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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?

- 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
- A proof of concept was developed to:
  - Determine whether the value of EP could be quantified, and if so,
  - Determine whether the value of specific EP elements (e.g., sirens) could be quantified

2

Emergency Preparedness (EP)

- EP includes physical and administrative infrastructure
- EP is a defense in depth measure
- EP is not necessary until there is an accident
- EP program elements are regulated as being needed to respond to an emergency

3

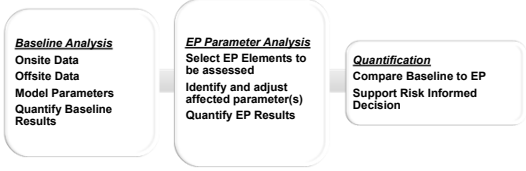
Quantify the Protection of Emergency Preparedness

- Develop a quantification process
  - Select accident sequences
  - Compare nuclear plant Emergency Preparedness (EP) to ad hoc (all-hazards) response
  - Select EP elements to test
  - Used population dose avoided as the metric
  - Select modeling techniques to support analysis

4

Deductive Quantification Index (DQI)

- Key elements of the DQI process



- The metric for this proof of concept was population dose.
- A next step would be to determine the most appropriate metric and convert it into an Index for use in the process.

5

Accident Scenarios

- 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

6

Contributing Factors

- The DQI process is site specific
- Process implementation requires site specific parameters related to:
  - Population data
  - Source term
  - Accident Classification
  - Emergency response
    - Evacuation time estimates
    - Mobilization times
    - Speeds
    - Etc.
  - Roadway network
  - Emergency plans and procedures
- Assumes emergency plans are implemented as written, approved, inspected and demonstrated in exercises

7

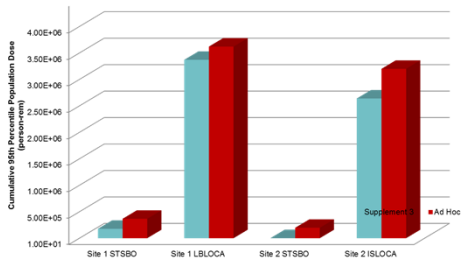
Value of EP Programs

- 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
- 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
- MELCOR Accident Consequence Code System (MACCS) code used

8

Value of EP Programs

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



Cumulative Population Dose for Supplement 3 Response and Ad Hoc Response

9

Value of EP Elements

- 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

10

Proof of Concept

- 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 were used in the proof of concept

11

Value of EP Elements

For this proof of concept, delay in offsite 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}

12

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
- Demonstrates that risk analysis techniques could be used to 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

13

Questions?

14