REACTOR PIK
PRESENT STATUS AND TRENDS

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CARR - China Advanced Research Reactor (2010) – technical analog of reactor PIK (Gatchina)
CMRR - China Mianyang Research Reactor (2012) – cold source, n- guides, diffractometer by PNPI
Modernized IBR-2 High Flux Pulsed Reactor (FLNP JINR)

Information: [http://flnp.jinr.ru/34/](http://flnp.jinr.ru/34/)


Operational since 1984

2007-2010: modernization shutdown

2010 – 2011 Physical and power start-up completed

2012 – Regular operation renewed

By D.P. Kozlenko, FLNP, Dubna
Neutron Sources: fluxes

But the real gain comes from the technical progresses on the neutron instruments!
European neutron instrument days = (facility operating days) x (number of operational instruments).

In practice days delivered to users will be 80---85% of this value.
Developed last year; got full support of international reviewers in April (POF-III) is a basis for the long-term planning in BMBF.
REACTOR PIK: PRESENT STATUS
1 - Hf absorbing shutters
2 - burnable absorber rods
   \( \text{Gd}_2\text{O}_3 + \text{ZrO}_2 \)
3 - Zr fuel assembly cover;
4 - fuel elements with reduced fuel contents (0.48 of nominal content)
5 - fuel elements with nominal fuel contents
6 - fuel assemblies with witness-specimen of vessel material
7 - irradiated samples
2011 a critical state of the fuel assembly was achieved and a complete test of the reactor systems was produced without coolant at $W = 100\, W$
Central part of the reactor complex PIK (commissioned in 2013)
Main entrance to the reactor PIK
Technical engineering infrastructure
Building 100B – Equipment of primary cooling
Petersburg Nuclear Physics Institute of the NRC “Kurchatov Institute”

Building 100G - Equipment of secondary cooling
Building 116 – backup diesel power station, backup control panel, training and modeling complex
Building 122 - Emergency storage of liquid radioactive waste
Building 104 - Neutron guide hall
ROAD MAP 2014-2020
INVESTMENT PROJECTS PNPI NRC KI 2014-2020

Projects for the building of the research reactor complex PIK

- Modernization of engineering infrastructure of the reactor complex PIK (commissioning in 2018)
- Reconstruction of laboratory complex PIK (commissioning in 2019)
- Instrumentation program of the reactor complex PIK (commissioning in 2020)
A unique combination of technologies is used:
• catalytical isotopic exchange;
• electrolysis;
• Hydrogen cryogenic distillation

TRF provides:

• Tritium removal - 30 000 Ci/year
• Protium elimination (40kg/year H_2O)

Modernization of Engineering and Technical Systems

Tritium removal facility (TRF)

A facility for tritium removal and heavy water upgrading is being constructed for the first time in Russia.

D_2O from heavy water reflector for purification

Water return in reflector

Separated products treatment

D_2O conditioning

• D_2O sorting
• Storage
• Degassing
• Salts removal
• Organics removal

• Storing of separated products
• D_2O return to the reflector

• Tritium chemosorption
• Pure D_2O and D_2 withdrawal

D_2O sorting
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Fuel burnup modeling at energy start-up (MCNP, MONTEBURNS, ORIGEN)

Reconstruction of the Laboratory Complex PIK

Buildings of the Laboratory Complex

Offices and Data Center
Bldg.105
Reconstruction of the Laboratory Complex PIK

Computer Information System Tier-0 of the reactor PIK (analog to CERN Data Centre)

- Creating computing power with a speed of about 100 teraflops for data processing and data storage.
- Creating a data collection system connected to the neutron experimental stations and if necessary convert them to an unified data storage format.
- Creation and development of the information infrastructure to provide a mechanism of interaction between participants of the research process.
Cold Neutron Source for Channel HEC-3 of the reactor PIK

UCN source - parameters
Liquid deuterium - 25 L, T = -250°C
The distance from the active zone of the reactor - 60 cm
The flux density of cold neutrons - $6 \times 10^{10} \text{ n cm}^{-2}\text{s}^{-1}$, which is 3-5 times higher than the same values of the CNS at high-flux reactors HFR at the ILL and OPAL at ANSTO.

Experience of PNPI NRC KI
Installation of CNS produced for reactor OPAL - Australia

Cold neutron source just before setting to the reactor

Reconstruction of the Laboratory Complex PIK

Project of CNS Channel HEC-3 of reactor PIK

(1) The reactor vessel
(2) Heavy water reflector tank
(3) Support tube for CNS
(4) Protection
(5) Steel cladding of light water pool
(6) Biological protection of the reactor
(7) Channel HEC-3
(8) Vacuum container
(9) Thermosiphon

Cold Neutron Source for Channel HEC-3 of the reactor PIK
Reconstruction of the Laboratory Complex PIK

Front view of the neutron guide system of the reactor PIK

Neutron guides of the first stage at HEC-3

Neutron guides of the second stage at HEC-2
INTERNATIONAL CENTER
FOR NEUTRON RESEARCH
The project aiming to equip RC PIK with the modern experimental stations for the multidisciplinary research will be started and completed within the period between 2015 and 2020.

The Government of the Russian Federation has approved the idea to organize the International Center for Neutron Research based on the reactor complex PIK.
INTERNATIONAL COOPERATION

7 neutron stations (with the total cost of 30 mln. euro) were transferred from the Helmholtz Center Geesthacht (Germany) to the Petersburg Nuclear Physics Institute of NRC "Kurchatov Institute".

Placing of small-angle scattering spectrometer at the neutron guide hall of the reactor PIK.
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Ultra Cold Neutron Source on HEC-2

Schematic view of the idea of the helium ultra cold neutron source on thermal neutron source

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Placement option for ultra cold neutron source on extracted channel of thermal neutrons of the reactor PIK
Education: The chair of Neutron and Synchrotron Physics was founded at St. Petersburg State University.

Plans: Construction of the synchrotron facility in Gatchina at about 1 km away from the reactor PIK.
Students of the chair of Neutron and Synchrotron Physics at the reactor PIK, Gatchina, February 2013
The first magisters have graduated the Chair of Neutron and Synchrotron Physics.
10.06.2014
Gatchina International Center for Neutron Research

Administrative Structure (Proposal)

- Board of Directors
- Advisory Committee
- User Center
- Instrumentation Board
- Scientific Council
- Scientific Committees for Realization of User Policy
The cooperation includes
• development of modern
  systems neutron
  polarization and neutron
  polarization analysis;
• development and
  production of modern
  experimentation stations;
• development and
  production of modern
  neutron detectors.

The parties intend to create
Advisory Committee and
scientific subcommittees to
discuss in greater detail the
scientific program to be
developed for the PIK reactor
to establish a world-class suite.
During the joint PNPI-ILL meeting at 15-th June 2013 both parties agrees to extend the technical transfer collaboration and to organize the regular expertise of research and instrumentation program.
Project of Social Infrastructure for Gatchina ICNR
Welcome to Gatchina!