OECD Nuclear Energy Agency

Nuclear Science Committee
and
Committee on the Safety of Nuclear Installations

OECD/NEA Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs - Twelfth Workshop (LWR-UAM-12) and of SFRs – Fourth Workshop (SFR-UAM-4)

Lucca, Italy
May 14-18, 2018

in conjunction with BEPU-2018 conference on multi-physics and multi-scale simulations with uncertainty

Hosted by NINE S.r.l.
Italy

PROPOSED PROGRAMME

Sponsorship

The 12th workshop for the OECD/NEA Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs (LWR-UAM-12) will be held from May 16-17, 2018 in Lucca, Italy, and is a follow up to the previous eleven workshops. The 4th workshop for the OECD/NEA Benchmark for UAM for Design, Operation and Safety Analysis of SFRs (SFR-UAM-4) will be held from May 14-15, 2018 in the same place i.e. Lucca, Italy. There are annual benchmark workshops, which are attended by many experts in industry, research institutes, national laboratories, academia, and government agencies. Both benchmark activities are under the auspices of the Expert Group on Uncertainty Analysis in Modelling (EGUAM), which reports to the Working Party on Scientific issues of Reactor Systems (WPRS) at the Nuclear Science Committee (NSC), OECD/NEA. Since it addresses multi-scale/multi-physics aspects of uncertainty analysis, it works in close co-ordination with the benchmark groups on coupled neutronics/thermal-hydraulics simulations and on coupled core-plant problems. The Expert Group also coordinates its activities with the Working Group on Analysis and Management of Accidents (WGAMA) of the Committee on the Safety of Nuclear Installations (CSNI). The Expert Group provides advice to the WPRS and the nuclear community on the scientific development needs (data and methods, validation experiments, scenario studies) of sensitivity and uncertainty methodology for modelling of different reactor systems and scenarios.

The OECD/NEA UAM-LWR Benchmark is an international high-visibility benchmark under EGUAM for uncertainty analysis in best-estimate coupled code calculations for design, operation, and safety analysis of LWRs. The benchmark activities are coordinated by the NCSU faculty Dr. Maria Avramova and Dr. Kostadin Ivanov in cooperation with Dr. Eric Royer from CEA, France. The main activity is focused on uncertainties in modelling LWR transients. In this context the objectives are:

a) To determine modelling uncertainties for reactor systems under steady-state and transient conditions, quantifying the impact of uncertainties for each type of calculation in the multi-physics analysis:
   - Neutronics calculations;
   - Thermal-hydraulics modelling;
   - Fuel behaviour

b) For each of these types of calculation the major sources of uncertainty are determined, arising from:
   - Data (e.g. nuclear data, geometry, materials);
   - Numerical methods;
   - Physical models.

c) To develop and test methods for combining the above sources of uncertainty for each type of calculation so as to yield uncertainty assessment for the coupled multi-physics analyses;

d) To develop a benchmark framework, that combines information from available integral facility and Nuclear Power Plant (NPP) experimental data with analytical and numerical benchmarking. Where available, experimental data will be used to test the individual types of calculation as well as coupled multi-physics simulations.

To summarise, in addition to LWR best-estimate calculations for design and safety analysis, the different aspects of 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/optimised uncertainty methods for use in best-estimate reactor simulations. Such an effort can be undertaken within the framework of a programme 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 (LWR-UAM-12) will be held in conjunction with other meetings/workshops and the BEPU-2018 conference, in order to facilitate co-ordination and sharing of work. Seven other meetings are being held in 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 14 – May 15, 2018* – Fourth OECD/NEA Sodium Fast Reactor (SFR) Uncertainty Analysis in Modelling (UAM) benchmark meeting (SFR-UAM-4);
- *May 14 – May 15 (morning), 2018* – Fifth COBRA-TF User's Group Meeting (CTF-5);
- *May 15 (afternoon), 2018* - Kick-off meeting on Blind benchmark on CANDU THermal-hydraulics (CANDU T-H);
- *May 15 – May 16, 2018* - Competence Building Program for Embarking Countries workshop (CBPEC);
- *May 16 - May 17 (afternoon), 2018* – Kick-off meeting on Multi-Physics Pellet Clad Mechanical Interaction Validation benchmark (MPCMIV);
- *May 17 (afternoon) – May 18, 2018* - Third OECD/NEA Time-Dependent Neutron Transport (C5G7-TD) benchmark meeting (C5G7-TD-3);

- *May 18, 2018* - Kick-off meeting on Rostov-2 VVER-1000 Multi-Physics benchmark (Rostov-2).

Background and Purpose of the LWR-UAM Benchmark Workshop

The objective of the work is to define, conduct, and summarise an OECD/NEA benchmark for uncertainty analysis in best-estimate coupled code calculations for design, operation, and safety analysis of LWRs. The title of this benchmark is: "LWR-UAM 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, which is composed of 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. Uncertainty propagation is being estimated through the whole simulation process – the benchmark builds a unified framework, which can be used and followed in the future. 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/NEA LWR-UAM benchmark consists of three phases with different exercises for each phase:

Phase I (Neutronics Phase)

Exercise I-1: "Cell Physics" focused on the derivation of the multi-group microscopic cross-section libraries

Exercise I-2: "Lattice Physics" focused on the derivation of the few-group macroscopic cross-section libraries

Exercise I-3: "Core Physics" focused on the core steady state stand-alone neutronics calculations

Phase II (Core Phase)

Exercise II-1: "Fuel Physics": Fuel thermal properties relevant to steady-state and transient performance

Exercise II-2: "Time-dependent Neutronics": Neutron kinetics and depletion stand-alone performance

Exercise II-3: "Bundle Thermal-Hydraulics": Thermal-hydraulic fuel bundle performance

Phase III (System Phase)

Exercise III-1: "Core Multi-Physics" - Coupled neutronics/thermal-hydraulics core performance (coupled steady state, coupled depletion, and coupled core transient with boundary conditions)

Exercise III-2: "System Thermal-Hydraulics" - Thermal-hydraulics system performance

Exercise III-3: "Coupled Core-System" - Coupled neutronics kinetics thermal-hydraulic core / thermal-hydraulic system performance

Exercise III-4: "Comparison of Best Estimate Plus Uncertainties (BEPU) vs. Conservative Calculations"

This benchmark project is challenging and responds to needs of estimating confidence bounds for results from simulations and analysis in real applications. Separate Specifications are being 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 was finalized and 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 Neutronics Cases (Phase I) Version 2.1 (Final Specifications)", NEA/NSC/DOC(2013)7. An updated version of Volume 2 - Specification and Supporting Data for the Core Cases (Phase II) Version 2.0 will be distributed to the participants by mid-March 2018. Updated version of Volume 3 Specifications and Supporting Data for the System Cases (Phase III) Version 1 will be distributed to the participants by end of March 2018.

The OECD Kalinin-3 Coupled code Benchmark and OECD/NRC Oskarshamn-2 BWR Stability Benchmark have been merged in the Phase III of LWR-UAM benchmark through their uncertainty analysis exercises (phases). Special sessions on Kalinin-3 and Oskarshamn-2 benchmarks will be included in the LWR-UAM-12 workshop.

Scope and Technical Content of the LWR-UAM Benchmark Workshop

The technical topics to be addressed at the workshop include:

- Review of the benchmark activities after the UAM-11 workshop;
- Discussion of the updated results for Exercises I-1, I-2, and I-3;
- Participants' presentations on their modelling and results for Phase I;
- Discussion of final report on comparative analysis of participants' results for Phase I;
- Discussion of the updated Specification for Phase II;
- Discussion of interactions between Phase II and Phase III;
- Discussion of the submitted results for Exercises II-1, II-2, and II-3;
- Participants' presentations on their modelling and results for Phase II;
- Discussion of the Draft Specifications for Exercise III-1 and Exercise III-2;
- Session on Kalinin-3 benchmark and the Kalinin-3 test case for Exercise III-1;
- Session on Oskarshamn-2 benchmark;
- Discussion of Draft Specification for Oskarshamn-2 test case for Exercise III-1;
- Discussions of first results for Exercise III-1;

- 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.

Organization of the LWR-UAM Benchmark Workshop

The meeting is organised around the discussion in depth of the specifications (Volumes II and III); support data for Phases II and III of the LWR-UAM benchmark, comparative analysis of submitted results for Phases I and II, output parameters and format for Phase III, priorities and draft specifications for Phase III, first results for Phase III, and the proposed work plan and time schedule for the OECD/NEA LWR-UAM benchmark activities. The participants are requested to present their modelling and results for three phases as well as their experience and expertise in uncertainty and sensitivity analysis of LWRs.

Organisation and Programme Committee of the LWR-UAM Benchmark Workshop

An Organisation and Programme Committee has been nominated to make the necessary arrangements for the Twelfth Benchmark Workshop and to organize the Sessions, draw up the final programme, appoint Session Chairmen, etc. The members of the Programme Committee (who are also members of the OECD/NEA LWR UAM Scientific Board) are:

Eric Royer – Co-Chair and Co-ordinator
Centre d'Etudes de Saclay, France

Alessandro Petruzzi - Local Co-Chair
NINE S.r.l., Italy

Maria Avramova - Co-ordinator
North Carolina State University, USA

Tomasz Kozlowski
University of Illinois, Urbana, USA
Chair of EGUAM, NSC, NEA, OECD

Francesco D'Auria
Universita degli Studi di Pisa, Italy
Member of CSNI, NEA, OECD

Kiril Velkov
Gesellschaft fuer Anlagen und Reactorsicherheit mbH, Germany

Hakim Ferroukhi
Paul Scherrer Institut, Switzerland
Co-Chair of WPRS and Chair of EGRPANS, NSC, NEA, OECD

Yoshiro Kudo
Nuclear Regulation Authority, Japan

Tom Downar
University of Michigan, USA

Soeren Kliem
Forschungszentrum Dresden-Rossendorf, Germany

Andreas Pautz
Paul Scherrer Institut, Switzerland

Member of NSC, NEA, OECD

Yassin Hassan
Texas A&M University, USA

Mark Williams
Oak Ridge National Laboratory, USA

Kostadin Ivanov - Co-ordinator
North Carolina State University, USA
Chair of WPRS, NSC, NEA, OECD

Secretariat: **Tatiana Ivanova**
Ian Hill
OECD/Nuclear Energy Agency, France

Background and Purpose of the SFR-UAM Benchmark Workshop

There is a strong incentive to design reactors with improved safety performance while preserving a sustainable source of energy at a rather low cost. The Generation IV International Forum (GIF) has defined the key research goals for advanced Sodium-cooled Fast Reactors (SFR):

- improved safety performance, specifically a demonstration of favourable transient behaviour under accident conditions;
- improved economic competitiveness;
- demonstration of flexible management of nuclear materials, in particular, waste reduction through minor actinide burning.

Sodium-cooled Fast Reactors offer the most promising type of reactors to achieve such Generation IV goals at a reasonable time scale given the experience accumulated over the years. However, it is recognized that new regulations and safety rules as they exist worldwide are requiring improved safety performance. In particular, one of the foremost GIF objectives is to design cores that can, as much as possible, passively avoid core damage when the control rods fail to scram in response to postulated accident initiators (e.g., inadvertent reactivity insertion or loss of coolant flow). The analysis of such unprotected transients depends primarily on the physical properties of the fuel and the reactivity feedback coefficients of the core.

Under the auspices of the Working Party on Scientific Issues of Reactor Systems (WPRS), an OECD/NEA sub-group on Uncertainty Analysis in Modelling (UAM) for Design, Operation and Safety Analysis of Sodium-cooled Fast Reactors (SFR-UAM) has been formed under the NSC/WPRS/EGUAM to investigate the use of best-estimate codes and data.

Recently, the International Atomic Energy Agency (IAEA) produced guidance on the use of deterministic safety analysis (DSA) for the design and licensing of nuclear power plants (NPPs): ‘‘Deterministic Safety Analysis for Nuclear Power Plants Specific Safety Guide’’. Since the early days of civil nuclear power, the conservative approach has been used and is still widely used today. However, the desire to utilize current understanding of important phenomena and to maximize the economic potential of NPPs without compromising their safety has led many countries to use best-estimate codes and data together with an evaluation of the uncertainties.

Scope and Technical Content of the SFR-UAM Benchmark Workshop

The UAM-SFR working group will have to define the grace time or the margin to melting available in the different identified accidental scenarios, apply the Best Estimate Plus Uncertainty (BEPU) methodology, and possibly recommend some changes to the design so that it meets some safety concerns.

The work is progressive to avoid possible compensating errors. Two SFR cores are being studied: a large 3,600MWth oxide core and a medium 1,000MWth metallic core [2]. In order to assess tools being used for studying these cores, various sub-exercises have been developed for neutronics with cell, sub-assembly, super-cell and core benchmarks under steady state conditions either at BOL conditions or at EOEC depending on the benchmark. A sub-assembly depletion benchmark is being set up before considering full-core calculations with depletion.

Since the objective is to define the grace period or the margin to melting available in the different accident scenarios and this within uncertainty margins, uncertainties of different origins (methods, neutronics, thermal-hydraulic, fuel behaviour) once identified and evaluated will be propagated. At first two simple Unprotected Transients over Power (UTOP) and Loss of Flow (ULOF) are proposed because they allow useful insights without need of accurate modelling of secondary loop and primary vessel (negligible impact).

Another benchmark on control rod withdrawal has been added recently and will challenge tools on a particularly difficult asymmetrical transient.

In order to ensure validity to these exercises, the sub-group incorporates some experimental validations on neutronics, thermal hydraulics, fuels and systems. This will be done with neutronic experiments from ICSBEP & IRPhE, SEFOR , thermal hydraulic experiments from THORS and system experiments with the SUPER-PHENIX start-up transient programme.

The technical topics to be addressed at the workshop include:

- Review of the benchmark activities after the SFR-UAM-4 workshop;
- Discussion of the updated results for the different core exercises;
- Participants' presentations on their modelling and results for core exercises;
- Discussion of the updated Specification for the different sub-exercises
- Participants' presentations on their modelling and results for the different sub-exercises;
- Discussions on the different sources of uncertainties including those on the fuel behaviour and the core thermal hydraulic
- Discussion of Draft Specification for uncertainties
- Participants' presentations on core characteristic uncertainties ;
- Discussion on the different experiment specifications in support to the core designs
- Participants' presentations on their modelling and results for the different experiment analyses;
- Discussions on the possible structure of the final report

Organization of the SFR-UAM Benchmark Workshop

The meeting is organised around the discussion in depth of the specifications, comparative analysis of submitted results for the different phases and the proposed work plan and time schedule for the OECD/NEA SFR-UAM benchmark activities. The participants are requested to present their modelling and results for the different phases as well as their experience and expertise in uncertainty and sensitivity analysis of SFRs.

Organisation and Programme Committee of the SFR-UAM Benchmark Workshop

An Organisation and Programme Committee has been nominated to make the necessary arrangements for the Fourth Benchmark Workshop and to organize the Sessions, draw up the final programme, appoint Session Chairmen, etc. The members of the Programme Committee (who are also members of the OECD/NEA SFR UAM Scientific Board) are:

Gerald Rimpault –Co-ordinator
Centre d'Etudes de Cadarache, France

Laurent Buiron – Co-Chair
Centre d'Etudes de Cadarache, France

Alessandro Petruzzi - Local Co-Chair
NINE, Italy

Maria Avramova
North Carolina State University, USA

Nicolas Stauff
Argonne National Laboratory, USA

Taek. K. Kim
Argonne National Laboratory, USA

T. A. Taiwo
Argonne National Laboratory, USA

Tomasz Kozlowski
University of Illinois, Urbana, USA
Chair of EGUAM, NSC, NEA, OECD

Kostadin Ivanov - Co-ordinator
North Carolina State University, USA
Chair of WPRS, NSC, NEA, OECD

Secretariat: **Tatiana Ivanova**
Ian Hill
OECD/Nuclear Energy Agency, France

Participation in the Benchmark Workshops

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/NEA 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.

Proposed Programmes of the Benchmark Workshops

The proposed programme for the 12th OECD/NEA LWR UAM Benchmark Workshop (UAM-12) was drawn-up by the Programme Committee and is enclosed as ***Appendix 1***. The proposed programme for the Fourth Sodium Fast Reactor (SFR) Uncertainty Analysis in Modelling (UAM) Benchmark Meeting (SFR-UAM-4) is attached in ***Appendix 2***.

Language of the Benchmark Workshops

The official language of the Benchmark Workshops is English.

Proceedings of the Workshops

Summaries of the workshops will be published by the OECD/NEA after the meeting. The summary will be distributed free of charge to the participants in the Workshops 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. Presentations will be available free of charge to the participants to download from participants' restricted area after the workshop.

Contacts and Registrations

The eight meetings/workshops to be held in conjunction with the BEPU-2018 conference are named WPRS Workshops and include: SFR-UAM-4, CTF-5, CANDU T-H, CBPEC, LWR-UAM-12, MPCMIV, C5G7-TD-3, and Rostov-2. There is an established the process by which those wishing to attend only the WPRS workshops/meetings (i.e. not participating in or presenting at the concurrent BEPU conference) should register to this event.

These instructions should be followed, in order to register without a conference package.

Please be aware and respect the following regarding this format of registration:

- **Dinners and lunches are not included**, and must be bought separately as desired by the individual. Coffee breaks however, will kindly be made available to all;
- This option **precludes access to any of the BEPU conference rooms**;
- For those attendees to the WPRS workshops who have also **submitted a paper to the BEPU conference, attendance of the conference, and hence purchase of a conference package is necessary**. This is in order to publish the paper, to have access to the conference rooms and furthermore to be provided with the final conference proceedings.

At the initial sign-up page http://www.nineeng.com/bepu/index.php/register

1. Answer "Yes" to the question "Do you want to attend ONLY WPRS Workshops?"
2. Type as the 'WPRS code' the following: "wprs2018lucca" (all lower case)

3. Once logged in, use the registration system to add the intended workshops to your cart. At this time you may also purchase, additional dinners, lunches and technical / guided tours.

Should you have any question, please do not hesitate to contact the NEA wprs@oecd-nea.org or the Organizing Committee http://www.nineeng.com/bepu/index.php/contact.

Please send the titles and authors of your presentations for:

a) LWR-UAM-12 workshop to Kostadin Ivanov - knivanov@ncsu.edu;

b) For SFR-UAM-4 workshop to Gerald Rimpault - gerald.rimpault@cea.fr.

Workshops' Location

The meeting place for the eight workshops during the week of May 14-18, 2018 is the same as for the BEPU-2018 conference – the Real Collegio, which is located inside the city walls of Lucca: http://www.nineeng.com/bepu/index.php/venue/the-real-collegio

The information for transportation and hotels are provided at the links below:

http://www.nineeng.com/bepu/index.php/conference-info/transportation

http://www.nineeng.com/bepu/index.php/conference-info/hotel-reservations

The programme and schedule of the meetings is shown below:

	Morning 08:30 - 12:30 (1 coffee break)	LUNCH	Afternoon 14:00 - 18:00 (1 coffee break)
MONDAY	SFR-UAM-4		SFR-UAM-4
	CTF-5		CTF-5
TUESDAY	SFR-UAM-4		SFR-UAM-4
	CTF-5		CANDU T-H
	CBPEC		CBPEC
WEDNESDAY	LWR-UAM-12		LWR-UAM-12
	MPCMIV		MPCMIV
	CBPEC		CBPEC
THURSDAY	LWR-UAM-12		LWR-UAM-12
	MPCMIV		C5G7-TD-3
FRIDAY	ROSTOV-2		ROSTOV-2
	C5G7-TD-3		C5G7-TD-3

Appendix 1

OECD/NEA Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs – Twelfth Workshop (UAM-12)

Host Organization
NINE S.r.l.
Lucca, Italy

May 16-17, 2018

PROPOSED PROGRAMME

U01-36: Session code

Day 1: May 16, 2018

U01. Introduction and opening remarks

U02. Overview and status of benchmark activities

U03. Discussion of the updated glossary

U04. Presentations on related activities – IAEA CRP ON HTGR UAM, OECD/NRA EGMPEBV, CASL UQ activities, etc.

U05. Updates on evaluated nuclear data files and associated covariance libraries as well as on SCALE versions, releases and added capabilities

U06. Presentation and discussion of submitted results on Exercises I-1, I-2, and I-3 (Phase I)

U07. Discussion of final report on Phase I results

U08. Participants' presentations on their modelling and results for Exercises I-1, I-2 and I-3 as well as on their expertise and experience relative to Phase I - sensitivity and uncertainty analysis on steady state stand-alone neutronics calculations (including multi-group microscopic cross-section libraries, few-group macroscopic cross-section libraries, and core calculations)

U09. Overview of the updates in the Specification for Exercise II-1, the interaction between Exercise II-1 and Exercise III-1, and discussion of submitted results on Exercises II-1

U10. Participants' presentations on their modelling and results for Exercise II-3 as well as on their expertise and experience relative to Exercise II-1 - Sensitivity and uncertainty analysis of fuel modelling.

U11. Overview of the updates in the Specification for Exercise II-2, the interaction between Exercise II-2 and Exercise III-1, and discussion of submitted results on Exercises II-2

U12. Participants' presentations on their modelling and results for Exercise II-2 as well as on their expertise and experience relative to Exercise II-2 - Sensitivity and uncertainty analysis of assembly depletion and neutron-kinetics calculations

U13. Overview of the updates in the Specification for Exercise II-3, the interaction between Exercise II-3 and Exercise III-1, and discussion of submitted results on Exercises II-3.

U14. Participants' presentations on their modelling and results for Exercise II-3 as well as on their expertise and experience relative to Exercise II-3 - Sensitivity and uncertainty analysis of thermal-hydraulics bundle/core calculations

Day 2: May 17, 2018

U15. Presentation of draft Specifications on Exercise III-1 of Phase III - TMI-1 PWR Rod Ejection Cases

U16. Discussion of the cross-section libraries for TMI-1 PWR Rod Ejection test cases of Exercise III-1

U17. Session on Kalinin-3 VVER-1000 cases for Exercise III-1 – specifications, cross-section covariance libraries, and results.

U18. Session on Oskarshamn-2 benchmark – results for the first three exercises (phases); presentation on the status of two-group covariance (uncertainty) cross-section libraries; and specifications of the uncertainty analysis cases for Exercise III-1.

U19. Presentation and discussion of preliminary results on Exercises III-1

U20. Participants' presentations on their experience and expertise relative to Exercise III-1 - Uncertainty and sensitivity analysis of core multi-physics calculations

U21. Presentation of draft Specification on Exercise III-2 of Phase III.

U22. Discussion of the support data and tools for Exercise III-2.

U23. Discussion of the selected test problems and requested output for Exercise III-2.

U24. Participants' presentations on their experience and expertise relative to Exercise III-2 - Uncertainty and sensitivity analysis of thermal-hydraulics system performance

U25. Discussion of the definition of the remaining two exercises for Phase III - Exercises III-3 and III-4

U26. Participants' presentations on their experience and expertise in uncertainty and sensitivity analysis of LWRs relative to Exercise III-3 - Coupled neutronics kinetics thermal-hydraulic core/thermal-hydraulic system performance

U27. Participants' presentations on their experience and expertise in uncertainty and sensitivity analysis of LWRs relative to Exercise III-4 - Comparison of best estimate plus uncertainties (BEPU) vs. conservative calculations"

U28. Action items and schedule of benchmark activities - Next workshop (UAM-12) and plans

U29. Conclusions and closing remarks

Appendix 2

OECD Benchmark for Uncertainty Analysis in Best-Estimate Modelling for Design, Operation and Safety Analysis of SFRs (SFR-UAM-4) meeting

Host Organisation
NINE S.r.l.
Lucca, Italy

May 14- May 15, 2018

Co-chair: Laurent Buiron
Local co-chair: Alessandro Petruzzi

DRAFT AGENDA

S01-26: Session code

Day 1: 14 May 2018

S01. Introduction and opening remarks

S02. Overview and status of benchmark activities

Best Estimate Results for the different core benchmark exercises

S03. Best Estimate Neutronic Results for the SFR 3600 MWth Core

S04. Best Estimate Neutronic Results for the ABR 1000 MWth Core

Discussions on the different benchmark sub exercises

S05. Cell exercises

S06. Sub-assembly exercises

S07. Sub-assembly burn up exercises

Best Estimate Results for the different transient exercises

S08. 2 UTOP (fast and mild)

S09. ULOF.

S10. Inadvertent withdrawal of control rod (centered and off center)

Day 2: 15 May 2018

Identification of the Different Sources of Uncertainties

S11. Nuclear Data Uncertainties

S12. Uncertainty propagation of Nuclear Data Uncertainties

S13. Standard Deviation between participants

S14. Pin mechanical models

S15. Thermal Hydraulic

Impact of the Different Sources of Uncertainties

S16. Nuclear Data Uncertainties

S17. Uncertainty propagation of Nuclear Data Uncertainties

S18. Standard Deviation between participants

S19. Pin mechanical models

S20. Thermal hydraulic

Experimental evidence in support to calculations Validation Exercises

S21. ZPR-6 Assembly 7

S22. ZPPR-2

S23. βeff experimental validation

S24. Doppler measurements

S25. Super-Phénix start up measurements

S26. THORS experimental data