Falcon Analytics

ACADEMIC FORUM FOR NUCLEAR AWARENESS

Mass destruction or mass disruption?

Assessing radiological and nuclear terror scenarios

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When Hitler first bombed London the **panic** the bombs caused did far **more damage than the bombs** themselves. After the citizens of London lost their exaggerated fears of the bombings, life went on much as normal. And so it would be with a nuclear terrorist attack ...

Cresson H. Kearny
Civil Defense Consultant
to the US Government

Radiological Terror

- RDD (radiological dispersal device), *or* "Dirty bomb"

- Complexity level: low
  - radioactive waste + usual explosive

- Scale:
  - Suicide bomber/car (if no panic)

Radiological Terror

- "It is easier to make atomic bomb than effective RDD"
  T. Schlesinger, Soreq NRC

- "Such a device would be a weapon of mass disruption rather than a weapon of mass destruction."
  Mark Gwozdecky, IAEA

- "We agree that in many cases this is more of a **panic** weapon than anything else"
  Vayl Oxford, director , Domestic Nuclear Detection Office

HOWEVER

"…any bomb that killed people and set off Geiger counters would terrify a whole city. It's ultimately a **pure terror** weapon"

Time, Jun 10, 2002

Radiophobia

1) Costs per one year of life saved
   - Nuclear regulations: $27 million
   - Health care programs: $0.1 million

2) Threshold
   - Nuclear hazards: **no** threshold
     - any dose of radiation is considered harmful
   - Other hazards: threshold
     - considered harmless if below maximal allowable dose

Radiophobia vs. emerging scientific evidence

Japan A-bombing 1945 – 2008

no evidence of effects in offspring

RERF, 2008

Chernobyl accident 1986 – 2005

very limited increase in cancers – 15 lethal cases 1986-2002

no radiation-related increase in congenital malformations

IAEA, 2005

May Low-Dose Radiation Benefit?

"Hormesis" – beneficial health effects of low doses of radiation
Compare with UV!

Taiwan accident, 1983-2003 (radioactive buildings)
10,000 persons irradiated for 9 to 20 years.

Natural (expected) cancer deaths	**232**
Irradiated population: predicted cancer deaths	302
Irradiated population: **observed** cancer deaths	**7**

Is Chronic Radiation an Effective Prophylaxis Against Cancer?
J. American Physicians and Surgeons V.9 N.1 2004

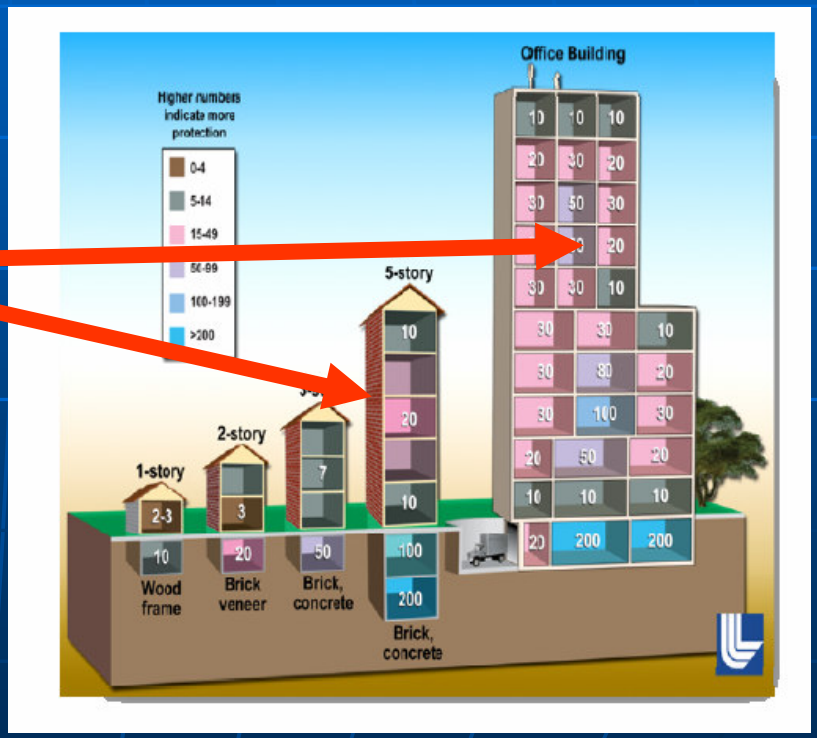
Radiophobia endangers us!

- Invites radiological terror
- Prevents effective screening (X-rays)
- Imposes heavy burden on the society

Response to radiological attack

"Come in, stay in, tune in"

1. Don't panic!
2. Enter building ("come in") – preferably upper floors
3. Do not exit – "Stay in"
4. Many radio-isotopes dangerous only if swallowed – behave accordingly
5. Listen to instructions ("tune in")



Nuclear Terror

Compact Nuclear Devices

1953: “Atomic Annie”

Caliber 280 mm
Length 1380 mm
Weight 365 kg

Yield 15 KT

1963: “W-48”

Caliber 155 mm
Length 846 mm
Weight 58 kg

Yield 1 KT

1956: “Davy Crockett”

Caliber 273 mm
Length 400 mm
Weight 23 kg

Yield 1 KT

Nuclear Terror

- Complexity level: extremely high
  - Rogue-state infrastructure support
- Scale:
  - 9/11 x **?**
- Casualties – 2 groups
  - On-spot effects (blast, prompt radiation)
  - Delayed effects (fallout)

Nuclear Terror

- Possibility of IND
  - (Improvised Nuclear Device)
  - US Congress OTA, 1979 1 KT
  - US DHS, 2008 10 KT
- Hiroshima
  - UK HO estimate, 1950 20 KT

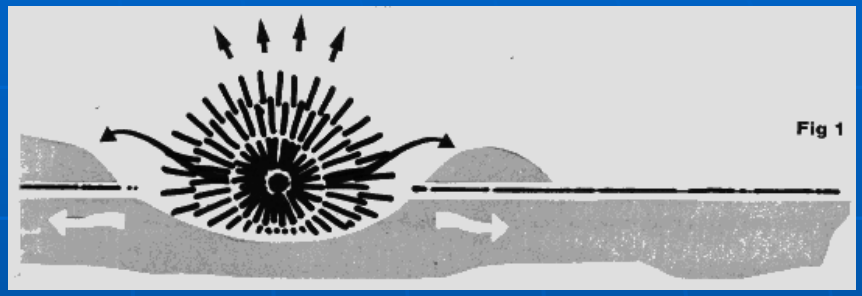
On-spot casualties estimation

	1KT Ground burst (US Congress OTA, 1979)	10KT Ground burst (US DHS, 2008)	20KT Air burst (Hiroshima; UK HO, 1950)
No warning	5,000	20,000	50,000
Population in buildings	2,500	10,000	25,000
Sheltered population	500	2,500	6,000

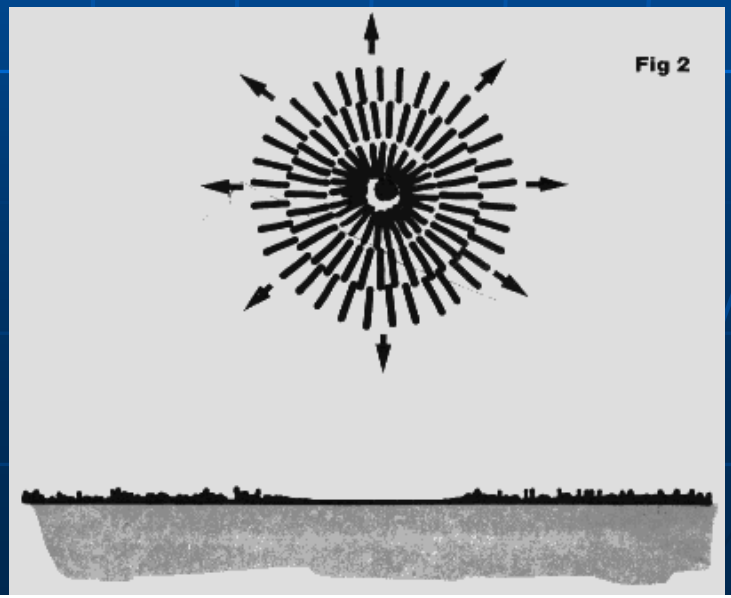
Delayed effects: Fallout

On spot effects

1. Shock wave
2. Thermal emission
3. Penetrating radiation
4. Fallout – Radioactive contamination

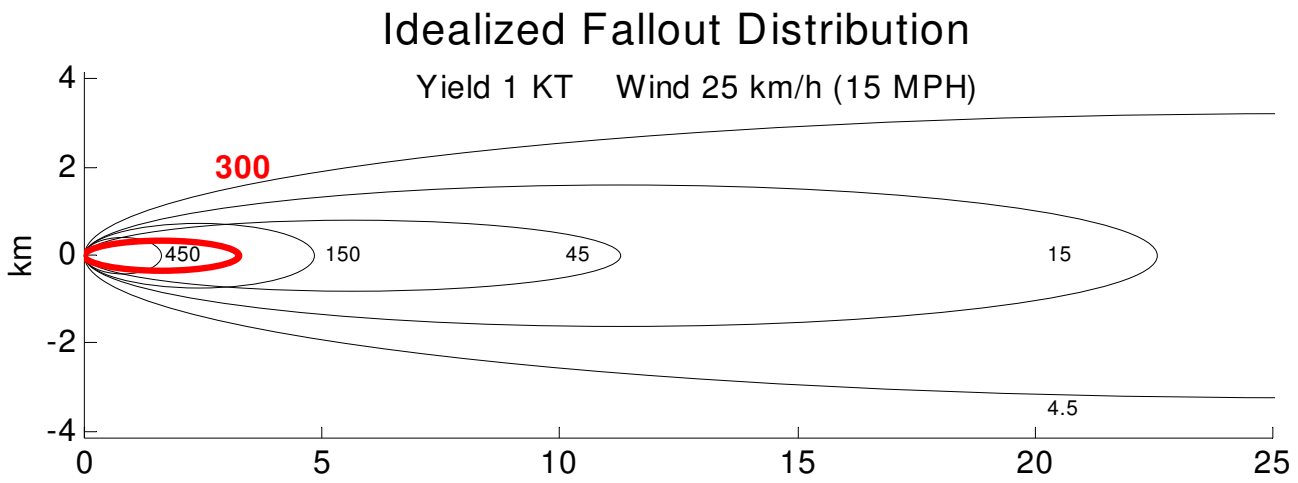


Hiroshima, Nagasaki:
air burst => **no fallout !**

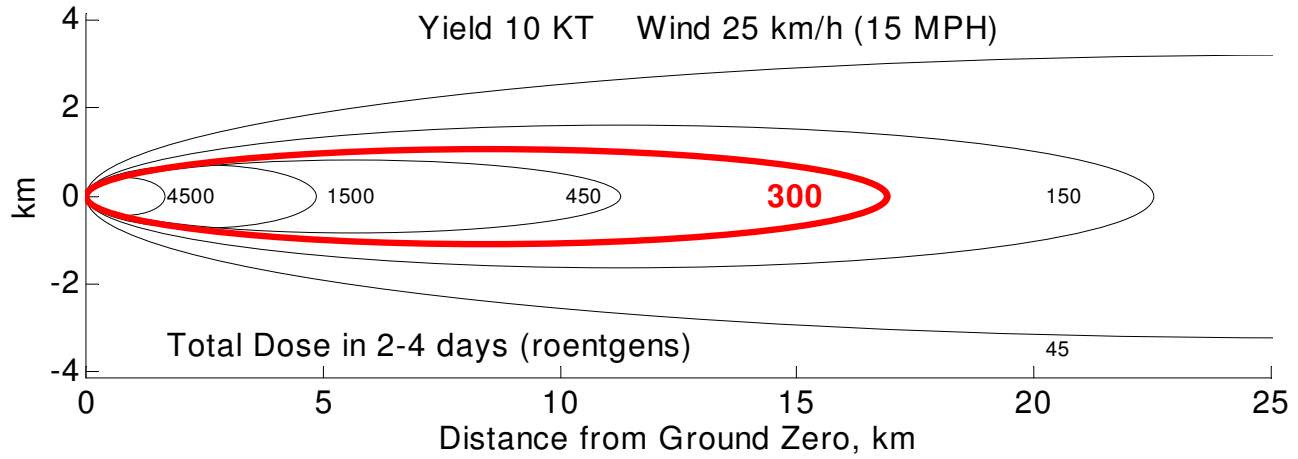


Fallout Area

1 KT



10 KT



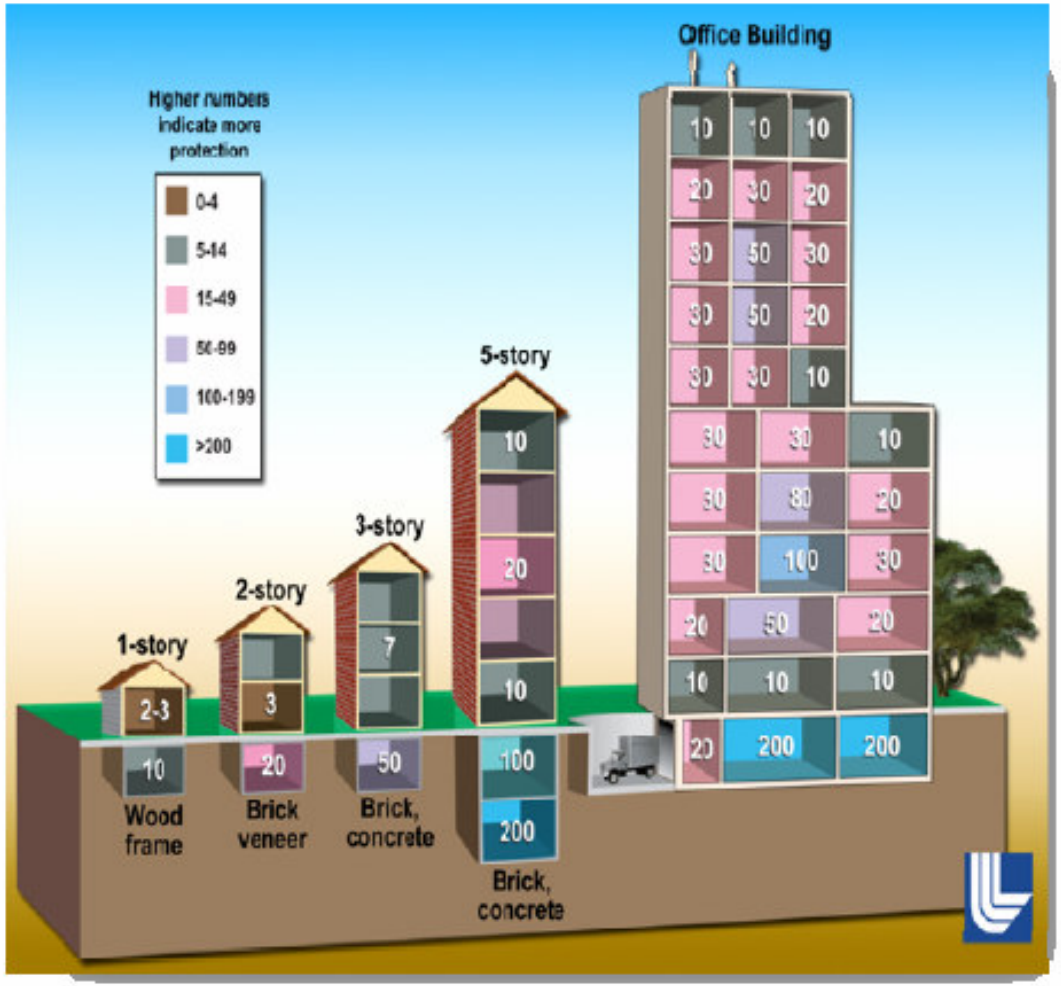
People in danger – unless take shelter (or evacuate)

Fallout decay: first 2 days critical

(2 days – 1 year) = ½ (0 – 2 days)

Radiation Decay	
1 h	100
7 h	10
2 days	1
2 weeks	0.1

Response:
similar to radiological attack
+ rescue works



Protection from exposure to radiation provided by sheltering in different types of structures and various places within those structures.

Source:
Lawrence Livermore National Laboratory, 2009.

Technical summary

1. **Radiological terror**
   1. Rather simple and probable
   2. Ultimately panic weapon - limited scale (suicide or car bomb)
   3. Response: "come in, stay in, tune in"

2. **Nuclear terror**
   1. Cannot be ruled out. Direct rogue-state infrastructure support must be involved
   2. Scale: 9/11 x ?
   3. Civil defense – psychological and physical – may reduce the casualties by more than an order of magnitude

Conclusions

1. **Avoiding panic by informing** the public is one of the main challenges
2. Inter-disciplinary approach, **collaboration** between **technical** experts, **social** scientists and **decision-makers** is crucial
3. **Civil defense** is an important part of the deterrence

Further Reading

1. Samuel Glasstone and Philip J. Dolan. *The Effects of Nuclear Weapons*. United States Department of Defense, 3rd edition 1977.
2. Office of Technology Assessment, Congress of the United States. *The Effects of Nuclear War.* 1979.
3. Cresson H. Kearny. *Nuclear War Survival Skills*. Oak Ridge National Lab 1977. 3rd edition: Oregon Institute of Science & Medicine 1999.
4. *The Number of Atomic Bombs Equivalent to the Last War Air Attacks on Great Britain and Germany.* Office of the Chief Scientific Adviser, UK Home Office CD/SA.16 1950.
5. IOM (Institute of Medicine). *Assessing medical preparedness to respond to a terrorist nuclear event: Workshop report.* Washington, DC: The National Academies Press 2009.

Appendices

Radiophobia vs. emerging evidence

"…**no evidence** of clinical or subclinical effects has yet been seen **in children** of A-bomb survivors."

Radiation Effects Research Foundation (Japan-US)
"A Brief Description", 2008. p. 30

"Apart from the dramatic increase in thyroid cancer incidence among those exposed [after **Chernobyl**] at a young age [4000 cases, 15 deaths by 2002], there is **no clearly demonstrated increase** in the incidence of solid cancers or leukaemia due to radiation in the most affected populations."

"There has been a modest but steady increase in reported congenital malformations in both 'contaminated' and 'uncontaminated' areas of Belarus since 1986; … This does not appear to be radiation-related and may be the result of **increased registration**."

International Atomic Energy Agency,
Chernobyl Report, 2005

Fallout

(2 days – 1 year) = ½ (0 – 2 days)

Lethal Dose:

LD_{50}	=	350 R
Slight or no radiation sickness		100-200 R
No illness	<	100 R
Acceptable dose (present peace-time standard for life-threatening emergency)		50 R

Cancer: +4% for 50 R
ICRP, 1990

Natural: 40%

Radiation Level Decay

1 h	100 R/h
7 h	10 R/h
2 days	1 R/h
2 weeks	0.1 R/h

Natural background: 0.4 R/year

Lung X-ray: 0.03 R