



THE RDD

POCKET GUIDE

THE RDD POCKET GUIDE

SUGGESTED ZONES FOR IMPACTED AREA

Assume 2 milliroentgens (mR) = 1 millirem (mrem)
1 R/h = 1000 mR/h

INCIDENT ZONES AND SUGGESTED ACTIVITIES FOR EACH ZONE DURING THE FIRST 12 HOURS

Boundary mR/hr	Incident Zones mR/hr	Activities	Total Stay Time*
Background	Uncontrolled	No restrictions. Best location for Incident Command and decontamination activities.	Unlimited
<30	Low Radiation Zone <10-100	If feasible, restrict access to essential personnel. Initial decontamination of responders should occur near outer boundary. Uninjured personnel can be directed home to shower if contamination surveying at the scene is not feasible.	Full 12 hours
300	Medium Radiation Zone 100-5000	Only authorized personnel. Personal dosimetry should be worn. Buffer zone/transition area between the high and low radiation zones. Survey people for contamination before releasing.	5 - 12 hours (12 hours for critical property and lifesaving)
1000	High Radiation Zone 1000-10,000	Only authorized personnel with specific critical tasks such as firefighting, medical assistance, rescue, extraction, and other time-sensitive activities. Personal dosimetry should be worn. Survey people for contamination before releasing.	30 minutes - 5 hours
10,000	Extreme Radiation Zone > 10,000	Located within the high radiation zone. Restricted to the most critical activities, such as lifesaving. Personal dosimetry required (one monitor for severe response is acceptable). Limit time spent in this area to avoid acute radiation sickness. Survey people for contamination before releasing.	Minutes to a few hours

*Total Stay Time is calculated by dividing total allowed dose by exposure rate. For example, if total allowed dose for lifesaving is 50,000 mrem, total stay time in a 200,000 mR/hr field is 15 minutes.
50,000 mrem = 0.25 hour (15 minutes)
200,000 mR/hr

TURN-BACK EXPOSURE RATES AND DOSE GUIDELINES

Activities	Suggested Turn-Back Exposure Rates	Guidelines for Total Accumulated Dose	Increased Cancer Risk**
Emergency worker dose limit	Follow Radiation Safety Officer Instructions	5,000 mrem**	0.5%
Non-lifesaving activities (major critical property protection)	10,000 mR/hr	10,000 mrem	1%
Lifesaving activities	200,000 mR/hr*** EXTREME CAUTION	50,000 mrem	5%

**National Council on Radiation Protection and Measurements Report No. 138.
***Note that the 5,000 mrem dose guideline represents the standard occupational dose limit for one year. The 50,000 mrem dose guideline is a level where effects from short-term radiation exposure are possible.
****Specific approval and controls required to exceed this turn-back exposure rate.

The Penetrating Ability of Radiation

FIRST RESPONDER'S GUIDE

RADIOLOGICAL DISPERSAL DEVICE

DIRTY BOMBS

The First 12 Hours

Conference of Radiation Control Program Directors, Inc. (CRCPD)
For ordering information, visit www.crcpd.org or call 800-227-6945.
CRCPD P&B 06-1

This guide is a quick reference for State and local first responders. It provides general information for use during the first 12 hours after the detonation of an explosive radiological dispersal device (RDD), also called a *dirty bomb*.

It does not attempt to address all situations, but many concepts can be applied to other types of radiation incidents. A CRCPD RDD companion handbook provides additional information including contacts. The last page of this booklet provides an area to list your contact numbers.

Law enforcement and local/State radiation control staff play a key role in response to an RDD event. It is assumed that an incident command structure has been established and its role is not discussed in this guide.

Radiation usually is measured by field survey instruments in Roentgens per hour (R/hr), milliRoentgens per hour (mR/hr), or counts per minute (cpm). It is strongly recommended that you become familiar with your radiation detection equipment prior to responding to an incident. Refer to your instrument user's manual or the CRCPD RDD handbook for additional guidance.

Remember ... Saving Lives is a Priority!

Contacts

Local/State Radiological Lead Agency _____

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Rules of Thumb

- For outdoor explosions, most of the airborne radioactive dust will have settled to the ground within 10 minutes.
- In the absence of any other information, evacuate to 500 meters (1650 feet) from the detonation site in all directions.
- Check batteries and turn on your radiation detection instrument prior to arriving at the incident scene.
- Do not plan to perform decontamination if a large number of people are affected.
- Removing outer clothing can eliminate the majority of contamination.
- For large incidents, it is not necessary to retain runoff.

Local/State Radiation Control Program should act as Radiation Safety Officer, as adjunct to the Incident Commander as defined by the National Incident Management System.

- Measure radiation levels (alpha, beta, gamma, neutron).
- Set up and verify radiation boundaries.
- Verify/redesignate contaminated areas.
- Establish dose guidelines and dosimetry.
- Identify radiotopes.
- Assist in monitoring and decontamination of noninjured victims (including first responders).
- Provide support to medical personnel.
- Provide support to Public Information Officer.

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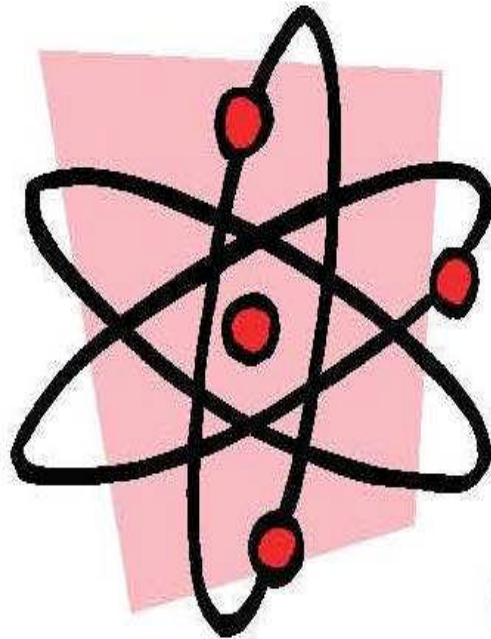
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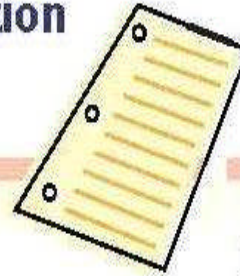
Contact your state or local radiation control program for recommended policies and procedures or if you have additional questions.

The Penetrating Ability of Radiation



Alpha

Stopped by
sheet of
paper



Loses energy rapidly.
Less likely to penetrate
skin and cause damage

Beta

Stopped by
layers of
clothing



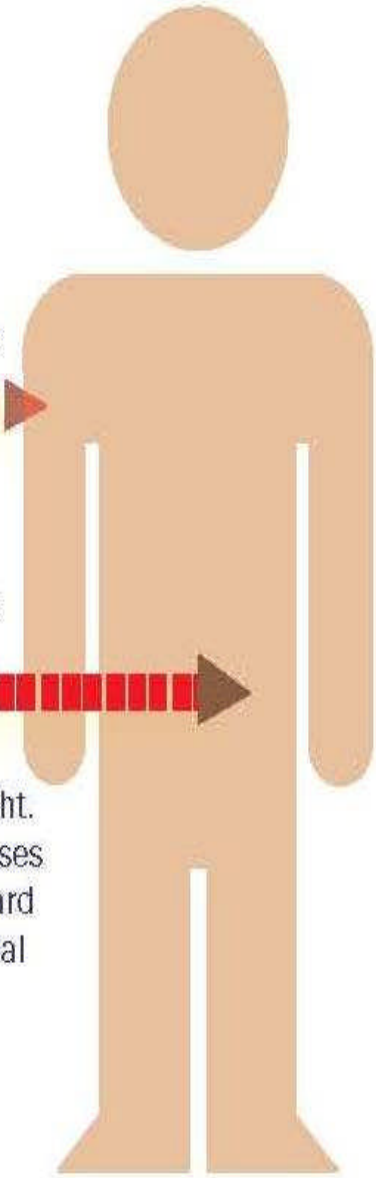
Faster, capable of
penetrating skin and
causing radiation damage

Gamma

Stopped by
several feet
of concrete
or a few
inches of
lead

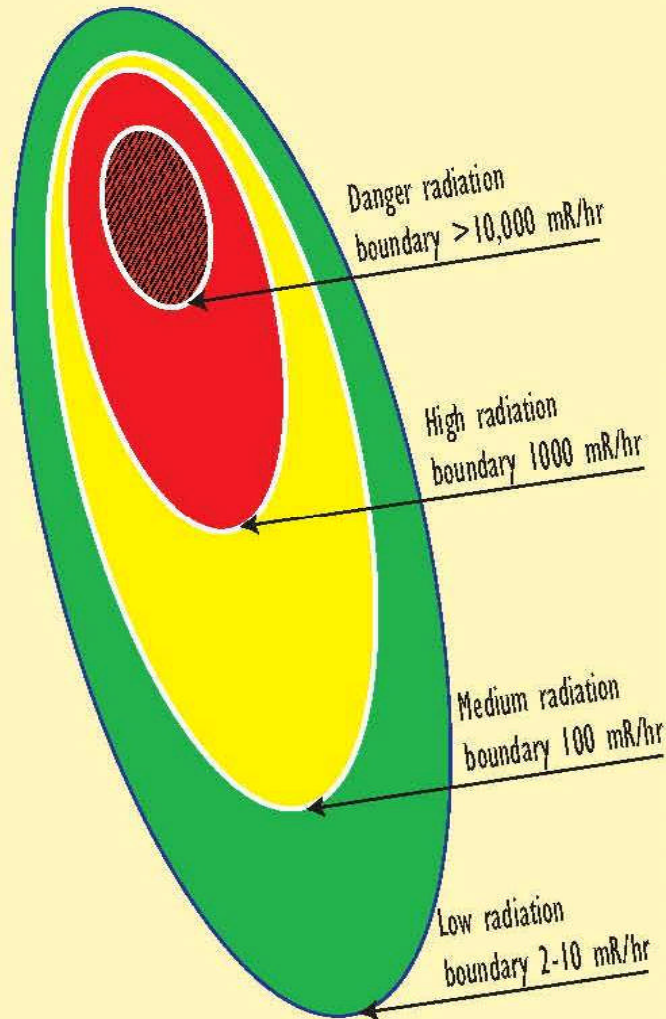


Travels at speed of light.
Very penetrating. Causes
serious radiation hazard
and damage to internal
organs



SUGGESTED ZONES FOR IMPACTED AREA

★
Incident
Command



1 R/hr = 1000 mR/hr

INCIDENT ZONES AND SUGGESTED ACTIVITIES FOR EACH ZONE DURING THE FIRST 12 HOURS

Boundary mR/hr	Incident Zones mR/hr	Activities	Total Accumulated Stay Time*
2-10	Low-Radiation Zone 2-100	Restrict access to essential personnel. Initial decontamination of first responders should occur near the outer boundary of this area. Uninjured personnel within this zone can be directed to proceed directly home to shower if resources do not permit contamination surveying at the scene.	Full 12 hours
100	Medium-Radiation Zone 100-1000	Only authorized personnel. Personal dosimetry should be worn. Survey people within this for contamination before being released.	5 - 12 hours (12 hours for critical property and life saving activities)
1000	High-Radiation Zone 1000 - <10,000	Only authorized personnel with a specific task. Personal dosimetry should be worn. Fire fighting, medical assistance, rescue, extrication, and other time sensitive activities. People within this zone should be surveyed for contamination before being released.	30 minutes - 5 hours
10,000	Danger Zone ≥ 10,000	This area of the High Zone is restricted to the most critical activities, such as lifesaving. Personal dosimetry required, although one monitor for several responders is acceptable if they remain near the person with the monitor. Limit time spent in this area to avoid Acute Radiation Sickness. Survey people within this zone for contamination before being released.	Minutes to a few hours

*Total accumulated stay time is calculated by dividing total allowed dose by exposure rate. For example, if total allowed dose for lifesaving is 50,000 mRem, total accumulated stay time in a 200,000 mRem/hr field is 15 minutes.

$$\frac{50,000 \text{ mRem}}{200,000 \text{ mRem/hr}} = 0.25 \text{ hour (15 minutes)}$$

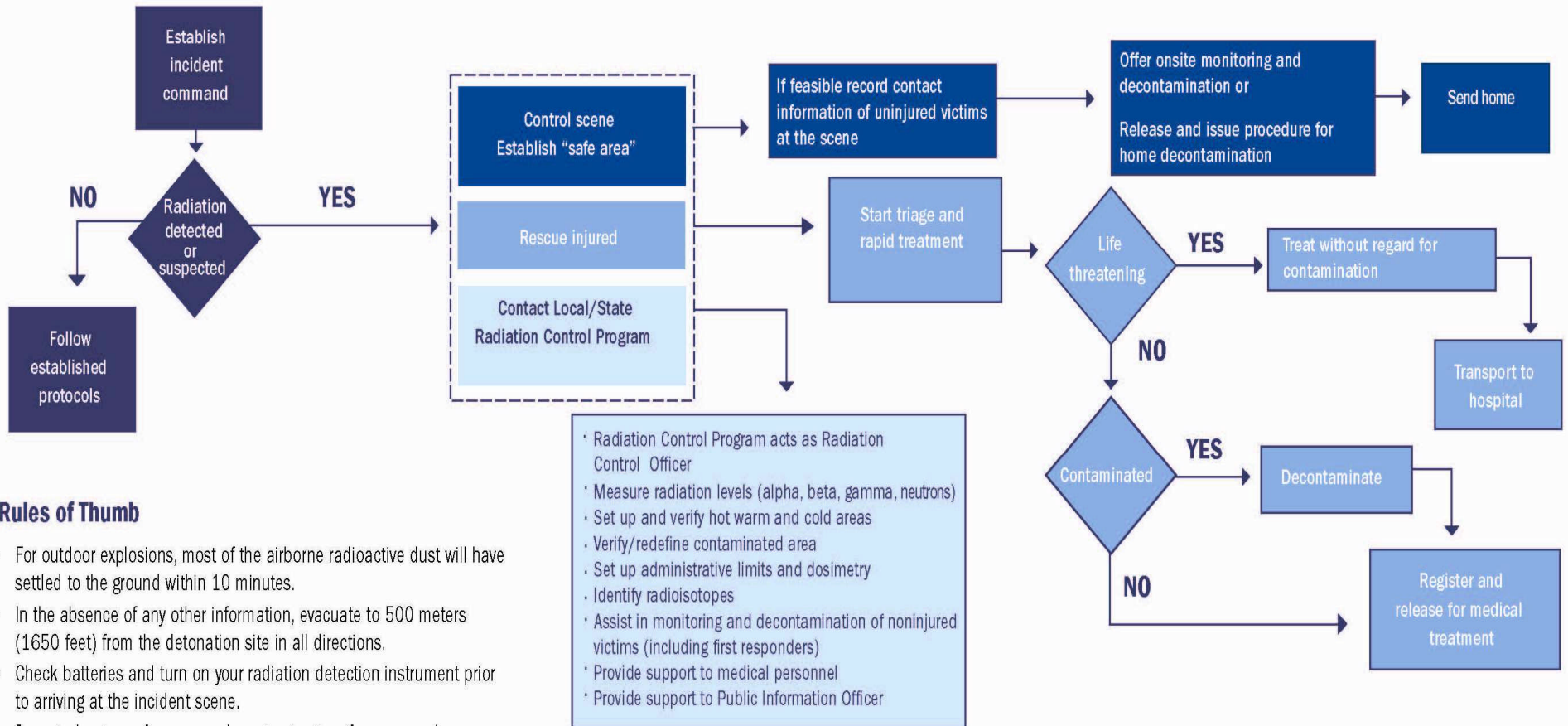
PROPOSED ADMINISTRATIVE DOSE LIMITS AND TURN BACK EXPOSURE RATES

Activities	Suggested Turn-back Exposure Rates	Guidelines for Total Accumulated Dose
Emergency worker dose limit	Follow Radiation Safety Officer instructions	5,000 mrem* (50 mSv)
Non-lifesaving activities (major critical property protection)	10,000 mR/hr HIGH RADIATION	10,000 mrem (100 mSv)
Lifesaving activities	50,000 mR/hr** DANGER	50,000 mrem (500 mSv)

* The 5000 mrem dose guideline represents the standard occupational dose limit for one year. The 10,000 mrem and 50,000 mrem dose guidelines are levels where minor effects from short-term radiation exposure are possible.

** Specific approval and controls required to exceed this turnback exposure rate.

REMEMBER ... LIFE SAVING IS A PRIORITY!





THE RDD HANDBOOK

**DEVELOPED BY THE
CONFERENCE OF RADIATION
CONTROL PROGRAM DIRECTORS
(CRCPD)**

HS/ER-2 TASK FORCE

**WITH FUNDING FROM THE
CENTERS FOR DISEASE CONTROL
AND PREVENTION
(CDC)**

What is the RDD Handbook?

- **Companion to the RDD pocket guide**
- **Developed for state and local responders who may be called upon to respond to a radiological dispersal device or “dirty bomb”**
- **Training and Reference tool for Responders**

Why did we put it together?

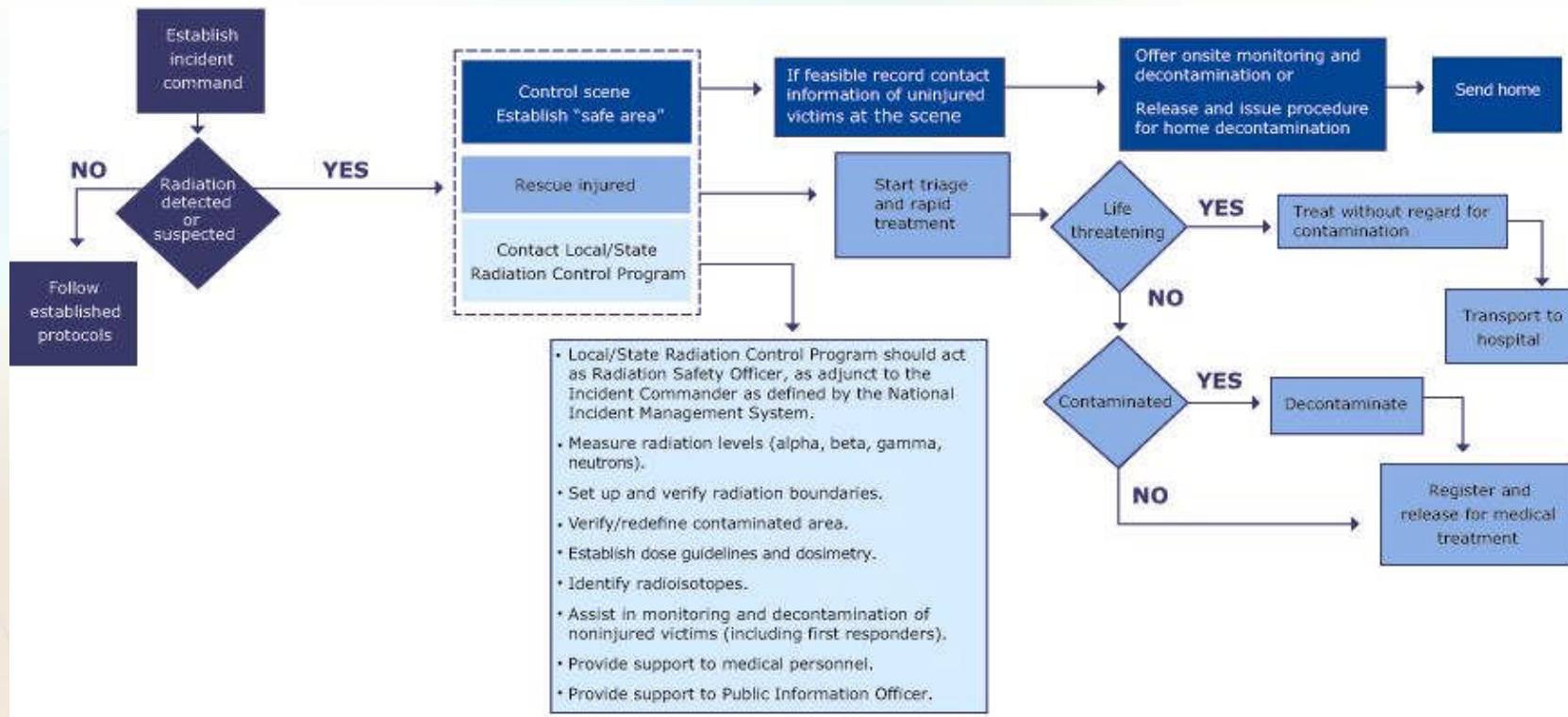
- **Ability to deal with radiological incidents at the local and state level varies across the country**
- **Some states/localities have very advanced plans (especially those that have nuclear power plants), while others do not**

Highlights of the Handbook

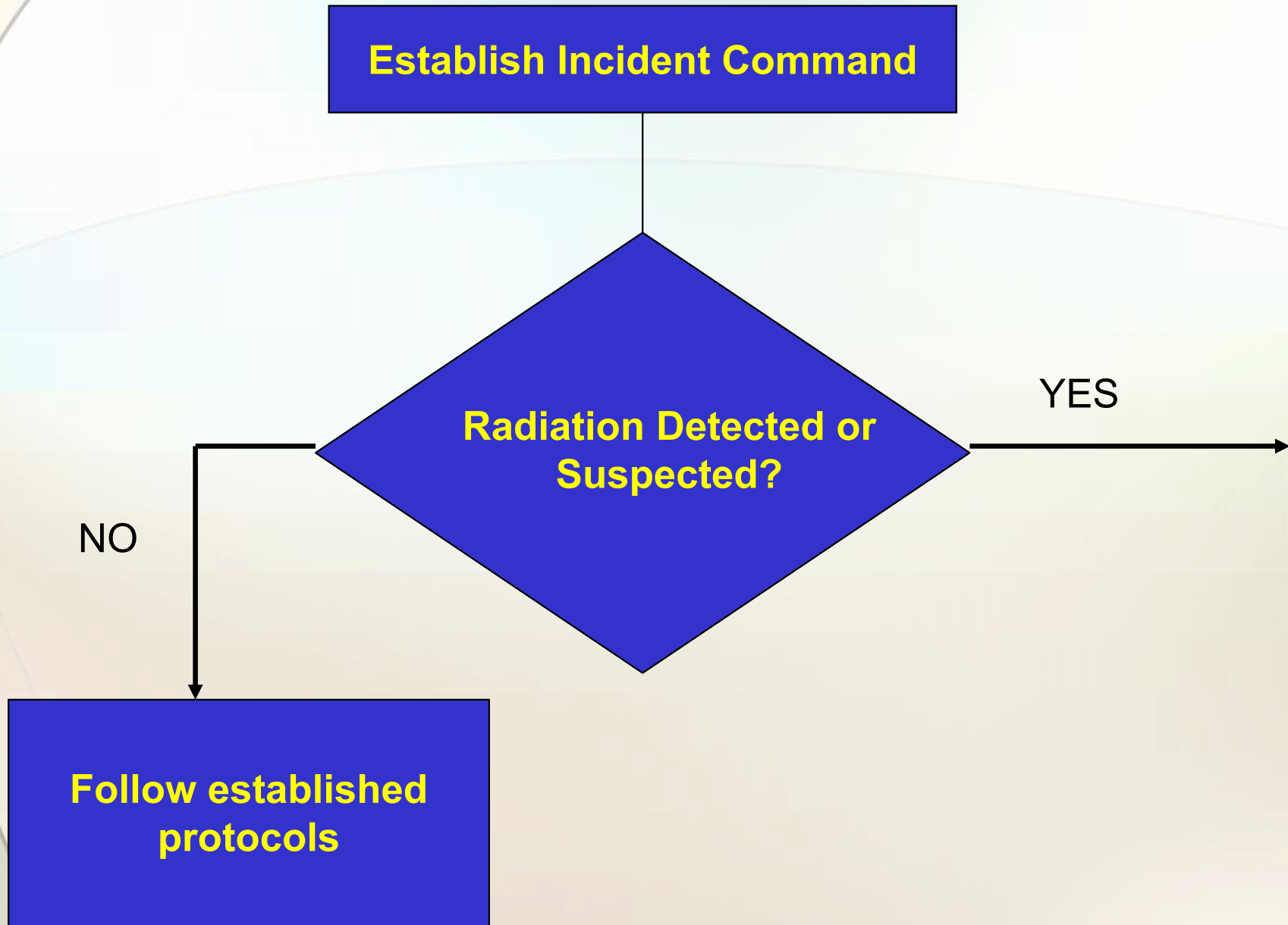
- **Flowchart**
- **Definition of Radiation Zones aka the “Bull’s Eye”**
- **Suggested Activities for each zone**
- **Turn back exposure rates**
- **Decontamination Guidelines**
- **Conducting Radiation Surveys**
- **Forms**
- **Contacts (Local/State/Federal)**

FLOWCHART OF ACTIONS

Remember ... Saving Lives is a Priority!



The Flowchart



The Flowchart

Control scene
Establish "safe area"

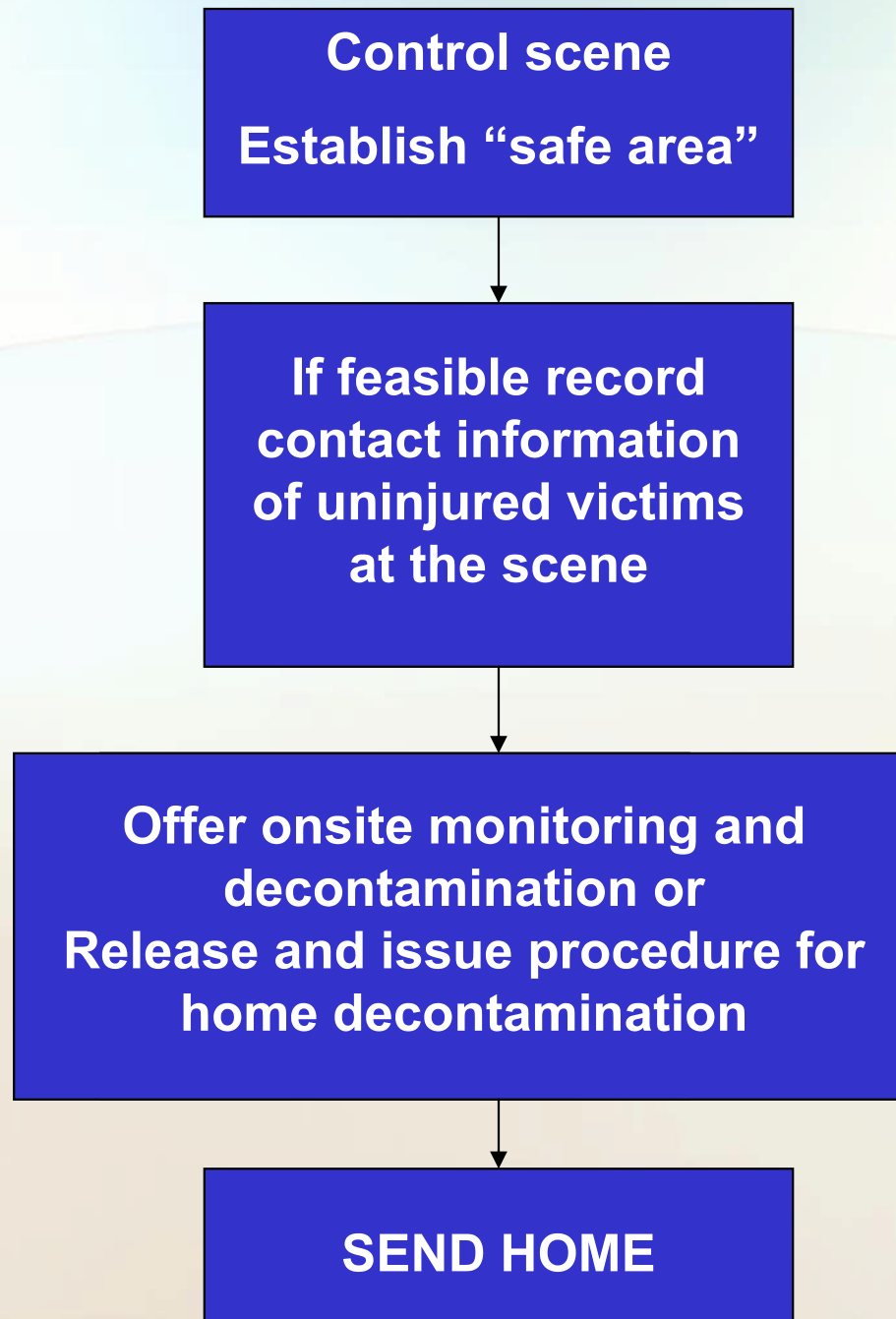
Rescue Injured

Contact Local/State
Radiation Control Program

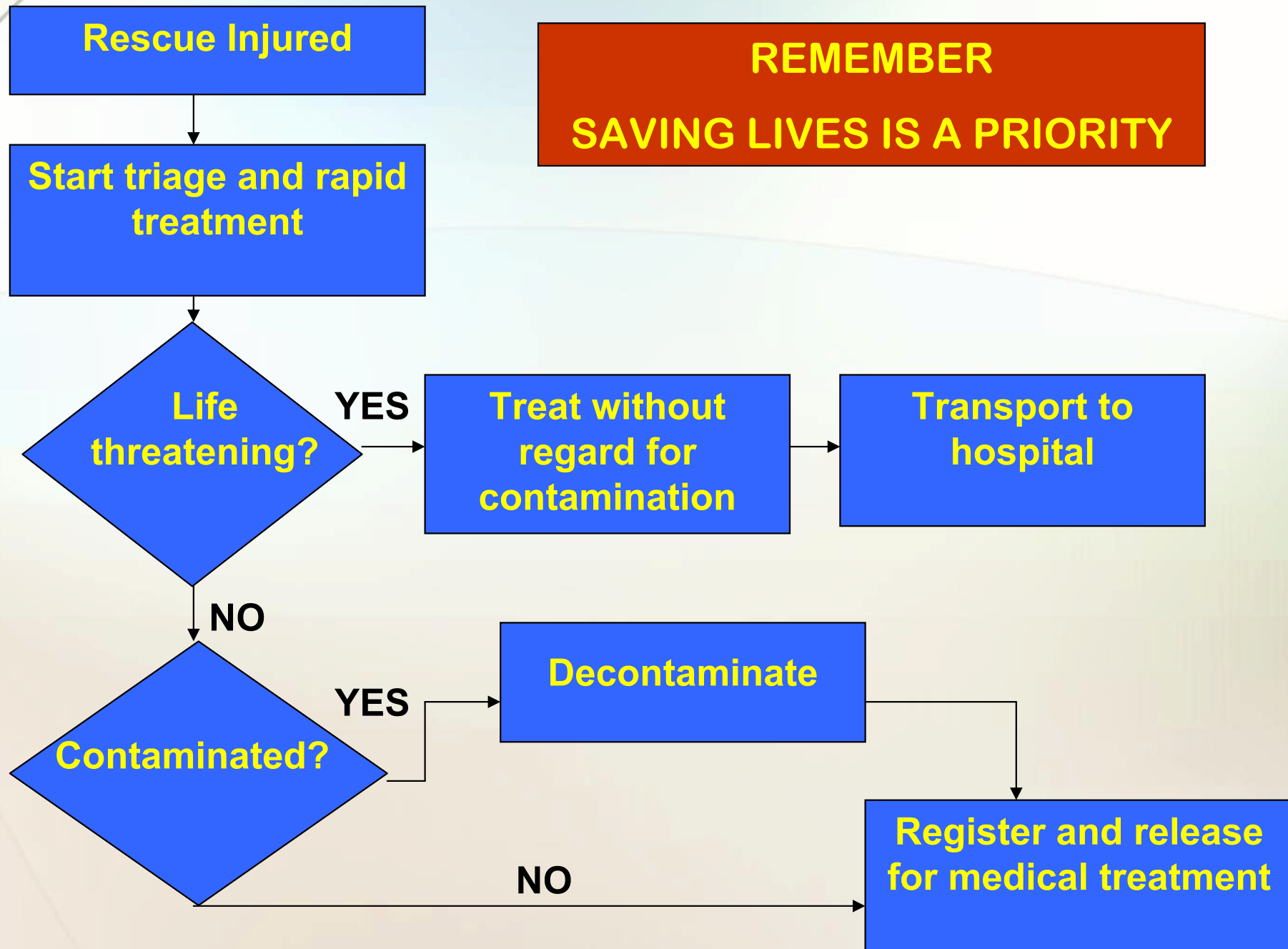
YES



The Flowchart



The Flowchart



The Flowchart

Contact Local/State Radiation Control Program

In Georgia 800-241-4113

- **Measure radiation levels (alpha, beta, gamma, neutrons)**
- **Set up and verify radiation boundaries**
- **Verify/redefine contaminated area**
- **Establish dose guidelines and dosimetry**
- **Identify radioisotopes**
- **Assist in monitoring and decontamination of victims (including first responders)**
- **Provide support to medical personnel**
- **Provide support to Public Information Officer**

Rules of Thumb:

- **For outdoor explosions, most of the airborne radioactive dust will have settled to the ground within about 10 minutes**
- **In the absence of any other information, evacuate to 500 meters (1650 ft) from the detonation site in all directions**
- **Check batteries and turn on your radiation detection instrument prior to arriving at the incident scene**
- **You may not be able to perform decontamination onsite if a large number of people are affected**
- **Removing outer clothing can eliminate the majority of contamination**
- **For large incidents, it is not necessary to retain runoff**

ESTABLISH INCIDENT COMMAND

Since ICS training is required training for first responders:

- RDD handbook assumes ICS will be established according to existing protocols**
- A staff member of the state/local radiation control program should function as the Radiation Safety Officer in the Incident Command upon arrival at the scene**

ESTABLISH INCIDENT COMMAND

- **If feasible, establish the Incident Command Post at a location upwind with background radiation levels**
- **If not feasible, use an area of less than 2 mR/hr and contamination levels < 1,000 cpm (measured 1-2 inches from the ground with a pancake probe)**
- **Check with Radiation control staff if it is necessary to establish Incident Command Post in a higher radiation/contamination area**

RADIATION DETECTED OR SUSPECTED

- **If you suspect radiation or your meter shows a positive reading (above background), assume you are in a radiation field**
- **Always believe your instrument if it tells you radiation is present**
- **Some instruments saturate (“peg”) and indicate low or no reading in a very high radiation field**
- **If possible wrap the probe and instrument with plastic wrap or place in a plastic bag (unless you are measuring alpha radiation) prior to use to minimize contamination of the instrument**

CONTROL THE SCENE AND ESTABLISH “SAFE” AREAS

- **Recommended values to be used when Radiation Control staff are not yet at the site and responders have limited instrumentation**

THESE ARE RECOMMENDATIONS !

- **Responders should consult with Radiation Control program in their state**

CONTROL THE SCENE AND ESTABLISH “SAFE” AREAS

- **Distribution of exposure levels will not be homogenous**
- **Multiple “hot” spots may be present in “low” radiation areas**
- **Deposition may be uneven, so may not be able to have well defined radiation (zone) boundaries**

CONTROL THE SCENE AND ESTABLISH “SAFE” AREAS

Radiation Area Boundaries or “Decision Points”

- **Demarcations of various radiation levels that will help define types of activities and time limits**
- **Will help prioritize activities**
- **Location and exposure rates will depend on physical size of impacted area**

NOTE: THE PROPOSED GUIDELINES FOR RADIATION EXPOSURE FOR EXPLOSIVE RDD ARE EXPECTED TO BE GREATER THAN THOSE TRADITIONALLY USED WHEN RESPONDING TO A TRANSPORTATION ACCIDENT INVOLVING RAM

Radiation Area Boundaries or “Decision Points”

- **Number of radiation zones will depend on the event**
- **For a very large area - may be difficult to set up a Low Radiation Boundary at < 10 mR/hr within a reasonable distance from epicenter of blast**

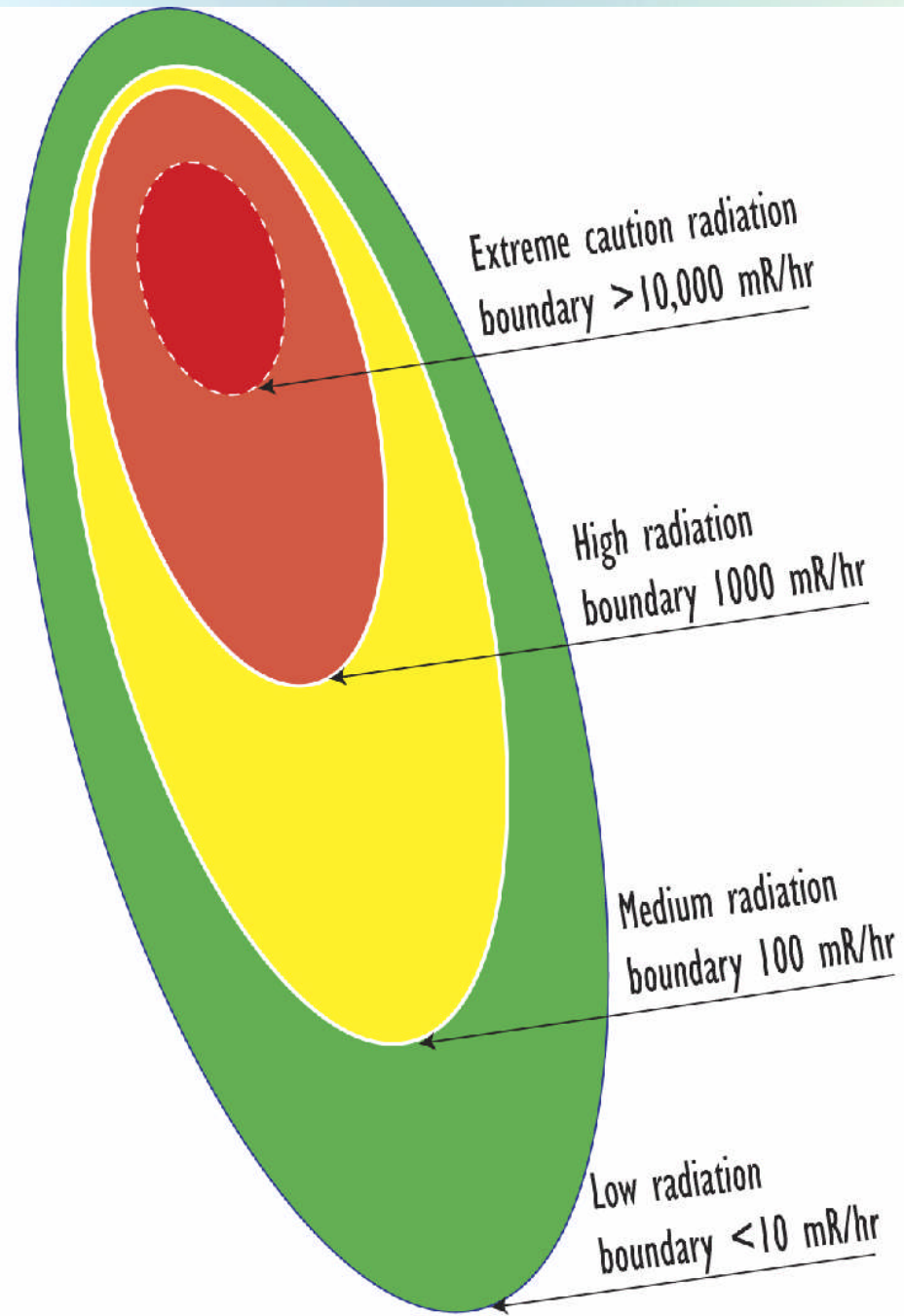
SHOULD BE SET AS LOW AS PRACTICAL

Radiation Area Boundaries or “Decision Points”

Guidance is provided for:

- **Setting Up Zones when Instrumentation IS NOT available**
- **Setting Up Zones when Instrumentation IS available**

★
Incident
Command



Radiation Area Boundaries or “Decision Points”

- Controlling radiation exposure to responders while saving lives and preserving critical properties
- Definition of “stay times”

Table 1. Radiation Zones and Boundaries

Boundary between Zones	Radiation Exposure Rates	
	mR/hr	R/hr
Extreme Caution and High Radiation	10,000	10
High and Medium Radiation	1,000	1
Medium and Low Radiation	100	0.1
Low Radiation	< 10	< 0.01

RADIATION ZONES AND SUGGESTED ACTIVITIES FOR EACH ZONE DURING THE FIRST 12 HOURS

Decision Exposure Rate mR/hr	Incident Zones	Activities	Total Accumulated Stay Time for First 12 Hours
Background	Uncontrolled	No restrictions. The best location for Incident Command and decontamination activities.	Unlimited
< 10	Low-Radiation Zone < 10 -100 mR/hr	If feasible, restrict access to essential personnel. Initial decontamination of first responders should occur near the outer boundary of this area. Uninjured personnel within this zone at the time of the RDD explosion can be directed to proceed directly home to shower if resources do not permit contamination surveying at the scene. (For RDDs containing up to ~1000 Ci, this may be the only zone that exists.)	Full 12 Hours
100	Medium-Radiation Zone 100-1000 mR/hr	Restrict access to only authorized personnel. Personal dosimetry should be worn. Serves as a buffer zone/transition area between the High and Low radiation zones. People within this zone at the time of the explosion should be surveyed for contamination before being released. (For RDDs up to ~ 10,000 Ci, this may be the highest radiation zone that exists.)	5 - 12 Hours (12 hours for critical property and life saving activities)

RADIATION ZONES AND SUGGESTED ACTIVITIES FOR EACH ZONE DURING THE FIRST 12 HOURS

Decision Exposure Rate mR/hr	Incident Zones	Activities	Total Accumulated Stay Time for First 12 Hours
1000	High-Radiation Zone 1000 - <10,000 mR/hr	Restrict access to authorized personnel with specific critical tasks such as fire fighting, medical assistance, rescue, extrication, and other time sensitive activities. Personal dosimetry should be worn. People within this zone at the time of the explosion should be surveyed for contamination before being released.	30 minutes – 5 Hours
10,000	Extreme Caution Zone = 10,000 mR/hr	This area, located within the High radiation zone, is restricted to the most critical activities, such as lifesaving. Personal dosimetry required, although one monitor for several responders is acceptable if they remain near the person with the monitor. Limit time spent in this area to avoid Acute Radiation Sickness. People within this zone at the time of the explosion must be surveyed for contamination before being released.	Minutes to a few hours

DOSE GUIDELINES

- **Ensure critical doses are not exceeded**
- **Help manage doses to As Low as Reasonably Achievable (ALARA)**
- **Seek assistance from Radiation control program staff for dose tracking**
- **Use “Turn back” exposure rates and guidelines to minimize doses**
- **Emergency worker dose limits provided for completeness**

Dose Guidelines and Turn Back Exposure Rates

Activities	Suggested turn-back exposure rates	Guidelines for total accumulated dose	Increased Cancer Risk ^{4,5}
Emergency worker dose limit	Follow Radiation Safety Officer instructions	5,000 mrem¹	0.4 %
Non-lifesaving activities (major critical property protection)	10,000 mR/hr	10,000 mrem	0.8 %
Lifesaving activities	200,000 mR/hr² Extreme Caution	50,000 mrem³	4 %

• Personnel dosimeters should be provided and used, if not enough at least one per entry team

• Follow Guidance for areas > 1 R/hr, >10 R/hr, >200 R/hr

RESCUE INJURED

ASSESS AND TREAT LIFE-THREATENING INJURIES IMMEDIATELY

- Patients with non-life threatening conditions: decontaminate (if not medically contraindicated) then treat
- Uninjured contaminated persons should NOT be directed to a medical facility.
- Externally irradiated patients are NOT contaminated. **Exposure without contamination requires no decontamination**
- Contaminated patients who do not have life threatening or serious injuries may be decontaminated onsite (or at a designated decontamination center)

DECONTAMINATION GUIDELINES

- If there is a large population to be evacuated in the *low radiation zone* (<10-100 mR/hr) self decontamination at home may be advised
- Use portal monitors if available
- If event is small, and adequate resources are available, use more restrictive guidelines
- If individuals do not require immediate medical attention - decontaminate on site or allow to go home to decontaminate

DECONTAMINATION GUIDELINES

Suggested Release Levels (pancake GM at 1 inch from source)

- Up to 1,000 cpm - allow individuals to leave; Instruct people to go home and shower**
- If event is large and adequate decontamination resources are NOT available - release level up to 10,000 cpm; Instruct people to go home and shower**
- If > 10,000 cpm - send to designated decontamination area**
- If >100,000 cpm - Likely to have internal contamination
- Priority for follow-up for internal contamination**

HOW TO PERFORM A RADIATION SURVEY FOR CONTAMINATION - INSTRUCTIONS FOR WORKERS

- **Screening Survey**
- **Complete Whole Body Survey**
- **Instructions on How to Decontaminate**

FORMS AND HANDOUTS

- **INITIAL RDD INCIDENT FORM**
- **INITIAL SITE SURVEY**
- **ICS FORMS**
- **HOW TO PERFORM A RADIATION SURVEY**
- **CONTAMINATION SURVEY SHEET**
- **HOW TO PERFORM DECONTAMINATION AT HOME**
- **INSTRUCTIONS TO THE PUBLIC WAITING FOR DECONTAMINATION**
- **SUGGESTED MASS DECONTAMINATION SUPPLIES**

APPENDICES

- **FLOW CHART (FULL SIZE)**
- **OVERVIEW OF THE TYPES OF RADIATION**
- **PRIMER ON RADIATION MEASUREMENT**
- **HOW TO DISTINGUISH BETWEEN ALPHA, BETA AND GAMMA RADIATION USING A PANCAKE GM SURVEY METER**
- **EXPOSURE VS. CONTAMINATION**
- **GUIDANCE FOR ASSESSING INTERNAL CONTAMINATION**
- **HEALTH EFFECTS OF RADIATION EXPOSURE**
- **ACCUTE RADIATION SYNDROME**
- **STATE AND LOCAL RADIATION CONTROL PROGRAM CONTACTS**
- **FEDERAL RADIATION CONTROL PROGRAM CONTACTS**
- **SUGGESTED INTERNET SITES FOR ADDITIONAL INFORMATION**
- **ACKNOWLEDGEMENTS**
- **GLOSSARY**

The RDD Handbook

- **Does NOT apply to all situations but many of the concepts can be applied to other radiation incidents**
- **Assumes that all responders are familiar with ICS**
- **Does NOT include IND response**