

WPEC Sub group 34

“Coordinated evaluation of ^{239}Pu in the resonance region”

Proposed by R. D. McKnight

Slightly modified by C. De Saint Jean

Justification

In recent history, the US and Europe have adopted the same evaluation for the ^{239}Pu resonance region, largely based on work from ORNL and the CEA. In data testing for ENDF/B-VII.0, a general over prediction of Pu-SOL-THERMAL assemblies was noted, with an over prediction of typically about 0.5% - a very serious discrepancy indeed. Testing of the new evaluation in intermediate assemblies also shows a very large (and unwanted) increase in the C/E's. In recent years, two efforts should be mentioned. Firstly, the JEFF community has developed an updated ^{239}Pu file for JEFF-3.1.1 that has modifications to the original file, at thermal energies, that has improved some of the aforementioned discrepancies. Secondly, at ORNL, Derrien and Leal have developed a new set of resonance parameters that have been incorporated into a file in ENDF/A for testing. This most recent evaluation is more consistent with the cross section resonance data and believed by the evaluators to be the best representation of these data to date. Nonetheless, this new evaluation does not improve the poor integral performance of the ENDF/B-VII.0 file, and in fact most of the discrepancies become slightly worse, as was noted by McKnight at the June 2009 CSEWG meeting. The goal of the new subgroup would be to bring together the experts in this area in the OECD/NEA community to see if a new evaluation can be developed that both uses the most accurate fundamental cross section data with nuclear theory constraints, and also better models the relevant integral criticality data. It is hoped this proposed collaboration would lead to the type of improvements obtained previously by WPEC collaborations in SG22 for ^{238}U .

Subgroup Monitor

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Subgroup participants

H. Derrien, ORNL (ENDF); L. Leal, ORNL (ENDF); A. Kahler, LANL (ENDF); TBD, JAEA (JENDL); O. Bouland, G. Noguere, O. Serot, O. Litaize, D. Bernard, CEA, P. Schillebeeckx, IRMM, A. Trkov, JSI (JEFF);

Definition of the project and proposed activities

It is proposed as a mandate for this new WPEC subgroup to work on an improved ^{239}Pu resonance evaluation. This evaluation would build on the recent work done in the US (e.g., by Derrien et al), in Europe (e.g., refinements at thermal), and relevant work done in Japan. The goal is for the experts in this field to develop the best possible evaluation containing covariances that is consistent with our fundamental cross section data, and leads to improvements in calculations of integral data, especially for the long standing overprediction of the Pu-thermal solution critical assemblies.

Relevance to Evaluated Data Files

Meet accuracy requirements of reactor analysis and criticality safety for thermal and intermediate energy systems.

Tasks:

- Evaluation task :
 - ^{239}Pu resonances range with covariances
 - ^{239}Pu unresolved resonances range with covariances
 - ^{239}Pu fission spectra (chi)
 - ^{239}Pu nubar in the thermal range as well as in the resonance range.
- Benchmarking task :
 - Define a set of public Benchmarks related to ^{239}Pu nuclear data: ICSBEP and IRPhEP.
 - Calculations of these benchmarks with various evaluations (ENDF, JEFF, JENDL,...)
 - Spot as far as possible (via perturbation analysis) possible nuclear data improvements
- Various Task :
 - Insure a proper link with sub-group32 on the unresolved treatment.
 - “Background” information analysis :
 - We note that LANL has done simulations to test the impact of various prompt neutron spectra on criticality, and found a significant sensitivity of the results to the chi matrix adopted. The proposed WPEC subgroup should take advantage of ongoing work, coordinated by a new IAEA CRP, on the prompt fission spectrum.
 - Fast region evaluations (JEFF, ENDF) and the corresponding partial cross sections splits : contributions from capture, inelastic, etc are quite different and differences between various evaluations for inelastic scattering, were pointed out.
 - Initiate or target if needed new microscopic measurements

Time-Schedule and Deliverables:

It is anticipated that the experts of this SG could complete and document the activities (mandate) listed above within 2 years.

Date Deliverables

- June, 2010 Review of SG Proposal by WPEC; initiate Subgroup activities
- December 2010, Report on Benchmarks with fine analysis of sensitivities to ^{239}Pu nuclear datafiles,
- June, 2011 New resonance evaluation, if possible, for consideration for adoption by ENDF, JEFF, JENDL, etc.
- June, 2011 Report on ^{239}Pu fission spectra breakthrough
- June, 2012 Present Final Report of Subgroup activities, including documentation and recommendation of a new resonance evaluation for ^{239}Pu and of the improved performance for Pu-fuelled thermal and intermediate energy systems. Include motivation for new ^{239}Pu measurements, if needed.