Status Report of the WPEC Subgroup 6 (SG6) activities

A. D'ANGELO

May 1998

Background

Last year, a meeting was held at Obninsk to review progresses on the Delayed Neutron Data activities (Colloquy on Delayed neutron Data, IPPE Obninsk, 9-10 April 1997 / see Minutes annexed to the 1997 SG6 Status Report). At the end of the meeting it was stated to terminate the SG6 activities after having defined a new group-structure of the time-depending parameters and written a state-of-the-art giving recommendations on the best delayed neutron data for the principal isotopes.

Status report

Here below the state-of-the-art of the activities is synthetically reported in accordance with the 3 kinds of delayed neutron data to be improved by SG6: 1) Total delayed neutron yields; 2) Time depending group parameters; 3) Spectra.

1) TOTAL DELAYED NEUTRON YIELDS (DNY)

The validation of main-fissile-isotope total-delayed-neutron-yields (DNY) on integral results (in-pile effective beta measurements) is well in progress at Cadarache (Eric Fort and Veronique Zammit). The Lendel model and recent prompt-neutron yield evaluations are used to determine the DNY dependence on the incident neutron energy. Preliminary results show that the DNY energy dependence below 4 MeV is not a determinant problem for data of $^{235}$U and $^{239}$Pu main fissile isotopes.

The XIX experimental campaign of effective-beta measurements at the FCA facility (Tokay-Mura) is terminated. A post-experiment meeting has been recently held at Tokay-Mura (the Minutes are annexed to the present status report). Experimental techniques, row results analysis and uncertainties have been presented and discussed during the meeting. A paper on the XIX campaign will be presented at the next International Conference on the Physics of Nuclear Science and Technology (Long-Island, N.Y., October 1998). Moreover, a summary paper, for both the XIX/FCA and the previous BERENICE/MASURCA experimental campaigns should be written to be annexed to the SG6 final report.

During the works of the XIX Post Experiment meeting at Tokay, a JAERI activity to validate DNY data by using the BERENICE and XIX in-pile integral results has been mentioned. The SG6 is interested in this further activity, but stresses the opportunity of
the maximum co-operation with Eric Fort and Veronique Zammit who are working on this important task at the CEA.

2) TIME DEPENDING GROUP PARAMETERS

Gregory Spriggs and Joann Campbell (Los Alamos) are working to define a new (in comparison with the classical Keepin's structure) 8-group structure of time-depending constants (i.e. of the constants fitting the delayed neutron activity in function of time). The work is done in cooperation with the other SG6 members. The $\lambda$ values of the first three groups will satisfy the asymptotic die-away time constants associated with the three longest lived precursors of significant yield: $^{87}\text{Br}$, $^{131}\text{I}$, $^{86}\text{Br}$. This characteristic will allow a better analysis of stable-period in-pile measurements and a better simulation of slow transients. The same set of $\lambda$ values are used for all the isotopes and all the incident neutron energies. This characteristic will allow better reactor-kinetics calculations.

A first report has been terminated and diffused, containing more than 200 different sets of delayed neutron group parameters published in the open literature.

A second report has been completed in a draft version and it is now being prepared for distribution to the SG6. The report is containing the expansion in the new group-structure of 238 DN sets. Vladimir Piksaikin (IPPE, Obninsk) contributed to the expansion work.

David Loaiza (Los Alamos) will also propose a new group structure.

3) SPECTRA

During the Obninsk meeting, Joann Campbell showed that the agreement between the main-isotope spectra measured at the University of Massachusset Lowell and the spectra obtained at Los Alamos using the summation technique is generally good.

When the test-phase of the new group constant structure will be terminated, also data on spectra will be produced on the new group structure.

Final report and persisting interests

At the end of the 1998 the SG6 will produce a state-of-the-art report, based on the two main works on the DNY data validation and of time-depending data group-structure re-definition, and recommending the best delayed neutron data for the major fissile isotopes.

At the end of the Obninsk meeting, it was decided that mean/long term activities on delayed neutron data will be the specific object of a new NEANSC subgroup. The new subgroup should monitor and promote the improvement of data relevant to fissile isotopes of interest for transmutation applications and for Th fuel cycle. Owing to the difficulty to have targets containing a sufficient amount of minor fissile isotopes with a satisfactory purity, aggregate delayed neutron properties of minor actinides are generally not easy to be directly measured. In order to allow sufficiently good evaluations based on the summation technique, microscopic data of fission yields, $P_n$ values and half-lives of
fission product nuclide should be improved. The possibility of measuring $P_n$ values much more precisely than with the traditional experimental technique has been recently mentioned by Kazuhiro Oyamatsu (Nagoya University) and should be deeply verified. Present Lendel-model predictions of the $^{237}$Np DNY (by Eric Fort) underline the problem of a significant incident neutron energy dependence below 4 MeV. This conclusion agrees with the results of recent $^{237}$Np DNY measurements (Vladimir Piksaikin et al.) and with semi-empirical investigations (V Pronyaev and Vladimir Piksaikin). The new subgroup should also monitor and promote further activities to investigate this argument. Moreover, the DNY energy dependence problem confirms the more general interest in improved methods, data and codes allowing theoretical (or semi-empirical) predictions on minor-actinide delayed-neutron emission.
List of SG6 members

1  Dr. J. Campbell
   Los Alamos National Laboratory

2  Dr. A. D’Angelo
   ENEA Cr. Casaccia

3  Dr. T.R. England,
   Los Alamos National Laboratory

4  Dr. Alexandre Filip
   CEA - Retired

5  Dr. Eric Fort
   CEA, CR CADARACHE

6  Dr. Walter J. Furman
   Frank Laboratory of Neutron Physics,

7  Dr. Robert Jacqmin
   CEA, CR CADARACHE

8  Dr. Jun-ichi Katakura
   Japan Atomic Energy Research Institute

9  Dr. D. Loaiza
   Los Alamos National Laboratory

10 Dr. Robert William Mills
    BNFL Sellafield,

11 Dr. Massimo Martini
    ENEA - C/O CEA, CE. CADARACHE

12 Dr. Richard Dick McKnight
    Argonne National Laboratory

13 Dr. Shigeaki OKAJIMA
    Japan Atomic Energy Research Institute

14 Dr. Kazuhiro Oyamatsu
    Nagoya University

15 Prof. Theodore A. Parish
    Texas A&M University

16 Dr. Vladimir M. Piiskaikin
    Institute of Physics & Power Engineering,
17 Dr. Gregory Spriggs
Los Alamos National Laboratory

18 Dr. Francois Storrer
CEA, CE. CADARACHE

19 Ing Jiří Švarný
SKODA, Nuclear Machinery, Plzeň, Co.Ltd., Czech Republic

20 Prof. David Weaver
The University of Birmingham

21 Dr. William B. Wilson
Los Alamos, New Mexico 87545 USA