

Ukrainian Nuclear Data Centre: Progress Report, 2003/04

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Summary of nuclear data activity by staff of the UKRNDC
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Introduction

Ukrainian Nuclear Data Centre (UKRNDC) is subdivision within the Neutron Physics Department at the Institute for Nuclear Research of the National Academy of Sciences of Ukraine. UKRNDC has 6 permanent researchers. The staff is partly involved in the experimental investigations of neutron cross sections at Kyiv Research Reactor.

Compilation

We continue collection and compilation of experimental neutron data published by Ukrainian researchers. We also started to compile the experimental charged particle data. After compilation of numerical data and related information using EXFOR format they are sent to NDS IAEA to be included to EXFOR library (see Table 1).

Table 1. EXFOR's entries sent to NDS IAEA by UKRNDC.

#	EXFOR's entry	Reference	Date of compilation y/m/d
<i>Neutron data</i>			
1	32205	(J,NST,1,425,200208) (J,ZNJD,4,(2),53,2001)	2003/11/11
2	32206	(J,UFZ,39,785,1994)	2003/10/08
3	32212	(J,NST,1,389,200208)	2003/11/25
4	32213	(J,YF,61,(9),1562,199809)	2004/06/18
<i>Charged particle data</i>			
5	D5001	(J,YF,61,(9),1569,199809)	2004/04/10
6	D5002	(J,YF,61,(9),1562,199809)	2004/06/18

We started to collect the photonuclear data executed by Ukrainian scientists and we plan to begin their compilation in the near future.

Collaboration

- We continue our collaboration with the Laboratory of Engineering and Technology (LET) of the Chernobyl Center for Nuclear Safety, Radioactive Waste and Radioecology (CCNSRWR), Slavutych in scientific support of Slavutych Nuclear Data Bank and its users. This work is

supported by Science and Technology Center in Ukraine (STCU Project #1648, “*Development and support of Nuclear Data Base in Slavutych for decommissioning of Chornobyl NPP reactor units*”). In frame of this activity the following actions were carried out:

- A series of lectures (“*Using the NJOY code system for preparation of the MCNP libraries*”, “*Data Table Formats used in the MCNP libraries*”) was read for the LET staff.
- In cooperation with the LET staff the analysis of a list of nuclides, which require preparing of data libraries for calculations of the RBMK-1000 reactor radiation characteristics, was conducted [1].
- The neutron activation cross section calculations were carried out for 40 elements of the RBMK structure material (natural isotope abundance). These elements are H, Li, Be, B, C, N, O, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Br, Zr, Nb, Mo, Ag, Cd, Ba, Sm, Eu, Dy, Hf, W, Pb, Bi. For input data the nuclear evaluated data libraries BROND-2, ENDF-VI (rel. 8), JEFF-3.0, JENDL-3.3, CENDL-2 were used. The calculations were conducted with precision 0.1%, at three temperatures - 0K, 293K, 573K, with the help of a software package NJOY-99.81 and NJOY94 (module MIXR).
- The pointwise cross section (PENDF format) libraries and the ACE-format libraries for the elements which are the main constituents of the RBMK-1000 reactor fuel, namely, for ^{235}U , ^{238}U , ^{238}Pu , ^{239}Pu , ^{240}Pu and ^{241}Pu isotopes, were produced. The input data were taken from five nuclear data libraries: BROND-2, ENDF-VI (rel. 8), JEFF-3.0, JENDL-3.3, CENDL-2. Calculations were made for three temperatures, T=0K, 293K and 593K, by NJOY99.81 code on the computer with RISC/6000 processor under AIX operating system. Results of calculations are combined in two ACE-format libraries, ULIB and PULIB, separately for Uranium and Plutonium isotopes.

All calculations were performed at the UKRNDC computer base, scheme of which is shown at Figure 1.

We are very much obliged to our STCU Project #1648 collaborators, two of them are here: NNDC, USA and NDS, IAEA. Due to their support we were able to fulfil these works and can plan our activity for next year.

- We continue our collaboration with the Physical Department of the Kyiv National University. The teaching course “*Nuclear Data for Science and Technology*” (68 hours) was lectured in 2003-2004 for graduate course students of NPD KNU. This course included the following items: ENDF/B libraries, EXROR system, ENSDF library, the use of UTILITY and PREPRO codes in work with the ENDF libraries, the introduction to NJOY99 code system, the Network of Nuclear Reaction Data Centers and the use of on-line services.

- We started a collaboration with the Lawrence Livermore National Laboratory (STCU Project #P176, “*Experiments at Kyiv Research Reactor*”) to determine the neutron standard cross sections with high accuracy. In frame of this activity the measurements of total, total scattering and angle scattering neutron cross sections at reactor neutron filtered beams with energies in the range from 2 up to 144 keV on carbon samples will be performed.

Customer Services

- During 2003-2004 the data for users requests were prepared and adapted (from ENDF, ENSDF and EXFOR libraries) for our institute researchers and for ones from other institutes. The organizations, whose requests on nuclear data have arrived and were executed in the accounting period:

1. Department of Nuclear Physics of the Institute for Nuclear Research (INR) NASU.
2. Department of Nuclear Physics of Kyiv National University.
3. Department of Physics of Biological Systems of the Institute of Physics NASU.
4. Department of the Theory of Nuclear Reactions INR NASU.
5. Department of Nuclear Reactions INR NASU.
6. Center of Environmental Problems INR NASU.
7. Kharkiv Institute of Physics and Technology.
8. Uzhgorod Institute of Nuclear Physics NASU.

- The UKRNDC site is operating and developing. Ukrainian customers, especially students and those physicists, who wish to prepare the pointwise and multigroup cross sections self-dependently, but do not have a good experience in it, use this site very often. Address of the UKRNDC site: <http://ukrnrc.kinr.kiev.ua>.

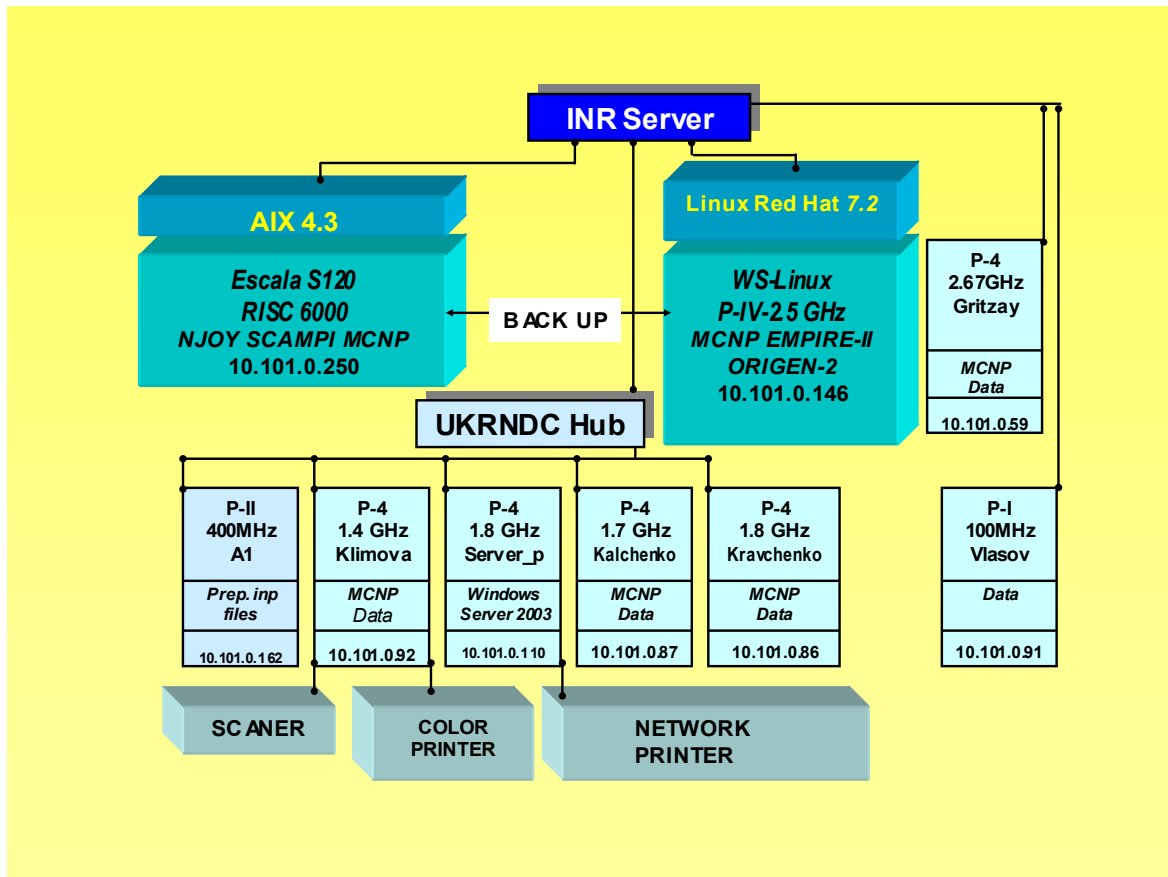


Figure 1. Scheme of the UKRNDC computer base.

Calculation

- Special library for simulation of neutron filters by means the code FILTER_L (ver. 5) was extended using ENDF/B-6 (rel.8), JENDL-3.3, JEFF-3.0.
- Analysis of self-shielding factors for Cr-52, using ENDF-VI (rel. 8), JEFF-3.0, JENDL-3.3, BROND-2, CENDL-2 libraries was fulfilled at several energy ranges. These calculations were carried out with the code complex DT_GRO, GROUPIE, SELF. The results were used to present the measured cross sections on Cr-52 samples [2] and will be used in further investigations.
- The ACE-format libraries for the elements which are generated during operation of the WWR-M reactor type, namely, for ^{24,25,26}Mg, ^{28,29,30}Si, ^{84,86,87,88,89,90}Sr, ^{89,90,91}Y, ^{90,91,92,93,94,95,96}Zr, ^{92,94,95,96,97,98,99,100}Mo, ^{96,98,99,100,101,102,103,104,106}Ru, ^{140,141,142,144}Ce, ^{106,108,110,111,112,113,114,115m,116}Cd, ^{120,122,123,124,125,126,127m,128,129m,130,132}Te, ^{124,126,128,129,130,131,132,133,134,135,136}Xe, ^{138,139,140}La, ^{141,142,143}Pr, ^{134,135,136,137,138,140}Ba, ^{142,143,144,145,146,147,148,150}Nd, ^{147,148,148m,149,151}Pm isotopes, were produced. Most of them are absent in the standard MCNP distribution. These libraries were used for calculation of the effective multiplication factor, k_{eff} , to estimate a level of the Kyiv Research Reactor safety [3].

Experimental Neutron Data Measurements

- □ The total neutron cross section and its self-shielding values for Cr-52 were measured at Kyiv Research Reactor using Neutron Filter Technique. The accuracy of measured cross sections was better than 2%, as it was requested 3% in *The NEA High Priority Nuclear Data List (1998)*. These data for neutron energies 24 and 58 keV were compared with the data from ENDF libraries and presented at the ND2004.
- The total neutron cross sections for natural carbon were measured using neutron filtered beams with accuracy better than 1% at average energies 24, 59 and 148 keV at the Kyiv Research Reactor.

Visits and Conferences

- In December 1-5, 2003 N. Klimova visited NDS IAEA as EXFOR compiler to take part in the Workshop on Relational Databases for Nuclear Data Development - Dissemination and Processing.
- In September 26-October 1, 2004 O. Gritzay and O. Kalchenko took part in International Conference on Nuclear Data for Science and Technology, Santa Fe, NM, USA.

References

1. D.G. Bobro, A.V. Nosovsky, O.O. Gritzay, Ju.A. Kochegura, "Forming of nuclear constant library for transport calculation of RBMK-1000 reactor", *Jad. Rad. Bez.*, vol. 3, 2003 (in Ukrainian).
2. Olena O. Gritzay, Volodymir V. Koloty, Nataliya A. Klimova, Oleksandr I. Kalchenko, Mykola L. Gnidak, Oleksandr I. Korol', Petro M. Vorona, "Total Cross Section And Self-Shielding Effects Of Cr-52 Isotope Measured At Kyiv Research Reactor Neutron Filtered Beams", ND2004, 26 September-1 October, 2004, Santa Fe, NM, USA.
3. Olena Gritzay, Oleksandr Kalchenko, Nataliya Klimova, Volodymyr Razbudey, Andriy Sanzhur, Stephen Binney, "Monte-Carlo Calculation Of Core Reactivity And Fluxes For The Development Of BNCT Neutron Source At The Kyiv Research Reactor", ND2004, 26 September-1 October, 2004, Santa Fe, NM, USA.