"STAND B" REACTOR-LASER SYSTEM

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A reactor–laser system, consisting of a BARS-6 double-core aperiodic pulsed reactor operating on fast neutrons and equipment for performing investigations of the laser radiation generation by direct nuclear pumping, is described. The neutron-physical characteristics of the reactor and the laser unit as well as the reactor–laser unit system are presented. The special features of the formation of fission pulses and the parameters of the pulses are indicated. 8 figures, 1 table, 12 references.

The "Stand B" reactor–laser system, equipped for investigating the generation of laser radiation by direct nuclear pumping [1] and a BARS-6 double-core aperiodic pulsed fast reactor as a neutron source for irradiating the laser-active components, has been operating at the Physics and Power-Engineering Institute since 1996.

Work on the development, in the USSR, of BARS-type aperiodic action pulsed self-extinguishing fast reactors started in 1961 [2]. The first fission pulse in a BARS-1 reactor was obtained in 1964 at the All-Russia Scientific-Research Institute of Theoretical Physics. The reactor described here is the sixth modification. Compared with the preceding models, this reactor contains certain improvements intended for increasing safety during operation and expanding the experimental possibilities.

Investigations [3, 4] with laser-active media and with structurally different laser-active components including with neutron-physical simulators assembled in a laser unit [5, 6] are being conducted on this stand. In addition, radiation-chemical and medical-biological investigations [7], requiring the samples and objects to be irradiated with pulsed neutron and γ-ray fluxes are being conducted. In [7, 8], where the work was performed on the basis of the results of experiments with a BARS-6 reactor, certain parameters of the reactor were mentioned but the information concerning the reactor was not of a systems character. The present paper fills this gap, giving more detailed information.

Neutron-Physical Characteristics of the Reactor. The BARS-6 reactor possesses two cores placed on a platform, which can move along rails to one of two working locations or to biological shielding, where the cores are placed during the preparation of experiments. In turn, one of the cores is mobile and can be moved relative to the other so that the distance between their axes varies in the range 340–1500 mm (Fig. 1). Each core consists of ring-shaped fuel elements, fabricated from a uranium–molybdenum alloy with an anticorrosion coating. The enrichment with respect to 235U is 90%; the total amount of 235U in each core is 105 kg. Grooves and gaps, along which air can be delivered in order to accelerate the cooling of the fuel components after a pulse is generated, are present between the fuel elements. To decrease the effect of objects located next to the reactor on the reactor reactivity, the cores are surrounded with a 5-mm thick screen consisting of amorphous 10B, which is incorporated into a thin-wall steel jacket.

Each core contains the following units for influencing the reactivity:

1. A safety unit, which provides emergency shielding, transfers the reactor into a subcritical state, and compensates the reactivity. This unit is a hollow cylinder placed in the central channel of the core, where an electromagnet secures it in the upper

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position. When inserted, it can introduce into the core a negative reactivity up to $15\beta_{\text{eff}}$ at a rate of up to $200\beta_{\text{eff}}$/sec. The material used for the safety unit is similar to the material used for the fuel elements. Here and below, when discussing the efficiency of the control-rod unit, the efficiency of the unit is interpreted as the efficiency in a single-core reactor (all control-rod units of the other core are in the bottom position).

2. A stop rod, which is a second shielding unit. It is held in the upper position by compressed air. When dropped, it can introduce into the core a negative reactivity of $2.1\beta_{\text{eff}}$ at a rate of $40\beta_{\text{eff}}$/sec. The stop rod is made of a uranium-molybdenum alloy and is ring-shaped. It is placed beneath the core.

3. A fine-regulation rod with an efficiency of $2.4\beta_{\text{eff}}$, which regulates the reactivity on delayed neutrons. It is also made of a uranium-molybdenum alloy and ring-shaped. It is placed outside the stop-rod. When both rods are in the upper position, they form the bottom fuel ring.

4. A pulsed rod, which is used as a reactivity standard, and can be positioned with an error of $0.001\beta_{\text{eff}}$. It consists of a curved $130 \times 90$ mm rectangular copper plate, which covers part of the outer surface of the core. Its efficiency is $1.3\beta_{\text{eff}}$.

5. A reactivity regulator, intended for introducing during pulse generation a positive reactivity at a prescribed rate in the range $15-200\beta_{\text{eff}}$/sec. It consists of a cylinder filled with a composite material consisting of $^{10}\text{B}$ and a moderator. The reactivity regulator is held in a stationary position at a definite position inside the bearing tube, and when a pulse is generated, it is "shot out" by stiff springs into the upper, strictly fixed position.

The possibility of moving one core relative to the other makes it possible to optimize, within certain limits, the axial distribution of the neutron flux incident on the irradiated object, depending on its length (Fig. 2). As the cores draw together, the coupling on the fast neutrons increases, which increases the excess reactivity of the reactor (Fig. 3). Since the cores do not have