

**Table 11: Responder Equipment Contamination Release Levels**

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
<b>Level 1 (Third Priority)</b>			
Beta <sup>1</sup>	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 <sup>2</sup>	(Gamma instruments not usable at these levels)		
Alpha <sup>3</sup>	10 to 1,000 cpm		
<b>Level 2 (Second Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	10,000 to 100,000 cpm or 50 <sup>(4)</sup> to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)	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. <sup>5</sup>
Alpha <sup>3</sup>	1,000 to 10,000 cpm		
<b>Level 3 (First Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)	10 % of Release Level	Do not reuse or release. Contact a Radiation Technical Specialist for determination of disposition. <sup>6</sup>
Alpha <sup>3</sup>	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.

<sup>1</sup> 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).

<sup>2</sup> 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).

<sup>3</sup> 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.

<sup>4</sup> 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).

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

<sup>6</sup> 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
<b>Level 1 (Third Priority)</b>			
Beta <sup>1</sup>	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 <i>Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home</i> before release for self-decontamination.
Gamma <sup>2</sup>	(Gamma instruments not usable at these levels)		
Alpha <sup>3</sup>	10 to 1,000 cpm		
<b>Level 2 (Second Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	10,000 to 100,000 cpm or 50 <sup>(4)</sup> to 100 μR/hr (i.e., 0.01 to 0.1 mR/hr)	10 % of Release Level	Decontaminate to Level 2 lower values, then release for home decontamination in accordance with <i>Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home</i> . <sup>4,5</sup>
Alpha <sup>3</sup>	1,000 to 10,000 cpm		
<b>Level 3 (First Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or 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. <sup>5</sup> If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Alpha <sup>3</sup>	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.

<sup>1</sup> 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).

<sup>2</sup> 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).

<sup>3</sup> 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.

<sup>4</sup> 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).

<sup>5</sup> 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 13: Victim and Public Property Contamination Release Levels**

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
<b>Level 1 (Third Priority)</b>			
Beta <sup>1</sup>	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 <sup>2</sup>	(Gamma instruments not usable at these levels)		
Alpha <sup>3</sup>	10 to 1,000 cpm		
<b>Level 2 (Second Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	10,000 to 100,000 cpm or 50 <sup>(4)</sup> to 100 µR/hr (i.e., 0.01 to 0.1 mR/hr)	10 % of Release Level	Control large items, bag smaller items, and retain until evaluated by a Radiation Technical Specialist. <sup>5</sup>
Alpha <sup>3</sup>	1,000 to 10,000 cpm		
<b>Level 3 (First Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or Greater than 100 µR/hr (i.e., Greater than 0.1 mR/hr)	10 % of Release Level	Do not release. Contact a Radiation Technical Specialist for determination of disposition. <sup>6</sup>
Alpha <sup>3</sup>	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.

<sup>1</sup> 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).

<sup>2</sup> 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).

<sup>3</sup> 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.

<sup>4</sup> 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).

<sup>5</sup> 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.

<sup>6</sup> 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 microrentgen per hour

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

**Table 14: Radionuclides of Concern**

<b>Radionuclide</b>	<b>Half-Life</b>	<b>Primary Radiation<sup>1</sup> Type</b>
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

<sup>1</sup> Includes primary radiation emitted from daughter products

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

<b>Minimum Number</b>	<b>Position</b>	<b>Considerations</b>
1	Facility Group Director	
1	Assistant Facility Group Director	
2 <sup>(1)</sup>	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	

<sup>(1)</sup>May need more to reduce fatigue

Reference: CDC 2006

**Table 16: Protective Action Guides**

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

<sup>1</sup> International Council of Radiation Protection (ICRP) definition 1991.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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.

**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 <sup>1</sup> 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

<sup>1</sup> 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

**Table 10: Responder Contamination Release Levels**

Radiation Type	Existing Contamination Level	Maximum Background Levels	Decontamination Instructions / Release Levels
<b>Level 1 (Third Priority)</b>			
Beta <sup>1</sup>	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 <i>Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home</i> before release for self-decontamination.
Gamma <sup>2</sup>	(Gamma instruments not usable at these levels)		
Alpha <sup>3</sup>	10 to 1,000 cpm		
<b>Level 2 (Second Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	10,000 to 100,000 cpm or 50 <sup>(4)</sup> 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 <i>Instructions No. 2: Instructions to Public on How to Perform Decontamination at Home</i> . If not going directly home decontaminate as noted for Level 1. <sup>4,5</sup>
Alpha <sup>3</sup>	1,000 to 10,000 cpm		
<b>Level 3 (First Priority)</b>			
Beta <sup>1</sup> or Gamma <sup>2</sup>	Greater than 100,000 cpm (Use gamma above 200,000 cpm) or 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. <sup>5</sup> If respiratory protection was not used, responder needs to be evaluated to determine if internal contamination bioassay is needed.
Alpha <sup>3</sup>	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.

- <sup>1</sup> 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).
- <sup>2</sup> 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).
- <sup>3</sup> 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.
- <sup>4</sup> 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).
- <sup>5</sup> 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)