Environmental Consequences of Radioactive Material following a Nuclear or Radiological Incident

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1. 10 kT surface burst
2. 100 kT high altitude burst
3. Nuclear power plant accident
4. Radiological dispersal device

Caveat: Responders – special case and not encompassed
10 kT Surface Burst – Prompt Effects

Rad

> 450
> 300
> 200
> 100
> 10

~ 200,000 Survivors
10 kT Surface Burst – Fallout Effects

Rad

- > 450
- > 300
- > 200
- > 100
- > 10

~ 700,000 people
100 kT Burst at 1000 Feet – Prompt Effects

~ 500,000 Survivors

Rad
> 450
> 300
> 200
> 100
> 10
100 kT Burst at 1000 Feet – Fallout Effects

~ 100,000 Survivors
Nuclear Power Plan Accident

- 25,000 people
- Dose is avoided, but public perception may require follow up

Projected Dose
- > 5 rem
- > 1 rem
Contour does not indicate dose to people.

Assumed dose from ingestion of contaminated products continuously for one year and VERY conservative!

If the public sees this graphic designed for decision-makers, unintended consequence may be perceived exposure and desire for health monitoring.

(over 1,000,000 people within the contour)
Radiological Dispersal Device – High Activity Source

- Dispersal: **Fragments** (> 90% of material)
- Cleaned up and restored to normal
- No large population involved

- 10 mR/hr (NCRP hot zone)
- 10 R/hr (NCRP dangerous rad zone)
Radiological Dispersal Device – High Activity Source

If the device produced a large aerosol fraction

~ 50,000 people

But very low dose
What information can be made available to responders, how fast, and how?
Nuclear Power Plant Accident – Best Case

- Evolve slowly
  - If containment failure occurs, time frame is many hours to days
- Plant operator in direct communication with the Nuclear Regulatory Commission and the State
- Responders are warned long before a release occurs
- Likely a release would be detected and monitored in real-time
- Plant personnel (others if pre-deployed) would make field measurements and share data
Nuclear Detonation – Not so best case

• Occurs “out of the blue”
  ▪ Local observations – Flash, “thump”, mushroom cloud
  ▪ IMACC product zero – keyhole plot can be issued State/Local
  ▪ IMACC issues a model within ~30 Minutes

• State and local Emergency Operations Centers are not fully staffed at time of detonation

• Some local communications within the first hours may be hampered by damage to infrastructure

• Local first response in the first 24-48 hours will be self-organized in varying degrees
  ▪ The ability to communicate will depend on the degree of preparedness and infrastructure of the affected region.
Radiological Dispersal Device – Worst Case

- Time to recognition variable
  - First responders equipped with radiation detectors – within minutes
  - If not equipped, must wait for a HAZMAT Team to arrive, could be an hour
  - Then issue a default Shelter-in-Place protective
Radiological Dispersal Device – Worst Case

- Time to identify the actual footprint of contamination and notify the affected area ~1-2 hours
Conclusion

- Nuclear detonation – Registry for a very large number of people

- Everything else – Driven by perception of risk and possible need to prove a negative