Sixth OECD/NEA Rostov-2 VVER-1000 multi-physics transient benchmark workshop (Rostov2-6)

Lucca, Italy
Monday, May 20, 2024
In conjunction with the BEPU 2024 Conference

Hosted by N.IN.E. (Nuclear and Industrial Engineering), Italy

Announcement and Proposed Program

Background and Purpose of 6th Rostov-2 Benchmark Meeting

The sixth OECD/NEA Rostov-2 VVER-1000 multi-physics transient benchmark workshop (Rostov2-6) will be held on May 20, 2024 (track 2 afternoon), in Lucca, Italy and is a follow up to the previous workshops. The Rostov2-6 meeting will be held in conjunction with the 2024 Best-Estimate Plus Uncertainty (BEPU-2024) international conference as well as with other OECD/NEA Working Party on scientific issues and uncertainty of Reactor Systems (WPRS) meetings/workshops to facilitate co-ordination and sharing of work. Other meetings are being held in three parallel tracks at Lucca, Italy during the same week in order to combine efforts in common areas such as neutronics, thermal-hydraulics, and multi-physics modelling and uncertainty analysis and to make the participation more efficient. The meetings/workshops concerned are:

- *May 19, 2024 (morning)* – COBRA-TF (CTF)-10 a Hands-on Training Session
- *May 19, 2024 (afternoon)* – CTF-10 User Group (UG) Meeting
- *May 20, 2024 (track 1 morning)* – Third OECD/NEA Lead Fast Reactor (LFR) benchmark (LFR-3) workshop – LFR Thermal-Hydraulic (T/H) Stage
- *May 20, 2024 (track 2 morning)* - Third OECD/NEA Fluoride High Temperature (FHR) Reactor Benchmark (FHR-3) workshop
- *May 20, 2024 (track 1 afternoon)* – Third OECD/NEA Lead Fast Reactor (LFR) benchmark (LFR-3) workshop – LFR Neutronics Stage
- *May 21, 2024 (track 1)* - Ninth OECD/NEA Sodium Fast Reactor (SFR) UAM Benchmark workshop (SFR-UAM-9)
- *May 21, 2024 (track 2 morning)* - Ninth OECD/NEA Time-Dependent Neutron Transport (C5G7-TD) Benchmark (C5G7-TD-9) workshop
- *May 21, 2024 (track 2 afternoon)* – Fifth Multi-Physics Pellet Cladding Mechanical Interaction Validation Benchmark (MPCMIV-5) workshop
- *May 20*-21 (track 3), 2024 – 2nd OECD/NEA International School on Simulation of Nuclear Reactor Systems (SINUS-2)
- *May 22, 2024 (track 1)* - Seventeen OECD/NEA Light Water Reactor (LWR) Uncertainty Analysis in Modelling (UAM) Benchmark (LWR-UAM-17) workshop including OECD/NEA Task Force on Doppler Effective Fuel Temperature meeting
- *May 22, 2024 (track 2 morning)* – Fourth Liquid Metal Fast Reactor (LMFR) Thermal-Hydraulics (T/H) Benchmark workshop (LMFR T/H-4)
- May 22, 2023 (track 2 afternoon) – First OECD/NEA HTGR-TH Benchmark (based on HTTF Data) workshop (HTGR-TH-1)
- *May 23, 2024 (track 1)* – Fourth OECD/NEA TVA Watts Bar 1 (WB1) Multi-Physics Multi-Cycle Depletion Benchmark (TVA-WB1-4) workshop
- *May 23, 2024 (track 2 morning)* - Summary session with presentations of recently concluded benchmarks: OECD/NEA First Burst-Fission-Gas Release Benchmark (BFGR) and OECD/NEA McMaster Core Thermal-Hydraulics (CTH) Benchmark
- *May 23, 2024 (track 2 afternoon)* – OECD/NEA Task Force on Artificial Intelligence & Machine Learning meeting

The Rostov-2 benchmark is based on recent measurements of VVER-1000 transient behavior from tests with a multitude of well-documented neutron-physics and thermal-hydraulics data that have been performed at Rostov Unit 2 (Rostov-2) Nuclear Power Plant (NPP). The reactor type is VVER-1000 with fuel assemblies type TBC-2M, which enables an 18-month fuel cycle depletion length. Integral (plant) data and local (core) measured data were collected during the test, which are used for the validation of both traditional and novel multi-physics codes. The measurement and recording of parameters were performed by the standard means available at NPP and by a special system of experimental control. The difference in comparison with all previous OECD/NEA benchmarks for coupled code validation is the introduction of high-fidelity multi-physics simulation codes that could predict pin-by-pin power distributions in the reactor core as well as flow mixing in the primary loop, in the reactor pressure vessel including its active core part. For the OECD/NEA Rostov-2 VVER-1000 multi-physics benchmark the reference problem chosen for simulation and comparison with the measured data is based on a test characterized by the "Reactivity compensation with diluted boron by stepwise insertion of control rod cluster into the VVER core". The selected benchmark transient allows performing simulation tests with different levels of modeling fidelity, resolution, and complexity.

The general frame of the OECD/NEA Rostov-2 benchmark consists of two phases with different exercises for each phase:

Phase I - Assembly-wise (traditional) analysis:

      Exercise I.1 - Thermal-Hydraulic (T-H) plant simulation using power tables.

      Exercise I.2 - Coupled Three-Dimensional (3D) neutronics/core T-H response evaluation:

            Exercise I.2a – Hot Zero Power (HZP) state.

            Exercise I.2b – 75% Hot Power (HP) state.

      Exercise I.3 – Best-estimate coupled core/plant transient modelling.

Phase 2 - Full core pin-by-pin (novel) analysis:

      Exercise 2.1 – Core boundary condition steady-state problem.

      Exercise 2.2 – Core boundary condition transient calculations

      Exercise 2.3 – Best-estimate coupled core pin-by-pin/plant transient calculations.

Benchmark Specification has been updated to Version 1.8 by the benchmark team to be discussed at the incoming first benchmark workshop along with remaining missing information and needed clarifications.

The information about the Rostov-2 benchmark is provided at:
https://www.oecd-nea.org/jcms/pl_32189/rostov-2-vver-1000-benchmark

Scope and Technical Content of the Meeting

The topics to be addressed at the workshop include:

- Review and discussion of the updated specifications including templates for submitting participants' results,
- Present updated support data and cross-section libraries,
- Present updated experimental and measured data,

– Discuss missing information and needed clarifications,

– Present and discuss benchmark team support and related studies,

Participants' presentations on their modelling and results for the two benchmark Phases,

Presentations on other related activities in multi-physics validation of VVERs,

Defining a work plan and schedule for Rostov-2 activities.

The proposed meeting program is attached as Annex 1.

Organization of the Meeting

The meeting is organized around the discussion of the Rostov-2 benchmark specifications, preliminary results, participants' questions, and benchmark-related activities. The participants are requested to present their expertise and experience in benchmark-related VVER-1000 modeling, verification and validation, uncertainty quantification/propagation and applications.

Participation in the Meeting

Participation is restricted to individuals from OECD/NEA member country institutions who agree to the benchmark Non-Disclosure Agreement (NDA). Participants are asked to sign and send the corresponding NDA form to wprs@oecd-nea.org.

Rostov-2 benchmark conditions to release form can be found at:

https://www.oecd-nea.org/upload/docs/application/pdf/2021-02/rostov-2_conditions_for_release.pdf

Organization and Program Committee of the Meeting

An Organization and Program Committee has been nominated to make the necessary arrangements for the Rostov2-6 meeting and to draw up the final program, etc.

The members of the Program Committee are:

> **Alessandro Petruzzi** – *Co-Chair, and Local Host*
> NINE S.r.l., Italy
>
> **Maria Avramova** - *Co-Chair*
> North Carolina State University, USA
>
> **Yann Perin**
> Gesellschaft fuer Anlagen und Reaktorsicherheit (GRS) mbH, Germany
>
> **Kostadin Ivanov**
> North Carolina State University, USA

Secretariat: **Oliver Buss**
OECD/Nuclear Energy Agency, France

Proposed Program of the Meeting

The proposed program was drawn up by the Program Committee and is enclosed as Annex 1.

Language of the Benchmark Workshop

The official language of the Rostov2-6 meeting is English.

Proceedings of the Meeting

A summary of the Rostov2-6 meeting will be published by the program committee after the meeting. The summary will be distributed free of charge to the participants in the meeting. The presentations will be available free of charge to the participants to download from participants' restricted area after the Rostov2-6 meeting.

Contacts and Registrations

The annual benchmark workshops/meetings of the Working Party on Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS) and CTF UG Meeting and Training will be hosted by NINE S.r.l. in Lucca (Italy). The meetings will take place in three tracks in parallel during the week of May 19 to May 23, 2024, in conjunction with the international BEPU-2024 conference, to exchange our results and lessons-learned for the different WPRS benchmark activities and to discuss future activities.

The link to registration page for the WPRS-related workshops/meetings including CTF-10 registration, and overall program is:

https://www.oecd-nea.org/jcms/pl_89133/wprs-benchmarks-workshops-2024

In addition, there is a link to registration form for the CTF-10 UG Meeting and Training is at the NCSU/RDFMG website:

https://www.ne.ncsu.edu/rdfmg/cobra-tf/tenth-ctf-user-group-ug-meeting-and-training/

Workshop Location

The meeting place/venue for the BEPU-2024 conference and the WPRS meetings/workshops including CTF-10 UG Meeting and Training during the week of May 19 to May 23, 2024 is the Real Collegio, which is located inside the city walls of Lucca. The local information for transportation and hotels is given at:

https://www.nineeng.com/bepu2024/index.php/conference-info/about-the-conference

The schedule for the incoming WPRS Workshops, SINUS-2 school and CTF-10 Meeting and Training is given in the table below (all times in CEST):

The program and schedule of the meetings is shown below:

Sunday, 19 May 2024	9:00-13:00	CTF UG Training		
	14:00-18:00	CTF UG Meeting		
	Starting at 18:00	Registration & informal networking		
		Track 1	**Track 2**	**Track 3 (SINUS)**
Monday, 20 May 2024	Starting at 8:00	Registration		

	9:00-13:00	Lead-cooled Fast Reactor Benchmark (LFR) - T/H Stage	FHR - Fluoride High Temperature Reactor Benchmark	OECD NEA International School on Simulation of Nuclear Reactor Systems (SINUS)
	14:00-18:00	Lead-cooled Fast Reactor Benchmark (LFR) - Neutronics Stage	Rostov-2 VVER-1000 Benchmark	SINUS
Tuesday, 21 May 2024	9:00-13:00	Uncertainty Analysis in Modelling (UAM) for Design, Operation and Safety Analysis of Sodium-cooled Fast Reactors (SFR-UAM)	C5G7-TD: The Deterministic Time-Dependent Neutron Transport Benchmark C5G7-TD without Spatial Homogenization	SINUS
	14:00-18:00	SFR UAM	Multi-physics Pellet Cladding Mechanical Interaction Validation (MPCMIV) Benchmark	SINUS

ANNEX 1

OECD/NEA Rostov-2 VVER-1000 Multi-Physics Transient Benchmark - Sixth Workshop (Rostov2-6)

Host Organization
Hosted by N.IN.E. (Nuclear and Industrial Engineering), Italy
Lucca, Italy

May 20, 2024 (track 2 afternoon)
14:00 h – 18:00 h

PROPOSED PROGRAM

R01-10: Session code

May 20, 2020 (track 2 afternoon)

R01.   Introduction and opening remarks.

R02.   Overview and status of benchmark activities.

R03.   Discussion of the updated Specifications and templates for submitting participants' results.

R04.   Presentation of updated experimental and measured data.

R05.   Presentation of updated support data and cross-section libraries.

R06.   Discussion of missing information and needed clarifications in the benchmark specifications.

R07.   Presentation and discussion of preliminary, and support studies.

R08.   Presentations of reference analyses.

R09.   Participants' presentations on their modelling and results for the exercises of Phases I and II of the Rostov-2 benchmark.

R10.   Participants' presentations on their modelling and results of VVER-1000 multi-physics transient calculations.

R11.   Action items and schedule of benchmark activities - next workshop and plans.

R12.   Conclusions and closing remarks.