

**OECD/NEA/NSC  
PBMR COUPLED NEUTRONICS/THERMAL HYDRAULICS TRANSIENT BENCHMARK  
THE PBMR-400 CORE DESIGN– 2<sup>nd</sup> Workshop  
(PBMRT2)**

OECD/NEA Headquarters, 12 boulevard des Iles, 92130 Issy les Moulineaux, France  
26 – 27 January 2006

**Background and Purpose of the Benchmark Workshop**

The Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and Development (OECD) has accepted, through the Nuclear Science Committee (NSC), the inclusion in its programme of the Pebble-Bed Modular Reactor (PBMR) coupled neutronics/thermal hydraulics transient benchmark problem.

The PBMR is a High-Temperature Gas-cooled Reactor (HTGR) concept, which has attracted the attention of the nuclear research and development community. The deterministic neutronics, thermal-hydraulics and transient analysis tools and methods available to design and analyse PBMRs have, in many cases, lagged behind the state of the art compared to other reactor technologies. This has motivated both the testing of existing methods for HTGRs, and the development of more accurate and efficient tools to analyse the neutronics and thermal-hydraulic behaviour for the design and safety evaluations of the PBMR. Both tasks require defining appropriate benchmarks to verify and validate the existing and new methods in computer codes.

The first workshop for the Coupled Neutronics/Thermal Hydraulics Transient Benchmark - the PBMR-400 Core Design, was held on 16<sup>th</sup> and 17<sup>th</sup> June 2005 at the OECD Headquarters in Paris, France, with the support of the Nuclear Science Committee (NSC) of the NEA of OECD and the supervision of the Working Party on Scientific Issues in Reactor Systems (WPRS).

At the 1<sup>st</sup> workshop the need for code-to-code validation in HTR methods and software were noted. The PBMR 400MW benchmark test cases were introduced in detail including the neutronic and thermal hydraulic design and data. The three steady-state cases and the six different transient cases, which are the main focus area of the benchmark, were discussed. The details of the meeting are available in NEA/NSC/DOC(2005)13. Other aspects that attracted some attention included the cross section library with leakage feedback options and the fuel temperature calculation methodology during fast reactivity insertion. Finally the future possibilities of benchmarks against experimental or plant data were explored by including presentations on the AVR and HTR-10 reactors.

An ad-hoc lunchtime meeting was also held on Tuesday 13 September 2005 (PBMRT1.5) during the M&C2005 conference in Avignon, France. At this meeting the benchmark was further promoted and specific aspects of the benchmark definition were discussed. Most of the time was spent on the cross section model to be employed and more specifically if the pre-tabulated cross sections data should be dependent on the leakage.

The second workshop is scheduled for 26 - 27 January 2006 at the OECD/NEA Headquarters, Room A, 12 boulevard des Iles, 92130 Issy les Moulineaux, France. This document contains the announcement, detailed scope and proposed agenda for the meeting.

## **Sponsorship**

The second workshop for the Coupled Neutronics/Thermal Hydraulics Transient Benchmark - the PBMR-400 Core Design, will be held on 26<sup>th</sup> and 27<sup>th</sup> January 2006 at the OECD/NEA Headquarters, Issy les Moulineaux, France, with the support of the Nuclear Science Committee (NSC) of the NEA of OECD and under the supervision of the Working Party on Scientific Issues in Reactor Systems (WPRS).

## **Scope and Technical Content of the Benchmark**

The scope of the benchmark is to establish a well defined problem, based on a common given set of cross sections, to compare methods and tools in core simulation and thermal hydraulics analysis with a specific focus on transient events through a set of multi-dimensional computational test problems.

In addition, the benchmark exercise has the following objectives:

- Establish a standard benchmark for coupled codes (neutronics/thermal-hydraulics) for PBMR design;
- Code-to-code comparison using a common cross section library – important for Verification and Validation;
- Obtain a detailed understanding of the events and the processes;
- Benefit from different approaches, understanding limitations and approximations;
- Organize a special session at conference/special issue of publication (good exposure)

## **Scope and Technical Content of the 2<sup>nd</sup> Workshop (PBMRT2)**

The focus of the second workshop is two fold,

- 1) to determine if the participants were successful to develop the PBMR 400MW models for their code systems and
- 2) to finalise the cross section library philosophy and transient case definitions.

Results from standalone calculations will be compared and discussed while others from coupled calculations will also be evaluated as part of the process to finalise the cross section library.

The workshop has the following tasks and objectives:

- Feedback from participants on Test case implementations into their codes and methods
- Show and explain updated data in the PBMR benchmark Specification document;
- Finalization of transient test case definitions;
- Present and discuss all available results of Steady-State Exercise 1 & 2 (stand-alone neutronics and thermal-hydraulics calculations)
- Present and discuss preliminary results for Steady-State Exercise 3
- Finalise the benchmark participation list
- Discuss and coordinate contributions to a PHYSOR2006 special session on the benchmark (agreement for submission has been obtained)
- Specific technical issues of the benchmark such as cross sections, correlations and formats of results;

In addition, the proposed meeting programme is attached as Annex I.

### **Participation in the Benchmark Workshop**

Participation in the Benchmark Workshop is sponsored by the Nuclear Science Committee (NSC), and is restricted, for efficiency, to experts (research laboratories, safety authorities, regulatory agencies, utilities, owners' groups, vendors, etc.) from OECD Member countries nominated by delegates to the Committees in consultation with official authorities concerned, and with the assistance of members of the Nuclear Science Committee (information about members is provided as Annex II) and in particular to participants in this study.

The meeting is open also to experts from IAEA member countries, who are in a position to provide a substantive contribution to this study. Participation of these experts will be arranged by the NEA Secretariat and it includes participants involved in the Gen-IV International Forum VHTR studies.

### **Organization and Programme Committee of the Benchmark Workshop**

An Organization and Programme Committee proposed to make the necessary arrangements for the Second Benchmark Workshop and to organize the Sessions, draw up the final programme, appoint Session Chairmen, etc. Its proposed members are:

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**Chairman**

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**The Proposed Programme of the second Benchmark Workshop**

The proposed program is included in the Annex I.

**Language of the Benchmark Workshop**

The official language of the Second Benchmark Workshop is English.

**Proceedings of the Workshop**

A summary of the Workshop will be published by the OECD after the meeting and distributed to the participants in the Workshop. The programme committee and the session chairmen will prepare a Summary Report on the main results of the meeting for presentation to the NSC. In addition, copies of presentations will be distributed free of charge to all participants at the meeting.

**Workshop Location / Local Arrangements / Transportation**

OECD/NEA Headquarters. Room A, 12 boulevard des Iles, 92130 Issy les Moulineaux, France  
(Participants are requested to have an identity card with a photograph in order to be able to enter the OECD/NEA premises.)

A map of the location, hotel accommodation and transport can be found by accessing the following Web pages <http://www.nea.fr/html/general/hotels.html> and <http://www.nea.fr/html/general/nea-access.html>

The public transportation network provides easy access from many Paris areas. For additional information check <http://www.paris.org/Metro/>.

Annex I

**OECD/NEA/NSC  
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**PROPOSED PROGRAMME**

Chairs and presentations by participants to be updated

**Day 1: 26 January 2005**

I. General Session (Chair: F. Reitsma)

1. 09:15 – 09:30 Introduction and opening remarks – introduction of participants
2. 09:30 – 09:35 Adoption of agenda
3. 09:35 – 10:20 Feedback on Benchmark Specification updates and PBMRT1.5 meeting  
10:20 – 10:45 Break

II. Feedback by all participants I (Chair: E Sartori )

4. 10:45 – 12:45 Presentations from all participants on progress and results.  
(details of participants to be added)

12:45 – 14:00 Lunch

III. Feedback by all participants II (Chair: H D Gougar)

5. 14:00 – 16:00 Presentations from all participants on progress and results.  
(details of participants to be added)

16:00 – 16:20 Break

IV. Benchmark Steady State Cases (Chair: N Z Cho)

6. 16:20 – 16:30 Summary of definitions of steady state cases
7. 16:30 – 17:00 Results of Test case 1 (K Ivanov / F Reitsma)
  - a. Summary of all results received
  - b. Comparisons
8. 17:00 – 17:30 Results of Test case 2 (K Ivanov / F Reitsma)
  - a. Summary of all results received
  - b. Comparisons

**Day 2: 27 January 2006**

V. Benchmark Steady State Cases II (Chair: M. Methnani)

9. 08:30 – 09:15 Discussions of Steady State Test Cases 1&2 (K. Ivanov)
  - a. Discussion of results / interpretation of results
  - b. Finalization of Test cases / additional work
10. 09:15 – 10:00 Discussions and Preliminary Results of Steady State Test Case 3 (F. Reitsma)

10:00 – 10:20 Break

VI. Cross section library (Chair: K. Ivanov )

11. 10:20 - 11:00 Feedback of PBMRT1.5 meeting: Discussions of leakage feedback issues
12. 11:00 – 11:30 Update of status of 3D and 5D libraries and tests performed (F. Reitsma / S. Sen)
13. 11:30 – 12:30 Discussion and finalise decision on library and leakage feedback implementation.

12:30 – 13:45 Lunch

VII. Transient cases (Chair. Han de Haas )

14. 13:45 – 14:15 Transient cases definitions (H. Gougar)
15. 14:15 – 14:40 Specific issues on transient cases (F. Reitsma)

14:40 – 15:00 Break

VIII. Discussion and closing (Chair: F. Reitsma)

16. 15:00 – 16:00 Discussion of future actions, contributions to PHYSOR2006 and schedule
17. 16:00 – 16:15 Discussion of next meeting and deliverables
18. 16:15 – 16:30 Any other business and closure of meeting

NUCLEAR SCIENCE COMMITTEE

OECD/NEA/NSC  
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26 – 27 January 2006

**PARTICIPANT REGISTRATION FORM**

To be sent as soon as possible, and by 15 January 2006, to

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Organization:

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I shall attend the Coupled Neutronics/Thermal Hydraulics Transient Benchmark - The PBMR-400 Core Design Benchmark Workshop \_\_\_\_\_

If you are attending, will you be giving a presentation on Day 1 (Presentations from participants - focus on development of PBMR model and / or results, 10-15 minutes)? \_\_\_\_\_

If yes, what is the title of this presentation and authors?

I will not attend but send me a summary \_\_\_\_\_

Additional Comments:



## Annex II

(For detailed address information please look up <http://www.nea.fr/add/>)

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