China Nuclear Data Center (CNDC) Status Report

Zhuang Youxiang

1. General Situation

1.1 Nuclear Data Evaluation

CENDL-3.0 was developed during 1996 - 2001, it includes 214 nuclides for general purpose. Among them, the data of 169 nuclides were newly evaluated or reevaluated. Comparing to CENDL-2.1 and other evaluated libraries, the data were updated and improved. For structure materials, the data were given for both natural element and their isotopes, and are consistent between them. For fission product nuclides, the data were completely newly evaluated. For light nuclides, the data of double differential cross section can be made much improved. The data are being tested for some thermal, fast reactor assembles and some leak spectrum experiments. Some problems have been found and are being improved; for example, (1) double differential cross sections of light nuclides ^{6,7}Li, and ^{9}Be; (2) fission neutron spectra of ^{233,235,238}U and ^{239,240}Pu; (3) a complete set of data for unstable and/or short-lived nuclides; (4) excitation function of fission-product yield.

The present status of CENDL-3.0 is shown in Table 1.

Table 1. The present status of CENDL-3.0

Nuclides	Planned	Evaluated	Being Tested
Fissile nuclide	15	15	^{233,235,238}U, ^{239,240}Pu
Structure material	24	42	^{nat}Fe
Fission products	91	109	(n,γ)
Light nuclide	3	3	^{9}Be
Total evaluated	133	169	
Total CENDL-3	178	214	

1.2 Validation of CENDL-3.0

The Benchmarks testing of CENDL-3.0 has been done for some homogeneous fast reactors with the continuous Monte Carlo code MCNP and AMPX code system, and for thermal reactors with reactor lattice code WIMSD etc.. The comparisons of calculated results with different evaluated nuclear data libraries were also made.

In most thermal and fast uranium criticality benchmarks, the calculated K_{eff} values with CENDL-3.0 are in good agreements with experimental results. In small fast cores with ^{233}U fuel, good results of K_{eff} values are given with CENDL-3.0, due to reevaluation of ^{233}U fission cross sections.

For most uranium assemblies, CENDL-3.0 shows better agreements with references experimental cases. In the benchmarks testing for both uranium metal fuel lattice assemblies and uranium oxide fuel lattice assemblies, the K_{eff} values calculated with ENDF/B-6.7 are underestimated. We can see that the excellent K_{eff} values with CENDL-3.0 are given. The reason is that the inelastic cross section data of ^{238}U from CENDL-3.0 show better agreements with the most experimental results compared to the corresponding data in the ENDF/B-6.7 library. ^{238}U inelastic scattering effect of ENDF/B-6 makes assemblies spectrum harder and

underestimates the fission contributions of ^{235}U, so that the K_{eff} values calculated with ENDF/B-6 are underestimated.

It is well known that ^{238}U data affects strongly on the calculated results of reactor physics parameters and their trend, due to high concentration in the uranium fuel reactors. It is obvious that ^{238}U data of CENDL-3.0 are better than those of ENDF/B-6.7 for most reactors calculations, especially for thermal reactors calculations.

In the plutonium fast cores, the K_{eff} values were improved significantly with CENDL-3.0. This is duo to reevaluation of the fission spectrum and elastic angular distributions of ^{239}Pu and ^{240}Pu from CENDL-2.1 to CENDL –3.0.

In the spherical or cylindrical assemblies of plutonium or uranium with beryllium reflector, the K_{eff} values were improved considerably with CENDL-3.0, due to modification of elastic angular distribution and the (n,2n) cross sections of ^{9}Be, but CENDL-3.0 still underestimated the K_{eff} values compared with other evaluated data libraries for most assemblies. It's necessary to do further improvement for the data of beryllium from CENDL-3.0.

Benchmark testing for some structure materials has been done at CNDC. It can be seen that further improvement for data of iron is needed, and further benchmarks testing will be done with these materials.

The data testing for fission product nuclides has been done at CNDC. The reactor spectrum averaged (n,γ) cross sections were calculated and compared with the measured ones. Good results are given for most fission product nuclides compared with other nuclear data libraries. This is because of using the newest experimental data and adding the direct inelastic scattering for the evaluated data.

1.3 Future Work

A new five year plan (from 2001 to 2005) was made for the nuclear data development. It is certainly that CENDL-3.0, both general purpose data file and special purpose data file, will be developed further to CENDL-3.1. The general purpose data file will include more nuclides and more files (for example covariance data files). More fission product nuclides will also be included. The data for important nuclides will be improved further. The resonance parameters will be investigated and evaluated. The fission yield data and decay data will be continuously evaluated.

The nuclear data measurement, evaluation and validation will still be combined in CENDL-3.0 improvement and development.

2. CINDA and EXFOR Compilation

2.1 CINDA

Total 102 entries were compiled from the papers of "Communication of Nuclear Data Progress", No. 23 - 26 in 2000 - 2001.

2.2 EXFOR

Two young staff members under the guidance of Zhuang Youxiang compiled 15 entries for measurements made in China.

3. Publications

"Communication of Nuclear Data Progress" (CNDP) has been published for 4 issues (No.2 - 26) during 2000 - 2001, and it (350 books/each issue) has also been distributed by IAEA Nuclear Data Section as an INDC document.

4. Short-term Programs, New Tasks and Staffs

4.1 Short-term Program

The benchmark testing of CENDL-3.0 will be continued during two years, in order to improve and release it.

4.2 New Task (Nuclear Data for ADS)

Accelerator Driven Sub-critical System (ADS), called Accelerator Driven Radioactive Clean Nuclear Power System, is investigated in preparation as national project now in China. To meet the requirement, the data of some nuclides are being evaluated, the multi-group cross sections are being generated with the microscopic data taken from CENDL, and a code system to calculate the data in high-energy region is being developed.

4.3 Staff

There are four groups in CNDC:
(1) Evaluation Group: 6
(2) Theory Group: 4
(3) Macroscopic Data Group: 3
(4) Data Library and Computer Group: 3

They are engaged in neutron, charged-particle and photo-nuclear data evaluations; nuclear structure and decay data, fission product yield evaluations; parameters library, EXFOR, CINDA, data service, library management; group constant generating, validation and so on, respectively.

5. Activities and Cooperation during 2001

5.1 Meetings Held in China

(1) The meeting on the 10^{th} years plan of nuclear data evaluation, June 12 - 17, Zhangjiajie city, Hunan province;
(2) The Working Group Meeting of Nuclear Data Evaluation and Theoretical Calculation, July 25, Beijing;
(3) The Standing Committee Meeting of the Second China Nuclear Data Committee,

September 13, Beijing;

(4) The first plenary session of the third committee of China Nuclear Data Committee, September 14, Beijing. Prof. Zhao Zhixiang, the president of CIAE, was appointed to be the new chairman of this Committee.

5.2 The International Meetings in Nuclear Data Field Attended by Staffs of CNDC

(1) Research Co-ordination Meeting on Development of a Database for Prompt Gamma-ray Neutron Activation Analysis, May 14 - 17, Zhou Chunmei, Vienna, Austria;
(2) Consultants' Meeting on the Co-ordination of Nuclear Reaction Data Centers (Technical Aspects), May 28 - 31, Zhuang Youxiang, Vienna, Austria;
(3) International Conference on Nuclear Data for Science and Technology, Oct. 7 - 12, Xia Haihong, Zhuang Youxiang, Zhou Zuying, Yu weixiang, Shen Qingbiao and Yu Hongwei, Tsukuba, Japan;
(4) Research Co-ordination Meeting on Fission Product Yield Data Required for Transmutation of Minor Actinide Nuclear Waste, Oct. 8 - 12, Liu Tingjin, Vienna, Austria;
(5) Research Co-ordination Meeting on Final Stage of WIMS-D Library Update Project, Nov. 5 - 8, Liu Ping, Vienna, Austria;
(6) Research Co-ordination Meeting on Nuclear Model Parameter Testing for Nuclear Data Evaluation (Reference Input Parameter Library: Phase II), Dec. 3 - 7, Ge Zhigang, Vienna, Austria.

5.3 The Foreign Scientists in Nuclear Data Field Visited CNDC/CIAE

(1) Drs. T.V.Golashvili, V.P.Chechev and A.Demidov, Ministry of Atomic Energy of Russia Federation, Sep. 10 - 20;
(2) Dr. Jun-ichi Katakura, NDC/JAERI, Sep. 16 - 21;
(3) Dr. Guinyun Kim, Pohang Technology University, Korea, Sep. 20 - 21;
(4) Dr. Andrej Trkov, NDS/IAEA, Oct. 13 - 17;
(5) Dr. E.T.Cheng, San Diego, USA, Nov. 16.

5.4 Staffs of CNDC Worked in or Visited Foreign Country

(1) Rong Jian, JAERI, from Aug. 1, 2000 to July 31, 2001;
(2) Shu Nangchuan, ORNL, from Mar. 26, 1999 to Oct. 1, 2001.