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**English - Or. English**

**NUCLEAR ENERGY AGENCY  
NUCLEAR SCIENCE COMMITTEE**

**OECD Benchmark Workshop for Kalinin-3 Coupled Code Calculations  
and Uncertainty Analysis in Modelling (Kalinin-2009)**

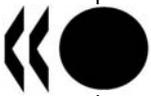
**PROPOSED PROGRAMME**

**University Park / State College, Pennsylvania, USA  
April 27-28, 2009**

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

**OECD Benchmark Workshop for Kalinin-3 Coupled Code Calculations  
and Uncertainty Analysis in Modelling (Kalinin-2009)**

**University Park / State College, Pennsylvania, USA**

**April 27-28, 2009**

**Hosted by**

**The Pennsylvania State University (PSU)**

**PROPOSED PROGRAMME**

**OECD Benchmark for Kalinin-3 Coupled Code Calculations and Uncertainty Analysis in Modelling - First Workshop (Kalinin-2009)**

**University Park / State College, Pennsylvania, USA**

**April 27 - 28 2009**

**Sponsorship**

The first workshop for the OECD Benchmark for Kalinin-3 Coupled Code Calculations and Uncertainty Analysis in Modelling (Kalinin-2009) will be held from April 27 to April 28, 2009 in University Park / State College, Pennsylvania, USA. During the last several years considerable effort and progress have been made in various countries and organizations in incorporating full three-dimensional (3D) reactor core models into system transient codes. The coupled thermal-hydraulic (TH) and neutron kinetics (NK) code systems allow performing of a “best-estimate” calculation of interactions between the core behavior and plant dynamics. Several benchmarks have been developed to verify and validate the capability of the coupled codes to analyze complex transients with coupled core-plant interactions for different types of reactors.

The Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD) has recently completed the VVER-1000 Coolant transient benchmark (V1000CT-1) and (V1000CT-2) for evaluating coupled TH system NK codes by simulating transients at the Bulgarian NPP Kozloduy Unit #6. The available real plant experimental data made these benchmark problems very valuable.

This benchmark is a continuation of the above activities and it defines a coupled code problem for further validation of thermal-hydraulics system codes for application to Russian-designed VVER-1000 reactors based on actual plant data from the Russian NPP Kalinin Unit #3 (Kalinin-3). The selected transient ‘Switching-off of one Main Circulation Pump (MCP)’ is performed at a nominal power and leads to asymmetric core conditions with broad ranges of the parameter changes. The experimental data is very well documented. These are measured with a quite high frequency and the measurement errors are known for almost all measured parameters. This fact allows applying the studied transient not only for the validation purposes but also for uncertainty analysis as a part of the NEA/OECD LWR Uncertainty Analysis in Modelling (UAM) Benchmark.

This workshop (Kalinin-2009) 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 CFD modelling and uncertainty analysis and to make participation more efficient. The meetings concerned are the Third OECD LWR Uncertainty Analysis in Modelling Workshop (UAM-3) and the OECD/NRC BFBT-6 benchmark workshop. The OECD/NRC BFBT-6 and the First OECD Kalinin-3 workshops will be held in parallel on April 27-28 2009 followed by the OECD UAM-3 benchmark workshop (April 29 - May 1 2009) and will be hosted by PSU, USA. The 3 workshops will take place in University Park / State College, Pennsylvania (located in the Happy Valley) – home of PSU. There will be a special session on LWR UAM in multi-physics multi-scale simulations at the M&C 2009 Conference in Saratoga Springs, NY, USA (6 hours drive from PSU). The M&C 2009 conference will take place on May 3-7, 2009 (the week after the Benchmark workshops at PSU).

## **Background and Purpose of the Benchmark Workshop**

Under the guidance of the NEA/OECD many benchmarks have been performed concerning the application of coupled 3D TH/NK codes. Some of them have utilized code-to-code comparisons, others have compared code predictions with real measured data.

Most transients in a VVER reactor can be properly analyzed with a system thermal-hydraulics code, with simplified neutron kinetics models (point kinetics). A few specific transients require more advanced modeling for neutron kinetics for a proper description. A coupled thermal-hydraulics 3D neutron kinetics code would be the right tool for such tasks.

The proposed benchmark problem has already been analyzed by the coupled system code ATHLET-BIPR-VVER. This allowed a better fixing of the Benchmark Specifications. However, within the present context the results of participants will be compared against the measurements. Interesting additional problems have to be solved in order to perform correctly the comparisons. This experience is incorporated in the text of the specification.

The reference problem chosen for simulation is the MCP #1 switching off at nominal power when the other three main coolant pumps are in operation, which is a real transient of an operating VVER-1000 power plant. This event is characterized by rapid rearrangement of the coolant flow through the reactor pressure vessel resulting in a coolant temperature change, which is spatially dependent. This leads to insertion of spatially distributed positive reactivity due to the modeled feedback mechanisms and a non-symmetric power distribution. Simulation of the transient requires evaluation of core response from a multi-dimensional perspective (coupled 3D neutronics/core thermal-hydraulics) supplemented by a one-dimensional (1D) simulation of the remainder of the reactor coolant system. The purpose of this benchmark is four-fold:

- To verify the capability of system codes to analyze complex transients with coupled core-plant interactions and complicated fluid mixing phenomena.
- To fully test the 3D neutronics/thermal-hydraulic coupling.
- To evaluate discrepancies between predictions of the coupled codes in best-estimate transient simulations with measured data.
- To perform uncertainty analysis having at disposal not only the measured values but also their accuracy

The benchmark includes a set of input data for the NPP Kalinin-3 and consists of four exercises:

### *Exercise 1 – Point kinetics plant simulation*

The purpose of this exercise is to test the primary and secondary system model responses. Provided are compatible point kinetics model inputs, which preserve the axial, and radial power distribution, and CR #10 and #9 reactivity obtained using a 3D code neutronics model and a complete system description.

### *Exercise 2 – Coupled 3-D neutronics/core T-H response evaluation*

The purpose of this exercise is to model the core and the vessel only. Inlet and outlet core transient boundary conditions are provided by the benchmark team on the basis of calculations performed with the ATHLET-BIPR-VVER coupled code system: alternatively the participants can apply the measured data. HFP state (Exercise #2a) of the core is required for comparison.

*Exercise 3 – Best-estimate coupled code plant transient modeling*

This exercise combines elements of the first two exercises of this benchmark and represents an analysis of the transient in its entirety. For participants that have already taken part in the Kozloduy-6 NEA/OECD Benchmark [6], it is suggested to start directly with this exercise. As a preliminary step for these latter participants it is recommended to perform steady state core calculations at HZP state (Exercise #3a), HFP (Exercise #3b) and deliver the results for comparisons. Exercise #3a and Exercise #3b will ensure and check out the correct application of the cross section libraries, the core loading and the core design geometry.

*Exercise 4 – Performing of uncertainty analysis* for the purpose of Phase-III (System Phase) of the OECD Benchmark for Uncertainty Analysis in Best –Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs.

The aim and the specification of this exercise will be described in a separate volume, which will depict the state of the art of the results and requirements identified after performing the UAM Phases I and II.

The specification document (Edition 1) that covers Exercises 1-3 of the OECD Kalinin-3 VVER-1000 Coupled Code Benchmark will be distributed to the participants in March 2009.

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

The technical topics to be addressed at the workshop include:

- Introduction of the Kalinin-3 benchmark and Edition 1 of the benchmark specification
- Discussion of the benchmark neutronics core data
- Discussion of the benchmark thermal-hydraulic data
- Discussion of thermal-hydraulic coupling and reactor control system modelling
- Discussion of initial steady state and transient scenario
- Discussion of the different benchmark exercises
- Discussion of the available measured data and comparisons with ATHLET-BIPR-VVER results
- Presentations on participants' experience and expertise in VVER coupled code calculations, and uncertainty and sensitivity analysis of VVERs
- 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 an in-depth the discussion of the first Edition of the specification and provided support data for Exercises 1-3 of the Kalinin-3 VVER-1000 coupled code benchmark, and the proposed work plan and time schedule for the Kalinin-3 VVER-1000 benchmark activities. The participants are requested to present their experience and expertise in VVER-1000 coupled code analysis.

### **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:

**Kiril Velkov (Chair)**

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**Member of NSC, NEA, OECD**

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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 First 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**

The First workshop will take place in University Park / State College, Pennsylvania (located in the Happy Valley) – home of PSU. For the State College Airport (SCE) there are flight connections from Washington DC (United), Philadelphia (US Air) and Detroit (Northwest). State College is on 2 and 1/2 hours drive from Pittsburgh, 3 and 1/2 hours drive from Philadelphia, 4 hours drive from Washington DC and 5 hours drive from New York City.

### **Local Arrangements**

The organisers propose accommodation at the hotels in State College, which will be managed by:

Donna M. Gensimore  
Administrative Support Assistant  
Dept. Mechanical and Nuclear Engineering  
336-C Reber Building  
(814) 865-5947  
FAX: (814) 863-4848  
E-mail: [dmgl@enr.psu.edu](mailto:dmgl@enr.psu.edu)

Please fill the registration form for the series of workshops and accommodation, which can be found as Annex 2.

### **Transportation**

At the State College Airport there is taxi and shuttle transportation available to hotels and downtown.

Annex 1

**OECD Benchmark for Kalinin-3 Coupled Code Calculations and Uncertainty Analysis in Modelling - First Workshop (Kalinin-2009)**

Hosted by  
The Pennsylvania State University (PSU), USA  
April 27-28, 2009

**PROPOSED PROGRAMME**

**Day 1: 27 April 2009**

1. Introduction and opening remarks
2. Overview of Edition 1 of the Kalinin-3 coupled code benchmark specification
3. Discussion of the benchmark neutronics core data
4. Discussion of the benchmark thermal-hydraulic data
5. Discussion of thermal-hydraulic coupling and reactor control system modelling
6. Discussion of initial steady state and transient scenario
7. Participants' presentations on their experience of VVER coupled code calculations

**Day 2: 28 April 2009**

8. Discussion of cross-section library and preliminary results using the library.
9. Discussion of requested output
10. Discussion of the different benchmark exercises
11. Discussion of the available measured data and comparisons with ATHLET-BIPR-VVER results
12. Presentations on participants' experience and expertise in uncertainty and sensitivity analysis of VVERs
13. Defining a work plan and schedule outlining actions to progress on the three phases of the benchmark activities
14. Discussions of the interactions between Exercise 4 of the Kalinin-3 benchmark and Phases I and II of the LWR UAM benchmark.

Annex 2

**OECD/NEA Workshops in University Park / State College, PA, USA**

**OECD Kalinin-3 Coupled Code Benchmark – First Workshop  
(Kalinin-2009)**

Host Organization  
The Pennsylvania State University (PSU), USA  
April 27 – 28, 2009

PARTICIPATION AND HOTEL REGISTRATION FORM

Even if you attend more than one of the following workshops (BFBT-6, Kalinin-2009, UAM-3), please send only one form as soon as possible, and in any case not later than April 14, 2009, both to:

**Kostadin Ivanov**

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Name:

Company or organization:

Address:

E-mail:

Tel:

Fax:

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

Please fill in the following table:

<b>Workshop / Date /Contact Person</b>	<b>Attendance / Presentations / Comments – Requests</b>
<b>Sixth workshop of the OECD/NRC Benchmark based on NUPEC BWR – Full-size Fine-mesh Bundle Tests (BFBT) – (BFBT-6)</b>	<i>Will you attend BFBT-6?</i>
	<i>If so, will you be giving a presentation?</i>
	<i>Please specify titles, authors, and sessions for the presentation(s)</i>
	<i>I shall not attend but send me the summary. (Yes – No)</i>
<b>April 27-28</b>	
<b>First OECD Kalinin-3 Coupled Code Benchmark (Kalinin-2009)</b>	<i>Will you attend the Kalinin-2009 workshop?</i>
	<i>If so, will you be giving a presentation?</i>
	<i>Please specify titles, authors, and sessions for the presentation(s)</i>
	<i>I shall not attend but send me the summary. (Yes – No)</i>
<b>April 27-28</b>	
<b>Third workshop for the OECD Uncertainty Analysis in Modelling (UAM) Light Water Reactor (LWR) benchmark – (UAM-3)</b>	<i>Will you attend the UAM-3?</i>
	<i>If so, will you be giving a presentation?</i>
	<i>Please specify titles, authors, and sessions for the presentation(s)</i>
	<i>I shall not attend but send me the summary. (Yes – No)</i>
<b>April 29 – May 1</b>	

Accommodation is proposed at the following hotel – Atherton Hotel – within walking distance from the workshops’ location. A set of **40 rooms** have been pre-reserved. The organising committee will take care of the hotel reservation.

*Do you wish to stay at Atherton Hotel?*

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

*Type of room (Single or Double):*

*Check in:*

*Check out:*

Alternative hotels are listed herewith for which participants are requested to do their own booking at:

### **Other Hotels**

A map with the location of the hotels and the venue can be found at <http://www.pahotels.com/cities/State-College/>

### **Workshop Location**

The three workshops will take place in the same building in University Park (the campus) – Reber Building Rooms 135, 125 and 214 and conference rooms of the Atherton Hotel.

The exact location can be found at <http://www.campusmaps.psu.edu/buildings/reber.shtml>

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

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