For Official Use **NEA/SEN/NSC/WPNCS(2001)1**

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

12-Apr-2001

English - Or. English

NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE

NEA/SEN/NSC/WPNCS(2001)1
For Official Use

Working Party on Nuclear Criticality Safety (WPNCS)

SUMMARY RECORD OF THE FOURTH MEETING OF THE WORKING PARTY ON NUCLEAR CRITICALITY SAFETY

15 September, 2000
Issy-les-Moulineaux, France

English - Or. English

JT00106025

Document complet disponible sur OLIS dans son format d'origine
Complete document available on OLIS in its original format

**Summary Record of the fourth meeting of the
Working Party on Nuclear Criticality Safety**

Issy-les-Moulineaux, September 15, 2000

I. INTRODUCTION

The fourth meeting of the Working Party on Nuclear Criticality Safety was held at the OECD Nuclear Energy Agency headquarters (Issy-les-Moulineaux, France) on September 15, 2000. The list of participants is given in Annex 1.

Y. Nomura (JAERI, Japan), the chairman of the working party opened the meeting and welcomed the participants. The proposed agenda of the meeting (see Annex 2) was accepted without modification.

II. REPORTS FROM EXPERT GROUPS

The meeting started with brief reports presented by the chairs of the different expert groups.

II.1. Report from the Burnup Credit Expert Group

M. Brady Raap (PNNL, USA) presented a summary report on the activities of the expert group (a more detailed report can be found in the summary record of the expert group, NEA/NSC/WPNCS/DOC(2000)1). Phase III-A on criticality calculations of BWR fuel storage has been completed and its findings published by JAERI in September 2000. Phase III-B, on depletion calculations of BWR fuel assembly, is under analysis. The publication of the final report is foreseen for September 2001 after the peer-review is completed. Phases IV-A and IV-B on MOX fuel criticality and depletion calculations are both on-going. More detailed reports on these phases will be presented at the next meeting. Phase II-C was specified to study the sensitivity of multiplication factors to the axial burnup profile asymmetry. The group is submitting a review paper to RAMTRANS Journal.

D. Mennerdhal (E. Mennerdahl Systems, Sweden) asked whether accidental situations, similar to those studied in Phase II-B, will be considered in Phase II-C. M. Brady Raap answered that accidental situations will be proposed to participants as optional supplementary cases. Participants will choose whether or not to run these cases.

Y. Naito (NAIS, Japan) inquired about the status of the Spent Fuel Isotopic composition SFCOMPO. Kenya Suyama, who was responsible for the database in JAERI, joined the OECD/NEA in September 2000. He was asked by the chairman to make a brief presentation on the status of SFCOMPO. K. Suyama explained that work is in progress at JAERI to translate the different web search pages into English. This work, together with the addition of new results from post-irradiation analysis, should take about six months. The technical feasibility of migrating the database to the NEA server was investigated after the meeting. It was concluded that this migration should not cause technical problems and that the NEA is willing to support the effort of migration and maintenance and to make the database available through the NEA web pages. An internal discussion in JAERI will take place first before deciding when this migration can occur.

II.2. Report from the Expert Group on the International Criticality Safety Benchmark Evaluation Project

Blair Briggs (INEEL, USA) presented the status of the International Criticality Safety Benchmark Evaluation Project. Twelve countries are participating in the project and the criticality handbook is used in forty nine countries. A new edition is being prepared and should be released before the end of September 2000. Twenty two new critical evaluations and one subcritical evaluation were added, representing a total of 201 configurations. Spectral data continue to be generated and added to the handbook. More than thirty evaluations are in progress for the 2001 publication. At the last expert group meeting, it was suggested generating evaluation abstracts summarising the essential parameters of the experiments in order to facilitate use of the handbook. Collaboration between the NEA and the INEEL was initiated in order to create a relational database from which such summaries can be generated and to improve search options through important characteristics of experiments such as composition, geometry, spectral data, etc.

II.3. Report from the Expert Group on Subcritical Experiments

J. Gulliford (AEA-T, UK) presented a summary of the expert group meeting. T. Valentine (ORNL) has prepared the first subcritical experiment evaluation. This evaluation is included in the 2000' edition of the ICSBEP handbook. The next evaluation will be produced in the UK and the application concerned is transport of PWR fuel. The experiment was performed in the Dimple reactor. The expert group needs to contact an expert on noise analysis to help in the preparation of the next evaluation.

II.4. Report from the Expert Group on Experimental Needs in Criticality Safety

P. Cousinou (IPSN, France) gave an overview of the expert group meeting. Methodologies developed at ORNL and IPSN to help identify experimental needs were discussed. P. Cousinou presented examples of configurations describing low-moderated MOX dump powders as encountered in MOX fuel fabrication. Studies performed at IPSN with the characterisation technique demonstrated the lack of experimental data for such media. It was agreed to apply the sensitivity methodology in use at ORNL to further justify this need.

A form outlining the requirement for further experimental data was discussed and it was agreed to make it available on the NEA web site. As a first step, R. Anderson will describe the high priority requests established at Los Alamos National Laboratory. The requirements specified will be reviewed by the expert group to establish the potential benefit of designing a new experimental programme and to examine whether existing experiments already cover requirements. The expert group will encourage possible international collaboration aiming at the set-up of experimental programs covering common needs.

II.5. Report from the Expert Group on Minimum Critical Values

W. Weber (GRS, Germany) presented the progress report of the expert group. The compilation of minimum critical data has continued through the web site prepared by Y. Naito et al.. It was, however, felt that updating directly the html files in order to enter the data was not a simple procedure. It was thus agreed that the compilation would continue through the exchange of EXCEL files, pending a more convenient solution. W. Weber has prepared the first version of these files and distributed them to the participants. W. Weber pointed out that the primary goal of the expert group was the collection of existing minimum critical values without affording re-calculations of these parameters. The aim is to present the range of values in use in the different countries without seeking to reach consensus on recommended values. Consistency checks will, of course, be made when large differences are observed.

II.6. Report from the Expert Group on Source Convergence Analysis

R. Blomquist (ANL, USA) gave an overview of the first expert group meeting (the detailed report, NEA/NSC/WPNCS(2000)2, can be found on the NEA web site). A first phase of the study covered the following four benchmark exercises:

Benchmark 1, proposed by N. Smith (AEA-T, UK), describes a LWR storage rack composed of 20x3 assemblies with asymmetric reflector conditions.

Benchmark 2, proposed by Y. Naito, is based on the OECD/NEA burnup credit benchmark Phase II-A (axial burnup profile study in an infinite array of LWR storage of assemblies).

Benchmark 3, proposed by Y. Nomura, describes two fuel slabs separated by water.

Benchmark 4, proposed by O. Jacquet (IPSN, France), is an array of 5x5 interacting spheres.

This results of this phase will be discussed at the next meeting. A second phase of the study will consist of a more detailed investigation of Monte-Carlo convergence strategies proposed or in use in eigen value calculations.

III. THE JCO ACCIDENT

Y. Nomura presented an evaluation of physical phenomena in the JCO accident (paper by I. Takeshita, Y. Miyoshi and G. Uchiyama, JAERI). This accident occurred on September 30, 1999 in the Conversion Test building of the JCO Company Ltd. in Tokai-mura. The accident was due to the fact that the critical volume of an 18.88% enriched uranium solution was exceeded in a precipitation vessel. This vessel was designed to precipitate ammonium diuranate by chemical reaction of uranyl nitrate with ammonium gas. The vessel (with an inner diameter of approximately 45 cm) was equipped with a cooling system (a water jacket of approximately 2.2 cm at the bottom and around the cylinder) to control the temperature.

The total amount of uranium, which caused the accident, was estimated to be 16.6 kg. The uranium concentration was about 370 g/l. The solution was added to the vessel in seven batches of 6.5 litres and 2.4 kg each (total volume of 45.5 litres as compared to a critical volume of about 41 litres). The inserted reactivity was estimated at between 1.5 $ and 3 $.

The fission chain reaction was terminated more than 20 hours later due to the following two external actions:

- the drainage of water from the coolant jacket of the precipitation vessel,

- the injection of boric acid solution into the vessel through the peeping hole (concentration of boron ~ 5.5 g/l). This particular action was implemented to avoid re-criticality following positive reactivity given to the solution by temperature decrease after the termination of the reaction (the temperature of the solution during the accident was about 80°C).

Simulations of the criticality transient during the accident (power, energy and temperature behaviour) were performed in JAERI using the AGNES2 code. The first burst is evaluated at 4.8 10^{E}+16 fissions with a peak power between 10 and 15 MW. The total number of fissions during the accident was estimated at 3 10^{E}+18 (independent estimation from experimental fission products analysis and activation analysis of the stainless steel give an estimation of about 2.4 10^{E}+18 fissions). After the first peak, a few oscillations lasting 10 seconds were observed. After divergence, the power and temperature increase and radiolytic gas is produced. The power then quickly decreases due to negative reactivity feedbacks (expansion, gas production, Doppler). A power increase is observed again when the gas disappears from the surface of the solution. These phenomena are repeated while the solution temperature increases gradually, resulting in a gradual decrease of power (Doppler and expansion effects). Due to the cooling system, the solution temperature decreases gradually, and the power is increased after a few hours, which causes the temperature to increase again. A quasi-steady stead (with long oscillation periods of power and temperature as described above) was observed due to the balance between heat generation and its cooling, provided by the cooling system in operation during the accident. The radiological impact of the accident was mainly due to direct irradiation because of the short distance between the critical vessel and environment and especially because of the lack of shielding. Most of the fission products (except long lived rare gases) were retained in the building. Radioactive iodine release was estimated at 0.1% of the total product (1.2^{E}+6 Bq/ml of solution)

IV. THE INTERNATIONAL WORKSHOP ON THE SAFETY OF THE NUCLEAR FUEL CYCLE

This workshop was organised in Tokyo from 29 to 31 May 2000 under the auspices of the Nuclear Energy Agency (NEA) at the invitation of the Science and Technology Agency (STA) and the Nuclear Safety Commission (NSC) of Japan. Close to 400 participants from around the world participated in this meeting in order to discuss and exchange information on technical and regulatory issues relevant to the safety of the nuclear fuel cycle. Sessions focused on criticality aspects, safety and regulation of facilities and emergency planning, preparedness and management issues. The following conclusions of the workshop have been taken from the Press Communiqué published by the NEA after the workshop.

- Countries have well-established, relatively mature and effective programmes to protect workers and the public from accidents in nuclear fuel cycle facilities. Many countries have performed programme reviews since the JCO incident at Tokai-mura. No major deviations were found although some areas of improvement were identified.

- It is recognised that the event at Tokai-mura was an anomaly. Approaches being taken by Member countries in the regulation of fuel cycle facilities to reduce criticality safety hazards are very similar. Consideration of human factors and the need for passive safety system features are very important.

- There is a need for a strong safety culture in order to maintain safe facilities and prevent accidents. This includes the recognition that criticality events, while highly unlikely, can occur.

- The challenge of maintaining the competence of operators, managers and regulators was recognised not only for fuel cycle facilities but for the whole of the nuclear industry.

- Lessons learned from international emergency exercises are very important for planning and preparedness.

- Further research for improving the dosimetry technology is required, and quick analysis of the types of radiation exposure is necessary.

- Significant communication and organisational challenges are brought about by quickly developing fire, explosion or criticality accidents. National and local authorities should be prepared for such accidents as well as larger ones at nuclear power plants.

- Strong endorsement is given to the efforts under way to develop an information exchange system, similar to that used for the Year 2000 (Y2K), in as timely a manner as possible. Such a system will enhance the international exchange of information between experts regarding incidents at nuclear facilities and enable them to assess possible consequences quickly.

The Proceedings from the workshop will be published in 2001.

V. NATIONAL AND INTERNATIONAL PROGRAMMES IN CRITICALITY SAFETY

V.1. Summary of criticality safety programs in the USA

C. V. Parks (ORNL, USA) presented a Summary Report on Criticality Safety Activities in the United States. As reported in previous WPNCS meetings, the US Department of Energy (DOE) has formulated a Nuclear Criticality Safety Program (NCSP) which contains seven technical tasks and provides a resource for supporting DOE specific issues as they arise. Extensive assistance was rendered to the DOE on the performance of its Improvement Self-Assessment, conducted at every site and field office, partly in response to the criticality accident in Japan. At the DOE workshop in March, the NCSP activities were reviewed and a survey conducted to obtain feedback relative to the seven technical areas. The NCSP technical tasks and their status at the end of FY2000 are summarised below.

<u>Critical Experiments:</u> Measurements are being conducted with the intermediate spectrum ZEUS machine and with a silicon dioxide/hydrogen/uranium assembly at Los Alamos National Laboratory (LANL). The low-enriched fuel pins from the Hanford Critical Mass Laboratory have been shipped to Los Alamos and plans are being developed to acquire ZPR plutonium and U-233 fuel.

<u>Benchmarking</u>: The ICSBEP, which reports separately to the WPNCS, is supported strongly by the DOE/NCSP and is co-ordinated by INEEL.

<u>Nuclear Data:</u> Work is proceeding on cross-section measurements in the ORELA facility at Oak Ridge National Laboratory (ORNL). New and more rigorous cross-section evaluations are being performed for oxygen, aluminium, silicon, chlorine, U-233 and U-235. The indications are that the unresolved data for U-238 should be improved. A Np-237 target is being made available for new measurements.

<u>Analytical Methods</u>: The DOE/NCSP programme is seeking to maintain analysis capabilities and provide user assistance and training via continued support to MCNP (LANL), SCALE/KENO (ORNL), and VIM (ANL). New versions of MCNP and SCALE/KENO were released through RSICC with workshops arranged and user assistance provided. The VIM user's manual has been installed on a web site. ANL has led in the organisation of the WPNCS Expert Group on Source Convergence and support is anticipated from other national laboratories.

<u>Applicable Ranges of Bounding Curves & Data:</u> Several sensitivity/uncertainty techniques were refined and applied to spent fuel and waste matrix problems in an effort to test the techniques for establishing range of applicability, estimate uncertainty margins, and determine experimental needs. Anomalous results from slowing-down measurements have also been studied. An automated scheme that uses adjoint-based technology to obtain material optimisation for 1-D criticality safety problems has been developed within a SCALE prototypic sequence. Extension to geometry optimisation is underway.

Information Preservation and Dissemination: The major objective of this task is to preserve and disseminate past and present knowledge related to the practice of criticality safety and lessons learned. In conjunction with the NRC, a report on criticality accidents in the United States and Russia was prepared by LANL. Log books from several former critical experiment facilities have been moved to an accessible, safe storage site at LANL. Log books from the ORNL critical experiments programme (~22,000 critical approaches) were converted into electronic files. An ongoing effort is underway to electronically preserve all the log books and to videotape interviews with former experimentalists and criticality safety experts.

Training and Qualifications: Personnel qualification standards were issued for DOE staff members and DOE contractors in the nuclear criticality safety field. A DOE standard on the performance of nuclear criticality safety evaluations was issued. A new five-day advanced course at the Los Alamos Critical Experiments Facility was piloted and is being conducted.

The NCSP is also seeking to maintain an effective interface with other programme elements of the DOE that are carrying out activities involving fissile material operations. Such major programs include:

1. The Fissile Material Disposition Program (FMDP) which is working to dispose of excess plutonium in the US stockpile via the processing of U-233 and plutonium material and the fabrication and irradiation of MOX fuel.
2. Permanent disposition of DOE and commercial spent fuel in an underground repository; and
3. Safe storage of the HEU stockpile.

Burnup credit continues to be a major area of interest, investigation and discussion in the US. The US Nuclear Regulatory Commission (NRC) has issued staff guidance that contains recommendations for use of burnup credit in storage and transport. The NRC is also reviewing a criticality safety methodology developed by the DOE for repository licensing. This methodology includes burnup credit for commercial PWR and BWR spent fuel. The NRC has initiated a research programme to support effective implementation of burnup credit into the regulatory framework.

The extension of fuel assembly initial enrichments to the regime beyond 5 wt% continues to be an interest area to the NRC and commercial fuel industry.

V.2. On going and future criticality programmes in France

P. Cousinou (IPSN, France) presented a summary of the on going and foreseen criticality work in France. This includes on going experiments in Valduc with six fission products (Sm-149, Rh-103, Cs-133, Nd-143, Sm-152 and Gd-155) in different configurations:

Solution of fission products in the middle of a LWR array.

High burnup uranium rods (a composition representative of uranium fuel at high burnup but without minor actinides and fission products) immersed in a solution of fission products.

High burnup uranium rods immersed in a solution of fission products and natural uranium.

LWR rods immersed in a solution of uranium and fission products.

Another experimental program is planned in Valduc and will allow for the testing of different structural materials (Cu, Ti, Mo, Ta, graphite, lead, organics) as reflectors surrounding a solution of highly enriched uranium. Other studies concern the development and validation of the criticality calculation package CRISTAL. This includes the development of the characterisation system which was used recently to justify the need for experimental programmes with MOX dump powder.

V.3. Criticality programmes in the UK

J. Gulliford (AEA-T, UK) presented a summary report of criticality activities in UK. This includes the on going validation effort of the MONK code and participation inICSBEP evaluations. A review of different fuel cycle facilities was organised as a follow up action after the JCO accident. A survey was also carried out in the UK on methodologies used in different countries to extract uncertainty for criticality applications from benchmark data. A report is in preparation.

V.4. Criticality programmes in Switzerland

Peter GRIMM (PSI, Switzerland) gave a short overview regarding on going criticality activities in Switzerland. In particular, he gave a brief description of measurements planned at the PSI PROTEUS reactor. These are reactivity worth measurements of spent fuel samples (up to 82 GWd/t) in PROTEUS.

V.5. Criticality programmes in Germany

J-C. Neuber (Siemens, Germany) presented an overview of criticality activities in Germany. Siemens is participating in the REBUS and PROTEUS burnup credit experiments. Licensing agreements were also requested for the use of burnup credit in wet storage as a short term and as longer term in dry storage.

VI. FUTURE PROGRAMME OF WORK AND NEW WPNCS EXPERT GROUPS

VI.1. New Expert Group on Criticality Accidents Simulation

The proposal to set up a new expert group on criticality accidents simulation was discussed. Members of the working party were asked to express their opinion on the opportunity to set up such an expert group. Jim Stewart (UK), C.V Parks (USA), P. Cousinou (France), D. Mennerdahl (Sweden) and Y. Nomura (Japan) expressed their support. Germany and Belgium however showed less interest for the project. It was agreed to prepare a proposal to be discussed at the next working party meeting.

VI.2. Benchmarks of Mixed Configurations of Fissionable Units

D. Mennerdahl (EMS, Sweden) presented a proposal for the set up of a new Expert Group on Mixed Configurations. The idea behind his proposal is to design specific benchmarks which could help test the applicability of different rules/techniques used in the safety analysis of mixed configurations. Different physics phenomena that affect the criticality of mixed configurations are worth studying, including differences in the spectra of basic configurations, reflection conditions… A consensus on the establishment of the new expert group could not be reached during the meeting. Since the subject has important regulatory and safety aspects, A. Nouri suggested that the NEA Secretariat study the mutual benefit of collaboration between the WPNCS and ad-hoc expert groups from the Committee on the Safety of Nuclear Installations.

VI.3. Liaison between OECD/WPNCS and IAEA activities

Working group members and the NEA Secretariat have been willing to collaborate in IAEA activities dealing with criticality issues, including transport regulations for which the IAEA asked the

WPNCS to play a role in the peer-review process. Burnup credit implementation in IAEA Member countries is another subject of fruitful collaboration between the two agencies.

VI.4 Approval of Expert Group reports and their Scope and Objectives

The reports presented by the different expert group chairpersons were approved as well as their respective programmes of work. The revised versions of the Scope and Objectives of the different groups were also presented and discussed and editorial changes were suggested. The working party approved the scope and objectives of all the groups except the one of minimum critical values, which was not in its final version during the meeting. The NEA Secretariat will request the approval of the working party members later. A discussion also took place on the status of the ICSBEP and its interaction with other expert groups (subcritical experiments experimental needs in criticality safety and the newly established expert group on reactor physics experiments). Also, the fact that the ICSBEP has its own funding mechanism distinguishes it from the other expert groups. However, it was agreed that this funding concerns primarily the US contribution and US-Russian collaboration and does not include the contribution of other OECD countries (France, UK, Japan …). It was also felt that the project has always had a positive interaction with the working party through its users (criticality analysts and scientists involved in criticality code validation) and reports/discussions at the working party meetings. An example of such positive feedback is the availability of spectra data in the new edition and work on the relational database.

VI.5 Approval of the Scope and Objectives of the Working Party

Working party members reviewed the scope and objectives of the working party and proposed editorial changes. The new version is attached in Annex 3.

VII. STATUS OF THE PREPARATION OF ICNC’2003

The Chairman, Y. Nomura, presented the status of the preparation of the ICNC'2003 conference to be held in Japan in September or October 2003 (The Tokai-mura region is a possible candidate for hosting the conference). Conference sponsorship is being considered. The International Organisation and Technical Programme Committees will be set up by mid-2001. Posters will be distributed by August 2001. More up-to-date information on the preparations will be presented at the next meeting.

VIII. DATE AND PLACE OF THE NEXT MEETING

The next working party meeting will be held in Paris, on September 19, 2001. The Expert Groups on Burnup Credit, Source Convergence Analysis, Experimental Needs and Minimum Critical Values will be held in conjunction with this meeting. The Expert Groups on the ICSBEP project and on Subcritical Experiments will meet in Jackson Hole, USA, in June 2001.

ANNEX 1

List of participants

BELGIUM

LANCE, Benoit * Belgonucleaire Avenue Ariane 2-4 B-1200 BRUXELLES	Tel: +32 (2) 774 0631 Fax: +32 (2) 774 0614 Eml: b.lance@belgonucleaire.be
VAN DER MEER, Klaas Head Reactor Dosimetry Group Studie Centrum voor Kernenergie SCK/CEN 200 Boeretang B-2400 MOL	Tel: +32 14 33 22 14 Fax: +32 14 32 15 29 Eml: kvdmeer@sckcen.be

CZECH REPUBLIC

MARKOVA, Ludmila Ustav jaderneho vyzkumu Rez Theoretical Reactor Physics Nuclear Research Institute 25068 REZ	Tel: +420 (2) 6617 2291 Fax: +420 (2) 20940 156 Eml: mar@nri.cz

FRANCE

COUSINOU, Patrick Chef de Service IPSN/DPEA/SEC B.P. 6 F-92265 FONTENAY AUX ROSES CEDEX	Tel: +33 1 4654 7421 Fax: +33 1 4657 2998 Eml: patrick.cousinou@ipsn.fr
SANTAMARINA, Alain * CEA Cadarache DRN/DER/SPRC/LEPh Bat. 230 F-13108 ST. PAUL LEZ DURANCE CEDEX	Tel: +33 4 42 25 70 46 Fax: +33 4 42 25 70 09 Eml: Alain.Santamarina@cea.fr
THIOLLAY, Nicolas CEA Cadarache SPRC/LECY Batiment 230 13108 St Paul lez Durance Cedex	Tel: +33 4 42 25 7264 Fax: +33 4 42 25 7979 Eml: nthiollay@cea.fr

GERMANY

GMAL, Bernhard
Gesellschaft fuer Anlagen-
und Reaktorsicherheit
Postfach 1328
D-85739 GARCHING
Tel: +49 (0)89 32004 494
Fax: +49 (0)89 32004 491
Eml: gma@grs.de

NEUBER, Jens Christian
SIEMENS Nuclear Power GmbH
Dept. NDM3
Berliner Str. 295-303
Postfach 10 10 63
D-63010 OFFENBACH
Tel: +49 (69) 807 3913
Fax: +49 (69) 807 4407
Eml: jens-christian.neuber@off1.siemens.de

WEBER, Wolf-Juergen
Gesellschaft fuer Anlagen- und Reaktorsic
Forschungsgelaende
Postfach 1328
D-85739 GARCHING
Tel: +49 89 / 3 20 04 - 4 85
Fax: +49 89 / 3 20 04 - 4 91
Eml: web@grs.de

JAPAN

MITAKE, Susumu
NUPEC
Institute of Nuclear Safety
Fuel Cycle Facility Safety Analysis ec.
17-1 Toranomon 3-chome
Minato-ku, TOKYO 105-0001
Tel: +81 (3) 4512 2773
Fax: +81 (3) 4512 2799
Eml: mitake@nupec.or.jp

NAITO, Yoshitaka
President
Nippon Advanced Information
Service
416 Muramatsu, Tokai-mura
Naka-gun, Ibaraki-ken 319-11
Tel: +81 29 270 5000
Fax: +81 29 270 5001
Eml: ynaito@nais.ne.jp

NOMURA, Yasushi (Chairman)
Fuel Cycle Safety Evaluation Lab.
JAERI
2-4 Shirata-Shirane,Tokaimura, Naka-gun
Ibaraki-ken, 319-1195
Tel: +81 (0)29 282 5834
Fax: +81 (0)29 282 6479
Eml: nomura@popsvr.tokai.jaeri.go.jp

SAKURAI, Shungo
NUPEC
Institute of Nuclear Safety
Fuel Cycle Facility Safety Analysis ec.
17-1 Toranomon 3-chome
Minato-ku, TOKYO 105-0001
Tel: +81 (3) 4512 2773
Fax: +81 (3) 4512 2799
Eml: s-sakurai@nupec.or.jp

Japan cont'd

SUTO, Toshiyuki
2nd Chemical Process. Section
Tokai Reprocessing Plant
Japan Nuclear Cycle Dev.Inst.-Tokai Works
TOKAI-MURA, Muramatsu
Naga-Gun, Ibaraki-ken 319-1194

Tel: +81-29-282 1111 ext 2853
Fax: +81-29-282-2321
Eml: toshi@tokai.jnc.go.jp

KOREA (REPUBLIC OF)

BAIK, Joo Hyun
NSSS Engineering & Development Division
Korea Power Engineering
Company, Inc.
PO Box 148, Yousung
TAEJON 305-600

Tel: +82 (42) 868 2215
Fax: +82 (42) 861 0653
Eml: jhbaik@ns.kopec.co.kr

SPAIN

CONDE LOPEZ, Jose Manuel *
Jefe de Area Ingeneria Nuclear
Consejo de Seguridad Nuclear
C/ Justo Dorado 11
28040 MADRID

Tel: +34 (91) 3460253
Fax: +34 (91) 3460588
Eml: jmcl@csn.es

SWEDEN

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

Tel: +46 (0) 8 756 58 12
Fax: +46 (0) 8 756 58 72
Eml: dennis.mennerdahl@ems.se

SWITZERLAND

GRIMM, Peter
Paul Scherrer Institute
CH-5232 VILLIGEN PSI

Tel: +41 (56) 310 2071
Fax: +41 (56) 310 4527
Eml: peter.grimm@psi.ch

UNITED KINGDOM

GULLIFORD, Jim
Winfrith Technology Centre
350/A32
Dorchester,
Dorset DT2 8DH

Tel: +44 1305 20 2795
Fax: +44 1305 20 2194
Eml: jim.gulliford@aeat.co.uk

United Kingdom cont'd

SIMISTER, David
Health and Safety Executive
Nuclear Installations Inspectorate
St. Peter's House
Balliol Road
BOOTLE L20 3LZ

Tel: +44 (151) 951 3664
Fax: +44 (151) 951 3710
Eml: david.simister@hse.gsi.gov.uk

STEWART, James T.
Department of Environement, Transport, Regions
2/33 RMTD
GMH
76 Marsham Street
LONDON SW1P 4DR

Tel: +44 (207) 890 5777
Fax: +44 (207) 676 2187
Eml: Jim_Stewart@detr.gsi.gov.uk

UNITED STATES OF AMERICA

ANDERSON, Richard E.
Los Alamos National
Laboratory
NIS-6, MS J562
P.O. Box 1663
LOS ALAMOS, NM 87545

Tel: +1 (505) 667 6912
Fax: +1 (505) 665 3657
Eml: randerson@lanl.gov

BLOMQUIST, Roger N.
Reactor Analysis Division
Argonne National Laboratory
9700 South Cass Avenue (RA-208)
ARGONNE, IL 60439

Tel: +1 630-252-8423
Fax: +1 630-252-4500
Eml: RNBlomquist@anl.gov

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

Tel: +1 (509) 375-3781
Fax: +1 (509) 372-6421
Eml: michaele.bradyraap@pnl.gov

BRIGGS, J. Blair
Idaho National Engineering
& Environmental 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: bbb@inel.gov

DEHART, Mark D.
Building 6011, MS 6370
Oak Ridge National Laboratory
Post Office Box 2008
Oak Ridge, TN 37831-6370

Tel: +1 (865) 576 3468
Fax: +1 (865) 576 3513
Eml: dehartmd@ornl.gov

United States cont'd

FUJITA, Edward K.
Reactor Analysis Division
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 208
ARGONNE, IL 60439-4842
Tel: +1 630 252 4866
Fax: +1 630 252 4500
Eml: ekfujita@anl.gov

LITTLE, Robert C.
Los Alamos National Laboratory
Radiation Transport Group
Group X-CI, MS F633
PO Box 1663
Los Alamos, NM 87545
Tel: +1 (505) 665 3487
Fax: +1 (505) 665 3046
Eml: rcl@lanl.gov

NIEMER, Keyes
Duke Engineering & Services, Inc.
400 South Tryon St.
Charlotte
North Carolina 28201-1004
Tel: +1 704 382-9525
Fax: +1 704 382-8666
Eml: kaniemer@dukeengineering.com

PARKS, Cecil V.
Building 6011, MS 6370
Comp. Physics & Engineering
Oak Ridge National Laboratory
Post Office Box 2008
Oak Ridge, TN 37831-6370
Tel: +1 (865) 574 5280
Fax: +1 (865) 576 3513
Eml: cvp@ornl.gov

WITHEE, Carl J.
U.S. NRC
Office of Nuclear Material
Safety & Safeguards /SFPO
Mail Stop O-13-D13
WASHINGTON, DC 20555
Tel: +1 (301) 415 8534
Fax: +1 (301) 415 8555
Eml: cjw@nrc.gov

International Organisations

DYCK, Hans Peter
IAEA
Division of Nuclear Fuel Cycle
and Waste Technology
P.O. Box 100
A-1400 VIENNA
Tel: +43 1 2600 22768
Fax: +43 1 26007 22768
Eml: h.p.dyck@iaea.org

HALLEMANS, Jean-Marc
Commission Européenne
DG TREN C/4
Rue de la Loi 200
B-1049 Bruxelles
Tel: +32 (2) 296 94 04
Fax: +32 (2) 295 58 52
Eml: Jean-marc.Hallemans@cec.eu.int

International organisations cont'd

NOURI, Ali
OECD Nuclear Energy Agency
Le Seine St-Germain
12, Boulevard des Iles
92130 Issy-les-Moulineaux

Tel: +33 (0)1 45 24 10 84
Fax: +33 (0)1 45 24 10 28
Eml: nouri@nea.fr

SARTORI, Enrico
OECD/NEA Data Bank
Le Seine-Saint Germain
12 boulevard des Iles
F-92130 ISSY-LES-MOULINEAUX

Tel: +33 1 45 24 10 72 / 78
Fax: +33 1 45 24 11 10 / 28
Eml: sartori@nea.fr

* regrets not to have been able to participate

ANNEX 2

NEA/SEN/NSC/WPNCS(2000)1
Paris, 30 August 2000

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

Nuclear Energy Agency

Nuclear Science Committee

Fourth Meeting of the **Working Party on Nuclear Criticality Safety** (WPNCS)

15 September 2000

NEA Issy les Moulineaux, France,

PROPOSED AGENDA

The meeting will be held at the Nuclear Energy Agency, 12 boulevard des Iles, 7th floor, Room A, 92130 Issy les Moulineaux, France, staring at **9:00 a.m. in room A**

1. Introduction, Announcements, Participants

2. Review and Approval of the Agenda

3. Summary of NSC Programme of Work

4. Report from Expert Groups

   a) Burnup Credit Benchmarks

   b) ICSBEP

   c) Sub-critical Benchmarks

   d) Minimal Critical Configurations

   e) Experimental Needs in Criticality Safety

   f) Source Convergence for Criticality Analysis

   g) Liaison with other Working Parties

5. JCO Accident
   Y. Nomura: Evaluation of Physical Phenomena on the JCO Criticality Accident

6. Summary from International Workshop on the Safety of the Nuclear Fuel Cycle

7. National and International Programmes, Priorities in Criticality Safety
   Y. Nomura: 5 Year Plan for Nuclear Safety Research on Criticality

8. Discussion on future programme, priorities, schedule

   a) Discussion on setting up an Expert Group on Criticality Excursion Experiments Analysis (Criticality Accidents)

   b) Benchmarks on Mixed Configurations of Fissionable Units. Scope and Objectives: D. Mennerdahl

   c) Involvement of WPNCS with criticality issues in IAEA transport regulations

   d) Grouping of activities

   e) Approval of Expert Groups' Reports, their Scope and Objectives and Proposed Actions

9. Conferences and Meetings of Relevance to the WPNCS

   a) ANS Criticality Safety Topical 11-15 November 2001, Reno, Nevada

   b) Status of Proposals for ICNC2003 (Y. Nomura)

   c) PATRAM2001, Chicago, USA 3 to 7 September 2001.

10. Training Courses
    a) using Public Domain Computer Codes (MCNP-4C, KENO-VI/KENO-3D, TRIPOLI-3, TART-98)
    b) other issues (i.e. Burnup Credit at EPRI - IAEA/OECD)

11. Report and Recommendations to NSC concerning Work Results and Programme

12. Election of Working Party Officers and of Expert Groups

13. Date and Place of Fifth Meeting

ANNEX 3

OECD/NEA Nuclear Science Committee

Working Party on Nuclear Criticality Safety

Expert Group on Source Convergence for Criticality Analyses (EGSCA)

Scope and Objectives

Scope

To improve the robustness of criticality safety analyses with respect to source convergence[*] by investigating the long-standing problem of source convergence for certain classes of nuclear criticality safety problems.

Objectives

Under the guidance of the Working Party on Nuclear Criticality Safety, the major assignments of the Expert Group include:

- Develop criticality safety benchmark problems which exhibit convergence problems.
- Test fission source algorithms for vulnerability to slow convergence.
- Develop criteria to measure convergence reliability.
- Develop source convergence guidelines for the nuclear criticality safety analysts.
- Explore and evaluate methods to ensure and detect source convergence
- Publication of the results

[*] Improper source convergence can lead to non-conservative estimates of the k-effective for various fissionable configurations, e.g., the “Whitesides problem”, spent fuel casks, spent fuel storage pools, fuel processing systems.

OECD/NEA Nuclear Science Committee

Working Party on Nuclear Criticality Safety

Expert Group on Sub-Critical Measurements (EGSCM)

Scope and Objectives

Scope

To evaluate and review subcritical measurements for code and nuclear data validation, and test that the bias or uncertainty observed for critical experiments can be applied directly to calculations for sub-critical systems

Objectives

Under the guidance of the Working Party on Nuclear Criticality Safety, the major assignments of the Expert Group include:

- To promote international co-operation in the field of sub-critical experiments
- To provide a set of evaluated sub-critical benchmark experiments for inclusion in the "International Handbook of Evaluated Criticality Safety Benchmark Experiments"
- To assess uncertainty and bias associated with the interpretation of measured sub-critical parameters in terms of k-effective
- Assessment of value of subcritical measurements for criticality safety analysis

The Expert Group will coordinate its work closely with the International Criticality Safety Benchmark Evaluation Project (ICSBEP). The final evaluations will be integrated into the ICSBEP Handbook

OECD/NEA Nuclear Science Committee

Working Party on Nuclear Criticality Safety

International Criticality Safety Benchmark Experiments (ICSBEP) Project

Scope and Objectives

Scope

Development and maintenance of an international handbook containing criticality safety benchmark specifications derived from experiments performed at various nuclear critical facilities around the world. The benchmark specifications are intended for use by criticality safety engineers to validate calculational techniques used to establish minimum subcritical margins for operations with fissile material.

Objectives

to provide the nuclear industry with qualified benchmark data sets by collecting criticality experiment data from the nuclear criticality laboratories, world-wide. More specifically the objectives are as follows:

- Identify and evaluate a comprehensive set of critical benchmark data.
- Verify the data, to the extent possible, by reviewing original and subsequently revised documentation, and by talking with the experimenters or individuals who are familiar with the experimenters or the experimental facility.
- Compile the data into a standardized format.
- Perform calculations of each experiment with standard criticality safety codes.
- Formally document the work into a single source of verified benchmark critical data.
- Publish editions of the handbook on CD-ROM

The Expert Group will coordinate closely its work with other NSC experimental work groups: (reactor lattice and core experiments - IRPhE, experimental needs in criticality safety - EGENCS, and Shielding Experiments Data Base - SINBAD)

OECD/NEA Nuclear Science Committee

Working Party on Nuclear Criticality Safety

Expert Group on Experimental Needs in Criticality Safety (EGENCS)

Scope and Objectives

Scope

Compilation of high-priority needs for experiments in criticality safety. Analysis of the range of applicability for criticality experiments and estimation of the bias and uncertainty.

Objectives

Under the guidance of the Working Party on Nuclear Criticality Safety, the major assignments of the Expert Group include:

- Compilation of needs for high-priority experiments, update and reaffirm on a regular basis
- Promote the exchange of measurement objectives and experimental planning on a national and international basis.
- Encourage and coordinate development of quantitative methods to identify and justify experimental needs:
  - Means to estimate bias and uncertainties using existing data base
  - Determine “value” of new experiments
- Encourage coordination in performance of needed experiments.

The Expert Group will coordinate its work with other NSC experimental work groups:
(critical experiments - ICSBEP, sub-critical experiments - EGSCM, reactor lattice and core experiments - IRPhE)

OECD/NEA Nuclear Science Committee

Working Party on Nuclear Criticality Safety

Expert Group on Burnup Credit Criticality Safety (EGBUC)

Scope and Objectives

Scope

Burnup Credit(*) as applied to criticality safety in the transportation, storage, and treatment of spent fuel for a wide range of fuel types, including UOX and MOX fuels for PWR, BWR, and VVER.

Objectives

Under the guidance of the Working Party on Nuclear Criticality Safety, the major assignments of the Expert Group include:

- carrying out international comparison exercises and benchmarks and to assess the ability of code systems to predict the reactivity of spent nuclear fuel systems, including comparison with experimental data as available
- investigation of the physics and predictability of burnup credit based on the specification and comparison of calculational benchmark problems
- publication of the results for the benefit of criticality safety community, so that the work may be used to help establish suitable safety margins

(*) Burnup credit is a term that applies to the reduction in reactivity of burned nuclear fuel due to the change in composition during irradiation.

WORKING PARTY ON NUCLEAR CRITICALITY SAFETY (WPNCS)

Chair: Mr. Y. Nomura (Japan)

Members: All NEA Member countries

Date of creation: June 1996

Duration: June 2002

Mandate: Agreed at the 7th Meeting of the Nuclear Science Committee (NSC), 29-30 June 1996 [NEA/SEN/NSC(96)3] and extended at the 11th meeting of NSC in June 2000

SCOPE

The Working Party will deal with technical away from reactor criticality safety issues relevant to fabrication, transportation, storage and other operations related to the fuel cycle of nuclear materials.
Areas and items of activity include:

- Experiments – critical, subcritical and supercritical;
- Experiments databases: critical, subcritical, spent fuel isotopic composition;
- Code and data validation and benchmarking;
- Basic criticality condition data;
- Criticality safety handbooks and technical support to standards;
- Burn-up credit;
- Criticality accidents;
- Criticality safety of fuel cycle installations;

OBJECTIVES

- Guide, promote and co-ordinate high priority activities of common interest to the international criticality safety community, establish co-operations.
- Propose to NSC the setting up of specific Working Groups when needed.
- Maintain priority list of needs.
- Promote establishing international databases relevant to nuclear criticality safety.
- Monitor progress and report to NSC.
- Publish progress reports.
- Assist the Steering Committee of the International Conferences on Nuclear Criticality Safety (ICNC).
- Hold an annual meeting.
- Co-ordinate work with other organisations (e.g. IAEA) and other working groups within NEA, to avoid overlap of activities.

DURATION

Three years, with possible extension after revision of scope and objectives.