NUCLEAR RESEARCH INSTALLATIONS AT RFNC – VNIITF: THE CURRENT STATE AND PROSPECTS FOR THEIR USE

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The paper is devoted to the description of operating compact nuclear research installations at RFNC – VNIITF, designed for solving radiation hardness problems and conducting precision nuclear physics experiments. A brief over 60-years history of designing and development of these installations is covered [1–4]. Physical operation principles are described and main parameters of pulsed reactor radiation fields are given [5–9]. Integral criticality experiment procedures on FKBN-type critical assembly machines are reviewed, and the achievable accuracy factors are summarized [10]. The capabilities of RFNC – VNIITF installations are compared with those of other research centers [11]. A number of unique experiments, conducted using the installations, addressing nuclear-pumped lasers, the issue of charge symmetry in nuclear force, etc. is considered [12–14]. Insight is provided into further development and employment of the installations in long-term tasks to develop research reactors on ejected beams and advance nuclear fuel cycle [15, 16], as well as application of robotics, digital twins and artificial intelligence technologies to nuclear research installations [17].

References

1. **Andreev, S. A.** On the 60th anniversary of the first aperiodic pulse reactor in Russia [Text] / S. A. Andreev, A. V. Lukin, Yu. A. Sokolov, A. A. Kuzinskaya // At Energy. – 2024. – Vol. 136. – P. 13–19. – DOI: 10.1007/s10512-024-01123-6.
2. **Andreev, V. V.** The history of creation and development of pulsed nuclear reactors of ELIR, IGRIK, YAGUAR type [Text] / V. V. Andreev et al. // Problems of Atomic Science and Technology. Ser. “Nuclear Reactor Physics”. – 2014. – No. 3. – P. 11–17 (in Russian).
3. **Andreev, S. A.** The history of creation and development of pulsed nuclear reactors of BARS type [Text] / S. A. Andreev et al. // Problems of Atomic Science and Technology. Ser. “Nuclear Reactor Physics”. – 2014. – No. 3. – P. 3–10 (in Russian).
4. **Andreev, S. A.** The history of creation and development pulsed nuclear reactors of EBR type [Text] / S. A. Andreev, A. V. Lukin, Yu. A. Sokolov // Problems of Atomic Science and Technology. Ser. “Nuclear Reactor Physics”. – 2014. – No. 3. – P. 18–23 (in Russian).
5. **Manakov, A. A.** Results of Research of YAGUAR Reactor Characteristics after Modernization [Text] / A. A. Manakov et al. // Physics of Atomic Nuclei. – 2021. – No. 84. – Iss. 8. – P. 1419–1423.
6. **Manakov, A. A.** Results of the Physical Startup of the IGRIK-2 Research Reactor Facility in the Stationary Mode [Text] / A. A. Manakov et al. // Physics of Atomic Nuclei. – 2021. – No. 84. – Iss. 8. – P. 1413–1418.
7. **Andreev, S. A.** Assembly of the core of the IGRIK-2 solution pulse reactor [Text] / S. A. Andreev et al. // At Energy. – 2023. – Vol. 134. – P. 283–289. – DOI: 10.1007/s10512-024-01056-0.
8. **Snopkov, A. A.** Comparative possibilities of multi-core reactors BARS-5, TIRAN with one-core reactor type BARS [Text] / A. A. Snopkov et al. // Problems of Atomic Science and Technology. Ser. “Nuclear Reactor Physics”. – 2018. – No. 4. – P. 108–115 (in Russian).
9. **Evert, M. Yu.** Reconstruction of control and protection system for pulsed reactor BARS-5M [Text] / M. Yu. Evert et al. // Problems of Atomic Science and Technology. Ser. “Nuclear Reactor Physics”. – 2019. – No. 4. – P. 120–125 (in Russian).
10. **Sokolov Yu. A.** Development of critical-mass measurement techniques at RFNC – VNIITF. Physics of Atomic Nuclei. – 2021. – Vol. 84, No. 8. – C. 1380–1388.
11. **Kolesov, V. F.** Aperiodic pulse reactors [Text]: Monograph in two volumes. Vol. 1. – Sarov : RFNC – VNIIEF, 2006.
12. **Zagidulin, A. V.** 500 J nuclear pumped laser [Text] / A. V. Zagidulin, et al. // JETP Letters. – 2012. – Vol. 38, No 23. – P. 31–39 (in Russian).
13. **Mitchell, G. E.** Direct nn-Scattering Measurement with the Pulsed Reactor YAGUAR [Text] / G. E. Mitchell et al. // J. Res. Natl. Inst. Stand. Technol. – 2005. – Vol. 110. – P. 225–230.

14. **Kandiev, Ya. Z.** Justification of the experimental technique to measure neutron-neutron scattering cross-section on the YAGUAR reactor [Text] / Ya. Z. Kandiev et al.// Journal Chelyabinsk Scientific Center Bulletin. – 2007. – No 4 (38). – P. 19–25 (in Russian).
15. **Khmelnitsky, D. V.** Justification of the experimental setup to study the dynamic bending of a fuel rod in the NEPTUN pulsed reactor [Text] / D. V. Khmelnitsky et al. // Accepted for publication in Problems of Atomic Science and Technology. Ser. "Nuclear Reactor Physics". – 2024. – No. 3 (in Russian).
16. **Andreev, S. A.** Experimental setup on FKBN-2 critical assembly machine for validation of RMSR computational methods [Text] / S. A. Andreev et al. // Accepted for publication in Problems of Atomic Science and Technology. Ser. "Nuclear Reactor Physics". – 2024. – No. 3 (in Russian).
17. **Andreev, S. A.** Prospects for application of robotics and digitalization in integral critical experiments at compact assembly machines [Text] / S. A. Andreev, S. Y. Kasyanov // At Energy. – 2023. – Vol. 135. – P. 27–33. DOI: 10.1007/s10512-024-01077-9.