The information provided below in the table is directly linked to the section numbers of this standard practice. The content linked to the section numbers provides the emergency responder additional details and examples related to the material content in the referenced section.

A1.2 After review of the standard practice and annex materials, Appendix X8 – Appendix X10 can be reviewed as additional tools for emergency responder communities. Appendix X8 contains guidelines for writing a radiological emergency response guidance document. It summarizes the recommendations of the standard practice in the form of guidance. Appendix X9 provides checklists that can be used by three audiences that will use this standard practice as follows: *(1)* the first on-scene responder that may not have specialized radiological training, *(2)* the operations level responder, and *(3)* individuals responsible for conducting radiation measurements. Appendix X10 provides a summary of radiation measurement units, conversions, and prefixes.

A1.3 Although radiation crisis communication is not expressly covered in the context of the standard practice, it is imperative for emergency responders to be able to communicate radiation risks. The U.S. EPA has produced a guide entitled "Communicating Radiation Risks" (EPA-402-F-07-008). It can be obtained directly from the EPA.

Section Number	Additional Information for Responder Use
1.4	The ERG (DOT, current edition) provides specific actions to be taken when radioactive materials are involved in transportation accidents. Responders using the ERG should be aware of the potential for secondary hazards that may exist and take precautions as necessary. In cases where the radiological hazard is not defined, jurisdictions should refer to the "Table of Placards and Initial Response Guide To Use On-Scene" section of the ERG for appropriate response actions.
6.2.2.1	For a total defensive operation, no one is expected to encounter a situation where they could die or compromise their health and safety. For defensive operations in the absence of victims, time is sufficient to develop a plan that reduces or negates radiation exposure. ALARA principles should always be a primary consideration in planning.
6.2.2.1*(2)*	*Hot Zone:* Appendix X1 provides two illustrations that represent zone considerations at a radiological incident. Appendix X2 is adapted from CRCPD 2006, IAEA 2006, and NCRP Commentary No. 19. It presents a summary of various exposure zones within the hot zone that responders could use for additional discrimination of zones to maximize protection of responder health. These additional considerations would be particularly beneficial during response to incidents that result in release of radioactive material such as that anticipated from an RDD terrorist event. Additional guidance for emergency responders managing an RDD event is available from Harper et al. (2007)[A] , Musolino and Harper (2006)[B] , and Musolino et al (2013).[I] *Contamination:* In addition to assessing the radiation levels present at a scene, responders should also be aware of the potential for radioactive contamination. Radioactive material that is properly contained, such as material in transport, as a component of certain devices, or as a sealed source, may pose only a radiation hazard. These sources do not pose a contamination hazard since the radioactive material is contained. The presence of contamination is usually an indication that radioactive material has been dispersed, such as in a RDD, or that the source/item containing the radioactive material has been breached. The responder should attempt to assess whether contamination is present, and act accordingly (for example, don appropriate PPE) if it is present to mitigate the spread of the material. If contamination is present responders may need to establish the hot line at a more conservative location than setting the hot line at less than or equal to 10 mR/h (0.1 mSv/h) at 1 m (3.3 ft). This is especially important for those responders conducting operations without respiratory protection (for example, responders located at the ICP, or those manning the decontamination activities). The ICP should be established outside of an area of blowing dust, debris or settling ash. Table A1.1 presents contamination level recommendations with corresponding activity recommendations (CRCPD 2006; IAEA 2006; NCRP Commentary No. 19). Contamination levels can be measured using a variety of instruments such as a survey meter with a GM pancake probe or similar thin window GM detector. Since measurements will vary depending on the type of instrument used, it is important that responders become familiar with the background levels measured with their own instrument so they can determine if they are in an area with contamination levels above background. For RDD events, CRCPD 2006 recommends that, if possible, responders should set the ICP and the decontamination zone in areas with contamination levels of less than 1000 counts per minute (cpm) using a GM pancake probe, measured 1 to 2 in. from the ground.