SOFTWARE CONVERSION OF DATA FOR
FULL-SCALE RBMK CALCULATION WITH MCU

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Software that converts data for precision calculations of an actual state of the RBMK-1000 reactor taking account the configuration, thermohydraulic characteristics, fuel burnup and position of the control rods in the initial data for the MCU software complex is described. The C++ language is used. In the software, the typical elements of the RMBK-1000 (prototypes) core structure are described in the input language of the geometric module of the MCU package (NCGSIM). Together with the files containing libraries of the isotopic composition of the fuel, they make it possible to describe the reactor core in working, heated and cooled states in the language of the initial data for the MCU package.

Up to now, the rapid development of computer technology has made it possible to perform full-scale calculations of reactors, including RBMK-1000, with the help of not only engineering but also high-precision computer programs. The MCU complex package based on the Monte Carlo method with a universal description of the core geometry, arbitrary level of accuracy and an evaluated nuclear data library, which makes it possible to take account of the fuel burnup, the position of the rods of the control-and-protection system (CPS) and the thermohydraulic parameters, is used for high-precision calculations of an actual state of different types of reactors [1]. A description of an actual state of the RBMK reactor requires 4–150 Mb of information depending on the accuracy of the model. The initial data describing the state of the reactor core serve as the source of a portion of this information: load composition, fuel burnup, position of the rods of the control-and-protection systems, temperature of the fuel, coolant and moderator and others. Some of these data are transferred from the reactor control system; the geometric characteristics and the composition of the elements of the core design are represented, as a rule, in the form of blueprints with the standard specification. The fuel characteristics, which vary during the operation of the reactor (material composition), are formed on the basis of data on the three-dimensional distribution of the burnup and preliminary calculations performed using the MCU code with modeling of the variation of the nuclide composition in the burnup regime. The program KDMK, characterized by relative universality, was developed to convert this information into the input data in the language used in MCU package. It uses specialized libraries, which are required in order to describe the structural elements of the RBMK core. The internal data structure of the libraries is fixed. The data are stored as text files with a prescribed format and data can be added without changing the program. The program is written in C++ using a hereditary tree of classes, which makes it possible to control the data conversion process. This is important when working with diverse data, and it makes the problem of modifying the program so as to meet user needs easier to solve.

The KDMK program is related with a definite class of reactor plants, in this case RBMK. It converts the description of the initial data on the state of the reactor expressed in engineering language into the specialized language of MCU [2].

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The program uses input information in a special format, supplements this data with information from internal specialized libraries and forms the final file in the input-data format for MCU. The main tasks of KDMK are to minimize the time required to prepare the initial data and decrease the number of errors in them. Programs of this type are often called code generators. They can perform the functions of converters, i.e., convert the data created by one program package into the form of input data for different package.

The reduction and simplification of the representation of the input information are possible because only a small part of the complete set of data describing a real reactor plant can change, and only within known limits. This makes it possible to create a specialized input language in which a significant part of the information becomes implicit. The information resides in internal libraries, which are a part of KLMK, and not in the input data. In our case, a large part of the implied information is a description of the structures (geometry) of the assembly channels, their arrangement in the core, the isotopic composition of the fuel and the structural materials.

The remaining (smaller) part of the information can be input in a more convenient form, for example, using an interactive graphics interface. Aside from reducing the volume, such a specialized code generator makes possible a more deeply semantic check of the data.

In KDMK part of the input data consists of control parameters, part comes from the reactor control system in a form that is standard for computational support of operation, and the remainder comes from calculations performed using engineering codes.

**Computational Model of RBMK.** The RBMK model which is constructed to perform calculations with the MCU code represents a region consisting of the core and the side, bottom and top end reflectors [3]. In the plan, it is divided into square columns with side 25 cm, height 800 cm, of which 700 cm is the core, and the top and bottom end reflectors each 50 cm. The core consists of 1884 columns, surrounded by three rows of 448 graphite columns of the uncooled side reflector, including the channels of a fission chamber, and an outer row consisting of 156 columns of a cooled side reflector. The corners of the computational region are filled with vacuum columns. Thus, the computed region consists of 56 × 56 columns. One fragment of the model of the system in the plan is presented in Fig. 1. The graphite columns of the core have vertical openings for the assembly channels, made of a zirconium-niobium alloy, which are surrounded by graphite bushings. Fuel assemblies or rods of additional absorbers are located in the assembly channels. A fuel assembly consists of two parts – top and bottom. Each part contains a carrying rod and 18 fuel elements with spacing lattices. The fuel elements are filled with uranium dioxide fuel pellets and are arranged in two rows. Six fuel elements are located in the inner row and 12 in the outer