Consultants Meeting of INDEN on Structural Materials

Report of Contributions

https://conferences.iaea.org/e/407

Contribution ID: **1** Type: **not specified**

Development status of endf-userpy

Monday 16 December 2024 13:30 (1 hour)

Presenter: SCHNABEL, Georg (IAEA)

Session Classification: Evaluations

Contribution ID: **2** Type: **not specified**

Enhancing Nuclear Data predictions through Bayesian Model Averaging

Wednesday 18 December 2024 11:00 (1 hour)

Presenter: ALHASSAN, Erwin

Session Classification: Evaluation Methodology

Contribution ID: **3** Type: **not specified**

Interest on high quality evaluation of Zr isotopes for LWRs

Tuesday 17 December 2024 14:30 (1 hour)

Presenter: BERNARD, David

Session Classification: Benchmarking

Contribution ID: **4** Type: **not specified**

PAST AND PLANNED Integral Experiments: IEs for Structural Material Validation

Tuesday 17 December 2024 15:30 (1 hour)

Discussing integral criticality experiments done at the National Criticality Experiments Research Center in the Nevada National Security Site in the United States of America.

Primary author: BRAIN, Peter

Presenter: BRAIN, Peter

Session Classification: Benchmarking

Contribution ID: **5** Type: **not specified**

Review of INDEN structural material evaluations and challenges

Tuesday 17 December 2024 11:00 (1 hour)

Presenter: CAPOTE NOY, Roberto Mario (IAEA NAPC-NDS)

Session Classification: Benchmarking

Contribution ID: **6** Type: **not specified**

Measurements and evaluation of structural materials at RPI

Monday 16 December 2024 10:25 (1 hour)

Presenter: DANON, Yaron (Rensselaer Polytechnic Institute)

Session Classification: Opening

Contribution ID: **7** Type: **not specified**

Updates on neutron-induced reaction cross section measurements on structural isotopes

Wednesday 18 December 2024 14:30 (1 hour)

Presenter: DIAKAKI, Maria

Session Classification: INDEN & Measurements

Contribution ID: **9** Type: **not specified**

New copper broomstick and Teflon leakage experiments

Wednesday 18 December 2024 15:30 (1 hour)

Presenter: KOSTAL, Michal

Session Classification: INDEN & Measurements

Contribution ID: **10** Type: **not specified**

INDEN Cu and Fe Benchmark tests

Monday 16 December 2024 09:25 (1 hour)

In the presentation, the results of INDEN benchmark tests using JAEA/FNS Cu and Fe experiments and QST/TIARA Fe experiments. Some remarks for further INDEN improvement will be presented.

Presenter: KWON, Saerom

Session Classification: Opening

Contribution ID: **11** Type: **not specified**

PETALE stainless-steel transmission experiments in CROCUS: feedback on INDEN evaluations

Tuesday 17 December 2024 13:30 (1 hour)

The CEA-EPFL PETALE program on stainless steel and its elements took place at the end of 2020 in the CROCUS reactor at EPFL. The program consists of 21 experiments in transmission, in which the neutron flux in the reflector was measured through activation dosimetry (115In(n,g), 197Au(n,g), 115In(n,n'), 58Ni(n,p), 54Fe(n,p), 56Fe(n,p), and 27Al(n,a)), and 5 reactivity worth experiments, one per reflector –stainless steel 304L, chromium, nickel, and iron –as well as water. The high-fidelity analysis is now reaching its conclusion, and the Benchmarking is now funded and starting.

This presentation focuses on the transmission experiments, includes the last troubleshooting performed during the analysis of the results, and presents the observed differences in the C/E respectively to the distance in the reflectors, between the current official JEFF release (JEFF-3.3) and the new evaluations of INDEN. It is now confirmed that the previously presented discrepancies between the results from Serpent2 and Tripoli-4®, for the fast neutron sensitive dosimeters with the Chromium reflector, are due to unexpected definitions in the MT5 and MF6 that our Serpent2 build has trouble interpreting. This issue is solved by using JEFF-3.1.1 for these cases. Additionally, the common drop observed at the end of the reflectors in the C/E of 56Fe(n,p) dosimeters, is attributed to the presence of around 6 ppm of 55Mn in the dosimeters. These impurities activate into the same product as the dosimeter by radiative capture. It results in a contribution of up to 20% of a dosimeter's total activity.

In the case of the trends, the observed results show that the new evaluation for iron performs significantly better than JEFF-3.3 for the 115In(n,n') and 58Ni(n,p) fast neutron dosimeters. The previous evaluation shows an increase in the C/E respectively to the increase in reflector thickness, while the INDEN evaluation presents a flat profile. At higher Energy (56Fe(n,p) and 27Al(n,a)) the increase in the C/Es respectively to the thickness is preserved. With the non-threshold capture dosimeters (115In(n,g) 197Au(n,g)), in which the median energy of activations is in the eV range, the good agreements are preserved. Similarly, the new evaluation performs better in the 115In(n,n') and 58Ni(n,p) dosimeters range for the 304L reflector. At higher energy (56Fe(n,p)) the observed increase in C/E is slightly reduced, offering a better agreement, while in the low energies, the good agreement is preserved. In the case of the chromium, a gradual decrease of the C/E is observed for the 115In(n,g) and 197Au(n,g) dosimeters, resulting in a slightly worse comparison to the experiments respectively JEFF-3.3. The results with 115In(n,n') dosimeters are slightly closer to the experimental results but a strong decrease in the C/E is still visible. At higher energy, INDEN and JEFF-3.1.1 show similar results, a downward trend for 58Ni(n,p), and upward trends for both 56Fe(n,p) and 27Al(n,a). In the case of the nickel reflector, which INDEN does not currently re-evaluate, TENDL-24 shows similar results to JEFF-3.3 in the fast region, with an especially strong downward trend for the 115In(n,n'). In the lower energies, the results degraded considerably, with a new upward trends in the reflectors and sharp drops in the C/E on both sides of the reflector.

Pile-oscillation of samples cut from the spare sheets of the reflectors are currently running and will be analyzed in parallel with PETALE's reactivity worth experiments

Presenter: LIGONNET, Thomas

Session Classification: Benchmarking

Contribution ID: **12** Type: **not specified**

Structural materials in the latest and next ENDF/B releases

Monday 16 December 2024 14:30 (1 hour)

Presenter: NOBRE, Gustavo

Session Classification: Evaluations

Contribution ID: **13** Type: **not specified**

Narrow beam neutron transmission benchmarks and evaluated data in the region of resonance cross section structures

Tuesday 17 December 2024 09:00 (1 hour)

Presenter: PRONYAEV, Vladimir

Session Classification: Benchmarking

Contribution ID: **16** Type: **not specified**

Current status of the tungsten evaluations

Wednesday 18 December 2024 13:30 (1 hour)

Presenter: TRKOV, Andre

Session Classification: INDEN & Measurements

Contribution ID: **17** Type: **not specified**

Adjustment and validation of iron-56 data with shielding benchmarks

Tuesday 17 December 2024 10:00 (1 hour)

Iron is an important structural and shielding material in nuclear reactors. In the recent international Fe-56 nuclear reaction evaluation data, there are still significant differences in the evaluated 56Fe(n,inl) cross-sections. The results of the iron shielding benchmark test showed that the nuclear reaction data for iron still needed further improvement. In order to improve the accuracy of shielding calculation and provide quantitative feedback for nuclear data evaluation, a nuclear data adjustment study based on shielding benchmark experiment was carried out.

In this work, the adjustment of Fe-56(n,el), (n,inl) and (n,γ) reaction cross-sections was carried out based on the IPPE iron sphere shielding benchmark experiment (ALARM-CF-FE-01) and the maximum likelihood function method, and the adjustment coefficients of the cross-sections were calculated, which were used to adjust the Fe-56 cross section data in PENDF format. The microscopic cross-section and covariance data of this adjustment study are from the JEFF-3.3 library, and the neutron leakage spectrum before the test is calculated by the MCNP program. The sensitivity coefficients of the cross-sections were obtained by the direct perturbation method.

The adjustment results showed that the neutron leakage spectrum calculated based the adjusted Fe-56 data was improved in the MeV energy region but no in the keV energy region. The adjusted neutron leakage spectrum obtained by the nuclear data adjustment based on the 3-fold covariance is in better agreement with the experimental data than with the 1-fold covariance. The adjustment factor for (n, inl) cross-section was larger than 1 standard deviation in a certain energy region when 3-fold covariance was used. And the posterior cross section for (n,inl) reaction with the 3-fold covariance used was closer to the corrected Nelson(2004) data. In the energy range of 10 - 15 MeV, the adjusted cross section was closer to the C33b4 revision of Fe-56 data.

The adjusted Fe-56 data was validated with the ASPIS/Fe88 experiment. The 32S(n,p)32P reaction rate calculated with the 3-fold covariance-adjusted Fe-56 data was significantly improved, with the maximum calculation deviation reduced from 31% to 9%. However, the adjusted 27Al(n,α) reaction rates worsened, while the adjusted reaction rate deviations for 115In(n,n')115mIn and 103Rh(n,n')103mRh remained similar to before adjustment but better than C33b4 and INDEN evaluations. The adjusted reaction rate bias for 197Au(n,γ)198Au improved, especially with 3-fold covariance.

In summary, adjustment coefficients for Fe-56 reaction cross-sections were obtained, and the adjusted inelastic scattering cross-section was closer to the C33b4 evaluation in a specific energy range. The neutron leakage spectrum calculation improved partially, and the ASPIS/Fe88 experiment validated the posterior data, highlighting the effectiveness of the 3-fold covariance adjustment in some cases.

Primary author: WU, Haicheng

Presenter: WU, Haicheng

Session Classification: Benchmarking

Contribution ID: **19** Type: **not specified**

LEAD ISOTOPE EVALUATIONS: Current progress and limitations

Monday 16 December 2024 15:30 (1 hour)

Will give a 15 min version of a 3 year thesis regarding nuclear data of lead isotopes. In particular, 206, 207,208 from 1e-5 eV to 20 MeV.

Primary author: BRAIN, Peter

Presenter: BRAIN, Peter

Session Classification: Evaluations

Contribution ID: **20** Type: **not specified**

Research on Machine Learning Methods for Nuclear Reaction Cross Section Data of Structural Materials

Wednesday 18 December 2024 09:00 (1 hour)

The field of neutron induced nuclear reaction data has a rich history and well-established methodologies. However, it is often observed that existing models fail to accurately capture the drastic variations in experimental measurements corresponding to specific neutron energies, and for isotopes lacking measurement data, the uncertainty in theoretical models is substantial. My report endeavors to address these challenges through the application of two machine learning techniques. Specifically, it includes utilizing Bayesian Networks to analyze experimental data in the unresolved resonance region (URR) and fast neutron energy range for Fe-56, and Neural Networks for systematically learning neutron capture cross sections.

Primary author: SUN, Xiaodong

Presenter: SUN, Xiaodong

Session Classification: Evaluation Methodology

Contribution ID: **21** Type: **not specified**

Nuclear data evaluation pipeline for structural materials - treating model defects and inconsistent data

Wednesday 18 December 2024 10:00 (1 hour)

Presenter: SJÖSTRAND, Henrik

Session Classification: Evaluation Methodology

Contribution ID: **22** Type: **not specified**

Welcome address

Monday 16 December 2024 09:00 (10 minutes)

Presenter: KONING, Arjan

Session Classification: Opening

Contribution ID: **23** Type: **not specified**

Meeting formalities

Monday 16 December 2024 09:10 (15 minutes)

Presenter: SCHNABEL, Georg (IAEA)

Session Classification: Opening