U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

RIC 2014

## Office of Nuclear Regulatory Research

# State-of-the-Art Reactor Consequence Analyses

### Recent developments

- **The U.S. Nuclear Regulatory Commission (NRC) recently completed an integrated uncertainty analysis for the SOARCA Peach Bottom unmitigated long-term station blackout scenario. The analysis assigned distributions to uncertain MELCOR and MACCS input parameters and propagated uncertainty through Monte Carlo simulation.**
- **Assessing key MELCOR and MACCS modeling uncertainties in an integrated fashion yields an understanding of the relative importance of each uncertain input on potential consequence metrics.**
- **The results of this uncertainty analysis indicated that parameters describing safety relief valve behavior and the dry deposition velocity of contaminants are the most important uncertain model inputs for the chosen accident scenario.**
- **The results of this uncertainty analysis also corroborated the SOARCA project's conclusions on delayed releases compared to earlier studies, essentially zero risk of immediate deaths and only a very, very small increase in an individual's risk of a long-term cancer death.**

### What is SOARCA?

- **SOARCA was a major research project conducted by NRC and its contractors to develop best estimates of the offsite radiological health consequences for severe reactor accidents at two nuclear power plants--Peach Bottom and Surry.**

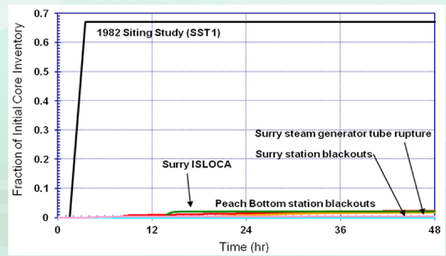
### What were the project's results?

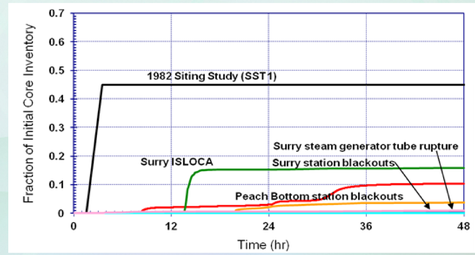
- **Existing resources and procedures, when effectively implemented, can stop an accident, slow it down, or reduce its impact before the accident affects public health.**
- **Even if accidents proceed without effective intervention, they take much longer to happen and release much less radioactive material than suggested by earlier analyses.**
- **The analyzed accidents would cause essentially zero immediate deaths and only a very, very small increase in an individual's risk of a long-term cancer death relative to the average annual risk of cancer death for an individual in the United States from all causes.**

### Scenarios Analyzed in SOARCA

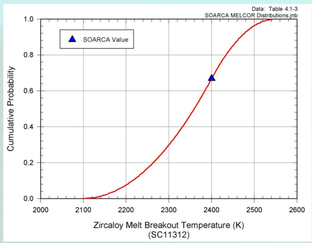
| Reactor Site | Accident Scenario | Description |
|---|---|---|
| **Peach Bottom & Surry** | Long-Term Station Blackout (LTSBO) | Seismic event; loss of ac power; batteries available initially |
| **Peach Bottom & Surry** | Short-Term Station Blackout (STSBO) | Seismic event; loss of ac power; batteries 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 |

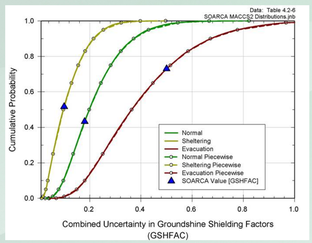
### Cesium (left) and Iodine (right) Release for SOARCA Unmitigated Scenarios and 1982 Siting Study (SST1)



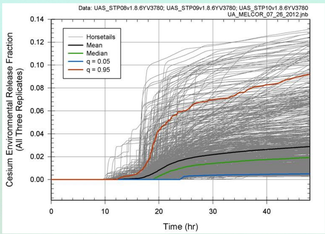



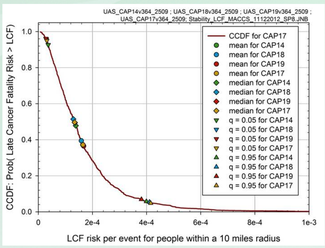

### Distributions for Key Uncertain Parameters



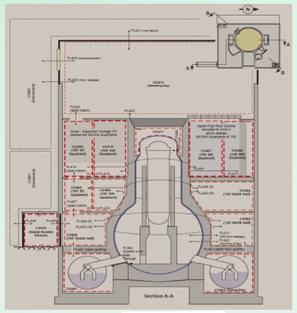




### Distribution of Results

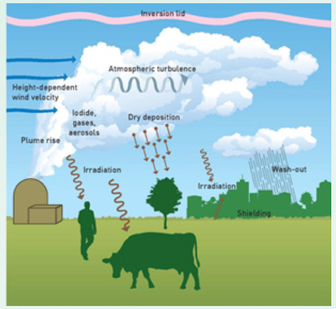


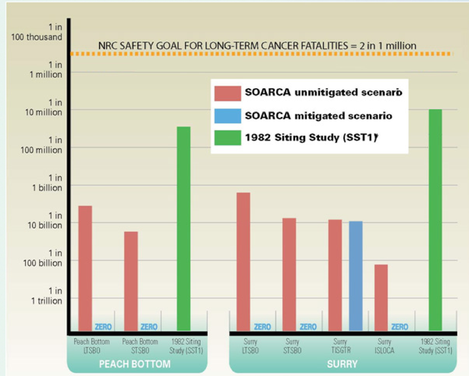

### MELCOR Model of Peach Bottom Reactor Building



### Transport Pathways of Radioactive Materials




### Scenario-Specific Risk of Latent Cancer Fatality for an Individual within 10 miles Assuming Linear-No Threshold Dose Response Model (per Reactor-Year)

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