

Research reactor MARIA

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Currently, access to methods using neutrons is very limited in the world. Lately, the nuclear reactor, OSIRIS in Saclay was closed (2015) and BER II in Helmholtz-Zentrum Berlin is under closure (2019) – this results in closing down the activities of associated neutron laboratories. The MARIA reactor is continuously modernized. Lately conversion of the fuel elements from medium to low enriched has been done. Moreover, primary cooling system has been enhanced, new emergency cooling system installed and emergency power supply voltage converters replaced. Operation desk is also under renovation now and all connectors exchange is under conceptual preparation for 2020. The future plans are: beryllium blocks replacement (2019/2020) and cooling towers renovations. Current license of the MARIA reactor is valid to 2025 and another improvements enable to plan research until at least 2035 (hopefully until 2050). Furthermore, NCBJ works are being conducted on renovation of the measurement and research facilities for all eight horizontal channels and separation of the reactor hall from the experimental hall for the security and radiological safety reasons.

Scientific interest of reactor laboratory can be divided into two sections: horizontal (outside the core) and vertical (in-core) experiments. Epithermal neutron beam with the flux of $2 \cdot 10^9$ n/cm²/s is under certification by the authorities. The scientific program “Neutrony H2” is a large multi institutional project of international significance (institutions from over a dozen countries) in the field of biomedical and material research. One of the interests is boron neutron therapy (BNCT). Exposure of the biological material (or small and large animals) was dictated by the renaissance of this method in the world due to the development of demonstrators of therapeutic neutron generators at medical universities in Japan with the participation of Sumitomo and Mitsubishi (2015). Moreover, the refurbishment of the reactor experimental hall is due to the world-class research instruments worth 12 million \$ transfer from HZB to MARIA reactor (four modern built between 2000 and 2016 spectrometers and diffractometers). One of the spectrometers has already been transferred to the NCBJ, all other 3 will be delivered in 2020 after final shut down of the reactor in Berlin.

The second group of research is based on high fluxes densities inside the MARIA reactor core (up to $4 \cdot 10^{14}$ cm²/s of thermal neutrons). This ensure research on radiopharmaceuticals production: holmium (2016), itrium (2015), molybdenium (2017), nuclear construction testing (fuel elements, beryllium blocks poisoning, material modification). Furthermore, a new irradiation position has been installed: channel for 14MeV neutrons (2016), high fluxes of fast neutrons inside fuel elements MR-2 (2019) and high gamma flux (large cubature).

Additionally as a step reactor MARIA become MTR (Material Testing Reactor) first experiments of metal testing in special capsules positioned in the beryllium block was carried out (2018) and rough schedule of material testing program is prepared for high temperature modules for DONES (2019). Basic research for HTGR and preparation position for irradiation of JMTR capsules (new Japan Materials Testing Reactor after Fukushima decided not to be operated) is now under preparation and starting those projects is planned for 2020.