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Protecting People and the Environment

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State-of-the-Art Reactor Consequence Analyses (SOARCA) Peach Bottom Uncertainty Analysis

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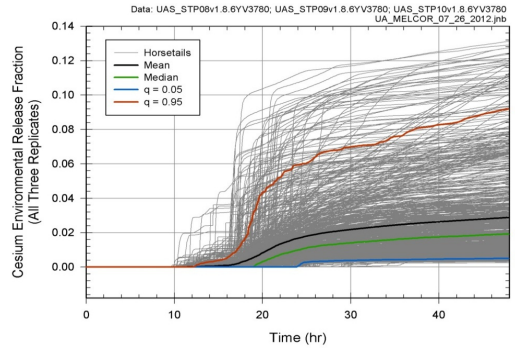
Goals of the Uncertainty Analysis

- Develop insight into overall sensitivity of SOARCA results and conclusions to uncertainty in inputs
- Identify most influential input parameters for releases and consequences
- Demonstrate uncertainty analysis (UA) methodology for future studies

Study Approach

- An integrated uncertainty analysis of key parameters completed for the Peach Bottom, unmitigated, long-term station blackout scenario
- Monte Carlo simulation carried out with 865 samples of ~40 independent uncertain input parameters
- Results studied include cesium and iodine release, latent cancer fatality (LCF) risk, early fatality risk
- Tools used to analyze results include statistical regression-based methods as well as scatter plots and investigation of individual realizations of interest
- Handful of separate sensitivity analyses also completed

Fraction of cesium core inventory released to the environment for the first 48 hours



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Conditional, mean (over weather) individual LCF risk statistics for the 10- and 50-mile radial areas around the plant

	0-10 miles	0-50 miles
5th percentile	3 x 10^{-5}	2 x 10^{-5}
Median	1 x 10^{-4}	7 x 10^{-5}
Mean	2 x 10^{-4}	1 x 10^{-4}
95th percentile	4 x 10^{-4}	3 x 10^{-4}
SOARCA UA Base Case	9 x 10^{-5}	3 x 10^{-5}

Note that the scenario frequency is ~3 x 10^{-6} per reactor year

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Conditional, mean (over weather) individual early-fatality risk statistics for given radial areas

	0 - 1.3 miles	0 - 2.5 miles	0 - 5 miles	0 - 10 miles
Median and 75th percentile	0.0	0.0	0.0	0.0
Mean	4.5x10^{-7}	8.9x10^{-8}	1.4x10^{-8}	4.8x10^{-9}
95th percentile	1.9x10^{-6}	3.5x10^{-8}	0.0	0.0

Note that the scenario frequency is ~3 x 10^{-6} per reactor year

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Overall UA Conclusions

- Peach Bottom UA corroborates SOARCA study conclusions
  - Public health consequences from severe nuclear accident scenarios modeled are smaller than previously calculated, and very small in absolute terms
  - Delayed releases calculated provide more time for emergency response actions such as evacuating or sheltering; long-term phase dominates health effect risks because emergency response is faster than progression to release
  - Essentially zero early fatality risk

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Overall Conclusions (2)

- A major determinant of source term magnitude and health consequences is whether or not Main Steam Line (MSL) rupture occurs (leads to higher consequences)
- Health-effect risks vary sublinearly with source term because people are not allowed to return to their homes until dose is below habitability criterion
- Analysis confirms known importance of some phenomena, and reveals some new phenomenological insights
- The use of multiple techniques to post-process Monte Carlo results provides better explanatory power of which input parameters are most important to uncertainty in results

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Most Influential Parameters for Individual LCF Risk

- MACCS2 dry deposition velocity
- MELCOR safety relief valve (SRV) stochastic failure rate
- MACCS2 residual cancer risk factor
- MELCOR fuel failure criterion
- MELCOR drywell liner melt-through open flow area
- MACCS2 residual dose and dose-rate effectiveness factor

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