### Experimental Programs on the BFS Facility Aimed for Validation of Criticality Safety for Plutonium Utilization

The BFS critical facility was originally designed to investigate neutron-physics characteristics of sodium-cooled fast reactors. However, because of the plutonium utilization problem, the facility is now being used to investigate criticality safety issues for nonreactor applications. The first experiments under this program were performed in 1999–2000 at the BFS-79, -81 assemblies. Critical conditions simulating near autocatalytic chain reactions in an underground fissile material repository were measured. Various levels of water ingress into a fissile material- silicon dioxide medium were modeled. In 2003, a second series of experiments was performed at the...
BFS-93 assemblies in which the reactivity effects and power distributions were measured for water-moderated VVER-type fuel assemblies with replacement of standard fuel rods with vibrocompacted MOX-fuel. The third series of experiments was performed in 2004–2005 at the BFS-97, -99, and -101 assemblies. Critical parameters of systems with MOX-fuel and low hydrogen-to-fuel ratios that occur during fuel manufacture were modeled.

In Russia, a new plant has been designed for the pyrochemical technology of manufacturing of vibrocompacted MOX-fuel for the BN-800 reactor. Several additional critical experiments at the BFS facility are planned.

Results of Russian and U.S. critical experiments with plutonium and low H/Pu ratios revealed some contradictions. The report will show unexpected differences between the experimental data and the calculational results. These discrepancies do not allow the uncertainty of criticality estimations for these systems to be reduced below 1%. Additional experiments are planned to resolve the discrepancies. In the pyrochemical technology plant project, damp MOX powder occurs when washing residual salts from the granulated fuel. To validate criticality calculations for transportation and storage of fresh fuel assemblies of the BN-800 reactor with MOX-fuel (~25% of plutonium in the highly enriched zone), experiments will be performed with the 80-cm-height vibrocompacted MOX-fuel rods (~400 rods). Low water content will be modeled by placement of a thin polyethylene displacer into the gaps between the fuel rods. High water content will be modeled by filling tanks containing MOX fuel rods with water while using the BFS core as a driver. To validate criticality calculations of the melt of salts with MOX fuel, reactivity measurements will be taken with CsCl, NaCl, and Na in the assemblies modeling the electrolyzer and critical characteristics of assemblies containing the CsCl salt will be investigated.