Applying Whisper to Traditional USL Calculational Methods

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Outline

- LANL and SNL Collaboration
- Updating and Expanding SNL’s Benchmarks
- The SVVR and the General USL
- Building Whisper Libraries
- Whisper’s Role in the Validation Process
Collaboration

Benchmark Library Update

SNL Whisper Library

Whisper

SVVR & Validation
594 Additional benchmarks added from multiple sources and were assumed to be reviewed but all benchmarks in are in review. (857 Total Benchmarks).

All benchmarks material ZAIDs were converted to isotopes from elements.

MLIB card was used to make future cross section updates easier.

S\(\alpha\beta\) cards and complementary binaries were added if missing.
Per LANL good practices, 10000 neutrons per cycle, and enough cycles to ensure convergence and good statistics.

All benchmarks included a heading with the ICSBEP benchmark values and uncertainties for Whisper processing.
Whisper

- Whisper is a statistical analysis software developed by LANL to support NCS and distributed with MCNP 6.2.

- For each isotope, 12 cross-sections & sensitivities over 44 energy groups are used.

- Compares benchmark sensitivities to application and determines highest correlating benchmarks.
SNL’s Whisper Library

- Created our own Whisper Libraries using our benchmarks
  - Sensitivity calculations, TOC, Adjusted covariance data, and Exclude files

- Whisper Library is updated when benchmarks are added, changed, or deleted.

- Benchmarks and Sensitivity data under version control

- SNL+LANL and LANL+SNL show little statistical differences.

<table>
<thead>
<tr>
<th></th>
<th>Bias ± Std.Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>357 LANL cases</td>
<td>0.00175 ± 0.00024</td>
</tr>
<tr>
<td>357 SNL cases</td>
<td>0.00179 ± 0.00021</td>
</tr>
<tr>
<td>Ave. SNL-LANL</td>
<td>0.00004 ± 0.00010</td>
</tr>
</tbody>
</table>
SNL’s SVVR and the General USL

- SVVR calculates a “generic” USL of 0.959 for the complete set
  - using statistical methods found in NUREG/CR-6698
  - includes a 0.02 MOS, historically 0.05 was used

- Planned NCSP SVVR procedure
  - Git server for benchmark version control
  - One version of MCNP for validation
  - Benchmark maintenance and updating
Whisper’s Role in the Validation Process

- Whisper is used to determine if the benchmarks in our library have enough matches to a system or process to confidentially apply our general USL.

- NCSE determines if enough correlated benchmarks at a high enough confidence level (Ck values) such that additional benchmarks are not needed or with good judgment apply an AoA margin.

- ! WHISPER’S REPORTED USL IS NOT USED FOR VALIDATION !
CR-6698 statistical methods can be applied to Whispers correlated benchmarks to calculate a USL to determine if the general USL is still bounding or confidence is questionable.

<table>
<thead>
<tr>
<th>Application</th>
<th>Distribution</th>
<th>USL Traditional Methods on Whisper’s Correlating Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>SingleCyl_Mass_0.0005_100_15.846</td>
<td>NON-Normal</td>
<td>0.97227</td>
</tr>
<tr>
<td>SingleCyl_Mass_0.0005_1060.8_7.2117</td>
<td>NON-Normal</td>
<td>0.97154</td>
</tr>
<tr>
<td>SingleCyl_Mass_0.0005_40_5.08</td>
<td>Normal</td>
<td>0.96688</td>
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<tr>
<td>SingleCyl_Mass_0.01_75_17.441</td>
<td>NON-Normal</td>
<td>0.97094</td>
</tr>
<tr>
<td>SingleCyl_Mass_0_10_38.1</td>
<td>Normal</td>
<td>0.97411</td>
</tr>
</tbody>
</table>
ANS-8.24-2007 section 5.1

“Appropriate system or process parameters that correlate the experiments to the system or process under consideration shall be identified.”

- Less experienced Analyst not as knowledgeable about the 1000’s of benchmarks from the ICSBEP.

- Employing Whisper reduce the uncertainty in the benchmark selection process.
Thank You for Your Attention