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ROSATOM STATE ATOMIC ENERGY CORPORATION

# Russia's nuclear power engineering

**Keynote speaker: Alexander Lokshin, First Deputy  
Director General for Operations  
Management, ROSATOM**

**26 June 2019, Obninsk**

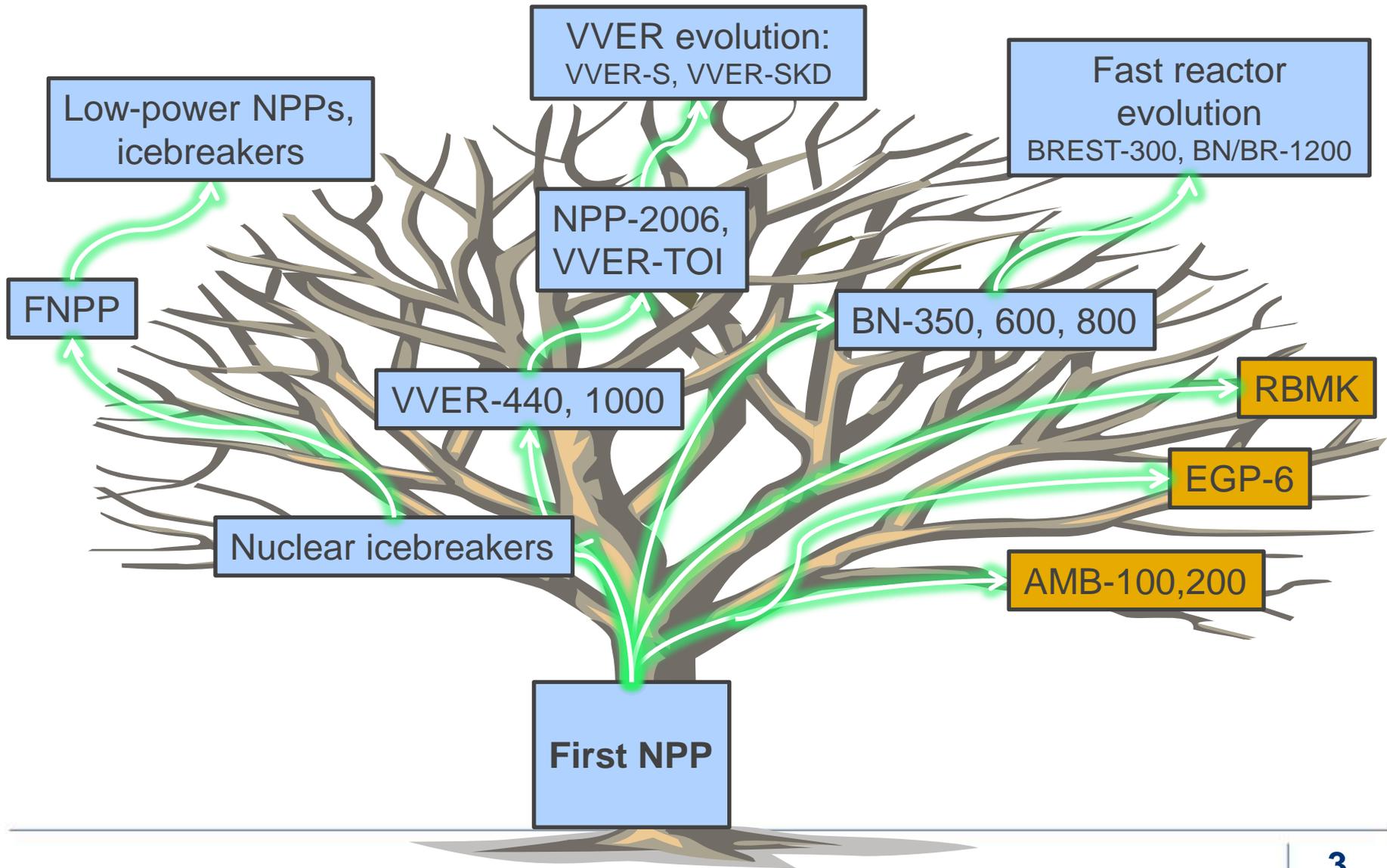


**26 June 1954 –**  
Official Birthday of **Nuclear Power Engineering**

# World's first NPP – the core of nuclear power engineering



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## 10 NPP



**20** power units  
with VVER type reactors



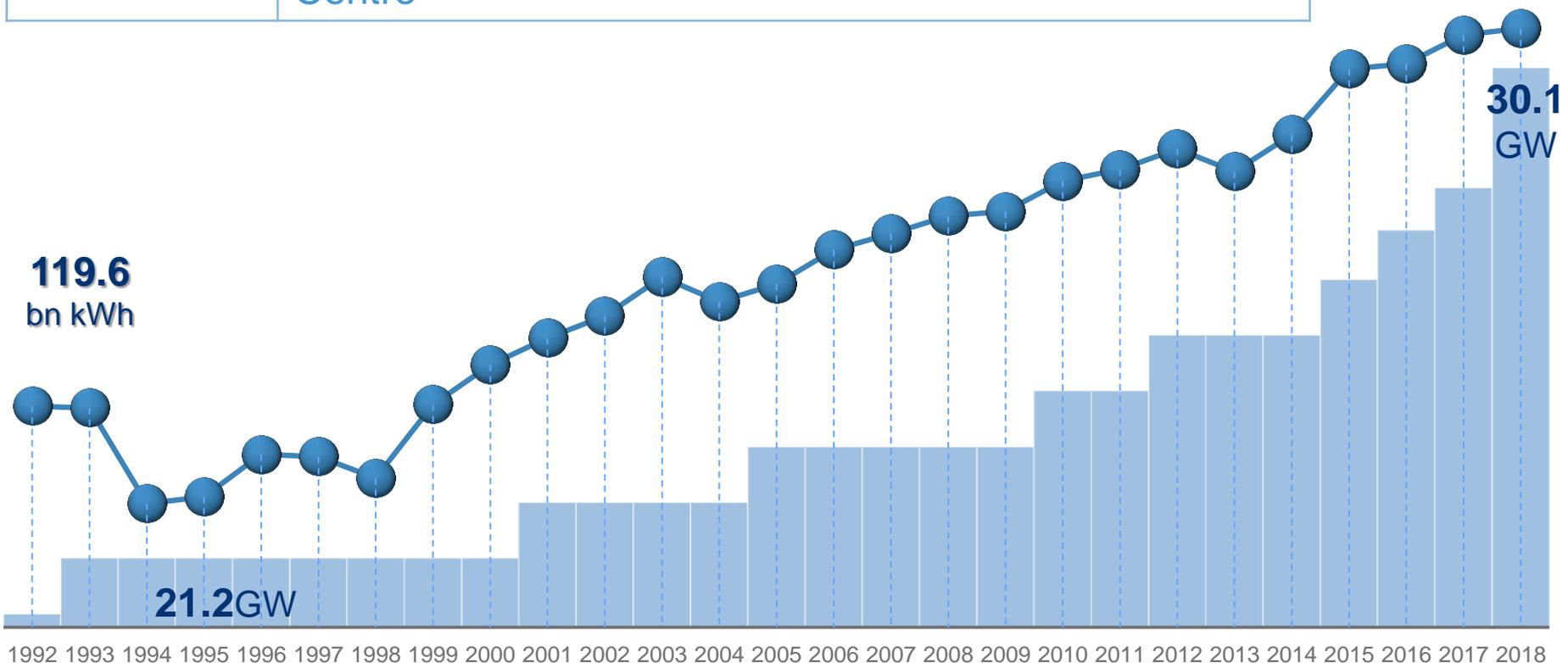
**13** power units  
with channel type reactors



**2** power unit  
with fast reactors

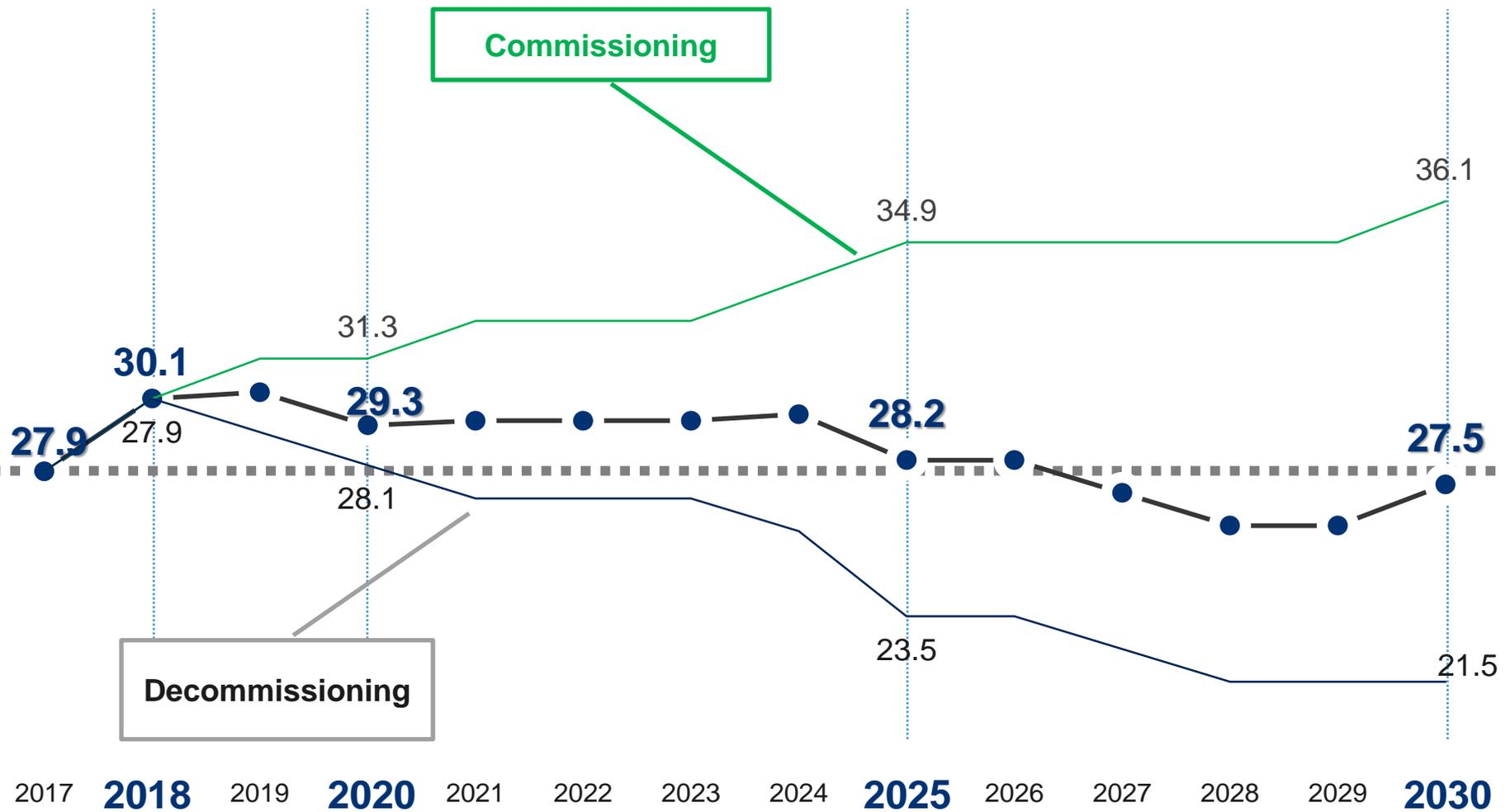
# Electricity generation trend. 2018 results

<b>30.1GW</b>	Installed capacity (maximum during the year)
<b>18.7%</b>	Share of NPPs in electricity generation
<b>46.3%</b>	Share of NPPs in electricity generation within IES Centre



# Current status of Russia's nuclear power engineering

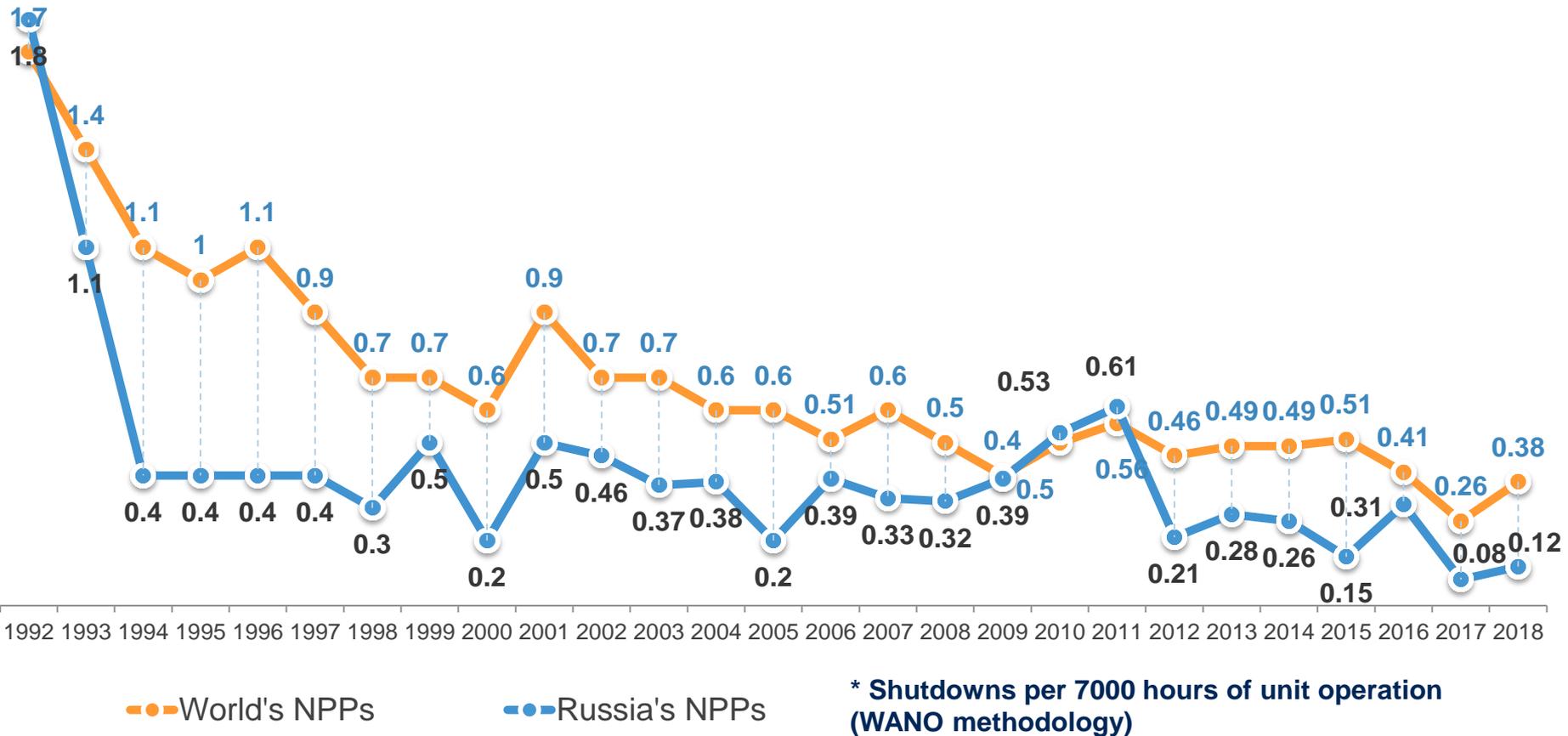
## Generating capacities (MW) and decommissioning of power units by 2030



# Reliability and safety – a priority and integral part of what we do!



## Automatic shutdown of reactors in a critical condition\*



# New generation III+ power units (NPP-2006). Novovoronezh NPP-2 and Leningrad NPP-2



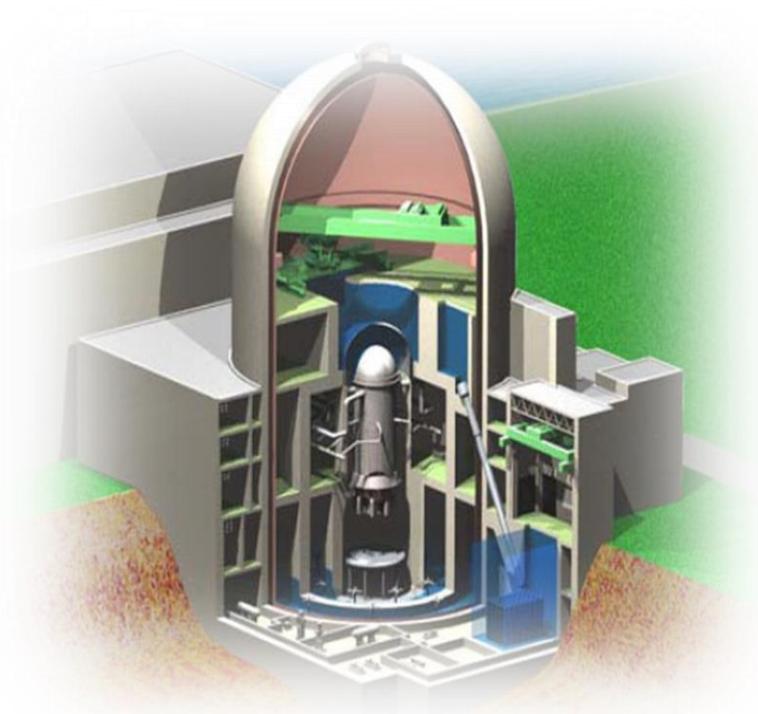
- Electrical capacity up to 1200MW
- Operation life – 60 years
- Active and passive safety systems
- 72 hours full station blackout + large break LOCA





## VVER-TOI:

- Electrical capacity – 1255MW
- Power plant information and economic model
- EUR-certified
- Compact
- Bears seismic load of up to M 8 (optionally, SLE-based)



## Substantiation and implementation of proposals for:

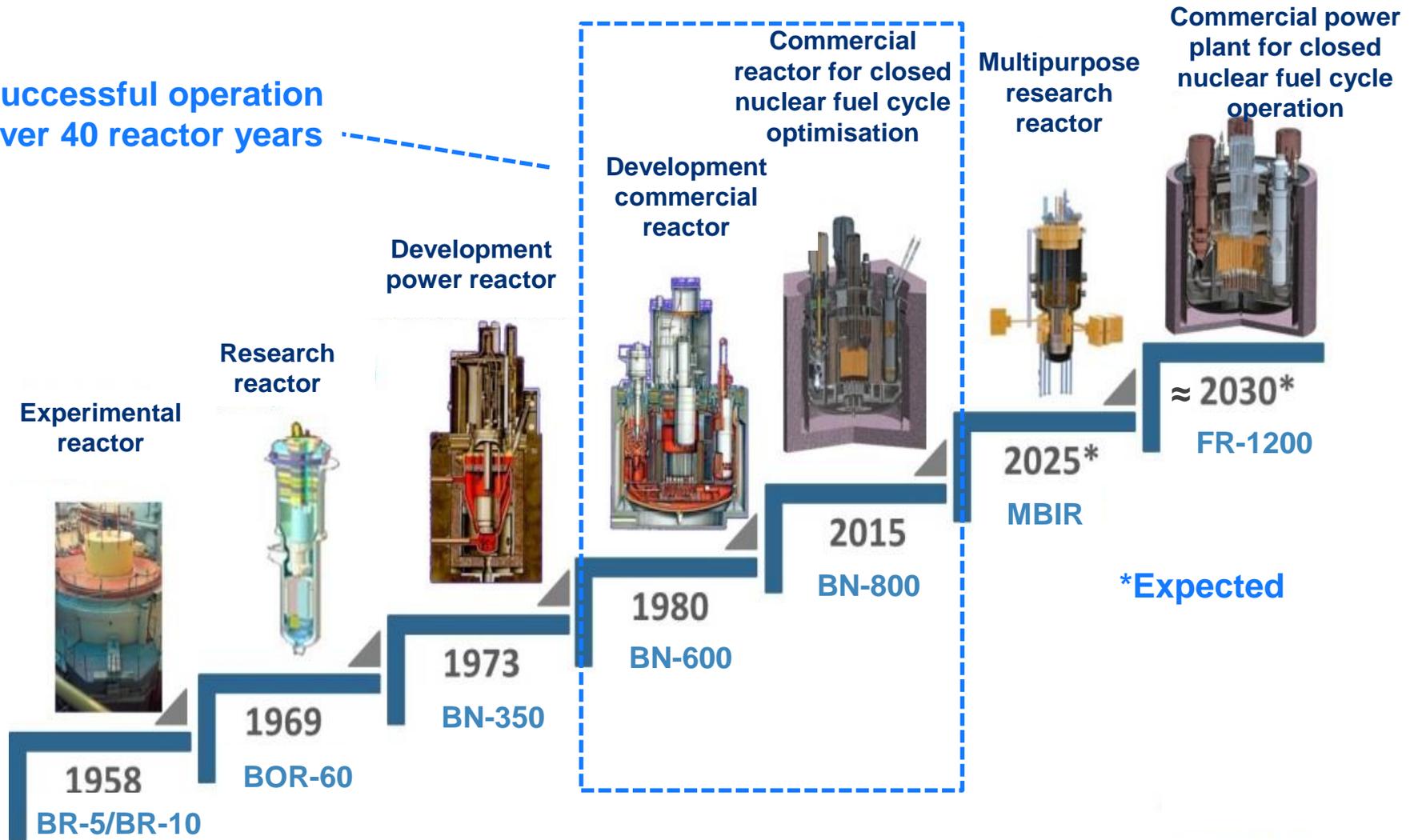
- **improving consumer appeal (reliability, safety, manoeuvrability, etc.);**
- **development of new structural materials for internal elements and fuel element shells;**
- **creation of VVERs with spectral regulation:**
  - **reduced CAPEX and OPEX;**
  - **possibility of 100% transition to MOX fuel**
  - **elimination of boron regulation**

# Development of sodium-cooled fast neutron reactors



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Successful operation  
over 40 reactor years

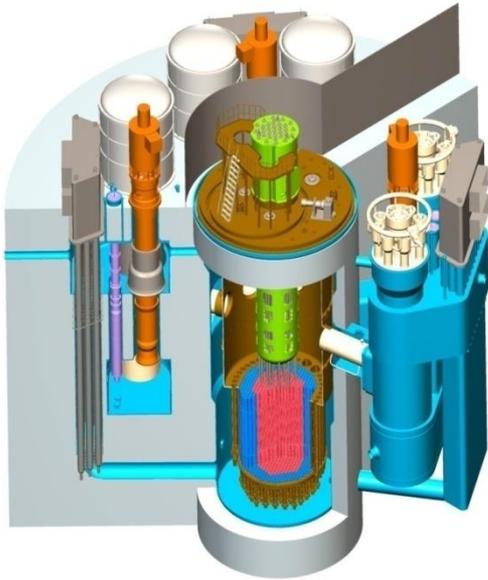


# Peculiarities of a closed nuclear fuel cycle with generation IV fast reactors (FR)

- Rules out of accidents entailing population evacuation
- Uses the entire potential of uranium raw materials
- Burns long half-life isotopes owing to a better neutron balance
- Highly efficient liquid metal-cooled NPPs



Beloyarskaya NPP



## ➤ **BREST-300 (to be launched in 2026):**

confirmation of the main technical solutions;

substantiation of long-term performance for the creation of commercial NPPs

## ➤ **Uranium plutonium nitride (U-Pu-N) fuel:**

substantiation of long-term performance in BN-600;

fabrication, operation, SNF processing and refabrication in the pilot demonstration energy facility with BREST-300



# Atomenergomash (AEM) – full-cycle NSSS equipment manufacturer

As of 2018, AEM was Russia's leading player on the power engineering market by market share, revenue and business portfolio



AEM's share –  
34%



**Reactor vessel**  
*For the second power unit of  
Belarusian NPP*



**GTsNA main circulation  
pump unit**  
*For the second power unit of Belarusian NPP*



**Steam generator**  
*for the third power unit of  
Kudankulam NPP*



Simultaneous manufacture of up to **four** sets of NSSS equipment for NPPs

## New businesses



Thermal power and waste incineration plants



Gas and petrochemical industry and LNG



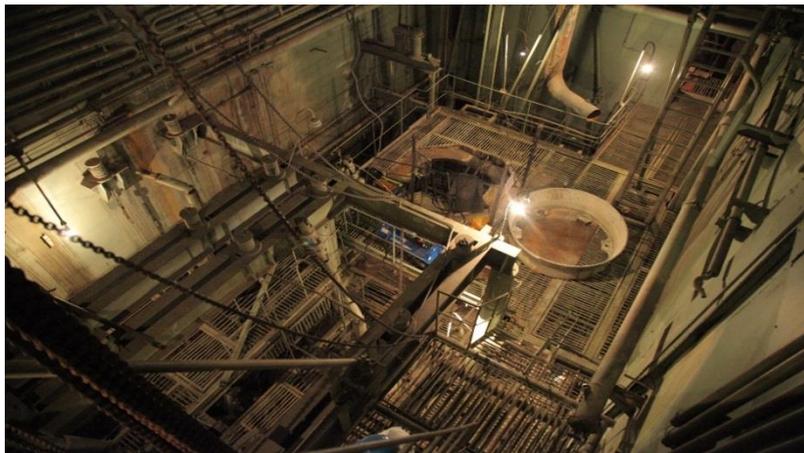
Shipbuilding



Special steel



and other businesses (*commercial and research reactors, small hydropower generation, etc.*)



- Number of decommissioned power units:
  - » 2018 – 6
  - » 2030 – 19
  - » 2050 – 32
- Decommissioning of power units 1 and 2 of the IEE with completion of work in 2035
- Decommissioning of the first phase of the Belarusian NPP and Leningrad NPP

# Use of NPP facilities to manufacture isotope products and market-related products, and offer services

## RBMK



### Current production



*Low specific activity Co<sup>60</sup>*

*Medical isotopes:  
I<sup>131</sup>, Mo<sup>99</sup>*

### Future



*Co<sup>60</sup>-based commercial isotopes*



*Medical isotopes  
Mo<sup>99</sup>, I<sup>125</sup>, I<sup>131</sup>, Ba<sup>130</sup>, Sm<sup>153</sup>, Lu<sup>177</sup>, Y<sup>90</sup>*



*Medical Co<sup>60</sup>*



*Commercial Si<sup>28</sup>, Si<sup>29</sup>, Si<sup>30</sup>, Ni<sup>63</sup>*



*Irradiation centres*



*Radiotherapy centres*

## BN



# ROSATOM is the global leader in NPP construction

- ROSATOM's portfolio of foreign orders – **36 power units in 12 countries**
- ROSATOM accounts for **70% of the world's market** for foreign NPP construction
- The number of countries building NPPs is projected to **increase to 20** by 2030



# Belarusian NPP – first foreign generation III+ NPP



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# Akkuyu NPP, Turkey – the world's first BOO project



# Personnel training is a crucial strategic development area for nuclear power

- Russia's NPPs require **360** young specialists annually
- The personnel training requirement for Russia-designed foreign NPPs is estimated at up to **8000** by 2030

## Main universities:

**National Research Nuclear University MEPHI**

**Ivanovo State Power Engineering University**

**Tomsk Polytechnic University**

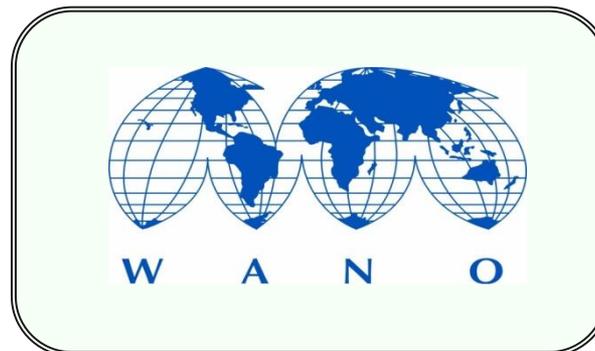
**Ural Federal University, Ekaterinburg**



261 pers. are trained in 2019  
from over 25 countries



By 2025 ~ 1 100 pers. annually from more than 30 countries



International nuclear organisations and energy companies

# Promising technologies and their place in nuclear power structure



**Floating power plant – the core for building low-power NPPs**



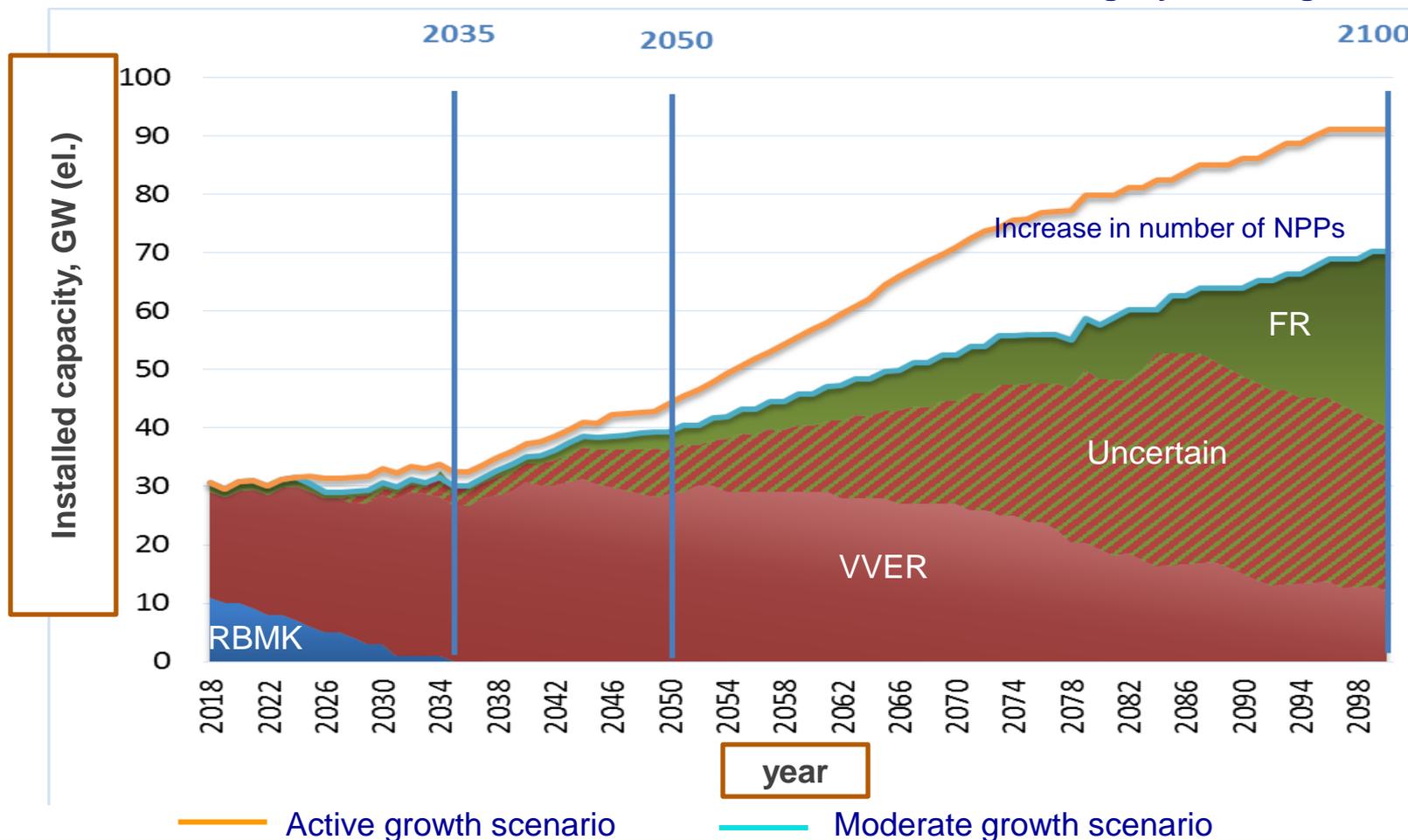
**Establishing research and technology centres abroad**

# Russia's nuclear power development strategy.

## Status and outlook



Developed **VVER** + Pu breeding and minor actinide burning in **fast reactors (FR)** = **Two-component nuclear power with closed nuclear fuel cycle + addressing legacy challenge**



# Nuclear power is a key component of carbon-free energy of the 21<sup>st</sup> century



- *Preservation of organic matter, resolved environmental issues, reduced CO<sub>2</sub> emissions*
- *Basic generation and local power supply*
- *Economic competitiveness*
- *No resource base limitations*



- *Framework for development of high technologies in medicine, material engineering and industry*