RELAP5 Model Development and 3D Reactor Kinetics Coupling Workshop

April 30 – May 4, 2018
AERB, Anushakti Nagar, Mumbai-400094, India

ISS Office

Innovative Systems Software (ISS)

Innovative Systems Software, LLC is a private, limited liability company located in Ammon, Idaho. ISS is the developer of the RELAP/SCDAPSIM system thermal hydraulics and FUELSIM LWR fuel behavior codes. ISS also manages the SCDAP Development and Training program (STDP), an international consortium of more than 100 research, regulatory, and other organizations in 30 countries focused upon the development of improved reactor safety analysis and simulation technology. ISS staff provides technical support and training on thermal hydraulics and severe accident model development and analysis for the International Atomic Energy Agency, other SDTP member organizations, and licensed software users, and researchers.

About RELAP5

RELAP5 is the most widely used system thermal hydraulic code in the world. Our version, RELAP/SCDAPSIM, is now used in 30 countries and is applied to the design and analysis of power and research reactors, advanced fluid systems, and experiments. Ongoing model development activities include the (a) development of improved severe accident models to support "post-Fukushima-Daiichi" assessment and cleanup, (b) addition of advanced fluid properties and correlations for advanced reactor and fluid systems, and (c) development of enhanced graphic and interactive simulator environments for training and analysis.

Model Development Training (April 30 - May 2)

The objective of this code development workshop is to disseminate the knowledge of the code structure and to develop capabilities to modify the code as per the need of each individual organization throughout the country. India has a huge work force which is involved in the thermal hydraulic design, safety and severe accident analyses of nuclear reactor systems using RELAP/SCDAPSIM. This work force is already having world class experience on code applications and this workshop will provide them the opportunity to enrich their code understanding as well as to be skilled on code modification. The training will include the following:

- Compile library transmittal installation
- Compile library transmittal description
- Getting started
- Command line window
- Hands on: change code version
- Compilation of the code
- Compilation command and make files
- Hands on: addition of a source file
- IED (Integrated Development Environment) for FORTRAN and Intel compilers
- Background:

RELAP5-SCDAP code structure
Database

- Bit packing

FORTRAN intrinsic functions iand, ior, ishft.
Hands on: Analysis of bit packing functions in the RELAP5-SCDAP code

- Equivalent databases
- Sample problems

A – Adding debug printouts
Ex. A.1 – Average volume velocity
Ex. A.2 – Interpolated values in pumps
Ex. A.3 – Heat structure coefficients and surface temperature
Ex. A.4 – Sum control component
Ex. A.5 – Hydrodynamic variables
B – Preparing a library transmittal
Ex. B.1 – New file
C – Modification of the coding
Ex. C.1 – Dittus-Boelter correlation
Ex. C.2 – Adding a minor edit

3D Reactor Kinetics Coupling (May 3 - 4)

The RELAP/SCDAPSIM 3D kinetics seminar will be focused on showing the capabilities and the main characteristics of reactor 3D kinetics codes as well as to introduce new RELAP/SCDAPSIM options for coupled calculation, NIRK3D standard interface and 3DKIN nodal kinetics package. The course is divided in three general blocks. The first block will introduce the user to the 3D kinetics codes with a general overview of their main characteristics, their differences with the point kinetics codes, and the different methodologies that have been used for coupling system codes with core physics codes. The second block will introduce 3DKIN package as well as the guidelines on how to input the neutronic part for RELAP5/3DKIN coupled

calculations. This block includes sample problems for testing both the Eigen value and the transient calculation for a typical PWR reactor core. Finally, the third part of the training will introduce NIRK3D standard interface by demonstrating some skills on how to adapt the sources of a neutron kinetic code to be integrated within RELAP/SCDAPSIM. In this block instructors will execute (with a debugger) a typical BWR transient case with unexpected sub-cooled water injection. Participants will be able to observe that how the code manages the TH/NK data exchange as well as the levels of neutronic package in which the sources need to be reprogrammed for integrating in RELAP/SCDAPSIM.

- Point kinetics theory
- 3D kinetics theory
- Differences between 0D - 3D kinetics
- Review of the potential applications of TH-NK coupled codes
- Neutronic codes
- XS libraries and cell codes
- 3DKIN package:
- RELAP5 modeling guidelines for TH-NK coupled calculations
- 3DKIN modeling guidelines for TH-NK coupled calculations
- PWR Eigen value problem
- PWR accident problem
- NIRK3D interface:
- How to adapt neutron kinetics codes sources for being coupled with RELAP/SCDAPSIM
- Typical BWR problem: unexpected sub-cooled water injection transient

Instructors Introduction

Dr. Marina Pérez Ferragut graduated in Physics from the University of Barcelona in 2002, joined the PhD Nuclear Engineering Program at the Technical University of Catalonia (UPC) in 2003 and finished her PhD on "Integration Of a Quantitative-based Selection Procedure in an Uncertainty Analysis Methodology for NPP Safety Analysis" in 2011. She has continued working in the ANT group until 2017. In 2009 she started working part-time at Innovative Systems Software as an external consultant providing support in RELAP5 training and code development. Her main areas of research are uncertainty analysis and application of best estimate thermal hydraulic codes for LWRs. She has 15 years of experience in the application of TH system codes, and 10 years of experience in the code development of RELAP.

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. As a consultant to ISS, he is the project manager and code developer of RELAP5/SCDAPSIM nodal kinetics capabilities (NIRK3D and 3DKIN). NIRK3D is a standardized interface for a user supplied 3D reactor kinetics package while 3DKIN is a new nodal kinetics code that has been added to the RELAP5/SCDAPSIM internal modules. Victor would be covering a few important aspects of 3D Reactor Kinetics coupling through SKYPE during the last two days of the workshop.

Dr. Anuj Trivedi is a full time consultant for ISS since March 2017 after he finished his Master of Technology and Doctor of Philosophy both in Nuclear Engineering and Technology from IIT Kanpur, India. He was actively involved in the RELAP5 application to the Indian PHWR, input deck development of advanced LWRs such as AP1000 and alternative fluid module development for LBE, LLE and Na cooled systems. His research also includes the severe accident analyses of Fukushima type BWRs as well as SBO studies for the AP1000 using core degradation models built into RELAP/SCDAPSIM.

Registration Process

Please visit to https://www.relap.com/events.html to register for this training workshop in Mumbai. The first thirty people will be provided the link to pay the registration fee online as the seating is limited. The detailed program of the workshop would be sent to the registered participants in the first week of April, 2018. Registration fee includes training material on a memory stick which would contain a demo version of RELAP/SCDAPSIM (with the compile library transmittal), demo Intel compiler, sample input decks and presentations to be used during the training and hands on exercises. Registration fee also includes tea/coffee breaks and lunches during the workshop. Participant will need to come with their laptops so that they can install the required software for successfully implementing the code modification exercises. ***Organizers will not be responsible for accommodation and travel of the participants. The deadline for completing the registration and the fee payment is April 25th 2018.***

Registration Fees:

USD 250 Students
USD 350 Industry & other participants

For any query contact:

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Acknowledgement

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