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PROSPECTS FOR USING HEAT-RESISTANT EK-181 STEEL IN FUEL ASSEMBLIES WITH MIXED NITRIDE URANIUM-PLUTONIUM (MNUP) FUEL

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Amid the global transition to low-carbon energy and growing demand for safer nuclear technologies, fast neutron reactor developments have become critically significant. Fuel assemblies utilizing mixed nitride uranium-plutonium (MNUP) fuel are recognized as one of the most promising solutions to enable a closed nuclear fuel cycle (NFC), enhance fuel burnup efficiency and minimize long-lived waste.

The most critical components of such fuel assemblies are structural materials to withstand extreme operating conditions: high temperatures, intense neutron irradiation, and corrosive environments. A detailed analysis of EK-181 (16Kh12V2FTR) low-activation, heat- and radiation-resistant steel developed by A.A. Bochvar VNIINM (JSC) was made as part of this study. This material demonstrates exceptional performance characteristics for fast reactor core applications.

The EK-181 steel offers four fundamental advantages:

1. Significantly lower induced radioactivity compared to conventional materials
2. Rapid activity decay post-irradiation
3. High resistance to radiation embrittlement at operational temperatures (270-400°C)
4. Retained heat-resistant properties up to 650°C.

These characteristics establish EK-181 as an ideal candidate for manufacturing fuel rod claddings, spacer grids and other core internal components in advanced fuel assemblies.

The implementation of EK-181 steel in MNUP fuel assembly designs for fast neutron reactors (such as Russia's actively developed BN-1200) will significantly enhance the safety, reliability, and economic efficiency of next-generation nuclear power systems. The report will provide a comprehensive examination of research findings and industrial application prospects for the advanced material in Generation IV nuclear energy.