Volunteer Opportunities in Radiological Incident Response

Virginia Department of Health
Office of Radiological Health
# Emergency Classifications

<table>
<thead>
<tr>
<th>Description of plant conditions</th>
<th>UNUSUAL EVENT</th>
<th>ALERT</th>
<th>SITE AREA</th>
<th>GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events which indicate a potential degradation of the level of safety of the plant</td>
<td>Events which involve an actual or potential substantial degradation of the level of safety of the plant.</td>
<td>Events which involve actual or likely major failures of plant functions.</td>
<td>Events which involve actual or imminent substantial fuel degradation or melting with potential for loss of containment.</td>
<td></td>
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</tbody>
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<th>Radiation Dose to the public</th>
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<td>Radioactivity release detectable by plant radiation monitors and may be from 0.1 to 1 mR/hr measurable offsite.</td>
<td>Radioactivity release detectable by plant radiation monitors and may be from &gt; 10 to &lt;100 mR/hr measurable offsite.</td>
<td>Radioactivity release detectable by plant radiation monitors and may be from &gt; 100 to &lt; 1000 mR/hr measurable offsite.</td>
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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
  - Conduct dose assessment
  - Manage and deploy state field teams

- **Staging Area and Field Teams**
  - Equip and brief state field teams prior to deployment
  - Receive, manage, store, and analyze samples
Protective Actions (Escalation)
Protective Actions Impact

North Anna Power Station
EPZs and PAZs

Emergency Planning Zones
- 2 Miles
- 5 Miles
- 10 Miles

Protective Action Zones
- No PAR
- Shelter In Place
- Evacuation
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

**Alpha Particles**
Stopped by a sheet of paper

**Beta Particles**
Stopped by a layer of clothing or less than an inch of a substance (e.g. plastic)

**Gamma Rays**
Stopped by inches to feet of concrete or less than an inch of lead

**Neutrons**
Stopped by (large amounts of) water, concrete
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

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$_{50/30}$ 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:

- 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)
  - 123.6 "pennant" probe (DET 3 – Green)
- Form REC-4 Field Team Survey Record
- Hand-held Radio (if available)
- Cell Phone
- 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 Alerting Dosimeter (DAD)
- Optically-Stimulated Luminescence 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:
- RA/DCA Air Pump
- Tripod
- Car battery pack adapter cable
- Fiberglass filters
- Air sample cartridges (charcoal and silver zeolite)
- Tweezers
- Perc filters
- Extra air pump sampling head
- Sample Bags
- Binder clips

Equipment and Supplies for Post-Plume (inspection 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 Cylinders 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 (30 cm rope with metal eyellets)
- Square Foot template (shorter rope with metal eyellets)
- 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 <400mR/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) that 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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