Present Status of CENDL Project

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1 General

CENDL is carried out by China Nuclear Data Center and China Nuclear Data Network, China Nuclear Data Committee assumes responsibility the management of CENDL project. The committee meetings are generally held once per year. The follows is the organization of the committee and the network.

Committee Chair:	Prof. Zhao Zhixiang, CIAE
Technical working party:	Evaluation Working Party
	Measurements Working Party.
	Benchmark Working Party.
China Nuclear Data Network:	China Institute of Atomic Energy.
	Peking University,
	Sichuan University.
	Lanzhou University.
	Tsinghua University
	Nankai University,
	Jilin University
	Zhenzhou University ,
	Northwest University and et al

2 General purpose file

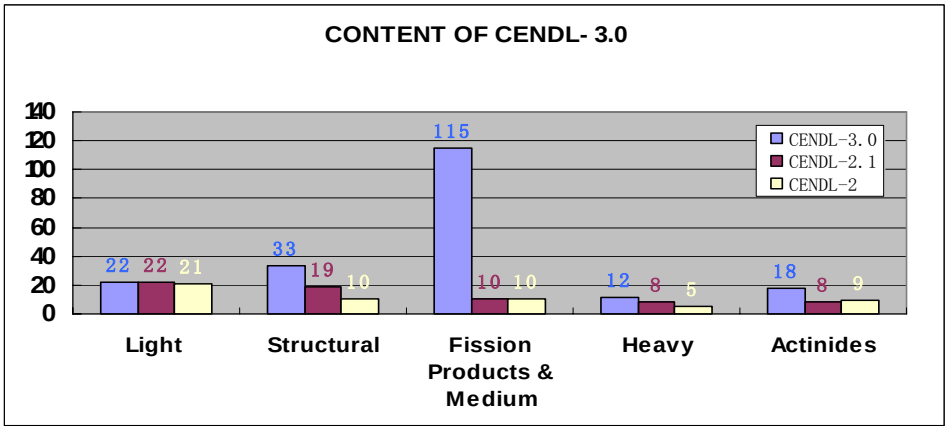
• CENDL-3.1

The evaluated activities of CENDL-3.0 were started in 1995 and finished in 2000. The library includes comprehensive data evaluations for all neutron reactions in the energy range from 10^{-5}eV to 20MeV for 200 nuclides, among them, 133 nuclides are newly evaluated, and 67 nuclides are taken from CENDL-2.1. The ENDF-6 format is adopted, the files 1, 2, 3, 4, 6, 12~15 are included for major fissile nuclide, structure material and light nuclide, files 1, 2, 3, 4, 5 are given for minor fissile and fission production nuclides.

CENDL-3.0 was distributed inside of China as an internal test version in 2001. The criticality benchmark testing of CENDL-3.0 had been carried out for various types of fast and thermal reactors and neutron leakage spectra experiments by Integral Test Working Group in CNDC. After that some feedback information from benchmark testing and users has been received. These were considered in the re-evaluations for improving the data of the important nuclides, especially for the uranium and plutonium isotopes when the improvement is completed, CENDL-3.1 is the new version of CENDL-3.0. CENDL-3.1 will be released in the end of 2008.

The Nuclides of CENDL-3.1

Nucl.	Content
Light Elements	^{1,2,3}H,^{3,4}He,^{6,7}Li,^{9}Be,^{10,11}B,^{12}C,^{14}N,^{16}O,^{19}F,^{23}Na,^{nat}Mg,^{27}Al,^{nat}Si,^{31}P,^{nat}S,^{nat}Cl,^{nat}K,^{nat}Ca
Structural Materials	^{nat}Ti,^{nat}V,$^{50,52\sim54,nat}$Cr,^{55}Mn,$^{54,56\sim58,nat}$Fe,^{59}Co,$^{58,60\sim62,64,nat}$Ni,^{63,65,nat}Cu,^{nat}Zn
Fission Products & Medium Elements	^{69,71,nat}Ga,$^{83,84\sim86}$Kr,^{85,87,nat}Rb,$^{88\sim90}$Sr,^{89,91}Y,$^{90\sim96,nat}$Zr,^{93,95}Nb,^{95,97,98,100,nat}Mo,^{99}Tc,$^{99\sim105}$Ru,^{103}Rh,^{105,108}Pd,^{107,109,nat}Ag,^{113,nat}Cd,^{115,nat}In,^{nat}Sn,^{121,123,nat}Sb,^{130}Te,^{127}I,$^{124,129,131,132,134\sim136}$Xe,$^{133\sim135,137}$Cs,$^{130,132,134\sim138,nat}$Ba,^{139}La,$^{140\sim142,144}$Ce,^{141}Pr,$^{142\sim148,150,nat}$Nd,^{147,148,149}Pm,$^{144,147\sim152,154,nat}$Sm, $^{151,153\sim155,nat}$Eu,$^{152,154\sim158,160,nat}$Gd,^{164}Dy
Heavy Elements	^{nat}Lu,^{nat}Hf,^{181}Ta,^{nat}W,^{197}Au,^{nat}Hg,^{nat}Ti,^{204,206,207,207,nat}Pb,
Actinides	^{233,234,235,236,238,239}U, ^{237}Np,^{238,239,240,241,242}Pu, ^{241,242}Am, ^{249}Bk,^{249}Cf



• New evaluations

During past two years, more than 40 new neutron data evaluations have been performed in CNDC cooperated with CNDN. The range of nuclei contains light nuclides, structure material nuclides, fission product nuclides and actinides (^{12}C,^{14}N,^{16}O,^{23}Na,Mg,Al,^{46,47,48,49,50,nat}Ti,$^{58,\ 60,\ 61,\ 62,}$ ^{64}Ni,^{63}Cu, ^{85}Y,^{95}Zr, ^{99}Mo,^{129,131,132,134}Xe,^{169}Tm,^{181}Ta, ^{240}Pu et al.). The UNF code for nuclear data model calculations with the unified Hauser-Feshbach and exciton model are implemented in the evaluations. The APMN code was used for automatically searching a set of optimal optical potential parameter. A method to set up file-6 of light nuclei for evaluated neutron data in ENDF/B-6 format below 20 MeV has been established and the energy balance was strictly considered. These new evaluations will be collected by CENDL future edition.

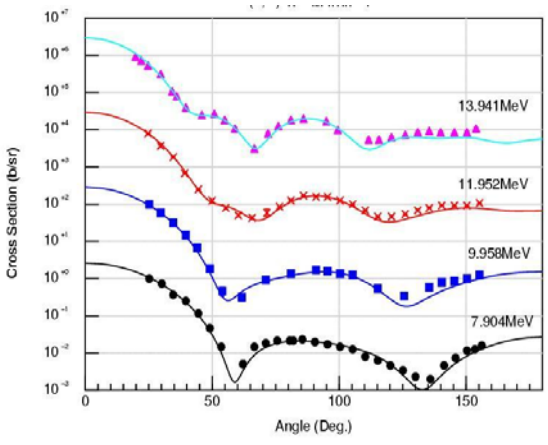


Fig1, n+^{58}Ni elastic scattering distributions

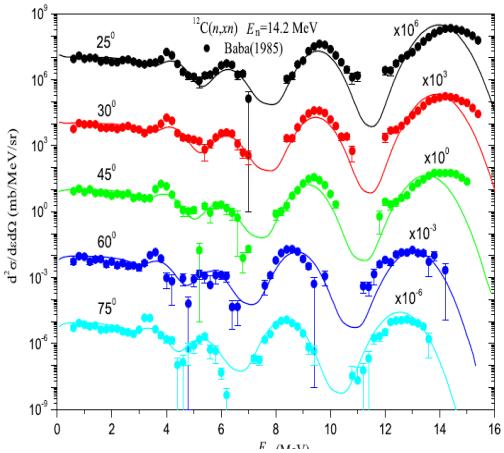


Fig 2. Double-differential cross sections of n+^{12}C

The evaluation of covariance data for natural aluminum, iron and its isotopes in the energy range from the upper limit of the resonance to 20 MeV was carried out based on the experimental data mainly taken from EXFOR library. The experimental data and their uncertainties were analyzed, selected and corrected. The EXPCOV code, based on Bayes principle and generalized least square method (SPCC code), were used to fit the data and merge the covariance matrix with the bases of analyzing the different kind of experimental error, e.g. short range, middle range and long range error or statistical and systematical error. The covariance data are output in ENDF/B-6 format.

3 Nuclear data for ADS

This work is a part of the project of ADS system of China, and is supported by China Ministry of science and technology. The theoretical models code MEND has been improved, and the calculation and evaluation of n and p+^{54,56,57,58}Fe reactions for incident nucleon energy below 250 MeV were carried out based on the new MEND code. The calculation and evaluation of n+^{233,234,235,236,238}U reactions for incident neutron energy below 20 MeV were also done, and the benchmark test calculations were done for the neutron data.

Based on the proposed benchmarks of the CRP, preliminary testing calculations for YALINA-Booster were carried out using IAEA ADS library and the data from LA150 with Monte Carlo code.

4 Structure and decay data

• Structure Data

The nuclear structure and decay data evaluations in CNDC and CNDCN has permanent responsibility for evaluating and updating NSDD for A=51, and 195-198; temporary for A=67. In recent 2 years, the mass chain A=51, 67 have been revised using available experimental decay and reaction data. A=67 was published in NDS in 2005 and A=51 have been sent to NNDC in review. Now A=196 was being updated.

• Decay Data

About 40 new decay data evaluations finished in recent 2 years. The range of nuclides from^{37}Ar to ^{153}Gd. These evaluations included the half-life, γ –ray intensity, branch ratio and decay schemes et.al. Two evaluation methods ENSDF and DDEP were used in our new evaluations.

5 Fission yield

• Systematics on Mass Distribution Data

Based on the experimental data of mass distribution of fission product, measured by double kinetic energy, and chain yield data, measured by radio active method, the systematics on mass distribution of fission product nuclides were studied with multi-Gaussian Model for ^{235}U and ^{238}U.

• Systematics on Independent Yield

Based all experimental data of independent yield data for ^{235}U, ^{238}U and ^{239}Pu, retrieved from EXFOR Master Library, the systematics on independent yield with Zp model was studied. The systematics code was developed and the parameters were determined by fitting experimental data.

• The Evaluation of Cumulative Yield Data

Cumulative yield data from ^{235}U and ^{238}U fission were evaluated for each about 50 fission product nuclides as a base of updating CENDL/FY and for some practical applications.

7. Nuclear reaction model code

The code system LUNF series used for light nuclei model calculations were developed. This code system can be used for the model calculation for neutron introduced reaction with targets ^{6,7}Li ^{9}Be,^{10}B,^{12}C,^{14}N and^{16}O. LUNF system can also provide the energy-angular spectra (MF6 in ENDF format) model calculations.

The theoretical model code MEND of nucleon-induced reaction has been improved. In the new version of MEND code, the gamma-production cross sections and ENDF format are included.

8. International Co-operation:

At present, The scientists of CNDC participate in two IAEA Coordinated Research Projects: Parameters for Calculation of Nuclear Reactions of Relevance to Non-energy Applications (RIPL-3); Updated Decay Data Library for Actinides.

《Nuclide Chart》complied with Russian scientists were published in 2007

9 The meeting and symposium

- The Technical Meeting of covariance data, May 25-30, 2007, Haikou
- The Meetings of China Nuclear Data Committee，7 Aug. 2007, Harbing
- 2007 Nuclear Data Conference of China, 8-10 Aug. 2007, Harbing

10. Future development

A five years paln for the year 2006 to 2010 is ongoing. The following is planned.

- New evaluation for some nuclides in the energy range from 10^{-5}eV to 30MeV.
- Revision and validation of the evaluations.
- Inclusion of more covariance data in the evaluations
- Evaluations for resonance parameters.