Direction-Specific Planned Initial Protective Actions

Technical, Policy and Health Risk Considerations for DOE Site Emergency Planning

Objectives

1. Review DOE Emergency Management requirements and guidance on planned initial protective actions.
2. Summarize technical, health risk and other factors for selecting planned initial protective actions.
3. Examine alternative protective action approaches for consistency with current policy.

Part 1

Protective Action Principles, Requirements and Guidance

Guiding Principles (from IAEA & ICRP)

1. Avoid severe early health effects through actions to keep individual doses or exposures below thresholds for effects.
2. Limit risk to individuals through actions that produce a positive net benefit.
3. Limit overall risk to workers and public by reducing collective dose or exposure.

DOE O 151.1C, Attachment 2 (the CRD)

- DOE emergency management directives implement these guiding principles

- *"Predetermined conservative onsite protective actions and offsite protective action recommendations must be associated with the classification of these Operational Emergencies…."*

Emergency Management Guidance

- DOE G 151.1-2, 2.2, Technical Planning Basis
- DOE G 151.1-4, Categorization & Classification
- DOE G 151.1-4, Consequence Assessment
- DOE G 151.1-4, 7.3.5, Protective Actions & Reentry

Protective Action Criteria (PAC)

- *"The planning process … includes establishing a **PAC** that determines when protective actions should be initiated…".*
- For a given hazard, there is only one PAC value
- If a PAC is exceeded or expected (projected) to be exceeded, protective actions are needed to mitigate the impact

Key Policy Themes

1. Planned PAs linked to classification
2. Respond according to plans
3. Conservatism

Theme 1: Planned PAs Linked to Classification

- Carefully thought out with consideration of analysis results and other conditions
- Avoids making critical decisions under stress of emergency response
- Eliminates a decision process, speeds notification and execution of PAs

Theme 2: Respond According to Plans

- Carry out PAs as planned (unless conditions at the time ***clearly*** indicate otherwise)
- Any attempts to refine consequence estimates are likely to produce response that is…
  - Less timely
  - Less conservative
  - Less effective

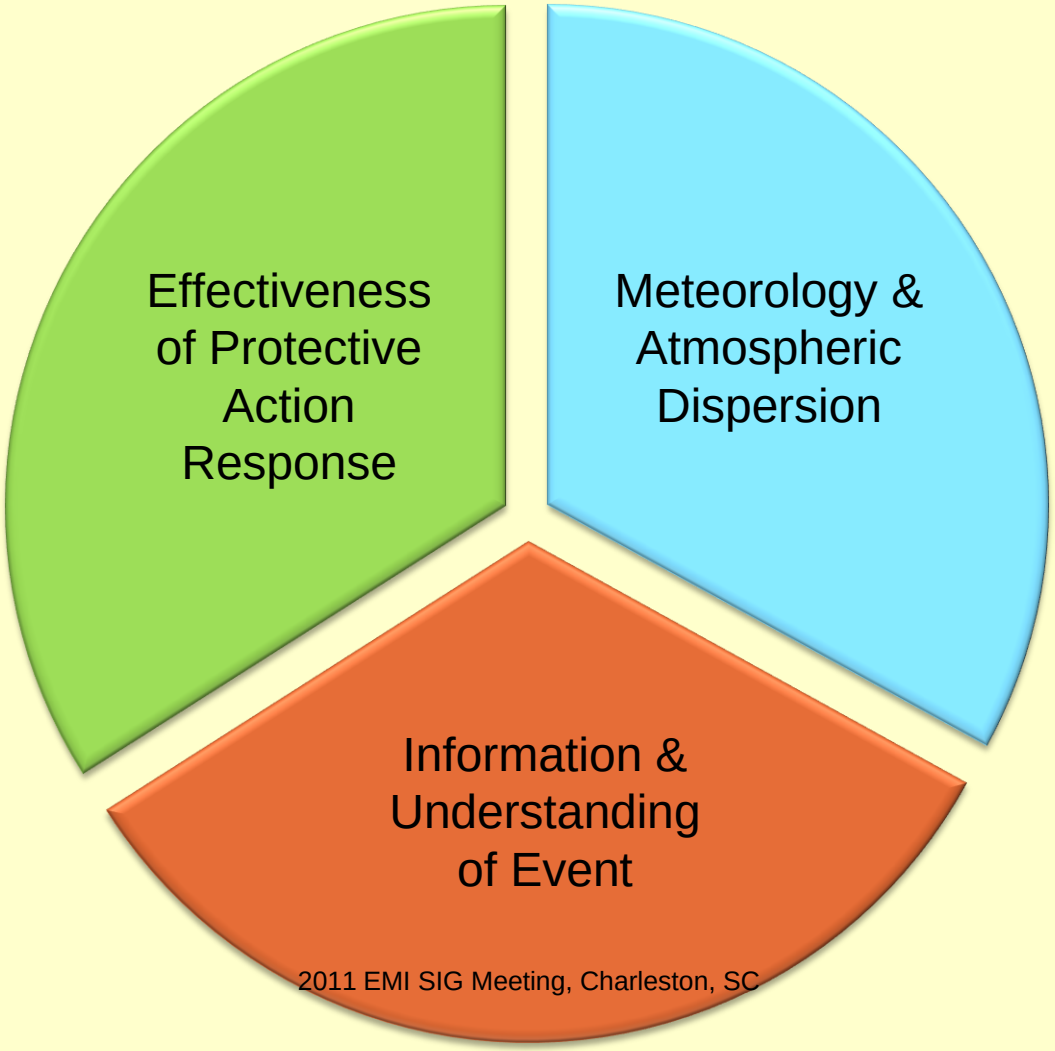
Theme 3: Conservatism

- Policy docs encourage conservatism….
  - in selection of scenarios
  - in hazardous material inventories
  - in source term assumptions
  - in assumed meteorological conditions
  - in human exposure parameters

- Why the repeated emphasis?

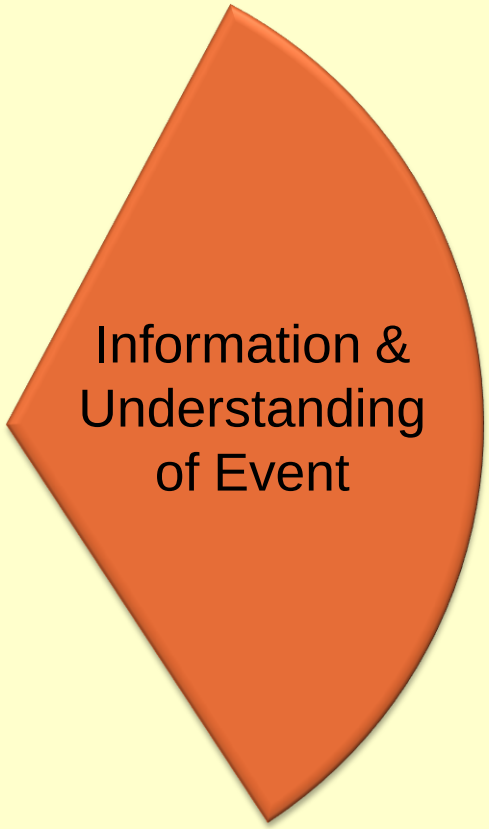
<u>Compensation for large uncertainties</u>.

Sources of Uncertainty



Sources of Uncertainty:
Information and Understanding of the Event

- Cause/initiator?
- Location?
- Extent of damage?
- Instruments available?
- Hazardous material involvement?
- Release status (past, present, future?)
- Source term (amount, rate, release point?)



Sources of Uncertainty: Meteorology and Atmospheric Dispersion

- How representative are the observations?
  - Site may be lacking enough measurements to adequately characterize conditions at the incident location.
- What is the condition and state of the measurement equipment?
  - Quality assurance of instrument readings is *not* performed continuously…may be days or weeks before instrument errors or problems become known.
  - Instrumentation naturally degrades over time.

Meteorology & Atmospheric Dispersion

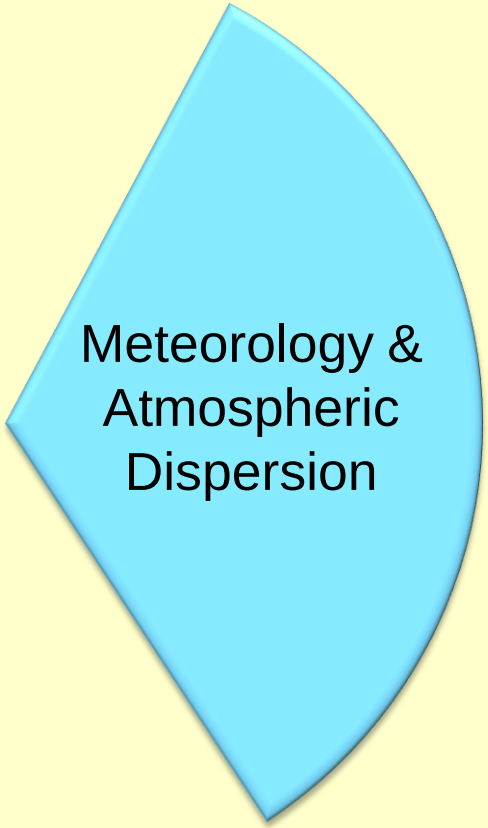
Sources of Uncertainty: Meteorology and Atmospheric Dispersion (cont'd)

- Are there complex, local flows?
  - Complex terrain, river valleys, or nearby large bodies of water can cause local wind flow patterns to rapidly develop and/or change.
  - Complex, 3-D flows are likely not well-resolved by observations (or a point observation).
- Are there buildings/obstructions near the incident location?
  - Wake effect complicates plume transport and increases diffusion.

Meteorology & Atmospheric Dispersion

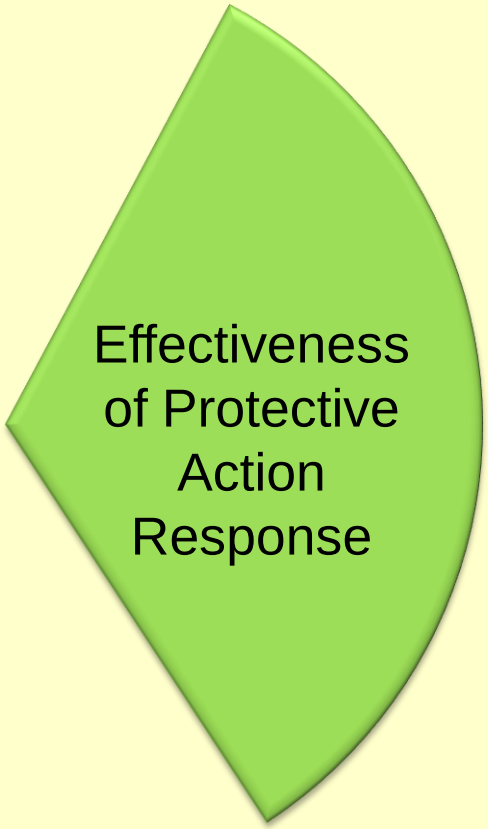
Sources of Uncertainty: Meteorology and Atmospheric Dispersion (cont'd)

- Are winds light and variable?
  - No defined plume transport direction.
- Is there weather?
  - Large-scale, synoptic conditions may be changing right at event initiation (e.g., frontal passage).
- How to interpret meteorological variables?
  - Initial responders may incorrectly interpret conditions (e.g., wind direction vs. flow vector).



Sources of Uncertainty:
Effectiveness of Protective Action Response

- Different PA options available for different groups?
  - Is there enough time?
  - Staff to interpret meteorological conditions?
- Communications with workers & public?
  - Different groups, different info
  - Will people act ?



Other (Random) Sources of Meteorological Uncertainty

Part 2

Protective Action Options and Current “Standard” Practices

Options

1. Evacuation
2. Sheltering
3. Access control
4. Accountability
5. Medical intervention
6. Decontamination
7. Shielding
8. Long-term (relocation, food pathway, etc.)

"Standard" Practices at DOE sites

1. Accidents that may require classification are identified and *conservatively* modeled in facility-specific Hazards Assessments
2. Consequences (doses, concentrations) in all directions under *conservative* atmospheric transport conditions are calculated.

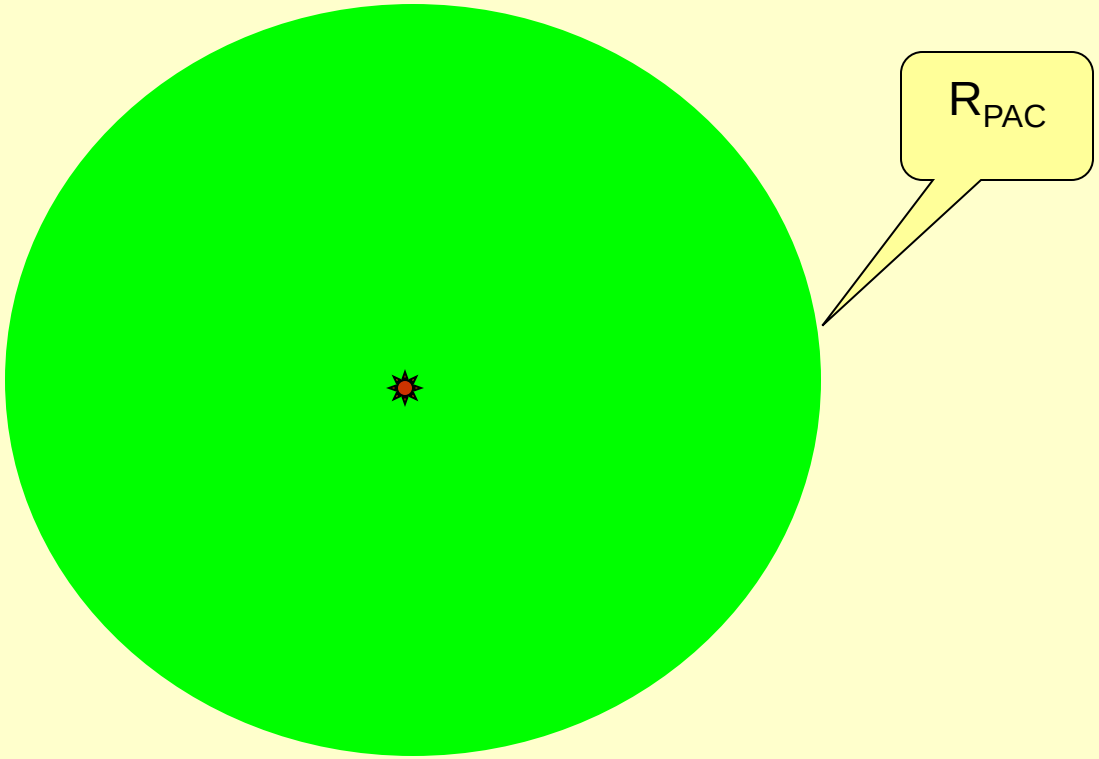
"Standard" Practices (cont'd)

3. Areas and populations that may experience consequences exceeding the defined *Protective Action Criterion* for each particular hazardous material are identified.
4. Actions to prevent or mitigate the predicted consequences are selected (almost always evacuation & sheltering)

"Standard" Practices (cont'd)

5. Initial protective action(s) are procedurally linked to the criteria (Emergency Action Levels) used to classify each type of accident/event.
6. Implementation of initial protective actions is independent of wind direction
   - Refined consequence estimates & modification of PAs begins when CA team arrives

Initial PA Independent of Wind Direction



R_{PAC} = Distance at which PAC is exceeded under conservative meteorological conditions.

Considerations for Selecting Planned Initial Protective Actions

1. The event.
   - Hazardous material(s) involved and effects of exposure?
   - Lethal or severe early effects?
   - Non-lethal or transient effects?
   - Incremental cancer risk increase?

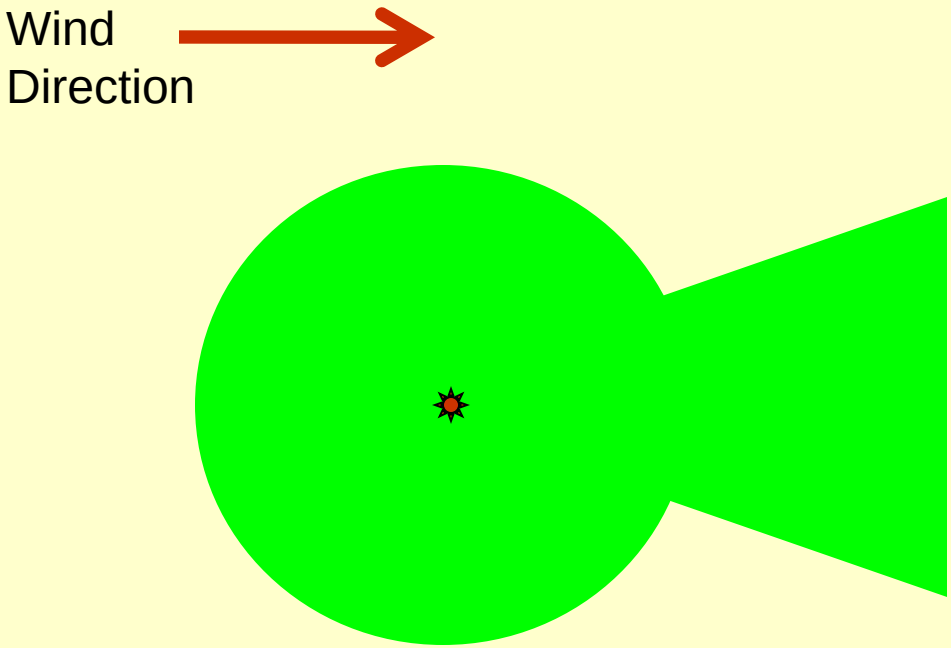
Considerations for Selecting Planned Initial Protective Actions (2)

2. Release status implied by the EAL
   - In progress?
   - Imminent?
   - Anticipated at some future time?
   - Highly uncertain?

Part 3

"Alternatives" to the Standard Practices?

Direction-Dependent Initial Protective Actions

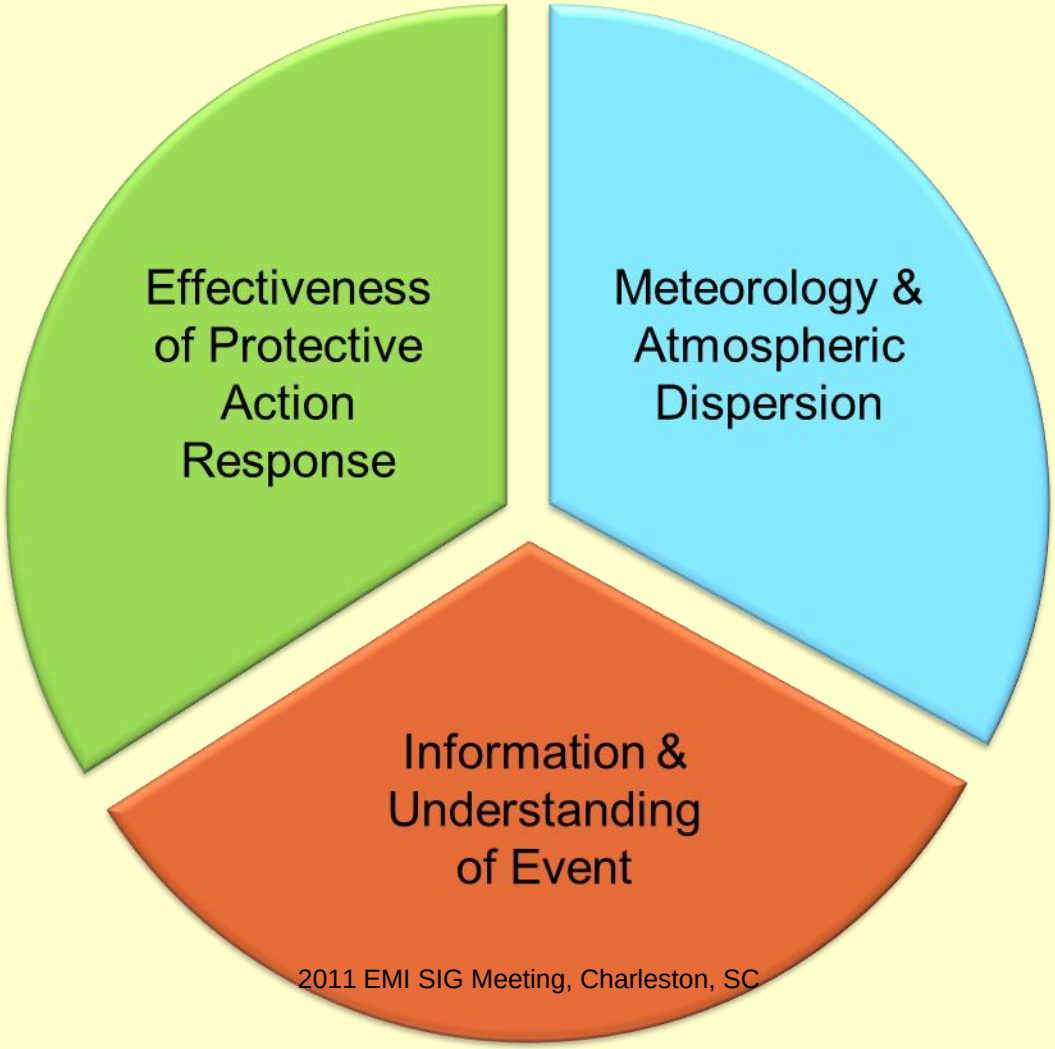


Example of direction-dependent Initial Protective Action zone (“Keyhole”)

Direction-Dependent Initial Protective Actions

- Current Policy: Using real-time met to classify events & make initial PAs is discouraged
- The policy rationale:
  - Need qualified staff to interpret met conditions
  - More complex decision process
  - Less timely, less conservative, less anticipatory, etc.

Sources of Uncertainty: What's Changed?



Direction-dependent Initial Protective Actions (cont'd)

- What's changed?
  - Met instruments & systems?
  - Staff ability to interpret met data in context of local conditions, diurnal, other influences?
  - Reduced risk by subjecting fewer people to PAs (better understanding of PA risk)?
  - Better understanding of uncertainties?

Direction-dependent Initial Protective Actions (cont'd)

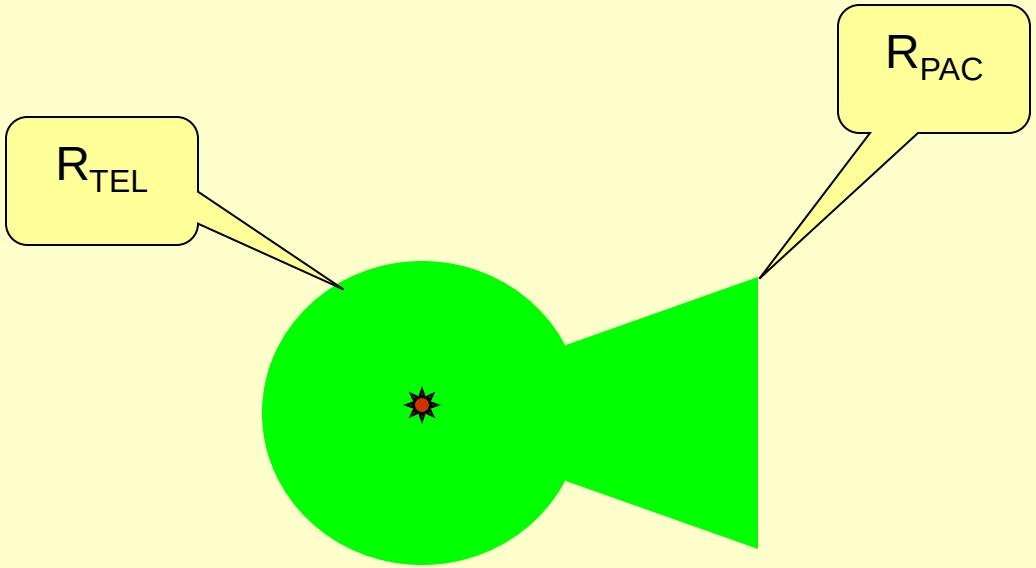
NA-41 Position:

1. *Use of direction-dependent initial protective actions is <u>not</u> consistent with DOE Emergency Management policy as spelled out in current directives.*
2. *Despite some reductions, <u>total</u> uncertainty associated with predicting consequences early in a hazardous material release event continues to be large. No change in policy that reduces conservatism is appropriate at this time.*

Different PA Criteria for Different Areas/Populations

- Current Policy:
  - Consequences ≥PAC should define distance for planned initial PAs.
  - Different initial PA distance for downwind and other sectors ("keyhole" approach) is *not* encouraged.
- The Policy Rationale:
  - Protective actions should be planned for areas where the PAC will be exceeded under conservative meteorological conditions.

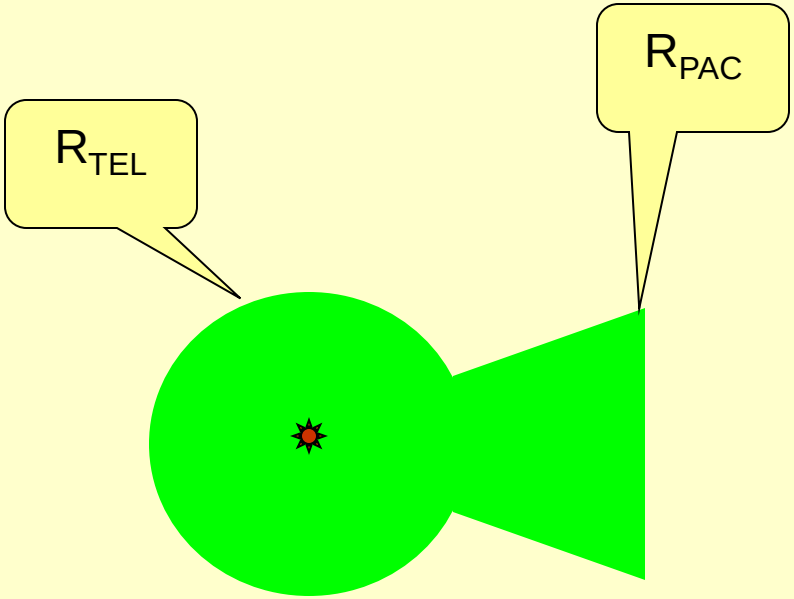
Applying Different PA Criteria to Different Areas/Populations



A "Keyhole" Initial Protective Action zone

What's wrong with this picture?

- TEL is defined **ONLY** as an element in EPZ size determination.
  - Severe irreversible health effects
  - Increased mortality in sensitive groups
- NOT appropriate for determining planned initial PAs



Different PA Criteria for different areas/populations

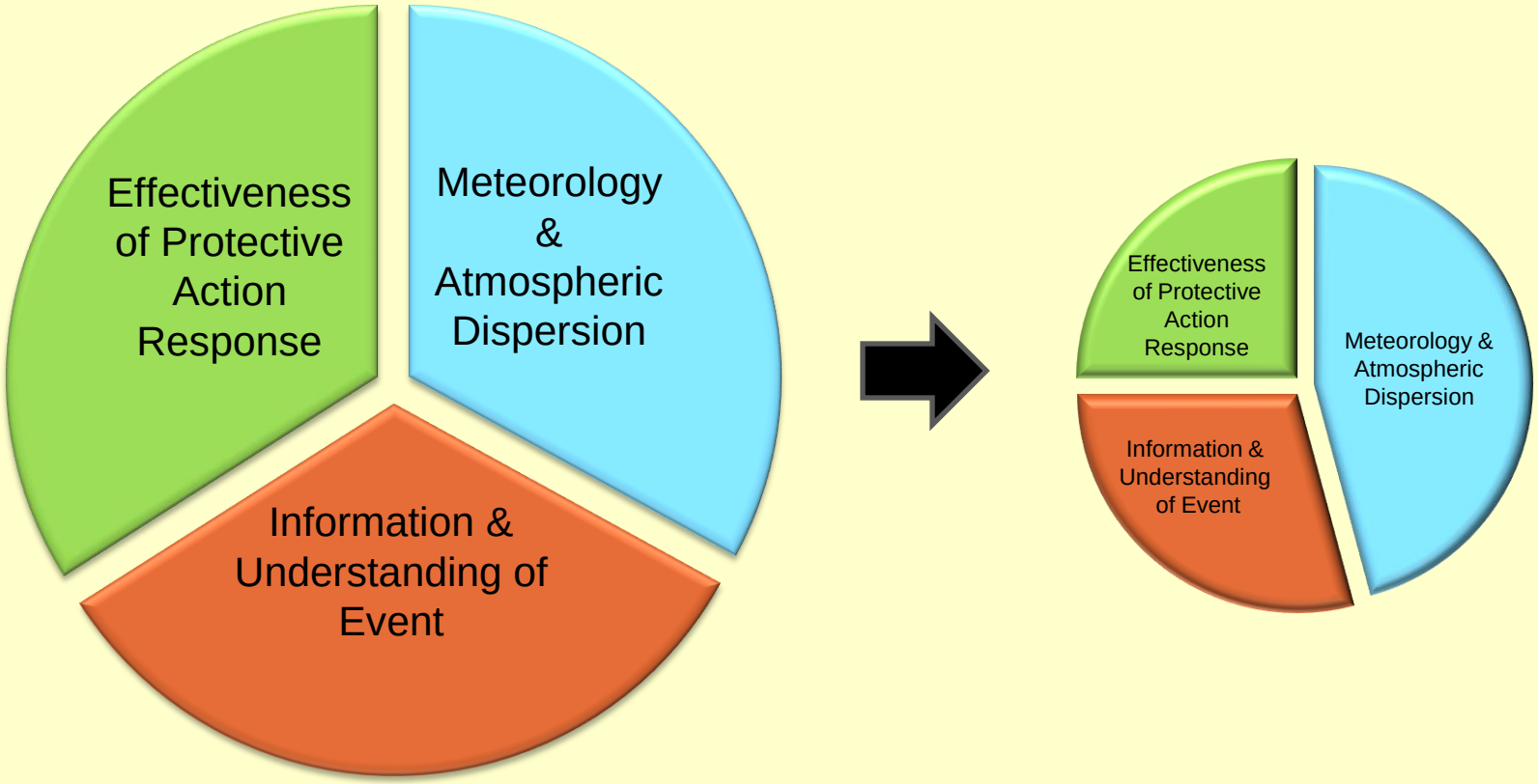
- What's changed?
  - Met instruments & systems?
  - Staff ability to interpret met data in context of local conditions, diurnal, other influences?
  - Reduced risk by subjecting fewer people to PAs (better understanding of PA risk)?
  - Better understanding of uncertainties?
  - Changes in facility/site hazards?

Different PA Criteria for different areas/populations

NA-41 Concern:

Use of a larger (>PAC) exposure/dose criterion to define initial PAs for non-downwind areas is not consistent with DOE Emergency Management policy as set forth in current directives and does not adequately address/compensate for the large total uncertainty associated with <u>initial</u> protective actions for hazardous material release.

What's Changed?



Summary

1. There are large uncertainties associated with predicting impacts from hazardous material releases and protecting people from those impacts.

2. It is DOE Emergency Management policy that conservatism in analysis, planning and response be greater when uncertainty is large.

Summary (cont'd)

3. Certain advances (e.g., communications technology, understanding of accident phenomenology) may have reduced some of the uncertainties associated with protecting workers and the public.

4. However, *overall* uncertainty is still large and no policy change that reduces the level of conservatism in analysis, planning and response is appropriate at this time.