

**Radiation Survey Equipment Recommendations  
and Guidance for Emergency Response in Ohio  
Dirty Bomb Sub-Committee**

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**First Responder Radiological Equipment Recommendations**

<p><b>Awareness</b></p>	<p><b>1. <u>Electronic Personal Dosimeter (EPD)</u>:</b> gamma detection capability; accumulated exposure and exposure rate display; mR and mR/hr units; digital backlit display; user adjustable multiple separate alarms for exposure and exposure rate (audible and visual); chirper function (audible indication increasing with radiation intensity); 9-volt, AA or AAA battery-powered; long battery life (720+ hours [30 days, 24 hours/day continuous usage]); belt clip; electromagnetic radiation resistant; wide operating temperature range; water resistance.</p> <p><b>Alarm setpoints:</b> Exposure rate alarms: 0.1 mR/hr (radiation awareness); 2 mR/hr (initial isolation perimeter); 1,000 mR/hr (suggested turn back limit). Accumulated exposure alarms: 900 mR (dose warning); 1,000 mR (suggested accumulated exposure limit).</p> <p><b>Justification:</b> Functions include hazard recognition, self-protection, initial scene isolation, warning of public and segregation of exiting ambulatory victims from the scene; and notification of cognizant officials.</p>
<p><b>Operations</b></p>	<p><b>1. <u>Electronic Personal Dosimeter (EPD)</u>:</b> gamma detection capability; accumulated exposure and exposure rate display; mR and mR/hr units; digital backlit display; user adjustable multiple separate alarms for exposure and exposure rate (audible and visual); chirper function (audible indication increasing with radiation intensity); 9-volt, AA or AAA battery-powered; long battery life (720+ hours [30 days, 24 hours/day continuous usage]); belt clip; electromagnetic radiation resistant; wide operating temperature range; water resistance.</p> <p><b>Alarm setpoints:</b> Exposure rate alarms: 0.1 mR/hr (radiation awareness); 2 mR/hr (initial isolation perimeter); 1,000 mR/hr (suggested turn back limit, unless lifesaving). Accumulated exposure alarms: 1,000 mR (suggested accumulated exposure limit); alarm adjustable upwards to 25,000 mR for lifesaving activities under direction of Incident Commander.</p> <p><b>2. <u>Contamination Survey Meter</u>:</b> alpha, beta, gamma detection capability; cpm units; digital or analog display; alarm optional; audible contamination indication (headset or speaker); AA, AAA, C-cell, D-cell, or 9-volt battery-powered; long battery life (100+ hours, continuous usage); carrying strap; electromagnetic radiation resistant; wide operating temperature range; water resistance.</p> <p>Use 300 counts per minute above background (in an area less than 0.1 mR/hr) for exiting personnel and equipment.</p> <p><b>Justification:</b> Functions include setting up control zones (hot, warm, cold – modifying the initial scene isolation area, if necessary., entering scene isolation area to evacuate public and rescue victims, and implement monitoring and decontamination procedures.</p> <p><b>3. <u>Portal Monitor</u>:</b> gamma detection capability; cps units; digital display; audible alarm. 110 Vac and D-cell battery power; water resistant for outdoor usage.</p> <p><b>Alarm Setting:</b> function of standard deviation above background.</p> <p><b>Justification:</b> Option for monitoring large quantities of personnel and equipment.</p>

<b>Technician</b>	<p><b>1. <u>Electronic Personal Dosimeter (EPD)-same as operations</u></b></p> <p><b>2. <u>Contamination Survey Meter-same as operations</u></b></p> <p><b>3. <u>Dose Rate Survey Meter:</u></b> gamma detection capability; mR/hr and/or R/hr units; 0 – 500+ R/hr range; digital or analog display; alarm preferred; audible radiation intensity indication optional; AA, AAA, C-cell, D-cell, or 9-volt battery-powered; long battery life (100+ hours continuous usage); carrying strap; electromagnetic radiation resistant; wide operating temperature range; water resistance. 1,000 mR/hr (suggested turn back limit, unless lifesaving).</p> <p><b>Justification:</b> Functions include extended entrance into the Hot Zone for rescue, fire suppression, etc.</p> <p><b>4. <u>Permanent Non-Self-Reading Dosimeter (TLD or OSLD):</u></b> precise measurement of gamma dose; sensitivity to 2-10 mrem.</p> <p><b>Justification:</b> serves as legal, precise record of exposure to personnel engaged in offensive actions within the Hot Zone.</p> <p><b>5. <u>Personal Radiation Detector (PRD):</u></b> Sodium Iodide scintillator, high sensitivity to gamma radiation in levels near background. Vibrate, audible, and visual alarms.</p> <p><b>Justification:</b> option for covert detection of gamma-emitting radioactive material.</p>
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**Recommended Equipment \* OR EQUIVALENT \***

<b>Electronic Personal Dosimeter (EPD)</b>	
<b>Canberra Miniradiac</b>	
	<p><b>Radiation Detected:</b> Gamma/X-ray  <b>Detector Type:</b> geiger-mueller tube  <b>Measurement Range:</b> dose: 0.1 <math>\mu</math>R – 999 R; dose rate: 1 <math>\mu</math>R/hr - 500 R/hr  <b>Energy Response:</b> 80 keV – 3 MeV, within <math>\pm</math>20%  <b>Alarms:</b> Two dose rate alarms (low and high), Two dose alarms (low and high), visual flashing icon, audible (if activated), vibrate (if activated). Vibrate option.  <b>Low Battery Indicator:</b> battery icon on visual display.  <b>Power Supply:</b> four AAA alkaline, 150 hours continuous use, 1500 hours if sleep mode activated (unit wakes up every 5 minutes to detect rate).  <b>Reader:</b> IR interface with any computer (with S900 software). optional.  <b>Button Functions:</b> rate display (displays current rate, used with clr/test button to reset alarm levels), dose display (displays current accumulated dose, used with clr/test button to reset alarm levels), alarm (acknowledges lower alarm), light (activates display backlight), clear/test, on/off.  <b>Temperature Range:</b> -59.8°F to +141 °F operational, humidity up to 100% RH  <b>Dimensions:</b> 3.96 x 2.60 x 1.14 inches  <b>Weight:</b> 9.5 oz,  <b>Models:</b> MRADxyz where x = 1 (yellow case), x = 2 (black case); y = 0 (no vibrate alarm), y = 1 (vibrate alarm); z = 1 (sievert units), z = 2 (gray units), z = 3 (roentgen units).                      Recommended for police MiniRad 213, fire Minirad 113, ems Minirad 113</p>
<b>Canberra Miniradiac S900 software (optional)</b>	
	<p><b>Option:</b> helps users program large quantities of miniradiacs.</p>
<b>ThermoElectron RadEye G</b>	
	<p><b>Radiation Detected:</b> Gamma/X-ray  <b>Detector Type:</b> Energy compensated Geiger-mueller tube  <b>Measurement Range:</b> dose: 1 <math>\mu</math>R – 9,999 R; dose rate: 5 <math>\mu</math>R/hr - 5 R/hr                      Note: has over-range indication to 1000R/hr  <b>Energy Response:</b> 45 keV – 1.3MeV, within <math>\pm</math> 30 %  <b>Alarms:</b> Multiple (includes vibrating alarm)  <b>Low Battery Indicator:</b> low battery indicator on top left of LCD display  <b>Power Supply:</b> 600 hrs on powered by 2 AAA regular or rechargeable batteries  <b>Reader:</b> Optical reader base and infrared adapter with cable to COM port of PC  <b>Button Functions:</b> Simple four-key menu driven user interface. All functions can be hidden or active as required depending on user requirements.  <b>Temperature Range:</b> -4 °F to + 122 °F operational, humidity up to 95% RH  <b>Dimensions:</b> 3.8 x 2.4 x 1.2 inches  <b>Weight:</b> 5.6 oz,</p>

<p><b>Contamination Survey Meter</b> Ludlum 14C (202-608 meter face) with 44-9 contamination detector</p>	<p><b>Display:</b> analog scale 0-2 mR/hr, 0-6.6k cpm  <b>Response Time:</b> variable &lt;4-22 seconds  <b>Range:</b> 5 linear ranges: 0.2, 2, 20, 200, 2000 mR/hr; 660, 6600, 66000, 660000 cpm  <b>Controls:</b> position rotary switch– off, x1000, x100, x10, x1, x0.1; 2 position response time toggle switch– fast, slow; audio toggle switch– off, on; reset push button; battery check push button  <b>Power:</b> 2 D-cell battery, &gt;600 hours  <b>Internal Detector:</b> internal compensated G-M tube  <b>Audio:</b> built-in speaker with panel mounted on/off switch.  <b>External Probe Connector:</b> series C, with other connectors available  <b>Operating Temperature:</b> -20°C to +50°C  <b>Size:</b> 6.5”x3.5”x8.5”  <b>Weight:</b> 3.5 lbs excluding probe  <b>Options:</b> check source, source holder, shoulder strap, headset, carrying case</p>
	
<p>202-608 meter face</p>	
 <p style="text-align: center;">202-608</p>	
<p><b>Ludlum 44-9 Detector</b></p>	
	<p><b>Radiation Detected:</b> Alpha, Beta, Gamma, X-ray  <b>Detector Type:</b> Geiger-Mueller, uncompensated  <b>Operating Voltage:</b> 900 V  <b>Dead Time:</b> 80 μS nominal  <b>Window:</b> mica, 15 cm<sup>2</sup> active area, 1.7±0.3 mg/cm<sup>2</sup>  <b>Connector:</b> series C, with other connectors available  <b>Housing:</b> aluminum  <b>Size:</b> 10.7” long x 2.7” wide x 1.8” high  <b>Weight:</b> 1 lb</p>
<p>Note: The Ludlum 14C contamination survey meter may serve as limited dual -use contamination meter and dose rate meter due to its internal detector (range up to 2 R/hr). The primary use of the 14C with 44-9 detector would be the detection of contamination on exiting personnel exiting. The background radiation level in the area of monitoring exiting personnel should be less than 0.1 mR/hr (100 μR/hr) one meter above the ground and free of surface contamination. The internal detector of the 14C (active on the x100 scale only) is adequate to determine areas less than 0.1 mR/hr. If entry into the Hot Zone is required, the internal detector is adequate for radiation intensities up to 2 R/hr. This can be used for alpha detection, but a zinc sulfide detector is more effective. Contact ODH for more information.</p>	

<p><b>Contamination Portal Monitor</b>  <b>ThermoElectron TPM-903</b></p>  <p>The image shows a black, U-shaped contamination portal monitor. It consists of two vertical posts connected by a horizontal top bar. A control panel with a digital display is mounted on the left vertical post. The device stands on four flat feet.</p>	<p><b>Radiation Detected:</b> Gamma/X-ray  <b>Detector Type:</b> plastic scintillator  <b>Measurement Range:</b> &lt;1 <math>\mu</math>Ci  <b>Energy Response:</b> 60 keV – 2 MeV  <b>Alarms:</b> Audible with red indicator light  <b>Power Supply:</b> 110 Vac, or 6 D-cell alkaline batteries (40 hrs continuous use)  <b>Temperature Range:</b> -4° F to +122° F  <b>Dimensions:</b> 91" x 36.5" x 24" assembled  <b>Weight:</b> 90 lbs</p>
<p><b>Canberra MiniSentry</b></p>  <p>The image shows a white, L-shaped contamination portal monitor. It has a vertical post on the left with a control panel featuring a small screen. A horizontal arm extends from the top of this post to a second vertical post on the right. The 'MINISENTRY' logo is visible at the bottom of the left post.</p>	<p><b>Detector Type:</b> plastic scintillator  <b>Measurement Range:</b> &lt;1 <math>\mu</math>Ci  <b>Energy Response:</b> 60 keV – 2 MeV  <b>Alarms:</b> Audible with indicator light  <b>Power Supply:</b> 110 Vac, and 20 Ah sealed lead acid batteries (40 hrs continuous use)  <b>Temperature Range:</b> -4° F to +122° F  <b>Dimensions:</b> 84" x 48" x 10.5" assembled  <b>Weight:</b> 90 lbs</p>

Contamination Survey Meter/Dose Rate Survey Meter Combination	
<p><b>Ludlum 2241-3</b></p> 	<p><b>Control Switch:</b> 5 position rotating switch to allow for quick change among four detector setups.</p> <p><b>Alert/Alarm:</b> Indicated by annunciation on display and audible tone.</p> <p><b>Display:</b> 4 digit LCD display with 0.5" high digits, separate annunciators for display units, alert, alarm, low battery, detector overload, counting overflow, and scaler counting.</p> <p><b>Backlight:</b> push-button to activate.</p> <p><b>Ratemeter:</b> can display in <math>\mu\text{R/hr}</math>, <math>\text{mR/hr}</math>, <math>\text{R/hr}</math>, and cpm</p> <p><b>Display Range:</b> autoranging from 00.0 <math>\text{mR/hr}</math> – 9999 <math>\text{R/hr}</math>; 0.00 – 999k cpm.</p> <p><b>Battery Life:</b> typically 200 hours with alkaline batteries.</p> <p><b>Size:</b> 6.5" H x 3.5" W x 8.5" L</p> <p><b>Weight:</b> 3.5 lbs, including batteries</p>
<p><b>Ludlum 44-9 Detector</b></p> 	<p><b>Radiation Detected:</b> Alpha, Beta, Gamma, X-ray</p> <p><b>Detector Type:</b> Geiger-Mueller, uncompensated</p> <p><b>Operating Voltage:</b> 900 V</p> <p><b>Dead Time:</b> 80 <math>\mu\text{S}</math> nominal</p> <p><b>Window:</b> mica, 15 <math>\text{cm}^2</math> active area, <math>1.7 \pm 0.3 \text{ mg/cm}^2</math></p> <p><b>Connector:</b> series C, with other connectors available</p> <p><b>Housing:</b> aluminum</p> <p><b>Size:</b> 10.7" long x 2.7" wide x 1.8" high</p> <p><b>Weight:</b> 1 lb</p>
<p><b>Ludlum 44-2</b></p> 	<p><b>Radiation Detected:</b> gamma</p> <p><b>Detector Type:</b> 1" x 1" NaI scintillator</p> <p><b>Operating Voltage:</b> 500-1200 volts</p> <p><b>Connector:</b> series C</p> <p><b>Size:</b> 2" dia x 7.3" long</p> <p><b>Weight:</b> 1 lbs</p> <p><b>Range:</b> 0.1 <math>\text{mR/hr}</math> – 25 <math>\text{mR/hr}</math></p>
<p><b>Ludlum 133-7 Detector</b></p> 	<p><b>Radiation Detected:</b> gamma</p> <p><b>Detector Type:</b> halogen quenched g-m</p> <p><b>Operating Voltage:</b> 460 volts</p> <p><b>Dead Time:</b> typically 50 <math>\mu\text{sec}</math></p> <p><b>Connector:</b> series C</p> <p><b>Size:</b> 0.9" dia x 4" long</p> <p><b>Weight:</b> 0.2 lbs</p> <p><b>Linear Range without DTC*:</b> 25 <math>\text{mR/hr}</math> – 30 <math>\text{R/hr}</math></p> <p><b>Linear Range with DTC (Dead Time Correction):</b> 25 <math>\text{mR/hr}</math> – 100 <math>\text{R/hr}</math></p>
<p><b>Ludlum 133-8 Detector</b></p> 	<p><b>Radiation Detected:</b> gamma</p> <p><b>Detector Type:</b> halogen quenched g-m</p> <p><b>Operating Voltage:</b> 460 volts</p> <p><b>Dead Time:</b> typically 50 <math>\mu\text{sec}</math></p> <p><b>Connector:</b> series C</p> <p><b>Size:</b> 0.9" dia x 4" long</p> <p><b>Weight:</b> 0.2 lbs</p> <p><b>Linear Range without DTC*:</b> 150 <math>\text{mR/hr}</math> – 300 <math>\text{R/hr}</math></p> <p><b>Linear Range with DTC (Dead Time Correction):</b> 150 <math>\text{mR/hr}</math> – 1000 <math>\text{R/hr}</math></p>
<p>The 2241-3 with 44-9 detector, would be appropriate for monitoring exiting personnel for contamination. The 2241-3 with 44-2 detector is an appropriate instrument to determine the adequacy of the monitoring area and determine the boundary of the isolated area (0.1 <math>\text{mR/hr}</math>). If entry into the Hot Zone is necessary, the 2241-3 with 133-7 and 133-8 detectors is appropriate for radiation intensities as high as 100 <math>\text{R/hr}</math> and 1000 <math>\text{R/hr}</math>, respectively, (for missions such as lifesaving). Radiation Protection Specialist support is encouraged.</p>	

<p><b>Ludlum 2241-3RK Response Kit</b></p> 	<p>The Ludlum 2241-3RK response kit is composed of: 2241-3 digital survey meter, 44-9, 44-2, 133-7, 133-8 detectors, probe cable, carrying case, 1 <math>\mu\text{Ci}</math> Cs-137 check source with check source holder.</p>
<p><b>ThermoElectron RadEye PRD</b></p> 	<p><b>Radiation Detected:</b> Gamma/X-ray  <b>Detector Type:</b> NaI scintillator  <b>Measurement Range:</b> dose: 1 <math>\mu\text{R}</math> – 9,999 R; dose rate: 1 <math>\mu\text{R/hr}</math> - 25 mR/hr  Over-range indication to 1000 R/hr  <b>Energy Response:</b> 60 keV – 1.3 MeV, within <math>\pm 30\%</math>  <b>Alarms:</b> Multiple including vibrating alarm  <b>Low Battery Indicator:</b> low battery indication on top left of LCD display  <b>Power Supply:</b> 300 hrs. on regular or rechargeable 2 AAA-cell batteries  <b>Reader:</b> Optical reader base and infrared adapter with cable to COM port of PC  <b>Button Functions:</b> Simple four-key menu driven user interface. All functions can be hidden or active as required depending on user requirements.  <b>Temperature Range:</b> - 4°F to + 122 °F operational, humidity up to 95 % RH  <b>Dimensions:</b> 3.8 x 2.4 x 1.2 inches  <b>Weight:</b> 5 oz,</p>
<p><b>Landauer OSLD</b></p> 	<p><b>Radiation Detected:</b> Gamma/X-ray  <b>Detector Type:</b> Aluminum Oxide  <b>Measurement Range:</b> 1 mrem – 1000 rem  <b>Energy Response:</b> 5 keV – 40 MeV  <b>Temperature Range:</b> unaffected by heat, moisture, and pressure while clear blister packaging is uncompromised  <b>Time Period:</b> may be worn for up to 1 year. Sent to vendor for reading.</p>
<p><b>Global Dosimetry System TLD Wallet Card</b></p> 	<p><b>Radiation Detected:</b> Gamma/X-ray  <b>Detector Type:</b> Lithium Fluoride  <b>Measurement Range:</b> 20 mrem – 1000 rem  <b>Energy Response:</b> &gt;500 keV  <b>Temperature Range:</b> unaffected by heat, moisture, and pressure while clear packaging is uncompromised  <b>Time Period:</b> may be worn for up to 1 year. Sent to vendor for reading.</p>

<b>Equipment Supplier</b>	
Canberra Miniradiac	Canberra <a href="http://www.canberra.com">www.canberra.com</a> Siegfried "Zig" Ditzig (440) 878-0888 KY, MI, Western NY and PA, OH, IA, IL, IN, KS, MN, MO, ND, NE, SD, WI Email: <a href="mailto:sditzig@canberra.com">sditzig@canberra.com</a>
Canberra MiniSentry Portal Monitor	
Carrying case, large	
ThermoElectron Radeye G	ThermoElectron <a href="http://www.thermo.com">www.thermo.com</a>
ThermoElectron RadEye PRD	
ThermoElectron TPM-903 Portal Monitor	
Carrying case, large (accessory option)	
Ludlum 14C Survey Meter	Ludlum Regional Sales: <a href="http://www.ludlums.com">www.ludlums.com</a>
Ludlum 44-9 Alpha, Beta, Gamma G-M detector	LACO <a href="http://www.LACOonline.com">www.LACOonline.com</a>
1 mCi Cs-137 check source (accessory option)	P.O. 666
Check Source Holder (accessory option)	Chesterland, OH 44026
Shoulder Strap (accessory option)	440.729.3034 voice
Carrying case - small (accessory option)	440.729.8238 fax
Ludlum 2241-3 Response Kit	
Ludlum 44-9, 44-2, 133-7, 133-8 G-M detectors	
1 mCi Cs-137 check source (accessory option)	
Check Source Holder (accessory option)	
Carrying Case - medium (accessory option)	
Shoulder Strap (accessory option)	
Landauer OSLD	Landauer <a href="http://www.landauerinc.com">www.landauerinc.com</a> 2 Science Road Glenwood, Illinois 60425-1586 Telephone: (708) 755-7000 Toll Free: (800) 323-8830 Facsimile: (708) 755-7016 Email: <a href="mailto:custserv@landauerinc.com">custserv@landauerinc.com</a>
Global Dosimetry Solutions TLD Wallet Card	Global Dosimetry Solutions <a href="http://www.dosimetry.com">www.dosimetry.com</a> (800-945-4437)