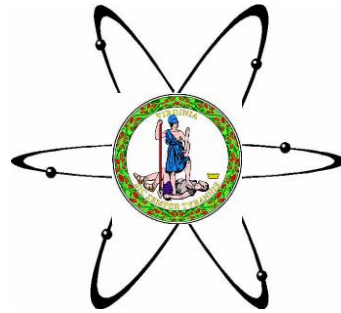


# Radiological Incident Response



Virginia Department of Health  
Office of Radiological Health

# Office of Radiological Health

## What We Do

- Register and inspect x-ray producing devices.
- License and inspect radioactive material.
- Conduct environmental monitoring around nuclear facilities.
- Provide public information and education about radon.



# Office of Radiological Health

## What We Do

- Respond to radiation incidents and emergencies.
- Recommend protective measures.
- Protect people from unnecessary exposure to ionizing radiation.
- Train first responders and first receivers (local, regional, state, businesses and non-government partners).

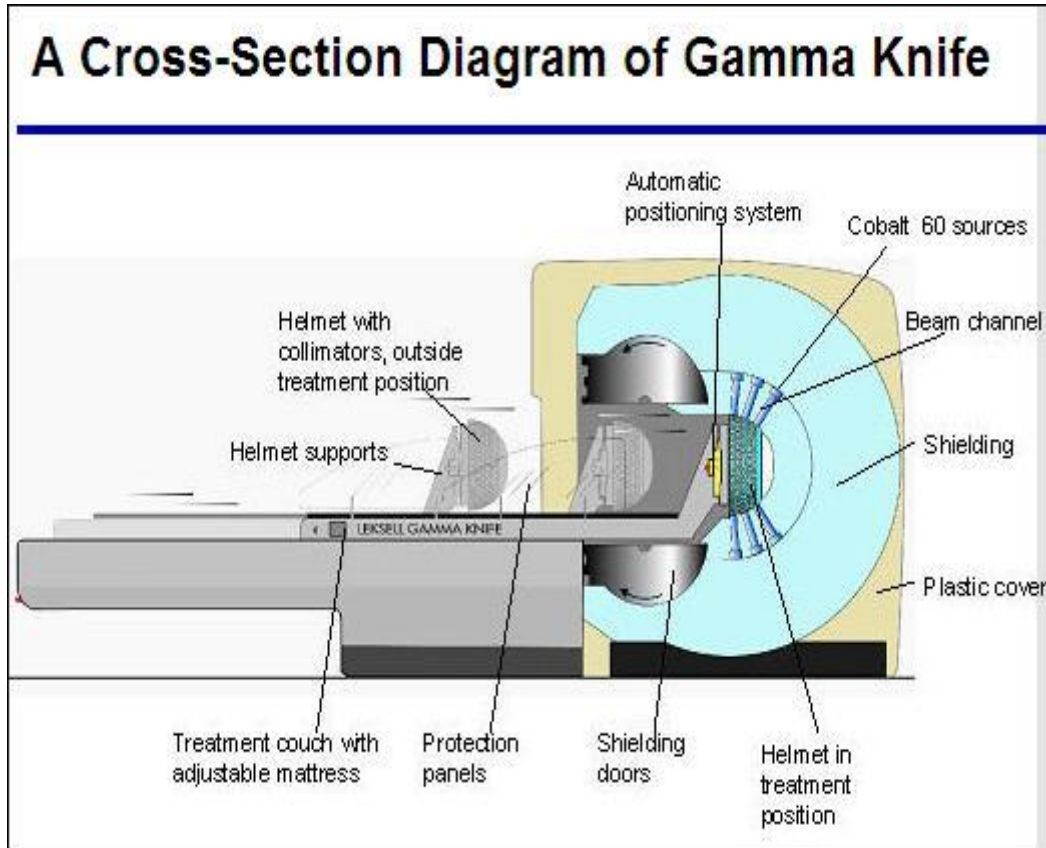


# High Dose Remote Afterloader (HDR)



Dose rate: 85 R/hr at 1 foot unshielded

# Gamma Knife



**Dose rate: 109,915 R/hr at 1 foot unshielded**

# Radiography Camera



**Dose rate: 1,574 R/hr at 1 foot unshielded**



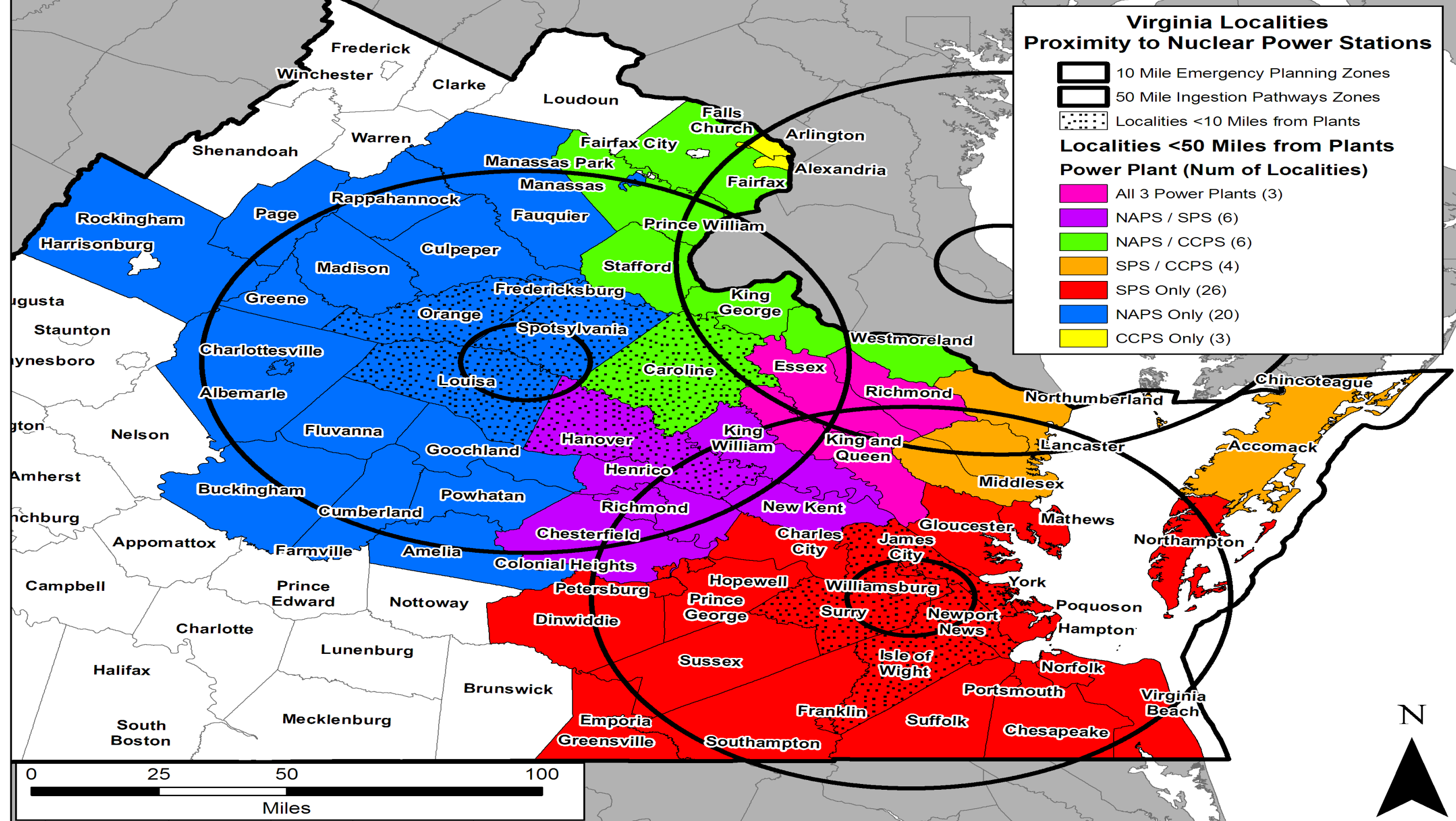
# Density & Moisture Gauges



Dose rate: 40 mR/h at 1 foot unshielded

# Nuclear Power Station Emergencies





# 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.

# Emergency Classification Levels (ECLs)

- Increase sequentially based on plant conditions and/or increased risk to the public
- A radiological release can occur at any Emergency Classification Level
- Generally, actions to protect the public are not initiated until a General Emergency is declared
- Radiation levels outside of the plant boundary can be significantly above background (400+ times background)
- Very little information is communicated to the public prior to the declaration of a General Emergency and the initiation of protective actions

# ORH Response to a Nuclear Power Station Event

- Office of Radiological Health mobilizes three distinct response groups
  - **ESF-8 at the Virginia Emergency Operations Center**
    - *Overall Command and Control*
    - *Interface with VDEM and other ESFs*
    - *Protective Action Recommendations*
  - **Dominion Energy Corporate Emergency Response Center (CERC)**
    - *Interface with Dominion Energy & VDEM Staff*
    - *Dose Assessment*
    - *Provide situational awareness to ESF-8*
  - **Staging Area and Field Teams**
    - *Equip, brief, and deploy field teams*
    - *Analyze various samples*



# Dominion Energy CERC



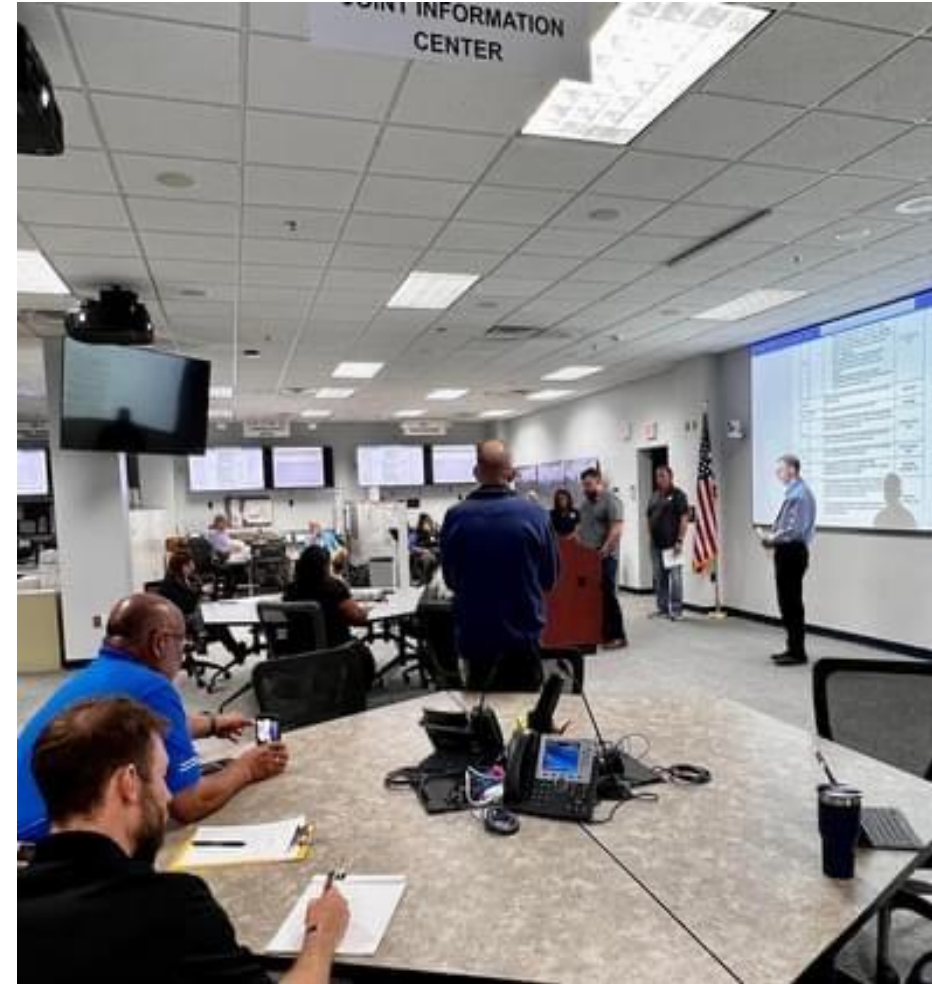
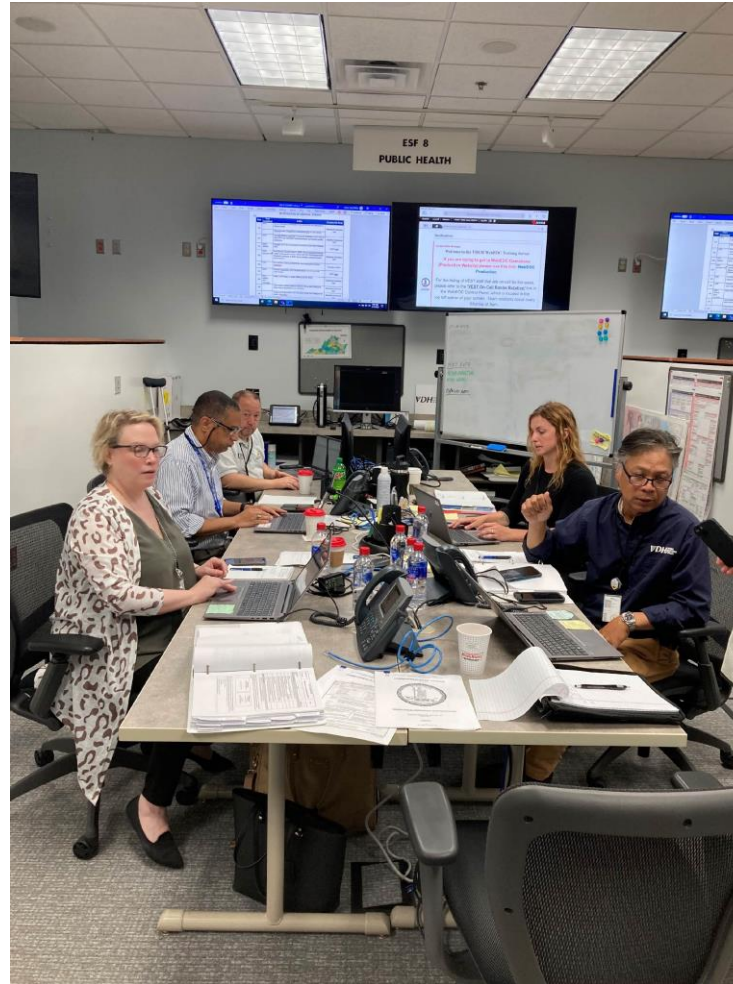


# Dominion Energy CERC





# State Emergency Operations Center (State PAR)





# Field Monitoring





# Fission Product Barriers

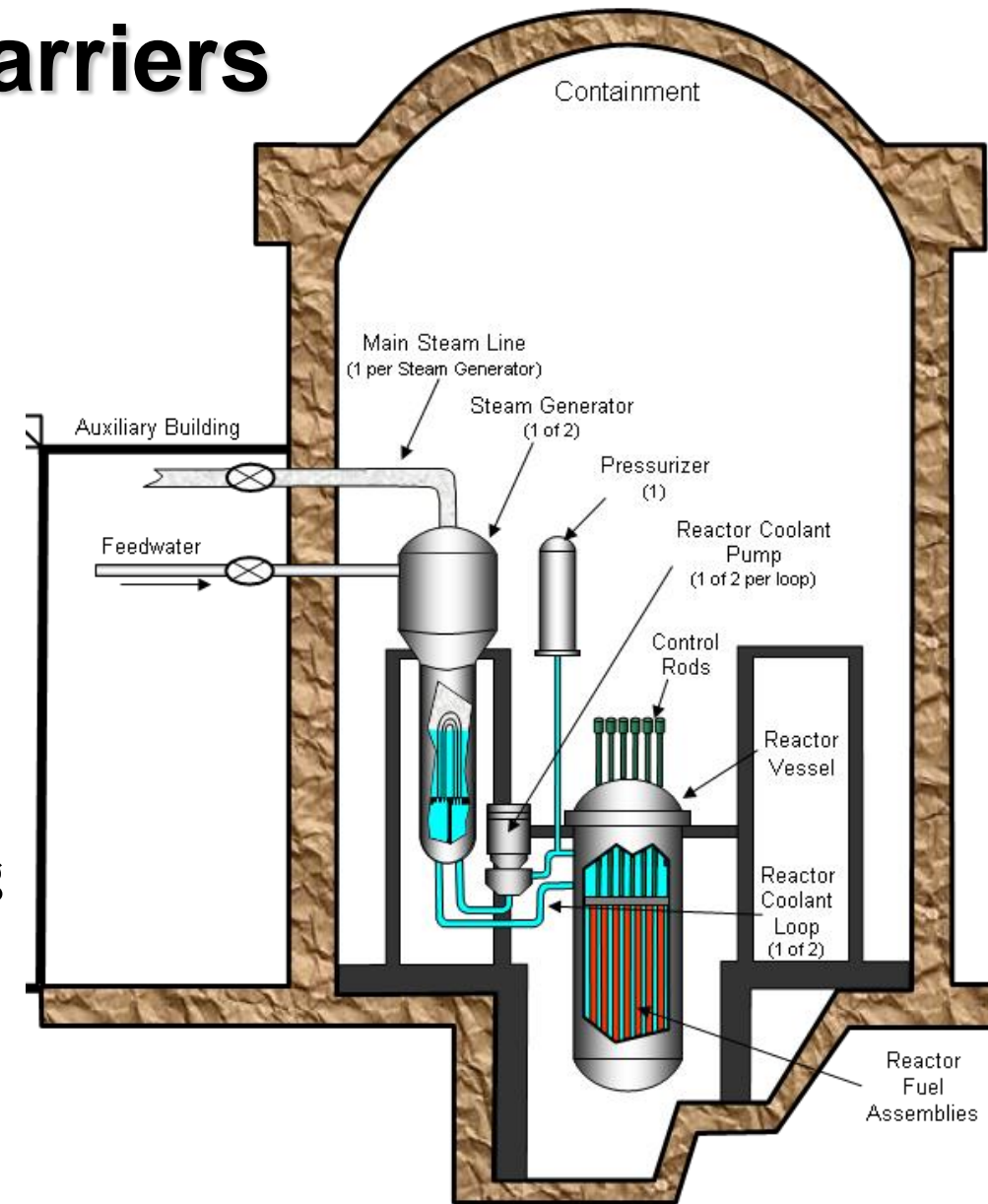
**Fuel Clad (FC)** - Fuel Clad Barrier consists of cladding material that contains the fuel pellets.

**Reactor Coolant System (RCS)** - RCS primary side and its connections

**Containment (CTMT)** - Reactor Building and connections up to and including the outermost containment isolation valves.

This barrier also includes the main steam, feedwater, and blowdown line extensions outside the Reactor Building up to and including the outermost secondary side isolation valve.

Containment Barrier thresholds are used as criteria for escalation of the Emergency Classification Level from Alert to a Site Area Emergency or a General Emergency.



# Barrier Loss and Potential Loss

## Loss

The barrier no longer assures containment of radioactive materials

## Potential Loss (P-Loss)

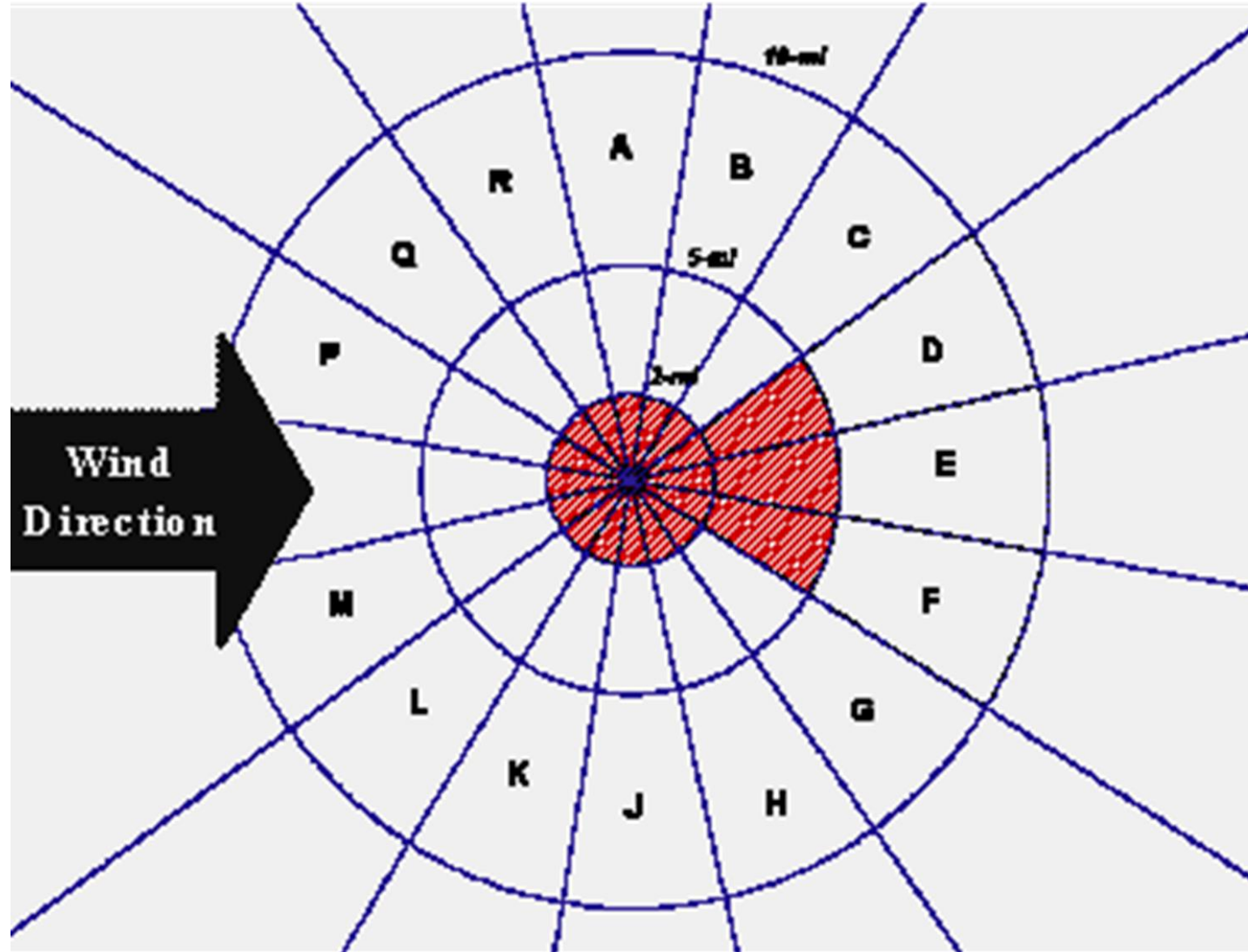
Infers an increased probability of barrier loss and decreased certainty of maintaining the barrier

- **ALERT** - Loss or Potential Loss of EITHER: Fuel Clad or RCS
- **SAE** - Loss or Potential Loss of any two barriers
- **GE** - Loss of any 2 barriers and Loss or Potential Loss of third barrier.

# Protective Actions

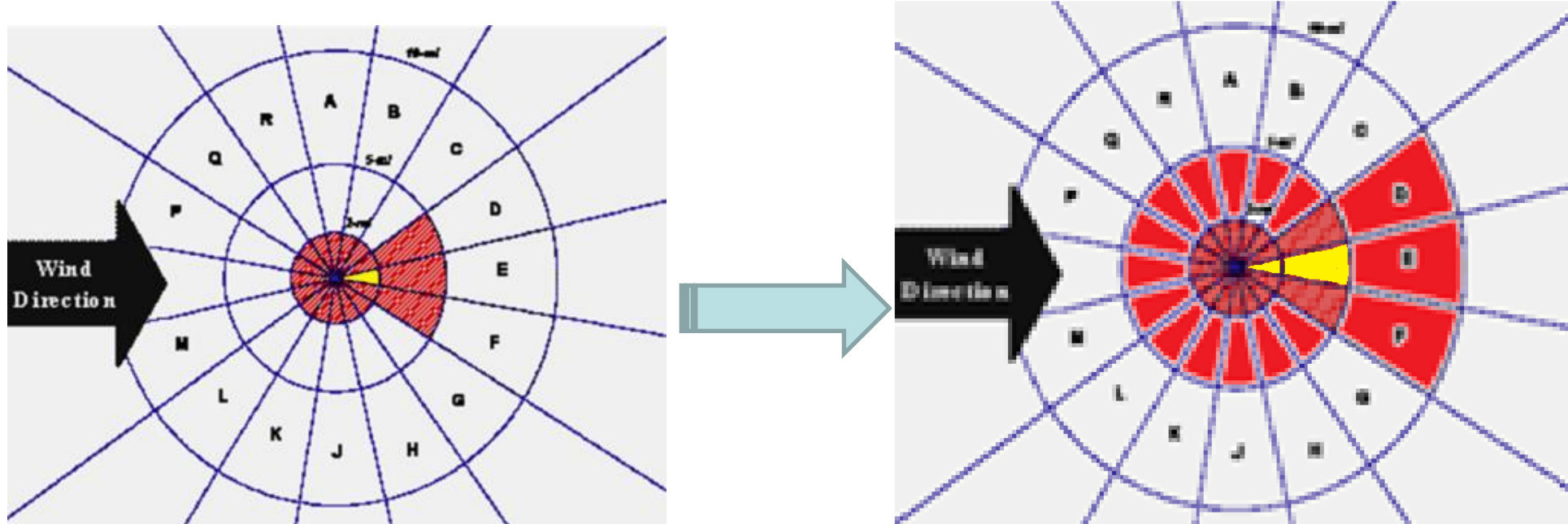
- Shelter in place
  - Primarily used during hostile action based events
  - Keeps the public from being mistaken as the “bad guys”
  - Go inside, stay inside, listen for further instructions
  - Turn off HVAC systems
  - Close doors, windows, etc. to seal the home
  - Provides limited protection from radiation exposure
  - Primary impact is prevention of contamination including inhalational hazards
- Evacuation

# Protective Actions (Evacuation)

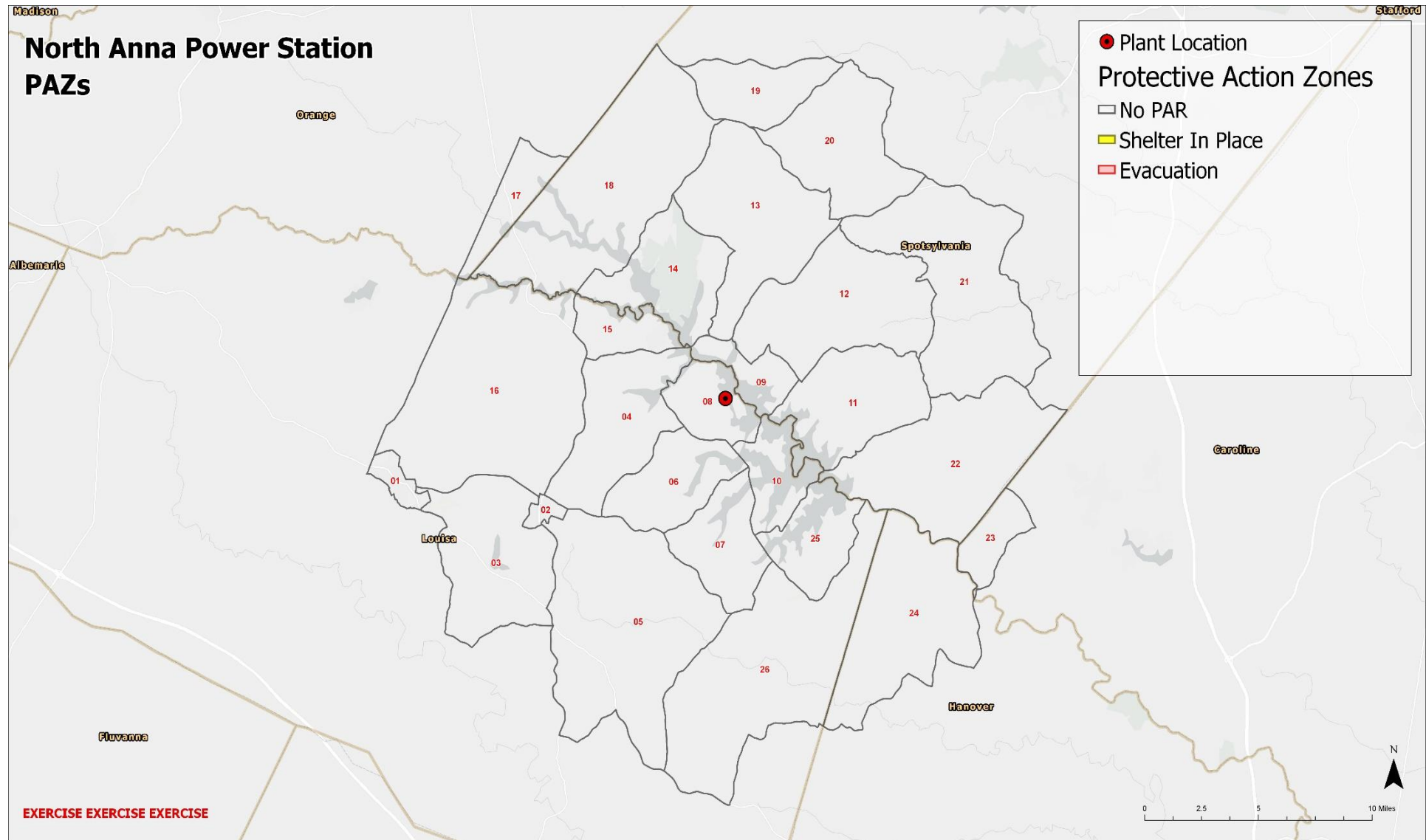




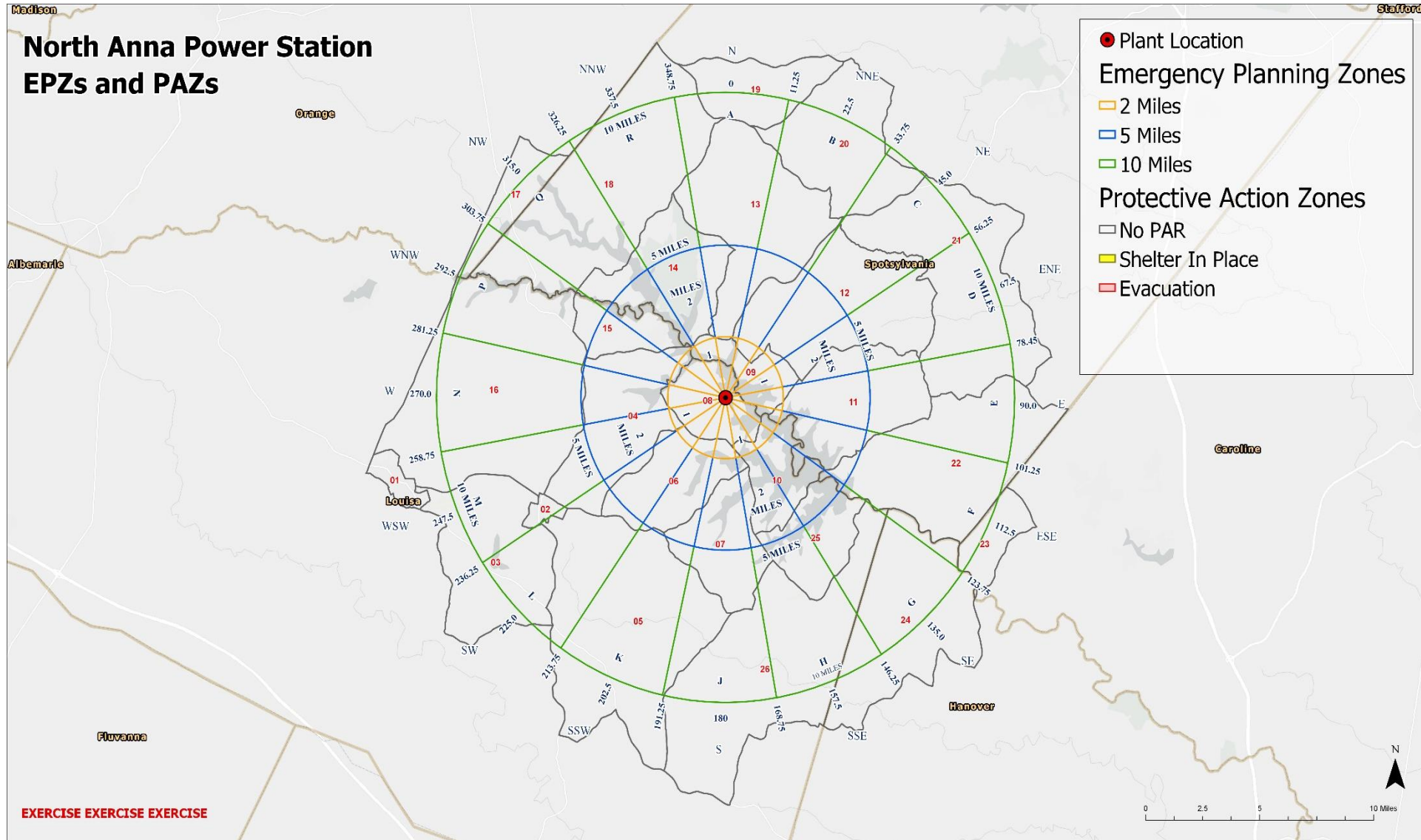
# Protective Actions (Escalation)



# Protective Actions Impact

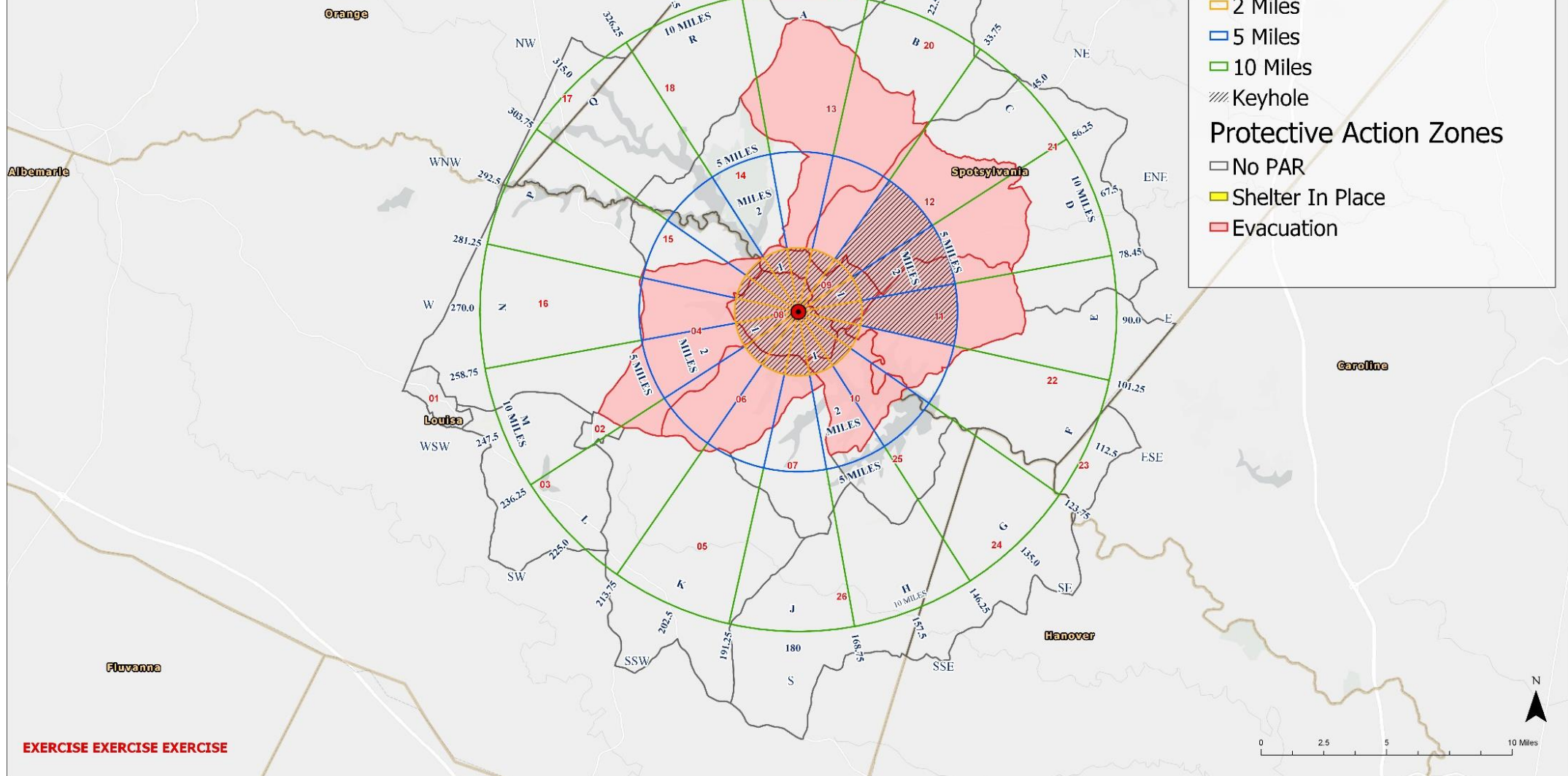


# Protective Actions Impact



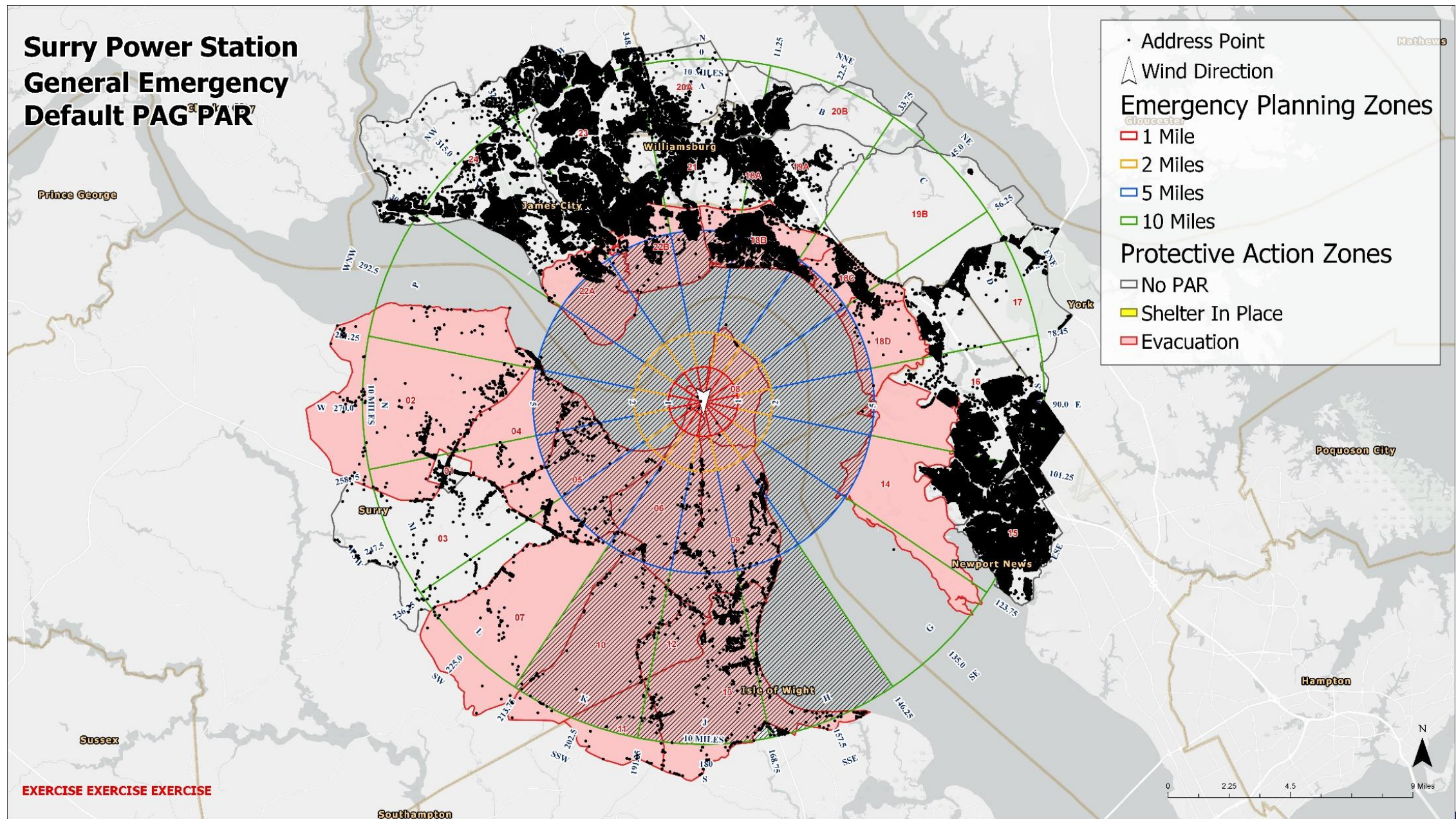


# North Anna Power Station GE Default PAR - Wind from 247





# **Surry Power Station General Emergency Default PAG PAR**



# Factors Driving Protective Actions

- Plant conditions
  - A Protective Action Recommendation (PAR) is made whenever the plant upgrades to a General Emergency regardless of radiological releases
  - Evacuation is the default protective action outside of HAB incidents
- Radiological Factors (Dose Assessment and/or Field Data)
  - > 1R TEDE – Whole Body Dose
  - > 5R Adult CDE – Thyroid Dose
- Potassium Iodide
  - >5R Child CDE – Thyroid Dose



# Protective Action Development

- State PAR is communicated to all of the Emergency Planning Zone localities
- If all localities agree with the proposed State PAR it is presented to the State Coordinator (or his/her designee) at the Virginia Department of Emergency Management
- If approved by the State Coordinator the State PAR is presented to the Governor (or his/her designee).
- Once approved by the Governor the State PAR becomes the official Protective Action Decision (PAD)
- The PAD is communicated to the localities where it is put into action

# Nuclear Power Station 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 can be difficult to grasp

# Radioactive Device and Materials Incident Response

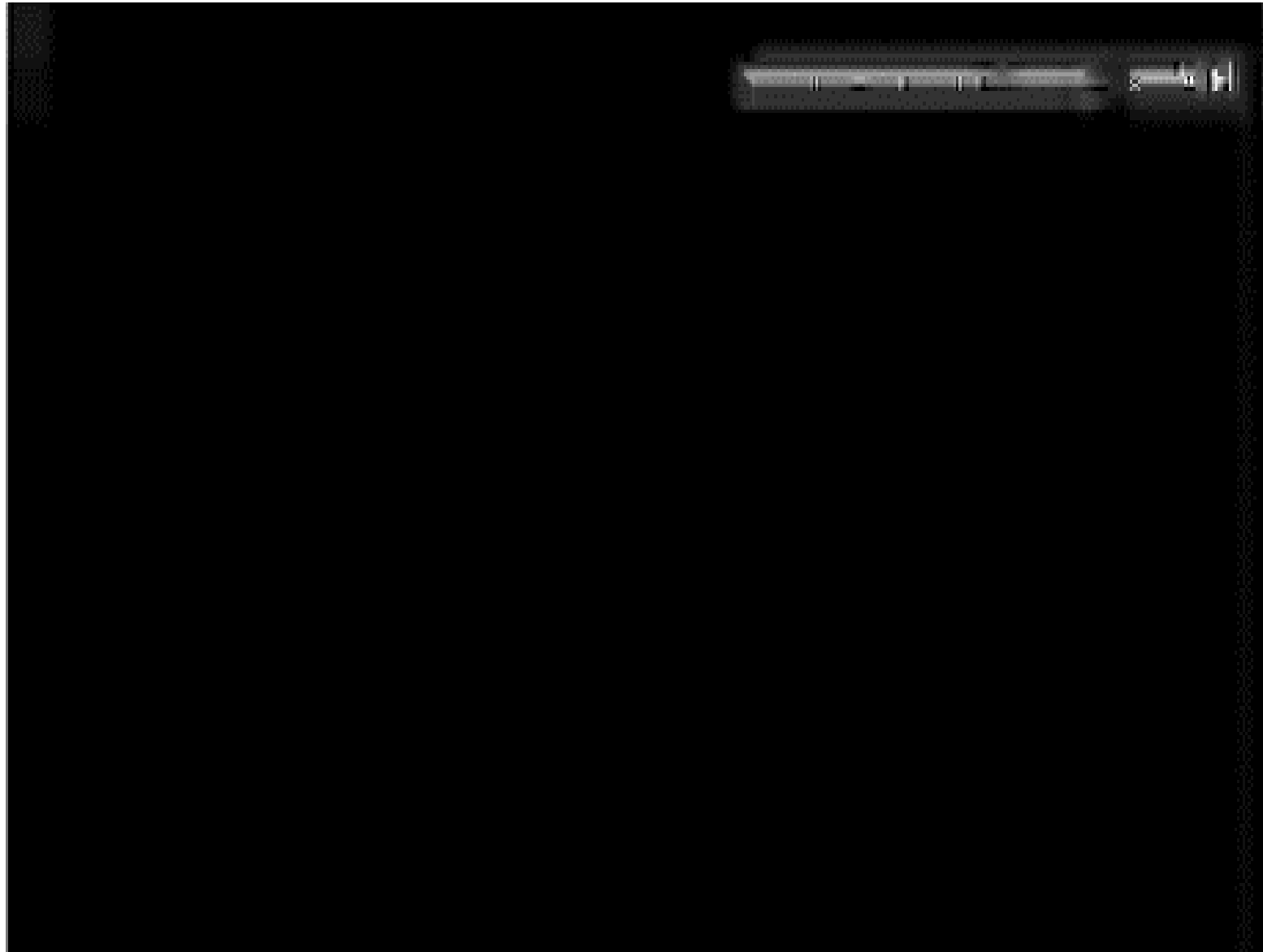


# Vehicular Accident Involving a Moisture Density Gauge













# Source Origin





# Federal Bureau of Investigation

- The FBI had arrested an individual following a lengthy investigation
- During a search of the individual's computer they found numerous searches on the use of radiation to kill
- In addition they found an extremely large stash of smoke detectors in the home most of which had been dismantled so the Americium 241 source could be removed
- A relative of the individual had died unexpectedly about a year prior to the arrest following a lengthy illness with bizarre symptoms
- Decision was made to exhume the body for further investigation



# Federal Bureau of Investigation

- The FBI Weapons of Mass Destruction Coordinator in Norfolk contacted the Office of Radiological Health (ORH) and the Virginia Department of Emergency Management (VDEM) for assistance
- Additionally the Medical Examiner assigned to the case contacted the Office of Radiological Health for guidance and personal protective equipment
- Personnel from ORH and VDEM conducted radiation screening during all portions of the exhumation and autopsy
- No radiation above normal background was detected
- Tissue samples were collected and sent to a federal laboratory for further analysis

# ORH Response Based Training











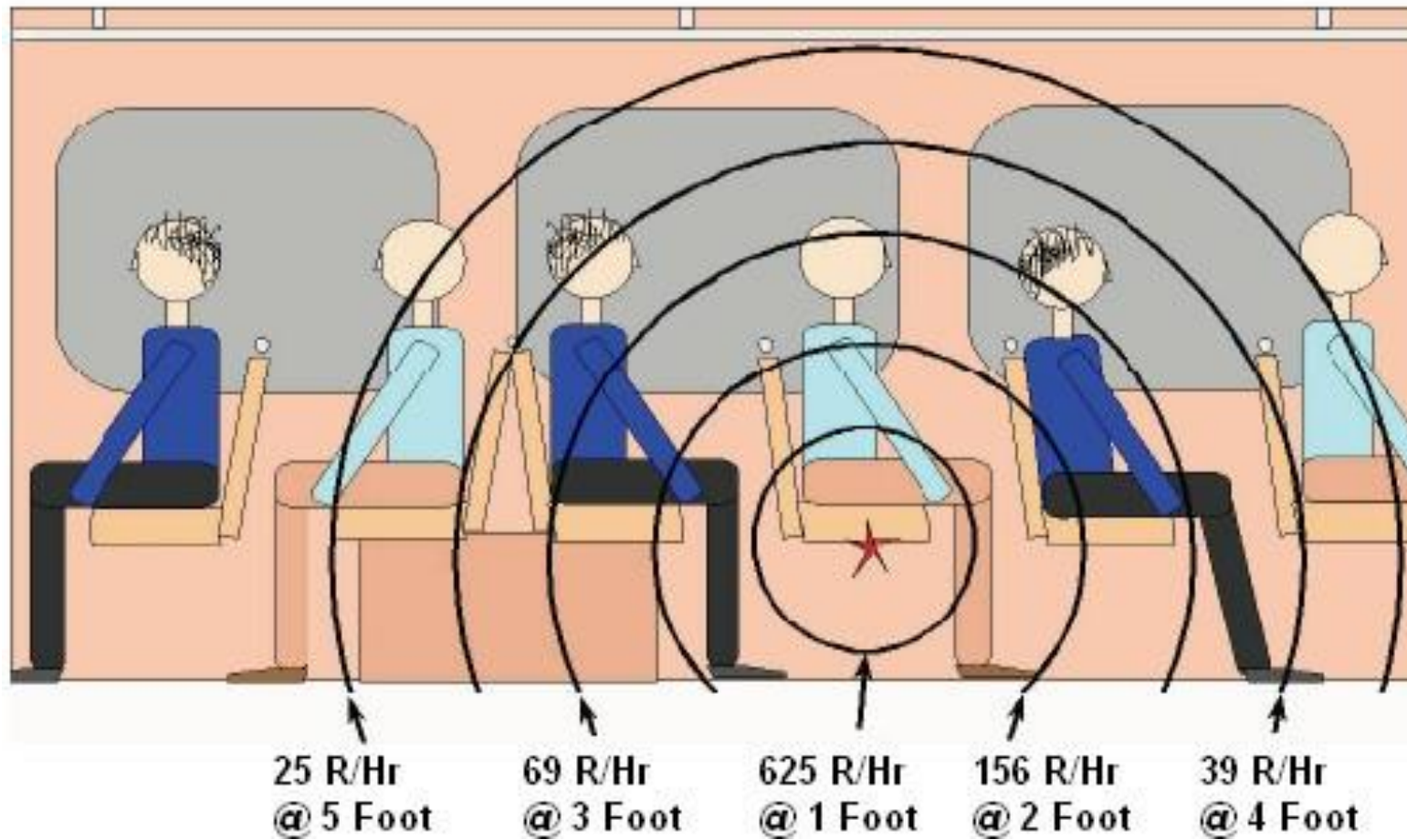




# Radiological Terrorism

# Radiation Exposure Device (RED)

150 Ci Iridium Source Under Seat



# Radiography Camera



Dose rate: 1,574 R/hr at 1 foot unshielded



# Radiation Dispersion Device or RDD (Dirty Bomb)

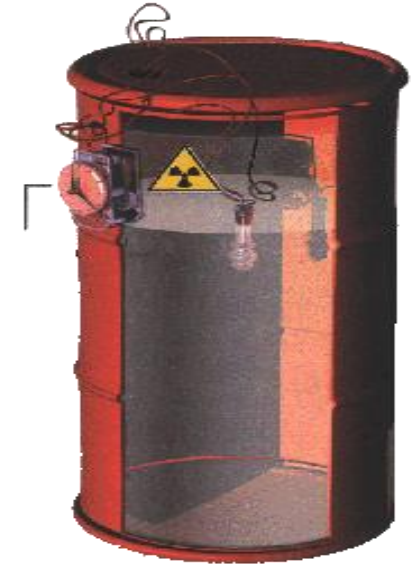
Conventional explosive combined with radioactive material  
Intent to spread radioactive material over a relatively large area

*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



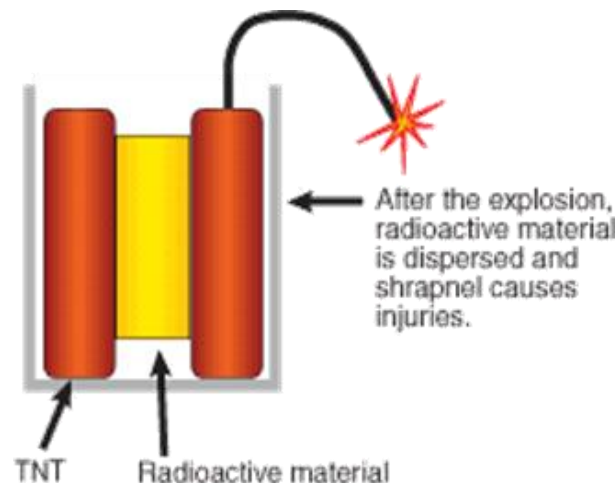
# Unique Aspects of an RDD

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, except those related to the explosion











# Improvised Nuclear Device (IND)

- Smaller yield than tactical nuclear weapons (Kiloton vs Megaton)
- Ground level detonation versus airborne
- Highly trained teams to detect and disarm devices
- Development of protective actions is difficult (mm = kt)
- Communication of risk and appropriate actions between federal, state and local assets is undefined
- Lesser prompt effects (heat/pressure wave) but much more contamination
- Flash blindness and EMP effects are significant concerns
- Triage rescue efforts based on level of structure destruction



# IND Resources

- <https://nuclearsecrecy.com/nukemap/>
- **PrepTalks: Brooke Buddemeier "Saving Lives After a Nuclear Detonation."**  
<https://youtu.be/EueJrCJ0CcU?si=NqsPxOHWDmBYPJYN>



# Thank You

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