U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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State-of-the-Art Reactor Consequence Analyses (SOARCA) Overview

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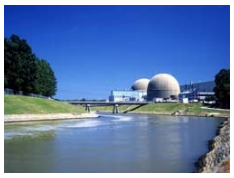
Objective of SOARCA

- SOARCA was initiated to develop a body of knowledge on the realistic outcomes of severe reactor accidents

Peach Bottom



Surry

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SOARCA Objectives

- Update the quantification of offsite consequences
- Incorporate plant changes not reflected in earlier assessments
- Evaluate the benefits of security-related improvements
- Incorporate state-of-the-art modeling (MELCOR/MACCS2)
- Enable NRC to communicate severe accident aspects of nuclear safety

SOARCA Approach

- Focus on important severe accident scenarios
- Realistic assessments and detailed analyses
  - Examples: simulator-based timing, aerosol deposition on piping surfaces
- Integrated accident progression and offsite consequence models
- Incorporated recent physical experiments
- Treatment of seismic impacts on evacuation
- Range of health effects modeling

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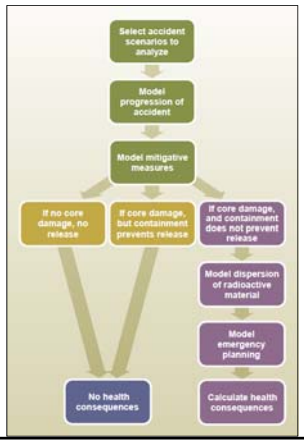
SOARCA Process Flow Chart



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Scenarios Analyzed

Reactor Site	Accident Scenario	Description
Peach Bottom & Surry	Long-Term Station Blackout (LTSBO)	Seismic event; loss of ac power; batteries available initially
Peach Bottom & Surry	Short-Term Station Blackout (STSBO)	Seismic event; loss of ac power; batteries unavailable
Surry	STSBO with Thermally Induced Steam Generator Tube Rupture (TISGTR)	Variation of STSBO – a steam generator tube ruptures resulting in a pathway for radioactive material to potentially escape
Surry	Interfacing Systems Loss-of-Coolant Accident (ISLOCA)	Random failure of valves ruptures low-pressure system piping outside containment

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Accident Progression Modeling

- MELCOR's detailed, integrated computer model includes the reactor, plant systems, plant buildings
- MELCOR calculates accident scenario progression and release of radioactive material
  - Physics and chemistry models
    - Water boil-off in the reactor, core overheating and melting, reactor and containment failure, release of radioactive material
  - Operator actions
    - Installed and portable equipment for depressurizing reactor and injecting water

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Mitigated vs. Unmitigated Cases

- SOARCA evaluated the benefits of post-9/11 improvements by modeling two versions of each scenario:
  - Mitigated: Successful in carrying out mitigating actions
  - Unmitigated: Unsuccessful in implementing post-9/11 measures and other actions to prevent core damage

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Examples of Post-9/11 Mitigation

- Procedures to manually (without electricity) operate steam-driven pumps
- Portable diesel-driven pumps
- Portable generators to power critical instrumentation and operate valves
- Portable air bottles to operate valves
- Designated make-up water sources

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Emergency Response Modeling

- Information included:
  - Site, State, and local emergency plans
  - Site's timeline for declaring an emergency
  - State/local protective action procedures
  - Site Evacuation Time Estimate (ETE) data
- Real-world examples help show:
  - The public will largely obey direction from officials
  - Emergency workers will implement plans

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Offsite Consequence Modeling

- MACCS2 code models:
  - Atmospheric transport
  - Dose pathways: cloudshine, groundshine, and inhalation
  - Uses site-specific weather data
- Metrics reported:
  - **Early fatality risk** – Individual risk of death shortly after exposure to large doses of radiation
  - **Latent cancer fatality risk** – Individual risk of cancer fatality years after exposure to radiation
    - Results compared to NRC Safety Goal and 1982 Siting Study

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