DEFINITION OF THERMOPHYSICAL PARAMETERS OF THE IVG.1M REACTOR CORE WITH LEU FUEL

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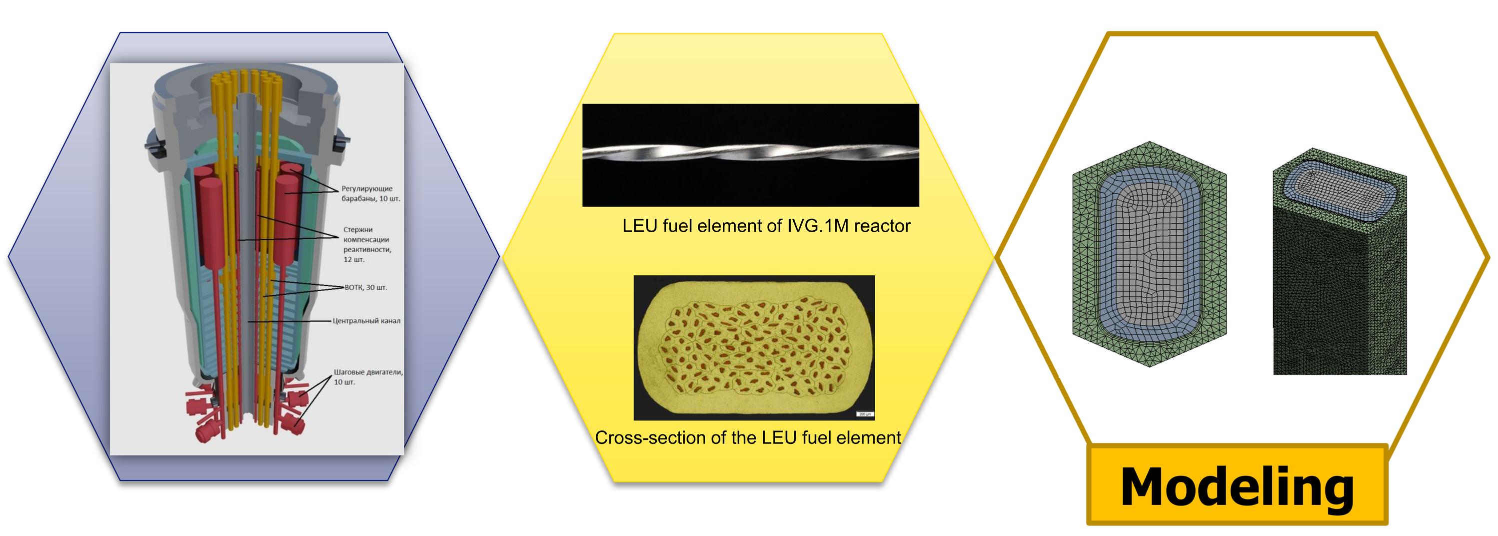
INTRODUCTION

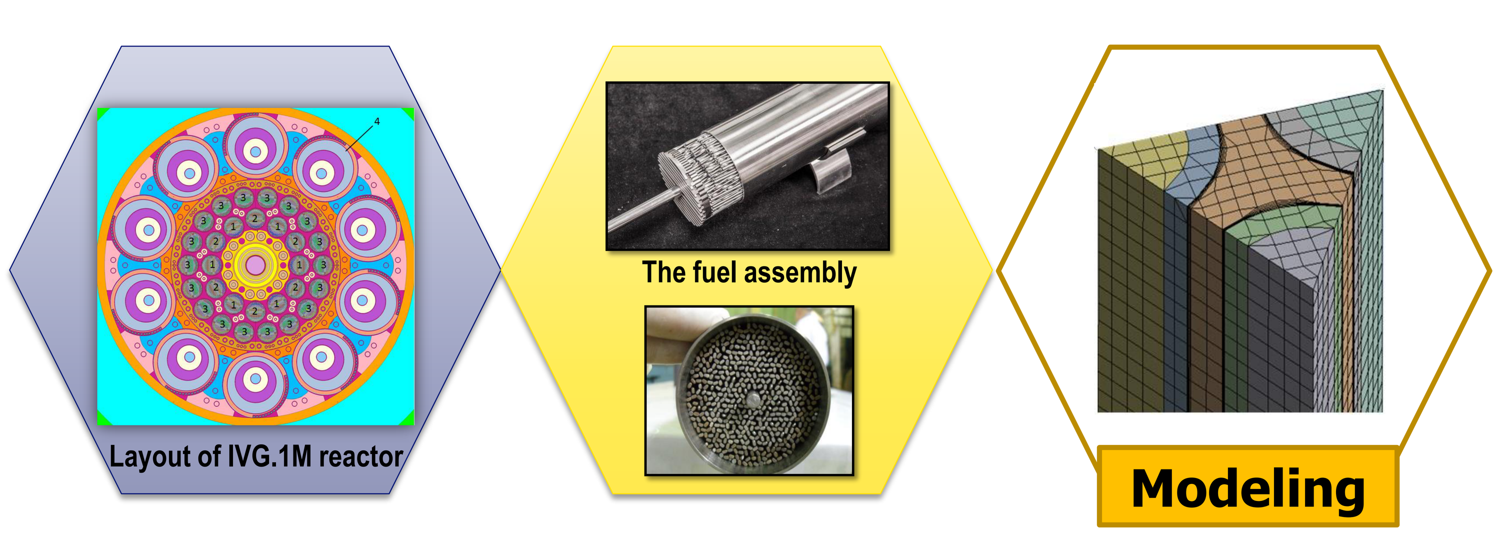
During the periods from 27.10.22 to 01.02.23, the energy start-up of the research water-water reactor IVG.1M was carried out within the framework of conversion to the low-enriched uranium fuel.
The IVG.1M RR start-up was carried out in a series of nine separate starts up of the reactor with the output to the operating power levels.
In this work, the research was aimed at studying the thermophysical effects caused by the conversion of the IVG.1M reactor to low-enriched uranium fuel [1], determining the thermophysical operating conditions of the conversed core.
During the research, the following tasks were solved: checking the thermal engineering and neutronic parameters of the core at operating power levels; determination of the energy release distribution in the reactor and WCTC based on the results of measurements of thermal parameters; clarification of the calibration of channels for measuring the reactor power; determination of temperature and power effects of reactor reactivity.

OBJETIVE: IVG.1M research reactor (Kurchatov, Kazakhstan), fuel rod, Water-cooled technological channel, energy release

MATERIALS AND METHODS



1. Thermophysical calculations
The temperature distribution of water and structural materials WCTC-LEU was carried out by computer simulation using the ANSYS [2,3] Fluent software package. To carry out the calculation, a three-dimensional model was constructed that simulates a symmetrical section of a fuel assembly with one fuel element and a coolant
During the calculation, a symmetry condition is imposed on the side faces of the model. When specifying the conditions for the flow of the coolant, the boundary conditions of the flow velocity at the inlet (velocity inlet) and the flow outlet (outflow) were used. The pressure in the cooling path was taken to be 1 MPa.



2. The Calculation of the distribution of energy release from experimental data
Based on the calculated values of the thermal power of WCTC-LEU, the relative energy release in the channels that complete the core of the IVG.1M reactor was determined. The relative energy release was obtained by normalizing the power value of each WCTC-LEU to the arithmetic mean value of the power of WCTC-LEU located in the third row of the core (for a given mode).

RESULTS

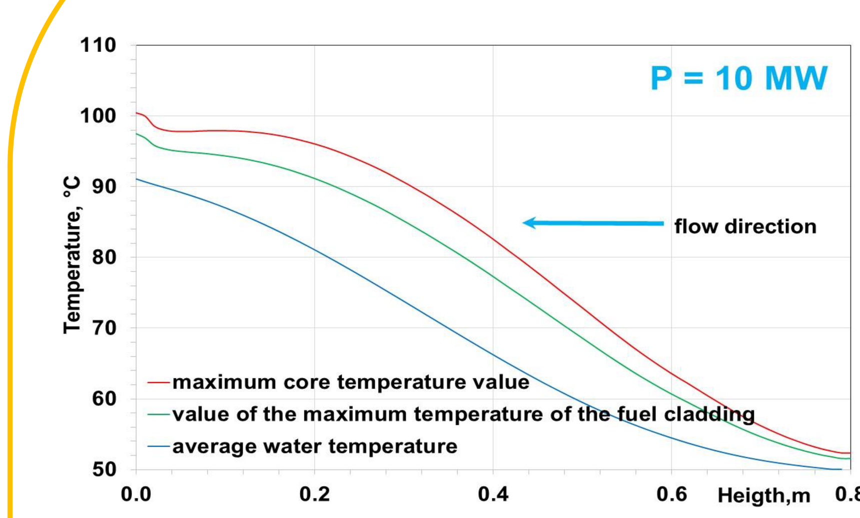


Figure 1. Estimated temperature distribution

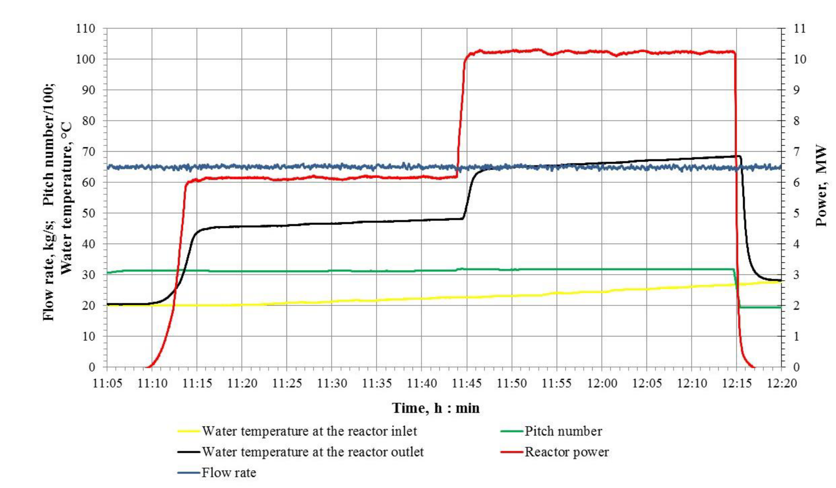


Figure 2. Diagram of Energy Start-Up (22.11.2022)

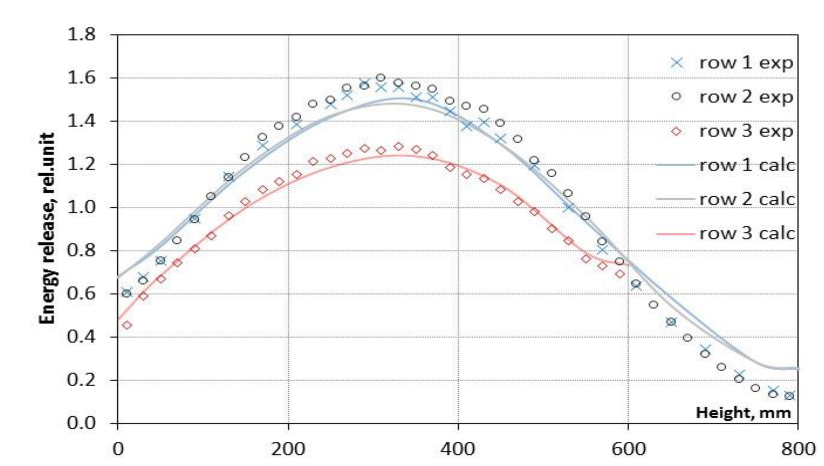


Figure 3. Results of power distribution in the IVG.1M

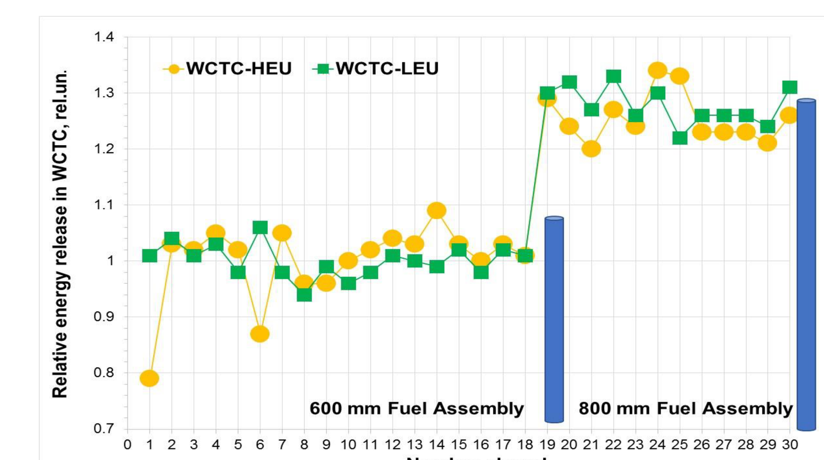


Figure 4. Total Distribution of energy release (WCTC) in the reactor core on Energy Start-Up

Main parameters of the IVG.1M reactor

Parameters	Value HEU	Value LEU
Uranium-235 loading, g	4600	5670
System Efficiency CD Reactor, $\beta_{эф}$	11.2	11.3 ± 0,3
Efficiency RCR, $\beta_{эф}$	3.5	4.8 ± 0,1
Reactivity margin of reactor, $\beta_{эф}$	8.3	6.0 ± 0,2
The position of the CD system in a critical state, step (degree)	3050±20 step (91.5^0)	2880±20 step (79^0)
Relative energy release by rows of the reactor: 1 row 2 row 3 row	 1.26 1.21 1.00	 1.18 1.16 1.00
Altitude coefficient of uneven energy release: WCTC 1,2 rows WCTC 3 row	 1.58 1.27	 1.55 1.275

CONCLUSIONS

The relevance of these research is associated with international agreements supported by the IAEA on the conversion of research reactors to low-enriched uranium (LEU) fuel. The National Nuclear Center of the Republic of Kazakhstan completed a project to convert the research reactor IVG.1M from 90% to 19.75% enrichment in U-235.

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