Statistical analysis of Tritium Breeding Ratio deviations in the DEMO due to nuclear data uncertainties

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Objectives
- Estimation of TBR uncertainty due to Nuclear Data
  - Compare TBR results for different DEMO concepts using different international nuclear data libraries
  - Assessment of the TBR uncertainty in different DEMO concepts due to uncertainty of the nuclear data
    - using global Monte-Carlo method
    - using up to 300 TENDL-2017 random files for each isotope

Design & models
- Based on CAD model of DEMO Base line 2017
- Full size 3D DEMO model of 11.25 torus sector
- Fully heterogeneous designs DEMO HCPB & WCLL Breeder Blanket

Workflow
- Nuclear Data Selection
  - JEFF-3.2
  - IAEA-3
  - ENDF/B-VIII
  - TENDL-2017
  - Random/Files
- TBR Calculation
  - Standard
  - Temperature dependent

Sensitivity analyses: HCPB case
- Different number of repetition
- Different number of source particles

Summary
- The TBR uncertainty due to nuclear data was assessed:
  - Uncertainty due to different libraries: ± 1.2%
  - Uncertainty due to temperature effects: ± 0.3%
  - Global Monte-Carlo methods using random TENDL-2017 data files
    - Without random files for Li and Be: > ± 3% for both HCPB and WCLL DEMOs
    - With Lithium [TENDL-2015 random files]: > ± 21%
  - The results are not justified as the random files for Li and Be were produced with TALYS code outside the valid mass number region.

TBR results based on different nuclear data library

<table>
<thead>
<tr>
<th>Library</th>
<th>HCPB (%)</th>
<th>WCLL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JEFF-3.2</td>
<td>1.2000</td>
<td>1.1033</td>
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<td>JEFF-3.3</td>
<td>1.1996</td>
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<td>FENDL-3.1d</td>
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<td>TENDL-2017</td>
<td>1.1945</td>
<td>0.9542</td>
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<td>ENDF/B-VIII</td>
<td>1.1983</td>
<td>0.9858</td>
</tr>
</tbody>
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Temperature dependent
- HCPB
  - JEFF-3.2 + Lithium random files: 1.1820 ± 2.521%
  - WCLL: 1.0911 ± 2.942%

Source particles
- TBR
  - HCPB
    - 1.2000 ± 2.483
    - 1.2000 ± 2.626
  - WCLL
    - 1.1033 ± 2.500
    - 1.1033 ± 2.497


TBR results using TENDL-2017 random files

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