

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

Working Party on Nuclear Criticality Safety

**THE FIFTH MEETING OF THE EXPERT GROUP ON
ADVANCED MONTE CARLO TECHNIQUES (EGAMCT)**

July 7th, 2015
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. 26 participants attended the meeting (see participants list in Appendix B).

This meeting was split in 3 main parts:

- A first part dedicated to Phase I benchmark exercise and presentation of results
- A second part dedicated to general technical presentations and discussion
- A third part dedicated to the request of an extension to the present Mandate (2015-2017) and the election of a new Chairman for the EG.

2. Administrative Items

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

The summary record of the 2014 meeting was approved without modifications. Actions from the previous meeting were reviewed. Outstanding actions are discussed under the specific agenda item and concern only Phase I benchmark, and completion of the associated report.

2.2. Approval of the agenda

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

3. Phase I results

J. Miss gave a short introduction to the Expert Group activity, which is currently Benchmark Phase I (*On quantifying the Effect of Undersampling Biases in Monte Carlo Reaction Rate Tallies*). Phase I benchmark exercise investigates undersampling, which occurs when the neutrons in one generation do not interact with all regions in the problem and results in generational eigenvalue estimates that have not incorporated information from all regions in the system, leading to inaccurate tally and tally

variance estimates. J. Miss reports that due to lack of time the draft report of Phase I benchmark has had little progress since last meeting.

A. Onillon gave an in-depth presentation on the analysis of Phase I results using MORET ([EGAMCT2015-01](#)). Among his conclusions, he points out that to avoid local scores bias for all R1, R2, S1, S2 & S3 models in the Phase I benchmark represents an unreasonably large CPU time consumption and memory space, only foreseeable in the case of a benchmark study. **A. Onillon** concludes on the need of an undersampling diagnostic tool for “everyday” use in MC calculations; this is part of the work undertaken by Dumonteil, Zoia and Nowak on the *stationarity of the centre of mass of neutrons over cycles*. A presentation on this topic followed later in the afternoon.

C. Perfetti has implemented undersampling diagnostic metrics in TSUNAMI and presented preliminary results as applied to Phase I benchmark ([EGAMCT2015-03](#)).

4. General, Technical Presentations

E. Dumonteil gave an overview and update on the work performed by Dumonteil, Nowak and Zoia on *neutron clustering diagnostics* ([EGAMCT2015-02](#)). This work examines the viability to construct other indicators for diagnostics of undersampling in a MC calculation.

A. Onillon gave a second presentation on *Spatio-temporal correlations in fuel pin simulations: prediction of true uncertainties on local neutron flux* ([EGAMCT2015-06](#)). In this work, he looks at existing correlations of histories between cycles that impact the proper estimation of the variance of the tallies (the underlying hypothesis is that there are no correlations between different cycles in the cycle iteration method) and establishes a methodology for building and using a correlation matrix for these spatial and cycle to cycle (“temporal”) correlations between particle histories, which is used to estimate true variances of the tallies.

The Expert Group extended particular appreciation to the outstanding work performed by Mr. Onillon. **F. Brown** highlighted the need to have many diagnostic indicators, not only one, all are needed (Shannon entropy, Center of Mass displacement,...).

In a post-meeting note, **D. Mennerdahl** has submitted his comments to these presentations in document ([EGAMCT2015-07](#)) where he questions some of the results and conclusions presented.

A. Zoia presented the lecture *Criticality Catastrophy Revisited* ([EGAMCT2015-05](#)).

F. Brown presented the status of MCNP6.1 development ([EGAMCT2015-04](#)). MCNP6.1.1 has been released in 2014 with ENDF/B-VII.1 nuclear data libraries. and noted that MCNPX has not been as validated for Criticality Safety Calculations as has been MCNP5 or MCNP6. MCNP5 is now unsupported. He highlights that the Criticality Safety community using MCNP should update to MCNP6.

5. Change of EGAMCT Chairmanship

J. Miss announced he would be stepping down from his function of Chairman due to his own changing functions at his institution and unavailability to continue acting as Chairman. He thanked the EG and the NEA for the work and support provided. It was proposed and accepted by all present that Mr. Eric Dumonteil (then at CEA, now at IRSN) takes the lead of the EG as Chairman.

6. Request of an extension of Mandate (2015-2017)

In view of the pending compilation of the first draft of the report and the change of Chairmanship, it was proposed to request from the WPNCs a simple 2 year extension of the present mandate (ending in 2015) without revision of its scope nor deliverables. As expressed in the mandate given by the

Draft for approval

WPNCs to the Expert Group on Advanced MC techniques, the main objectives of the EG, which remain unchanged 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

All agreed and the Mandate was formally extended later that week at the WPNCs meeting.

7. Status of Phase I Report

It was agreed that:

- New Chairman E. Dumonteil would iterate with NEA and EGAMCT participants to provide a reviewed draft of the report. A section or sections of the report could compile recent advancements in MC criticality analysis codes, in particular those used in:
 - UK (UKNNL)
 - Germany (GRS)
 - Sweden (EMS)
 - US (ORNL)
 - France (IRSN, CEA)
- C. Perfetti would help in compiling the results into a template.

8. Any Other Business and Date of Next Meeting

The next EGAMCT meeting will be held in conjunction with the WPNCs meetings on the week of July 4-8, 2016.

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

List of Actions arising from the 4th EGAMCT meeting

1. All: *To submit pending results of Phase I benchmark to NEA/EGAMCT Chair*
2. Chair: *To submit new proposed draft structure of report to NEA for distribution to participants*

APPENDIX A

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT
Nuclear Energy Agency
Nuclear Science Committee
Working Party on Nuclear Criticality Safety
5th Meeting of the Expert Group on
Advanced Monte Carlo Techniques for Criticality Safety Assessment (EGAMCT)

Tuesday July 7, 2015
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
 - a. Status of Benchmark Phase I and Results – J. Miss (IRSN)*
 - b. IRSN results for Phase I with MORET – A. Onillon (IRSN)*
4. Other Presentations
 - a. Diagnosis of spatial correlations – E. Dumonteil, M. Nowak (CEA)
 - b. Study of cycle to cycle correlation in fuel pin simulation : effect on true statistical uncertainties – A. Onillon (IRSN)
 - c. Statistical methods for predicting M.C. undersampling biases – C. Perfetti (ORNL)
 - d. The Critical Catastrophe Revisited – A. Zoia (CEA)
 - e. MCNP Status – F. Brown (LANL)
5. Request for an extension of Mandate NEA Secretariat / All
 - a. Revision of scope (if any)*
 - b. Revision of deliverables list and timeline*
6. Any other business
7. Date and place of the next meeting
 - 4-7 July 2016 ?
8. Adjourn

APPENDIX B

List of Participants to EGAMCT meeting of July 7th 2015 NEA Headquarters, France

FRANCE

COCHET Bertrand	bertrand.cochet@irsn.fr
DUMONTEIL Eric	eric.dumonteil@irsn.fr
JINAPHANH Alexis	alexis.jinaphanh@irsn.fr
MISS Joachim	joachim.miss@irsn.fr
ONILLON Anthony J.	anthony.onillon@irsn.fr
ZOIA Andrea	andrea.zoia@cea.fr
DIEUDONNE Cyril	cyril.dieudonne@cea.fr
NOWAK	micHEL.nowak@cea.fr

GERMANY

STUKE Maik	maik.stuke@grs.de
TITTELBACH Sven	tittelbach@wti-juelich.de
FAST Ivan	i.fast@fz-juelich.de

HUNGARY

HORDOSY Gabor	hordosy.gabor@energia.mta.hu
---------------	------------------------------

JAPAN

MIYOSHI Yoshinori	miyoshi.yoshinori@jaea.go.jp
SUYAMA Kenya	suyama.kenya@jaea.go.jp
YAMAMOTO Toshihisa	toshihisa_yamamoto@nsr.go.jp
YAMANE Yuichi	yamane.yuichi@jaea.go.jp

RUSSIA

DUDNIKOV Anatoly A.	dudnikov_aa@nrcki.ru
---------------------	----------------------

SWEDEN

MENNERDAHL Dennis	d.mennerdahl@ems.se
-------------------	--

UNITED KINGDOM

SMITH Paul N.	paul.smith3@amecfw.com
---------------	------------------------

UNITED STATES

BROWN Forrest	fbrown@lanl.gov
PERFETTI Chris	perfetticm@ornl.gov
RAHIMI Meraj	meraj.rahimi@nrc.gov
REARDEN Bradley T.	reardenb@ornl.gov
BESS John	john.bess@inl.gov
MARSHALL William	marshallwj@ornl.gov

International Organisations

MICHEL-SENDIS Franco	franco.michel-sendis@oecd.org
----------------------	--