

# WPEC Subgroup 44

## *Investigation of Covariance Data in General Purpose Nuclear Data Libraries*

Vladimir Sobes (ORNL, USA)

Cyrille de Saint Jean (CEA, France)

*29<sup>th</sup> WPEC meeting  
15-19 May 2017  
OECD Headquarters  
Paris, France*



# Agenda

|                      |  |                              |
|----------------------|--|------------------------------|
| 9:00 – 9:30          | Welcome and Introduction   | V. Sobes<br>C. de Saint Jean |
| 9:30 - 10:00         | Comments on Covariance Data  | O. Iwamoto                   |
| 10:00 – 10:30        | JEFF-3.3T3 Processed Covariances:<br>Uncertainty Propagation Analysis and Comparison                     | J. Dydra                     |
| <b>10:30 – 10:45</b> | <b>Coffee Break</b>  |                              |
| 10:45 – 11:00        | Report from SG38 on New Covariance Format  | C. Mattoon                   |
| 11:00 – 11:30        | <i>Group Discussion.</i> Subject Area:<br>Formats / Interpretation / Processing Error                    | All                          |
| 11:30 – 12:00        | A-Priori and A-Posteriori Covariance Data in Nuclear Cross Section<br>Adjustments: Issues and Challenges | G. Palmiotti                 |
| 12:00 – 12:30        | <i>Group Discussion.</i> Subject Area:<br>Propagation of Uncertainty & Integral Experience               | All                          |
| <b>12:30 – 13:30</b> | <b>Lunch Break</b>   |                              |
| 13:30 – 14:15        | Sensitivity/Uncertainty Analysis Features of SCALE 6.2   | B. Rearden                   |
| 14:15 – 14:45        | <i>Group Discussion.</i> Subject Area:<br>Cross-Correlations   | All                          |
| 14:45 – 15:30        | Potential Presentation from CEA  | CEA Staff                    |
| <b>15:30 – 15:45</b> | <b>Coffee Break</b>  |                              |
| 15:45 – 16:15        | Progress of Covariance Evaluation For CENDL  | R. Xu                        |
| 16:15 – 16:45        | <i>Group Discussion.</i> Subject Area:<br>Experimental Sources of Uncertainty                            | All                          |
| 16:45 – 17:00        | <i>Group Discussion,</i> Subject Area:<br>Best Practices Document  | All                          |
| 17:00 – 17:15        | Closing Remarks  | V. Sobes<br>C. de Saint Jean |
| 17:15                | Adjourn  |                              |

## Differences from Previous WPEC Subgroups

SG-2: Generation of covariance files for Iron-56 and natural Iron

SG-20: Covariance matrix evaluation and processing in the res. region

SG-24: Covariance data in the fast neutron region

- More advanced S/U analysis capability today. Monte Carlo sensitivity calculations have brought S/U analysis mainstream.
- Development of nuclear data adjustment as feedback to nuclear data evaluation in a systematic manner (continuous-energy nuclear data adjustment).
- Addressing of cross correlations.
- Availability of low-fidelity covariance data.

## Unique Aspects of SG-44

- Opportunity to redefine the covariance format working with GND. Of special interest is to provide covariance data in an SVD form.
- Consider cross-correlations for energy, reaction and isotopes. Care has to be devoted in order to avoid generating a full matrix that can become untreatable.
- Can we define a nuclear data covariance validation procedure in a “loose” sense of validation? Can we construct a frame work that will be able to identify if evaluated nuclear data uncertainty proposed for inclusion in a nuclear data library is “way too small” or “way too large?”
- Use of “a-posteriori” covariance and cross correlations data as a result of an adjustment?

## Considerations for Discussions this Week

1. Have these questions been answered previously in a satisfactory/unanimous manner?
2. Is this subgroup qualified to answer these questions?
3. Will coming to a consensus and providing the answer in the Best Practices Document have an impact on the community?

## 4 Subject Areas for SG-44



# Best Practices Document

- The central deliverable of this Subgroup.
  - Address all four Subject Areas.
  - Promote/advertise the usage of the published document/recommendations. How can we best promote the future use/application of the recommendations of this international sub-group?
  - Stress that covariances should be generated with mean values not as an after-thought.
  - Assemble an authoritative and succinct library of references
1. Address / Review any open questions or questions worth reconsidering from previous sub-groups in light of latest computational advancements and experimental methods.
  2. Explore previously unexplored questions.

# Area 1: Analysis of Experimental Data

- Interpretation and treatment of experimental sources of uncertainty.
- List of often over-looked sources of experimental uncertainties.
- Identify/improve documentation methods for experimental uncertainties. *Joint effort with Area 4.*
- How do we know if reported experimental uncertainties are too small?
- Provide guidance on how to eliminate or correct bad data sets. Look at other scientific fields and statistical methods.
- Consider statistical distributions other than normal/log-normal. *Joint effort with Area 4.*
- Consider uncertainty on uncertainty.
- Provide detailed examples:
  - Autonomous/automatic methods used on non-discrepant data.
  - Handling of discrepant data sets.
- The effect of data normalization in RRR evaluation? Can it be directly absorbed in resonance parameters? Should it? Should resonance parameter uncertainties make sense or should only cross section uncertainty make sense? Can we have instances when both are not possible?
- Model defects: phenomenological models can be poor but with very low evaluated uncertainties.
- Model biases: how to infer and calculate models biases from advanced models, even if these are not able to reproduce experimental data for the time being?

## Area 2: Cross-Correlation

- Energy regions (RRR/URR, RRR/Continuum)
- Reactions, constricted by Unitarity
- Other types of data, not just cross sections
- Cross-Isotope
  
- Consider the effect of neglecting cross correlations.  
*Joint effort with Area 3.*
- Can we fill in cross-correlations using integral feedback mechanisms?  
Energy, reaction, isotope? *Joint effort with Area 3.*
- Can we dedicate space for storing evaluation/integral experiments correlations?
- How can integral feedback be useful in defining nuclear data covariance for general purpose libraries without tying up all isotopes together? Need for an agreed protocol to perform adjustments. Strong link with SG39 and follow-up SG (being finalized).

## Area 3: Propagation of Uncertainty & Integral Experience

- Propagated uncertainty versus observed spread in C/E values.
- Can we handle other probability distributions for nuclear data uncertainty? *Joint effort with Area 1, Area 4.*
- Validation of covariance data? Performance. *Joint effort with Area 4.*
- Can we begin to fill in cross-correlations with feedback techniques from Integral Experiments? Energy, reaction, isotope? *Joint effort with Area 2.*
- Low fidelity covariance data. Reliability of covariance data?

## Area 4: Formats / Interpretation / Processing Error

- Upper limit and consequences of error from processing codes.
- Documentation of covariance evaluation technique. LANL has provided a document as a start.
- Documentation for clear interpretation.
- Verification: positive definite, robust, stable to numerical errors. What algorithm to eliminate negative eigenvalues? They affect cross section adjustments.
- Other statistical distributions for nuclear data uncertainty. *Joint effort with Area 1 and Area 3.*
- Identify a place to save/preserve evaluator covariance plots and tables.
- Validation of covariance data? *Joint effort with Area 3.*
- How integral validation can apply both to central values and to covariance data of cross sections? Joint effort with SG39 and successor.
- Treatment and representation of uncertainties in the URR where self-shielding is important for reactors (example of probability tables).

## Other Areas

- What have I missed?
- What will we NOT study?

# Agenda

|                      |  |                              |
|----------------------|--|------------------------------|
| 9:00 – 9:30          | Welcome and Introduction   | V. Sobes<br>C. de Saint Jean |
| 9:30 - 10:00         | Comments on Covariance Data  | O. Iwamoto                   |
| 10:00 – 10:30        | JEFF-3.3T3 Processed Covariances:<br>Uncertainty Propagation Analysis and Comparison                     | J. Dydra                     |
| <b>10:30 – 10:45</b> | <b>Coffee Break</b>  |                              |
| 10:45 – 11:00        | Report from SG38 on New Covariance Format  | C. Mattoon                   |
| 11:00 – 11:30        | <i>Group Discussion.</i> Subject Area:<br>Formats / Interpretation / Processing Error                    | All                          |
| 11:30 – 12:00        | A-Priori and A-Posteriori Covariance Data in Nuclear Cross Section<br>Adjustments: Issues and Challenges | G. Palmiotti                 |
| 12:00 – 12:30        | <i>Group Discussion.</i> Subject Area:<br>Propagation of Uncertainty & Integral Experience               | All                          |
| <b>12:30 – 13:30</b> | <b>Lunch Break</b>   |                              |
| 13:30 – 14:15        | Sensitivity/Uncertainty Analysis Features of SCALE 6.2   | B. Rearden                   |
| 14:15 – 14:45        | <i>Group Discussion.</i> Subject Area:<br>Cross-Correlations   | All                          |
| 14:45 – 15:30        | Potential Presentation from CEA  | CEA Staff                    |
| <b>15:30 – 15:45</b> | <b>Coffee Break</b>  |                              |
| 15:45 – 16:15        | Progress of Covariance Evaluation For CENDL  | R. Xu                        |
| 16:15 – 16:45        | <i>Group Discussion.</i> Subject Area:<br>Experimental Sources of Uncertainty                            | All                          |
| 16:45 – 17:00        | <i>Group Discussion,</i> Subject Area:<br>Best Practices Document  | All                          |
| 17:00 – 17:15        | Closing Remarks  | V. Sobes<br>C. de Saint Jean |
| 17:15                | Adjourn  |                              |

# WPEC Subgroup 44

## *Investigation of Covariance Data in General Purpose Nuclear Data Libraries*

Vladimir Sobes (ORNL, USA)

Cyrille de Saint Jean (CEA, France)

*29<sup>th</sup> WPEC meeting  
15-19 May 2017  
OECD Headquarters  
Paris, France*

