# 2. NEUTRON SOURCES

## THE IBR-2 PULSED REACTOR

1. Rostechnadzor license №GN-03-108-2614 of 27.04.2012 has been obtained for the regular operation of the IBR-2 reactor.

2. In accordance with the license requirements during the year the specialized organizations together with the IBR-2 personnel have been performing the scheduled work on the technical evaluation and assessment of the remaining life of the technological reactor equipment.

3. The modernization of the cooling system of the movable reflector MR-3 jacket has been carried out: The scheme of pump unloading has been changed over to partial discharge of water directly to a distillate tank and the pumps of the cooling system of the movable reflector MR-3 jacket have been replaced.

Since May 2012 regular IBR-2 cycles of physics experiments have been carried out at a power of 2 MW with the CM-202 moderator operating either in a water or cryogenic mode depending on the schedule of the physical start up of the cold moderator.

The working parameters of the reactor during the cycles are presented in **Table 2**.

**Table 2.** Data on the IBR-2 operation for physics experiments.

| № cycle | Period | Moderator mode | Reactor power, MW | Reactor operation at power, h | Reactor operation for physics experiments, h |
|---|---|---|---|---|---|
| 1 | May, 21 - June, 1 | water | 2 | 247 | 241 |
| 2 | June, 18 - June, 29 | water | 2 | 272 | 264 |
| 3 | September, 24 - September, 28<br>October, 3 - October, 9 | cryogenic<br>cryogenic | 2 | 244 | 201 |
| 4 | October, 22 - November, 1 | water | 2 | 179 | 171 |
| 5 | November, 12 - November, 24 | water | 2 | 290 | 281 |
| 6 | November, 28 - December, 4 | cryogenic | 2 | 171 | 131 |
| 7 | December, 13 - December, 21 | cryogenic | 2 | 189 | 182 |
| | | | **Total:** | **1592** | **1471** |

From May 21 to June 1, 2012 the first IBR-2 cycle of physical experiments was carried out at a power of 2 MW with the CM-202 cryogenic moderator operating in the mode of a water moderator. During the cycle there were two cases of actuation of the safety system because of a voltage drop in the external power supply system of the reactor. The reason for the actuation of the safety system is power failures in the municipal power supply system.

From June 18 to June 29, 2012 the second IBR-2 cycle of physical experiments proceeded trouble-free at a power of 2 MW with the CM-202 cryogenic moderator operating in the mode of a water moderator. There were no cases of activation of the safety system.

From September 24 to October 9, 2012 the third IBR-2 cycle of physical experiments was conducted. During the cycle the CM-202 moderator was tested at a power of 2 MW in accordance with the “Program of commissioning and tests of the CM-202 cryogenic moderator of the IBR-2M reactor”. During the cycle there were two cases of activation of the safety system because of a voltage drop in

the external power supply system of the reactor. The reason for the activation of the safety system is power failures in the municipal power supply system.

From October 22 to November 1, 2012 the fourth IBR-2 cycle of physical experiments was carried out at a power of 2 MW with the CM-202 cryogenic moderator operating in the mode of a water moderator. During the cycle there were three cases of activation of the safety system. Two events of activation of the safety system occurred because of a stoppage of the MR-3 movable reflector as a result of a malfunction of a rotation stabilization device and shutdown of a magnetic particle clutch. On one more occasion the safety system was activated following a signal of decreasing sodium level in the reactor vessel caused by a malfunction of an electronic device for processing reactor sodium level signals. In all cases of activation of the safety system the defective units were replaced with spare ones and the developer-manufacturer made necessary repair and checked them for serviceability.

From November 12 to November 24, 2012 the fifth IBR-2 cycle of physical experiments was carried out at a power of 2 MW with the CM-202 cryogenic moderator operating in the mode of a water moderator. During the cycle there was one case of activation of the safety system because of a voltage drop.

From November 28 to December 4 and from December 13 to December 21, 2012 the sixth and seventh IBR-2 cycles of physical experiments was conducted at a power of 2 MW with the CM-202 cryogenic moderator operating in the cryogenic mode. There were no cases of activation of the safety system.

**Information on the operation of the cryogenic moderator system.**

1. On January 24-25, 2012, the WM-302 water grooved moderator (neutron beams 7÷11) was replaced with a CM-202 cryogenic moderator.
2. A cryogenic pipeline for transporting mesitylene (C9H12) beads to the moderator chamber, equipment for discharging liquid C9H12 from the CM-202 chamber and a cryostat with a heat exchanger and a helium blower have been assembled and installed. Vacuum tests of the above-mentioned equipment have been performed.
3. In cooperation with the specialized organization the adjustment of KGU-700/15 has been performed with the following results:

3.1. The minimum achieved helium temperature at the outlet of the KGU refrigerator (during its operation "for itself") was Tmin = 17.6 K.

3.2. The KAESER compressor output was measured to be 660-770 m3/h depending on the mode of operation.

3.3. The computer monitoring system of KGU 700/15 operating parameters (temperature, pressure, alarm signaling, helium amount in a gas holder, revolutions of turbines) was developed and installed.

3.4. The experiments on cooling the moderator chamber were carried out, during which the minimum temperatures before and after the chamber were obtained to be 29 K and 32.8 K, respectively. Thermometers were installed at a 3-m distance from the moderator chamber and the temperature at the outlet of the KGU refrigerator was 21.1 K. The data were obtained with the reactor operating at 2 MW and after 24-hour continuous operation of the moderator chamber fully loaded with mesitylene.

3.5. The longest duration of continuous operation of KGU 700/15 for cooling CM-202 was 160 hours (in accordance with the program of tests).

3.6. The activation of the alarm signaling and automatic emergency protection system of turbines of the KGU 700/15 refrigerator was tested.

3.7. The operability of a spare turbine module for KGU 700/15 was tested and proved to be satisfactory.

3.8. The personnel were trained and certified in respect of their competence in the design and operating instructions of KGU 700/15 as well as of safety rules in emergency situations.

3.9. The KGU 700/15 cryogenic helium facility was accepted for commissioning and is completely ready for use.

4. The program of start-up and tests of CM-202 cryogenic moderator of the IBR-2M reactor and instruction manuals for KGU-700 and CM-202 have been developed. A group was appointed to conduct start-up activities and tests. The Working Commission allowed the start-up of CM-202.

5. The start-up of CM-202 with the reactor operating at power has begun. On July 10, 2012 a trial start-up at W = 500 kW was carried out at an average temperature in the moderator chamber of 30 K. In September-October the implementation of the start-up program was continued at W = 2 MW. Four cycles of tests were carried out: one lasted for 39 h (3.7 MW·day), the second one – for 133 h (11.8 MW·day), the third one – for 131 h (10.9 MW·day) and fourth one –for 159 h (13.2 MW·day).

## THE IREN FACILITY

During 2012 the IREN facility provided more than 1500 h for experiments. the instrument development activities on the preparation of experiments at the pulsed resonance neutron source IREN continued. The multi-detector system «ROMASHKA»-1 intended for neutron cross-section measurements and the AURA facility for (n,e)-scattering investigations were tested on the extracted neutron beams. The applied research activities using the neutron spectroscopy techniques were actively carried out. The collaboration with a number of scientific centers from Russia and the JINR Member States in the field of physics experiments and development of new equipment for nuclear data experiments continued.