

Nuclear criticality and safety analyses preparedness at VTT (KATVE)

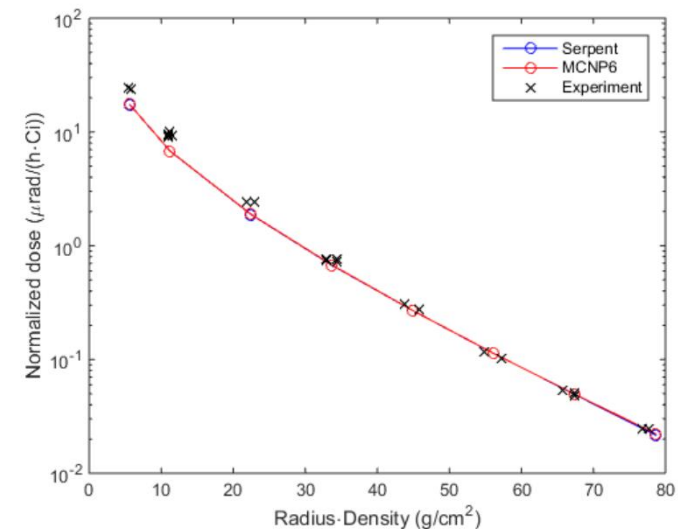
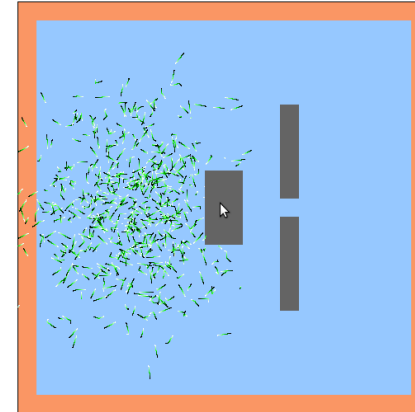
SAFIR interim seminar 2017
Pauli Juutilainen

Objectives of KATVE

- Development of codes and methods, improvement of analysis tools, educating experts
- Main topics and targets:
 - Criticality safety – improvement of capabilities to perform criticality safety analyses (validation package, burnup credit expertise)
 - Radiation shielding – expanding the scope of applicability of Serpent 2 from reactor physics to radiation shielding
 - Neutron dosimetry and activation analysis – educating new experts, replace outdated computing software
 - Spent fuel in dry storage – heat transfer and fuel integrity

Results & achievements

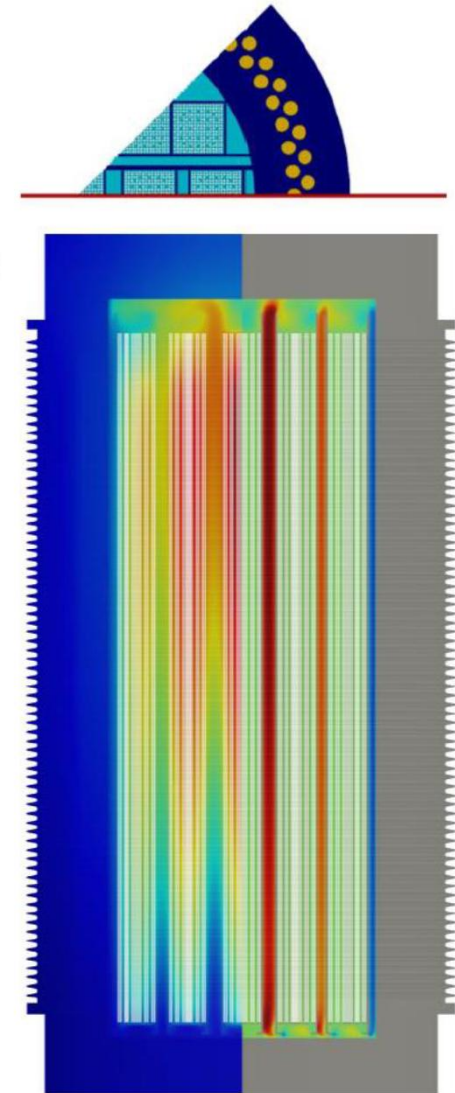
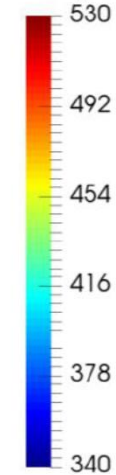
- Radiation shielding
 - Serpent 2.1.24 – the first version containing gamma transport mode – was released in June 2015
 - Interaction physics, photon vs. material, secondary radiation, etc.
 - Variance reduction methods required for acceptable computational efficiency
 - Very good agreement with MCNP6 in test calculations



Results & achievements (2)

- Spent fuel in dry storage cask:
 - Spent fuel at 50 GWd/t_{HM}, composition (source term) calculated with Serpent
 - CFD (computational fluid dynamics) calculations to determine the spatial and time-dependent temperatures in the cask (Castor-V/21)
 - The problem: will the highest fuel cladding temperature remain under 400°C?
 - Yes, if the fuel has been cooled somewhere else more than ~3.5 years after discharged from reactor

Temperature (K)



Results & achievements (3)

- Neutron dosimetry & activation analysis:
 - Improvements to the manual of the LSL-M2 code
 - Test calculations with MAVRIC, the code to replace the outdated TORT and DORT codes in activation analyses
- Criticality safety:
 - Validation package required to determine the bias between the computing system and the real world
 - New cases added to validation package (72 for MCNP, 234 for Serpent), large number of MCNP-inputs was obtained from NRG (NL)
 - Improvements to the script that runs the calculations and performs statistical analysis
 - Burnup credit: literature study about international standards and guidelines



TECHNOLOGY «FOR» BUSINESS

