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NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE

"Benchmarking the Accuracy of Solution of 3-Dimensional Transport Codes and Methods over a Range in Parameter Space"

Final Meeting held in conjunction with M&C-2009

The Saratoga Hilton Hotel
Saratoga Springs, New York

Enrico SARTORI
sartori@nea.fr
+33 1 45 24 10 72

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OECD Nuclear Energy Agency

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The Saratoga Hilton Hotel
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Room: Broadway 1

6 May 2009, 6:30 to 8:30 pm

Chair: Prof. Yousry Azmy

Summary

1. Welcome, Introduction of participants

Yousry Azmy welcomed participants to this last meeting, aiming at presenting the most recent results, some of which had been presented also at the M&C-2009 conference sessions, and to decide the next steps to complete the benchmark work and publish it.

The meeting was attended by 14 participants, who introduced themselves (see Annex).

2. Status of benchmark

a. New reference solution

Kursat B. Bekar presented the "Reference Solution Set for the NEA Suite of Benchmarks for 3 D Transport Methods and Codes over a Range in Parameter Space". First the preliminary MCNP reference solution set was presented which had been obtained with 2 billion particle histories. Of the 729 different configurations (each having 23 different quantities) computed by MCNP5 (with multi-group options, 1 group calculation) and using no biasing, 72 quantities were not computed (0-tally scoring for some benchmark quantities for some benchmark cases), more than 500 quantities had a statistical error larger than 5 % (poor statistics for many cases), 159 cases had unreliable results.

An improved MCNP reference solution set using ADVANTG/MCNP5 with FW-CADIS (John C. Wagner, Radiation Transport & Criticality Group, ORNL) was produced. ADVANTG uses TORT driven cell-averaged scalar flux distributions to generate Monte Carlo weight windows parameters by implementing FW-CADIS methodology. Then, MCNP5 computes the benchmark quantities for all benchmark cases using the generated weight windows parameters. With this procedure the new reference solution set was produced. The use of ADVANTG/MCNP5 code sequence improved the reference solution set. In fact this removed the 0-tally scoring problem, and reduced the statistical errors for most quantities that had unreliable values without variance reduction.

An additional effort to obtain the reference solution set had been provided by Alan P. Copestake, Rolls-Royce plc, using MCBEND results for a few sample cases. For these cases MCBEND and ADVANTG/MCNP results are consistent with each other for most quantities . Some quantities (e.g. 2.e,…,2.h) with net leakage across internal faces show larger discrepancies between the two codes. In fact, the leakage term was not calculated in the same way as with MCNP5. These cases will be recalculated and resubmitted.

In conclusion the latest reference solution set computed by ADVANTG/MCNP is more reliable than the preliminary reference solution set. This set can be used by the participants to evaluate the solution of their 3D deterministic code to this benchmark.

b. Results from participants

Presentations from some participants followed

-   Yi Ce presented the results obtained with TITAN,

-   Nicolas Martin presented the results obtained with DRAGON,

-   Armin Seubert presented a TORT solution using very strict convergence criteria (10^{-7}),

-   Dave Barrett presented orally his results.

3.   Publication of Benchmark report

The results will be published in a special issue of *Progress in Nuclear Energy* (*PNE*) within a year or so. Enrico Sartori will distribute a form to participants for them to provide the relevant information on the code used, including, name, references, method used, assumptions made in the calculations and convergence criteria used. A synthesis of this will be added as an Appendix to the summary report.

A report to be published by OECD/NEA summarizing the benchmark and the results obtained, including conclusions, recommendations and lessons learned, will be prepared. The benchmark specification, the reference solutions and the results provided by the participants will be 'packaged' at the NEA Data Bank for distribution to participants and to others who wish to use the benchmark for testing their codes or to learn how to solve difficult cases.

The *PNE* issue will contain

1. The description of the benchmark and the synthesis of the results.
2. The reference solutions.

3. The individual solutions compared with reference solutions. This part will consist of individual articles written by participants describing in detail the methodology used and assumptions made.

a. Schedule

– Y. Azmy sends out an e-mail asking participants to vote on how they wish the data to be presented and condensed, norms to be used for absolute and relative errors, RMS? Issues of monotonicity etc. (week of 11 May 2009)

– Participants indicate their preferences (by 21 May 2009). In case of lack of consensus, the chairman will make the choice.

– Participants submit their paper for *PNE* by September 1st 2009.

– Participants submit their final results by September 1st 2009 to Kursat Bekar.

– A copy of the collected files will be submitted to the NEA Data Bank by Kursat Bekar for 'packaging' and distribution. Distribution will be done also by RSICC.

4. Proposal for Further Benchmarks

It was proposed to continue this activity by proposing new benchmarks. One proposal was made by David Barrett, entitled "Benchmark to Assess the Accuracy of the Various Methods Used by Transport Codes to Model Material Interfaces". Transport codes use many different spatial meshing or grid generation techniques. When faced with a configuration with curved interfaces between distinct materials codes may model these interfaces using different approximations. The idea behind this benchmark proposal is to provide a single test problem that quantifies and qualifies the effects of the different approximations. A Monte Carlo based 'reference solution' would be used as a reference solution. This proposal will be submitted at the forthcoming OECD/NEA Data Bank meeting. A draft version of the specification will be distributed to potential participants for comments. A final version and a schedule for completing the benchmark will be provided. Results could be presented at the M&C-2011 conference.

Annex

List of participants

CANADA

MARLEAU, Guy   **Tel: +1 514 340 4711 ext 4204**
Institut de genie nucleaire   Fax: +1 514 340 4192
Ecole Polytechnique de Montreal   Eml: guy.marleau@polymtl.ca
Case Postale 6079
succ. Centre-Ville
MONTREAL, QUEBEC H3C 3A7

MARTIN, Nicolas   Tel: +1 514 340 4192
Ecole Polytechnique de Montreal   Fax:
Institut de Genie Nucleaire   Eml: NICOLAS-3.MARTIN@POLYMTL.CA
PO Box 6079, Station Centre-Ville
2900 boul. Edouard-Montpetit
Montreal H3T 1J4

GERMANY

SEUBERT, Armin   Tel: +49 89 32004 469
Gesellschaft fuer Anlagen-   Fax: +49 89 32004 10599
und Reaktorsicherheit (GRS) mbH   Eml: armin.seubert@grs.de
Forschungsinstitute
D-85748 GARCHING b. Muenchen

UNITED KINGDOM

BARRETT, David   Tel: +44 118 9826398
AWE Aldermaston   Fax: +44 118 9824820
Building E3   Eml: dave.barrett@awe.co.uk
READING RG7 4PR

COPESTAKE, Alan   Tel: +44 1 332 667124
Rolls Royce Marine Power   Fax +44 1 332 622 939
P.O. Box 2000   Eml: alan.copestake@rolls-royce.com
Derby DE21 7XX

SMEDLEY-STEVENSON, Richard P.   Tel: +44 1 18 9824173
AWE Aldermaston   Fax: +44 1 18 9824820
Building E3.1, Room 206   Eml:richard.smedley-stevenson@awe.co.uk
READING, RG7 4PR

UNITED STATES OF AMERICA

AZMY, Yousry   Tel: +1 919 515 3385
Head, Department of Nuclear Engineering   Fax: +1 919 515 5115
North Carolina State University   Eml: yyazmy@ncsu.edu
Campus Box 7909
1110 Burlington Laboratories
Raleigh, NC, 27695-7909

BEKAR, Kursat B.   Tel: +1 865 241 2437
OAK RIDGE NATIONAL LABORATORY   Fax: +1 865 576 3513
PO Box 2008 MS6170   Eml: bekarkb@ornl.gov
OAK RIDGE TN 37831-6170

DAHL, Jon A.   Tel: +1 505 665 3972
Los Alamos National Laboratory   Fax: +1 505 665 5538
LOS ALAMOS, NM 87544   Eml: dahl@lanl.gov

HAGHIGHAT, Alireza   Tel: +1 352 392 1401 x306
Nuclear and Radiological Engineering   Fax: +1 352 392 3380
202 Nuclear Sciences Building   Eml: haghighat@ufl.edu
University of Florida
Gainesville, FL 32611

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KIRK, Bernadette L.                        Tel: +1 865 574 6176
Director                                   Fax: +1 8652414046
RSICC/ORNL                                 Eml: kirkbl@ornl.gov
PO Box 2008
Bldg. 5700, MS 6171
Oak Ridge, TN 37831-6171


ROSA, Massimiliano                         Tel: +1 505 667 0869
Computational Physics (CCS-2)              Fax: +1 505 665 4972
Los Alamos National Laboratory             Eml: maxrosa@lanl.gov
P.O. Box 1663, MS K784
Los Alamos, NM 87545


YI, Ce                                     Tel:
Nuclear and Radiological Engineering       Fax:
202 Nuclear Sciences Building              Eml: yice@ufl.edu
University of Florida
Gainesville, FL 32608
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International Organisations
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SARTORI, Enrico                            Tel: +33 1 45 24 10 72 / 78
OECD/NEA Data Bank                         Fax: +33 1 45 24 11 10 / 28
Le Seine-Saint Germain                     Eml: sartori@nea.fr
12 boulevard des Iles
F-92130 Issy-les-Moulineaux
France
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