PROGRESS IN NSC ACTIVITIES
June - November 2008

NSC Bureau Meeting
4 December 2008

NEA Headquarters
Issy-les-Moulineaux [France]
TABLE OF CONTENTS

Introduction ................................................................................................................................................. 3
Progress in NSC Working Party activities ............................................................................................. 3
  Working Party on Scientific Issues of the Fuel Cycle (WPFC) ................................................................. 3
  Working Party on Nuclear Criticality Safety (WPNCS) ........................................................................... 5
  Working Party on Scientific Issues of Reactor Systems (WPRS) ............................................................ 7
  Working Party on International Nuclear Data Evaluation Cooperation (WPEC) ..................................... 12
  Working Party on Multi-scale Modelling of Fuels and Structural Materials for Nuclear Systems (WPMM) ........................................................................................................................................... 12
Progress in other NSC activities ................................................................................................................ 13
  Needs of Research and Test Facilities in Nuclear Science ..................................................................... 13
Workshops, meetings and conferences ..................................................................................................... 14
  Recently organised by NSC ................................................................................................................... 14
  NSC workshops in preparation .............................................................................................................. 14
  Recent International Meetings and Conferences ................................................................................... 14
  Workshops and conferences in 2009 and 2010 of relevance to the NSC programme of work .............. 15
Annex 1 ...................................................................................................................................................... 17
  WPFC Expert Group on Innovative Fuels (EGIF) ................................................................................ 17
Annex 2 ...................................................................................................................................................... 18
  WPEC subgroup proposal .................................................................................................................... 18
Annex 3 ...................................................................................................................................................... 19
  WPMM Expert Group on Multiscale Modelling Methods (M3) ............................................................ 19
Annex 4 ...................................................................................................................................................... 20
  WPMM Expert Group on Benchmarks of Methods (EGBM) ............................................................... 20
Annex 5 ...................................................................................................................................................... 21
  WPMM Expert Group on Structural Materials Modelling (EG_SMM) ................................................ 21
PROGRESS IN NSC ACTIVITIES
June - November 2008

Introduction

1. The text below highlights the progress in the different NSC activities during the period June to November 2008. New and discontinued activities, as well as issues requiring advice or decision by the NSC have been highlighted.

Progress in NSC Working Party activities

Working Party on Scientific Issues of the Fuel Cycle (WPFC)

2. The work of the WPFC is organised as follows:

   - Expert Group on Heavy Liquid Metal (HLM) Technology
   - Expert Group on Chemical Partitioning
   - Expert Group on Fuel Cycle Transition Scenarios
   - Expert Group on Innovative Fuels
   - Expert Group on Innovative Structure Materials
   - WPFC Task Forces (to be confirmed at forthcoming WPFC meeting)
     - Comparative study on homogeneous vs. heterogeneous recycle of TRU in fast reactors
     - Potential benefits of advanced fuel cycles with partitioning and transmutation and impact studies

3. The seventh meeting of WPFC will be held on 25 February 2009 at the NEA headquarters.

Expert Group on HLM Technology

4. The seventh meeting of the expert group was held on 29 and 30 October 2008, at the OECD premises. The update of the handbook on lead and lead-bismuth technology is underway to be published in the second half of 2010. A new chapter on the analysis of heavy liquid metal coolant natural and forced convection study will be added. Experimental results from the Russian Federation, as well as scheduled European, Japanese and US programmes, will be added. Next meeting of the expert group will be held in September 2009 to review a draft version of the handbook. A peer review of the handbook is also planned before publication.

Expert Group on Chemical Partitioning

5. The seventh meeting of the expert group was held on 4 and 5 November 2008 at the OECD headquarters. Korea and USA will update their chapters in the status report on national programmes on chemical partitioning. The Russian Federation is still awaiting official approval from the Rosatom before releasing their contribution to the report on national programmes. The UK contribution needs to be updated to reflect recent reorganisations of national nuclear institutions.
6. The fuel cycle flowsheet study has advanced. Ten flowsheets have been collected out of the initially planned twelve. It was agreed to discard two flowsheets, one from USA (UREX+1a) and one from EC (extended PUREX). A report will be prepared for publication in the first half of 2010.

7. The activity on separation criteria was discontinued due to lack of available information and human resources, as well as to avoid duplication with the new WPFC task force on P&T impact studies. E. Collins (USA), the chair of the activity, will delegate to the task force to exchange information and contribute necessary data.

8. In the study of curium management, it was noted that five contributions from four countries (France, Japan, Russian Federation and USA) will be available. Draft text for the final report, which will be published in the first half of 2010, will be prepared by the next meeting.

9. A new activity on “Progress of Separation Chemistry and Minor Actinide Separation and Perspective of Future R&D” was proposed and approved by WPFC. The main idea of this work is to assess technical maturity and needs for separation processes in three recycling methods: aqueous, pyro and fluoride. It is also envisaged to evaluate separation requirements from the point of fuel cycle scenarios and suggest perspectives for future steps. A draft of table of content was discussed and chapter leaders were decided. Progress in separation technology will be prepared for the next meeting. The goal of this work is to publish a report by the end of 2010.

10. The next meeting of the expert group is planned for 21-22 April 2009 at the NEA headquarters.

11. The seventh meetings of the Expert Group was held on 6 October 2008 in Mito, Japan. A state-of-art report on fuel cycle transition scenarios, including issues on country-dependant scenarios and key technologies to be identified to implement future scenarios was sent for printing.

12. The first phase of the benchmark on scenario codes, devoted to depletion calculations, is finished. Results from Belgium, France, Germany, Italy, Japan and Spain will be summarised in a report. For the second phase, devoted to transition calculations, France, Italy and Japan have contributed results. Canada, Spain and USA will investigate the possibility to contribute solutions by the next meeting of the expert group. The benchmark specifications will also be updated.

13. The study of a European scenario was finalised, and the main findings and perspectives were presented at the 10th Information exchange meeting on P&T. A draft report is being prepared, and a peer review of the report will be performed before publication.

14. Working schedule and different scenarios for the global transition scenario study were discussed. Three phases were proposed: Phase 1 – homogeneous world analysis, Phase 2 – Parsing of homogeneous results into regions (simplified approach to regional analysis) and Phase 3 – Regional analysis. The initial conditions and assumptions for phase 1 will be provided by the next meeting of the expert group. Germany will provide preliminary result in the first half of 2009.

15. The eighth meeting of the expert group will be held on 23-24 February 2009, at the NEA headquarters.

16. The first meeting of the expert group was held on 10 October 2008, in Mito, Japan. Twelve members from six countries and one international organisation (ITU of EC) attended. K. Pasamehmetoglu
(INL, USA) was elected chair of the expert group. The working plan and mandate (see Annex 1) were reviewed. A database on minor actinide bearing fuel was also planned. The NEA Data Bank would be asked to help establishing such a database.

17. Two main deliverables were planned: a state-of-the-art report on the development of innovative fuels and benchmark studies on fuel performance codes and experiments. The contents of the status report and potential benchmarks will be discussed at the second meeting of the expert group.

18. The second meeting of the expert group will be held on 26 and 27 February 2009 at the OECD conference centre. Italy and the Russian Federation will nominate members to the expert group and members from Canada, the Netherlands, Spain, Switzerland and UK will be solicited.

**Expert Group on Innovative Fuels**

19. The first meeting of the expert group will be held on 24 and 25 November 2008 at the NEA headquarters to elect expert group chair and to review mandate, deliverables and work plan. State-of-the-art in member countries on the development of innovative structural materials will be reported. Preparation of a second workshop on Structure Materials in Innovative Nuclear Systems (SMINS-2) will also be discussed. By now, ten members from seven countries have been nominated to the expert group.

**WPFC Taskforces**

20. The first phase of the benchmark on Thermal-Hydraulic Loop Models for Lead-Alloy Cooled Advanced Nuclear Energy Systems (LACANES), devoted to forced convection, has been completed. Seven results have been contributed and the report is being written. At the next meeting, which is planned for 15 and 16 December 2008 at the NEA headquarters, the expert group will discuss phase 2 of the benchmark, related to natural convection.

21. Nomination of experts to the two new task forces on a “comparative study on homogeneous vs. heterogeneous recycle of TRU in fast reactors”, and on “potential benefits of advanced fuel cycles with partitioning and transmutation” is underway. Details and work plans will be discussed at task force meetings in near future.

**Publications**

22. The status report on “Fuel cycle transition scenarios studies” is in print.

**Working Party on Nuclear Criticality Safety (WPNCS)**

23. The latest meeting of Working Group on Nuclear Criticality Safety (WPNCS) was held on 25 September 2008 in NEA headquarters, France. The Working Party reviewed the national programmes related to nuclear criticality safety and the perspective for future applications in advance fuel cycles. The progress in the work of the different WPNCS expert groups was also discussed.

**Assay Data for Spent Nuclear Fuel**

24. The expert group held his second meeting the last 24 September 2008 in the NEA headquarters. A preliminary version of the state-of-the-art-report on assay data for spent nuclear fuel was discussed. The different chapters were presented and a review team was established. The expert group has decided to dedicate more efforts on the chapter related to the development and validation of methods to estimate the uncertainties caused by the lack of experimental data.
25. Participants from Japan, Spain, Sweden, UK, and USA presented new data to be included in the NEA database for spent nuclear fuel, SFCOMPO. Data from VVER reactors will also be uploaded in the database with the help of the delegates from the Czech Republic. The participants highlighted the need to collect complete sets of data. It has been proposed that a new SFCOMPO format should include mechanisms to identify uncompleted data.

26. Ian Gauld from ORNL was elected new chair of the group, replacing Kenya Suyama (JAEA).

International Criticality Safety Benchmark Evaluation Project (ICSBEP)

27. The September 2008 issue of the ICSBEP handbook contained evaluations of 485 experimental series, representing 4207 critical or sub-critical experiments and 24 criticality-alarm/shielding configurations. In addition, there are four fundamental physics measurement evaluations relevant to criticality safety applications. The accompanying database DICE, for retrieval of data from the International Criticality Safety Benchmark Evaluation Handbook was reviewed and updated, and various errors and misinterpretations were corrected.

Uncertainty Analyses for Criticality Safety Assessment

28. Following a kick off meeting in December 2007, the first meeting of the expert group will be held on 4 and 5 December 2008 at the NEA headquarters. The objective of the group is to provide information exchange on the methodological and practical issues of the existing validation techniques. The group will also assist with selection, development, and qualification of the efficient and safe methodology(ies) for high-confidence validation of criticality analysis codes.

29. The expert group will produce a state-of-the-art report summarising the methodologies and codes available for the criticality analysis code validation. Their compliance with the existing standards for nuclear criticality safety will be checked and results and lessons learned of the first phase of the benchmark will be presented.

Burn-up Credit

30. The latest meeting of the group was held in conjunction with the Working Party meeting on 22 September 2008 at the NEA headquarters.

31. The report on benchmark Phase II-C was published and distributed in September 2008. A preliminary version of the Phase II-E benchmark, on the axial distribution and the effect of the partial insertion of control rods during irradiation, was presented. The final version is expected to be ready for reviewing before the next meeting in October 2009.

32. Participants presented the first results from the benchmark on the analyses of post irradiation experimental results from the ISTC 2670 project.

33. The specifications of the Phase VII benchmark, on the study of spent fuel compositions for long-term disposal, were discussed. A final version will be distributed before December 2009.

Source Convergence

34. The group is preparing a report on guidelines for criticality safety analysts on source convergence aspects. The benchmark activity proposed by IRSN, to test the statistical methods used by the different codes to estimate source convergence, has not progressed much.
Criticality Excursions

35. The report covering a first set of benchmark exercises based on step reactivity experiments at the TRACY and SILENE reactors has been finalised and has been reviewed both internally and externally. The publication is expected to be ready for distribution by the end of 2008.

Conferences and workshops

36. The Working Party members discussed the draft agenda of the OECD-NEA Workshop on Criticality Safety Research Needs for Future Nuclear Systems. The workshop will be held at the Idaho State University, USA on 21 and 22 September 2009.

37. The next International Conference on Nuclear Criticality Safety (ICNC.11) will be held in Edinburgh, UK.

Publications

38. The results of the burn-up credit criticality benchmark, phase II-C, was published in September 2008.

Working Party on Scientific Issues of Reactor Systems (WPRS)

39. The next meeting of the WPRS is scheduled for 25 and 26 February 2009 in conjunction with the WPFC meeting.

Experiments

40. The activities related to experiments and the corresponding databases are carried out with the strong support of the Data Bank. A brief summary is presented in the following. More detailed discussions are available in the Data Bank Progress report NEA/SEN/NSC/EG(2008)5.

International Reactor Physics Experiments Evaluation (IRPhE) project

41. Fourteen new series of reactor physics experiments were reviewed for integration in the March 2009 edition of the IRPhEP Handbook at the Technical Review meeting on 20-24 October 2008. The edition will contain 38 series of reactor physics experiments performed at 25 reactor facilities. Fifteen countries have been contributing to this project through release of experimental data and financial support. The Third edition of the IRPhEP Handbook, issued in March 2008 was requested and distributed in 261 copies during the first six months since its release. This represents an increased interest when comparing with 213 requests for a full year for the March 2007 Edition. For more details see the full summary of the meeting (NEA/NSC/DOC(2008)11) and http://www.nea.fr/html/dbprog/IRPhE-latest.htm for updates. The next Technical review meeting is scheduled for 26-29 October 2009.

IFPE - Fuel performance experiments

42. In cooperation with the IAEA, the comprehensiveness of the International Fuel Performance Experiments (IFPE) database was enhanced by including new experimental data. Further compilations are ongoing or are planned, in particular as relevant for the FUMEX-III exercise organised by the IAEA Technical Working Group in cooperation with the NEA. In this context, it is planned to include five new series of experiments relative to MOX fuel, niobium doped fuel and experiments on transient (load-follow) and accident (LOCA) conditions.
SINBAD – Radiation Shielding and Dosimetry experiments

43. The SINBAD database is currently being updated with new compilations relative to
   • Thorium shell transmission experiments series
   • Li metal benchmark
   • OKTAVIAN Mn spheres transmission experiments series.

44. Since the experimental data presently available in SINBAD are of varying quality, a revision and
    classification of the benchmark experiments according to the completeness and reliability of information
    is being undertaken in order to provide users with easier choices and help them make better use of
    the experimental information. A series of 23 experiments, mostly of relevance for fusion neutronics will
    be revised and reclassified.

Radiation Transport and Dosimetry

SATIF ( Shielding of Accelerators, Targets and Irradiation Facilities)

45. A first meeting of the subgroup charged with drafting the handbook on Accelerator Shielding is
    scheduled for April 2009. Progress in preparing the chapters and harmonization of content will be
    discussed. The plan is to have a final discussion at the next SATIF workshop, which will be held at CERN,
    Geneva on 2-4 June 2010. The handbook will be published in the course of 2010.

Skyshine benchmark

46. The BAIKAL-1 skyshine experiment (neutron-photon skyshine experiment), first included in
    SINBAD has now undergone further evaluation and review for inclusion in the chapter for criticality alarm
    systems in the September 2009 edition of the ICSBEP handbook. The comparison of performance of
    different codes to predict this experiment can be performed once the evaluation of the experiment is
    completed and published.

Computational Radiation Transport Benchmark Activities

47. The wrap-up meeting of the Expert Group on computational radiation transport benchmarks
    relative to “Benchmarking the Accuracy of Solution of 3-Dimensional Transport Codes and Methods over
    a Range in Parameter Space” was held at Interlaken, Switzerland on 17 September 2008 in connection with
    the Physor-2008 conference. It was attended by 14 participants from five countries. So far six solutions
    were produced. An exact solution based on long Monte Carlo calculations for 729 cases was compared
    against the deterministic solutions. Other independent reference solutions will be made available in order
    to validate the one currently available. This benchmark is designed to elucidate important issues necessary
    to judge the quality of numerical solutions obtained with particle transport software. Several papers were
    presented at the Physor-2008 conference and the one comparing TORT (3D $S_n$) with the MCNP solution
    was selected for publication in Annals of Nuclear Energy.

48. Preparation of the final report is scheduled for spring 2009. A special issue of Progress in
    Nuclear Energy will be devoted to this benchmark, where the different solutions and methods will be
    discussed and compared. It is expected that this benchmark will be used frequently in the future to validate
    transport code performance and precision.

49. A new benchmark proposal to “Monitor the Performance of Detailed Monte Carlo Calculation of
    Power Densities in a Full Size Reactor Core” was proposed for consideration to the Data Bank by
    Prof. J.E. Hoogenboom, University of Delft and Prof. W.R. Martin, University of Michigan. This
benchmark is also of interest for the WPRS activities in computational radiation transport benchmark activities. (For more details see NEA/DB/DOC(2008)2).

Reactor and Fuel Analysis

Minor Actinide Burning in Thermal Reactors

50. A first ad-hoc meeting was held at Interlaken, Switzerland during the Physor-2008 conference. Relevant bibliography on the subject was gathered by the NEA Secretariat and potential contributors from Belgium, Canada, France Japan, Netherlands, USA and EC/ITU have been contacted. The list of contents is being prepared and the papers will be made available in electronic form to the group in charge of preparing the report. First progress will be discussed during the next WPRS meeting on 25 and 26 February 2009 in Paris. It is planned to finalize the draft by the end of 2009 and to publish the report in 2010.

VVER-1000 Coolant Transient Benchmarks Phase 1 & 2

51. The fourth and last volume of phase I, on Best-Estimate Coupled 3-D Core/Thermal-Hydraulic Plant Transient Modelling, is being finalised. For phase II (V1000CT-2), it is planned to issue all volumes in one publication. Volume I and II have been completed, volumes III (Comparison of Computational Fluid Dynamics and Coarse Mesh Calculations with Measured Data) and V (MSLB Best Estimate Coupled Simulation) are being finalised, and volume IV (MSLB Coupled 3D Neutronics / Vessel TH Simulation) is available in draft form.

BWR Full Bundle Test Benchmark (BFBT)

52. Further progress has been made in finalising the papers relative to this benchmark for a special journal issue of Nuclear Engineering and Design. Papers have to be submitted by December 2008 and the reviewing is expected in March 2009.

53. The sixth workshop (BFBT-6) will be held on 27 and 28 April 2009, and will be hosted by the Pennsylvania State University (PSU), USA. The objectives of the next workshop (BFBT-6) will be the following:
   a) Discussion of the report on Phase I
   b) Discussion of the report on Phase II
   c) Discussion of the results submitted for the uncertainty analysis exercises

54. The BFBT database contains a wealth of detailed experimental data and their release and very large participation in the benchmarks starts to show clear benefits to detailed 2-phase-flow modelling. The donors of the data have expressed the wish that this work on 2-phase flow be continued, and that the momentum gained is used to really advance work in this field.

55. The proposal to continue development of refined modelling through benchmarking with very detailed experimental results, such as the one provided within the NUPEC BWR fine-mesh full-bundle tests (BFBT), was discussed at the June 2008 NSC meeting. It was concluded that more details about the proposed extension be provided to delegates well in time for the NSC Bureau meeting in December 2008.

56. In response to this request the Japan Nuclear Energy Safety Organization (JNES) is proposing an expansion of these benchmarks to include PWR bundle tests. Such data have not been released so far to the public domain. Therefore this offer is particularly welcome by the experts and researchers, working in improving the models. The offer concerns a benchmark based on NUPEC PWR sub-channel and bundle tests as described below.
Benchmark Based on NUPEC PWR Sub-channel and Bundle Tests (PSBT)

57. Void fraction measurements and departure from nucleate boiling (DNB) tests were performed under the conditions simulating PWR thermal-hydraulic conditions including the steady states and the transients such as the power increase, the flow reduction, the depressurization and the temperature increase. The database with the measured experimental values and corresponding documentation would be made available including the uncertainties.

58. This issue will be discussed at the WPRS meeting in February 2009 and during the series of meetings scheduled for the end of April 2009, including the third workshop on the OECD Uncertainty Analysis in Modelling (UAM) LWR benchmark, the BFBT6 and the first workshop on the Kalinin-3 VVER coupled code benchmark (see below).

59. **The NSC Bureau is asked to endorse in principle this extension covering new data for PWR bundle tests** in support of code development for the benefit of next generation nuclear power plants and advanced simulations.

Kalinin-3 Coolant Transient Benchmark

60. In support of advanced simulation in best-estimate coupled neutronics/thermalhydraulics and for validation of the simulation tools the availability of detailed, comprehensive, high quality data is required. The release of a comprehensive set of data based on Kalinin-3 NPP measurements was discussed in past meetings related to benchmarks, such as V1000CT, and the UAM (Uncertainty Analysis in Modelling) workshops.

61. A preparatory meeting was held on 31 July and 1 August 2008 in view of such a release and in order to prepare the documentation presenting the data, the setting up of the database and a specification for a benchmark study. Preliminary reports have been prepared, but additional work is going on to finalise the documentation, the database and the cross-section data required for the study. The experimental database will consist of 150 Mbytes of numerical data, plus documentation. Co-ordination of this work will be carried out by the Gesellschaft für Anlagen und Reaktorsicherheit mbH, Garching (GRS) in cooperation with The Pennsylvania State University (PSU), the Kurchatov Institute of Atomic Energy (KIAE) and the NPP Operations Research Institute (VNIIAES), Moscow. A successful start of the Kalinin-3 coolant transient benchmark would ensure that the database could be expanded with many more different transients to be released.

62. The benchmark is structured in four exercises:
   1. Point kinetics plant simulation
   2. Coupled 3-D neutronics/core T-H response evaluation
   3. Best estimate coupled code plant transient modelling
   4. Performing uncertainty analysis for the purpose of phase III of UAM

63. First results will be presented at the meeting scheduled for the week of 27 April - 1 May 2009 at the Pennsylvania State University, USA.

PBMR Coupled Neutronics/Thermal Hydraulics Transient Benchmark

64. The fifth and final workshop on the PBMR Coupled Neutronics/Thermal Hydraulics Transient Benchmark – The PBMR-400 Core Design – was held on 14 September 2008 at Interlaken, Switzerland during the Physor-2008 conference. It was attended by 20 participants from nine countries. The objective was to wrap-up the work accomplished and to define the schedule for finalising and publishing the benchmark reports and to submit papers describing the work in archival journals.
65. The agreed schedule includes the finalisation of results (by the end of October), the draft to be sent to all participants for comments (in November 2008), and the final report to be submitted to the NEA (by the end of January 2009) and published in March/April 2009. A special journal issue containing all the detailed submissions to the benchmark will be pursued in 2009 as a final detailed summary of all the related work.

66. In summary, the PBMR 400MW Code to Code Benchmark added value to methods’ development. It will form part of the PBMR’s V&V work supporting the license application. It has contributed to the verification of available codes and it was the catalyst for new code developments. In addition, five PhD theses (completed or in progress) are related to this work. Finally, increased confidence in the tools used to calculate pebble bed reactors has also been achieved.

67. Further phases under consideration, after the results of the current phase are published, would concern:

- Burn-up benchmark proposal, possibly based on available experimental data
- ASTRA experiment analysis (IAEA / CRP5 definition available)
- AVR experiments (In European program; DLOFC simulated test, Melt-wires)

MOX Fuel Behaviour

68. Two papers related to the WPRS fuel behaviour experiments and benchmarks were presented at Physor-2008. The first paper is entitled “Mixed-oxide (MOX) fuel performance benchmarks” and has been selected for publication in Annals of Nuclear Energy. It summarises the calculation results provided by the contributors for the first two fuel performance benchmark problems (OECD Halden Reactor MOX Fuel and Benchmark and the Belgonucléaire and SCK•CEN PRIMO MOX Fuel Benchmark), including also a sensitivity study of the effect of the rod power uncertainty on code predictions of fuel centerline temperature and fuel pin pressure. The second paper, “Summary of irradiation tests of mixed oxide fuel prepared with weapons-derived plutonium”, relates to irradiations carried out in the Advanced Test Reactor (ATR) at the Idaho National Laboratory (INL). This benchmark is the next one to be addressed by the WPRS.

Physics of MOX-loaded Reactors

69. The report entitled “International comparison of a depletion calculation benchmark devoted to fuel cycle issues; Results from the Phase 1 dedicated to UOx fuels”, prepared by CEA Cadarache, has been submitted for printing. Results of the second phase “Depletion Calculation Benchmark devoted to MOx Fuel Cycles” will be discussed at the next WPRS meeting.

70. An updated summary relative to the VENUS7 benchmark concerning a cold moderated LWR fuel pin lattice with UO₂ and MOX fuel in the core was presented at the Physor-2008 conference. VENUS-7 will be integrated into IRPhE, once the uncertainty analysis is complete; this is scheduled for the March 2010 edition of the Handbook.

71. The VENUS-9 plutonium recycling experiments contributed by SCK•CEN, designed to study boundary effects between zones with different plutonium content and the influence of perturbations at the boundary, were evaluated by the NNL (National Nuclear Laboratories, UK) and reviewed at the October 2008 IRPhE technical review meeting. The results of the review are being integrated for publication in the March 2009 edition of the IRPhE handbook. The VENUS-17 configuration comparing different types of MOX fuel with varying plutonium content and varying plutonium composition will be evaluated for the 2010 edition of the IRPhE handbook.
72. The three benchmarks on the KRITZ-2 LEU and MOX critical experiments were re-evaluated and have undergone recent review for inclusion in the IRPhE handbook. The added sensitivity and uncertainty analyses will considerably enhance the value of these benchmarks for future use. They will be integrated into the March 2009 edition of the IRPhE handbook.

Uncertainty Analysis in Best-Estimate Modelling (UAM)

73. Further work on the OECD Benchmark for Uncertainty Analysis in Best-Estimate Modelling (UAM) for Design, Operation and Safety Analysis of LWRs is in progress. The objectives of the third workshop (UAM-3), which is scheduled for the week of 27 April – 1 May 2009, will be to discuss submitted results of Phase I (Neutronics), draft specifications for Phase II (Core Phase) and priorities for Phase III (System phase). The meeting will be held at the Pennsylvania State University (PSU).

Working Party on International Nuclear Data Evaluation Cooperation (WPEC)

74. Since the latest meeting of the Working Party on International Nuclear Data Evaluation Cooperation (WPEC) on 5 and 6 June 2008 in Japan, the subgroup on “Nuclear Data Needs for Advanced Reactor Systems” published its final report in September 2008. The recommendations for nuclear data improvements mentioned in the report have been reviewed and entered into the WPEC request list for nuclear data. The list contains currently 43 requests of which 32 are considered of high priority.

75. Two additional subgroup reports are expected in draft form by the end of 2008. It concerns the subgroups devoted to the “Evaluated data library for the bulk of fission products” and to the “Processing of Covariance Data”. They will then be reviewed by the WPEC members before being published.

76. The two new subgroups, decided at the last WPEC meeting and confirmed by the NSC, are being established. The titles of the two new subgroups are:
   - Meeting nuclear data needs for advanced reactor systems
   - Assessment of the unresolved resonance treatment for cross section and covariance representation

77. The third subgroup proposed at the last WPEC meeting, entitled “Methods and issues for the combined use of integral experiments and covariance data”, was discussed at the last NSC meeting and it was decided to further review the mandate of the subgroup and take a final decision at the NSC bureau meeting in December 2008. The subgroup mandate can be found in Annex 2.

78. The next meeting of the WPEC will be held on 24-26 June 2009 near the Brookhaven National Laboratory, USA, preceded by a 2-day workshop on covariance data.

Publications


80. The first meeting of the Working Party was held at the NEA headquarters on 25-26 September 2008. The participants discussed the content and organisation of the work.
81. **An organisation with three expert groups was proposed.** The first group on Multiscale Modelling Methodologies will provide a critical review of the present status of modelling, as well as its mid-term and long-term future. The objectives of this expert group are twofold. One objective is to assess the possibilities and limits of numerical methods applied to multiscale modelling of materials for nuclear energy. The second objective is to assess the means to link the different scales. The two other expert groups are problem oriented groups; they are in charge of critically reviewing the development and the bottlenecks for future progress in the fields of fuels and structural materials.

82. Finally **it was suggested to create two additional transversal groups.** One group will lead a reflection on DPA (e.g. radiation damage: revisiting DPA standards). The other group will lead a reflection on possible benchmarks. The group will compare the outcome of various codes and compare calculated with experimental results. Three draft mandates are presently written (see Annex 3 to 5)

![Diagram]

83. Recommendations have been made and expert group members are being nominated. The WPMM members agreed that, before taking any decision, they would like to discuss their respective interests within their organisations.

84. As deliverables, the WPMM has suggested that the critical reviews should be in the form of written contributions collected in one volume to be published by the NEA. The WPMM also envisaged the organisation of a workshop in collaboration with a European Collaborative Project (F-Bridge) and MMSNF (Materials Models and Simulations for Nuclear Fuels) possibly in 2009. During the organisation of such workshops (or sessions in workshops) the reviews are to be presented and discussed within an enlarged community.

85. The second meeting of the Working Party will be held at the NEA headquarters on 30-31 March 2008.

**Progress in other NSC activities**

*Needs of Research and Test Facilities in Nuclear Science*

86. Following the release in February 2008 of the on-line database on “Research and Test Facilities (RTFDB)”, the expert group has finalised a report entitled “Research and Test Facilities Required in Nuclear Science and Technology”. The report is currently being reviewed by some NSC members, before being issued in early 2009.
Workshops, meetings and conferences

Recently organised by NSC

10th IEM on Actinide and Fission Product Partitioning & Transmutation

87. The 10th information exchange meeting on Actinide and Fission Product Partitioning & Transmutation was held in Mito, Japan on 6-10 October 2008 and hosted by JAEA. 155 participants from 14 countries and three international organisations were attended. A total of 117 papers were presented either orally or by poster in following sessions (number of oral and posters are shown in the brackets, respectively):

- NEA, IAEA and EURATOM activities (3, 0)
- Fuel cycle strategies and transition scenarios (8, 2)
- Impact of P&T (4, 3)
- Transmutation fuels and targets (8, 7)
- Partitioning, waste forms and management (9, 34)
- Materials, including spallation targets and coolants (3, 2)
- Transmutation physics experiments, nuclear data (4, 6)
- Transmutation systems (6, 18)

88. The 11th Information Exchange Meeting will be held in the second half of 2010 in USA, hosted by INL and 12th meeting was also suggested by J. Uhlir to host by NRI, Czech Rep., in 2012.

NSC workshops in preparation

International Workshop on the Technology and Component of Accelerator Driven Systems (TCADS)

89. First meeting of Scientific Advisory Committee (SAC) was held on 5 June 2008 at Karlsruhe, Germany. A special session on the EUROTRANS will be organised in the first day. The scope covers: specific aspects for the ADS accelerators, neutron sources, sub-critical systems and current ADS experiments and test facilities. The first announcement will be circulated as soon as the exact date is fixed which is foreseen between February and March 2010. It was also agreed to perform a peer review for the proceedings and a poster session could be organised if there are too many submitted abstracts. The workshop will be hosted by FZK, Germany.

4th IEM on Nuclear Production of Hydrogen

90. The Fourth Information Exchange Meeting on Nuclear Production of Hydrogen will be held in USA on 13-15 April 2009, hosted by Argonne National Laboratory. The meeting was tentatively planned for 2008, but was postponed to avoid overlap with two international conferences, the 4th International Topical Meeting on High Temperature Reactor Technology (HTR 2008) and the 16th Pacific Basin Nuclear Conference, which both will include hydrogen production topic and be held in the autumn 2008.

Recent International Meetings and Conferences

91. The Physor-2008 conference, to the organisation of which the NEA has contributed was a great success. The conference was attended by 554 participants from 35 countries, the largest Physor conference so far. In all 440 papers were presented in oral and poster sessions. The three plenary sessions concerned nuclear in a sustainable world: challenges and perspectives, reactor analysis: advances and new needs, experimental facilities: experience, results and needs. During the four conference days, all aspects of reactor physics – from the newest computational methods and experiments, over issues of coupling neutronics with thermal-hydraulics and materials development, up to the safety of Generation IV fuel
cycles – were discussed in plenary sessions and over 60 parallel and poster sessions. The high number of young participants – more than 80 graduate and doctoral students from all over the world – was outstanding and refreshing. The Conference was framed by two workshops on Advances and Challenges of Monte Carlo Methods and on Reactors for Actinide Management. The next conference in the series will be Physor-2010 to be held in Pittsburgh, USA.

**Workshops and conferences in 2009 and 2010 of relevance to the NSC programme of work**

3-7 May 2009  
*International Conference on Advances in Mathematics, Computational Methods, and Reactor Physics M&C-2009*, Saratoga Springs, NY., USA

10-14 May 2009  
*2009 International Congress on Advances in Nuclear Power Plants (ICAPP ’09)*, Tokyo, Japan

7-10 June 2009  
*The first International Conference on Advancements in Nuclear Instrumentation, Measurement Methods and their Applications ANIMMA*, Marseille, France

29 June-3 July 2009  
*14th International Conference on Emerging Nuclear Energy Systems (ICENES 2009)*, Ericeira, Portugal,

12-17 July 2009  
*17th International Conference on Nuclear Engineering (ICONE 17)*, Brussels, Belgium

6-10 September 2009  
*GLOBAL 2009 — 8th Global Congress on Nuclear Fuel Cycle: Sustainable Options and Industrial Perspectives*, Paris, France,

13-17 September 2009  
*ANS Nuclear Criticality Safety Division Topical Meeting*, Hanford, Wa, USA

21-22 September 2009  
*NEA Workshop on Criticality Safety Research Needs for Future Nuclear Systems*, Idaho State University, USA

27 September-2 October 2009  
*13th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH 13)*, Ishikawa, Japan

7-11 December 2009  
*International Conference on Fast Reactors and Related Fuel Cycles – Challenges and Opportunities*” (FR09), Kyoto, Japan.

19-23 April 2010  
*2010 Topical in Radiation Protection and Shielding (RPSD), Isotopes & Radiation (IRD), and Biology and Medicine (BMD) Joint Topical* Las Vegas, NV , USA

9-14 May 2010  
*Physor-2010 – Advances in Reactor Physics to Power the Nuclear Renaissance*, Pittsburgh, Pennsylvania, USA
May 2010

- **ND-2010 - International Conference on Nuclear Data for Science and Technology**, Republic of Korea
  - 2–4 June 2010
    - **Workshop on Shielding of Accelerators, Targets and Irradiation Facilities**, SATIF10, CERN, Geneva

3–7 October 2010

- **Tenth International Topical Meeting on Nuclear Applications of Accelerators (AccApp ’10)**, Knoxville, TN

18–21 October 2010

- **Joint Symposium on Supercomputing in Nuclear Applications + Monte-Carlo 2010 (SNA2010 + MC 2010)**, Hitotsubashi Memorial Hall, Tokyo, Japan

Autumn 2010

- **11th NEA Information Exchange Meeting on Actinide and Fission Product Partitioning & Transmutation**, USA
Annex 1

Mandate of the

WPFC Expert Group on Innovative Fuels (EGIF)

Chair: K. Pasamehmentoglu (INL, USA)
Members: All NEA member countries
Date of Creation: June 2008
Mandate Expires: June 2010

Objective
Under the guidance of the Nuclear Science Committee (NSC) and the mandate of the Working Party on Scientific Issues of the Fuel Cycle (WPFC), the objective of the Expert Group on Innovative Fuels (EGIF) is to conduct joint and comparative studies to support the development of innovative fuels (including innovative clad materials) that can be implemented in advanced nuclear fuel cycles.

Scope
The scope of the Expert Group covers the technical issues associated with the development of innovative fuels (homogeneous and heterogeneous fuels, ADS fuels, and oxide and metal fuels) and clad materials targeted for use in advanced fuel cycles. The fuel types of interest for EGIF are those that contain minor actinides (MA) as opposed to standard fuels (i.e. uranium or uranium-plutonium fuels that are currently being used in the fuel cycle). The following technical issues associated with innovative fuel development are covered by the Expert Group:

- Innovative fuel fabrication techniques;
- Irradiation performance of innovative fuels (including advanced clad materials);
- Characterisation and post-irradiation examination methods;
- Predictive models/codes for the innovative fuel fabrication and performance;
- Phenomenological experiments in support of model development or validation.

Pertinent to these topics, EGIF will carry out:

- Compile an experimental database;
- Qualification methodologies;
- Develop a process to the technology readiness level for various technologies;
- Perform code-to-code, code-to-experiment benchmark studies;
- Generate status reports on various fuel technologies;
- Define and propose standard benchmark cases for fuel performance and fabrication codes;
- Define experimental benchmarks as well as phenomenological tests to compare characterisation and PIE techniques and results.

Deliverables

- State-of-the-art report on development of innovative fuels;
- Benchmark studies on fuel performance codes and experiments.
Annex 2

WPEC Subgroup Proposal

Title
"Methods and issues for the combined use of integral experiments and covariance data"

Justification for a Subgroup
As a result of the work performed in the WPEC Subgroup 26 on "Nuclear Data Needs for Advanced Reactor Systems" many target accuracies for different reactions, isotopes, and energy ranges have been defined in order to satisfy design requirement uncertainty for many integral neutronic parameters. Many of these target accuracies are very tight and not likely to be achieved with current experimental measurement techniques. It has been suggested that a combined use of integral experiments and differential information (e.g., measurements, evaluation, uncertainty data) would make possible to provide designers with improved nuclear data that would be able to meet design target accuracies.

Subgroup Monitor
R.D. McKnight, ANL (ENDF)

Subgroup Coordinator
M. Salvatores, ANL&INL

Proposed Subgroup Participants (to be revised and/or updated)
G. Palmiotti, INL (ENDF); Won Sik Yang, ANL (ENDF); P. Oblozinsky, BNL (ENDF); R. Little, LANL (ENDF); M. Dunn, ORNL (ENDF); M. Ishikawa, JAEA (JENDL); K. Shibata, JAEA (JENDL); R. Jacqmin, CEA (JEFF); G. Rimpault, CEA (JEFF); I. Kodeli, NEA Data Bank

Definition of the project and proposed activities
It is proposed as a mandate for this new WPEC subgroup to study methods and issues of the combined use of integral experiments and covariance data. Indication should be provided how to best exploit existing integral experiments, define new ones if needed, provide trends and feedback to nuclear data evaluators and measurers. Participation of evaluators (to account for feedback to the files) and a close link to related activities like those coordinated by the WPNCS expert group on Uncertainty Analysis for Criticality Safety Assessment (UACSA) should be clearly established.

Relevance toEvaluated Data Files
Resource to advance the quality of Evaluated Data Files to meet accuracy requirements of Advance Reactor Systems

Time-Schedule and Deliverables:
It is anticipated that the experts of this subgroup could complete and document the activities (mandate) listed above within 2 years.
- June, 2008 Review of subgroup Proposal by WPEC; initiate Subgroup activities.
- June, 2010 Present Draft Report of Subgroup activities; WPEC consideration of potential implementation of subgroup recommendations.
Annex 3

Proposed mandate of the

*WPMM Expert Group on Multiscale Modelling Methods (M3)*

**Chair:**

**Members:** All NEA member countries

**Date of Creation:**

**Mandate Expires:**

**Scope**

Under the guidance of the Nuclear Science Committee (NSC) and under the mandate of the Working Party on Multiscale Modelling of Materials (WPMM), the objective of the Expert Group on Multiscale Modelling Methods (M3) is to provide a state of the art of the various methods and levels of models used for modelling materials for the nuclear industry (fuels and structural materials). The state of the art includes an overview of the methods but also the possibilities and limits of linking different scales.

**Objectives**

The objectives of the Expert Group are:

1. Assess the possibilities and limits of both numerical methods applied to multiscale modelling of materials for nuclear energy and means to link them, in written form:

   - Brief outline of the methods as applied to nuclear materials
   - Advantages and disadvantages
   - Limits, needs and recommendation

2. Foster exchange of experience and dissemination of knowledge gained by applying multiscale tools to fuels and structural materials

**Deliverables**

- A written critical review
- Organisation of an international meeting
Annex 4

Proposed mandate of the

WPMM Expert Group on Benchmarks of Methods (EGBM)

Chair:
Members: All NEA member countries
Date of Creation:  
Mandate Expires:

Scope
At present there are various methods applied in the multi-scale approach for nuclear fuels and structural materials for nuclear systems. These tools have been developed with differing objectives and for various nuclear materials. Most of them have been designed as research tools, even though some are considered for use in the frame of licensing. The different tools are in differing stages of development and have varied validation and verification status. These codes need to be continuously updated and maintained to ensure that they are fit for the design purpose. Under the guidance of the Nuclear Science Committee (NSC) and under the mandate of the Working Party on Multi-scale Modelling of Fuels and Structural Materials for Nuclear Systems (WPMM), the objective of the Expert Group on Benchmarks of Methods (EGBM) is therefore to conduct comparative studies to evaluate and benchmark various methods applied for the multi-scale modelling of nuclear materials.

Objectives
The objectives of the Expert Group are to:

- Assess the accuracy and calculation time of the various first principle tools applied in the assessment of the nuclear materials properties
- Assess the accuracy and calculation time of the various classical molecular dynamic tools applied in the assessment of the nuclear materials properties
- Assess the accuracy and calculation time of the various dislocation dynamics tools applied in the assessment of the nuclear materials properties
- Define the needs for developments of the tools applied in the benchmarks
- Foster exchange of experience and dissemination of knowledge acquired by the application of the various simulations tools to nuclear materials

Deliverables

- Definition of a protocol and a standard test for each modelling tool
- A written report for each benchmark
- Presentation of the outcome of each benchmark at the appropriate workshops organised by the other EG
- Recommendations for improvements of the modelling tools

The presentations of the outcome of each benchmark at the workshops organised by the other EGs will materialize their collaboration.
Annex 5

Proposed mandate of the

WPMM Expert Group on Structural Materials Modelling (EG_SMM)

Chair: All NEA member countries
Date of Creation: 
Mandate Expires:

Scope

In recent years the multiscale modelling approach (MMA) has become more and more important to complement experiments in the search for new materials for nuclear applications. Worldwide, a lot of both scattered and co-ordinated work applying a MMA to a number of structural nuclear materials (SNMs) has been carried out in the last couple of decades, with diverse outcome. In order to define the next steps to be taken towards the development of integrated multiscale modelling frameworks of practical use for nuclear applications and to enlarge the number of possible contributors to this long-term activity, it is important to provide a critical and complete reference review of the state-of-the-art. This review should highlight weak and strong points of the applied approaches and evidence, as much as possible, up to what extent the existing work contributes to enhance our understanding of radiation damage processes in SNMs and bears the promise of providing, one day, predictive tools. Based on this review, some conclusions about the priorities in the field should be also drawn.

Objectives

Within the above stated scope, under the guidance of the Nuclear Science Committee (NSC) and under the mandate of the Working Party on Multiscale Modelling of Fuel and Structural Materials for Nuclear Systems (WPMM), the objective of the Expert Group on Structural Materials Modelling (EGSMM) is to provide a critical review of the state-of-the-art concerning the use of a MMA to describe the changes induced by irradiation in SNMs.

More in detail, the objectives of the Expert Group are:

- To review, based on literature data and direct experience of the experts, significant existing examples of application of the multiscale modelling approach to SNMs;
- To review existing work on different SNMs for present and future reactors and on the different issues concerning these materials;
- To evaluate up to what extent the existing work and results come close to the goal of not only reliably reproducing experimental data, but also providing keys to understand and interpret existing experimental results, with a view, in the long-term, to predicting the behaviour of SNMs under unexplored conditions and/or support the choice and even development of new materials;
- To identify, based on the reviews of points 1 and 2, and the evaluation of point 3, key problems that should be addressed as priorities towards the goal of developing integrated multiscale modelling frameworks of use for SNM applications (in terms of physical phenomena to be quantitatively described, materials and materials properties to be addressed, and also modelling techniques to be developed);
- To foster exchange of experience and dissemination of knowledge, e.g. by organising or participating in the organisation of international workshop(s) on the subject (the workshops can be part of existing initiatives)
This Expert Group is expected to work closely with the Expert group on Multiscale Modelling Methods (EG3M), especially concerning points 4 and 5.

**Deliverables**

- Critical reviews in the form of written contributions collected in one volume to be published under the NEA-OECD sponsorship.
- Organisation of a workshop (or sessions in workshops) where the reviews are to be presented and discussed within an enlarged community.