IAEA Coordinated Research Project:

"Development of Database for Prompt Gamma-ray Neutron Activation Analysis"

Led by: R. Firestone, Isotopes Project, LBNL

Participants: China, Hungary, India, Korea, US, Vietnam

Mission: To improve accuracy, completeness and availability of thermal (n,γ) data needed for prompt-gamma neutron activation analysis.

Status:

- Commenced November 1999, final meeting March 2003.
- Produced 'EGAF' (Evaluated Gamma-ray Activation File) database of 35,000 evaluated prompt and decay gamma-ray cross-sections for thermal-neutron capture on any stable element from H to U.
- Prepared TECDOC publication with CD-ROM (in press).
- Created web site (in press) and developed software for searching database on CD-ROM and on the web.
- Energies and cross sections adopted by the CRP will also be published in *Handbook of Prompt Gamma-ray Activation Analysis* (Kluwer).

Impact of EGAF on ENSDF

- ENSDF-format files will be available to us in the very near future, probably from a new database set up at NNDC to accommodate them.
- They will impact all existing thermal-neutron capture γ-ray datasets in ENSDF.
- For each nuclide there will be 2 or 3 datasets provided:
  1. Energies and cross sections adopted by the CRP (primary and secondary gamma rays).
  2. New data from elemental measurements at the Budapest reactor (not yet published).
  3. An evaluated dataset prepared independently by Reedy and Frankle (At. Data & Nucl. Data Tables **80**, 1 (2002)); available primarily for the lighter nuclides.
- Existing ENSDF datasets will need to be modified appropriately; the CRP (adopted) datasets can **not** replace them (they do not include the ENSDF file's comments, documentation, conversion data, etc.).

Examples

1. Data Adopted for CRP.

```
17O      16O(N,G) E=THERMAL: ADOPTED                          2003IAEA
17O  C   Evaluated Gamma-ray Activation File (EGAF).
17O2C   Evaluated by R.B. Firestone (LBNL).
17O  C   SIGMAN=0.000189 {I8}
17O  C   SIGMAN=0.000190 {I19} (1981MuZQ)
17O  CG RI$ Elemental sigma(gamma) assuming %Abundance=99.757 16.
17O    N   1.00239 15          1.0
17O   CN  NR$ Isotopic sigma(gamma)=NR*RI.
17O 2CN  Divide by SIGMAN for intensity per neutron capture.
17O     L      0.0   5/2+                 STABLE
17O     L    870.71  6 1/2+               179.2 PS  18
17O     G    870.68  6 1.77E-4 11
17O     L   3055.28 9 1/2-                 0.08 PS   +6-4
17O     G   2184.42 7 1.64E-4   7
17O     L   4143.06 10 1/2+
17O     G   1087.75 6  1.58E-4   7
17O     G   3272.02 8  3.53E-5 23
```

← Newly deduced σ_n

← Newly deduced S_n

2. New Data from Budapest

```
17O      16O(N,G) E=THERMAL: BUDAPEST                    2003BUDA
17O  C   Budapest Reactor data measured with thermal beam.
17O  CG RI$ Elemental sigma(gamma) assuming %Abundance=99.757 16
17O   N   1.00239 15          1.0
17O   L       0.0        5/2+
17O   L     870.70  3 1/2+              179.2 PS 18
17O   G     870.68 3 1.75E-04 11
17O   L    3055.27 5 1/2-               0.08 PS  +6-4
17O   G    2184.38 4 1.75E-04 11
17O   L    4143.04  5 1/2+
17O   G    1087.71 3 1.51E-04  9
17O   G    3272.11 7 3.53E-05 25
```

3. Evaluation by Reedy and Frankle (Los Alamos)

```
17O     16O(N,G) E=THERMAL          1977MC05,1993TI07       LANL2002
17O   C             For energies of the gamma rays made by thermal-neutron
17O AC  capture with 16O, I used the level energies in Tilley et al. (1993)
17O BC  [1993Ti07]. For the gamma-ray intensities, I used McDonald et al.
17O CC  (1977) [1977Mc05]. The absolute error in the intensities is about +-3%
17O DC  (e.g., 18+-3%). Tilley et al. (1993) accepted these gamma-ray
17O EC  intensities and their errors. The set is complete.
17O   N  1.0
17O   L      0.0       5/2+
17O   L    870.73    1/2+
17O   G    870.71    100.000
17O   L   3055.36    1/2-
17O   G   2184.48     82.000
17O   L   3842.80     5/2-
17O   L   4143.33    1/2+
17O   G   1087.93     82.000
17O   G   3272.26     18.000
```

The Good News and the Bad

Not so Good!

• The existing ENSDF datasets are often VERY large and will need to be reworked.

• Both the CRP (adopted) and CRP (Budapest) datasets give **elemental cross sections** (not relative Iγ) in the RI field (so it is not immediately obvious which of the 'old' values has been changed).

On the Positive Side …

• Primary and secondary intensities are now available on the same scale.

• The intensity normalization has been done for us.

• We will gain access to a large volume of data from Budapest and some of those gamma-ray intensity and energy data will be superior to what we already have.