Organisation for Economic Co-operation and Development

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Tenth OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD) Benchmark Workshop (C5G7-TD-10)

2 July 2025
Department of Engineering of the University of Cambridge, Trumpington Street, CB2 1PZ, Cambridge, United Kingdom

The workshop will be held in Cambridge, UK, as part of the Benchmarks Workshops of the Working Party on Scientific Issues and Uncertainty of Reactor Systems (WPRS). The WPRS Benchmarks Workshops event with three parallel tracks combines benchmarking efforts in common areas such as neutronics, thermal-hydraulics, and multi-physics modelling and uncertainty analysis.

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Sponsorship

The 10th workshop for the OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD) benchmark – C5G7-TD-10 – will be held on 2 July 2025 in Cambridge, UK, as part of the Benchmarks Workshops Event of the Working Party on Scientific Issues and Uncertainty of Reactor Systems (WPRS). This event with three parallel tracks combines benchmarking efforts in common areas such as neutronics, thermal-hydraulics, and multi-physics modelling and uncertainty analysis. The full schedule for the incoming WPRS Workshops, SINUS-3 school and CTF-11 Meeting and Training is given on the public meeting web page: https://www.oecd-nea.org/jcms/pl_98752/wprs-benchmarks-workshops-2025

Executive Summary

The objective of the workshop is to define, refine, conduct, and summarize the OECD/NEA Time-Dependent Neutron Transport Benchmark without Spatial Homogenization – C5G7-TD. This benchmark was proposed to the Expert Group on Radiation Transport and Shielding (EGRTS) and has been approved by the NSC WPRS in the meeting in February 2015. The benchmark team led by NCSU is reporting the progress on benchmark activities to the Expert Group on Physics of Reactor Systems (EGPRS), Expert Group on Reactor Core Thermal-Hydraulics and Mechanics (EGTHM), and the Expert Group on Multi-Physics of Reactor Systems (EGMUP) of WPRS, NSC. The C5G7-TD benchmark was established to develop a series of well-defined exercises to test and verify the standalone neutron transport and coupled multi-physics simulation capabilities for light water reactor (LWR) applications. The targeted solution methods in this benchmark do not utilize spatial homogenization above the fuel pin level, i.e., pin-averaged or pin-resolved methods in reactor physics and sub-channel-based methods in thermal-hydraulics simulation. There are three phases planned for this benchmark:

- Phase I (Kinetics Phase): verification of methods and codes for heterogeneous time-dependent neutron transport calculations without feedback
  - Part A: Cartesian geometry exercises
  - Part B: Neutron noise analysis
  - Part C: Hexagonal geometry exercises
- Phase II (Dynamics Phase): verification of methods and codes for heterogeneous time-dependent neutron transport calculations with feedback
  - Part II-1: Prompt feedback
  - Part II-2: Complete feedback
- Phase III (High-fidelity Phase): uncertainty propagation in high-fidelity multi-physics calculations

In Phase I, both Part A and Part B are based on the well-established steady-state C5G7 benchmark problem in Cartesian geometry, while Part C is designed to address the hexagonal core configuration. The specifications of Part A and B have been finalized, and that for Part C have been expanded and will be discussed at the workshop. The summary report of Part A has been finalized,

and the final version is posted on the benchmark SharePoint.
The cases in Phase II-1 have been defined and are currently being refined according to the feedback from participants. Specifications for Phase II-1 have been updated on the benchmark SharePoint. Results have been submitted by the participants and are being analyzed. Phase II-2 specification (complete feedback) is being further developed and will be finalized after this workshop.
Scoping studies are being carried out by NCSU to obtain preliminary results and develop the specification for cases in Phase III. Discussions at the workshop will focus on making a work plan to conduct Phase III.
More information and supporting documents are available on the benchmark website.

Scope and Technical Content of the Meeting

The topics to be addressed at the workshop include:

- Final report and conclusions on Phase I-A;
- Comparative analysis of submitted results for Phase I-B;
- Discussion on the final benchmark specifications for Phase I-C, as well as received comments, suggestions, and corrections;
- Corrections to Phase II-1 specifications;
- Finalization of draft the specification of Phase II-2, including new data libraries and functions prepared for it;
- Discussion of reference results for benchmark cases for Phase II;
- Discussion of final templates and methods for submission of participants' results for Phase II;
- Comparative analysis of submitted results for Phase II;
- Discussion of Phase III exercises and preliminary results;
- Presentations on participants' experience and expertise in time-dependent neutron transport calculations;
- Presentations on participants' experience and expertise in high-fidelity dynamics calculations;
- Defining a work plan and schedule outlining actions to progress on the benchmark activities.

The proposed meeting program is attached as Annex 1.

Organization of the Meeting:

The meeting is organized around the discussion in depth of the benchmark specifications, templates for submission of participants' results, reference solutions, and a proposed work plan and time schedule for the OECD/NEA C5G7-TD benchmark activities. The participants are requested to present their modelling and results, as well as their experience and expertise in time-dependent neutron transport analysis.

Participation in the Meeting

Meeting participation is not restricted. Benchmark 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. The benchmark NDA form can be found at:

https://www.oecd-nea.org/upload/docs/application/pdf/2024-10/c5g7-td-conditions_for_release_v3_2024-10-04_15-40-15_749.pdf

Organization and Program Committee of the Meeting

An Organization and Program Committee has been nominated to make the necessary arrangements for the C5G7-TD-10 workshop and to draw up the final program, etc.
The members of the Program Committee are:

Jason Hou – Co-Chair and Coordinator
North Carolina State University, USA
Maria Avramova – Co-Chair
North Carolina State University, USA
NEA Technical 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 workshop is English.

Proceedings of the Meeting

The program committee and the session Chairs will prepare a summary report on the main results of the meeting. Presentations will be available free of charge to the benchmark participants to download from participants' restricted area of the benchmark website after the workshop.

Contacts and Registrations

Link to the registration page for the WPRS-related workshops and meetings and the overall program:
https://www.oecd-nea.org/jcms/pl_98752/wprs-benchmarks-workshops-2025

Workshop Location

The meeting place/venue for the meetings/workshops during the week of 30 June to 4 July 2025 is the Department of Engineering of the University of Cambridge:

Trumpington Street, CB2 1PZ, Cambridge, United Kingdom.

Annex 1:

10th workshop for the OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD) – C5G7-TD-10

Host Organization
Department of Engineering of the University of Cambridge in collaboration with the Cambridge Nuclear Energy Centre, University of Cambridge, United Kingdom

2 July 2025

PROPOSED PROGRAM

C01. Introduction and opening remarks

C02. Overview of benchmark activities

C03. Presentations on related activities

C04. Overview of Phase I-A summary report

C05. Discussion of Phase I-C specification and cross section data

C06. Discussion of the final Specifications for Phase II-1

C07. Participants' presentations on their modelling and results for time-dependent neutron transport calculations

C08. Discussion of the draft Specifications and preliminary results for Phase II-2

C09. Discussion of the selected dynamics test problems and requested output for Phase II-2

C10. Participants' presentations on their expertise and experience in high-fidelity dynamics modelling and results

C11. Planning of Phase III strategies

C12. Action items and schedule of benchmark activities - next workshop (C5G7-TD-11) and plans

C13. Conclusions and closing remarks