

**SUBGROUP 6 : DELAYED NEUTRONS (DN)  
DATA EVALUATION AND BENCHMARKING  
STATUS REPORT, MAY 1994**

**A. FILIP**

A. THE MAIN REALISATIONS are to be considered with respect to the "Recommended actions" of the previous report (5<sup>th</sup> meeting of the WPIEC hold on 16<sup>th</sup> - 17<sup>th</sup> June 1993 in Aix-en-Provence, France) which are reproduced, for convenience, in annexe 2. We list the realizations following the § notations in this document.

**A.1 Basic experimental / evaluated data : summation method**

Point (§.1.1) : the measurements of  $Y_i$  for U233 are done in Studsvik and the interpretation of those on U238 are realized excepting for the normalisation (§ B.1.2). In DUBNA (FLNP/JINR), the preliminary measurements of the  $v_d$  and  $\{\alpha_k, \lambda_k\}$  for the U235 (normalisation) and Pu239 are realized.

The measurement of the same parameters of DN for U235 (normalisation) and U238 in Birmingham is in good progress ; in particular, the absolute fission rate and DN long counter calibrations have been performed.

**A.2 Integral - level 3 - Data**

Point (§ B.2) : The outstanding result concerns the  $\beta_{eff}$  experimental campaign on MASURCA in Cadarache. The good results in the measurement of the  $\beta_{eff}$  of the U235 R2 core confirm the reliability of this (integral) technique for the extraction of the information on  $v_d$  with precision comparable to those in differential (level 2) measurements (ref. 1).

Actually it was shown (ref. 2) that the target precision in  $\beta_{eff}$  measurements for achieving this reliable  $v_d$  extraction is  $\sim 2.5$  %. The table in annexe 1 (extracted from ref. 1) shows that this target is reached.

Measurements in the second (Pu239 + U238) core are performed at present and the preliminary results are consistent. However, for separating the Pu239 / U238 respective contributions a third core is to be built and measured (see later B.3.B).

## B. FURTHER PLANNED AND/OR RECOMMENDED WORK, PARTICULAR DIFFICULTIES

### B.1 Differential (1 & 2) levels

- a) The  $Y_i$  for Th232 will be measured in Studsvik in 1995. As a particular result the overall U235, 233, 238 and Th232 interpretation will allow a better modelling of  $v_d$  calculation / extrapolation by summation.
- b) The Birmingham and Dubna direct  $v_d$  measurement (level 2) will be carried on respectively for  $v_d$  (U238) and  $v_d$  (Pu239, Np237) and final results are to be expected the end of 1995 (see B3).

### B.2 Integral level ( $\beta_{eff}$ )

The third core ( $\geq 65$  % Pu content in the core fuel) is foreseen for 1995 and so the final interpretation and the U235 / U238 / Pu239  $v_d$  data separation is expected for the end of 1995.

### B.3 Particular difficulties

Some delays in the experimental programs :

- a) Dubna, IBR-2 pulsed reactor shut down for the replacement of the reactor rotating reflector.
- b) Cadarache, MASURCA experimental program change related to the new, Pu burner reactors program. So, the third, 65 % Pu core realization will be hardly realized before mid 1995.

### C. ORGANISATIONAL SIDE

An outstanding result is the co-operation agreement (in preparation) between FLNP (Dubna), CEA and OECD-NEA concerning a common effort in DN (level 2) measurements.

### REFERENCES

- [1] P. BERTRAND et al.  
BERENICE Program.  
Topical ANS meeting on Reactor Physics, 11-15 April, Knoxville, USA.
- [2] A. FILIP and A. D'ANGELO.  
On the measurement of the DN yields in effectively input critical media.  
Top. Meet. on Adv. in Reactor Physics, March 8-11, Charleston, USA.

# ANNEXE I

*From Reactor Physics Topical ANS meeting (1994), see ref. 1.*

## The RESULTS (pcm)

(only CEA results)

	U core*	Pu core**
Californium Source	763 ± 42	361 ± 20
Noise	725 ± 38	343 ± 18
Average	744 ± 37	352 ± 17
Calculated Value	744	346

Uncertainty :  $2\sigma$ .

\* Preliminary interpretations.

\*\* Preliminary results of experiments.

## ANNEXE 2

*From the 6<sup>th</sup> S/G Report on the 5<sup>th</sup> meeting of the WPIEC,*

*16-17 June 1993, Aix-en-Provence.*

### B.1 Basic, level 1 & 2, Data

- B.1.1** The measurements of  $Y_i$  for U233, Th232 is planned for the spring of 1994 at Studsvik and the full interpretation of U238 measurement is expected by the fall.
- B.1.2** The first results of the measurement of  $\nu_d$  and  $\{\alpha_k, \alpha_k\}$  for the U235 and Pu239, in the thermal range are expected by the end of 1993 at the FLNP-JINR in Dubna, Russia.

During 1994, in parallel with the refinement of the Pu239 results, new measurements, related to "higher actinides" (Np237, Am241, some Cm isotopes) will be performed.

At the same time efforts are foreseen at the FLNP-JINR towards :

- extend the thermal range measurements to resonance region (0 - 10 keV) in order to fit, the Birmingham ones ( $\geq 50$  keV),
- investigate the possibility of using the results from the  $Y_i(z)$  measurements to improve the  $Y_i$  modelling in a possible co-operation with Los Alamos (A. Wahl) and TU of Dresden (M. Marten),
- possible measurement of the prompt neutron dispersion factor (Diven factor).

### B.2 Integral - level 3 - Data

- The second and third cores (with different Pu239 / U238 proportions) will be measured during the next 10 month or so.

- The final interpretation of the basic R2 core measurements (U235 normalisation) is expected by the fall.

The full (three cores) interpretation will be performed together with Birmingham and Dubna results by the fall of 1994 - beginning of 1995.

### **B.3 Particular recommendations**

**B.3.1** The carrying out, naturally, the works mentioned at B1-B.

**B.3.2** It is proposed that the FLNP-JINR representative participate in the next meetings of the 6<sup>th</sup> subgroup of NEANSC. The FLNP also proposes to hold one of the next NEANSC 6<sup>th</sup> subgroup meetings in the FLNP-JINR, Dubna, Russia.

Considering the importance of the work planned at FLNP-JINR and the related necessary technical support as well as the known actual difficulties of this laboratory, ways are being sought among the concerned national and international establishments to contribute to the material effort (samples, FC's) and also to meetings.