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Significance Quantification Process for Emergency Preparedness Oversight

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Is It Possible To Quantify The Protection of Emergency Preparedness?

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- The Nuclear Regulatory Commission directed the staff to use PRA techniques in regulatory issues
- In 2010 the Commission charged the staff to quantify the protection provided by emergency preparedness (EP) programs

Emergency Preparedness (EP)

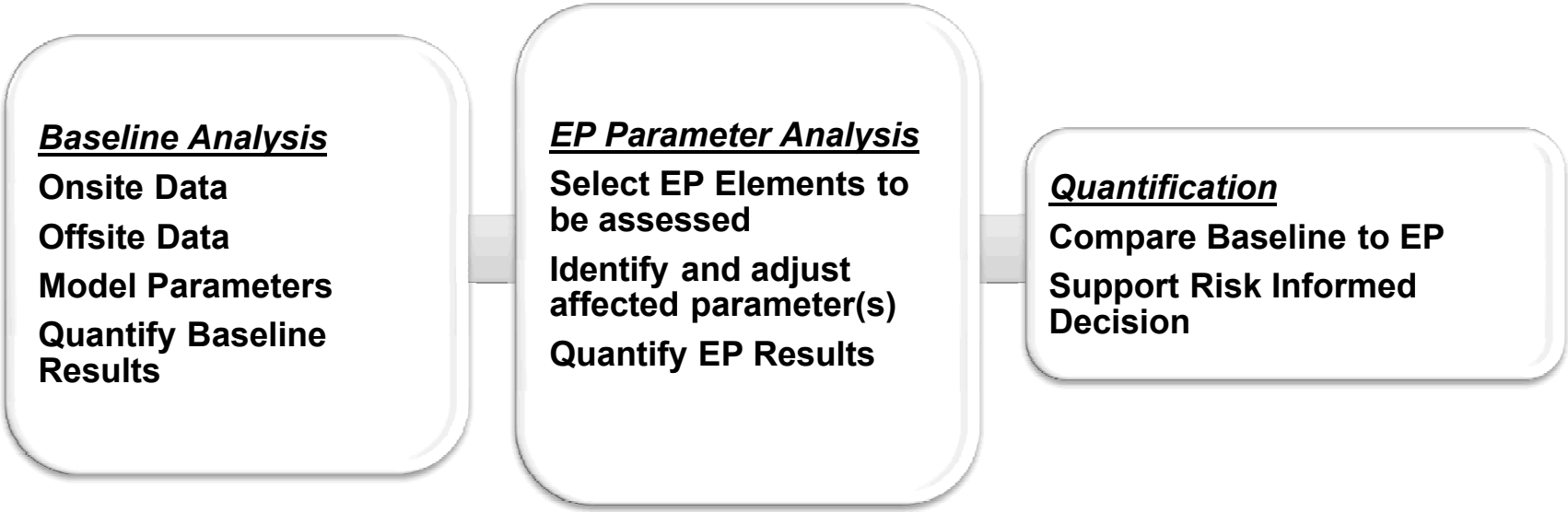
- EP includes physical and administrative infrastructure
- EP is a defense in depth measure with no connection to core damage frequency
- EP is not necessary until there is an accident
- EP program elements are regulated as being needed to respond to an emergency

Quantify The Protection of Emergency Preparedness

- Develop a quantification process
- Approach
  - Comparing nuclear plant Emergency Preparedness (EP) to ad hoc response
  - Select EP elements to test
  - Use population dose avoided as the measure of effectiveness
  - Select modeling techniques to support analysis

Deductive Quantification Index (DQI)

- Key elements of the DQI process



Deductive Quantification Index

- To explore potential to quantify risk significance of EP program elements, a premise was assumed:
  - "There is a suite of accident scenarios appropriate for regulatory oversight of EP"
  - This suite considered in this study is identified in NUREG/CR-7160
- If successful, the effort could support a risk informed and performance based EP regulatory regimen

Deductive Quantification Index

- DQI models site specific parameters
  - Population data
  - Source term
  - Evacuation time estimates
  - Roadway network
  - Emergency plan procedures
- Assumes emergency plans are implemented as written, approved, inspected and demonstrated in exercises
- MELCOR Accident Consequence Code System (MACCS) code used

Deductive Quantification Index

- Population divided into cohorts, which are population segments with similar response characteristics
  - In a manner similar to the “State of the Art Reactor Consequence Study,” (SOARCA) NUREG-1935
- Analyze response to accident scenario with nuclear plant EP.
- Analyze response with an all-hazards response plan
  - Described as ad hoc response, but it is not entirely ad hoc

Deductive Quantification Index

- Selected 2 EP program elements for significance determination
  - Assumed sirens not operable in the 2-5 mile area.
  - Assumed a one hour delay in offsite response
    - Reason undefined, but could occur in classification, notification, protective action implementation, communication equipment failure, etc., or a combination
- Determined which modeling parameters this would be affected for each of the above and made adjustments to reflect the response under the postulated condition

Deductive Quantification Index

- Site specific data was used, but results not directly applicable to any specific site
- Large number of cohorts used to demonstrate capability to evaluate many individual population segments
- 95th percentile dose results used

Deductive Quantification Index

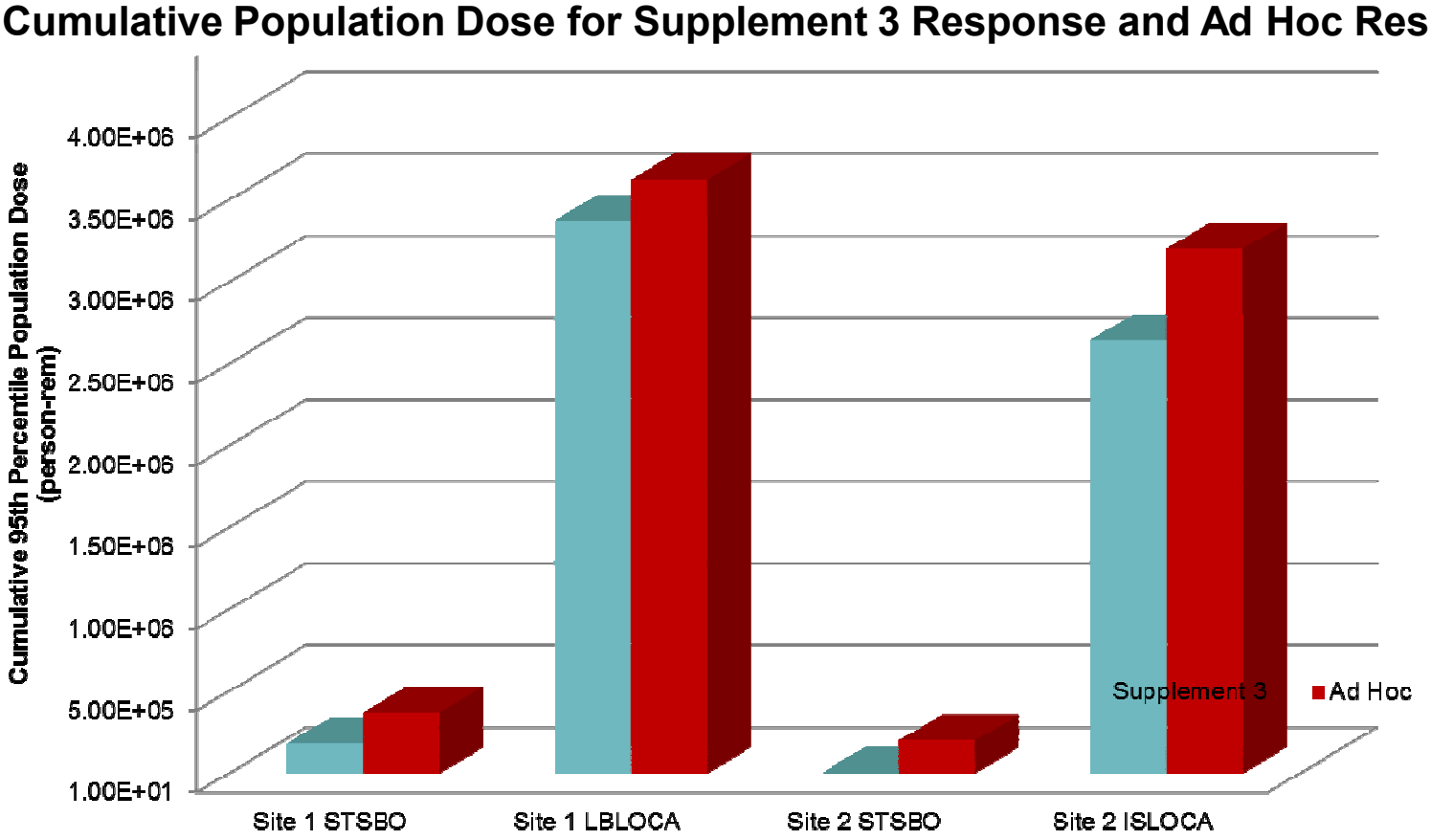
For the modeled sites, delay in notification was more significant than a localized failure of sirens

Attributed to effectiveness of backup notification measures, societal notification, and larger area of the impacted system

Scenario	Site 1 (Rem)	Site 2 (Rem)
Baseline	1.78×10^{5}	1.65×10^{3}
Notification Delay	2.12×10^{5}	3.90×10^{3}
Siren Outage	1.93×10^{5}	1.95×10^{3}

Value of EP Programs

Cumulative dose is greater for the ad hoc response than the EP response for every scenario illustrating the value of EP in terms of dose avoided through implementation of an EP program



Deductive Quantification Index

- Nuclear EP reduces dose in all of the modeled scenarios
  - Demonstrated the capability to quantify the value of EP in terms of dose avoided
  - The difference between ad hoc and nuclear EP for these scenarios was measurable but not large
- Demonstrates that risk analysis techniques can prioritize resources, enhance focus on safety and reduce regulatory burden
- DQI has shown the potential to determine the relative risk significance of EP program elements

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Questions?