Los Alamos NATIONAL LABORATORY

Spring 2021 Update on the Los Alamos Benchmark Suite

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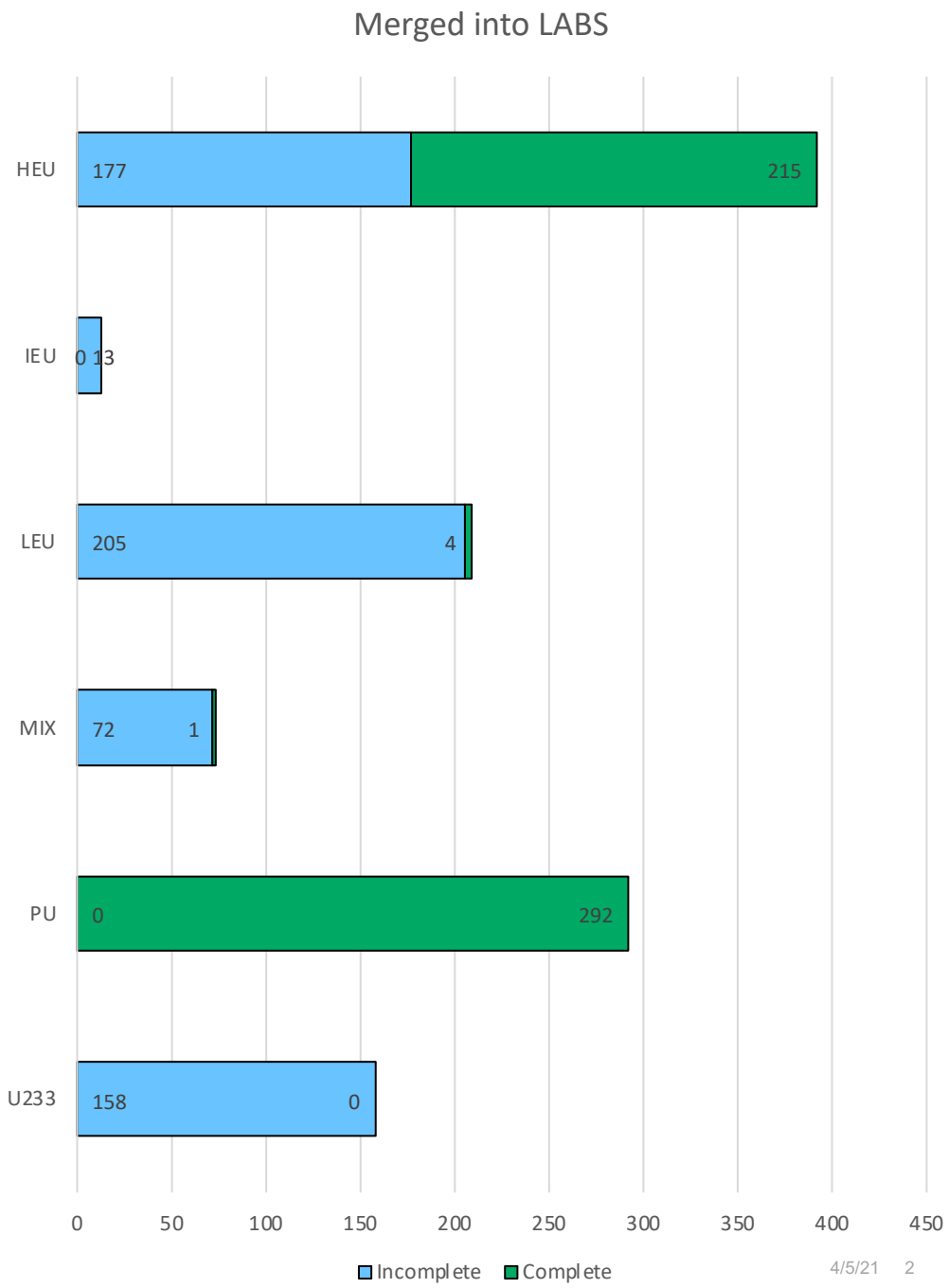
Los Alamos Benchmark Suite (LABS)

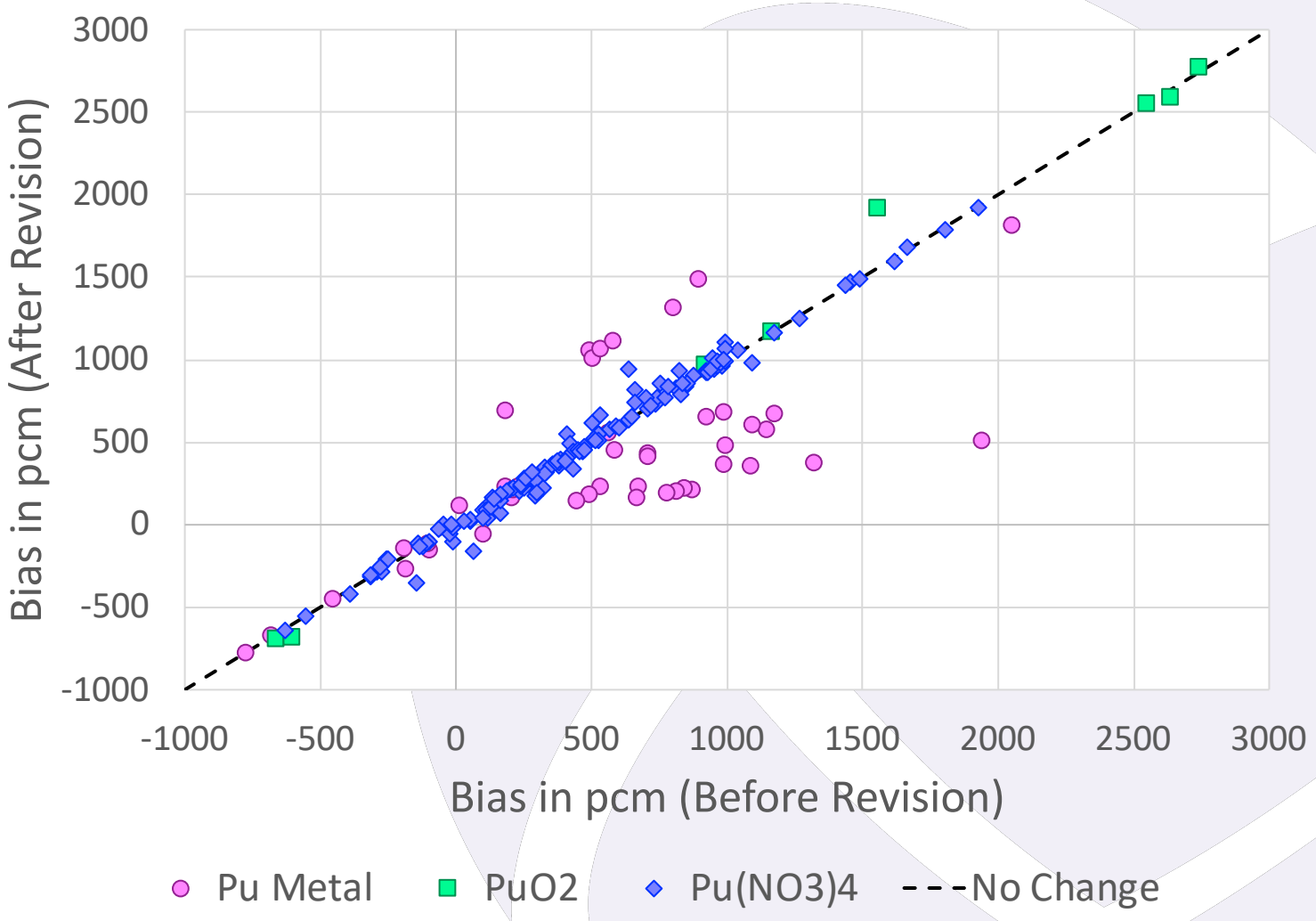
- Effort to centralize benchmark models, implement formal review/revision process
- LABS is being initialized through QA of Whisper 1.1.0 MCNP files
- Completed adding all plutonium cases currently used at LANL in February!



Corrections to Plutonium Benchmark Model Multiplication Factors

Benchmark Case	Benchmark k_{eff} in Whisper 1.1.0	Corrected Benchmark k_{eff}
pu-met-fast-044-003 *Typo*	0.9927 ± 0.0021	0.9977 ± 0.0021
pu-sol-therm-009-003 *Used bias for complete model instead of model w/o impurities*	1.0000 ± 0.0033	1.0003 ± 0.0033
pu-sol-therm-032, cases 001 to 017 *Stated bias uncertainty rounded down instead of up*	1.0000 ± 0.0019	1.0000 ± 0.0020

Changes in Bias - Plutonium



Changes in Bias - Plutonium

- 187 input files revised out of 262 total cases
- 48 cases changed significantly
- 35 cases were significant and > 100 pcm difference
- 17 cases were significant and > 500 pcm difference

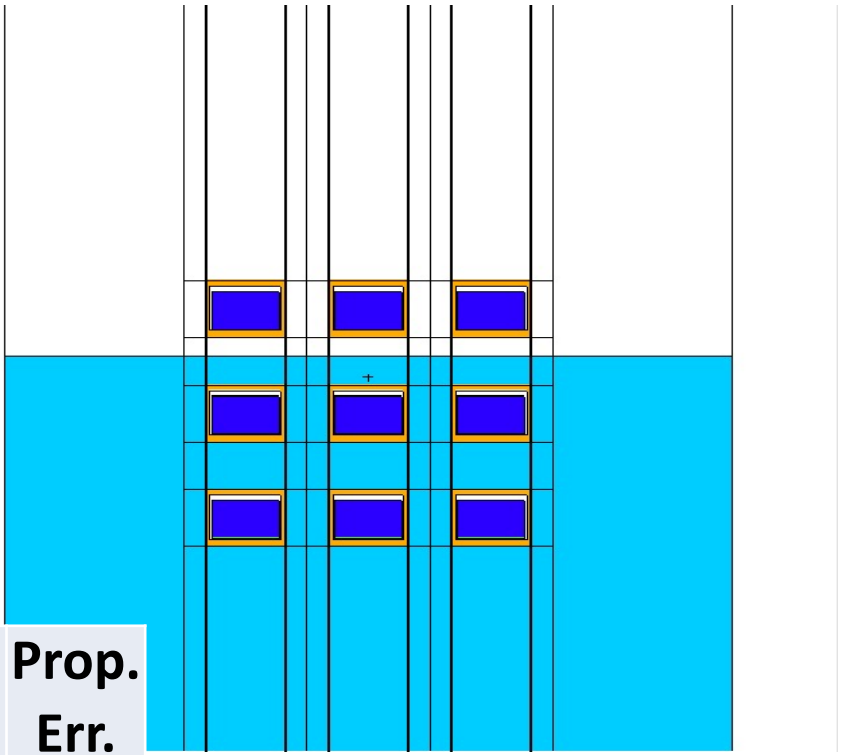
PU-COMP-MIXED-002-004

- Plutonium oxide-polystyrene cubes reflected by Plexiglas slabs
- Plexiglas reflector ~10 cm too small

Statistically Significant Changes	Change in Bias	Prop. Err.
pu-comp-mixed-002-004.i	362	42

PU-MET-FAST-016

- Refer to LA-UR-20-29300
- 27 small plutonium cylinders suspended in a cubic array flooded with water



Statistically Significant Changes	Change in Bias	Prop. Err.
pu-met-fast-016-001.i	-227	16
pu-met-fast-016-002.i	-273	16
pu-met-fast-016-003.i	-301	16
pu-met-fast-016-004.i	-305	16
pu-met-fast-016-005.i	-294	16
pu-met-fast-016-006.i	-287	16

PU-MET-FAST-042

- Spherical and hemispherical plutonium assemblies
- A number of revisions, such as small surfaces corrections (on the order of 0.003 cm) and material corrections
- Oil material card missing “poly.20t” $S(\alpha,\beta)$ table

Statistically Significant Changes	Change in Bias	Prop. Err.
pu-met-fast-042-001.i	-1430	110
pu-met-fast-042-002.i	-943	106
pu-met-fast-042-003.i	-724	106
pu-met-fast-042-004.i	-656	113
pu-met-fast-042-005.i	-615	105
pu-met-fast-042-006.i	-440	110
pu-met-fast-042-007.i	-612	106
pu-met-fast-042-008.i	-619	101
pu-met-fast-042-009.i	-583	102
pu-met-fast-042-010.i	-568	106
pu-met-fast-042-011.i	-497	104
pu-met-fast-042-012.i	-266	104
pu-met-fast-042-013.i	-505	100
pu-met-fast-042-014.i	-304	103
pu-met-fast-042-015.i	-490	104

PU-MET-FAST-045

- Benchmark series was performed to support construction and operation of the Los Alamos Molten Plutonium Reactor
- Typo in plutonium metal density (3.966E-02 vs. 3.996E-02)

Statistically Significant Changes	Change in Bias	Prop. Err.
pu-met-fast-045-001.i	512	95
pu-met-fast-045-002.i	515	96
pu-met-fast-045-003.i	565	92
pu-met-fast-045-004.i	507	87
pu-met-fast-045-005.i	595	96
pu-met-fast-045-006.i	537	95
pu-met-fast-045-007.i	532	91

PU-SOL-THERM-012

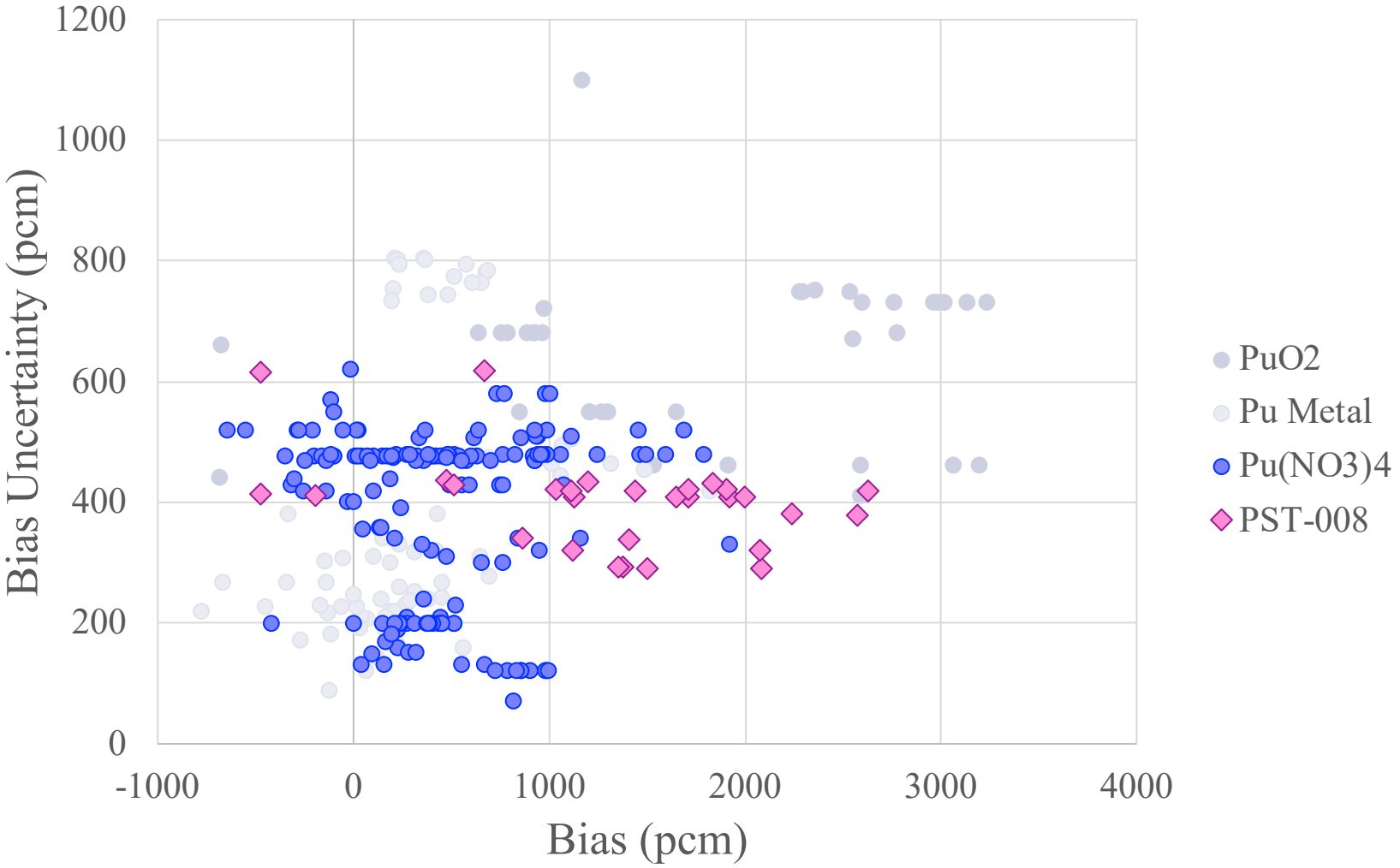
- Large tank of plutonium nitrate solution and multiple configurations of water reflection
- Several revisions
- Lucoflex reflector placed 20 cm too far

Statistically Significant Changes	Change in Bias	Prop. Err.
pu-sol-therm-012-006.i	158	18
pu-sol-therm-012-007.i	137	18
pu-sol-therm-012-008.i	140	17

New Pu Benchmark to LANL (borrowed from NRG Suite): PU-SOL-THERM-008

- 14-inch diameter steel shells with spherical or hemispherical concrete reflectors of various thicknesses
- Corrections:
  - Surface 5 in simple case 001 (changed to 27.9673 cm)
  - Surface 3, detailed cases 016-030 (the liquid level ranged from 0.0002 to 0.0016 cm too high)
  - Material 3 in all cases (the Ca and Si nuclides)
  - Material 1 In case 018 (the total atom density changed to be 9.999102E-02)
  - Other policy-style corrections

PU-SOL-THERM-008



Summary & Conclusions

- The majority of plutonium revisions had very little impact on the bias.
- More than 20% of the input file revisions resulted in statistically significant changes to bias.
- Big changes due to missing thermal scattering tables, typos in plutonium density
- Next:
  - Complete revisions for Whisper 1.1.0 Suite (625 cases remaining)
  - Send LABS through Feynman Center to share with Subgroup 45

Thanks! Questions?

- Department of Energy, NA-50, ASC-PEM
- Advisors from NCS, XCP, and NEN-2, including Bob Little, Forrest Brown, and Joetta Goda
- Our 19 reviewers of MCNP input files, including Ethan Moll, Ray Sartor, and Trevor Stewart
- Everyone assisting with input file revisions, including Jennifer Arthur, Cole Kostelac, Noah Kleedtke, Holt Mendleski, Ernesto Ordonez, Mariah Ramirez, Andrew Smiley, and Dalton Wise