Assessing the Impact of Sensitivity/Uncertainty-Based Selection Criteria on Computational Bias Prediction

Annual DOE NCSP Technical Program Review

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Goal and Role in DOE NCSP Mission

- Validation is an essential part of criticality safety
  - Sensitivity/Uncertainty (S/U) methods are used to form a validation suite of similar experiments to estimate computational bias
  - The S/U-based correlation coefficient, c_k, can be used to quantify similarity between an experiment and application
  - How similar is similar enough?

- <u>Goal:</u> Assess the relationship between the minimum c_k threshold value and predicted computational bias

S/U Similarity Assessment
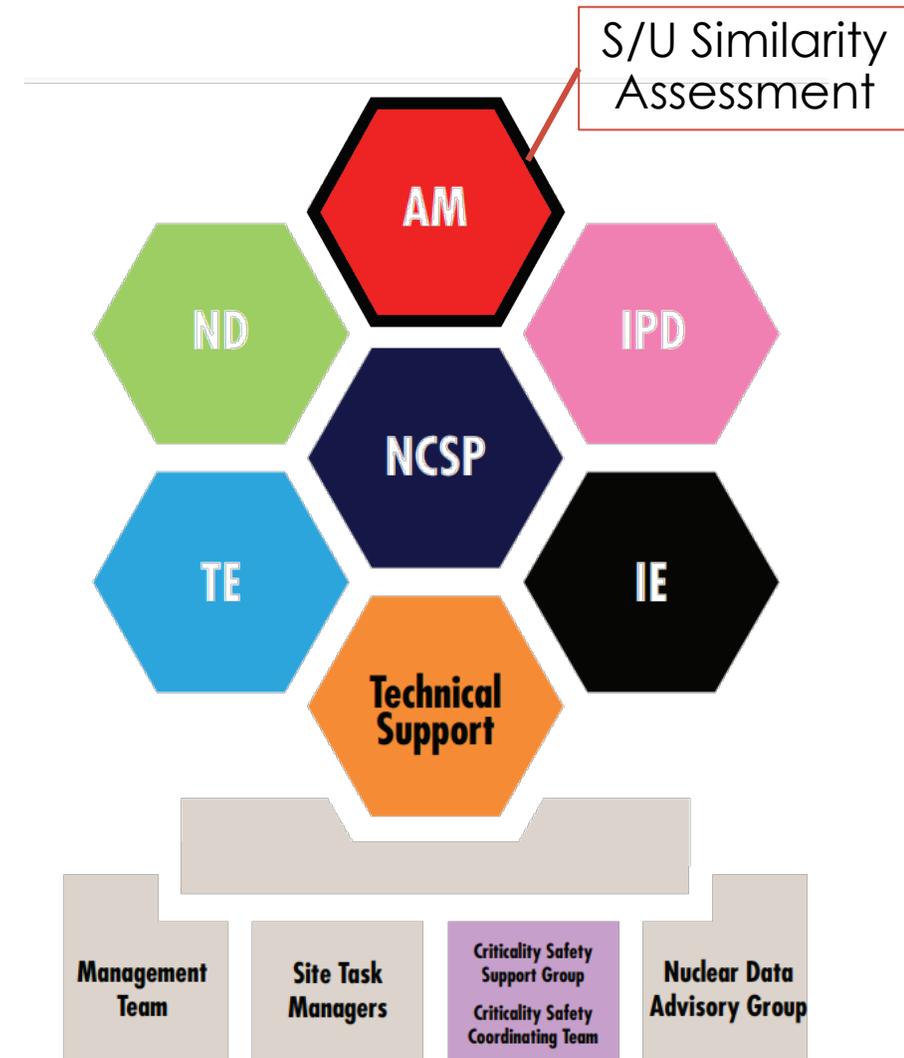
NCSP Technical Program Structure

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Method

- Develop a tool to calculate the predicted computational bias for a given application as a function the of c_k threshold

- Apply this tool to critical experiment benchmarks with <u>known computational biases</u>
  - Computational bias is defined by $\beta = C/E - 1$

- Each application's bias is predicted by averaging the computational biases of similar benchmark experiments

- Then assess the bias misprediction
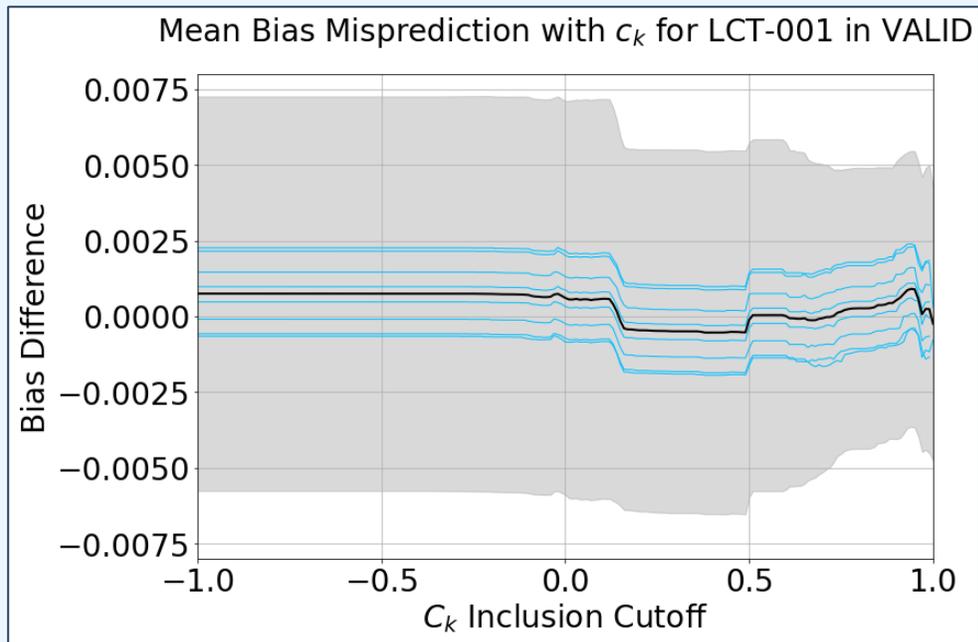 - The <u>difference</u> between the <u>predicted and actual computational bias</u>

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Results

Application: The 8 LEU-COMP-THERM-001 (LCT-001) benchmark cases in the SCALE Verified, Archived Library of Inputs and Data (VALID)

Bias Misprediction for LCT-001
8 Cases (001→008), **(blue)**
Mean of LCT-001 ($\pm 1\sigma$), **(black/grey)**

- Evaluation cases are excluded as minimum c_k threshold increases

- Similar behavior for cases within the same evaluation

- What about LCT systems as a whole?

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Results

<u>Application</u>: The140 LEU-COMP-THERM (LCT) benchmark cases in VALID

Bias Misprediction for LCT in VALID
9 Evaluations, 140 Cases, **(blue)**
Mean of LCT ($\pm 1\sigma$), **(black/grey)**

Mean Bias Misprediction with c_k for LCT in VALID
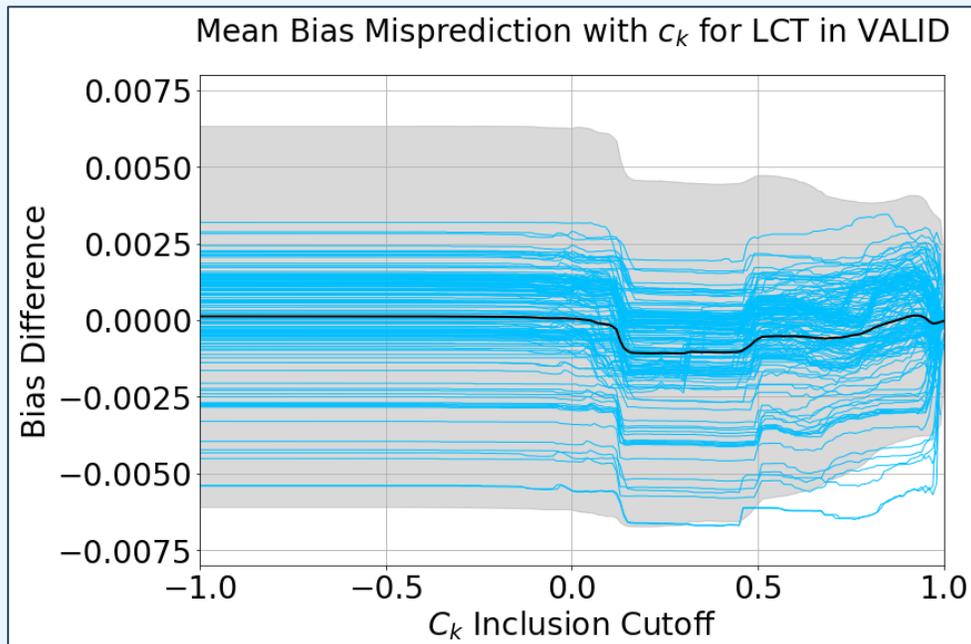
- Larger variety of evaluations

- Noticeable differences in certain evaluations with respect to the mean

- What will this look like across multiple fissile system categories?

Conclusions and Future Work

- We have developed a tool that implements our proposed methodology and confirmed that it works correctly

- The proposed method may be useful in performing the envisioned study to inform current guidance on c_k thresholds

- **Future work:**
  - Assess the impact of the c_k threshold on different types of fissile systems
  - Analyze results across more categories of fissile systems in VALID and understand the impact of these findings

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Acknowledgement

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