Wissenschaftlicher Ergebnisbericht / Scientific Report 2003

Schwerpunkt / main research area	Materie / Matter
FE-Vorhaben / RD project	**M05 Betrieb und Weiterentwicklung der Neutronenquelle FRJ-2**
Institutsbeitrag / institute's contribution	50105 Zentralabteilung Forschungsreaktoren / Central Research Reactors Division (ZFR)
Verantwortlich / in charge	Dr. Gunter Damm G.Damm@fz-juelich.de
HGF-Forschungsbereich / Research Field	*Structure of Matter*
HGF-Programm / Programme	***Large Scale Facilities for Research with Photons, Neutrons and Ions***
HGF-Thema / Topic	*Neutrons*
Internet	www.fz-juelich.de/scientific-report

Detailergebnisse / Details

Operation and further development of the FRJ-2 neutron source

Operation of the reactor and its experimental devices (cold source, irradiation rigs)

In 2003 the FRJ-2 was operated for a total of 10 periods. An availability of approx. 95 % relative to the planned operating time was achieved. This enabled an intensive use of the 16 neutron scattering experiments connected and of the irradiation rigs. It should be specifically mentioned that the FRJ-2 is one of a total of four research reactors in Europe in which molybdenum-99 is produced as a precursor product for the radiopharmaceutical technetium-99 meanwhile indispensable in medical diagnosis. In 2003, after installing and commissioning the third irradiation insert in the FRJ-2, it was possible for the first time to irradiate uranium targets for the industrial production of molybdenum-99 in three irradiation inserts.

The further development of the MCNP Monte Carlo computer program, which simulates in detail the nuclear-physical conditions in the FRJ-2 reactor core, meanwhile enables measurement campaigns to be replaced by calculated predictions to demonstrate the reactor's reliable shutdown capability. The verification of the corresponding three-dimensional calculations has meanwhile also been recognized by the licensing authority. Moreover, after further development work, the MCNP program can now also calculate the way in which a suitable loading of the reactor core with fuel elements should be carried out in order to be able to expose specific irradiation positions, as required, to elevated neutron flux density.

Upgrading measures

The research reactor was further upgraded in various respects in 2003 and adapted to the state of the art. This included, above all, the further renewal of the instrumentation and control of the cold neutron source, the replacement of part of the radiation protection instrumentation and the installation of digital components in the instrumentation of the reactor protection system.

Conversion of the reactor core from HEU to LEU

The development of a new fuel element type for low-enriched uranium (LEU) was completed by converting the complete reactor core to a new fuel element design, although still with high-enriched uranium (HEU). Moreover, all post-examinations of LEU fuel elements irradiated for test purposes were positively rated by the technical expert. This created the prerequisite to formally filing the application for the conversion of the FRJ-2 reactor core to low-enriched uranium in January 2003. In the course of 2003, all the calculations, accident analyses and investigations necessary for drawing up a detailed safety report were carried out by the Central Research Reactors Division of Research Centre Jülich. The MCNP simulation program proved to be an excellent instrument for calculating the reactor-physical data of the future LEU reactor core as a basis for the necessary operational and accident analyses. The safety report for the conversion to LEU and all the necessary technical reports were submitted to the licencing authority. Licensing for the conversion of the FRJ-2 to operation with low-enriched uranium is expected in the first half of 2004.