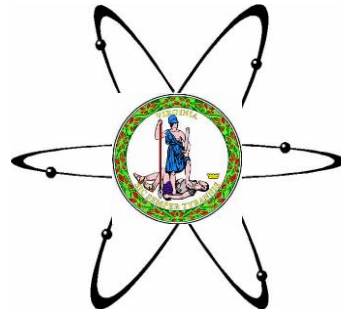


Radiological Terrorism Threats



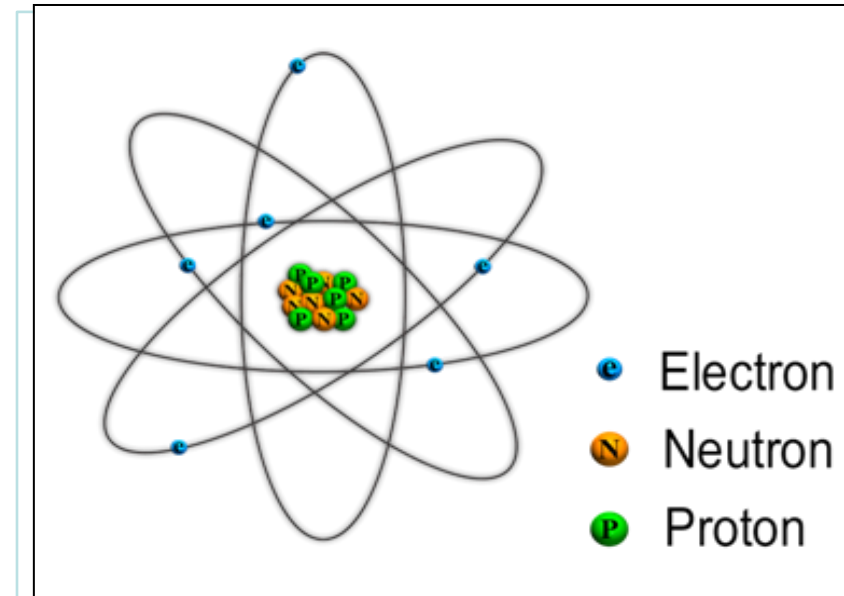
Virginia Department of Health
Office of Radiological Health

Radioactivity

Definition

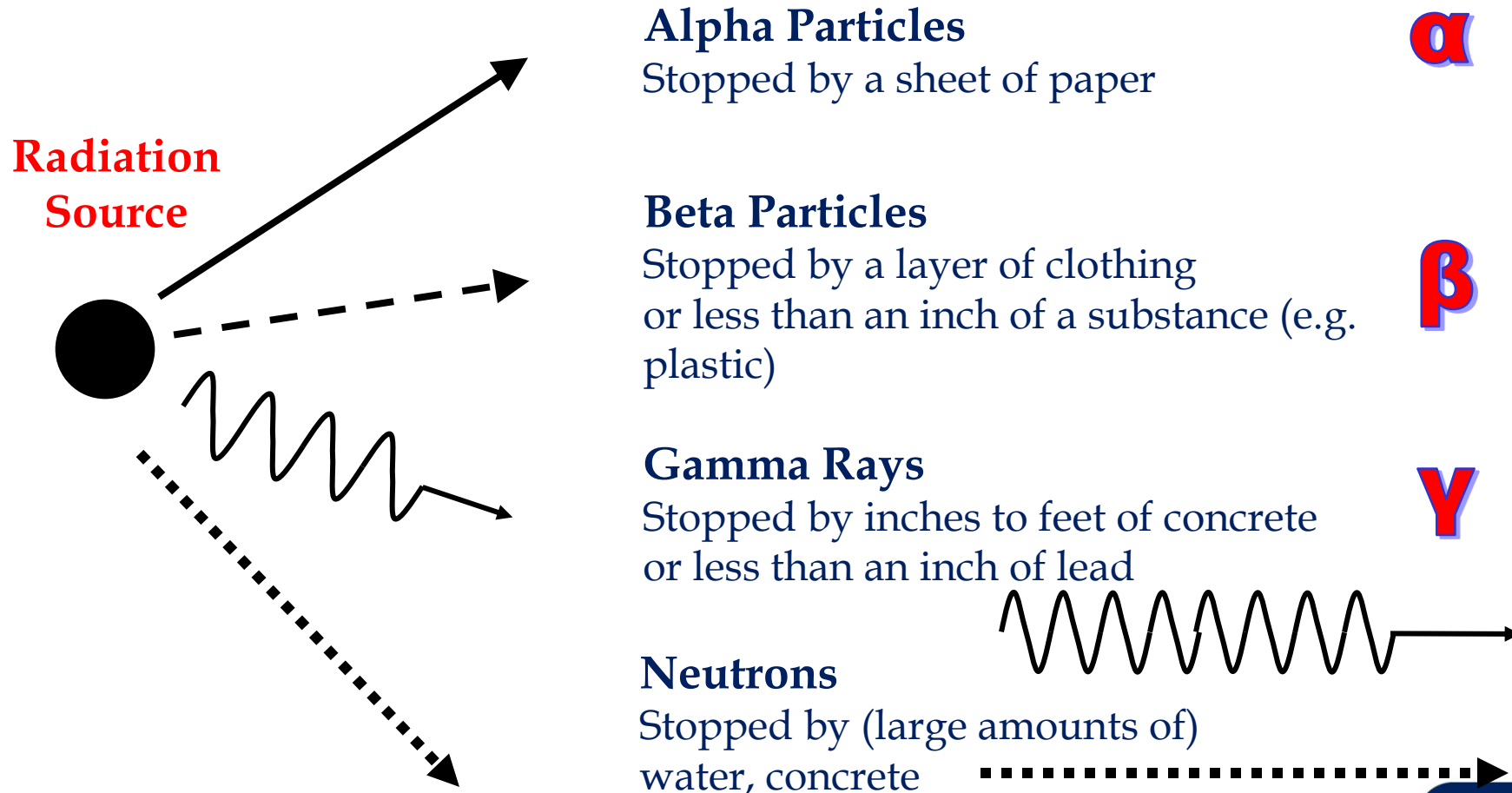
Any spontaneous change in the state of the nucleus accompanied by the release of energy.

- Atomic Structure:
All matter is made up of atoms
All atoms contain:
Protons
Neutrons
Electrons



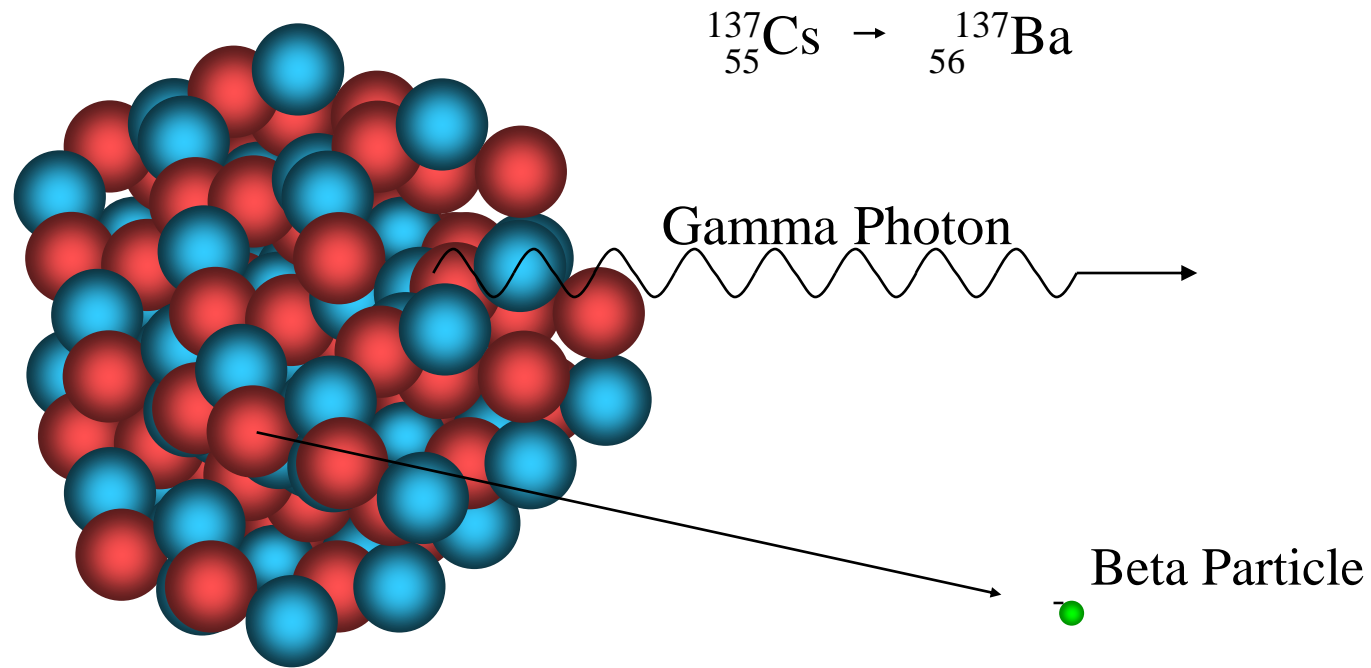
Not all atoms are stable.
Unstable atoms are
known as radioactive.

Penetration Abilities of Different Types of Radiation



γ Decay

- Emission of a photon from the nucleus
- Often occurs after α or β when nucleus is left in an excited state



Terminology

➤ **Dose rate** — is the absorbed dose per unit of time

- Micro-Rem per hour (uR/hr)
- Milli-Rem per hour (mR/hr)
- Rem per hour (R/hr)

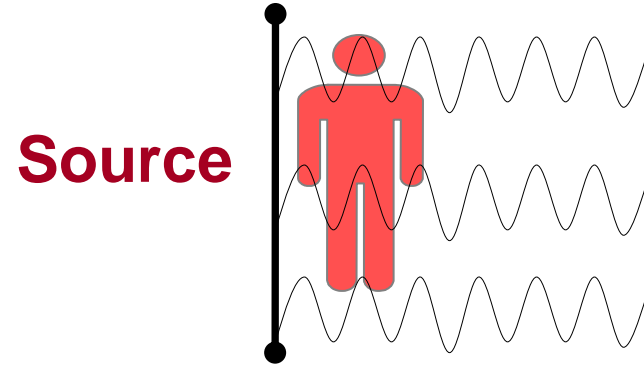
➤ **Dose** — the total amount of radiation received

- Calculated by multiplying dose rate by number of hours spent in radiation field
- 10 R/hr field x 2 hour exposure time = 20 R dose received

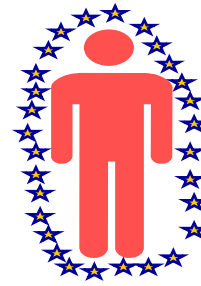


Types of Exposure

External Exposure



External Contamination



Internal Contamination



Radiation Risk in Perspective

Medical Management of Radiological Casualties, Armed Forces Radiobiology Research Institute (April 2003):

- Radiogenic health effects (Primarily cancer) are observed in humans only at doses in excess of 10 rem delivered at high dose rates.
- Below this dose, estimation of adverse health effects is speculative since risk of health effects are either too small to be observed or are non-existent.
- Epidemiological studies have not demonstrated adverse health effects in individuals exposed to small doses (less than 10 rem) delivered in a period of many years

Acute Radiation Syndromes

(Very high radiation doses in a very short period of time)

- Between 0 and 100 rads
 - Generally, there are no clinically observable changes
 - Some nausea at the high end of range in more susceptible persons.
- 100 - 200 rads
 - Nausea in 5-50% of individuals 3-6 hours after exposure
 - Nausea lasts less than 24 hours
 - Lymphocyte count minimally decreased
 - No central nervous system impairment
 - Minimal mortality
 - Most recover at lower end of range with some medical care

Acute Radiation Syndromes

(Continued)

- 200 – 600 rads
 - Nausea in 50-100% of individuals 2-4 hours after exposure lasting less than 24 hours
 - Lymphocyte count <1000 at 24 hours
 - Cognitive impairment for 6-20 hours
 - Mortality is low with aggressive therapy
- 600 – 800 rads
 - Nausea in 75-100% of individuals 1-2 hours after exposure lasting less than 48 hours
 - Lymphocyte count <500 at 24 hours
 - Cognitive impairment for >20 hours
 - High mortality even with aggressive treatment

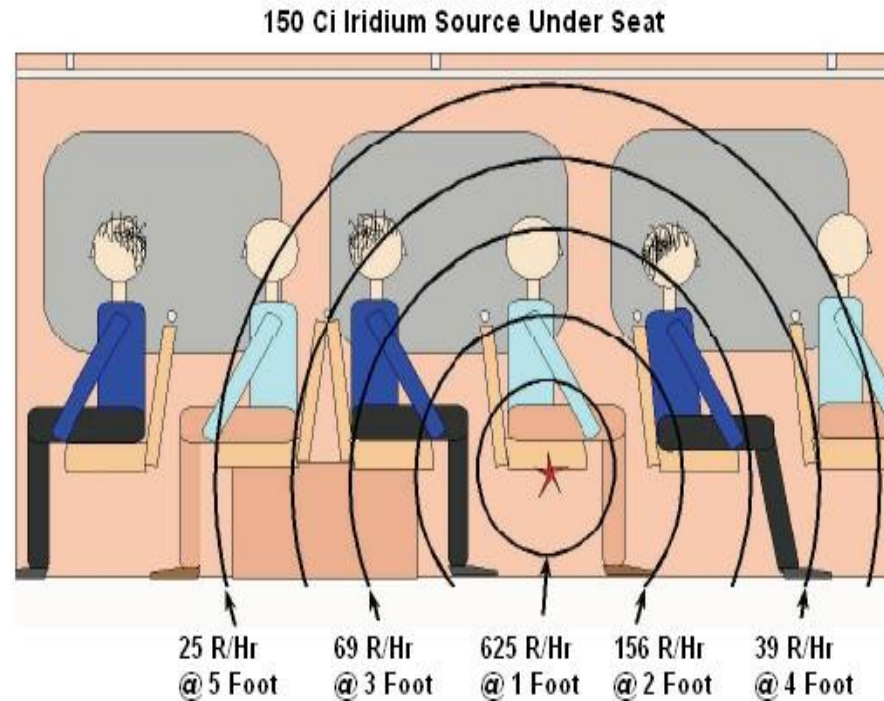
LD_{50/30} is approximately 450 rads with modest medical treatment

Acute Radiation Syndromes

(Continued)

- >800 rads
 - Nausea in 90-100% of individuals in minutes to <1 hours after exposure
 - Nausea last less than 48 hours
 - Lymphocyte count drastically decreases within hours
 - Rapid and total cognitive impairment progressing to total incapacitation
 - Extremely high mortality rate
 - Significant neurological symptoms indicate lethal dose

Radiological Exposure Device (RED)



Food Contamination

- Biological
 - Most Common
 - Generally accidental
 - Few instances of intentional acts
- Chemical
 - Rare
 - Accidental and intentional
 - Prevalence of chemical can be a clue
- Radiological
 - Known incidents in Russia and Japan
 - No known large scale intentional acts
 - Unique challenges



Intentional Radiological Contamination of Foods

- Commodities designed for consumption
- Contamination internalized
- Potentially thousands of individuals exposed
 - Direct contact or consumption
 - Contact with individuals, container, or surfaces
- External exposure likely limited primarily internal contamination

Radiological Contamination of Foods

- Dilution is the solution
 - Food manufacturing tends to be high throughput and high volume
 - Introduction of radiological contaminate in amounts necessary to significantly affect the product may be impractical
 - Uniform distribution of the contaminant within the food matrix may also be a challenge
- Social effect may be the same
 - Public lack of knowledge and understanding
 - Irrational fear of radiation
- Reported attack just as damaging?

Public Perception



- Fear level
 - Likely to be very high
 - Minimal impact from actual data (i.e. radiation levels)
 - Media sensationalism and social media will heighten fear
- Public information campaign
 - Messages will need to be informative and reassuring
 - Social media
 - Role of PIO and/or JIC
 - How much is too much

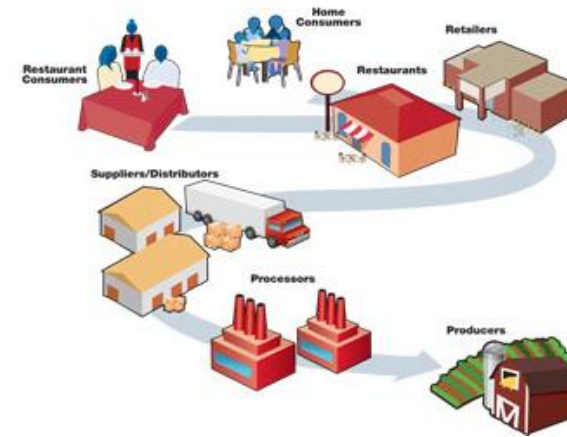


Detection

- Heavily influenced by point of introduction, complexity of food product, and type of radiation
 - Stage: Ingredient vs. finished product
 - Additional processing/packaging
- Radiological monitoring/testing of foods is rarely performed (Milk)
- Epidemiological Challenges
 - Commonly reported symptoms
 - Lack of experience/understanding in medical community
 - Delayed onset of symptoms
 - Conflicting or confusing food histories
 - Food not initially considered as vehicle

Investigation/Traceback

- Identifying origin of contamination
 - Ingredient or packaging
 - Finished product
 - Manufacturing or retail
 - Epidemiological data invaluable
- Sampling: Where does it end?
 - How many samples
- Need for speed
 - Management, politicians, and the public will be demanding answers
 - Continued exposure



Recall and Disposal

- Scope dependent on results of traceback
 - Ingredient vs. finished product
- Product disposition
 - Disposal by the consumer
 - Return to point of purchase
 - Secure and isolated space for storage of product
 - Avoid exposure
- Disposal
 - Limited options for disposition of food
 - Screening of samples
 - Packaging may block radiation
 - Very high quantities

Radiation Dispersion Device or RDD (Dirty Bomb)

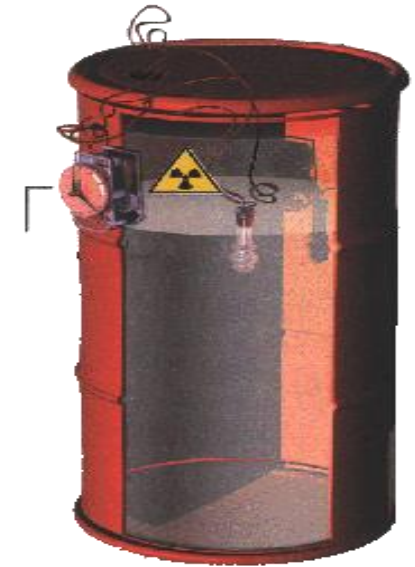
Conventional explosive combined with radioactive material
Intent to spread radioactive material over a relatively large area

Not a nuclear device, but a disruptive device!

Few, if any, injuries or deaths from radiation exposure

Likely to result in widespread panic and chaos

Widespread surface contamination may require prolonged evacuation and expensive clean-up



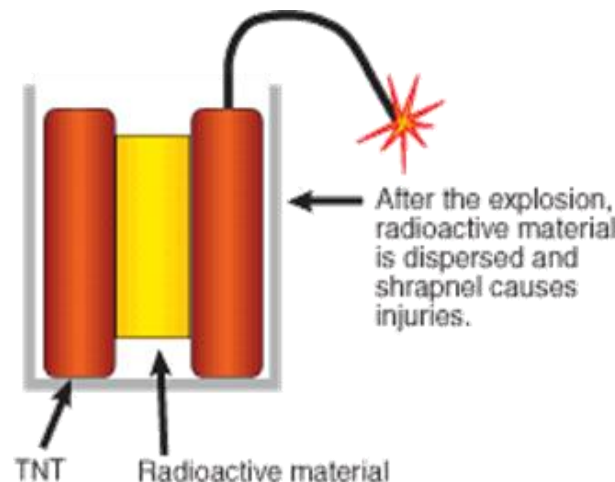
Unique Aspects of an RDD

Treatment of medical conditions take precedence over decontamination!

Urgency of decontamination is much less than that for chemical or biological events

Public has an exaggerated and irrational fear of radiation—this may extend to the response community!

RDD event will not likely result in any acute radiological health effects





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Radiation Dispersion Devices

- Best defense against an RDD is early detection and mitigation of the threat before it can be detonated
- Once a device detonates response efforts become much more complicated
- Detection before detonation is heavily reliant on response personnel carrying the proper equipment and being trained in it's use
- Identification of the isotope(s) involved can help guide response efforts
- Detection and identification equipment is equally important in the response to a successful detonation
- Training of detection and response personnel is paramount to the successful interdiction and mitigation of an RDD threat

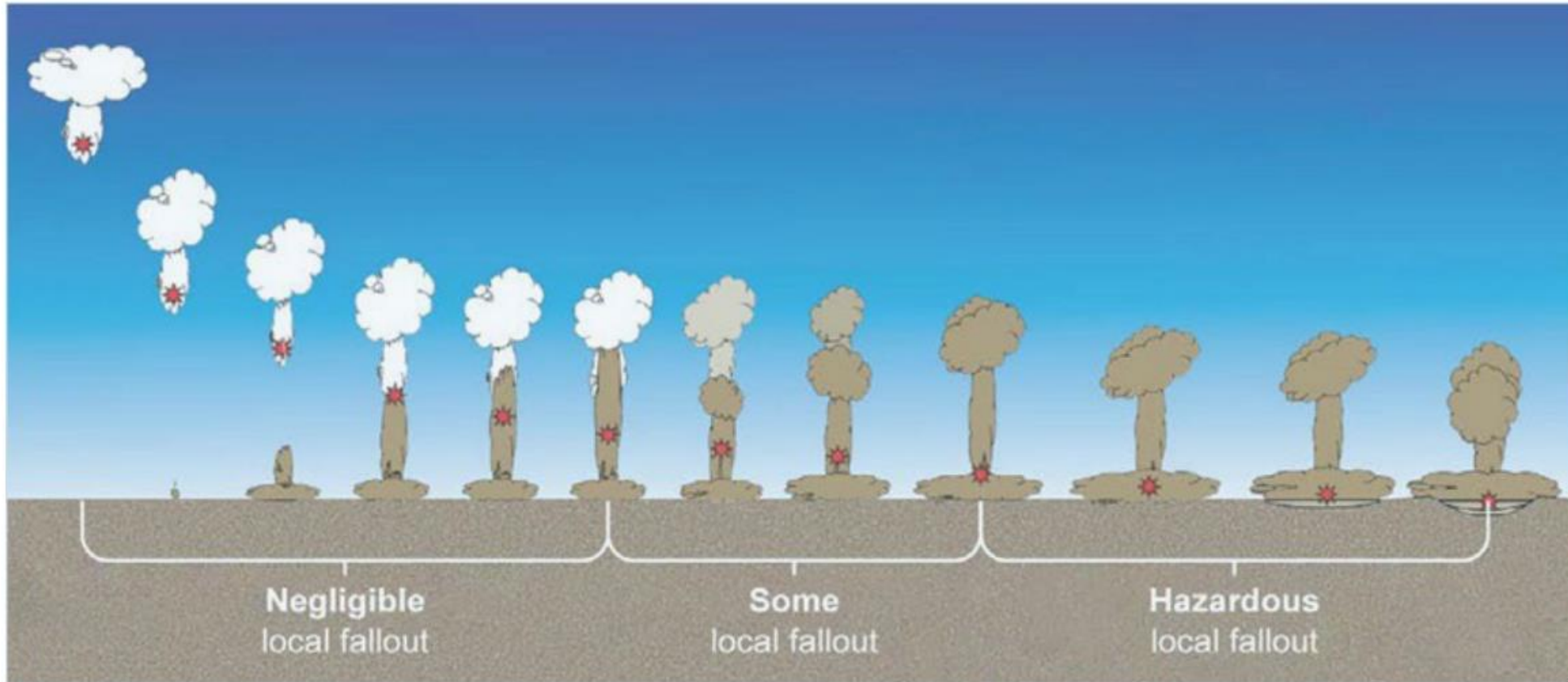


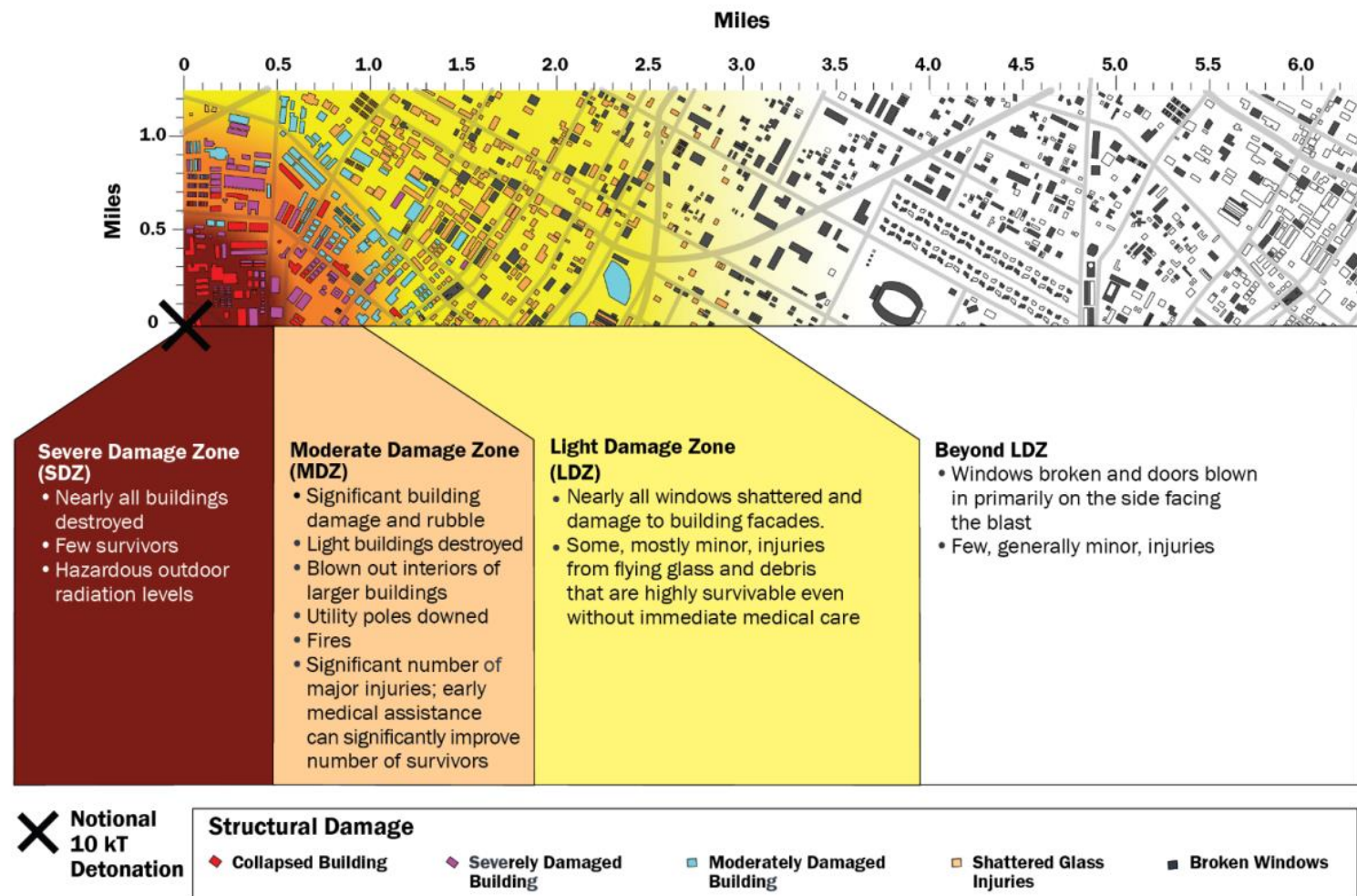
Nuclear Detonation

Federal Emergency Management Agency. (2022). *Planning guidance for response to a nuclear detonation* (3rd ed.). U.S. Department of Homeland Security. https://www.fema.gov/sites/default/files/documents/fema_nuc-detonation-planning-guide.pdf

Nuclear Detonation

- What to expect
 - Warning
 - Recognition
 - Immediate Actions
 - Zones
 - Fallout
 - 7-10 Rule of Thumb
 - Height of Burst Considerations
 - EMP





Radiation Zones

(Approximate for a 10 kT)

Dangerous Radiation Zone (DRZ)

- Bounded by radiation levels of 10 R/hr
- Acute Radiation Injury possible within the DRZ
- Could reach tens of miles downwind
- Begins to shrink after about 1-2 hours

Hot Zone

- Bounded by radiation levels of 0.01 R/h (10 mR/h)
- Acute radiation effects unlikely; however, steps should be taken to control exposure
- Could extend in a number of directions for hundreds of miles
- Begins to shrink after 12-24 hours
- After ~ 2 weeks the Hot Zone will be the size of the maximum extent of the DRZ (tens of miles)

Blast Zones

(Approximate for a 10 kT)

Severe Damage Zone (half-mile radius)

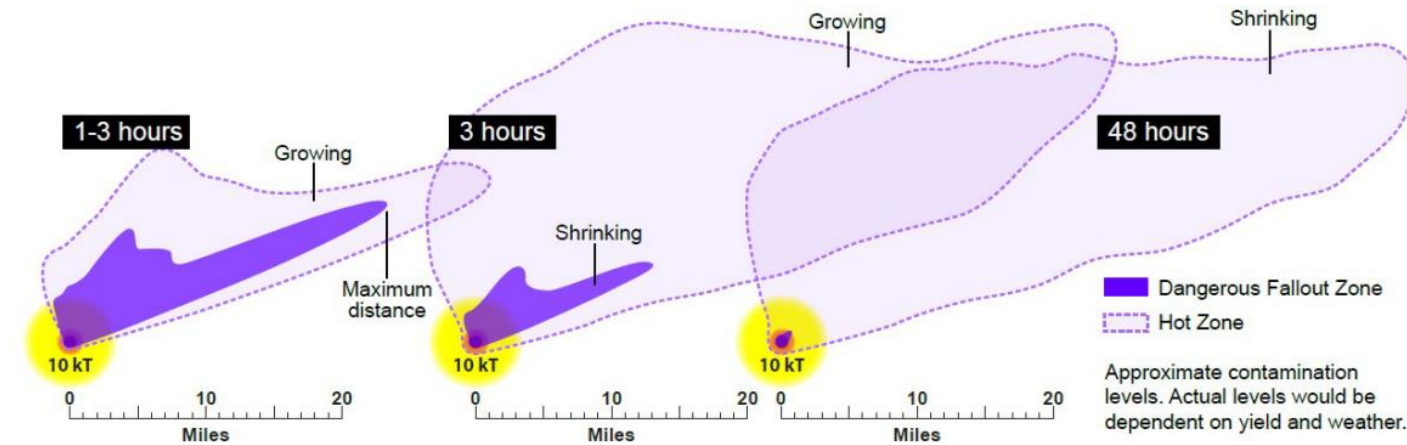
Most buildings destroyed; hazards and radiation initially prevent entry into the area; low survival likelihood

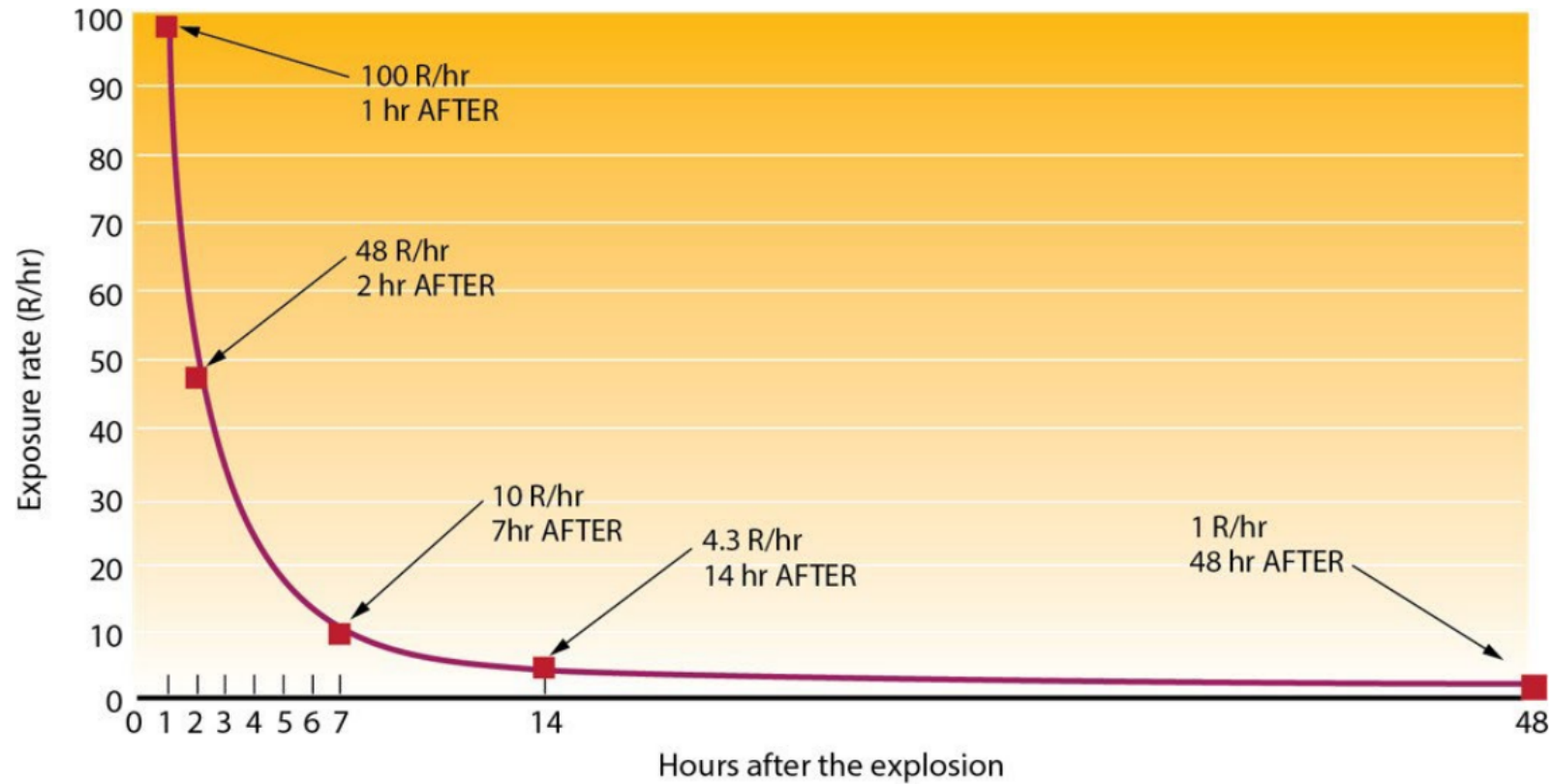
Moderate Damage Zone (half- to 1-mile radius)

Significant building damage and rubble; downed utility poles, overturned automobiles, fires, and many serious injuries; early medical assistance can significantly improve the number of survivors

Light Damage Zone (1- to 3-mile radius)

Windows broken; mostly minor injuries that are highly survivable even without immediate medical care

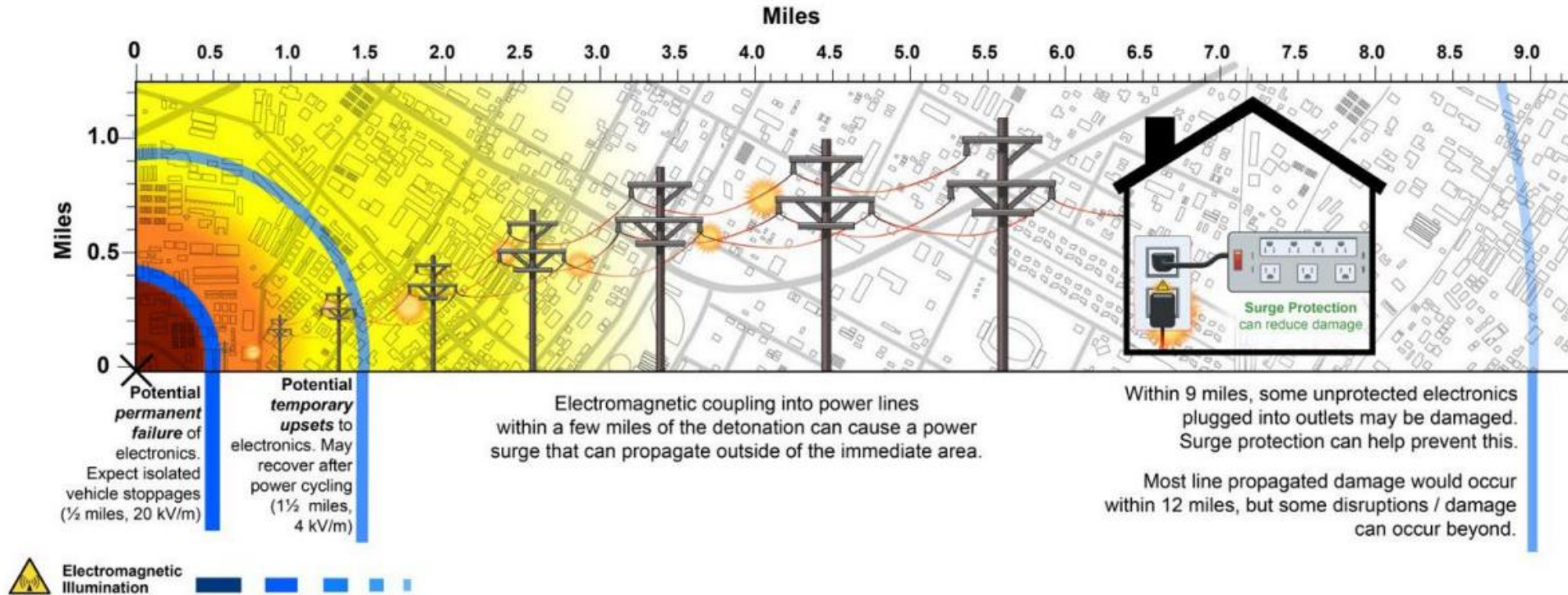




Decay of the dose rate of radiation from fallout, from the time of the explosion, not from the time of fallout deposition.

Blast damage zones shown for a nominal 10kT detonation

■ Severe Damage Zone ■ Moderate Damage Zone ■ Light Damage Zone



Thank You

Matthew Ettinger

Director, Environmental Monitoring & Emergency Preparedness Division

Virginia Department of Health - Office of Radiological Health

804-864-8160

matthew.ettinger@vdh.virginia.gov

Chris Ryker

Radiation Safety Specialist

Radioactive Materials Division

Virginia Department of Health - Office of Radiological Health

804-690-8637

christopher.Ryker@vdh.virginia.gov