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Title: Impact on Whisper USL from Modern Ta Benchmark Inclusion

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Impact on Whisper USL from Modern Ta Benchmark Inclusion

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08/24/2026



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8/17/2026

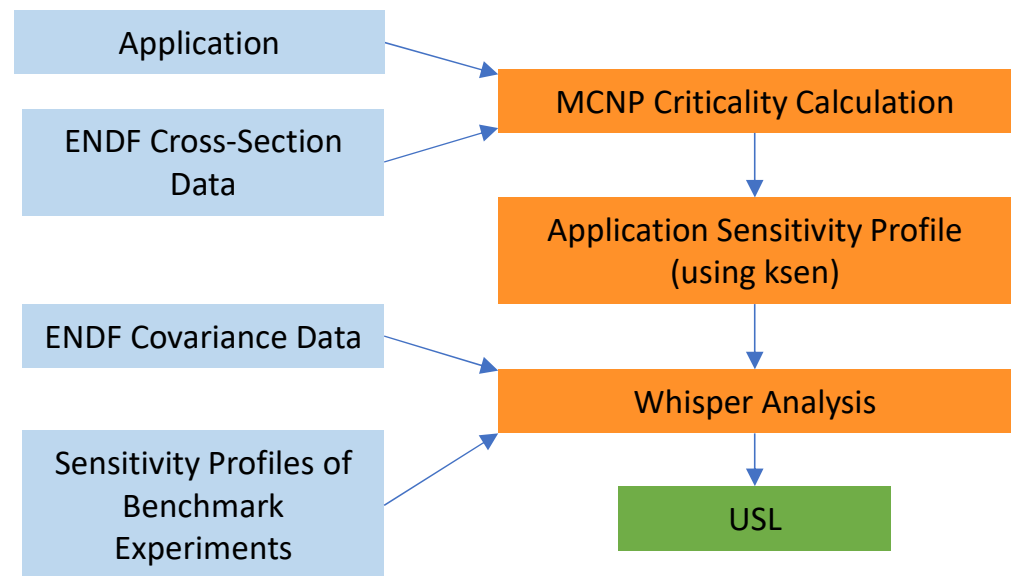
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Why Tantalum?

- Tantalum is an attractive refractory metal for operations at LANL and SRNL:
 - High melting point
 - High tensile strength
 - High chemical resistance*
- There are few relevant criticality benchmarks with high sensitivities to Ta nuclear data making it hard to meet the validation requirements of ANSI/ANS-8.24.
 - Has been a priority item for new evaluations and validations.

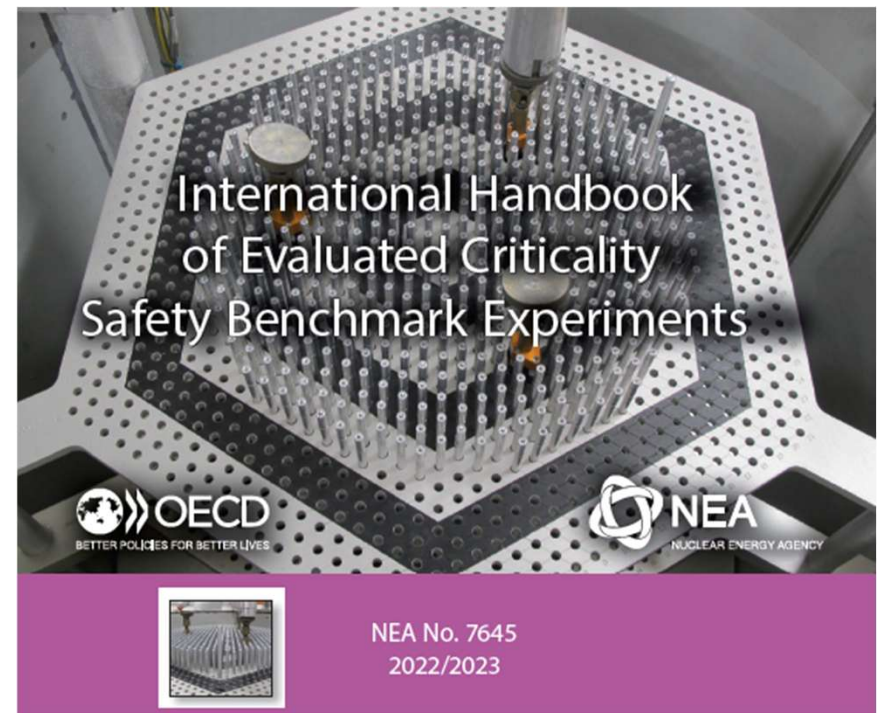
Whisper

- MCNP[®] statistical analysis package
 - Developed to simplify work done by criticality safety analysts
 - Uses experimental models and data from critical experiments
 - Computes sensitivities and USLs



International Criticality Safety Benchmark Experiment Project (ICSBEP)

- Contains experiments categorized by:
 - Fissile media (Pu, HEU, LEU, U233, Mixed, etc.)
 - Physical form (metal, compound, or solution)
 - Neutron energy range
- Documentation:
 - Model information (material compositions, geometries, densities, and temperatures)
 - Detailed uncertainty analysis



Nuclear Energy Agency, *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, OECD Nuclear Energy Agency, Paris, France, 2023.

Benchmarks

Existing:

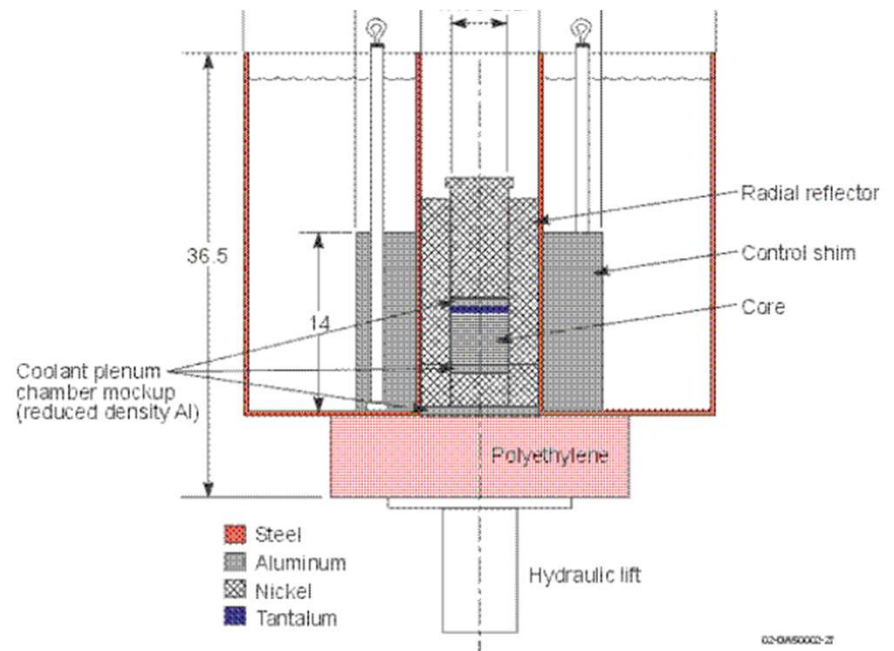
- Los Alamos Molten Plutonium Reactor (LAMPRE)
 - Listed in the ICSBEP as PU-MET-FAST-045
 - Contains 7 benchmark cases
- Thermal/Epithermal eXperiments with plutonium configuration (TEX)
 - Listed in the ICSBEP as PU-MET-MIXED-003
 - Contains 5 benchmark cases

Future:

- Thales: Ta-Reflected Fast Pu Experiment
 - Not yet listed in the ICSBEP
 - Contains 4 benchmark cases

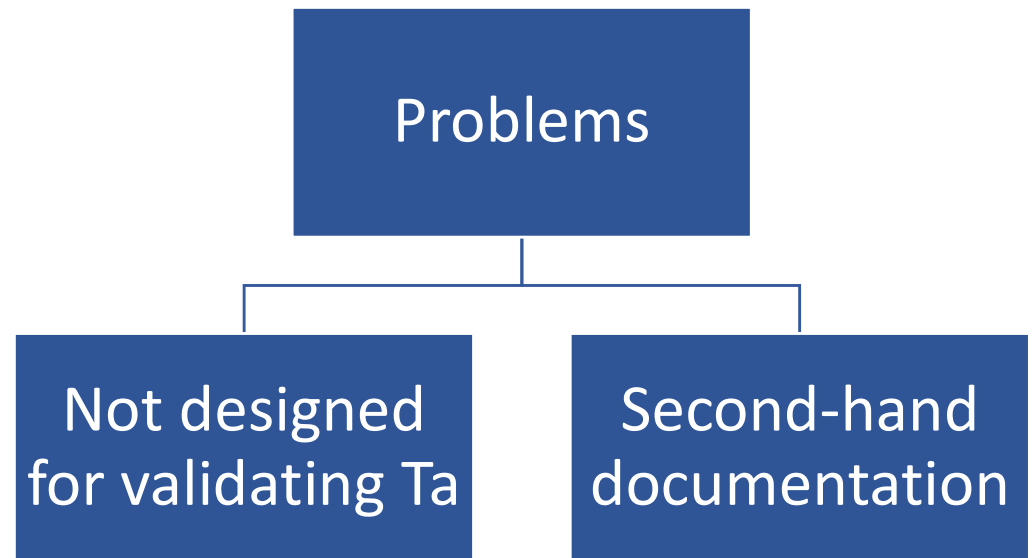
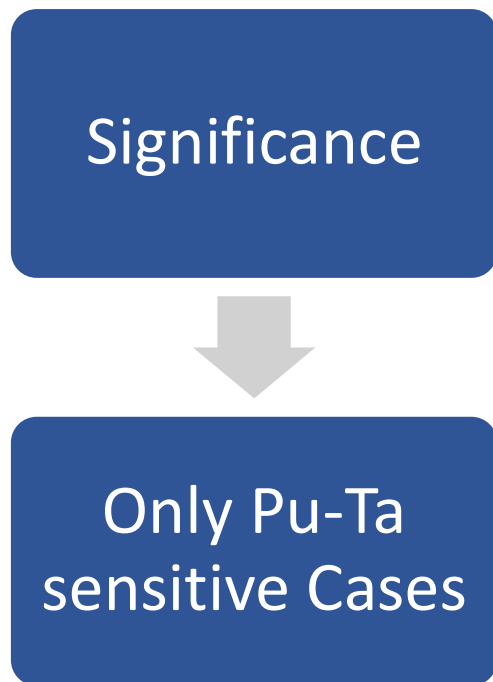
PU-MET-FAST-045

- Overview of experiment:
 - Performed in 1957 at LANL to support construction and operation of the LAMPRE
 - Goals:
 - Establish critical mass for LAMPRE
 - Establish effectiveness of various control schemes
 - Determine power and flux distributions



R. Brewer and D. Loaiza, "Critical experiments performed for LAMPRE, The Los Alamos Molten Plutonium Reactor," in *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, OECD Nuclear Energy Agency, 2019, NEA-7328.

PU-MET-FAST-045



PU-MET-MIXED-003

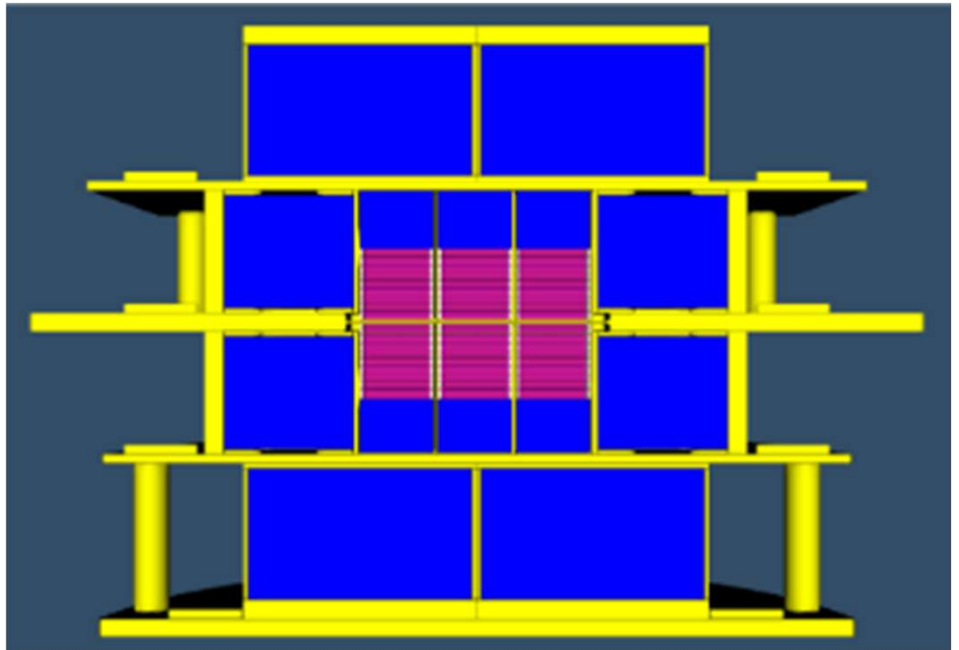
- Overview of experiment:
 - Performed in 2018 at NCERC using the Planet machine
 - Goal was to establish critical benchmark data to be used in safety validation
 - Utilized:
 - Zero Power Physics Reactor (ZPPR) Plutonium-Aluminum No-Nickel (PANN) plates
 - Interstitial tantalum
 - Polyethylene moderator



C. Percher and J. Norris, "TEX plutonium assemblies with tantalum: Plutonium/Aluminum metal alloy plates with varying thicknesses of polyethylene moderator, interstitial tantalum, and a thin polyethylene reflector (PU-MET-MIXED-003)," in *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, OECD Nuclear Energy Agency, 2021, NEA-7328.

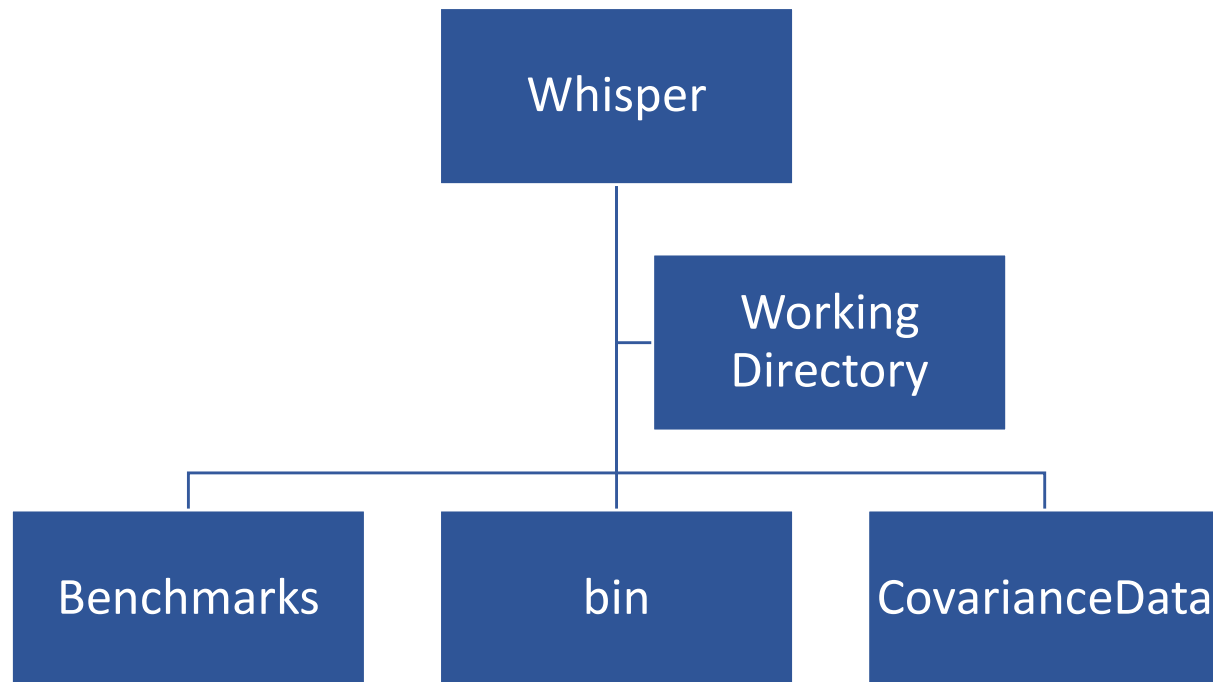
Thales

- Overview of experiment:
 - Goal was to establish critical benchmark data addressing nominal and upset work conditions between LANL and SRPPF
 - Utilized:
 - Zero Power Physics Reactor (ZPPR) Plutonium-Aluminum No-Nickel (PANN) plates
 - Tantalum reflector

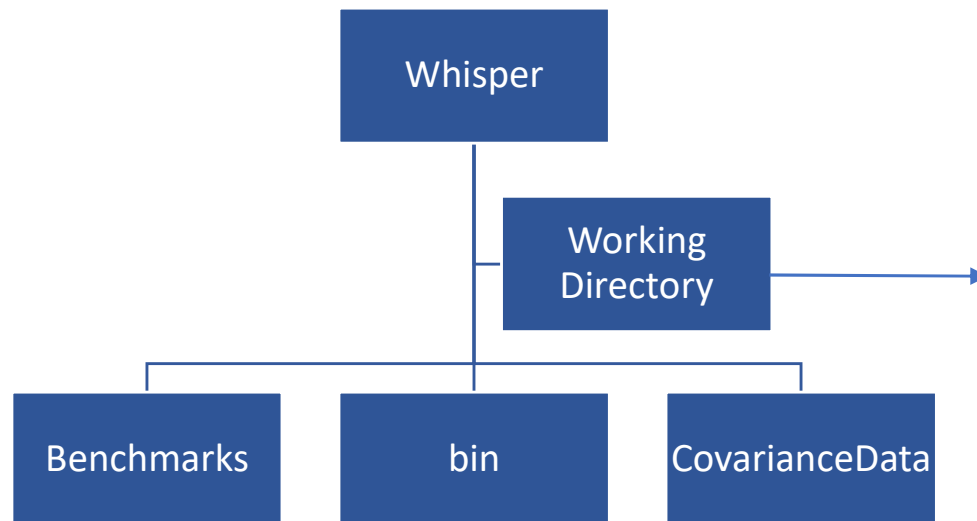


P. Brain, J. Alwin, T. Cutler, E. Faust, J. Hutchinson, N. Kleedtke, I. Michaud, and D. Neudecker, "IER 607: Thales—Ta-reflected fast Pu experiment," presented at the Nuclear Criticality Safety Program Technical Program Review, Knoxville, Tennessee, March 2026, [LA-UR-26-21477](#).

Benchmark Inclusion



Benchmark Inclusion



- MCNP input files of Benchmarks

Benchmark Inclusion

Running the command:

`whisper_mcnpl`

Creates:

- Table of contents (TOC)
- Calcs Directory
 - Kcalc
 - Sensitivity Profiles
- KeffSenLib Directory

- MCNP input files of Benchmarks
- **MCNPInputlist.toc**
- **Calcs**
- **KeffSenLib**

Benchmark Inclusion

Running the command:

`whisper_usl.pl`

Creates:

- **KeffSenLib**
 - Profiles stripped from Calcs
- **KeffSenList.toc**
 - Name, kcalc, unc

- MCNP input files of Benchmarks
- MCNPInputlist.toc
- KeffSenList.toc
- Whisper.out
- **Calcs**
- **KeffSenLib**

Benchmark Inclusion

In the Whisper.out for each input:

- Similarity metrics
- USLs

- MCNP input files of Benchmarks
- MCNPInputlist.toc
- KeffSenList.toc
- Whisper.out
- Calcs
- KeffSenLib

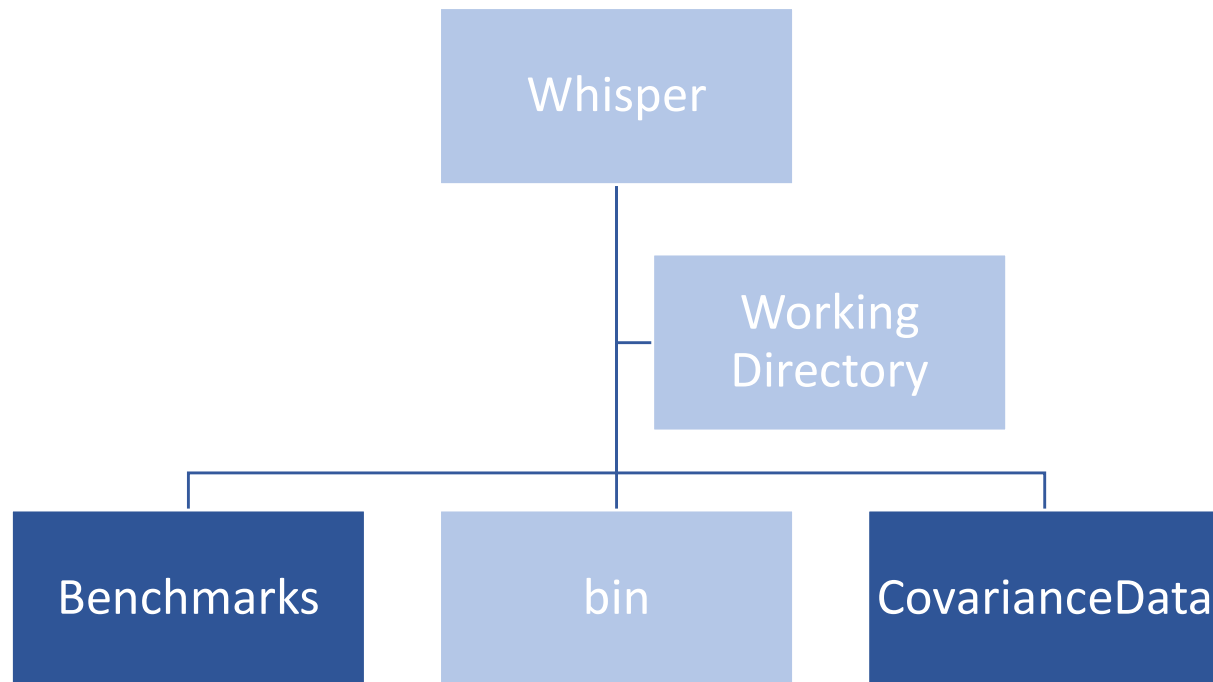
Benchmark Inclusion

Requirements to incorporate benchmarks:

- MCNP input files
- KeffSenList.toc
- Sensitivity profiles

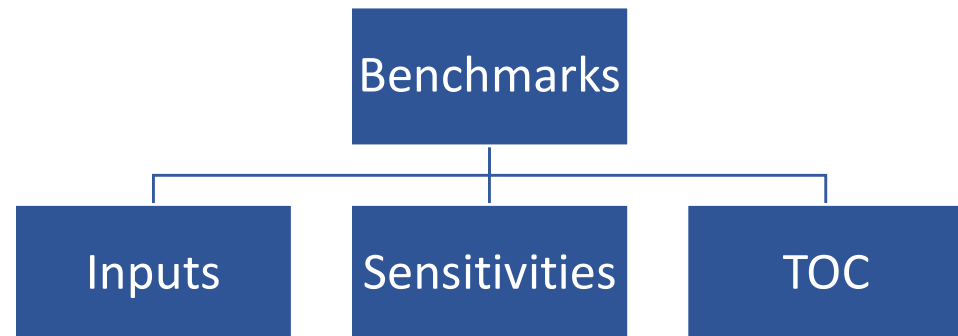
- MCNP input files of Benchmarks
- MCNPInputlist.toc
- KeffSenList.toc
- Whisper.out
- Calcs
- KeffSenLib

Benchmark Inclusion



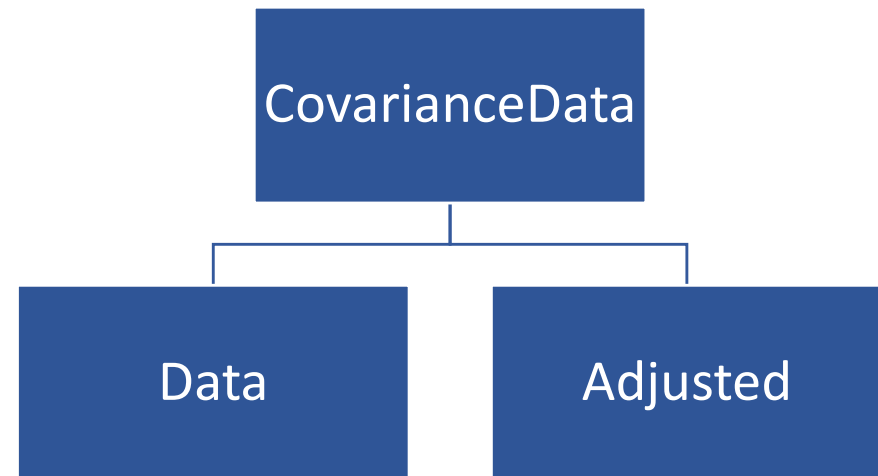
Benchmark Inclusion

- Inputs
 - Copy over new inputs
- Sensitivities
 - Copy over new profiles
- Table of Contents
 - Append KeffSenList.toc to BenchmarkTOC.dat

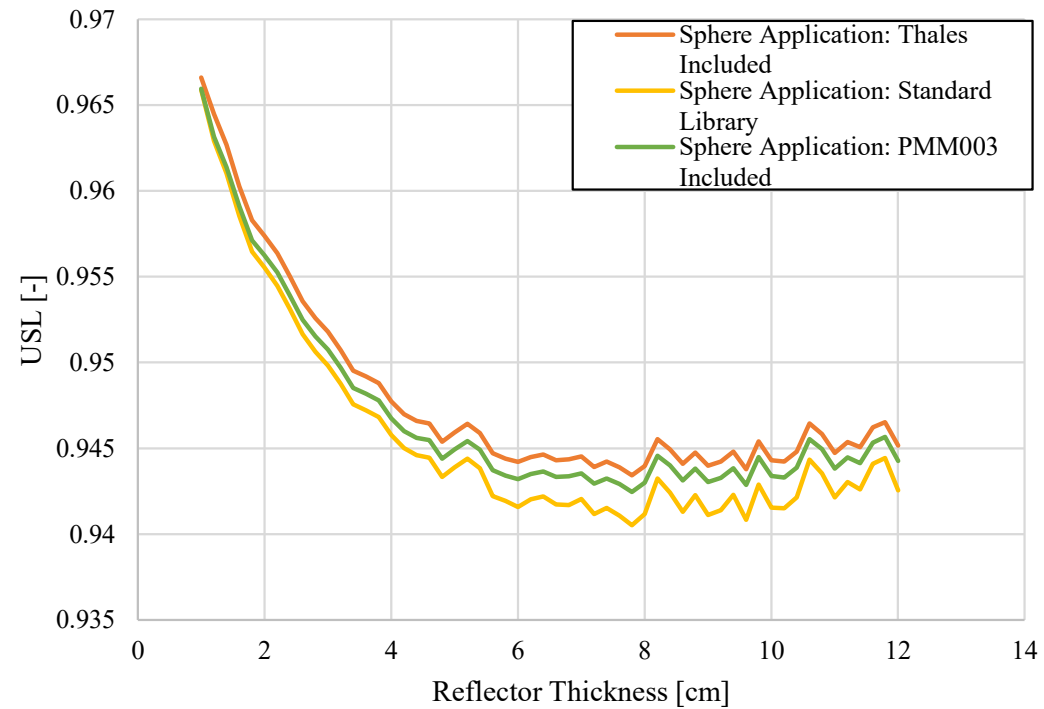
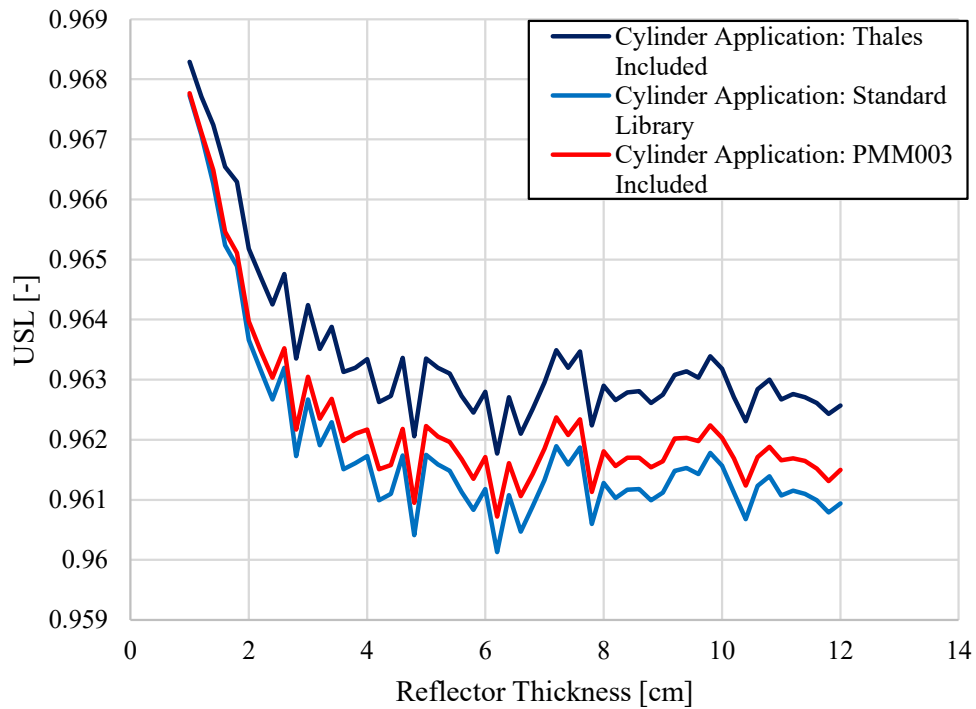


Benchmark Inclusion

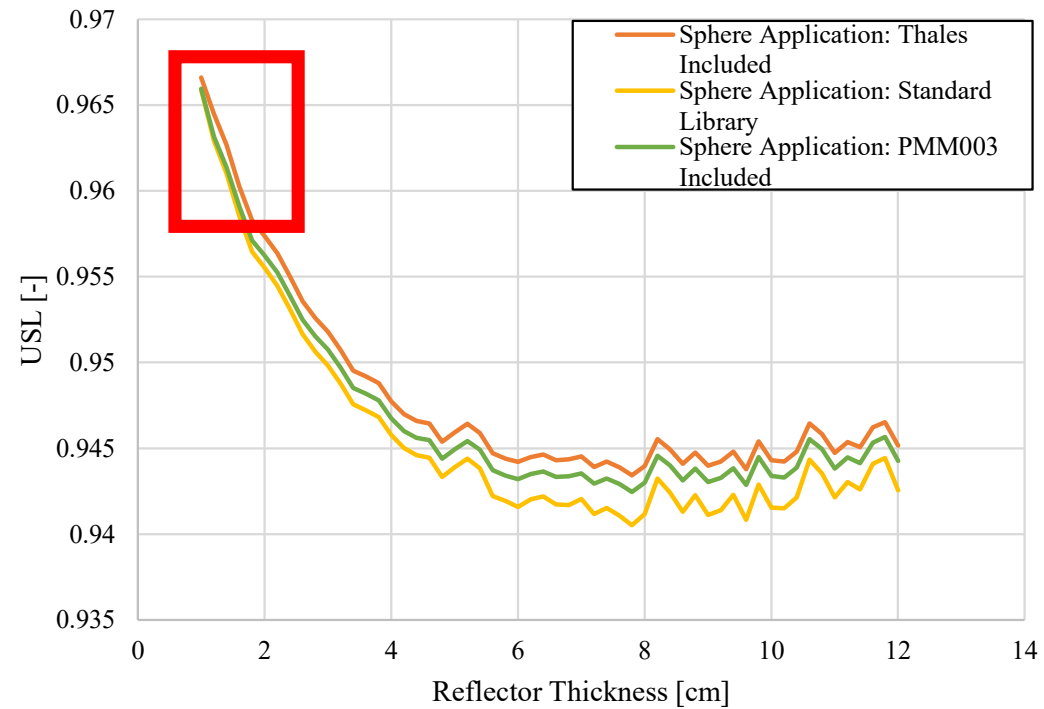
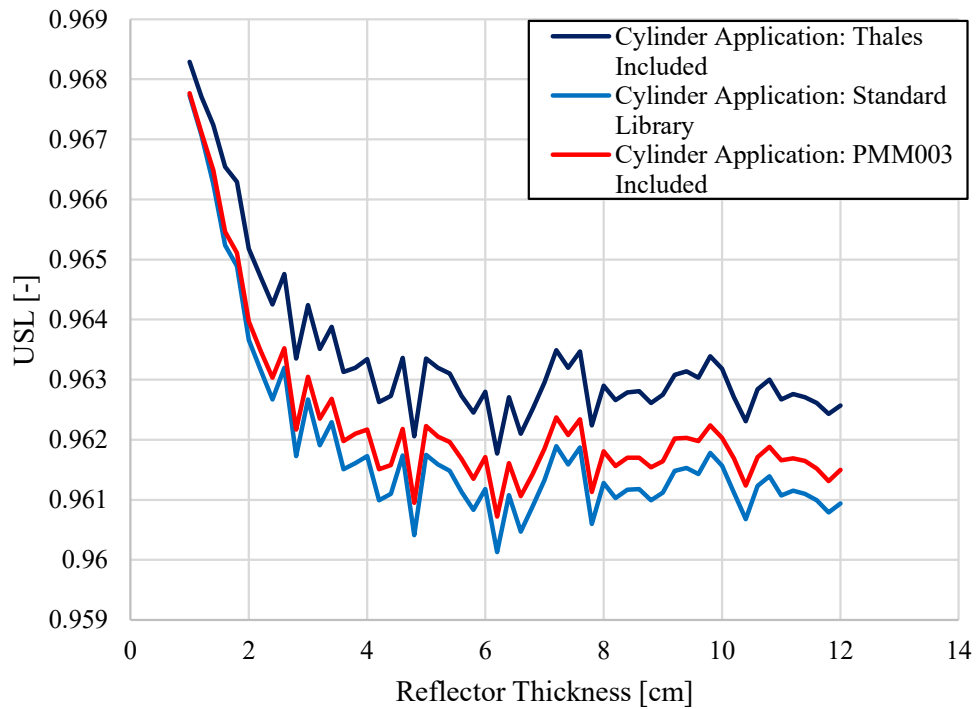
- Adjusted covariance update
 - Copy data to adjusted
 - Overwrites changed covariances
 - Unchanged covariances will remain the same when copied over



Results

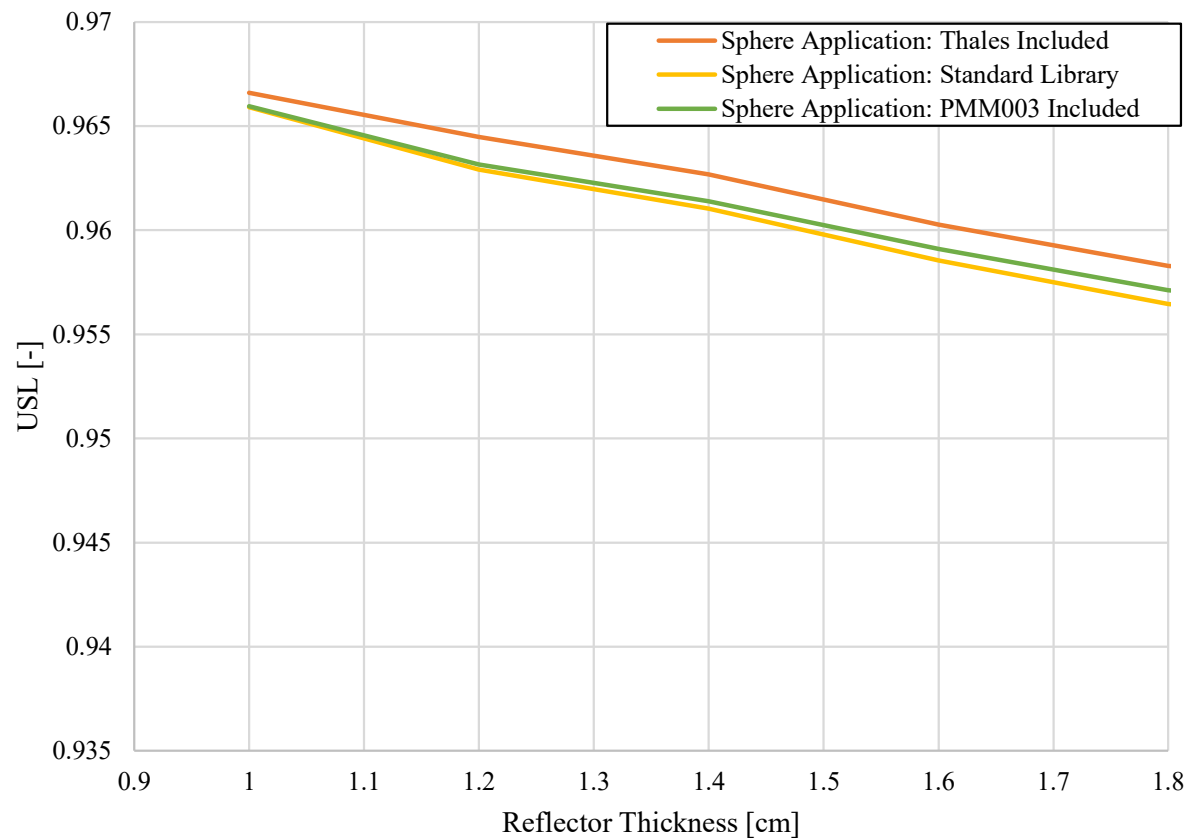


Results



Results

- Significant differences
 - PU-MET-MIXED-003
 - Lowest change: 0.00004
 - Greatest change: 0.00202
 - Thales
 - Lowest change: 0.00056
 - Greatest change: 0.00294



Acknowledgements

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Thank you! Any Questions?