

**NUCLEAR SCIENCE COMMITTEE
and
COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS**

**OECD Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design,
Operation and Safety Analysis of LWRs - Second Workshop (UAM-2)**

Gesellschaft für Anlagen und Reaktorsicherheit (GRS) mbH, Garching, Germany

2-4 April 2008

**Hosted by
GRS mbH
Germany**

PROPOSED PROGRAMME

OECD Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs - Second Workshop (UAM-2)

**Garching, Germany
2-4 April 2008**

Sponsorship

The second workshop for the OECD Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs (UAM-2) will be held from 2 to 4 April 2008 in Garching, Germany, and is a follow up to the first workshop. The first workshop for the OECD UAM LWR benchmark (UAM-1) was held on 10 and 11 May 2007 at the OECD/NEA Headquarters, Issy-les-Moulineaux, France.

In recent years there has been an increasing demand from nuclear research, industry, safety and regulation for best estimate predictions to be provided with their confidence bounds. Consequently an "in-depth" discussion on "Uncertainty Analysis in Modelling" was organized at the 2005 OECD/NEA Nuclear Science Committee (NSC) meetings, which led to a proposal for launching an Expert Group on "Uncertainty Analysis in Modelling" and the endorsement to hold a workshop with the aim of defining: future actions and a program of work.

As a result the OECD/NEA Workshop on Uncertainty Analysis in Modelling took place in Pisa, Italy, on April 28-29, 2006 (UAM-2006). The major outcome of the workshop was to prepare a benchmark work program with steps (exercises) that would be needed to define the uncertainty and modelling task. The other proposals made during the meeting would be incorporated under the different steps (exercises) within the overall benchmark framework for the development of uncertainty analysis methodologies for multi-physics (coupled) and multi-scale simulations.

Following the results from the UAM-2006 Workshop the OECD/NEA Nuclear Science Committee at its June 2006 meeting endorsed the creation of an Expert Group on Uncertainty Analysis methods in Modelling. This Expert Group will report to the Working Party on Scientific issues in Reactor Systems (WPRS). Since it addresses multi-scale / multi-physics aspects of uncertainty analysis, it will work in close co-ordination with the benchmark groups on coupled neutronics-thermal-hydraulics simulations and on coupled core-plant problems. The Expert Group will also coordinate its activities with the Group on Analysis and Management of Accidents (GAMA) of the Committee on Safety of Nuclear Installations (CSNI). The Expert Group has the following mandate:

1. To elaborate a state-of-the-art report on current status and needs of sensitivity and uncertainty analysis (SA/UA) in modelling, with emphasis on multi-physics (coupled) and multi-scale simulations.
2. To identify the opportunities for international co-operation in the uncertainty analysis area that would benefit from coordination by the NEA/NSC.
3. To create a roadmap along with schedule and organization for the development and validation of methods and codes required for uncertainty analysis including the benchmarks adequate to meet those goals.

The NEA/NSC has endorsed that this activity be undertaken with PSU as the main coordinator and host with the assistance of the Scientific Board. The 40 participants in the UAM workshop in Pisa (from 26 organizations in 16 countries representing industry, regulatory agencies, national laboratories and research institutions) expressed interest in participating and contributing to this UAM Expert Group and proposed an uncertainty analysis benchmark activity.

To summarize, in addition to LWR best-estimate calculations for design and safety analysis, the different aspects of uncertainty analysis in modelling (UAM) are to be further developed and validated on scientific grounds in support of its performance. There is a need for efficient and powerful analysis methods suitable for such complex coupled multi-physics and multi-scale simulations. The proposed benchmark sequence will address this need by integrating the expertise in reactor physics, thermal-hydraulics and reactor system modelling as well as uncertainty and sensitivity analysis, and will contribute to the development and assessment of advanced/optimized uncertainty methods for use in best-estimate reactor simulations. Such an effort can be undertaken within the framework of a program of international co-operation that would benefit from the coordination of the NEA/NSC and all participants by interfacing with the CSNI activities.

This workshop (UAM-2) will be held in conjunction with other meetings, in order to facilitate co-ordination and sharing of work. Two other meetings are being held during the same week in order to combine efforts in common areas such as computational fluid dynamics (CFD) modelling and uncertainty analysis and to make participation more efficient. The meetings concerned are the fifth workshop for the OECD/NRC Benchmark based on NUPEC BWR Full-size Fine-mesh Bundle Tests (BFBT-5), scheduled for 31 March and 1 April 2008; in parallel with the BFBT-5 workshop also the annual meeting of the Working Group D involved in VVER reactor dynamics and safety research is being held at the same premises. For further details concerning this meeting please contact Soeren Kliem at s.kliem@fzd.de.

Background and Purpose of the Benchmark Workshop

The objective of the work is to define, conduct, and summarize an OECD benchmark for uncertainty analysis in best-estimate coupled code calculations for design, operation, and safety analysis of LWRs. The title of this benchmark is: “**OECD UAM LWR Benchmark**”. Reference systems and scenarios for coupled code analysis are defined to study the uncertainty effects for all stages of the system calculations. Measured data from plant operation are available for the chosen scenarios.

The proposed technical approach is to establish a benchmark for uncertainty analysis in best-estimate modelling and coupled multi-physics and multi-scale LWR analysis, using as bases a series of well defined problems with complete sets of input specifications and reference experimental data. The objective is to determine the uncertainty in LWR system calculations at all stages of a coupled reactor physics/thermal hydraulics calculation. The full chain of uncertainty propagation from basic data, engineering uncertainties, across different scales (multi-scale), and physics phenomena (multi-physics) are tested on a number of benchmark exercises for which experimental data are available and for which the power plant details have been released. The principal idea is: a) to subdivide the complex system/scenario into several steps or Exercises, each of which can contribute to the total uncertainty of the final coupled system calculation, b) to identify input, output, and assumptions for each step, c) to calculate the resulting uncertainty in each step; d) to propagate the uncertainties in an integral systems simulation for which high quality plant experimental data exists for the total assessment of the overall computer code uncertainty. The main scope covers uncertainty (and sensitivity) analysis (SA/UA) in best estimate modelling for design and operation of LWRs, including methods that are used for safety evaluations. As part of this effort, the development and assessment of different methods or techniques to account for the uncertainties in the calculations will be investigated and reported to the participants.

The general frame of the OECD LWR UAM benchmark consists of three phases with three exercises for each phase:

Phase I (Neutronics Phase)

- Exercise 1 (I-1): “Cell Physics” focused on the derivation of the multi-group microscopic cross-section libraries

- Exercise 2 (I-2): “Lattice Physics” focused on the derivation of the few-group macroscopic cross-section libraries
- Exercise 3 (I-3): “Core Physics” focused on the core steady state stand-alone neutronics calculations

Phase II (Core Phase)

- Exercise II-1: Fuel thermal properties relevant for transient performance
- Exercise II-2: Neutron kinetics stand-alone performance (kinetics data, space-time dependence treatment, etc.)
- Exercise II-3: Thermal-hydraulic fuel bundle performance

Phase III (System Phase)

- Exercise III-1: Coupled neutronics/thermal-hydraulics core performance (coupled steady state, coupled depletion, and coupled core transient with boundary conditions)
- Exercise III-2: Thermal-hydraulics system performance
- Exercise III-3: Coupled neutronics kinetics thermal-hydraulic core/thermal-hydraulic system performance

The expected impact and benefits of the OECD LWR UAM benchmark activity for LWR safety and licensing are summarized in “Technology Relevance of the Uncertainty Analysis in Modelling. Project for Nuclear Reactor Safety”, NEA/NSC/DOC(2007)15. This benchmark project is challenging and responds to needs of estimating confidence bounds for results from simulations and analysis in real applications. Separate Specifications will be prepared for each Phase in order to allow participation in the full Phase or only in a subset of the Exercises. Boundary conditions and necessary input information are provided by the benchmark team. The intention is to follow the calculation scheme for coupled calculations for LWR design and safety analysis established in the nuclear power generation industry and regulation. The specification document that covers Phase I (which includes the first 3 Exercises) was distributed to the participants - “Benchmark for Uncertainty Analysis in Modelling (UAM) for Design, Operation and Safety Analysis of LWRs. Volume 1 – Specification and Supporting Data for the Neutronics Cases (Phase I) Version 1.0”, NEA/NSC/DOC(2007)23.

Scope and Technical Content of the Benchmark Workshop

The technical topics to be addressed at the workshop include:

- Review of the benchmark activities after the UAM-1 Workshop
- Discussion of the Specification for the Phase I of the UAM LWR benchmark
- Discussion of preliminary results of Phase I
- Discussion of output parameters and format for Phase II
- Discussion of the Priorities for Phases II and III.
- Presentations on participants’ experience and expertise in uncertainty and sensitivity analysis of LWRs
- Defining a work plan and schedule outlining actions to progress on the three phases of the benchmark activities

The proposed workshop programme is attached as Annex 1.

Organization of the Benchmark Workshop

The meeting is organized around the discussion in depth of the specification and support data for Phase I of the UAM LWR benchmark, preliminary results of Phase I, output parameters and format for Phase II, priorities for Phases II and III, and the proposed work plan and time schedule for the UAM LWR benchmark activities. The participants are requested to present their experience and expertise in uncertainty and sensitivity analysis of LWRs.

Participation in the Benchmark Workshop

For Benchmark Workshops sponsored by the Nuclear Science Committee (NSC) and Committee on the Safety of Nuclear Installations (CSNI), 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 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 and the Committee on the Safety of Nuclear Installations (information about members are provided as Annex 3 and 4).

Organization and Programme Committee of the Benchmark Workshop

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

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Proposed Programme of the Benchmark Workshop

The proposed programme was drawn up by the Programme Committee and is enclosed as Annex 1

Language of the Benchmark Workshop

The official language of the Fourth 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 and CSNI. The programme committee and the session chairmen will prepare a Summary Report on the main results of the meeting for presentation to the NSC and CSNI. In addition, copies of presentations will be distributed free of charge to all participants at the meeting.

Workshop Location

Offices of GRS in research area Garching, Germany.

Local Arrangements

The organisers propose accommodation at two hotels one of them located at Garching and the other located in Munich. Meanwhile a direct Metro connection exists between the research area, the hotel in Garching and Munich.. A registration form for the series of workshops and accommodation can be found as Annex 2.

Other Hotels

Internet sites for information on the location and other hotels are www.garching.de or www.muenchen.de

Transportation

A map showing the location of GRS offices in the research area Garching is available at www.grs.de When arriving at the airport participants should take a taxi to reach the GRS offices or if they have chosen the hotel in Garching.

Annex 1

OECD Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs - Second Workshop (UAM-2)

Hosted by
GRS mbH, Garching
April 2-4 2008

PROPOSED PROGRAMME

Day 1: 2 April 2008

1. Introduction and opening remarks
2. Overview and status of benchmark activities
3. Technology relevance of the Uncertainty Analysis in Modelling.
4. Overview of Specification for Phase I
5. Discussion in depth of the definition for Exercise 1 of Phase I (I-1) - Cell Physics
6. Discussion of the covariance data and tools distributed for the Exercise I-1
7. Discussion of the selected test problems for Exercise I-1
8. Discussion of requested output for Exercise I-1
9. Presentation and discussion of preliminary results on Exercises I-1
10. Participants' presentations on their expertise and experience relative to Exercise I-1 - sensitivity and uncertainty analysis on the derivation of the multi-group microscopic cross-section libraries

Day 2: 3 April 2008

11. In depth discussion of the definition for Exercise 2 of Phase I (I-2) - Lattice Physics
12. Discussion about the data and tools applicable to Exercise I-2
13. Discussion on the selected test problems for Exercise I-2
14. Discussion on requested output for Exercise I-2
15. Presentation and discussion of preliminary results on Exercises I-2
16. Participants' presentations on their expertise and experience relative to Exercise I-2 - sensitivity and uncertainty analysis on the derivation of the few-group macroscopic cross-section libraries

17. In depth discussion of the definition for Exercise 3 of Phase I (I-3) - Core Physics
18. Discussion on the data and tools applicable to Exercise I-3
19. Discussion on the selected test problems for Exercise I-3
20. Discussion on requested output for Exercise I-3

Day 3: 4 April 2008

21. Presentation and discussion of preliminary results on Exercises I-3
22. Participants' presentations on their expertise and experience relative to Exercise I-3 - sensitivity and uncertainty analysis on the core steady state stand-alone neutronics calculations
23. Discussion on the priorities for Phases II and III
24. Discussion on output parameters and format for Phase II
25. Discussion on general Specification and support data for Phase II
26. Discussion on output parameters and format for Phase III
27. Discussion on general Specification and support data for Phase III
28. Participants' presentations on their experience and expertise in uncertainty and sensitivity analysis of LWRs relative to Phases II and III.
29. Action items and schedule of benchmark activities - next workshop (UAM-3) and plans
30. Conclusions and closing remarks

Annex 2

OECD/NEA Workshops in Garching

Host Organization
Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH, Germany
31 March 2008 - 4 April 2008

PARTICIPATION AND HOTEL REGISTRATION FORM

Even if you attend more than one of the following workshops (BFBT-5, AER-WG-D-2008, UAM-2), please send only one form as soon as possible, and in any case not later than 29 February, 2008, both to:

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If you are attending the **AER Working Group D** meeting please send a copy also to Soeren Kliem at s.kliem@fzd.de.

Name:

Company or organization:

Address:

E-mail:

Tel:

Fax:

I need an invitation from the organisers to obtain a **visa** to enter Germany (Yes/No)

Please fill in the following table:

Workshop / Date /Contact Person	Attendance / Presentations / Comments - Requests
Fifth workshop of the OECD/NRC Benchmark based on NUPEC BWR - Full-size Fine-mesh Bundle Tests (BFBT) - (BFBT-5) March 31 – April 1	Will you attend BFBT-5?
	If so, will you be giving a presentation?
	Please specify titles, authors, and sessions for the presentation(s)
	I shall not attend but send me the summary. (Yes – No)
Second workshop for the OECD Uncertainty Analysis in Modelling (UAM) Light Water Reactor (LWR) benchmark - (UAM-2) April 2-4	Will you attend the UAM-2?
	If so, will you be giving a presentation?
	Please specify titles, authors, and sessions for the presentation(s)
	I shall not attend but send me the summary. (Yes – No)

Workshop / Date /Contact Person	Attendance / Presentations / Comments - Requests
AER Working Group D Workshop (VVER Dynamics and Safety) March 31 – April 1 to be sent to s.kliem@fzd.d	Will you attend the AER workshop?
	If so, will you be giving a presentation?
	Please specify titles, authors, and sessions for the presentation(s)
	I shall not attend but send me the summary. (Yes – No)

Accommodation is proposed at the following hotels: a hotel in Garching and alternatively some rooms in hotels in Munich. We recommend to stay in Garching, because the availability of rooms in Munich is very limited due to international fairs. A set of **40 rooms** have been pre-reserved. The organising committee will take care of the hotel reservation. You should know that meanwhile a direct Metro connection exists between the research area, the hotel in Garching and Munich.

Do you wish to stay at a hotel in Garching (recommended) or in Munich.
 We recommend an early confirmation by 18 February, and not later than 29 February.2008.

If so, please specify the type of room, check in and check out dates:

Type of room (Single or Double):

Check in:

Check out:

Annex 3(For detailed address information please look up <http://www.nea.fr/add/>)

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NEA/NSC/DOC(2008)3

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