Quality Assurance Requirements for ENDF Covariance Evaluations

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The main issue

- Everyone agrees in principle that evaluated covariances files ought to be of good quality to be included in ENDF/B (a QA requirement).
- However, it is also evident that there is widespread disagreement on what these specific QA requirements ought to be.
- Challenge: To agree very soon on a set of minimal QA requirements for evaluated covariances in order for them to be acceptable for inclusion in ENDF/B-VII.1.

A fundamental consideration

- To decide on exactly how we should interpret the meaning of covariances in an evaluation?

  - As the strict outcome from a mechanical process of combining various estimated uncertainty components that are treated by an evaluation procedure or algorithm (e.g., least squares, etc.)?

  … Or …

  - As an evaluator's best assessment of the current state of uncertainty of the evaluated physical quantities based on both objective and subjective considerations, including experienced judgment?

A Pragmatic Approach

- Agree now on a few very basic covariance QA requirements for ENDF/B-VII.1 evaluations.
- Continue to develop more sophisticated and comprehensive methods for producing, representing, processing, testing, and utilizing evaluated covariance data.
- Gradually increase the minimal QA requirements for covariance data in future releases of ENDF/B, according to both the evaluation and user communities' capabilities to benefit from these more stringent requirements.

What we can agree on now

(Maybe …)

- Covariances should be provided for the main isotopes of important materials that figure in contemporary applications.
- Covariances in a particular isotopic evaluation should be provided for at least the main neutron reaction processes, depending on the specific mass number: e.g., total, elastic scat., inelastic scat., (n,p), (n,α), (n,2n), (n,γ), fission, nu-bar, etc.

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- The energy ranges for covariances must equal those of the evaluated physical parameters and incorporate adequate “resolution” to fully reflect variations in the variances and correlations present in the evaluated data.
- Evaluator covariance matrices must be square, symmetric, and positive definite.
- Diagonal correlations must be unity and off-diagonal correlations smaller than unity in magnitude.

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- Covariance matrices for particle emission spectra must satisfy the “sum-to-zero” requirement for both rows and columns to the extent allowed by the ENDF formats precision.
- Evaluated covariances must be represented numerically using approved ENDF-6 formats.
- To be useful, all covariance data provided in a particular evaluation must be amenable to being processed by the major contemporary processing codes.
- Others?

Future QA requirements?

- Restrictions on use of some existing ENDF formats (i.e., eliminate certain older formats).
- Require covariances for ALL evaluated reaction processes for any given isotope.
- Require covariance data for ALL evaluated isotopes included in ENDF/B.
- Require that only covariances which are mathematically linked to the core evaluation process be acceptable in ENDF evaluations (e.g., as currently mandated by the dosimetry community).

Continued …

- The role of integral data in ENDF evaluations.
- Provide covariances for particle emission angular distributions.
- Provide cross-reaction covariances.
- Provide cross-material covariances for the important materials encountered in applications.
- Reconcile conventional C/E consistency testing with covariance error propagation analyses.
- Examine advantages and pitfalls of “tweaking”).
- Others?

The floor is open for discussion!

The End