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Organisation de Coopération et de Développement Économiques  
Organisation for Economic Co-operation and Development

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**English - Or. English**

**NUCLEAR ENERGY AGENCY  
NUCLEAR SCIENCE COMMITTEE**

## **Working Party on Nuclear Criticality Safety**

**The Fourteenth Meeting of the Working Party on Nuclear Criticality Safety**

### **SUMMARY RECORD**

**10 September 2010  
NEA Headquarters, Issy-les-Moulineaux, France**

<p>Jim Gulliford jim.gulliford@oecd.org +33 1 45 24 10 72</p>
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ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

Nuclear Energy Agency  
Nuclear Science Committee  
Working Party on Nuclear Criticality Safety

**THE FOURTEENTH MEETING OF THE WORKING PARTY  
ON NUCLEAR CRITICALITY SAFETY**

Friday 10 September 2010  
NEA Headquarters, Issy-les-Moulineaux, France

**SUMMARY RECORD**

**1. Introduction & Welcome**

**Veronique Rouyer**, the WPNCS chair, opened the meeting and welcomed the delegates (see list of participants – Annex 1).

**2. Approval of the agenda**

With a few minor modifications the proposed agenda was approved (see Annex 2).

**3. Approval of the summary record and Review of Actions**

The Summary Record of the previous meeting was approved with the following modification to the summary of the German national programme on page 3: ‘Good progress has been achieved on the licensing report for final disposal, a draft version is under study’, to become: ‘Good progress has been achieved on the safety regulation standard for final disposal, a draft version is under preparation’.

Action WPNCS-2009.1 on the Chairs of the Pocatello workshop to produce summaries of their sessions is closed. The conclusions of the Workshop were presented to the Nuclear Science Committee and have been taken into account in setting the technical programme for the relevant WPNCS Expert Groups. There are no other outstanding Actions.

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

During the last NSC meeting (June 2009), **Rouyer** reported on the progress of the Working Party and its Expert Groups. She also presented a summary of the main conclusions of the Pocatello Workshop and an update on planning for ICNC2011.

The NSC reviewed the proposed extended mandate for the WPNCS and the mandate for the proposed Expert Group on Advanced Monte-Carlo Techniques (EGAMCT). With some minor modifications both mandates were accepted.

**5. Reports from Nuclear Criticality Safety National Programmes and International Bodies**

**5.1 National Reports**

*Czech Republic*

**Markova** provided a summary of activities, highlighting recent PIE programmes on VVER fuel. Production of final reports on this work has been delayed by problems encountered with the measurements

on Tc99 and Rh103. She also reported on a new project to develop advanced safety analysis methods as part of a 3-year programme in collaboration with the utilities. Part of the programme involves extending the application of partial boron credit for spent fuel pools.

#### *Finland*

**Ranta-Aho** gave a brief update on activities in Finland. Ratification of plans for 2 new NPP and enlargement of the disposal facility has recently been given. The EPR under construction is expected to be brought on line in 2013 and the disposal facility should be available in 2020. Review of plans to increase discharge burnup from Finnish plant (from 45 to 50 GWd/te) is ongoing. Recent studies indicate that optimum discharge (taking into account 'back-end' costs) is in the region of 52GWd/te. Development of methodologies for Burnup Credit (BUC) continue, with recent work focusing on the possible use of reactor restart data for validation purposes. Analysis of a recent misloading event following an outage continues. The event has highlighted the importance of human error in safety analyses.

In the discussion that followed it was agreed that a report from a recent ANS meeting will be circulated to the Working Party for discussion at the next meeting (Action WPNCS 2010.4). In addition an EPRI report on the deterioration of neutron poisons in spent fuel ponds will be made available (Action WPNCS 2010.3).

#### *France*

**Rouyer and Santamarina** presented an overview of the French criticality program. **Rouyer** summarised activities related to the fuel cycle, pointing out that the Hague reprocessing plant treats a wide diversity of fuels and that the construction of Georges Besse II (centrifuge enrichment plant) is progressing well. BUC is planned to be applied to criticality assessment for BWR and PWR (MOX) fuel operations at the Hague plant as well as in transport. The method will include taking credit for 6 of the most important fission product absorbers. A safety review has been made for the restart of the MOX fabrication plant which includes a significant analysis of human errors.

**Santamarina** presented the CEA experimental program for PWR-BUC. Recent studies include analyses for the TN-24E transport cask and for BWR fuels. Recommendations for improvements to nuclear data have been identified, and code users are currently advised to use the JEF3.1.1 library. Santamarina also confirmed that permission has now been given for the release of data from small sample reactivity measurements made in the MINERVE and DIMPLE reactors as part of the CERES collaboration between France, the UK and the USA. A benchmark proposal was presented at the recent Expert Group on BUC to help underpin appropriate reactivity perturbation modelling methods. Santamarina reported that EdF have recently given notification that no extension to current burnup limits are planned for fuel discharged from the French fleet of NPP. Cost optimisation studies, taking into account back-end issues and the quality of Pu recovered for use in MOX fuels, suggest that burnup around 40GWd/te may be optimum.

#### *Germany*

**Neuber** informed the participants about the Criticality Safety programme in Germany, highlighting in particular waste disposal related activities. Approval of the new safety standard for disposal anticipated in November 2010 with possible publication in March 2011. In the area of code development Neuber noted that AREVA have been testing a new Monte Carlo tool for assessing uncertainties (nuclear data and manufacturing). **Wagner** reported on GRS activity concerning the update of nuclear data libraries in collaboration with PSI.

*Hungary*

**Hordosy** made a brief summary of activities in the national programme, noting their participation in the VVER PIE project mentioned in the Czech Republic's report and associated benchmarking activities. He also reported that government decisions on the need for new NPP is anticipated soon, commenting that most political parties and the majority of the public appear to be in favour of this option.

*Japan*

**Miyoshi** reported on the current activities of Nuclear Criticality Safety in JAEA. He also presented current activities at the Nuclear Fuel Cycle Safety Engineering Research Facility (NUCEF).

**Miyoshi** presented the critical experimental programs in the TRACY and STACY experimental facilities. A new experimental program is being designed to study the static and kinetic features of next generation fuels for LWR reactors: high burn-up and higher <sup>235</sup>U initial enrichment (above 5%). In connection with the issue of >5w/o fuels Miyoshi gave a presentation on behalf of the Japanese Institute of Applied Energy outlining their aspirations of forming international partnerships to help progress activities. Further details are reported in Section 5.3, below.

*Slovakia*

**Chrapciak** reported that Slovakia will be hosting an IAEA meeting from May 23-27 in 2011 (see international reports, below). He went on to summarise other criticality safety related activities including licensing of fuel casks and interim storage arrangements. For fuel above 4.4w/o initial enrichment, actinide-only BUC will be applied. A guide on BUC associated with this application will be prepared shortly.

*Spain*

**Ortego** summarized recent activities in Spain noting that recent activities have focused on BUC, particularly with respect to validation of depletion calculations. An on-going task is the detailed evaluation of PIE data for inclusion in SFCOMPO.

*Sweden*

**Mennerdahl** summarized activities in Sweden highlighting the recent law change allowing replacement of old NPP with new nuclear plant. He noted that political and public support for nuclear power in Sweden is divided, with the current opposition party being opposed to any further build.

*Switzerland*

**Vasiliev** briefly summarised activities performed in Switzerland highlighting that after the release of JEFF-3.1.1 this library was assessed at PSI in combination with MCNPX for criticality safety evaluations of LWR compact storage pools and transport casks. Overall this library shows a slight improvement over JEF-2.2 and JEFF-3.1, with a correction to the slight trends in bias with respect to captures of Pu-239 and Zr-90. Collaborations with NAGRA towards application of BUC for final disposal and with GRS in Germany on burnup calculation methods are on-going. PSI is currently participating in three of the WPNCs Expert Groups, namely EG-BUC, EG-AMCT and EG-UACSA.

*UK*

**O'Connor** informed the participants on the activities related to criticality safety in the UK highlighting recent developments in the area of assessment of waste management operations. In this area there has been work on risk-informed assessment and related 'ALARP' considerations along with contributions in the area of fissile exceptions criteria for transport. More generally government announcements of the need for

new build are anticipated next year. The renaissance of the nuclear industry in the UK may present some significant challenges, given the history of fragmentation of the UK's R&D capability. In this context the UK Working Party on Criticality (WPC) initiated a programme of Professional Development Workshops, which have now been running very successfully for several years. He noted that planning for ICNC11 is well advanced (see item 8 below for further details).

#### *USA*

**McKnight** presented the Nuclear Criticality Safety Program (DOE/NCSP) in the USA. Details of the Mission and Vision plan are available on-line at: <http://ncsp.llnl.gov>. **Wagner** added some details of work carried out for the regulator (NRC) on updates to guidance on BUC for Spent Fuel Pools. In addition it was noted that the NRC has been considering the impact of a move to >5w/o fuels, in particular for the proposed HTFR design for which enrichments may approach 20w/o. In the area of waste management, activities in the near future are now expected to focus more on interim surface storage rather than deep geological disposal. Nevertheless a review of the Yucca Mountain safety assessment by the NRC is still anticipated.

## **5.2 Reports from International Bodies**

### **ISO Standards**

On behalf of Calvin Hopper, **Mennerdahl** gave a brief overview of how projects at the ISO Technical Committee 85 (TC85)/Working Group Criticality Safety (WG8) are progressing. Recently standards on MOX and Burnup Credit for PWR fuel have been completed. Work is on-going on standards for Waste Management and for Criticality Alarm systems. Sylvie Tarle (Areva, France) was recently elected unanimously as a co-convenor for the group. Calvin Hopper remains as convenor.

#### *Czech Republic*

### **IAEA Meetings**

No representative from IAEA was available to attend the meeting. **Chrapciak** reported that Slovakia will be hosting an IAEA meeting from May 23-27 in 2011. He will provide details of the meeting to the Secretariat for distribution. (Action WPNCS 2010.1 – see Annex 3). He noted that the meeting will include discussion of criticality safety issues associated with fuels of greater than 5w/o initial enrichment. Details of further discussion on this issue are given in Section 5.3, below.

**Neuber** reported that the IAEA has expressed its intention to continue activities in the area of Burnup Credit with training courses planned in Armenia and China.

### **Discussions on >5w/o enriched Fuels**

Several reports touched on the issue of the potential for new fuel designs to exceed 5w/o initial enrichment. This issue was also identified as being a potential challenge at the 2009 Criticality Safety Workshop at INL, Pocatello and as a result has been included as an item in the programme for the forthcoming ICNC 2011 conference as part of the technical element on Standards and Methodology Development (the full programme is attached at Annex 4).

In some existing NPP fleets, fuel designs are now starting to encroach on what has historically been something of a threshold in enrichment and fuel fabrication facilities, as well as in relation to some transport regulations. Some participants reported challenges to this status quo from fuel designs for VVER, PWR and BWR plant. Also, for advanced reactor designs such as those associated with the GEN-IV project, greater than 5w/o enrichment fuels are expected. On the other hand, studies in some countries (*e.g.* France & Finland) seem to indicate that, if back-end costs are taken into account, current burnup levels in

LWRs are already approaching or exceeding optimum. This would tend to negate the requirement for increased initial enrichment.

In the discussions which followed it was noted that the challenges raised by a move to  $>5\text{w/o}$  fuel arise not only in technical aspects of criticality safety (e.g. code validation) but also in areas such as international law, fuel enrichment capabilities, regulatory acceptance, etc. It was also noted that a move to higher initial enrichment as a means to achieve higher burnup would also raise other significant technical challenges in areas such as fuel & materials performance.

It was agreed that this topic would benefit from coordination at an international level. In the context of criticality safety analysis, however, it would appear that the technical challenges could, if required, be addressed under the existing structure of Expert Groups under WPNCS supervision. Therefore it was agreed that the topic should be discussed at a higher level within the NEA and links with other relevant **technical areas established (see Action WPNCS 2010.2).**

## 6. Reports from the WPNCS Expert Groups

(Full details are given in respective Summary Reports for these meetings)

- ***Burnup Credit***

**Brady-Raap** provided an overview of the main business and discussions at the meeting. She highlighted progress on the Lessons Learned report which is now expected to be in final draft next year. There has also been good progress in completing the report on PIE for VVER fuel, which should also be completed shortly. The EG meeting reviewed the new mandate for the EG and commend it to the WPNCS for approval. The WPNCS approved the mandate unanimously.

- ***Advanced Monte Carlo Techniques***

**Brown** outlined the main business of the first meeting of the Expert Group on Advanced Monte Carlo Techniques. He noted that the previous work of the Expert Group on Source Convergence Analysis provided an excellent example of the development and transfer of Monte Carlo technology to practitioners. Longstanding difficulties were resolved, and new techniques have become established as routine tools for practitioners. The aim of the new group is to extend that approach to other techniques. Two topics for special study have now been identified, namely depletion calculations and perturbation analysis. Two groups have been established to study the issues and produce appropriate user guidance ahead of the next meeting scheduled for September 2011. The meeting reviewed the new mandate for the EG and commend it to the WPNCS for approval. The WPNCS approved the mandate unanimously.

- ***Criticality Excursion (Miyoshi)***

**Miyoshi** summarised the outcomes from the last meeting. Results from the benchmark exercise Phase II were presented by the different contributors (JAEA, IRSN and CEA). He presented the publication schedule; the first draft version is expected by the end of May 2011.

The EG participants reviewed provisional results for the Phase II of this exercise. It was agreed that an additional exercise should be added to Phase II to study the modelling of sloshing of the fissile solution. A proposal for an exercise on a dilute Pu solution system with very low temperature feedback was discussed. A detailed specification will be prepared ahead of the next EG meeting, scheduled for September 2011. The EG meeting reviewed the new mandate for the EG and commended it to the WPNCS for approval. The WPNCS approved the mandate unanimously.

- ***Uncertainty Analysis for Criticality Safety Assessment***

**Ivanova** informed the delegates about the results of the third meeting of the Expert Group on Uncertainty Analysis for Criticality Safety Assessment. The EG discussed the publication of a state-of-the-art report that compares the different methods and tools in use for a criticality safety assessment and the benchmarking of the methods. A final draft of this report should be ready by January 2011. The meeting also received updates on the provisional analysis of the Phase II exercise on manufacturing tolerances. A third phase of study on methods for deriving sensitivity coefficients was proposed and the specification of this exercise was agreed. A proposal for an additional ‘blind-test’ will be discussed at the next EG meeting. An updated 2-year mandate for the group was reviewed at the EG meeting and is commended to the WPNCS for approval. The new mandate was unanimously approved.

## **7. Status of the ICSBEP**

**Briggs** described the activities of the International Criticality Safety Benchmark Evaluation Project (ICSBEP). The September 2009 issue of the handbook contains first evaluations of a series of ZPR integral experiments. A meeting of the ICSBEP review group was held in Ljubljana, Slovenia in May 2010 and a further set of about 30 evaluations will be ready for inclusion in the next issue of the handbook, scheduled for publication in September/October 2010.

## **8. ICNC 2011**

An update on the status of planning for ICNC 2011 was presented by the Secretariat. The venue is now confirmed as the Edinburgh Conference Centre (at Herriot-Watt University), for September 19-23<sup>rd</sup> 2011. Following discussion at the last WPNCS meeting and subsequent comment from WPNCS members a technical programme has been finalised – see Annex 4.

The UK Organising committee in consultation with the Chair of the WPNCS has established a list of members for the International Advisory Committee (IAC) and the International Technical Programme Committee (ITPC). These committees are Chaired by Veronique Rouyer, in her role as Chair of the WPNCS.

The ITPC will have responsibility for reviewing abstracts. Testing of the OECD-NEA website tool for abstract review is nearing completion. Submission of abstracts will be opened in October 2010, closing at the end of February 2011. The UK website for ICNC 2011 is already open: [www.informaglobalevents.com/event/icnc2011](http://www.informaglobalevents.com/event/icnc2011).

The conference programme will include technical tours on the Friday immediately after the main conference (24<sup>th</sup> September) and an extensive Guest Programme.

A visit by the UK Organising Committee and accompanied by the Chair of the IAC to the conference venue is scheduled for September 17<sup>th</sup> 2010.

## **9. WPNCS Mandate**

A new Mandate for the WPNCS was presented at the last NSC meeting in June and approved. The new Mandate was endorsed by the WPNCS.

## **10. Date and place of the next meeting**

The next meeting of the Working Party on Nuclear Criticality Safety (WPNCS) will be held in conjunction with ICNC 2011 in September of that year. More precise details will be circulated to WPNCS members as they become available.

**ANNEX 1**  
**WPNC Meeting**  
**List of Participants**

**CZECH REPUBLIC**

MARKOVA, Ludmila  
Nuclear Research Institute at REZ  
Theoretical Reactor Physics  
Husinec - Rez 130  
CZ - 250 68 Rez

Tel.: +420 2 6617 2291  
Fax: +420 2 6617 2390  
Eml: mar@nri.cz

**FINLAND**

RANTA-AHO, Anssu  
Teollisuuden Voima Oyj  
Töölönkatu 4  
FI-00100 Helsinki

Tel.: +358 9 6180 5452  
Fax: +358 9 6180 2570  
Eml: anssu.ranta-aho@tvo.fi

**FRANCE**

COUSINOU, Patrick  
IRSN/DSU  
B.P. 17  
92265 Fontenay-aux-Roses Cedex

Tel. +33 1 58 35 74 21/78 44  
Fax: +33 1 58 35 79 73  
Eml: patrick.cousinou@irsn.fr

IVANOVA, Tatiana  
IRSN/DSU/SEC/LERD  
B.P. 17  
92262 Fontenay-aux-Roses Cedex

Tel.: +33 1 58 35 74 19  
Fax: +33 1 46 57 29 98  
Eml: tatiana.ivanova@irsn.fr

ROUYER, Véronique  
IRSN/DSDRE/DIR  
B.P. 17  
92262 Fontenay-aux-Roses Cedex

Tel.: +33 1 58 35 74 04  
Fax: +33 1 46 57 29 98  
Eml: veronique.rouyer@irsn.fr

SANTAMARINA, Alain  
CEA Cadarache  
DEN/DER/SPRC  
Bât. 230  
13108 St Paul lez Durance Cedex

Tel.: +33 4 42 25 70 46  
Fax: +33 4 42 25 48 49  
Eml: alain.santamarina@cea.fr

**GERMANY**

NEUBER, Jens Christian  
AREVA NP GmbH  
Department PEEA8-G  
Kaiserleistrasse 29  
P.O. Box 100551  
D-63067 Offenbach

Tel.: +49 69 2557 31385  
Fax: +49 69 2557 31876  
Eml: jens-christian.neuber@areva.com

WAGNER, Markus  
GRS  
Forschungsinstitute  
D-85748 Garching

Tel.: +49 89 32004 499  
Fax: +49 89 32004 491  
Eml: markus.wagner@grs.de

## HUNGARY

HORDOSY, Gabor  
KFKI Atomic Energy Research Institute  
Konkoly Thege u. 29-33  
1525 Budapest 114, Pf. 49.  
Budapest 1121

Tel.: +36 1 392 2222, ext. 3442  
Fax: +36 1 395 9293  
Eml: hordosy@aeki.kfki.hu

## JAPAN

MIYOSHI, Yoshinori  
Nuclear Science Research Institute  
Japan Atomic Energy Agency  
Shirakata Shirane 2-4, Tokai-mura  
Naka-gun Ibaraki Prefecture  
319-1195

Tel.: +81 29 282 5542  
Fax: +81 29 282 5937  
Eml: miyoshi.yoshinori@jaea.go.jp

YAMAMOTO, Toshihisa  
JNES  
Tokyu Reit Toranomom Bldg.,  
3-17-1, Toranomom,  
Minato-ku, Tokyo 105-0001

Tel.: +81 (3) 4511-1802  
Fax: +81 (3) 4511-1898  
Eml: yamamoto-toshihisa@jnes.go.jp

## SLOVAK REPUBLIC

CHRAPCIAK, Vladimír  
VUJE Trnava a.s  
Okružná 5  
918 64 TRNAVA

Tel.: +421 33 599 1312  
Fax: +421 33 599 1191  
Eml: chrapciak@vuje.sk

## SPAIN

ORTEGO, Pedro  
SEA Ingeniería y Analisis de Blindajes S.L.  
Av. Atenas 75 Locales 106-107  
28232 Las Rozas (Madrid)

Tel.: +34 91 6317 807  
Fax: +34 91 6318 266  
Eml: p.ortego@seaingenieria.es

## SWEDEN

MENNERDAHL, Dennis  
E. Mennerdahl Systems  
Starvägen 12  
SE-183 57 TÄBY

Tel.: +46 8 756 58 12  
Eml: dennis.mennerdahl@ems.se

## SWITZERLAND

VASILIEV, Alexander  
Laboratory for Reactor Physics and Systems  
Behaviour  
Paul Scherrer Institut  
CH 5232 Villigen PSI

Tel.: +41 56310 2702  
Fax: +41 56310 2327  
Eml: alexander.vasiliev@psi.ch

**UNITED KINGDOM**

O'CONNOR, Greg  
Criticality and Radiological Protection,  
Dangerous Goods Division  
Department for Transport  
Zone 2/27, Great Minster House,  
76, Marsham Street,  
London SW1P 4DR

Tel.: +44 20 7944 8693  
Fax: +44 20 7944 2187  
Eml: Greg.O'Connor@dft.gsi.gov.uk

**UNITED STATES OF AMERICA**

AISSA, Mourad  
US Nuclear Regulatory Commission  
CSB-3A07M  
Washington, DC 20555-0001

Tel.: + 1 301 251-7511  
Fax: +1 301 251 7423  
Eml: mourad.aissa@nrc.gov

BRADY RAAP, Michael  
Pacific Northwest National Laboratory (PNNL)  
902 Battelle Blvd  
P.O. Box 999, MSIN K8-34  
Richland, WA 99352

Tel.: +1 509 375 3781  
Fax: +1 509 372 6421  
Eml: michael.bradyraap@pnl.gov

BRIGGS, Blair  
Idaho National Laboratory  
P.O. Box 1625, MS-3860  
2525 North Fremont  
Idaho Falls, ID 83415-3860

Tel.: +1 208 526 7628  
Fax: +1 208 526 2930  
Eml: j.briggs@inl.gov

BROWN, Forrest  
Los Alamos National Laboratory  
P.O. Box 1663, MS A143  
Los Alamos, NM 87544

Tel.: +1 505 667 7581  
Fax: +1 505 665 2879  
Eml: fbrown@lanl.gov

MCKNIGHT, Richard  
Argonne National Laboratory  
Nuclear Engineering Division Bldg. 208  
9700 S. Cass Avenue  
Argonne, IL 60439-4842

Tel.: +1 630 252-6088  
Fax: +1 630 252-4500  
Eml: rdmcknight@anl.gov

REARDEN, Bradley  
Radiation Transport and Criticality Group  
Nuclear Science and Technology Division  
Oak Ridge National Laboratory  
P.O. Box 2008, M.S. 6170  
Oak Ridge, TN 37831-6170

Tel.: +1 865 574-6085  
Fax: +1 865 574-3527  
Eml: reardenb@ornl.gov

WAGNER, John C.  
Oak Ridge National Laboratory  
P.O. Box 2008  
Oak Ridge, TN 37831-6170

Tel.: +1 865 241 3570  
Fax: +1 865 576 3513  
Eml: wagnerjc@ornl.gov

WOOD, Kent  
US Nuclear Regulatory Commission  
OWFN O10D-11,  
One White Flint North  
11555 Rockville Pike  
Rockville, MD 20852-2738

Tel.: +1 301 415-4120  
Fax: +1 301-415-3577  
Eml: kent.wood@nrc.gov

**International organisations**

**OECD Nuclear Energy Agency**

GULLIFORD, Jim  
12 boulevard des Iles  
92130 Issy les Moulineaux  
France

Tel.: +33 1 45 24 10 72  
Fax: +33 1 45 24 11 06  
Eml: jim.gulliford@oecd.org

MICHEL-SENDIS, Franco  
12 boulevard des Iles  
92130 Issy les Moulineaux  
France

Tel.: +33 1 45 24 10 72  
Fax: +33 1 45 24 11 06  
Eml: franco.michel-sendis@oecd.org

**ANNEX 2**

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT  
Nuclear Energy Agency  
Nuclear Science Committee

**14th Meeting of the Working Party on Nuclear Criticality Safety**

10 September 2010, 9:00 – 17:00  
NEA Headquarters, Issy-les-Moulineaux, France

**PROPOSED AGENDA**

1. Welcome and administrative items: *V. Rouyer*
2. Review of actions from the previous meetings: *Secretariat*
3. Approval of the summary records of the previous meeting: *All*
4. Feedback from the Nuclear Science Committee Meeting: *Secretariat*
5. ISO standards
6. Nuclear Criticality Safety National Programmes and IAEA activities
7. Reports from the WPNCS Expert Groups: Approval of new Mandates: *M. Brady Rap, F. Brown, Y. Miyoshi, T. Ivanova*
8. Status of the ICSBEP: *B. Briggs*
9. ICNC 2011 Current Status: *J. Gulliford*
10. Review of WPNCS Mandate, Future Activities: *All*
12. Date and place of the next meeting
13. Adjourn

## ANNEX 3

**List of Open Actions (as of 10 September 2010)**

<b>ID</b>	<b>Action</b>	<b>By</b>	<b>Responsible</b>
WPNCs 2010.1	Distribute information on IAEA meeting (Slovakia May 23-27th) on > 5% issues to WPNCs	Oct. 2010	Secretariat
WPNCs 2010.2	Contact NEA groups with potential interest in >5% issues (WPRS, CSNI, Head of Nuclear Science, etc.)	Oct. 2010	Secretariat
WPNCs 2010.3	Provide details of EPRI report on neutron absorber materials to WPNCs	Dec. 2010	Mourad
WPNCs 2010.4	Provide details of ANS Meeting presentations on Human Performance to WPNCs	Dec. 2010	Mikey Brady
WPNCs 2010.5	Identify options to close out source convergence work. Circulate to WPNCs	Oct. 2010	Secretariat

## ANNEX 4

## ICNC 2011 Technical Programme

Technical Programme Element	Element Sub-headings
1. Development of Standards and Assessment Methodology, e.g.	<ul style="list-style-type: none"> <li>• Guides, standards, handbooks</li> <li>• General methodology developments for fuel fabrication, storage, reprocessing, transport, decommissioning, etc.</li> <li>• 'Special' methodology developments, e.g. for fuel fabrication &amp; transport of advanced reactor fuels &gt;5w/o enrichment, risk informed methods</li> <li>• Optioneering studies/methods</li> <li>• Consistency of safety margins, integration with overall facility safety cases, 'fit-for purpose' safety cases</li> </ul>
2. Operational Practise	<ul style="list-style-type: none"> <li>• Practical considerations in the implementation of criticality control</li> <li>• Selection of methods of control, measurement techniques, compliance issues</li> <li>• Operator training, human factors, criticality audits and inspections</li> <li>• Lessons learnt from operating experience, incidents</li> </ul>
3. Criticality Codes and Nuclear Data	<ul style="list-style-type: none"> <li>• Improved user interface/checking tools</li> <li>• Testing of new codes &amp; data</li> <li>• Improvements to nuclear data</li> <li>• Identification of experimental needs</li> </ul>
4. Criticality Experiments	<ul style="list-style-type: none"> <li>• New evaluations of existing experiments</li> <li>• New experiments</li> <li>• Future programmes</li> </ul>
5. Uncertainty Analysis	<ul style="list-style-type: none"> <li>• Derivation of code bias and its uncertainty</li> <li>• Sensitivity analysis, selection of representative validation benchmarks</li> </ul>
6. Analysis of Criticality Accidents and Incidents	<ul style="list-style-type: none"> <li>• Modelling of criticality excursions</li> <li>• Analysis of causes of accidents/incidents</li> <li>• Lessons learnt for emergency response planning</li> <li>• Accident detection and alarm systems: adequacy/omission studies</li> </ul>

7. Burnup Credit	<ul style="list-style-type: none"> <li>• Modelling issues, code development, validation</li> <li>• Application &amp; implementation, bounding assumptions, burn-up measurements, compliance issue</li> <li>• Future uses, <i>e.g.</i> disposal, new build</li> </ul>
8. Waste Management Issues	<ul style="list-style-type: none"> <li>• Waste inventories, variability, characterisation requirements, special issues</li> <li>• Design of waste packaging, design of waste packaging processes,</li> <li>• Assessment of retrieval/conditioning/packaging/surface storage operations</li> <li>• Design of disposal facilities, assessment of disposal operations, assessment of post-closure phase</li> </ul>
9. Professional Development Issues	<ul style="list-style-type: none"> <li>• Maintaining/building capability, national programmes, core competencies, training programmes</li> <li>• International coordination/collaboration</li> <li>• Meeting future challenges, <i>e.g.</i> new build</li> </ul>