Contribution ID: **22** Type: **not specified**

Serpent and Nuclear Data: Needs, processing and verification

Tuesday, 11 October 2022 16:00 (20 minutes)

This talk gives an overview of the development and applications of Serpent at VTT Technical research centre of Finland Ltd focusing on the nuclear and atomic data needs of Serpent as well as the validation of Serpent at VTT.

Serpent transports neutrons and photons in a decoupled or coupled manner starting from a criticality source, a fixed source or a radioactive decay source. Serpent is often used for burnup calculations.

Neutron interaction modelling in Serpent is based on ACE format data, with some application specific data either appended to the end of normal ACE-files (such as additional nonlocal/local energy deposition data) or read directly from ENDF files (dec, nfy, sfy data and energy dependent branching ratios). Photoatomic interactions are modelled based on data that is not as cohesively collected as the neutron interaction data is: At the moment ACE-format photoatomic cross sections are complemented with additional data from auxilliary files.

The neutron interaction data processing at VTT is conducted with NJOY. Serpent contains an automated stochastic testing routine for ACE libraries, based on reaction, energy and angular sampling for neutrons in randomly generated materials. This routine is utilized at VTT to identify inconsistencies in newly generated libraries. Serpent also executes several checks to the nuclide data included in a calculation to identify inconsistencies in the data such as stable nuclides with decay channels and issues a warning to the user.

The validation of Serpent at VTT has been application and target specific. The largest amount of preparation has gone to the criticality safety validation package, which contains several hundred Serpent inputs for critical experiments from the LEU-COMP-THERM section of the ICSBEP handbook. Intended for criticality safety validation of Serpent for wet storage geometries, this effort is mainly intended for determining the Upper Safety Limit for the k-eff for a specific application. A smaller amount of effort has been put to using SINBAD experiments for the validation of the photon transport in Serpent and to using SFCOMPO data for the validation of Serpent's burnup capabilities.

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