TENTH INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCE “SAFETY, EFFICIENCY AND ECONOMICS OF NUCLEAR POWER INDUSTRY”

ГОСУДАРСТВЕННАЯ КОРПОРАЦИЯ ПО АТОМНОЙ ЭНЕРГИИ «РОСАТОМ»

Present status of Russian nuclear power industry. Future outlook through the analysis of the past

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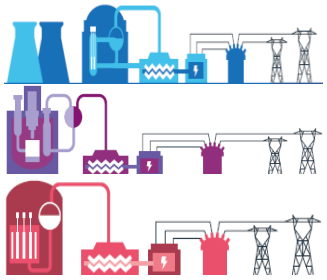
Director General
Rosenergoatom Concern JSC

1. ROSENERGOATOM CONCERN TODAY

Rosenergoatom Concern JSC today



34 **operating power units at 10 NPP sites:**

18 power units with VVER-type reactors

15 power units with channel-type reactors

1 power unit with sodium-cooled fast neutron reactors

26,242 MW **installed capacity**

Beloyarsk Unit 4 **In pilot operation**

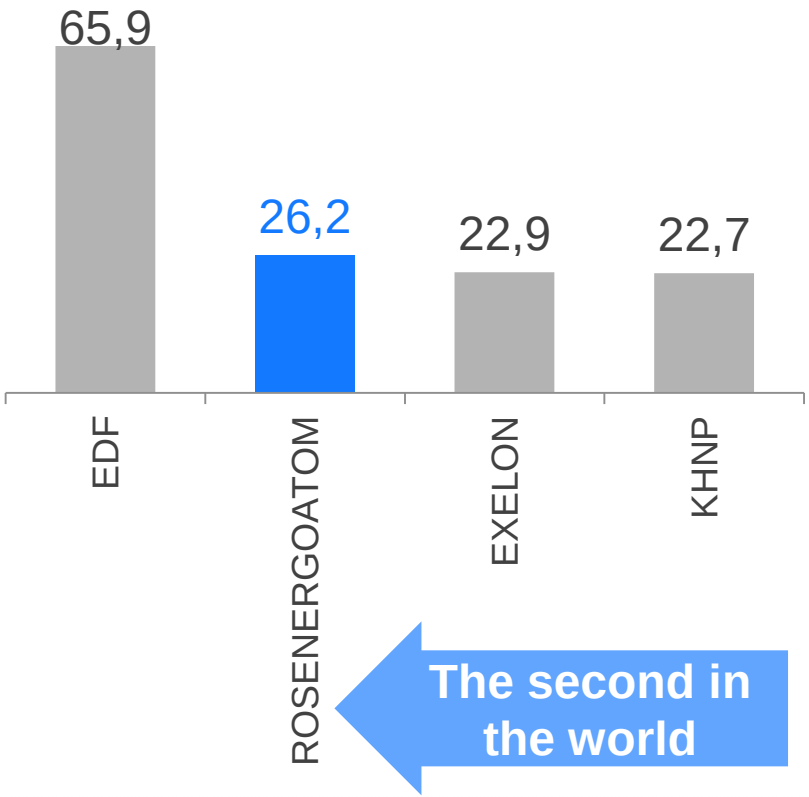
Novovoronezh Unit 6 **Physical start-up has been performed**

6 **power units under construction**

1 **unit of Floating NPP under construction**

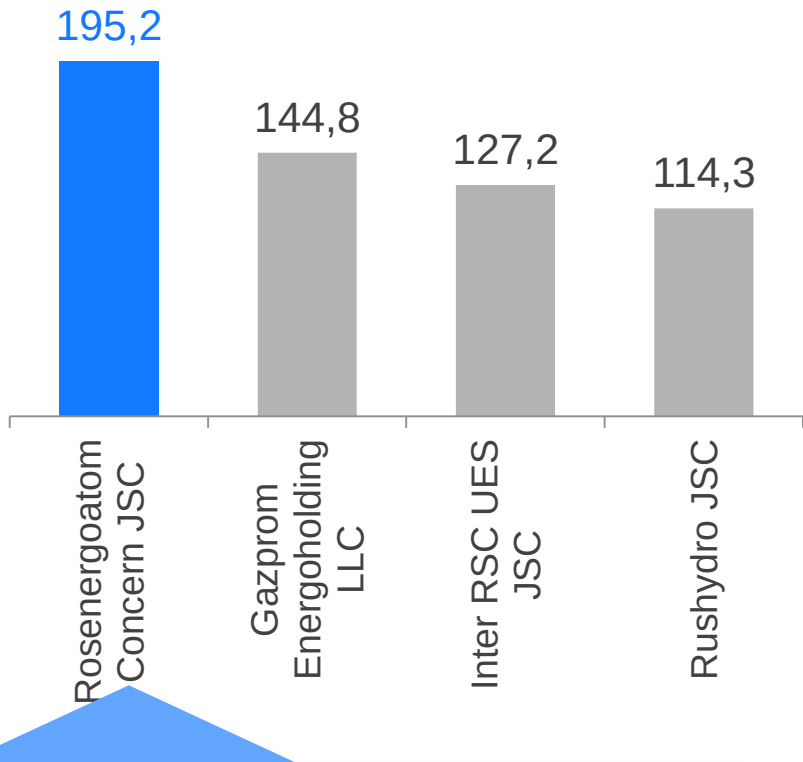
Rosenergoatom Concern JSC

The largest operators in the world in terms of installed capacity (GW)



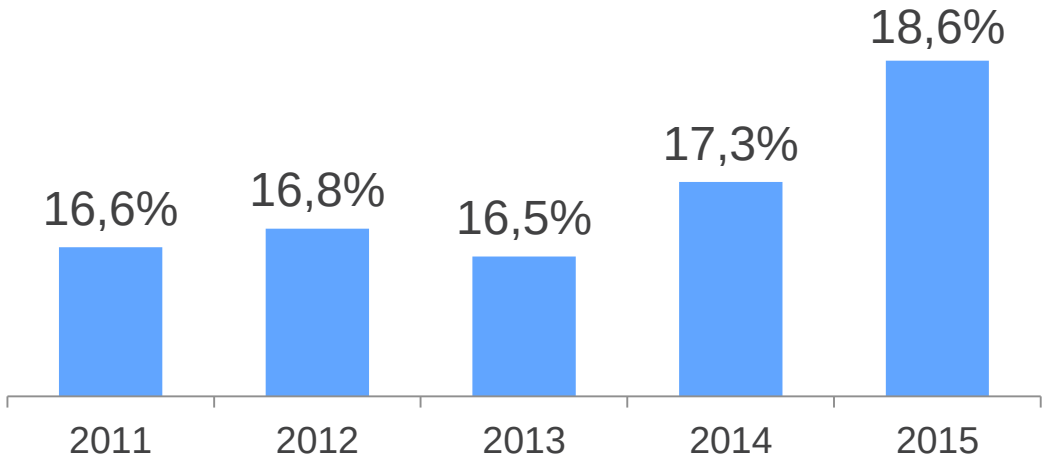
The largest electricity generation companies in Russia

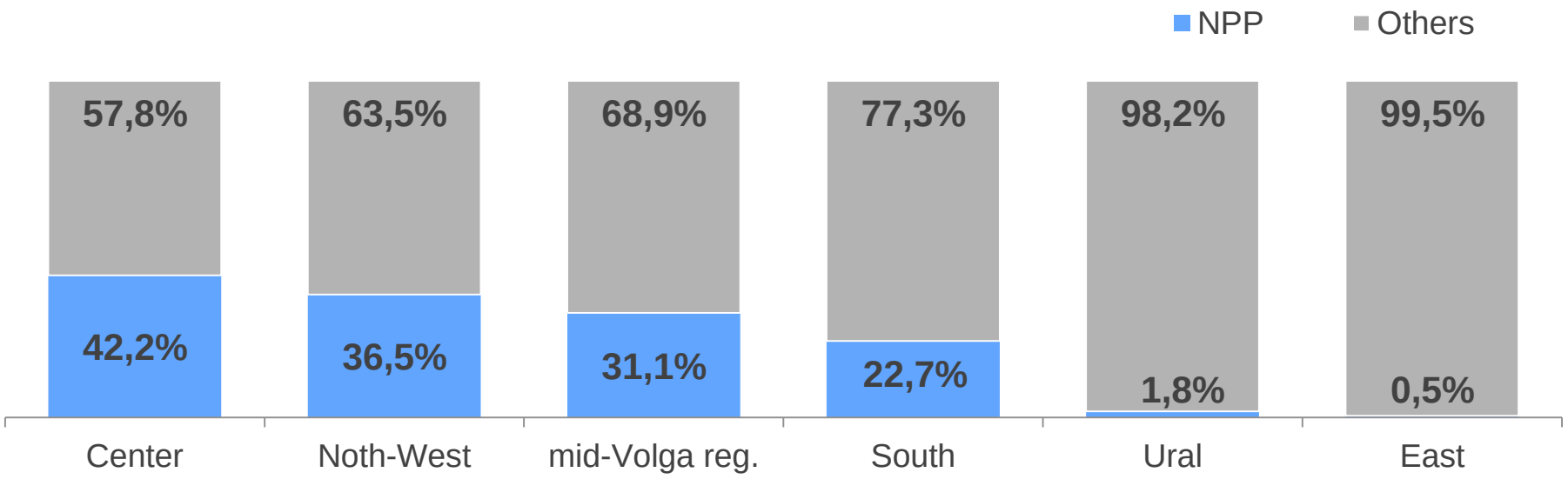
Bln. kWh



Rosenergoatom Concern's share of electric power supply to the Russian market, %

195.2 bln.kWh of electricity generated at Russian NPPs





Rosenergoatom Concern JSC today

Headcount
over 37,000 people

Commercial output
over 260 bln. RUB

Annual investments
over 160 bln. RUB

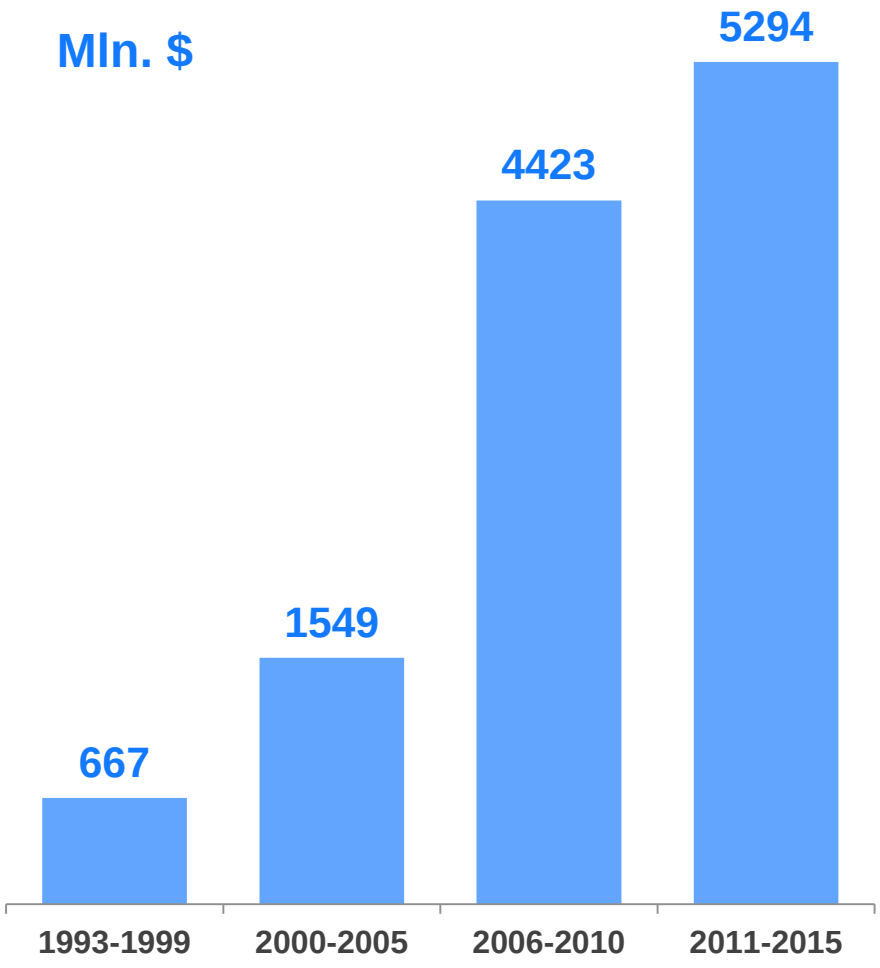
2. GROWTH DYNAMICS (1992-2015)

Priorities

POCATOM

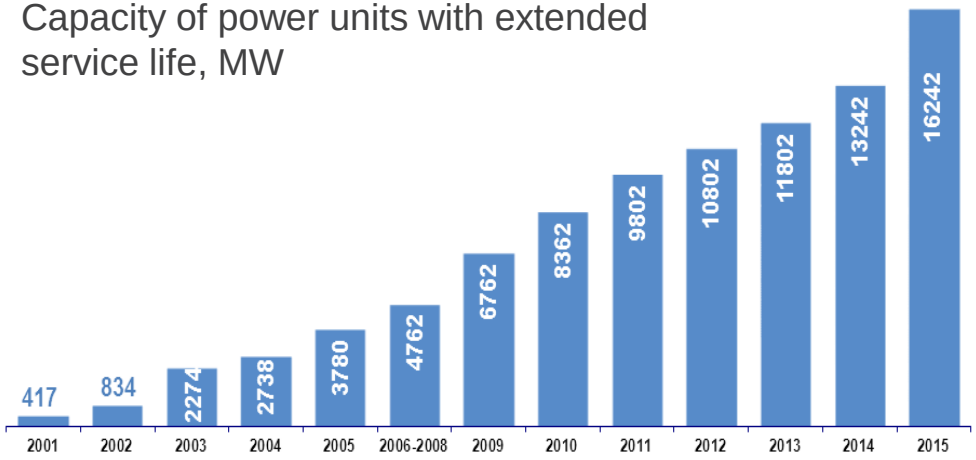
- Human factor
- Emergency response system
- In-depth safety assessment for power units
- Safety upgradings

Cost of systems and equipment upgrading



Output of units with the extended service life was **~50%** of the total output of Russian NPPs in 2015

Capacity of power units with extended service life, MW

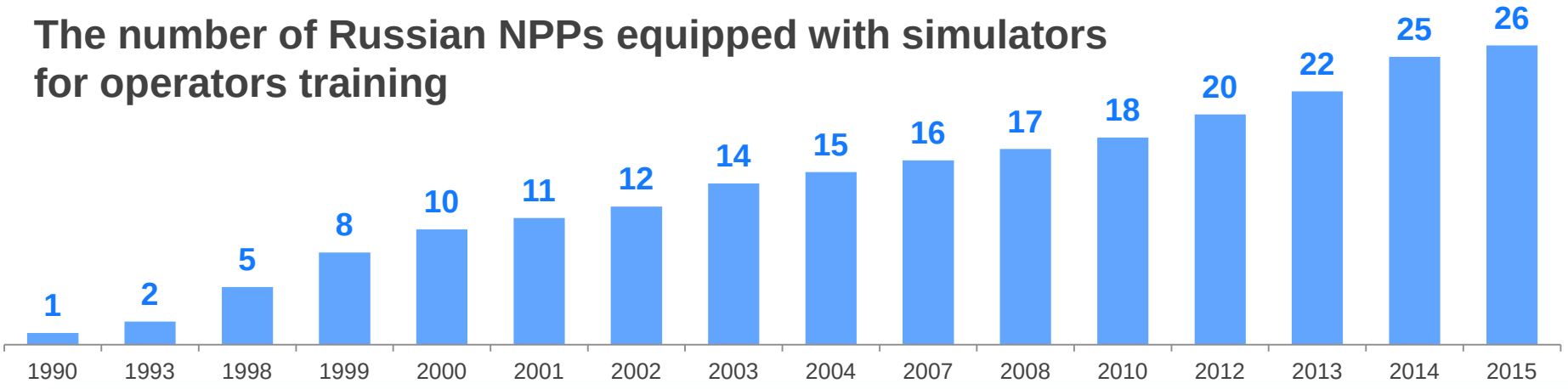


Human factor

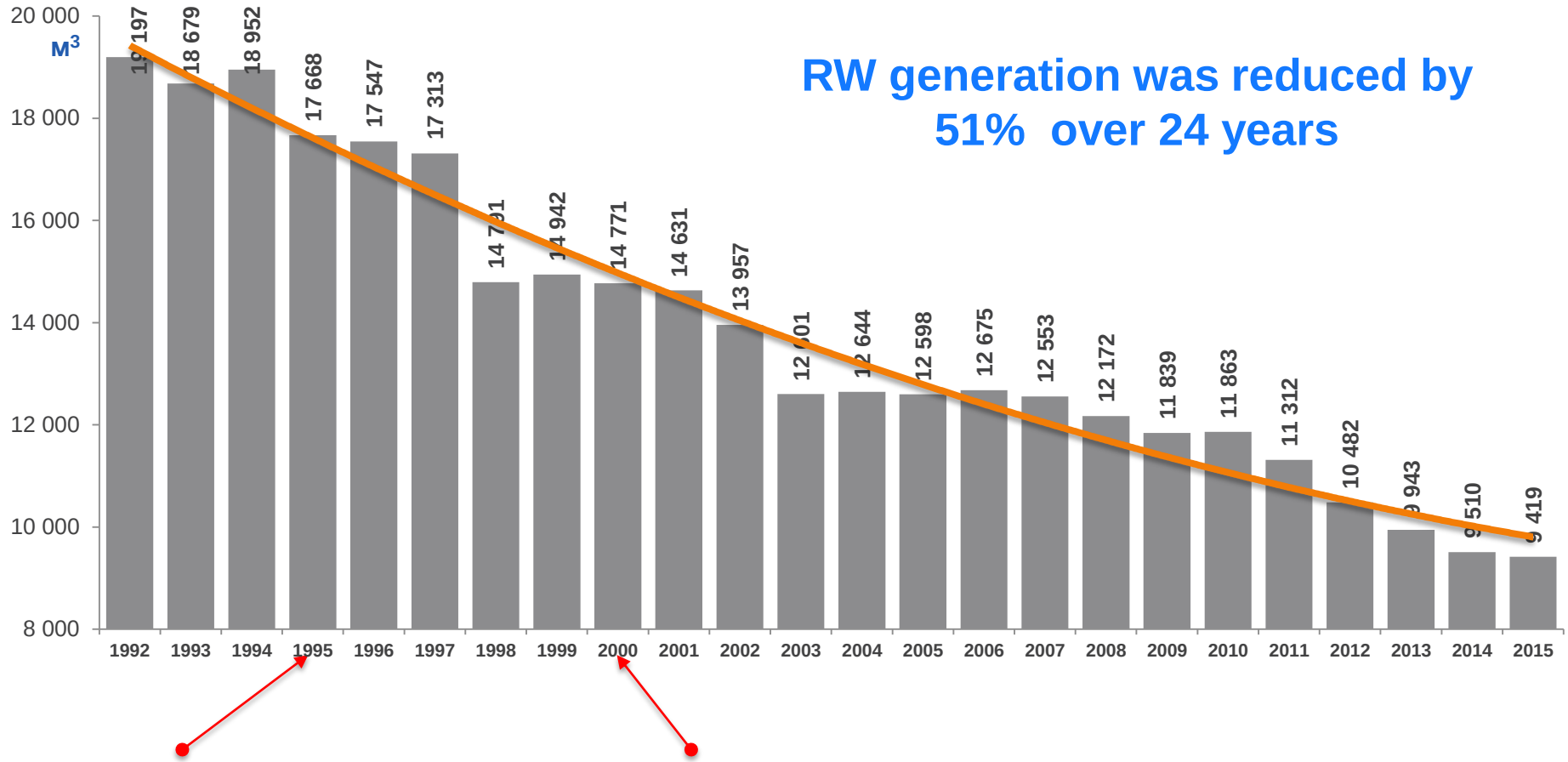
- All NPPs are equipped with full-scale simulators;
- All NPPs have training centers for personnel training;

- NPP personnel training is aimed to improve safety culture :
  - ✓ Training program for a position
  - ✓ Qualification maintaining program
  - ✓ Advanced training programs in educational institutions

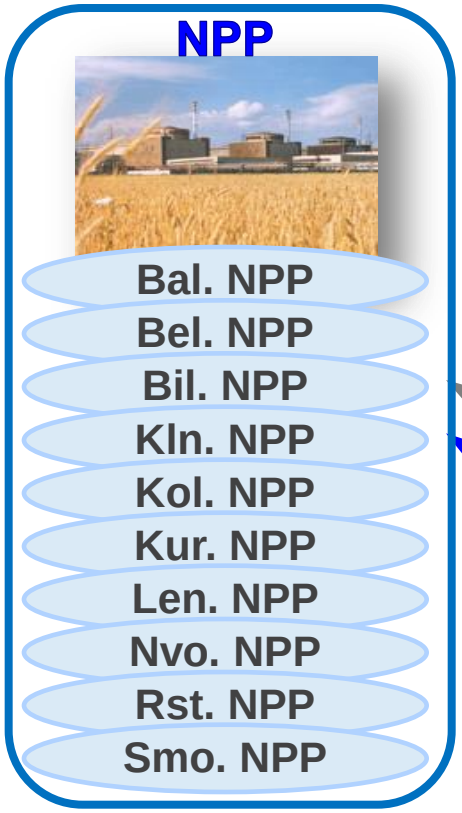
The number of Russian NPPs equipped with simulators for operators training

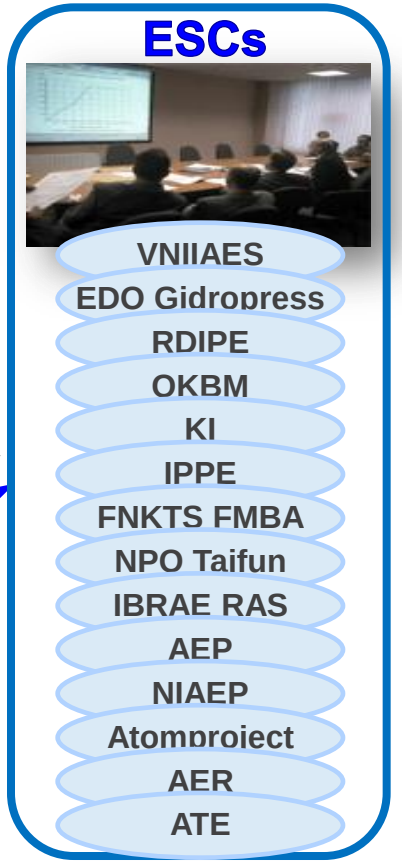


Dynamics of radioactive waste generation and commisioning of facilities for RW processing at NPPs of Rosenergoatom Concern JSC



Emergency response system at Russian NPPs





СО ЦДУ ЕЭС

Video conference call

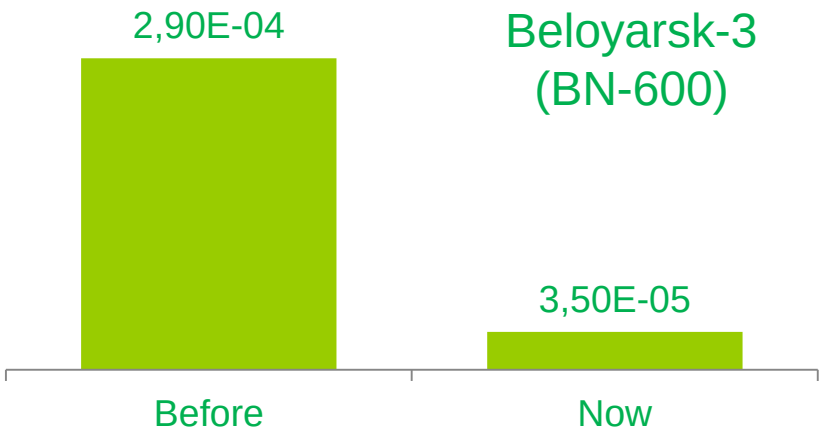
datalink system

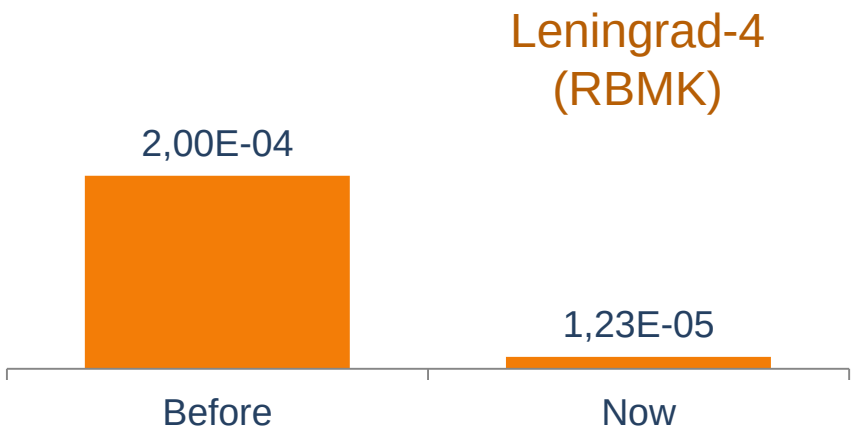
Primary areas for operation efficiency upgrading

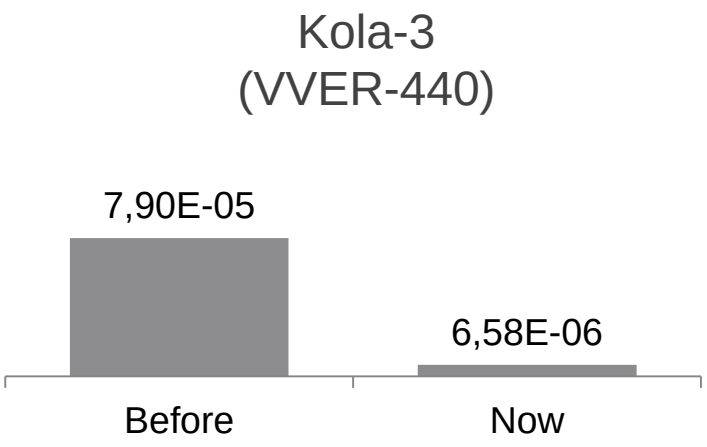
- Reactor unit power uprate
- Efficiency upgrading
- Enhancement of maintenance and repair technology

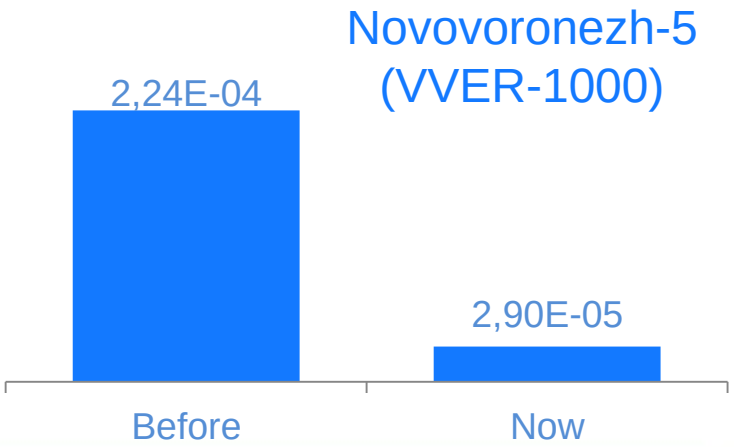
Safety improvement results for operating units

Probability of severe core damage

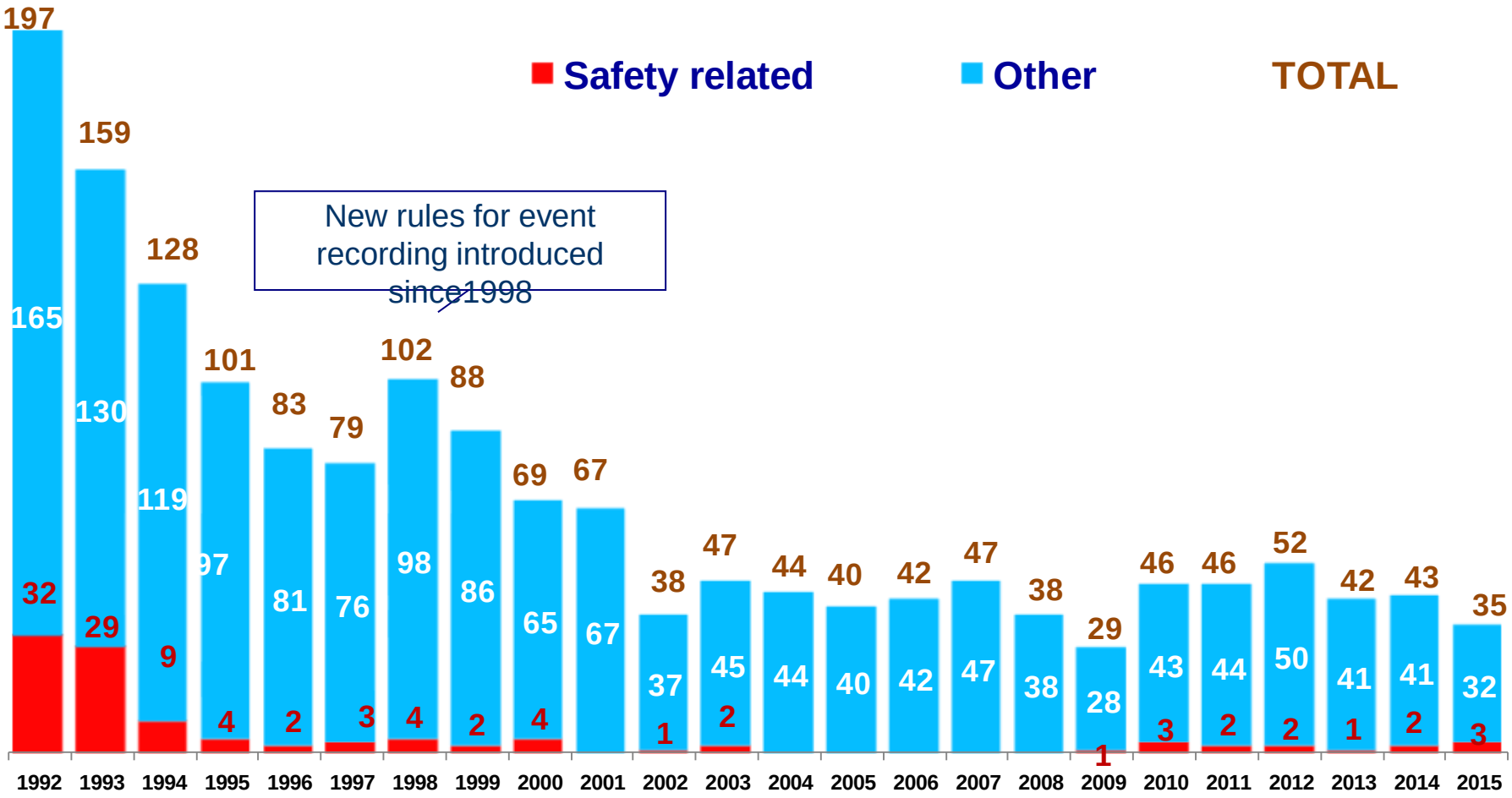




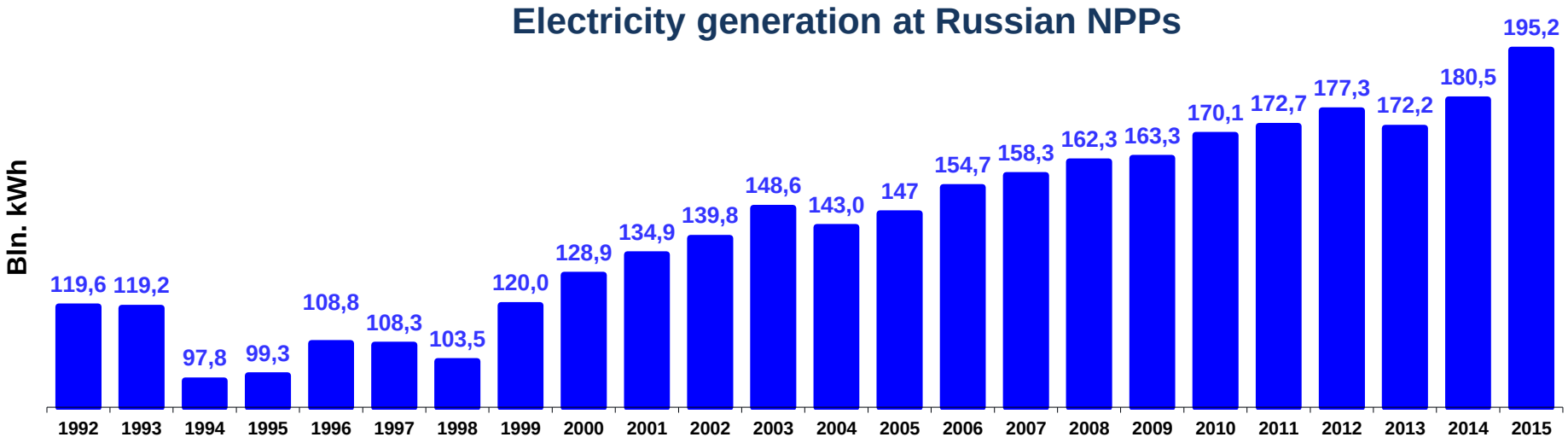


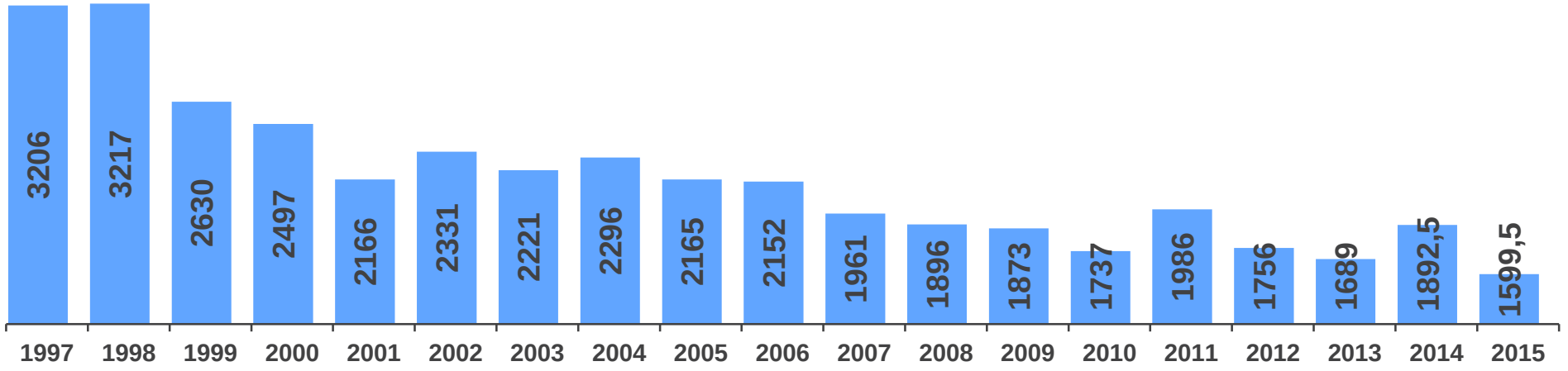


Dynamics of operational events at Russian NPPs



NPP performance indicators





Optimization of maintenance outage duration (actual repair times, in days)

3. PRESENT STATUS OF NUCLEAR POWER INDUSTRY

Challenges and priorities

INTERNAL AND EXTERNAL CHALLENGES:

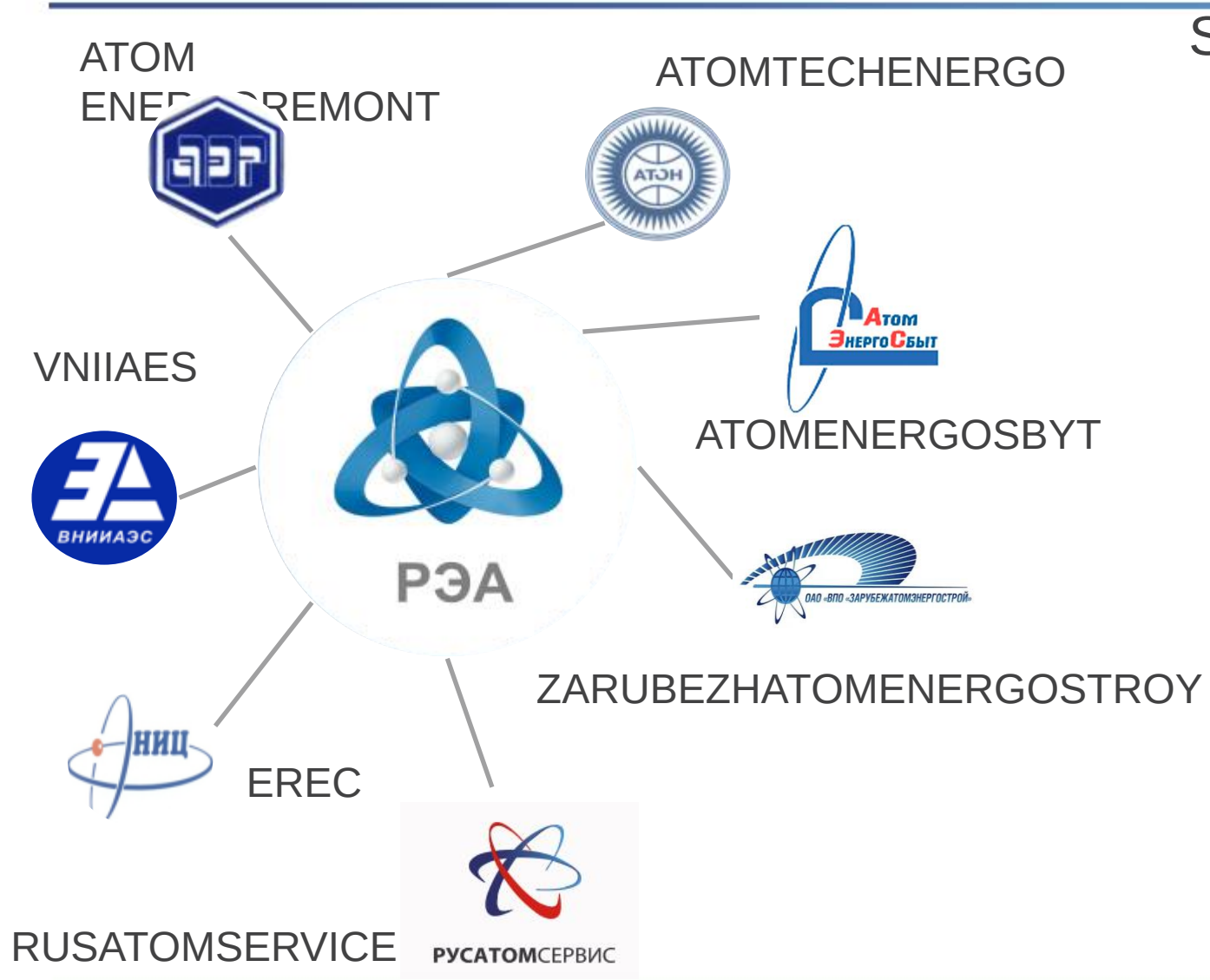
Cheapening of hydro carbons

Slowdown in economics

Entering an active stage of Gen-I power units shutdown and decommissioning

THE ELECTRIC POWER DIVISION OF SC ROSATOM

Structure of the Electric Power Division of State Corporation Rosatom



Strategic priorities of the Division :

- Safety
- Economical production
- Innovative products

Competitive growth (economical production)

1 Cost management

- Cost reduction at the operating NPPs by **22%** by 2018
  - Labor efficiency increase by **25%** by 2018
  - Increase of the estimated VVER load factor up to **91%** by 2019

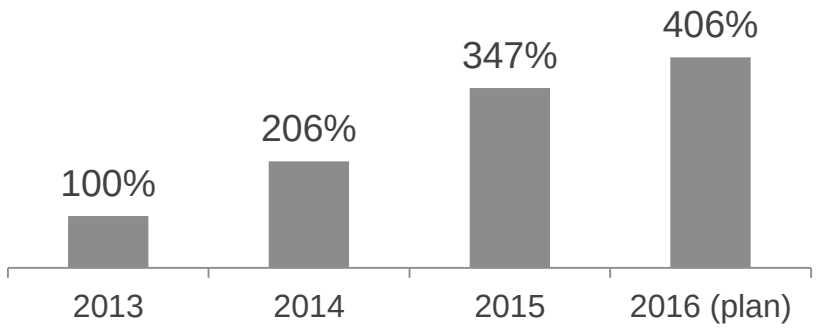
2 Construction management

- LCOE reduction at Russian NPPs by **15%** and **28%** by 2020 and 2030, respectively
- Construction terms reduction from **60 months** (2014) to **48 months** (2019), and to **40 months** (2030)
- Load factor **93%** for new power units

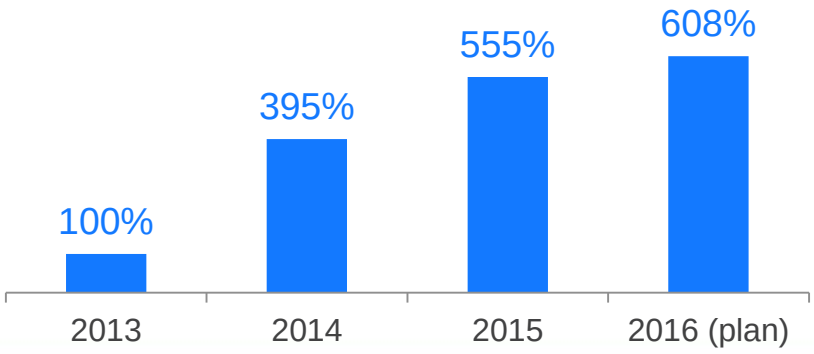
International business

1. Bilateral plans on nuclear infrastructure development with Bangladesh, Belarus, Vietnam and Jordan
2. Personnel training
3. Commissioning (a package of start-up works)
4. Operation support services for foreign NPPs
5. Maintenance, repair, upgrading, service life extension, equipment and spare parts supply

Revenues dynamics for innovative products (foreign NPP servicing), %



Dynamics of innovative product portfolio of orders (foreign NPP servicing), %



Innovative products

Isotope products

- The project for Cobalt-60 production jointly with Canadian company “Nordion”

Data processing center

- Under construction at Kalinin NPP
- Capacity – 48 MW
- Total number of rack cabinets – 8000 pcs.

Generation I power units decommissioning

2016	Novovoronezh Units 1 and 2 Beloyarsk Units 1 and 2
Next 10 years	Novovoronezh Unit 3 Bilibino Units 1, 2, 3 Leningrad Units 1, 2, 3 and 4 Kursk Units 1 and 2

Strategic tasks:

- Development and introduction of reference decommissioning technologies f at Russian NPPs
- Creation of an innovative product for rendering decommissioning services to foreign NPPs

The Division's strategic business indicators

	Long-term (up to 2030)
Russian electricity market share	**21%**
Electricity production	**+73%**
Innovative products revenue	**10 times more**
New power units commissioning	**19 units**
Power unit life extension	**11 units**
Foreign NPP servicing	**42 times more**
Revenue growth	**3 times more**

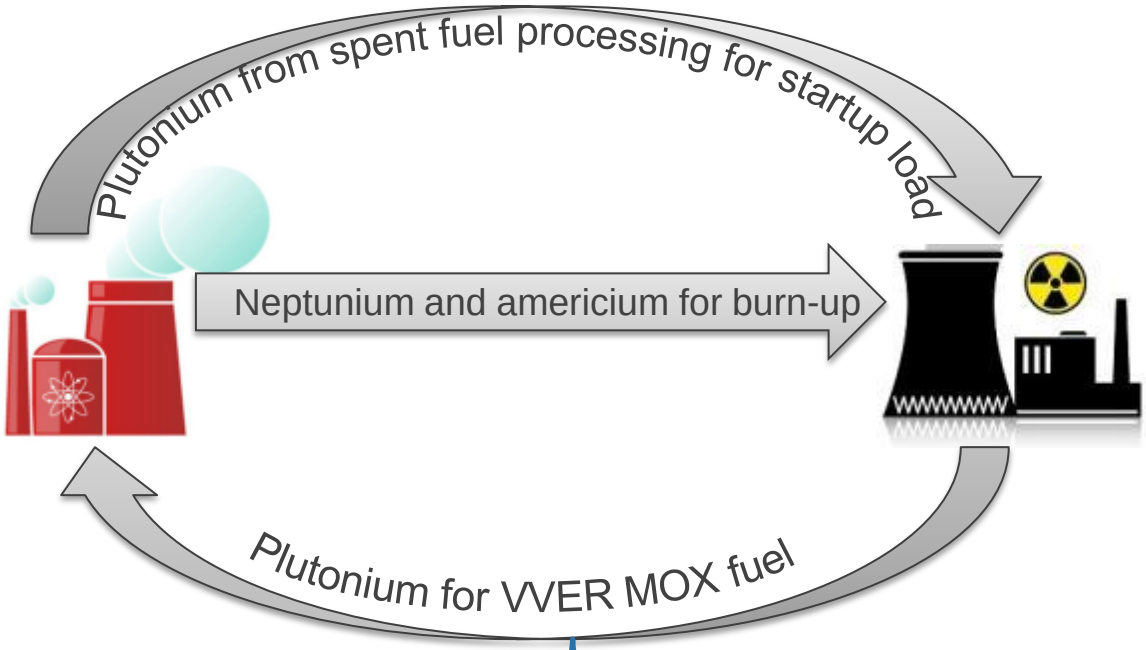
4. FUTURE OUTLOOK

Two-component nuclear power system with thermal and fast-neutron reactors of VVER and BN types within a closed nuclear fuel cycle

POCATOM

VVER
In maneuvering mode

Enriched uranium makeup



BN-1200
In basic mode

Depleted uranium makeup

Uranium consumption reduction

Reduction of SNF build-up

Reduction of long-lived RW

In a two-component NPS (with VVER and BN-type reactors), an optimal solution for "mutual assistance" within the fuel cycle, RW minimization and the load-carrying should be found, in order to raise the NPS competitive strength

AES-2006 and VVER-TOI designs

1. Passive safety systems for all critical safety functions
2. Double containment with controlled gap
3. Emergency heat removal via secondary circuit is not limited in time neither in active nor in passive modes

AES-2006

- Long-term (at least 24 hours) ability to prevent fuel damage from going beyond the limits established for design basis accidents under blackout conditions without operator's intervention
- Design compliance analysis jointly with EUR

VVER-TOI NPP

- Ensuring an elevated unit resistance to extreme external impacts
- Long-term (at least 72 hours) ability to prevent fuel damage from going beyond the limits established for design basis accidents under blackout conditions without operator's intervention
- Design compliance analysis jointly with EUR

Implementation of construction projects for small and medium NPP power units

Rosenergoatom Concern JSC implements the project on first-of-a-kind floating NPP construction in Pevek, Chukotka autonomous district, with its commissioning scheduled for 2019

THANK YOU FOR YOUR ATTENTION!