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Digital technologies for the development of PDEC and IEC projects and digital twins

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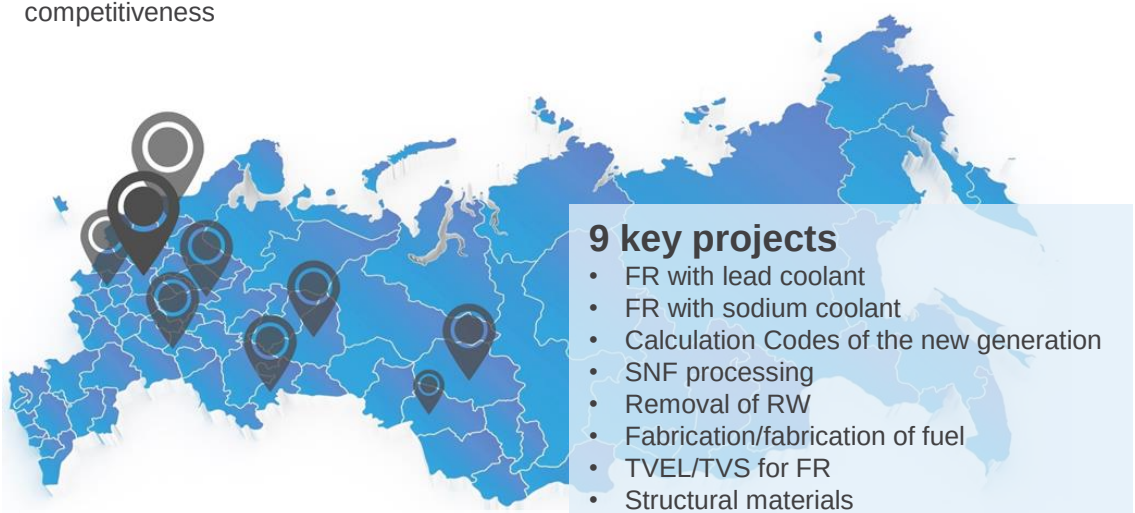
Preconditions for the appearance of a digital twins in the Proryv project

Goal

A closed nuclear fuel cycle that meets the principles of natural safety and the criterion of competitiveness



9 key projects

- FR with lead coolant
- FR with sodium coolant
- Calculation Codes of the new generation
- SNF processing
- Removal of RW
- Fabrication/fabrication of fuel
- TVEL/TVS for FR
- Structural materials
- Integrating projects

40+ organizations
1500+ specialists
Industry institutes
Universities
Institutes of the Russian Academy of Sciences
The largest enterprises of the Rosatom State Corporation

Challenges

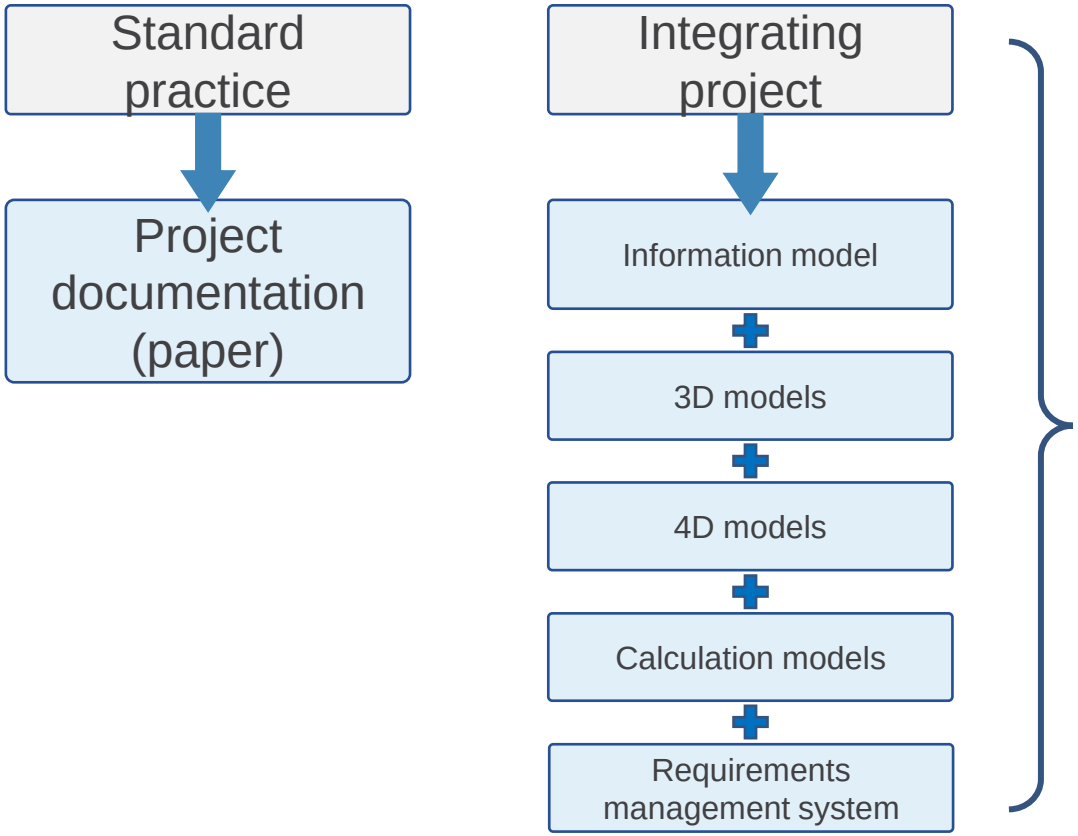
Heterogeneous information, calculation and modeling tools and approaches to their use that require integration

Significant uncertainty with the way to achieve the final results, a large amount of R&D performed, the results of which constantly cause changes in the projects of objects

Solution

Digital twins of the Proryv project objects have been developed and successfully applied, allowing to consolidate the development of projects in various representations and to optimize them

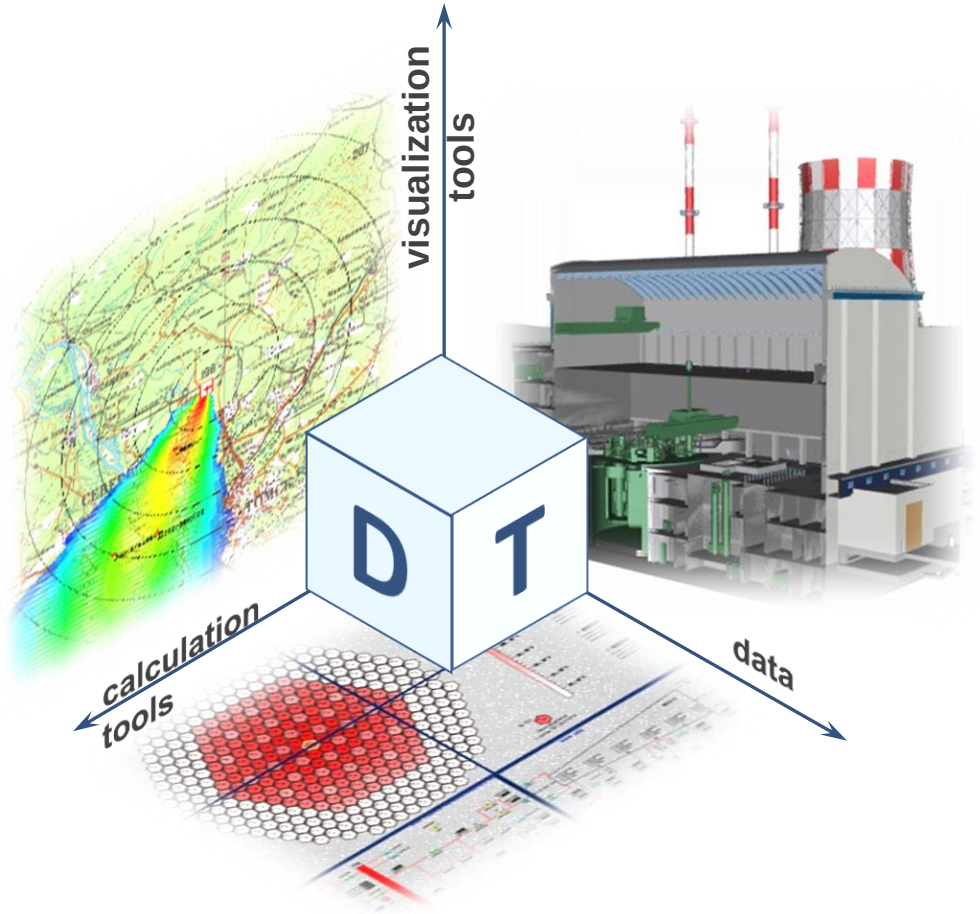
Digital technologies and the definition of digital twin in Proryv project



A digital twin (DT) is an object built in virtual space, with a set of databases, models, 3D visualization tools, software products, data obtained in online mode, allowing you to simulate the operation and maintenance of an object both under normal operating conditions and in case of deviation from them, including design and out-of-design accidents. DT is used to optimize design, engineering, technological solutions, the creation of simulators, maintenance of operation and decommissioning

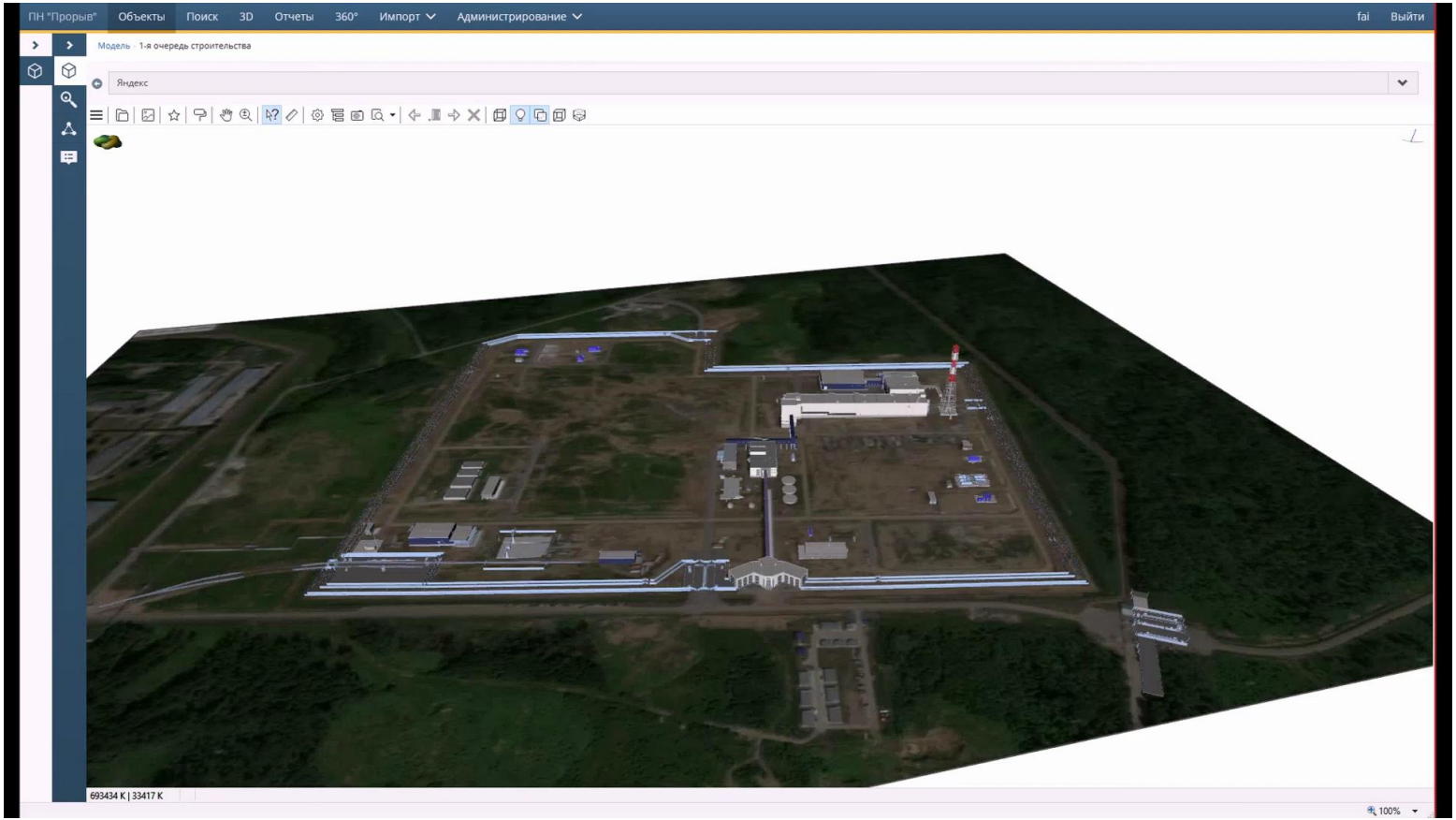
Digital twins in the Proryv project are formed as a result of the development and updating of the integrating project

Key differences between the digital twin and the model

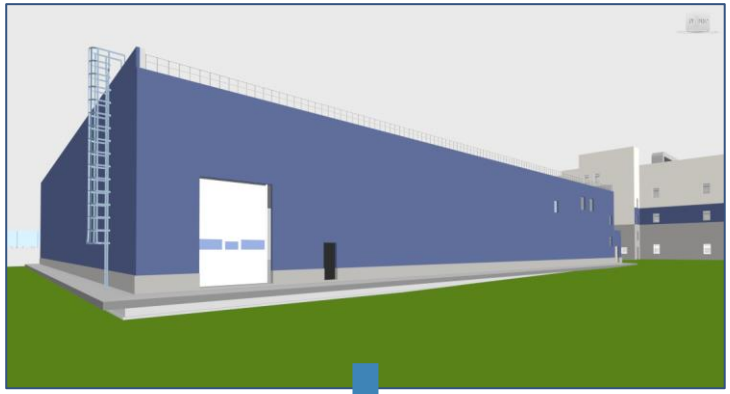


- Multidisciplinary views
- Coverage of the entire LC of the twin object
- Orientation to the applied result
- Accounting and analysis of requirements
- Integration with a twin object

Various representations of the digital twin



Development and creation of objects using digital twins



Model

DT has already been successfully used at Rosatom in the development and creation of innovative facilities (a plant for the manufacture of nitride uranium-plutonium fuel (MFR) and a power unit with the BREST-OD-300 fast reactor within the framework of the Proryv project).
DT provides data consolidation, timely detection and elimination of spatiotemporal and technological collisions in the design and construction of facilities

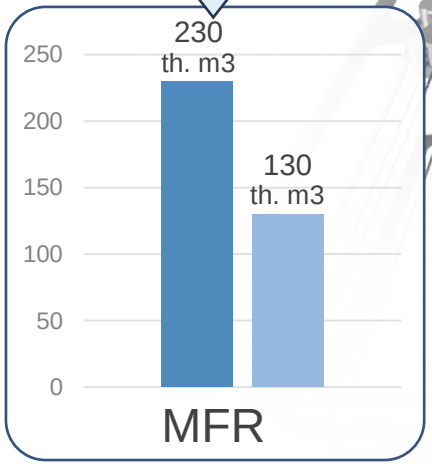
Built object

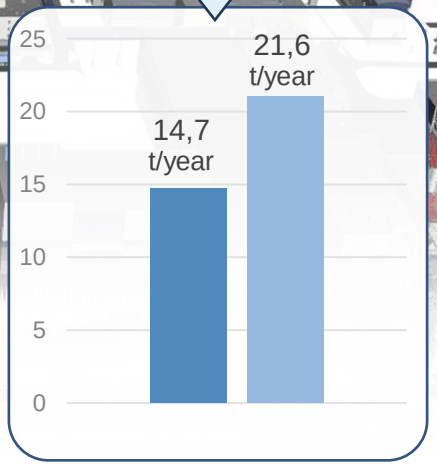
Effects obtained with the use of digital twins in the Proryv project

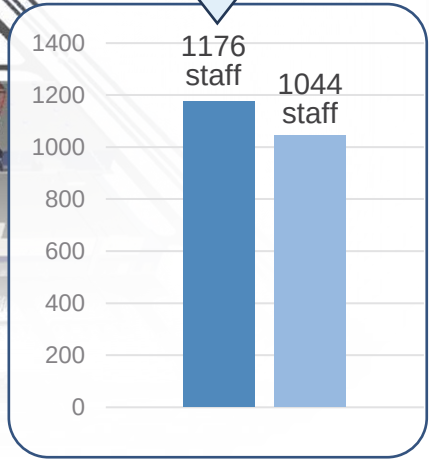
Reduction of construction volumes of PDEC facilities. The projects have passed the national regulators, the construction of the MFR is under completion, the construction of the FR has begun in 2021

Increased the possible productivity of MFR from **14.7** to **21.6** tons/year

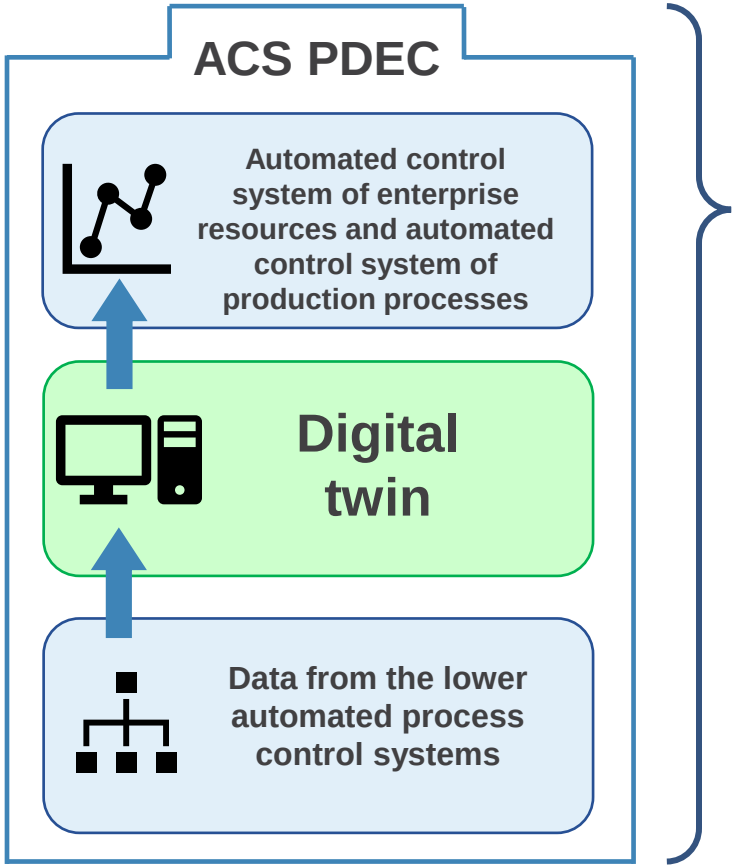
Optimization of the number of personnel agreed with the operating organization by **11.2%**







Digital twin as part of the automated control system PDEC



Risk assessment, planning, quality management, personnel support, efficiency analysis

The key feature of the PDEC automated control system: the composition of the PDEC automated control system should include most of the models used in digital twins

Transition from demonstration complex to industrial energy complex

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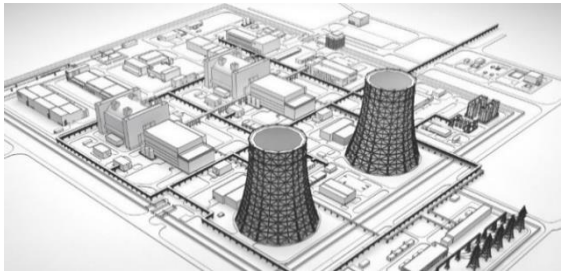
Launch PDEC (2023-2026-2029) → **R&D on the base of PDEC (until 2034)** → **Launch IEC (2030-2034-2036)** → **Replication of serial industrial complexes**

PDEC

The development is based on the DT



IEC

PDEC	Параметр	IEC
1x300	Installed electric capacity of the power unit, MW	2x1255
14,7 (21,6*)	Production capacity of fabrication and refabrication of nuclear fuel, t/year	>30
5 (10*)	SNF processing production capacity, t/year	>30
Operating break-even	Economic efficiency	Competitive ability

* potential increase relative to design productivity