# INGESTION PATHWAY EXERCISE REVIEW

# HELLO!

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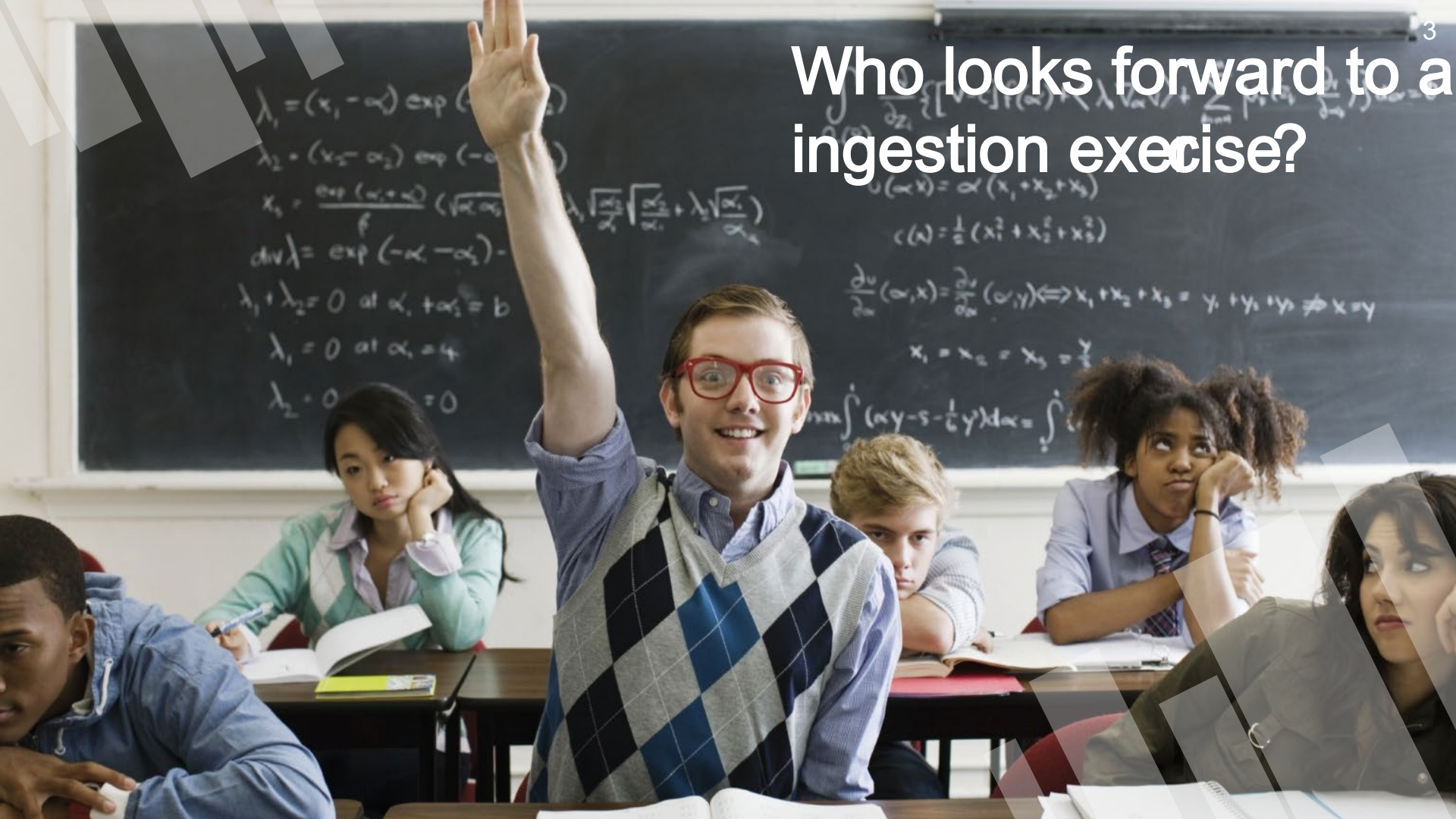
# Who looks forward to an ingestion exercise?



# INTERMEDIATE OR PROLONGED PHASE

| Early Phase | Intermediate Phase |
| --- | --- |
| Has its own PAGs | Has its own PAGs |

PAGs are levels of avoidable dose which warrant protective actions.

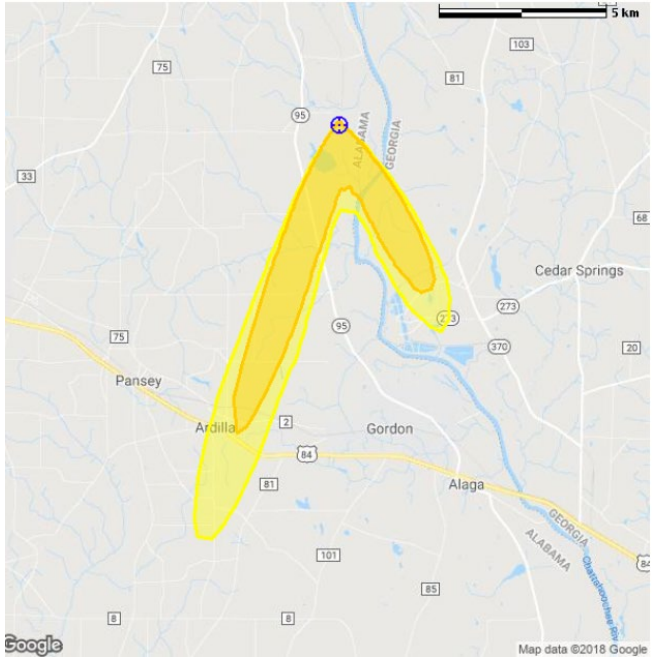
# Duration of the Intermediate Phase

- Extends until protective actions are completed
- May overlap early and late phases
- May last from weeks to many months
- For purposes of dose projection, is assumed to last one year

# Intermediate Phase: General Information

- Protective actions have already been taken based upon the PAGs for the early phase
- Assessment of environmental measurements may indicate that the previous protective actions need to be modified
- Primary source of exposure to the population is due to deposited radionuclides

# METEOROLOGICAL CONDITIONS

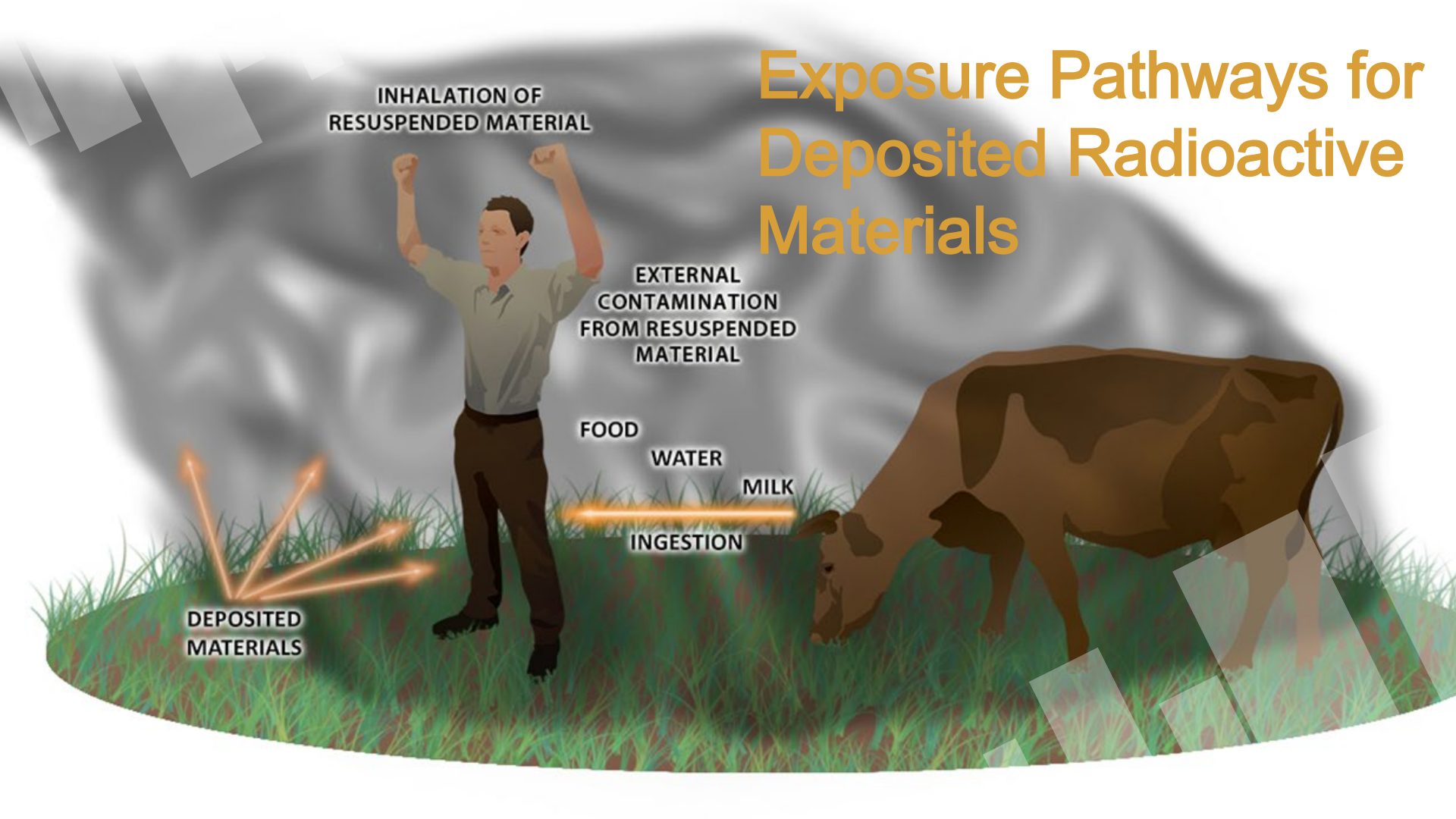



- Same as plume?
- Include a wind shift?

# What are the primary protective actions to consider in the intermediate phase?

Relocation, embargo, decontamination

# Exposure Pathways for Deposited Radioactive Materials



# Intermediate Phase Relocation PAGs

1st Year

**2 rem TED**

2nd Year

**500 mrem TED**

# How do we determine relocation?

## Soil samples and direct radiation surveys

# Early vs. Intermediate Phase Protective Actions

## Early Phase

- Based upon plant condtions and dose projection models

## Intermediate Phase

- Based upon actual measurements

Have we evacuated fa
enough?

# How Do We Correlate the Relocation PAG With Our Measurements?

- Take environmental samples to determine isotopic mix
- Take gamma exposure rate measurements at 1 meter at sample locations
- Calculate Derived Response Levels (DRLs) that equal 1st year and 2nd year PAG dose

# Derived Response Levels (DRLs)

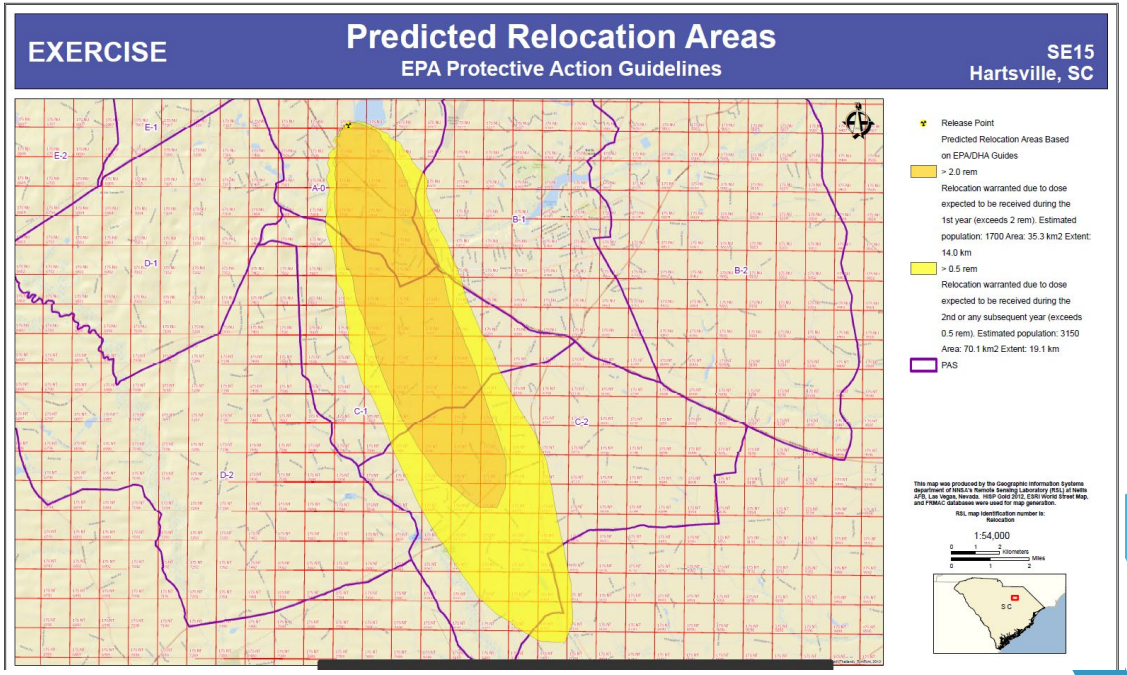
- After the DRLs are determined for the incident, it is possible to use exposure rates to establish a restricted zone boundary equal to the relocation PAG

# DOE Aerial Measuring System

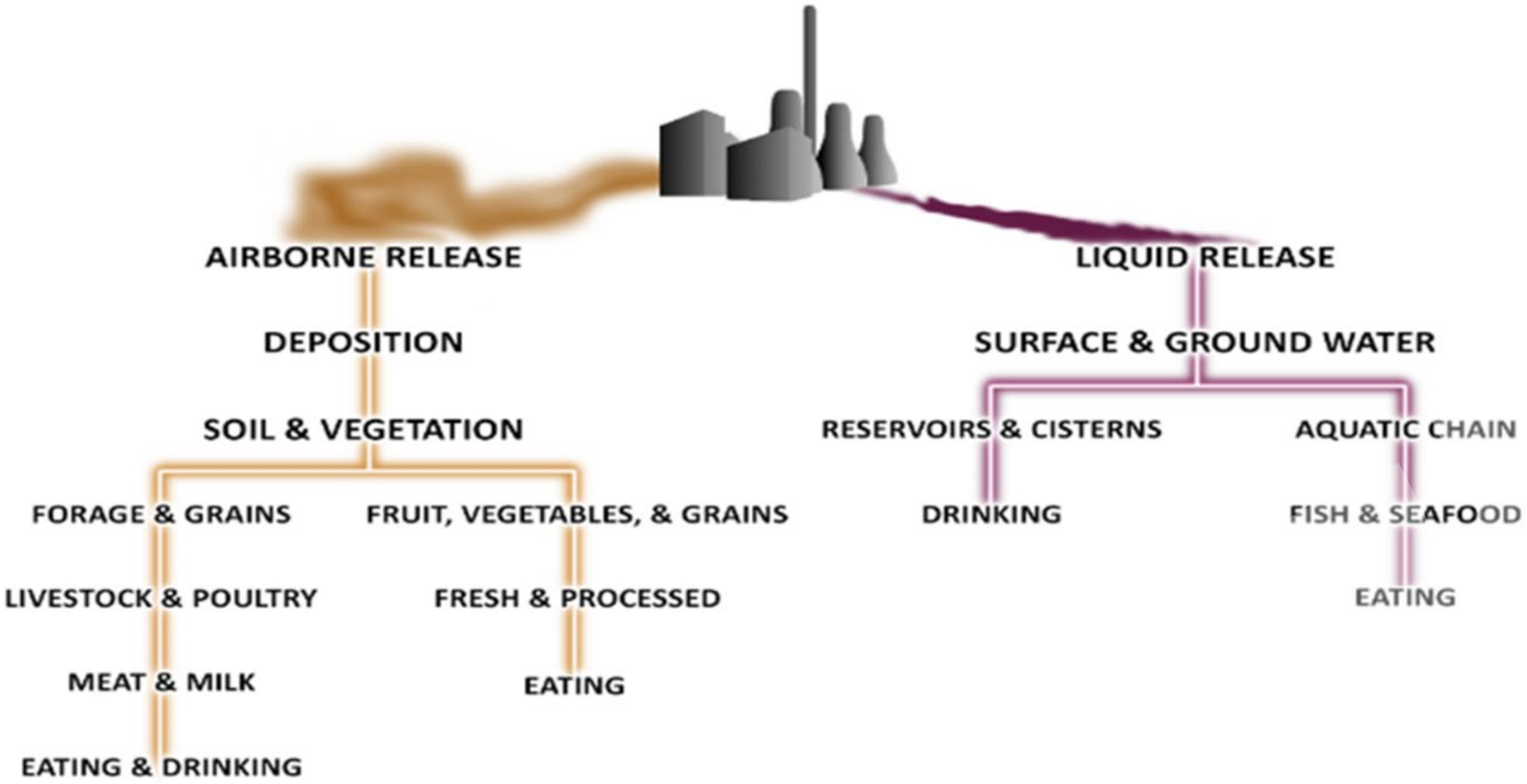
# DOE AMS EXPOSURE DATA

- Establishes general patterns of exposure rates from deposited material
- Data normalized to a height of one meter
- May be principal data source in establishing initial isodoselines
- Lower limit for fixed wing ~50 μR/hr

# FRMAC Predicted Relocation Map



# Ingestion Pathways



# FDA PAGs (1998)

***whichever is most limiting***

| | | |
|---|---|---|
| CEDE | 5 mSv | 0.5 rem |
| CDE | 50 mSv | 5 rem |

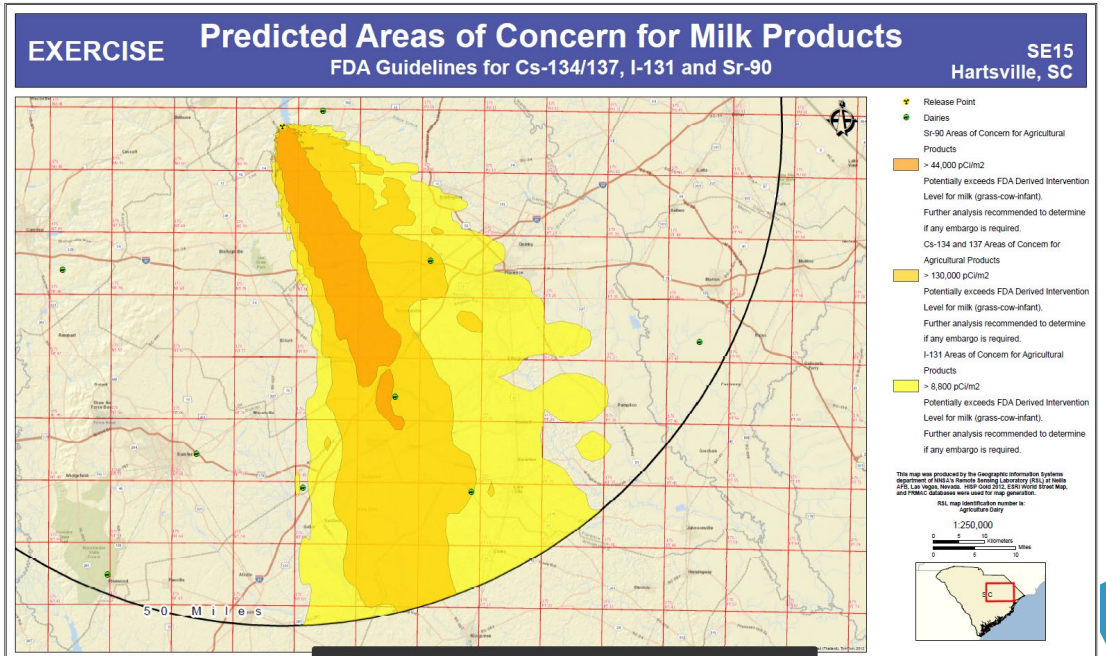
# Derived Intervention Level (DIL)

- Concentration of radionuclides in food that will cause a PAG to be exceeded, assuming a defined ingestion period and percent of food contamination
- DIL is the surrogate for the PAG

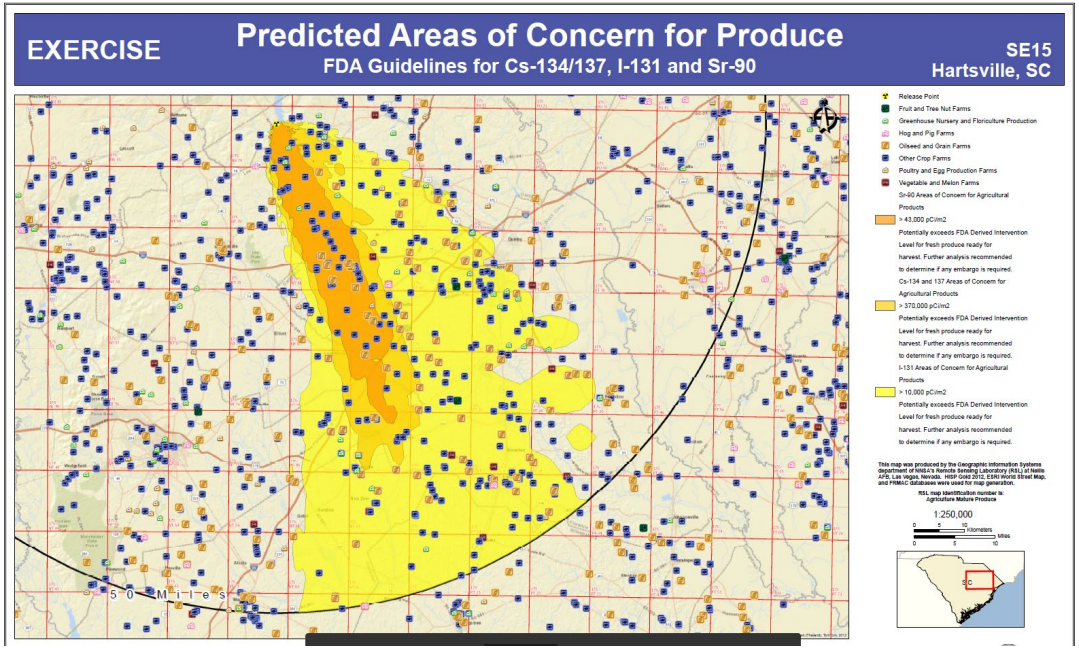
# Principle Nuclide Rounded DILs

| Nuclide | DIL Bq/kg | pCi/kg |
|---|---|---|
| Sr-90 | 160 | 4300 |
| I-131 | 170 | 4600 |
| Cs-134+137 | 1200 | 32000 |
| Pu-238+239+Am-241 | 2 | 54 |
| Ru-103+106 | $\frac{C_{103}}{6{,}800} + \frac{C_{106}}{450} < 1$ | $\frac{C_{103}}{180{,}000} + \frac{C_{106}}{12{,}000} < 1$ |

# FRMAC Dairy Products Map



# FRMAC Mature Produce Map



# Example Spreadsheet

| | |
|---|---|
| **Sample Control Number:** | 3M |
| **Sample Description:** | Probe10 |
| **Sample Type:** | Milk |
| **Latitude:** | 31.043 |
| **Longitude:** | 85.0895 |

| Isotope | Concentration (µCi/L) | DIL (µCi/L) | DIL (Bq/L) | Fraction of DIL | |
|---|---|---|---|---|---|
| Sr-90 | [redacted] | 4.32E-03 | 160 | 0.00E+00 | Primary FDA Radionuclides or Groups |
| I-131 | 5.64E+00 | 4.51E-03 | 167 | 1.25E+03 | |
| Cs-134 | 7.49E-01 | 2.51E-02 | 930 | 2.98E+01 | |
| Cs-137 | 5.09E-01 | 3.68E-02 | 1360 | 1.39E+01 | |
| Cs group | 1.26E+00 | 3.11E-02 | 1150 | 4.05E+01 | |
| Ru-103 | 0.00E+00 | 1.83E-01 | 6770 | 0.00E+00 | |
| Ru-106 | 0.00E+00 | 1.21E-02 | 449 | 0.00E+00 | |
| Ru group | 0.00E+00 | 2.70E-05 | 1 | 0.00E+00 | |
| Pu-238 | 0.00E+00 | 6.76E-05 | 2.5 | 0.00E+00 | |
| Pu-239 | 0.00E+00 | 5.95E-05 | 2.2 | 0.00E+00 | |
| Am-241 | 0.00E+00 | 5.41E-05 | 2 | 0.00E+00 | |
| Pu+Am group | 0.00E+00 | 5.95E-05 | 2.2 | 0.00E+00 | |
| Sr-89 | 0.00E+00 | 3.78E-02 | 1400 | 0.00E+00 | |
| Y-91 | 0.00E+00 | 3.24E-02 | 1200 | 0.00E+00 | |
| Zr-95 | 0.00E+00 | 1.08E-01 | 4000 | 0.00E+00 | |
| Nb-95 | 0.00E+00 | 3.24E-01 | 12000 | 0.00E+00 | |
| Te-132 | 0.00E+00 | 1.19E-01 | 4400 | 0.00E+00 | |
| I-129 | 0.00E+00 | 1.51E-03 | 56 | 0.00E+00 | |

# What Do We Do About the Wate

| EPA PAGs (2017)<br>*For Drinking Water* | | |
|---|---|---|
| Most sensitive populations | 1 mSv | 0.1 rem |
| General population | 5 mSv | 0.5 rem |

# Decisions to Consider

- Facilitation provided by what group(s)
- Meteorological conditions/protective actions the same or different for ingestion portion
- Desired relocation distance exceeding first year (2 rem) or second year (0.5 rem) PAG (can be less than 10 miles or slightly more)

# Decisions to Consider

- Time of year different or the same in the scenario as compared to actual time of year (for crop purposes)
- Time lapses for phases of sampling and decision-making
- Desired maximum extent for ingestion distance exceeding DILs for food and milk (usually not more than 50 miles downwind)
- Limiting the distance to 50 miles if calculations indicate greater than 50 miles

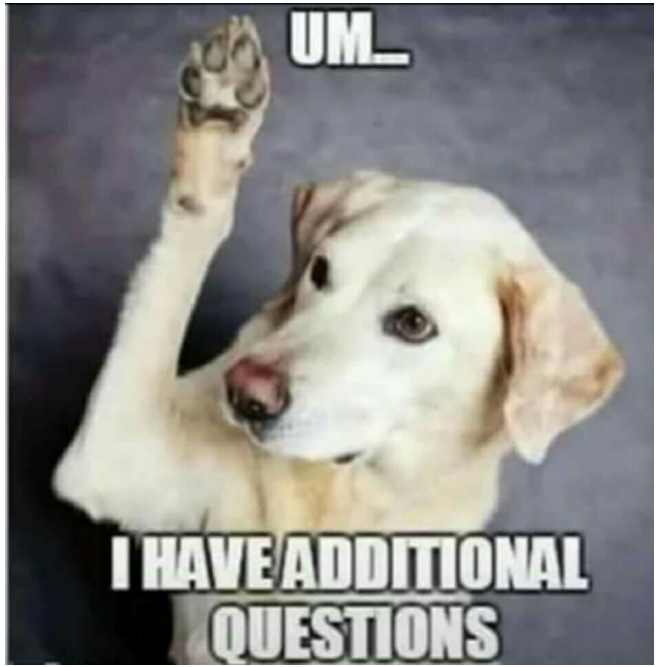
# Decisions to Consider

- Location, quantity, failure rate, and type of samples to be included in FRMAC spreadsheets
  - Soil to confirm predicted relocation areas (recommend 10)
  - Water
  - Milk
  - Crops– specify crop types based on location of site and time of year

# Decisions to Consider

- State ingestion spreadsheets using same or different methodology as FRMAC spreadsheets
- Use of default Derived Response Level (DRL) and/or accident-specific DRL based on soil
- Ingestion sampling team field dose rates
- Dose rates from samples collected
- Quantity of maps and spreadsheets that FRMAC brings with them for exercise

# Questions?



# WAIT  There is MORE!

# Now for the Really Boring (but important) Part!

- What does FEMA evaluate during an Ingestion Pathway Exercise????

# What do we Evaluate?

- Criterion 2.d.1 – Radiological Assessment for Ingestion Pathway
- Criterion 2.e.1 – Radiological Assessment and Decision Making for Relocation, Return and Reentry
- Criterion 3.e.1 – Implementation of Ingestion Pathway Decisions
- Criterion 3.e.2 – Implementation of IP Decisions for Information on contaminated food and water
- Criterion 3.f.1 – Implementation of Decisions for Relocation, Return, and Reentry
- Criterion 4.b.1 – Post Plume Field Monitoring and Sampling
- Criterion 4.c.1 – Laboratory Operations

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# What is looked at in 2.d.1

- Create Sampling Plan to assess radiological consequences of release on food and H20
- Compare sampling data to ingestion PAGS in Plan or Procedures
- Timely appropriate recommendations should be provided to decision makers
- What precautionary actions are considered before any analytical result is available on contamination levels
- Does the dose assessment staff compare analytical results with pre-determined Derived Intervention Levels
- How are the boundaries of any temporary embargo zones determined
- What arrangements are made to coordinate potential decisions with other political jurisdictions
- What is the appropriate coordination between decision makers, if more than one individual has jurisdiction

FEMA

# What is looked at in 2.e.1

- Relocate personnel in areas not previously evacuated but where projected doses are in excess of the Relocation PAGs; 2 Rem 1st yr, 500 mR 2nd yr, 5 Rem over 50 yrs.

- Reentry policies regarding access and exposure control for EWs and general public who need to temporarily enter the evacuated area
  - Dosimetry and briefing requirements for non Emergency Worker personnel

- Return – Decisions are based on environmental data and political boundaries or physical features which allow previously evacuated personnel to reoccupy homes and business on an unrestricted basis, based upon measurements of radiation from ground deposition

  - Are Medical and Social Services, utilities, water treatment, roads, schools, housing available

FEMA

# What is looked at in 3.e.1

- Demonstrate the capability to secure and utilize current information on the locations of
  - dairy farms,
  - meat and poultry producers,
  - fisheries,
  - fruit farms,
  - vegetable growers,
  - grain producers,
  - food processing plants and
  - water supply intake points

  to implement protective actions within IPZ

  How is this information obtained, what are the sources, how often is it updated

FEMA

# What is looked at In 3.e.2

- What are the State and Local requirements to implement embargos or condemnations
- Where and how are condemned food products taken for disposal
- What measures are taken and strategies developed by the ORO to implement protective actions for the general public and food producers in the IPZ
- Observe whether reproduction-ready information and instructions for predetermined individuals and businesses are available for production and distribution.

FEMA

# What is looked at In 3.f.1

- **Relocation**
  - How will transportation – dependent evacuees be transported from the restricted zone if they had not been previously evacuated
  - How will decisions and instructions for relocation be communicated to the public

**Re-entry**

- How will those individuals permitted temporary re-entry to restricted areas be protected from unnecessary radiation exposure
- What are the procedures for monitoring and decontaminating vehicles, equipment and personnel that have been allowed re-entry to the restricted area

**Return**

- Are there procedures for permitting a gradual return of evacuees to low-level contaminated areas
- Does the procedure identify and prioritize services and facilities that require restoration before return of evacuees can occur

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# What is looked at In 4.b.1

- What instruments, equipment, and supplies are required for each type of sampling assignment
- What are the specified minimum sample sizes to be collected
- Are there specific directions on taking milk, water, vegetation, and soil samples
- How and when will the results of direct radiation measurements be transmitted to the appropriate location
- How will the collected samples be transported to a laboratory for analysis

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# What is looked at In 4.c.1

- Does the laboratory have the capability to analyze the radionuclides that might be released in a reactor accident
- What is the highest contact reading allowed on any sample that is processed in the laboratory, what happens to the samples that exceed this contact reading
- How often are the instruments in the laboratory calibrated, and to what standard (NIST)
- What sample preservation techniques are used in the laboratory
- How are chain of custody forms processed and sample integrity maintained
- How are samples prepared for counting and what contamination control procedures are used during this process

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