Barcelona June 26 – 30, 2023

Hands on training on NPP simulations: achieving steady state conditions and conducting the simulation of thermal hydraulic phenomenology

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

enso

INCHEON NATIONAL UNIVERSITY

ANT Advanced Nuclear Technologies

The training organized last year had 21 participants from 5 different countries: Argentina, Bulgary, China, South Korea and Spain.

Overview of 2022 edition (onsite-online)

For the sixth 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 2022, we hosted 21 people from 5 different countries: South Korea, China, Bulgary, Argentina 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 the participants had to develop from scratch a simplified model of a light water pressurized SMR (iPWR). They were guided through the process starting by the review of public information that can be found on the literature.

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.

In this course you will learn how to stabilize a full model of a generic Nuclear Power Plant. The final objective is to transfer knowledge on best practices in system code modeling

Objective of the 2023 edition:

In 2023, The 'Hands on training on NPP simulations: achieving steady state conditions and conducting the simulation of thermal hydraulic phenomenology' aims at a transfer of advanced knowledge and best practices in system code modeling for nuclear power plants. The 2023 edition differs from previous editions in the sense that the contents will focus on the modelling of a full power plant model from the starting day. In addition to general modelling technique for nuclear power plant systems, the course will provide a hands-on training on how to implement proper operation actions to achieve steady-state conditions by using control components of system codes. 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 26 (Mon)	- Registration - Introduction to the course and thermal hydraulics - NPP modelling · Introduction and familiarization · Hydraulic components, modeling
June 27 (Tue)	- Achieving the steady state · Control systems · Discussion and trouble shooting
June 28 (Wed)	- Scaling principles - Control system for achieving a steady state - Achieving a steady state (continuation)
June 29 (Thu)	- Accident analysis · Configuring transients · Understanding transient phenomenology · Specific development and special processes
June 30 (Fri)	- Accident analysis · Discussion and trouble shooting - Wrap-up

ens

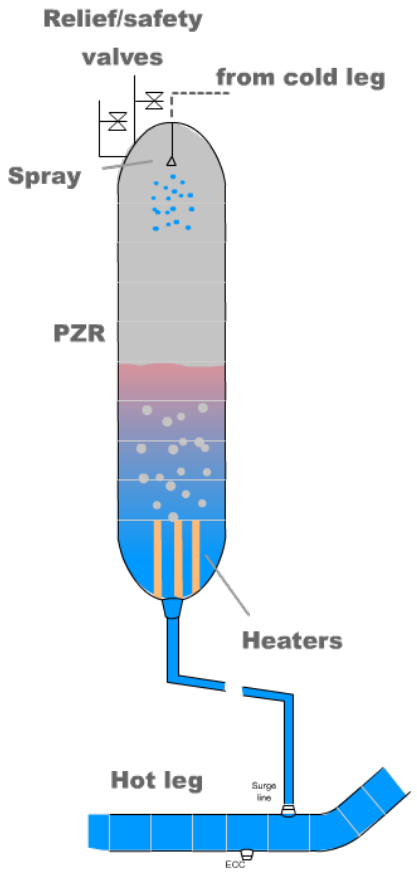
INCHEON NATIONAL UNIVERSITY

ANT Advanced Nuclear Technologies

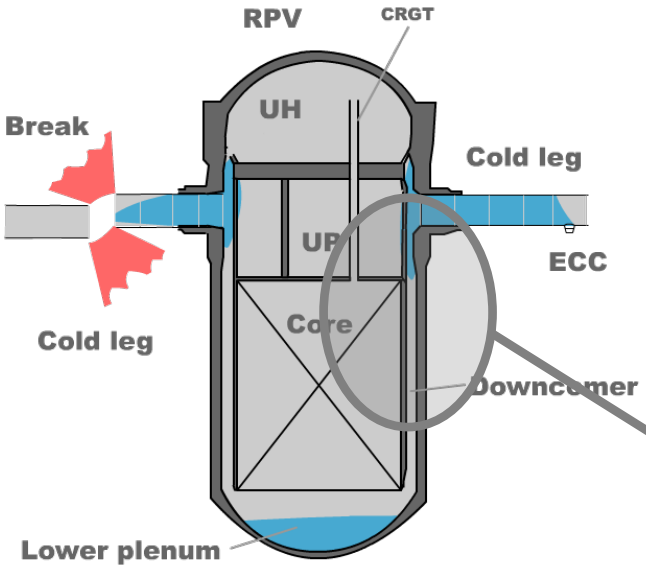
The PWR session will be focused in the simulation of a full power plant model. The main goals will be stabilization and control of full plant nodalizations and configuring transient scenarios.

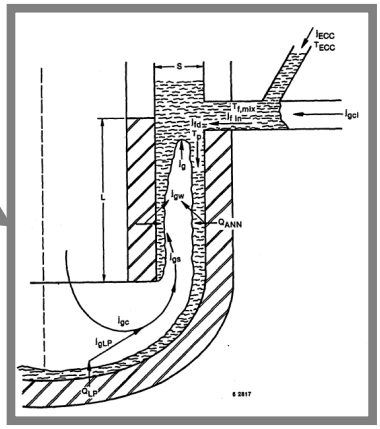
PWR session (June 26-30) :

- **Nuclear Power Plant problem**
  - Developing a nodalization
  - Qualifying a nodalization
- **Improvements to plant nodalization**
  - Hydrodynamic improvements
  - Steady-state improvement
  - Control implementation
- **Transient analysis**
  - Understanding transient scenario
  - Specific development
  - Executing base case
  - Extracting results
  - Sensitivity analysis
- **Working with user supplied input models**
  - Understanding transient scenario
  - Plans of use
  - Executing calculation



Learning how to control and stabilize your system





Assessment of local phenomena and system behavior during Design Basis Accidents

Registration Fee:
1800€ per participant
(1500€ for university students)

The course will be held at The Barcelona School of Industrial Engineering (ETSEIB) which is part of the Technical University of Catalonia - BarcelonaTech (UPC), a public institution dedicated to higher education and research, specialized in the fields of engineering, architecture and science.

The School is located in Barcelona and is well connected with the airport and the city center.

The course is organized by ENSO together with the Advanced Nuclear Technologies group (ANT) from the Technical University of Catalonia, and the Incheon National University. Their research groups have a long experience in R&D and teaching in Nuclear Engineering, principally nuclear reactors technology, thermal-hydraulic analysis and safety for both fission and fusion reactors.

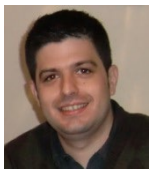
For more information do not hesitate contact us at info@ensobcn.com

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.

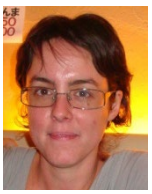
Lecturers and instructors:

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.

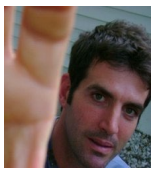
Prof. Jordi Freixa has about 18 years of experience in the use of TH system codes. During this time, he has developed or worked with more than 10 full plant models. His main areas of research are the validation and application of best estimate thermal hydraulic codes for LWRs.



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.

For online training options, please also contact to info@ensobcn.com

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)

enso

INCHEON NATIONAL UNIVERSITY

ANT Advanced Nuclear Technologies

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).

ANT Advanced Nuclear Technologies

Organizing committee

Prof. Dr. Taewan Kim
Prof. Jordi Freixa
Dr. Víctor Martínez-Quiroga
Dr. Marina Pérez-Ferragut

Feel free to contact us at:

jordi.freixa-terradas@upc.edu
victor.martinez@ensobcn.com
taewan.kim@inu.ac.kr
info@ensobcn.com

To register send an email to:

info@ensobcn.com

Registration Fee:

1800€ per participant
1500€ universities

enso

INU
INCHEON
NATIONAL UNIVERSITY