McSAFE

High-Performance Monte Carlo Methods for SAFEty Demonstration – From Proof of Concept to realistic Safety Analysis and Industry-like Applications

OBJECTIVES

The overall objective of the McSAFE project is to move the Monte Carlo based stand-alone and coupled solution methodologies to become valuable and widespread numerical tools for realistic core design, safety analysis and industry-like applications of LWRs of Generation II and III reactors including advanced depletion, optimal coupling of MC-codes to thermal-hydraulic solvers, time-dependent Monte Carlo and methods and algorithms for massively parallel simulations. Another important objective is the validation of the developed methods by using plant data of different NPPs.

DESCRIPTION OF WORK

The technical work of McSAFE is focused on:

- Methods for full-core MC-depletion and optimised thermal-hydraulic feedback integration
- Code integration and coupling methods for multi-physics based on MC-methods e.g. integration of TRANSURANUS and SERPENT in NURESIM Platform and coupling with thermal hydraulic solvers e.g. SUBCHANFLOW
- Developments of dynamic MC-methods for transient analysis. In this context, the MC codes MCNP, SERPENT and TRIPOLI will be extended for the simulation of the delay and prompt neutrons during transients scenarios and it will be coupled with TH-solvers.
- Validation of MC-based simulations using plant data for depletion, static and dynamic core analysis using the implemented coupled approaches. In addition, data from the SPERT-III-E tests will be used.

MAIN RESULTS / HIGHLIGHTS

- The McSAFE project will provide improved and more advanced numerical simulation tools for the design and optimisation of reactor cores as well as for the assessment of the core performance and safety assessment for any core design. The main European tools in the project are the Monte Carlo particle transport codes SERPENT and TRIPOLI and the thermal-hydraulic subchannel codes FLICA4 and SUBCHANFLOW.
- Numerical tools and methods developed within McSAFE can be used by different end-users (industry, regulators, research centres, etc.). Since they reflect the state-of-the-art, it will be a basis for technical discussions between utilities and regulators aiming to keep plant safety at high level.
- The McSAFE tools are essential to design reactor systems with improved safety features keeping sufficient safety margins. Disseminating most advanced safety analysis tools is a key factor to improve the safety culture in Europe and worldwide.
- The advanced numerical tools to be further developed, improved and validated within McSAFE are unique with regards to their physical models and methodologies and the prediction capability and the spatial resolution.
- These numerical tools can be also applied for research reactors, SMRs and innovative reactors.

DURATION

1 September 2017 – 31 August 2020
3 years

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PARTNERS

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