WPEC Subgroup Proposal (SG46) "Efficient and Effective Use of Integral Experiments for Nuclear Data Validation"

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Subgroup Monitors

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Subgroup Coordinators

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Subgroup Participants

The data projects will identify appropriate participants from their community. It will be essential to build-up a group where nuclear data and uncertainty evaluators, integral experiments experts and reactor physics experts will be represented.

Justification for a Subgroup

Idaho National Laboratory

Currently, integral experiments are used for data validation according to **different approaches** with different objectives:

a) A **"global test" approach** usually applied to several thousand benchmarks (ICSBEP), when a new evaluated file is released, which consists essentially of the calculation, with the new data set to be validated, of thousands of K_{eff} and few other integral experiments. The resulting list of K_{eff} offers a global "feeling" for the performance of the new data set and it is not intended to provide specific conclusions on nuclear data e.g. in selected energy ranges.

b) Most current evaluation efforts are, de facto, informed by the results of benchmark (integral experiments) calculations already in the phase of evaluation. This approach can hide some risks since the evaluators should be sure that they are using reliable experiments (i.e. with low uncertainties). At that level, the choice of the appropriate experiments is also a rather challenging issue.

The outcome of both these approaches, although valuable within their specific objectives, cannot point out compensation effects: this is a major drawback that has been generally recognized. Moreover, **feedback on data uncertainties and correlations are seldom derived.**

Finally, **a large number of very valuable experiments, more reactor physics oriented, are not accounted for.**

c) The **more general approach** to the use of integral experiments **is based on a generalized use of sensitivity and uncertainty analysis and uses a larger variety of integral experiments and attempts to account for integral experiment uncertainties, possible systematic errors and correlations**. The **outcome** is:

- **adjusted data sets,**
- **revised uncertainties and correlations and**
- **a validated data set applicable to a wide range of different applications.**

Despite the potential of this last approach,

- **the appropriate integral data selection,**
- **the use of ad-hoc (e.g. "representative") integral experiments and**
- **the use of specifically tailored experiments**

are still goals under discussion and a **more rigorous, efficient, and effective approach needs to be worked out, agreed and suggested for general use** in order to make it a true interdisciplinary integration of evaluation, assimilation and validation, - a critical step in advancing nuclear data methodology.

Definition of the project and of proposed activities

It is proposed a new WPEC subgroup that should have a mandate on formalizing and applying a methodology for:

- **Selecting appropriate experiments and in particular those that provide separate effects information on the basis of the findings of Subgroup 39**.

- **Analyzing C/E by isotope, reaction, and energy range in order to point out compensation effects** (based on low uncertainty, sensitivity coefficients, and χ^2). Possibly, all energy range from thermal to fast, should be examined.

- **Computing sensitivity coefficients of selected experiments and integral parameters according to the guidelines worked-out in the previous Subgroups 33 and 39**. This part of the work should account for and complete the work performed at the Databank by Ian Hill available through the DICE code.

- **Performing new generalized adjustments to provide unambiguous feedbacks**. Some approaches has been proposed (Yokoyama, Palmiotti, and Ivanov) but not yet finalized or widely used. Other approaches could be proposed and compared. **The use of reaction cross correlations and of covariance data for angular distributions (elastic scattering), secondary energy distribution for inelastic scattering should be done as far as these data will be made available** in the different nuclear data projects.

Moreover **the new SG46 should give guidelines** on:

- How to **define a general protocol for the use of sensitivity coefficients and covariances in order to provide an improved traceability for safety and design purposes**.

- How to **systematically quantify impact on a list of selected target power reactors (thermal, epithermal, and fast spectrum reactors)**. This list of reactors should be defined as far as possible with the help of industry representatives

- How **to provide updated target accuracies for nuclear data uncertainty reduction by combining inverse approach and integral experiments** (some efforts in this direction have started at ORNL). **This last goal should have a significant impact in prioritizing new experiments, both differential and integral and to foster international collaborations for that purpose.**

The **new subgroup should work in in close contact with the new WPEC Subgroups 44, working on new Covariance Data, and 45 VaNDaL that is supposed to create a database of the selected benchmarks along with the respective decks for calculations.**

Relevance to Evaluated Data Files

This activity is of particular relevance to the foreseen objective to improve future data files using synergies from different nuclear data projects, while focusing on the requirements for specific new experimental programs and effectively accounting for users data needs.

Time-Schedule and Deliverables

It is anticipated that the experts of this SG could complete and document the activities (mandate) listed above in approximately 3 years.

Dates and Deliverables

May 2017: Review for approval of subgroup proposal by WPEC Committee;
November 2017: preparatory meeting;
May 2018: first official meeting (J0);
May 2021: Final report

Planned Schedule:

a) Selection of experiments and associated protocol J0+1year
b) C/E analysis for experiments of a) J0+2years
c) Generalized adjustment and feedbacks (new evaluations, status of uncertainties, target accuracies) J0+3years