FAST NEUTRON FLUX CALCULATION IN PIK REACTOR

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Proving the PIK reactor [1] serviceability is closely connected with the fast neutron flux on the welds of experimental channels [2] and on their attaching arrangements to a heavy water tank (AAT). Fast neutron flux measurements on the PIK reactor physical model are restricted by the critical assembly power and the sensitivity of the irradiated foils (detectors). For determination of the neutron flux the calculational method of four steps has been employed.

1. The discrete-ordinate code [3] DOT carries out the unperturbed neutron flux calculations in the rector reflector.

2. The DOT code produces an internal boundary neutron flux on a chosen surface.

3. The DOT-to-MORSE coupling code DOMINO-M analyses the DOT boundary neutron flux [4] and produces the normalized cumulative source distributions in space, energy and angles.

4. The tree-dimensional Monte-Carlo code MORSE [5] takes the DOMINO-M normalized probability distributions and calculates the neutron flux in the reflector.

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[1]berillium layer decreases volume peaking factor (K_V) up to $\simeq 2.5$ which helps to maintain the value of maximum reactor's power at the level of 100 MW

A special feature of the method is utility of the internal boundary flux. It makes possible to estimate the neutron flux in the complex reflector structure.

To test the method an experiment on the critical assembly has been prepared and carried out to measure the perturbed fast fluxes by the GEC-1 and the unperturbed ones. The special experimental device was designed and made for detector loading above the GEC-1 (Fig.1). Unperturbed flux measurements were performed in a sealed thin-wall aluminium capsule, located in the GEC-1.

The unperturbed calculated and measured fast neutron flux at the GEC-1 axis are in a good agreement (Fig.2), as well as the perturbed ones in the empty channel and above the channel [3].

One of the first task was to estimate the fast neutron flux at the GEC-1 AAT weld. The flux was computed at the upper and lower points of weld. The wedge-like GEC-2 channel was included in calculation as well, insofar as it is very close to the GEC-1. The flux ($E > 1.2$ MeV) at the upper point of the weld is five times greater than the unperturbed one due to the neutrons (passed through) the GEC-1 and the GEC-2 (see Table).

Table

Points	Coordinats		$\Phi_f^{0,1}$	$\Phi_f^{0,55}$	$\Phi_f^{1,2}$	$\Phi_f^{0,1}$	$\Phi_f^{0,55}$	$\Phi_f^{1,2}$
	R	Z	GEC-1,GEC-2 channels			unperturbed flux		
	cm	cm	$\times 10^7$ n/(cm^2×s×Mw)					
1	112	26	9,1±1,4	6,3±0,9	5,2±0,8	1,51	1,17	0,99
2	112	14	7,3±1,1	4,8±0,7	3,9±0,6	1,65	1,26	1,06

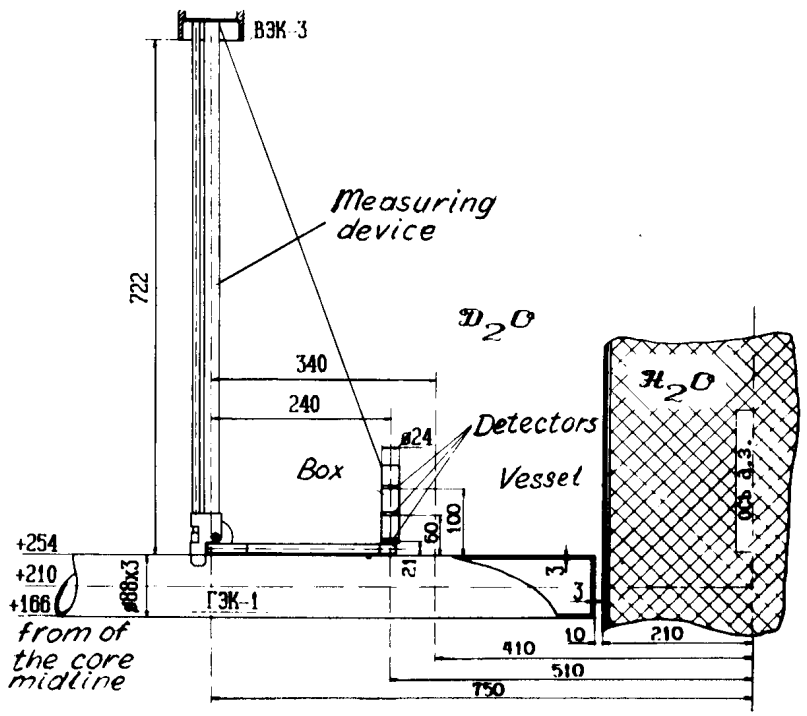

Fig.1. Measurement device scheme (dimensions in mm)

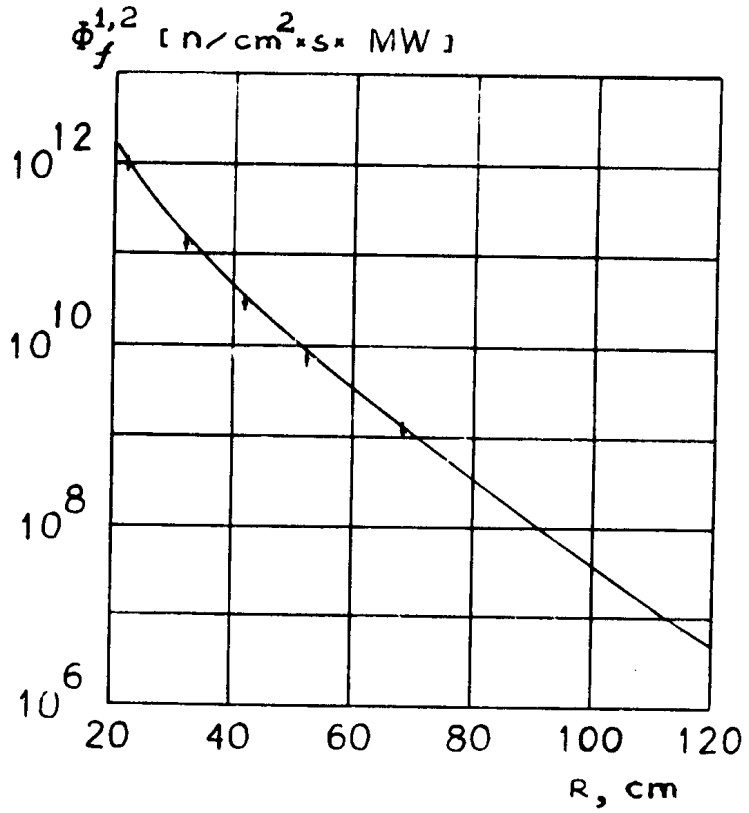

Fig.2. $\Phi_f^{1,2}$ in heavy water on GEC-1 axis (curve — calculation, points — measurements)

REFERENCES

1. *Erykalov A.N. et al.* Preprint PNPI-1784. St.-Petersburg, 1992. 38 p.
2. Pravila ustroistva i bezopastnoi expluatatzii oborudovanija i truboprovodov atomnikh energeticheskikh ustanovok (PN AE G-7-008-89, data vvedenija 01.01.90). M.: Energoatomizdat, 1990. P.65
3. *Rhoades W.A., Mynatt F.R.* ORNL-TM-4280, September 1973.
4. *Emmett M.B., Burgart C.E., Hoffman T.J.* ORNL-4853, July 1973.
5. *Emmett M.B.* The Monte Carlo Radiation Sistem. ORNL-4972, February 1975.