

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

Public Meetings

Surry, VA February 21, 2012

Delta, PA February 22, 2012



NRC's Office of Nuclear Regulatory Research (RES)

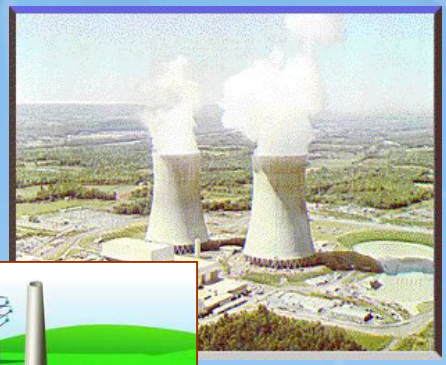
Who We Are:

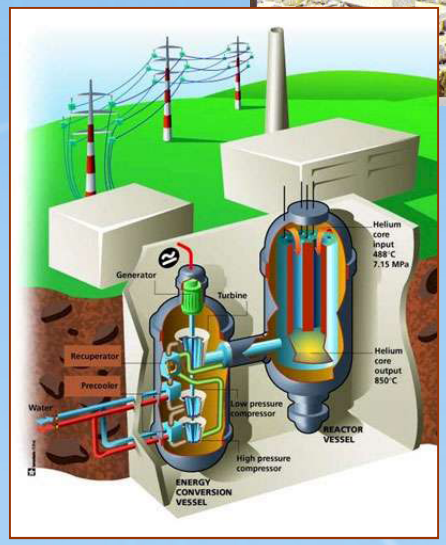
- Major NRC program office
- Mandated by Congress
- Engineers, scientists, analysts
- Located on Church Street in Rockville, MD



RES: What We Do

- Develop technical bases to support regulatory decisions
- Provide in-house technical expertise to licensing offices and the Regions
- Manage projects with National Labs and independent contractors
- Anticipate NRC's future needs
  - Develop technical infrastructure for advanced reactor licensing reviews
  - Support new reactor licensing
  - Develop Long-Term Research Plan







What Is SOARCA?

- SOARCA was initiated to develop a body of knowledge on the realistic outcomes of severe reactor accidents
- Plants examined in pilot study: Peach Bottom and Surry

Peach Bottom

Surry



Why Did We Do SOARCA?

- 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 the NRC to communicate severe accident aspects of nuclear safety

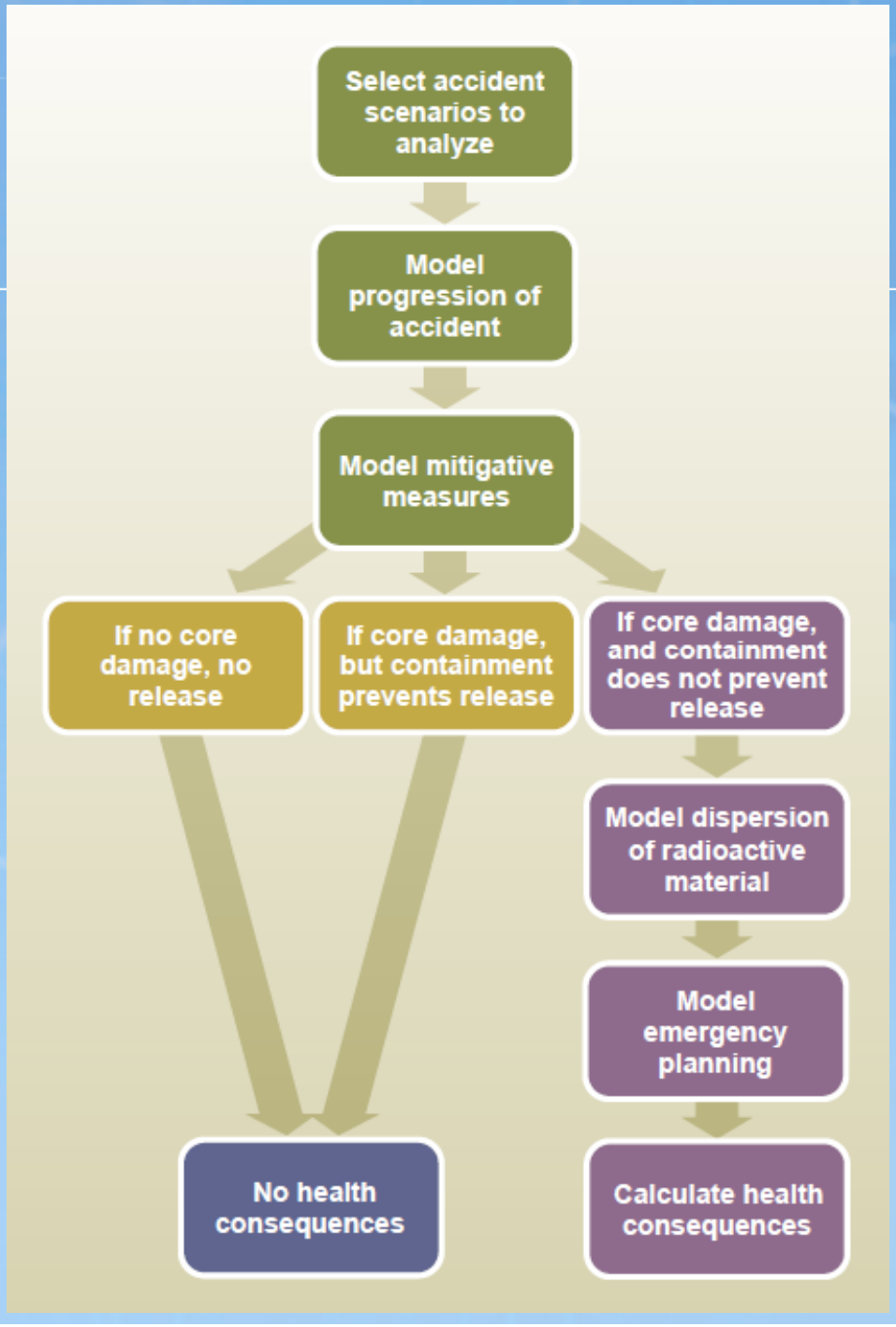


How Is SOARCA Different?

- Focus on important severe accident scenarios
- Realistic assessments and detailed analyses
- Integrated analyses
- Incorporated recent physical experiments
- Treatment of seismic impacts on evacuation
- Range of health effects modeling



How Did We Do SOARCA?



U.S. Nuclear Regulatory Commission

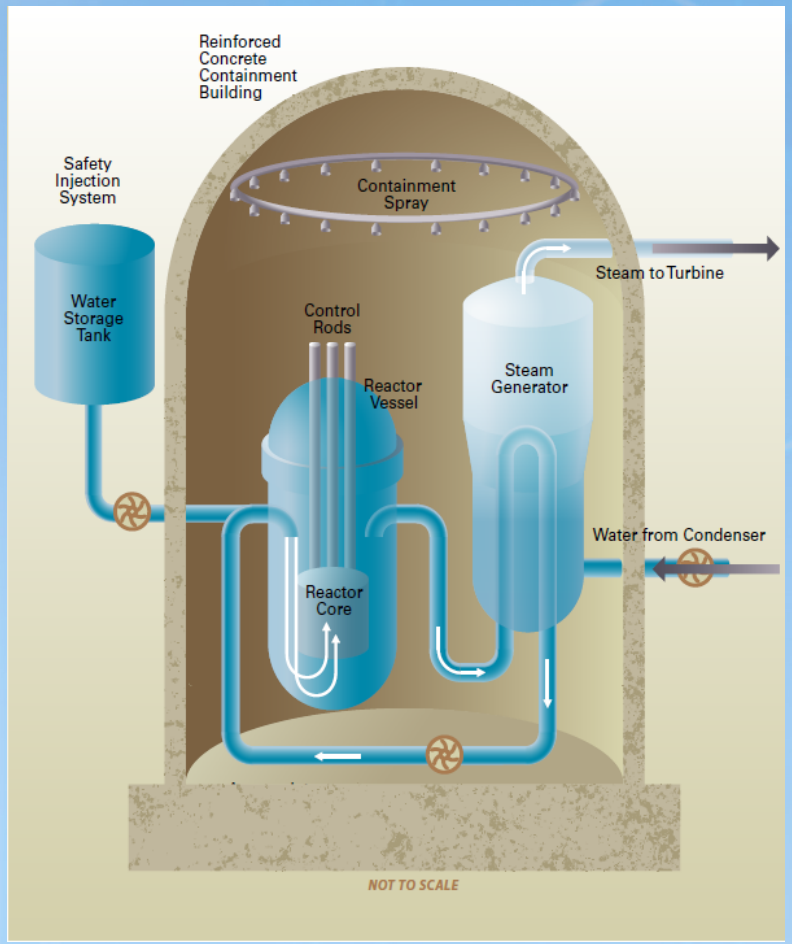


What Scenarios Were Analyzed?

Reactor Site	Accident Scenario	Description
Peach Bottom, Surry	Long-Term Station Blackout	Seismic event; loss of AC power; batteries available initially
Peach Bottom, Surry	Short-Term Station Blackout	Seismic event; loss of AC power; batteries unavailable
Surry	Short-Term Station Blackout with Thermally Induced Steam Generator Tube Rupture	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	A random failure of valves ruptures low-pressure system piping outside containment



Containment Bypass Scenarios



How Were The Accidents Modeled?

- 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

What Is Mitigation?

- SOARCA evaluated the benefits of recent 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

What Is Mitigation?

- Examples
  - 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

How Did We Model Emergency Response?

- Realistic modeling for emergency response (MACCS2)
  - Site, State, and local emergency plans
  - Site's timeline for declaring an emergency
  - State/local protective action procedures
    - Precautionary protective actions modeled
  - Used Site Evacuation Time Estimate (ETE) data
  - Real-world examples help show:
    - The public will largely obey direction from officials
    - Emergency workers will implement plans



Peach Bottom and Surry Emergency Planning Zones

Peach Bottom

Surry

How Are Health Consequences Reported In SOARCA?

- **Early Fatality Risk**—Individual risk of death shortly (usually within a few weeks or months) after exposure to large doses of radiation

- **Long-Term Cancer Fatality Risk**—Individual risk of cancer fatality years after exposure to radiation
  - Results compared to the NRC Safety Goal and the 1982 Siting Study

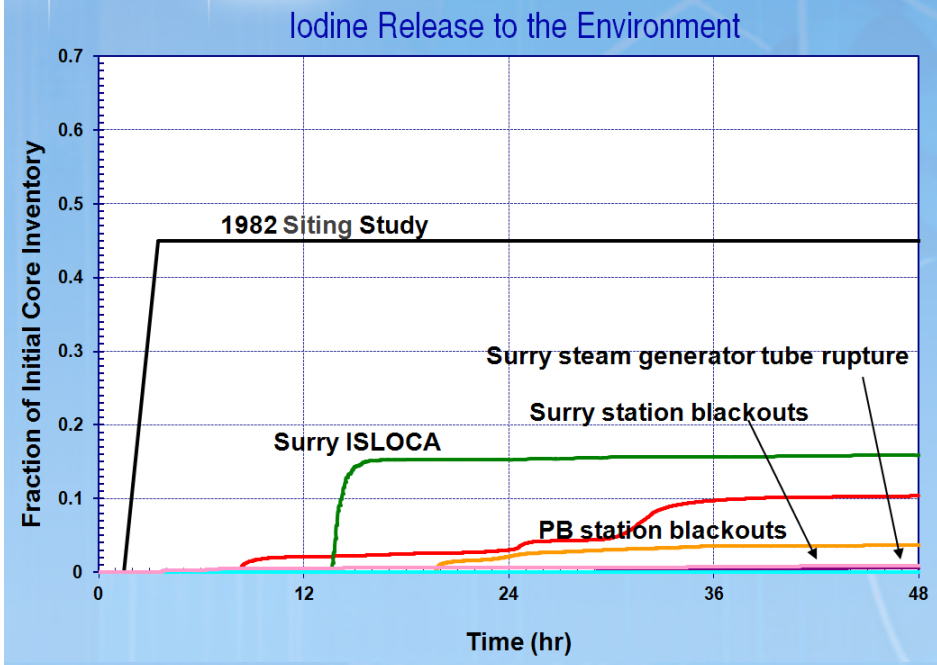
SOARCA Results

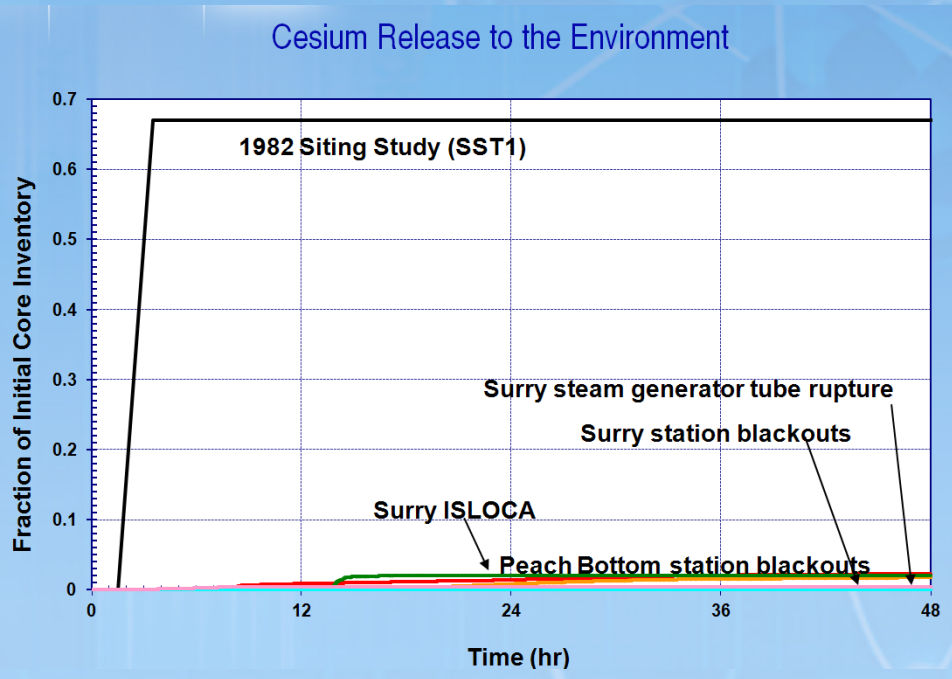
- When operators are successful, they can prevent the reactor core from melting, or delay or reduce releases of radioactive material

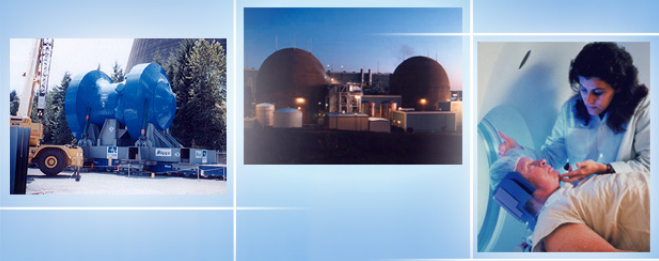
- Modeled accident scenarios progress more slowly and release much smaller amounts of radioactive material than calculated in earlier studies.



SOARCA Results: Iodine and Cesium Release To The Environment For Unmitigated Scenarios

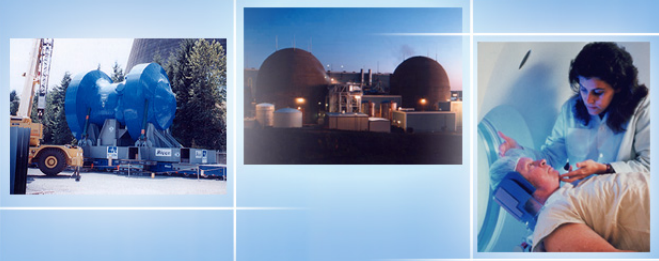






SOARCA Results

- Public health consequences from severe nuclear accident scenarios are smaller than previously calculated
- Delayed releases calculated provide more time for emergency response actions such as evacuating or sheltering
- Modeled severe accident scenarios in SOARCA cause essentially no early fatality risk

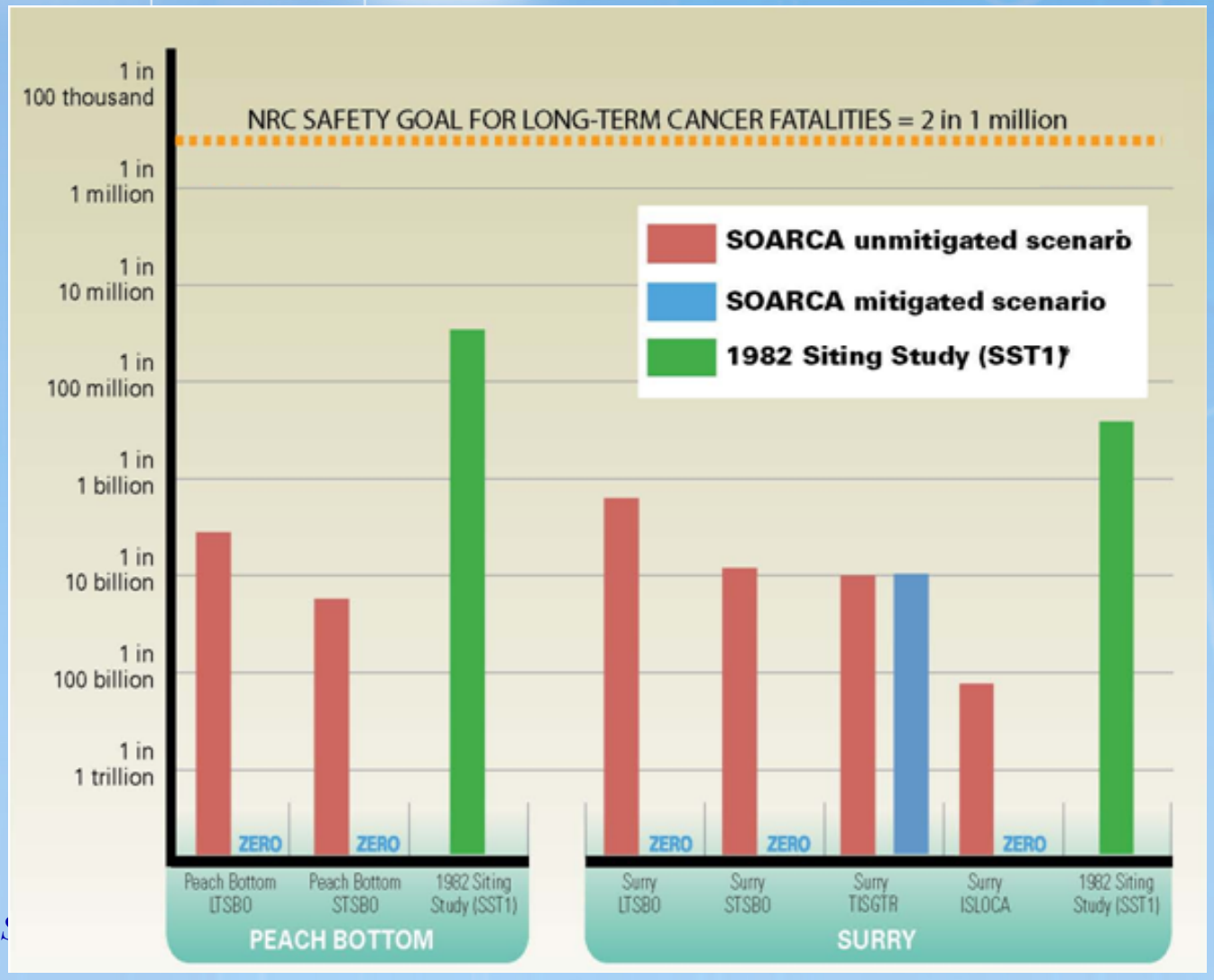


SOARCA Results

- Calculated individual long-term cancer fatality risks for the accident scenarios analyzed are millions of times lower than the general U.S. cancer fatality risk

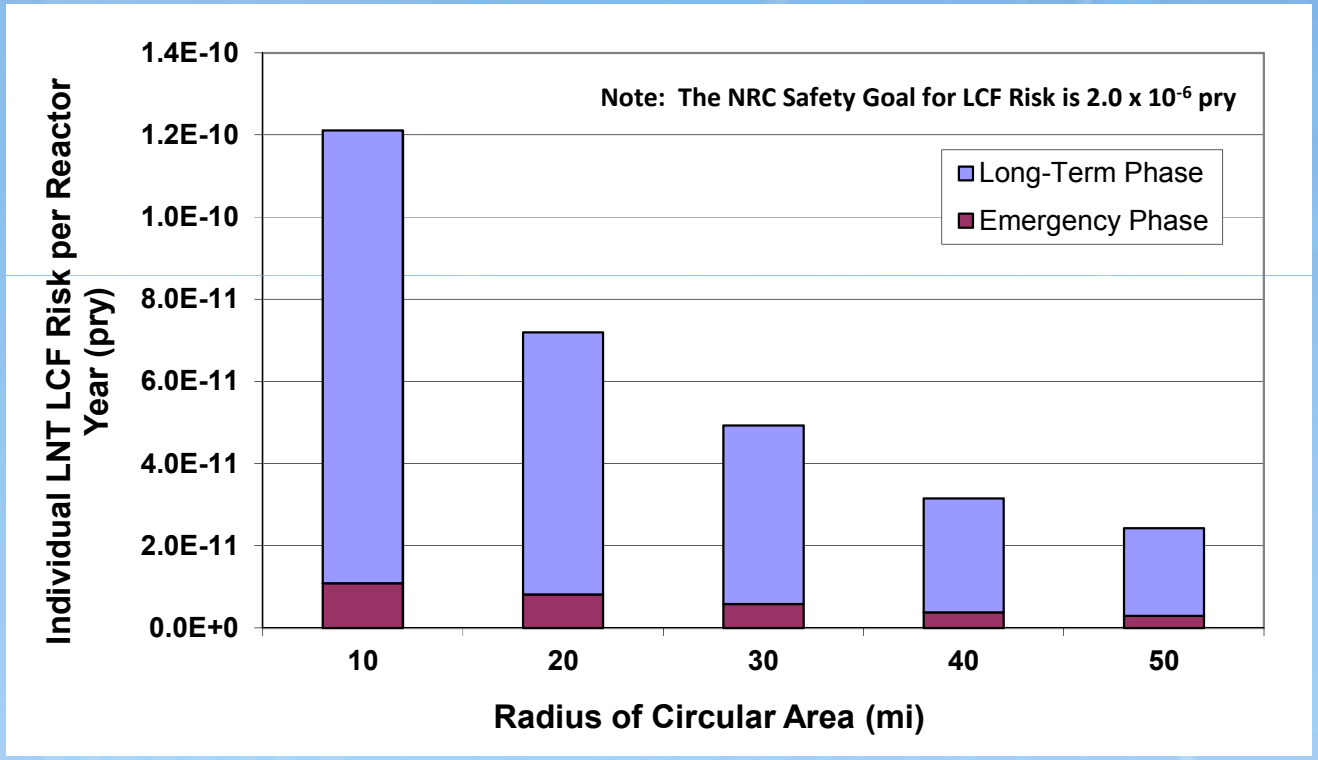


Individual Long-term Cancer Fatality Risk Results Per Year for SOARCA Mitigated and Unmitigated Scenarios



* The 1982 Siting Study did not calculate the risk of long-term cancer deaths. Therefore, to compare the 1982 Siting Study SST1 results to SOARCA's results for risk of long-term cancer death, the SST1 release was put into the MACCS2 code files for Peach Bottom and Surry unmitigated STSBO calculations.

Risk Is Mostly From Returning Home After The Accident



STSBO with TISGTR Shown



Next Steps

- Submitted comments will be considered
- NRC staff will provide a paper to the Commission
  - NUREG and NUREG/CRs
  - Peer Review Committee Review Summary
  - Public Comment Summary



Formal Comments On SOARCA

Electronically:

www.regulations.gov

Docket ID: NRC-2012-0022

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