AID Report 60-77

31 October 1960

REACTORS

DEVELOPED IN THE USSR AND ITS BLOC COUNTRIES

Library Services Section

Air Information Division

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FOREWORD

For some time there has been a real need for easy-reference tables to the reactors developed in the USSR and its bloc countries. This report represents our first attempt to satisfy the need. The information in the following pages has been compiled from Soviet and Soviet Bloc monographs, reports, conference proceedings and papers, and newspapers published between 1955 - October 1, 1960.

Although reactors were in operation in the USSR as early as 1947, no information concerning them was found in its publications until 1955.

The main features of all reactors are listed: name, type, uses and applications, affiliation, location, start-up-date, maximum neutron flux, power (thermal and electrical), fuel, moderator, reflector, coolant, shielding, experimental facilities, remarks and references.

In order to clarify interpretation of the Soviet trademarks and designation symbols, the original Cyrillic letters have been retained. Transliteration used by the Board on Geographic Names follows the original symbols.

In Part I a review is made of all known research and experimental reactors formerly or presently in operation in the Soviet Union.

Part II lists power stations in operation or in advanced stages of planning or design and when available, their specific geographic location in the USSR.

In Part III experimental and research reactors and power stations in Bulgaria, China, Czechoslovakia, East Germany, Egypt, Hungary, North Korea, Poland, Romania, and Yugoslavia are identified.

Part IV consists of bibliographical references. They are arranged alphabetically by author and numerically for ready cross reference. The numerals in brackets in Parts I, II, and III refer to bibliographical references; the numerals following the brackets indicate pages in the source. Entries for monographs are given in Russian followed by an English translation.

Library of Congress call numbers are included at the end of the entries when the source is cataloged and available in its collections.

Although this report was initiated prior to the receipt of Work Assignment No. 16 levied upon the Division by its sponsoring agency, it is submitted in partial fulfillment of this assignment.

TABLE OF CONTENTS

III. RESEARCH AND POWER REACTORS IN:

NAME:	Первый советский [First Soviet]
TYPE:	Thermal, heterogeneous, graphite
USES OR APPLICATION:	a) physical experiments b) production of isotopes
AFFILIATION:	Academy of Sciences, USSR
LOCATION:	Moscow, USSR
START-UP-DATE:	Approx. 1947
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	Several thousand (th)
FUEL:	45 t of metallic uranium in blocks 30 x 40 mm in dia.
MODERATOR:	Graphite
REFLECTOR:	Graphite 80 cm
COOLANT:	—
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	1st reactor in Europe
REFERENCES:	[40]; p. 6-14; [41], p. 15-28; [68]; [88], p. 136-317; [94], p. 18-44

NAME:	TP or TBP [TR or TVR]
TYPE:	Thermal, heterogeneous, heavy-water
USES OR APPLICATION:	Experiments: a) nuclear physics b) radiochemistry c) neutron densities Production of isotopes
AFFILIATION:	Thermotechnical Laboratory of the Academy of Sciences USSR
LOCATION:	Moscow, USSR
START-UP-DATE:	April, 1949; reconstructed and put into operation June 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	Initial: 2×10^{12}; after reconstruction: 2.5×10^{13}
POWER kw:	Initial: 500; after reconstruction: 2,500 (th)
FUEL:	Initial: natural uranium (2.5 t) after reconstruction: enriched uranium 2% U-235 (270 kg)
MODERATOR:	D_2O (5 t)
REFLECTOR:	Graphite; upper reflector, variable to 580 mm; 1 m thick in space between inner tank and the steel vessel; sides and bottom, 300 mm D_2O
COOLANT:	D_2O
SHIELDING:	2.5 m concrete; entire apparatus is surrounded by water 1 m thick
EXPERIMENTAL FACILITIES:	After reconstruction: 52 vertical channels with dia. from 50-100 mm; 24 channels enter the reactor core and 28 enter the graphite reflector zone.
REMARKS:	The reactor was designed in 1947, installed in 1948
REFERENCES:	[4]; [42]; [45], p. 321, 336-340; [66], p. 43; [88], p. 144-145; [93a]

NAME:	MP [IR]
TYPE:	Thermal, heterogeneous, graphite
USES OR APPLICATION:	Production of radio-active isotopes
AFFILIATION:	----
LOCATION:	----
START-UP-DATE:	1952
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	From 3 up to 4.5×10^{13}
POWER kw:	50,000 (th)
FUEL:	Uranium enriched 2% U-235 (3t); total 248 cells, of which 140 are loaded; reactor was disassembled to rectify damage in the reactor masonry; put into operation in 1957
MODERATOR:	Polycrystallic artificial graphite
REFLECTOR:	Polycrystallic artificial graphite (upper, 1.5 m thick)
COOLANT:	H_2O flow from top to bottom, outlet temperature about 80 to 90°C
SHIELDING:	Upper, 1.5 m of concrete and 50 cm of cadmium layer with 20 cm of aluminium alloy bricks
EXPERIMENTAL FACILITIES:	----
REMARKS:	Disassembly and reassembly of the reactor, including the relaxation time prior to the disassembly work, was close to 10 months; the integral neutron flux during the reactor operation (4 years) was 4.5×10^{21} n/cm^2
REFERENCES:	[20]

NAME:	MP or PФТ [MR or RFT]
TYPE:	Thermal, heterogeneous, graphite, pressurized water
USES OR APPLICATION:	a) physical research b) reactor engineering
AFFILIATION:	Institute of Atomic Energy of the Academy of Sciences USSR
LOCATION:	Moscow, USSR
START-UP-DATE:	April 1952; reconstructed in 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	Initial: 8×10^{13}; after reconstruction: 1.8×10^{14}
POWER kw:	Initial: 10,000 (th); after reconstruction: 15,000 to 20,000
FUEL:	Initial: natural uranium enriched 15% U-235; after reconstruction: uranium enriched 90% U-235
MODERATOR:	Graphite and H_2O
REFLECTOR:	Graphite; top and side, 80 cm; bottom, 60 cm
COOLANT:	H_2O
SHIELDING:	Top, 150 cm graphite, 40 cm Pb, 20 cm thick iron slab; side, layer of iron 2.5 cm thick
EXPERIMENTAL FACILITIES:	A square lattice with 14-cm channel spacing 11 vertical channels for experiments on loops 15 vertical channels for testing fuel elements 15-20 fuel elements in central region for irradiation of materials and the production of isotopes
REMARKS	The essential foundation of the Soviet nuclear power program. After reconstruction, thermal output: 3,640 kw/kg U-235
REFERENCES:	[6], p. 651-654; [33]; [40]; [41], p. 14-22; [45], p. 321-331; [70]

NAME:	ГВФ [GVF]
TYPE:	Thermal, heterogeneous, graphite
USES OR APPLICATION:	Reactor engineering, preliminary calculations for future atomic power stations
AFFILIATION:	Atomic Power Station of the Academy of Sciences USSR
LOCATION:	Obninsk, USSR
START-UP-DATE	—
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	—
FUEL:	Uranium enriched 10% U-235 (U_3O_8 powder between two stainless steel tubes)
MODERATOR:	Graphite and H_2O (6.3 kg)
REFLECTOR:	Graphite; bottom, 40 cm; top and side, 54 cm
COOLANT:	—
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	A square lattice with 140 mm spacing
REFERENCES:	[60], p. 146; [68], p. 3-4

NAME:	ВВР, ВВР-2 or ЭЯР [VVR, VVR-2 or EYaR]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Experiments: a) physical research b) study of shielding properties of materials Production of isotopes
AFFILIATION:	Institute of Atomic Energy of the Academy of Sciences USSR
LOCATION:	Moscow, USSR
START-UP-DATE:	Approx. 1953 (multiplier was introduced in August 1957)
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	Initial: 2×10^{12}; after reconstruction: 4×10^{13}
POWER kw:	Initial: 300; after reconstruction: 3,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Cast iron and water 50 cm thick
EXPERIMENTAL FACILITIES:	After reconstruction: 5 horizontal and 3 vertical channels, thermal column
REMARKS:	Thermal output 650 kg/kw U-235; the construction of a multiplier; a heterogeneous uranium-water system developed power of 100 kw 2×10^{12} $n/cm^2.sec$
REFERENCES:	[45], p. 321, 331-336; [49]; [60], p. 27, 59, 111; [71]; [79]; [81], p. 44; [98]

NAME:	БРФ [BRF]
TYPE:	Thermal, heterogeneous, beryllium
USES OR APPLICATION:	Research: calculations of physical parameters for a reactor with beryllium moderator
AFFILIATION:	Atomic Power Station of the Academy of Sciences USSR
LOCATION:	Obninsk, USSR
START-UP-DATE:	April 1954
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	
POWER kw:	Zero (th)
FUEL:	The fuel elements are tubular, 214 g of U_3O_8 powder occupying the space between two thin-walled co-axial steel tubes of 13.40 x 0.2 mm and 9.0 x 0.4 mm dia. The tubes are filled to a height of 960 mm
MODERATOR:	Metallic Be (1200 kg)
REFLECTOR:	Sides (only): 15.5 cm metallic Be (6.66 kg U-235 for criticality)
COOLANT:	H_2O
SHIELDING:	Concrete wall 1 m thick serves to protect personnel against radiation.
EXPERIMENTAL FACILITIES:	Vertical channels form a rectangular lattice with a mesh 107 x 64 mm; the central channel of each elementary cell, 107 horizontal channels, and the inner tube of the element are used to study the effect of water on the multiplication parameters of the reactor core. 2 Cd control rods, 8.2 mm dia., 9 min long. 8 Cd safety rods. Thermal column may be used in center.
REMARKS:	Experiments showed the possibility of construction of beryllium power reactors with small capacity.
REFERENCES:	[67]; [69]

NAME: BBP-C [VVR-S]

TYPE: Thermal, heterogeneous, light water, submerged

USES OR APPLICATION: Research:
a) physical research
b) chemical research
c) biology
Production of isotopes

AFFILIATION: Institute of Nuclear Physics, Moscow State University

LOCATION: Moscow, USSR

START-UP-DATE: ----

MAXIMUM NEUTRON FLUX $n/cm^2/sec$: 2.5×10^{13}

POWER kw: 2,000 (th)

FUEL: Uranium enriched 10% U-235 (60 kg)

MODERATOR: H_2O

REFLECTOR: H_2O

COOLANT: H_2O

SHIELDING: Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete

EXPERIMENTAL FACILITIES: 52 sections of 15 uranium fuel rods:
9 horizontal channels with a diameter of 60-100 mm
10 vertical channels with diameter of 40-54 mm for experiments
3 special channels for biological research
1 graphite column for research in thermal neutrons

REMARKS: The reactor VVR-S was designed on the basis of experience gained from the operation of the experimental enriched uranium reactor VVR. At the present time several such reactors have been manufactured and are in use in the USSR and Soviet Bloc countries.. Six were built and put into operation in 1957-1959; five more are still in the production, assembly and testing stages

REFERENCES: [45], p. 243; [63]; [79]; [80], p. 43; [81]; [97]

NAME:	A gaseous UF_6 reactor
TYPE:	Thermal, heterogeneous, beryllium
USES OR APPLICATION:	Experiments: a) to test a chain reaction using uranium hexafluoride as a fissionable material b) to verify the results of theoretical calculations and physical investigations
AFFILIATION:	Institute of Atomic Energy of the Academy of Sciences, USSR
LOCATION:	—
START-UP-DATE:	9 August 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.7×10^{10}
POWER kw:	1,500 (th)
FUEL:	Uranium hexafluoride enriched 90% U-235 in aluminium channels of quadratic lattice 40 x 40 cm; a gas pressure under 1.3 atm. with total gas volume of 213 liters was used
MODERATOR:	Metallic Be
REFLECTOR:	Sides, graphite 500 mm; upper and lower, 600 mm; upper reflector is pierced with a system of vertical channels 12 mm in dia. through which gas is fed to the channels of the core
COOLANT:	To maintain a high pressure of UF_6 the tubes are heated by low-voltage current (30-40 v) and during the initial heating consume 35 kw. From 10-15 hours are required to heat the unit to a temperature of 80-90°C. About 4 kw will be required to maintain this temperature
SHIELDING:	—
EXPERIMENTAL FACILITIES:	148 rectangular channels; 1 horizontal and 4 vertical channels for control and safety rods
REMARKS:	The reactor's critical stage is reached by gradually raising the gas pressure
REFERENCES:	[57]

NAME:	Pulsed reactor
TYPE:	High-neutron flux pile
USES OR APPLICATION:	To establish the limits of the stability of graphite impregnated with uranium, at high temperatures and under the influence of powerful, but short-lived, thermal surges; and to serve as a source of very intensive, but short, bursts of neutrons
AFFILIATION:	Laboratory of Neutron Physics of United Institute for Nuclear Research
LOCATION:	Dubna, USSR
START-UP-DATE:	Developed between 1954-1955; reached critical stage end of 1958
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	10^{17} (during the burst)
POWER kw:	5,000 (th)
FUEL:	Aqueous solution of enriched uranium salt
MODERATOR:	—
REFLECTOR:	Movable reflector consists of two parts each of which is attached to the rim of a wheel rotating at constant speed
COOLANT:	H_2O
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	It is possible to construct a power plant using a design similiar to that of the pulsed research reactor if the cooling water is heated to a sufficiently high temperature while passing through the condenser. There is also the possibility of providing the condenser with a piston so that the pulsed reactor operates as an atomic piston engine. Such an engine could operate as a solenoid type electric generator
REFERENCES:	[145]; [146]

NAME:	BBP-C [VVR-S]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Research: a) physical research b) chemical research c) biology; Production of isotopes
AFFILIATION:	Institute of Nuclear Physics of the Academy of Sciences Uzbekskaya SSR
LOCATION:	Kibray, 12 miles northeast of Tashkent, Uzbekskaya SSR
START-UP-DATE:	10 September 1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60 kg)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	Similar to VVR-S, p. 8
REMARKS:	
REFERENCES:	[26], p. 68; [46]; [49]; [51]; [59]; [92]; [93f]; [112]

NAME:	ИРТ-1000 [IRT-1000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear physics b) material testing in neutron and gamma-source fields Production of isotopes
AFFILIATION:	Institute of Atomic Energy of the Academy of Sciences USSR
LOCATION:	Moscow, USSR
START-UP-DATE:	December 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	1.2×10^{13}
POWER kw:	1,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O with ejector
SHIELDING:	Side, 1.8 m of heavy-aggregate concrete divided into four zones
EXPERIMENTAL FACILITIES:	8 horizontal channels and a thermal column; 7 vertical channels; active zone of the reactor located in a pool, under 6 m of water
REMARKS:	This industrially produced reactor is available to institutions of high learning and some scientific-research centers.
REFERENCES:	[21]; [60], p. 29, 112, 113, 143, 144

NAME:	ИРТ-2000 [IRT-2000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear physics b) molecular physics c) radiochemistry d) biology Production of isotopes
AFFILIATION:	Institute of Atomic Energy of the Academy of Sciences USSR
LOCATION:	Moscow, USSR
START-UP-DATE:	23 November 1957 (physically)
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	3.2×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (UO_2 and Mg diluent confined in Al shell)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O; water ejector for pumping coolant through reactor core, $540 m^3$/hr. water temperature in reactor tank 40°C. Max. fuel element temperature 90°C.
SHIELDING:	Iron-cement mixtures of three compositions are used in the shield. The side shield, 0.5 m of water and 1.8 m of heavy aggregate concrete
EXPERIMENTAL FACILITIES:	9 horizontal experimental channels each 100 mm in dia. 2 horizontal experimental channels each 150 mm in dia. 1 thermal column
REMARKS:	
REFERENCES:	[45]; p. 321, 340-352; [142]; [143]

NAME:	ИРТ-2000 [IRT-2000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear spectroscopy b) neutron physics c) solid state physics d) biology and medicine Production of isotopes
AFFILIATION:	Ural Branch of the Academy of Sciences USSR
LOCATION:	Sverdlovsk, USSR
START-UP-DATE:	Installation began 1958
MAXIMUM NEUTRON FLUX n/cm²/sec:	1.2×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O; water ejector for pumping coolant through reactor core, 540 m 3/hr. water temperature in reactor tank 40°C. Max. fuel element temperature 90°C.
SHIELDING:	Iron-cement mixtures of three compositions are used in the shield. The side shield, 0.5 m of water and 1.8 m of heavy aggregate concrete
EXPERIMENTAL FACILITIES:	Similar to IRT-2,000, p. 13
REMARKS:	
REFERENCES:	[45], p. 352; [93 e]; [142]

NAME:	ИРТ-2000 [IRT-2000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research a) nuclear spectroscopy b) neutron physics c) solid state physics d) biology and medicine Production of isotopes
AFFILIATION:	Institute of Physics of the Acadmey of Sciences, Gruzinskaya SSR
LOCATION:	Near Tbilisi, Gruzinskaya SSR
START-UP-DATE:	20 November 1959
MAXIMUM NEUTRON FLUX n/cm²/sec:	1.2×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O; water ejector for pumping coolant through reactor core, 540 m 3/hr. water temperature in reactor rank 40°C. Max fuel element temperature 90°C.
SHIELDING:	Iron-cement mixtures of three compositions are used in the shield. The side shield, 0.5 m of water and 1.8 m of heavy aggregate concrete
EXPERIMENTAL FACILITIES:	Similar to IRT-2,000, p. 13
REMARKS:	—
REFERENCES:	[26], p. 69; [45], p. 352; [93a]; [142]; [143]

NAME:	ИРТ-2000 [IRT-2000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Training and research technology
AFFILIATION:	Polytechnical Institute
LOCATION:	Tomsk, USSR
START-UP-DATE:	1959
MAXIMUM NEUTRON FLUX n/cm^2/sec:	1.2×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O; water ejector for pumping coolant through reactor core, 540 m 3/hr. water temperature in reactor rank 40°C. Max. fuel element temperature 90°C.
SHIELDING:	Iron-cement mixtures of three compositions are used in the shield. The side shield, 0.5 m of water and 1.8 m of heavy aggregate concrete
EXPERIMENTAL FACILITIES:	Similar to IRT-2,000, p. 13
REMARKS:	
REFERENCES:	[45], p. 352; [142]

NAME:	ИРТ-2000 [IRT-2000].
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear spectroscopy b) neutron physics c) solid state physics c) biology and medicine Production of isotopes
AFFILIATION:	The Academy of Sciences, Belorusskaya SSR
LOCATION:	Malyye Dubny, near Minsk, Belorusskaya SSR
START-UP-DATE:	Under construction since February 1959
MAXIMUM NEUTRON FLUX n/cm²/sec:	1.2×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O; water ejector for pumping coolant through reactor core, 540 m 3/hr. water temperature in reactor rank 40°C. Max. fuel element temperature 90°C.
SHIELDING:	Iron-cement mixtures of three compositions are used in the shield. The side shield, 0.5 m of water and 1.8 m of heavy aggregate concrete
EXPERIMENTAL FACILITIES:	—
REMARKS:	Similar to IRT-2,000. However, there is disagreement in the information found in several sources:. some indicate that the reactor is being constructed in Malyyé Dubny as an IRT-1,000; other sources indicate that it is being constructed as an IRT-2,000. The latest available information would seem to confirm the IRT-2,000 description and it has been accepted in compiling this survey
REFERENCES:	[116]; [93m]

NAME:	ИРТ-2000 [IRT-2000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear spectroscopy b) neutron physics c) solid state physics d) biology and medicine Production of isotopes
AFFILIATION:	Institute of Physics of the Academy of Sciences, Latviyskaya SSR
LOCATION:	Salaspils, near Riga, Latviyskaya SSR
START-UP-DATE:	Construction started in first half of 1959; planned completion in 1960
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	1.2×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O; water ejector for pumping coolant through reactor core, 540 m 3/hr. water temperature in reactor tank 40°C. Max. fuel element temperature 90°C; a rotor fan with capacity of 100,000 cubic meters of air per hour extracts heat from water which cools a reactor.
SHIELDING:	Side, 2 m heavy-aggregate concrete and 6 m water (top)
EXPERIMENTAL FACILITIES:	Similar to IRT-2000, p. 13
REMARKS:	The reactor will serve as a research center for Academy of Sciences, Latvian State University, Riga Politechnical Institute, and for scientists from Estonia and Lithuania
REFERENCES:	[76]; [93a]

NAME:	БР-1 [BR-1]
TYPE:	Fast, heterogeneous
USES OR APPLICATION:	Experiments: a) investigations at different neutron energies inside the core and the reflector; b) study properties of systems with fast neutrons; c) check the theory of fast reactors
AFFILIATION:	Institute of Physics of the Atomic Energy Utilization Board
LOCATION:	Obninsk, USSR
START-UP-DATE:	April 1955
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	----
POWER kw:	0.05 to 100 w max (th)
FUEL:	Plutonium rods 10 mm dia. enclosed in sealed stainless steel cans and rods from depleted uranium, 10.8 dia. are placed in the core
MODERATOR:	H_2O at a pressure of 100 atms
REFLECTOR:	Detachable cylindrical reflector (shield) 700 mm in dia. and height. Two types of blanket were used: 1 consisted of solid blocks of depleted uranium; the other, of copper
COOLANT:	----
SHIELDING:	No biological shield; reactor mounted on special metal platform 2.5 m from floor in center of reactor hall with 1 m thick walls which serve as biological shield
EXPERIMENTAL FACILITIES:	----
REMARKS:	No special protection is provided; the reactor is installed in a separate building. Other laboratories and rooms for preparing experiments are located in this building. Specific features of the reactor: a) Multiple channels are available b) Practically negligible activation of material occurs in the core c) Biological shield, usually attached to the apparatus, is not provided d) A heat-transfer fluid is not provided These features provide easy access into the reactor and also make it possible to easily replace any components of the core
REFERENCES:	[79]; [83], p. 3-12; [85], p. 348-350

NAME:	БР-2 [BR-2]
TYPE:	Fast, thermal, heterogeneous
USES OR APPLICATION	Experiments: a) material testing b) fission process c) work with liquid-metal heat-transfer agents
AFFILIATION:	Physics Institute of the Atomic Energy Utilization Board
LOCATION:	USSR
START-UP-DATE:	February 1956
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	10^{14}
POWER kw:	120 kw to 200 kw (th)
FUEL:	Pu rods, 10 mm dia. 130 mm long enclosed in stainless steel tubes of 0.3 mm walls; 108 Pu and U (depleted) rods
MODERATOR:	—
REFLECTOR:	Two parts: a) stationary, outer dia., 700 mm; height, 700 mm; U-rod dia., 35 mm; all in stainless steel cans b) inner moving parts, Ni-Cu alloy; aircooled
COOLANT:	—
SHIELDING:	600 mm of water, 400 mm of cast iron, and 1,200 mm of heavy concrete containing limonite
EXPERIMENTAL FACILITIES:	1 vertical central channel in the center of the core 2 channels in the side reflector 3 horizontal channels and themal column of graphite
REMARKS:	BR-2, one of the most advauced and convenient devices for carrying out experiments on effects of radiation on proposed reactor materials. After sucessfully carrying program, the BR-2 was dismalted in 1957 and used to build BR-5
REFERENCES:	[60], p. 44, 97; [83], p. 13-15; [84]; [85], p. 350-353

NAME:	БР-3 [BR-3]
TYPE:	Fast, combined with thermal; heterogeneous
USES OR APPLICATION:	Study the possibilities of fast-thermal system type reactors
AFFILIATION:	Institute of Physics of the Atomic Energy Utilization Board
LOCATION:	USSR
START-UP-DATE:	Middle of 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	Zero (th)
FUEL:	Lattice consists of cylindrical blocks of natural uranium 35 mm dia. encased in Al cans.
MODERATOR:	H_2O (in inner part)
REFLECTOR:	—
COOLANT:	—
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	The uranium-water lattice was built up of cylindrical blocks of natural uranium 35 mm in dia. encased in aluminium cans. Around the lattice is a 15 cm layer of water
REFERENCES:	[79]; [83], p. 12-13

NAME:	БР-4 [BR-4]
TYPE:	
USES OR APPLICATION:	
AFFILIATION:	
LOCATION:	
START-UP-DATE:	
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	
POWER kw:	
FUEL:	
MODERATOR:	
REFLECTOR:	
COOLANT:	
SHIELDING:	
EXPERIMENTAL FACILITIES:	
REMARKS:	Specifications are not available
REFERENCES:	[79], p. 407

NAME:	БР-5 [BR-5]
TYPE:	Fast, heterogeneous
USES OR APPLICATION:	Experiments: a) testing fuel and shield elements for the reactor BN-50 b) study of nuclear properties of matter in general and of radioactive sodium as heat-transfer agent in particular. c) nuclear-and material-testing in intensive, fast neutron fluxes
AFFILIATION:	—
LOCATION:	Obninsk, USSR
START-UP-DATE:	July 1958; reached critical stage 21 July 1959
MAXIMUM NEUTRON FLUX n/cm²/sec:	10^{15}
POWER kw:	5,000 (th)
FUEL:	Steel tube, filled with briquettes of sintered plutonium oxide: outside dia. of the tube is 5 mm, the wall thickness is p.4 mm, and the length of the active part is 280 mm; helium at 1 atm. is sealed in the fuel tube with welded plugs to improve thermal contact
MODERATOR:	Na max. 500°C; secondary Na-NaK
REFLECTOR:	Nickel and small amount of uranium in inner part
COOLANT:	Na cooled downward flow, 450°C outlet temperature; 2 Na-NaK heat exchangers
SHIELDING:	Side is the same as in the BR-2 reactor; upper is of boron carbite (80 cm), rotating steel plugs (120 cm); bottom, 20 cm water and 40 cm iron layer
EXPERIMENTAL FACILITIES:	Experimental loop, 4 channels and thermal column
REMARKS:	Reported to be the most powerful operating reactor of its kind, the BR-5 was constructed on the spot of the dismantled BR-2 reactor using some equipment of the latter; a model of the BR-5 was exhibited in New York in 1959. One feature is the easy access to its individual fuel subassemblies.
REFERENCES:	[63]; [79]; [85]; [138], p. 11

NAME:	BBP-M [VVR-M]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Physical research and reactor engineering Production of high specific activity isotopes Study of neutron and gamma-ray effects on matter and nuclear spectroscopy
AFFILIATION:	Physico-Technical Institute of the Academy of Sciences USSR
LOCATION:	Leningrad, USSR
START-UP-DATE:	31 December 1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	1.1×10^{14}
POWER kw:	10,000 (th)
FUEL:	Uranium enriched 20% U-235 (braced metal-ceramic tubes of UO_2+Al in the shape of an axially-disposed hexagonal tube)
MODERATOR:	H_2O
REFLECTOR:	Cylindrical; beryllium with internal hexagonal cavity; top, water 3.5 m
COOLANT:	H_2O (max 32 to 45°C)
SHIELDING:	Top, 350 cm of water and 80 cm of pig iron; side, 65 cm of water, 20 cm of pig iron, and 230 cm of cement
EXPERIMENTAL FACILITIES:	9 horizontal channels for letting neutron beams out into the experimental hall, and 11 vertical channels for irradiating samples
REMARKS:	—
REFERENCES:	[45], p. 322, 352-357; [82]; [93]

NAME:	BBP-M [VVR-M]
TYPE:	Thermal, heterogeneous, light-water, submerged
USES OR APPLICATION:	Research: a) physics; b) radiation chemistry; c) agricultural biology; d) physiology; e) microbiology; f) radiation biology Production of short-lived isotopes
AFFILIATION:	Institute of Physics of the Academy of Sciences Ukrainskaya SSR
LOCATION:	Kiyev, Ukrainskaya SSR
START-UP-DATE:	12 February 1960
MAXIMUM NEUTRON FLUX n/cm2/sec:	1.1×10^{14}
POWER kw:	10,000 (th)
FUEL:	Uranium enriched 20% U-235 (braced metal-ceramic tubes of UO_2+Al in the shape of an axially-disposed hexagonal tube) 268 fuel elements
MODERATOR:	H_2O
REFLECTOR:	Cylindrical beryllium with internal hexagonal cavity
COOLANT:	H_2O
SHIELDING:	Top, 350 cm of water and 80 cm of pig iron; side, 65 cm of water, 20 cm of pig iron, and 230 cm of cement
EXPERIMENTAL FACILITIES:	9 horizontal channels for letting neutron beams out into the experimental hall, and 11 vertical channels for irradiating samples For investigation of resonance scattering of slow neutrons by the transit time method a mechanical selector and 1024-channel temporary analyzer were added. A special wide-angle gamma-spectrometer with an 80° capture angle was constructed for investigation of the capture of gamma-ray spectra
REMARKS:	--
REFERENCES:	[26], p. 69; [54]; [104]; [110]; [115]; [25]; [135]

NAME:	CM [SM]
TYPE:	Intermediate, heterogeneous, light water
USES OR APPLICATION:	Research in structure and behavior of materials in fields of radiation; Production of new trans-uranium elements and radioactive isotopes
AFFILIATION:	—
LOCATION:	USSR
START-UP-DATE:	Under construction
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2×10^{15}
POWER kw:	50,000 (th)
FUEL:	Mixture of polyethylene and uranium oxide enriched 90% U-235 (54 plates per block 0.5 mm thick, 1.65 mm thick, 1.65 mm spacing between plates)
MODERATOR:	H_2O
REFLECTOR:	BeO (core and reflector are encased in stainless-steel pressure vessel designed for an internal pressure of 50 kg/cm^2 chielded from reactor steel by water-cooled screens
COOLANT:	H_2O
SHIELDING:	Steel water-cooled mesh
EXPERIMENTAL FACILITIES:	1 experimental channel with an outer dia. of 80 mm enters the 140 x 140 x 250 mm^3 water cavity which is provided in the center of the core; 5 horizontal channels (bundles 15 vertical channels with independent cooling system
REMARKS:	—
REFERENCES:	[35]; [36]; [138], p. 11

NAME:	BBP-Ц [VVR-TS]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Radiochemical research: a) physicochemical processes due to irradiation b) activation analysis c) radiochemical processes on a semi-production scale d) radiation effect on solid and semi-conductors e) study of the physicochemical properties of coolants f) study of chemical reactions with nuclear irradiation
AFFILIATION:	Institute of Nuclear Physics of the Academy of Sciences Kazakhskaya SSR
LOCATION:	Alma-Ata, Kazakhskaya SSR
START-UP-DATE:	Under construction
MAXIMUM NEUTRON FLUX $n/cm^2/sec$**:**	1×10^{14}
POWER kw:	10,000 (min.) to 20,000 (th)
FUEL:	Uranium enriched 20% U-235 (braced metal ceramic tubes of UO_2+Al)
MODERATOR:	H_2O
REFLECTOR:	Metal beryllium and H_2O
COOLANT:	H_2O flow from top downward, 1,040 m 3/hr, mean velocity m core 2.3 m/sec, temperature rose 8.3°C mean water temperature 3.15°C
SHIELDING:	Top, 350 cm of water and 800 mm of pig iron; side, 800 mm of water and 200 mm of pig-iron with 2,400 mm concrete layer; bottom, 1,100 mm of water
EXPERIMENTAL FACILITIES:	1) for periodical passage of liquid and gaseous media into the intensive reactor radiation field. 2) to let out radiation beams from core and employ them 3) for long-time irradiation of materials 4) as auxiliary radiation source 5) for additional experiments 12 loops, 10 horizontal and 20 vertical channels, and a graphite thermal column for experimental purposes
REMARKS:	—
REFERENCES:	[45], p. 322, 357-367; [93d]; [93h]

NAME:	АЭПС or АЭС [AEPS or AES]
TYPE:	Thermal, heterogeneous, graphite, pressurized water
USES OR APPLICATION:	Atomic power station: a) to accumulate technical and economic experience with an atomic power plant b) to serve as a base for traning personnel
AFFILIATION:	Power Station of the Academy of Sciences, USSR
LOCATION:	Obninsk, 75 miles from Moscow, near Maloyaroslavets, USSR
START-UP-DATE:	Completed 9 May 1954; 27 June 1954 was generating electricity
MAXIMUM NEUTRON FLUX n/cm²/sec:	5×10^{13} (average)
POWER kw:	30,000 (th) 5,000 (el)
FUEL:	Enriched uranium 5% U-235
MODERATOR:	Graphite and water (later simultaneously serves as the coolant)
REFLECTOR:	Side: Graphite, 80 cm; end, 60 cm
COOLANT:	H_2O (100 atm.)
SHIELDING:	Top, steel and cast iron; side; 100 cm of water and 300 cm of concrete
EXPERIMENTAL FACILITIES:	Several experimental channels, a thermal commun, and neutron beam holes provide facilities for carrying out investigations with neutrons and the production of radioactive isotopes
REMARKS:	First industrial atomic power station in the world
REFERENCES:	[17]; [18]; [19]; [30]; [32]; [41], p. 1-3; [40], p. 22-39; [44]; [46]; [65], p. 3-13; [68], [75]; [77]; [87]; [88], p. 134-144, 147-153; [94], p. 18-44; [96]; [101]; [105]; [114]; [117]; [119]; [124]; [131]; [134], p. 107-114

NAME:	Beloyarsk Atomic Power Station imeni I.V. Kurchatov
TYPE:	Thermal, heterogeneous, graphite, superheated high-pressure steam
USES OR APPLICATION:	Prototype of atomic power station with high output
AFFILIATION:	—
LOCATION:	Beloyarsk [Pyshma river canyon of Sverdlovskaya oblast'] USSR
START-UP-DATE:	Under construction; fir 200,000 kw section will deliver industrial current by 1961
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	1,540,000 (th) 400,000 (el)
FUEL:	Enriched uranium 1.3% U-235 (90 t); cladding undetermined
MODERATOR:	Graphite, water and steam
REFLECTOR:	Graphite (80 cm)
COOLANT:	H_2O and steam [160 atms.) by max. 309°C
SHIELDING:	Concrete and water 1 m thick, cooled by coil
EXPERIMENTAL FACILITIES:	—
REMARKS:	Secondary steam with 110 atm., is conducted into the channels where it is superheated to 510°C with 90 atm. absolute pressure then conducted to the turbine; the station will have 4 reactors, each 285,000 kw (th), 1,000,000 kw (el)
REFERENCES:	[8]; p. 10-13; [28]; [29]; [44]; [45]; [47]; [50]; [52]; [105]; [114]; [138], p. 2; [139], p. 91-92; [140], p. 6-9

NAME:	Siberian
TYPE:	Thermal, heterogeneous, graphite, water
USES OR APPLICATION:	Atomic power station with large capacity, designed to produce both plutonium and power
AFFILIATION:	—
LOCATION:	Troitsk, Siberia, USSR
START-UP-DATE:	7 September 1958
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	600,000 (el)
FUEL:	Natural uranium (200 t)
MODERATOR:	Graphite
REFLECTOR:	Graphite
COOLANT:	Pressurized water cooling (max. 220°C). Secondary circuit produced steam at 185°C
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	The world's largest atomic power station; the first 100,000 kw stage has been accomplished; after completion, the station will have 6 reactors and each reactor, three turbo-generators
REFERENCES:	[30], p. 28-29; [44]; [129]; [141]

NAME:	----
TYPE:	Thermal, heterogeneous, graphite, sodium
USES OR APPLICATION:	Experimental power station
AFFILIATION:	Reactor Testing Station
LOCATION:	Ulyanovsk, USSR
START-UP-DATE:	Under Construction
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	----
POWER kw:	140,000 (th) 50,000 (el)
FUEL:	Uranium slightly enriched (1.5%) clad in stainless steel
MODERATOR:	Graphite
REFLECTOR:	----
COOLANT:	Sodium; inlet temperature 300°C; outlet, 560°C; 1,600 t/hr. Second, Na circuit
SHIELDING:	----
EXPERIMENTAL FACILITIES:	400 channels, 42 control rods
REMARKS:	Different types of fuel will be tested. Superheated steam 200 t/hr at 500°C and at a pressure of 90 atms. will be produced
REFERENCES:	[44]; [95]; [137]

NAME: ВВЭР-210 [VVER-210]

TYPE: Thermal, heterogeneous, pressurized water

USES OR APPLICATION: Prototype of atomic power station with large capacity

AFFILIATION: —

LOCATION: Novovoronezhskaya near Voronezh on the Don River, USSR

START-UP-DATE: Under construction; about 1960/1961

MAXIMUM NEUTRON FLUX n/cm^2/sec: —

POWER kw: 1,520,000 (th) 420,000 (el)

FUEL: Uranium oxide enriched 1.5% U-235, with alloyed zirconium cladding. Both natural, 17 t of metal, and enriched uranium (25 t) used for fuel loading.

MODERATOR: H_2O under pressure of 100 atm., circulating along six circulation loops

REFLECTOR: H_2O

COOLANT: H_2O (under the pressure of 100 atm. circulating along six circulation loops

SHIELDING: Cylindrical tank filled with water 100 cm thick and 300 cm of concrete

EXPERIMENTAL FACILITIES: —

REMARKS: It will have two reactors of pressurized water type, each reactor 760,000 kw (thermal), 210,000 kw (electrical); the ordinary water at a pressure of 100 atm. will serve as the neutron moderator. Heated to 275°C in the core of reactor, this water will produce steam at 29 atm. to drive 70,000 kw turbines

REFERENCES: [6]; [30], p. 29; [73]; [95]; [110]; [125]; [133]; [139], p. 88-91; [140].

NAME:	ВВЭР-210 [VVER-210]
TYPE:	Thermal, heterogeneous, pressurized water
USES OR APPLICATION:	Prototype of atomic power station with large capacity
AFFILIATION:	—
LOCATION:	Leningrad region; USSR
START-UP-DATE:	Under construction
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	760,000 (th) 420,000 (el)
FUEL:	Uranium dioxide enriched 1.5% U-235; fitted with zirconium tube claddings, Both natural 17 t of metal, and enriched uranium (23 t) used for fuel loading
MODERATOR:	H_2O under pressure of 100 atm., circulating along six circulation loops
REFLECTOR:	H_2O
COOLANT:	H_2O (under pressure of 100 atm. circulating along six circulation loops)
SHIELDING:	Cylindrical tank filled with water 100 cm thick and 300 cm of concrete
EXPERIMENTAL FACILITIES:	—
REMARKS:	It will have two reactors of pressurized water type, each reactor 760,000 kw (thermal), 210,000 kw (electrical); the ordinary water at a pressure of 100 atm. will serve as the neutron moderator. Heated to 275°C in the core of reactor, this water will produce steam at 29 atm. to drive 70,000 kw turbines
REFERENCES:	[6]; [73]; [95], p. 386-387; [110]; [123]; [137]; [140], p. 9-22

NAME:	Mobile
TYPE:	Thermal, heterogeneous, pressurized water
USES OR APPLICATION:	Small experimental mobile atomic power station
AFFILIATION:	—
LOCATION:	Obninsk, USSR
START-UP-DATE:	Installed for testing at the end of 1958 on the grounds of the first Atomic Power Station
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	2,000 (el)
FUEL:	Enriched uranium
MODERATOR:	H_2O
REFLECTOR:	—
COOLANT:	H_2O (120 atm.) Secondary circuit provides steam at 20 atms., 280°C
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	Reactor vessel 1 m dia., 2.2. m high
REFERENCES:	[137]

NAME:	
TYPE:	Thermal, heterogeneous, boiling water
USES OR APPLICATION:	Experimental atomic power station with small capacity
AFFILIATION:	----
LOCATION:	Ulyanovsk district on the Volga River, USSR
START-UP-DATE:	Under construction. Expected completion 1961
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	----
POWER kw:	50,000 (el)
FUEL:	UO_2 enriched 1.5% U-235 fitted with alloyed zirconium tube cannings. 144 fuel elements of the pressurized water type
MODERATOR:	H_2O
REFLECTOR:	----
COOLANT:	H_2O and steam (29 atms.)
SHIELDING	----
EXPERIMENTAL FACILITIES:	----
REMARKS:	Steam pressure in the reactor 100 atms., and 30 atms. before turbines
REFERENCES:	[95], p. 381-388 [123], p. 8

NAME:	—
TYPE:	Thermal, homogeneous, boiling water
USES OR APPLICATION:	Experimental atomic power station with small capacity; study of boiling reactors stability and to determine efficiency of the thorium cycle.
AFFILIATION:	—
LOCATION:	Ulyanovsk district on the Volga River, USSR
START-UP-DATE:	Under construction
MAXIMUM NEUTRON FLUX $n/cm^2/sec$**:**	—
POWER kw:	Up to 35,000 (th)
FUEL:	Suspended uranium oxide in D_2O; Th
MODERATOR:	D_2O
REFLECTOR:	—
COOLANT:	D_2O (up to 50 atms.)
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	—
REFERENCES:	[5a]; [137]; [61]

NAME:	—
TYPE:	Thermal, homogeneous, heavy water
USES OR APPLICATION:	Prototype of an atomic power station with large capacity
AFFILIATION:	—
LOCATION:	USSR
START-UP-DATE:	Preliminary example design
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	6.5×10^{13}
POWER kw:	From 1,150,000 to 2,000,000 (th) From 280,000 to 500,000 (el)
FUEL:	Natural uranium with addition of slightly enriched uranium (0.8 to 0.9% U-235) at a concentration of 200 kg/t of water
MODERATOR:	D_2O
REFLECTOR:	—
COOLANT:	D_2O
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	Length of campaign is from 7 to 8 years during which 306 tons of natural uranium and 43 tons of 0195% U-235 will be consumed
REFERENCES:	[22]

NAME:	БН-50 [BN-50]
TYPE:	Fast breeder
USES OR APPLICATION:	Experimental atomic power reactor
AFFILIATION:	—
LOCATION:	Ulyanovska oblast' on the Volga River, USSR
START-UP-DATE:	1960/1961
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	0.9×10^{16} and 1.3×10^{16}
POWER kw:	200,000 (th) 50,000 (el)
FUEL:	Pu (core composition: 40% of heat-transfer agent, 47% of fuel elements from PuO_2, 13% structural materials)
MODERATOR:	—
REFLECTOR:	Depleted uranium 600 mm thick
COOLANT:	Na, NaK
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	Average specific heat generation 800 kw/l core; steam temperature 415°C; steam pressure 29 kg/sq. cm; breeding ratio 1.9
REFERENCES:	[55]

NAME:	БН-250 [BN-250]
TYPE:	Fast breeder
USES OR APPLICATION:	Atomic power station
AFFILIATION:	—
LOCATION:	—
START-UP-DATE:	Planned; not yet decided
MAXIMUM NEUTRON FLUX n/cm2/sec:	0.9×10^{16} 1.3×10^{16}
POWER kw:	250,000 (el)
FUEL:	Core composition: 44% of heat-transfer agent, 43% of fuel elements from PuO_2, 13% of structural materials
MODERATOR:	—
REFLECTOR:	Depleted uranium 600 mm thick, 480°C max.
COOLANT:	Na, NaK 500° max.
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	Average specific heat generation 1,000 kw/l core; breeding ratio 1.8 to 2.0
REFERENCES:	[55]

NAME:	"Lenin" atomic icebreaker
TYPE:	Thermal, heterogeneous, pressurized water
USES OR APPLICATION:	Experimental atomic power station with middle capacity; marine; first in the northern seaway
AFFILIATION:	—
LOCATION:	Leningrad, USSR
START-UP-DATE:	Construction begun 1955; launched 15 December 1957; started on her maiden voyage in December 1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	270,000 (th) close 10,500 hp
FUEL:	Sintered UO_2 enriched 5% U-235 fitted with alloyed zirconium tube cannings (85 kg)
MODERATOR:	Graphite
REFLECTOR:	—
COOLANT:	H_2O
SHIELDING:	Equal volume of iron and water
EXPERIMENTAL FACILITIES:	—
REMARKS:	Steam temperature 310°C; steam pressure 28 atms. Two of the water-water type reactors with which the ice-breaker is equipped are in operation; the third is kept in reserve. In the secondary circuit a turbine operates on steam with pressure at 20 atms and temperature of 280 °C.
REFERENCES:	[1]; [12]; [13]; [78]; [100]; [122]

NAME:	ИРТ-1000 [IRT-1000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear physics b) material testing in eutron and gamma-source fields Production of isotopes
AFFILIATION:	Institute of Physics of the Bulgarian Academy of Sciences
LOCATION:	Geo Milev Section of Sofia, Bulgaria
START-UP-DATE:	Under construction
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	1.2×10^{13}
POWER kw:	1,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O with ejector
SHIELDING:	Side, 1.8 m of heavy-aggregate concrete divided into four zones
EXPERIMENTAL FACILITIES:	8 horizontal channels and a thermal column; 7 vertical channels; active zone of the reactor located in a pool, under 6 m of water
REMARKS:	This industrially produced reactor is available to institutions of high learning and some scientific-research centers
REFERENCES:	[93 1]; [137]; [80]

NAME:	TBP-C [TVR-S]
TYPE:	Thermal, heterogeneous, heavy-water
USES OR APPLICATION:	Research: a) nuclear physics; b) radiochemistry c) biology, production of isotopes
AFFILIATION:	Institute of Nuclear Physics
LOCATION:	Peking, China
START-UP-DATE:	27 September 1958
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	5.5×10^{13}
POWER kw:	7,000 to 10,000 (th)
FUEL:	Uranium enriched 2% U-235 (340 kg)
MODERATOR:	D_2O (5 t)
REFLECTOR:	Graphite
COOLANT:	D_2O
SHIELDING:	Side, 2 m of special concrete and 70 cm of water in the form of a reservoir separated from the concrete by a layer of sand 7.5 cm thick
EXPERIMENTAL FACILITIES:	9 channels for experimental work: 1 in central part 100 mm in dia., 4 in the middle of core, each 50 mm in dia. and 4 in the periphery, each 100 mm in dia.
REMARKS:	Similiar to TR, p. 2
REFERENCES:	[23]; [24]; [25]; [80], p. 44; [102]; [137]

NAME:	—
TYPE:	Homogeneous research reactor
USES OR APPLICATION:	Research and instruction Production of isotopes
AFFILIATION:	Nan-K'ai Polytechnic Institute
LOCATION:	Tientsin, China
START-UP-DATE:	1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	4.5×10^6 (outside the reactor)
POWER kw:	3 w (th)
FUEL:	—
MODERATOR:	—
REFLECTOR:	—
COOLANT:	—
SHIELDING	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	Reactor was built and put into operation by teachers and students of the Institute
REFERENCES:	[93 g]

NAME:	BBP-C [VVR-S]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Research: a) physical research b) chemical research c) biology Production of isotopes
AFFILIATION:	Institute of Nuclear Physics
LOCATION:	Rezi near Prague, Czechoslovakia
START-UP-DATE:	24 September 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60 kg)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	Similar to VVR-S, p. 8
REMARKS:	The research reactor of the Czechoslovak Academy of Sciences was delivered by the Soviet Union on the basis of the bilateral agreement of April 1955, between the two states.
REFERENCES:	[50]; [60], p. 59; [91]; [93 c]; [130]

NAME:	KS-150
TYPE:	Thermal, heterogeneous, heavy water
USES OR APPLICATION:	Prototype of an atomic power station with large capacity
AFFILIATION:	—
LOCATION:	Bohunice (10 km west of Trnava), Slovakia
START-UP-DATE:	1960 (under construction)
MAXIMUM NEUTRON FLUX n/cm²/sec:	—
POWER kw:	590,000 (th) 150,000 (el)
FUEL:	Natural uranium
MODERATOR:	D_2O
REFLECTOR:	—
COOLANT:	CO_2 at 60 atms. inlet temperature 125°C, outlet temperature 425°C
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	First atomic power station in Czechoslovakia; 3 turbines, each 50,000 kw; Czechoslovakian plants are entrusted of manufacturing equipment and the carrying out the constructional work, Soviet Union will make available the services of experts on specific matters
REFERENCES:	[4]; [5]; [13]; [56]; [58]; [118]; [120]; [121]

NAME:	BBP-C [VVR-S]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Research: a) physical research b) chemical research c) biology Production of isotopes
AFFILIATION:	Central Institute for Nuclear Physics
LOCATION:	Rossendorf near Dresden, GDR
START-UP-DATE:	16 December 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60 kg)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	Similar to VVR-S, p. 8
REMARKS:	
REFERENCES:	[39]; [60], p. 59; [72]; [80], p. 44

NAME:	ВВЭР-70 [VVER-70]
TYPE:	Thermal, heterogeneous, pressurized water
USES OR APPLICATION:	Experimental atomic power station; prototype of middle capacity
AFFILIATION:	Techno-Scientific Office for the Construction of Reactors
LOCATION:	Near Rheinsberg, north of Berlin, GDR
START-UP-DATE:	About 1961; construction started in 1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	265,000 (th) 70,000 (el)
FUEL:	UO_2 enriched 1.4 - 1.5 - to 1.7% U-235, fitted with alloyed zirconium tube cannings
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O in the primary circuit will be subjected to a pressure of 100 atms. The reactor intake temperature will be 250°C and reactor outlet temperature 267°C
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	The construction project for the power plant was worked out in the GDR; reactor section was designed in the Soviet Union with the cooperation of German experts.
REFERENCES:	[126]; [126a]

NAME:	BBP-C [VVR-S]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Research: a) physical research b) chemical research c) biology Production of isotopes
AFFILIATION:	—
LOCATION:	Abu Za'bal, Egypt
START-UP-DATE:	—
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60kg)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	Similar to VVR-S, p. 8
REMARKS:	The research reactor of the Czechoslovak Academy of Sciences was delivered by the Soviet Union on the basis of the bilateral agreement of April 1955, between the two states
REFERENCES:	[137]; [95b]

NAME:	BBP-C [VVR-S]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Research: a) physical research b) chemical research c) biology Production of isotopes
AFFILIATION:	Central Research Institute of Physics of the Academy of Sciences
LOCATION:	Csillebero Hilltop, Hungary
START-UP-DATE:	29 March 1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60 kg); 51 sections containing 16 fuel elements
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	6 horizontal experimental channels 8 vertical experimental channels 1 horizontal channel opening into core, embedded on a graphite disc 1 thermal column with 4 vertical experimental channels 3 vertical experimental channels for biological research
REMARKS:	Similar to VVR-S, p. 8
REFERENCES:	[60]; [80], p. 44 [93 i]; [103]; [128]; [132]

NAME:	Hungarian subcritical reactor
TYPE:	—
USES OR APPLICATION:	Experiments in reactor physics which will give Hungarian experts the necessary knowledge for building a small-output power reactor of domestic design Production of isotopes Investigation of neutron multiplier systems
AFFILIATION:	Central Physics Research Institute
LOCATION:	Budapest, Hungary
START-UP-DATE:	5 November 1959
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	—
FUEL:	Reserve fuels from the experimental reactor
MODERATOR:	—
REFLECTOR:	—
COOLANT:	—
SHIELDING:	—
EXPERIMENTAL FACILITIES:	—
REMARKS:	—
REFERENCES:	[89]; [90]; [127]

NAME:	ИРТ-1000 [IRT-1000]
TYPE:	Thermal, heterogeneous, light water, submerged, swimming pool
USES OR APPLICATION:	Research: a) nuclear physics b) material testing in neutron and gamma-source fields Production of isotopes
AFFILIATION:	—
LOCATION:	Korea
START-UP-DATE:	—
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	1.2×10^{13}
POWER kw:	1,000 (th)
FUEL:	Uranium enriched 10% U-235
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O with ejector
SHIELDING:	Side, 1.8 m of heavy-aggregate concrete divided into four zones
EXPERIMENTAL FACILITIES:	8 horizontal channels and a thermal column; 7 vertical channels; active zone of the reactor located in a pool, under 6 m of water
REMARKS:	This industrially produced reactor is available to institutions of high learning and some scientific-research centers
REFERENCES:	[137]

NAME:	EWA
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	Research: a) physical research b) chemical research c) biology Production of isotopes
AFFILIATION:	Center of Nuclear Research
LOCATION:	Swierk near Warsaw, Poland
START-UP-DATE:	31 May 1958
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60 kg)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	Similar to VVR-S, p. 8
REMARKS:	
REFERENCES:	[2]; [3]; [3a]; [9]; [15]; [16]; [57]; [63]; [80], p. 44; [99]; [136]

NAME:	Second Polish Research Reactor
TYPE:	High-flux
USES OR APPLICATION:	
AFFILIATION:	
LOCATION:	Poland
START-UP-DATE:	
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	
POWER kw:	
FUEL:	Fuel elements of the type used in the Soviet RFT reactor for physical and technical research with 20 or 90% enriched uranium; this element consists of a number of concentrated ceramic tubes (UO_2+Al), aluminium clad and water cooled
MODERATOR:	Graphite
REFLECTOR:	
COOLANT:	Gas
SHIELDING:	
EXPERIMENTAL FACILITIES:	
REMARKS:	The experiments took place on water moderated and cooled reactors, heavy water moderated reactors and graphite moderated reactors (Pilot, Perun and water-cooled reactors) between 1958-1960. At the present stage the preliminary design of the critical assembly has been completed
REFERENCES:	[26a]; [64]; [99]

NAME:	Graphite-moderated exponential assembly
TYPE:	—
USES OR APPLICATION:	Constitutes a mock-up of the Second Polish high-flux reactor
AFFILIATION:	Experimental Reactor Physics Group of the Reactor Detectors Group of the Institute of Nuclear Research of the Polish Academy of Sciences
LOCATION:	Swierk, near Warsaw, Poland
START-UP-DATE:	1958-1960
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	In graphite 10^6; in uranium 0.7×10^6
POWER kw:	—
FUEL:	20% and 90% enriched uranium, in tubular fuel-elements; critical mass (calculated) about 4 kg U-235; maximum fuel element loading, 30 units.
MODERATOR:	Water, 70%; graphite, 30%
REFLECTOR:	80 cm of graphite
COOLANT:	Water
SHIELDING:	30 cm of concrete
EXPERIMENTAL FACILITIES:	—
REMARKS:	—
REFERENCES:	[26a]

NAME:	BBP-C [VVR-S]
TYPE:	Thermal, heterogeneous, light water, submerged
USES OR APPLICATION:	To determine: a) what information may be obtained on the characteristics of the reactor, using the measuring equipment normally provided with the reactor; b) to what extent it is possible to forecast the dynamic behavior of the reactor by using a simple system of equation describing the reactor and the cooling loop; c) if it is necessary to take account of the existence of two temperature coefficients, and when; d) the predetermination, to a first approximation, of the transitory conditions brought about by a sudden modification in the relativity.
AFFILIATION:	Institute of Atomic Physics of the Rumanian Academy of Sciences
LOCATION:	Bucharest, Rumania
START-UP-DATE:	31 July 1957
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	2.5×10^{13}
POWER kw:	2,000 (th)
FUEL:	Uranium enriched 10% U-235 (60 kg)
MODERATOR:	H_2O
REFLECTOR:	H_2O
COOLANT:	H_2O
SHIELDING:	Top, 3,500 mm of water and 800 mm of cast iron; side, 800 mm of water, 200 mm of cast iron and 2,200 mm of heavy concrete
EXPERIMENTAL FACILITIES:	Similar to VVR-S, p. 8
REMARKS:	
REFERENCES:	[60], p. 59; [80], p. 44; [111]; [113]

NAME:	RB, Bare critical assembly
TYPE:	Thermal, heterogeneous, heavy water
USES OR APPLICATION:	Provide experience in: 1. carrying out critical experiments 2. operational experience with nuclear reactors 3. high accurate critical conditions for heavy water-natural uranium lattices
AFFILIATION:	Boris Kidric Institute of Nuclear Sciences
LOCATION:	Vinca, near Beograd, Yugoslavia
START-UP-DATE:	29 April 1958
MAXIMUM NEUTRON FLUX $n/cm^2/sec$:	—
POWER kw:	Zero (th)
FUEL:	Natural uranium in 200 aluminum covered rods
MODERATOR:	Heavy water
REFLECTOR:	Completely non-reflected by placing reactor core on a platform 4 m above floor
COOLANT:	D_2O
SHIELDING:	He, D_2O
EXPERIMENTAL FACILITIES:	The reactor is controlled by D_2O level and 2 Cd safety rods
REMARKS:	An accident occurred on 15 October 1958. Introduction of RaBe source together with elevation of D_2O level, led to excessive neutron and gamma radiation; 6 persons affected, 1 death, 4 received 600-1000 rem; 1,400 rem
REFERENCES:	[38]; [93f]; [106]; [107]; [108]; [109]

NAME:	TBP-C [TVR-S]
TYPE:	Thermal, heterogeneous, heavy-water
USES OR APPLICATION:	Research: a) nuclear physics b) radiochemistry c) biology, production of isotopes
AFFILIATION:	Boris Kidric Institute of Nuclear Sciences
LOCATION:	Vinca, near Beograd, Yugoslavia
START-UP-DATE:	1958
MAXIMUM NEUTRON FLUX n/cm²/sec:	5.5×10^{13}
POWER kw:	7,000 to 10,000 (th)
FUEL:	Uranium enriched 2% U-235
MODERATOR:	D_2O (5 t)
REFLECTOR:	Graphite
COOLANT:	D_2O
SHIELDING:	Side, 2 m of special concrete and 70 cm of water in the form of a reservoir separated from the concrete by a layer of sand 7.5 cm thick
EXPERIMENTAL FACILITIES:	9 channels for experimental work: 1 in central part 100 mm in dia., 4 in the middle of core, each 50 mm in dia. and 4 in the periphery, each 100 mm in dia.
REMARKS:	Similar to TR, p. 2
REFERENCES:	[63f]; [80], p. 44; [93k]; [137]

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