



**ROSATOM**

State atomic energy corporation "Rosatom"

# Operation of nuclear power plants in Russia today and tomorrow

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**Sochi, 14 May 2018**

# Concern Rosenergoatom today

**1992 - 2017**



**35** power units in commercial operation on 10 NPPs with a gross installed capacity

**27890 MW**

**2** power units at the stage of pilot operation (Rostov NPP Unit 4 Leningrad NPP-2 Unit 1)

**6** power units under construction

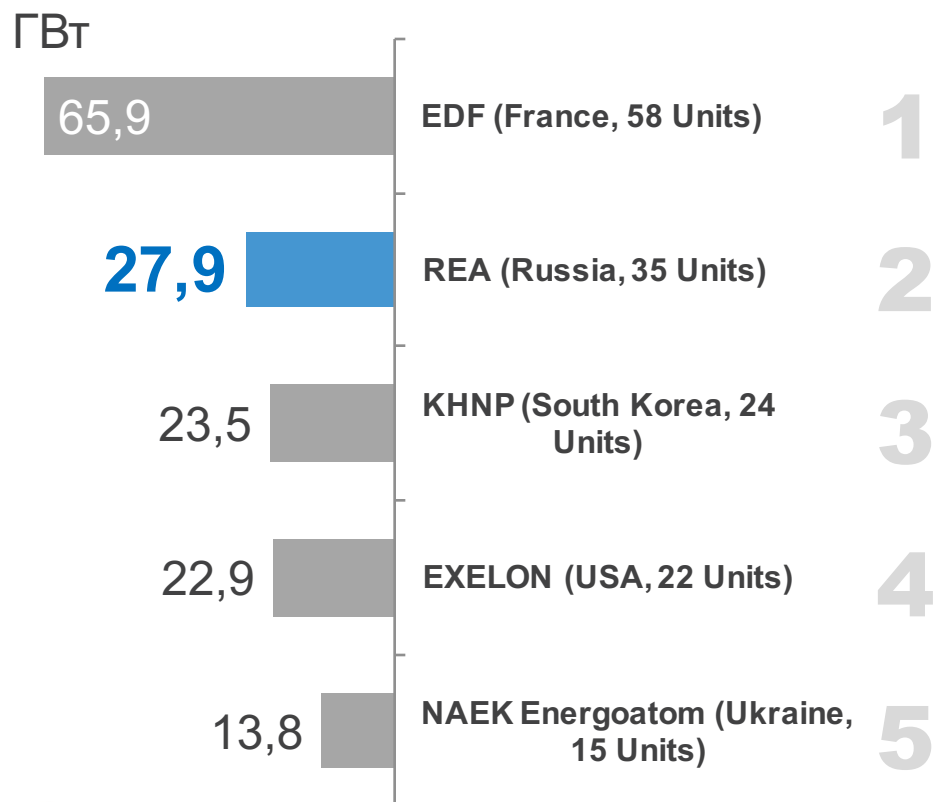
**1** floating power unit under construction

More than **34**  
**thous.** employees of Concern

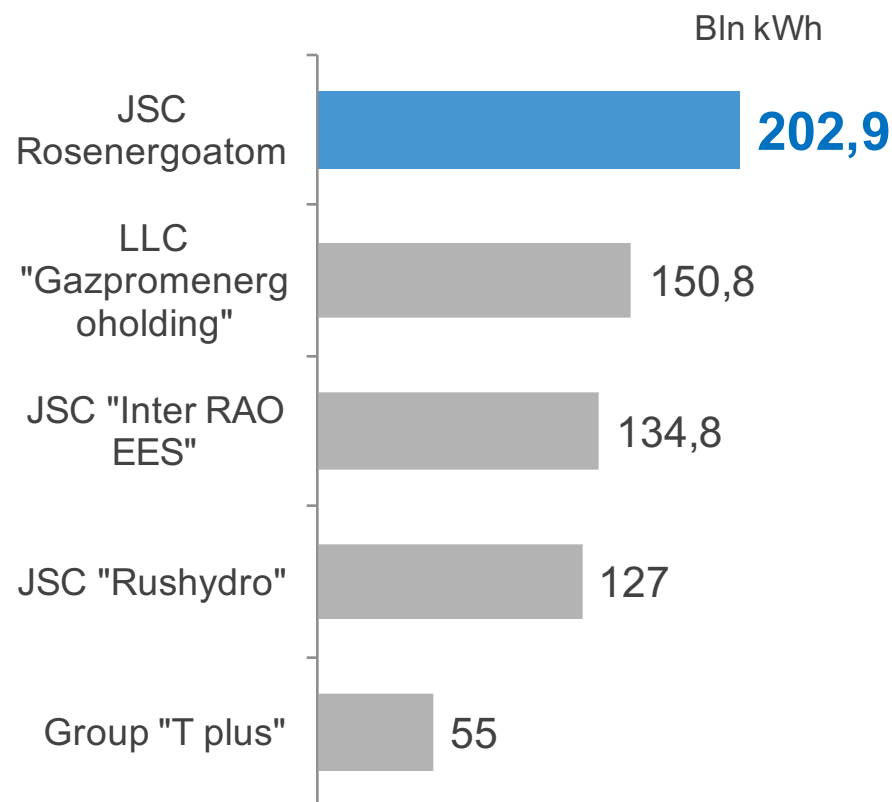
# Rosenergoatom is one of the largest power generating companies



## Top-5 world energy companies as per installed capacity



## Biggest electric power generation companies in Russia

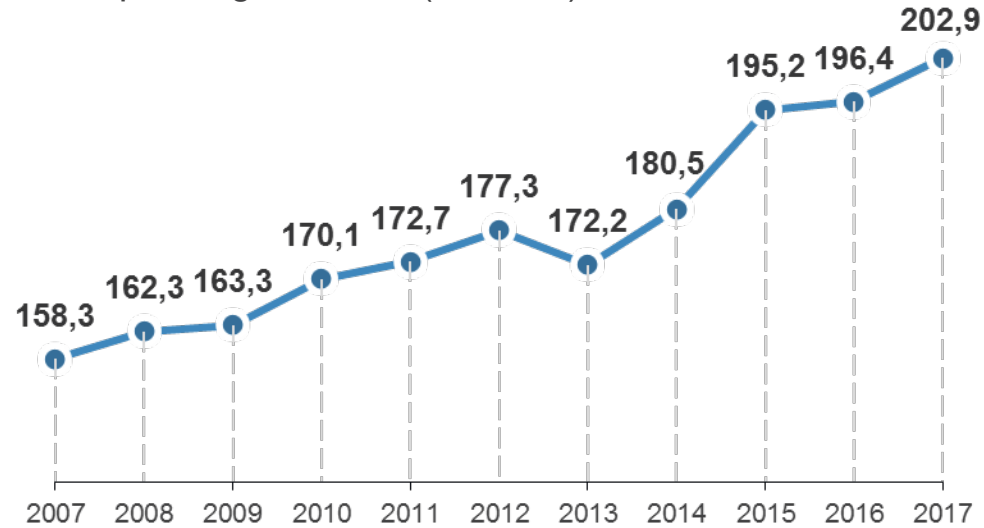
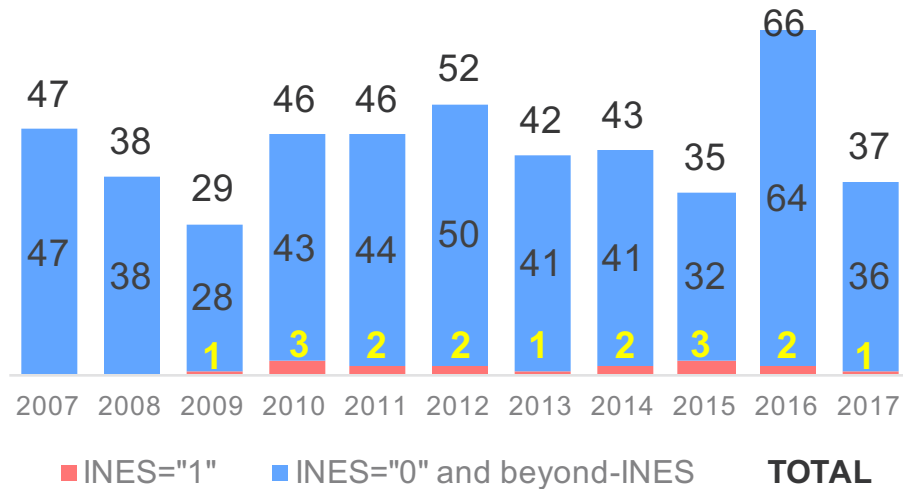


# Key performance indicators of NPP operation in Russia

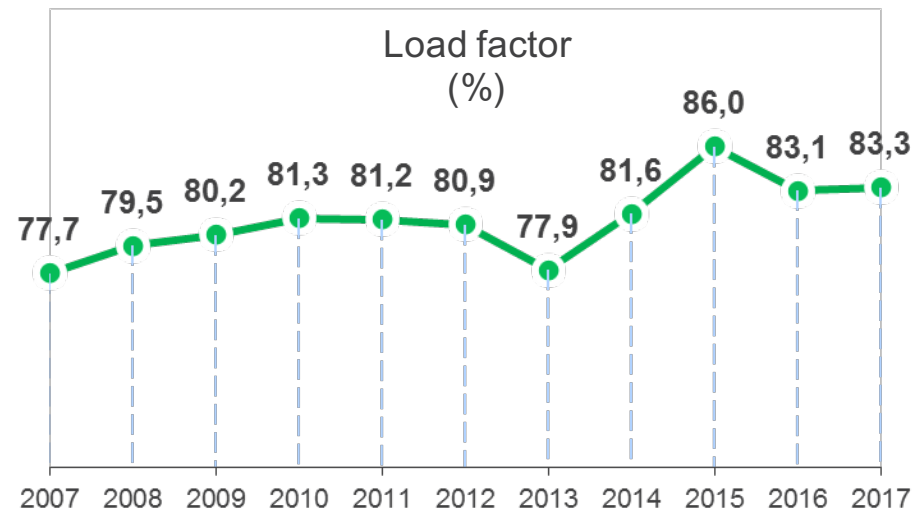
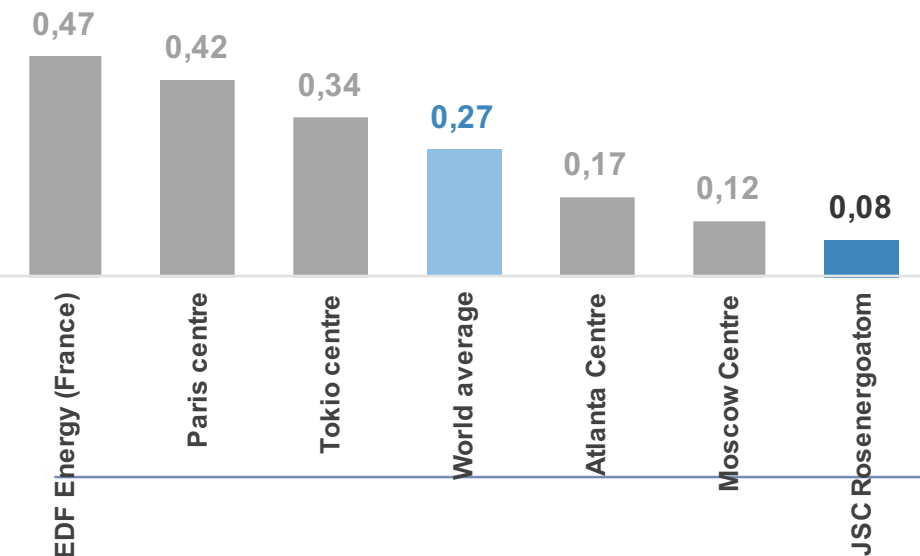


Dynamics of events in operation of Russian NPPs

Electric power generation (Bln Kwh)



Automatic scrams per 7,000 operation hours in 2017 (WANO data)



# Strategic goal is to keep leading role in the Russian Federation power balance

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**Implementation of life time extension program at operating plants**

**Construction of new units**

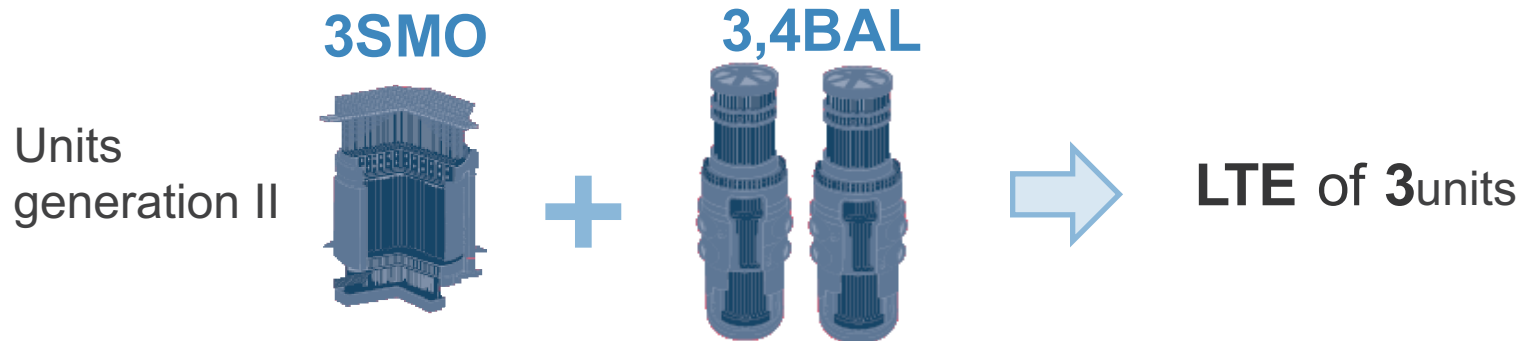
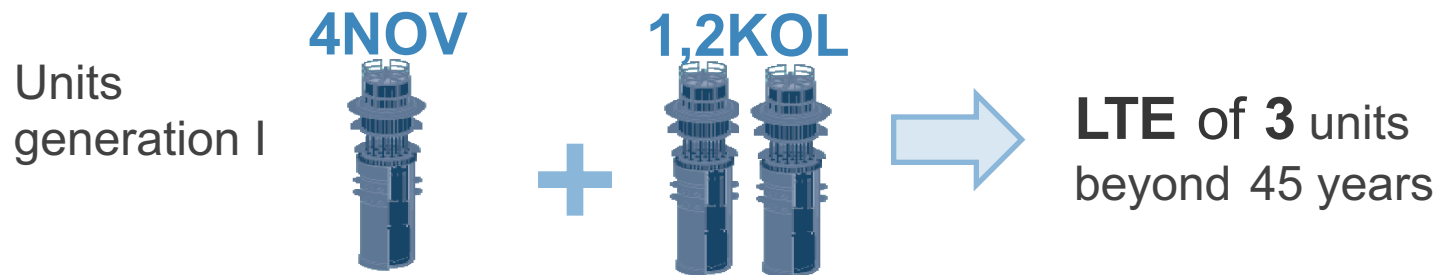
# Retaining generating capacities due to LTE



Total power generation at power units following LTE in 2017 amounted to **121** Bln kWh  
 ~60% of the total generation by the RF Nuclear Power Plants

# LTE tasks for power units in Russia

The task of Rosenergoatom up to 2025 is to keep **6 power units** in operation with gross installed capacity **4297 MW**:



# New units start-up

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## **Beloyarsk NPP Unit 4**

Up to date power unit with fast breeder reactor BN-800  
(put into operation in 2016)



## **Novovoronezh NPP-2 Unit 1**

Up to date power unit  
AES-2006 generation 3+  
(put into operation in 2017)



## **Rostov NPP Unit 4**

Generic power unit VVER-1000  
(at the stage of pilot operation)



## **Leningrad NPP-2 Unit 1**

Up to date power unit AES-2006 generation 3+  
(at the stage of pilot operation)



# New units construction

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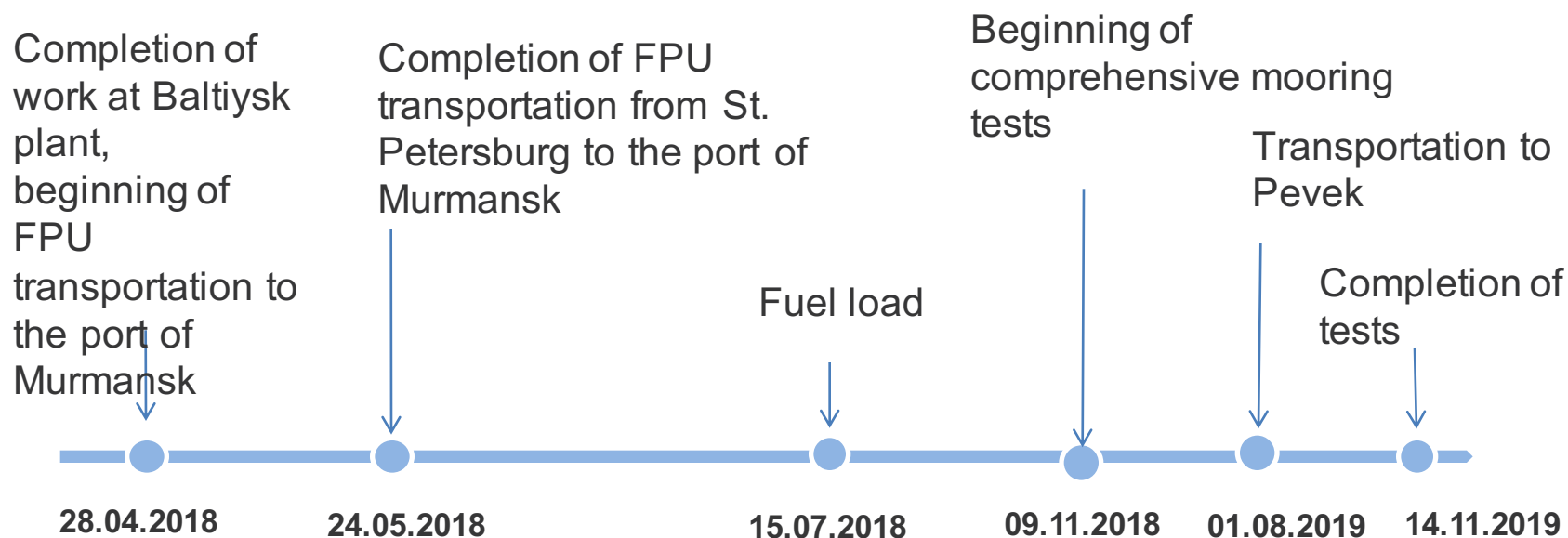
NPP	Unit	Scheduled life time
Novovoronezh NPP-2 (design AES-2006)	No. 2	2019 -2079
Leningrad NPP-2 (design AES-2006)	No. 2	2020 - 2080
Kursk NPP-2 (design VVER-TOI)	No.1	2023 - 2083
	No.2	2024 - 2084

# Floating nuclear power plant in Pevek (to be put into operation in 2019)



## Characteristics of Floating Power Unit

Length / width, m	140 / 30
Draft, m	5,6
Displacement tonnage, t	21 500
Electric power, MW	2x38,5
Thermal power, Gcal/h	50



# Main areas of operation efficiency improvement

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**Further development of safety culture**

**Safety goal modernization**

**Reactor plant uprate**

**Advancement of fuel cycles**

**Maintenance technology improvement**

# Further development of safety culture program



## Focus areas:

Leadership and mentoring development for safety

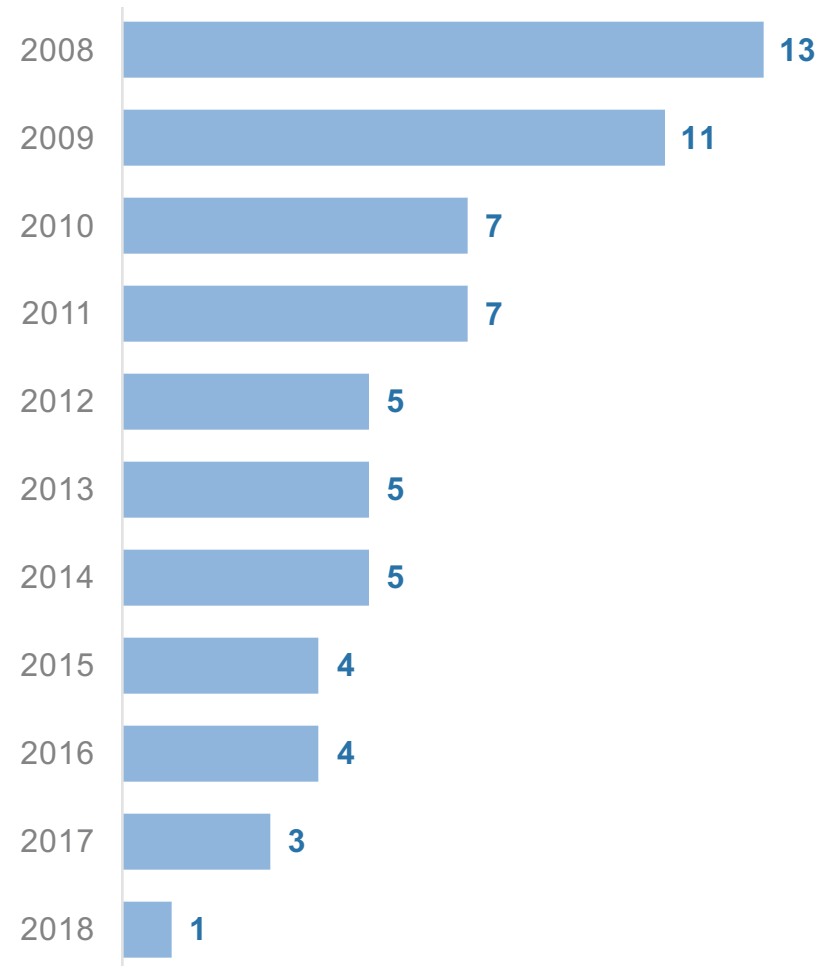
The atmosphere of trust in the organization

Continuous safety improvement

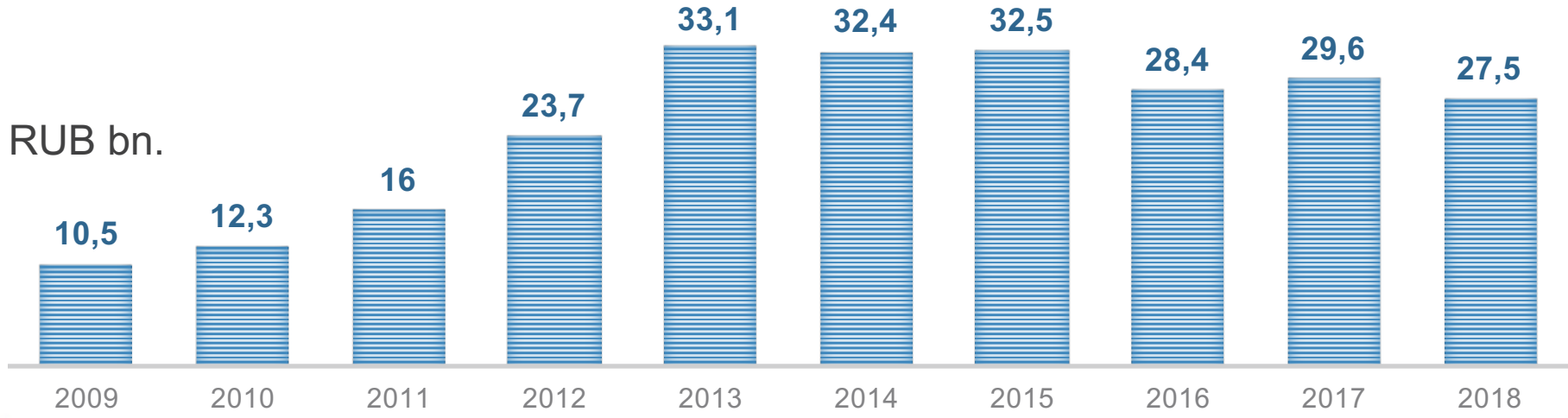
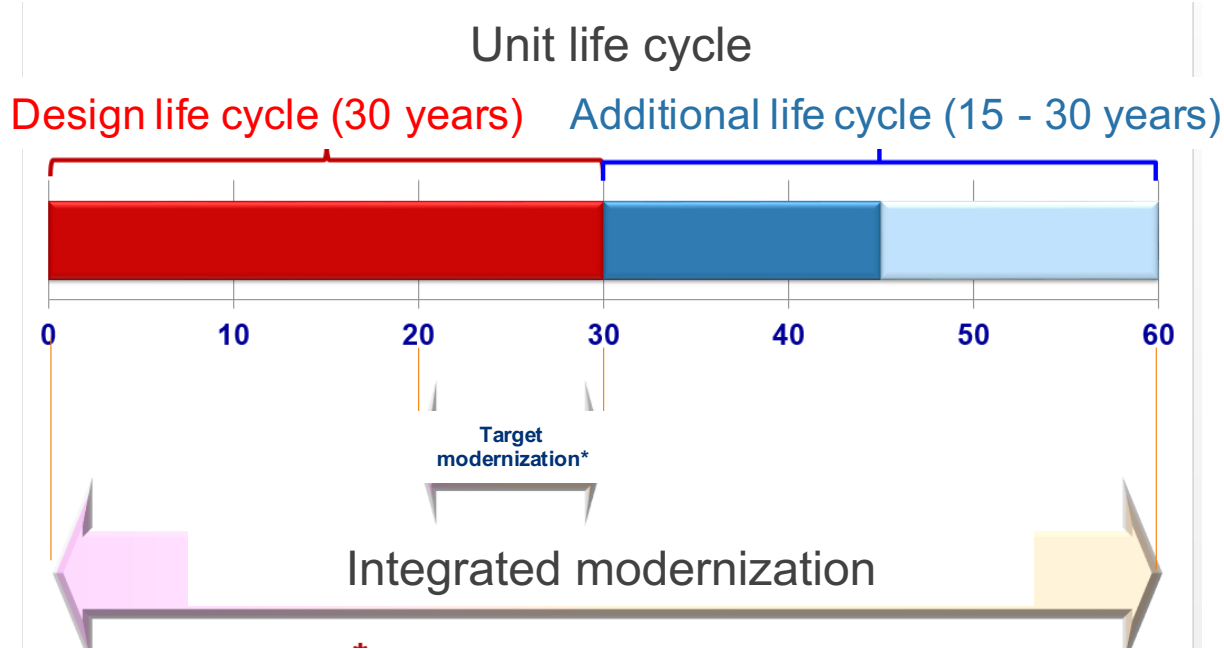
The atmosphere of intolerance towards violations of safety requirements by personnel

Communication between managers and personnel

## Dynamics of violations related to the human factor



# Modernization of systems and equipment



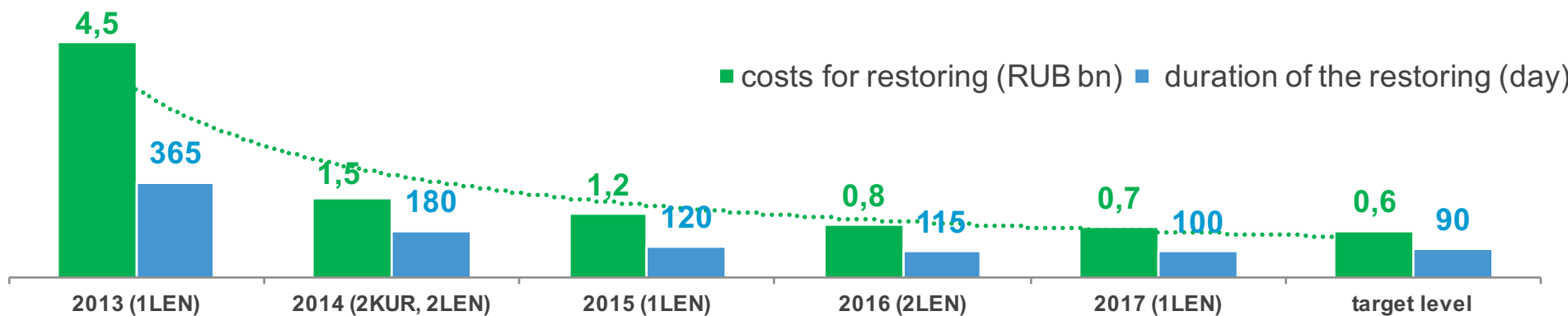
# Restoring of life characteristics of graphite stack of the RBMK-1000



POCATOM

	2013	2014	2015	2016	2017	2018	2019	2020	2021
1LEN	RLC-1 (R&D)		RLC-2	RLC-3	RLC-4	RLC-5			
2LEN		RLC-1		RLC-2	RLC-3	RLC-4	RLC-5	RLC-6	
3LEN						RLC-1		RLC-2	
4LEN							RLC-1		RLC-2
1KUR				RLC-1		RLC-2		RLC-3	
2KUR		RLC-1		RLC-2	RLC-3	RLC-4		RLC-5	
3KUR							RLC-1		RLC-2
4KUR								RLC-1	
1SMO								RLC-1	
2SMO									RLC-1
3SMO									

– complete RLC



# The increase of operational efficiency. The increase of thermal power of VVER-1000



100%Ninst

104%Ninst

107%Ninst

**7** power units are in commercial operation

**4** power units at the stage of pilot operation

Capacity gains **440 MBT**

**3,2 blnkWh** total energy generated in 2017 г.

Balakovo NPP  
pilot Unit 4

2018	Start of power testing 107% Nom
2020	Pilot operation during 2 campaigns
2022	Change-over to commercial operation

# The increase of operational efficiency. Change-over of VVER-1000 power units for 18-month fuel cycle operation



NPP, Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Balakovo NPP, 1	409	-	444	424	503	-	491	515	-	503
Balakovo NPP, 2		461	-	501	503	-	486	473	-	487
Balakovo NPP, 3		451	496	-	463	512	-	519	506	-
Balakovo NPP, 4		420	488	476	-	483	521	-	503	-
Kalinin NPP, 1									502	-
Kalinin NPP, 2				436	486	-	505	522	-	505
Kalinin NPP, 3			481	493	-	429	489	-	528	-
Kalinin NPP, 4						419	490	-	474	515
Rostov NPP, 1			332	439	521	-	498	496	-	502
Rostov NPP, 2					274	250	457	527	499	-
Rostov NPP, 3							478	-	477	-

- 18-month fuel cycle operation

- Change-over loads of 18-month fuel cycle

The duration of the work is given in days. At the top - the year of the start of campaigns of the specified duration



# The increase of operational efficiency. Change-over of design AES-2006 power units for 18-month fuel cycle operation



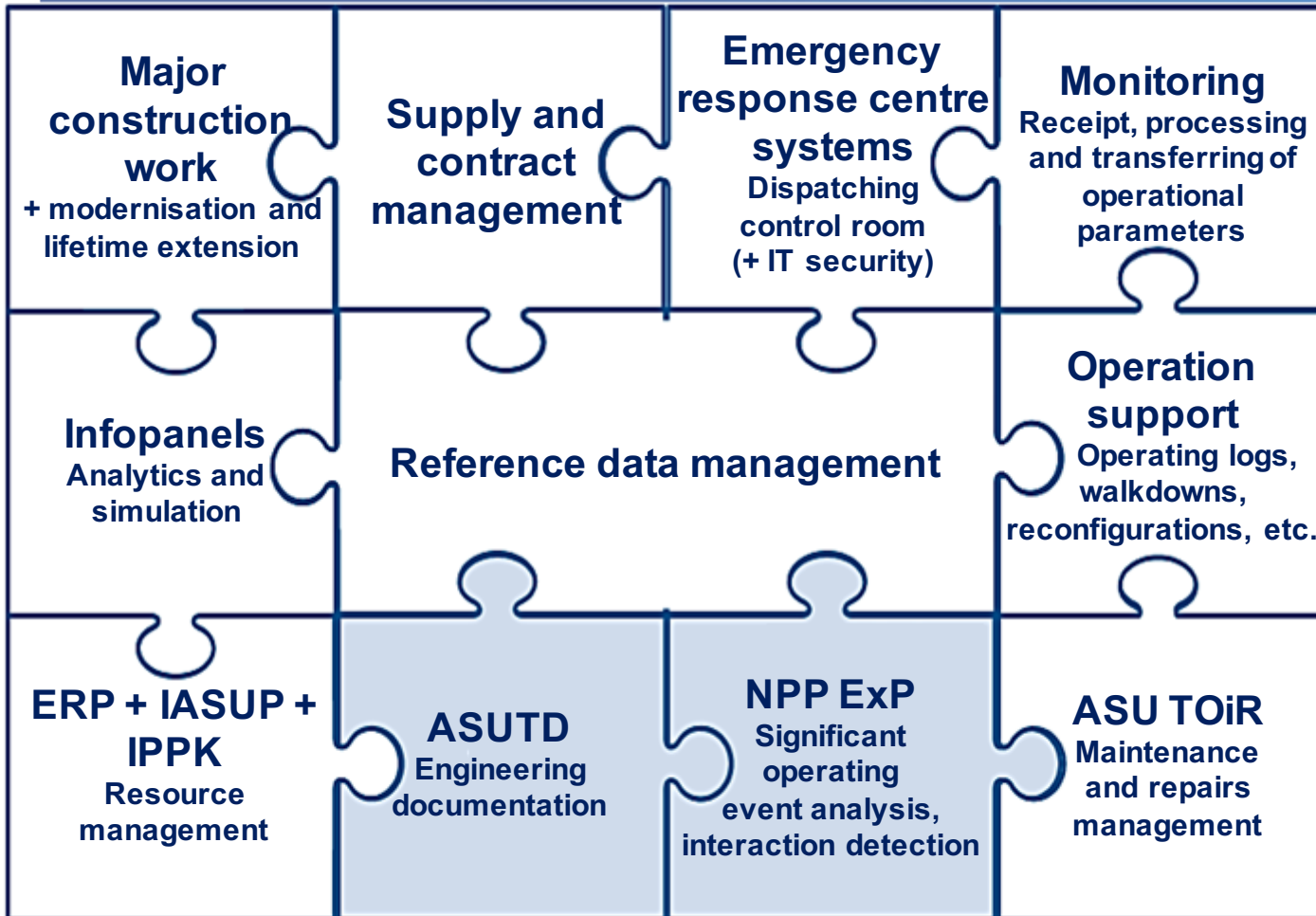
12-month fuel cycle (4x1) was substantiated and implemented for design AES-2006 (WWER-1200) units

Perspective up to 2022: **VVER-1200: sustained and change-over for 18-month fuel cycle**

## Decisions made to change-over for 18-month fuel cycle

	FUEL CYCLE					
	I	II	III	IV	V	VI
6NOV				2020 г.		
7NOV			2021 г.			
5LEN			2020 г.			
6LEN	2020 г.					

# Digital Template for NPP Operation



**Currently available:**

**NPP Exp** – a database of NPP operating experience and set of tools for predictive modelling and analysis of undesirable events

**ASUTD** – a repository of engineering documentation for the entire NPP lifecycle

# Road map for the development of generating capacity



## COMMISSIONING OF NEW POWER UNITS

~ 10,7 GW

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
4RST VVER-1000	5LEN VVER-1200	7NOV VVER-1200	6LEN VVER-1200	1KUR-2 VVER-TOI	2KUR-2 VVER-TOI	7Len VVER-1200	8Len VVER-1200	1SMO-2 VVER-TOI	
	1LEN RBMK-1000		2LEN RBMK-1000	1KUR RBMK-1000		2KUR RBMK-1000	3LEN RBMK-1000	4LEN RBMK-1000	~ 6,6 GW
	1BIL GR-12			2-3BIL GR-12				3BEL BN-600	
				4BIL GR-12					

## POWER UNITS DECOMMISSIONING

# JSC "Concern Rosenergoatom" is the reliable international partner at all stages of the NPP life cycle



**RUSATOM SERVICE**  
**INTEGRATOR OF SERVICE FOR**  
**POTENTIAL CLIENTS**

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