EXPERIMENTAL ENSURING OF SAFETY START-UP OF REACTOR PIK

E.L. Abramkov, V.V.Gostev, V.I.Gudkov, A.S.Zaharov,K.A.Konoplev, R.G.Pikulik, V.F.Samodurov, S.L.Smolskiy, V.P.Stulov

Experiments imitating physical starting and other typical states of reactor PIK [1] were fulfilled on the critical facility "Physical Model of the Reactor PIK". Construction of the facility core is in full coinciding with one of the reactor PIK, especially according to nuclear safety parameters. Data of experiments will be used as necessary information for ensuring secure forming of initial core load without burnup and for transition to stationary load with average burnup according to normal exploitation.

Observance of the nuclear safety rules and norms at performance proposed order by initial and rise power start up is proved. Obtained results are used in Ensuring Safety of Reactor PIK. Assembling of the active core was executed with regular fuel cells PIK in single one. First layer of fuel elements in internal circular row of cells contains pooring fuel under 1/3 from normal it. Load control was performed by means of regular and additional control safety channels.

It was found relative disposition of counting detectors, loaded fuel cells and initial reactor source, in which was ensured safety form of reverse count curves $1/N$ for any load. Criticality is attained by loading of 11 hexagonal cells arranged in circle form (see figure). The last quadrangular cells (in fig.numbers 8.10,12,14,16,18) was loaded with aluminium dummy fuel assemblies after the 12-d assemblies loading. This procedure allows to level the neutron flux distribution to increase worth of control rods up to 1.7 times.

Maximum of the core loading consists of 15 fuel cells and 3 aluminium dummy fuel assemblies in 10, 14 and 18-th cells. Final critical assembly resulting configuration has the next parameters: reactivity excess is $(11.6 \pm 0.5)\beta_{eff}$; reactivity margin of control rods — $(16.2 \pm 0.5)\beta_{eff}$; mean reactivity margin of single rod —$(0.65 \pm 0.05)\beta_{eff}$; whole reactivity margin of both circular cylindrical absorbing blinds — $(12.0 \pm 0.5)\beta_{eff}$ [1].

Investigations of neutron fluxes were performed and gauging control channels at a power of 100 W [2].

Measured value of nonuniformity coefficient of the flux distribution along the volume is $K_V = 3.2+$ +0.3 [1] at the beginning of operation period. This constraints nominal power at level 100 MW.

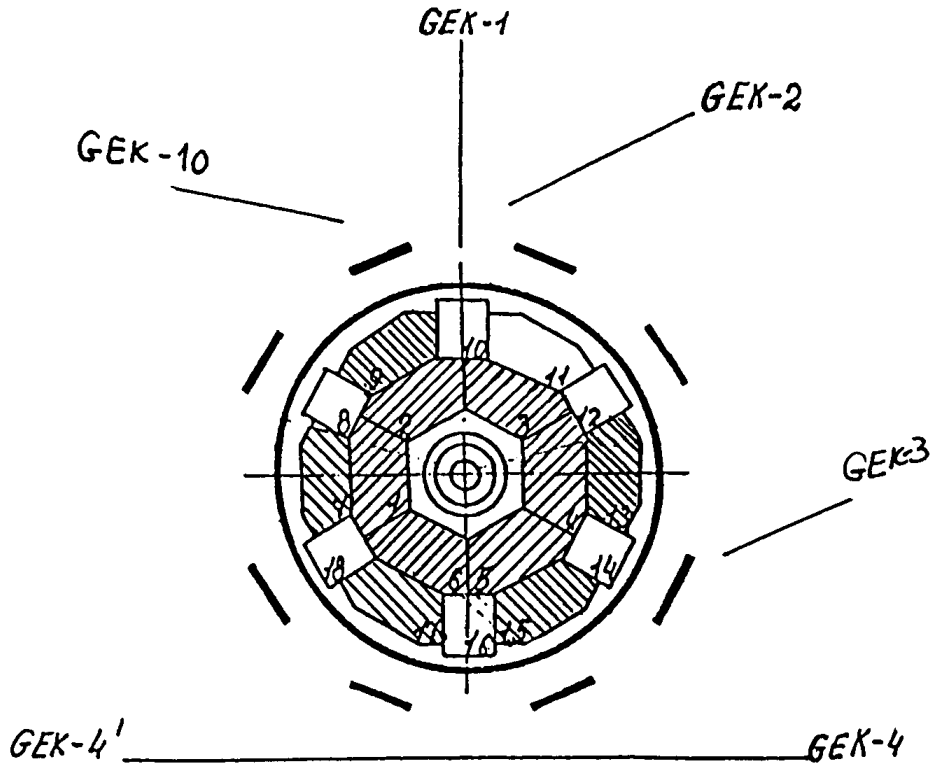

Fig. Reciprocal arrangement of core cells, control rods and experimental channels of reactor PIK

The total loading active core was received by means of consequent replacement aluminium dummy fuel assemblies with fuel assemblies (total reactivity excess $(+2.4 \pm 0.2)\beta_{eff}$), which corresponds to the utilit 960 *MW* hour according to heat removal by primary coolant.

Next reactivity effects were determined experimentally: effect of filling of experimental GEK-1 channel with heavy water — no more than $0.02\beta_{eff}$; estimate of loading of all channels in reflector is less $0.3\beta_{eff}$. Effect of replacement in fuel cells stainless steel shrouds to Al or Zr one is $+(1.6 \pm 0.05)\beta_{eff}$. Placing of ampoule with structural material into fuel assembly gives $-(0.4 \pm 0.1)\beta_{eff}$, and unloading of steel sample $+(0.10 \pm 0.10)\beta_{eff}$ Estimate for replacement burned fuel assemblies to fresh one is equal: for internal hexagonal cell $+(1.7 \pm 0.1)\beta_{eff}$, for outer one $+(0.9 \pm 0.1)\beta_{eff}$, for quadrangular $+(0.6 \pm \pm 0.1)\beta_{eff}$

The maximum effect from assemblies disorder in core is no more than $0.2\beta_{eff}$

References

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