Narrative

Introduce self, provide background info …

I developed this presentation because my work with first responders has provided me with some insight into their frustrations and needs. They are often eager and willing to meet the challenges of radiological emergency response, but are stymied by confusing instrument vendor claims and and often conflicting health physics guidance.

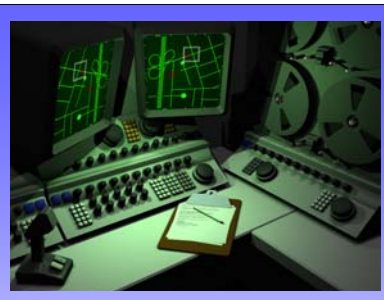
Supporting information

Abstract

Firefighters, police, and other first responders have a variety of tools, training, and national radiological emergency assistance available to them. These assets can be used by first responders to perform an initial assessment of the event and take appropriate steps to protect themselves and the public. The primary factors for determining the appropriate radiological emergency assessment and response tools are: (1) The type of event (explosive dispersal, fire, reactor incident, orphan source, or general contamination), (2) the nature of the radiological material (activity, chemical form, and decay mode), and (3) the phase of the emergency.

There are several national programs that support first responders, either remotely or with the rapid deployment of local or national assistance teams comprised of radiological safety experts. The effective use of these resources is built on planning and communication. For this reason, many assistance resources have an active outreach program comprised of training, drills and exercises. Free or low cost radiological emergency response training is available from several local and national venues. This training provides the basic information necessary to properly respond to a radiological emergency and utilize the tools available.

Objectives



- **Examples of Radiological Emergencies**
- **Defining "First Responders"**
- **Radiological Assessment Tools**
- **Training**
- **Assistance Resources**

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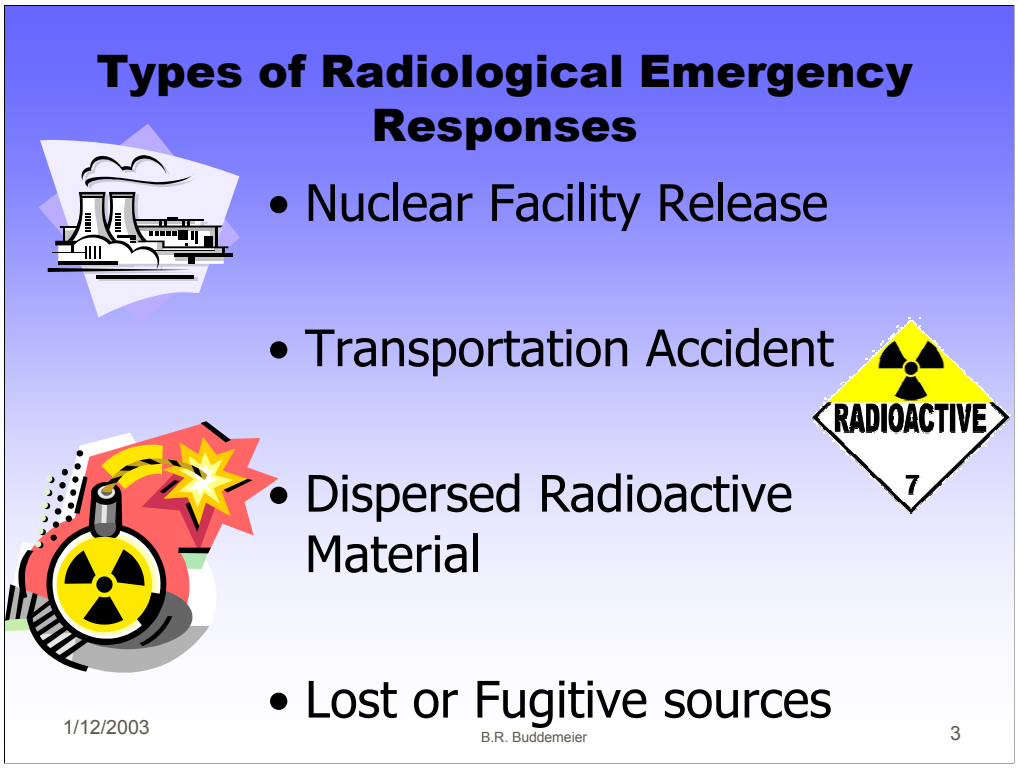
Narrative:

Before launching into the meat of this presentation, I will first "set the stage" by throwing out a few radiological emergency examples and identify who I am talking about when I mention "first responders"

Once that is done, I will discuss some of the tools that I have seen in use and where they do and do not work.

Next I will discuss training programs and aids that I have encountered and relate some of my experience and suggestions as a person who does quite a bit of first responder training.

Finally I will identify some assistance resources that you may not be familiar with.



Narrative:

These days we often have visions of “dirty bombs” in our head when we talk about radiological emergency response, but it is important to realize that there are several types of radiological emergencies that first responders need to be aware of.

The same concerns prevalent before 9/11 are still valid today. The release of radioactive material from nuclear power plants, research facilities, and other industrial radiological facilities is still an issue. A facility fire at a radiography source manufacturer can certainly pose radiological hazard to responders.

On average, over 7,000 radioactive material shipments occur each day. Chances are good that this nation will have to respond to a few accidents involving these shipments. Properly responding to accidents involving these shipments is important.

[Click]

And, of course, there are the terrorist concerns of late; the explosive dispersal of radioactive material (a.k.a “Dirty Bomb”) is an issue that is causing many emergency responders to think twice about there radiological response capability. Especially when you consider that the distribution of radioactive material can occur without any “announcing event” like a fire or explosion.

Finally, Let’s not forget where most radiological accidental injuries do occur… Lost sources making their way into unsuspecting hands (usually the hands of scrap metal dealers).

Firefighters embody the image of “First Responders.” When an event occurs that places individuals or the community in jeopardy, firefighters respond, usually within minutes, to perform rescue and mitigate the hazard.

When considering radiological events and issues however, a more complete list of first responders might be;

[click] Law Enforcement….

[click] Our friends in the Coast Guard, who often wear both law enforcement and responder hats

[click] and finally Hospital Emergency Department who may receive walk in or delivered patients before the radiological nature of an event is discovered.

Recognition of a Radiological Event

- The radiological nature of **nuclear facility** and **placarded transportation accidents** may be self evident, however
- Less obvious is the radiological component of;
  - Fire involving radioactive materials,
  - Radiological "dirty bomb,"
  - Dispersed material (fire, sprayed, etc..), and
  - Exposed high intensity sources.
- Tools are needed to help first responders recognize the radiological nature of an event.

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Narrative:

With the exception of nuclear facility based accidents, the radiological aspect of an event may not be readily apparent.

The fact that you can not see, hear, smell, or taste radiation makes the initial determination of radiological event a technological problem. Whether an accident (e.g., transportation fire) or a malevolent act (e.g., radiation dispersal devise), the actions and equipment carried by these individuals can help quickly identify the radiological nature of an event and may significantly reduce its overall impact.

It is not practical (or advisable) to delay the response to every fire, car accident, explosion, or suspicious activity until a radiological evaluation is performed. Therefore tools are needed that will help the first responder detect the radiological nature of an event without significantly delaying the response.

Desirable Properties for Detection Tools for First Responders

- Alerts user of radiation above background
- Detect alpha & beta radiation
- Records dose
- Alarms in hazardous situations

- Work continuously without user intervention
- Simple and intuitive, requiring little training
- Small size, something easily worn
- Inexpensive to purchase and maintain

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If we could design the perfect first responder tool, it might have the following properties…

Although the distinction is often lost on the public, there is a difference between radiation and contamination. In a few rare (but important) cases, you can have one without the other. The perfect tools should be able detect both at low levels… and as long as we are dreaming, despite our desired sensitivity, it should not alarm on variations caused by natural background.

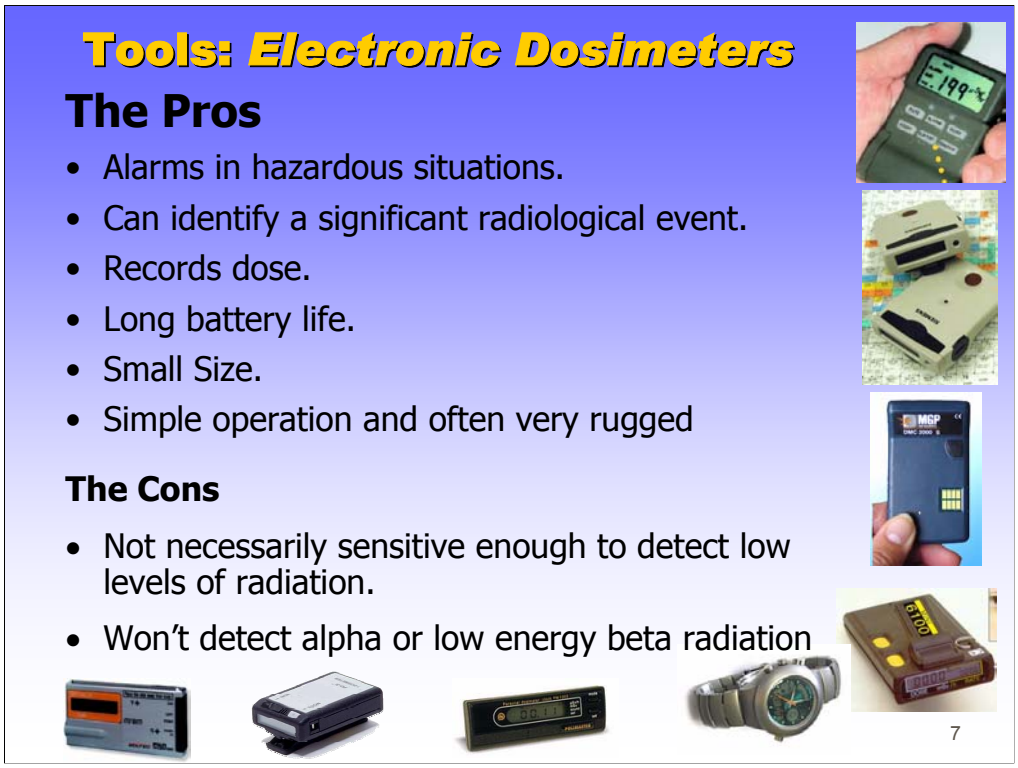
It should also help ensure the wearer's safety by indicating when hazardous levels of radiation are present and track the wearers total exposure.

The best instrument should not even have to be turned on, it should just be part of their work clothes or gear.

First responders need SIMPLE tools, ones that just indicate whether or not there is an issue that needs to be dealt with. No interpreting analog scales and multiplying by scaling factors. Basically "red light, green light"

For the 1st line responders, the instrument should require little training. Although radiation training is always good for 1st responders, it is not always practical beyond the awareness level.

In alignment with our objective to get as many of these devices into the hands of first responders as possible, they need to be cheap! They also need to use standard batteries (one time or rechargeable) and not need a PhD to replace them.



Although the perfect tool does not currently exist, there are a few different types of instruments that have some of the right properties. One example would be the one of the numerous electronic dosimeters that are currently on the market.

The Pros
These devices are becoming more common in the industry today. In addition to their small size & ruggedness, they track the exposure received by the wearer and can even alert them to hazardous situations by an audible alarm. The user simply needs to turn the unit on and wear it. Many units have low power consumption and the batteries can last for months while on.

[Click to Display Cons]
•**The Cons**
Although some of these devices have beta radiation detectors, when used passively, these devices won't alert the user to alpha and beta radiation from contamination unless there was an accompanying deep dose field. Many of the units are not sensitive enough to detect low levels of radiation that may be associated with contraband concerns (microSv or fractions of a mrem)

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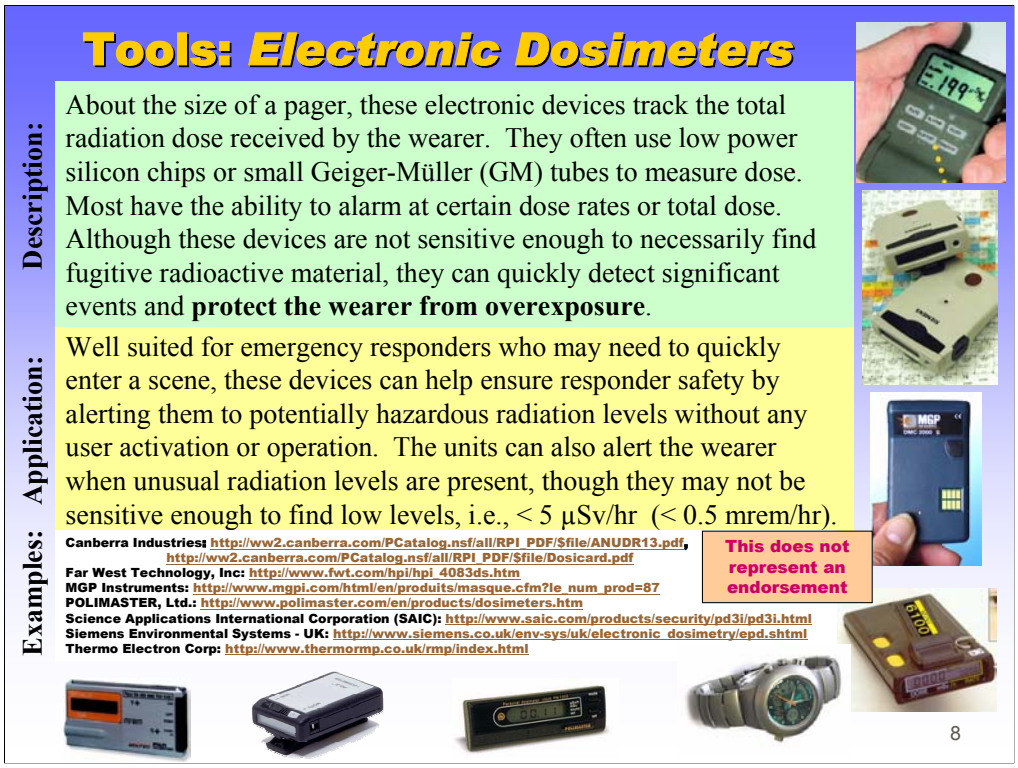

{Note to readers, only the yellow application section is initially displayed}

In summary, the issues associated with electronic Dosimeters are
Well suited for emergency responders who may need to quickly enter a scene, these devices can help ensure responder safety by alerting them when radiation is present, but they may not be sensitive enough to identify the radiological nature of events involving small quantities or alpha emitting isotopes.

Units with more than 1 alarm levels preferred, one alarm used for radiation proximity "alert" (1 µSv/hr) and one used to indicate hazardous "turn back" levels (0.1 Sv/hr or 0.1 Sv).

Training must be provided to ensure that the user continues to perform rescue and first aid efforts even with "alert" alarms. Additional victim casualties could result from ill trained responders who leave the scene at alert levels.

Typical costs are several hundred dollars per unit, but models that detect beta or neutron radiation, or those with external probes can be more expensive.

[click]
I've summarized the description and some EXAMPLE units on this slide. Don't try to read this eye-chart, it is there to complete your hand out. This does not represent an endorsement!

Tools: *Personal Radiation Proximity Alert Systems*

Pros

- Very sensitive. Alerts the user of any statistically significant changes to the natural background radiation levels.
- Useful for finding contraband radioactive material.
- Good battery life
- Small Size
- Simple operation

Cons

- Will alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation.
- Does not accurately measure (or work in) high dose rates which would be of concern to emergency responders performing rescue operations.
- Won't detect alpha or low energy beta contamination (other than by any associated dose field)
- Expensive ($800 – $2,000)

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Although it looks similar to a electronic dosimeter, there is a very different kind of detector out there which I call "Personnel Radiation Proximity Alert Systems."

The Pros
•Very sensitive. Alerts the user of any statistically significant changes to the natural background radiation levels.
•Useful for finding contraband radioactive material.
•Good battery life (often weeks of continuous operation)
•Small Size (pager or notebook sized)
•Simple operation (requires no user action, simply wear the unit)

[Click Display Cons]

•**Cons**
•Will alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation.
•Does not accurately measure (or work in) high dose rates which would be of concern to emergency responders performing rescue operations.
•Won't detect alpha or low energy beta contamination (other than by associated dose fields)
•Expensive ($800 – $2,000)

Tools: *Personal Radiation Proximity Alert Systems*

Description: Often called "Radiation Pagers," and similar in appearance to the electronic dosimeters, these units have the very different function of finding low levels of radiation using very sensitive crystal or plastic scintillators. Although good for finding contraband radioactive material, these units do not have the range necessary for personnel protection (i.e., high dose rates).

Application: Well suited for law enforcement or inspectors, these devices can alert the wearer to any unusual radiation in their proximity. These devices are best used when there is an opportunity for a measured response, as most alerts will occur from legitimate commercial, medical, or natural radioactive material. Training and protocols need to be provided to properly resolve any alarms.

Examples:

POLIMASTER, Ltd: http://www.polimaster.com/en/products/ratemeters.htm
Sensor Technology Engineering, Inc http://www.nttc.edu/ertProgram/radpagers.asp
T_A TECHNICAL ASSOCIATES: http://www.tech-associates.com/dept/sales/product-info/dsi-2.html

This does not represent an endorsement

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In summary

Well suited for law enforcement or inspectors, these devices can alert the wearer to any unusual radiation in their proximity. These devices are best used when there is an opportunity for a measured response, Training must be provided to ensure that the user realizes that the alarms do not necessarily indicate a hazardous situation. As in all of these cases, additional victim casualties could result from ill trained responders who leave the scene because of the proximity alarms. Training must also be provided on how to resolve the many alarms that will occur from legitimate radioactive material uses.

click]

I've summarized the description and some EXAMPLE units on this slide. Don't try to read this eye-chart, it is there to to complete your hand out.

Tools: Isotope Identification Equipment (Gamma Spectroscopy)

Pros

- Very sensitive. Alerts the user of any statistically significant changes to the natural background radiation levels.
- Useful for finding contraband radioactive material.
- Often tracks dose rates and total dose of user while on.
- Can identify many common isotopes

Cons

- Although fairly good at identifying common isotopes with simple spectra, these units can not identify all possible isotopes of concern and can also mis-identify isotopes.
- Will alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation (though the analysis capability can often help resolve this)
- Expensive ($8,000 - $12,000)
- Won't detect alpha or low energy beta contamination.
- Requires extensive training or support to use properly

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Commercially available handheld NaI gamma spectroscopy has seen great improvements in the last 5 years. Mostly in the form of better analysis algorithms and easier interfaces.

Pros

•Very sensitive. Alerts the user of any statistically significant changes to the natural background radiation levels.
•Useful for finding contraband radioactive material.
•Often tracks dose rates and total dose of user while on.
•Can identify many common isotopes

[Click to Display Cons]

Cons

Although fairly good at identifying common isotopes with simple spectra, these units can not identify all possible isotopes of concern and can mis-identify isotopes.
•Will alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation (though the analysis can often resolve this)
•Expensive ($8,000 - $12,000)
•Won't detect alpha or low energy beta contamination.
•Requires extensive training or support to use properly

Tools: Isotope Identification Equipment (Gamma Spectroscopy)

Description: These expensive and sophisticated units use the different gamma ray "signatures" given off by the radioactive material to identify the originating isotope(s). Proper identification of the isotope is important for determining the appropriate response actions. Although the analysis being performed is complicated, these units offer a simple interface to help non technical users make a measurement. Many of the units have modes of operations similar to the proximity alert and electronic dosimeters.

Application: Best suited for experienced users or well trained and practiced responders, these units will help identify the radioactive material involved at a scene or in contraband. Good for follow-on radiological emergency response teams or inspectors.

Examples:
Berkeley Nucleonics Corp http://www.berkeleynucleonics.com/radiation/rindex.htm
Bicron/Thermo Electron: http://www.thermormp.co.uk/us/rmp/
Exploranium Radiation Detection Systems: http://www.exploranium.com/gr135pg1.htm
Perkin Elmer (Ortec): http://www.ortec-online.com/safeguards.htm
Quantrad Sensor: http://www.quantradsensor.com/
Radiation Alert: http://www.seintl.com/ursa.htm
XRF Corporation: http://www.xrfcorp.com/products/ics.html

This does not represent an endorsement

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In Summary,
Their expensive prohibits them from being in every first responder's back pocket, but they can be a valuable tool in the hands of a well trained regional responder.
Although most units have been ruggedized, the technology is inherently shock sensitive and the automated analysis is not 100% effective.
Accurate assessment often requires an experienced spectroscopist to assess data. Fortunately, many of the units have the ability to download the spectrum for remote analysis by an expert. However, even with an expert the limited resolution or efficiency of room temperature spectroscopy systems may be insufficient to accurately identify an isotope and higher resolution, liquid nitrogen cooled detectors would need to be used ($30,000+)

[click]
I've summarized the description and some EXAMPLE units on this slide. Don't try to read this eye-chart, it is there to to complete your hand out.

Industry Standard Radiation / Contamination Survey instruments are those commonly used by health physicists and radiation control technicians at nuclear power plants, hospitals, and research laboratories. These instruments use a variety of detector technology (GM, Ion chamber, scintillator, proportional counter, etc..) to measure dose rates and contamination. Although well suited for the experienced user, they may not be appropriate for the occasional user like an emergency responder. In order to meet the needs of the occasional, novice user, manufacturers have tried to create sub-genre of instruments that are smaller and easier to use. I have labeled this category *Simplified Contamination Survey Instruments*

Pros

- Most have Good Sensitivity.
- Digital models can have set alarm levels
- "Open window" GM for alpha and beta contamination.
- Small Size (cell phone or notebook sized)
- Simple operation (user action required, but usually only one or two switches)
- Rugged, simple technology.

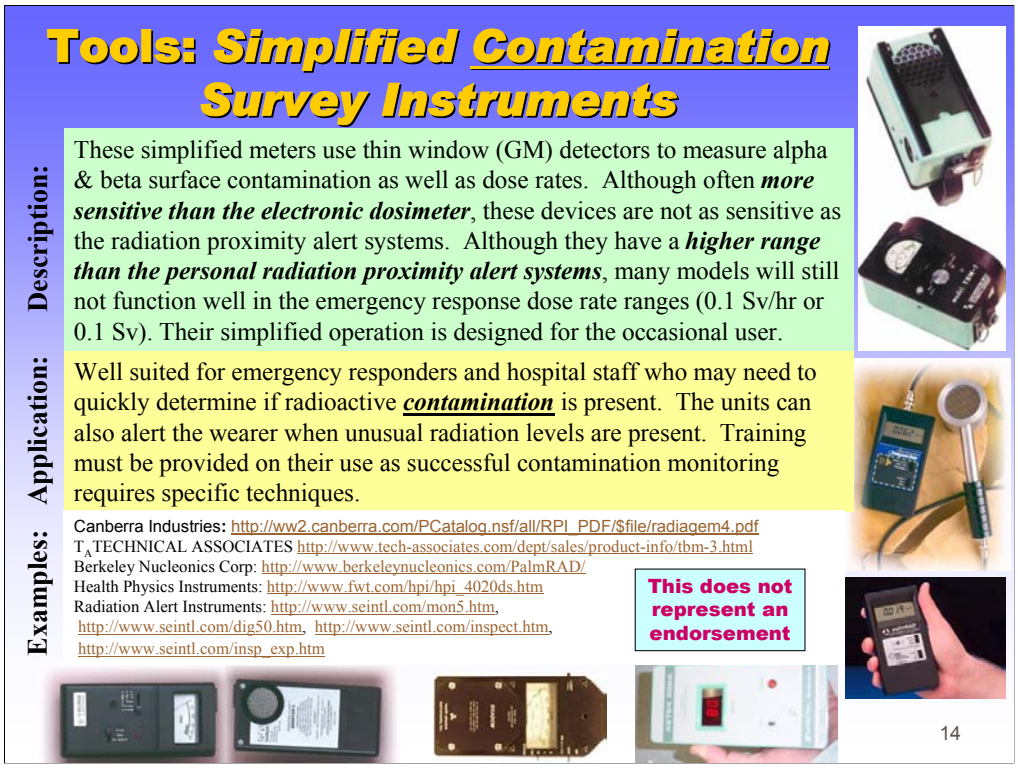
[Click to show Cons]

Cons

Sensitive enough alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation.

Many models can not be used in high dose rates which would be of concern to emergency responders performing rescue operations (>0.1 Sv/hr | >10R/hr).

Low accuracy (i.e., uses pancake GM for dose measurement)



In Summary

Smaller, simpler, and often cheaper than commercial equipment, these devices are well suited for the emergency responders. There is a large variety of capabilities in this class of instrument to the appropriate features must be considered for the task and the user. Training must be provided to ensure that the user understands how to interpret readings. Using the instrument to detect contamination will require also require special training.

Typical costs are $300 - $600 dollars per unit. For the occasional user, choose the more expensive digital models as they will have alarms and are easier to operate.

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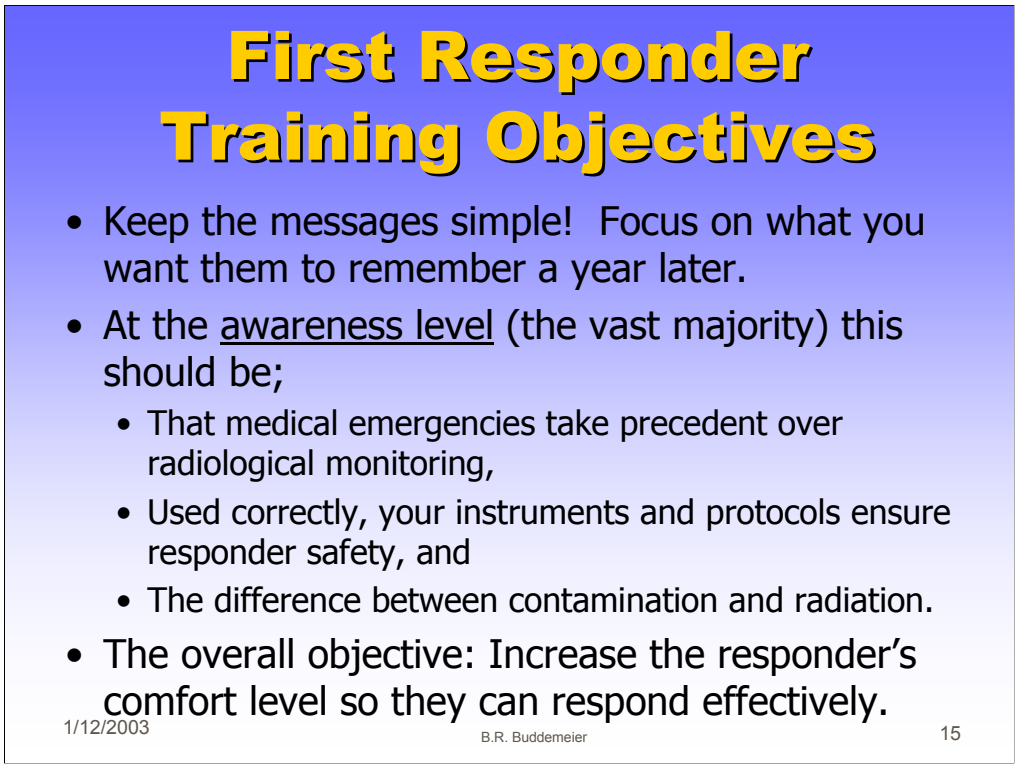

Narrative:

When training first responders in radiological safety, it's important to clearly understand your objectives.

Lets face it, most first responders will never have to use the information you are providing them… and they know it. You can't expect them to retain the details of radiation science, but you can let them walk away with several impressions that will serve them well if they ever do have to respond to a radiological emergency.

Unfortunately most untrained responders see the radiation symbol and stop dead in their tracks or tend to over-respond.

Often what is needed at the awareness level is to improve their understanding about radiation and their instrumentation. Through this understanding will come the confidence to effectively respond to a radiological emergency. The responder should walk away with

Medical emergencies take precedent over radiological monitoring,

Used correctly, your instruments and protocols ensure responder safety, and

They should understand the difference between contamination and radiation.

Effective Training Methods

- "Hands On" training with the tools used by the responders.
  - **Demonstrate** the principles of radiation (types of radiation, distance & shielding effects, etc..)
  - **Utilize the responders own equipment** with actual radiation sources.
- Trainers need to be able to address the radiological concerns of the students.
- Leave training materials that are interesting and can be used as a reference

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Narrative:

It has been my experience that first responders tend to be action oriented and retain more from "hands on" training. It's probably no surprise to you that demonstrating the principles of radiation using sources and meters rather than overheads is much more effective.

It has also been my experience that first responders don't get much "play time" with their own instruments and time spent in this manner will increase their confidence level in their own equipment.

More than anything else, it is important to be open, trustworthy, and credible. There are always a few responders in a class who may have exaggerated concerns about radiation. It is important to provide a comfortable environment where they can ask questions about their concerns and have the instructor answer them in a honest and straightforward manner (without trying to give them a lesson on statistics).

If possible, try to leave behind more than just printouts of your overheads. Provide quality and interesting student guides and/or computer programs that can be used by interested students for follow up or refresher training.

Training Materials

- Many high quality, low cost training programs exist in the federal government.
  - *"Compendium of Weapons of Mass Destruction Training"* produced by the federal government.
  - Department of Energy's (DOE) Transportation Emergency Preparedness Program (TEPP).
- "Train the Trainer," Interactive Computer Based, or Web Based Training formats used for cost efficiency

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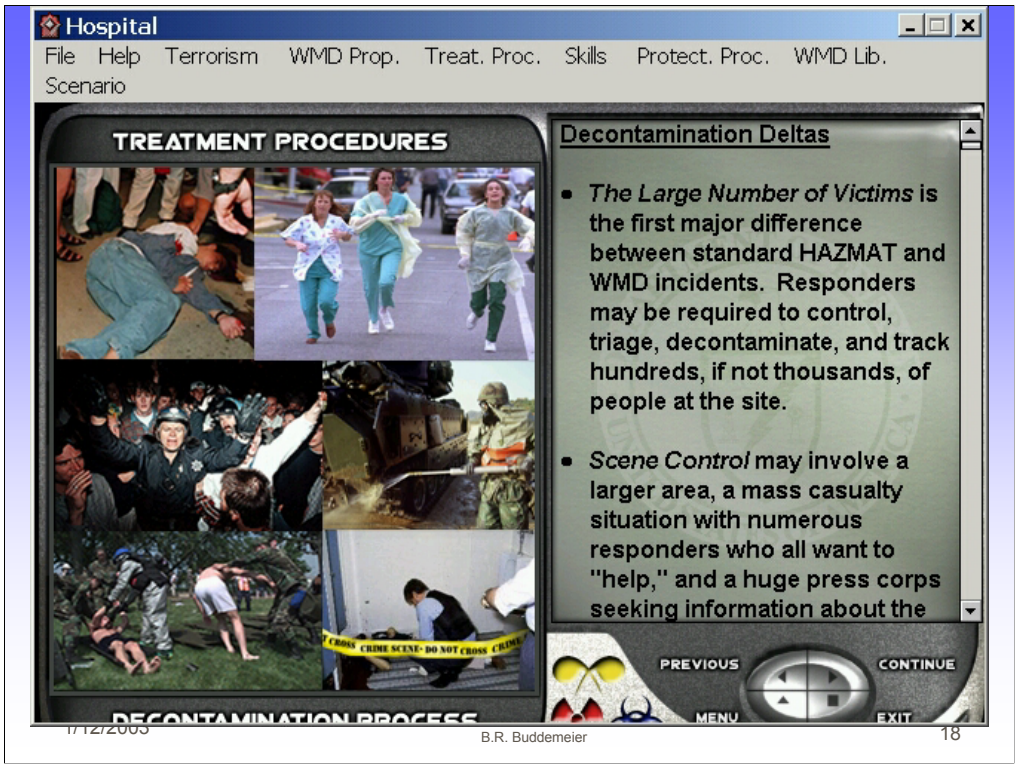
The Nunn-Lugar-Domenici legislation directed the Federal Government to improve the capabilities of state and local agencies to respond to incidents involving WMD.

A compendium of some of these classes exist. Many of these efforts by various departments of our government can be found in *Compendium of Weapons of Mass Destruction Training"* produced by the federal government.

Outside of the WMD Arena, there are several excellent programs on radiological emergency response. An example of this is the Department of Energy's Transportation Emergency Preparedness Program which provides free, multimedia rich training materials to trainers as part of a comprehensive emergency management system for DOE radioactive materials shipments or use.

Although funding was established to develop these quality products, to actually perform the training for every first responder in the nation would be cost prohibitive. So many of these programs utilize the "train the trainer" format in which every local response program's trainer would attend a free class offered periodically throughout the nation and, after demonstrating competence, be given the training materials so that they can integrate them into their own training program.

At the end of this presentation I have provided references you may use too look up these products.



Another cost effective training method is to develop and disseminate Computer or Web Based training tool. An example of this effort is DOE's Emergency Operation's Training Academy's Weapons of mass destruction Computer Based training or CBT. This FREE training is distributed on 8 CDs is a multimedia rich interactive training to provide self paced individual training at the hospital or EMS facility.

An effective training program uses a combination of these different training tools to effectively communicate a consistent message through several different methods.

For example, leaving behind product like this after some onsite training may encourage the student to continue to learn via other venues.

First Responders should be aware of local and national radiological response resources. Depending on the nature of the response, some of these resources might be:

1) Local Fire and Hazmat Responders
2) County/State Department of Health Services
3) National Guard Civil Support Teams
4) Federal assistance also available:
   Local DOE Radiological Assistance Program (RAP) Teams
   Local FBI WMD/HAZMAT teams
   Other National Assistance (FEMA)

Local responders should work to develop communication with, and integrate into their response protocols, these various agencies so that they work together smoothly in a radiological emergency

Department of Energy's Radiological Assistance Program (RAP)

- Regional, On-Call Responders
- Specialized Equipment
- Volunteers with Extensive Radiological Experience
- Outreach to help 1st Responder Preparation
- Tailored Response that provides access to **all of DOE assets.**

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Narrative:

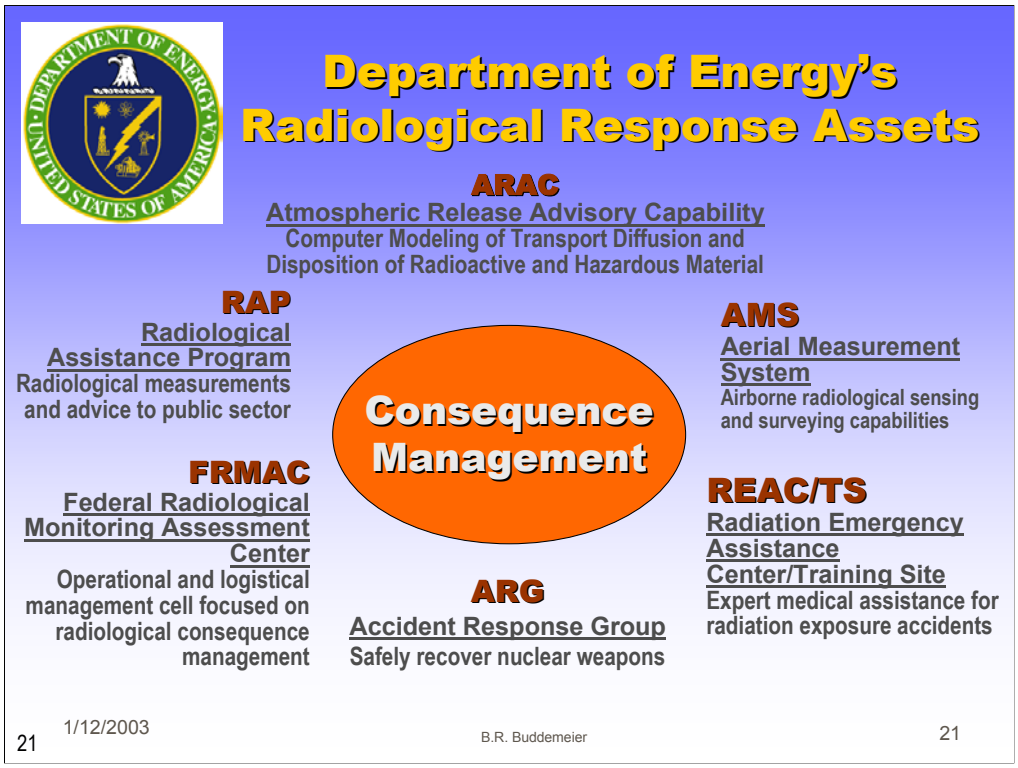
An example of sometimes little known, but a valuable resource is the Department of Energy's Radiological Assistance Program or "RAP". This program utilizes health physicists and HP technicians from DOE nuclear & radiological facilities scattered across the country to provide free radiological emergency response assistance to local responders.

These volunteer HPs and HP technicians receive special training to help them manage off site emergency response and integrate with first responders.

Through this program, the local responders can tap into the skills, experience, and equipment of people who are actively working in a radiological environment to help them properly manage a radiological emergency.

Responses can be as trivial as getting phone advise to a full blown event that requires all of the DOE assets about to be discussed.

Most common response is a low-key site visit involving a few, non uniformed, RAP experts. But when the need arises for a large radiological emergency response, RAP is your doorway to all DOE assets.



When managing the Consequence of an event, the DOE national assets are: RAP, already described previously

Atmospheric Release Advisory Center or (ARAC) provides atmospheric dispersion modeling using realtime wind data to generate potential population exposures.

Aerial Measuring System or (AMS) is comprised of three DOE fixed wing aircraft and helicopters which are specially equipped with radiation measuring equipment and highly trained aircrews and scientists. Their mission is to rapidly respond to radiological releases and provide local decision makers with initial plume data so that timely, information protection decisions can be made. These aircraft are currently on alert and ready to respond 24 hours a day.

Radiation Emergency Assistance Center/Training Site or (REAC/TS) provides medical advice, specialized training, and the unique capability of on-site assistance for the treatment of all types of radiation exposure accidents.

Accident Response Group or (ARG) provides safe recovery and transport for accidents involving nuclear weapons.

Federal Radiological Monitoring & Assessment Center or (FRMAC) helps coordinate monitoring and assessment data with other federal agencies (NOT A DOE ASSET).

Summary:

- **Detection tools.** There are many different detection tools for first responders, always consider;
  - The Task
  - The User
- **Training** must be provided to give the responder the confidence to respond properly. Even simple detection tools can lead to inappropriate responses without training.
- **Forge links with radiological responders**. Many local response agencies may not be aware of the resources available to them.

Questions

References

The devices pictured and web pages referenced in this presentation were chosen as examples and in no way represent an endorsement of any manufacturer or product.

Homeland Defense Office of the U.S. Army Soldier and Biological Chemical Command, "Compendium of Weapons of Mass Destruction Training produced by the federal government" [online]. Available at http://hld.sbccom.army.mil:80/downloads/dp/compendium_wmd_aug_2000.pdf

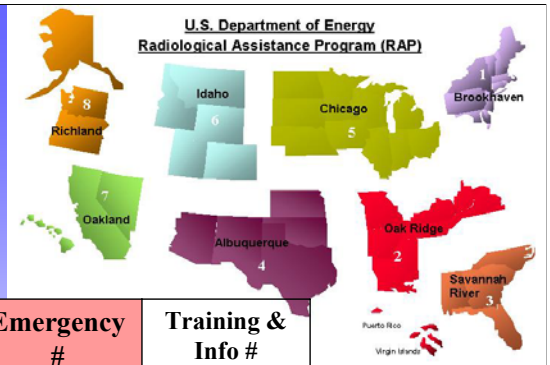
The Department of Energy, Transportation Emergency Preparedness Program (TEPP) [information available online] http://www.em.doe.gov/otem/program.html

A Practical Guide To Incident Response, ARSCE 2002; WPM-A.4 James G. Barnes, CHP Rocketdyne/Boeing

The Department of Energy's "Partners in Emergency Response" Publication. [information available online] http://www.doeal.gov/opa/Freedom.htm

The Department of Energy, Emergency Operations Training Academy (EOTA), **Computer Based Training (CBT)** for the response to Weapons of Mass Destruction CDs can be copied and have been distributed to each state's FEMA representative who can be found at www.fema.gov/fema/statedr.shtm or by contacting DOE's Emergency Operation Training Academy at www.eota.doe.gov or call (505) 845-5170 ext.172

DOE Emergency Assistance or Training Info, Contact:



Region	NNSA Regional Response Coordinator	Emergency #	Training & Info #
1	Steve Centore	(631) 344-2200	(631) 344-7309
2	Steve M. Johnson	(865) 576-1005	(865) 576-9740
3	Christina T. Edwards	(803) 725-3333	(803) 952-6613
4	James E. Straka	(505) 845-4667	(505) 845-5581
5	Christine Van Horn	(630) 252-5731	(630) 252-2498
6	Steven A. Morreale	(208) 526-1515	(208) 526-0199
7	Mike Cornell	(925) 422-8951	(925) 422-0138
8	Kathy Beecher	(509) 373-3800	(509) 376-8519
HQ	Duty Officer, Washington, DC	(202) 586-8100	(202) 586-3201