Organisation for Economic Co-operation and Development  
Nuclear Energy Agency  
Nuclear Science Committee  

Working Party on Nuclear Criticality Safety  

The Fourth Meeting of the Expert Group on Advanced Monte Carlo Techniques (EGAMCT)  

Thursday September 18, 2014  
NEA Headquarters, Issy-les-Moulineaux  
France  

Summary Record  

Under the auspices of the Working Party on Nuclear Criticality Safety (WPNCS), the Expert Group on Advanced Monte Carlo Techniques for criticality safety assessment was formed in 2010 (www.oecd-nea.org/science/wpncs/amct). The goal of the Expert Group is to transfer new Monte Carlo technology to criticality safety practitioners by establishing benchmark exercises to compare the different Monte Carlo codes and methods used by EG members, and suggest guidelines for applying Monte Carlo techniques to problems of importance to practitioners.  

1. Introduction and Welcome  

The Chair of the Expert Group, Mr. Joachim Miss of IRSN, France, opened the meeting and welcomed the participants. Over 20 experts attended the meeting. The meeting was held in parallel with the final meeting of the WPNCS EGBUC.  

This meeting was split in 4 parts:  
- A first part on administrative and general considerations  
- A second part dedicated to Phase I benchmark exercise  
- A third part devoted to discussing other Monte Carlo subjects  
- A last part on the identification of potential future activities/studies and potential review of the EG Mandate.  

2. Administrative Items  

2.1. Approval of the previous Summary Record and Review of Actions  

The summary record of the 2013 meeting was approved without modifications. Actions from the previous meeting were reviewed and discussed. Outstanding actions are discussed under the specific agenda item.  

2.2. Approval of the agenda  

The agenda (appendix A) was approved with minor modifications.  

3. General Considerations  

The Chair, J. Miss gave an overview of the activities and objectives of the Expert Group (EGAMCT2014/01), which is currently working on Benchmark (Phase I) entitled On quantifying the Effect of Undersampling Biases in Monte Carlo Reaction Rate Tallies.
4. Phase I Benchmark

Phase I benchmark is designed to investigate issues that affect the accuracy of Monte Carlo-calculated reaction rate tallies. Undersampling occurs when the neutrons in one generation do not interact with all regions in a problem and results in generational eigenvalue estimates that have not incorporated information from all regions in the system, reaction rate tallies are “skipped” and not scored for an entire generation. Undersampling can lead to inaccurate eigenvalue and reaction rate tally and tally variance estimates.

Already in 2013 participants had pointed out some exercises within the benchmark were in need of simplification. A revision of the benchmark was done. Other minor changes/adaptations in the specifications were found necessary.

4.1. Discussion on Current Results

Four organisations presented their current results:

- **Sweden** (EGAMCT-2014/06) EMS Detailed Results – D. Mennerdahl
  - The discussion highlighted the need to perhaps have precisions for example on the way to ensure fission source convergence, and fixed the very large number of generations that it is recommended to use to ensure that the tally statistical uncertainty is small relative to the expected size of the undersampling bias.
  - Low number of Sources Per Gen (SPG) Biased the results – No clear remedy appears?
    - Very high number of SPG are not efficient an Optimum may be to start with low number of SPG and then increase.

- **France** (EGACMT-2014/03) IRSN Detailed Results – A. Onillon
  - True neutron flux and fission rates uncertainties estimations have been carried out by using 150 simulations with different random seeds
  - For the considered statistical set of parameters, 5000 neutrons per cycle appears to be enough to avoid oversampling bias in keff, and average flux and fission rates in each axial zone.

- **Hungary** (EGACMT-2014/02) KFKI Preliminary Results – G. Hordosy
  - Preliminary results on the case R2
  - An interesting study on ratio of fluxes by comparing pin cell at symmetric positions was presented.

- **U.S.A** (EGACMT-2014/04) ORNL Detailed Results – Ch. Perfetti
  - Investigation on 5 potential metrics for detecting undersampling that show promising potential.
  - These metrics should be detailed in the report.

4.2. Status of first draft of EGAMCT Phase I Report

A first draft of the report was submitted to NEA by J. Miss. A first review of this still incomplete draft was performed. It was asked to the participants to take time to read this draft and send proposals to:

- Add input
- Retitle sections / create new sections
- Identify volunteers for writing sections

5. Other Presentations
Additional discussion on other technical developments in other Monte-Carlo related technical subjects

- D. Mennerdahl presented a study on *Symmetry in Monte Carlo simulations* (EGAMCT-2014/05)
- F. Brown gave a presentation of *New hash-based Energy Lookup Algorithm for Monte Carlo* This new method is announced as promising very significant speedups, running 15-20 times faster than conventional scheme while also reducing memory storage in comparison with the unified energy approach.
- E. Dumonteil spoke about *Particle Clustering in Monte Carlo criticality simulations* (EGAMCT-2014/07)

6. Further extension of Mandate

It was noted that the current Mandate of EGAMCT ends in June 2015; it is likely an extension will be needed.

As expressed in the mandate given by the WPNCS to our Expert Group on Advanced MC techniques, the main objectives are to:

- Survey recent advances in the development of new techniques for Monte Carlo criticality analysis codes.
- Identify new techniques as high-priority for further detailed study, and solicit EG members to investigate each technique.
- Establish benchmark tests that could be used by EG member Monte Carlo codes, and suggest guidelines for applying the new techniques to problems of importance to practitioners.
- Draft recommendations to practitioners for using the improved methodology in their work, and to guide its employment

Pending conclusion of Phase I benchmark and report, other activities to justify an extension of the Mandate are needed (if sufficient common interest is found).

7. Any Other Business and Date of Next Meeting

The next EGAMCT meeting will be held in conjunction with the WPNCS meetings, possibly in July 2015 not to conflict with ICNC-2015 held in September.

With no other business to discuss, the meeting was adjourned.

**List of Actions arising from the 4th EGAMCT meeting**

1. NEA Secretariat – *To distribute revised specifications / draft report*
2. All: *To submit pending results of Phase I benchmark to NEA/J.Miss*
3. All: *To submit contributions to draft report to NEA/J. Miss*
APPENDIX A

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT
Nuclear Energy Agency
Nuclear Science Committee
Working Party on Nuclear Criticality Safety

4th Meeting of the Expert Group on
Advanced Monte Carlo Techniques for Criticality Safety Assessment (EGAMCT)

Thursday September 18, 2014
NEA Headquarters, Issy-les-Moulineaux
France

AGENDA
Meeting venue: NEA Room A

Proposed Meeting Schedule: 9h00 – 18h00

1. Welcome – J. Miss

2. Approval of the agenda, review of actions from past meeting and approval of summary record - Secretariat

3. Benchmark Phase I
   3.1. New Specifications of Benchmark Phase I and Results – J. Miss
   3.2. First global comparisons – Joachim Miss
   3.3. EMS detailed results – Dennis Mennerdahl
   3.4. IRSN detailed results – Anthony Onillon
   3.5. KFKI results – G. Hordosy
   3.6. ORNL detailed results
   3.7. Results from other participants

4. Presentations
   4.1. Symmetry in Monte Carlo simulation, Dennis Mennerdahl
   4.2. New hash-based Energy Lookup Algorithm for Monte Carlo, Forrest Brown
   4.3. TBD - A. Onillon

5. Identification of other activities/studies (Note: Current Mandate of EGAMCT ends in June 2015)

6. Any other business (next meeting): All

7. Adjourn
APPENDIX B

List of Registered Participants to EGAMCT meeting of September 18th 2014
NEA Headquarters, France

Last Name
Alberto OTTONELLO
Alexis JINAPHANH
Dr Dennis MENNERDAHL
Dr Eric DUMONTEIL
Dr Forrest BROWN
Dr Gabor HORDOSY
Dr Joachim MISS
Dr John SCORBY
Dr Maik STUKE
Dr Mourad AISSA
Dr Sedat GOLUOGLU
Dr Toshihisa YAMAMOTO
Dr Yann RICHET
Dr Yuichi YAMANE
Fausto MALVAGI
Mr Anthony J. ONILLON
Mr Bertrand COCHET
Mr Peter ANGELO
Ms Alyse Marie SCURLOCK
Ms Isabelle DUHAMEL
Prof. Paul N. SMITH
Brad Rearden
Christopher Perfetti