Used Fuel Disposition Campaign

Statistical Outputs of Probabilistic Performance Assessment

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Used Fuel Disposition Working Group Meeting

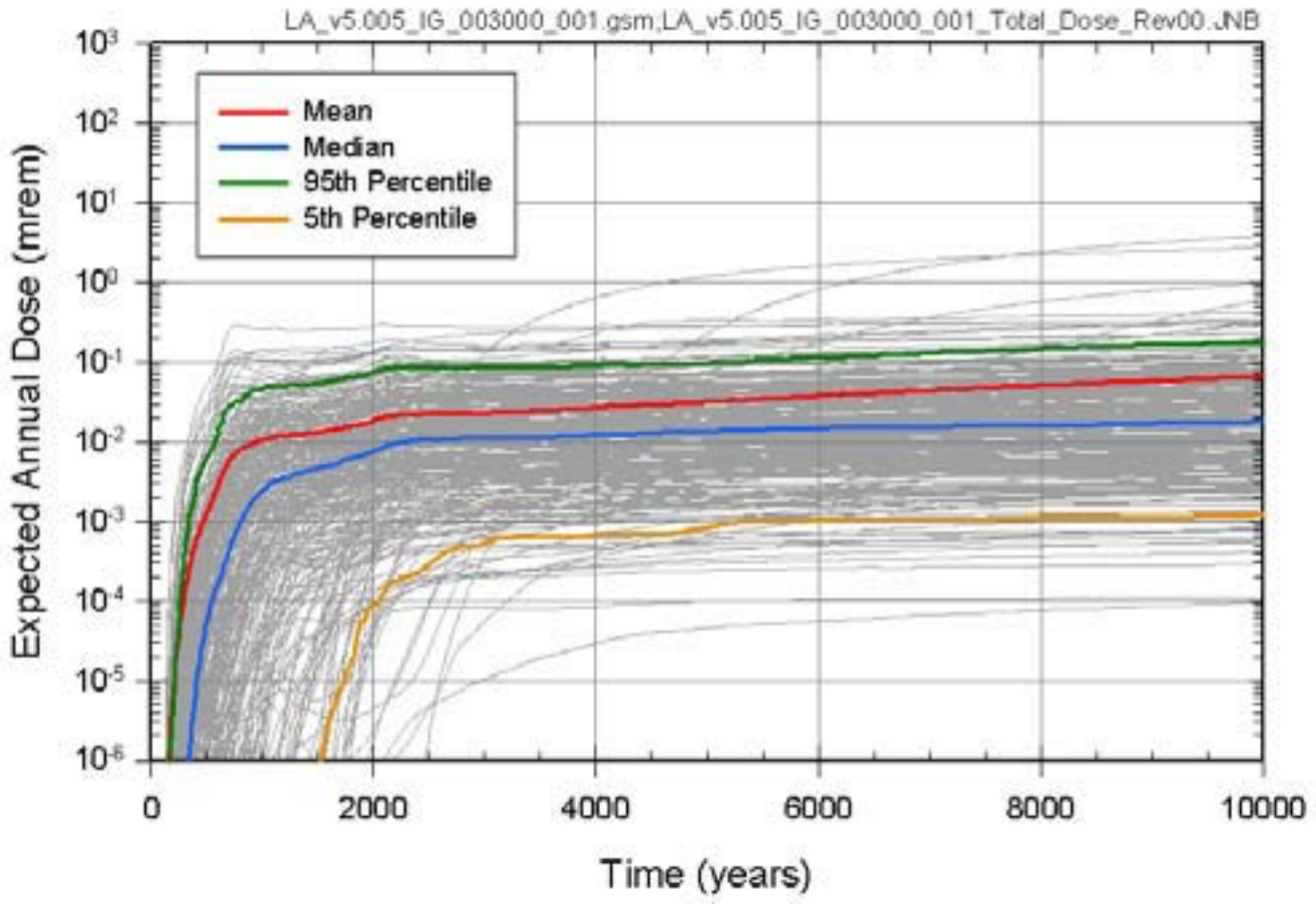
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Performance Assessment Modeling and Predictions

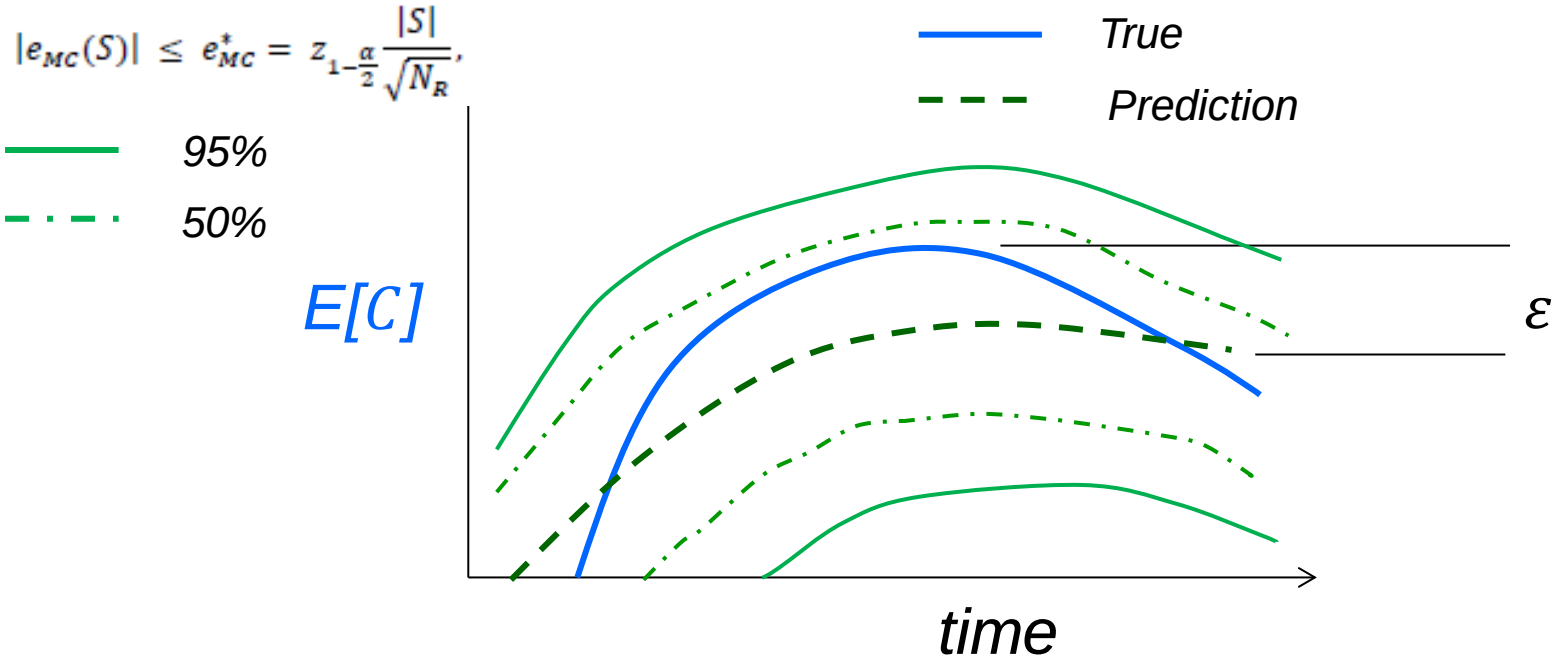
- **PA is the required regulatory approach for assessing DGR compliance with quantitative radiological safety criteria**
- **Overall error and uncertainty arise from the following major modeling activities:**
  - Selection of the mathematical models providing an abstraction of the physical processes and events of interest;
  - Identification of appropriate parameters and data defining the models;
  - Use of physical observations and measurements, including data from the literature, laboratory, and field to validate and calibrate the models;
  - Development of a computational model through discretization of the mathematical model and its implementation on a computer;
  - Identification of specific goals of PA simulations and the performance quantities of interest; and
  - Quantification of uncertainties in the predictions, including sensitivity analysis.

Regulation requests "mean" and "median" values of dose to a reasonably maximally exposed individual



Expected Value of Performance Quantity of Interest: Precision and Reliability

$$|e_{MC}(S)| \leq e^*_{MC} = z_{1-\frac{\alpha}{2}} \frac{|S|}{\sqrt{N_R}},$$



$$\varepsilon = Statistical\ Error + Spatial\ Discretization\ Error + Temporal\ Discretization\ Error$$

with +/- Confidence levels

Numerical Errors

Tolerance = maximum allowable ε

Statistical Error $e_{MC} \sim \frac{S}{\sqrt{N_R}}$

Spatial Error $e_h \sim C_h h^{k}$

Temporal Error $e_t \sim C_t \Delta t^{l}$

Computational Work $W \sim O(N_R \times N_e \times N_t)$

1: Mackinnon and Kuhlman, 2016. A Control Variate Method for Probabilistic Performance Assessment: Improved Estimates for Mean Performance Quantities of Interest

2: Currently analyzing e_{MC} and e_h for elliptic model problem, including W

3: Parabolic Model Problem e_{MC}, e_h, e_t, W

Goal is to meet the tolerance with $\frac{dW}{d\varepsilon} = 0$

Control Variate Technique

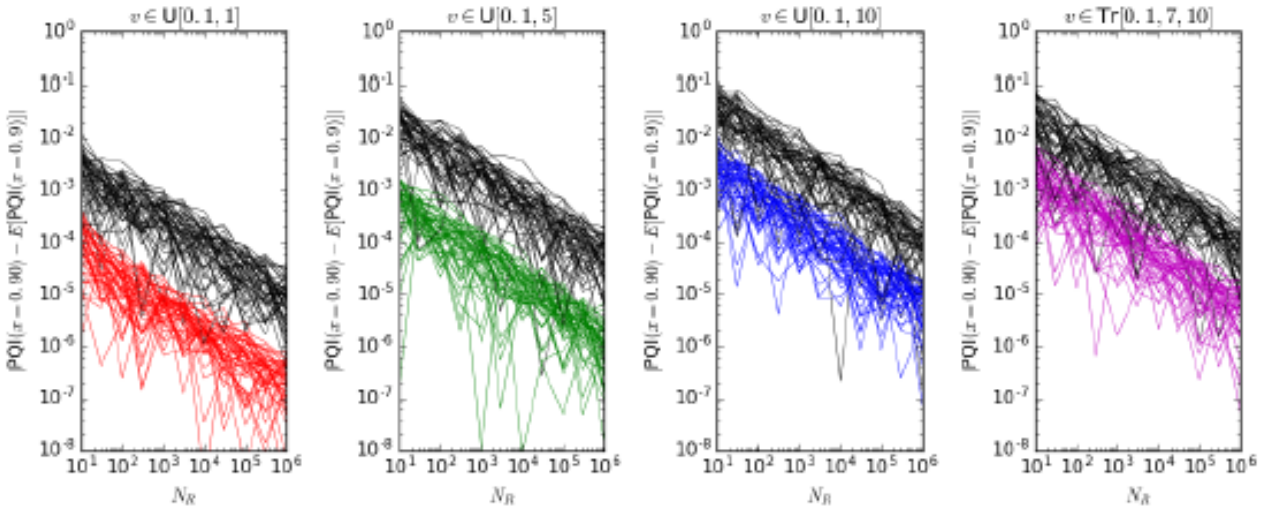


Figure 2. PQI(x=0.9) for Four Distributions in Table 1 across Sample Sizes N_R for 50 different random seeds.