

State Atomic Energy Corporation "Rosatom"

MBIR International Research Center: Current Progress and Prospects

Alexander TUZOV



High flux research reactors in the world





New generation of nuclear R&D infrastructure



Nuclear R&D needs:

- Licensing of most commercial PWRs for the 60 years
- Increasing of nuclear fuel cycle duration
- Development of robust fuel for current LWR fleet
- Minor actinide transmutation
- Proliferation resistance fuel
- Fuel & reactor materials for Next Generation reactors (VHTR, SFR, GFR, LFR, Supercritical WR, MSR) are to be tested and approved

New generation of R&D infrastructure:

- High flux reactor
- Experimental loops with different types of coolant
- Instrumented reactor cells for in-pile testing
- PIE hot cells, research labs
- Facilities for manufacturing of samples, test devices, assemblies, etc.
- On-site fuel fabrication and spent fuel handling facilities
- Highly qualified staff
- Developed social infrastructure and acceptable transportation availability

MBIR Project



- Basis for the implementation of the project FTP «New Generation Nuclear Power in 2010 - 2015's and up to 2020» (FTP NGNP)
- The project is a **part of the Nuclear Innovation Cluster of Dimitrovgrad** (Cluster has been receiving Governmental subsidy for infrastructure development since 2013)
- International status of the project since the MBIR Project's early beginning ROSATOM announced the intension of the MBIR International Research Centre establishment
- MBIR Project's Key Participants:

Supervisor:	Innovation Mana	gement Unit, ROSATOM (Vyacheslav PERSHUKOV)		
MBIR's Director:	JSC "SSC RIAR", Director General (Alexander TUZOV)			
Owner & Operator: State Scientific Center RIAR (Dimitrovgrad, Ulyanovsk region)				
Chief Reactor Designer:		JSC «NIKIET» (Moscow)		
General Design Contractor:		JSC «ATOMPROEKT» (Saint-Petersburg)		
Scientific Adviser:		State Scientific Centre IPPE (Obninsk)		
General contractor (civil works):		Company «UralEnergoStroy» (Yekaterinburg)		
Equipment manufacturers:		Atomenergomash, OKBM Afrikantov and others *)		

*) to be selected by the results of the open competitive procedures



MBIR is a Multipurpose Sodium Fast Research Reactor

- 150 MW(t)
- Maximum neutron flux 5.3.10¹⁵ n/(cm²·s)
- Designed life time 50 years
- Upgradeable experimental capabilities: more loops, irradiation devices, channels, neutron beams, etc.
- Priority on research activities providing reliability and safety of operation
- Using of existing infrastructure (incl. fuel supply), the unique operation experience and staff resources of RIAR
- Closed fuel cycle
- Commissioning in 2020 (target)



Top intended mission — enhancement of international R&D infrastructure

Reactor and primary circuit





Core cross section





Parameter	Value
Effective core diameter, cm	88.8
Core height, cm	55.0
Fuel cycle, EFPD	100
Reactivity loss through cycle, %	3.0
Average FA power, MW	1.49
Maximum linear heat rate, W/cm	485.0
Maximum / average fuel burn-up of discharged FAs, % h. a.	13.5 / 8.35
Maximum / average neutron flux, cm ⁻² ·s ⁻¹	5.3·10 ¹⁵ / 3.1·10 ¹⁵
Fast neutron (En > 0.1 MeV) share in the core	0.73

Instrumented in-pile experimental devices (3 pcs.)

Control rod (8 pcs.)

Blanket assembly (278 pcs.) In-pile fuel storage (38 pcs.)

Shielding assembly (74 pcs.)

Fuel assembly





Parameter	Value
Width across flats, mm	72.2
Height, mm	2700
Wrapper material	martensitic steel EP-450sh
Number of fuel pins	91
Fuel cladding material	austenitic steel ChS-68
Height of fuel pin, mm	1575
Approved fuel type	Vibro-MOX*)
Fuel core effective density, g/cm ³	9.0 ± 0.2
PuO2 share in fresh fuel, %	up to 38.8
Fuel types	pellet MOX / metal fuel / dense fuel

Material test assembly



Value



Width across flats, mm	72.2
Height, mm	2 700.0
MTA useful volume, cm ³	2 280.0
Number of MTA (core).	14
Number of MTA (1 st row of blanket)	up to 36
Dose rate in core, dpa / year *)	20÷24
Dose rate in 1 st blanket row, dpa / year *)	11÷14
Maximum neutron flux, (En > 0.1 MeV), cm ⁻²	1.5·10 ²³

*) in case of MBIR's utilization rate = 0.65

External loop channel





Sodium loop parameter	Value
Total height of loop channel, mm	11900
Outer diameter of loop channel cover (core level), mm	120
Outer / inner diameter of loop channel removable unit (core level), mm	63.0 / 60.0
Experimental fuel assembly coolant temperature (inlet/outlet), °C	up to 600 / up to 850
Sodium flow rate, kg/s	up to 2.9
Experimental FA parameter	Value
Width across flats, mm	50.0
Total height, mm	1435
Height of the fuel column, mm	550
Capacity, kW (th)	up to 500

Instrumented in-pile experimental devices





Horizontal and vertical experimental channels





Neutron radiography research cell 7.1 m (length) × 4.1 m (width) × 2.9 m (height)

Cutting-edge silicon doping facility :

- 6 vertical channels (Ø 350 mm)
- Silicon irradiation and transportation container height 885 mm
- Irradiation temperature up to 80.0 °C

Six horizontal experimental channels:

- for neutron radiography
- for physical researches
- for medical applications



Silicon doping facility

PIE facilities





Additional facilities provided in the MBIR Research Complex:

- Experiment preparation and support labs
- Analytical labs equipped with the cutting-edge examination devices (spectrometry, radiographic, microscopes, diffractometers etc.)

PIE facilities in the MBIR research complex





Sub-Cell for MTA handling and examination

Hot Cell for long length experimental devices

- hot-cell have three full-equipped operator workplaces
- 10.0 m (length) × 3.0 m (width) × 12.6 m (height)

Each complex of Hot-Cell for MTAs Handling & Examination*):

- 4 sub-cells interconnected by the technological penetrations
- each sub-cell is equipped with the analytical and scientific devices
- 4.0 m (length) \times 2.7 m (width) \times 4.5 m (height)
- service zone and crane equipment

MBIR Research Complex includes 8 hot cells able to provide handling operations with one full-size MTA



Long length experimental devices handling

Beneficiaries







IAEA

MBIR is sited at Research Institute of Atomic Reactors in Dimitrovgrad

ROSATOM / RIAR



- Owner of the full-scale research center
- Liabilities, operation & maintenance
- R&D program execution

- Marketing and promotion
- R&D program management
- User's joint activities facilitating

International Research Center MBIR

- ✓ Estimated total project cost is about \$1,1 billion
- Available \$300 M funding is provided by Russian Government for the reactor construction
- Additional funding up to \$800 M for equipping and general conveniences

IRC management structure





Time schedule





otential partners have the unique window of opportuniti for early-bird participation

MBIR Project: Key Milestones achieved (1/2)



- **2006-2010** preliminary discussions, pre-conceptual phase
- February, 2010 FTP NGNP is approved by the Government of Russian Federation
- September, 2010 ROSATOM in the framework of the IAEA General Conference announced the intension of the MBIR International Research Centre (MBIR IRC) establishment
- **December, 2010** MBIR's Design Concept is approved by ROSATOM
- December, 2011 Preliminary Design of MBIR Reactor Unit is completed
- October, 2013 Basic Detailed Design of MBIR Facility is completed
- March, 2014 positive conclusion of the Principal Russia State Expert Agency by results of the state expertise of MBIR Facility's Basic Detailed Design is received
- April, 2014 procurement procedures are launched
- June, 2014 contract for RPV & Reactor internals signed (Atomenergomash)
- July, 2014 MBIR's Site License issued by the Regulatory Authority
- September, 2014 comprehensive environmental assessment of the MBIR's Construction License materials is finished & approved by the Russia State Environmental Authority

MBIR Project: Key Milestones achieved (2/2)



- September, 2014 MBIR IRC's Concept announcement (58th IAEA General Conference)
- **October, 2014** contract for MBIR's detailed documentation signed (ATOMPROEKT)
- October, 2014 by the results of the Regulatory Authority's target inspection, the RIAR's full readiness for the MBIR's construction was confirmed
- November, 2014 5th MBIR IRC International Workshop was held (Saint-Petersburg)
- **November**, **2014** contract for MBIR's civil work signed (UralEnergoStroy)
- May, 2015 MBIR's Construction License issued by the Regulatory Authority
- August, 2015 preliminary MBIR's civil work is almost completed
- September, 2015 first concrete for the MBIR's foundation plate is poured
- October, 2015 concrete pouring for the MBIR's Reactor Unit foundation plate is finished

MBIR Construction Site: Current Status







MBIR Construction Site: Current Status









Thank you for your attention!

For further information please contact:

Alexander TUZOV, JSC "SSC RIAR", Director General MBIR project director, +7 (84235) 6-41-41 AATuzov@rosatom.ru AATuzov@niiar.ru