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

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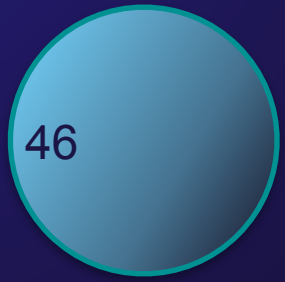
# Chain of WPEC Subgroups


Start-up subgroup, sensitivity and uncertainty analysis, general indications


Comparison of adjustment methods and covariances, first feedback on ND


Deeper analysis and extension of the adjustment methodologies




Formalizing and applying the methodology

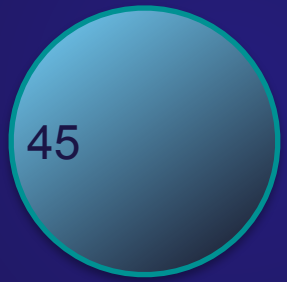
Target accuracy requirements
Adjustment methodology
Uncertainty reduction
Error compensation
Nucl. data feedback
Sensitivity profiles
Covariances

# Matrix of WPEC Subgroups


Uncertainty and target accuracy assessment for innovative systems using recent covariance data evaluations


Investigation of Covariance Data in General Purpose Nuclear Data Libraries


Methods and issues for the combined use of integral experiments and covariance data




Validation of Nuclear Data Libraries (VaNDaL) Project

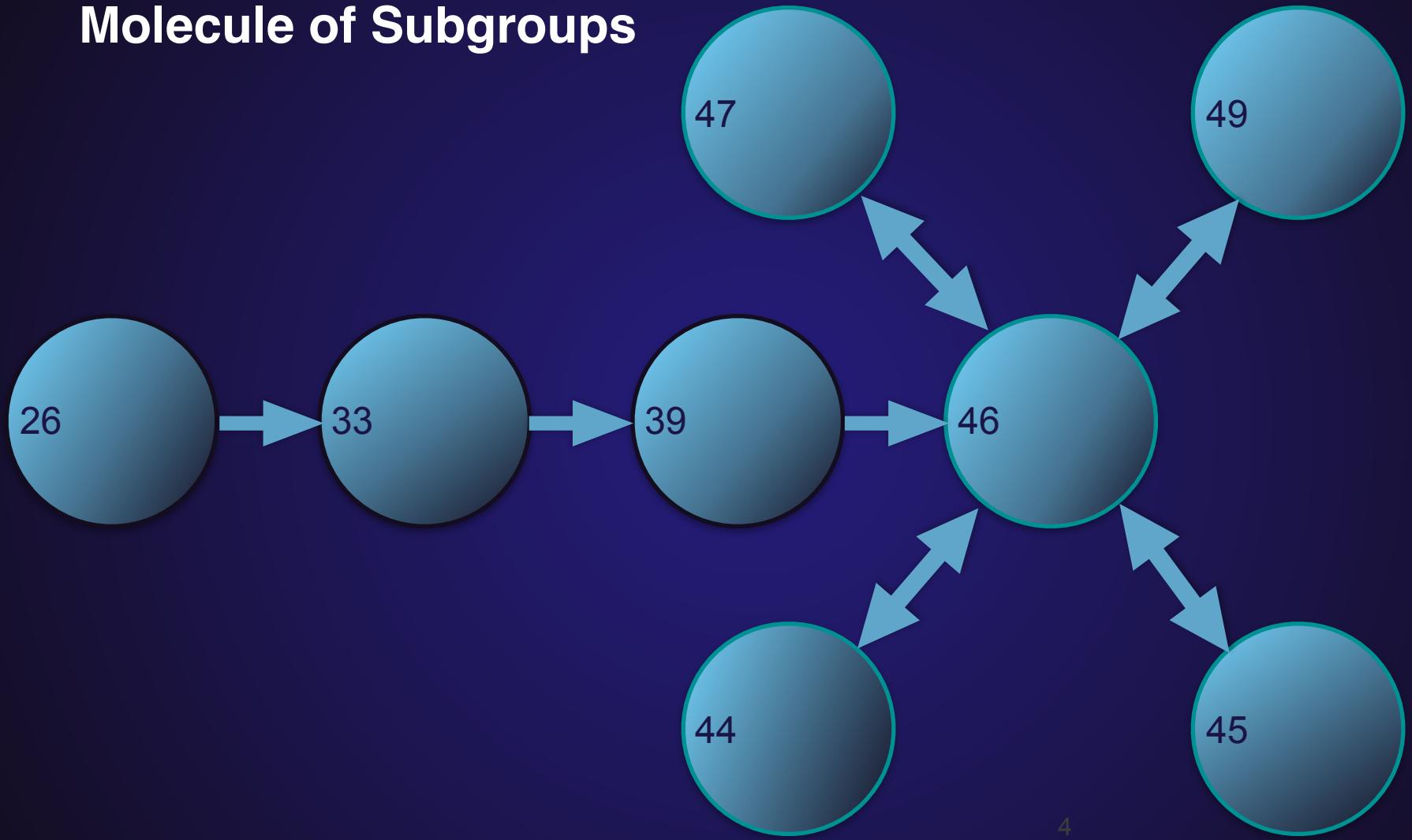

Use of Shielding Integral Benchmark Archive and Database for Nuclear Data Validation


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


Efficient and Effective Use of Integral Experiments for Nuclear Data Validation


Reproducibility in Nuclear Data Evaluation

# Molecule of Subgroups

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# SG46 Motivation

- Effective feedbacks to evaluations - utilization of integral experiments by evaluators
- Optimization of the choice of integral experiments - a priority in order to avoid compensations; separate physics effects:
  - separate burn-up reactivity swing components
  - separate capture from scattering in reactivity effects both for actinides and FP
  - n-leakage experiments for scattering data assessment
  - etc…

Subgroup Coordinators:
G. Palmiotti, M. Salvatores

Subgroup Monitors:
M. Hermann, A. Plompen.

# SG46 Motivation (cont.)

- Improvement and extension of covariance data (cross correlations, angular distributions, secondary neutrons from inelastic scattering, photon production data, delayed neutron data).
- How to assess the reliability of covariance data - interaction with SG44
- Explore the potential of the Continuous Energy Assimilation (i.e. beyond multi-group data)
- Definition of updated target accuracies for design, operation and fuel cycle parameters. Assess impact of present covariance data on accuracy requirements.

# SG46 goals & deliverables

- Selecting appropriate experiments especially those providing more specific information.
- Analyzing C/E by isotope, reaction and energy range to point out compensation effects.
- Computing sensitivity coefficients of selected experiments and integral parameters (following SG 33 and 39).
- Perform new generalized adjustment to provide unambiguous feedback (some approaches already proposed). Use reaction x-sec correlations and covariances for angular and energy distributions as far as possible.

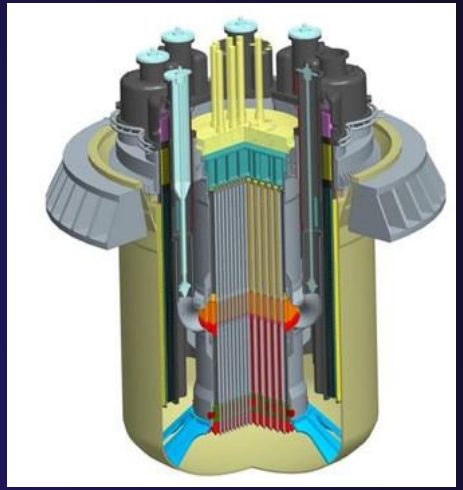
# … + provide guidelines on how to:

- Define general protocol for the use of sensitivity profiles and covariances to improve traceability  for safety and design.
- Quantify impact on selected target power reactors (thermal, epithermal,  fast)
- Update target accuracies for nuclear data uncertainty reduction by combining inverse approach and integral experiments (prioritizing new experiments)

# SG46 Target Accuracy Requirements Exercise

- New reactors concepts are presently explored besides Gen IV, MA burners, and ADS: MSR, SMR, micro reactors, and test reactors
  - Data and accuracies are required for new materials, reaction types and energy ranges
  - It is essential to verify the status of design target accuracies and their potential evolution (reactor and fuel cycle)
  - The HPRL will certainly benefit from an update, to motivate and focus new experiments and to meet potential new requirements
- New covariance data available in ENDF, JEFF, and JENDL (crude BOLNA without correlations was used for the SG26 exercise). Those that incorporate integral experiments information should not be used in this exercise.

- Second phase: possibly incorporate integral experiment information e.g., by performing an adjustment using integral experiments and using the new covariance matrix in the target accuracy requirements.



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From P. Romojaro et al,
WPEC SG 46 June 25th, 2019

# Target accuracies requirements - MYRRHA

Project information

CHANDA

Grant agreement ID: 605203

Status
Closed project

Start date
1 December 2013

End date
31 May 2018

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FP7-EURATOM-FISSION

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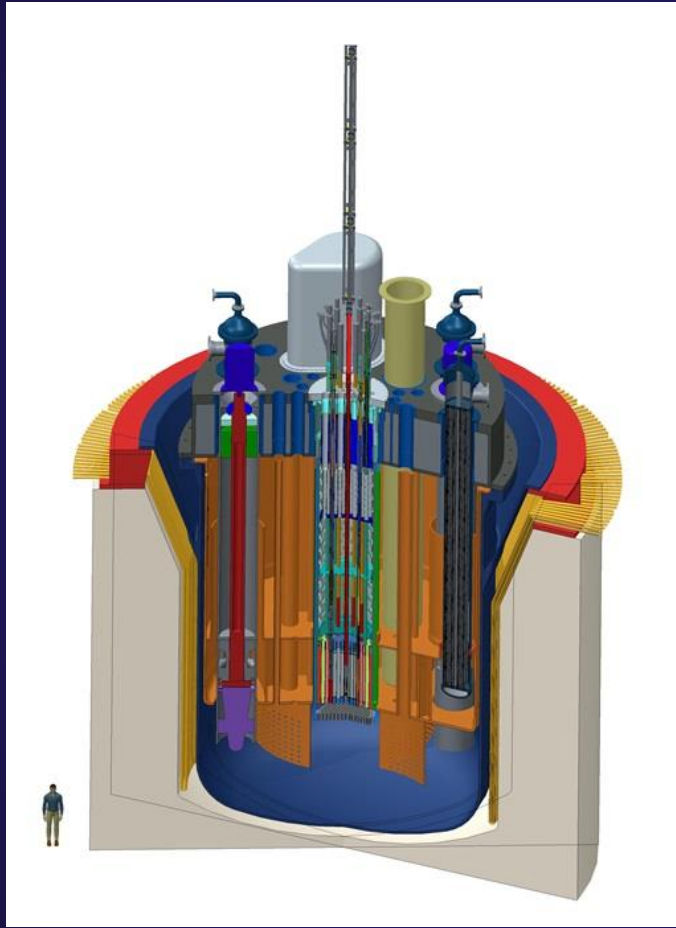
EU contribution
€ 5 400 000

Coordinated by:
CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT
Spain



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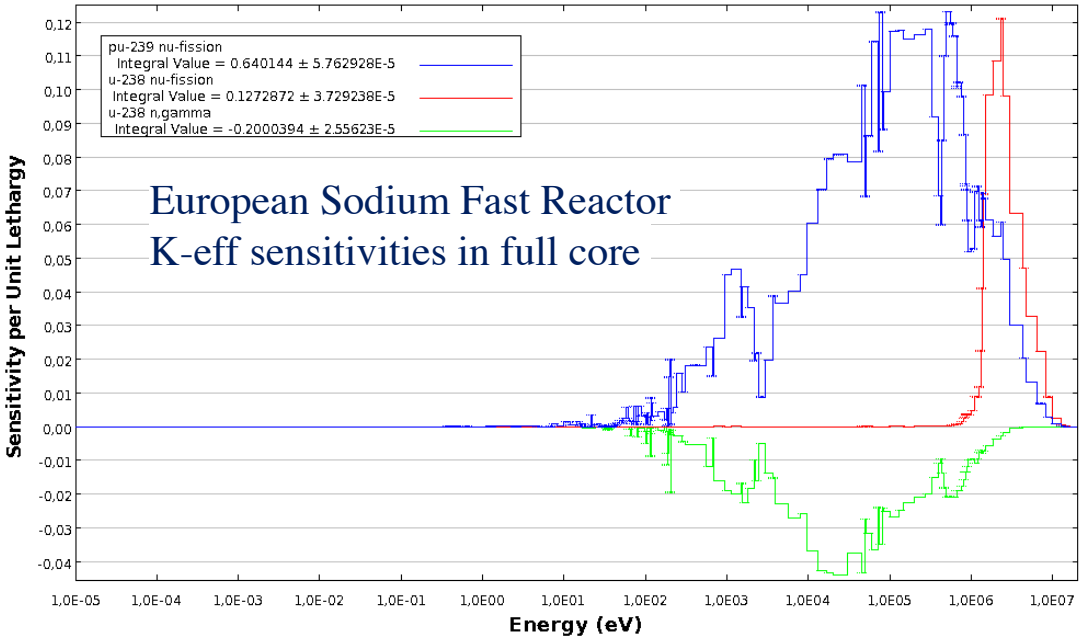
| Parameter | TA (%) | Unc. (%) |
|---|---|---|
| $k_{eff}$ | 0.3 | 0.8 |
| $\beta_{eff}$ | 3 | 1.1 |
| $\Lambda_{eff}$ | - | 20.8 |
| Doppler coefficient (+400 K) | 7 | 9.1 |
| Coolant density coefficient (-5%) | 7 | 20.3 |
| Control rod worth | 7 | 1.8 |

# SG46 list of actions (June 2019)

Summary of Actions

- Target Accuracy Requirements:
  Action on K. Yokoyama: ADS proposed by JAEA (to be discussed and make recommendations based on analysis performed), coordinate with proposed target accuracies as proposed by E. Ivanov (see below).
- Committed to provide models (possibly R-Z): Pablo ROMOJARO (MYRRHA, ESFR, ASTRID, and ALFRED), ENEA (ALFRED, LFR WESTINGHOUSE). Kodeli (MYRRHA), JAEA ADS (?). SG26 and SG33 (available on reports and website). Available models from SG26 and from F. Gabrielli (benchmarks of SFRs and MSR)
- People providing models will provide list of integral parameters (to be discussed if complete), sensitivities, and uncertainty analysis. Based on uncertainty analysis a recommended list of isotopes for TAR will be provided (by next meeting)
- Format for sensitivities: SG33. Uncertainty tables following recommendations made in SG33.
- Kodeli has committed to provide delayed neutron covariance data matrix.
- List of reactions for sensitivity: capture (includes: (n,γ), (n,α), (n,p), etc.), fission, ν, χ, elastic, inelastic, μ
- Action on SG46 to provide enlarged list of benchmarks (upon request of A. Plompen). In particular fuel cycle installation related target accuracies to be considered (All). To get feedback for next meeting in order to finalize the list of considered systems.
- .Circulate TAR tables to a wider community (Code libraries developers, users of industry, safety authorities): O. Cabellos (lead), M. Hursin, A. Plompen. Get feedback to be finalized by the November 2019 meeting
- Action on P. Romojaro: To verify interest of adding the low Na void ASTRID-like system provided by F. Gabrielli. Also look to the SFR-UAM benchmarks to find out need to include them in the TAR exercise.
- Actions related to MSR:
  - I. Hill circulate TAR material to parties interested in MSR
  - C. Perfetti to investigate ORNL comments to TAR initiative. Suggest possibly a) which MOSART model to be put as priority b) to provide an extra benchmark closer to ORNL interest
  - Find out if C. Perfetti could take care of MSR system(s) for the SG46 TAR activity
  - Ask E. Ivanov to specify if his comments come from MOSART team requirements and if he could contribute to the TAR exercise for the MSR part
- Circulate for comments, suggestions the TAR material for VHTRs to the groups participating to HTR benchmarks (I. Hill)
- M. Hursin will provide methods used at PSI to provide uncertainties to regulators
- Provide feedback on interest of experiment correlation to IRPHE (Secretariat)
- All: consolidate commitments to contribute to the TAR exercise by next meeting

- K. Yokoyama to provide papers to G. Palmiotti which illustrate the equivalence of different bias factors methods and their equivalence to the extended adjustment method
- M. Herman to circulate a paper on the proposed new paradigm for evaluation for comments, suggestions (e.g. use of stress tests), criticism etc., in order to have a discussion at the next November SG46 meeting, aiming to the preparation of an agreed document with options, potential time scale for implementation, tools to be preferred etc.



# Future Actions and Conclusions (from June 2019)

- The subgroup is already very active and many, very useful, contributions have been produced by the participants.
- Actions will continue on:
  - Target Accuracy Requirements
  - New developments in adjustment techniques
  - Performing adjustments
  - Selection of Experiments
  - Collaboration with SG44
  - New paradigm for future evaluations