Version 1

Field: NUCLEAR SAFETY

Topic: SAFETY ASSESSMENT APPLICATIONS

Course type	TUTORING
Host institute	Centre for Energy Research Budapest, Hungary
Date	13 November – 8 December 2023
Duration	Four weeks
Working language	English

Objective and learning outcomes

This course provides the tutees with theoretical and practical knowledge to support them in improving their technical discipline competences and skills in implementing and evaluating reactor physics calculations as part of safety assessments by delving into Monte Carlo-based methodologies and practical applications.

Outline of course content

Safety assessments, such as the deterministic safety assessment increasingly relies on high-fidelity reactor physics calculations, owing to advancements in computational performance. Monte Carlo-based reactor physics calculations are employed not solely for research purposes but also for regulatory licensing processes. Consequently, regulatory bodies and technical support organizations must acquaint themselves with the practical intricacies of such analyses to aptly evaluate associated technical documents.

This course offers a hands-on learning experience for acquiring knowledge about Monte Carlo reactor physics codes and practical considerations, as outlined in the following content:

- Introduction to reactor physics calculations in the Deterministic Safety Assessment processes. In-depth coverage of nuclear and reactor physics fundamentals. Examination of calculation methodologies and best practices tailored to facilitate the high-level assessment of technical documentations related to reactor physics calculations.
- Comprehensive overview of Monte Carlo-based reactor physics calculations. Detailed exploration of underlying modeling methodologies. Identification of nuclear data requirements. Emphasis on fundamental principles and a thorough exploration of their advantages and limitations. Overview of a cutting-edge Monte Carlo reactor physics code and practical insights into its utilization for nuclear reactor core analysis.
- Practical training in the application of Monte Carlo reactor physics codes. Hands-on instruction for utilizing Monte Carlo reactor physics codes. Proficiency in handling nuclear data. Competency in constructing geometrically complex models. Execution of basic calculations and thorough evaluation of the resultant data. Comprehension of how the stochastic nature of Monte Carlo calculations influences outcomes.
- Case Study: Analysis of a real-world nuclear reactor core. Examination of core safety parameters. Comprehensive understanding of their significance in deterministic safety analyses.

Upon completion of this course, the tutee is expected to be able to perform and evaluate Monte Carlo reactor physics calculations as part of deterministic safety assessments, including nuclear data processing, model development and core safety parameter calculations.

Technical schedule and delivery methods

The course consists of one module taking 4 working weeks (i.e. 4 × 5 workdays).

1–2 working weeks deal with the basics of nuclear reactor modelling fundamentals and Monte Carlo methods applied to reactor physics calculations. They are structured as follows:

- **Classroom lectures** take 2 days with 2 units per day (tentatively morning sessions with 2 lectures of 90 minutes each, with time allocated for discussions and appropriate breaks).
- **On-the-job training** to gain hands-on experience in modeling nuclear reactors, focusing on simpler exercises. Overview of a Monte Carlo reactor physics code, understanding nuclear data requirements, building complex geometries, and performing basic calculations.
- Half-day **technical visit** to the Budapest Research Reactor.

3–4 working weeks are related to modelling and analyzing a nuclear reactor core based on the experiences from the previous two weeks. They are structured as follows:

- **Classroom lectures** take 2 days with 2 units per day (tentatively morning sessions with 2 lectures of 90 minutes each, with time allocated for discussions and appropriate breaks).
- **On-the-job training** to model a real-world nuclear reactor core using a Monte Carlo reactor physics code, understand the modeling principles, build and validate the model, and determine the most important core safety parameters.
- **Presentation** (30 min) of the experiences and achieved results by the trainee at the seminar of the Reactor Analysis Department.

Target audience

This course is intended to experts and professionals of Nuclear Regulatory Authorities (NRAs) and Technical Support Organisations (TSOs) with responsibilities in the field of nuclear safety.

Target number of participants: 2

Prerequisites and requirements for participants

Participants should have a basic knowledge of nuclear and reactor physics and an adequate level of knowledge in English (at least an 'Independent user' level defined by the CEFR). A university degree with nuclear specialization and 2 years of professional experience in functions relevant to the content of the course is also a prerequisite.

Relevancy of the course topic in the work and institutionally justified interest in participating will be considered as well as the need and opportunity for filling competence gaps. Efforts are made to ensure gender equality.

Terms of participation

The project is implemented under the European Union (EU) external assistance programme, called the European Instrument for International Nuclear Safety Cooperation (INSC), and aims to support the National Nuclear Regulatory Authorities (NRAs) and their Technical Support Organisations (TSOs) in non-EU countries in strengthening their capabilities with regard to their regulatory tasks and responsibilities in the field of nuclear safety and radiation protection.

Employees of the NRAs or their TSOs in the Beneficiary Countries are eligible for financially supported participation in the T&T courses. Beneficiary Countries of the project are published on the website https://training.ek-cer.hu/.

Costs

Travel and accommodation costs and subsistence allowances (including the international and national travel tickets, shuttle services, insurance and visa costs, per diems) for participants will be covered from the project budget.

Application

Application via the website https://training.ek-cer.hu/, according to the process and deadlines indicated there.

Examination

Technical and linguistic tests will be written as part of the application and selection process to assess the underlying knowledge and preparedness of applicants. Knowledge and development of selected participants will be assessed through technical tests throughout the course.

Work reports will be prepared to allow for progress monitoring and determining the final development through acquisition of knowledge, practical experience and expertise, as well as task completions.

Participants attending the full course will be issued with attendance certificates. Successful participants will receive certificates confirming their knowledge achieved and skills acquired.