WPEC/46/18/11/2

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NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE

Working Party on International Nuclear Data Evaluation Co-operation (WPEC)

WPEC Subgroup 46 Meeting

SUMMARY RECORD

27 November 2018

OECD-NEA, Boulogne-Billancourt 92100, France

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Organisation for Economic Co-operation and Development
Nuclear Energy Agency
WPEC Subgroup 46 Meeting
OECD-NEA, Boulogne-Billancourt 92100, France

27 November 2018

Contents

1 Welcome and practicalities

The chairs, **Massimo Salvatores and Giuseppe Palmiotti**, opened the meeting. They welcomed the participants (see Appendix A) and the NEA Secretariat, **Michael Fleming**.

2 Adoption of the agenda and approval of summary records

The proposed agenda (see Appendix B) was adopted at the opening of the session. The summary record of the previous WPEC Subgroup 46 Meeting (**WPEC/46/18/4/1**) was approved without modifications.

3 Review of actions

The list of actions agreed upon in the previous meeting (see **WPEC/46/18/4/1**) was reviewed and the following statements were made regarding those actions:

3.1 (I. Kodeli) Confirm if ASPIS iron measurements were performed in a continuous set

It was reported that this action could not be completed and it has been **closed**.

3.2 (I. Kodeli) Retrieve Czech (Rez) data for SINBAD from B. Jansky

There is considerable interest in this data and the JANUS 2-7 experiments. The JANUS 1 and 8 are already included in SINBAD and this action will be expanded to include both the Rez data and the addition of the remaining JANUS set.

3.3 (G. Palmiotti) Update SG39 report with contribution from V. Huy (CEA)

Action completed

3.4 (M. Salvatores + G. Palmiotti) Provide SG39 introduction

Action completed

3.5 (M. Fleming) Solicit contribution from E. Ivanov

Action completed

3.6 (M. Salvatores and G. Palmiotti) Provide Methods: PIA and REWIND for SG39 report

Action completed

3.7 (M. Salvatores and G. Palmiotti) Provide Experiments: Introduction for SG39 report

Action completed

3.8 (H. Wu) Provide Experiments: Stress Test for SG39 report

Action completed

3.9 (M. Fleming) Verify the M. Hursin PROTEUS contribution for SG39 report

Action completed

3.10 (I. Kodeli) Submit β_{eff} and Propagation sections

Action completed

3.11 (M. Salvatores and G. Palmiotti) Provide Experiments: FCA for SG39 report

Action completed

3.12 (S. Pelloni) Provide contributions on TENDL adjustment

Action completed

3.13 (G. Palmiotti) Provide Adjustments: CIELO section

Action completed

3.14 (G. Palmiotti) Provide Adjustments: Impact of New Evaluations

Action completed

3.15 (V. Huy and C. de Saint-Jean) Provide Adjustments: Integral Experiments and Assimilation

Action completed

3.16 ((M. Salvatores and G. Palmiotti)) Provide Final Recommendations chapter

Action completed

4 Presentations

4.1 Status of the WPEC SG 39 Summary Report, M. Fleming

The draft of the summary record for the WPEC Subgroup 39 on 'Methods and approaches to provide feedback from nuclear and covariance data adjustment for improvement of nuclear data files' was distributed to the participants in advance of the meeting and the content of the report was discussed.

Recommendations from the participants of the meeting were recorded in Actions that are included in the subsequent section of this document.

4.2 Summary of SG26 action on target accuracy requirements and its impact, M. Salvatores

A new expanded exercise to update target accuracies for design and required cross section accuracies would be of relevance for the HPRL update and to support data files adjustments based on selected integral experiments and improved adjustment methods as suggested in SG39.

4.3 HPRL status and procedures for feedback/request/update, E. Dupont

The status of the Expert Group on the High Priority Request List (HPRL) for Nuclear Data (SG-C) was presented by the current Chair, Emmeric Dupont. The procedures and HPRL entries, as well as possible collaborations between SG46 and SG-C were described. This included a review of the new classification scheme of existing HPRL entries, addition of new requests and a discussion of the value of previous activities such as the WPEC SG26.

4.4 SG46 Target Accuracy Requirements Exercise, G. Palmiotti

The presention illustrated first the why of the exercise including the action indicated in the mandate and the motivations. The invesre problem methodology was then shown, followed by the energy group structured adopted in the past by SG26 (33 groups) and the new one (7 energy groups) proposed for this current exercise. The target accuacies for design integral parameters adopted by the SG26 were shown. The list of reactions, cost paramters and isotopes are proposed for discussion. Finally, a potential list of cnadidate advanced target reactors are indicated and examples of related available data were shown.

4.5 2-dimensional R-Z calculation model of 750MWe JSFR (Japan Sodium-cooled Fast Reactor), K. Yokoyama

The document on the calculation models of the 750MWe JSFR core was presented. The models are based on the latest core design of the next-generation sodium-cooled fast reactor in Japan. The document provides 2-dimensional R-Z models and compositions.

4.6 Treating inconsistent data in Monte Carlo integral adjustment using Marginal Likelihood Optimization, H. Sjöstrand

When adjusting nuclear data integral experiments, it is important to include experimental uncertainties, but also, unreported experimental uncertainties, correlations between experiments, and calculation uncertainties [1]. These, sometimes unknown uncertainties and correlations can be quantified using the so-called marginal likelihood optimization (MLO) [2] [3].

It was shown that MLO can be an effective tool in addressing unknown uncertainties and correlations for a selected number of integral experiments. The method has also been qualitatively compared to other methods to address inconsistent data.

The findings are important for any integral adjustment where complete information of all uncertainty components is out of reach. It was proposed that this is always the case and hence that the conclusion from the SG46 should contain recommendations on methods for the marginalization of unknown uncertainties.

1. E.Alhassan et al. On the use of integral experiments for uncertainty reduction of reactor macroscopic parameters within the TMC methodology Progress in Nuclear Energy, 88, pp. 43-52. (2016)
2. G. Schnabel, Fitting and Analysis Technique for Inconsistent Nuclear Data, Proc. of MC2017, 2017
3. H. Sjöstrand et al. Monte Carlo integral adjustment of nuclear data libraries – experimental covariances and inconsistent data, WONDER 2018.

4.7 Example of a Bayesian Monte Carlo (BMC) Technique applied for 235U adjustment using Criticality and Transmission Integral Benchmarks, O. Cabellos

The Bayesian Monte Carlo technique for data adjustment was presented. An example for 235U adjustment using criticality and shielding integral benchmarks shows the importance of performing joint adjustment based on different set of integral benchmarks for avoiding as much as possible compensations in the “a posteriori” evaluated data.

4.8 Continuous energy sensitivities with CONRAD/TRIPOLI-4, C. de Saint Jean

Cyrille de Saint Jean presented work done at CEA to couple CONRAD with the TRIPOLI Monte-Carlo code in order to calculate sensitivities of full systems to more fundamental physical quantities such as resolved resonance parameters. Examples PST sensitivities to Pu239 resonance parameters were shown.

4.9 Performance assessment of adjusted nuclear data along with their covariances on the basis of fast reactor experiments, S. Pelloni and D. Rochman

In view of fast reactor analyses, it was shown that efficient nuclear data adjustments can be obtained on a limited assimilation database consisting of just six well documented integral parameters, i.e. the central spectral indices measured in Godiva and ZPPR-9. This study uses a Generalized Linear Least-Squares (GLLS) based data assimilation method by means of Asymptotic Progressing Incremental nuclear data Adjustment (APIA) simulations with two

incremental steps, one involving Godiva; the other one ZPPR-9. Consistent JEFF-3.3 and posterior data. These experiments consist of spectral indices as well as multiplication factors which pertain to 11 fast spectrum configurations including the six integral parameters which are part of the assimilation. It was found that (1) after adjustment the mean χ^2 is strongly reduced to values smaller than 2, in each case. (2) The performance of the adjustment is comparable between JEFF-3.3 and TENDL also in terms of the Gaussian Coverage Factor (GCF), which is the common surface spanned below two normal probability density functions associated with data means and variances. Correspondingly it was shown that by comparing JEFF-3.3 and TENDL data among each other in a similar way by computing GCFs of cross-sections, that (3) posterior data overall appears less deviating than prior data. It seems worthwhile investigating whether similar promising results and trends assessed based upon a deterministic code, namely ERANOS, are reproducible with a stochastic method which is deemed to be a reference tool.

4.10 Recent developments and enhancements of the APIA methodology, S. Pelloni

In view of precise fast reactor analyses, it was presented that the Asymptotic Progressing Incremental nuclear data Adjustment (APIA) methodology described in previous papers is able to provide particularly useful, consistent adjustments by assimilating the integral experimental data in an individual manner. The outcome of dedicated APIA simulations, largely resulting independent of experimental and postulated analytical modeling uncertainties including cross-correlations, supports this conclusion. The fully decoupled approach allows identifying and thus best separating effects coming from the different integral experiments considered in the assimilation process; we thus propose a criterion for considering or rejecting additional, individual experiments to enlarge an existing database. This presentation advised considering further a new experiment under the condition that after completion of the corresponding incremental step the posterior ratios of computed to experimental values for all experiments whose assimilation has occurred in the preceding steps remain unchanged, coinciding with one. Only in this case, the mean χ^2 of a larger number of representative target experiments covering the database may decrease, improving the quality of the data; otherwise, it is recommended to reject the experiment. This general result was based on representative APIA sequences involving assimilations of central spectral indices measured in the critical configurations Godiva, ZPPR-9, Big Ten, Pu239 Jezebel and SNEAK 7A.

4.11 On Using Statistically-Uncertain Sensitivities from Monte Carlo Codes in GLLS, D. Siefman

When Monte Carlo neutron transport codes are used in the GLLS methodology, their sensitivity coefficients have an associated uncertainty. In this presentation, the impact of these sensitivities on the adjustments was discussed. Additionally, the extended GLLS equations, or xGLLS, that can account for the sensitivity uncertainties in the adjustments were described. With large sensitivity uncertainty, we see that xGLLS works in a way to constrain the nuclear data adjustments. For sensitivity uncertainties that would be typically found in an analysis, the xGLLS adjustments are nearly identical to the GLLS adjustments. This indicates that the sensitivity uncertainties do not play a very signficant role. Importantly, these results leave out the effect of correlations between nuclear data and sensitivity coefficients, which are expected to be significant.

4.12 Step toward to a comprehensive roadmap for BEPU and experimental V and UQ, E. Ivanov

Raphaelle Ichou presented, on behalf of Evgeny Ivanov, a roadmap for nuclear data validation where Application Objects are identified and Target Accuracies determined from some analyses (e.g. PIRT). Two separate sets of calibration and testing integral experiments are then used to perform adjustment and validation. The adjustment process uses a combination of GLLS and TMC methods. Examples were shown for MELOX safety assessment.

5 Any other business

None

6 Date and place of the next meeting

The next meeting of the WPEC Subgroup 46 will take place during **the week of 24-28 June 2019** at the **OECD-NEA, Boulogne-Billancourt 92100, France**.

7 Actions

The following actions were agreed upon and will be reviewed at the next WPEC Subgroup 46 Meeting:

7.1 (Fleming) Make JSFR materials supplied by Yokoyama-san through the SG46 webpages

7.2 (All) Review content of draft SG39 summary report

All participants have been given access to the draft report in advance of the November 2018 meeting and are requested to send all comments and corrections to Michael Fleming before 11 December 2018.

7.3 (Fleming) Integrate SG39 comments/corrections into report for NEA Publications

Depending on the complexity of modifications, a revised draft is expected in advance of the June 2019 WPEC meetings.

7.4 (Hill) Liaise with SG46 co-ordinators regarding suitability of sensitivity data collected within other NEA NSC activities

7.5 (All) Provide updates to the list of (new) systems and identify desired accuracies

7.6 (All) Provide the co-ordinators with any updates to the prioritisation of and setting of target accuracies

A Participants

List of participants in the **WPEC Subgroup 46 Meeting** held at **OECD-NEA, Boulogne-Billancourt 92100, France** on **27 November 2018**, organised by represented country or international organisation.

Given name	Name	Country	
Erwin	ALHASSAN	SWITZERLAND	
Eric	BAUGE	FRANCE	
Oscar	CABELLOSDEFRANCISCO	SPAIN	
Mario	CARTA	ITALY	
Thibault	CORDIER	FRANCE	
Cyrille	DESAINTJEAN	FRANCE	
Pierre	DOSSANTOS-UZARRALDE	FRANCE	
Emmeric	DUPONT	FRANCE	
Luca	FIORITO	FRANCE	
Michael	FLEMING	FRANCE	Secretary
Mark	GILBERT	UNITED KINGDOM	
Giacomo	GRASSO	ITALY	
Stephane	HILAIRE	FRANCE	
Mathieu	HURSIN	SWITZERLAND	
Raphaelle	ICHOU	FRANCE	
Evgeny	IVANOV	FRANCE	
Clément	JEANNESSON	FRANCE	
Ivan-Alexander	KODELI	SLOVENIA	
Luiz Carlos	LEAL	FRANCE	
Nicolas	LECLAIRE	FRANCE	
Ping	LIU	CHINA	
Giuseppe	PALMIOTTI	UNITED STATES	Co-chair
Sandro	PELLONI	SWITZERLAND	
Arjan	PLOMPEN	BELGIUM	
Massimo	SALVATORES	UNITED STATES	Co-chair
Daniel	SIEFMAN	SWITZERLAND	
Stanislav	SIMAKOV	GERMANY	
Stanislav	SIMAKOV	GERMANY	
Henrik	SJÖSTRAND	SWEDEN	
Thomas	STAINER	UNITED KINGDOM	
Wenming	WANG	CHINA	
Haicheng	WU	CHINA	
Xiaofei	WU	CHINA	
Kenji	YOKOYAMA	JAPAN	

B Agenda

OECD Nuclear Energy Agency
WPEC Subgroup 46 Meeting, 27 November 2018

OECD-NEA, Boulogne-Billancourt 92100, France
Room BB-10

AGENDA

Start	End	Topic	Participant(s)	Country
09:00	09:15	Welcome and session outline	Massimo SALVATORES, Guiseppe PALMIOTTI	France, USA
09:15	09:35	Review of actions and status of the WPEC SG 39 Summary Report	Michael FLEMING	OECD-NEA
09:35	10:00	Summary of SG26 action on target accuracy requirements and its impact	Massimo SALVATORES	France
10:00	10:20	HPRL status and procedures for feedback/request/update	Emmeric DUPONT	France
10:20	10:35	**Coffee Break**		
10:35	11:00	SG46 Target Accuracy Requirements Exercise	Giuseppe Palmiotti	USA
11:00	11:15	2-dimensional R-Z calculation model of 750MWe JSFR (Japan Sodium-cooled Fast Reactor)	Kenji YOKOYAMA	Japan
11:15	11:40	Treating inconsistent data in Monte Carlo integral adjustment using Marginal Likelihood Optimization	Henrik SJÖSTRAND	Sweden
11:40	12:05	Example of a Bayesian Monte Carlo (BMC) Technique applied for 235U adjustment using Criticality and Transmission Integral Benchmarks	Oscar CABELLOS DE FRANCISCO	Spain
12:05	12:30	Continuous energy sensitivities with CONRAD/TRIPOLI-4	Cyrille DE SAINT JEAN	France
12:30	13:45	**Lunch Break**		
13:45	14:10	Performance assessment of adjusted nuclear data along with their covariances on the basis of fast reactor experiments	Sandro PELLONI, Dimitri ROCHMAN	Switzerland
14:10	14:35	Recent developments and enhancements of the APIA methodology	Sandro PELLONI	Switzerland
14:35	15:05	On Using Statistically-Uncertain Sensitivities from Monte Carlo Codes in GLLS	Daniel SIEFMAN	Switzerland
15:05	15:30	Step toward to a comprehensive roadmap for BEPU and experimental V and UQ	Evgeny IVANOV	France
15:30	15:45	Discussion and next meeting	All	
15:45	16:00	**Coffee Break**		

OECD Nuclear Energy Agency
WPEC Subgroups 44 and 46 Joint Session, 27 November 2018

OECD-NEA, Boulogne-Billancourt 92100, France
Room BB-10

AGENDA

Start	End	Topic	Participant(s)	Country
16:00	16:10	Introduction to Joint 44/46 session	Cyrille DE SAINT JEAN	France
16:10	16:30	JEFF-3.3 covariance application to ICSBEP using SANDY and NDaST	Luca FIORITO	OECD-NEA
16:30	16:50	Inconsistent data and unceratainties	Henrik SJÖS-TRAND	Sweden
16:50	17:10	The progress of n+U-238 evaluation at CNDC	Haicheng WU	China
17:10	18:00	Discussion	All	