Working Party on Nuclear Criticality Safety (WPNCS)

SUMMARY RECORD OF THE TENTH MEETING

1 September 2006
Aix-en-Provence, France
Summary Record of the Tenth Meeting of the
NEA Nuclear Science Committee
Working Party on Nuclear Criticality Safety (WPNCS)

Friday, 1 September, 2006
Aix-en-Provence, France

SUMMARY RECORD

1. Introduction

The WPNCS chair, Gulliford, opened the meeting and welcomed the delegates. Twenty-two delegates attended the meeting (see the list of participants in Annex 1).

2. Review of actions from the previous meeting

The Minimum Critical Values report has been reviewed by the working party members and the final version was sent last July to the NEA for publication. The reviewing procedure was completed by Brady Raap and included the specifications of the BUC EG publications. The final version is available on the working party website. On 11-12 May 2006, a workshop on “The Need of PIE Data from VVER reactors” was organized in Rez, Czech Republic; details concerning the conclusions would be discussed under item 9 of the agenda. The progress of the ICNC 2007 organization would be discussed under item 10.

3. Approval of the summary record

The Summary Record of the previous meeting (NEA/SEN/NCS/WPNCS(2005)1) was approved without modification.

4. Feedback from the Nuclear Science Committee (NSC) meeting

During the last NSC meeting (31 May to 2 June 2006), Rugama presented the progress of the Working Party and its Expert Groups. Publication of the ICSBEP 2006 Handbook and reports from the different Expert Groups were announced for the end of 2006. The results from the workshop on the need of PIE data from VVER reactors were reported in a separate presentation.

5. ISO standards (Brady Raap)

Gulliford thanked Brady Raap for presenting, on his behalf, the WPNCS activities in the last ISO (International Organization for Standardization) meeting. Brady Raap briefly reported on the progress of the ISO Technical Committee 85 (TC85 Nuclear Energy), Subcommittee 5 (SC5 Nuclear Fuel Technology), and the Working Group 8 (WG8 Nuclear Criticality Safety), TC85/SC5/WG8. The activities of the NEA Working Party and Expert Groups are appreciated by the ISO participants and the need was
highlighted to have stronger collaboration between the two groups. The current situation is that some participants are members of both working groups and many subjects are common to the two communities. It was concluded that WPNCS may provide advice on some technical issues discussed in the ISO group.

Mennerdahl added that for some projects, participation is too limited and he encouraged the contribution from WPNCS members from countries such as Japan, Spain or Korea. Suyama will contact Hopper (Chair of TC85/SC5/WG8) for information about a possible participation from Japan.

6. Nuclear Criticality Safety National Programmes (Czech Republic, France, Germany, Japan, Sweden, UK, USA).

Belgium

Baeten provided a brief report about the criticality safety activities in Belgium, highlighting that the analysis of the experimental data from the REBUS project is almost completed. He added that the open distribution of Assay data for Spent Nuclear Fuel from experimental projects coordinated in Belgium needs to be agreed among the partners.

Czech Republic

Markova informed the Working Party that the Czech Republic had contributed with one more evaluation to the 2006 ICSBEP Handbook. Two other evaluations are under preparation. With regard to the preparation of post-irradiation experiments in collaboration with other OECD member countries, more information would be given by Brady Raap under item 10 of the agenda.

France

Cousinou from IRSN and Santamarina from CEA presented the French national program. The fuel cycle industry progress report was summarized with the addition that a new license for the Hague plant had been approved and the uranium enrichment facility Georges Besse II is on its first step of construction. The waste management law of 2006 concluded the need to build a “reversible” geological repository and to support the research programmes on the improvement of fuel reprocessing.

The activities on criticality code development and validation were briefly summarized and comprised the continued development of the CRISTAL code and the improvement of the validation Data Base. The JEFF3.1 library is being validated for BUC and criticality applications with experimental data from PIE and oscillation measurements in the Minerve reactor. The participation in international projects such as ICSBEP and the calculation of ISTC-815.1 MOX powder experiments project are making good progress.

Suyama asked if the French industry will fabricate UOX fuel with a U-235 enrichment higher than 5%. Cousinou answered that at present there is no plan to go above 5%.

Vasielv questioned the method used in the CRISTAL package to calculate uncertainties. Santamarina replied that they propagate the uncertainties in the cross section and in the experimental parameters from integral experiments. He added that in their method a selection of the most relevant integral experiments available in the CEA database is always performed. Details about the method used in CRISTAL are published in the Nuclear Criticality Safety Division topical meeting of 2005.
Germany

Neuber and Gmal informed the participants about the nuclear energy programme in Germany. The investigations on the new generation of transport and storage casks include the use of higher margins of BUC, as does the new IAEA standard that is being developed on criticality safety in final disposal of spent nuclear fuel.

Gmal and Neuber reported on the German contribution to the working group for code validation in the frame of the REBUS project. Gmal added that at GRS efforts on code validation and on the extension of the German criticality Handbook are on-going. Neuber commented that AREVA NP is involved in various BUC projects for transport and wet storage in Germany as well as in the UK and Slovenia.

Hungary

Hordosy presented briefly the activities on criticality safety and GEN IV related activities in Hungary. The Hungarian regulation was drafted as well as the current situation of the spent fuel storage facilities. The participation to GEN IV is mainly through the European Commission via the 6th Framework Programme (FP6).

Japan

Miyoshi reported on the current activities of Nuclear Criticality Safety in JAEA. The structure of the new organization and the department responsible of criticality safety activities was presented. The following set of experiments was briefly presented by Miyoshi:

- STACY: Reactivity worth measurements of the following list of Fission Products (FP): Sm, Rh, Cs, Eu, Gd. New cross section evaluations are expected for the FP under study. Criticality experiments on reactivity effects of Gadolinium used as poison are on-going.

- TRACY: Experiments for transient behaviour of water reflected core were initiated for comparison with the experiment performed on un-reflected core. An experimental program on spatial dose distribution is being evaluated with the help of deterministic and Monte Carlo codes.

The progress of the on-going project “Criticality evaluation in MOX fuel fabrication process” and the “Criticality excursion analyses for Diluted Plutonium solution” were presented.

Korea

Park informed the participants of the plans to use Burn-up credit for the design of the cask storage in Korea.

Sweden

Mennerdahl reported on the main developments in Sweden. Burn-up credit during encapsulation and final storage of the spent fuel are also planned. A compilation of references was made during last year to support licensing review of Burn-up credit and burnable absorber credit applications. The reference list will be available at the NEA website under the Burn-up Credit webpage.
Switzerland

Vasiliev presented the new methods developed at PSI for criticality safety. This new methods will use Monte Carlo transport codes (MCNP) instead of the deterministic codes used in the past. A full paper would be presented during the PHYSOR 2006 conference.

UK

Gulliford informed the participants that in the UK the national (and international) activities are co-ordinated through the UK Working Party on Criticality (WPC).

A key activity is related to the development of national consensus on Waste Methodology. A subgroup was formed in 2004 to help establish industry and regulatory consensus on criticality assessment for waste.

The list of international projects with UK participants was detailed; Gulliford highlighted their contribution to the following international organisations: ISO, NEA (NSC/WPNCS), IAEA and ANS Standards Groups. A WPC Sub-group has been formed to establish UK support for hosting of ICNC11, the city of Edinburgh was proposed as the venue.

USA

Westfall presented the Nuclear Criticality Safety Program (DOE/NCSP) in the USA. The extensive validation of the ENDF-VII library before its release on 15th December was stressed as well as the progress in the implementation of sensitivity and uncertainty methods on the new version of the SCALE package (SCALE 5.1). A second part of the presentation was devoted to the projected criticality needs of the Global Nuclear Energy Partnership (GNEP) Advanced Fuel cycle. The more precise safety margins and the increasing of efficiency would need of extra effort on nuclear data but also on the methods used for the calculations.

Barto added that a BUC transportation and storage project including Fission Products and full benchmarking is on-going at NRC. Measurements of Fission Products cross section data are being funded by DOE, as well as fuel cycle projects with the view to obtain new fuel plant licenses.

IAEA

Waernecke informed the participants of the activities on criticality safety at the IAEA. Three departments are involved in the work on criticality safety. Specific assistance can be provided upon request, including the assistance though Technical Co-operation projects. The IAEA assists Eastern European countries by holding workshops on criticality safety/burnup credit

Gulliford summarized the main activities related to criticality safety in the different member countries as follows: developments of codes, extension of the existing data bases and new experiments have been performed to validate the new applications. Gulliford concluded that the status of the projects related to innovative reactors is in its early stages and that the activities related to criticality safety will take place in the near future. Neuber added that a lot of work performed in the past and related to fast reactors can be of great interest for the teams working on GEN-IV projects.
7. Reports from the WPNCS Expert Groups

• Burnup Credit (Brady Raap)

Brady Raap reported on the outcome of the last meeting of the BUC Expert Group. The Expert Group met on 30 August 2006.

The publication of the Phase II-C report was postponed so as to be able to incorporate the comments of Mennerdahl and Neuber. The chair of the working party accepted the action to nominate within the participants a reviewer for the report Phase II-C.

The Phase II-D report was sent for publication and its distribution is expected by the end of 2006.

The publication of the summary report on the activities of the Expert Group was delayed; the participants fixed a new deadline of March 2007.

The progress of the Phase II-E report, which looks at the effect of the partial insertion of control rods during irradiation, was presented by Neuber who asked for more contributions.

Discussions related to the need for Post Irradiation Examination (PIE) data for VVER fuels was also considered during the meeting and a new benchmark to study the results of the data available at the ISTC2670 project was launched.

Brady Raap informed the participants that the BUC Expert Group endorsed the creation of a new Expert Group on “Assay Data for Spent Nuclear Fuel”. At the origin the idea was to have a subgroup of the Burnup Credit Expert Group but considering the scope of the group and the application of the assay data is larger than BUC, the proposal changed to an Expert Group. Suyama has been proposed as chair of the new Expert Group if the proposal gets the support of the WPNCS members.

Suyama presented the main activities together with the draft of the mandate discussed by the participants interested in participating in the proposal. Suyama detailed the deliverables agreed by the Expert Group as follows:

1. A revised SFCOMPO database including an archive of original reports on assay data and reference information. New assay data will be included into the database and made available to the public through the NEA web server.

2. A state-of-the-art report on assay data measured by PIE including descriptions of measurement methods, error, and quality of the assay data.

3. Organization of a special session on assay in the forthcoming criticality safety conference (ICNC2007) to be held from 28 May to 1 June-1, 2007, at St. Petersburg, Russia

Santamarina asked if the structure of the special sessions has been already discussed. Gulliford answered that we need to consult with the local organisers about the possibility to add special sessions. In particular the possibility a special session on PIE would be raised.

Gulliford consulted the delegates about their support to the formation of this new Expert Group on Assay Data for Spent Nuclear Fuel. All participants approved the proposal and recommended that the Nuclear Science Committee be informed.
• **Source Convergence (Blomquist)**

Blomquist outlined the main tasks of the Expert Group on Source Convergence. The report of Phase I has been completed and will be distributed September 2006.

The completion of a guideline report on Nuclear Criticality Safety and Source Convergence was proposed as report Phase II. Blomquist encouraged the participants to send their contributions because not much progress had been made since the last meeting.

Experts from IRSN had proposed a new benchmark exercise to test the statistical methods used by the different codes to estimate source convergence. The specifications will be distributed by the NEA and reviewed by Blomquist and Wagner.

• **Criticality Excursion (Miyoshi)**

Miyoshi informed the Working Party that the publication of the Phase-I report was the main issue of the last meeting (31 August 2006). The final draft version was extensively discussed by co-authors and the Expert Group members.

An additional benchmark (Phase II) was proposed by Yamane and several participants showed interested in joining this activity. At the last meeting a new exercise was proposed by the French delegates to study the effect of the approximations made by the code users on the description of the geometry.

8. **Status of the ICSBEP (Briggs)**

Briggs described the activities of the International Criticality Safety Benchmark Evaluation Project (ICSBEP). The September 2006 issue of the handbook contains evaluations of 442 experimental series, containing 3,955 critical and sub-critical experiments. Three Criticality-Alarm/Shielding Benchmarks, covering 21 configurations, with each configuration containing numerous dose points, and one Fundamental Physics Benchmarks with 20 fission rates measurements are included in the 2006 edition.

Rugama added that DICE has been modified to include the search features needed for the physics measurements, that the database has been improved and errors have been corrected.

9. **Experimental needs**

- **MOX experimental needs – Status Report (Briggs)**

Briggs reported on the progress of the projects related to the integral critical experiments with low-moderated MOX fuels. A consortium of IPPE, DOE/ORNL, IRSN and INL was created to support the Russian experimental programme presented to the Nuclear Science Committee (NSC). The experimental phase has been completed successfully and the first analyses have been performed by the partners. The main results will be published as an ISTC report.

- **PIE data needs – Status Report (Brady Raap)**

Brady Raap reported on the conclusions of the *Workshop on the Need for Post Irradiation Experiments to Validate Fuel Depletion Calculation Methodologies* held at the Nuclear Research Institute
Rez, Czech Republic, 11-12 May 2006. Thirty-three participants from twelve countries and two international organizations were involved in the proceedings. The workshop was organized by the Organization for Economic Cooperation and Development (OECD)/Nuclear Energy Agency (NEA) in order to promote a common understanding of the need for experiments for validating the burnup credit approach to criticality for VVER fuels, and the following topics were addressed:

1) Expression and justification of the need for fuel depletion calculation methodology validation;
2) Evaluation of the current status of validation work for different calculational methodologies and reactor types;
3) Consideration of the current status of experimental validation work;
4) Proposal for new experimental programs to address these needs;
5) Prospects for international co-operative program(s)

Two recommendations concluded the meeting: (1) pursue VVER measurements as a precursor to the application of burnup credit to VVER fuel (this means the measurements are needed quickly due to spent fuel management issues in countries like Ukraine and Slovakia) and (2) pursue establishing a systematic evaluation and database of spent fuel isotopic data for all Light Water Reactors (including VVERs) in the SFCOMPO format.

10. ICNC conferences (Technical Program)

Gulliford and Rugama informed the participants of the progress in the organization of the International Conference on Nuclear Criticality Safety 2007. In November 2005 Gulliford and Rugama met the local organisers in St Petersburg. The WPINCS members were asked to solicit abstracts and to participate in the reviewing process coordinated by the WPINCS chair and the NEA secretariat.

Gulliford reported to the participants that the UK has proposed their interest to hold ICNC 2011.

11. Proposal for a standing yearly agenda item at WPINCS meetings - Reference values for nuclear criticality safety (Mennerdahl)

Mennerdahl proposed to add a standing yearly item in the agenda of the WPINCS meeting about reference values for nuclear criticality safety. The proposal is to support the ISO activities with technical advice and to update regularly the report on Minimum Critical values coordinated by Mennerdahl.

Suyama commented that in Japan they already have an activity on-going but the database they are working on is under proprietary bases and cannot be distributed.

It was decided to postpone the working group actions on reference values at this stage.

Westfall acknowledged the effort Mennerdahl has dedicated to this activity during last year as well as his significant contribution to the final report.

12. Perspectives and future activities

Future activities of the existing Expert Groups were discussed under item 7 as was the creation of an Expert Group on Assay Data for Spent Nuclear Fuel.
13. **Date and place of the next meeting**

   The next meeting of the Working Party is tentatively scheduled to be held on 31\textsuperscript{st} August 2007, in Paris, France.
### Annex 1

**WPNCS2006 (WPNCS 2006 meeting)**

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<th>Name</th>
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### Annex 2

**LIST OF ACTIONS**

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<td>Nominate a reviewer for BUC/Phase II-C report</td>
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Annexe 3

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

Nuclear Energy Agency
Nuclear Science Committee
Tenth Meeting of the Working Party on Nuclear Criticality Safety

Friday, September 1 2006, starting at 9:30 a.m.
Aix en Provence (France)

PROPOSED AGENDA

1) Welcome and Administrative Items
2) Review of actions from the previous meetings (Y. Rugama)
3) Approval of the summary records of the previous meeting
4) Feedback from the Nuclear Science Committee meeting (Y. Rugama)
5) ISO standards (M. Brady-Raap)
6) Nuclear Criticality Safety National Programmes (Belgium, Czech Republic, France, Germany, Hungary, Japan, Korea, Slovakia, Sweden, Switzerland, UK, USA,..).
7) Reports from the WPNCS Expert Groups
   • Burnup Credit (M. Brady Rapp)
   • Source Convergence (R. Blomquist)
   • Criticality Excursions (Y. Miyoshi)
8) Status of the ICSBEP (B. Briggs)
9) Experimental needs
   MOX experimental needs – Status Report (B. Briggs)
   PIE data needs – Status Report (M. Brady Rapp)
   Other needs
10) ICNC conferences
    ICNC 2007 Technical Program Committee
11) Proposal for a standing yearly agenda item at WPNCS meetings - Reference values for nuclear criticality safety (D. Mennerdahl)
12) Perspectives and future activities
13) Date and place of the next meeting