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NEA/NSC/DOC(2016)10

Organisation de Coopération et de Développement Économiques
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21-Mar-2016

English - Or. English

**NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE**

NEA/NSC/DOC(2016)10
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**OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark
without Spatial Homogenization (C5G7-TD) – First Workshop (C5G7-TD-1)**

PROPOSED PROGRAMME

**May 31, 2016
Paul Scherrer Institut (PSI)
Switzerland**

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JT03392399

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English - Or. English

OECD Nuclear Energy Agency

Nuclear Science Committee

OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD) – First Workshop (C5G7-TD-1)

Villigen, Switzerland

May 31, 2016

**Hosted by the Paul Scherrer Institut (PSI)
Switzerland**

PROPOSED PROGRAMME

Sponsorship

The 1st workshop for the OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD) – C5G7-TD-1 will be held on May 31, 2016 in Villigen, Switzerland, and will be hosted by Paul Scherrer Institut (PSI).

Increasing efforts have been made to the development of codes for transient calculations of nuclear reactors in recent years. In order to ensure reliable modelling of neutron physics within a State-of-the-art transient code, the neutron kinetics part of such a code should be based on the full-scale calculation of the space-time neutron kinetics equations without use of the diffusion approximation and spatial homogenization. Such advanced approaches require the verification of neutron kinetics program modules through the cross-verification of codes, which are used to calculate thoroughly defined test cases, or the benchmarks.

However, existing benchmark problems are not able to satisfy the demand for verifying codes/methods for performing the homogenization-free time-dependent transport calculations. On one hand, some of them are simplified diffusion benchmarks, in which the computational domain is composed of several homogeneous regions. On the other hand, some of them have a broad range of sources of uncertainties involved in the calculation, such as the nuclear data, group cross-section preparation procedure, and potentially other computational simplifications, making it difficult to reveal methodical errors of space-time neutron kinetics codes.

The main objective of this benchmark is to specify a series of space-time neutron kinetics test problems with heterogeneous domain description for solving the time-dependent group neutron transport equation without feedbacks. Physical materials in these benchmarks are described by transport macroscopic cross sections. Such benchmarks would allow carrying out verification of developed deterministic codes and rigorously revealing methodical errors. Moreover, such benchmarks would allow studying possible inaccuracy of spatial homogenization and diffusion approximation in time-dependent cases.

In February 2015, this benchmark was proposed at the fifth meeting of Expert Group on Radiation Transport and Shielding (EGRTS) and has been approved by Nuclear Science Committee (NSC) Working Party on Scientific Issues in Reactor Systems (WPRS) in the twelfth meeting (WPRS-12).

This workshop (C5G7-TD-1) will be held in conjunction with other meetings, in order to facilitate co-ordination and sharing of work. Five other meetings are being held in Villigen, Switzerland, during the same week in order to combine efforts in common areas such as neutronics, thermal-hydraulics, multi-physics modelling and uncertainty analysis and to make the participation more efficient. The meetings concerned are:

- *May 30-31, 2016* - Fifth OECD/NRC Oskarshamn-2 BWR Stability Benchmark for Coupled Code Calculations and Uncertainty Analysis in Modelling benchmark workshop (O2-5)
- *May 30-31 (morning), 2016* - AER Working Group D meeting (VVER dynamics and safety)
- *June 1-3, 2016* – Tenth OECD/NEA Light Water Reactor (LWR) Uncertainty Analysis in Modelling (UAM) benchmark workshop (UAM-10)
- *June 1-2 (morning), 2016* - Third COBRA-TF User's Group Meeting (CTF-3) meeting
- *June 2 (afternoon) -3, 2016* - Second OECD/NEA Sodium Fast Reactor (SFR) Uncertainty Analysis in Modelling (UAM) benchmark meeting (SFR-UAM-2)

Background and Purpose of the Benchmark Workshop

The objective of the work is to define, conduct, and summarise an OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization benchmark – C5G7-TD. The current benchmark model is based on the well-studied steady-state C5G7 benchmark problems, which were developed to test the capabilities of radiation transport codes that do not utilize spatial homogenization above the fuel pin level. It is a miniature light water reactor (LWR) with sixteen fuel assemblies (mini-core): eight uranium oxide (UO₂) assemblies and eight mixed oxide (MOX) assemblies, surrounded by a water reflector. It features a quarter-core radial symmetry in the 2-dimensional (2-D) configuration.

There are two sets of exercises considered in this problem. The first set, including three exercises, is focused on the 2-D configuration of the C5G7 core. The second set, including two exercises, is with regard to the 3-D C5G7 configuration.

Draft specification document entitled “Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD)” has been prepared and distributed for comments and corrections. The detailed perturbation law of each exercise is described in the specification. Accurate multi-group Monte Carlo reference solutions will be obtained for all configurations.

After the completion of the proposed kinetics benchmark it will be extended to more realistic dynamics benchmark, which will take into account the thermal-hydraulic feedback mechanisms.

Scope and Technical Content of the Benchmark Workshop

The technical topics to be addressed at the workshop include:

- a) Discussion of the benchmark specifications, and received comments, suggestions and corrections;
- b) Finalization of specifications;

- c) Discussion and finalization of templates for submission of participants' results;
- d) Discussion of deterministic and Monte Carlo modelling for benchmark cases;
- e) Discussion of reference results for benchmark cases;
- f) Presentations on participants' experience and expertise in time-dependent neutron transport calculations;
- g) Discussion of the extension of kinetics benchmark cases to dynamics benchmark cases;
- h) Defining a work plan and schedule outlining actions to progress on the benchmark activities.

Organization of the Benchmark Workshop

The meeting is organised around the discussion in depth of the benchmark specifications, templates for submission of participants' results, reference solutions, and 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 Benchmark Workshop

For Benchmark Workshops sponsored by the Nuclear Science Committee (NSC), participation is restricted, for efficiency, to participants in this study and to experts (research laboratories, safety authorities, regulatory agencies, utilities, owners' groups, vendors, etc.) from OECD/NEA member countries nominated by Delegates to the Committee in consultation with official authorities concerned and with the assistance of members of the Nuclear Science Committee.

Organisation and Programme Committee of the Benchmark Workshop

An Organisation and Programme Committee has been nominated to make the necessary arrangements for the 1st Benchmark Workshop and to organize the Sessions, draw up the final programme, appoint Session Chairmen, etc. The members of the Programme Committee are:

Victor F. Boyarinov - Co-Chair and Co-ordinator

National Research Centre "kurchatov Institute", Russian Federation

Stefano Canera - Local Co-Chair

Paul Scherrer Institut, Switzerland

Jason Hou - Co-ordinator

North Carolina State University, USA

Kostadin N. Ivanov - Co-ordinator

North Carolina State University, USA

Kiril Velkov

Gesellschaft fuer Anlagen und Reactorsicherheit mbH, Germany

Tom Downar

University of Michigan, USA

Andreas Pautz

Paul Scherrer Institut, Switzerland

Secretariat: **Jim Gulliford**
Yukio Nakahara

OECD/Nuclear Energy Agency, France

Proposed Programme of the Benchmark Workshop

The proposed programme for the 1st OECD/NEA C5G7-TD Benchmark Workshop (C5G7-TD-1) was drawn-up by the Programme Committee and is enclosed as **Appendix 1**.

Language of the Benchmark Workshop

The official language of the 1st C5G7-TD Benchmark Workshop is English.

Proceedings of the Workshop

A summary of the workshop will be published by the OECD/NEA after the meeting. The summary will be distributed free of charge to the participants in the workshop and to Delegates of the NSC. The programme committee and the session Chairmen will prepare a summary report on the main results of the meeting for presentation to the NSC. Presentations will be available free of charge to the participants to download from participants' restricted area after the workshop.

Contacts and Registrations

A common registrations webpage is made available for the participants to UAM-10, O2-5, AER-D, CTF-3, C5-G7-TD, and SFR-UAM-2 workshops: <http://www.oecd-nea.org/confdb/confdb/conf?id=209>.

Inquiries about registrations can be directed to:

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Workshop Location

The meeting place for the six workshops during the week of May 30-June 3, 2016 is the Paul Scherrer Institut (PSI) in Villigen, Switzerland. The information for local organisation (including hotels) is provided at the following PSI web-site: <https://www.psi.ch/lrs/wprs-workshops-2016>.

The programme and schedule of the meetings is shown below:



2016 International meetings/workshops hosted by PSI
draft as of 08.02.16

	May				June					
	30		31		1		2		3	
Morning	O2-5	AER	O2-5	AER	LWR UAM	COBRA UGM OHSa	LWR UAM	COBRA UGM	LWR UAM	SFR UAM
Lunch	Lunch OASE		Lunch OASE		Lunch OASE		Lunch OASE		Lunch OASE	
Afternoon	O2-5	AER	O2-5	C5- G7-TD	LWR UAM	COBRA UGM	LWR UAM	SFR UAM	LWR UAM	SFR UAM
				Social Event						

Workshop / Meeting

O2-5	Oskarshamn Stability 5th Workshop
AER	AER Working Group D meeting (VVER Dynamics and Safety)
LWR UAM	Contacts OECD/NEA LWR Uncertainty Analysis in Modelling (UAM)-10 benchmark workshop
C5-G7-TD	1st OECD/NEA Time-Dependent Neutron Transport (C5-G7-TD) benchmark meeting
COBRA UGM	Third COBRA-TF User's Group Meeting (CTF-3) meeting
SFR UAM	OECD/NEA Sodium Fast Reactor (SFR) - Uncertainty Analysis in Modelling (UAM) benchmark meeting (SFR-UAM)

Appendix 1

OECD/NEA Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD) – First Workshop (C5G7-TD-1)

Host Organization

Paul Scherrer Institut (PSI)
Villigen, Switzerland

May 31, 2016

PROPOSED PROGRAMME

C1-9: Session code

- C1. Introduction and opening remarks
- C2. Overview of benchmark activities
- C3. Presentations on related activities
- C4. Discussion of the draft of specifications
- C5. Discussion of the selected test problems and requested output
- C6. Discussion of reference solutions
- C7. Participants' presentations on their modelling and results for time-dependent neutron transport calculations
- C8. Action items and schedule of benchmark activities - Next workshop (C5G7-TD-2) and plans
- C9. Conclusions and closing remarks