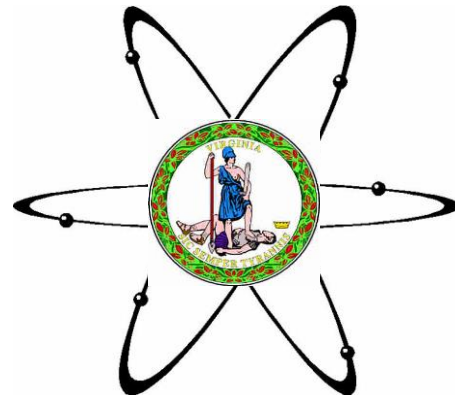





# Volunteer Opportunities in Radiological Incident Response










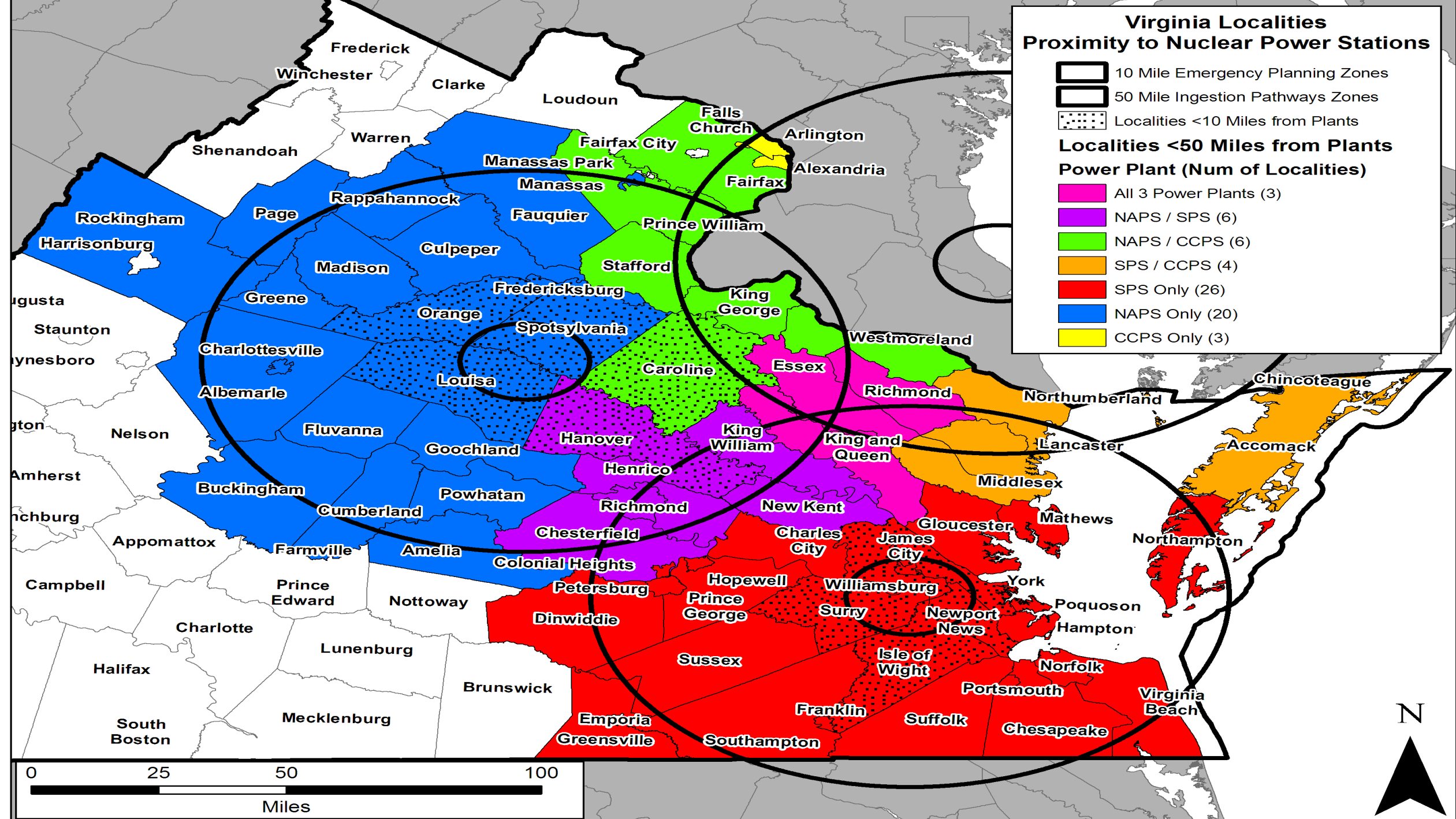
Virginia Department of Health  
Office of Radiological Health

# Virginia Localities Proximity to Nuclear Power Stations

-  10 Mile Emergency Planning Zones
-  50 Mile Ingestion Pathways Zones
-  Localities <10 Miles from Plants

## Localities <50 Miles from Plants Power Plant (Num of Localities)

-  All 3 Power Plants (3)
-  NAPS / SPS (6)
-  NAPS / CCPS (6)
-  SPS / CCPS (4)
-  SPS Only (26)
-  NAPS Only (20)
-  CCPS Only (3)



# Emergency Classifications

	Emergency Action Levels			
	UNUSUAL EVENT	ALERT	SITE AREA	GENERAL
Description of plant conditions	Events which indicate a potential degradation of the level of safety of the plant	Events which involve an actual or potential substantial degradation of the level of safety of the plant.	Events which involve actual or likely major failures of plant functions.	Events which involve actual or imminent substantial fuel degradation or melting with potential for loss of containment.
	Emergency Plan			
Radiation Dose to the public	Radioactivity release detectable by plant radiation monitors and may be from 0.1 to 1 mR/hr measurable offsite.	Radioactivity release detectable by plant radiation monitors and may be from > 10 to <100mR/hr measurable offsite.	Radioactivity release detectable by plant radiation monitors and may be from > 100 to < 1000mR/hr measurable offsite.	Radioactivity release detectable by plant radiation monitors and may be > 1000 mR/hr measurable offsite.

# State Response to a Nuclear Power Station Event

- Emergency Operations Center (EOC)
  - Numerous Emergency Support Functions (ESFs) represented
  - ESF-8 (Health-ORH) and VDEM are lead agencies
  - Overall command and control of response efforts
  - Develop Protective Action Recommendations (PARs)
- Dominion Corporate Emergency Response Center (CERC)
  - VDEM and ORH staff interface with Dominion Energy
  - Monitor plant conditions, meteorological data, and other factors
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  - Manage and deploy state field teams
- Staging Area and Field Teams
  - Equip and brief state field teams prior to deployment
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# Dominion Energy CERC



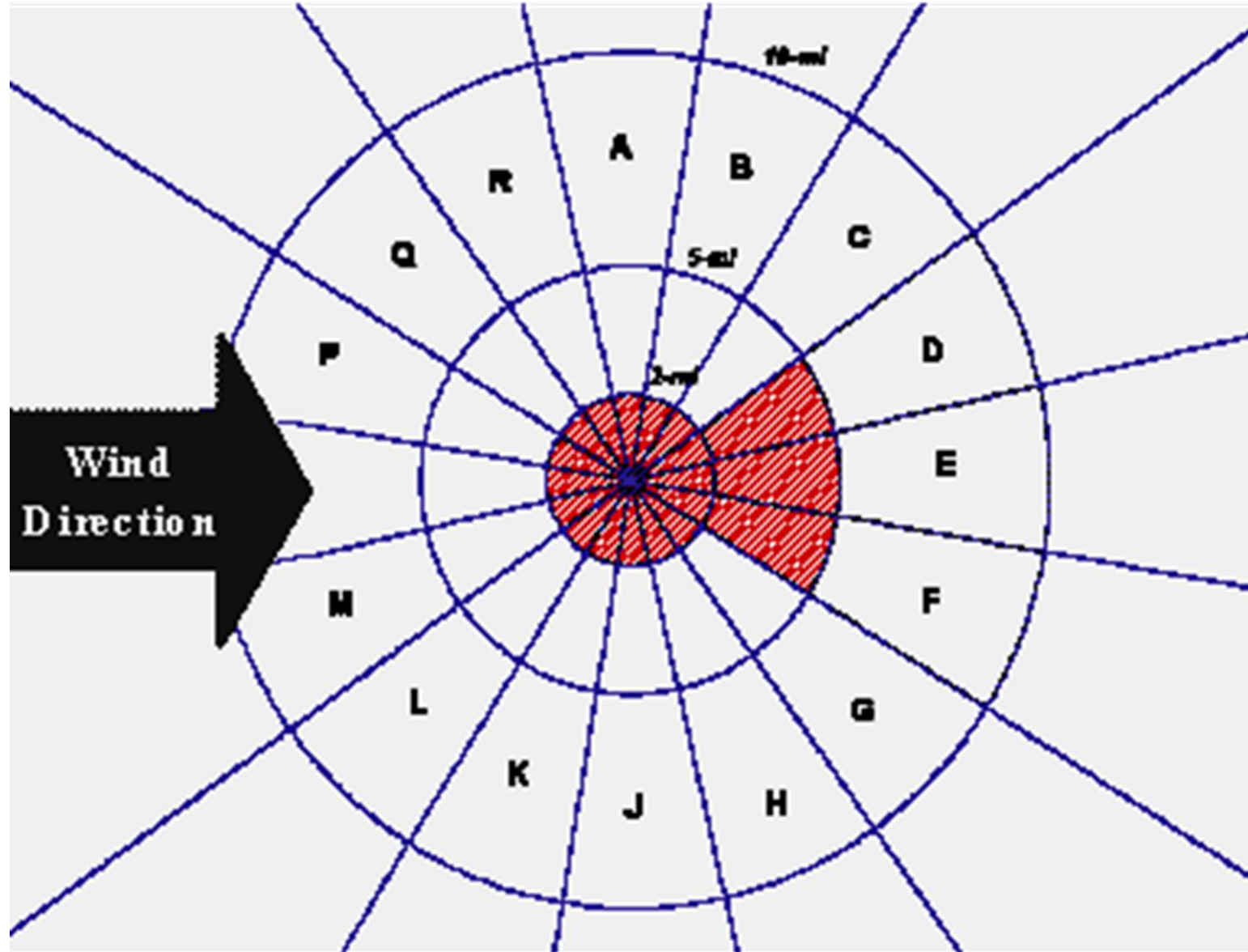
# Dominion Energy CERC



# State Emergency Operations Center

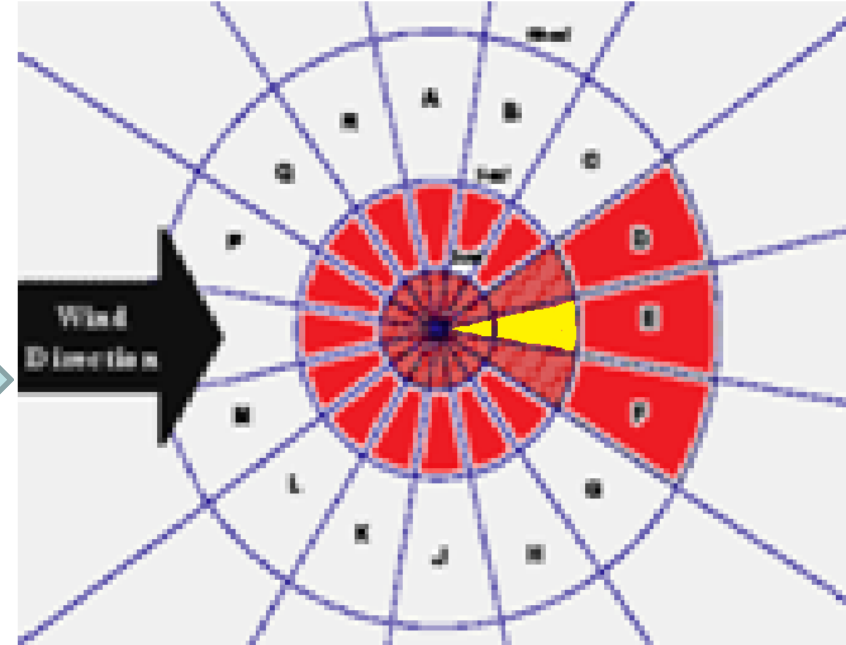
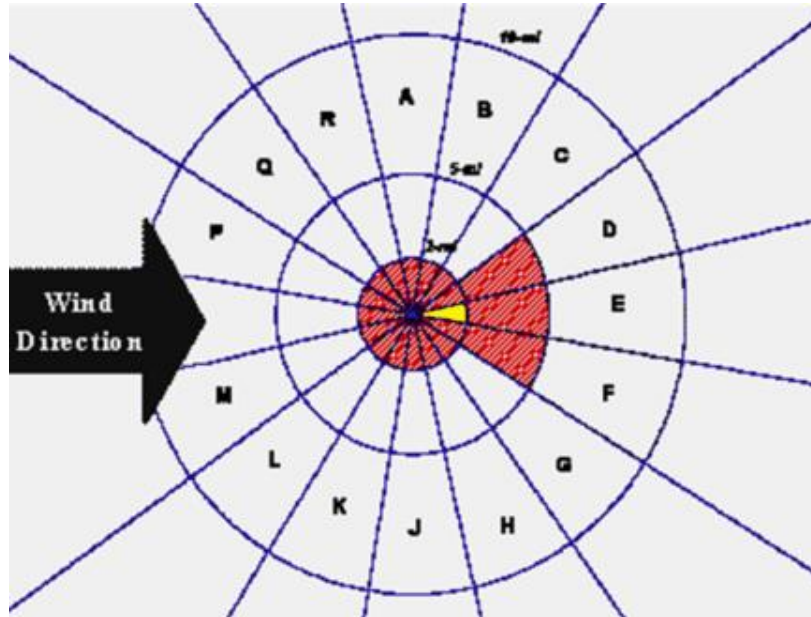


# Protective Actions (Evacuation)

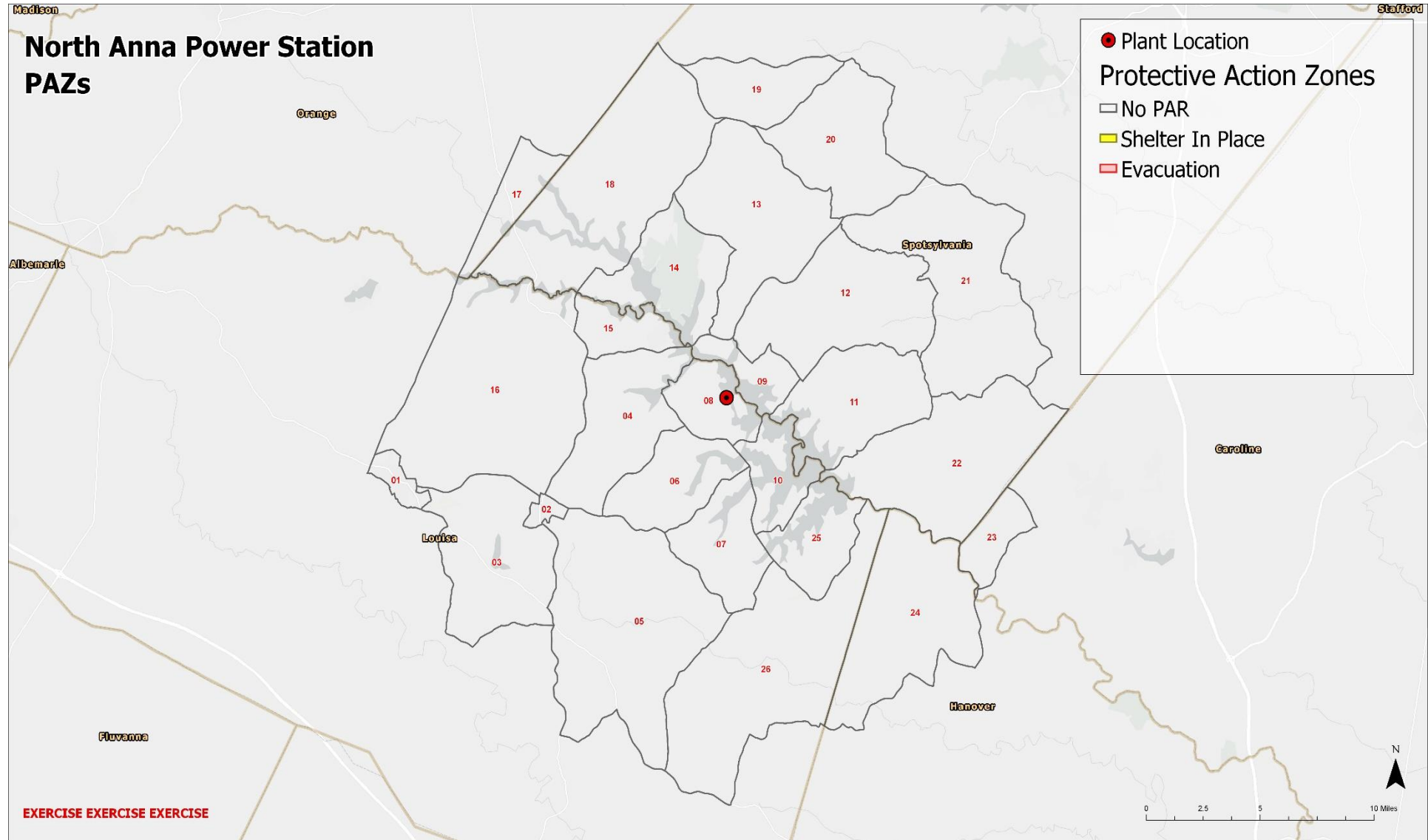




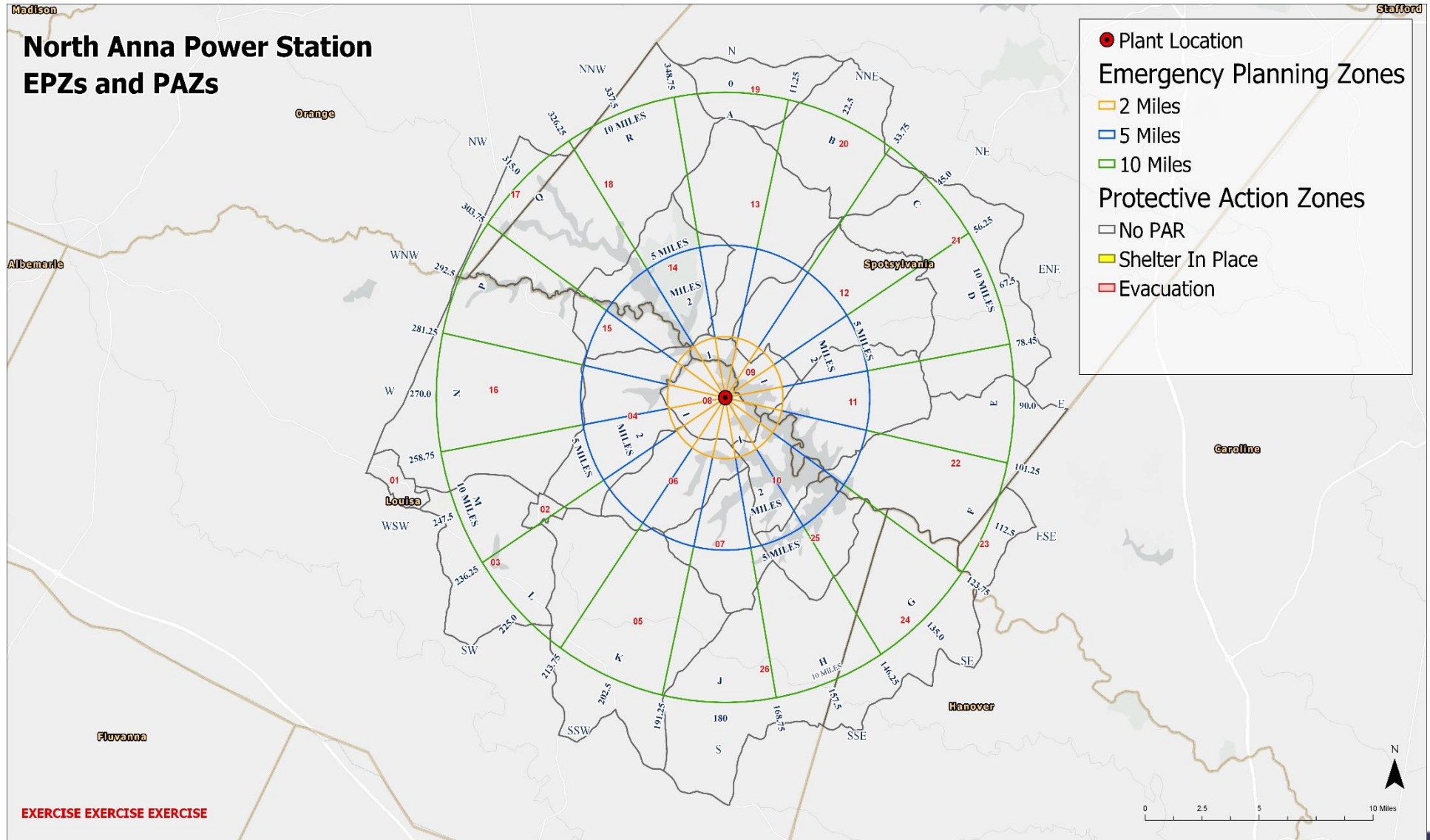
# Protective Actions (Escalation)



# Protective Actions Impact



# Protective Actions Impact



# Evacuation Assembly Center (EAC)

- Population and vehicle screening
- Decontamination
- Basic medical attention
- Temporary shelter providing for basic needs
- Administration of Potassium Iodide

# Evacuation Assembly Center (EAC)



# Radiological Emergencies and the Public

- People fear things they don't understand
- Unseen threat cannot see, smell, or taste radiation
- Presence of contamination will escalate fear and anxiety
- Decontamination = loss of possession
- Emergencies and evacuations are extremely stressful
- Pets and livestock may have been left behind
- Abandoning most or all of their possessions
- Will they be able to return
- Few individuals have even a basic understanding of radiation
- Even basic radiation principles cannot be difficult to grasp

# Radioactivity

## Definition

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

- Atomic Structure:

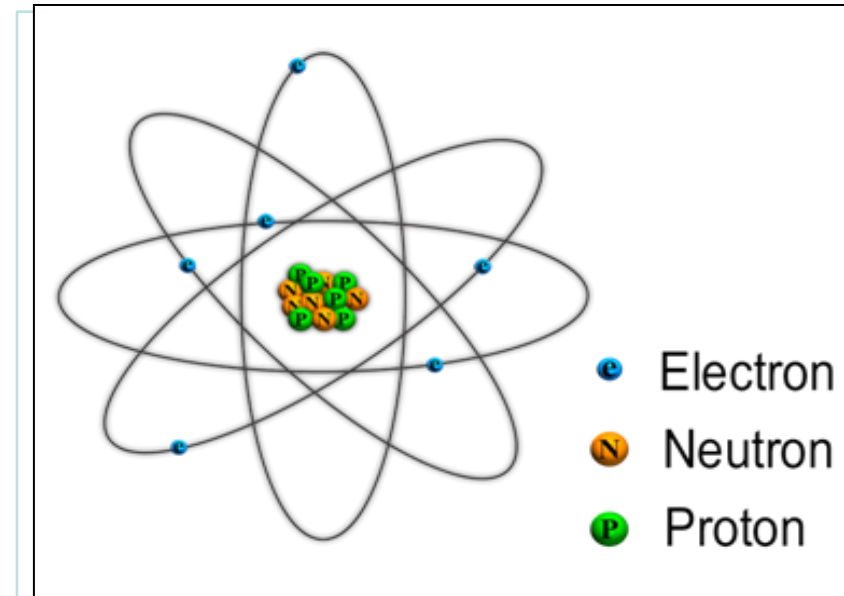
All matter is made up of atoms

All atoms contain:

Protons

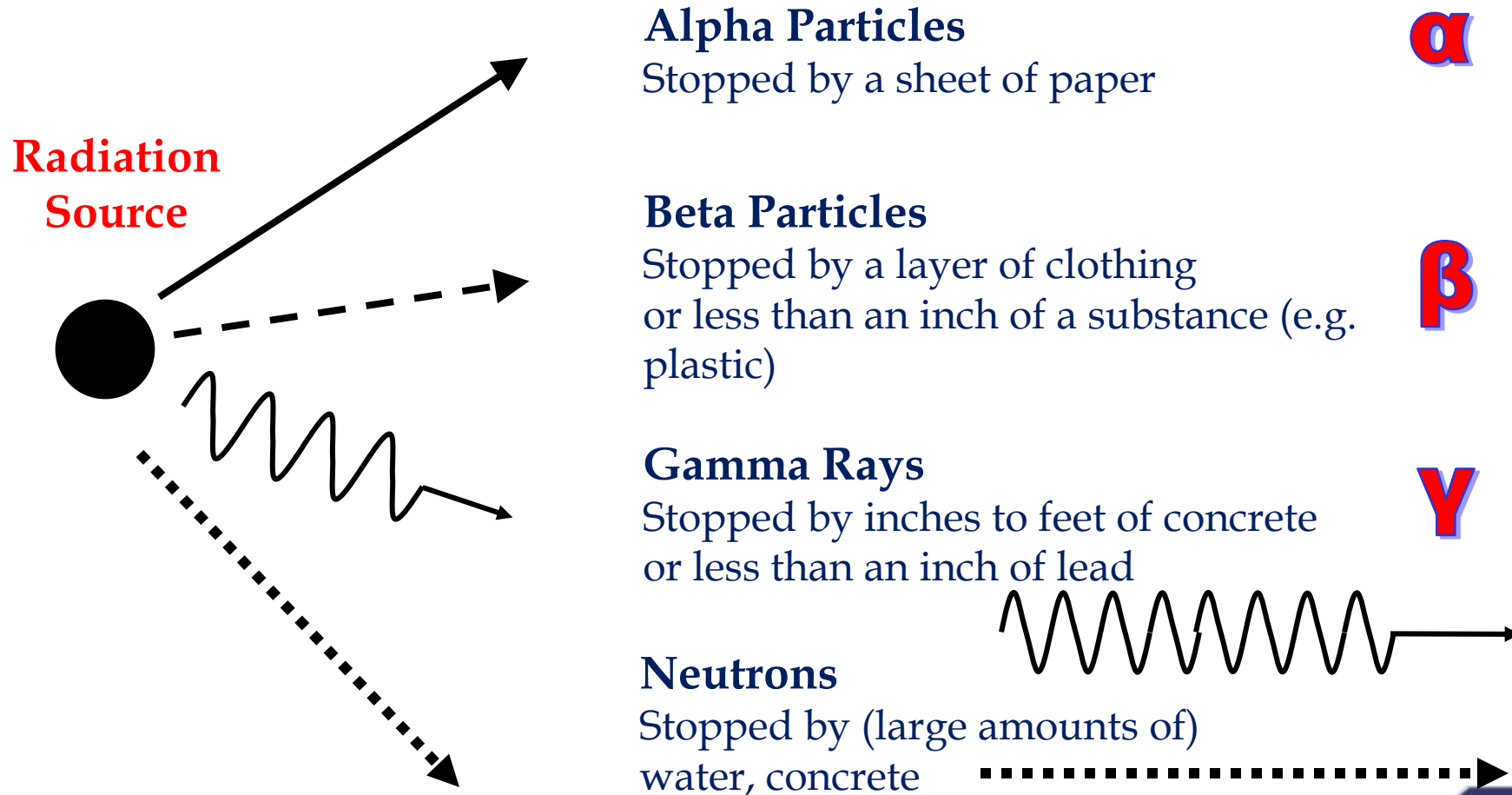
Neutrons

Electrons



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

# Penetration Abilities of Different Types of Radiation





# 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)

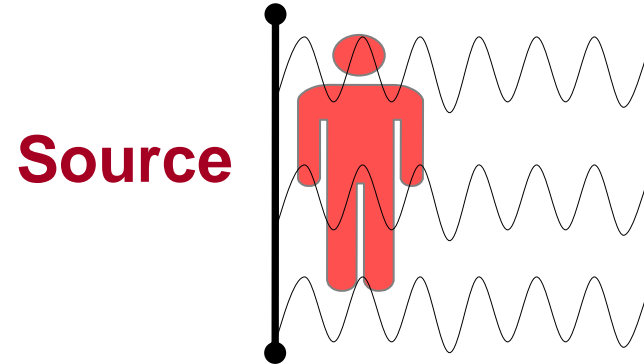
➤ **Dose** — the total amount of radiation received

- 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

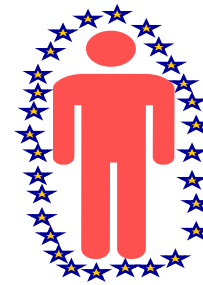


# Types of Exposure

External Exposure



External Contamination

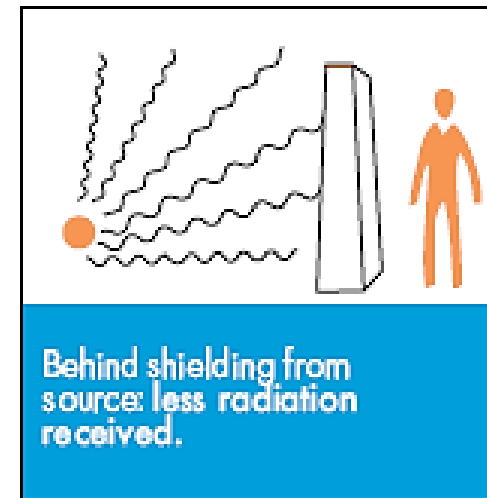
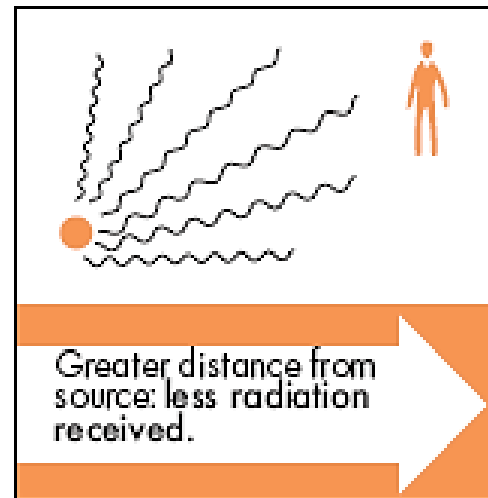
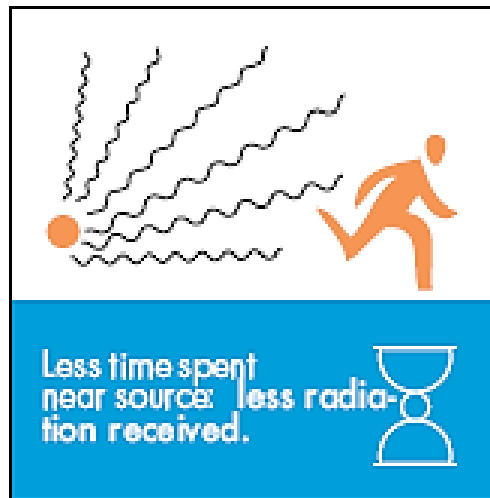


Internal Contamination



# Protecting Responders

## Time, Distance and Shielding



<http://www.nrc.gov/about-nrc/radiation/protects-you/protection-principles.html>

# 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.
  - Some blood changes above 25 rads
- 100 - 400 rads
  - The hematopoietic system is affected
  - Blood cell precursors are very radiosensitive
  - Gradual depression in blood count over days or weeks
  - Increased susceptibility to infection and hemorrhage
  - Most recover at lower end of range with some medical care

# Acute Radiation Syndromes

(Continued)

- 400 – 1400 rads
  - Gastrointestinal system is affected
  - Cells lining the intestinal track are radiosensitive
  - Bacteria and toxic material gain access to the bloodstream\
  - Diarrhea, dehydration, infection, toxemia
  - Survival is unlikely at the upper end of the range
- Above 1400 rads
  - Cardiovascular and Central Nervous System are affected
  - Blood supply impaired leading to nausea, vomiting, convulsions, or unconsciousness
  - No hope for survival

LD<sub>50/30</sub> is approximately 450 rads with modest medical treatment

# Evacuation Assembly Center (EAC) Support Teams

- Provide up to date information on the emergency and any protective actions recommendations
- Answer basic radiation related questions from member of the public
- Explain the use of Potassium Iodide and its mode of action
- General support of affected individuals
- Assist with other tasks at the EAC upon request

# EAC Support Teams - Knowledge, Skills, Abilities

- Maintain situational awareness
  - Current protective actions
  - Evacuation orders
  - Release status
- Knowledge of protective actions
  - Shelter in place versus evacuation
  - Ingestion of Potassium Iodide
- Ability to explain complex radiation principles in simple terms
  - Exposure versus contamination
  - Personnel monitoring
  - Decontamination
  - What is “clean”
- Knowledge of Evacuation Assembly Center operations

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# State Field Monitoring Teams

- Comprised of highly trained emergency response personnel
- Deploy in specially equipped state vehicles
- Full PPE including respiratory protection
- Assigned to find centerline of release plume
- Monitor radiation levels and collect air samples
- Exposure to radiation is expected
- Reporting, Turnback, Protecting Valuable Property, and Lifesaving dose limits
- High levels of contamination are expected
- Report all information to Office of Radiological Health personnel
- **Procedural adherence at all times is paramount**

# Non-Plume Monitoring Teams (NPTs)

- Comprised of volunteers
- Deploy in personal vehicles utilizing equipment, dosimetry, and PPE provided by the state - no respiratory protection
- Perform radiation monitoring along the periphery of evacuated areas
- No radiation exposure expected
- Strict dose rate based turnback limits
- Report readings back to Office of Radiological Health personnel
- May be asked to collect air and other environmental samples
- **Procedural adherence at all times is paramount**

# Non-Plume Monitoring Teams- Knowledge, Skills, Abilities

- Transportation
  - Personal vehicle
  - Valid drivers license
- Navigation
  - GPS navigational system or application
  - Ability to use paper map and follow directions if necessary
- Basic understanding of radiation measurement principles
  - Units (uR, mR, R)
- Effective communication skills
- Ability to deploy with 1-2 others and work effectively as a team
- Procedural adherence must be maintained at all times

# Field Monitoring Teams

- Upon arrival at staging area, sign-in. Receive situation briefing from the Staging Area Coordinator followed by an emergency worker briefing provided by the Radiation Safety Officer
  - Dosimetry
  - Potassium Iodide (KI)
  - Forms
  - Equipment and Supplies
  - Operational Check on Equipment



# Mobile Incident Command Laboratory

- Outfitted with sophisticated equipment that will enable personnel to detect radioactive sources/contamination in the environment and identify the radioisotopes and help quantify the amount
- Field teams primary role would be performing environmental radiological survey monitoring and sampling/analysis but they could also possibly assist with communication and decontamination efforts if directed
- Vehicle equipped with a wide array of communications gear and could serve as a mobile command post/conference room
- Vehicle stocked with dosimetry supplies, field survey meters and PPE



# Dosimetry and Potassium Iodide (KI)



# Equipment and Supplies



## Equipment and Supplies for ALL monitoring and sampling assignments:

### Vehicle:

- Full tank of fuel
- STARS radio

### Instrumentation:

- Ludlum Model 3001 Survey Meter
- Probes
  - > 44-9 "pancake" probe (DET 1 – Red)
  - > 44-38 "hotdog" probe (DET 4 – Blue)
  - > 133-6 "peanut" probe (DET 3 – Green)
- Form REC-4 Field Team Survey Record
- Hand-Held Radio (if available)
- Cellular Telephone
- Probe Covers

### Protective Gear:

- Tyvek suit (for each team member)
- Boots (2 pair for each team member)
- Disposable gloves (4 pair for each team member)
- Hood (for each team member)

### Dosimetry:

- Digital Alarming Dosimeter (DAD)
- Optically Stimulated Luminescent Dosimeter (OSLD)
- Form REC-1 Emergency Worker Radiation Exposure Record

### Miscellaneous:

- Potassium Iodide (KI)
- Flashlight
- Spare Batteries
- Permanent Markers
- Pens
- Maps/GPS
- Large plastic trash bags
- Swipes
- Duct Tape

### Air Sampling Equipment:

- RADeCo Air Pump
- Tripod
- Car battery pack adapter cable
- Fiberglass filters
- Air sample cartridges (charcoal and silver zeolite)
- Tweezers
- Petri dishes
- Extra air pump sampling head
- Sample Bags
- Binder clips

## Equipment and Supplies for Post-Plume (ingestion pathway) sampling assignments:

### Food Crop/Vegetation Sampling:

- 3.5 Liter Marinelli containers and lids
- Sample bags
- Grass clippers
- "Lab Sample Do Not Tamper" labels



### Water and Milk Sampling:

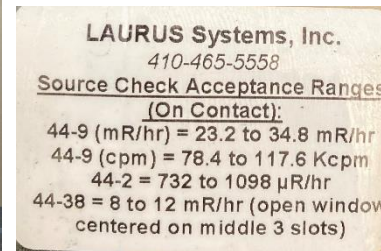
- 3.5 Liter Marinelli containers and lids
- 1 Gallon Cubitainers and lids
- Bucket
- Rope
- Funnel
- 1 Gallon Jug of rinse water
- "Lab Sample Do Not Tamper" labels

### Soil Sampling:

- 1 Liter Marinelli containers and lids
- Trowel
- Sample bags
- Square Meter template (longer rope with metal eyelets)
- Square Foot template (shorter rope with metal eyelets)
- Hammer
- Ground cover (tarp or large plastic bag)
- "Lab Sample Do Not Tamper" labels

# Ludlum Model 3001

- All instruments should have an attached calibration label. Before proceeding with operational check, verify instrument is within calibration. 
- The Ludlum Model 3001 has check source ranges for each probe indicated on the check source value label located on side of meter. 





# Plume Monitoring

Why? **Determine plume position**

How? **Area survey readings**

If reading  $<400\text{mR/hr}$ , use Ludlum Model 3001 Survey Meter with 44-38 “hotdog” probe:

- 1) 3 inches from ground -  
probe window open - facing down
- 2) 3 foot from ground -  
probe window open - facing up
- 3) 3 inches from ground -  
probe window closed - facing down
- 4) 3 foot from ground -  
probe window closed - facing up



An open window reading that is higher at 3 ft. (probe face up) than at 3 in. (probe face down)

**Plume is Overhead**

An open window reading that is lower at 3 ft. (probe facing up) than at 3 in. (probe face down)

**Plume has Passed**

Open window readings at 3 ft. (probe face up) and 3 in. (probe face down) that are equal

**Plume Immersion**

# Air Sampling

- Field teams will utilize air samplers to detect iodine in the presence of noble gases
- Information is used to determine if potassium iodide (KI) should be ingested by the general public
- Emergency workers ingest KI if a radiological release is in progress, imminent or if projections meet threshold criteria





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