# Nuclear Data Evaluation Lab. (NDEL) of Korea Atomic Energy Research Institute (KAERI)

Progress Report of 2007/2008 to the
IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres
22-25 September, 2008

*Young-Ouk LEE (yolee@kaeri.re.kr)*
*Web: http://www.atom.kaeri.re.kr*

## 0. General

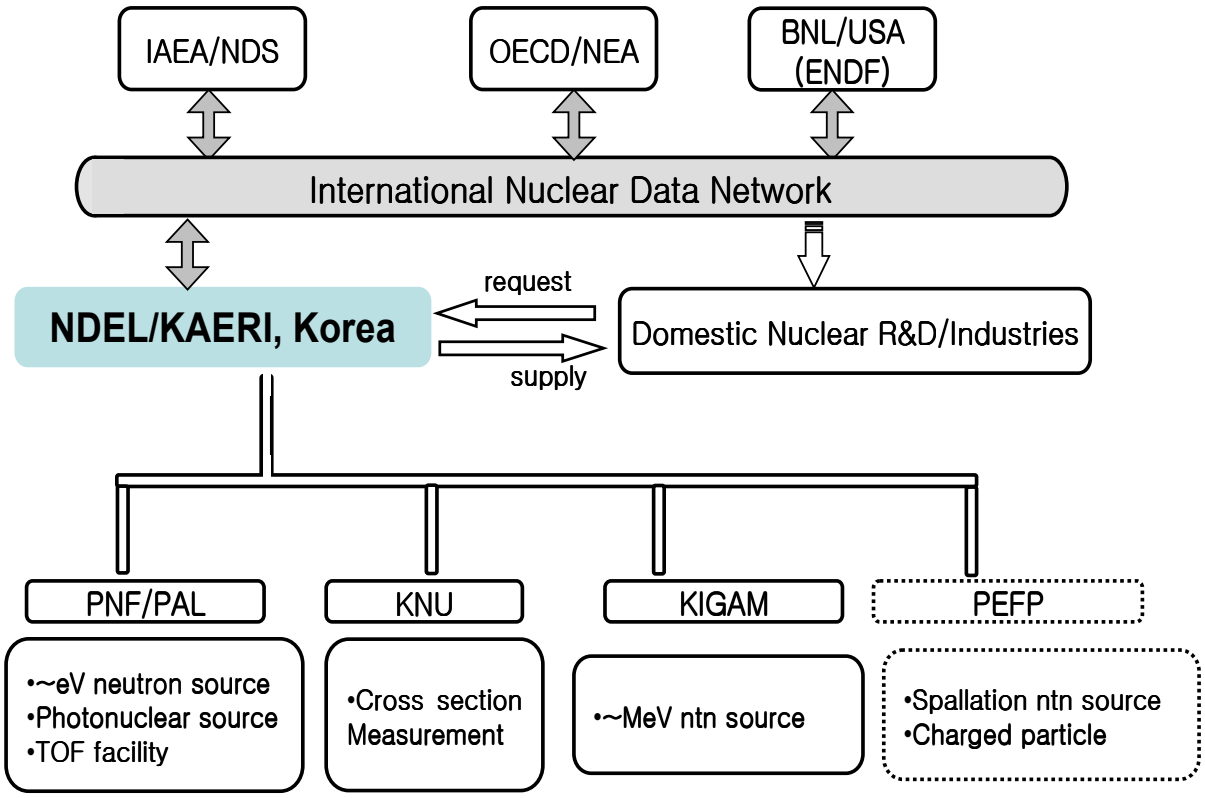
Nuclear Data Evaluation Laboratory (NDEL) of Korea Atomic Energy Research Institute (KAERI) has 7 staffs and 1 Secretary (Evaluation 3, Processing and Benchmark 4). Mission of NDEL includes disseminating outcomes of international network as well as promoting domestic activities related to nuclear data.

KAERI/NDEL has been established in 1997, and has been funded by government as one of the nuclear energy development program. It was recently decided by Korean government that **KAERI/NDEL be funded by a more stable and steady source of budget from the fiscal year of 2009. This decision will secure and expand activities of KAERI/NDEL, and lead to more contribution to the international nuclear data network.**

Nuclear data needs are mainly from following major nuclear R&D programs:

- **Advanced Reactor Development** (Liquid Metal Fast Reactor and High Temperature Gas Cooled reactor Supercritical Water Reactor) requires quantification of cross section uncertainties in their reactor designs.
- **Advanced Fuel Cycle** needs up-to-date neutron cross sections of MA and fission products.
- **Proton accelerator development** requires high energy neutron and proton nuclear data relevant to the radiological safety and beam application of the accelerator
- Usual activities for **the nuclear power plant operation, medical isotope production and the radioisotope applications**, are requesting up-to-date nuclear data

KAERI/NDEL is performing nuclear data evaluation, multi-group library processing, and validation which are required by the above mentioned R&D program in Korea. For measurement of nuclear reaction data, KAERI/NDEL is coordinating measurements of Pohang Neutron Facility (PNF) of Pohang Accelerator Laboratory (PAL), Van de Graff laboratory of Korea Institute of Geosciences and Mineral Resources (KIGAM), and MC-50 Cyclotron at Korea Institute of Radiological and Medical Sciences (KIRAMS)



## 2. Facilities and Measurements

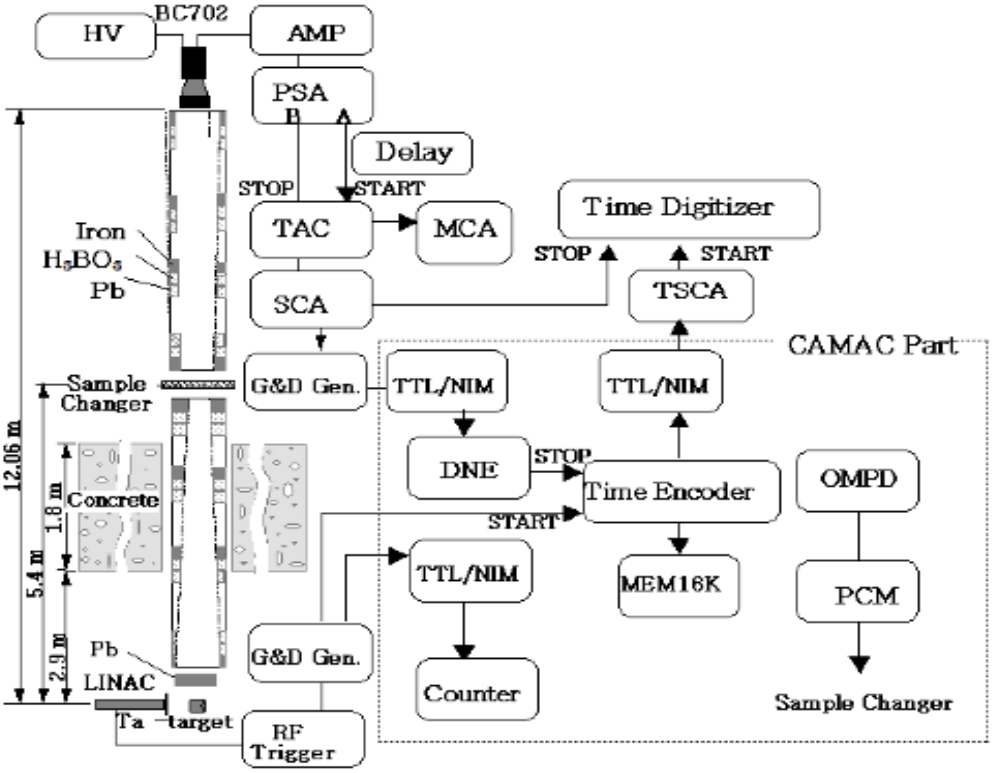
### 2.1 Pohang Neutron Facility of PAL (Y.D. Oh, ydoh@postech.ac.kr)

**Specifications:**

- electron energy = 50 - 75 MeV
- repetition rate = 10 ~ 15Hz,  pulse width = 1 ~ 2 μs
- peak beam current = 30 ~ 50 mA
- TOF flight length = 12m
- Target + water moderator to produce neutron pulse
- Ta plates + cooling system
- Detector : scintillator + PM tube
- BC702 [6Li-ZnS(Ag)]Thickness 1.6cm , diameter 12.5cm
- Sample changer  consisting of  remotely controlled 4 sample holders

**Measurements:**

- The total cross sections of natural Pd, Nb, Mo, Er , Fe using TOF method.
  - The resonance parameters of  Pd, Nb, Mo , Er were determined using SAMMY code
  - Nuclear spectroscopic data for Fe, Zr, Y, Bi, Cu with 50, 60, 70 MeV bremsstrahlung
-



**2.2 Van der Graaf of KIGAM (G.D. Kim, gdkim@kigam.re.kr)**

**Specifications:**

-monoenergetic pulsed neutron beam for energies 500 keV ~ 2.2 MeV with TOF system

-based on Van der Graaf with bunching and pulsing

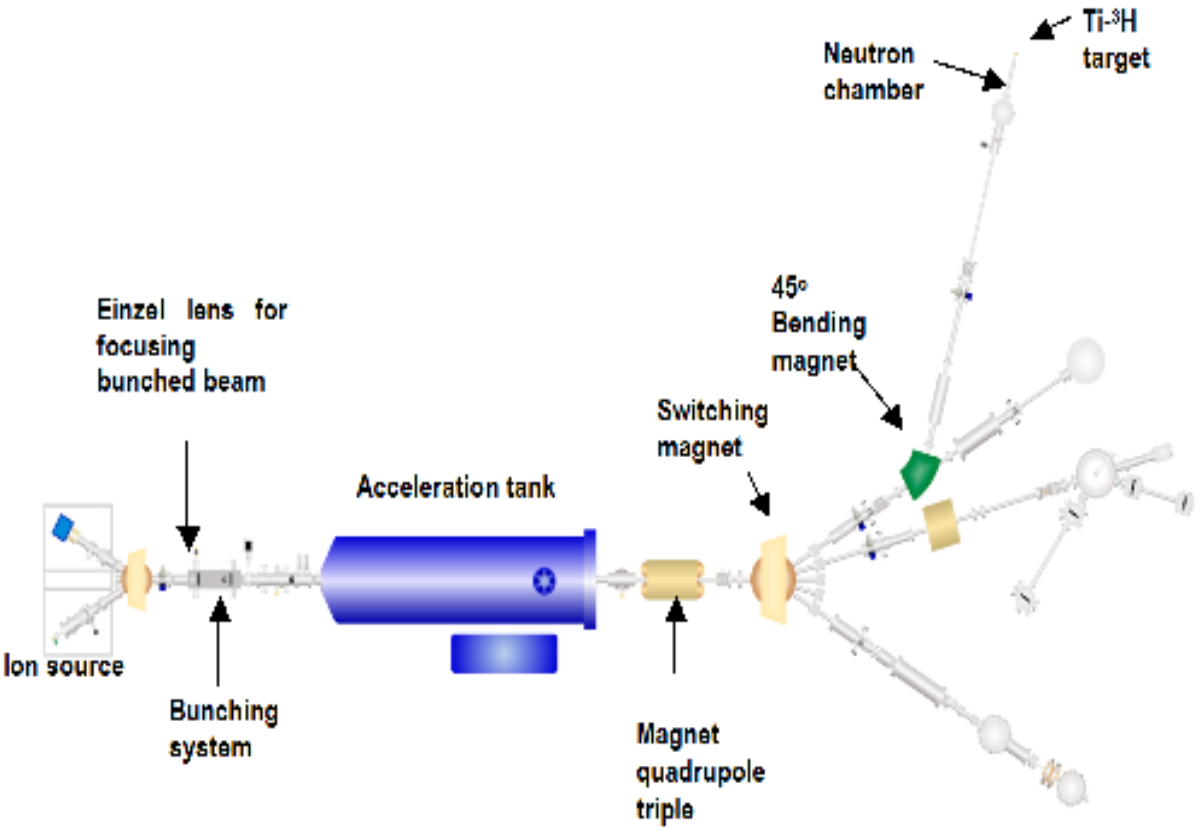
-$^{7}$Li(p,n) reaction with $10^{6}$~$10^{7}$ neutrons/sec and FWHM < 5 %

-pulsed beam with period 125 ns, width 1-2ns, Time Pick up detecting system

-two plastic detectors ( 3"x 1 cm)

**Measurements:**

-neutron total cross sections on $^{197}$Au, $^{28}$Si, and $^{27}$Al are measured and being analyzed for neutron energies below 1 MeV



## 2.3 MC-50 of KIRAMS (GN Kim, gnkim@knu.ac.kr)

**Specifications:**

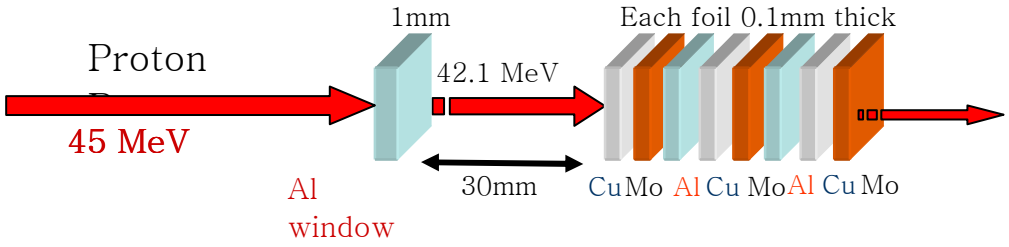
-azimuthally-Varying Field-Type MC-50 cyclotron

-proton beam Energy : ~ 45 MeV, Beam current : < ~ 50 nA

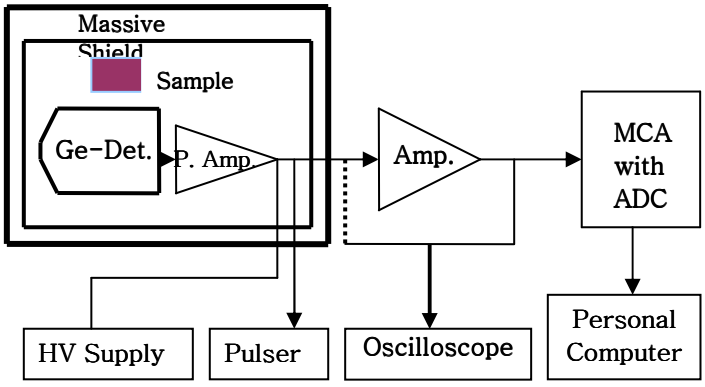
-used for neutron therapy with Be(p,n) reaction and radioisotope production

**Measurements**

-Proton induced reaction cross-sections on $^{nat}$Sn, $^{nat}$Cd, $^{nat}$Zr, $^{nat}$Ag and $^{nat}$Pd




Schematic diagram of stacked-foil activation technique




Electronic block diagram of γ-ray spectrometry

## 3. Evaluation and Benchmark (Y.-O. Lee, yolee@kaeri.re.kr)

**Tungsten** is considered as a prime candidate of plasma facing materials (PFM) in fusion environment. However the neutronics calculations using the existing libraries show large discrepancies with measurements of several benchmarks such as SINBAD fusion benchmarks (Oktavian, FNS, FNG) and ICSBEP fast reactor ones. In response to this situation, neutron cross sections for $^{180, 182,183,184,186}$W were evaluated in the neutron-incident energy range from 0.1 MeV to 100 MeV using the nuclear reaction model code EMPIRE-2.19 with a consistent set of input parameters for all tungsten isotopes.

**Validation of tungsten cross sections in ENDF-6 format** was performed through shielding and criticality safety benchmarks with the MCNPX code. The calculation results based on the new evaluations have been compared with those based on the ENDF/B-VII.0, JEFF-3.1, JENDL-3.3, and FENDL-2.1 as well as the benchmark experiments.

**Resonance Module in EMPIRE** has been improved to allow the evaluation of covariance data in cooperation with BNL/NNDC. The updated module has a capability of writing the MF32 covariances in the compact format. It first generates the sensitivity matrix for the resonance parameters. The sensitivity matrix is obtained by repeatedly adjusting parameters and calculating the variances of the resultant cross sections. Then, KALMAN code is jointly used for the calculation of the correlation coefficients based on the sensitivity matrix. These steps are automatically processed and controlled by the resonance module.

**MATXS-format 150-group neutron libraries** for fast reactors have been generated and updated based on the ENDF/B-VII.0, JEFF-3.1, and JENDL-3.3. The libraries have been validated through the 18 fast benchmark experiments from the CSEWG benchmark specifications and BFS critical assemblies. Now, the libraries named as KAFAX-E70, KAFAX-F31, and KAFAX-J33 are being distributed from the NEA Data Bank.

**ANISN-format neutron library** was provided for the design the conceptual design of a DEMO Tokamak reactor system. It is based on the FENDL-2.1 and incorporated into a one-dimensional neutronics code to optimize various reactor parameters such as the TBR, nuclear heating, radiation damage, etc.