

Radiological Emergency Response Planning and Exercise

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First Responder Considerations



Some Federal Guidelines Do Exist...

Dose Limit (rem)	Activity being performed	Limitations or conditions
5	Any	None
10	Protecting valuable property	None
25	Life saving or protection of large populations	None
>25	Life saving or protection of large populations	Person fully aware of the risks involved, uses this limit only on voluntary basis.



Fight Fires... Stay Times? Turn Back Dose?
Rescue Victims... Decontaminate?
...or wait for the Experts?

*Taken from Table 2-2 of EPA 400-R-92-001 *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*.

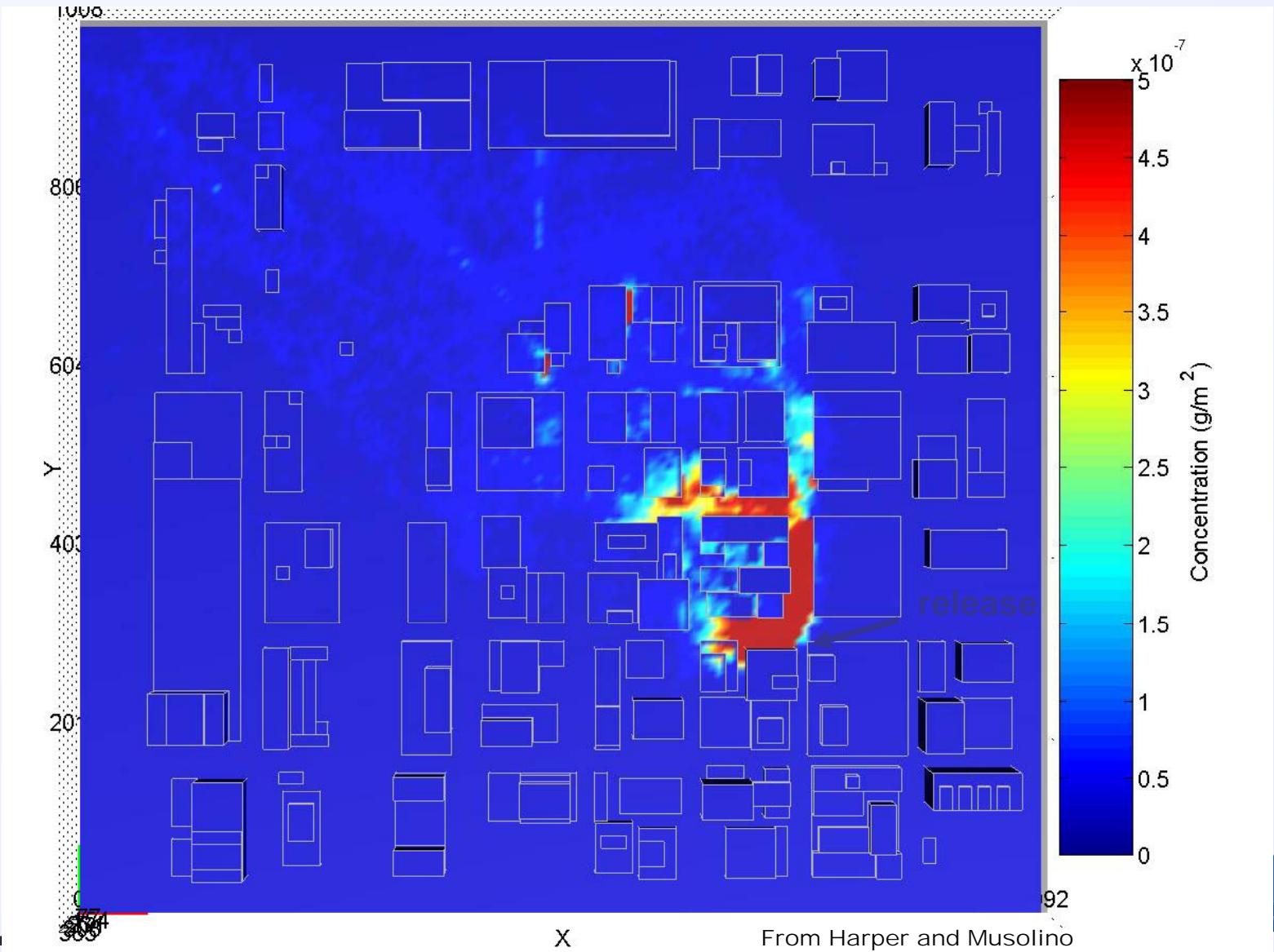


...and Hard to Implement.

Turn-Back dose rate (lifesaving)	200 R/hr
Turn-Back dose	10 rem
Personnel Decontamination trigger level (beta, gamma β,γ)	2 times background
Personnel Decontamination trigger level (alpha α)	Any constant, continuous clicks
Personnel Equipment reuse contamination level (beta, gamma β,γ)	1 mR/hr on contact (above this decontaminate the equipment prior to reuse.)

Gamma Ray Dose Rate			Stay Time to Receive This Dose					
Rate / hr	Rate / min	Rate / sec	1 rem	5 rem	10 rem	25 rem	100 rem	500 rem
5 mR/hr	83 μ R/min	1.4 μ R/min	200 hrs	6 weeks	12 weeks	30 weeks	2 years	
100 mR/hr	1.7 mR/min	27 μ R/sec	10 hrs	50 hrs	100 hrs	250 hrs	6 weeks	30 weeks
1R/hr	17 mR/min	270 μ R/sec	1 hr	5 hrs	10 hrs	25 hrs	100 hrs	500 hrs
10 R/hr	170 mR/min	2.7 mR/sec	6 minutes	30 minutes	1 hr	2.5 hrs	10 hrs	50 hrs
100 R/hr	1.7 R/min	27 mR/sec	36 seconds	3 minutes	6 minutes	15 minutes	1 hrs	5 hrs
500 R/hr	8.3 R/min	140 mR/sec	7 seconds	36 seconds	72 seconds	3 minutes	12 minutes	1 hrs

How Do We Define “Onsite”?



Who's Got the Right PPE?



What is the Appropriate DECON?



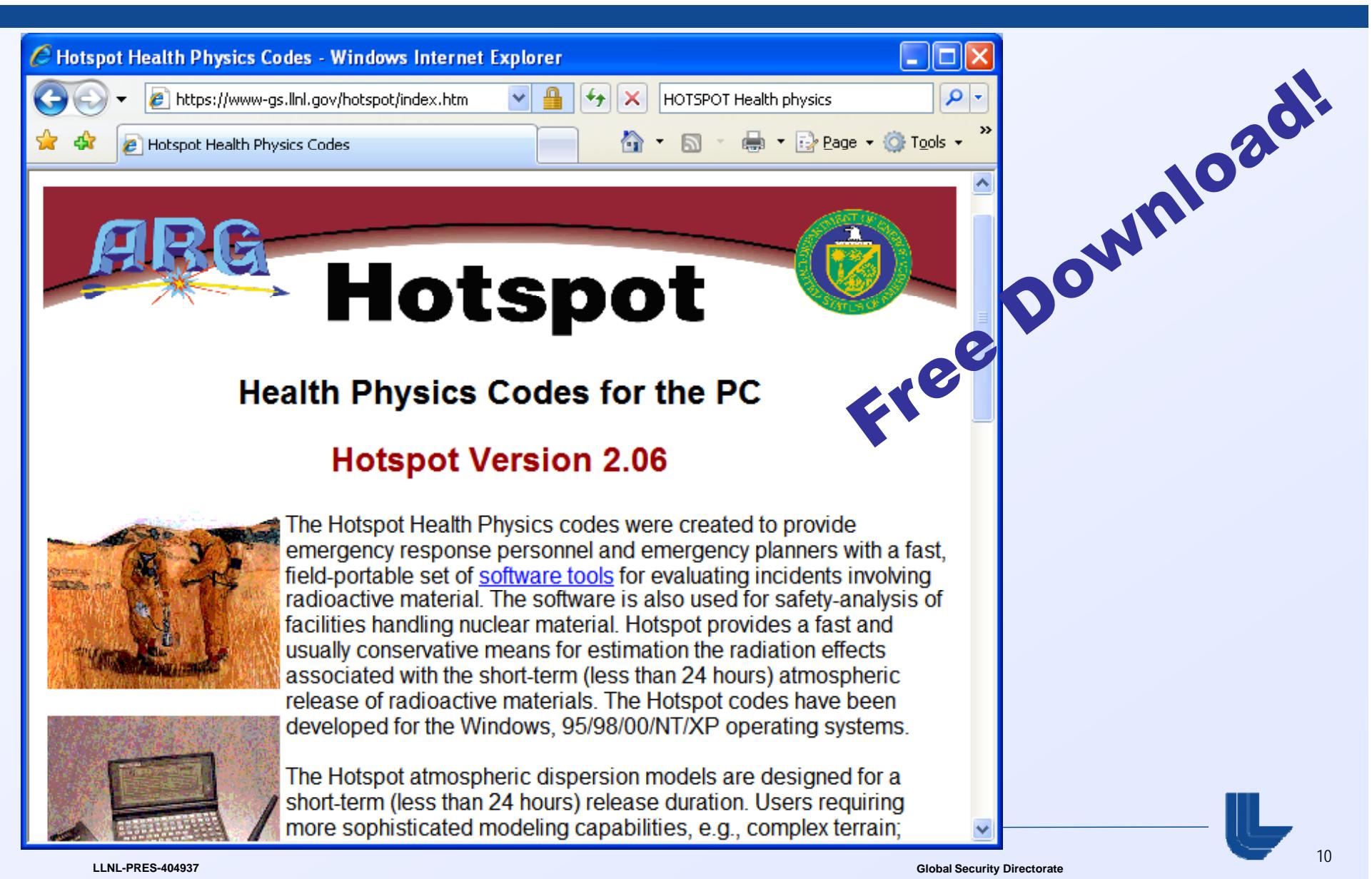
How Do You Handle the Injured?



And the Answer Is.... It Depends"

- Every community balances the “risk / benefit” equation differently and has different needs.
- Most important to have a **scaleable approach.**
- Planning is often more important than the plan itself.
- A sound scientific basis is important

Using HOTSPOT to Help Communities Understand the Issues



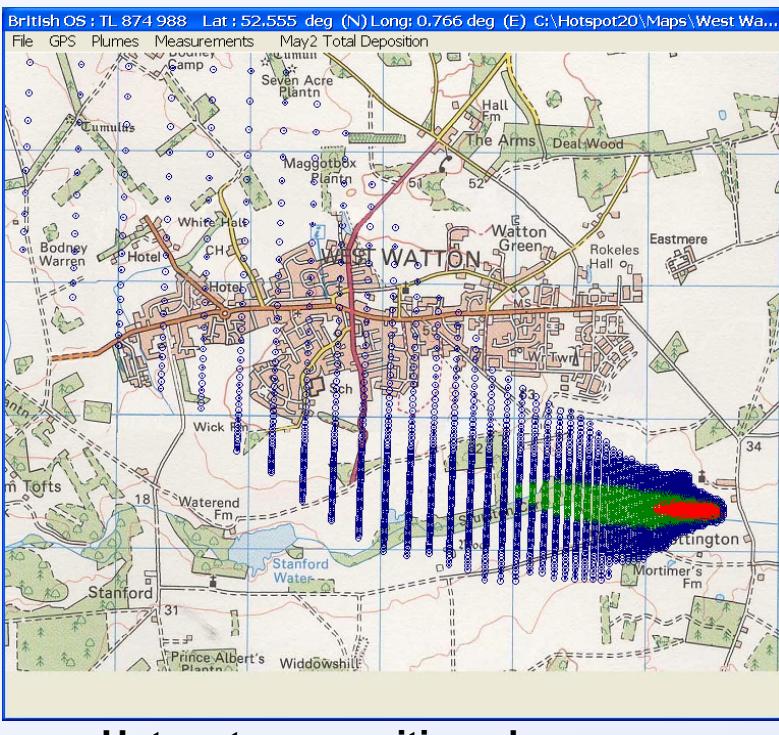
The Hotspot Health Physics codes were created to provide emergency response personnel and emergency planners with a fast, field-portable set of [software tools](#) for evaluating incidents involving radioactive material. The software is also used for safety-analysis of facilities handling nuclear material. Hotspot provides a fast and usually conservative means for estimation the radiation effects associated with the short-term (less than 24 hours) atmospheric release of radioactive materials. The Hotspot codes have been developed for the Windows, 95/98/00/NT/XP operating systems.

The Hotspot atmospheric dispersion models are designed for a short-term (less than 24 hours) release duration. Users requiring more sophisticated modeling capabilities, e.g., complex terrain;

Hotspot Exercise/Demo Support Capabilities

- Import NARAC modeling predictions
 - Plutonium ground deposition (Ci/m²)
 - Time-integrated air concentration ([Ci-sec]/m³)
- Accurate (meters), bi-directional geographical coordinate conversion between Latitude/Longitude and other coordinate systems
- Support all US/UK radiation detection/measurement capabilities
 - Ground survey instrumentation
 - Contamination (swipes/smears) measurements
 - Air filters (gross and radon corrected)
 - Miscellaneous (user's can add custom capabilities as needed)
 - Lung deposition
 - Bioassay
 - Etc.

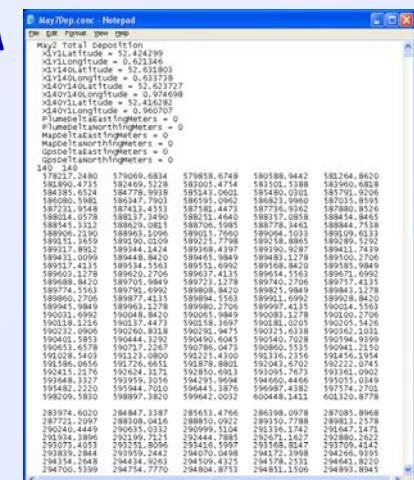
Can Importing Sophisticated NARAC Model Runs



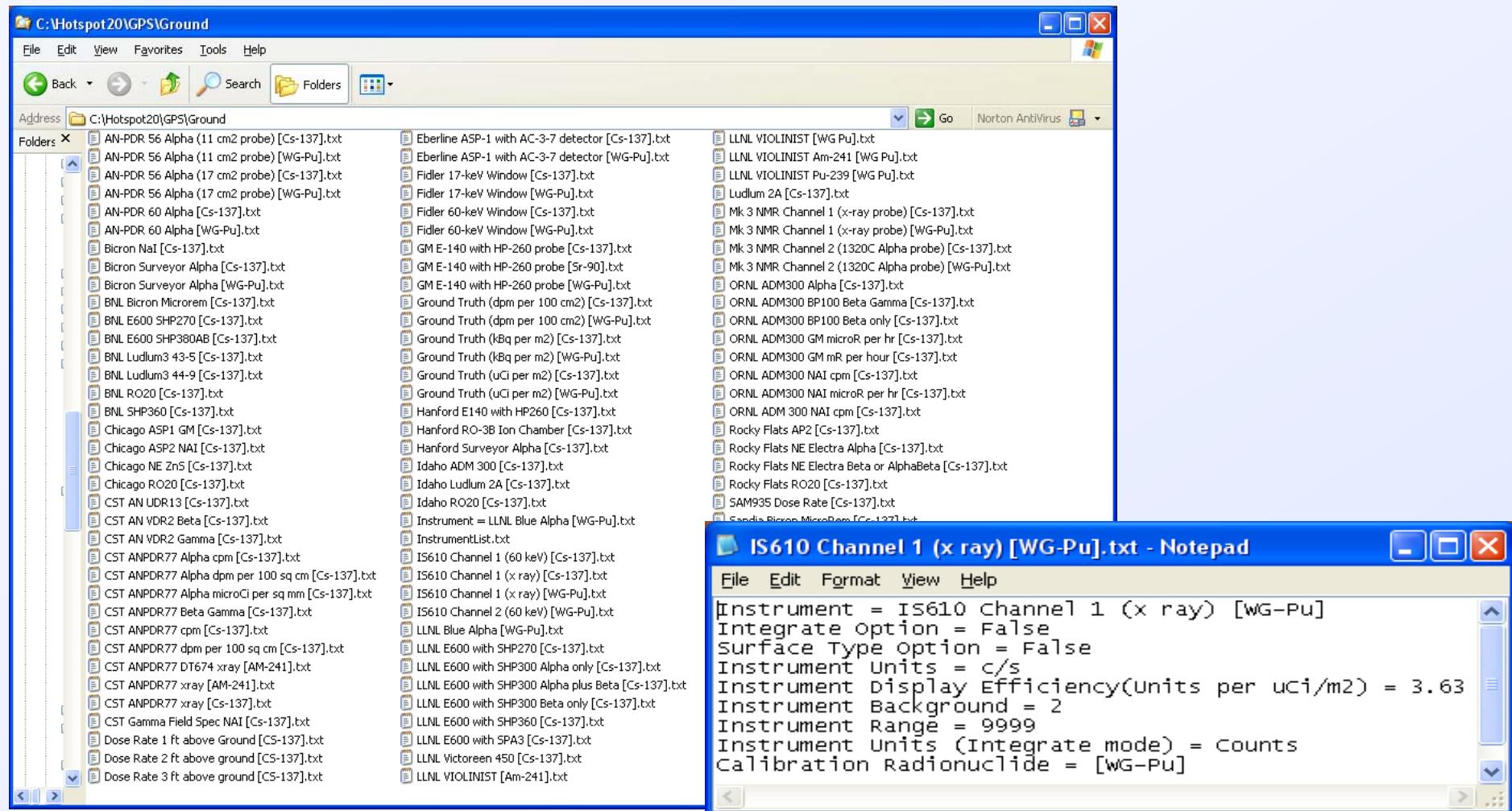
Hotspot geo-positioned map



NARAC



Current Hotspot Library contains over 100 radiation survey instruments



The screenshot displays two windows. The top window is a Windows File Explorer showing the contents of the 'C:\Hotspot20\GPS\Ground' folder. The bottom window is a Notepad application titled 'IS610 Channel 1 (x ray) [WG-Pu].txt' containing the following configuration parameters:

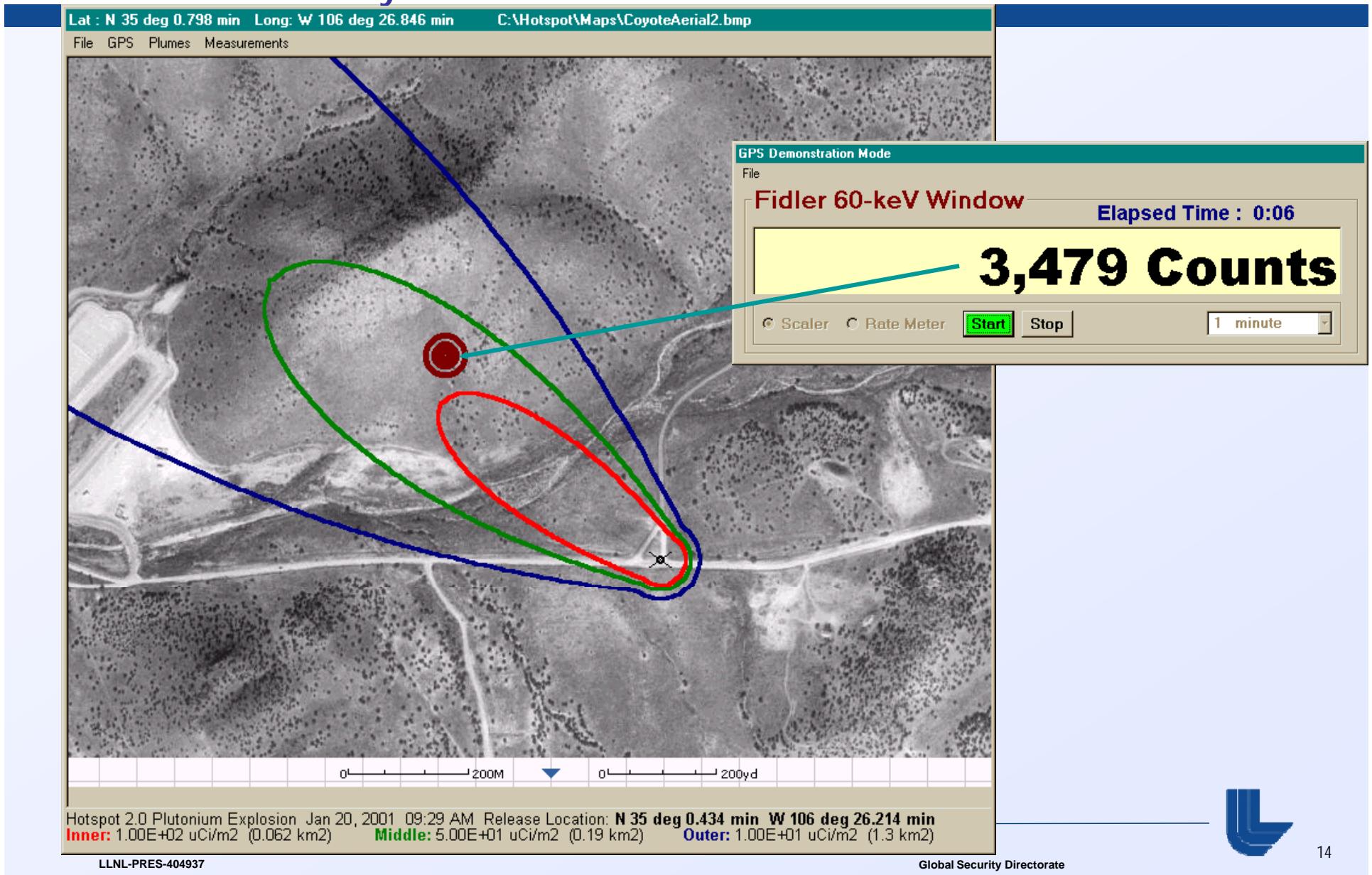
```

Instrument = IS610 Channel 1 (x ray) [WG-Pu]
Integrate Option = False
Surface Type Option = False
Instrument Units = c/s
Instrument Display Efficiency(Units per uCi/m2) = 3.63
Instrument Background = 2
Instrument Range = 9999
Instrument Units (Integrate mode) = Counts
Calibration Radionuclide = [WG-Pu]
  
```

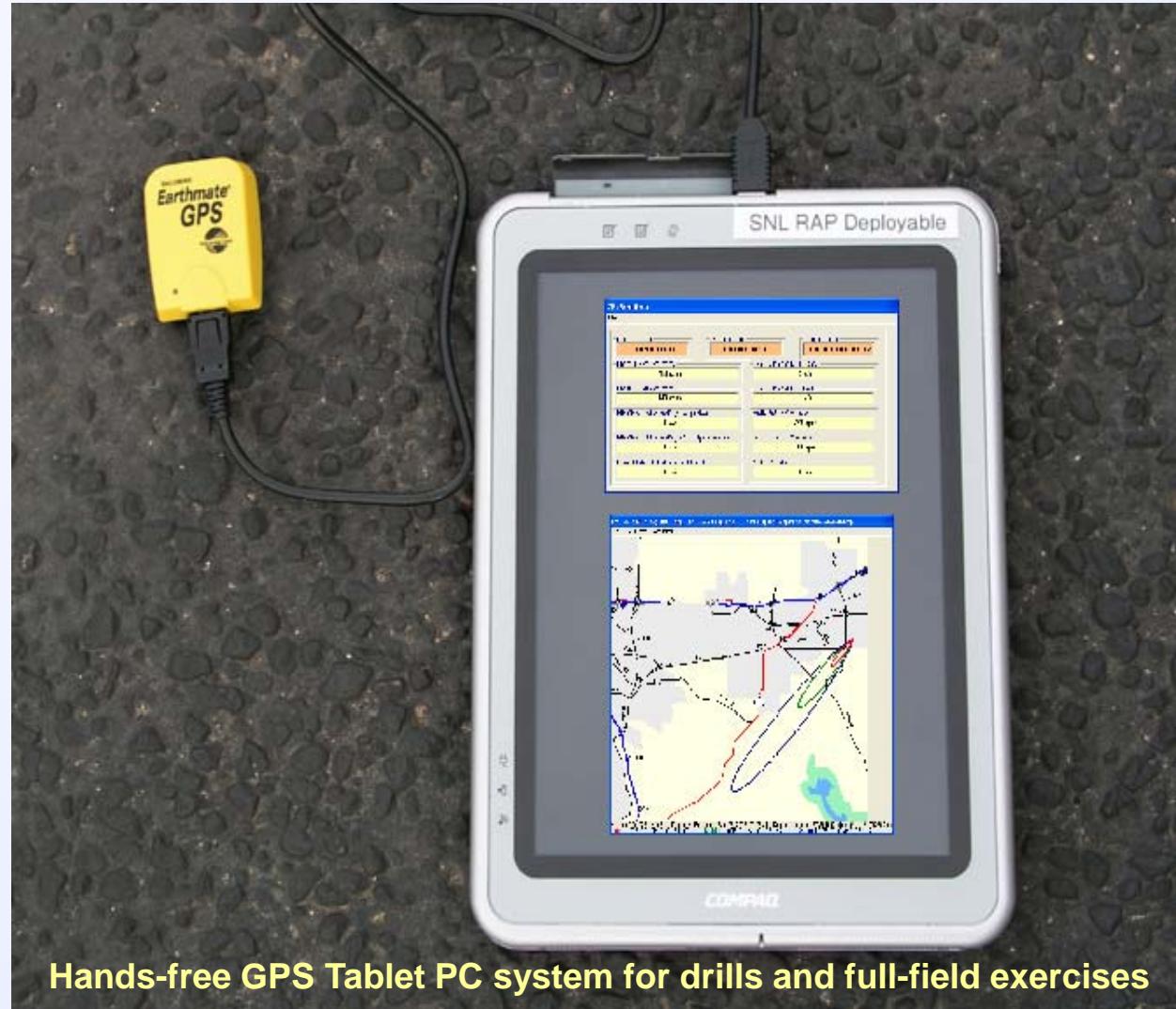
- Users can easily add their own instruments to the library



HotSpot GPS Virtual Plume Real-time Survey Instrumentation Simulation



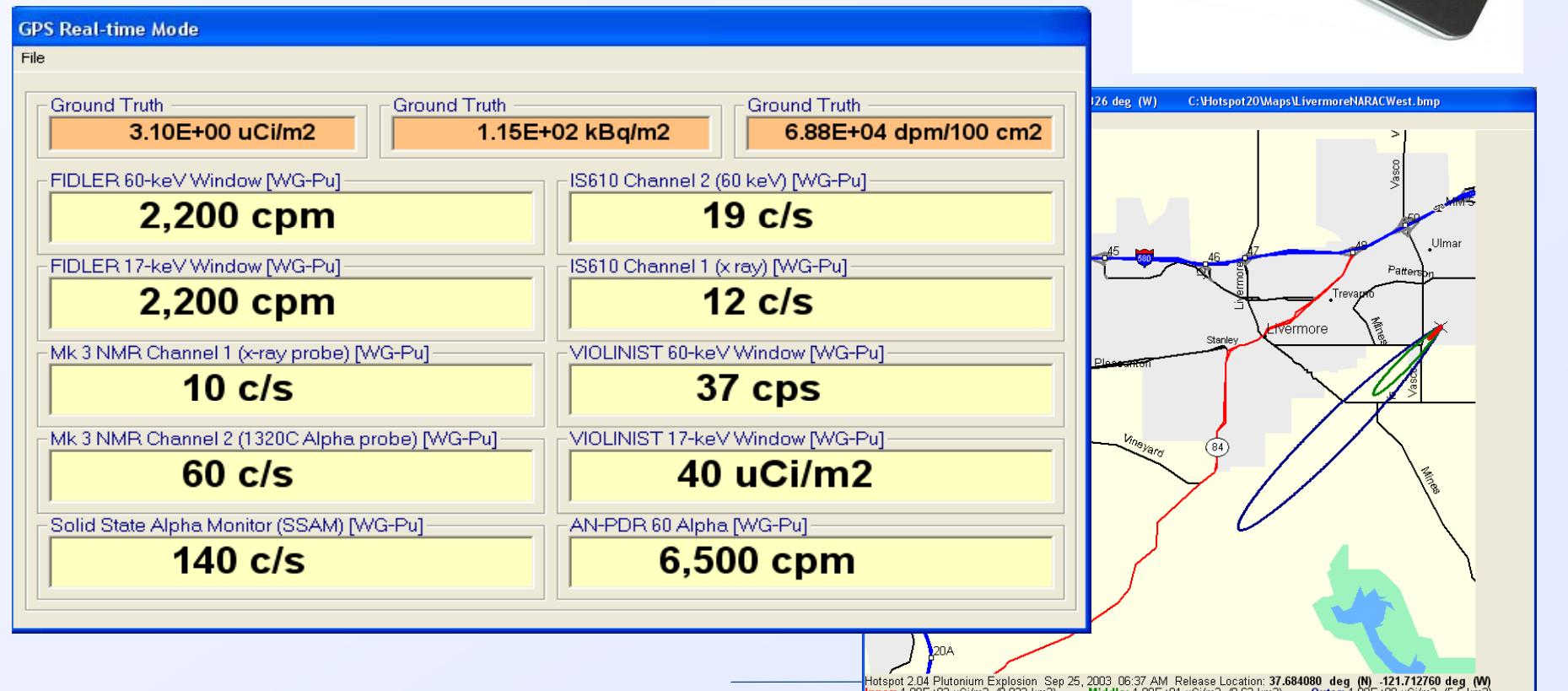
Hotspot GPS Capability Used by Exercise Controller to Simulate Real-time Data



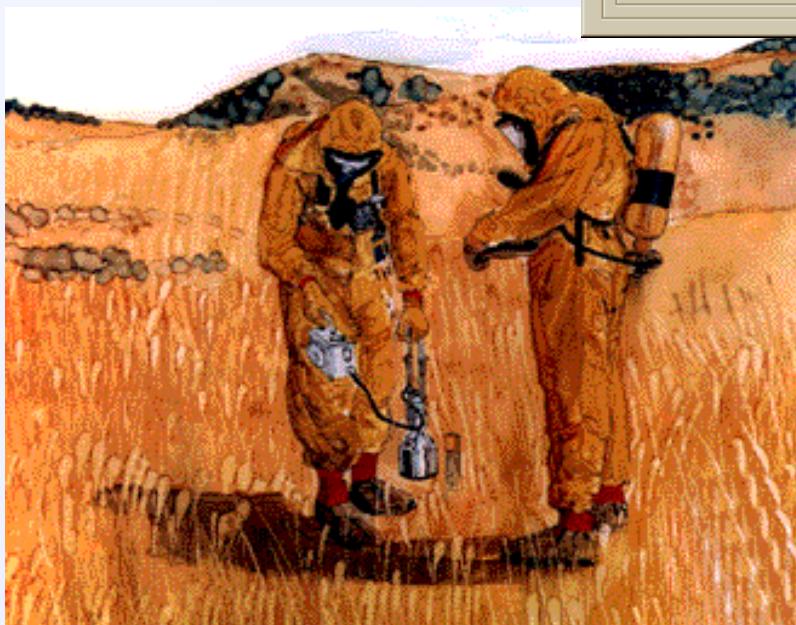
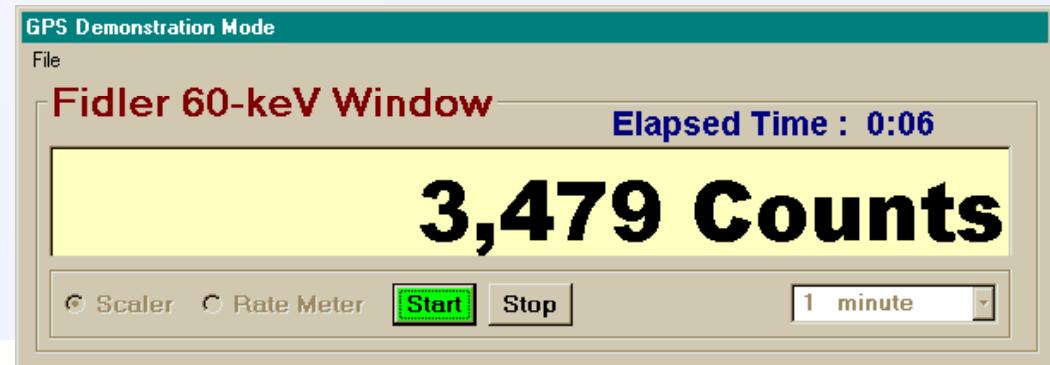
Hands-free GPS Tablet PC system for drills and full-field exercises

The simulated output of up to 10 radiation survey instruments, along with ground truth, can be displayed in real time

- Display options
 - Instruments, map and plume
 - Instruments and map
 - Instruments only



The display can consist of a single instrument,
effectively turning a tablet PC into a virtual instrument



LLNL FIDLER as an example

Hotspot can also simulate air filter sample data

- Hotspot provided counting data to realistically test the assessment of Alpha air concentration in the presence of natural radon background.

Air Filter Data - Resuspension

Resuspension Factor	1.0E-05 1/m
Radon Level	1216.2 pCi/m ³
	45.0 Bq/m ³
Limit of Sensitivity	0.0067 c/s
Alpha Counting Efficiency	10.000 %
Sample Volume	0.500 m ³
Ground Deposition	7.76E+01 uCi/m ²
	2.87E+03 kBq/m ² <input type="checkbox"/> Override Deposition Data

Enter Date and Time of Air Filter Data

T-0 (Time Filter Removed from Sampler)
18-Oct-2003 06:41

T-1 (Start of First Alpha Count)
18-Oct-2003 07:11

T-2 (Start of Second Alpha Count)
18-Oct-2003 07:41

Alpha Results (includes counter and radon background)

Count One	321 counts
	6.40E+01 Bq/m ³
	1.73E+03 pCi/m ³
Count Two	748 counts
	4.97E+01 Bq/m ³
	1.34E+03 pCi/m ³

Setup Exit Text File of Results

Air Filter Data - Resuspension

Resuspension Factor	1.0E-05 1/m
Radon Level	1216.2 pCi/m ³
	45.0 Bq/m ³
Limit of Sensitivity	0.0067 c/s
Alpha Counting Efficiency	10.000 %
Sample Volume	0.500 m ³
Ground Deposition	7.76E+01 uCi/m ²
	2.87E+03 kBq/m ² <input type="checkbox"/> Override Deposition Data

Enter Time Display Preferences

Sample Receipt Delay: 30 minutes T-1 Count Duration: 100 seconds

Time between T-1 and T-2: 30 minutes T-2 Count Duration: 300 seconds

Return Setup Exit Text File of Results

Alpha Results (includes counter and radon background)

Count One	321 counts
	6.40E+01 Bq/m ³
	1.73E+03 pCi/m ³
Count Two	748 counts
	4.97E+01 Bq/m ³
	1.34E+03 pCi/m ³

$$K = SA_{T_1} - \left[\left(\frac{SA_{T_1} - SA_{T_2}}{e^{-0.0173(T_1-T_0)} - e^{-0.0173(T_2-T_0)}} \right) \times e^{-0.0173(T_1-T_0)} \right]$$

K = the count rate due to plutonium

SA_{T1} = 1st count rate made at time **T1**

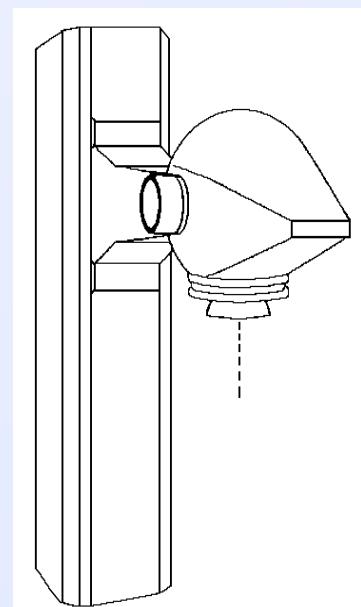
SA_{T2} = 2nd count rate made at time **T2**

T0 = time that the air sample stopped being taken



A Case Study: Goiania, Brazil 1987

- When a hospital changed locations, a radiation therapy unit was temporarily left behind.
- Scrap metal hunters found the unit and dismantled it for scrap metal (~ Sept 18th).
- The 1.4 kiloCi (1,400 Ci) Cs-137 source containment was breached during the process.
- Pieces of source distributed to family and friends.
- Everyone was impressed by “the glowing blue stones.” Children & adults played with them.
- Serious radiological accident recognized on Sept 29th when Acute Radiation Syndrome symptoms were recognized by hospital staff.



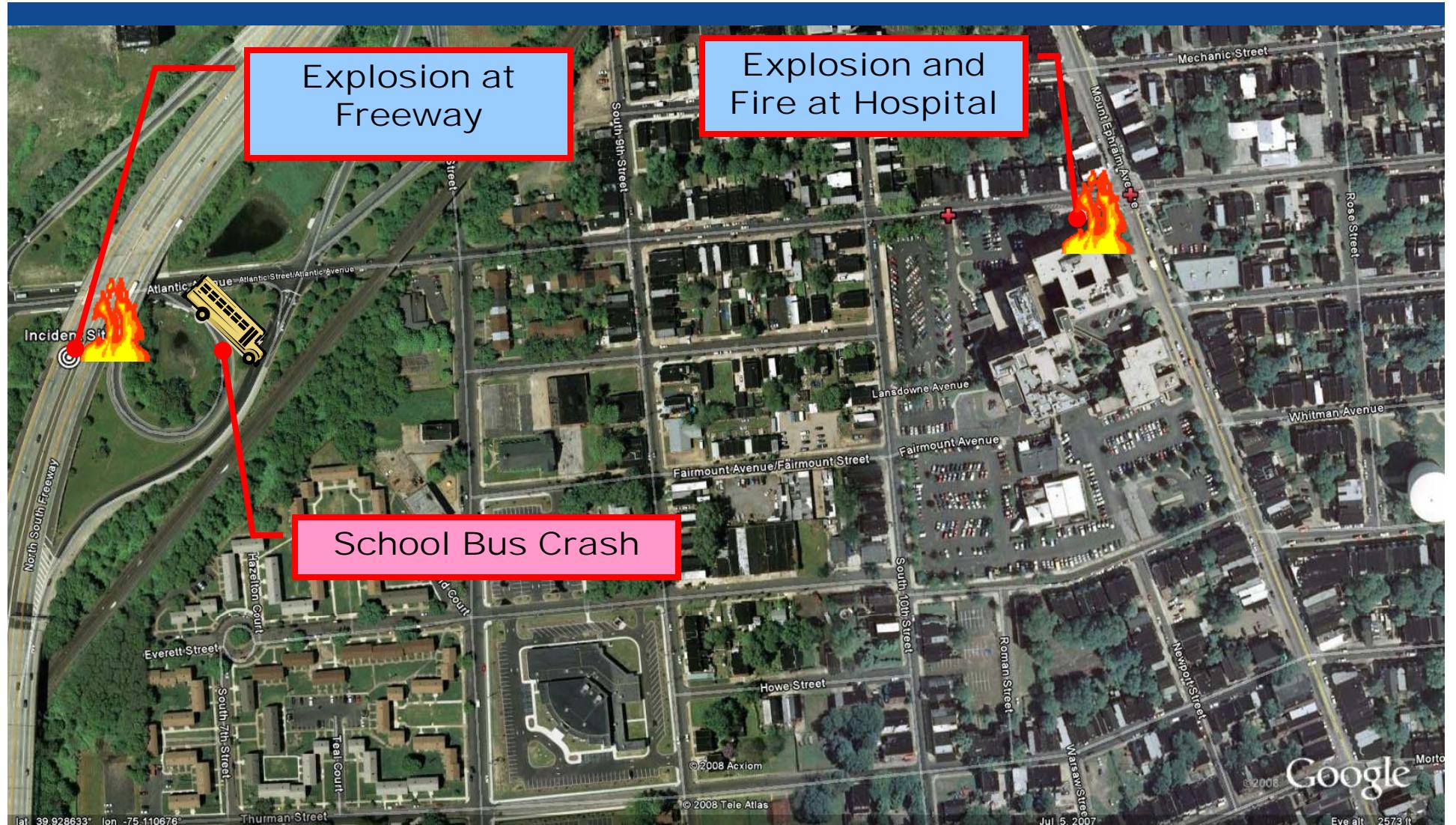
Example: Brazil's 1.37 kCi (1,370 Ci) Cs-137 Source Made Into a "Dirty Bomb"



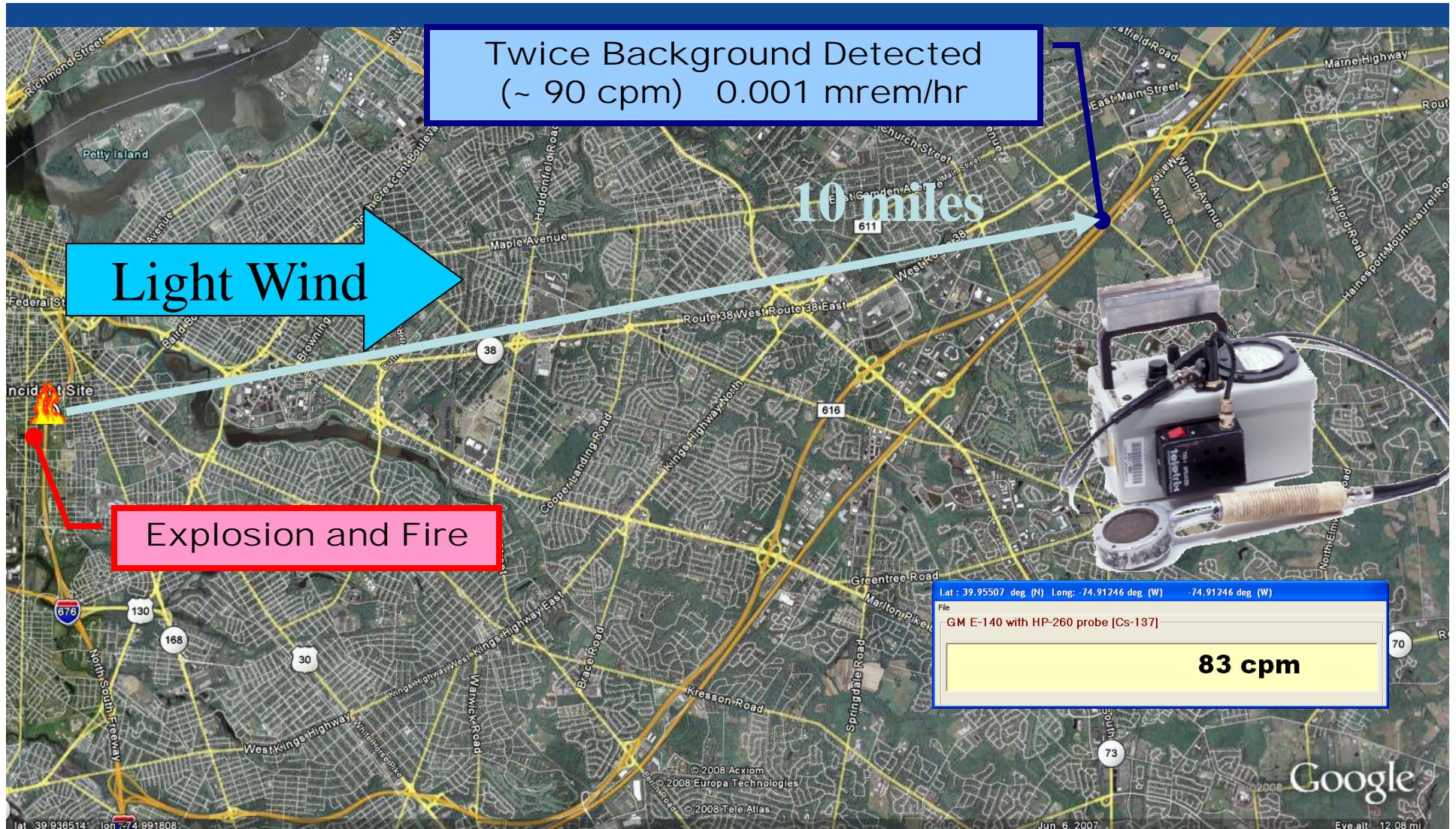
- Using Fictional “North Pointe” as an Example
- This model assumes “worse case” in that:
 - The source was 100% aerosolized (unrealistic)
 - Small explosive (~ 1 stick of dynamite)
 - Presumes exposed populations “stood outside” during the exposure period.
 - Effects dependent on weather



Trouble In North Pointe...

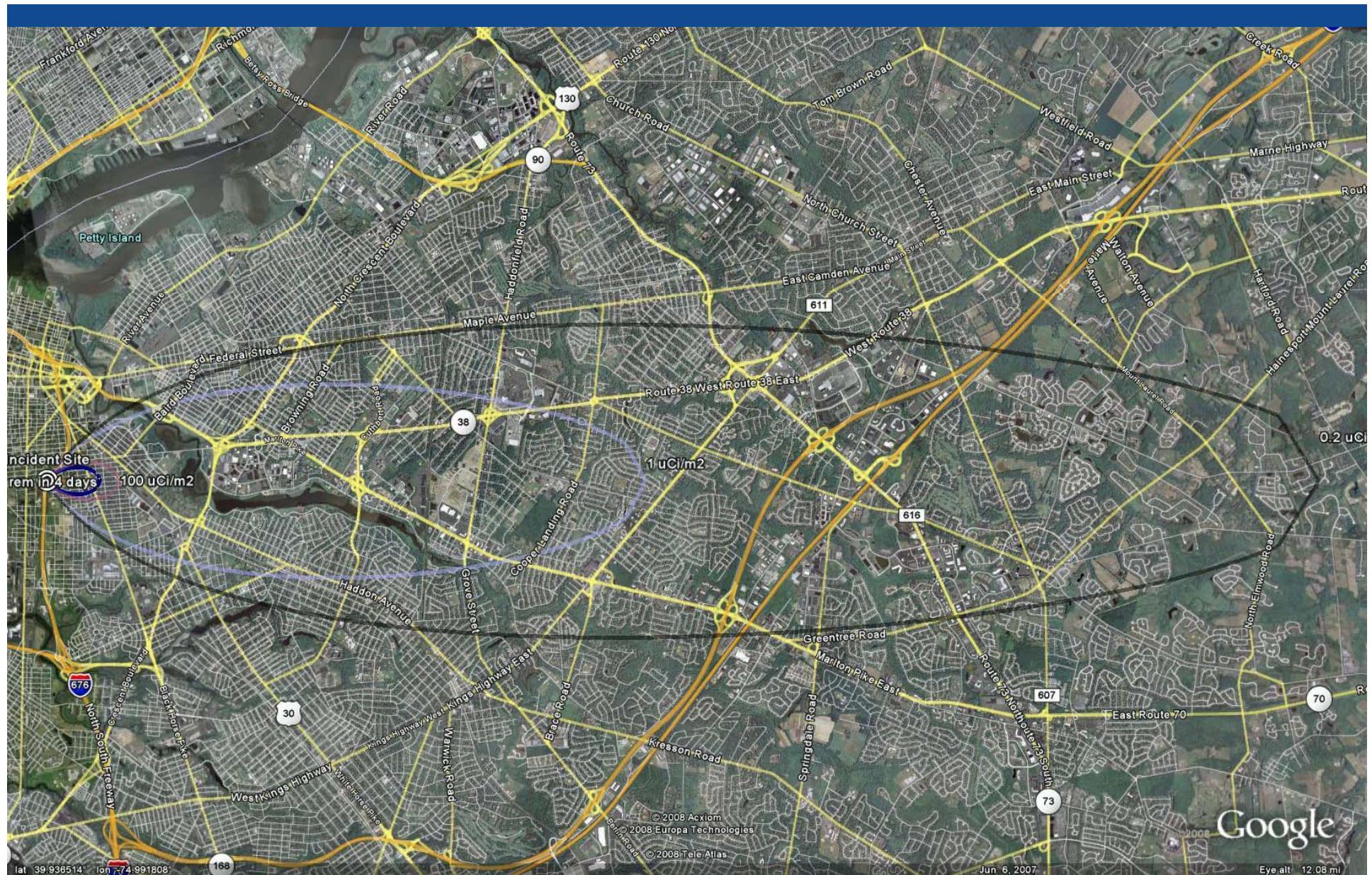


Detectable Ground Contamination Can Be Found Miles Downwind





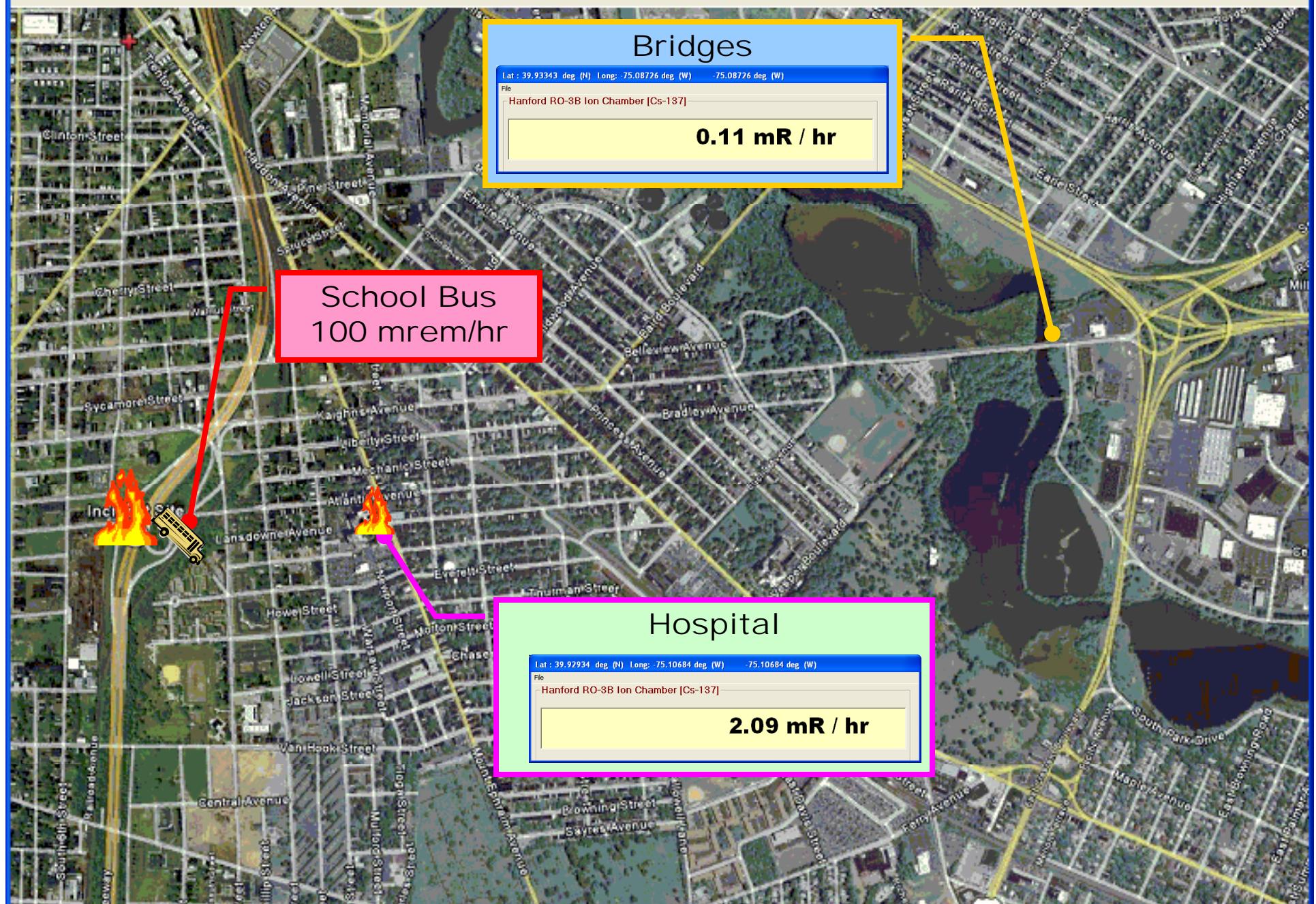
GlobalSecurity
Anticipate • Innovate • Deliver



Lat : 39.94184 deg (N) Long: -75.11230 deg (W)

C:\Documents and Settings\buddemeier1\My Documents\Train...

File GPS Plumes Measurements



Useful Points of Reference



1 rem in 4 days
Should Shelter
ALSO is
10mR/hr line!

1 rem / 4 day 0-1 rem / 4 day

School Bus: 2 hours of victim stabilization & rescue near scene:

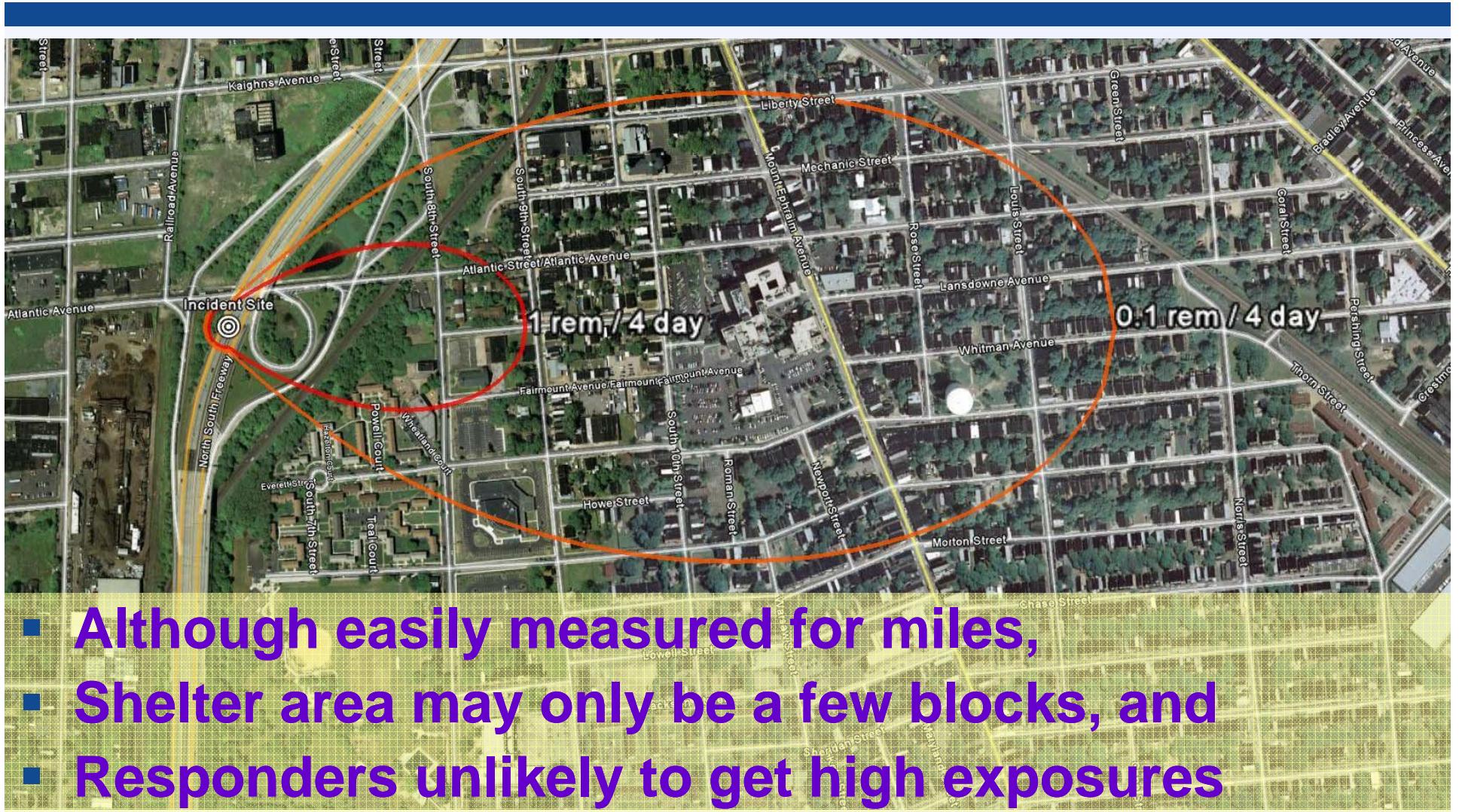
200 mrem total dose

Hospital: 10 hours of
firefighting and rescue:

40 mrem total dose



Putting It in Perspective



HotSpot Valuable Demonstration Tool

- HOTSPOT is a valuable demonstration and training aid for the community preparedness and emergency response planning, identifying ***operationally valid*** response guidelines
- HotSpot can help demonstrate that:
 - Acute health effects from radiation dose are unlikely for responders.
 - Contamination readily detectable at long distances.
 - Medical emergencies take precedent over radiological monitoring,
 - Used correctly, their instruments and protocols ensure their safety, and
 - The difference between contamination and radiation.

The overall objective when training first responders is to increase their confidence and lower their anxiety about effective radiological emergency response

What would you do?

http://trainex.org/web_courses/air_plume/

EPA Air Plume Maps WBT - Windows Internet Explorer

http://trainex.org/web_courses/air_plume/module.htm#m-1001

Welcome, Brooke Buddemeier

Page 1 of 3

Next ▶

The Details

Course Section

Important Docs



Breaking news from North Pointe...

You're about to take part in a fictional scenario involving the explosion of a radioactive (dirty) bomb from a truck traveling on the Interstate. You'll need to know some background information before you begin.

Your Title: Brooke Buddemeier, Special Consultant on Air Toxic Releases

Your Employer: Department of Emergency Services

Location: North Pointe (a small town)

Your Associates:

- Pat McDonald, Chief Consultant on Air Toxic Releases
- Maria Vazquez, Director of Emergency Services
- Grady Jones, Incident Commander
- James Lipscomb, Public Information Officer for North Pointe's Mayor

Your Tasks:

- Create an Action Plan
- Answer press questions
- Revise the Action Plan (based on updated information)
- Answer additional press questions

Tools: Files given to you by associates are stored within

Click NEXT to continue.

Internet 100% Done



References



Transportation Emergency Preparedness Program (TEPP)

<http://www.em.doe.gov/otem/program.html>

Predictive Modeling Provided By

HotSpot Health Physics Code v2.0, Steve Homann LLNL
National Release Advisory Center, LLNL (<http://narac.llnl.gov/>)

Gioania References Provided By

IAEA-TECDOC-1009, "Dosimetric and medical aspects of the radiological accident in Goiania in 1987," June 1998, International Atomic Energy Agency.

Radiation Emergency Assistance Services (SAER) from the Institute for Radiation Protection & Dosimetry (IRD), BRAZIL, Raul dos Santos.

Dr. Henry B. Spitz, Professor of Nuclear and Radiological Engineering, Department of Mechanical, Industrial & Nuclear Engineering, University of Cincinnati

Dr. Jose Julio Rozental

Bernardo Dantas, Instituto de Radioprotecao Dosimetria, Brasil

