Los Angeles County
Multi-Agency Radiological Response Plan

Volume II

Extended Plan

For Official Use Only

February 2009

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Prepared for
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The County of Los Angeles Department of Public Health is grateful for the cooperation and assistance from each agency and organization that participated on the Planning Committee in the development of this plan. This plan is designed to facilitate unprecedented communications and coordination of response efforts to significant radiological incidents for the protection of citizens of the County of Los Angeles and neighboring communities. These citizens will be well served by the efforts of the Planning Committee in the event of a radiological incident.

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Executive Summary

The Los Angeles County, Department of Public Health, Radiation Management program, has developed this plan in an effort to clarify the roles and responsibilities of response agencies likely to respond to a significant radiological incident. The term "significant" is defined as an incident that overwhelms the first agencies on-scene, requiring additional resources to mitigate the situation. The plan covers a major release of radiological materials, a radiological exposure device (RDD), and a radiological dispersal device (RED); it does not include improvised nuclear devices (IND).

There are two volumes in the plan: Volume I is the Responder Field Manual and Volume II is the Extended Plan, containing the Basic Plan and additional details to support Volume I. Volume I is a practical "Responder Field Manual" developed to assist responders during an incident with important information they need to know for effective incident management. Implementing the guidance in the Responder Field Manual will likely lead to lives saved, less responder confusion, and a coordinated response by local, State, and federal agencies. The plan was written in plain language and avoids radiological technical jargon. As much as possible, the plan provides simplified guidance and procedures for easier understanding and use by responders and other decision makers.

This plan focuses on the radiological aspects of an incident. Responders must be trained for all hazards and consider other hazards and corollary activities, such as implementing an evacuation, while responding to a radiological event. These other hazards and activities may supersede the radiological hazards present at the scene for protection of responder and public health and safety. The information provided in the plan should be considered as guidance. Each agency should evaluate the plan and adopt the guidance and recommendations to meet its response objectives.

Specific responder and public radiation levels and decision points for the protection of health and safety were selected as guidance for this plan. These levels/decision points are neither limits nor regulation. They are provided as guidance for each responding agency to consider when making decisions during an incident. Many agencies have policies to limit staff dose. Most response agencies in the United States have used a 2 mR/hr exposure rate and 25 rem dose limits as decision points. Since the 9-11 tragedy, terrorism preparedness and planning efforts have reconsidered existing radiological guidance, policies, and procedures, so that the guidance more appropriately addresses a terrorism scenario.

Since 9-11, national organizations have developed and published recommendations for responders to a radiological incident. Radiological experts on the Planning Committee accepted these recommendations and included them in this plan. One consequence is that the suggested control line exposure rate and dose decision points have increased to 10 mR/hr and 50 rem for life saving activities, respectively. These values are considered protective of responder health and safety.

There are substantial assets that response agencies can provide in the event of a significant radiological incident, including Los Angeles County Radiation Management. In coordination with the State Radiologic Health Branch, multiple staff are trained radiological specialists who can respond to an incident. Some of the program capabilities include expert advisory and consultative services, a full suite of advanced radiation detection, and staff trained and certified to enter a hazardous environment.

The County of Los Angeles Department of Public Health endorses the use of this plan by all appropriate local, State, and federal response agencies.

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Acronyms and Abbreviations

AFRRI	Armed Forces Radiobiology Research Institute
APR	air purifying apparatus
ARS	acute radiation syndrome
CAP	Common Alert Protocol
CDC	United States Centers for Disease Control and Prevention
cpm	counts per minute
CRCPD	Conference of Radiation Control Program Directors
CRZ	Contamination Reduction Zone
CST	Civil Support Team
Cs-137	cesium-137
DOE	United States Department of Energy
ECA	Extreme Caution Area
EMS	Emergency Medical Services
EMSA	California Emergency Medical Services Authority
EOC	Emergency Operations Center
EPA	Unites States Environmental Protection Agency
ERT-West	Emergency Response Team-West
EZ	Exclusion Zone
FRMAC	Federal Radiological Monitoring and Assessment Center
GPS	Global Positioning System
ICP	Incident Command Post
ICS	Incident Command System
IC/UC	Incident Command/Unified Command
HSAS	Homeland Security Advisory System
LA	Los Angeles
LACo	Los Angeles County
m	milli
MARRP	Multi-Agency Radiological Response Plan
mR	milliroentgen
MRC	Medical Reserve Corps
MRAT	Medical Radiobiology Advisory Team
mrem	millirem
mrem/hr	millirem per hour
mR/hr	milliroentgen per hour
NARAC	National Atmospheric Release Advisory Center
NCRP	National Council of Radiation Protection and Measurements
NIMS	National Incident Management System

PAPR	powered air purifying apparatus
PGM	Pancake Geiger-Mueller
PPE	personal protective equipment
R	roentgen
rad	Radiation absorbed dose
RAP	Radiological Assistance Program
RDD	Radiological Dispersal Device
REAC/TS	Radiation Emergency Assistance Center/Training Site
RED	Radiological Exposure Device
rem	roentgen equivalent man
REMM	Radiation Event Medical Management
RMR	Radioactive Material Release
SOG	standard operating guide
SZ	Support Zone
UC	Unified Command
USEPA	United States Environmental Protection Agency
μ	micro
μrem	microrem
μrem/hr	microrem per hour
μR	microroentgen
μR/hr	microroentgen per hour

1.0 Introduction

This section summarizes the purpose, objectives, and organization of the Los Angeles County Multi-Agency Radiological Response Plan (the MARRP). *Section 1.1, Purpose*, describes the intent of the MARRP and includes a plan synopsis; the scope is clarified in *Section 1.3, Objectives*. Due to the nontraditional format of this plan, an explanation of the format is included in *Section 1.4, Plan Organization*. The intent of this format is to provide responders a more user-friendly document, so they can easily access the most important information during an incident.

The MARRP does not replace, but instead supplements, existing response plans. Where existing plans may provide a framework for a response to a radiological incident, the MARRP provides detailed guidance and negotiated roles and responsibilities for responding local, State, and federal agencies and organizations. After determination of a significant radiological incident, the MARRP will be activated and implemented as applicable and appropriate. The word “significant” has an important meaning relative to the MARRP and is further explained in *Section 1.2, Definition of Significant*.

The MARRP was written to avoid conflicts with the requirements of existing local, State, and federal plans. In the event of a conflict, each agency should follow internal guidance and plans. This plan should never be interpreted as law or regulation; instead it should be used as a guidance document for responders and decision makers during an incident. If a reviewer believes that a conflict exists with a relevant, existing plan or law, the Planning Committee requests that comments be sent to the Los Angeles County (LACo) Radiation Management program (contact information is found on the inside jacket of the cover page or Section 2.5.4).

The MARRP does not address nuclear incidents. LACo considered including nuclear incidents and concluded, after careful review and consideration, that nuclear-specific planning should be addressed at a future date. LACo intends to complete a plan fully addressing nuclear incidents after local, State, and federal partners have had further discussions regarding the numerous and complex issues related to a nuclear catastrophe.

The MARRP development was a collaborative effort between 30 local, State, and federal agencies and organizations. With nearly 100 representatives providing input to the MARRP, an attempt to reach consensus was a continuous priority. Information in the MARRP is believed to provide responder guidance and agency coordination guidelines that will save lives, reduce confusion, and avoid response gaps during the early phase of a response.

Specific guidance that addresses difficult and complex organizational and technical issues in an easy to use format is challenging. The guidance in the MARRP was vetted by the Planning Committee and compromises were made to accommodate divergent opinions. In addition, technical guidance was simplified for ease of responder understanding and use during an incident. References or an explanation for the selection of technical guidance is provided when possible.

1.1 Purpose

The purpose of the MARRP is to describe response actions to be taken by LACo agencies in coordination with local, State, and federal response agencies and organizations during an intentional or accidental, significant radiological incident. The MARRP details the coordination efforts between responding agencies and their respective roles and responsibilities to prevent duplicative efforts and avoid gaps in providing critical resources and response actions. Included is an outline of LACo’s overall emergency response organization and policies for a significant radiological incident. The plan was written in compliance with the National Incident Management System (NIMS).

The MARRP was also written to provide specific guidance to responders regarding complex and numerous radiological issues that challenge even the most experienced radiation expert. The outcome is the Responder Field Manual, which is Volume I of the MARRP.

1.2 Definition of Significant

The term “significant” has a distinct and integral meaning in the MARRP. There are numerous possible emergencies that can involve radioactive materials, most of which are routine and are adequately handled by local responders with standard resources. Any local responding agency may request radiological assistance from local agencies (for example, LACo Radiation Management) for technical advice or consultation during a routine emergency. If the responders are not overwhelmed and do not request additional resources outside of their department’s capabilities, the emergency is not deemed significant and the MARRP is not activated.

An incident is deemed significant when it is non-routine, an unusual occurrence, or a catastrophic event, and standard resources are insufficient to respond adequately. As a rule of thumb, the incident is significant when multiple agencies are required to mitigate the situation (i.e., multiple local agencies or a mixture of local and State and/or federal agencies).

Ultimately, Incident Command/Unified Command (IC/UC) has the responsibility to declare an incident significant; however, the following departments are also authorized to make such a declaration based on their assessment of an incident:

1. Incident Command/Unified Command
2. LACo, Department of Public Health, Radiation Management Program[1]
3. LACo Fire Department, Health Hazardous Materials Division
4. LACo Department of Public Health

A declaration of a significant radiological incident triggers activation of the MARRP. The intent of the MARRP is that activation will occur when in doubt, erring on the side of caution to protect the public health at the cost of mobilizing resources that may not be needed. A more detailed discussion of the activation and deactivation of the MARRP is included in *Section 2.4.2, Plan Activation and Deactivation*.

1.3 Objectives

The objectives of the MARRP are as follows:

1. Describe predefined roles and responsibilities related to radiological issues between local, State, and federal responding agencies and organizations for a significant radiological emergency.
2. Provide a comprehensive plan to cover all critical aspects related to a significant radiological emergency response in a “manual” format that is practical and easy to use during an incident.
3. Describe predefined roles and responsibilities related to radiological issues between local, State, and federal responding agencies and organizations to establish, staff, and maintain public reception centers.
4. Provide a flexible and scalable approach sufficient to address all types of significant radiological emergencies, excluding nuclear incidents.

[1] Whenever LACo, Department of Public Health, Radiation Management is referenced in the MARRP, it includes the State Radiologic Health Branch. These two agencies seamlessly integrate during any radiological event.

5. Provide specific action-based guidance related to radiological issues to responding agencies and organizations with practical and detailed Standard Operating Guides (SOGs), instructions, and forms.

The primary focus of the MARRP is the radiological aspects of a response. Critical information necessary for mitigation of consequences typical of many emergencies is addressed in other response plans and generally has not been included in this plan. For example, evacuation plans have been developed for the LACo area, so information on implementing an evacuation is not included in the MARRP. However, the MARRP does provide guidance related to the radiological aspects of the decision making process to initiate or not initiate an evacuation and includes guidance that should be considered when conducting an evacuation.

Responders must resist focusing only on the radiological aspects of an incident. They must also consider other potential hazards and incident conditions while conducting operations per standard procedures and use the MARRP to supplement and guide response actions and decisions.

1.4 Plan Organization

The structure and organization of the MARRP is designed for practical use during an emergency. The MARRP is divided into two volumes: Volume I is designed as a “Responder Field Manual” and Volume II contains the “Extended Plan,” which follows the format of more traditional emergency operation plans, providing additional information to supplement the Responder Field Manual.

1.4.1 Volume I, Responder Field Manual

Volume I has the essential radiological information for implementing the MARRP during an incident and is designed as a stand alone document. It was purposely placed in the front of the MARRP to facilitate quick access during an emergency. It contains the following information:

1. Information Cards
2. Summary Tables
3. Position Job Aids
4. Activity Playbooks
5. Standard Operating Guides
6. Instructions
7. Forms
8. Tables

Position Job Aids and Activity Playbooks summarize the most important radiological information a responder needs to complete critical actions.

The first Information Cards, *First 30 Minutes of Radiological Response* and *Radiological Response Rules of Thumb*, are designed to give responders a quick primer on the most critical considerations related to a radiological incident, in particular to health and safety concerns. A third Information Card, *Radiological Instrument Summary,* provides a brief summary of common radiological instruments to remind responders about various instruments they may use during the incident; instruments are further addressed in Volume II, *Section 3.2.7, Radiological Instrumentation.* Summary Tables are provided after the Information Cards. Table 1, *Summary of Agencies Responsible for Implementing Activity Playbooks*, summarizes the Activity Playbooks relative to which agency or organization is likely to implement each Activity Playbook where as Table 2, *Summary of Activity Playbooks Applicable to Radiological Scenarios*, summarizes which Activity Playbooks may be implemented during each radiological scenario.

Table 1: Summary of Agencies Responsible for Implementing Activity Playbooks

Activity Playbook	Rad Mgmt*	Fire Hazmat	Fire	Law Hazmat	EPA	DOE	FBI	Coroner	Public Health	Law	CHP	Med
1. Exclusion Zone Operations	NL	**1**	**2**	**3**	NL	NL	NL	NL	NL	NL	NL	NL
2. Initial Incident Control Zones	**1**	**2**	NL	**3**	**4**	NL	NL	NL	NL	NL	NL	NL
3. Monitoring Responders and Equipment for Contamination	**1**	**2**	**3**	**6**	**4**	**5**	NL	NL	NL	NL	NL	NL
4. Monitoring Injured Victims for Contamination	**1**	**2**	**3**	NL	**4**	NL	NL	NL	NL	NL	NL	NL
5. Monitoring Uninjured Victims for Contamination	**1**	**2**	**3**	NL	**4**	**5**	NL	NL	NL	NL	NL	NL
6. Advanced Radiation Measurements	**1**	NL	NL	NL	**2**	**3**	NL	NL	NL	NL	NL	NL
7. Alpha Radiation Detection and Considerations	**1**	**2**	NL	**3**	**4**	**5**	NL	NL	NL	NL	NL	NL
8. Crime Scene Investigations	NL	NL	NL	**1**	NL	NL	**2**	**3**	NL	NL	NL	NL
9. Monitoring People for Contamination at Public Reception Centers	**1**	**2**	**3**	NL	**5**	**6**	NL	NL	**4**	NL	NL	NL
10. Monitoring Public Property for Contamination	**1**	**2**	**3**	NL	**4**	**5**	NL	NL	NL	NL	NL	NL
11. Public Protective Action Guides – Evacuation and Shelter-in-Place	**1**	NL	NL	NL	**2**	**3**	NL	NL	NL	NL	NL	NL
12. Traffic Control and Considerations	NL	NL	NL	NL	NL	NL	NL	NL	NL	**1**	**2**	NL
13. Hospital-Based Operations and Medical Considerations	NL	NL	NL	NL	NL	NL	NL	NL	**2**	NL	NL	**1**

***Rad Mgmt** Los Angeles County, Department of Public Health, Radiation Management; California Radiologic Health Branch will respond with Radiation Management. Note that Radiation Management has a limited number of staff, and they will be more likely to provide oversight, rather than actually conduct the activity.

Fire Hazmat All fire department hazardous materials teams
Fire All fire departments
Law Hazmat All law enforcement hazardous materials teams
EPA United States Environmental Protection Agency
DOE United States Department of Energy
FBI Federal Bureau of Investigations
NL Not Listed as a primary, secondary, tertiary, etc. resource to perform activity.
Coroner Los Angeles County Coroner's Officer
Public Health Los Angeles County Department of Public Health and/or public health agencies
Law All law enforcement agencies
CHP California Highway Patrol
Med Medical Organizations including Emergency Medical Services

Note: The primary agency to conduct each particular activity is listed with a "1", the secondary with a "2", and so on. If the primary agency is not available to conduct the activity, the secondary agency should be tasked and so on. Two or more agencies may be required to conduct a particular activity given the incident circumstances.

Position Job Aids and Activity Playbooks provide guidance to response teams on the most important and critical decisions that they should consider as well as critical actions they should consider taking during the early phase of an incident. These guidelines are designed to be practical, succinct, and written in plain, simple language. Only radiological related issues are addressed, thus response teams must consider the incident specific conditions when implementing the recommended guidance and actions; e.g., presence of a fire may be the driving factor in the decision to evacuate the public. All Activity Playbooks are designed as stand alone documents. The Position Job Aids are brief and should be used in conjunction with the Activity Playbooks.

Located at the back of Volume I are supporting SOGs, instructions, forms, and tables. The SOG on distinguishing alpha, beta, and gamma is of critical importance, and responders should implement it as soon as possible (see SOG No. 2). The presence of alpha contamination can have dramatic implications for responder and public safety, including appropriate protective action. This topic is further addressed in *Playbook 7: Alpha Radiation Detection and Considerations*, found in Volume I and Volume II, *Section 3.6.3, Determination of Type of Radiation*. The SOGs, instructions, forms, and tables referenced in the Activity Playbooks are included for easy access and should be removal for replication if needed.

Volume I was created with black and white text and shaded tables. Color versions of the tables are found in Attachment 1 of Volume II. Agencies should remove the color versions for reproduction and placement in their respective plans, guidance, and field manuals as appropriate.

1.4.2 Volume II, Extended Plan

In Volume II, there are three major parts: (1) a Basic Plan, (2) Response Planning Guides, and (3) Attachments. The Basic Plan addresses the overarching aspects of the MARRP whereas the Response Planning Guides provide detailed guidance on various radiological aspects. The Attachments include information referenced in the plan.

The Basic Plan found in Section 2.0 provides information that is common to all Response Planning Guides and provides the necessary framework to support the remainder of the MARRP. It describes the overview of LACo’s emergency response organization and policies and provides a general description of the response approach to a radiological incident for all participating agencies and organizations.

The Response Planning Guides in Section 3.0 provide additional details to supplement the Activity Playbooks found in Volume I. Since radiological issues are complex, additional useful information is included and can be used for training and planning purposes. The details of Section 3.0 should be reviewed during an incident as time permits; however, it is not necessary until the incident has been contained and is under control. Additional topics not addressed in the Activity Playbooks are also discussed.

Attachments include specific SOGs, instructions, forms, and tables referenced in the Basic Plan or Response Planning Guides.

1.5 Guiding Principals

Response to a significant radiological incident can not only overwhelm local resources, it can also push the mental, emotional, and physical limits of responders and the affected public. Handling a mass casualty radiological incident is unique compared to an incident involving other hazards, such as chemical or biological hazards. If an incident involves only radiological hazards, there are basic principles that provide a framework so responders can make informed decisions. The following are brief principles to guide decision making:

Lifesaving activities take priority over decontamination.

Cross contamination issues are a secondary concern if the incident affects a large population.

Contamination is not immediately life-threatening.

Radiation dose to workers is of paramount importance, but can be managed so responders can complete critical activities.

Responders in a hazardous materials situation will rely on pre-established health and safety limits as decision points. For example, in an atmosphere with an oxygen concentration of less than 19.5 percent, responders will wear supplied air respiratory protection, or if the lower explosive level is above 10 percent, evacuation from the scene may be warranted. In a significant radiological incident, there are few pre-established health and safety limits, and those that exist are designed for occupational safety at a contained and access controlled facility.

The primary reason pre-established limits do not exist is because the amount of radiation exposure and subsequent dose that a person receives can vary widely depending on the nature of an incident. Recent guidance has been developed by various agencies and organizations to fill the gap for terrorism related incidents; many are referenced in the MARRP.

The word “limit” is not used in the context of the MARRP for pre-established health and safety standards. Instead, dose, exposure rate, and contamination release values are provided as guidance and called “levels” or “decision points.” Radiation protection principles are based on keeping doses as low as possible and responders should strive to reduce their dose to the lowest level possible. Sometimes a dose greater than an occupational limit of 5 rem in a year may be warranted for critical actions like rescue of a victim or protection of critical infrastructure.

The levels chosen during an incident should take into consideration the unique circumstances of the situation. Radiological experts are available to assist in health and safety decisions and can recommend levels/decision points. Since consultation may not always be practicable during the initial 30 minutes of an emergency, or even later in the response, the MARRP provides levels that are believed to be protective of human health in most radiological disasters (nuclear excluded). Decision makers need to have proper training and knowledge, and appropriately adjust the dose, exposure rate, and contamination levels presented in the MARRP based on incident specific conditions.

2.0 Basic Plan

The Basic Plan addresses the overarching aspects of the MARRP in the following sections:

Section 2.1 Overview
Section 2.2 Situation
Section 2.3 Assumptions
Section 2.4 Concept of Operations
Section 2.5 Plan Development and Maintenance

These sections are applicable to all response scenarios and Response Planning Guides addressed by the MARRP.

2.1 Overview

LACo recognizes the potential for an occurrence of a significant radiological incident. The MARRP provides the framework for a successful response to three radiological scenarios; these are detailed in Section 2.2. To frame the development of the MARRP, numerous assumptions were made as outlined in Section 2.3. A brief concept of operations summarizes the basis for a response to a significant incident in Section 2.4. Finally, a discussion of how the plan was developed and how it will be maintained is provided in Section 2.5.

As previously stated, the MARRP does not replace existing response plans used by local, State, or federal agencies and organizations. Instead it supplements existing plans by providing specific guidance typically not found in most response plans. This guidance is designed to assist first responders during an incident to reduce confusion and protect human health. Information found in existing plans was not duplicated in the MARRP as much as possible; only issues related to radiological matters are included. It is important to recognize that other hazards may take precedence over the MARRP. For example, fire, chemical, and biological hazards can present more hazardous environments than radiological contamination. Obviously, responders should address higher priority hazards if deemed more immediate than the radiation hazards.

2.2 Situation

This section defines the situation which characterizes the MARRP and narrows the scope to focus the MARRP's development. Three generic radiological scenarios are addressed. These scenarios are related to all radioactive materials, with a bias toward terrorism incidents. Each scenario is briefly summarized to provide a basis for the response actions described in the MARRP.

2.2.1 Radiological Material Release

A radiological materials release (RMR) is any significant, unauthorized release of a radioactive material into the environment from a fixed facility or transportation vehicle. A fire at a radioactive source manufacturer for example could result in the release of large quantities of radioactive materials. An RMR typically will not have been caused by terrorist activities, but the possibility exists; e.g., purposefully starting a fire at a facility containing radioactive materials.

A RMR is an accidental or terrorism caused release of a large quantity of a radioactive material from a facility or transportation accident.

There are numerous radioactive materials that could be involved in an RMR incident. These materials could emit alpha, beta, gamma, and/or neutron radiation. Materials could be located in a wide variety of facilities, although the number of facilities with large quantities of radioactive materials is limited. The spread of contamination could be low or large if dispersed by a fire. General characteristics of an RMR incident include:

- Potential internal and external dose
- Likely a relatively small area of contamination
- Individuals may be injured or killed by an explosion or fire
- Unlikely to cause fatalities or affects from radiation exposure

The characteristic of an RMR is the potential for spread of radiological material. However, responders should consider that the harmful affects of fire generally outweigh the risk from radiation. Unless substantial quantities of highly radioactive material were involved in the incident, the area of contamination would be relatively low and exposure to the public minimal.

2.2.2 Radiological Exposure Device

A radiological exposure device (RED) is a high-intensity radiation source accidentally or deliberately placed in a public area to expose the public in close proximity to intense radiation. By definition, a RED is a contained radioactive source with no release of contamination. This fact simplifies mitigation efforts by responders. If the RED were to release part or all of the radioactive material it would be classified as an RMR or RDD, depending on the circumstances that caused the release. However, an exposure of sufficient duration can cause acute radiation syndrome (ARS), cutaneous radiation syndrome, or even death.

A RED is a containerized radioactive material that directly exposes the public to radiation but does not release contamination.

There are numerous radioactive materials that can be used to make a RED. Most likely the form of the material will be an industrial or medical device. Commercial devices will have substantial shielding which may or may not be removed to make the RED. The material could be placed in shielding to protect the person(s) delivering the device, with a movable "window" that, when opened, allows the radiation to emit directionally. Alternatively the material may have no shielding placing the person(s) delivering the device as well as the public in much greater harm. General characteristics of a RED incident include:

- Only external exposures
- No release of contamination (source is intact and contained)
- Likely affecting a small number of people
- Potential for an affect on exposed individuals
- Most likely a delay to the discovery of the device
- Potentially easier to locate and contain
- Easier to mitigate the situation
- Localized area of concern

Generally a RED would be an act of terrorism. However, an accidental release of a radioactive source could also constitute a RED. A RED can expose people to radiation, most likely gamma or neutron radiation, but could also include beta radiation depending on the device and proximity of those exposed to the device. The extent of a dose to an individual is highly dependant on how close he/she is to the radioactive source, the length of time they were proximal to the source, and the activity of the source.

An example of a RED is an industrial radiography device containing 100 curies of iridium-192 with all shielding removed. The exposure to this device would be substantial and an individual one foot from the source could obtain an acute lethal dose in approximately two hours. Without medical intervention, the individual would probably die within weeks. As the distance from the source increases the exposure and dose decrease dramatically. At six feet from the source, the same individual would receive approximately 1/4th of the dose and would survive the exposure, likely without exhibiting radiation exposure symptoms; e.g., ARS. Another example of a RED is the placement of an unshielded radioactive source under the seat of a public bus or theatre. Other devices exist with substantially larger activity sources that could cause a lethal dose in a much shorter time frame compared to that illustrated in the previous example.

Acute exposures can be life threatening, and if an exposure is not lethal, exposed individuals will have an increased risk of developing cancer later in life. The increased risk is statistically based; see Section 3.2.3 for more information. Depending on the design and delivery of the device, numerous people could be exposed before discovery.

The most challenging aspect of a RED is that discovery of the device can only occur in one of four ways as follows:

- Someone reports a lost source
- A terrorist group makes an announcement
- Medical staff recognizes the symptoms of ARS or other exposure symptoms
- The device is detected inadvertently with a radiation detector

After discovery, recovery of the device may require advanced techniques to reduce exposure to responders. Of all the radiological scenarios addressed by this plan, mitigation of a RED is likely to require the least quantity of resources and cause the least amount of damage to people and the environment.

2.2.3 Radiological Dispersal Device

A radiological dispersal device (RDD) is a device designed to purposely spread radioactive materials. An RDD can be radioactive material combined with an explosive device, commonly known as a dirty bomb, or the purposeful release of radioactive material without explosives. A purposeful release could target a specific infrastructure, like a community drinking water supply system or the ventilation system of a building, or simply a release of material via aerial drop or spraying contaminated water. The radioactive material could be a solid, liquid, or gas.

An RDD is the deliberate release of radioactive material by explosives, by contamination of a water or ventilation system, or by a release into the environment.

General characteristics of an RDD incident include:

- Explosive (dirty bomb) or nonexplosive release
- Potential internal and external dose
- Potential radioactive shrapnel from an explosive device
- Likely widespread contamination
- Individuals may be injured or killed by an explosive device
- Unlikely to cause fatalities or short term affects from radiation exposure

The primary characteristic of an RDD is the release of radioactive material likely contaminating a large area and exposing people and the environment to radiation. These materials could emit alpha, beta, gamma, and/or neutron radiation. Explosive RDDs release radioactive materials into the atmosphere and the radioactive dust will likely settle to the ground within 10 to 20 minutes (Harper, Mosolino, Wente

2007). There is the potential that discovery could be delayed if the release of material was made covertly. In this case, discovery would be the same as a RED (see Section 2.2.2).

2.3 Assumptions

Assumptions are statements that delineate what is assumed to be true when the MARRP was developed. The assumptions set the boundaries of the "playing field" for the MARRP. Assumptions used include:

1. Identified hazards could occur at some time in the future.
2. Participatory individuals, agencies, and organizations are familiar with the MARRP.
3. Individuals, agencies, and organizations will execute their assigned responsibilities.
4. Individuals, agencies, and organizations will provide assistance upon request as described in the MARRP.
5. Executing the MARRP will likely save lives and reduce damage.
6. The nature and scope of a significant incident will include radiological hazards.
7. A significant incident may occur with little or no warning.
8. A significant incident in LACo may result in hundreds or thousands of casualties and/or displaced persons.
9. The incident may cause disruption of LACo's critical infrastructure, such as energy, transportation, telecommunications, and public health and medical systems.
10. The response capabilities and resources of LACo, including mutual aid from surrounding jurisdictions and support from the State of California, may be insufficient and quickly overwhelmed.
11. Existing mutual aid agreements will be exercised as needed.
12. Local and State agencies may need to be self-sufficient for the first 24 to 72 hours until requested federal resources are available to assist.
13. The response to a radiological threat or incident will likely require an integrated federal Government response. The United States Secretary of Homeland Security quickly recognizes the event will need federal response resources and directs the appropriate agencies by implementing the National Response Framework-Catastrophic Incident Annex to assist LACo.
14. A significant mass casualty/mass evacuation incident triggers a Presidential disaster declaration, immediately or otherwise; i.e., in accordance with the Stafford Act.
15. Some local emergency personnel who normally respond to incidents may be among those affected and unable to perform their duties.
16. A detailed and credible common operating picture may not be achievable for 24 to 48 hours (or longer) after the incident. As a result, response activities must begin without the benefit of a detailed or complete situation and critical needs assessment.
17. Local, State, and federal support must be provided in a timely manner to save lives, prevent human suffering, and mitigate severe damage. This may require mobilizing and deploying assets before they are requested via normal protocols.
18. Large-scale evacuations, organized or self-directed, may occur. More people initially are likely to flee and seek shelter. The health-related implications of an incident aggravate attempts to implement a coordinated evacuation management strategy.
19. Radiological incidents may not be immediately recognized as such until the radioactive material is detected or the effects of radiation exposure are manifested in the population.
20. An incident involving the potential release of radioactivity may require implementation of protective measures.
21. Large numbers of people may be left temporarily, or for an extended period of time, homeless, and may require prolonged temporary housing.
22. A significant incident has unique dimensions and characteristics requiring that response plans and strategies be flexible enough to effectively address emerging needs and requirements.
23. A significant incident may have substantial international dimensions. These include potential impacts on the health and welfare of border community populations (e.g., Mexico), cross-border

trade (e.g., shipment of goods from the Port of Los Angeles), transit, law enforcement coordination, and other areas.

24. A radiological incident may include other hazards, such as chemical or biological contaminants, which may require concurrent implementation of other local, State, and federal plans and procedures.
25. If the incident is the result of terrorism, the Homeland Security Advisory System (HSAS) level will likely be raised regionally, and perhaps nationally. Elevation of the HSAS level carries additional local, State, and federal security enhancements that may affect the availability of certain response resources.
26. In the case of a radiological terrorist attack, the effect may be temporarily and geographically dispersed, requiring response operations to be conducted over a multijurisdictional, multistate region.
27. A radiological terrorist incident may affect a single location, or multiple locations, each of which may require an incident response and a crime scene investigation simultaneously.
28. A significant incident may produce environmental impacts (e.g., persistent radiological contamination) that severely challenge the ability and capacity of governments and communities to achieve a timely recovery.
29. Although a terrorist act involves a crime scene and requires an investigation and control of evidence, assuring public health and safety supersedes the criminal investigation.

2.4 Concept of Operations

This section explains LACo's overall emergency response approach to a significant radiological incident. The MARRP does not replace existing response plans of participating agencies or organizations. Instead the MARRP supplements existing plans with additional details of whom, what, when, and where along with roles and responsibilities of each responding agency or organization during an incident covered in the MARRP. The MARRP only addresses incidents with a significant radiological component.

Management and coordination of radiological incident control, containment, and mitigation activities are accomplished by local, State, and federal hazardous materials and radiological resources. Many of these resources are unique to a radiological incident and require highly specialized training and knowledge for maximum effectiveness. Coordination of these resources amongst other standard response activities, like rescue and fire suppression, requires a preplanned effort between responding agencies and organizations. Responsibility for the situational assessment, determination of resources, and command and control lies primarily with the IC/UC. The MARRP assists the IC/UC with these responsibilities.

2.4.1 Division of Roles and Responsibilities

The primary purpose of the MARRP is to provide a coordinated response effort of emergency response agencies and organizations to a significant radiological incident. This section describes the roles and responsibilities of local, State, and federal agencies and organizations that would respond and follow the guidance of the MARRP.

Volume I contains Activity Playbooks describing common activities that are likely to occur during a large hazardous materials disaster. When radioactive materials are involved, there are additional considerations that responders should evaluate while conducting operations and making decisions to protect responder and public health. Specialized capabilities and equipment are required to perform each activity. Agencies and organizations have been assigned primary, secondary, tertiary, etc., responsibility for performing each activity in the Playbooks. IC/UC staff can quickly determine the best organization(s) to execute an activity by reviewing Table 1. If the primary agency on the list is not available to perform an activity, the secondary agency should be selected and so on. Some activities may require multiple agencies to accomplish the objectives of an activity. For example, Monitoring People for Contamination at Public Reception Centers (Playbook 9) is likely to require numerous resources, including multiple Radiation Technical Specialists.

The division of roles and responsibilities described in this section is for general guidance and does not preclude IC/UC from using resources as deemed appropriate based on the incident particular conditions and circumstances. Deviations from this guidance should be clearly conveyed to all participating agencies and organizations in the MARRP to avoid confusion, duplication of efforts, or gaps in critical response actions.

2.4.2 Plan Activation and Deactivation

The MARRP will be activated when a responding agency at the scene is overwhelmed and requests additional resources outside of its agency; i.e., multiple agencies respond to the incident. The following are authorized to activate the MARRP:

1. IC/UC
2. LACo, Department of Public Health, Radiation Management
3. LACo Fire Department, Health Hazardous Materials Division
4. LACo Department of Public Health

Any other agency, local, State, or federal, may contact the above entities for consultation to determine the necessity to activate the MARRP.

Deactivation of the MARRP occurs when a multi-agency coordinated response to address the early phase radiological issues is no longer necessary. The decision to deactivate the MARRP should be discussed with key decision makers and coordinated to properly inform responders. Deactivation does not imply that responder assets and resources are not needed or should demobilize, as part or all may still be needed. Simply stated, deactivation only applies to the coordination guidance in the MARRP. The following are authorized to deactivate the MARRP:

1. IC/UC
2. LACo, Department of Public Health, Radiation Management
3. LACo Fire Department, Health Hazardous Materials Division
4. LACo Department of Public Health

Communication between the above entities is highly encouraged before activation or deactivation of the MARRP. However, the final decision lies with the IC/UC as they have the ultimate responsibility for the direction and control of the incident.

2.4.3 Transition of Response Phases

The MARRP primarily addresses the early phase of a response and more specifically the first few hours to a few days, until significant non-local assets arrive. Once these assets integrate into the Incident Command System (ICS) a transition to UC will occur. At this point in the response, the UC will begin addressing intermediate phase actions, and the agencies and organizations included in the MARRP may have responsibilities to implement some of these actions. Although intermediate actions requiring radiological expertise are not addressed in the MARRP, obviously the appropriate agencies and organizations should assist as requested by IC/UC, and if agreed upon by participating parties, the roles and responsibilities outlined in the MARRP could continue to guide coordination efforts and intermediate response actions.

Two primary radiological assets with substantial resources are the United States Department of Energy (DOE) and the United States Environmental Protection Agency (USEPA). Both assets, with forward teams, will most likely arrive at the incident within hours of notification, with accompanying full resources arriving within 24 hours. At that time, the DOE will head the Federal Radiological Monitoring and Assessment Center (FRMAC) and continue in such capacity during the early phase.

The transition from the early phase to the intermediate phase has no clear boundary. Typically, the immediate emergency is completed, control of the incident is secured, and remedial actions become the focus of the response. Coordination of the federal radiological response through the FRMAC will transition from DOE to the EPA upon mutual agreement.

2.5 Plan Development and Maintenance

The MARRP is maintained by LACo Department of Public Health, Radiation Management. The approval authority for the MARRP is the LACo Department of Public Health.

2.5.1 Planning Process

The MARRP was developed by LACo Department of Public Health, Radiation Management, with assistance from a Planning Committee over the course of many meetings, discussions, and reviews of draft plans from December 2007 until August 2008.

2.5.2 Planning Participants

The participating agencies and organizations that comprised the Planning Committee for the development of the MARRP are listed below.

1. American Red Cross
2. California Department of Homeland Security
3. California Department of Public Health
4. California Highway Patrol
5. California National Guard, Weapons of Mass Destruction 9th Civil Support Team
6. California Office of Homeland Security
7. Federal Bureau of Investigations
8. Federal Emergency Management Agency
9. Long Beach Fire Department
10. Long Beach Police Department
11. Long Beach Port
12. Los Angeles Airport Police Department
13. Los Angeles City Fire Department
14. Los Angeles City Police Department
15. Los Angeles City Police Department, Health Hazardous Division
16. LACo Coroner’s Office
17. LACo, Department of Public Health, Radiation Management
18. LACo Fire Department
19. LACo Public Social Services
20. LACo Sheriff’s Department
21. Los Angeles Port Police Department
22. Presbyterian Intercommunity Hospital
23. St. Mary’s Medical Center CHW
24. United States Coast Guard
25. DOE, Radiological Assistance Program
26. United States Department of Homeland Security
27. United States Environmental Protection Agency, Emergency Response Section
28. United States Environmental Protection Agency, Radiological Emergency Response Team

2.5.3 Planning Responsibilities

The MARRP is maintained by the LACo Department of Public Health, Radiation Management who will head future planning and revisions for the MARRP.

2.5.4 Revision Cycle

At a minimum, the MARRP will be reviewed annually. The plan may be changed based on lessons learned, exercise outcomes, or incident response needs. Interim changes will be issued as needed on separate instruction sheets.

Questions concerning this plan may be directed to:

Kathleen Kaufman
Director
County of Los Angeles
Department of Public Health
Radiation Management
3530 Wilshire Blvd, 9th Floor
Los Angeles, California 90010
(213) 351-7897
kkaufman@ph.lacounty.gov

3.0 Response Planning Guides

The following sections provide operational procedures, instructions, and guidance for responders during the early phase (emergency phase) of a radiological incident. These plans are written with the assumption that responders will have limited information during the early phase; i.e., approximately the first 24 hours. Modifications to these plans may be necessary based on incident specific conditions or upon the recommendations of technical experts.

IC/UC should realize that quick and decisive decisions are required for saving lives and for the protection of responders and the public. Many complex decisions have to be made based on best judgment at the moment. The guidance provided in the MARRP cannot predict every situation, but exceptions to the "rules" can result in increased risk to the health and safety of responders and the public. Radiological experts, including Radiation Technical Specialists, are available to assist with these decisions and exceptions and should be integrated into the ICS very early in the response. Depending on the magnitude of the incident, numerous Radiation Technical Specialists are likely to be needed.

3.1 Activity Playbooks

Activity Playbooks were developed to assist responders during an incident. They were written in a concise format providing pertinent radiological guidance to responders with responsibilities to conduct specific activities. All Activity Playbooks are designed to be removed from Volume I of the MARRP and provided to each responder responsible for implementation of the respective activity.

Remove the Activity Playbooks from Volume I and give them to the appropriate responders for use during an incident.

The following Activity Playbooks are located in Volume I:

1. Exclusion Zone Operations
2. Initial Incident Control Zones
3. Monitoring Responders and Equipment for Contamination
4. Monitoring Injured Victim for Contamination
5. Monitoring Uninjured Victim for Contamination
6. Advanced Radiation Measurements
7. Alpha Radiation Detection and Considerations
8. Crime Scene Investigations
9. Monitoring People for Contamination at Public Reception Centers
10. Monitoring Public Property for Contamination
11. Public Protective Action Guides – Evacuation and Shelter-in-Place
12. Traffic Control and Considerations
13. Hospital-Based Operations and Medical Considerations

Agencies with responsibility for implementation of each Activity Playbook are summarized in Table 1 with a summary of applicable Activity Playbooks for each incident scenario summarized in Table 2. Agencies were selected based on a combination of capabilities and estimated response times to an incident and accordingly assigned primary, secondary, tertiary, etc., responsibility for each activity. It is recognized that many highly qualified agencies are not primary or secondary because it may take many hours for their assets to arrive at the incident while most activities need to be accomplished within minutes or a few hours of the incident.

Table 2: Summary of Activity Playbooks Applicable to Radiological Scenarios

Activity Playbook	RMR	RED	RDD
1. Exclusion Zone Operations	Yes	Yes	Yes
2. Initial Incident Control Zones	Yes	Yes	Yes
3. Monitoring Responders and Equipment for Contamination	Yes	No	Yes
4. Monitoring Injured Victims for Contamination	Yes	No	Yes
5. Monitoring Uninjured Victims for Contamination	Yes	No	Yes
6. Advanced Radiation Measurements	Yes	Partial	Yes
7. Alpha Radiation Detection and Considerations	Yes	No	Yes
8. Crime Scene Investigations	Maybe	Yes	Yes
9. Monitoring People for Contamination at Public Reception Centers	Yes	Partial	Yes
10. Monitoring Public Property for Contamination	Yes	No	Yes
11. Public Protective Action Guides – Evacuation and Shelter-in-Place	Yes	No	Yes
12. Traffic Control and Considerations	Yes	No	Yes
13. Hospital-Based Operations and Medical Considerations	Yes	Yes	Yes

RMR Radioactive Material Release (accidental release of materials by fire, transportation accident, etc.)
RED Radiological Exposure Device (accidental or deliberate act to expose people to contained radioactive material)
RDD Radiological Dispersal Device (deliberate act to spread radioactive materials via explosive, fire, or direct release)

IC/UC can use Table 1 to determine which agency should perform a particular activity. If the primary agency is available with the necessary manpower and equipment they should be assigned the task. Two or more agencies may be necessary to perform some of the activities, for example, Monitoring People for Contamination at Public Reception Centers (Playbook 9). If the primary agency is not available, the secondary agency should be selected and so on.

It should be noted that Table 1 does not imply agencies listed or not listed are incapable of implementing a particular activity. Table 1 simply attempts to identify to IC/UC the likely best suited agencies and organizations to perform a particular activity.

3.2 Direction and Control

This section describes how an incident should be evaluated to decide on the appropriate response, direct the response teams, coordinate efforts with other local, State, and federal agencies and organizations, and to most effectively use available resources.

In a radiation emergency, the primary response goals are to:

1. Protect health and safety of responders, victims, and the public from short-term and long-term radiation exposure
2. Provide medical treatment to victims with injuries
3. Contain the radioactive materials to the extent practicable
4. Protect the environment and property, including critical infrastructure, to the extent practicable

The first goal is accomplished by controlling immediate exposures and doses to responders and the public. Long-term exposures are reduced by remediation efforts and implementing protective action guides: e.g., evacuation and shelter-in-place.

The second goal is accomplished by responders at the scene. If necessary, medical specialists and experts trained in radiological exposures and injuries may be needed for follow-up evaluation and treatment of patients with internal contamination, a high absorbed dose, ARS, or other serious radiation related conditions.

The third goal may be the sole responsibility of responders unless a facility is involved, in which case the facility owners bear some responsibility for containment and eventual cleanup. Limiting contamination spread reduces exposures to responders and the public while avoiding further environmental damage.

The last goal is met by decisions made by the IC/UC to prevent impacts to the environment or critical infrastructure to mitigate long-term consequences. A balance of risk versus gain is critical in this decision making process.

Priorities for direction and control are as follows:

1. Exclusion zone operations
2. Establishing initial incident control zones
3. Setting responder decision points
4. Verifying dosimeter alarms
5. Managing responders' dose
6. Wearing appropriate personal protective equipment
7. Using appropriate radiological instruments and interpreting them correctly
8. Implementing traffic control as necessary

Each topic is discussed in further detail in the following section.

3.2.1 Exclusion Zone Operations (Playbook 1)

Conducting critical operations in the Exclusion Zone (EZ) or Extreme Caution Areas (ECA) such as rescue, protection of critical infrastructure, crime scene investigations, and other authorized activities requires additional preparation and procedures to protect the responder from unnecessary radiation exposure. Section 3.2.2 provides details on establishing initial incident control zones as defined by the radiation levels in Table 3 and defines an ECA in more detail. These control zones are only initial boundaries. Radiation Technical Specialists may adjust the zone levels depending on incident specific conditions; i.e., based on the hazards of the specific radioactive materials present. Changes to the control zones may affect actions in the EZ/ECA, and preplanning should incorporate operational adjustments.

Health and safety procedures are paramount while conducting operations in the EZ/ECA as discussed further in the subsequent sections as follows:

- Establishing Decision Points (Section 3.2.3)
- Setting dosimeter alarm levels (Section 3.2.4)
- Managing dose (Section 3.2.5)
- Using appropriate instrumentation to measure radiation levels (Section 3.2.7)
- Determining the presence of alpha and beta radiation (Section 3.6.3)

Air purifying respirators are preferred in areas that do not require self-contained breathing apparatus due to the presence of another hazard such as low oxygen, chemical vapors, etc. Powered air purifying respirators are also acceptable.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform activities within the EZ/ECA.

1. Fire Department Hazmat Teams
2. Fire Departments
3. Law Enforcement Hazmat Teams

Table 3: Radiation Incident Zones and Activities

<table>
<tr><th>Incident Zone</th><th>Radiation Type</th><th colspan="2">Dose Rate / Contamination Level [1]</th><th>Activities [2]</th></tr>
<tr><td>Support Zone (SZ)</td><td>All</td><td colspan="2">Below Contamination Reduction Zone levels</td><td>Staging, Incident Command, etc.</td></tr>
<tr><td rowspan="3">Contamination Reduction Zone (CRZ)</td><td>Gamma</td><td colspan="2">1 to 10 mR/hr [3]</td><td rowspan="3">Decontamination Activities [6,7]</td></tr>
<tr><td>Beta</td><td colspan="2">1,000 to 100,000 cpm [4]</td></tr>
<tr><td>Alpha</td><td colspan="2">100 to 10,000 cpm [5]</td></tr>
<tr><td rowspan="3">Exclusion Zone (EZ)</td><td>Gamma</td><td colspan="2">10 mR/hr to 10 R/hr [3]</td><td rowspan="3">Rescue, Evaluation, Mitigation, and Activities[9]</td></tr>
<tr><td>Beta</td><td>Above 100,000 cpm [4]</td><td rowspan="2">Respiratory protection advised/required [8]</td></tr>
<tr><td>Alpha</td><td>Above 10,000 cpm [5]</td></tr>
<tr><td rowspan="3">Extreme Caution Area</td><td>Gamma</td><td>Above 10 R/hr [3] (200 R/hr Turn Back Limit) [10]</td><td rowspan="3">Level B (SCBA) respiratory protection required</td><td rowspan="3">Rescue, Preplanned Evaluation, and Mitigation Activities</td></tr>
<tr><td>Beta</td><td rowspan="2">No Limits</td></tr>
<tr><td>Alpha</td></tr>
</table>

1 Incident Zone classification is based on all Radiation Types; i.e., if gamma dose rate is 1 mR/hr, beta contamination level is 500 cpm, and alpha contamination level is 15,000 cpm, the proper Incident Zone classification is “Exclusion Zone” based on the alpha contamination.
2 All activities should be conducted in an area with the lowest levels of exposure and contamination as practicable to accomplish the mission.
3 Gamma radiation measured at approximately 3 feet with ion chamber, energy compensating Geiger-Mueller, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). For PGM, use the backside down, with protective cap on PGM, and mR/hr scale or 3,000 cpm = 1 mR/hr. While values are reasonably good for most gamma emitters, consult a Radiation Technical Specialist if a gamma emitter other than cesium-137 is identified.
4 Beta radiation measured at approximately 1 inch from surface with a Pancake Geiger-Mueller (PGM) detector or a beta-specific detector. **Caution**: PGMs will respond to gamma radiation at approximately 3,000 cpm per 1 mR/hr (for cesium-137). Therefore, when using a PGM to measure beta contamination levels, this gamma radiation response needs to be subtracted from the PGM readout before determining adherence to the beta levels in the table above. For example, if you have measured 1 mR/hr with a gamma detector (as noted in footnote 3 directly above), and using the PGM you measure 4,000 cpm, you need to subtract 3,000 cpm to account for the gamma response before determining the beta contamination level for use with the table above.
5 Alpha radiation measured at approximately ½ inch from a relatively smooth surface (such as a concrete sidewalk) with an alpha-specific detector. If an alpha-specific detector is not available, a PGM may be used as noted in *Standard Operating Guide No. 2, How to Distinguish Between Alpha, Beta, and Gamma Radiation Using a Pancake Geiger-Mueller Survey Meter*. **Caution**: Alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.
6 Decontamination activities should occur in areas with contamination levels no greater than 10% of the contamination release criteria (refer to Tables 10, 11, 12, or 13) to allow reasonable speed surveys.
7 Residents and other non-essential personnel already within the Contamination Reduction Zone may be allowed to shelter-in-place instead of evacuate, pending logistics for their removal.
8 Respiratory protection should be worn for entry into the exclusion zone and must be worn in areas above 1 R/hr for gamma, 100,000 cpm for beta, and 10,000 cpm for alpha.
9 Residents and other non-essential personnel within the Exclusion Zone need to be evacuated. Shelter-in-place should occur until evacuation is feasible.
10 Consult Incident Commander or Radiation Technical Specialist to exceed limit.

cpm counts per minute
mR/hr milliroentgen per hour
R/hr roentgen per hour
SCBA self-contained breathing apparatus

References: CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

Step-by-step instructions to accomplish the activities in this section are summarized in *Playbook 1: Exclusion Zone Operations*, located in Volume I with further supporting details found in the following subsections.

3.2.1.1 Rescue of Victims

Responders should rescue victims in the EZ without hesitation per standard procedures. Responders should monitor dose periodically or about every 30 minutes. If operations inside the EZ extend for more than one hour, even if multiple entries are required, responders should check dosimeters against the Decision Points in Table 4. Responders who reach a dose on the Decision Point table should contact the Safety Officer and a Radiation Technical Specialist.

Table 4: Decision Points

Activities	Exposure Rate (mR/hr)	Cumulative Dose[2] (mrem)
All	Up to 10[1]	Up to 5,000 (5 rem)[1, 3]
Critical infrastructure protection	Up to 10,000 (10 R/hr)[1]	Up to 10,000 (10 rem)[1]
Lifesaving or protection of large populations	Up to 200,000 (200 R/hr)[1] **TURN BACK LIMIT**	Up to 50,000 (50 rem)[1,4]

1 Gross gamma radiation measured with an ion chamber, or energy compensated Geiger-Mueller probe, or, if necessary, a sodium iodide or Pancake Geiger-Mueller (PGM) with the beta radiation shield closed; i.e., use the backside of the PGM, at approximately one meter (3.3 feet) above the ground.

2 Effective Dose Equivalent for external dose only. Dose level for eyes is three times the values listed above. Dose limit for any other organ (including skin and extremities) is 10 times the values listed above.

3 EPA 1992, 29CFR1910.1096(b)(1), and Cal-OSHA (see Volume II for specific citation)

4 A 50 rem dose will result in an increase in the theoretical cancer mortality risk from the background rate of approximately 24% to approximately 28% (Volume II, Attachment 1, Table 5). Doses above 50 rem are acceptable with approval of the Incident Command/Unified Command, Safety Officer, and a Radiation Technical Specialist in extreme cases. Responders that may receive doses up to this level should be a volunteer, well informed of the risks, and have proper training and detection equipment. For example, a 100 rem dose will result in an increase in the theoretical cancer mortality risk from the background rate of approximately 24% to approximately 32%. See Volume II, Attachment 1, Table 5 for risk values for other doses. This dose should be restricted to a once in a life-time event. However, if a future event requires use of these individuals, they may be used; however, their previous dose must be considered. If the IC/UC allows higher than recommended dose or exposure rate levels, documentation should justify the reasons, and the factors in Volume II, Section 3.2.3, should be considered.

Note: The word “limit” is not used in the context of the Multi-Agency Radiological Response Plan for pre-established health and safety standards. Instead dose, exposure rate, and contamination values are provided as guidance and called “levels” or “decision points.” As noted in the above table, doses greater than the occupational limit of 5 rem in a year may be warranted for critical response actions.

mrem millirem
mR/hr milliroentgen per hour
rem roentgen equivalent man
R/hr roentgen per hour

References: CRCPD 2006, NCRP 2005, NCRP 2001, and DHS 2008b (see Volume II for specific citation)

Rescue of victims in the ECA requires personal dosimetry and short stay times. Lifesaving activities require quick and decisive actions, as non-ambulatory victims in the ECA will accumulate dose while waiting for assistance. Incident specific conditions should be evaluated with the benefits of a planned activity before entry is made into the ECA.

While in the ECA, responders should monitor dose approximately every 5 to 10 minutes, and after 30 minutes, check dose against the Decision Points in Table 4. They should avoid exceeding 50 rem of dose unless specifically directed and authorized by IC/UC. For extended operations, teams may need to be changed out on a frequent basis to reduce individual dose. Responders who reach a dose on the Decision Point table should contact the Safety Officer and a Radiation Technical Specialist.

If potential cumulated dose to a victim within an ECA is estimated to be more than 1,000 rem, the victim may not be viable. Responders should conduct rescue with caution with consideration for risk versus gain of such actions.

3.2.1.2 Protection of Critical Infrastructure

Responders should protect critical infrastructure in the EZ without hesitation per standard procedures. Responders should monitor dose periodically or about every 30 minutes. If operations inside the EZ extend for more than one hour, even if multiple entries are required, responders should check dosimeters against the Decision Points in Table 4. Responders who reach a dose on the Decision Point table should contact the Safety Officer and a Radiation Technical Specialist.

Protection of critical infrastructure in the ECA requires personal dosimetry and short stay times. Responders should monitor dose approximately every 5 to 10 minutes, and after 30 minutes, check dose against the Decision Points in Table 4. They should avoid exceeding 10 rem of dose unless specifically directed and authorized by IC/UC. For extended operations, teams may need to be changed out on a frequent basis to reduce individual dose. Responders who reach a dose on the Decision Point table should contact the Safety Officer and a Radiation Technical Specialist.

3.2.1.3 Other Authorized Activities

Other authorized activities do not involve life saving or protection of critical infrastructure. Activities should be pre-planning to reduce responder dose. Responders should monitor dose periodically or about every 30 minutes. If operations inside the EZ extend for more than one hour, even if multiple entries are required, responders should check dosimeters against the Decision Points in Table 4. Responders who reach a dose on the Decision Point table should contact the Safety Officer and a Radiation Technical Specialist.

Conducting authorized activities in the ECA requires preplanning, personal dosimetry and short stay times. Responders should monitor dose approximately every 5 to 10 minutes, and after 30 minutes, check dose against the Decision Points in Table 4. They should avoid exceeding 5 rem of dose unless specifically directed and authorized by IC/UC. For extended operations, teams may need to be changed out on a frequent basis to reduce individual dose. Responders that reach a dose on the Decision Point table should contact the Safety Officer and a Radiation Technical Specialist.

3.2.2 Initial Incident Control Zones (Playbook 2)

Once the presence of radiation is confirmed, initial incident control zones should be delineated as needed. The Support Zone (SZ), Contamination Reduction Zone (CRZ), and EZ should be delineated as areas that meet the radiation criteria summarized in Table 3. Radiation fields and contamination are unlikely to be uniformly distributed. There may be several ECAs within the EZ due to fragments; some may be only a few feet in diameter, but each should be delineated as described in this section.

The EZ is an area that requires personal protective equipment (PPE) for health and safety purposes. In radiological incidents, and particularly after an RDD, the radiation will not be uniformly distributed, and radiation levels can vary widely, from low levels that are not an immediate health concern to high levels that can be deadly. It is possible for the EZ to have levels of radiation significantly above the EZ boundary (10 mR/hr) that necessitate extreme precautions. Therefore, an additional control zone above 10 R/hr within the EZ should be established as an ECA to alert responders to use extreme caution.

Consideration for responder health and safety must be balanced with the benefits of such activities within the ECAs.

An ECA is not a recognized control zone within NIMS for areas of extreme hazard. For a radiological event, it is appropriate and prudent to establish these areas for the protection of responders, victims, and the public. ECAs should only be delineated if activities will be performed in these areas such as lifesaving or critical infrastructure activities. Table 3 summarizes the radiation level for each initial incident control zone. Activities in the ECA warrant extra precautions and consideration as discussed throughout the MARRP.

The zones should be delineated and marked with visible indications such as barrier tape, traffic cones, streets, or other means such as natural barriers like buildings or topographical features such as waterways. If possible, radiation protection principles should be followed and all operations located within the SZ and CRZ at the lowest level of ground contamination and gamma exposure rate as practicable. However, the exposure rates and contamination levels outside of the EZ are considered generally safe for responders and public without PPE, including respiratory protection, for at least the first 24 hours of the response.

While responders are delineating control zone boundaries, lifesaving and critical infrastructure protection activities may occur within the ECAs. These activities should be carefully planned and responders should avoid doses that exceed 50 rem for lifesaving or 10 rem for critical infrastructure property protection and with specific direction and approval from IC/UC.

The initial incident control zones may require modification depending on the incident specific conditions. The values presented in Table 3 are specific for cesium-137 (Cs-137). Once the incident radionuclide(s) has been identified, a Radiation Technical Specialist should reevaluate each control zone radiation level criteria based on the radionuclide(s) characteristics.

Zone boundaries may also change due to contamination migration caused by wind, rain, or movement of people and equipment. Responders should verify boundaries periodically and inform IC/UC when boundaries are changed so operations can be adjusted accordingly.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. Fire Department Hazmat Teams
3. Law Enforcement Hazmat Teams
4. United States Environmental Protection Agency, Emergency Response Section

Step-by-step instructions to accomplish the activities in this section are summarized in *Playbook 2: Initial Incident Control Zones*, located in Volume I.

The detection of all types of radiation is necessary for establishing the control zones correctly. Absolute accuracy is not necessary, yet appropriate detectors must be used to measure alpha, beta, gamma, and neutron radiation as discussed in Section 3.6.3. Results are compared to Table 3 to delineate each control zone. Section 3.6.3, as well as Playbooks 6 and 7, detail the detection of each type of radiation.

3.2.3 Responder Decision Points

Dose and exposure rate levels are set based on the premise that an exposure is unlikely to result in an acute reaction, with a reasonable increased risk of developing cancer over the person's lifetime. These levels were selected based on recommendations from nationally recognized radiation protection organizations: the Conference of Radiation Control Program Directors (CRCPD) and the National Council on Radiation Protection and Measurements (NCRP). Three documents were reviewed to develop the Decision Points as follows:

- Handbook for Responding to a Radiological Dispersal Device, First Responder's Guide – The First 12 Hours (CRCPD 2006)
- Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, Commentary No. 19 (NCRP 2005)
- Management of Terrorist Events Involving Radioactive Material, Report No. 138 (NCRP 2001)

The Decision Points recommended in this section are not called "limits." They are provided as guidance to facilitate informed decisions by responders conducting operations in the EZ/ECAs. Occupational regulations limit exposures for workers to 5 rem in a year. In an emergency situation, exceeding 5 rem may be warranted for critical actions such as rescuing a victim.

A 50 rem dose will result in approximately a 4% increased risk of dying from cancer. (Note that the American Cancer Society states that the risk of dying from cancer, averaged for both men and women, is about 21%.) Doses above 50 rem are acceptable with approval of the IC/UC, Safety Officer, and a Radiation Technical Specialist, in extreme cases. Responders who may receive doses up to this level must be well informed of the risks, and have proper training and detection equipment. For example, a 100 rem dose will result in approximately an 8% increased chance of dying from cancer (from an average of 21% to 29%); see Table 5 for risk values for other doses. This dose should be restricted to a once in a lifetime event. However, if a future event requires use of these individuals, they may be used, but their previous dose must be considered. If the IC/UC allows higher than the dose or exposure rate level guidelines, careful documentation should justify the reasons, and the following factors should be considered:

1. Compelling reason (saving lives, protecting critical infrastructure, protecting large populations, etc.)
2. Responder understands the risk factors, both acute and chronic, of the exposure (see Table 5)
3. Responder has adequate training and knowledge
4. Responder has appropriate instrumentation to measure exposure rates and accumulated dose
5. The Incident Safety Officer has provided approval
6. A Radiation Technical Specialist, if available, has been consulted

Table 5: Dose and Potential Health Effects

Short-Term[1] Whole-Body Dose (rem)	Acute Death[2] from Radiation without Medical Treatment (%)	Acute Death from Radiation with Medical Treatment (%)	Acute Symptoms (nausea and vomiting within 4 hours) (%)	Lifetime Risk Fatal Cancer without Radiation Exposure (%)	Excess Lifetime Risk of Fatal Cancer Due to Short-Term Radiation Exposure[3] (%)
1	0	0	0	24	0.08
10	0	0	0	24	0.8
50	0	0	0	24	4
100	< 5	0	5 – 30	24	8
150	< 5	< 5	40	24	12
200	5	< 5	60	24	16
300	30 – 50	15 – 30	75	24	24[4]
600	95 – 100	50	100	24	> 40[4]
1,000	100	> 90	100	24	> 50[4]

1 Short-term refers to the radiation exposure during the initial response to the incident. The acute effects listed are likely to be reduced by about one-half if radiation exposure occurs over weeks.
2 Acute deaths are likely to occur from 30 to 180 days after exposure and few if any after that time. Estimates are for healthy adults. Individuals with other injuries, and children, will be at greater risk.
3 Most cancers are not likely to occur until several decades after exposure; although leukemia has a shorter latency period of less than five years.
4 Applies to those individuals that survive Acute Radiation Syndrome.

rem roentgen equivalent man
< less than
> greater than
% percentage

(Adapted from NCRP 2005)

As a dose control method, responders should adhere to the alarms set on real-time dosimeters and radiation instruments in accordance with Section 3.2.4. Other dose management techniques in accordance with radiation protection principals should be implemented as described in Section 3.2.5.

3.2.4 Instrument Alarm Levels

The single most important radiological instrument for a responder entering the EZ/ECA is a real-time digital dosimeter with alarms set in accordance with Table 6. Every responder who enters the EZ/ECA should have a personal real-time dosimeter. If there are an insufficient number of dosimeters, one per team for the EZ zone is the minimum requirement; one per person is required for entering the ECA. In such a case, the team should stay together while in the EZ to provide a reasonable estimate of each responder's dose.

Before entry into the EZ/ECA, *Form No. 3: Responder Dose Log* (Attachment 3) should be filled with pertinent information and maintained. All dosimeters should be "zeroed" before entry. Upon exiting the CRZ, each dosimeter is collected and the dose recorded on *Form No 3: Responder Dose Log*. At regular intervals, the Radiation Technical Specialist should review the log. If at any time a responder not involved in life saving or critical infrastructure protection exceeds 5 rem of dose the Safety Officer and a Radiation Technical Specialist should be notified as quickly as possible. For a team with one dosimeter, each responder on the team will receive the same dose value as indicated on the single dosimeter with a notation on the *Form No 3: Responder Dose Log* that the dose was a "Team Dose" value.

Table 6: Responder Alarm Levels

Alarm Level	Exposure Rate[1] (mR/hr)	Cumulative Dose[2] (mrem)
First Alarm	2	10
Second Alarm	10,000 (10 R/hr)	25,000 (25 rem)

[1] Gross gamma radiation measured with an appropriate real time dosimeter at 1 meter (3.3 feet) above the ground. External dose only.
[2] Effective dose equivalent for external dose only.

mR/hr milliroengten per hour
R/hr roengten per hour
mrem millirem
rem roengten equivalent man

Other radiation instruments may have programmable alarms that should be set to the recommended alarm levels in Table 6.

3.2.5 Dose Management

The MARRP is designed for a non-routine radiological incident that represents an extraordinary event. In such an emergency, standard occupational radiation protection considerations are neither practical nor appropriate. An extraordinary incident may justify non-routine radiation protection guidelines for limitation of radiation dose to responders and the public. Responder exposure and dose management is addressed in this section, whereas exposure considerations for the public are in subsequent sections.

The approach to radiation protection in the MARRP is based on two considerations: (1) the identification of incident control zones and (2) the control of the absorbed dose to individual emergency responders. Incident zones are designed on a graded approach to allow for an increase in dose when justified by the importance of a critical action. The absorbed dose to a responder will require careful consideration of the time spent (stay time) in contaminated areas for each emergency response activity. Once a responder has obtained the decision point of 50 rem, further exposure may be restricted which may require that the responder leave the incident, and may curtail future radiation response activities after incident termination.

A robust dose management program should be established to prevent excessive dose to a responder. IC/UC as well as responders should be cognizant of methodologies to reduce radiation exposure by following radiation protection principles as follows:

1. Reduce exposure time
2. Increase distance from radioactive sources and contamination
3. Increase shielding as practicable

Practice radiation protection principals to reduce exposure as much as possible by reducing exposure time, increasing distance from contamination, and using shielding when possible.

Strategies for implementing radiation protection include, but are not limited to, the following:

1. Limit amount of exposure time

2. Increase distance from radioactive sources, contamination, and high exposure rates
3. Use available shielding as practicable; i.e., buildings, vehicles, etc.
4. Set Decision Points at the lowest reasonable level possible and increasing them as necessary
5. Reduce number of entry teams
6. Reduce number of responders who make entry
7. Select responders who can most quickly accomplish the activity and entry objectives
8. Use dosimeters
9. Use alarms on dosimeters
10. Plan work methodology for maximum efficiency to reduce dose
11. Changing teams out frequently to reduce dose to each individual

The first radiation protection principal can be used to limit a responder's dose by limiting exposure time. Although exposure rates will fluctuate in the EZ/ECA, stay time calculations are an effective protection technique. The stay time calculation is as follows:

$$Stay\ Time = \frac{Maximum\ Dose - Accumulated\ Dose}{Exposure\ Rate}$$

Where,

Stay Time	maximum allowed time in radiation field to reach Maximum Dose in hours
Maximum Dose	maximum dose in millirem
Accumulated Dose	total dose in millirem received during the incident
Exposure Rate	exposure rate in EZ/ECA in millirem per hour (for safety purposes, the maximum exposure rate detected in the EZ or ECA, where responders will be conducting activities, should be used)

See Table 7 which summarizes stay times for various dose and exposure levels. Although the unit of millirem (mrem) and millirem per hour (mrem/hr) are used in the above stay time equation, other units can be easily substituted; i.e., milliroentgen (mR) and milliroentgen per hour (mR/hr).

The last radiation protection concept (number 11 above) is referred to as dose sharing. Spreading dose over a larger group of responders will reduce risk to each individual rather than a few responders receiving the majority of the dose and risk. Attention to dose management is necessary to avoid responders reaching dose Decision Points that may cause them to be removed from service at the incident.

Any exposure and accumulated dose should be documented on *Form No 3: Responder Dose Log*, which should be completed after a responder exits the CRZ. At regular intervals, the log should be provided to the Radiation Technical Specialist for review and signature. If any responder exceeds 5 rem of dose the Safety Officer and a Radiation Technical Specialist should be notified as soon as possible. If responders make multiple entries, the individual's *Form No 3: Responder Dose Log* should be reviewed before entry to prevent the responder from exceeding Decision Points based on assigned activity to be performed; i.e., 50 rem for lifesaving, 10 rem for critical infrastructure protection, or 5 rem for other activities. At the termination of the incident, all Responder Dose Logs should be submitted to each responder's respective agency's health and safety officer for record retention.

Table 7: Stay Time Table

Radiation Meter Gamma Exposure Rate		Time to Receive This Dose (Times rounded. Table only calculates dose from external sources.)									
		All Emergency Responder Activities Under Emergency Conditions				Protect Property	Lifesaving		Volunteer Only	Potentially Lethal	
		100 mrem	1 rem	2 rem	5 rem	10 rem	25 rem	50 rem	100 rem	300 rem	500 rem
CONTAMINATION REDUCTION ZONE / SUPPORT ZONE	10 µR/hr	1 yr									
	50 µR/hr	12 wk	2 yr								
	100 µR/hr	6 wk	1 yr								
	500 µR/hr	8 dy	12 wk	24 wk	1 yr						
	750 µR/hr	5.5 dy	8 wk	16 wk	40 wk	1.5 yr					
	1 mR/hr	4 dy	6 wk	12 wk	30 wk	1 yr					
	2 mR/hr	50 hr	3 wk	6 wk	15 wk	30 wk	74 wk				
	5 mR/hr	20 hr	8 dy	16 dy	6 wk	12 wk	30 wk	1 yr			
	7.5 mR/hr	13 hr	5.5 dy	11 dy	4 wk	8 wk	20 wk	40 wk	80 wk		
	10 mR/hr	10 hr	4 dy	8 dy	3 wk	6 wk	15 wk	30 wk	1 yr		
EXCLUSION ZONE CAUTION	20 mR/hr	5 hr	2 dy	4 dy	10 dy	3 wk	7 wk	15 wk	30 wk	2 yr	
	30 mR/hr	3.3 hr	33 hr	3 dy	1 wk	2 wk	5 wk	10 wk	20 wk	60 wk	
	40 mR/hr	2.5 hr	1 dy	2 dy	5 dy	11 dy	4 wk	8 wk	15 wk	1 yr	
	50 mR/hr	2 hr	20 hr	40 hr	4 dy	8 dy	3 wk	6 wk	12 wk	35 wk	1 yr
	75 mR/hr	80 min	13 hr	1 dy	3 dy	5.5 dy	2 wk	4 wk	8 wk	24 wk	40 wk
	100 mR/hr	1 hr	10 hr	20 hr	2 dy	4 dy	10 dy	3 wk	6 wk	18 wk	30 wk
	200 mR/hr	30 min	5 hr	10 hr	1 dy	2 dy	5 dy	11 dy	3 wk	9 wk	15 wk
	300 mR/hr	20 min	3 hr	7 hr	16 hr	32 hr	3 dy	1 wk	2 wk	6 wk	10 wk
	400 mR/hr	15 min	2.5 hr	5 hr	12 hr	1 dy	2.5 dy	5.5 dy	11 dy	31 dy	52 dy
	500 mR/hr	12 min	2 hr	4 hr	10 hr	19 hr	2 dy	4 dy	8 dy	25 dy	40 dy
	750 mR/hr	8 min	78 min	2.6 hr	6.5 hr	13 hr	33 hr	3 dy	5.5 dy	16 dy	4 wk
	1 R/hr	6 min	1 hr	2 hr	5 hr	10 hr	25 hr	50 hr	4 dy	12 dy	3 wk
	1.5 R/hr	3 min	40 min	78 min	3.5 hr	6.5 hr	16.5 hr	33 hr	3 dy	8 dy	14 dy
	2 R/hr	3 min	30 min	1 hr	2.5 hr	5 hr	13 hr	25 hr	2 dy	6 dy	11 dy
	3 R/hr	2 min	20 min	40 min	100	200 min	8 hr	16 hr	1.5 dy	4 dy	1 wk
	4 R/hr	90 sec	15 min	30 min	75 min	2.5 hr	6.5 hr	13 hr	1 dy	3 dy	6 dy
	5 R/hr	72 sec	12 min	24 min	1 hr	2 hr	5 hr	10 hr	20 hr	2.5 dy	4 dy
	7.5 R/hr	48 sec	8 min	16 min	40 min	78 min	200 min	6.5 hr	13 hr	40 hr	3 dy
EXTREME DANGER AREA	10 R/hr	36 sec	6 min	12 min	30 min	1 hr	2.5 hr	5 hr	10 hr	30 hr	50 hr
	20 R/hr	18 sec	3 min	6 min	15 min	30 min	75 min	2.5 hr	5 hr	15 hr	1 dy
	30 R/hr	10 sec	2 min	4 min	10 min	20 min	50 min	96 min	3 hr	10 hr	17 hr
	40 R/hr	9 sec	90 sec	3 min	7.5 min	15 min	38 min	75 min	2.5 hr	7.5 hr	12 hr
	50 R/hr	7 sec	72 sec	80 sec	6 min	12 min	30 min	1 hr	2 hr	6 hr	10 hr
	75 R/hr	5 sec	50 sec	100 sec	4 min	8 min	20 min	40 min	80 min	4 hr	6.5 hr
	100 R/hr	4 sec	30 sec	1 min	3 min	6 min	15 min	30 min	1 hr	3 hr	5 hr
	200 R/hr	2 sec	18 sec	30 sec	90 sec	3 min	7 min	15 min	30 min	90 min	2.5 hr
GRAVE DANGER	300 R/hr	1 sec	10 sec	20 sec	1 min	2 min	5 min	10 min	20 min	1 hr	100 min
	400 R/hr	1 sec	9 sec	15 sec	45 sec	90 sec	3.5 min	7.5 min	15 min	45 min	75 min
	500 R/hr	1 sec	7 sec	15 sec	30 sec	72 sec	3 min	6 min	12 min	36 min	1 hr
	750 R/hr	1 sec	5 sec	9 sec	24 sec	48 sec	2 min	4 min	8 min	24 min	40 min
	1,000 R/hr	1 sec	3 sec	7 sec	18 sec	36 sec	90 sec	3 min	6 min	18 min	30 min

1 µR = 0.001 mR = 0.000001 R
1,000 µR = 1 mR = 0.001 R
1,000,000 µR = 1,000 mR = 1 R

µR microroentgen
mR milliroentgen
R roentgen
rem roentgen equivalent man

yr year
wk week
dy day

hr hour
min minute
sec second

Natural Background: about 10 µR/hr = 0.01 mR/hr = 0.00001 R/hr = 0.25 mR/day

3.2.6 Personal Protective Equipment

Responders must wear appropriate PPE while performing activities in the EZ/ECA. Respiratory protection is critical for protection of responders from internal contamination. During the initial entry, responders should wear a self-contained breathing apparatus. After all other hazardous atmospheres have been confirmed not present (e.g., low oxygen, chemical, biological, etc.) an air purifying respirator (APR) or powered air purifying respirator (PAPR) is fully protective unless a radioactive gas is present, which is highly unlikely. Cartridges for the APR/PAPR should be high efficiency particulate filters, like N95 filters.

Respiratory protection is mandatory in the Exclusion Zone during the initial phase! If only radioactive materials are present, wear an APR or PAPR.

If the incident only involves radioactive materials, responders will be fully protected in standard PPE including an APR or PAPR. Note that after careful consideration by the Radiation Technical Specialist, an APR or PAPR may not be required. Extended operations require careful attention to accumulated dose in these cases.

Any protective suit/coverall will prevent or reduce skin contamination but will provide no protection from gamma radiation; exposure to alpha radiation is only an internal contamination health hazard.

Standard fire fighting gear and respiratory protection is protective for skin and internal contamination but not protective for external exposure to gamma radiation.

Modifications to standard PPE and respiratory protection should be approved by the Safety Officer in consultation with the Radiation Technical Specialist.

3.2.7 Radiological Instrumentation

For the purpose of the MARRP, responders may estimate a person's radiation absorbed dose using real-time measurements by assuming 1 roentgen equivalent man (rem) or 1 radiation absorbed dose (rad) is equivalent to 1 roentgen (R).

For the purposes of this plan, 1 R (roentgen) = 1 rem = 1 rad.

It is important for responders to understand the difference between exposure rate and dose. Exposure rate is a measure of the radiation field with units typically in microR per hour (µR/hr), microrem per hour (µrem/hr), mR/hr, and mrem/hr. The difference between exposure rate and dose can be a source of confusion amongst responders. Exposure rate is like a vehicle speedometer which measures how much the vehicle moves in an hour. In radiation, exposure rate is a measure of how much radiation is emitted from a radioactive material or contaminated area in an hour. Dose is like a vehicle odometer which measures the total distance a vehicle has traveled. For radiation, dose is a measure of the total absorbed radiation by a person.

Another source of confusion amongst responders is the difference between various units; i.e., µR, mR, and R. The unit micro (µ) means one millionth and the unit milli (m) means one thousandth. Therefore, there are a million µR in one R and a thousand mR in one R. In other words, there is a thousand fold increase from µR to mR. When an instrument meter reads in the µR range a responder should have no health and safety concerns from the radiation exposure. When levels are in the mR range, the responder should be on alert but still have no immediate health and safety concerns. However, when the R range is obtained, responders should be especially attentive to the radiation levels and monitor their total dose periodically; approximately every 5 to 10 minutes is justified. Examples of comparison of these units are illustrated below:

10,000 µR/hr = 10 mR/hr = 0.01 R/hr

25,000,000 µrem = 25,000 mrem = 25 rem

An easy memory aid for the radiation units is presented in the box below. Measurements in the µR are not a health and safety concern whereas in the mR range there is cause to be alert while values in the R range warrant caution.

Memory Aid for Radiation Measurements

µR = OK

mR = Maybe

R = Rethink

Radiation is measured in various units that may be unfamiliar to responders because different units are used outside of the United States, may be found in literature, and are displayed by some instruments. Table 8 summarizes domestic and international units of measurements. Conversion between the units used in the United States and international units are summarized in Table 9.

Table 8: Units of Measurement

United States Unit/Symbol	International System Unit/Symbol	Relevance
Curie (Ci)	Becquerel (Bq)	Amount of radioactivity of a material
Rad	Gray (Gy)	Amount of absorbed dose to any object
Rem	Sievert (Sv)	Amount of damage to human tissue or dose equivalent
roentgen (R)	Coulomb/Kilogram (C/kg)	Amount of ionization of air

Table 9: Conversion of Units of Measurement

Unit	Conversion
1 curie	3.7×10^{10} disintegrations/second
1 becquerel	1 disintegrations/second
1 rad	0.01 gray (Gy)
1 rem	0.01 sieverts (Sv)
1 roentgen (R)	1 rem (approximate)
1 gray (Gy)	100 rad
1 centigray (cGy)	1 rad
1 sievert (Sv)	100 rem

An appropriate gamma detector is necessary for accurate measurement of exposure rate levels while conducting operations in the EZ, especially in the ECA, due to the very high radiation levels. Appropriate gamma detectors are as follows, in order of preference:

1. Ion Chamber
2. Energy Compensated Geiger-Mueller, like the Canberra Mini Radiac
3. Sodium Iodide or "gamma" probe

The minimum features that an appropriate gamma meter should have are:

1. Detection range for gamma exposure rate levels in the EZ or ECA
2. Alarms set at or below the applicable Decision Point gamma exposure rate
3. Ideally, auto ranging read out to reduce time adjusting the meter scale
4. Hand-held and easy to operate, preferably with one hand

Other instruments that measure gamma radiation beside the types listed above should be approved by a Radiation Technical Specialist for use in the EZ/ECA.

It is recommended that headphones are used for radiation instruments in noisy environments or when conducting contamination surveys on the public who may become unnecessarily disturbed by the sound of "clicks."

Detectors without anti-saturation circuitry may falsely read zero in a high radiation field. A detector, other than an alpha zinc sulfide scintillator, that reads zero is cause for caution that the detector may have malfunctioned.

The following is a quick reminder or primer on radiological instrumentation types, typical uses during a response, and cautions when using the instrument.

Detector: Pancake Geiger-Mueller (PGM)
Detects: Alpha, Beta, Gamma
Typical Uses: Contamination surveys
Cautions: Not very efficient for gamma radiation. Detector window has a thin mylar cover that holds a gas inside the detector, if punctured the reading will drop to zero and the detector will not function; it cannot be repaired in the field.

Detector: Sodium Iodide (a crystal) scintillator
Detects: Gamma radiation only
Typical Uses: Exposure rate (µR/hr) and activity (cpm) measurements
Cautions: Detector crystal and electronics are shock sensitive

Detector: Zinc Sulfide scintillator
Detects: Alpha radiation only
Typical Uses: Confirm presence or absence of, and measures, alpha radiation

Cautions: Detector window has a thin mylar cover to prevent detection of light. If punctured, false readings are obtained when exposed to light. Repair by replacing the mylar cover but ensure the mylar density is the same or the detection sensitivity of the detector will change.

Detector: Electronic real time dosimeter (typically an energy compensated Geiger-Mueller detector)
Detects: Gamma radiation only
Typical Uses: Approximate accumulated dose (R or rem) and exposure rate (μR/hr) measurements
Cautions: Dose should be zeroed before entering Exclusion Zone.

Detector: Ion chamber
Detects: Gamma radiation only, if meter has a beta window slide, it can detect high energy beta radiation in the open position.
Typical Uses: Highest accuracy instrument for exposure rate (μR/hr) or dose rate (mrem/hr) measurements.

Detector: Portal Monitor
Detects: Gamma radiation only
Typical Uses: Scan a large number of people, including non-ambulatory victims. Portal Monitor can be configured to scan the sides of vehicles.
Cautions: Instrument cannot detect alpha radiation.

Detector: microR or microrem meter
Detects: Gamma only
Typical Uses: Measure low (micro-levels) radiation field rates. Very sensitive to gamma. Can be used for contamination surveys on people or property.
Caution: Cannot be used in high radiation fields.

Radiation instrumentation with wireless telemetry systems should be utilized wherever possible. Within LACo, several response agencies have radiation instruments integrated into this system. This allows real-time radiation transmission through the internet. Upon receipt by a Telemetry Technical Specialist and/or a Radiation Technical Specialist, the data or specified alert information can be forwarded as a Common Alerting Protocol (CAP) message to other processing systems for analysis or notification. The CAP is in compliance with federal standards for information interoperability based on Organization for the Advancement of Structured Information Standards Open consortium recommendations. Systems capable of utilizing this CAP include:

- Geographic Information Systems for processing the readings in conjunction with other map based geographic data (roadways, terrain, population, and critical infrastructure sites)

- Plume models
- Alerting and notification systems (telephone and mobile telephone, facsimile, E-mail, short message service, and public address)
- Guidance material including substance library data and personal protection guides
- Regional server farms allowing multiple concurrent live sensor feeds indicating their location and alarm condition

The use of wireless telemetry equipment can play a significant role in minimizing risk and reducing response time. As telemetry technology grows within LACo, this plan will be updated accordingly.

3.2.8 Traffic Control (Playbook 12)

Migration of contamination into or radiation exposure of traffic corridors can place vehicle occupants at risk. Vehicle occupants are not protected from gamma radiation in contaminated or high exposure areas. The longer vehicle occupants are traveling through these areas, the greater their dose and health risk. In addition, vehicles traveling through contaminated areas can also result in spread of contamination. Instructions should be given to drivers to close all windows and turn off the air conditioner/heater or keep it on recirculation to prevent drawing contaminated air into the vehicle.

Mitigation of this situation requires a coordinated effort to redirect vehicles to alternate routes for safe passage, to redirect occupants to shelter-in-place locations, or to allow vehicles to quickly travel through the affected area to reduce or eliminate exposure to occupants. Rerouting traffic to uncontaminated areas may take more effort and time than directing vehicle occupants to take refuge in a building for shelter-in-place. However, under certain cases it may be more advantageous to allow a limited number of vehicles through the affected area if reducing exposure as much as possible has been considered and vehicles pass through in an expeditious time frame. The estimated dose to vehicle occupants should be considered when selecting the most appropriate option considering radiation protection principals. In LACo, the Traffic Management Center can post directions on electronic message billboards to instruct drivers of road closures and alternate routes.

Maps of confirmed or projected contaminated areas can be helpful to determine affected traffic that should be rerouted. However, early in the response, gross assumptions may need to be made about the level and location of contamination.

Numerous resources are likely required to assist during a significant radiological incident. These resources will come from nearby local agencies which may have easy access to the scene. However, local resources farther away from the scene and State and federal resources may require assistance with access. Creating access corridors for incoming responders can expedite arrival of valuable assets to the scene or other locations as needed. Depending on the resources requested by IC/UC, access corridors that may be established are:

1. Routes on interstate freeways, State highways, and local roadways from outside LACo to the scene, staging area, or other designated locations.
2. Routes on interstate freeways, State highways, and local roadways from nearby airports to the scene, staging area, or other designated locations.
3. Routes on interstate freeways, State highways, and local roadways from the scene, staging area, or other designated location to hospitals, public reception centers, or emergency operations centers.

If an evacuation of the scene or impacted areas is initiated, evacuation routes will need to be established for safe passage of the public. Similar to establishing access corridors for responders coming onto the scene, special considerations are required for the public leaving the scene or impacted areas.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. Law enforcement agencies
2. California Highway Patrol

Step-by-step instructions to accomplish these activities are not provided in the *Playbook 12: Traffic Control and Considerations*, located in Volume I, because every incident and situation is unique, and law enforcement agencies have plans for traffic control for hazardous materials incidents. The Playbook provides considerations that should be taken into account while conducting traffic control.

3.3 Monitoring Responders and Equipment for Contamination (Playbook 3)

Responders exiting the EZ will undergo decontamination in the CRZ to reduce or eliminate contamination from their skin and equipment. Equipment encompasses all objects removed from the EZ, including tools, PPE, instruments, vehicles, victim backboards, clothing, and any object suspected of contamination. Contaminated evidence collected by law enforcement agencies will require evaluation on a case-by-case basis (see Playbook 8); a Radiation Technical Specialist should be consulted to assist in the evaluation of radiation levels and decontamination strategies, if appropriate. Table 10 summarizes the responder contamination release levels for personnel, with responder equipment release levels summarized in Table 11. Note that the responder release levels are identical to the victim and public release levels. Likewise, responder equipment and victim and public property release levels are the same.

The location of the decontamination station is critical to effective measurement of contamination levels before and/or after decontamination. A decontamination station should be located in an area with background radiation levels below one hundredth (1%) of the release levels, if possible. If this cannot be achieved or is not practicable, do not exceed one tenth (10%) of the release level. Secondly, contamination on radiation survey personnel should not exceed ground contamination levels at the location. This will prevent inadvertent false or inaccurate readings on the persons or objects being surveyed for contamination.

Surveys for radiation must be performed in an area with background levels that are at least one tenth or 10% (preferably one hundredth or 1%) of the contamination release level; i.e., a contamination release level of 10,000 cpm requires a background area of less than 1,000 cpm and ideally below 100 cpm.

If possible, practice radiation protection principals and locate decontamination stations within the CRZ at the lowest level of contamination and gamma exposure rate possible, preferably near background. Periodically check contamination levels at the decontamination stations as they can become contaminated with use. Attempts to reduce and maintain contamination levels as low as possible at the station are helpful but should not hinder operations of the station. The decontamination station may need to be moved if contamination levels exceed acceptable background levels.

If available, portal monitors can be used in lieu of a hand-held survey for responders to expedite release from the CRZ. If applicable, the alarm should be set at four standard deviations above background. However, portal monitors only detect gamma radiation; hand-held surveys with appropriate instrumentation are required to detect alpha or beta radiation. If a responder is contaminated above release levels after initial decontamination, the responder should return to the decontamination station for further attention. A resurvey is necessary to confirm contamination release levels have been met. If

Table 10: Responder Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to 1,000 cpm beta and 100 cpm alpha, if returning to duty station or if doing so does not preclude decontamination of others with higher contamination levels. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* before release for self-decontamination.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	If responder is going directly home, decontaminate to Level 2 lower values, then release for home decontaminate in accordance with *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*. If not going directly home decontaminate as noted for Level 1. [4,5]
Gamma [2]	50 [(4)] to 100 μR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Decontaminate without delay to achieve Level 2 values.[5] If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Gamma [2]	Greater than 100 μR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 μR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 μR/hr; therefore, 50 μR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 μR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute mR/hr milliroentgen per hour μR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

Table 11: Responder Equipment Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to lowest level practicable using routine field decontamination methods (wiping and washing) and release without restriction if less than 1,000 cpm beta and 100 cpm alpha.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	Control large items, bag smaller items, and retain until evaluated by a Radiation Technical Specialist. Items returning to contaminated areas, including ambulances, may be reused during the incident with these contamination levels.[5]
Gamma [2]	50 [(4)] to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Do not reuse or release. Contact a Radiation Technical Specialist for determination of disposition.[6]
Gamma [2]	Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 µR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 µR/hr; therefore, 50 µR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 µR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Upon demobilization, high priority equipment, like an ambulance, should be given quicker attention for decontamination efforts to release at the lowest contamination level possible.

6 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute mR/hr milliroentgen per hour µR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

contamination is below release levels the responder may exit the CRZ; otherwise consult a Radiation Technical Specialist for further instructions and evaluation. The Safety Officer and a Radiation Technical Specialist should be notified immediately if Level 3 contamination (see Table 10) is found on a responder's skin after decontamination; a review of radiation controls and potential operational adjustments may be necessary to prevent further contamination at this level.

Most equipment does not need to be decontaminated if reuse in the EZ is planned and the item will remain in the CRZ. If equipment does not undergo decontamination and a contamination survey, check the item periodically to ensure that contamination buildup is not creating an exposure hazard. If equipment is not needed in the EZ or CRZ, it must be decontaminated and surveyed for contamination before release from the CRZ. Contaminated equipment above Level 3 contamination (see Table 11) should be bagged for future evaluation and further decontamination, or potential disposal.

Contamination may be located in the SZ in accordance with Section 3.2.2 at significant levels above typical release levels; e.g., twice background. Equipment located in areas of contamination should be surveyed and decontaminated, if necessary, before demobilization or release from the SZ.

Retention of decontamination fluids is not an immediate priority. If feasible and practicable retain contaminated fluids for future testing and potential disposal. The IC/UC should determine the degree that fluids are contained or released to the environment based on incident specific conditions, including the volume of contaminated fluids, number of responders, victims, and equipment requiring decontamination, available resources, and decontamination requirements. Release of contaminated fluids to a stormwater or sewer system is preferred rather than to the environment; e.g., bare ground. However, if not practicable to release to the stormwater or sewer system, attempt to release decontamination fluids to a convenient location and prevent responder and public access. The EPA has regulatory provisions to allow for the release of contaminated decontamination fluids during an emergency response (Comprehensive Environmental Response, Compensation, and Liability Act Section 107(d)(1) or 42 U.S.C. Section 9607(d)(1)). If contamination is released to a sewer, make provisions for contamination monitoring at the applicable public wastewater treatment plant.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. Fire Department Hazmat Teams
3. Fire Departments
4. United States Environmental Protection Agency, Emergency Response Section
5. DOE, Radiological Assistance Program
6. Law Enforcement Hazmat Teams

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 3: Monitoring Responders and Equipment for Contamination*.

3.4 Monitoring Injured Victims for Contamination (Playbook 4)

Responders should triage victims in accordance with standard medical and trauma criteria. Priorities for providing medical services to a contaminated victim are listed below (NCRP 2001).

1. First aid and resuscitation
2. Medical stabilization
3. Definitive treatment of serious injuries
4. Prevention/minimization of internal contamination
5. Assessment of external contamination and decontamination

6. Treatment of other minor injuries
7. Containment of contamination to the treatment area and prevention of contamination of other personnel
8. Minimization of external radiation to treatment personnel
9. Assessment of internal contamination
10. Treatment of internal contamination (this could be concurrent with many of the above)
11. Assessment of local radiation injuries/radiation burns
12. Careful long-term follow up of patients with significant whole-body irradiation or internal contamination
13. Careful counseling of patient and family members about expected long-term effects and risks

Do NOT delay medical treatment for victims with life- or limb-threatening injuries to conduct decontamination!

Emergency Medical Service (EMS) personnel should consider the following principles for handling contaminated, injured victims:

1. Saving lives is the first priority.
2. Treatment of life- or limb-threatening medical conditions takes precedence over decontamination.
3. Contamination is not immediately life-threatening.
4. In the very rare case that a highly radioactive material or shrapnel is embedded in a patient, emergency responders must take extra precautions to reduce their dose. Removal of the radioactive material/shrapnel procedures should require consultation with medical personnel and a Radiation Technical Specialist.
5. If contamination levels on bare skin are not significantly reduced after two attempts or skin becomes abraded, stop decontamination efforts.
6. Do not use strong cleansers on bare skin.
7. Do not aggressively scrub bare skin.
8. Contaminated wounds may be cleaned by gentle scrubbing. Aggressive scrubbing must be avoided as abrasion of the skin can cause greater introduction of internal contamination. Removal of dead skin as a method for decontamination should be carefully considered and excision of wounds is appropriate when surgically reasonable. Radioactive contaminants will be in the wound surfaces and will be removed with the tissue. (NCRP 2001)
9. Contaminated burns must not be washed; instead they should be gently rinsed and covered. Expelled fluids will assist in removing most of the contamination into the dressings over several days. Blisters should be left closed, open blisters washed out, and treated in accordance with appropriate burn protocols. (NCRP 2001)

Radioactive contamination is rarely an immediate health threat. Two exceptions are the fallout from a nuclear detonation and radioactive shrapnel embedded in a person.

Use tongs or hemostats to remove highly radioactive shrapnel from a victim, if it can be done safely.

A person has <u>external contamination</u> when radioactive materials are on their skin, hair, or clothing.

A person has <u>internal contamination</u> when radioactive materials are inhaled, ingested, injected, or absorbed through the skin or a wound.

Prioritization of large numbers of Delayed or Minor category victims may be necessary to focus efforts on the most contaminated people. A simple order of priority is as follows:

1. Prioritize victims by proximity to the release location of the radioactive material. Individuals within approximately 1,650 feet (500 meters) of the release or within the EZ should have the highest priority for decontamination and exposure evaluation as they are more likely to be contaminated.
2. If a victim has Level 3 contamination levels (see Table 12) and does not have life- or limb-threatening injuries, decontaminate them immediately. Medical attention should follow decontamination. Reevaluation of contamination should be performed before release.
3. If a victim is not grossly contaminated provide medical attention and either release them to decontaminate at home or evaluate for contamination. If decontamination is warranted and resources are available, the victim should be decontaminated to contamination levels as low as possible before release. If the victim is released without decontamination, provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*.
4. If a victim refuses to be monitored or decontaminated, they should be informed that they could have become contaminated. If they want to leave the scene, a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* should be provided and the individual released in accordance with public health policy.
5.

The location of the decontamination station is critical to effective measurement of contamination levels before and after decontamination. A decontamination station should be located in an area with background radiation levels below one hundredth (1%) of the release levels, if possible. If this cannot be achieved or is not practicable, do not exceed one tenth (10%) of the release level. Secondly, contamination on radiation survey personnel should not exceed ground contamination levels at the location. This will prevent inadvertent false readings on the persons or objects being surveyed for contamination.

Surveys for radiation must be performed in an area with background levels that are at least one tenth or 10% (preferably one hundredth or 1%) of the contamination release level; i.e., a contamination release level of 10,000 cpm requires a background area of less than 1,000 cpm and ideally below 100 cpm.

If possible, practice radiation protection principals and locate decontamination stations within the CRZ at the lowest level of contamination and gamma exposure rate possible, preferably near background. Periodically check contamination levels at the decontamination stations as they can become contaminated with use. Attempts to reduce and maintain contamination levels as low as possible at the station are helpful but should not hinder operations of the station. The decontamination station may need to be moved if contamination levels exceed acceptable background levels.

Table 12: Victim and Public Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to 1,000 cpm beta and 100 cpm alpha, but only if doing so does not preclude decontamination of others with higher contamination levels. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* before release for self-decontamination.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	Decontaminate to Level 2 lower values, then release for home decontamination in accordance with *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home.* [4,5]
Gamma [2]	50 [4] to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Decontaminate without delay to achieve Level 2 values.[5] If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Gamma [2]	Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 µR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 µR/hr; therefore, 50 µR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 µR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute
mR/hr milliroentgen per hour
µR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

The setup and design of a standard hazardous materials decontamination station is adequate for radiological incidents. If victims are waiting in a line to be decontaminated they should be provided a copy of *Instructions No. 1: Public Waiting for Decontamination*. Decontamination procedures should follow standard hazmat procedures. Dry and wet decon systems are adequate for radiological contamination. Wet decon for some victims may not be appropriate depending on their condition, weather, and other factors. If possible, release victims to perform self decontamination at home. Use of cold water or fire hoses for gross decontamination is the least preferred method. A quick decontamination method is to remove outer clothing, which should remove 80 to 90% of external contamination.

Removing the outer layer of clothes from a person should remove 80 to 90% of external contamination.

Retention of decontamination fluids is not an immediate priority. If feasible and practicable retain contaminated fluids for future testing and potential disposal. The IC/UC should determine the degree that fluids are contained or released to the environment based on incident specific conditions, including the volume of contaminated fluids, number of responders, victims, and equipment requiring decontamination, available resources, and decontamination requirements. Release of contaminated fluids to a stormwater or sewer system is preferred rather than to the environment; e.g., bare ground. However, if not practicable to release to the stormwater or sewer system, attempt to release decontamination fluids to a convenient location and prevent access. The EPA has regulatory provisions to allow for the release of contaminated decontamination fluids during an emergency response (Comprehensive Environmental Response, Compensation, and Liability Act Section 107(d)(1) or 42 U.S.C. Section 9607(d)(1)). If contamination is released to a sewer, make provisions for contamination monitoring at the applicable public wastewater treatment plant.

A contamination survey should be performed after decontamination to determine if the victim may be released from the CRZ; see *Standard Operating Guide No. 1: Procedure for Performing a Radiation Contamination Survey*. The most likely contaminated and most critical areas on the victim should be surveyed first including the head/face, shoulders, hands, and feet. If available, portal monitors can be used in lieu of a hand-held survey for responders to expedite release from the CRZ. If applicable, the alarm should be set at four standard deviations above background. However, portal monitors only detect gamma radiation; hand-held surveys with appropriate instrumentation are required to detect alpha or beta radiation.

If a victim is contaminated above release levels after initial decontamination, the victim should return to the decontamination station for further attention. A resurvey is necessary to confirm contamination release levels have been met. If contamination is below release levels the victim may exit the CRZ; otherwise consult a Radiation Technical Specialist for further instructions and evaluation. The Safety Officer and a Radiation Technical Specialist should be notified immediately if Level 3 contamination (see Table 12) is found on a victim's skin after decontamination for further evaluation or medical attention.

If a victim requires medical attention at a hospital and they cannot be decontaminated below release levels or decontamination takes too long, the victim may be released for transport to a hospital. The ambulance personnel and hospital staff should be notified of the potential contamination. Wrapping the victim in a blanket before placing them in an ambulance can reduce cross contamination inside the vehicle and with the ambulance crew. Ambulances that transport contaminated victims should be surveyed for contamination upon termination of service before release for normal operations.

Victim property should be decontaminated and surveyed for contamination. Property that meets the requirements of Table 13 should be released to the owner. If release levels cannot be achieved, the item should be bagged for future evaluation and potential disposal. However, identification, credit cards, money, jewelry, and other unique valuables should not be kept by responders. If contaminated, these items can be bagged and returned to the owner. If contaminated clothing was removed from the victim, the clothing should be bagged for future evaluation and potential disposal; this is critical for medical treatment and dose reconstruction.

A registry of affected victims should be established before release of victims. The information collected should, at a minimum, include the person's name, address, phone number, Driver's License number if available, location during the incident, and general contamination levels measured by responders.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. Fire Department Hazmat Teams
3. Fire Departments
4. United States Environmental Protection Agency, Emergency Response Section

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 4: Monitoring Injured Victims for Contamination*.

3.5 Monitoring Uninjured Victims for Contamination (Playbook 5)

If there is a large population to be evacuated in an area of radiation levels of less than 1 mR/hr, consider releasing people to self-decontaminate at their home. They should be provided a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*. If on-scene decontamination is performed, consider the contamination release levels in Table 12. Prioritization of large numbers of uninjured victims may be necessary to focus efforts on the most contaminated people. A simple order of priority is as follows:

1. Prioritize victims by proximity to the release location of the radioactive material. Individuals within approximately 1,650 feet (500 meters) of the release or within the EZ should have the highest priority for decontamination and exposure evaluation as they are more likely to be contaminated.
2. If a victim has Level 3 contamination levels (see Table 12) and does not have life- or limb-threatening injuries, decontaminate them immediately. Medical attention should follow decontamination. Reevaluation of contamination should be performed before release.
3. If a victim is not grossly contaminated, provide medical attention and either release them to decontaminate at home or evaluate for contamination. If decontamination is warranted and resources are available, the victim should be decontaminated to contamination levels as low as possible before release. If the victim is released without decontamination, provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*.
4. If a victim refuses to be monitored or decontaminated, they should be informed that they could have become contaminated. If they want to leave the scene, a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* should be provided and the individual released in accordance with public health policy.

Table 13: Victim and Public Property Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to lowest level practicable using routine field decontamination methods (wiping and washing) and release without restriction if less than 1,000 cpm beta and 100 cpm alpha.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	Control large items, bag smaller items, and retain until evaluated by a Radiation Technical Specialist.[5]
Gamma [2]	50 [(4)] to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Do not release. Contact a Radiation Technical Specialist for determination of disposition.[6]
Gamma [2]	Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1. Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).
2. Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 µR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).
3. Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.
4. Normal gamma background is 5-10 µR/hr; therefore, 50 µR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 µR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).
5. Valuables should be returned to the owner, including credit cards, identification, money, jewelry, medicines, et. Bag items and notify owner that further evaluation will be required at a later time.
6. Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute
mR/hr milliroentgen per hour
µR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

5. The location of the decontamination station is critical to effective measurement of contamination levels before and/or after decontamination. If victims are waiting in a line to be decontaminated they should be provided a copy of *Instructions No. 1: Public Waiting for Decontamination*. A decontamination station should be located in an area with background radiation levels below one hundredth (1%) of the release levels, if possible. If this cannot be achieved or is not practicable, do not exceed one tenth (10%) of the release level. Secondly, contamination on radiation survey personnel should not exceed ground contamination levels at the location. This will prevent inadvertent false readings on the persons or objects being surveyed for contamination.

Surveys for radiation must be performed in an area with background levels that are at least one tenth or 10% (preferably one hundredth or 1%) of the contamination release level; i.e., a contamination release level of 10,000 cpm requires a background area of less than 1,000 cpm and ideally below 100 cpm.

If possible, practice RADIATION PROTECTION PRINCIPALS and locate decontamination stations within the CRZ at the lowest level of contamination and gamma exposure rate possible, preferably near background. Periodically check contamination levels at the decontamination stations as they can become contaminated with use. Attempts to reduce and maintain contamination levels as low as possible at the station are helpful but should not hinder operations of the station. The decontamination station may need to be moved if contamination levels exceed acceptable background levels.

The setup and design of a standard hazardous materials decontamination station is adequate for radiological incidents. Decontamination procedures should follow standard hazmat procedures. Dry and wet decontamination systems are adequate for radiological contamination. Wet decontamination for some victims may not be appropriate depending on their condition, weather, and other factors. If possible, release victims to perform self decontamination at home. Use of cold water or fire hoses for gross decontamination is the least preferred method. A quick decontamination method is to remove outer clothing which should remove 80 to 90% of external contamination.

Removing the outer layer of clothes from a person should remove 80 to 90% of external contamination.

Retention of decontamination fluids is not an immediate priority. If feasible and practicable retain contaminated fluids for future testing and potential disposal. The IC/UC should determine the degree that fluids are contained or released to the environment based on incident specific conditions, including the quantity of contaminated fluids, number of responders, victims, and equipment requiring decontamination, available resources, and decontamination requirements. Release of contaminated fluids to a stormwater or sewer system is preferred rather than to the environment; e.g., bare ground. However, if not practicable to release to the stormwater or sewer system, attempt to release decontamination fluids to a convenient location and prevent access. The EPA has regulatory provisions to allow for the release of contaminated decontamination fluids during an emergency response (Comprehensive Environmental Response, Compensation, and Liability Act Section 107(d)(1) or 42 U.S.C. Section 9607(d)(1)). If contamination is released to a sewer, make provisions for contamination monitoring at the applicable public wastewater treatment plant.

A contamination survey should be performed after decontamination to determine if the victim may be released from the CRZ; see *Standard Operating Guide No. 1: Procedure for Performing a Radiation Contamination Survey* for further guidance. The most likely contaminated and most critical areas on the victim should be surveyed first including the head/face, shoulders, hands, and feet. If available, portal monitors can be used in lieu of a hand-held survey for responders to expedite release from the CRZ. If applicable, the alarm should be set at four standard deviations above background. However, portal monitors only detect gamma radiation; hand-held surveys with appropriate instrumentation are required to detect alpha or beta radiation.

If a victim is contaminated above release levels after initial decontamination, the victim should return to the decontamination station for further attention. A resurvey is necessary to confirm contamination release levels have been met. If contamination is below release levels the victim may exit the CRZ; otherwise, consult a Radiation Technical Specialist for further instructions and evaluation. The Safety Officer and a Radiation Technical Specialist should be notified immediately if Level 3 contamination (see Table 12) is found on a victim's skin after decontamination for further evaluation or medical attention.

Victim property should be decontaminated and surveyed for contamination. Property that meets the requirements of Table 13 should be released to the owner. If release levels cannot be achieved, the item should be bagged for future evaluation and potential disposal. However, identification, credit cards, money, jewelry, and other unique valuables should not be kept by responders. If contaminated, these items can be bagged and returned to the owner. If contaminated clothing was removed from the victim the clothing should be bagged for future evaluation and potential disposal; this is critical for medical treatment and dose reconstruction.

A registry of affected victims should be established before release of victims. The information collected should, at a minimum, include the person's name, address, phone number, Driver's License number if available, location during the incident, and general contamination levels measured by responders.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. Fire Department Hazmat Teams
3. Fire Departments
4. United States Environmental Protection Agency, Emergency Response Section
5. DOE, Radiological Assistance Program

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 5: Monitoring Uninjured Victims for Contamination*.

3.6 Advanced Radiation Measurements (Playbook 6)

Early in the response, Radiation Technical Specialists should accomplish seven primary objectives related to radiation measurements. The seven objectives are necessary for health and safety evaluations for protection of responders and to assist in decision making for protection of public. They are summarized in this section in order of priority, although concurrent execution of the activities is recommended.

3.6.1 Verification of the Presence of Radiation

The first responders on scene will have detected the presence of radiation—their measurements were a primary reason the MARRP was activated. Verification of the presence of radiation at exposure rates or contamination levels above twice background establishes the premise that radioactive materials are present. Appropriate instrumentation, including specialized detectors, is required for alpha, beta, gamma, and neutron radiation.

Judgment of the significance of the radiation levels is necessary to justify activation of the MARRP, and numerous factors are involved in the decision making process. Some of the factors include but are not limited to:

1. Exposure rates and/or contamination levels above incident control zone criteria (see Table 3)
2. Type of radioactive material released
3. Size of impacted area
4. Number of the public affected by the release
5. Critical infrastructure affected by the release

Documentation of the factors should justify the decision to activate the MARRP.

3.6.2 Verification of Control Zones

Responders may have established initial incident control zones in accordance with Playbook 2 and Section 3.2.2. After the presence of radiation has been confirmed, external exposure rates and contamination levels in the SZ/CRZ, EZ, and ECAs should be verified. Appropriate radiological instruments used for gamma exposure rate measurements must have a detection range up to a minimum of 10 R/hr. Materials that emit alpha radiation are of particular importance and require specialized detectors; i.e., alpha scintillator. Likewise, a radioactive material that emits only beta, like strontium-90, will require a beta scintillator or PGM for accurate measurement.

The location of the control zones should be adjusted, if necessary, based on the verification surveys and reported to IC/UC for proper dissemination and incorporation into operation plans, including Incident Action Plans. In addition, exposure rates and contamination levels at decontamination stations, the ICP, staging areas, and perimeter control locations should be determined with consideration for protection of responder and public health and safety. If any operations require relocation due to unsafe radiation levels or in compliance with radiation protection principals, IC/UC must be notified immediately.

3.6.3 Determination of Type of Radiation (Playbook 7)

The determination of the type of radiation is necessary for health and safety related decisions; e.g., selection of appropriate PPE, identification of the source material(s) for medical treatment, and selection of instrumentation and survey techniques. The presence and absence, exposure rates, and contamination levels of all types of radiation—alpha, beta, gamma, and neutrons (unlikely for the purposes of this plan)—must be determined as soon as possible. Proper determination will require specialized instrumentation operated by a qualified Radiation Technical Specialist. Potentially, all types of radiation could be present, necessitating identification of each radionuclide as discussed in Section 3.6.5.

Alpha radiation and identification of alpha emitting materials are of special importance and concern for health and safety considerations and is discussed in this section and in Playbook 7. An appropriate alpha detector, like a zinc sulfide scintillator, used with proper technique, is required to determine the presence or absence of alpha emitting radioactive materials.

Accurate detection of alpha radiation is challenging due to the attenuation of alpha by air, rough or porous surfaces, moisture, oil, dust, dirt, etc. Optimally, a dry, clean, smooth, and hard surface would be tested for alpha radiation. A single location is inadequate for verification of presence/absence and scanning surveys may be necessary for this purpose. All control zones should be checked and zone boundaries adjusted if necessary. The IC/UC should be notified if adjustments are necessary.

The presence of beta radiation can cause false positive detection of alpha when using an alpha/beta detector; this is known as cross-talk. Beta radiation measurement should be collected in conjunction with the alpha radiation measurements and, if necessary, the alpha values corrected for cross-talk.

3.6.4 Determine Amount of Removable Contamination

The levels of fixed and removable contamination can impact health and safety decisions for responders as well as the public. Fixed contamination presents more of a remediation challenge than a health and safety consideration, as simple isolation of areas with high activity fixed deposition is protective for both responder and the public. Removable contamination is a more serious problem since the radioactive material can become resuspended in the air to present an inhalation hazard, potentially a very serious hazard if the radionuclide(s) emits alpha radiation. Another threat is that the removable contamination can migrate to clean areas requiring reevaluation of incident control zones, evacuation zones, or shelter-in-place zones. Migration can also result in accumulation in isolated areas at high activities that cause an immediate health threat.

The presence or absence of removable alpha and/or beta emitting contamination is critical to determine adequacy of contamination release levels for responders (and equipment), victims (and property), the public (and property), and for incident control zones boundaries. The fraction of removable contamination is assumed to be 10-20% of the total contamination present. While it is likely that this is the approximate fraction that will be present, it is possible that other fractions could exist and this could impact the contamination release levels or incident control zones, particularly for transuranics. A Radiation Technical Specialist needs to be consulted in the case of transuranics to confirm the appropriate release levels or incident control zones. Any adjustment to release levels or incident control zones should be communicated to IC/UC.

3.6.5 Identification of Radionuclide(s)

The identification of radionuclides is very important for Radiation Technical Specialists to provide the best advice on protective actions for responders and the public. Once identified, contamination release levels and incident control zone levels can be adjusted based on the particular radionuclide. Although not immediately important, radionuclide identity will assist medical staff in providing effective treatment to internally contaminated patients.

Because of the unique characteristics of a radionuclide such as strontium-90, a pure beta emitter, confirmed identification is critical. Likewise materials that emit alpha must be identified early in the response due to the high health risk from internal contamination. There is a low probability that neutron emitting radioactive materials would be present at sufficient quantities to pose a health threat to responders or the public; nonetheless, reasonable attempts should be made to identify any neutron emitters.

Radioactive materials are found in nature, industrial and research facilities, businesses, and nuclear reactors. Naturally occurring materials in LACo are very low activity and not a threat. Industrial, research, and medical facilities within or near LACo include licensees with curie quantities of various radionuclides. Some businesses have industrial devices containing radioactive sources in the low millicurie range; these do not pose a serious threat to public health nor would a release of the material typically result in activation of the MARRP.

No nuclear reactors are located in LACo. The closest reactor, San Onofre Nuclear Generating Station near Camp Pendelton United States Marine Corps Base, has a 10-mile radius Emergency Planning Zone that does not extend into LACo. The most southern boundary of LACo is located approximately 41 miles from the facility, and therefore, LACo's concern relates to ingestion pathway issues only in the event of a release.

Radionuclides of concern within LACo or materials recognized by experts as most likely used for purposes of terrorism are summarized in Table 14.

Table 14: Radionuclides of Concern

Radionuclide	Half-Life	Primary Radiation[1] Type
Americium-241 (Am-241)	430 years	Alpha, Gamma
Am-241/Beryllium	430 years	Alpha, Gamma, Neutron
Cesium-137 (Cs-137)	30 years	Beta, Gamma
Cobalt-60 (Co-60)	5.3 years	Beta, Gamma
Iridium-192 (Ir-192)	74 days	Beta, Gamma
Plutonium-238 (Pu-238)	86 years	Alpha, Gamma
Plutonium-239 (Pu-239)	24,400 years	Alpha, Beta, Gamma
Pu-239/Beryllium	24,400 years	Alpha, Beta, Gamma, Neutron
Radium-226 (Ra-226)	1,600 years	Alpha, Beta, Gamma
Ra-226/Beryllium	1,600 years	Alpha, Beta, Gamma, Neutron
Strontium-90 (Sr-90)	29.1 years	Beta, Bremsstrahlung (low energy x-rays)
Uranium-235 (U-235)	700,000,000 years	Alpha, Beta, Gamma
Uranium-238 (U-238)	4,500,000,000 years	Alpha, Beta, Gamma

[1] Includes primary radiation emitted from daughter products

Numerous additional radionuclides could possibly be released from a facility or used by a terrorist. Many response teams have gamma spectrometers to tentatively identify gamma emitting radionuclides. Before decisions are made based on tentative identification, consultation with Radiation Technical Specialists experienced with gamma spectroscopy, is necessary. Once a spectrum is captured, it should be sent to LACo Radiation Management for interpretation; call 213-351-7897 during work hours or 213-974-1234 after hours. The secondary contact is the DOE Radiological Assistance Program (RAP) at 925-447-8951 (24 hours) who has spectroscopy experts for interpretation through their reach back system.

For non-gamma emitting radionuclides, identification may not be possible with field instrumentation. In such a case, samples of the radioactive material should be collected and analyzed by a laboratory. Samples should not be highly radioactive as laboratories are better equipped to analyze lower activity materials for identification of radionuclides. LACo Radiation Management has agreements with laboratories within LACo to analyze samples quickly during an emergency.

3.6.6 Determine Extent and Level of Contamination

If control zones have been properly established in accordance with Section 3.2.2, efforts to delineate the extent and level of contamination outside of the SZ/CRZ/EZ should occur when sufficient resources are available. This activity involves determining the extent or “footprint” of the plume or release and location of radioactive sources.

3.6.6.1 Extent and Level of Contamination

There are three methods for determining the extent of contamination of a plume or release. Plume modeling based on initial estimates of the release characteristics, location, and real-time weather data can provide quick but rough maps of the contamination plume. Ground based teams can drive to various locations with radiation meters and a suite of detectors to collect measurements that are very accurate at specific locations, but teams are limited by access and time to collect sufficient data for full coverage of the plume. Aircraft, fixed and rotary, can quickly provide full coverage of the contamination extent in a short time period to bridge the gap between the plume model and ground based teams. All three methods must be coordinated through the Planning Section so resources can be directed in an efficient manner and data collection and management is coordinated.

Ground Truth: Ground mapping of widespread contamination is a labor intensive and time consuming process; LACo Radiation Management has plans to perform this activity. Teams should be organized in a manner to collect measurements at various geographical locations and relay the data to a central contact within the Planning Section. Global Positioning System (GPS) coordinates should be included for each measurement.

LACo Radiation Management plume mapping teams use a telemetry system to relay radiation measurements to a central database so the measurements can be displayed on a map. The map is updated automatically with new measurements as they are collected and is viewable from any computer with internet access and applicable software. Radiation Management protocol upon notification of an incident that activates the MARRP is to send teams to delineate the extent of contamination. These teams will self-deploy to the downwind area of the plume to collect measurements with appropriate detectors depending on the suspected radionuclide.

Aircraft: LACo Sheriff's Department and Los Angeles (LA) City Police Department have rotary aircraft with sensitive radiation detection capabilities. The detection system has a telemetry system that downloads data to the same central database used by the ground based teams. These aircraft are expected to provide data within a few hours after a request for assistance.

Plume Modeling: LACo Radiation Management can provide an initial plume model using HOTSPOT. Contact the DOE's National Atmospheric Release Advisory Center (NARAC) in Livermore, California at 925-422-9100 (24 hours) who have staff expertise in modeling a wide variety of releases.

3.6.6.2 Location of Radioactive Sources

Detection of radiation is relatively straight forward if the source(s) emits gamma radiation. Detecting sources that only emit alpha, beta, or neutron radiation are more challenging and require specialized instrumentation and survey techniques.

A specialized team with a mission to locate radioactive sources is necessary for this task. Appropriate instrumentation will depend on the suspected or confirmed radionuclides. Once locations of sources are determined, a plan to contain or remove the sources from the incident may be necessary to safely conduct further activities in the EZ; e.g., crime scene investigations.

3.6.7 Determine the Presence of Airborne Radioactivity

The presence of airborne radioactive materials is a very serious health threat to both responders and the public. PPE should be worn in environments with airborne radioactive materials, depending on the concentration. There are very few field instruments that can directly measure airborne contamination; therefore, the primary methodology is air sampling and field screening analysis with laboratory confirmation. Since laboratory confirmation could potentially take days to obtain results, decisions are likely made based on field screening results. Careful consideration of the data accuracy is important in the decision making process; if results are considered to have low accuracy, more conservative decisions are justified.

Air sampling should take place in areas where responders are not wearing respiratory protection; i.e., in the SZ/CRZ. Downwind air sampling may be justified to establish or terminate shelter-in-place or evacuation zones. LACo Environmental Health industrial hygienists have an existing plan to conduct air sampling, collect air filters, and submit the filters for quick turnaround laboratory analysis.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. United States Environmental Protection Agency, Emergency Response Section and Radiological Emergency Response Team

3. DOE, Radiological Assistance Program

The activities in this section can be accomplished by different radiological teams to expedite collection of pertinent information. However, careful coordination of activities and data management is necessary.

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 6: Advanced Radiation Measurements* and *Playbook 7: Alpha Radiation Detection and Considerations*.

3.7 Crime Scene Investigations (Playbook 8)

Crime scene investigations and/or recovery of decedents in the EZ require planning and monitoring of responder's dose. If investigations or decedent recovery operations extend into ECAs, more detailed planning, personal dosimetry, and short stay times should be considered to avoid exceeding Decision Points (see Table 4). Investigators should avoid exceeding doses of 5 rem (FEMA 2006), unless specifically directed and authorized by IC/UC.

If possible, aircraft should be used to collect detailed photography in the area under investigation. Situational awareness cameras can possibly be used to observe and photograph or videograph areas or items of interest. Robotic assets can retrieve items of interest or decedents to prevent unnecessary human dose. Another method to reduce dose is to reduce radiation exposure rates before investigations and recovery efforts are attempted. For extended operations, investigation teams should be changed out on a frequent basis, if necessary. If doses reach any level listed in Table 4, the Safety Officer and a Radiation Technical Specialist should be notified.

Release of contaminated evidence collected by law enforcement agencies will require evaluation on a case-by-case basis. A Radiation Technical Specialist should be consulted to assist with evaluation of items removed from the EZ.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. Law Enforcement Hazmat teams
2. Federal Bureau of Investigations
3. LACo Coroner's Office (for recovery of decedents)

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 8: Crime Scene Investigations*.

3.8 Monitoring People for Contamination at Public Reception Centers (Playbook 9)

Any incident that warrants activation of the MARRP will likely warrant establishing public reception centers. This section discusses mostly the radiological considerations for the setup and operations of reception centers. The primary objectives when receiving the public at a reception center are to:

1. Provide medical treatment for individuals
2. Evaluate contamination levels on individuals and, as practicable, personal property
3. Provide for decontamination, if necessary
4. Recommend ways to minimize future health consequences resulting from radiation exposure
5. Register potentially effected individuals

This section assumes a large number of people will visit the reception centers but is scalable to any population size expected. Prior to opening a reception center, allocation of the public to a specific reception center can reduce a massive influx to a single location. For example, a geographic area can be assigned to a specific reception center based on its design capacity.

Key components to establishing effective reception centers are its organization, adequate staff with appropriate equipment and supplies to service the expected population, location, and facility amenities. If a large population is effected, multiple reception centers are likely needed to handle the influx of people in a reasonable time frame. Time is of essence as the longer contamination remains on a person’s body or clothing the greater the dose and potential health effects to individuals. Special populations requiring additional consideration, both at the center and in other locations if they are not able to visit a center, include:

1. Children
2. The elderly
3. Pregnant women
4. Immuno-compromised individuals
5. Disabled persons
6. Homeless people
7. Institutionalized individuals

People who bring their pets, farm animals, and property can create a bottleneck if not managed appropriately. A separate pet decontamination area should be established for owners to decontaminate their pets.

Select the location of a reception center that has the following features:

1. Size based on number of expected people
2. Location based on proximity to impacted areas
3. Adequate washing facilities; i.e., locker rooms with numerous restrooms and showers
4. Access for disabled
5. Heat and air conditioning control, if possible
6. Hard, smooth floors that are easily decontaminated is not mandatory but helpful
7. To process 1,000 people per hour, approximately 5,000 square feet of covered space and 8,000 square feet uncovered space are recommended (CDC 2007)

To process approximately 1,000 people per hour see Table 15 for minimum staffing requirements. Approximately 135 people are needed to staff one reception center. Staffing requires both technical and non-technical personnel of sufficient numbers to maintain operations for days to weeks. The technical staffing requirements are:

1. Radiation Technical Specialists to operate hand-held detection instruments and portal monitors
2. Radiation Technical Specialists to evaluate survey results, provide advice to individuals on radiological issues, answer questions, and provide general radiation related advice and consultation
3. Clinicians to administer medical services and provide general health advice and consultation (i.e., Nurses, Counselors, etc.)
4. Public health staff or others to fulfill general staff position

Efficient flow of people through the reception center is necessary to avoid long lines and delays. Operations need to be flexible and scaleable. Modifications should be evaluated periodically to obtain the most efficient throughput.

Table 15: Staffing Requirements for 1,000 Persons per Hour Reception Center

Minimum Number	Position	Considerations
1	Facility Group Director	
1	Assistant Facility Group Director	
2[(1)]	Greeter	Additional needed for various languages
As needed	Uniformed security officers	Police and National Guard
As needed	Media relations staff	Coordinate with Joint Information Center
5	Crisis counselors	
20	Line attendant	2 per hand-held monitoring station
20	Radiation monitoring technicians	2 per hand-held monitoring station
10	Escort attendant	1 per hand-held monitoring station
10	Line attendant	1 per portal monitor station
20	Radiation monitoring technicians	2 per portal monitor station
10	Escort attendant	1 per portal monitor station
25	Registry staff	
10	Clinicians	Nurses/doctors as needed
1	Emergency Medical Services (EMS)/ambulance	

[(1)]May need more to reduce fatigue

Reference: CDC 2007

The term "monitoring line" in this section is used generically to mean conducting a radiation scanning survey of the person's clothing and body and decontamination, if necessary. Below is a brief, general step-by-step guide to the operations of a reception center. Attachment 6 provides example flow diagrams for the design of public reception centers that handle people only and designs that include people and handling pets.

3.8.1 Greeting Station

A greeter will meet people as they arrive at the reception center to explain procedures, answer questions, and provide comfort to those who may be stressed and worried. Greeters who speak the various languages of the community are extremely helpful. Depending on the number of people, several or more greeters may be required to prevent long lines.

3.8.2 Medical Triage Station

A clinician posted at the entrance or walking the line of public waiting to be decontaminated can observe people for signs and symptoms of medical conditions that require immediate attention. If identified, the individual is directed to the medical station for examination, potential treatment, and disposition. The two dispositions are to send the patient to a hospital or to fast track the patient through the monitoring line.

3.8.3 Registry Station

Begin the registration process before monitoring and decontamination, if possible. Do not delay monitoring and decontamination for registration. Register victims, responders, health care workers, volunteers, and others who were or may have been contaminated or exposed to radiation. Registration of individuals is important for tracking health concerns post incident. Collecting the following information can assist in the tracking process:

1. Name
2. Address

3. Phone number
4. Contact information
5. Gender
6. Age
7. Status; i.e., responder, health care worker, person at the scene, person affected by plume, person who believes they were affected as defined in a public announcement, or volunteer.
8. Location at time of incident. The distance from the person to the release of radioactive materials is very important information. Attempt to obtain the address, street intersection, visual landmark, etc., to document the location as closely as possible.
9. If possible, categorize based on radiological exposure
10. External and internal contamination
11. External contamination only
12. Uncontaminated

Registry data is confidential and controlled storage and access should be required. The Center for Disease Control and Prevention (CDC) and the Agency for Toxic Substance and Disease Registry can provide assistance with establishing and maintaining the registry. However, it is important to start and maintain the registry until federal resources arrive.

Prioritization of individuals is critical if a large population is affected. A contamination triage process should identify and prioritize people according to the following guidelines in order of priority:

1. Life-threatening conditions (do not delay medical attention in order to decontaminate)
2. Contaminated (confirmed or suspected)
3. Less likely contaminated
4. Unlikely contaminated (including people that have performed self-decontamination)

The contamination triage is based on responses obtained in the registry process and a quick radiation scan.

Do NOT delay medical treatment for victims with life- or limb-threatening injuries to conduct decontamination!

Before proceeding to a Waiting Line, each individual or family should be provided a copy of *Instructions No. 1: Public Waiting for Decontamination*.

3.8.4 Waiting Lines

A Radiation Technical Specialist, or a worker who has received just-in-time training, should walk the line of those waiting to be monitored with a radiation detection instrument (the best choice is a PGM detector), to determine if anyone waiting in line has contamination levels on their person more than Level 1 are of an immediate concern (see Table 12). These individuals should be removed from the line and more quickly decontaminated. If there are too many individuals showing these contamination levels, the readings could be adjusted to Level 2 (see Table 12). The Radiation Technical Specialist may adjust the above values based on the identity of the radionuclide(s); therefore, workers should verify before using the above contamination levels.

If an individual is suspected to have a high level of contamination (Level 3), send the person and his/her family directly to decontamination. This reduces the chance of cross contamination and gives priority to the most contaminated victims decreasing their dose as quickly as possible.

Never separate family members from each other.

3.8.5 Radiation Screening Survey Stations

Radiation screening surveys are designed to identify contamination above a specific release level. The public contamination release levels (see Table 12) should be developed based on the specific radionuclide (assumed to have been identified prior to the commencement of survey operations at reception centers).

A survey station can consist of a PGM detector, gamma detector, portal monitor, or radiation specific meter, like an alpha or beta scintillator. Hand-held surveys should be performed in accordance with *Standard Operating Guide No. 1: Procedure for Performing a Radiation Contamination Survey*. *Form No. 1: Contamination Survey* and *Form No. 2: Public Property Contamination Survey* should be completed and included in the registry. A general staff person will help to control the flow of the public through the stations. Radiation Technical Specialists can oversee several general staff performing monitoring who have received just-in-time training. If an individual is contaminated, he/she should proceed to the decontamination area; otherwise, he/she should be released to go home or to an American Red Cross shelter facility.

3.8.6 Decontamination Station

Individuals who are contaminated are sent to the Self Decontamination Station, if applicable. The configuration of the reception center will dictate the setup of decontamination stations. After decontamination, individuals will need to be surveyed for remaining contamination. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* as an example of how they should perform self-decontamination and a copy of *Instruction No.3: Instructions to Public on How to Perform Decontamination of Pets*, if applicable. After decontamination, individuals will need to be surveyed for remaining contamination.

Retention of decontamination fluids is not an immediate priority. If feasible and practicable retain contaminated fluids for future testing and potential disposal. The IC/UC should determine the degree that fluids are contained or released to the environment based on incident specific conditions, including the quantity of contaminated fluids, number of responders, victims, and equipment requiring decontamination, available resources, and decontamination requirements. Release of contaminated fluids to a stormwater or sewer system is preferred rather than to the environment; e.g., bare ground. However, if not practicable to release to the stormwater or sewer system, attempt to release decontamination fluids to a convenient location and prevent access. The EPA has regulatory provisions to allow for the release of contaminated decontamination fluids during an emergency response (Comprehensive Environmental Response, Compensation, and Liability Act Section 107(d)(1) or 42 U.S.C. Section 9607(d)(1)). If contamination is released to a sewer, make provisions for contamination monitoring at the applicable public wastewater treatment plant.

3.8.7 Checkout Station

After each person has completed the monitoring process, they should proceed to a Checkout Station to complete registry. The following information and instructions should be provided:

1. Basic information about radiation and its effects on human health
2. Action that they can take to protect their health
3. Public health contact information for questions and additional information

If the individual is going into an American Red Cross shelter located adjacent to the reception center or by controlled transport, they should receive a wrist band or other identifier indicating completion of the monitoring process. The American Red Cross will not allow any persons to enter their shelter without a wrist band or other identifier that the person has been monitored.

Recommendations for monitoring:

1. If there is a large number of people, prioritize hand-held surveys to focus on only the head/face, face, shoulders, and hands.
2. Do not take an individual’s identification, money, credit cards, jewelry, or other valuables; give these items to the owner. Provide instructions on how to decontaminate them and provide a bag for storage until the items can be decontaminated and surveyed later. Public property contamination release levels are summarized in Table 13 and further address in Playbook 10.

3.8.8 Considerations

Other considerations that should be included in the establishment of reception centers are as follows:

1. Provide transportation services to assist victims at the scene and to reduce the influx of vehicles at the reception centers.
2. Following Universal Precautions will likely provide sufficient protection.
3. Counseling services may be needed due to the public’s perception or fear of radiation.
4. Attempt to reduce and maintain contamination levels at decontamination stations as low as possible.
5. Experts predict that the number of worried well could be ten times more than the number of individuals who were actually exposed or contaminated.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. Fire Department Hazmat Teams
3. Fire Departments
4. LACo, Department of Public Health
5. USEPA, Emergency Response Section and Radiological Emergency Response Team
6. DOE, Radiological Assistance Program

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 9: Monitoring People for Contamination at Public Reception Centers*.

3.9 Monitoring Public Property for Contamination (Playbook 10)

Whether at the scene or at public reception centers, people will request for an evaluation and decontamination of personal property. Property can consist of virtually anything the person values including money, credit cards, identification, photographs, medicine, pets, clothing, toys, jewelry, vehicles, food, sentimental items, etc. Prioritization may be necessary if a large quantity of items is requested for evaluation. The following guidance is recommended:

1. Property owners may decontaminate their property at their residence. In such cases provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*.
2. Do not retain identification, money, credit cards, jewelry, and other valuables if decontamination is unsuccessful. Bag the items for future decontamination and evaluation efforts, and return to their owner.
3. Containers for medicines are easily replaced if contaminated. Regardless, never prevent a person from keeping their medication.

4. Decontamination of pets can be accomplished by the owner, not responders. Decontamination of pets should be done in a separate area from people. Decontamination techniques for pets are the same as for people (wash thoroughly; do not use conditioner; do not contain the runoff water). Provide a copy of *Instructions No. 3: Instructions to Public on How to Perform Decontamination of Pets*.

A determination of fixed and removable contamination is recommended to fully protect the property owner depending on the radionuclide(s). Table 13 summarizes the release levels for property and does not consider the use of an item which may require adjustment to more conservative release levels.

Large items like vehicles, homes, or land present a much more complex process. During the early phase of the incident delaying decontamination and evaluation efforts is likely to occur depending on resources and priorities. Messages to the public should state this policy clearly. Depending on the situation, vehicles may be released to the owners prior to decontamination and evaluation in order to facilitate transportation from the incident to their home which could expedite the owner's self-decontamination and decontamination of the vehicle.

The location of the decontamination station is critical to effective measurement of contamination levels before and/or after decontamination. A decontamination station should be located in an area with background radiation levels below one hundredth (1%) of the release levels, if possible. If this cannot be achieved or is not practicable, do not exceed one tenth (10%) of the release level. Secondly, contamination on radiation survey personnel should not exceed ground contamination levels at the location. This will prevent inadvertent false readings on the persons or objects being surveyed for contamination. If the station is located at a public reception center then background contamination is not likely to be an issue.

Surveys for radiation must be performed in an area with background levels that are at least one tenth or 10% (preferably one hundredth or 1%) of the contamination release level; i.e., a contamination release level of 10,000 cpm requires a background area of less than 1,000 cpm and ideally below 100 cpm.

For decontamination and monitoring stations at the scene, if possible, practice RADIATION PROTECTION PRINCIPALS and locate decontamination stations within the CRZ at the lowest level of contamination and gamma exposure rate possible, preferably near background. If the station is located at a public reception center then achieving background levels of radiation is not likely to be an issue. Periodically check contamination levels at the decontamination stations as they can become contaminated with use. Attempts to reduce and maintain contamination levels as low as possible at the station are helpful but should not hinder operations of the station. The decontamination station may need to be moved if contamination levels exceed acceptable background levels.

The setup and design of a standard hazardous materials decontamination station is adequate for radiological incidents. Decontamination procedures should follow standard hazmat procedures. Dry and wet decon systems are adequate for radiological contamination. A contamination survey must be performed after decontamination to determine if the item may be released from the CRZ or from the reception center; see *Standard Operating Guide No. 1: Procedure for Performing a Radiation Contamination Survey*.

If available, portal monitors can be used in lieu of a hand-held survey for responders to expedite release from the CRZ or reception center. However, portal monitors only detect gamma radiation; hand-held surveys with appropriate instrumentation are required to detect alpha or beta radiation. If a responder is contaminated above release levels after initial decontamination, the responder should return to the decontamination station for further attention. A resurvey is necessary to confirm contamination release levels have been met. If contamination is below release levels the responder may exit the CRZ; otherwise, consult a Radiation Technical Specialist for further instructions and evaluation. The Safety Officer and a Radiation Technical Specialist should be notified immediately if Level 3 contamination is found on an item after decontamination; the item may require additional decontamination or disposal.

Items that have been decontaminated or evaluated and released should be identified as processed at the scene with a tag and identifying information recorded. This will avoid resurveying an item. Completion of a survey sheet is recommended to document measurement results; see *Form No. 2: Public Property Contamination Survey* in Attachment 3.

Retention of decontamination fluids is not an immediate priority at the scene or reception centers. If feasible and practicable, retain contaminated fluids for future testing and potential disposal. The IC/UC should determine the degree that fluids are contained or released to the environment based on incident specific conditions, including the quantity of contaminated fluids and number of items requiring decontamination, available resources, and decontamination requirements. Release of contaminated fluids to a stormwater or sewer system is preferred rather than to the environment; e.g., bare ground. However, if not practicable to release to the stormwater or sewer system, attempt to release decontamination fluids to a convenient location and prevent access. The EPA has regulatory provisions to allow for the release of contaminated decontamination fluids during an emergency response (Comprehensive Environmental Response, Compensation, and Liability Act Section 107(d)(1) or 42 U.S.C. Section 9607(d)(1)). If contamination is released to a sewer, make provisions for contamination monitoring at the applicable public wastewater treatment plant.

3.9.1 Vehicles

Vehicle decontamination can present major challenges. The public should be instructed to use car washes to decontaminate the exterior of the vehicle. Car wash businesses should be instructed to not run the water recycle mode and allow water to release to the sewer after each car wash. Decontamination of vehicle internal contamination is more problematic and may require extensive detailed cleaning techniques and contamination surveys. In addition, contamination mixed with engine oil or gasoline is likely to be classified as a hazardous and radioactive waste (i.e., mixed waste) requiring special handling, packaging, transportation, and disposal protocols. *Instruction No 2: Instructions to Public on How to Perform Decontamination at Home* can be provided to assist the public with decontamination procedures.

3.9.2 Pets

Decontamination of pets can be accomplished by the owner, not responders. Decontamination of pets should be done in a separate area from people. Decontamination techniques for pets are the same as for people (wash thoroughly; do not use a conditioner; do not contain water runoff). After the owner decontaminates their pet, the owner should go through the decontamination process. *Instructions No. 3: Instructions to Public on How to Perform Decontamination of Pets* can be provided to pet owners to assist them with decontamination procedures.

3.9.3 Residences

Decontamination of residences presents major challenges. The public should be instructed to use hoses to wash off the roofs of their house, hard surfaces (driveways, sidewalks, patios, etc.), lawn furniture, grills, toys, and any other surface or item outside their residence. They should be instructed to not attempt to wash their lawns, gardens, or bare soil areas.

The water should not be contained; instead, it should be flushed into the stormwater/sewer system. If water pools, it should be swept into drainage areas to avoid contamination becoming concentrated in one location that causes an exposure to the public. *Instructions No. 2: Instructions to Public on How to*

Perform Decontamination at Home can be provided to assist the public with decontamination procedures.

3.9.4 Other Property

Large items or items with internal spaces that could trap contamination are particularly time consuming. Consider prioritization of critical items and delay efforts for non-critical items. *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* can be provided to assist the public with decontamination procedures.

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. Fire Department Hazmat Teams
3. Fire Departments
4. United States Environmental Protection Agency, Emergency Response Section and Radiological Emergency Response Team
5. DOE, Radiological Assistance Program

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 10: Monitoring Public Property for Contamination*.

3.10 Public Protective Action Guides – Evacuation and Shelter-in-Place (Playbook 11)

Protective action guides (PAGs) are implemented to reduce or eliminate exposure and/or contamination to nuclear radiation and/or radiological materials. The actions presented in this section are largely based on the EPA's *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents* (EPA 1992) and the Department of Homeland Security's *Planning Guide for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device Incidents* (DHS 2008b).

Protective actions will be based on four criteria during the early and intermediate phase of an emergency. The criteria are:

1. Immediate (acute) health effects should be avoided
2. Risk of delayed health effects should not exceed a level that is judged to be adequately protective of health in an emergency situation
3. Any reduction of risk to public health achievable at acceptable cost should be implemented
4. Risk to health from a protective action should not exceed the risk from the dose that is avoided

Only the early phase is considered in the MARRP. The early phase is characterized as the period at the beginning of a release, ending arbitrarily when deposition of materials has ceased and suitable information about the incident has been obtained to make decisions on longer term protection. Actions that typically will occur during this phase are the control and containment of the radioactive materials, lifesaving activities, and the implementation of protective actions; e.g., evacuation or shelter-in-place.

Radiation measurements collected from impacted areas should be evaluated to determine if any early phase potential effective dose is exceeded as summarized in Table 16. If a potential effective dose is exceeded a decision to implement shelter-in-place or initial evacuations should be considered. A third alternative is to instruct populations to stay-at-home, whether or not they are in an impacted area, which ensures they will not pass through a contaminated area and receive unnecessary dose. In addition, this strategy reduces traffic on streets and highways facilitating access by responders.

Table 16: Protective Action Guides

Phase	Potential Effective Dose[1]	Action
Early	< 100 mrem[3]	No sheltering
	≥ 1 rem[3] in first four days	Sheltering
	≥ 1 rem[3] and ≤ 5 rem[3] in first four days	Evacuation, if more protective than sheltering, except for sensitive populations[2]
Intermediate	≥ 500 mrem[3] in second year or any subsequent year	Decontamination and other dose-reduction techniques
	≥ 2 rem[3] in first year	Relocation
	≥ FDA guidance for human food and animal feed	See guidance document
Late	≥ 100 mrem[4] and < 500 mrem[4]	Use ALARA
	< 100 rem[4]	No action

[1] International Council of Radiation Protection (ICRP) definition 1991.
[2] Special groups for which evaluation could cause greater risk to themselves or the public (e.g., persons on medical life support, institutionalized criminals, etc.); evacuation should not be implemented if the projected effective dose is less than 10 rem.
[3] Projected doses are maximally exposed individual and calculation methods consistent with those currently in the Protective Action Guide Manual but should be based on current dose conversion factors.
[4] Projected doses are maximally exposed individual and calculation methods should use dose-assessment computer programs or methodologies accepted by federal agencies using realistic exposure scenarios for the intended actual use of the radioactively contaminated areas.

mrem	millirem
rem	roentgen equivalent man
<	less than
≥	greater than or equal to
FDA	United States Food and Drug Administration
ALARA	as low as reasonably achievable

References: EPA 1992, DHS 2008b.

In evaluating data, the following should be considered in the decision making process:

1. The number of population affected by the risk of evacuation versus shelter-in-place
2. The potential exposure pathways as summarized in Table 17
3. Critical populations (infirmed, incarcerated, elderly, day care centers, etc.) in the impacted areas
4. Generally, shelter-in-place is safer for people than evacuation
5. Workers at impacted critical infrastructures may need to remain at facilities for continued operations
6. Plume modeling can provide initial impact assessments but requires ground truthing to modify the modeling predictions; thus actions implemented based on preliminary modeling should proceed with caution and balance the risk versus gain.

Regardless of the decision to shelter-in-place or evacuate a population, Radiation Technical Specialists should provide recommendations to the IC/UC and assistance with development of public announcements that instruct citizens on the selected protective actions. Messages to the public should include instructions on ad hoc respiratory protection to mitigate internal contamination from radioactive airborne particulate. Such instructions would instruct the public to cover their mouth and nose, if they are outside or need to go outside, with one of the following:

1. dry or wet handkerchief, bandana, or cloth (shirt, pillow case, etc.)
2. dry or wet towel
3. dry toilet paper or paper towel

Table 17: Exposure Pathways and Protective Actions

Potential Exposure Pathway	Protective Actions
External radiation from facility or source material	Sheltering Evacuation Control of access to incident
External radiation from overhead plume or immersion in plume	Sheltering Evacuation Control of access to incident
External and internal (inhalation and ingestion) radiation from contamination of skin and clothes	Sheltering Evacuation Control of access to incident Decontamination of people
External and internal (inhalation) radiation from ground deposition	Sheltering Evacuation Relocation Decontamination of land and property
Internal radiation from inhalation of plume	Respiratory protection[1] Sheltering Evacuation Control of access to incident Administration of stable iodine
Internal (inhalation) radiation from contamination resuspension	Evacuation Relocation Control of access to incident Decontamination of land and property
Internal (ingestion) radiation of contaminated food and water	Food and water controls Use of stored animal feeds

[1] Includes covering nose and mouth with a dry or wet handkerchief, bandana, piece of cloth, towel or mask

References: EPA 1992, NCRP 2001, DHS 2008b

Instructions should state that the ad hoc respiratory protection should be used until further notification with an explanation that preventing inhalation of radioactive materials is extremely important for protection of health.

3.10.1 Evacuation

LACo and Los Angeles City as well as other LACo communities have existing evacuation plans. Therefore, the information in this section only addresses radiological specific issues related to evacuation.

For an explosive RDD, the plume should settle in 10 to 20 minutes (Harper, Mosolino, Wente 2007). Therefore, evacuation will not be possible before the plume passes into an area of concern. However, the effects of the logistics of an evacuation on the population may supersede the benefits gained. Evacuation after plume passage may be appropriate depending on the conditions of the impacted area to reduce or eliminate exposure to the contamination. Areas selected for evacuations should be prioritized based on exposure rates and/or contamination levels.

3.10.2 Shelter-In-Place

LACo and LA City as well as other LACo communities have existing shelter-in-place plans. Therefore, the information in this section only addresses radiological specific issues related to shelter-in-place.

Shelter-in-place is more protective than evacuation because for an explosive RDD, the plume should settle within 10 to 20 minutes (Harper, Mosolino, Wente 2007). Structures offer various levels of protection as summarized in Table 18.

Table 18: Representative Shielding Factors from Gamma Radiation in a Plume

Structure or Location	Reduction in Gamma Radiation
Outside	0 %
Vehicles	0 %
Wooden Frame House [1]	10 %
Basement in Wooden Frame House	40 %
Masonry House	40 %
Basement of a Masonry House	60 %
Large Office or Industrial Building	80 %

[1] Brick or masonry veneer is equivalent to a masonry home.

(Adapted from NCRP 138)

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

1. LACo, Department of Public Health, Radiation Management
2. United States Environmental Protection Agency, Emergency Response Section and Radiological Emergency Response Team
3. DOE, Radiological Assistance Program and Federal Radiological Monitoring and Assessment Center

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 11: Public Protective Action Guide—Evacuations and Shelter-in-Place*.

3.11 Hospital Based Operations and Medical Considerations (Playbook 13)

Complete guidance on medical treatment and considerations for patients exposed or contaminated is beyond the scope of the MARRP. General guidance is provided to address immediate medical actions health care providers can implement to mitigate mass care incidents. Further medical evaluation and treatment may be necessary that may require action from specialized medical professionals.

Medical care providers should triage victims in accordance with standard medical and trauma criteria. General objectives in approximate order of importance for the management of contaminated, injured patients are listed below (NCRP 2001). Ideally, initial decontamination efforts can be integrated with resuscitative efforts, i.e., removing all contaminated clothing during the initial assessment, using universal precautions including a mask, and wrapping the victim in a sheet to contain any residual contamination.

1. First aid and resuscitation
2. Medical stabilization
3. Definitive treatment of serious injuries
4. Prevention/minimization of internal contamination
5. Assessment of external contamination and decontamination
6. Treatment of other injuries and illness.
7. Containment of contamination to the treatment area and prevention of contamination of other personnel
8. Minimization of external radiation to treatment personnel
9. Assessment of internal contamination
10. Treatment of internal contamination (this could be concurrent with many of the above)
11. Assessment of local radiation injuries/radiation burns
12. Careful long-term follow up of patients with significant whole-body irradiation or internal contamination
13. Careful counseling of patient and family members about expected long-term effects and risks

A person has <u>external contamination</u> when radioactive materials are on their skin, hair, or clothing.

Do NOT delay medical treatment for victims with life- or limb-threatening injuries to conduct decontamination!

A person has <u>internal contamination</u> when radioactive materials are inhaled, ingested, injected, or absorbed through the skin or a wound.

EMS personnel should consider the following principles for handling contaminated, injured victims:

1. Saving lives is the first priority.
2. Treatment of life- or limb-threatening medical conditions takes precedence over decontamination.
3. Contamination is not immediately life-threatening.
4. In the very rare case that a highly radioactive material or shrapnel is embedded in a patient, emergency responders must take extra precautions to reduce their dose. Removal of the radioactive material/shrapnel procedures should require consultation with medical personnel and a Radiation Technical Specialist.
5. If contamination levels on bare skin are not significantly reduced after two attempts or skin becomes abraded, stop decontamination efforts. Consider internal contamination and consult a Radiation Technical Specialist.
6. Do not use strong cleansers on bare skin.
7. Do not aggressively scrub bare skin.
8. Contaminated wounds may be cleaned by gentle scrubbing. Aggressive scrubbing must be avoided as abrasion of the skin can cause greater introduction of internal contamination. Removal of dead skin as a method for decontamination should be carefully considered and excision of wounds is appropriate when surgically reasonable. Radioactive contaminants will be in the wound surfaces and will be removed with the tissue. (NCRP 2001)
9. Contaminated burns must not be washed; instead they should be gently rinsed and covered. Expelled fluids will assist in removing most of the contamination into the dressings over several days. Blisters should be left closed; open blisters washed out. All blisters should be treated in accordance with appropriate burn protocols. (NCRP 2001)

Use tongs or hemostats to remove highly radioactive shrapnel from a victim, if it can be done safely.

Radioactive contamination is rarely an immediate health threat. Two exceptions are the fallout from a nuclear detonation and radioactive shrapnel embedded in a person.

Prioritization of large numbers of Delayed or Minor category victims may be necessary to focus efforts on the most contaminated people. A simple order of priority is as follows:

1. Prioritize victims by proximity to the release location of the radioactive material. Individuals within approximately 1,650 feet (500 meters) of the release or within the EZ should have the highest priority for decontamination and exposure evaluation as they are more likely to be contaminated.
2. If a victim has Level 3 contamination levels (see Table 12) and does not have life- or limb-threatening injuries, decontaminate them immediately. Medical attention should follow decontamination. Reevaluation of contamination should be performed before release.
3. If a victim is not grossly contaminated, provide medical attention and either release them to decontaminate at home or evaluate for contamination. If decontamination is warranted and resources are available, the victim should be decontaminated to contamination levels as low as possible before release. If the victim is released without decontamination, provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*.
4. If a victim refuses to be monitored or decontaminated, they should be informed that they could have become contaminated. If they want to leave the scene, a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* should be provided and the individual released in accordance with public health policy.

If internal contamination is suspected; i.e., contamination levels on a person are greater than 100,000 cpm using a PGM detector or 0.1 mR/hr using a gamma detector, facial decontamination should be performed. After decontamination, monitor the nostril area for contamination. (CRCPD 2006 and NCRP 2005)

1. If nasal area contamination is greater than 100,000 cpm using a PGM, obtain a nasal swab or nasal blow to determine if contamination is inside the nose; if so radioactive materials have likely been inhaled.
2. In order to be helpful, nasal swabs must be obtained within the first approximately 20 minutes.
3. A Radiation Technical Specialist should be consulted to assist with evaluation of nasal swab or blow results. These levels are an indication that the patient has inhaled radioactive material near the radiation worker limit of 5 rem per year.
4. Gamma measurements of approximately 1 mR/hr using a gamma detector may also indicate the person has inhaled radioactive Cs-137 near the radiation worker annual intake limit.
5. Medical intervention, if needed, should be performed to reduce the total dose to the patient.
6. Additional assistance can be obtained from the resources listed in Section 3.15.

The management of exposed or contaminated patients requires as much information as possible regarding the exposure to individuals. Primary information that will enable medical professional to provide the best services for early medical management of radioactively contaminated persons is listed below (NCRP 138):

<u>Circumstances of the incident:</u>

- When did the event occur and what are the circumstances of the incident?
- What are the most likely exposure pathways?
- How much radioactive material is potentially involved?
- What injuries have occurred?
- What potential medical problems may be present besides the radioactive contamination?
- What measurements have been made at the site of the incident (e.g., air samples and analysis, smears, radiation monitors, nasal smear counts, and skin contamination levels)?
- Are industrial, biological, or chemical materials involved in addition to the radionuclides?
- Have any treatments been given for these?

<u>Present status of the patient:</u>

- If known, what radionuclides now contaminate the patient?
- Where and what are the radiation measurements at the surface of the skin?
- Was the patient also exposed to penetrating radiation; e.g., gamma or neutron? If dosimetry information is available, what has been learned from processing personal dosimeters, e.g., film badge, thermoluminescent dosimeter, or pocket ionization chamber? If not yet known, when is the information expected?
- What information is available about the chemical and physical properties of the compounds containing the radionuclides (e.g., solubility, particle size)?
- What decontamination efforts, if any, have already been attempted? What is the success of these efforts?
- What therapeutic measures, such as the use of blocking agents or isotopic dilution procedures have been taken?

<u>Patient follow up:</u>

- Has clothing removed at the site of incident been saved?
- What excreta have been collected?
- Who has the samples?
- What analyses are planned?
- When will they be done?

The following agencies are the primary, secondary, tertiary, etc., resources that have a reasonable incident response time and should perform the activity.

For medical management:

1. Medical organizations including Emergency Medical Services
2. LACo, Department of Public Health

For decontamination assistance:

1. Fire Department Hazmat Teams
2. Fire Departments

Step-by-step instructions to accomplish the activities in this section are summarized in Volume I, *Playbook 13: Hospital Based Operations and Medical Considerations*.

3.12 Incident Command System

The Incident Commander should establish an ICS early in the response in compliance with NIMS. The ICS structure should be scaled based on the actual conditions of the incident. Radiation Technical Specialists should be integrated into the ICS as soon as possible and as appropriate.

Radiation Technical Specialists should be integrated into ICS as soon as possible.

Radiation Technical Specialists can provide advice on radiation safety and health issues and can, at a minimum, provide support to the following ICS positions and sections:

1. Safety Officer
2. Liaison Officer
3. Public Information Officer
4. Operations Section
5. Decontamination Team Leader
6. Planning Section
7. Intelligence Group

Radiation Technical Specialists should coordinate decisions on contamination release levels, decision points, dose management strategies, etc.

Position Job Aids were developed to assist responders during an incident. They were written in a concise format providing pertinent radiological guidance to responders in specific IC/UC positions. All Position Job Aids are designed to be removed from Volume I of the MARRP and provided to each responder responsible for the respective position.

Remove the Position Job Aids from Volume I and give them to appropriate responders to use during an incident.

The following Position Job Aids are included in Volume I:

1. Incident Commander
2. Operations Section Chief
3. Planning Section Chief
4. Public Information Officer
5. Safety Officer
6. Liaison Officer
7. Decontamination Team Leader

The Job Aids are specific to radiological incidents and do not address other hazards—like fire, chemical, biological, and explosives—and other response actions that may be required. Position Job Aids should be used in conjunction with standard procedures, guidelines, job aids, and policies for other hazards.

3.13 Notification

Notification should occur as soon as possible to alert authorities of a significant radiological incident. Notification to numerous agencies is required; therefore, first responders should follow normal notification protocols. To facilitate the notification of critical radiological assets, the following agencies should be notified as soon as possible.

1. LACo, Department of Public Health, Radiation Management: 213-351-7897 (during work hours) or 213-974-1234 (after hours)
2. LACo, Office of Emergency Management, Joint Regional Intelligence Center: 562-345-1770 (business hours) or 323-821-1429 (24 hours)

3. California Office of Emergency Services: 800-852-7550 (24 hours)
4. National Response Center: 800-424-8802 (24 hours)

3.14 Emergency Public Information

Conveying messages to the public is critical to a successful response, especially for the protection of public health during a radiological emergency. Public concern will generate more interest and emotional charge when related to radiological matters due to fear and misunderstanding of radiation. Messages to the public must be crafted with care and simplicity to elicit public confidence.

Primarily, messages to the public would be safety related with clear and easy to understand incident related information and instructions. Demands for answers from government officials, politicians, media, and the public can disrupt response efforts when on-scene personnel are diverted to address questions. Developing messages during an incident with typical tight time frames is challenging. This section provides pre-scripted messages on various topics for incident command staff and Public Information Officers. Messages are organized into LACo Department of Public Health public information statements, situational statements, general statements, and answers to questions.

LACo Department of Public Health's pre-scripted "DRAFT Public Information Statements," consists of five general fill in the blank messages related to an RDD incident.

Situational statements cover three scenarios related to a radiological incident as follows:

1. When there is a possibility of radiological exposure to the public.
2. When there is a possibility of radiation exposure to the public and sheltering/evacuation is recommended.
3. When radioactive release has been confirmed.

General Statements are designed for local emergency response personnel who will normally issue public safety statements advising precautions to be taken against potential exposure to radiological material. For cases in which the IC/UC has determined that there has been a release of significant amounts of radioactive materials, the following information should be released to persons in affected areas as soon as possible after the incident. Until the amount of radiological contamination is determined, the following precautionary measures are recommended to minimize risk to the public:

1. Remain inside and minimize opening doors and windows.
2. Children should not play outdoors.
3. Fruit and vegetables grown in the area should not be eaten; food stored indoors is safe to eat.
4. Until further notice, tap water is safe for drinking and bathing.
5. Turn off fans, air conditioners, and forced air heating units that bring in fresh air from the outside. Use them only to recirculate air already in the building. The inhalation of radioactive material (like plutonium or uranium) is not an immediate medical emergency.
6. Trained monitoring teams will be moving through the area wearing special protective clothing and equipment to determine the extent of possible radiological contamination. The dress of these teams should not be interpreted as indicating any special risk to those indoors. If you are outside, proceed to the nearest permanent structure. If you must go outside for critical or lifesaving activities, cover your nose and mouth and avoid stirring up and breathing any dust. It is important to remember that your movement outside could cause you greater exposure and possibly spread contamination to others.
7. Local, State, and federal personnel are responding to the (terrorist)/(potential terrorist) attack. In the interest of public safety and to assist emergency response teams, authorities request that individuals within the vicinity (define) stay inside, with doors and windows closed, unless advised to do otherwise by the police.

8. Further statements will be made when there is more information. Please listen for announcements on local radio/television (name stations and frequencies). Check the Internet at (web site).

Key messages that public officials need to communicate to the public are listed below:

1. Radiation exposure can have short- and long-term consequences to human health. Health effects depend on the radiation dose received and many other factors including length of time exposed, distance from the radiation source, and protection such as shelter or clothing worn at the time of exposure. Therefore, an individual's health risk from radiation exposure from this incident may be uncertain.
2. Children exposed to radiation can be more at risk than adults.
3. Radiation exposure, like exposure to the sun, is cumulative.
4. Exposure to radiation may cause cancer in the long-term. Exposure to a very high dose of radiation can cause death in the short term.
5. There is no more effective or necessary screening for cancer than existing medical methods (mammograms, pap smears, colon cancer tests, etc.). People potentially at risk of developing cancer in the future due to radiation exposure resulting from this incident should see their physicians for an annual physical.

In addition, messages can emphasize that much is known about:

1. How to minimize human exposure to radiation and becoming contaminated
2. How to treat people exposed to radiation or who are contaminated
3. How to decontaminate people contaminated with radioactive materials
4. How to decontaminate animals contaminated with radioactive materials
5. How to cleanup property contaminated with radioactive materials

There are numerous potential questions and answers that the public or media may ask. Anticipated questions are provided with pre-scripted answers for those that are not incident specific.

These messages are located in Attachment 5.

3.15 Health and Medical Services

A full discussion of treatment options and authoritative resources for victims exposed to radiation or internally contaminated is beyond the scope of the MARRP. A few resources for the treatment of victims are summarized below:

1. The LACo Emergency Medical Services Agency has a stockpile some decorporation drugs to be used for internally radiocontaminated patients. Contact the Medical Alert Center to obtain necessary doses at 323-226-6619 or 323-722-8073.
2. One of the top authorities on management of radioactively contaminated patients is the Air Force Radiobiology Research Institute (AFRRI); call 301-295-0530 (24 hours).
3. The Radiation Emergency Assistance Center/Training Site (REAC/TS) can provide 24 hour availability to deploy and provide emergency medical services at incidents and provide advice and consultation on radiation emergency medicine, call 865-576-1005 (24 hour); see http://orise.orau.gov/reacts.
4. The California Emergency Medical Services Authority (EMSA) can provide additional assistance with evaluation and treatment of patients contaminated with radioactive materials; call (916) 322-4336 (not 24 hours).
5. The Office of the United States Surgeon General, Office of Civilian Volunteer, Medical Reserve Corps (MRC) program has numerous MRCs in LACo that can provide trained volunteer medical staff to assist hospitals; see www.medicalreservecorps.gov.

6. U.S. Department of Human and Health Services, Radiation Event Medical Management (REMM) can provide expert advice on treatment options; see www.remm.nlm.gov.

Numerous additional medical care providers are available throughout the country and international medical community. The above resources can provide additional information to contract these resources.

3.16 Resource Management

There are substantial local resources within LACo that can provide assistance during a significant radiological emergency. However, local resources are likely to become overwhelmed quickly if the incident involves a large number of people. Request for assistance of nearby local resources (San Diego County, Ventura County, San Bernardino County, Riverside County, and Orange County) will likely occur. In addition, activation and mobilization of State and federal resources is expected to be necessary. An early response by non-local agencies will provide the greatest benefit to mitigate the consequences of an incident. This section provides a summary of the available resources from various State and federal agencies and organizations that may provide assistance during a significant incident. This summary gives a quick overview of potential resources and assets that may be requested by IC/UC.

Activated local, State, and federal resources will be coordinated through the LACo Emergency Operations Center (EOC). When the EOC is not activated, resources will be coordinated through the LACo Department of Public Health Disaster Operation Center.

3.16.1 State Resources

Overall coordination of State resource is the responsibility of the California State Office of Emergency Services contacted at 800-852-7550 (24 hours).

3.16.1.1 California Highway Patrol

The California Highway Patrol is the lead agency for law enforcement on California State and federal highway system.

3.16.1.2 National Guard Civil Support Team

The National Guard Weapons of Mass Destruction - Civil Support Teams (CST) are a Department of Defense asset assigned to States and are activated at the request of a Governor. There are two teams in California, 9th CST in Los Alamitos and 95th CST in Hayward plus 55 teams nationwide. Each team is capable of responding to any terrorism incident, assessing consequences, advising on response measures, and assisting with appropriate requests for additional support.

3.16.1.3 Department of Public Health, Radiologic Health Branch

The Radiologic Health Branch provides radiological experts that can advise on all radiation related technical matters including recommendations on responder and public protective actions. Local field offices can be contracted at the City of Brea at 714-257-2025, LACo at 213-351-7897, and San Diego County at 619-338-2969. LACo Radiation Management works closely with Radiologic Health Branch personnel who will respond with LACo Radiation Management personnel as a single cohesive team.

3.16.2 Federal Resources

The Nuclear/Radiological Incident Annex of the National Response Framework explains how federal agencies will coordinate response efforts to an incident covered under the MARRP (DHS 2008a).

The primary resources that may respond are summarized in this section. Numerous additional resources are available with the listed federal government agencies and other agencies not listed. However, these primary agencies understand the full suite of federal resources and can assist with requests for assistance.

3.16.2.1 Federal Bureau of Investigations
The Federal Bureau of Investigations is the lead federal agency for enforcement coordination activities for terrorism incidents.

3.16.2.2 United States Coast Guard
The United States Coast Guard is the coordinating agency for the federal response to incidents involving the release of radiological materials in certain areas of the coastal zones.

3.16.2.3 United States Department of Defense
Medical Radiobiology Advisory Team (MRAT), Armed Forces Radiobiology Research Institute, National Naval Medical Center, Bethesda, Maryland: 301-295-0530 (24 hours)
Specialty: Consultation regarding medical and health physics problems associated with radiation accidents. Biological dosimetry capability and training program for medical personnel.

3.16.2.3 United States Department of Energy
The following primary DOE response organizations may provide radiological assistance:

Radiological Assistance Program (RAP), Region 7, Livermore, California: 925-422-8951 (24 hours)
Specialty: Provides radiological assistance to other federal agencies, State, tribal and local governments, and Nuclear Regulatory Commission licensees requesting assistance for events involving radioactive materials.

Headquarters Emergency Operations Center, Washington, D.C.: 202-586-8100 (24 hours)
Specialty: Provides overall coordination of DOE assets.

Radiation Emergency Assistance Center/Training Site (REAC/TS), Oak Ridge, Tennessee: 865-576-1005 (24 hours; http://orise.orau.gov/reacts)
Specialty: Direct or consultive assistance regarding medical and health physics problems associated with radiation accidents. Provides training in medical management for radiation accidents.

3.17.2.4 United States Department of Homeland Security
The Department of Homeland Security will provide a principal federal official to coordinate federal resources during a Stafford Act disaster and terrorism related incidents.

3.17.2.5 United States Environmental Protection Agency
The following primary EPA response organizations may provide radiological assistance:

Emergency Response Section, Region 9, Signal Hill and San Francisco, California: 800-300-2193 (24 hours)
Specialty: Provide federal On-Scene Coordinators and contract support to respond to environmental disasters, hazardous materials releases, and inland oil spills that threaten human health and/or the environment.

Radiological Emergency Response Team, Las Vegas, Nevada: 800-300-2193 (24 hours)
Specialty: Provides technical advice and assistance to prevent or minimize threats to public health and the environment including advice on protective measures. Conduct assessments for dose and impact to public health and the environment by monitoring, sampling, laboratory analyses and data assessments to assess and characterize environmental impact. Provide technical advice and assistance for containment, cleanup, restoration, and recovery following a radiological incident.

Emergency Response Team-West (ERT-West), Las Vegas, Nevada: 800-300-2193 (24 hours)

Specialty: Act as technical advisors to federal agencies during emergency responses with a group of skilled experts who are specially trained to respond to environmental emergencies and, more specifically, to provide on-scene assistance to deal with the human health and environmental impacts of terrorist attacks.

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United States Occupational Safety and Health Administration (OSHA). 29 Code of Federal Regulations 1910.1096(b)(1).

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Attachment 1: Tables

All tables from Volume I and Volume II of the MARRP are compiled in this attachment for convenience of access. In addition, these tables are presented in color for reproduction and used in field guide books, standard operating guidance, plans, etc.

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Table 1: Summary of Agencies Responsible for Implementing Activity Playbooks

Activity Playbook	Rad Mgmt*	Fire Hazmat	Fire	Law Hazmat	EPA	DOE	FBI	Coroner	Public Health	Law	CHP	Med
1. Exclusion Zone Operations	NL	**1**	**2**	**3**	NL	NL	NL	NL	NL	NL	NL	NL
2. Initial Incident Control Zones	**1**	**2**	NL	**3**	**4**	NL	NL	NL	NL	NL	NL	NL
3. Monitoring Responders and Equipment for Contamination	**1**	**2**	**3**	**6**	**4**	**5**	NL	NL	NL	NL	NL	NL
4. Monitoring Injured Victims for Contamination	**1**	**2**	**3**	NL	**4**	NL	NL	NL	NL	NL	NL	NL
5. Monitoring Uninjured Victims for Contamination	**1**	**2**	**3**	NL	**4**	**5**	NL	NL	NL	NL	NL	NL
6. Advanced Radiation Measurements	**1**	NL	NL	NL	**2**	**3**	NL	NL	NL	NL	NL	NL
7. Alpha Radiation Detection and Considerations	**1**	**2**	NL	**3**	**4**	**5**	NL	NL	NL	NL	NL	NL
8. Crime Scene Investigations	NL	NL	NL	**1**	NL	NL	**2**	**3**	NL	NL	NL	NL
9. Monitoring People for Contamination at Public Reception Centers	**1**	**2**	**3**	NL	**5**	**6**	NL	NL	**4**	NL	NL	NL
10. Monitoring Public Property for Contamination	**1**	**2**	**3**	NL	**4**	**5**	NL	NL	NL	NL	NL	NL
11. Public Protective Action Guides – Evacuation and Shelter-in-Place	**1**	NL	NL	NL	**2**	**3**	NL	NL	NL	NL	NL	NL
12. Traffic Control and Considerations	NL	NL	NL	NL	NL	NL	NL	NL	NL	**1**	**2**	NL
13. Hospital-Based Operations and Medical Considerations	NL	NL	NL	NL	NL	NL	NL	NL	**2**	NL	NL	**1**

***Rad Mgmt** Los Angeles County, Department of Public Health, Radiation Management; California Radiologic Health Branch will respond with Radiation Management. Note that Radiation Management has a limited number of staff, and they will be more likely to provide oversight, rather than actually conduct the activity.

Fire Hazmat All fire department hazardous materials teams
Fire All fire departments
Law Hazmat All law enforcement hazardous materials teams
EPA United States Environmental Protection Agency
DOE United States Department of Energy
FBI Federal Bureau of Investigations
NL Not Listed as a primary, secondary, tertiary, etc. resource to perform activity.
Coroner Los Angeles County Coroner's Officer
Public Health Los Angeles County Department of Public Health and/or public health agencies
Law All law enforcement agencies
CHP California Highway Patrol
Med Medical Organizations including Emergency Medical Services

Note: The primary agency to conduct each particular activity is listed with a "1", the secondary with a "2", and so on. If the primary agency is not available to conduct the activity, the secondary agency should be tasked and so on. Two or more agencies may be required to conduct a particular activity given the incident circumstances.

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Table 2: Summary of Activity Playbooks Applicable to Radiological Scenarios

Activity Playbook	RMR	RED	RDD
1: Exclusion Zone Operations	Yes	Yes	Yes
2: Initial Incident Control Zones	Yes	Yes	Yes
3: Monitoring Responders and Equipment for Contamination	Yes	No	Yes
4: Monitoring Injured Victims for Contamination	Yes	No	Yes
5: Monitoring Uninjured Victims for Contamination	Yes	No	Yes
6: Advanced Radiation Measurements	Yes	Partial	Yes
7: Alpha Radiation Detection and Considerations	Yes	No	Yes
8: Crime Scene Investigations	Maybe	Yes	Yes
9: Monitoring People for Contamination at Public Reception Centers	Yes	Partial	Yes
10: Monitoring Public Property for Contamination	Yes	No	Yes
11: Public Protective Action Guides – Evacuation and Shelter-in-Place	Yes	No	Yes
12: Traffic Control and Considerations	Yes	No	Yes
13: Medical Management of Patients	Yes	Yes	Yes

RMR Radioactive materials release (accidental release of materials by fire, transportation accident, etc.)
RED Radiological exposure device
RDD Radiological dispersal device (deliberate act to spread radioactive materials via explosive, fire, or release)

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Table 3: Radiation Incident Zones and Activities

<table>
<tr><th>Incident Zone</th><th>Radiation Type</th><th colspan="2">Dose Rate / Contamination Level [1]</th><th>Activities [2]</th></tr>
<tr><td>Support Zone (SZ)</td><td>All</td><td colspan="2">Below Contamination Reduction Zone levels</td><td>Staging, Incident Command, etc.</td></tr>
<tr><td rowspan="3">Contamination Reduction Zone (CRZ)</td><td>Gamma</td><td colspan="2">1 to 10 mR/hr [3]</td><td rowspan="3">Decontamination Activities [6,7]</td></tr>
<tr><td>Beta</td><td colspan="2">1,000 to 100,000 cpm [4]</td></tr>
<tr><td>Alpha</td><td colspan="2">100 to 10,000 cpm [5]</td></tr>
<tr><td rowspan="3">Exclusion Zone (EZ)</td><td>Gamma</td><td colspan="2">10 mR/hr to 10 R/hr [3]</td><td rowspan="3">Rescue, Evaluation, Mitigation, and Activities [9]</td></tr>
<tr><td>Beta</td><td>Above 100,000 cpm [4]</td><td rowspan="2">Respiratory protection advised/required [8]</td></tr>
<tr><td>Alpha</td><td>Above 10,000 cpm [5]</td></tr>
<tr><td rowspan="3">Extreme Caution Area</td><td>Gamma</td><td>Above 10 R/hr [3] (200 R/hr Turn Back Limit) [10]</td><td rowspan="3">Level B (SCBA) respiratory protection required</td><td rowspan="3">Rescue, Preplanned Evaluation, and Mitigation Activities</td></tr>
<tr><td>Beta</td><td rowspan="2">No Limits</td></tr>
<tr><td>Alpha</td></tr>
</table>

1 Incident Zone classification is based on all Radiation Types; i.e., if gamma dose rate is 1 mR/hr, beta contamination level is 500 cpm, and alpha contamination level is 15,000 cpm, the proper Incident Zone classification is "Exclusion Zone" based on the alpha contamination.

2 All activities should be conducted in an area with the lowest levels of exposure and contamination as practicable to accomplish the mission.

3 Gamma radiation measured at approximately 3 feet with ion chamber, energy compensating Geiger-Mueller, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). For PGM, use the backside down, with protective cap on PGM, and mR/hr scale or 3,000 cpm = 1 mR/hr. While values are reasonably good for most gamma emitters, consult a Radiation Technical Specialist if a gamma emitter other than cesium-137 is identified.

4 Beta radiation measured at approximately 1 inch from surface with a Pancake Geiger-Mueller (PGM) detector or a beta-specific detector. **Caution**: PGMs will respond to gamma radiation at approximately 3,000 cpm per 1 mR/hr (for cesium-137). Therefore, when using a PGM to measure beta contamination levels, this gamma radiation response needs to be subtracted from the PGM readout before determining adherence to the beta levels in the table above. For example, if you have measured 1 mR/hr with a gamma detector (as noted in footnote 3 directly above), and using the PGM you measure 4,000 cpm, you need to subtract 3,000 cpm to account for the gamma response before determining the beta contamination level for use with the table above.

5 Alpha radiation measured at approximately ½ inch from a relatively smooth surface (such as a concrete sidewalk) with an alpha-specific detector. If an alpha-specific detector is not available, a PGM may be used as noted in *Standard Operating Guide No. 2, How to Distinguish Between Alpha, Beta, and Gamma Radiation Using a Pancake Geiger-Mueller Survey Meter*. **Caution**: Alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

6 Decontamination activities should occur in areas with contamination levels no greater than 10% of the contamination release criteria (refer to Tables 10, 11, 12, or 13) to allow reasonable speed surveys.

7 Residents and other non-essential personnel already within the Contamination Reduction Zone may be allowed to shelter-in-place instead of evacuate, pending logistics for their removal.

8 Respiratory protection should be worn for entry into the exclusion zone and must be worn in areas above 1 R/hr for gamma, 100,000 cpm for beta, and 10,000 cpm for alpha.

9 Residents and other non-essential personnel within the Exclusion Zone need to be evacuated. Shelter-in-place should occur until evacuation is feasible.

10 Consult Incident Commander or Radiation Technical Specialist to exceed limit.

cpm	counts per minute
mR/hr	milliroentgen per hour
R/hr	roentgen per hour
SCBA	self-contained breathing apparatus

References: CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

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Table 4: Decision Points

Activities	Exposure Rate (mR/hr)	Cumulative Dose[2] (mrem)
All	Up to 10[1]	Up to 5,000 (5 rem)[1, 3]
Critical infrastructure protection	Up to 10,000 (10 R/hr)[1]	Up to 10,000 (10 rem)[1]
Lifesaving or protection of large populations	Up to 200,000 (200 R/hr)[1] **TURN BACK LIMIT**	Up to 50,000 (50 rem)[1,4]

1 Gross gamma radiation measured with an ion chamber, or energy compensated Geiger-Mueller probe, or, if necessary, a sodium iodide or Pancake Geiger-Mueller (PGM) with the beta radiation shield closed; i.e., use the backside of the PGM, at approximately one meter (3.3 feet) above the ground.

2 Effective Dose Equivalent for external dose only. Dose level for eyes is three times the values listed above. Dose limit for any other organ (including skin and extremities) is 10 times the values listed above.

3 EPA 1992, 29CFR1910.1096(b)(1), and Cal-OSHA (see Volume II for specific citation)

4 A 50 rem dose will result in an increase in the theoretical cancer mortality risk from the background rate of approximately 24% to approximately 28% (Volume II, Attachment 1, Table 5). Doses above 50 rem are acceptable with approval of the Incident Command/Unified Command, Safety Officer, and a Radiation Technical Specialist in extreme cases. Responders that may receive doses up to this level should be a volunteer, well informed of the risks, and have proper training and detection equipment. For example, a 100 rem dose will result in an increase in the theoretical cancer mortality risk from the background rate of approximately 24% to approximately 32%. See Volume II, Attachment 1, Table 5 for risk values for other doses. This dose should be restricted to a once in a life-time event. However, if a future event requires use of these individuals, they may be used; however, their previous dose must be considered. If the IC/UC allows higher than recommended dose or exposure rate levels, documentation should justify the reasons, and the factors in Volume II, Section 3.2.3, should be considered.

Note: The word “limit” is not used in the context of the Multi-Agency Radiological Response Plan for pre-established health and safety standards. Instead dose, exposure rate, and contamination values are provided as guidance and called “levels” or “decision points.” As noted in the above table, doses greater than the occupational limit of 5 rem in a year may be warranted for critical response actions.

mrem millirem
mR/hr milliroentgen per hour
rem roentgen equivalent man
R/hr roentgen per hour

References: CRCPD 2006, NCRP 2005, NCRP 2001, and DHS 2008b (see Volume II for specific citation)

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Table 5: Dose and Potential Health Effects

Short-Term[1] Whole-Body Dose (rem)	Acute Death[2] from Radiation without Medical Treatment (%)	Acute Death from Radiation with Medical Treatment (%)	Acute Symptoms (nausea and vomiting within 4 hours) (%)	Lifetime Risk Fatal Cancer without Radiation Exposure (%)	Excess Lifetime Risk of Fatal Cancer Due to Short-Term Radiation Exposure[3] (%)
1	0	0	0	24	0.08
10	0	0	0	24	0.8
50	0	0	0	24	4
100	< 5	0	5 – 30	24	8
150	< 5	< 5	40	24	12
200	5	< 5	60	24	16
300	30 – 50	15 – 30	75	24	24[4]
600	95 – 100	50	100	24	> 40[4]
1,000	100	> 90	100	24	> 50[4]

1 Short-term refers to the radiation exposure during the initial response to the incident. The acute effects listed are likely to be reduced by about one-half if radiation exposure occurs over weeks.
2 Acute deaths are likely to occur from 30 to 180 days after exposure and few if any after that time. Estimates are for healthy adults. Individuals with other injuries, and children, will be at greater risk.
3 Most cancers are not likely to occur until several decades after exposure; although leukemia has a shorter latency period of less than five years.
4 Applies to those individuals that survive Acute Radiation Syndrome.

(Adapted from NCRP 2005)

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Table 6: Responder Alarm Levels

Alarm Level	Exposure Rate[1] (mR/hr)	Cumulative Dose[2] (mrem)
First Alarm	2	10
Second Alarm	10,000 (10 R/hr)	25,000 (25 rem)

1 Gross gamma radiation measured with an appropriate real time dosimeter at 1 meter (3.3 feet) above the ground. External dose only.

2 Effective dose equivalent for external dose only.

mR/hr	milliroengten per hour
R/hr	roengten per hour
mrem	millirem
rem	roengten equivalent man

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Table 7: Stay Time Table

Radiation Meter Gamma Exposure Rate		Time to Receive This Dose (Times rounded. Table only calculates dose from external sources.)									
		All Emergency Responder Activities Under Emergency Conditions				Protect Property	Lifesaving		Volunteer Only	Potentially Lethal	
		100 mrem	1 rem	2 rem	5 rem	10 rem	25 rem	50 rem	100 rem	300 rem	500 rem
CONTAMINATION REDUCTION ZONE / SUPPORT ZONE	10 µR/hr	1 yr									
	50 µR/hr	12 wk	2 yr								
	100 µR/hr	6 wk	1 yr								
	500 µR/hr	8 dy	12 wk	24 wk	1 yr						
	750 µR/hr	5.5 dy	8 wk	16 wk	40 wk	1.5 yr					
	1 mR/hr	4 dy	6 wk	12 wk	30 wk	1 yr					
	2 mR/hr	50 hr	3 wk	6 wk	15 wk	30 wk	74 wk				
	5 mR/hr	20 hr	8 dy	16 dy	6 wk	12 wk	30 wk	1 yr			
	7.5 mR/hr	13 hr	5.5 dy	11 dy	4 wk	8 wk	20 wk	40 wk	80 wk		
	10 mR/hr	10 hr	4 dy	8 dy	3 wk	6 wk	15 wk	30 wk	1 yr		
EXCLUSION ZONE CAUTION	20 mR/hr	5 hr	2 dy	4 dy	10 dy	3 wk	7 wk	15 wk	30 wk	2 yr	
	30 mR/hr	3.3 hr	33 hr	3 dy	1 wk	2 wk	5 wk	10 wk	20 wk	60 wk	
	40 mR/hr	2.5 hr	1 dy	2 dy	5 dy	11 dy	4 wk	8 wk	15 wk	1 yr	
	50 mR/hr	2 hr	20 hr	40 hr	4 dy	8 dy	3 wk	6 wk	12 wk	35 wk	1 yr
	75 mR/hr	80 min	13 hr	1 dy	3 dy	5.5 dy	2 wk	4 wk	8 wk	24 wk	40 wk
	100 mR/hr	1 hr	10 hr	20 hr	2 dy	4 dy	10 dy	3 wk	6 wk	18 wk	30 wk
	200 mR/hr	30 min	5 hr	10 hr	1 dy	2 dy	5 dy	11 dy	3 wk	9 wk	15 wk
	300 mR/hr	20 min	3 hr	7 hr	16 hr	32 hr	3 dy	1 wk	2 wk	6 wk	10 wk
	400 mR/hr	15 min	2.5 hr	5 hr	12 hr	1 dy	2.5 dy	5.5 dy	11 dy	31 dy	52 dy
	500 mR/hr	12 min	2 hr	4 hr	10 hr	19 hr	2 dy	4 dy	8 dy	25 dy	40 dy
	750 mR/hr	8 min	78 min	2.6 hr	6.5 hr	13 hr	33 hr	3 dy	5.5 dy	16 dy	4 wk
	1 R/hr	6 min	1 hr	2 hr	5 hr	10 hr	25 hr	50 hr	4 dy	12 dy	3 wk
	1.5 R/hr	3 min	40 min	78 min	3.5 hr	6.5 hr	16.5 hr	33 hr	3 dy	8 dy	14 dy
	2 R/hr	3 min	30 min	1 hr	2.5 hr	5 hr	13 hr	25 hr	2 dy	6 dy	11 dy
	3 R/hr	2 min	20 min	40 min	100	200 min	8 hr	16 hr	1.5 dy	4 dy	1 wk
	4 R/hr	90 sec	15 min	30 min	75 min	2.5 hr	6.5 hr	13 hr	1 dy	3 dy	6 dy
	5 R/hr	72 sec	12 min	24 min	1 hr	2 hr	5 hr	10 hr	20 hr	2.5 dy	4 dy
	7.5 R/hr	48 sec	8 min	16 min	40 min	78 min	200 min	6.5 hr	13 hr	40 hr	3 dy
EXTREME DANGER AREA	10 R/hr	36 sec	6 min	12 min	30 min	1 hr	2.5 hr	5 hr	10 hr	30 hr	50 hr
	20 R/hr	18 sec	3 min	6 min	15 min	30 min	75 min	2.5 hr	5 hr	15 hr	1 dy
	30 R/hr	10 sec	2 min	4 min	10 min	20 min	50 min	96 min	3 hr	10 hr	17 hr
	40 R/hr	9 sec	90 sec	3 min	7.5 min	15 min	38 min	75 min	2.5 hr	7.5 hr	12 hr
	50 R/hr	7 sec	72 sec	80 sec	6 min	12 min	30 min	1 hr	2 hr	6 hr	10 hr
	75 R/hr	5 sec	50 sec	100 sec	4 min	8 min	20 min	40 min	80 min	4 hr	6.5 hr
	100 R/hr	4 sec	30 sec	1 min	3 min	6 min	15 min	30 min	1 hr	3 hr	5 hr
	200 R/hr	2 sec	18 sec	30 sec	90 sec	3 min	7 min	15 min	30 min	90 min	2.5 hr
GRAVE DANGER	300 R/hr	1 sec	10 sec	20 sec	1 min	2 min	5 min	10 min	20 min	1 hr	100 min
	400 R/hr	1 sec	9 sec	15 sec	45 sec	90 sec	3.5 min	7.5 min	15 min	45 min	75 min
	500 R/hr	1 sec	7 sec	15 sec	30 sec	72 sec	3 min	6 min	12 min	36 min	1 hr
	750 R/hr	1 sec	5 sec	9 sec	24 sec	48 sec	2 min	4 min	8 min	24 min	40 min
	1,000 R/hr	1 sec	3 sec	7 sec	18 sec	36 sec	90 sec	3 min	6 min	18 min	30 min

1 µR = 0.001 mR = 0.000001 R		µR	microroentgen	yr	year	hr	hour
1,000 µR = 1 mR = 0.001 R		mR	milliroentgen	wk	week	min	minute
1,000,000 µR = 1,000 mR = 1 R		R	roentgen	dy	day	sec	second
		rem	roentgen equivalent man				

Natural Background: about 10 µR/hr = 0.01 mR/hr = 0.00001 R/hr = 0.25 mR/day

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Table 8: Units of Measurement

United States Unit/Symbol	International System Unit/Symbol	Relevance
Curie (Ci)	Becquerel (Bq)	Amount of radioactivity of a material
Rad	Gray (Gy)	Amount of absorbed dose to any object
Rem	Sievert (Sv)	Amount of damage to human tissue or dose equivalent
roentgen (R)	Coulomb/Kilogram (C/kg)	Amount of ionization of air

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Table 9: Conversion of Units of Measurement

Unit	Conversion
1 curie	3.7×10^{10} disintegrations/second
1 becquerel	1 disintegrations/second
1 rad	0.01 gray (Gy)
1 rem	0.01 sieverts (Sv)
1 roentgen (R)	1 rem (approximate)
1 gray (Gy)	100 rad
1 centigray (cGy)	1 rad
1 sievert (Sv)	100 rem

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Table 10: Responder Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to 1,000 cpm beta and 100 cpm alpha, if returning to duty station or if doing so does not preclude decontamination of others with higher contamination levels. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* before release for self-decontamination.
Gamma [2]	(Gamma instruments not usable at these levels)	10 % of Release Level	Decontaminate to 1,000 cpm beta and 100 cpm alpha, if returning to duty station or if doing so does not preclude decontamination of others with higher contamination levels. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* before release for self-decontamination.
Alpha [3]	10 to 1,000 cpm	10 % of Release Level	Decontaminate to 1,000 cpm beta and 100 cpm alpha, if returning to duty station or if doing so does not preclude decontamination of others with higher contamination levels. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* before release for self-decontamination.
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	If responder is going directly home, decontaminate to Level 2 lower values, then release for home decontaminate in accordance with *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*. If not going directly home decontaminate as noted for Level 1.[4,5]
Gamma [2]	50 [(4)] to 100 μR/hr (i.e., 0.01 to 0.1 mR/hr)	10 % of Release Level	If responder is going directly home, decontaminate to Level 2 lower values, then release for home decontaminate in accordance with *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*. If not going directly home decontaminate as noted for Level 1.[4,5]
Alpha [3]	1,000 to 10,000 cpm	10 % of Release Level	If responder is going directly home, decontaminate to Level 2 lower values, then release for home decontaminate in accordance with *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home*. If not going directly home decontaminate as noted for Level 1.[4,5]
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Decontaminate without delay to achieve Level 2 values.[5] If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Gamma [2]	Greater than 100 μR/hr (i.e., Greater than 0.1 mR/hr)	10 % of Release Level	Decontaminate without delay to achieve Level 2 values.[5] If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Alpha [3]	Greater than 10,000 cpm	10 % of Release Level	Decontaminate without delay to achieve Level 2 values.[5] If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 μR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 μR/hr; therefore, 50 μR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 μR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute   mR/hr milliroentgen per hour   μR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

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Table 11: Responder Equipment Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to lowest level practicable using routine field decontamination methods (wiping and washing) and release without restriction if less than 1,000 cpm beta and 100 cpm alpha.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	Control large items, bag smaller items, and retain until evaluated by a Radiation Technical Specialist. Items returning to contaminated areas, including ambulances, may be reused during the incident with these contamination levels.[5]
Gamma [2]	50 [4] to 100 μR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Do not reuse or release. Contact a Radiation Technical Specialist for determination of disposition.[6]
Gamma [2]	Greater than 100 μR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 μR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 μR/hr; therefore, 50 μR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 μR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Upon demobilization, high priority equipment, like an ambulance, should be given quicker attention for decontamination efforts to release at the lowest contamination level possible.

6 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute mR/hr milliroentgen per hour μR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

Table 12: Victim and Public Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to 1,000 cpm beta and 100 cpm alpha, but only if doing so does not preclude decontamination of others with higher contamination levels. Provide a copy of *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home* before release for self-decontamination.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	Decontaminate to Level 2 lower values, then release for home decontamination in accordance with *Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home.* [4,5]
Gamma [2]	50 [(4)] to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Decontaminate without delay to achieve Level 2 values.[5] If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Gamma [2]	Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 µR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 µR/hr; therefore, 50 µR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 µR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute
mR/hr milliroentgen per hour
µR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

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Table 13: Victim and Public Property Contamination Release Levels

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
Level 1 (Third Priority)			
Beta [1]	100 to 10,000 cpm	10 % of Release Level	Decontaminate to lowest level practicable using routine field decontamination methods (wiping and washing) and release without restriction if less than 1,000 cpm beta and 100 cpm alpha.
Gamma [2]	(Gamma instruments not usable at these levels)		
Alpha [3]	10 to 1,000 cpm		
Level 2 (Second Priority)			
Beta [1] or	10,000 to 100,000 cpm or	10 % of Release Level	Control large items, bag smaller items, and retain until evaluated by a Radiation Technical Specialist.[5]
Gamma [2]	50 [(4)] to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)		
Alpha [3]	1,000 to 10,000 cpm		
Level 3 (First Priority)			
Beta [1] or	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or	10 % of Release Level	Do not release. Contact a Radiation Technical Specialist for determination of disposition.[6]
Gamma [2]	Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)		
Alpha [3]	Greater than 10,000 cpm		

Note: Except as noted in the table, either beta or gamma measurements can be used as release criteria. In addition alpha criteria must be met if alpha radionuclides are present.

1 Measured with a Pancake Geiger-Mueller (PGM) probe at approximately 1-inch from the surface. **Caution**: Do not use PGM above 200,000 cpm. Due to instrument dead-time loss above this value, PGM will significantly under-respond to radiation levels (e.g., a 500,000 cpm reading is actually 1,500,000 cpm).

2 Gamma radiation measured with ion chamber, energy compensated Geiger-Mueller detector, or if necessary, sodium iodide or Pancake Geiger-Mueller (PGM). If PGM is used for gamma, face backside of probe towards contamination and if feasible cover front side of probe to shield beta; then read mR/hr or calculate mR/hr using relationship 1 mR/hr = 3,000 cpm (for Cs-137 only). The table mR/hr values are based on a distance of 5-6 inches from the surface to the centerline of the detector. The mR/hr values can be increased by a factor of 5 (e.g., 500 µR/hr = 100,000 cpm) using a 1-inch surface-to-centerline distance. Consult a Radiation Technical Specialist if gamma emitter other than Cs-137 is present or if contamination is in a very small area (e.g., less than the PGM probe area).

3 Measured with an alpha specific detector at approximately ½ inch from a relatively smooth surface. **Caution**: alpha radiation is very difficult to measure accurately. Presence of moisture, oil, dust, or dirt may shield all alpha. Seek Radiation Technical Specialist assistance if alpha contamination is detected.

4 Normal gamma background is 5-10 µR/hr; therefore, 50 µR/hr is the lowest practicable gamma level for determining contamination presence while allowing reasonable speed scans. If local background level exceeds 5 µR/hr, the lowest practicable gamma level for determining contamination presence will increase (remember that background needs to be approximately 10% or less than the contamination release level to allow reasonable speed surveying).

5 Valuables should be returned to the owner, including credit cards, identification, money, jewelry, medicines, et. Bag items and notify owner that further evaluation will be required at a later time.

6 Contamination levels above 10,000 cpm (or even above 100,000 cpm) may be acceptable for release upon consultation with the Radiation Technical Specialist.

cpm counts per minute
mR/hr milliroentgen per hour
µR/hr microroentgen per hour

Reference CRCPD 2006, NCRP 2005, and NCRP 2001 (see Volume II for specific citation)

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Table 14: Radionuclides of Concern

Radionuclide	Half-Life	Primary Radiation[1] Type
Americium-241 (Am-241)	430 years	Alpha, Gamma
Am-241/Beryllium	430 years	Alpha, Gamma, Neutron
Cesium-137 (Cs-137)	30 years	Beta, Gamma
Cobalt-60 (Co-60)	5.3 years	Beta, Gamma
Iridium-192 (Ir-192)	74 days	Beta, Gamma
Plutonium-238 (Pu-238)	86 years	Alpha, Gamma
Plutonium-239 (Pu-239)	24,400 years	Alpha, Beta, Gamma
Pu-239/Beryllium	24,400 years	Alpha, Beta, Gamma, Neutron
Radium-226 (Ra-226)	1,600 years	Alpha, Beta, Gamma
Ra-226/Beryllium	1,600 years	Alpha, Beta, Gamma, Neutron
Strontium-90 (Sr-90)	29.1 years	Beta, Bremsstrahlung (low energy x-rays)
Uranium-235 (U-235)	700,000,000 years	Alpha, Beta, Gamma
Uranium-238 (U-238)	4,500,000,000 years	Alpha, Beta, Gamma

[1] Includes primary radiation emitted from daughter products

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Table 15: Staffing Requirements for 1,000 Persons per Hour Reception Center

Minimum Number	Position	Considerations
1	Facility Group Director	
1	Assistant Facility Group Director	
2[(1)]	Greeter	Additional needed for various languages
As needed	Uniformed security officers	Police and National Guard
As needed	Media relations staff	Coordinate with Joint Information Center
5	Crisis counselors	
20	Line attendant	2 per hand-held monitoring station
20	Radiation monitoring technicians	2 per hand-held monitoring station
10	Escort attendant	1 per hand-held monitoring station
10	Line attendant	1 per portal monitor station
20	Radiation monitoring technicians	2 per portal monitor station
10	Escort attendant	1 per portal monitor station
25	Registry staff	
10	Clinicians	Nurses/doctors as needed
1	Emergency Medical Services (EMS)/ambulance	

[(1)]May need more to reduce fatigue

Reference: CDC 2006

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Table 16: Protective Action Guides

Phase	Potential Effective Dose[1]	Action
Early	< 100 mrem[3]	No sheltering
	≥ 1 rem[3] in first four days	Sheltering
	≥ 1 rem[3] and ≤ 5 rem[3] in first four days	Evacuation, if more protective than sheltering, except for sensitive populations[2]
Intermediate	≥ 500 mrem[3] in second year or any subsequent year	Decontamination and other dose-reduction techniques
	≥ 2 rem[3] in first year	Relocation
	≥ FDA guidance for human food and animal feed	See guidance document
Late	≥ 100 mrem[4] and < 500 mrem[4]	Use ALARA
	< 100 rem[4]	No action

[1] International Council of Radiation Protection (ICRP) definition 1991.
[2] Special groups for which evaluation could cause greater risk to themselves or the public (e.g., persons on medical life support, institutionalized criminals, etc.); evacuation should not be implemented if the projected effective dose is less than 10 rem.
[3] Projected doses are maximally exposed individual and calculation methods consistent with those currently in the Protective Action Guide Manual but should be based on current dose conversion factors.
[4] Projected doses are maximally exposed individual and calculation methods should use dose-assessment computer programs or methodologies accepted by federal agencies using realistic exposure scenarios for the intended actual use of the radioactively contaminated areas.

mrem	millirem
rem	roentgen equivalent man
<	less than
≥	greater than or equal to
FDA	United States Food and Drug Administration
ALARA	as low as reasonably achievable

References: EPA 1992, DHS 2008b.

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Table 17: Exposure Pathways and Protective Actions

Potential Exposure Pathway	Protective Actions
External radiation from facility or source material	Sheltering Evacuation Control of access to incident
External radiation from overhead plume or immersion in plume	Sheltering Evacuation Control of access to incident
External and internal (inhalation and ingestion) radiation from contamination of skin and clothes	Sheltering Evacuation Control of access to incident Decontamination of people
External and internal (inhalation) radiation from ground deposition	Sheltering Evacuation Relocation Decontamination of land and property
Internal radiation from inhalation of plume	Respiratory protection[1] Sheltering Evacuation Control of access to incident Administration of stable iodine
Internal (inhalation) radiation from contamination resuspension	Evacuation Relocation Control of access to incident Decontamination of land and property
Internal (ingestion) radiation of contaminated food and water	Food and water controls Use of stored animal feeds

[1] Includes covering nose and mouth with a dry or wet handkerchief, bandana, piece of cloth, towel or mask

References: EPA 1992, NCRP 2001, DHS 2008b

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Table 18: Representative Shielding Factors from Gamma Radiation in a Plume

Structure or Location	Reduction in Gamma Radiation
Outside	0 %
Vehicles	0 %
Wooden Frame House[1]	10 %
Basement in Wooden Frame House	40 %
Masonry House	40 %
Basement of a Masonry House	60 %
Large Office or Industrial Building	80 %

[1] Brick or masonry veneer is equivalent to a masonry home.

(Adapted from NCRP 138)

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Attachment 2: Standard Operating Guides

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Standard Operating Guide No. 1:
Procedure for Performing a Radiation Contamination Survey

In performing a contamination survey with a hand-held instrument, first check to make sure the instrument is functioning properly. It is advisable to wrap the meter probe with plastic wrap to protect the probe from contamination (except if you are surveying for alpha contamination; see Playbook 7 to determine if alpha is present).

Make sure that the instruments have batteries and that they work. To do this, turn your instrument to battery check. If the batteries are acceptable, turn the dial to a measurement mode and use a radiation check source to verify the instrument is operating properly.

Screening Survey

If a large population must be surveyed, it is acceptable to perform only a screening survey of the head, face, hands, and shoulders, rather than a more detailed survey, since these are the most likely locations to become contaminated. You may also consider using portal monitors.

If only performing a screening survey, it is acceptable to hold the survey meter probe about 1 to 2 inches away from the body (instead of ½ inch), and move it twice as fast as the normal 1 to 2 inches per second. (If the probe is moved too quickly, its detection capability may be reduced.) If surveying for alpha radiation, hold the survey meter probe ½ inch away from the body and move it at 1 inch per second. Check with state/local radiation control personnel to determine the extent of contamination survey required.

Public that are not familiar with radiological instruments may become alarmed when they hear the “clicks” from the meter. Consider using head phones to listen to the “clicks” or turn the sound off. However, if the sound is turned off, the surveyor must look at the meter reading and watch the probe position at the same time. This will result in the surveyor taking a significantly longer time to survey an individual.

Return the probe to its holder on the meter when finished. *Do not set the probe down on the ground*. The probe should be placed in the holder with the sensitive side of the probe facing to the side or facing down so that the next person to use the meter can monitor his/her hands without handling the probe or allowing contamination to fall onto the probe surface.

Complete Whole Body Survey

If feasible, perform a complete, whole body contamination survey and record the findings on *Form No 1: Contamination Survey*. To begin a body survey, the individual should stand with their legs spread and arms extended. First holding the probe about a ½ inch away from the surface to be surveyed, slowly (1 to 2 inches per second) move the probe over the head, and proceed to survey the shoulders, arms, and bottoms of the feet. Care must be taken not to permit the detector probe to touch any potentially contaminated surfaces.

It is not necessary to perform the personnel contamination survey in exactly the order listed below, but a consistent procedure should be followed to help prevent accidentally skipping an area of the body. Pause the probe for about five seconds at locations most likely to be contaminated.

1. Top and sides of head, face (pause at mouth and nose for approximately five seconds; high readings may indicate internal contamination)
2. Front of the neck and shoulders
3. Down one arm (pausing at elbow), turn arm over
4. Backside of hands, turn over (pause at palms for about five seconds)
5. Up the other arm (pausing at elbow), turn arm over
6. Shoe tops and inside ankle area
7. Shoe bottoms (pause at sole and heel)

Standard Operating Guide No. 1 (continued)

As with the screening survey, return the probe to its holder on the meter when finished. *Do not set the probe down on the ground***.** The probe should be placed in the holder with the sensitive side of the probe facing to the side or facing down so that the next person to use the meter can monitor his/her hands without handling the probe or allowing contamination to fall onto the probe surface.

The most common mistakes made during the survey:

Holding the probe too far away from the surface (should be about 1 to 2 inches away for a screening survey or about ½ inch or less for a detailed survey).

Moving the probe too fast (should be about 2 to 4 inches per second for a screening survey or about 1 to 2 inches per second for a detailed survey.)

Contaminating the probe. Probe background should be observed and compared to initial background. If within a factor of 2, it is acceptable to continue to use the probe. Otherwise, check with radiation control personnel. Wrapping the probe in plastic wrap will help prevent surface contamination.

Recommended procedures for on-scene responders:

1. On-scene responders should wear gloves and a gown or other protective clothing. Each responder should be provided with a personal dosimetry device.
2. Medically unstable patients should be transported to a hospital immediately.
3. A radiological survey, decontamination procedures, or steps taken to contain the contamination may be performed in the ambulance provided these actions do not interfere with more immediate medical requirements of the patient.
4. If the patient is medically stable and conditions at the site permit, limit any further exposure to radiation by moving the patient to an area of low background. The outer clothing of the individual should be removed and the patient should be wrapped in a cloth sheet or blanket to permit handling. The wrapping should be loose to avoid hyperthermia and to allow easy access to the patient by medical personnel.
5. Treat the patient’s injuries (i.e., burns, cuts, etc.) sustained in the incident and, if needed, provide symptomatic treatment for the radiation illness (e.g., the use of anti-emetics).
6. If an open wound is involved, cover the wound with a clean dressing.
7. Do not release a medically stable patient to ambulance personnel before a radiological survey has been performed. If contamination is confirmed, a preliminary decontamination should be performed. Record the results of the radiological survey and proceed to decontaminate the patient.
8. Decontaminate the medically stable patient by washing the individual with tepid water to remove any radioactive contamination, beginning with the areas of highest levels of contamination. Proceed gently, mindful that this is a preliminary decontamination and that a more thorough decontamination process will be performed at a medical facility. When finished, repeat the radiation survey of the patient and record the final results. Save all clothing and bedding and all metal objects (e.g., jewelry, coins, belt buckles, etc.). A nasal swab is also recommended to detect inhalation of radioactive contaminants. However, it may be more practicable for medical personnel to perform the nasal swab.
9. Tag each item with the patient’s name, location, time, and date. Save each in appropriate containers; mark containers clearly with: “RADIOACTIVE—DO NOT DISCARD.”
10. Transport patient to a medical facility for further treatment. The medical facility should be given advanced warning if they are going to receive patients exposed to radiation so that the facility can institute the appropriate medical protocols. Remember, individuals suffering from radiation injury may not be radioactive, but their skin and clothing could be contaminated with radioactive material. Protection of first responders should be focused on the source of the radiation.

•

(NCRP 2005, Adapted from the 1998 FBI Contingency Plan for Weapons of Mass Destruction FBI, 1998)

Standard Operating Guide No. 2: How to Distinguish Between Alpha, Beta, and Gamma Radiation Using a Pancake Geiger-Mueller Survey Meter

This instruction describes a technique using a Pancake Geiger-Mueller, and if available, a sodium iodide meter, that may be used by first responders to make a quick, initial determination of the type of radiation (alpha, beta, or gamma) present at an incident. Many studies show that the most likely radionuclide(s) to be used in a terrorism incident (like a radiological dispersal device) would be either a gamma emitter or a beta-gamma emitter. However, it is possible that the radionuclide may only emit beta such as strontium-90 or only alpha such as plutonium-239.

This methodology was developed to assist responders in making an initial determination of the type of radiation present. This determination should be used to make decisions until radiation experts arrive with more sophisticated instrumentation to verify the type of radiation and identify the radionuclide(s).

Pancake Geiger-Mueller survey meters will respond to alpha, beta, gamma, and X-rays, but have very limited response to alpha radiation. Sodium iodide survey meters will only respond to gamma or X-rays. Do not be misled into thinking that radioactive materials are not present if no radiation is detected with a sodium iodide survey meter, since it cannot detect alpha or beta radiation.

Determining the Presence of Alpha Radiation Using Only a Pancake Geiger-Mueller Meter

Materials that emit alpha are very harmful when inhaled or ingested. Therefore, it is very important to check for the presence of alpha radiation. Until the presence of alpha radiation is ruled out, responders should use appropriate respiratory protection when conducting operations and while monitoring for radiation.

Procedure

Step 1: Turn on the Pancake Geiger-Mueller meter and check that it is working properly. In an area that has not been contaminated (background area), take and record a reading (typically 30 to 100 cpm).

Step 2: Take readings at approximately 3 inches and about ½ inch (as close as possible without touching) above a smooth, hard surface with the Pancake Geiger-Mueller window (mesh covered side) facing down. If the instrument reading increases by more than a factor of three at ½ inch above the ground as compared to 3-inches above the ground, assume alpha contamination is present.

Step 3: Place a sheet of paper on the smooth, hard surface and take a reading with the window facing down at ½ inch above the paper. The alpha radiation will not penetrate the paper and the window down reading should significantly decrease to near background levels. If the window down measurement taken over the paper does not significantly decrease, the material is probably not an alpha emitter. Note that some radioactive materials that emit alpha, such as americium-241, also emit low energy gamma radiation which will not be stopped by a sheet of paper and thus will be detected by the Pancake Geiger-Mueller.

Step 4: Flip the Pancake Geiger-Mueller probe over so that the window is facing up while maintaining the detector at ½ inch above the ground. The alpha and beta radiation will be stopped by the metal backing of the probe. If the measurement taken in Step 3 at ½ inch above the paper **does not** significantly decrease, the nuclide is likely not a beta emitter. If the measurement taken in Step 3 at ½ inch above the paper **does** significantly decrease, the nuclide is likely a beta emitter.

Note that many radioactive materials emit different amounts of alpha, beta, and/or gamma radiation.

Standard Operating Guide No. 2 (continued)

Determining the Presence of Strontium-90 (or Other Pure Beta Emitters) Using Only a Pancake Geiger-Mueller Survey Meter

Strontium-90 is a pure beta emitter and will not be detected by a sodium iodide instrument or other types of gamma identification survey meters. However, strontium-90 beta radiation can be easily detected and measured with a Pancake Geiger-Mueller. Suspect the presence of strontium-90 if a Pancake Geiger-Mueller meter reads between 1,000 cpm and 10,000 cpm (20 to 200 times background), but there is no corresponding increase in readings using a sodium iodide survey meter (still reads near background).

When strontium-90 is shielded by certain materials, the beta radiation cannot be detected. However, the interaction of the beta radiation with the shielding materials can produce X-rays, which can be detected by the Pancake Geiger-Mueller, sodium iodide, and other types of gamma identification survey meters.

Procedure

Step 5: Take a measurement with the window side of the Pancake Geiger-Mueller probe (mesh covered side) facing down at approximately 6 inches from the ground in an area where the meter reading is between 500 cpm to 1,500 cpm. Then take another measurement with the window side facing up (away from the ground) at the same height.

Step 6: Compare the two measurements.

Step 7: If only strontium-90 (or another pure beta-emitter) is present, the window up reading will be near background (depending on the model of the Pancake Geiger-Mueller probe, background should be in the range of 30 cpm to 100 cpm), and the window facing down reading should be 10 or more times greater than the window facing up reading. This is because the beta radiation is not able to penetrate the back side of the metal Pancake Geiger-Mueller probe.

Step 8: If a gamma or beta-gamma emitter is present (e.g., cesium-137, iridium-192, cobalt-60), the window facing down reading at 6-inches will be approximately twice the window up reading.

Step 9: Take another measurement with the window side of the Pancake Geiger-Mueller probe facing down at approximately 3 feet from the ground in an area where the meter reading is between 500 cpm to 1,500 cpm. Then take another measurement with the window side facing up at the same height. Compare the two measurements. If a gamma emitting nuclide is present, both readings will be approximately the same.

(Adapted from CRCPD 2006)

Attachment 3: Forms

Form No. 1: Contamination Survey

First Name: ______________________ Middle Initial: _______ Last Name: _________________________

Date of Birth: ______________ Home Phone:_________________ Mobile Phone: __________________

Address: ____

Date/Time: ________________________ Drivers License No./State: ____________________________

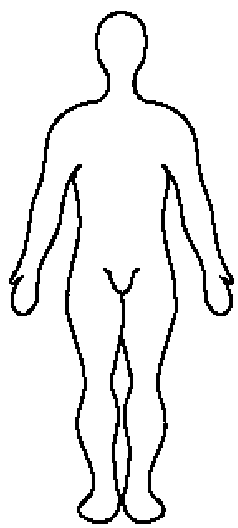
Location at Time of Incident: ____

Medical Radionuclides Received: ____

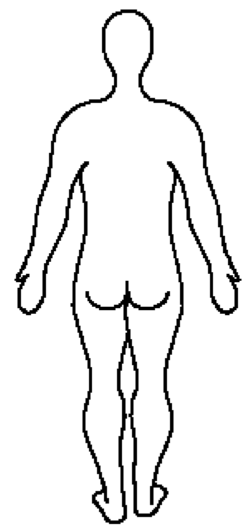
Survey Location: ____

Parent or Guardian (if child):____

Mark contamination locations and survey reading on the diagrams below.



Measurements:
1.____________
2.____________
3.____________
4.____________
5.____________
6.____________
7.____________
8.____________
9.



Measurements:
1.____________
2.____________
3.____________
4.____________
5.____________
6.____________
7.____________
8.____________
9.

Survey results □ before □ after decontamination
< ___________ _________ ; <10,000 cpm ___ or <0.1 mR/hr ___; <100,000 cpm ___ or <1 mR/hr ___
(fill in value) (fill in units)

Survey results □ before □ after decontamination (see next page)
< ___________ _________ ; <10,000 cpm ___ or <0.1 mR/hr ___; <100,000 cpm ___ or <1 mR/hr ___
(fill in value) (fill in units)

Survey results □ before □ after decontamination (see next page)
< ___________ _________ ; <10,000 cpm ___ or <0.1 mR/hr ___; <100,000 cpm ___ or <1 mR/hr ___
(fill in value) (fill in units)

Instrument Make and Model: ____ Serial Number: _________

Comments: ____

____

Monitored by (print name):____________________________________ Agency: _____________________

Person sent to decontamination area: _____Yes _____No Clothing bag number: ___________

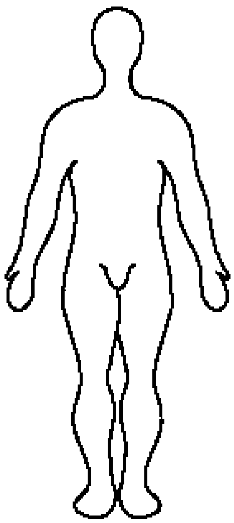
Nasal area reading of 100,000 cpm or 10 mR/hr: _____Yes _____No If Yes, refer to medical facility

Person sent to medical facility: _____Yes _____No

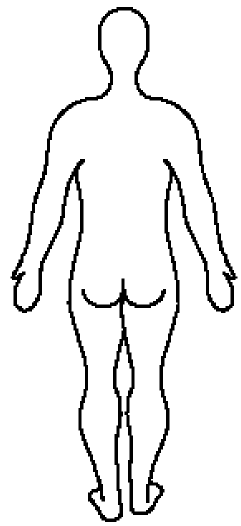
(Adapted from CRCPD 2006; see Volume II for specific citation)

Form No. 1: Contamination Survey (Continued)

Survey results □ before □ after decontamination *Circle if readings are in: cpm mR/hr μR/hr*



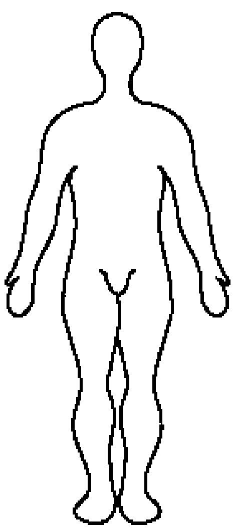
Measurements:
1.______________
2.______________
3.______________
4.______________
5.______________
6.______________
7.______________
8.______________
9.



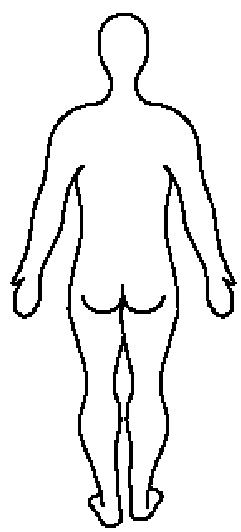
Measurements:
1.______________
2.______________
3.______________
4.______________
5.______________
6.______________
7.______________
8.______________
9.

Monitored by (print name):____________________________________ Agency: _____________________
Instrument Make and Model: __________________________________ Serial Number: _______________

Survey results □ before □ after decontamination *Circle if readings are in: cpm mR/hr μR/hr*



Measurements:
1.______________
2.______________
3.______________
4.______________
5.______________
6.______________
7.______________
8.______________
9.



Measurements:
1.______________
2.______________
3.______________
4.______________
5.______________
6.______________
7.______________
8.______________
9.

Monitored by (print name):____________________________________ Agency: _____________________
Instrument Make and Model: __________________________________ Serial Number: _______________

Form No. 2: Public Property Contamination Survey

First Name: _____________________ Middle Initial: _______ Last Name: ________________________

Date of Birth: ______________ Home Phone:_________________ Mobile Phone: __________________

Address: ____

Date/Time: ________________________ Drivers License No./State: ____________________________

Location at Time of Incident: ____

Survey Location: ____

Description of Property: ____

Draw diagram of property and mark contamination locations and survey reading.

Survey results □ before □ after decontamination
< ___________ _________ ; <10,000 cpm ___ or <0.1 mR/hr ___; <100,000 cpm ___ or <1 mR/hr ___
(fill in value) (fill in units)

Survey results □ before □ after decontamination (see next page)
< ___________ _________ ; <10,000 cpm ___ or <0.1 mR/hr ___; <100,000 cpm ___ or <1 mR/hr ___
(fill in value) (fill in units)

Survey results □ before □ after decontamination (see next page)
< ___________ _________ ; <10,000 cpm ___ or <0.1 mR/hr ___; <100,000 cpm ___ or <1 mR/hr ___
(fill in value) (fill in units)

Instrument Make and Model: _________________________________Serial Number: _______________

Comments: ____

____

Monitored by (print name):___________________________________ Agency:_____________________

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Form No. 3: Responder Dose Log

Organization(s) ________________________ Incident Name ________________________ Date ________________

Name (or ID#)	Dosimeter Type	Dosimeter Serial#	Dose Readings				Safety Officer Initials
			Start Reading *use units*	Time	End Reading *use units*	Time	

______Units_______
uR = microR = microrem
mR = milliR = millirem
R = rem

Page _____ of _____ Safety Officer Signature __________________

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Attachment 4: Instructions

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Instructions No. 1: Public Waiting for Decontamination

You may have been exposed to radioactive materials (“dust”). The dust from the explosion may have gotten on your clothes or body. To protect your health, you may be asked to go to a place at the incident called a decontamination station at a place called a reception center to clean off. Do not panic; your health is not in immediate danger. Follow these directions to prepare for the reception center:

Step 1: Go to the designated decontamination area or reception center, as directed.

Step 2: Do not touch your face or put anything into your mouth.

Step 3: Enter the decontamination area or reception center and follow the instructions from the staff. You will likely be asked to stand for a screening (survey) of yourself with clothing. Workers will ask you questions about necessary personal information; please provide answers as best as you can.

Step 4: After you are screened, you will be directed to leave if minimal or no radioactive dust is present. If radioactive dust is found, you will be directed to the wash area or you may be sent home with instructions on how to clean yourself. This is called decontamination.

Step 5: If you are directed to enter the wash area, you will be segregated with individuals of the same gender. To the extent possible, families will be kept together through the decontamination process. Prepare to remove your outer clothes behind a privacy curtain. If radioactive dust is on your clothes, removing them will reduce the dust and decrease the chance that you breathe in or ingest the dust. Quick removal of outer clothing will also reduce the length of time that you are exposed to radiation. When removing the clothing be careful of any clothing that has to be pulled over the head. Try to either cut the clothing off or prevent the outside from coming in contact with the nose and mouth area. You may also hold your breath while carefully pulling the clothing over your head.

Step 6: You will be provided with plastic bags. Place all of your clothing in one bag. You can wash most valuables. Anything that is plastic (including credit cards) or metal, identification, jewelry, and keys are easily washed off. Other types of materials can be wiped off carefully, like money, wallets, and purses. If something cannot be washed then place them in a separate plastic bag from your clothes and seal it. You may be asked to double bag your belongings to minimize the potential for bag breakage. You will be instructed on how to handle these items at a later time when more is known about the hazards of the radioactive dust.

Step 7: Pass through the wash area.

Step 8: When you reach the end of the wash station you will be given clothing to put on and directed to the final staging area. Do not leave without your valuables, even if they are not clean.

(Adapted from CRCPD 2006)

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Instructions No. 2:
Instructions to Public on How to Perform Decontamination at Home

You may have been exposed to low levels of radioactive materials (“dust”). The dust may have gotten on your hair, skin, clothing, and personal property. Depending on your location, the radioactive dust could be on your vehicle, home, yard, lawn furniture, BBQ grill, or anything outside. The dust may have gotten on your jewelry, wallet or purse, or other personal belongings if you were near the incident. You are not in immediate danger from this radioactive dust; however, you need to go home or to another designated area to remove the dust, which is called decontamination. Because radiation cannot be seen, smelled, felt, or tasted, people at the site of an incident will not immediately know if they have been exposed to radioactive materials. Follow these instructions to limit your contamination.

Get out of the immediate area quickly. Go directly home, inside the nearest safe building, or to an area to which you are directed by law enforcement or health officials. *Do not go to a hospital unless you have a medical condition that requires treatment***.**

If radioactive dust is on your clothes, removing them as quickly as possible will remove up to 90% of the dust, while helping to prevent you from breathing in or ingesting the dust and will also reduce the length of time that you are exposed to radiation. When removing the clothing be careful of any clothing that has to be pulled over the head. Try to either cut if off or prevent the outer layer from coming in contact with the nose and mouth area. You may also hold your breath while carefully pulling clothing over the head. Removal of clothes should be done in a garage or outside storage area if available, where the ground can be washed off easily. If an outside area is not available, the removal of clothing should take place in a room where the floor can be easily cleaned, such as a tub or shower area. Swiffer® pads are good for decontaminating smooth surfaces including the floor. Clothing should be rolled up with the outside “in” to minimize spreading the dust.

If possible, place the clothing in a plastic bag (double bagging is best to reduce the chances of it breaking), and leave it in an out-of-the-way area, such as the corner of a room or garage. Keep people away from it to reduce their exposure to radiation. You may be asked to bring this bag for follow-up tests or for disposal at a later time.

Keep cuts and abrasions covered when handling anything you think has the radioactive dust on it to avoid getting radioactive material in the wound.

Shower and wash all of the exposed parts of your body and hair using lots of soap and lukewarm water to remove the dust. Simple washing will remove most of the radioactive dust. Do not use abrasive cleaners, or scrub too hard. Do not use hair conditioners in your hair because it could trap the radioactive dust onto your hair.

You can also wash your valuables and other personal property. You can wash off valuables and small items at the same time that you wash yourself. If an outside area is not available or if the items are small, the decontamination should take place in a room where the floor can be easily cleaned, such as a tub or shower area. Swiffer® pads are good for decontaminating smooth surfaces including the floor. Wash the items with lots of water and soap. A scrub brush can be used to reach small spaces. Only decontaminate items that you can easily move to this location as other larger items can be washed off in place.

Instructions No. 2 (Continued)

For large items, decontamination should take place where the ground can be washed easily, like a sidewalk or driveway. Using a hose, wash off the roof of your home, hard surfaces (driveways, sidewalks, decks, patios), lawn furniture, grills, toys, and any other surface or item outside. You should NOT attempt to wash your lawn, gardens, or bare soil areas.

Clothes may be washed in your washing machine or at a commercial laundry mat. Any item that is water resistant can easily be washed by hand with water and soap, like jewelry, coins, paper money, credit cards, plastic identification cards, etc. Rinse all dust down the drain with lots of water.

Do not contain the used wash water; instead it should be flushed down the drain or if outside into the stormwater/sewer system. If the wash water pools outside, it should be swept into drainage areas.

If you are going to a reception center to be monitored for the radioactive dust, it is best to change clothes and shower *before* being monitored. Do not bring your valuables or personal property to the reception center.

Listen to the news for additional information and guidance.

(Adapted from CRCPD 2006)

Instructions No. 3:
Instructions to Public on How to Perform Decontamination of Pets

Your pet(s) may have been exposed to low amounts of radioactive materials ("dust"). The process of removing radioactive dust, which is called decontamination, from pets is similar to the decontamination process for people. Radioactive dust may be located on your pet's skin and in their fur. Your pet is not in immediate danger but should be decontaminated to minimize spread of the radioactive dust. In order to protect your health and safety as well as your pets, please follow these instructions:

Decontamination should take place where the ground can be washed with a hose. If an outside area is not available, the decontamination should take place in a room where the floor can be easily cleaned, such as the tub or shower areas. Swiffer® pads are good for decontaminating smooth surfaces including the floor.

Keep cuts and abrasions (both yours and your pet's) covered when washing the pet to avoid getting radioactive material in the wound.

If available, wear rubber dishwashing gloves and an apron. Shower and wash all of the exposed parts of your pet using mild dish soap and lots of lukewarm water. Simple washing will remove most of the radioactive dust. Do not use abrasive cleaners or scrub too hard. Do not use hair conditioners because it can trap the radioactive dust onto the hair.

After decontamination of your pet, remove your clothes and wash them separately from other clothes. Wash yourself thoroughly, and do not use conditioner in your hair because it could trap the radioactive dust onto your hair. This will remove any radioactive dust that may have gotten on you.

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Attachment 5: Pre-Scripted Public Messages

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Los Angeles County Department of Public Health

The following pre-scripted messages for an explosive radiological dispersal device (RDD) were prepared by the Los Angeles County Department of Public Health Radiation Management Program and Department of Health Services Psychological Programs for Bioterrorism.

DRAFT Public Information Statement No. 1

This message can be used immediately after the explosion, as soon as the fire department arrives and detects radiation.

There has been an explosion at________. Fire and police personnel are on the scene. There may have been some radioactive material released during the explosion. The public should stay away to facilitate response efforts and reduce the possibility of radiation exposure from this incident. We are requesting that the public avoid using telephones, including cell phones, to ensure lines are available for emergency responders.

We will be providing an update on this issue in 1 hour, or sooner if additional information becomes available.

DRAFT Public Information Statement No. 2

This message can be used when additional information becomes available.

There has been an explosion at __________. Fire, police, and health department personnel are on the scene. This was an explosive device where radioactive material was added to the explosives. This was NOT a nuclear bomb. The highest levels of radioactive contamination are within the immediate vicinity of the explosion, but we will be determining if the radiation has traveled from the site of the explosion. The public should stay away to facilitate response efforts, and to reduce the possibility of radiation exposure from this incident.

Although we do not have evidence that radioactive material has spread beyond the immediate vicinity of the explosion, there is a possibility that the wind carried smaller amounts away from the site of the explosion. As a precautionary measure, the public is advised to stay indoors for their personal safety. If you are located (north, south, west, east) of _______, and within _____ miles of the explosion, you should close the doors and windows and turn off fans that bring in air from the outside. In-room fans that only recirculate air are OK to use. Air conditioning systems do not bring in air from the outside, and may be operated.

To minimize your risk of radioactive contamination, those who were at the ______, (explosion site) or outdoors since __ (time of the explosion) in the ______ area, are advised to change clothes and place the clothes you had been wearing in a plastic bag, which will likely reduce any contamination by about 80 to 90%. If possible, take a shower with warm, not hot, water, and gently wash your body and hair with ordinary soap and shampoo. Again, we recommend you stay indoors. If we determine that you would be safer in another location, we will advise you where to go. You should not go to a hospital unless you were injured in the explosion, or have another medical emergency requiring immediate treatment, such as a heart attack.

The water from your faucet is safe to drink or bathe in, as is the food in your house. The only food that potentially might not be safe is food that was outdoors since ______ (time) today, within a few miles of ________(explosion site).

We are requesting that the public avoid using telephones, including cell phones, to ensure lines are available for emergency responders. We are also requesting that the media not fly over the scene so that airspace is available for emergency air responders, and to reduce air movement around the scene.

We will continue to monitor the area to establish the extent of radioactive contamination to ensure safety of the public. We will be providing an update on this issue in 1 hour, or sooner if additional information becomes available.

DRAFT Public Information Statement No. 3

This message can be delivered some hours later.

There has been an explosion at ______(site of explosion). Fire, police, and health department personnel are on the scene. This was an explosive device where radioactive material was added to the explosives. This was NOT a nuclear bomb. The public should stay away to facilitate response efforts, and to reduce the possibility of radiation exposure from this incident.

Over the last hour we have determined that some radioactive material was carried ____ (north, south, west, east) of the explosion site by the wind. At this point, we don't know the extent to which the winds have carried the radioactive material, so we continue to advise the public to stay indoors for their personal safety. As a precaution, if you are located within 5 miles east of_______(explosion site), you should close the doors and windows and turn off fans that bring in air from the outside. In-room fans that only recirculate air are OK to use. Air conditioning systems do not bring in air from the outside, and may be operated. If you were at _________(explosion site) when there was an explosion but have left and are not yet home, you may either continue home and shower there, or go to (evacuation location(s)).

To minimize your risk of radioactive contamination, those who were outdoors since ____(time of the explosion) and within ____ miles (north, south, west, east) of the _____(location of the explosion) are advised to change clothes and place the clothes you had been wearing in a plastic bag, which will likely reduce any contamination by about 80 to 90%. If possible, take a shower with warm, not hot, water, and gently wash your body and hair with ordinary soap and shampoo. Again, we recommend you stay indoors. If we determine that you would be safer in another location, we will advise you where to go. You should not go to a hospital unless you were injured in the explosion, or have another medical emergency requiring immediate treatment, such as a heart attack. Right now, the safest place for you is indoors.

The water from your faucet is safe to drink or bathe in, as is the food in your house. The only food that potentially might not be safe is food that was outdoors since ____ (time) today.

We have received questions about using potassium iodide (KI) pills. KI is not useful for the form of radiation used in this explosion. Therefore, we do not advise the use of KI pills.

We are requesting that the public avoid using telephones, including cell phones, to ensure lines are available for emergency responders. We are also requesting that the media not fly over the scene so that airspace is available for emergency air responders, and to reduce air movement around the scene.

We will continue to monitor the area to establish the extent of radioactive contamination to ensure safety of the public. We will be providing an update on this issue in 1 hour, or sooner if additional information becomes available.

DRAFT Public Information Statement No. 4

This message can be delivered after the presence/spread of radioactive material has been confirmed, when you are recommending evacuation of designated areas. If evacuation is needed, it may not occur until the following day.

There was an explosion at __________(site of the explosion). Fire, police, and health department personnel are on the scene. This was an explosive device where radioactive material was added to the explosives. This was NOT a nuclear bomb. Although the highest levels of radioactive contamination are within the immediate vicinity of the explosion, radioactive materials were carried by the wind in a _________(northern, southern, western, eastern) direction from the site of the explosion. As a precaution, we are evacuating residents closer than ______ mile ______ (north, south, west, east) of the explosion site. That is, those within the area __________ (compass direction) of ______ Street, ______(compass direction) of ___________street, _______(compass direction) of _____ Avenue. These residents may report to ______ (name the evacuation centers), where staff will be on site to determine if contamination is present, provide additional decontamination if needed. We have incorporated a significant safety factor and chosen an area larger than necessary. Therefore, ONLY the individuals within this designated area are advised to evacuate. If we determine that additional evacuations are advisable, you will be notified where to go.

As a precaution, if you are located within ____ miles _____(compass direction) of the _____(explosion site), you should continue to stay indoors, keep the doors windows closed and turn off fans that bring in air from the outside. In-room fans that only recirculate air are OK to use. Air conditioning systems do not bring in air from the outside, and may be operated.

Your water from the faucet is safe to drink or bathe in, as is the food in your house. The only food that potentially might not be safe is food that was outdoors since ____ (time) yesterday.

We have received questions about using potassium iodide (KI) pills. KI is not useful for the form of radiation used in this explosion. Therefore, we do not advise the use of KI pills.

(We may not need this paragraph by day two.) We are requesting the public avoid using telephones, including cell phones, to ensure lines are available for emergency responders. We are also requesting the media not fly over the scene so that airspace is available for emergency air responders, and to reduce air movement around the scene. We will continue to monitor the area to establish the extent of radioactive contamination to ensure safety of the public. We will be providing an update in 3 hours, or sooner if additional information becomes available.

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Situational Statements

Statement 1: When there is a possibility of radiological exposure to the public.

In the interest of public safety and law enforcement requirements, the area around the incident site is being monitored and a barrier (is being)/(has been) established around it. Radioactive material may have been released, so there is a possibility of radiation exposure in the restricted area. This area is also a crime scene. It is important that the movement of people into and out of the restricted area be strictly controlled. For the time being, only members of the emergency services, local, state, and federal response forces are being allowed inside the area. The public should stay away to reduce the possibility of radiation exposure from this incident and to facilitate response efforts. (NCRP No. 138)

Statement 2: When there is a possibility of radiation exposure to the public and sheltering/evacuation is recommended.

In the interest of public safety and law enforcement requirements, the area around the incident site is being monitored and a barrier (is being)/(has been) established around it. Radioactive material may have been released, so there is a possibility of radiation exposure. This area is also a crime scene. The highest levels of contamination are expected to be there. However, radioactive material may have been carried downwind beyond the established perimeter of the restricted area. As a precaution, the public is advised to [take shelter in (location)]/[evacuate the following areas…]. We will continue to monitor the site to determine whether there could be (any risk)/(any further risk) to the public. It is important that the movement of people into and out of the restricted area is strictly controlled. Only members of the emergency services, local, state, and federal response forces are being allowed inside the area. The public should stay away to reduce the possibility of radiation exposure from this incident and to facilitate response efforts. (NCRP No. 138)

Statement 3: When radioactive release has been confirmed.

A release of radioactive material has been detected. The highest levels of contamination are expected to be within the restricted area, which is also a crime scene. However, radioactive material may have been carried downwind beyond the perimeter of the restricted area. As a precaution, the public is advised to [take shelter in (location)]/[evacuate the following areas…]. We will continue to monitor the area to establish the extent of contamination and determine the risk to the public. It is important that the movement of people into and out of the cordoned area is strictly controlled. Only members of the emergency services, local, state, and federal response forces are being allowed inside the area. The public should stay away to reduce the possibility of radiation exposure from this incident and to facilitate response efforts. (NCRP No. 138)

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General Statements

Local emergency response personnel will normally issue public safety statements advising precautions to be taken against potential exposure to radiological material. For cases in which the IC/UC has determined that there has been a release of significant amounts of radioactive materials, the following information should be released to persons in affected areas as soon as possible after the incident. Until the amount of radiological contamination is determined, the following precautionary measures are recommended to minimize risk to the public:

1. Remain inside and minimize opening doors and windows.
2. Children should not play outdoors.
3. Fruit and vegetables grown in the area should not be eaten.
4. Turn off fans, air conditioners, and forced air heating units that bring in fresh air from the outside. Use them only to recirculate air already in the building. The inhalation of radioactive material (plutonium, uranium) is not an immediate medical emergency.

Trained monitoring teams will be moving through the area wearing special protective clothing and equipment to determine the extent of possible radiological contamination. The dress of these teams should not be interpreted as indicating any special risk to those indoors. If you are outside, proceed to the nearest permanent structure. If you must go outside for critical or lifesaving activities, cover your nose and mouth and avoid stirring up and breathing any dust. It is important to remember that your movement outside could cause you greater exposure and possibly spread contamination to those already protected.

Local, state, and federal personnel are responding to the incident. In the interest of public safety and to assist emergency response teams, authorities request that individuals within the vicinity (define) stay inside, with doors and windows closed, unless advised to do otherwise by the police. Further statements will be made when there is more information. Please listen for announcements on local radio/television (name stations and frequencies). Check the Internet at (web site).

Key messages that public officials need to communicate to the public are listed below.

1. Radiation exposure can have short and long-term consequences to human health. Health effects depend on the radiation dose received and many other factors including length of time exposed, distance from the radiation source and protection such as shelter or clothing worn at the time of exposure. Therefore, an individual’s health risk from radiation exposure from this incident may be uncertain.
2. Children exposed to radiation can be more at risk than adults.
3. Radiation exposure, like exposure to the sun, is cumulative.
4. Exposure to radiation may cause cancer in the long-term. Exposure to a very high dose of radiation can cause death in the short term.
5. If someone exposed to radiation from this incident eventually develops cancer, medical and scientific personnel will not be certain that this exposure caused the cancer.
6. There is no more effective or necessary screening for cancer than existing medical methods (mammograms, colon cancer tests, etc.). People potentially at risk of developing cancer in the future due to radiation exposure resulting from this incident should see their physicians for an annual physical.

Much is known about:

1. How to minimize human exposure to radiation
2. How to treat people exposed to radiation
3. How to decontaminate people exposed to radiation
4. How to decontaminate animals exposed to radiation
5. How to cleanup property contaminated with radioactive materials

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Answers to Questions

Media and public will have numerous questions regarding the incident particularly related to radiation. Below are potential questions and suggested answers (adapted from NCRP 138). Note that the supplied answers are not technically accurate scientific answers to these questions but are simplified for ease of understanding for the public.

Assistance

Q: What can volunteers do to assist?
A: We are grateful for volunteers. Although some citizens may have had radiation training and may have a radiation detector, many laws prevent volunteers from helping in areas with radiation contamination. Volunteers may help in other ways such as <insert available ways>.

Q: Where can volunteers go to assist?
A: <insert appropriate answer>

Casualties

Q: How many deaths/injuries were there?
A: <insert appropriate answer>

Q: What caused the deaths/injuries (explosion, radiation)?
A: <insert appropriate answer>

Q: Have responders been injured or killed? If so, how?
A: <insert appropriate answer>

Q: To which hospital(s) will the injured be transported?
A: <insert appropriate answer>

Q: Does/do the hospital(s) have staff to monitor contaminated patients?
A: <insert appropriate answer>

Q: Will the hospital staff and patients be in danger from treating/being near the contaminated patients?
A: Medical staff are not in immediate harm while treating a patient.

Claims

Q: Who will pay for the loss and damage?
A: <insert appropriate answer>

Q: Where can people file claims?
A: <insert appropriate answer>

Q: How soon is financial assistance available?
A: <insert appropriate answer>

Domestic animals/wildlife

Q: What is being done to protect pets, livestock and wildlife?
A: <insert appropriate answer>

Q: What should I do if I suspect my pet has been exposed or contaminated to radiation?
A: Wash your pet thoroughly with shampoo or mild dish soap; do not use conditioner because it could trap the radioactive dust onto its hair. Afterward remove your clothes and wash them separately from other clothes. Wash yourself thoroughly, and do not use conditioner because it could trap the radioactive dust onto your hair.

Environment

Q: What is the effect on the water system?
A: <insert appropriate answer>

Q: What is the effect on well water?
A: <insert appropriate answer>

Q: What is the effect on nearby rivers/lakes/streams?
A: <insert appropriate answer>

Q: Was there property damage? If so, what's the estimated cost?
A: <insert appropriate answer>

Hazards

Q: What are health officials' most immediate public health concerns?
A: <insert appropriate answer>

Q: What is an external radiation hazard?
A: An external radiation hazard can result when a source of radiation, for example, a quantity of radioactive material, is outside of (external to) the body. Time, distance, and shielding protect the body from external radiation.

Q: What is an internal radiation hazard?
A: An internal radiation hazard can result from radioactive material entering the human body. This can occur as a result of a person breathing radioactive material present as a dust, vapor or gas; through the ingestion of radioactive materials either in solid or liquid form; through the intake of radioactive materials through cuts or wounds; or through absorption of radioactive materials through the skin.

Q: How is radiation measured?
A: There are several ways to measure radiation. We can measure the actual energy in the air or the energy absorbed or released by a substance. Ground surveys and aerial measurements can be made to determine the extent of contamination on the ground. Air monitoring stations can be set up to detect contamination in the air. Sampling and testing of soil, vegetation, and crops can be conducted to determine the amount of contamination present.

Q: How can people tell if they have been contaminated?
A: If people think they were exposed to radioactive material from the terrorist event, they should contact appropriate local, state or federal authorities and arrange to be monitored. Survey instruments can be used to assess possible contamination of their clothing with radioactive materials. Urine and/or fecal samples can be collected and analyzed to estimate the quantities of radionuclides taken into their bodies. The amounts of radioactive materials deposited in their lungs can be estimated by counting the gamma radiation emerging from their chest wall, through a so-called "lung count."

Q: What is a lung count? Whole-body count?
A: Many of the more penetrating gamma radiations emitted by radionuclides within a person's body will not be absorbed. That is to say, they will escape from the body. A whole-body count is a procedure in which these escaping gamma radiations are counted. The total count provides an indication of the amount of radioactive material in the body. In the case of a whole-body count, all the gamma radiations escaping from the body are counted. In the case of a lung count, only those emerging from the chest wall are counted. Spectroscopic analyses of the energies of the gamma radiations can be used to identify the specific radionuclides present in the body.

Q: Can people die from radiation exposure in hours, days, weeks, months, or years from now? What are the short and long-term effects of radiation on people?
A: Massive exposure to radiation can cause death within a few hours or days. Smaller doses can cause burns, nausea, loss of hair, loss of fertility, and pronounced changes in the blood. Even smaller doses, too small to cause any immediate visible damage, are thought to increase the probability of developing cancer or leukemia, congenital abnormalities in children exposed *in utero* including physical deformities, diseases, and mental retardation.

Q: Is a child's exposure to radiation from this incident more hazardous than an adult's exposure?
A: Based on studies of exposed populations, children have a slightly higher risk of cancer following exposure to ionizing radiation.

Q: What precautions should residents take to avoid exposure/further exposure?
A: Protection:

1. Respiratory protection (includes closing windows and doors)
2. Protective clothing
3. Cover open cuts and wounds
4. Washing/decontamination
5. Food controls

Q: What are the United States government standards for radiation exposure?
A: The United States government has set the maximum acceptable levels for occupational exposure to radiation at 5 rem (5,000 mrem or 50 mSv) y^{-1} from all human-made sources combined and has set a variety of lower levels for protection of the general public that depend on the source of radiation.

Q: How does radiation hurt people?
A: Radiation can damage genetic natural (DNA) in the body's cells, especially dividing cells. If a small amount of radiation is absorbed by the body, it does not always damage the cells. If it does, the cells can sometimes repair themselves. Damaged cells can die right away, or if they survive, may be transformed into cells that could cause a tumor.

Q: How much radiation can cause cancer?
A: No one is sure how much radiation can cause cancer, but we assume that the risk of cancer is proportional to the absorbed dose. Low doses could cause cancers 5 to 30 year or longer after exposure. However, it is important to remember that people are exposed to radiation every day from a variety of sources in the natural environment. The amount of radiation that is absorbed by the body is quantified with a unit called a roentgen equivalent man (rem) or a millirem (mrem). One mrem is one-thousandth of a rem. Exposure to background radiation, from sources such as radon gas, outer space, rocks, and soil, results in the body absorbing about 5 mrem each week. Normally, 200 out of 1,000 United States citizens would be expected to die from cancer. With what we know now, a dose of 5 rem is thought to increase cancer deaths to about 203 out of 1,000.

Q: How can doctors tell how much radiation people have been exposed to?
A: Medical personnel can screen people using biological dosimetry. Techniques can also be used to determine if individuals have radioactive materials in or on their bodies. These methods are used to determine how best to treat patients with radiological injuries.

Q: Is it safe to eat food and drink milk and water? What about eggs, fruit, livestock, fish and crops?
A: (Answer to be determined based on command and control guidance.) Fruit exposed to any residue cloud from the event may have contamination on its surface. Wash and peel fruit before eating.

Q: Are plants in gardens and agricultural produce in the area contaminated by radioactive material?
A: <insert appropriate answer>

Radiation Concepts

Q: How much radioactive material has been released?
A: <insert appropriate answer>

Q: What areas are radiologically contaminated and at what levels?
A: <insert appropriate answer>

Q: Could the radiological contamination spread further?
A: <insert appropriate answer>

Q: What radiological materials were involved?
A: <insert appropriate answer>

Q: What is the highest radiation level and where is it?
A: <insert appropriate answer>

Q: What is plutonium, and how can it harm people?
A: Plutonium is an artificially produced radioactive material. This radioactive element decays by emitting alpha particles and has a very long half-life. The range in air for alpha particles is only a few inches. This means that alpha radiation is not a hazard to people as long as it remains external to the body. Inhalation of airborne plutonium is normally the most hazardous exposure pathway. Following deposition in the lungs, it is transferred primarily to the liver and the bones from where it is cleared only very slowly.

Ingestion is normally a less hazardous pathway because plutonium is only minimally absorbed into the body as it passes through the gastrointestinal tract.

Q: What is uranium?
A: Uranium is a natural substance widely distributed over the earth. Uranium slowly reacts chemically (oxidizes) when exposed to air. In the air, the metal becomes coated with a layer of oxide that will make it appear from a golden-yellow color to almost black. It is an element having several radioactive isotopes with very long half-lives. Uranium also produces more than a dozen other radioactive substances as by-products, including radon gas. Tiny amounts of uranium are found almost everywhere on earth. Concentrated deposits are found in just a few places, usually in hard rock or sandstone, normally buried by earth and vegetation. Uranium has been mined in the southwest United States, Australia, parts of Europe, Russia, Namibia, South Africa, and Niger. At high concentrations, uranium is chemically toxic to the kidney. The radioactive by-products from the decay of uranium are generally more of radiological hazard than uranium itself.

Q: What is cobalt?

A: Stable cobalt is mined and is used in a variety of industrial applications. Radioactive cobalt is generally obtained from the irradiation of cobalt metal. Cobalt-60 is widely used as a source of radiation in industry and is widely used in medicine to treat cancer. Cobalt-60 has a 5 year half-life and emits beta radiation and penetrating gamma radiation.

Q: What is cesium?
A: Cesium-137 has a 30 year half-life and is one of the radioactive fission products created within a nuclear reactor during its operation. It can be absorbed into the food chain and can be an external and internal hazard. Cesium-137 sources are used to measure the thickness or density of material and for gamma radiography.

Q: What is radioactivity?
A: Radioactivity is the spontaneous emission of radiation from the nucleus of an unstable isotope.

Q: What is radiation?
A: Radiation is a form of energy and comes from both natural and man-made sources. Natural radiation comes from the sun, soil, building materials, and food. There are numerous man-made sources which include X-ray equipment, color televisions, smoke detectors and nuclear power plants. There are three primary types of radiation, alpha, beta, and gamma.

Alpha particles have a very short range and are easily shielded by a single sheet of paper. Alpha particles cannot penetrate the outer layers of skin and are not an external hazard. Radioactive material that emits them is an internal hazard if ingested or inhaled.

Beta particles have a longer range and are less easily shielded. Aluminum foil or glass will stop beta particles. They can penetrate the outer layer of skin and are an external and an internal hazard.

Gamma radiation has a very long range and is very difficult to shield. Unlike alpha or beta particles, gamma rays are electromagnetic energy waves (radio waves with a much shorter wavelength) similar to x rays. Concrete, lead or steel is needed to shield sources of gamma rays. The radiation can penetrate through the whole body; it is an external and an internal hazard.

Q: What is a becquerel?
A: A becquerel (Bq) is the special name of a unit by which the quantity of radioactive material is described. One becquerel is equal to one disintegration of a radioactive atom within a mass of radioactive material per second. Another unit often used to describe the quantity of radioactive material is the curie (Ci). One curie is equal to 37 billion becquerels.

Q: What is half-life?
A: The activity of radioactive material decreases with time. The half-life equals the period in which the activity decreases by half due to radioactive decay. Different radionuclides have different half-lives, from a fraction of a second to millions of years or more.

Q: What is contamination?
A: Contamination is the presence of radioactive materials in unwanted locations. Contamination can be on people, pets, vehicles, the ground, and inside and outside of buildings.

Remediation

Q: What measures can be taken to cleanup the area now and in the future?
A: Response organizations, local, state, and federal, will prepare a site remediation, or cleanup, plan. The process is lengthy and depends on the type of contamination and the site contaminated. There are temporary measures that can be taken to fix radioactive materials in place and stop the spread of

contamination. These include “fixative” sprays such as flour and water mixtures, road oil, or water that can be used to wet ground surfaces and prevent resuspension.

Q: How much will it cost?
A: The cost will depend on the extent of contamination, site remediation methods, and the cleanup plan selected with community involvement.

Q: How long will cleanup take?
A: Site remediation is a lengthy process that can take years to complete, depending on the type of contamination, the site contaminated, and the remediation plan selected.

Q: How can I tell if my house is contaminated?
A: If your house was downwind from the residue cloud, it may be contaminated. You should contact local, state, or federal authorities. They will arrange for a team to survey your house to detect possible contamination.

Response

Q: Who is in charge?
A: (Name of Federal Coordinating Officer) is responsible for coordinating the joint response. The senior local official is (name, organization). The senior state official is (name, organization). The senior federal official is (name, organization).

Q: When did authorities know about this incident?
A: <insert appropriate answer>

Q: What response agencies are involved? What are their missions? What expertise do their response teams have? How many people are on the teams? What equipment do they bring? Where do they come from? How long does it take teams to respond following notification?
A: <insert appropriate answer>

Q: How experienced are responders? How often do these organizations practice responding to similar radiological incidents?
A: <insert appropriate answer>

Q: Under what authority does the Federal Coordinating Officer respond?
A: Presidential Decision Directive 39 (PDD-39), U.S. Policy on Counterterrorism, establishes policy to respond to terrorism directed against Americans. Responding federal agencies do so in accordance with the National Response Framework (for Public Law 93-288, as amended) and its Terrorism Incident Annex.

Q: Who pays for response teams?
A: Responding organizations pay for all their expenses unless otherwise directed by the President.

Q: How many people are responding?
A: <insert appropriate answer>

Q: Can I obtain copies of response plans?
A: The Federal Response Framework is located on the Internet at www.fema.gov.

Sheltering/Evacuation

Q: What is sheltering-in-place?
A: <insert definition>

Q: What areas are recommended for sheltering?
A: <insert appropriate answer>

Q: What areas are recommended for evacuation?
A: <insert appropriate answer>

Q: Why was sheltering recommended/ordered?
A: <insert appropriate answer>

Q: Why wasn’t sheltering recommended/ordered?
A: <insert appropriate answer>

Q: How many people are/were affected by the sheltering order/recommendation?
A: <insert appropriate answer>

Q: When will sheltering/evacuation guidance be lifted?
A: <insert appropriate answer>

Q: When will residents be able to return home?
A: <insert appropriate answer>

Q: When will businesses be able to reopen?
A: <insert appropriate answer>

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Attachment 6: Reception Center Flow Diagrams

(Reference: United States Centers for Disease Control and Prevention)

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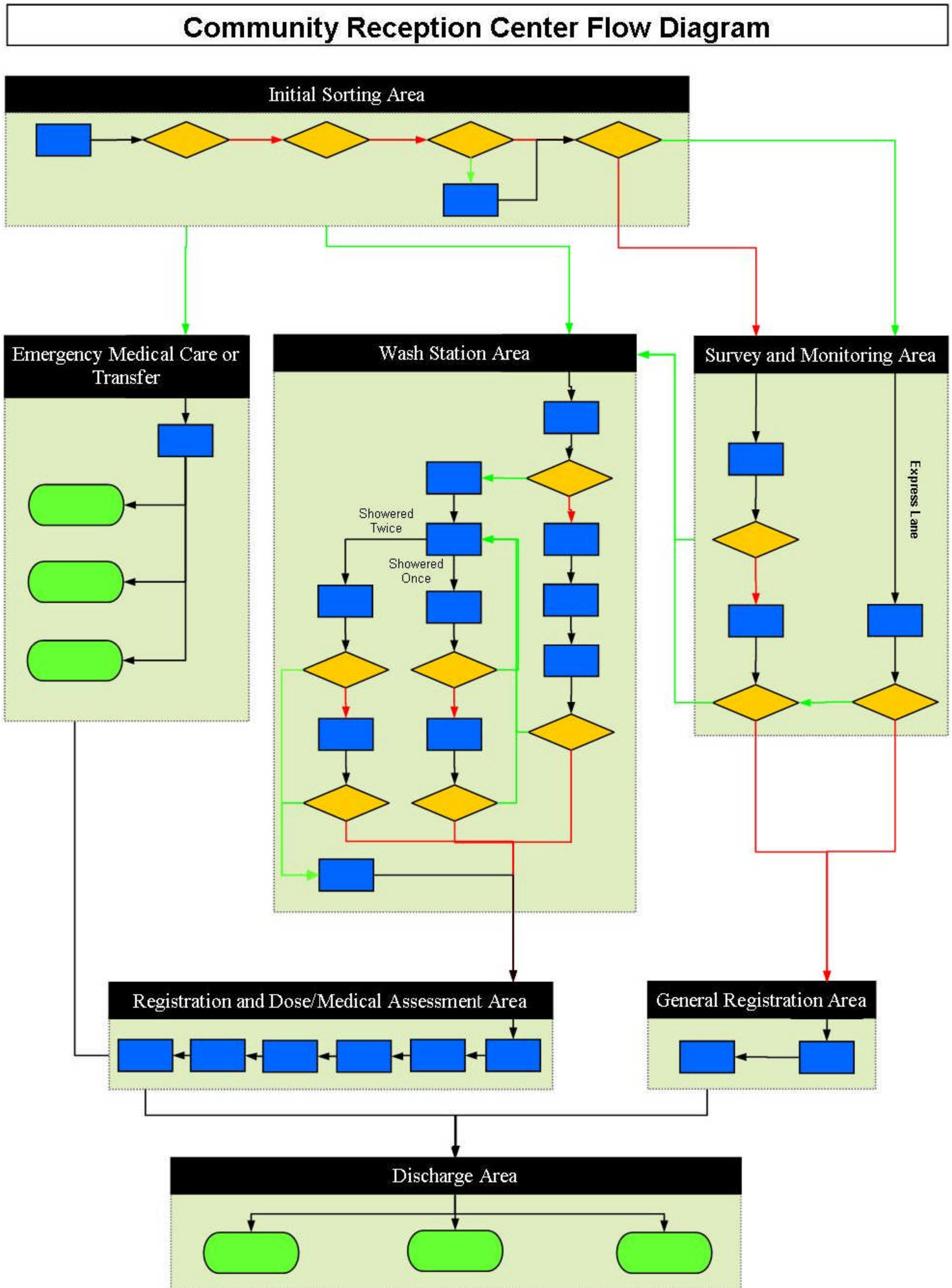
Community Reception Center Flow Diagram
Initial Sorting Area
Emergency Medical Care or Transfer
Wash Station Area
Survey and Monitoring Area
Showered Twice
Showered Once
Express Lane
Registration and Dose/Medical Assessment Area
General Registration Area
Discharge Area

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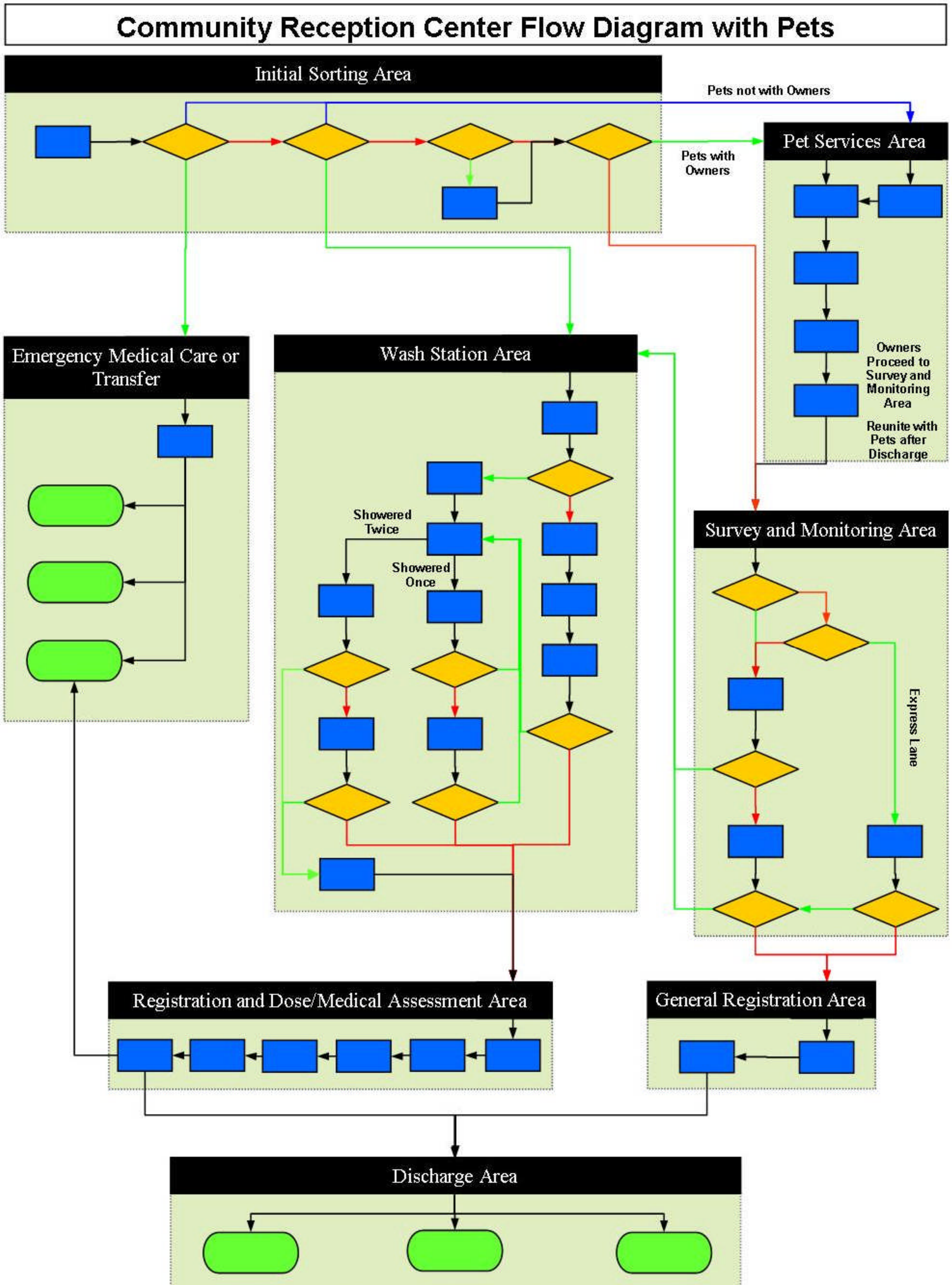
Community Reception Center Flow Diagram with Pets
Initial Sorting Area
Pets not with Owners
Pets with Owners
Pet Services Area
Owners Proceed to Survey and Monitoring Area
Reunite with Pets after Discharge
Emergency Medical Care or Transfer
Wash Station Area
Showered Twice
Showered Once
Survey and Monitoring Area
Express Lane
Registration and Dose/Medical Assessment Area
General Registration Area
Discharge Area

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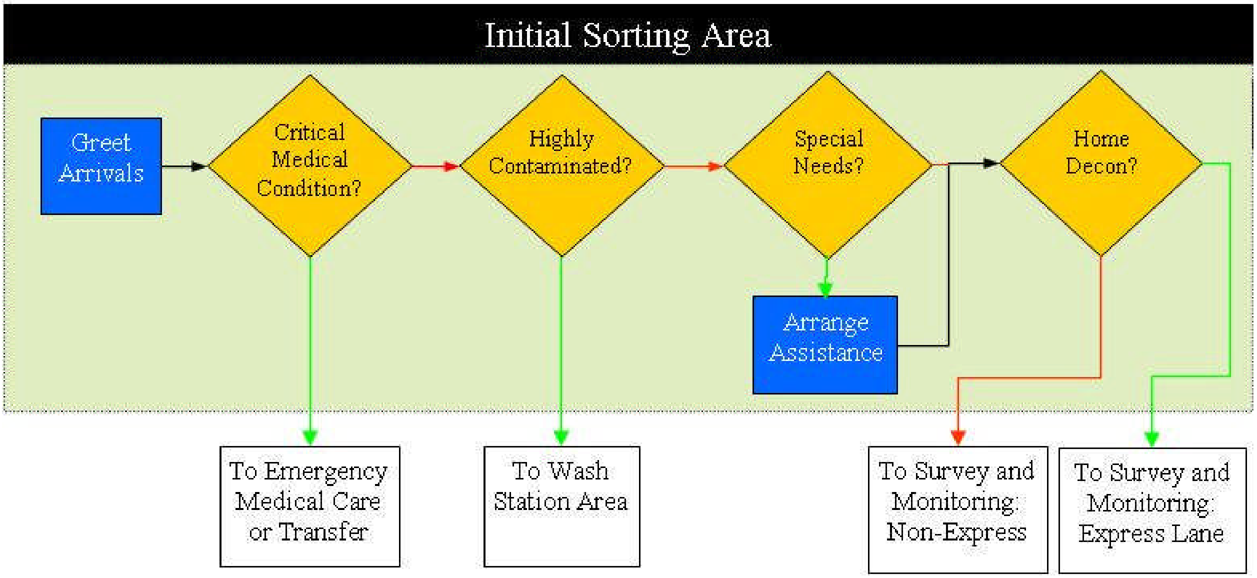
Community Reception Center Flow Diagram
Initial Sorting Area



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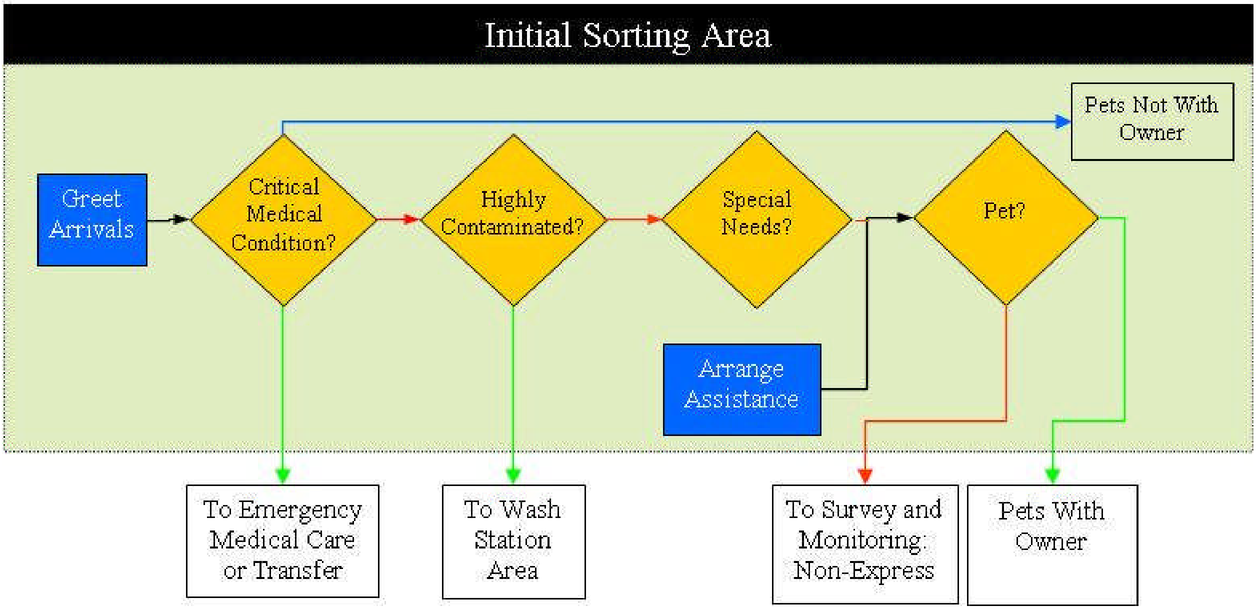
Community Reception Center Flow Diagram
Initial Sorting Area with Pets



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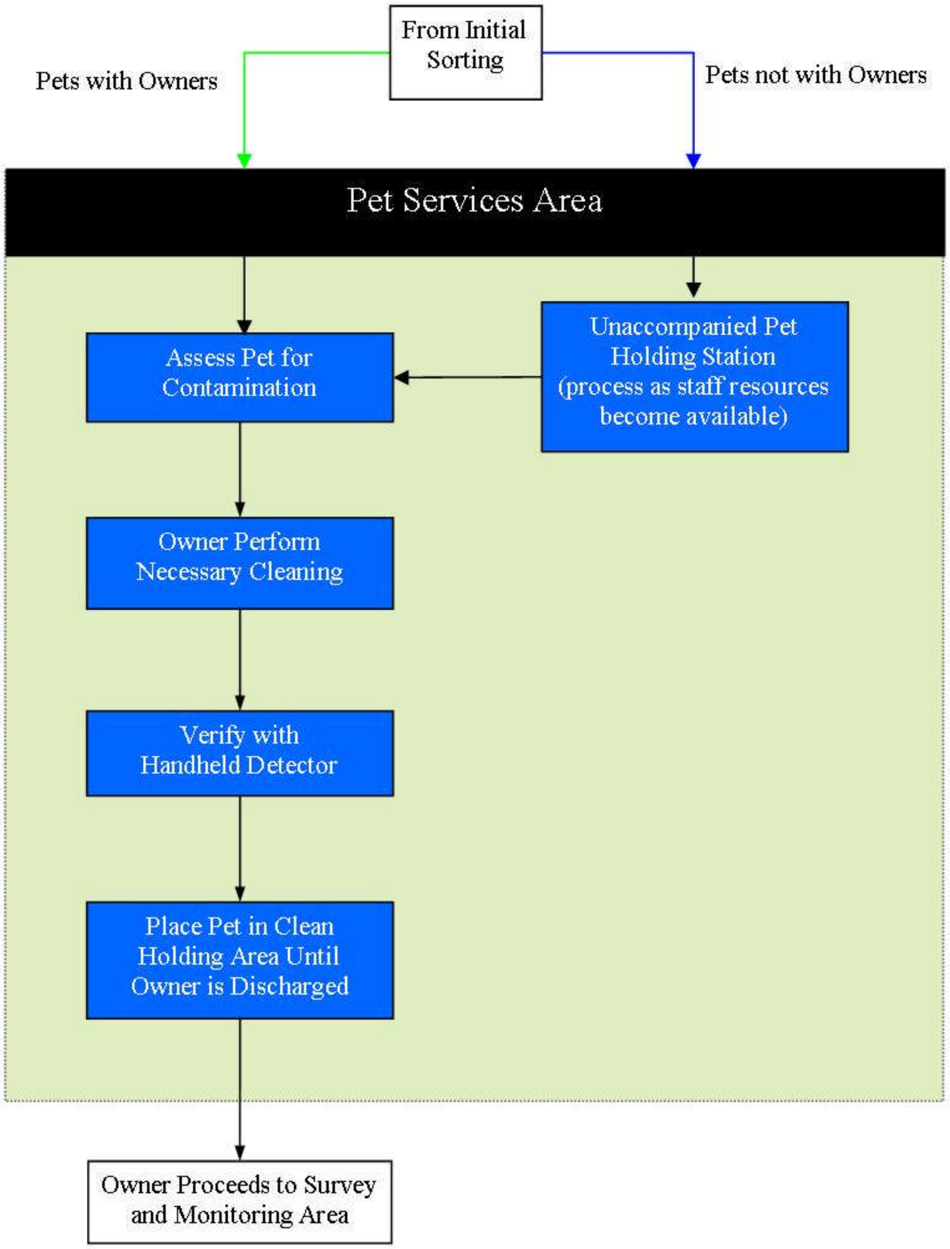
Community Reception Center Flow Diagram
Pet Services Area



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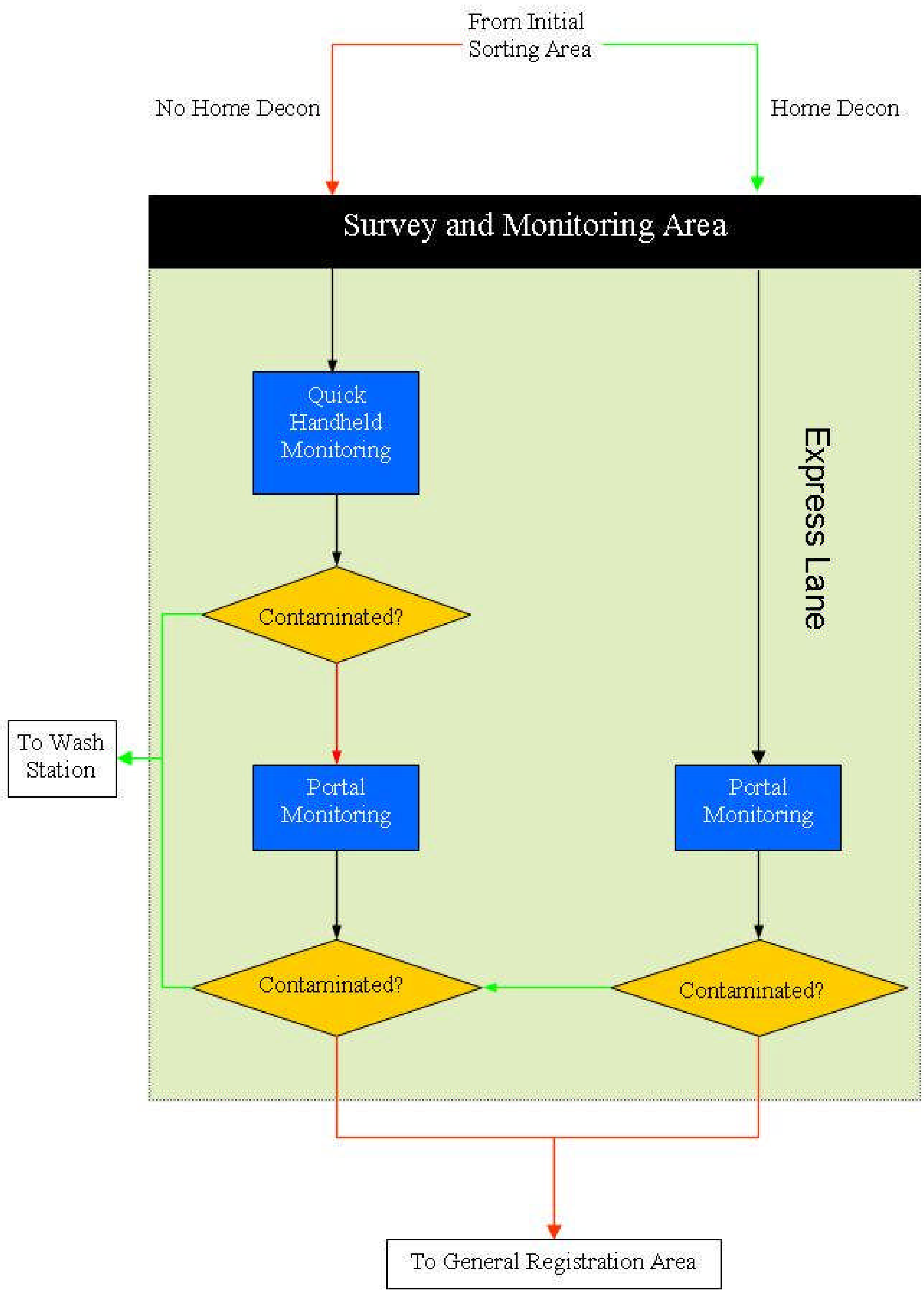
Community Reception Center Flow Diagram
Survey and Monitoring Area



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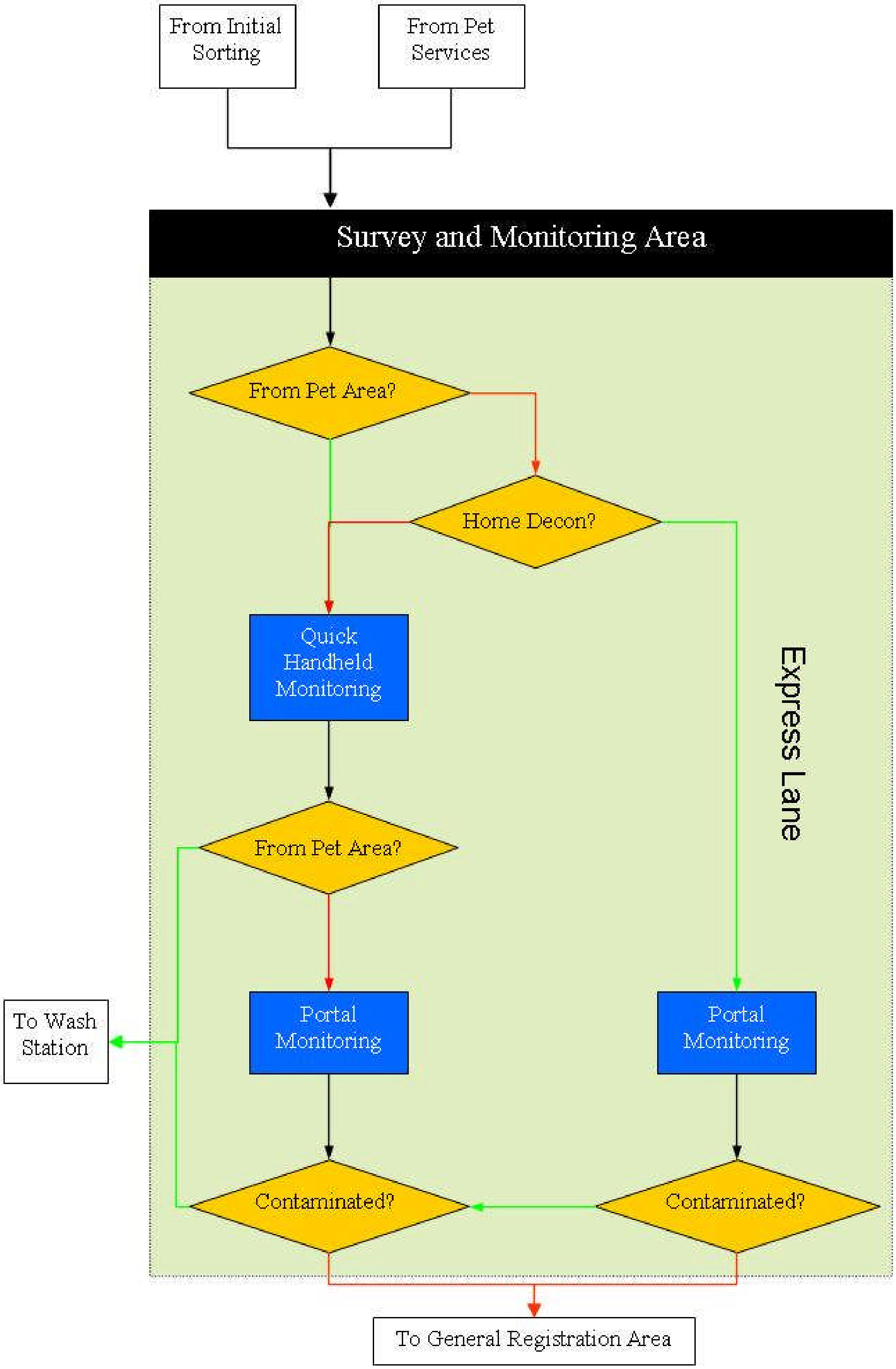
Community Reception Center Flow Diagram
Survey and Monitoring Area with Pets



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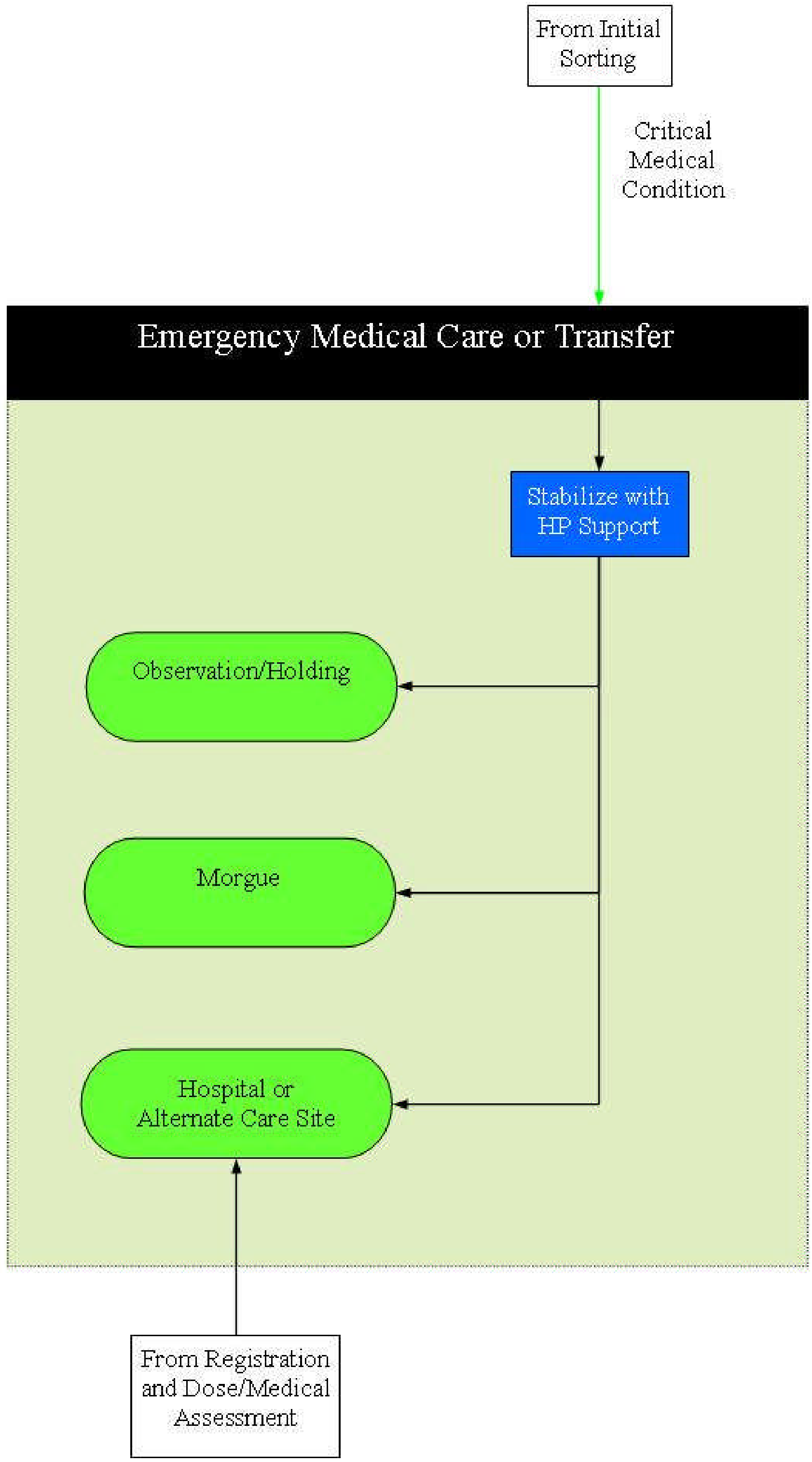
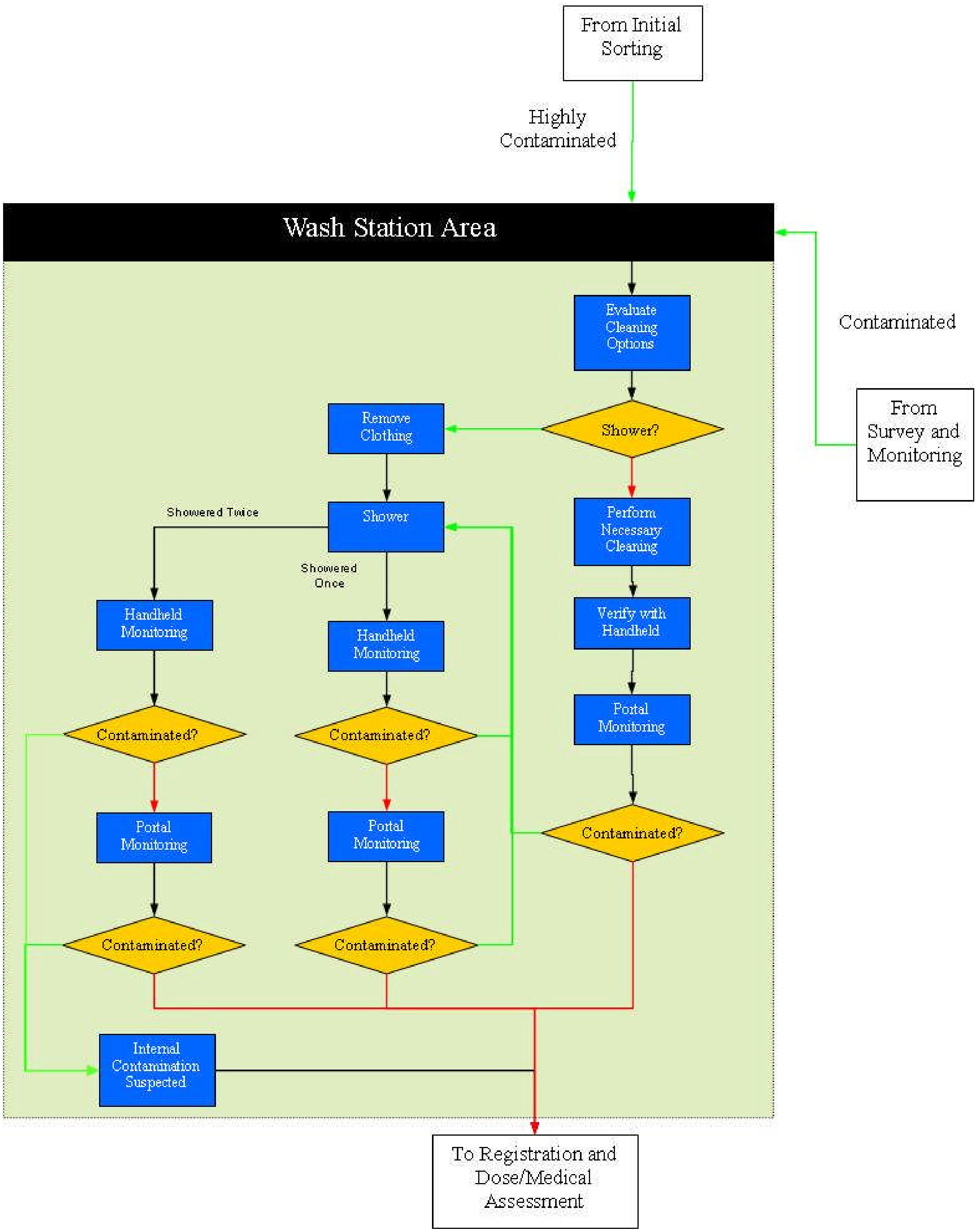
Community Reception Center Flow Diagram
Emergency Medical Care or Transfer



Community Reception Center Flow Diagram
Wash Station Area



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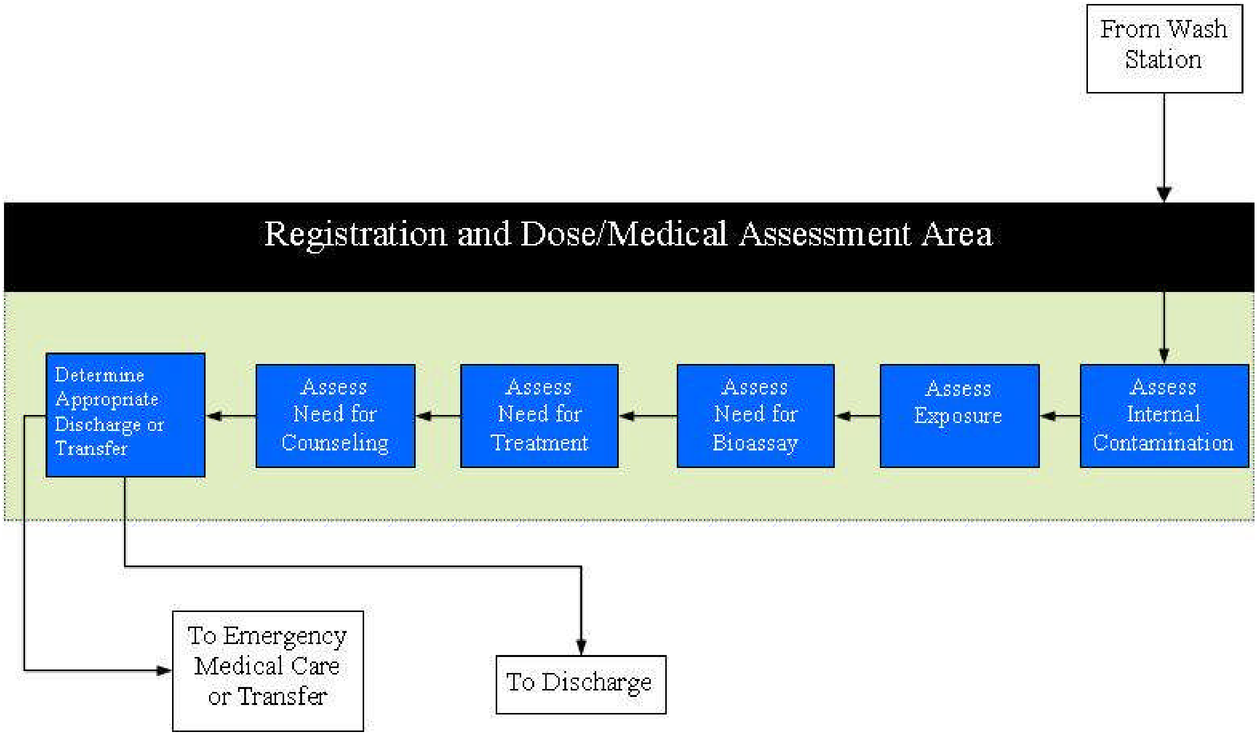
Community Reception Center Flow Diagram
Registration and Dose/medical Assessment Area



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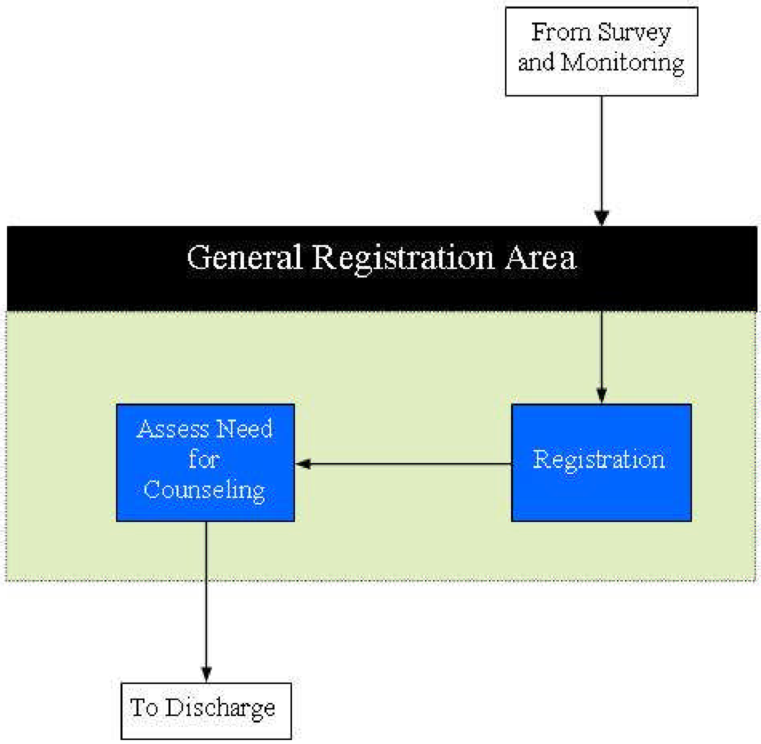
Community Reception Center Flow Diagram
General Registration Area



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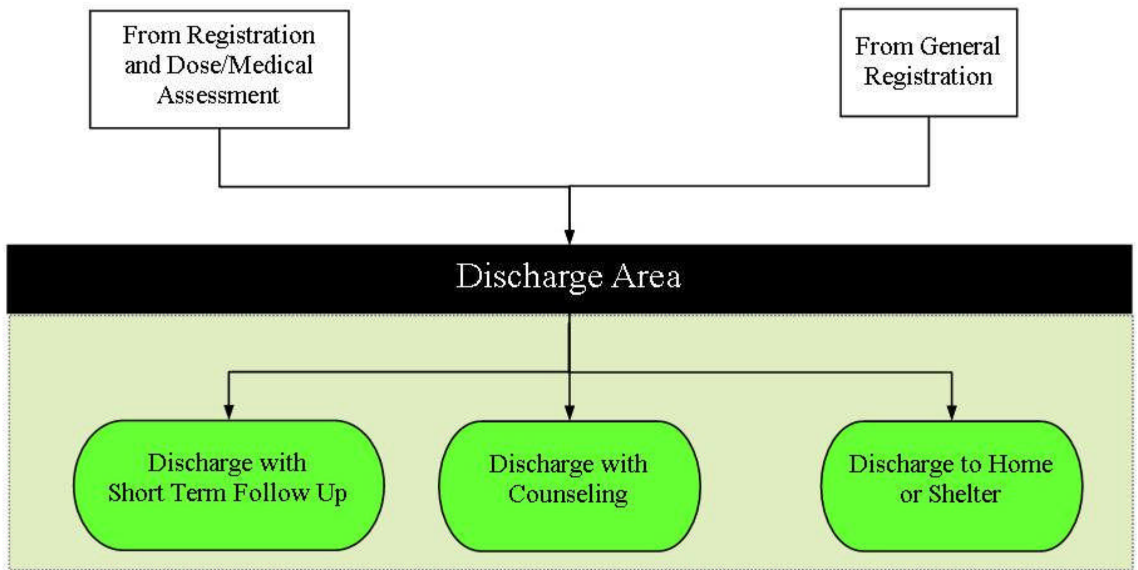
Community Reception Center Flow Diagram
Discharge Area



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Attachment 7: Definitions

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Definitions

Alpha Radiation: Radiation that travels only about an inch in air and is easily shielded by a single sheet of paper. Alpha radiation cannot penetrate the outer layers of skin and is not an external hazard. Radioactive materials that emit alpha radiation are an internal hazard if ingested or inhaled.

Beta Particles: Radiation that can travel a few yards in air and are less easily shielded with thin aluminum or glass. They can penetrate the outer layer of skin and are an external and an internal hazard.

Contamination Reduction Zone: Area in which decontamination procedures take place.

Curie: Unit for radioactivity. 1 curie = 3.7×10^{10} disintegrations per second.

Dose: Dose is a measure of the total absorbed radiation by a person.

Exclusion Zone: The area where contamination is either known or expected to occur and the greatest potential for exposure exists.

Exposure: A radiation measurement in air.

Exposure Rate: Exposure rate is a measure of how much radiation is emitted from a radioactive source or a contaminated area over a period of time. Instruments often measure exposure rate per hour.

Extreme Caution Area: Area within the Exclusion Zone with very high levels of radiation warranting extra precaution while conducting critical activities.

Gamma Radiation: Radiation that can travel many yards in air and takes thick concrete, lead or steel to shield. Gamma radiation is the same as X-rays, it's just produced in the nucleus of an atom rather than in an X-ray tube, which requires an electrical source. The radiation can penetrate through the whole body; it is an external and an internal hazard.

Neutron Radiation: Radiation that can travel many yards in air and takes very thick concrete or water to shield. The radiation can penetrate through the whole body; it is an external and an internal hazard.

Radioactive Material: A material that emits alpha, beta, gamma and/or neutron radiation.

Radiological: A general term pertaining to radiation and radioactive materials.

Radionuclide: see Radioactive Material

rem (roentgen Equivalent Man): A measure of dose to human beings.

roentgen (R): A unit for exposure rate. Many detectors read in roentgens or R per hour.

Support Zone: The uncontaminated area where workers are unlikely to be exposed to hazardous substance or dangerous conditions.

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Attachment 8: Record of Changes and Distribution

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Record of Changes

The County of Los Angeles Department of Public Health ensures that necessary changes and revisions to the plan are prepared, coordinated, published, and distributed.

The plan will undergo revision whenever:

1. An occurrence causes conditions to change.
2. New information becomes available that warrants a change.
3. Users find parts of the plan do not work well in an actual response and require incident-specific changes.
4. Exercises reveal deficiencies.
5. Local, State, or federal government structure changes.
6. Community situations change.
7. Local, State, or federal requirements change.

The County of Los Angeles Department of Public Health, will maintain a list of individuals and organizations which have controlled copies of the plan. Only those with controlled copies will automatically be provided updates and revisions. Plan holders are expected to post and record these changes. Revised copies will be dated and marked to show where changes have been made.

A “Record of Changes” form is on the following page.

Record of Changes

Nature of Change	Date of Change	Page(s) Affected	Changes Made by (Print Name and Initial)

Record of Distribution

Agency	Plan Recipient	Plan Number	Date Distributed
American Red Cross	Corey Eide	001	
California Department of Homeland Security	Elaine Jennings	002	
California Department of Public Health, Radiologic Health Branch	Gary Butner	003	
California Department of Public Health, Radiologic Health Branch	Robert Greger	004	
California Highway Patrol	Jeff Strobel	005	
California National Guard, Weapons of Mass Destruction 9th Civil Support Team	Keith Haviland	006	
California Office of Homeland Security	Bill Potter	007	
Federal Bureau of Investigation	James Peaco	008	
Federal Emergency Management Agency	Harry Sherwood	009	
Long Beach Fire Department	Steve Raganold	010	
Long Beach Police Department	John Benedetti	011	
Long Beach Port	Julio Meza	012	
Los Angeles Airport Police Department	Dennis Lau	013	
Los Angeles City Fire Department	Robert Cramer	014	
Los Angeles City Police Department	Mark Hurley	015	
Los Angeles County Coroner's Office	Renee Grand Pre	016	
Los Angeles County Department of Health Services	Kay Fruhwirth	017	
Los Angeles County Department of Public Health	Michael Contreras	018	
Los Angeles County Department of Public Health, Radiation Management Program	Kathleen Kaufman	019	
Los Angeles County Department of Public Social Services	John Cvjetkovic	020	
Los Angeles County Fire Department	Randy Alva	021	
Los Angeles County Fire Department, Health Hazardous Materials Division	Bill Jones	022	
Los Angeles County Sheriff's Department	Mick Kelleher	023	
Los Angeles Port Police Department	Martinez Fernando	024	
United States Department of Energy, Radiological Assistance Program	Mike Cornell	025	
United States Department of Homeland Security	Teresa Lustig	026	
United States Environmental Protection Agency, Emergency Response Section	Robert Wise	027	
United States Environmental Protection Agency, Radiological Emergency Response Team	Gregg Dempsey	028	
United States Coast Guard	CDR Jason Collins	029	