Barcelona June 27 – July 1, 2022

Hands on training on NPP simulations: Building up a full model of an SMR reactor

RELAP5, TRACE, SPACE, MARS-KS and ASYST training course

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The training organized last year had 18 participants from 5 different countries: Czech Republic, Poland, South Korea, United Arab Emirates and United Kingdom.

Overview of 2019 edition (onsite)

For the fifth consecutive year, the training “Advanced Simulation of Thermal Hydraulic Phenomenology with system codes” was held at the Technical University of Catalonia (Barcelona, Spain). We are really proud to see how the course has become consolidated during this time. In 2019, we hosted 18 people from 6 different countries: South Korea, Russia, United Kingdom, Belgium, Lithuania, Hungary and Spain. Participants came from diverse origins of the Nuclear Thermal-Hydraulics community: regulatory bodies, research institutes, universities and companies devoted to safety analysis. The training dealt with the simulation of thermal hydraulic phenomenology related to the simulation of Small Modular Reactor systems.

In the first part of the training we focused on the achievement of a steady state for a pressurized water reactor. A full model of a generic power plant was distributed. The participants learnt how to adjust the different control systems in order to bring the plant to stable conditions

In the second part of the training, the participants adjusted different Station Blackout accidental situations. The related phenomenology, the thermal hydraulic response and the effectiveness of the passive safety systems were studied and discussed.

Overview of 2021 edition (online)

Due to the global pandemic of coronavirus disease, the 2021 edition was held online. The online option was already available in the previous editions and in 2021 the training “Advanced Simulation of Thermal Hydraulic Phenomenology with system codes” was held online for the third time since 2015. There were 18 participants from 5 different countries: Czech Republic, Poland, South Korea, United Arab Emirates and United Kingdom. Participants came from diverse areas of the Nuclear Thermal-Hydraulics community: research institutes, universities and private companies devoted to safety analysis. The training dealt with the simulation of thermal hydraulic phenomenology related to the simulation of Small Modular Reactor systems.

In this course you will learn how to build up a full model for an SMR reactor. The final objective is to transfer knowledge on best practices in system code modeling

Objective of the 2022 edition:

In 2022, The 'Hands on training on NPP simulations: building up a full model of an SMR reactor' aims at a transfer of advanced knowledge and best practices in system code modeling for nuclear power plants. The 2022 edition focuses on the simulation of an SMR reactor. A simplified model of a light water pressurized SMR (iPWR) will be developed from scratch. The participants will be guided through the process starting by the review of public information that can be found on the literature. During the first part of the exercise the core of the reactor will be nodalized and tested. Afterwards the full primary and secondary systems will be developed.
In the last part of the course, a SBO scenario will be configured, and the capacity of the necessary safety systems will be evaluated. Additionally, basic guidelines on severe accident modeling and phenomena will be introduced for RELAP/SCDAPSIM.
In order to enhance the modeling skills of participants, information on important physical phenomena and the best practices in modeling will be given and discussed during the course.

Target of the course:

The course is recommended to users:
- who can make a simple model for a system code analysis,
- who can modify the existing input by him/herself,
- who want to analyze an integral behavior of nuclear power plant system based on TH system code analyses.
- who need to develop the logic and the control of a supplied NPP/facility input deck

Codes:

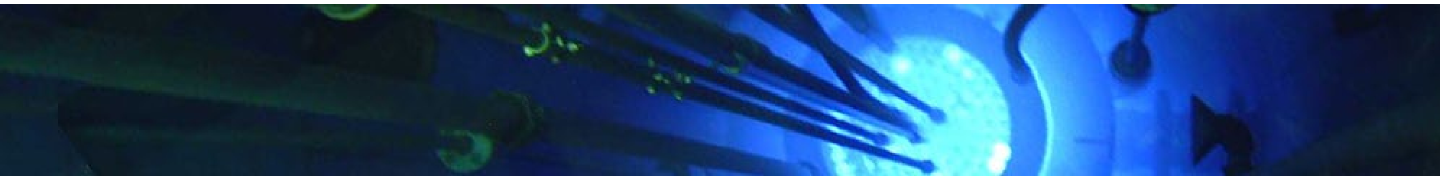
The exercises of the course can be performed with any of the following thermal hydraulic codes:

- TRACE
- RELAP5
- MARS-KS
- SPACE
- RELAP/SCDAPSIM
- ASYST

Participants will be expected to bring a laptop computer with their preferred TH code installed.

Schedule:

Date	Contents
June 27 (Mon)	• Registration • Introduction to the course and thermal hydraulics • SMR modelling · Analysis of the available data · building up of the core
June 28 (Tue)	• Scaling principles • Testing the core · Control systems · Discussion and trouble shooting
June 29 (Wed)	• Building up the rest of the SMR system • Achieving a steady state
June 30 (Thu)	• Testing the steady state • SBO accident · Configuring transients · Understanding transient phenomenology · Specific development and special processes
July 1 (Fri)	• Accident analysis · Discussion and trouble shooting • Wrap-up



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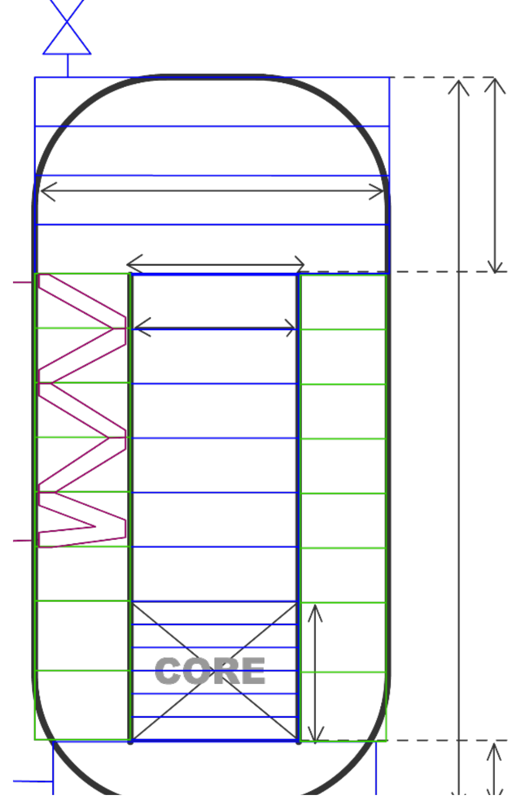
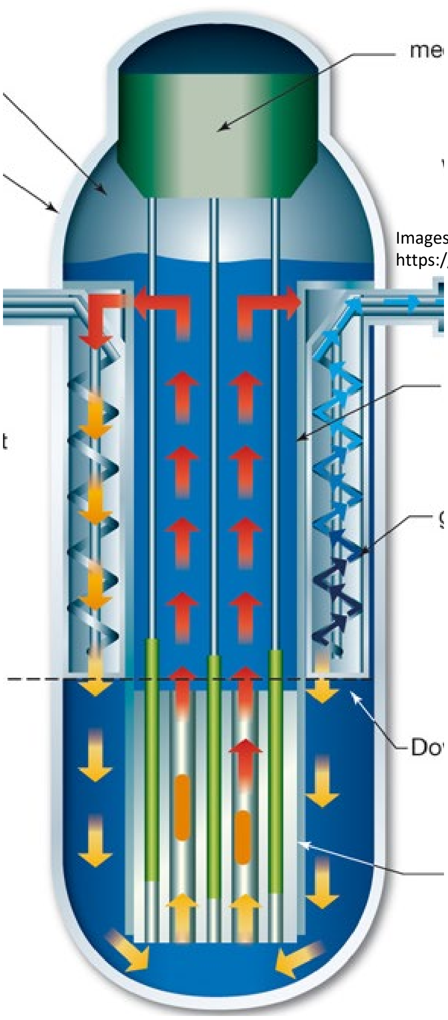
Methodology

The teaching methodology of the training focuses on a learning-by-doing approach. The participants will be provided with the necessary tools, design information and other background theoretical background. With this information the participants will build a TH model. Expert tutors will be available to provide continuous support.





Images: Proyecto Carem25.
https://www.cai.org.ar/wp-content/uploads/biblioteca/2018/El_modelo_nuclear_argentino/20181003_Boselli_Alfredo.pdf

Specific Lectures

- **State of the art of system codes**
  - Description of the 6 equation models used in system codes
  - Limitations and requirements for the simulation of LW-SMR
- **Small modular reactors**
  - Current SMR designs
  - Passive safety systems
- **Scaling of thermal hydraulic complex systems**
  - Basic principles in the scaling of TH complex systems
  - Integral Test Facilities
  - Benchmarking and the use of ITF data
- **Phenomenology of thermal hydraulic systems**
  - Phenomenology during accidental conditions for LWR
  - Passive safety systems

Most of the time of the training will be devoted to “Learning-by-doing”, but a limited number of theoretical lectures will be provided. Above is the list of presentations. Additional topics can be discussed upon demand.

Registration Fee:
1800€ per participant

This year the SMR training will be conducted by video streaming. Participants will join up to 5 people groups per lecturer in video chat rooms to perform the exercises. In addition, general lectures will be conducted for the whole audience in a main meeting room. The chat rooms will allow the participants to work together on the training materials as well to perform live individual questions to the lecturers. In the main meeting room, the lecturers will do master classes about SMR reactors, accident phenomenology, V&V, and the resolution of the exercises.

The course has been distributed in 6 sessions / 2 weeks' time frame to provide more time to work in depth with the training material and to complete the day-by-day tasks. In addition, a free day has been added between the sessions to allow the participants to work by their own and to send specific questions to the trainers by email.

For more information do not hesitate contact us at info@ensobcn.com

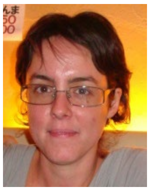
The seminar is open to vendors, utilities, regulatory bodies, national laboratories, consulting companies and universities. There will be at least one lecturer for every 5 participants.

Lecturers and instructors:

Prof. Taewan Kim has about 20 years of experience in nuclear TH system code. His specialty includes uncertainty evaluation in TH analyses for nuclear power plant, and the assessment and improvement of TH system codes.

Prof. Jordi Freixa has about 18 years of experience in the use of TH system codes. During this time, he has developed or worked with more than 10 full plant models. His main areas of research are the validation and application of best estimate thermal hydraulic codes for LWRs.

Dr. Victor Martinez-Quiroga participated as TH analyst in several OECD/NEA projects since 2006. His expertise includes scaling and Deterministic Safety Assessment. In his Thesis, Victor developed the SCUP methodology, a systematic approach for qualifying NPP nodalizations with experimental facilities database.



Dr. Marina Pérez has 15 years of experience in the use of TH system codes. In 2009 she started working part-time at Innovative Systems Software as an external consultant providing support in RELAP5 trainings and code development.

Dr. Raimon Pericas has 13 years of experience in the use of TH system codes. He also holds experience on Severe Accident analysis. His main area of research is focused on BEPU analysis with coupled calculations. He is currently lecturing as associate professor at University of Vic and UPC.

Individual course extension, customized training and tutoring

In this training we offer the possibility of extending courses for one week. In such extensions, the participant will have the opportunity to broaden the knowledge acquired in a course under the supervision of dedicated instructors. The cost will be agreed by both partners in the form of a collaboration agreement. For more information, please contact us (info@ensobcn.com)

Each code has its own particularities, understanding the assets and limitations of each code is essential to perform qualified thermal hydraulic simulations. In this training you will be able to sense what makes each code different

RELAP5

The RELAP5/MOD3.3Patch04 code has been developed for best-estimate transient simulation of light water reactor coolant systems during postulated accidents. The code models the coupled behavior of the reactor coolant system and the core for loss-of-coolant accidents and operational transients such as anticipated transient without scram, loss of offsite power, loss of feedwater, and loss of flow. A generic modeling approach is used that permits simulating a variety of thermal hydraulic systems. Control system and secondary system components are included to permit modeling of plant controls, turbines, condensers, and secondary feedwater systems.

TRACE

TRACE (TRAC/RELAP Advanced Computational Engine) is the latest best-estimate system codes developed by the US NRC for analyzing steady-state and transient neutronic/thermal-hydraulic behaviour of Light Water Reactors (LWRs). The TRACE code is designed to analyse reactor transients and accidents up to the point of significant fuel damage. The code is a product of a consolidation of the capabilities of the main system codes of US NRC, such as TRAC-PF1, TRAC-BF1, RELAP-5 and RAMONA.

TRACE includes models for multidimensional two-phase flow, non-equilibrium thermodynamics, generalized heat transfer, reflood, level tracking, and reactor kinetics. A two-fluid model is used to evaluate the gas-liquid flow.

ASYST

ASYST is a new BEPU integral code being developed through an international collaborative project, ADTP. The code incorporates advanced multi-dimensional and multi fluid models as well as advanced "open source" constitutive TH correlation library for multiple fluids. The ASYST reactor-specific modeling options include modules describing the behavior of the core/fuel assembly structures, late phase debris/melt relocation, the containment including melt spreading and molten core-concrete interactions, and fission product release and transport. The code also includes integral uncertainty and advanced 2D/3D GUI options.

SPACE

SPACE (Safety and Performance Analysis Code for Nuclear Power Plants) is a code developed jointly by Korea Hydro & Nuclear Power Co., LTD (KHNP), Korea Atomic Energy Research Institute (KAERI), and KEPCO Engineering & Construction Company (KEPCO E&C) for licensing of pressurized water reactors. The SPACE code adopts advanced physical modeling of two-phase flows, mainly two-phase three-field models which comprise gas, continuous liquid, and droplet fields but it has a capability to handle the classical two-phase two-field model by user's selection. It has the capability to simulate 3D effects by the use of structured and/or non-structured meshes.

MARS-KS

Korea Advanced Energy Research Institute (KAERI) conceived and started the development of MARS-KS code with the main objective of producing a state-of-the-art realistic thermal hydraulic systems analysis code with multi-dimensional analysis capability. MARS-KS achieves this objective by very tightly integrating the one-dimensional RELAP5/MOD3 with the multi-dimensional COBRA-TF codes. The system pressure equation matrices of both codes are implicitly integrated and solved simultaneously. In addition, the Equation-Of-State (EOS) for the light water was unified by replacing the EOS of COBRA-TF by that of the RELAP5. MARS-KS has been utilized as a regulatory confirmatory system code of Korea Institute of Nuclear Safety (KINS).

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Organizing committee

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To register send an email to:

info@ensobcn.com

Registration Fee:

1800€ per participant
1500€ universities

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