

**Summary Record of the 5th Meeting of WPEC Subgroup 39 on
Methods and approaches to provide feedback
from nuclear and covariance data adjustment
for improvement of nuclear data files**

Institut Curie
11, Rue Pierre et Marie Curie
75005 Paris, France

4 December 2015

The subgroup co-ordinators, **M. Salvatores** and **G. Palmiotti**, welcomed the participants to the meeting (see list in Appendix 1). **O. Cabellos** acts as secretary. The proposed agenda was adopted (see Appendix 2).

1. Review of actions

M. Salvatores welcomed the new participants, P. Leconte and V. Sobes, he also reminded the participants of the subgroup objectives. The review of actions agreed at the previous meeting is performed during technical presentations.

2. Presentations

[“Short update on deliverables”, K. Yokoyama](#)

K. Yokoyama presented the comments by Dr. Kodeli (15 June 2015) on differences between JENDL-4.00, COMMARA-2 and SCALE-6.0 covariance data in total nu-bar, delayed nu-bar, correlations between ²³⁸U elastic and inelastic, and ⁵⁶Fe inelastic. He also reported the comments by O. Cabellos and C.J. Diez (June 2015) on recent updates in covariance data for ²³⁹Pu and ²³⁵U nu-bar, and covariance data from TENDL-2012 library. It was agreed include few sentences based on these comments in the “Introduction” of the first deliverables.

K. Yokoyama reviewed the status of the first two deliverables, “Comments on Covariance Data” and “Summary of Methodology”. **M. Salvatores** acknowledges the work done.

[“Is it one shot Bayesian equivalent to successive updates? Bayesian inference: some matrix linear algebra”, C. De Saint Jean](#) (this presentation was not included in the agenda)

C. De Saint Jean assessed the impact of correlations between experiments and the effect of recalculated sensitivities at each step. It was concluded that once-through adjustment (all experiments at the same time) will give a posterior covariance matrices equivalent to a successive adjustment, if only if, there are not correlations between experiments and if the sensitivities are not recalculated at each steps.

[“Progress in Methodology”, G. Palmiotti](#)

G. Palmiotti presented the progress on methodology, incorporating REWIND weights in adjustment procedure in order to rank experiments. It can be seen that results compared against the standard methodology showed reasonable/good agreement. However, the ranking favours more global experiments than the elemental type one, and, therefore, it is not clear if compensations are avoided.

[“Use of PIA approach. Possible application to neutron propagation experiments”, S. Pelloni](#)

S. Pelloni presented the use of PIA approach applied to 4 experimental configurations (with 14 experiments) having measured spectral indices (JEZEBEL, ZPR6-7 and ZPPR9, and GODIVA), for 11 nuclides and 6 reactions. PIA method is applied for three different cases: 1) Adjusting simultaneously, 2) First GODIVA, then ZPPR9 coolant density effects, ZPR6-7, ZPPR9 and to finish with JEZEBEL, 3) reversed adjustment in (2). It was concluded that case (1) may suffer from larger compensation effect, cases (2) and (3) give similar results. Results are focused on ^{239}Pu cross-sections. Then, keff is included in the adjustment, leading to compensating effects in cross sections. So, it could be useful if the last keff adjustment is limited to specific data not adjustable elsewhere (e.g. nubar). The work will be completed including other isotopes and reactions.

[“Update on sensitivity coefficient methods”, E. Ivanov](#)

E. Ivanov presented a comparison of methodologies/theory to compute sensitivity coefficients, including bibliographic references on the theoretical analysis. A comparison of selected ICSBEP benchmarks was used to test the current capabilities: PMF-006 (Flattop-Pu), HMF-028 (Flattop-25), HMI-001 (ZPR 9/34 loading 303) and PMI-002 (ZPR 6/10 loading 24). A total number of 8 codes/methods were compared: Monte Carlo (MONK, SERPENTv2, MCNP6, SCALE6.2b) and Deterministic codes (SCALE6.1, ANISN/PARTISN). It was discussed the content of the Deliverable on “MC Sensitivity Coefficients” and how to address other important issues: negative sensitivity to (n,2n) reactions, the metric to the results presentation and the selection of experimental Benchmarks and their covariance matrices.

[“Stress test for U-235 fission”, H. Wu](#)

M. Salvatores (on behalf H. Wu) presented this work to identify potential compensation errors with critical benchmarks sensitive to $^{235}\text{U}(n, f)$ in 1-10 keV region due to missing essential constraints. The SG33's adjustment is modified with two new Benchmarks (HCI4.1 and HMI6.2 for keff) with intermediate neutron spectrum. This stress test shows that different constraints give different trends of adjustment for both integral and differential data. The study concluded that the lack of complete constraints for a global adjustment can be the cause of compensating errors.

[“Methods and approaches development at ORNL for providing feedback from integral benchmark experiments for improvement of nuclear data files”, V.Sobes](#)

V. Sobes presented the status of two methodologies developed by ORNL: **SAMINT** (A Code for Nuclear Data Adjustment with SAMMY Based on Integral Experiments), and **INSURE** (INverse Sensitivity/Uncertainty Estimator). **SAMINT** allows update the resonance parameter evaluation (and associated covariance) directly based on integral benchmark experiments. To demonstrate SAMINT capabilities, adjustment of the resolved resonance region evaluation of ^{56}Fe is presented. **INSURE** code is used to determine target accuracies of differential nuclear data needed to model applications based on integral benchmarks experiments. An example calculation for a PWR fuel array is presented, using the ICSBEP Benchmark LEU-COMPTHERM-001, a water-moderated UO₂ fuel rods with square-pitched arrays.

[“Update on SEG analysis. Status of MANTRA. Possible new experiments at NRAD”, G. Palmiotti](#)

G. Palmiotti (on behalf A. Hummel, INL) presented the re-analysis of the RRR/SEG (Fast-Thermal Coupled Facility) experiments: SEG 4/5 (energy-independent adjoint spectrum), SEG 6 (monotonously rising adjoint function) and SEG7 (similar to SEG 4/5 but have softer neutron spectrums). Flux and adjoint spectra and central reactivity worths are calculated with MCNP6.1. Future work is focused on sensitivity/uncertainty analysis and the use of TRIPOLI code for exact perturbation calculations. A. Hummel will spend three months at CEA Cadarache center where he will perform this latter task. He will report on the performed SEG analysis at next SG39 meeting.

G. Palmiotti presented “MANTRA-2” project, a proposal for a second irradiation experiment in the ATR reactor. It is focused on minor actinides in fast neutron spectrum. This activity has been also

presented in the *Expert Group on Integral Experiments for Minor Actinide Management, October 2015*. Participation to these experiments will be very welcome and possible expression of interest are expected in the next couple of months

G. Palmiotti presented **MASSIMO** project (Measurements in Adapted Spectra of Spectral Indices and Material Oscillations), and the proposed experimental campaign at the Neutron Radiography Reactor (NRAD) Reactor at INL. This project is still under consideration. The goal is to carry out spectral indices and reactivity oscillation measurements in a multi-spectra environment using filters at the experimental location. He presented a parametric investigation (different Cd-B-U filters) in order to assess the sensitivity profiles (Am241, Cm245, U235,...) and neutron spectra in the experimental zone. This activity has been also presented in the *Expert Group on Integral Experiments for Minor Actinide Management, October 2015*. Here again, expressions of interest would be very welcome and different modes for participation could be possible (attachment of staff for short periods of time, experimental techniques/equipment, analytical support etc.)

[“Comparison of deterministic and Monte Carlo sensitivity analysis including SAD/SED”, I. Kodeli](#)

Ivo Kodeli presented a beff sensitivity comparison between SUSD3D and SERPENT codes, with an excellent/good agreement for Jezebel, Flattop-Pu and SNEAK-7A, including SAD/SED sensitivities. Within OECD/UAM project, SNEAK-7A & 7B inter-comparison exercise of cross-section sensitivity and uncertainty codes has been proposed. Preliminary results show a good consistency between the sensitivities, both integral values and sensitivity profiles.

[“On going CEA activities related to dedicated integral experiments for nuclear date validation in the Fast energy range.”, P. Leconte](#)

P. Leconte presented an overview of ongoing activities on integral experiments by CEA. First, a review of ERMINE experiments on fission products, and the proposal of a new ZEPHYR experiment for substitution of MINERVE MTR assemblies to regular PWR-type UO₂ fuel pins. Second, shielding and transmission experiments: EXCALIBUR on ²³⁸U(n,n'), use of the GELINA pulsed neutron source to perform transmission/shielding experiments in the target hall, and transmission experiments in CROCUS(training reactor) for study Fe, Cr and Ni cross-sections. Finally, fast neutron activation experiments for minor actinides in TAPIRO fast reactor, and fission product activation measurements in CALIBAN.

[“PROTEUS Experiments: an update”, M.Hursin](#)

M Hursin presented a summary of PROTEUS FDWR-II (HCLWR) program for SG-39, including new results of void reactivity for core 7 and 8 calculated with MCNP and SERPENT. Detailed information of data provided to SG39 member is also summarized: C/E for kinf of core 7 and 8, sensitivity coefficients generated from pin-cell models according SG33 format, and infinitely dilute cross-sections and associated uncertainties for the isotopes and reactions of SG33. Enhanced S/U analysis with comparison between codes (MCNP, SERPENT, TSUNAMI) and methods (GPT) and non-kinf measurements (spectral indices, power traverse) will be presented in the next meeting.

[“Short updates on neutron propagation experiments, STEK, CIELO status”, O. Cabellos](#)

O. Cabellos presented the current status of STEK experiment checking with D.F. da Cruz (NRG). He also presented feedbacks/future actions from CIELO project. At this point, he informed on the *Consultant's Meeting on Compensating Effects due to Nuclear Reaction and Material Cross Correlations in Integral Benchmarks*, as part of the IAEA activity on the CIELO project, October 2015. The main objective of this Meeting is to identify the most common compensating effects in reaction cross-sections and cross-material correlations, defining a methodology for selecting a list of benchmarks in order to improve the basic physics of differential cross-section data. However, CIELO project is still at the stage of the mean values and covariance data are not assessed yet.

[“Update on ongoing activity of EGIEMAM-I”, G.Palmiotti, M.Salvatores](#)

G. Palmiotti reported on the current activities carried out in the “Expert Group on Integral Experiments for Minor Actinide Management” and close related with WPEC/SG39 activities. In the following discussion it was mentioned that the FCA IX experimental campaign has been made available by JAEA for analysis, and this is of interest for SG39. K. Yokoyama mentioned that he has already performed an updated analysis, but, due to financial constraints, results could not be made available to SG39 before end of March 2017.

3. Perspectives and review of pending actions.

Deliverables, reports, databases

- Finalize Deliverable on “Methodologies and Covariance Data”:
 - MS (INL) to write introduction by 31/12/2015
 - Secretariat: to edit and publish by next meeting the report based on the last versions provided by K. Yokoyama and M. Ishikawa (JAEA) and endorsed during the meeting
- E. Ivanov (IRSN) to finalize report on MC sensitivity coefficients by 1/3/2016. Update some bibliographic references in the report.
- I. Kodeli (IJS) to send to Secretariat by 1/1/2016 (Please confirm) sensitivity coefficients and infinite dilution cross sections in SG33 format together with the C/Es of:
 - Beff experiments in Flattop and SNEAK 7A and 7B
 - Propagation experiments in ASPIS-88 (which detector responses? Please specify)
- M. Hursin (PSI) to provide by next meeting new sensitivity for PROTEUS experiments (spectral indices, please specify which one) and C/E values for all experiments provided to SG39
- S. Pelloni (PSI) to complete report on PIA method utilization (adjusted results for more reactions etc.) and possibly to contribute to propagation experiments analysis and sensitivity coefficient data bases implementation.
- K. Yokoyama to provide status of FCA-IX experiments of central fission rate ratios for minor actinides measurements to be used in SG39.
- O. Cabellos to provide feedbacks from CIELO.

Ongoing activities and expected results/discussions

At the next meeting the following should be discussed:

- Further progress on optimal experiment utilization (avoiding compensations etc.) and new approaches: G. Palmiotti (INL), E. Ivanov (IRSN), S. Pelloni (PSI), K. Yokoyama (JAEA), M. Salvatores (INL), C. de Saint Jean (CEA) (?), others (?)
- V. Sobes (ORNL) to report progress at ORNL on target accuracies, continuous energy adjustments etc.

- M. Aufiero (Un. Berkeley) to be asked to report on continuous energy adjustment methodology
- A. Hummel presentation on TRIPOLI analysis of SEG experiments and associated uncertainty/sensitivity analysis
- E. Ivanov, generation of 33 and 44 groups pseudo-covariance matrices for major CIELO nuclides to support the methodological studies of adjustment algorithms

As far as data adjustments and feedback to CIELO, the following results are expected:

- SG33 benchmark exercise expanded to the new experiments provided in the frame of SG39 (PROTEUS, ASPIS, Beff) and any other experiment as suggested by H. Wu (CAEA) stress test. Use should be made also of suggested methods for optimal use of experiments.
- Extended adjustment using a wider integral data base and new proposed approaches for optimal use of experiments, with the objective to provide feedback to CIELO.

As for contributions to the last two points, commitment has been expressed by INL. It has been strongly suggested that JAEA and CEA provide their contributions to make trend assessment more robust

8. Next meeting

It is proposed to hold the next SG39 meeting during the next WPEC Nuclear Data Week at the NEA, **May 10** (Tuesday, starting in the afternoon)-**11**(Wednesday), **2016**.

Appendix 1

Participants to the 5th meeting of WPEC subgroup 39

NEA, Issy-les-Moulineaux, France

5 December 2015

Mr. Oscar CABELLOS Nuclear Data Physicist NEA/DB OECD Annexe Issy 503 2 rue André-Pascal 75016 Paris France	+ (33-1) 45 24 10 84 Oscar.Cabellos@oecd.org
Dr. Cyrille DE SAINT JEAN DRN/DER/SPRC/LEDC CEA CADARACHE Bat. 230 13108 SAINT PAUL LEZ-DURANCE France	+33(0)4 4225 4101 +33(0)4 4225 7595 cyrille.de-saint-jean@cea.fr
Dr. Mathieu HURSIN Paul Scherrer Institut OPRA/E07 CH-5232 Villigen-PSI Argau	mathieu.hursin@psi.ch
Dr. Evgeny IVANOV PSR-EXP Institute for Radiation Protection and Nuclear Safety 92262 Fontenay-aux-Roses France	+33(1)58358424 +33(1)46575412 evgeny.ivanov@irsn.fr
Dr. Ivan KODELI Institute Jozef Stefan Jamova 39 1000 Ljubljana Slovenia	+386 1 588 5412 ivan.kodeli@ijs.si
Pierre LECONTE	+33 04 42 25 23 97 pierre.leconte@cea.fr

<p>DER/SPEx/LPE CEA Cadarache Bat. 238 13115 ST. PAUL LEZ DURANCE</p>	
<p>Dr. Giuseppe PALMIOTTI</p> <p>Idaho National Laboratory (INL) INL/EROB 2525 Fremont Ave PO Box 1625 , ID 83415-3860 Idaho Falls United States</p>	<p>+12083603544</p> <p>giuseppe.palmiotti@inl.gov</p>
<p>Dr. Sandro PELLONI</p> <p>PSI CH-5232 VILLIGEN PSI Switzerland</p>	<p>+41 (56) 310 20 75</p> <p>sandro.pelloni@psi.ch</p>
<p>Professor Massimo SALVATORES</p> <p>Idaho National Laboratory (INL) Idaho National Laboratory /EROB 83415-3860 Idaho Falls United States</p>	<p>+33 6 43 85 25 04</p> <p>salvatoresmassimo@orange.fr</p>
<p>Dr. Vladimir SOBES</p> <p>Reactor and Nuclear Systems Division Department of Energy--Oak Ridge National Laboratory Oak Ridge National Laboratory 1 Bethel Valley Rd 37831-6170 Oak Ridge United States</p>	<p>+1 8572098287</p> <p>sobesv@ornl.gov</p>
<p>Mr. Kenji YOKOYAMA</p> <p>Assistant Principal Researcher Research Group for Reactor Physics and Standard Nuclear Code System, Nuclear Data and Reactor Engineering Division, Nuclear Science and Engineering Center, Sector of Nuclear Science Research Japan Atomic Energy Agency (JAEA) 2-4 Shirakata, Tokai-mura, Naka-gun 319-1195 Ibaraki-ken Japan</p>	<p>+81-29-284-3952 +81-29-282-6122 yokoyama.kenji09@jaea.go.jp</p>

Appendix 2

Agenda of the 5th meeting of WPEC subgroup 39

WPEC SG39

“Methods and approaches to provide feedback from nuclear and covariance data adjustment for improvement of nuclear data files”

Agenda

Institut Curie
11, Rue Pierre et Marie Curie
75005 Paris, France

Friday, December 4, 2015 Room BDD 2 Starting at 09:00 am – Ending at 18:00 pm	
09:00 - 09:15	Welcome, review of actions and introduction (O. Cabellos, G. Palmiotti and M. Salvatores)
	<u>Methods</u>
9:15- 9:35	SG39-1: “Short update on deliverables”, K. Yokoyama
9:35-10:05	SG39-2: “Progress in Methodology”, G. Palmiotti
10:05- 10:20	Coffee break
10:20-10:50	SG39-3: “Use of PIA approach. Possible application to neutron propagation experiments”, S. Pelloni
10:50-11:20	SG39-4: “Update on sensitivity coefficient methods”, E. Ivanov
11:20-11:40	SG39-5: “Stress test for U-235 fission”, H. Wu
11:40-12:10	SG39-6 "Methods and approaches development at ORNL for providing feedback from integral benchmark experiments for improvement of nuclear data files", V.Sobes
12:10 – 13:30	Lunch break
	<u>Integral experiments</u>
13:30-14:15	SG39-7: “Update on SEG analysis. Status of MANTRA. Possible new experiments at NRAD”, G. Palmiotti
14:15-14:45	SG39-8: “B-eff experiments”, I. Kodeli

14:45-15:15	SG39-9: “On going CEA activities related to dedicated integral experiments for nuclear date validation in the Fast energy range.”, P. Leconte
15:15-15:35	SG-39-10 “PROTEUS Experiments: an update”, M.Hursin
15:35-15:50	SG39-11: “Short updates on neutron propagation experiments, STEK, CIELO status” (Secretariat)
15:50- 16:00	SG39-12: “Update on ongoing activity of EGIEMAM-I“ (G.Palmiotti, M.Salvatores)
16:00- 16:30	<u>Future activities of the Subgroup</u>
16:30	Adjourn