

**FIRE CHIEFS ASSOCIATION DELAWARE COUNTY, OHIO  
STANDARD OPERATING GUIDELINE**

<b>SUBJECT</b>	<b>EFFECTIVE DATE</b>	<b>RESCINDS</b>
Canberra Radiological Detector	August 17, 2011	N/A
<b>REFERENCE NUMBER</b>	<b>PAGES</b>	
<b>DCFC-015</b>	<b>14</b>	

**SCOPE:**

The SOG is for all actual, suspected or potential radiological responses in Delaware County. The SOG is designed to facilitate a standardized response and use of the Canberra Radiological Detectors.

**PURPOSE:**

- To familiarize personnel with the CANBERRA UltraRadiac™ Personal Radiation Detector (PRD).
- To provide directives for daily operational checks to be performed by personnel.
- To provide action guidelines for use of the UltraRadiac™ PRD in the field.

**DEFINITIONS:**

- **Dose** The total amount of radiation received. Also called Accumulated Dose.
- **Dose Rate** The average rate (in time) of radiation exposure; e.g., Roentgen per hour (R/hr). Also called Rate
- **Gamma** One of the three types of natural radioactivity; unlike alpha and beta radiation, which are particles, gamma radiation is electromagnetic radiation (like X-rays or microwaves). Gamma rays are a most energetic and far-reaching form of electromagnetic radiation, with a very short wavelength Personal Radiation Detector (PRD)
- **Rate** The amount of radiation measured by the UltraRadiac™ every 2 seconds, then extrapolated to and displayed as units per hour
- **Roentgen** Unit of radiation exposure (R); directly proportional to **rem** (Roentgen equivalent man) which measures the biological danger of absorbed radiation
- **Stay Time** How much time remains, at the current Dose Rate, before the High Dose Alarm is triggered. (If the Dose Rate goes up, remaining Stay Time will go down.)

**GUIDELINE:**

The potential threat of a radiological terrorism incident requires that first responders be equipped with a radiation monitor designed to address the radiation hazards they may face. CANBERRA's UltraRadiac™ Personal Radiation Detector (PRD) is being assigned to fire/EMS departments as a small, rugged, simple-to-operate radiation monitor that measures and displays both the instantaneous radiation dose rate, and the total dose that is received. Alarms are annunciated by a flashing display and loud audible signal when set dose rate or total dose alarm levels are exceeded. These thresholds are pre-set by the

Delaware County Office of Homeland Security and Emergency Management (EMA) prior to distribution and are determined by the Hazardous Materials Response Guidelines. It is suggested that they **NOT** be reprogrammed.

There are two separate alarm levels for both dose rate and total absorbed dose. The first alarm (Low Level Alarm) is set at a level somewhat above natural background to alert personnel that abnormal radiation is present. The second alarm (High Level Alarm) is set at a higher level, indicating the barrier between the hot and warm zones. The PRD also has a “stay time” feature that shows personnel how much time (at the current dose rate) he/she can remain in place before the high dose alarm is reached.

All Departments have been issued a UltraRadiac™ by EMA. Spare units will be acquired to back-up frontline units not passing the Daily Operations Check discussed below (contact EMA). Action guidelines for when and where to power on the PRD are discussed below.

**Other specifications:**

- Gamma detector only – will not detect alpha or beta radiation
- Detection range of 1  $\mu$ R/hr – 500 R/hr (dose rate) and 0.1  $\mu$ R to 999 R (total dose)
- Low Rate Alarm set at 100  $\mu$ R/hr
- High Rate Alarm set at 2.00 mR/hr – **Barrier between the Hot and Warm Zone**
- Low Dose Alarm set at 500 mR – **1/10 Occupational Exposure Range**
- High Dose Alarm set at 2.50 R – **1/10 Life Saving Limit**
- Unit has an initialization time of less than 5 seconds
- Four AAA 1.5V alkaline batteries will provide 150 hours of continuous monitoring
- Low battery indication is triggered when remaining battery life is approximately 10 hours
- Unit is immersible to 3 ft and can be technically decontaminated
- Unit is NOT intrinsically safe

## BASIC FUNCTIONS

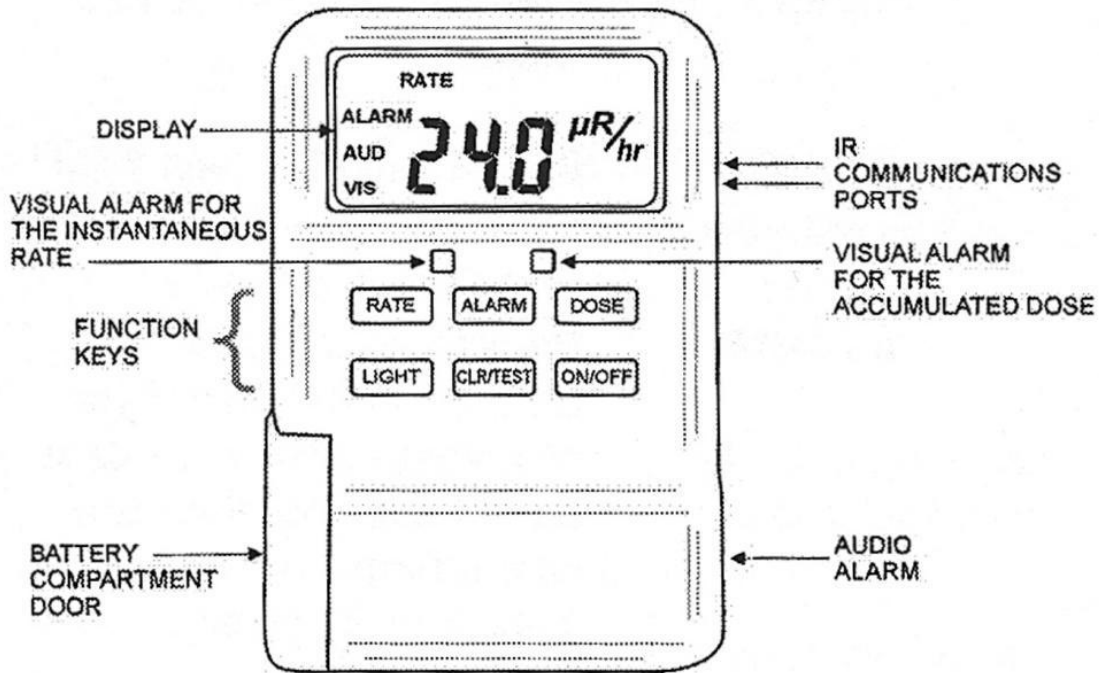


Figure 1 – The UltraRadiac™ Front Panel

### The Function Keys

- **ON/OFF** Press and hold to turn the unit on or off.
- **DOSE** Press to change to the Dose Mode (default ON mode is RATE). Current accumulated dose is displayed in R.
- **RATE** Press to change to Rate Mode from Dose Mode. Current Rate is displayed in R/hr.
- **ALARM** Press to see the Stay Time, the number of minutes you can safely stay in the area at the current Dose Rate.
- **LIGHT** Press to illuminate the display for about 5 seconds.
- **CLR/TEST** In the Rate Mode, press and hold to enable the Display Test Sequence (see Daily Operational Check).

### Battery Life Indicators

- If a blinking *b* is displayed, the unit has stopped functioning. Replace the batteries before the unit's next use.
- If a blinking *BAT* is seen in the top-left corner of the display, the unit's batteries have 10 hours or less of useful life. Replace the batteries as soon as possible.
- If the display is blank, the batteries are dead. Replace the batteries before the next use.
- In the Rate mode with the *BAT* indicator blinking, press the CLR/TEST key. A three-digit number indicating the approximate remaining battery life, in minutes, will be displayed.

- **NOTE:** When replacing batteries at any time, be sure to turn the unit off first!

### **DAILY OPERATIONAL CHECK**

Periodic maintenance and calibration of the UltraRadiac™ PRD will need to be handled by the fire department. It is suggested that the units be calibrated once every two years. The calibration can be handled by the Ohio Radiological Instrument Maintenance Calibration (RIMC) Lab at a low cost. It is suggested all departments perform weekly (at the minimum monthly) operational checks on the units assigned to them.

1. Check the calibration due date. If calibration is within 30 days of expiration, coordinate with Ohio EMA Radiological RIMC for re-calibration.
2. Perform a visual inspection. Remove dust, moisture, loose dirt from outside surfaces of the unit with a clean, soft cloth. If necessary, the unit may be cleaned with a mild solution of ordinary detergent and water, rinsed, and thoroughly dried.
3. Press and hold the ON/OFF key until the display appears, and release the key.
  - The Rate Mode should appear, with the word *RATE* shown at the top left of the screen (Figure 2).

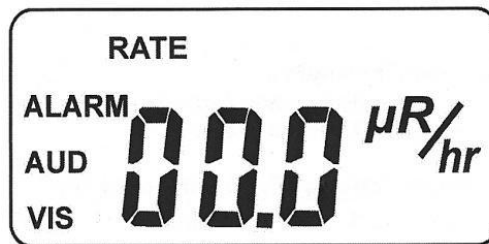


Figure 2 – The Rate Display

- *AUD* and *VIS* indicate that the Audio and Visual alarms are both enabled.
- The unit will start counting and displaying the instantaneous Rate. Naturally occurring background radiation will cause the unit to display a low reading.
- Press the DOSE key to switch to Dose Mode. The Dose Mode should appear, with the word *DOSE* shown at the top left of the screen (Figure 3)

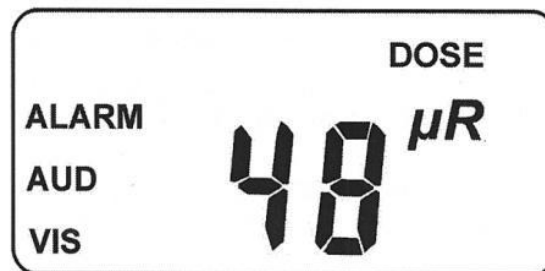


Figure 3 – The Dose Display

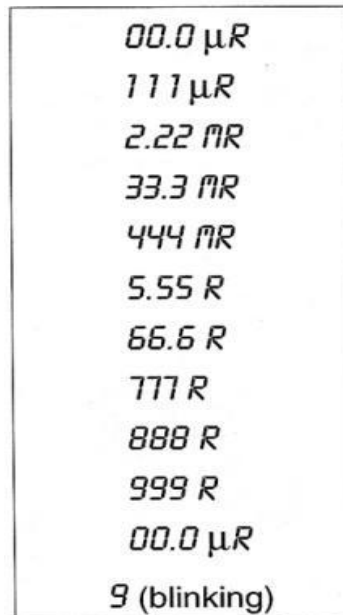
- Press the RATE key to switch to Rate Mode.

- While in Rate Mode, press and hold the CLR/TEST key until you see the test display in Figure 4 (approximately 4 seconds), and release the key.



Figure 4 – The Test Display

- A set of numbers in the following order will appear. Check that all of the numbers are exactly as shown in Figure 5.



- At any time during the CLR/TEST sequence of numbers:
  - Press the RATE key – the audio alarm should sound and the Rate LED (left one below the display) should turn on.
  - Press the DOSE key – the audio alarm should sound and the Dose LED (right one below the display) should turn on.
  - Press the ALARM key – the audio alarm should sound and both LEDs should turn on.
  - The blinking 9 indicates that the unit passed all self-tests. A blinking 0 indicates a failure; contact EMA immediately to arrange replacement.
  - Press the CLR/TEST key to return to Rate Mode (or wait about 10 seconds).
- Press the LIGHT key; the display's backlight will turn on for about 5 seconds.

4. **IMPORTANT**: Clear the accumulated dose before each use! Press and hold DOSE + CLEAR/TEST. The display will flash for a few seconds, then clear any accumulated dose. Return to the Rate Mode by pressing the RATE key.
5. Press and hold the ON/OFF key.
  - OFF will be displayed.
  - - - - will then be displayed. Release the ON/OFF key; the unit will power off.

### **ACTION GUIDELINES**

**NFPA 472**, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, was changed for 2008 to include new skill requirements for Operations-level personnel. While basic core competencies were not changed, a new mission-specific menu of objectives has been added, including air monitoring and sampling, evidence preservation and sampling, and victim rescue and recovery. The new standard and its mission-specific competencies address what the fire service has already found to be true: Operations-level personnel will fill in where possible and do what must be done when Technicians are not available.

The UltraRadiac™ gives Operations-level personnel an additional tool to not only facilitate better recognition of radiological incidents, but to enhance Operations-level participation in monitoring radiological incidents, making the scene safer for both Operations- and Technician-level personnel. Operations-level first responders – the most likely to diagnose a radiological terrorist/WMD event – will need to provide initial information about the radiation characterization of the incident site, as well be able to determine for themselves safe routes of travel to victims or fires.

Any unexplained detonation shall be considered a potential terrorist event utilizing a radiological dispersal device. Place, time, occupancy, and other clues to the origin of an explosion will determine Operations-level approaches to the response. Obviously, a car fire on the freeway would be considered an explained event and not necessitate the use of the PRD; a car bomb in front of a government building would be suspicious and require the use of the PRD when approaching the incident.

While on day-to-day business, leave the PRD in the apparatus with power off. Power on the PRD, clear any accumulated Dose, and monitor the units from the apparatus when:

- **Responding to unexplained detonations (assume RDD) or any other inexplicable circumstances: USE COMMON SENSE**
- **Responding to known HazMat incidents or to known hazard sites (hospitals, cancer-care units, industrial sites, universities, etc.)**
- **Elevated Threat Level (local/national)**
- **Directed by the Chief of the Department**

When the UltraRadiac™ is deployed, crews will employ a process of:

- **DETECT** elevated radiation levels
- **VERIFY** the radiation alarm

- **LOCALIZE** or narrow down the radioactive field or source material
- **MEASURE** the radiation level

### **Detect**

Detection begins when any of the radiation alarms on the PRD are triggered. Average background radiation is 5 – 25  $\mu\text{R/hr}$ . The Low Level Rate Alarm for all units is set at 100  $\mu\text{R/hr}$ . Note that this is still an exceedingly small amount of radiation: 250,000 times less than the rate at which a stay time of an hour would result in exceeding the life-saving limit (25 R). See Appendix I for an explanation of metric prefixes, and Appendix II for time/dose equivalents. A Low Level Rate Alarm indicates the abnormal presence of some radiation. Units should observe their surroundings (location, occupancy, event, anything that is out of place). Acknowledge the alarm and note the Rate reading.

### **Verify**

Move in a direction that allows the UltraRadiac™ to fall below the Low Level Rate Alarm (100  $\mu\text{R/hr}$ ). Return to the original area and observe if the instrument goes back into alarm. A repeat measurement with the same or other instrument is a positive indication that there is a real increase in radiation. Further investigation will be required. Again consider your surroundings:

- Could there be a legal process for using a radioactive source (e.g. hospitals, labs, medical treatment centers)?
- Is it a high value target (e.g. event with large group of people or dignitaries, government building)?
- Is there anything out of place (e.g. large, unplacarded vehicles, unattended packages)?

A verified Low Level Rate Alarm (100  $\mu\text{R/hr}$ ) indicates an abnormal presence of radiation. If no legal explanation exists, contact DELCOM via radio for a HAZMAT Response.

Verbalize the Rate readings and suspected threat in the initial report. Also request Police to your location. If possible, verify with a different instrument on hand such as the CDV-700 (Civil Defense Instruments).

If initial readings send the PRD into High Rate Alarm (2 mR/hr) immediately, contact DELCOM via radio for a HAZMAT response and provide the Rate readings and suspected threat in the initial report. Radiological responses should also notify the Ohio Department of Health. Each unit has a “cheat sheet” that describes many of these processes as well as contact phone numbers.

### **Localize**

A verified alarm requires further investigation. Recall that the Low Alarm for the UltraRadiac™ is set at 100  $\mu\text{R/hr}$ . Incident Commanders must take into account readings with time spent on-scene to ensure minimal dose is received and that operational guidelines are not exceeded. Delaware County does not have a defined turn back value

(see page 41 of reference 3) and any value defined as a turn-back value should be created by the IC. Note for the operations level firefighter that your primary use of the PRD is to further your tactical objectives (victim rescue, fire suppression, etc.) by determining safe routes of travel through a possible radiation field; NOT to become Technician-level identifiers or mitigators.

The UltraRadiac™ has a response time of about 2 seconds. By slowly sweeping the unit left to right, up and down, and around, pausing every few feet or so for 2 seconds, crews will be able to “hone in” on the source. Caution must be taken to give the unit time to catch up to your forward motion. Crews should attempt to use command boards or paper and pencil to keep records of their progress. Use as much detail as possible to map your immediate environs. Keep in mind it does detect Beta radiation. Sweeping surveys for both Gamma and Beta radiation can be conducted utilizing the Civil Defense Instruments (CDV-700) with the headphones attached for better response.

The result of the localization process is the approximate direction towards the radioactive material. In this fashion, “safe corridors” to victims can be mapped out, as well as providing valuable information about the point origin of the radioactivity, dissemination of the radioactivity, and contamination of the surrounding area. Remember that you can move forward toward the source in this fashion until you begin achieving dose limits determined by the IC. Delaware County utilizes the Hazmat IQ system in that radiological readings are considered “red-light” indicators. Our training allows us to bypass “red-lights” in life safety situations.

### **Measure**

As measurements are taken, describe the location in enough detail to be able to relocate the suspected source or general area.

- Take readings with the PRD positioned as close as possible to the suspected source. Note your distance from the suspected source (person, package, vehicle, building, object).
- Always remember to record the units of the reading (R/hr, mR/hr, R/hr). This is very important for later reckoning of absorbed doses. If utilizing the CDV-700 as verification, give the reading and the scale multiplier used. Let others do the math for you while you are in an abnormal situation.
- If possible, and allowed by Rate guidelines as determined by the IC, take a reading at the distance of one meter from the suspected source and record the results. Try to attain readings from more than one direction near the source.

### **Do not attempt to measure under the following circumstances:**

You achieve Rate readings greater than those established by the IC; consider your tactical objectives – if only in survey mode (plumbing job-Hazmat IQ), turn back

- Any High Alarm is activated
- The Gamma Detector Overload message (- - -) appears on the screen
- Undetonated explosives are suspected
- Loose, spilled, or leaking material is observed.

If you are unable to measure due to above conditions, report the following to the HazMat team and retreat to a safe location:

- Highest Rate reading
- Approximate location where the reading was taken
- Approximate distance from the suspected source where the reading was taken
- Description of the suspected source, including markings, labels, dimensions, color, etc.

**Important Note:** The new NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, allows for Operations-level personnel to work in the Hot Zone to achieve important tactical objectives such as saving lives. Crews now have the PRD to further guide them toward completion of those objectives. While crews are directed to not go beyond the threshold the IC sets while surveying, life-safety operations and other high-value mission-specific objectives can still be performed at higher rates with commonsense precautions. The IC must be kept informed of the situation, rad levels, victim numbers/conditions, as well as other pertinent information to adequately make good decisions to change rate or dose limits. OSHA specifies the following exposure limits for emergency workers in radiation fields:

- 5 rem any work
- 10 rem to protect property
- 25 rem to protect life (exceeded voluntarily with knowledge of risks)

Crews are directed to use the Dose function of the PRD to monitor their accumulated dose while operating in fields beyond the High Rate Alarm and performing high-value tactical objectives. Members must remain physically proximal to each other for the PRD's readings to apply to the entire crew. Crews must at all times practice the ALARA Principle (As Low As Reasonably Achievable) and at no time should crews exceed the OSHA exposure limits for life safety actions (25 rem). By monitoring with the PRD for lower-rate pathways through a radiation field, crews can significantly and positively influence the outcomes of a significant event.

ALARA can be achieved by:

- Maintain distance from sources of radiation
- Shield the radiation source
- Minimize the time spent in the contaminated area (e.g., rotation of personnel)
- Use dosimetry for knowledge of current amount received
- Properly select and use respirators/SCBAs and other PPE appropriate for minimizing dose to internally deposited radioactive materials.

Medical issues take precedence over radiological issues. Treat the patient to ensure stabilization of the patient (See Appendix IV)

## **CONCLUSION**

The CANBERRA UltraRadiac™ is just one more tool to aid responders while safely performing their duties at emergency scenes. As with any other operation, no one tool can replace common sense and judiciousness. Understanding the abilities and the limitations of the PRD will help responders make wise decisions when dealing with a radiological event. Performing the operational checks and regularly practicing with the UltraRadiac™ will foster familiarity with the instrument, familiarity that will be of great use should responders be called upon when responding to an actual incident.

## **APPENDICES**

### **Appendix I : Metric Prefixes**

A metric prefix is a modifier on the root word to tell us the unit of measure. For example, milligram (mg) means we are counting in steps of one one-thousandth of a gram and microgram ( $\mu\text{g}$ ) means millionths of a gram. Note that numbers we generally deal with in the macroscopic world reside in  $10^{-6}$  to  $10^6$ . Units used in this training guide can be viewed as:

<b>Prefix</b>	<b>Symbol</b>	<b>Numerical Multiplier</b>	<b>Exponential</b>
<b>kilo</b>	<b>k</b>	<b>1,000</b>	<b><math>10^3</math></b>
<b>No prefix</b>		<b>1</b>	<b><math>10^0</math></b>
<b>centi</b>	<b>c</b>	<b>0.01</b>	<b><math>10^{-2}</math></b>
<b>milli</b>	<b>m</b>	<b>0.001</b>	<b><math>10^{-3}</math></b>
<b>micro</b>	<b><math>\mu</math></b>	<b>0.000001</b>	<b><math>10^{-6}</math></b>



**Appendix III : Average Annual Absorbed Dose From Naturally-Occurring  
And Man-Made Sources**

To put radiation exposure in perspective, consider some sources that everyone is exposed to, year after year:

Smoke detectors	0.008 mrem (8 $\mu$ rem)
LCD wristwatch	0.06 mrem (60 $\mu$ rem)
Porcelain crowns/dentures	0.07 mrem (70 $\mu$ rem)
Jet plane travel	0.5 mrem per hour in air (Seattle to NY ~ 3.4 mrem)
Computer screen/TV	1 mrem
X-ray (extremities)	1 mrem
X-ray (chest)	6 mrem
Stone, brick, concrete	7 mrem
Cosmic space radiation	26 mrem
Food and water	40 mrem
Terrestrial radiation (Continental US)	63 mrem
X-ray (pelvis)	65 mrem
Naturally-occurring radon	200 mrem (0.2 rem)
X-ray (Upper GI)	245 mrem (0.245 rem)
Cigarettes (1 pack per day)	1300 mrem (1.3 rem)

The average annual dose per person from just environmental sources is about 360 mrem per year, 81% of which comes from natural sources of radiation. It is not, however, uncommon for persons to receive far more than that in a given year (largely due to medical procedures such as X-rays and CAT scans).

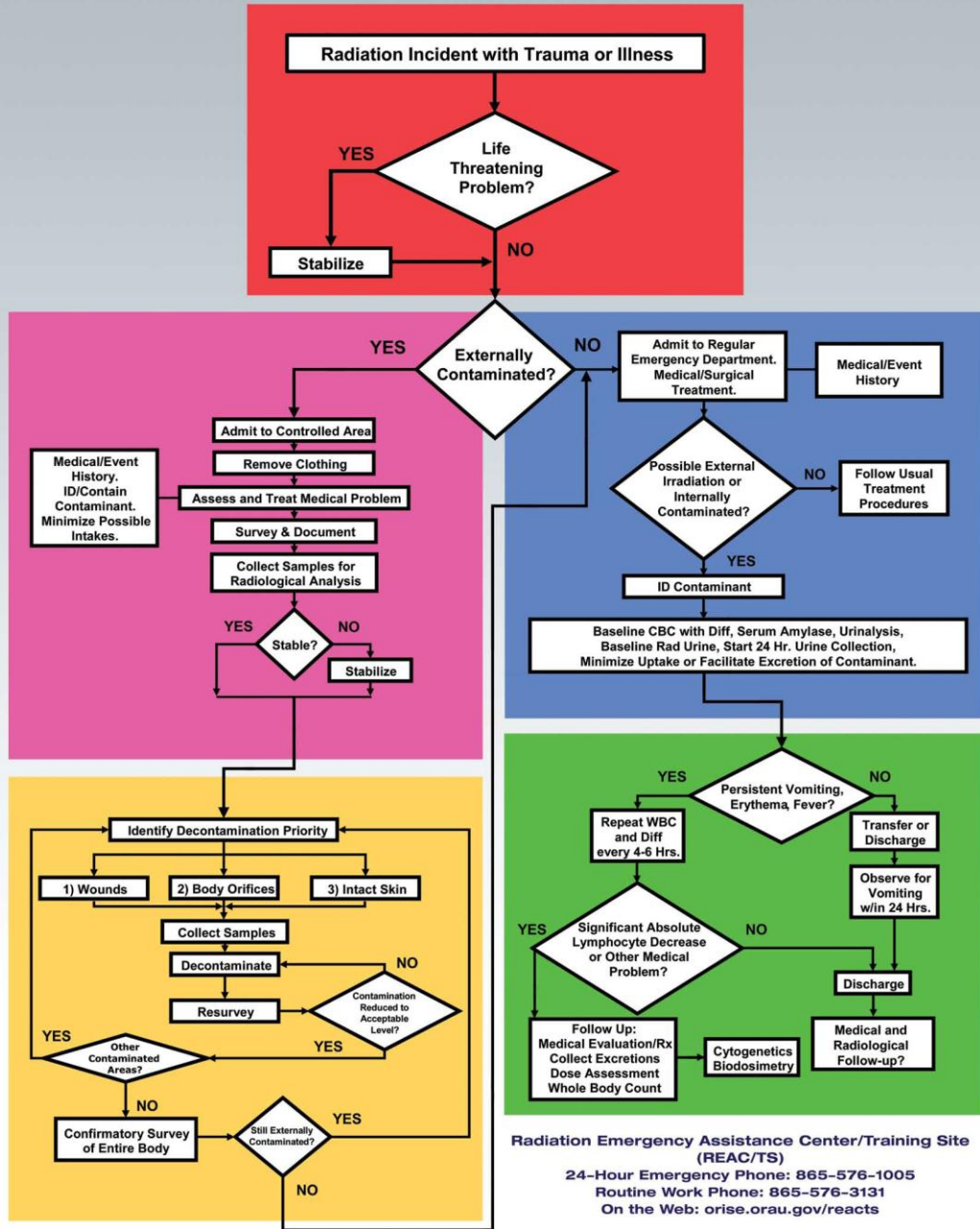
The human body largely has mechanisms for absorbing this dose with minimal risk of long-term negative effects.

Appendix IV: Radiation Patient Treatment

reacts

RADIATION EMERGENCY ASSISTANCE CENTER/TRAINING SITE OAK RIDGE, TENNESSEE

Radiation Patient Treatment



Radiation Emergency Assistance Center/Training Site (REAC/TS)  
 24-Hour Emergency Phone: 865-576-1005  
 Routine Work Phone: 865-576-3131  
 On the Web: [orise.orau.gov/reacts](http://orise.orau.gov/reacts)