5. NEUTRON SOURCES

5.1. THE IBR-2 PULSED REACTOR

Operation of the reactor. In 1994, the reactor operated, for physical experiments, for 720 hours in 3 scheduled cycles. In March, 1994 the reactor was shut down for a scheduled replacement of the movable reflector.

The reported year was the tenth year of IBR-2 operation for the rated power of 2 MW (started in February 1984). The International Seminar "Advanced Pulsed Neutron Sources" (June 1994, Dubna) was devoted to the main results of the past decade.

In the course of the reactor operating period the mean burning of fuel was 2.77%, and the achieved fluence in the jacket part subjected to the highest tension was 2.1×10^{22} n/cm^2. Careful investigations and calculations carried out together with NIKIET, Moscow, permitted the determination of the jacket (7 years) and sodium cooling system (20 years) residual resources. The results were approved by the General Constructor.

Movable reflector. Since October 1987, the reactor has operated with the second, PO-2, movable reflector. The total operation time was 19619 hours which corresponded to the operation resource determined by the General Constructor. In the first half of 1994 the new movable reflector PO-2R was manufactured. Its principal design repeated the PO-2 construction, but the new reflector was equipped with a more developed and updated system for dynamic control of rotor oscillations, displacements, and vibrations. In October, 1994 the PO-2R was assembled on a test stand, and after successful tests it was moved in December to its working site at the IBR-2 reactor. The PO-2 reflector was moved to the special storage room.

The automatic system for measuring reactor parameters (ASI IBR-2) was developed by the Regtron-KFKI firm (Hungary). Equipment delivery accomplished in the course of several years was completed in spring 1994. Tests of all systems are to be completed in 1995.

Cryogenic moderator (CM). In 1994 the test program for the CM prototype was completed with the following main results:

- the possibility of using solid methane at the reactor power of 2 MW was demonstrated;
- an increase in the cold neutron yield by 10-25 times (in dependence on the wavelength) in comparison with the water moderator was achieved (fig.10).

Design work on the new CM started (fig.11).

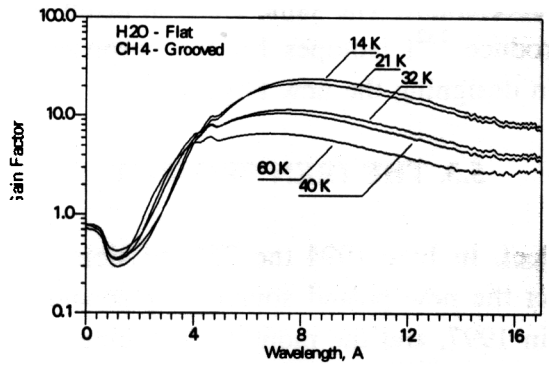


Fig.10. Ratio of the neutron yield from the cryogenic moderator surface for several values of mean methane temperature to the neutron yield from the moderator in a heated state (the plain water premoderator at 300 K). The x-axis is the neutron wavelength in angstroms.

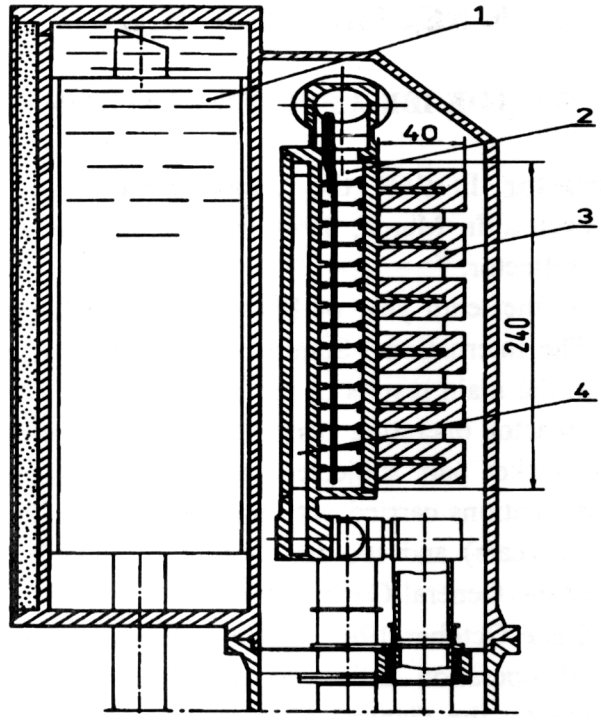


Fig.11. The cryogenic moderator for the IBR-2 reactor (vertical cross section): 1 - light water premoderator, 2 - solid methane, 3 - beryllium filter-reflector, 4 - helium-methane heat exchanger. The dimensions are given in mm.

5.2. THE IBR-30 BOOSTER

In 1994 the IBR-30 + LUE-40 complex operated for 2420 hours in ten scheduled cycles. Seven neutron beams were used to carry out experiments in nuclear physics and applied research.

In the reported year, a new system for electron beam control at the converter of the multiplying target was developed, constructed and tested. This system permitted increasing the power stability level of the neutron source. The new water moderator was installed on beams 3-5 of the booster to optimize the resonance neutron yield.

Tests of the principally new mono-crystal target of the converter were conducted on the electron beam of the LUE-40 accelerator. The same electron beam was used to test a xenon high pressure target intended to produce ^{132}I isotopes for the purposes of medical diagnostics. The obtained results will be used in designing the new target.

5.3. THE IREN PROJECT

The status of the project. In June 1994 the 76th session of the JINR Scientific Council adopted a decision to construct the new pulsed source of resonance neutrons, IREN. The work was decided to be completed in 1997, and the monthly financing scheme was determined by the JINR Directorate. The latter enabled JINR to not only pay debts to designing organizations but also start work on engineering design and manufacturing some systems of the source. The organization and financial rules for the work on the project carried out by other JINR laboratories were adopted by a special decision of the Institute Directorate.

Electron linear accelerator, LUE-200. In accordance with the JINR - DOE USA agreement for delivery of klystrons for the LUE-200, the first 5045 type klystron was shipped to Dubna and installed in bldg. 118 of FLNP in May 1994. By the end of the year, the first stage of the construction of a full-scale stand for the klystron modulator was completed.

In accordance with the approved working schedule a FLNP-LHE-LSHE collaboration carried out work on the creation of systems for synchronization and excitation of the klystron modulator. An agreement with RMIR (St.Petersburg), the leading organization in designing modulators, was signed. According to the agreement, equipment for the OLIVIN stations of these modulators will be delivered by ErPI as the contribution of Armenia to JINR.

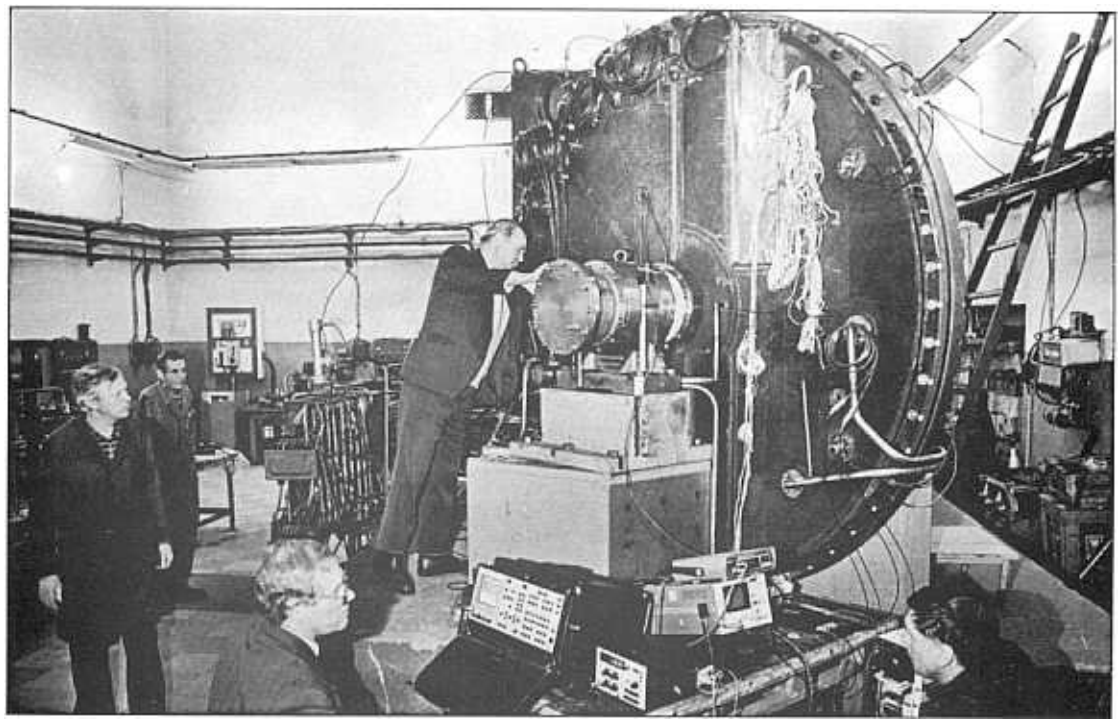
MEPI in cooperation with the ISTOK industrial enterprise (Friazino) is designing and manufacturing HF fiders. Specifications for designing and manufacturing magnetic systems of the accelerator were agreed to with LNP JINR.

A contract with INP SB RAS (Novosibirsk), the top organization in constructing the LUE-200, for manufacturing and complex adjustment of the accelerating system before the end of 1997 was prepared for signing.

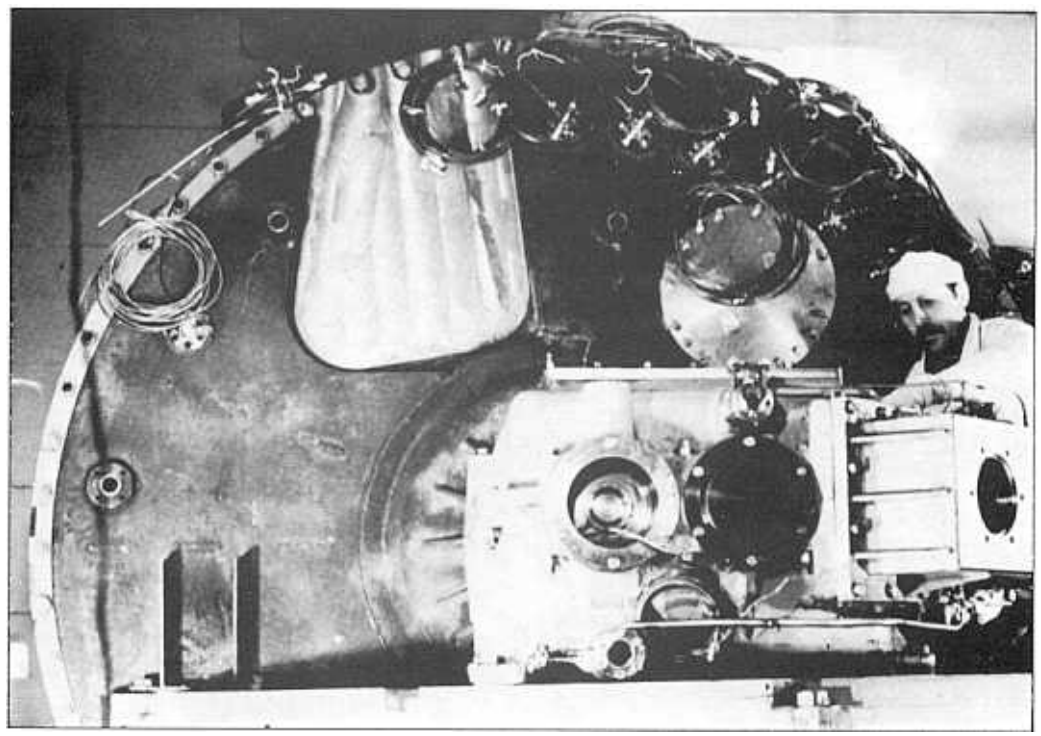
Multiplying target. NIKIET completed work on the engineering design of the first version of the target. Fuel element (TVEL) specifications were submitted for approval. A contract with the MAJAK industrial enterprise and the RF Ministry of Atomic Energy for renting feasible materials for TVELs was prepared.

Work on making the calendar plan and conditions of the agreement for developing a complex project of the IREN facility signed in 1993 more precise was carried out in collaboration with GSPI. A contract with the Obninsk Division of NIKIMT for the development of a project for disassembling the IBR-30 booster was prepared for signing. A working schedule for testing an electron-neutron converter for the multiplying target at the IBR-30 was adopted.

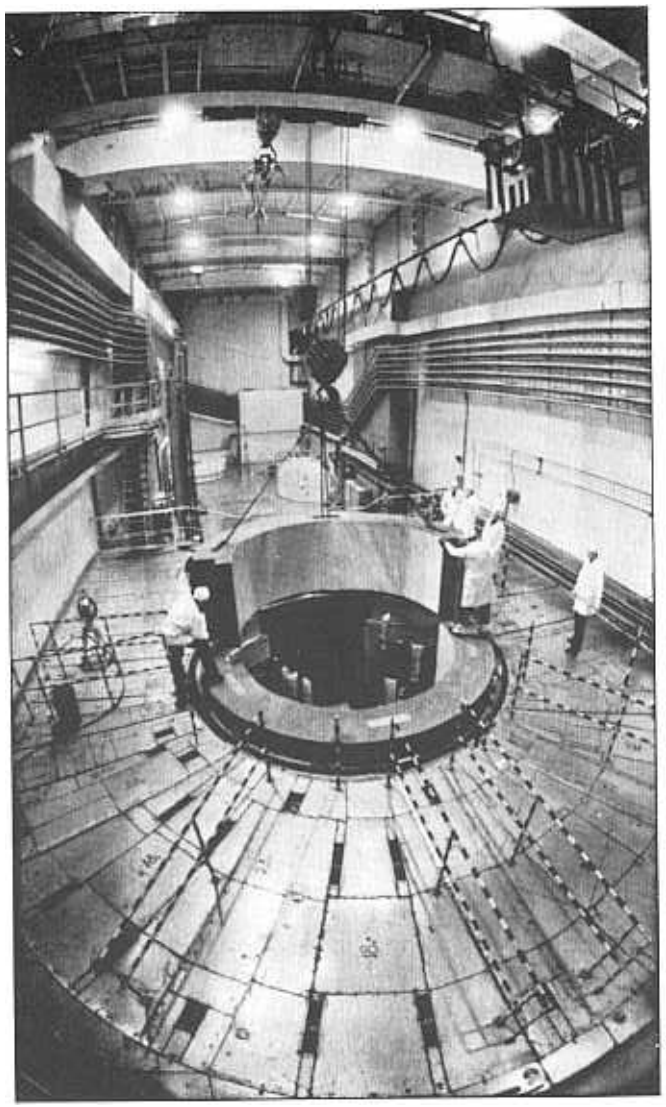
Participants of the International Seminar "Advanced Pulsed Neutron Sources dedicated to the 10th anniversary of IBR-2 reactor operation (June 1994, Dubna).



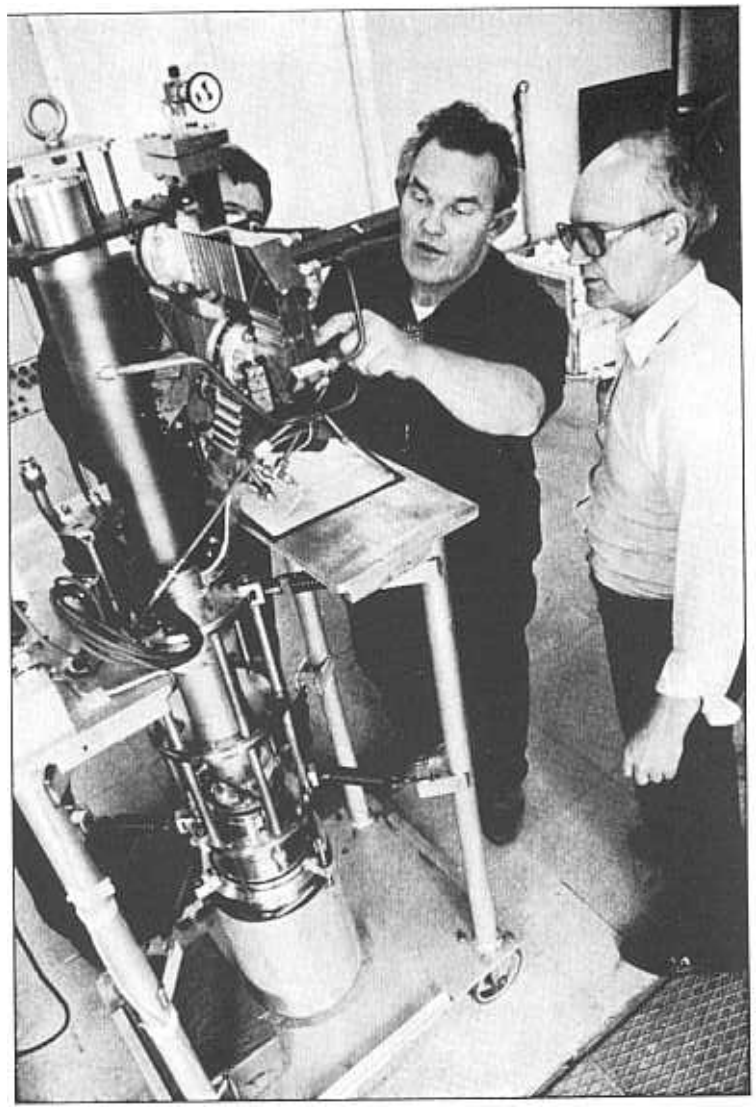
The testing stand the new movable reflector PO-2RM (November 1994)



The final stage installing the PO-2RM reflector front of the shielding gate the IBR-2 reactor (December 1994).



Assembly of the upper part of the ring shielding for the IBR-2 reactor jacket after completing maintenance work.



R.Koonz (SLAC) and A.K.Krasnykh are examining the 5045 klystron after its delivery from the USA.