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## Application of the 3D Coupled Code ATHLET- QUABOX/CUBBOX for RBMK-1000 Transients after Graphite Blocks' Modernization

*Aleksei Samokhin<sup>1</sup>, Matias Zilly<sup>2</sup>*

<sup>1</sup>Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS) / Malaya Krasnoselskayast/ 2/8, bld. 5, 107140 Moscow, Russian Federation

<sup>2</sup> Gesellschaft für Anlagen- und Reaktorsicherheit (GRS), Forschungszentrum, Boltzmannstraße 14, 85748 Garching bei München, Germany

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### Abstract

The work describes the application and the results of transient calculations for RBMK-1000 with the coupled code system ATHLET 2.2A-QUABOX/CUBBOX which was developed in GRS. Within these studies is taken into account the planned modernization of the graphite blocks of the RBMK-1000 reactor.

During the long time operation of the uranium-graphite reactors RBMK-1000, a change of physical and mechanical properties of the reactor graphite blocks is observed due to the impact of radiation and temperature effects. These have led to a deformation of the reactor graphite columns and, as a result, a deformation of the control and protection system (CPS) and fuel channels. Potentially, this deformation can lead to problems connected with the smooth movement of the control rods in the CPS channels and problems during the loading and unloading of the fuel assemblies.

Measures were taken on the first generation RBMK-1000 reactors (units №1 and 2 of Leningrad NPP and unit №2 of Kursk NPP) to decrease the deformation by cutting and removing parts of the graphite blocks which have led to a decrease of the mechanical impact on the fuel and CPS channels. The removal of a large amount of the moderator (graphite) results in a change of the core fuel/moderator ratio and hence the core neutron-physical and thermohydraulic properties.

The paper analyzes two reactivity insertion transients, each taking into account three graphite removal scenarios. Also the vapor reactivity coefficient for the same scenarios was estimated.

The presented work is directly connected with the modernization program of the RBMK-1000 reactors and has an important contribution to the assessment of the safety-relevant parameters after the modification of the core graphite blocks.