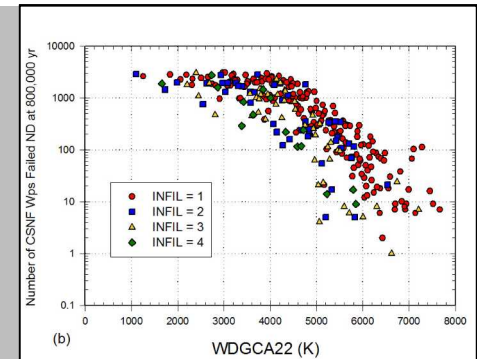
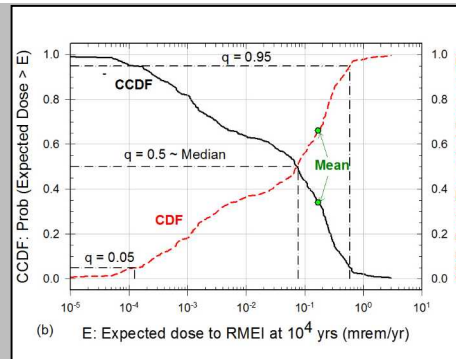
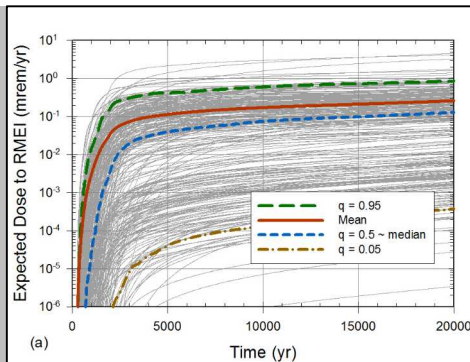


Exceptional service in the national interest



Sandia's propositions toward a joint activity on uncertainty quantification and sensitivity analysis

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IGD-TP Project on Uncertainties – Berlin May 21, 2013

- Sandia has acknowledged and advocated the importance of uncertainty treatment for several decades
- Sandia has been involved in two large nuclear waste repository performance assessments. It is therefore strongly supportive of any joint activity and will be happy to participate in such an effort
- Currently, we would like to focus our effort in three areas, described in more detail in the following slides
 1. Presenting the current conceptual and computational approach developed at Sandia
 2. Sharing new techniques with our counterpart and testing their effectiveness
 3. Promoting the use of Uncertainty Analysis (UA) and Sensitivity Analysis (SA) for complex systems

Presenting current conceptual and computational approach for uncertainty treatment

- Sandia was the lead laboratory for both the Performance Assessment of Waste Isolation Power Plant (WIPP) and proposed Yucca Mountain (YM) radioactive waste repositories.
- Sandia has developed a sampling-based methodology to incorporate aleatory and epistemic uncertainty into analyses for complex systems
- A special issue of Reliability Engineering System Safety (RESS) has been published in 2000 to present the approach used for WIPP* – Another one on YM is currently in preparation
- We would like to **share our expertise** via short courses, peer review publications and conference participation and presentations
- We are also eager to **learn in return** from exchange and comments as well as comparison with approaches used by our counterparts in other countries

* "The 1996 Performance Assessment for the Waste Isolation Pilot Plant" Volume 69, Numbers 1-3 (2000)

Sharing and testing new uncertainty and sensitivity techniques

- As the interest in Uncertainty and Sensitivity analysis grows among the scientific community, more sophisticated and promising techniques will be developed
- We are regularly working on developing, learning and testing new techniques and would like to continue efforts in that direction
- Among the new techniques we are particularly interested in the following:
 - **Non-parametric regressions techniques** using response surfaces and complete variance decomposition¹. We would like to test them more formally, mainly on results from past WIPP and YM analyses. We would also be happy to have such methods tested outside of Sandia to share experience and observations
 - We would be interested in testing the methods presented by D. A. Becker at the 3rd US-German workshop on Salt² such as the **change of variables**.
 - We thought also that some **technical exchanges** to present new ideas and **define benchmark testing** would be beneficial to all party involved

1: CB Storlie and JC Helton (2007). [Multiple Predictor Smoothing Methods for Sensitivity Analysis: Example Results](#). *Reliability Engineering and System Safety* **93** (1), 55-77.

2: D.-A Becker (2012) **Investigations on Sensitivity Analysis of Complex Final Repository Models – 3rd US-German Workshop on Salt Research, Design and Operations**, Albuquerque NM, (Oct. 2012)

Promoting the use of UA and SA in complex systems analyses

- While the treatment of uncertainty is increasingly acknowledged as an important and necessary part of any complex analysis, it is still not widely known and used.
- We are strong advocate of promoting uncertainty analysis (UA) and sensitivity analysis (SA) not only within the radioactive waste management community but in any research and application field dealing with complex systems:
 - The development of Special issues had greater impact than single articles in the past. We recommend considering **organizing any collaboration as a collection of suitable articles that could be published as a special journal issue** (with a generic title such as “Uncertainty Management and Sensitivity Analysis in Repository Safety Analysis”.) RESS editors in chief have always been supportive of such initiative
 - We also think that **articles published in other fields** dealing with complex systems involving uncertainty (nuclear power plant, petroleum engineering...) is important to broaden the perspective.
 - Finally, it is really important to **train future generations**, especially considering that most university program focus on well-known science and do not mention at all uncertainty. Therefore, we fully support development and teaching of courses at university levels as well as giving short courses and workshops (such as the SAMO summer school)