

Status of Nuclear Data Activity in Korea

Jonghwa Chang
Nuclear Data Evaluation Laboratory,
Korea Atomic Energy Research Institute

Introduction

As Korea decided to take the nuclear power plant option to support its economic growth, it has proceeded in the localization of nuclear fuel and power plant design technology since 1983. After ten years of localization efforts, Korea launched a long- and mid-term nuclear development plan in 1994.

The nuclear data activity has been included in the long- and mid-term nuclear development plan since 1997. The main efforts before this time were to generate multigroup libraries for the lattice neutronics codes such as WIMS-D, CASMO, and the MCNP library from the available evaluated libraries to support the design of the test reactor HANARO and partially to support the developments of the PWR.

Since 1997, the activity includes evaluation and measurement. Since there is no working nuclear data measurement facility yet, we are supporting people at Korean universities to develop measurement techniques using foreign facilities.

The NDEL(Nuclear Data Evaluation Laboratory) of KAERI(Korea Atomic Energy Research Institute) has 7 regular staff members and 5 temporal staff members in 1999. Among them, 7 are working for the evaluation, 4 for processing, and 1 for computer maintenance. The main computer facility is a linux cluster composed of 12 pentium PCs and three HP-700 series.

Evaluation

Since Korea is experiencing difficulties with spent fuels produced from 11 pressurized water reactors and 3 CANDU reactors, 12 GW in total, many nuclear development efforts are concerned with spent fuel. The burnup credit for spent fuel criticality is a favorite aspect for the transportation and depository. Current safety regulation permits partial credit for the minor actinides. So it is necessary to understand the fission product property accurately to receive credit for the 20 - 30 percent criticality.

KAERI NDEL has started re- evaluation of long-lived fission product nuclides with BNL NNDC. Currently, we are re- evaluating the resolved resonance parameters and the average resonance parameters for the unresolved energy region.[1] We will extend the evaluation up to 20 MeV with model calculation by ABAREX, ECIS, and GNASH.

Intermediate energy data needs in Korea are mainly to support the design of a proton accelerator driven nuclide transmutation system.[2] We have developed a computer code system, ECISPLOT, based on ECIS and GNASH, jointly with JNDC. And we have finished initial work with ECISPLOT.[3] We will continue this work under collaboration with JNDC.

There are several hospitals in Korea which have a medical cyclotron ranging from 30 to 50 MeV. To support the activity in producing nuclear medicine and industrial usage such as thin layer analysis (TLA), we have invited a scientist from CNDC to start evaluation.[4,5] After evaluating production cross section, we are doing a model calculation to estimate the subsidiary unwanted isotope production cross sections.[6]

For the feasibility study of constructing a pulsed neutron facility based on an electron linac, we have begun to study the photoneutron production cross section.[7] We have joined the IAEA CRP on "Compilation and evaluation of photonuclear data for application". The scope of

KAERI is about Mo, Sn, Zn, S and Cl. This work is performed together with an invited scientist from CNDC.[8]

Processing

During the design and construction of the test reactor HANARO, KAERI has developed the libraries for MCNP and WIMS-D based on recently evaluated libraries such as ENDF/B-6 and JENDL-3.[9] KAERI NDEL has been providing various libraries for the lattice neutronics codes WIMS-D, CASMO-3, and HELIOS to support the nuclear fuel design and development activity in Korea. Also, the ORIGEN-2 library was developed for the test reactor.

Recent efforts in KAERI NDEL processing are focused on the shielding and material damage calculation of the PWR vessel surveillance problem and material testing. We are using DOORS and DANTSYS.[10]

Service

KAERI NDEL is supporting nuclear data requests inside of the institute as well as korea. To supply the data, we are collecting the nuclear data from various sources, such as IAEA/NDS, OECD Databank, etc. Many times we need to interpret the collected data to make it understandable to and usable by the final users who are usually not accustomed to the standard exchange format. The KAERI web service was designed to provide nuclear data for those who need the data but do not have time to study various conventions in nuclear data society.

There are many web services for nuclear data, now. However, when we started to develop the service on the internet in 1994, the only available internet service was the telnet service. The web interface has the useful features of a link, a form, and a generic graphic user interface.

The table of nuclides provides nuclide-wise information about the mass based on Audi and Wapstra[11], decay property based on NUDAT[12], capture cross section graph based on NGATLAS[13], fission yield table based on ENDF/B-6, and summary of neutron interaction cross section based on JENDL-3.2[14]. For easy access, we have provided the hypertext link to other nuclides in the decay chain and between natural elements and nuclides. References to the sources of data are provided. A link to the decay diagram is provided based on ENSDF. The decay diagram displays a level diagram and radiation intensity.

The cross section plotter service provides the on-line generation of graphs for each nuclide and reaction type. We are providing ENDF-B/VI and JEF-2 pointwise files and the MCNP library. The user may plot several nuclide and reaction types on one graph to make a comparison between nuclides, reactions or libraries. The user can change the energy and the cross section range and scale. The output is provided in GIF, EPS and ASCII text as well as on-screen display.

The temperature dependent MCNP library, based on various evaluated library files, is provided for downloading.

We also created the EXFOR database for use during evaluation. The database has a web interface and a TCP daemon interface. With the daemon at EXFOR database server, several client programs are written to retrieve the experimental values in table form. For example, when we use gnuplot in unix, the following command will generate points on the workstation screen.

```
plot "|getexfor nnnnn.sss"
```

Currently, the KAERI EXFOR database is not synchronized with the international one.

To know the usage of the service, we defined valid statistics. Since the web page consists of introductory pages, such as a picture of the nuclides box or a form to fill-in user requests for plot, and result pages which display data. We only count the number of result pages excluding access by the service provider. Last year, the server had a 316,096 hit count, and among them, 43,690 valid ones(about 14 %).

Figure 1 displays the valid statistics for the table of nuclides, the ENDF graphs, the decay diagram, the capture cross section and the number of users (or IP addresses). The web service started in 1994, but we did not keep the web log before August 1996. The figure displays a large spread, but it shows an obvious increasing trend. There may be two reasons for the increase in users. First is the increase due to the increase in people who use the web (netizen). This increase is a natural one. The second is the increase by the introduction of new features. The rapid increase since 1998 is due to new features, the decay diagram and the neutron capture cross section graph.

Among the 25,817 visitors (based on the number of IP addresses) last year, 5,724 visitors contributed to the valid statistics. The total number of valid statistics was 43,690. So, the average access counts of each user was 7.6. As displayed in Figure 2, the number of users who have accessed many times to get information is inversely proportional to the number of accesses. If we consider the user who accessed more times than the average user access count, as a regular user, we had 986 regular users last year.

Summary

KAERI NDEL is a user of NRDC for domestic and internet services, evaluation and processing. And KAERI/NDEL will be a potential contributor to international nuclear data by ongoing measurement using either domestic or foreign facilities.

References

- [1] CHANG, J., S.Y. Oh, and S.F. Mughabghab, "Neutron Resonance Parameter Evaluation for Major Fission Product Nuclides (I)," to be presented at *Korea Nucl. Soc. Mtg.* on May 29, 1999.
- [2] CHANG, J. and T.Y. Song, "Nuclear Design Aspect of the Korean High Intensity Proton Accelerator Project," in Proc. of *The Third Specialists' Meeting on High Energy Nuclear Data*, March 30-31, 1998, JAERI, Tokai, Japan," p.91.
- [3] Lee, Y.O., et al., "Evaluation of neutron and proton induced nuclear data of Al-27 up to 2 GeV," submitted to *J. of Nucl. Sci. and Technology*, 1999.
- [4] Zhuang, Y.X., "The Evaluations and Calculations of Medical Isotope Production Reaction Excitation Functions," KAERI internal report NDL-3, 8, 14, 17, 19, 22/98, 1998.
- [5] Chang, J., "Proton reaction cross section evaluation for TLA," KAERI internal report NDL-31/98, 1998.
- [6] Kim, D.H., "Calculation and Evaluation of proton induced reactions," KAERI internal report NDL-32/98, NDL-2, 8/99,
- [7] Lee, Y.O., J. Chang, and T. Fukahori, "Evaluation of Photonuclear Reactions on Ta-181 up to 140 MeV," *J. of Nucl. Sci. and Tech.* 35(10) 685, 1998
- [8] Han, Y., KAERI internal report NDL-4,5,7/99, 1999.
- [9] Kim, J.D. et al., "Nuclear Data Evaluation and Group Constant Generation for Reactor Analysis," KAERI report KAERI/RR-1434/94, 1994.
- [10] Kim, J.D. et al., "Comparison of BFS-73-1 Benchmark Test using JENDL-3.2, JEF-2.2, and ENDF/B-VI.3," in Proc. of *The Third Specialists' Meeting on High Energy Nuclear Data*, March 30-31, 1998, JAERI, Tokai, Japan," p.141.
- [11] Audi, G. and A.H. Wapsta, "The 1995 update to the atomic mass evaluation," *Nuclear Physics A* 595(4) 409-480, 1995.
- [12] R.R. Kinsey, et al., "The NUDAT/PCNUDAT Program for Nuclear Data," paper submitted to the *9th International Symposium of Capture-Gamma ray Spectroscopy and Related Topics*, Budapest, Hungary, October 1996.
- [13] NGATLAS - Atlas of Neutron Capture Cross Sections (Courtesy of IAEA NDS)
- [14] XS averaged from JENDL3.2 (Courtesy of T. Nakagawa at JAERI)

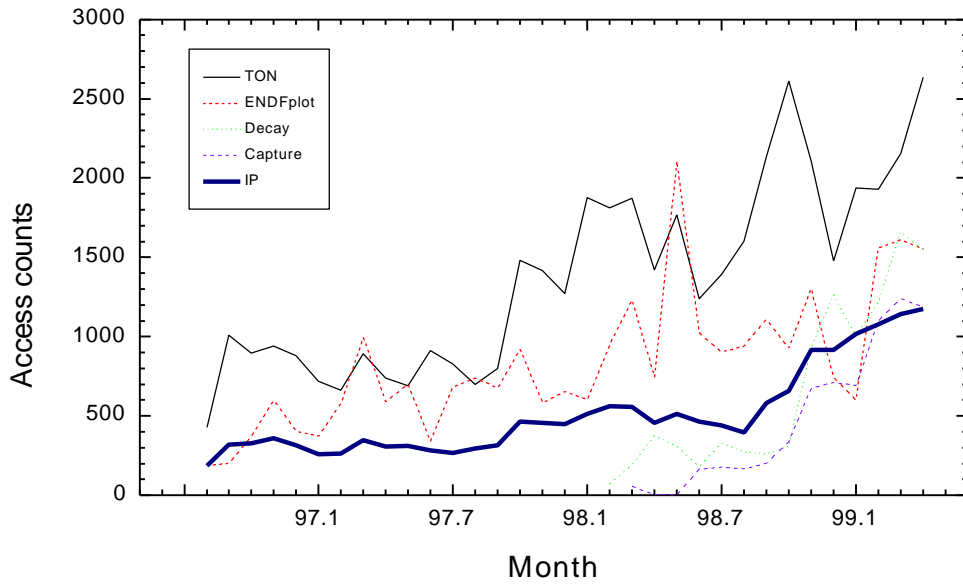


Figure 1. Monthly Usage of KAERI/NDEL web server

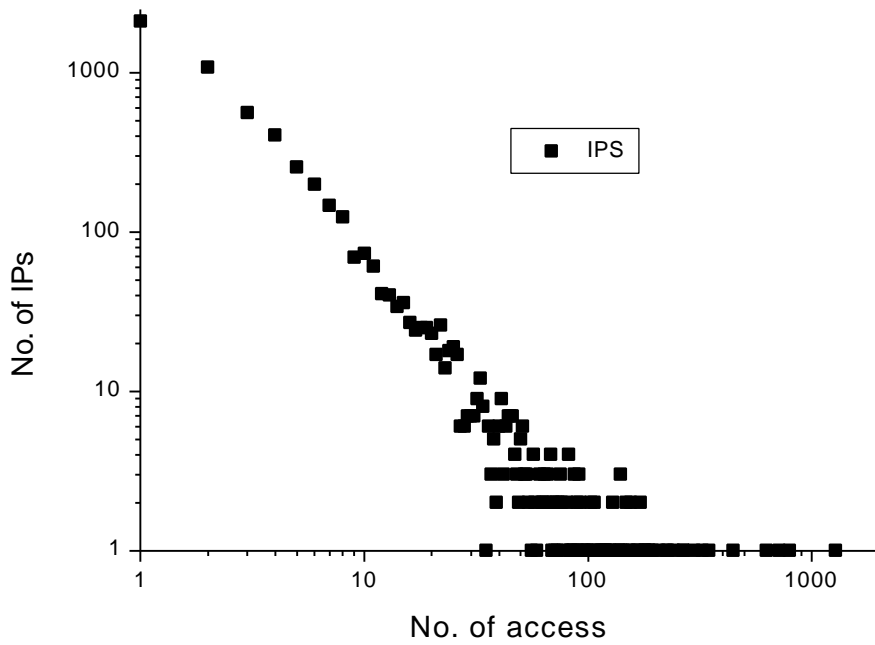


Figure 2. Valid User Statistics

