ADVANCED IRRADIATION OF SURVEILLANCE SPECIMENS (SS) OF VESSEL INSIDE THE PIK REACTOR CORE

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The PIK reactor core with a volume of about 50 liters is cooled by light water under 50 bar pressure. The core is isolated from heavy water reflector by double coaxial stainless vessels A 4 *mm* thick clearance for heavy water vessel cooling is located between the inner vessel being 390 *mm* in diameter and 8 *mm* thick and outer 3 *mm* thick one [1].

The fast neutron flux density (Φ_f) above 1.2 *MeV* on vessel surface is equal to 5×10^{12} $n/cm^2\cdot s\cdot MW$ and the energy release is 0.25 $W/g\cdot MW$ [2]. The change of the mechanical material properties due to fast neutron irradiation and mechanical loading limits the service life of the vessel. His necessary to perform destructive material testing of irradiated specimens in order to determinate service life of reactor vessel.

Possibility of advanced irradiation for SS due to neutron fluency in the PIK reactor core has been investigated. Fast neutron flux density (neutron energy being above 1.2 *MeV*) in the core and in the model ampoules with SS has been measured in critical assembly called "Physical model of the PIK reactor" and calculated by Monte-Carlo TAY code [3]. Values of neutron density fluxes are shown in a table.

Removal of 3 layers of fuel elements from square fuel assembly in the middle part of the core and loading of rectangular ampoule 55×6 *mm* with SS samples decreases reactivity excess by $\Delta\rho = -(0.37 \pm 0.10)\beta_{eff}$ [1].

The value of $\Phi_{1.2}$ in SS samples irradiated in the middle part of the core is 1.7 ± 0.1 times the value of $\Phi_{1.2}$ on the inner surface of the vessel. The temperature of specimens in the middle part of the core is approximately equal to the tempetature of the vessel.

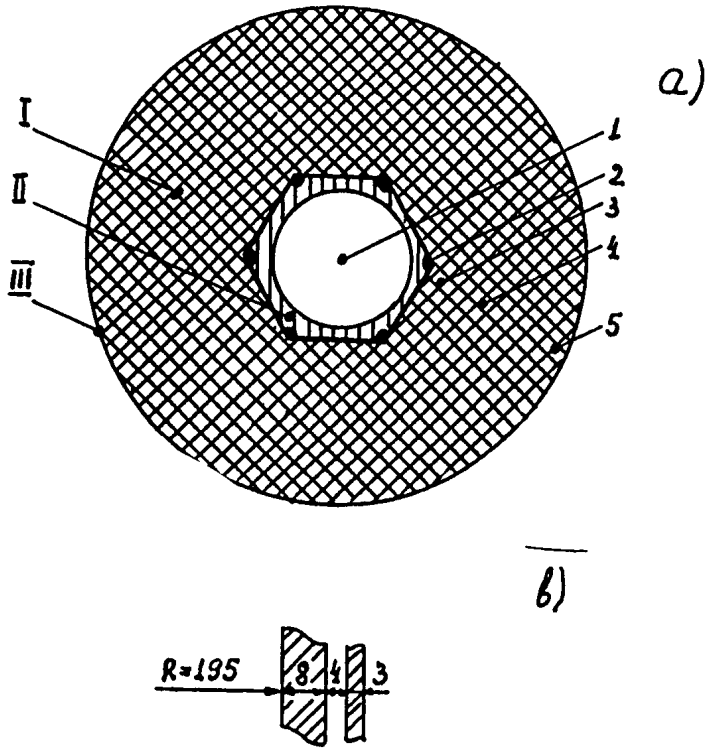

Fig.1. Scheme of the core.
a) I — the core; II — directing of supporting grid; III — the vessel; 1—5 points of measurement. *b*) Disposition of the details of the vessel

Table

Measured and calculated fast neutron flux density (E <1.2 *MeV*) and the energy release (in iron) in the reactor PIK core

Place of measurement	R *mm*	Z *mm*	$\Phi^m_{1.2}$ $10^{12}\ n/cm^2 \cdot s \cdot MW$	$\Phi^c_{1.2}$ $10^{12}\ n/cm^2 \cdot s \cdot MW$	q_{Fe} $W/g \cdot MW$
Central channel	0	0	5	5	0.53 [3]
Model of steel ampoule 55×6 *mm* in section in middle part of the core	131	0	8.3		0.35*
Dry aluminum channel 21×1 *mm* in the core	173	0	5		0.25
Inner curface of the vessel	195	0	5	4.9	4.9
Middle of the vessel	199	0		3.9	0.23**
Outer surface of the vessel	203	0		3.2	

* Approximation from measurement.

** Calculation [4].

The dispersion of measurement $\Phi_{1.2}$ and q_{Fe} is 15%.

References

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