



**ROSATOM**

**Rosatom State Atomic Energy Corporation**

# **Rusatom Service experience in LTO of VVER units**



**RUSATOMSERVICE**

**Nikolay Skirda**

**Plzen, Czech Republic**

**12.04.2016**





## Rosenergoatom Electric power division

Operational and technological engineering in the sphere of repair and modernization, personnel training



## Atomenergomash Machine building division

Warranty and post warranty service of the equipment throughout its life cycle



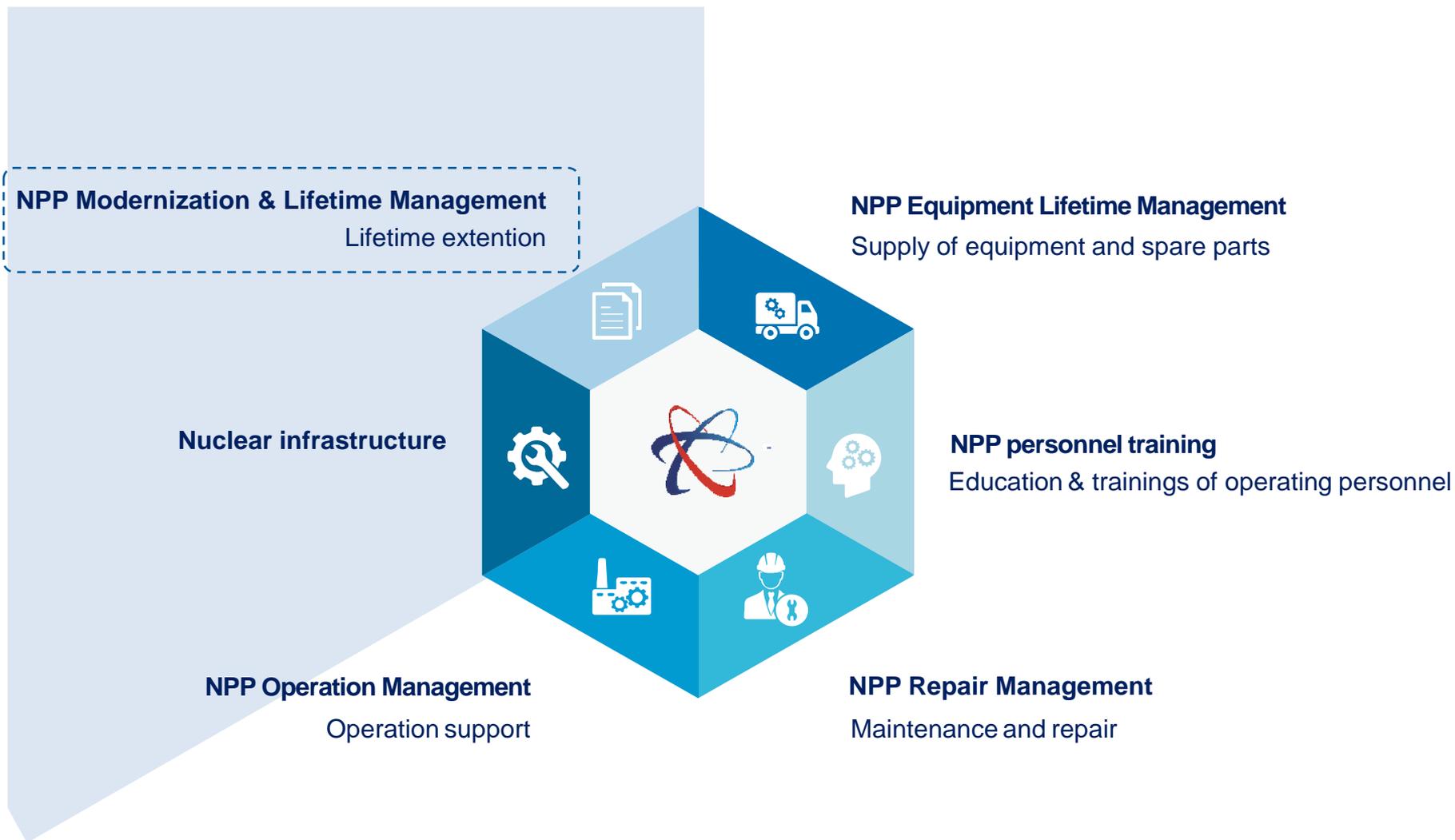
## Gidropress

R&D, modernization and optimization of power units



## Atomtechenergo

Commissioning operations, personnel training, developing documentation



## Models for the LTO project realization

Integrated organization  
of the LTO projects

“Keyturn” project  
realization

*Examples:*

- *Russia*
- *Armenia*

Realization of certain  
phases of the LTO  
projects

Realization of inspections  
and justification by  
modelling

*Example: Bulgaria*

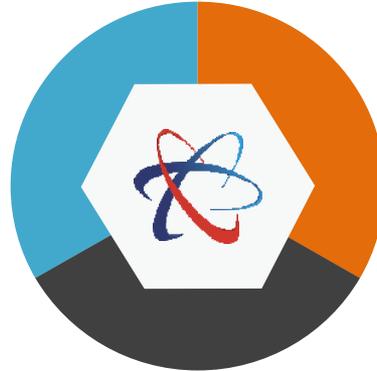
Particular calculations  
and works in the  
framework of LTO

- Realization of works and calculations
  - Preparation of the documentation
- Examples: Projects in Central Europe*
- Participation in modernization
- Examples: supply of new guiding vanes in Central Europe, generator modernization in Bulgaria*



## What we do

- Comprehensive survey of a power unit
- Modernization of a power unit in order to improve its safety level
- Justification of remaining lifetime of irreplaceable and non-renewable power unit elements
- In-depth power unit safety assessment



## What we consider

- Shorter time limits as compared to Russian extension projects
- Training of local subcontractors
- Development of multilanguage technical documentation
- New experience for the customer and local regulators
- Both Russian and local regulatory requirements

## Who performs the works

- General designer of the reactor plant
- Nuclear power plant design developers
- Manufacturers of main equipment
- Research organizations
- Local companies
- International partners



NPP	Extension period	Date of extension
Kola, units 1,2	15 years	2003, 2004
Novovoronezh, units 3,4	15 years	2001, 2002
Kola, unit 3	25 years	2011
Kola, unit 4	25 years	(October) 2014

- ✓ Lifetime management process has been initiated, is ongoing or is already achieved for all units in Russian NPP's

### Kola NPP



### Novovoronezh NPP





**RUSATOMSERVICE**



**NRC KURCHATOV INSTITUTE**

Consolidation of KI competences and products and global infrastructure of Rosatom

Effective sales of KI products and services at Russian and foreign markets



Implementation of current and future developments of KI in O&M offer of Rusatom Service

Base product: recovery annealing of reactor units  
«Heat annealing»



- ✓ Heat annealing planned for Kola-2 (September, 2016) and Novovoronezh -4 (May, 2017)
- ✓ It guarantees full restauration of the structure and mechanical properties of the RPV steels, and allows lifetime extension to 60 years and beyond

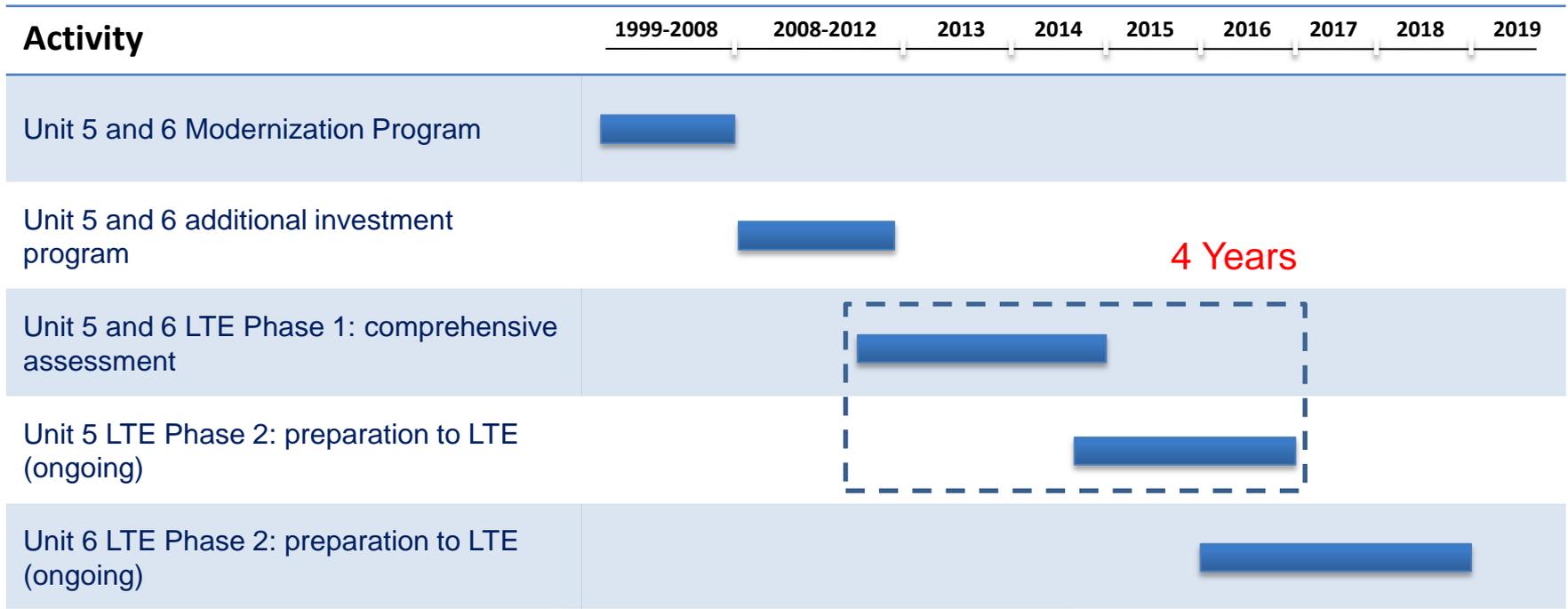
Country	Project	Implementation timeframe	Budget
Bulgaria	Feasibility justification of lifetime extension of Kozloduy NPP Unit 5 up to 60 years	2014 -2016	36.6 million €
Bulgaria	Feasibility justification of lifetime extension of Kozloduy NPP Unit 6 up to 60 years	2016 -2018	35 million €
Armenia	Armenian NPP Unit 2 lifetime extension for additional period up to 10 years	2015 – 2019	300 million €

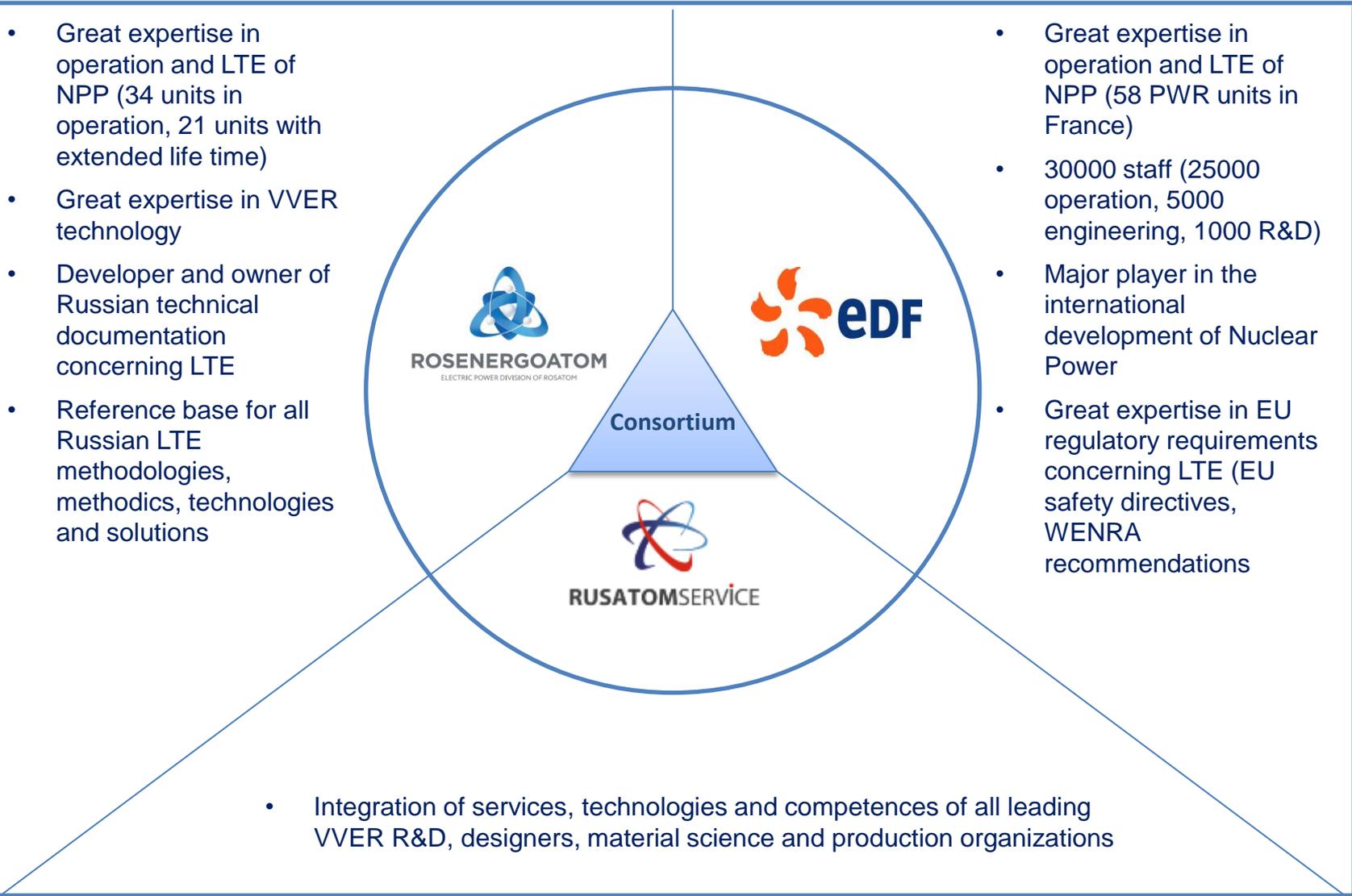
- ✓ NPP Kozloduy Unit 5 Lifetime Extension Project. Contractor - Consortium of Rusatom Service JSC (Consortium leader) – Rosenergoatom Concern OJSC - EDF (Electricite de France)
- ✓ NPP Kozloduy Unit 6 Lifetime Extension Project. Contractor - Consortium of Rusatom Service JSC (Consortium leader) – Risk Engineering (Bulgaria)
- ✓ Armenian NPP Unit 2 Lifetime Extension Project. Contractor – Rusatom Service JSC



## Lifetime extension for Kozloduy NPP UNITS 5,6









## Lifetime extension for Metsamor NPP UNIT 2





**Project goal:** Performance of a set of measures to prolong Armenian NPP service life by 10 years.

**Principal contractor:** affiliated structure

Rosatom State Corporation – Rusatom Service JSC

**Special conditions:** Absence of project cofinancing by Republic of Armenia

Twice shorter implementation time compared to Russian NPPs

**Power:** 1 x VVER-440 (408 MW)

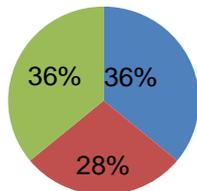
**Reactor type:** V-270

**Startup date:** May 3, 1980

**License expiration date:** September 2016

**Project time frame:** 2015–2019

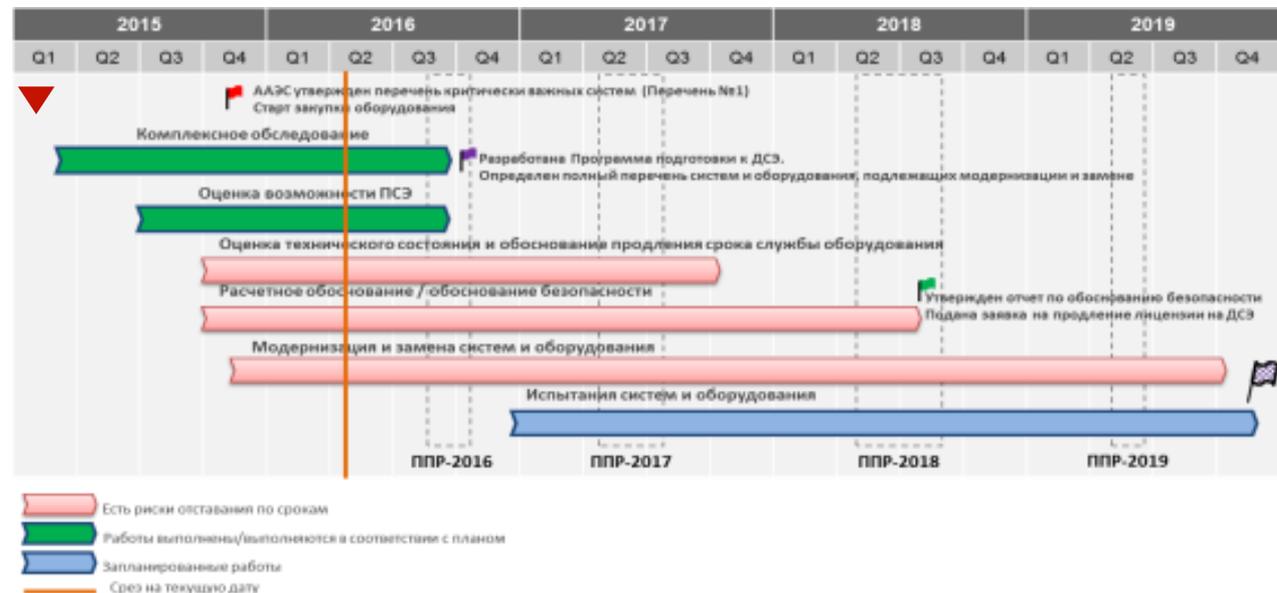
Share in power generation balance in Armenia



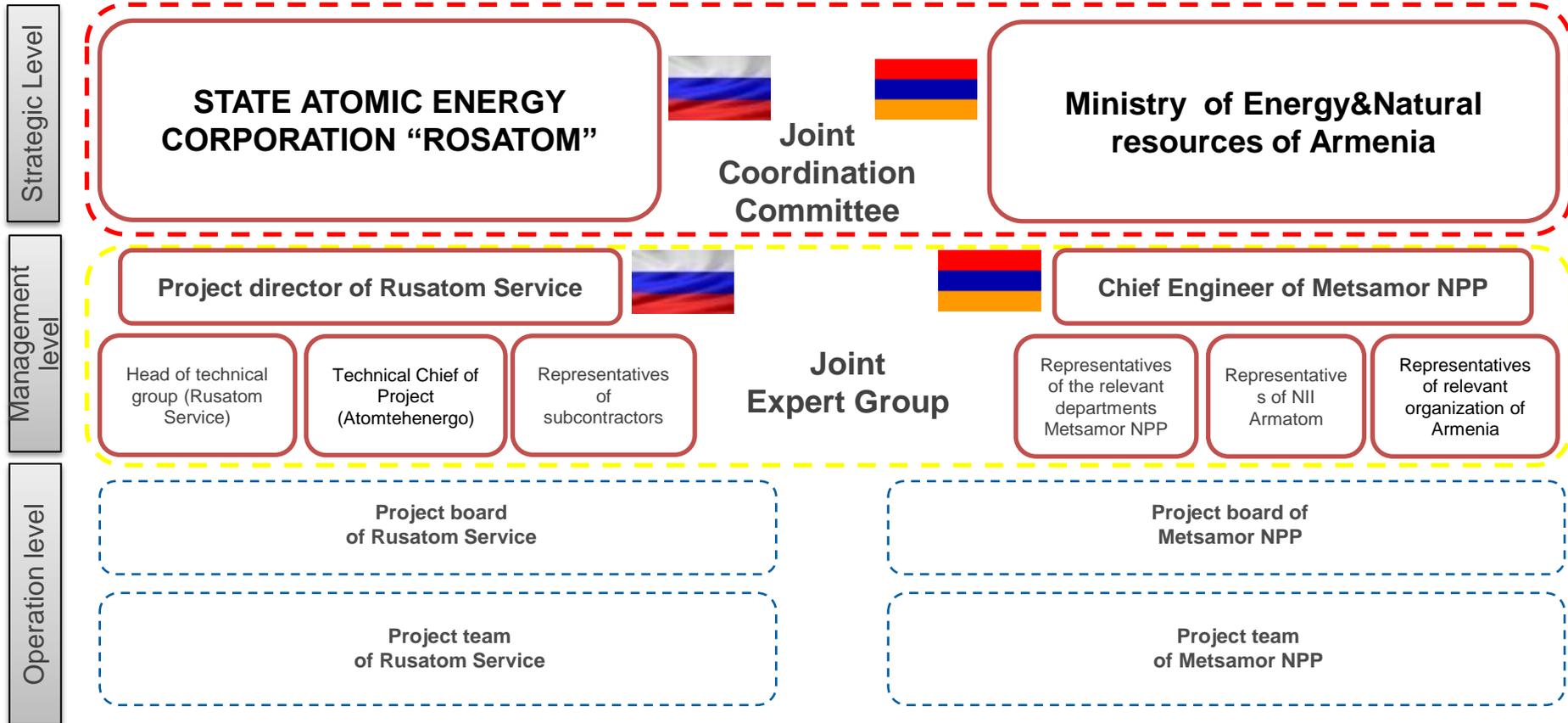
- TPP
- Hydroelectric and wind power plants
- NPP

**Power generation:**  
7.798 billion kW•h (in 2015).

**Cost per kW•h**  
TPP >> NPP



▼ The project is based on 2 intergovernmental agreements between Russian and Armenia  
 1. Agreement on Cooperation on Prolongation of Armenian NPP Unit 2 Service Life  
 2. Loan Agreement for Financing of Armenian NPP Unit 2 Service Life Prolongation



- STATE FINANCING OF THE PROJECT
- MANAGEMENT WITH THE PARTICIPATION OF THE Ministry of Energy & Natural resources of Armenia

### Phase 1: 2015 ÷ 2016

#### Performance of a set of works for assessment of technical feasibility and safety of lifetime extension:

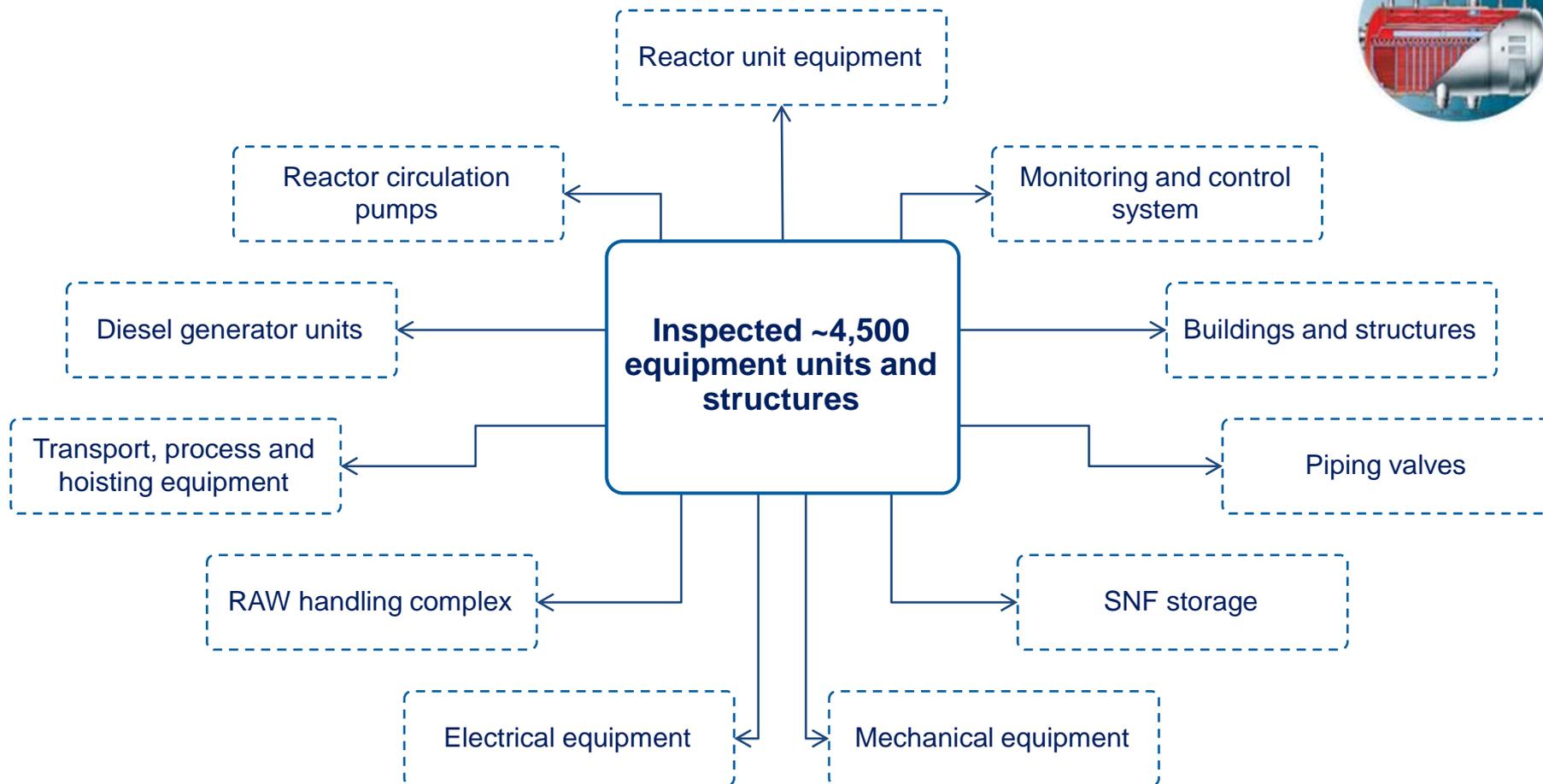
- Unit elements comprehensive assessment
- Unit safety evaluation
- Development of scope and range of works for unit preparation for extended operation period

### Phase 2: 2016 ÷ 2019

#### Performance of a set of works on unit preparation for extended operation period:

- Development of procedure for unit preparation for extended operation period:
- Modernization of systems and equipment, replacement of equipment
- Additional (instrumental) inspection of unit elements and performance of calculations
- Justifying calculations of feasibility of lifetime extension for unrestorable and irreplaceable equipment
- Comprehensive unit safety evaluation





### 1. Completed unit elements comprehensive assessment:

- preliminary assessment of unit elements lifetime extension feasibility
- justification of feasibility of SNF storage at NPP area during extended operation period (performed by Armenian NPP)
- justification of safe RAW handling during extended operation period
- justifying calculations of feasibility of lifetime extension for buildings and facilities
- defined unit elements to be replaced
- defined Unit elements requiring additional (instrumental) examination and calculations

### 2. Armenian NPP performed unit safety evaluation

### 3. Developed scope and range of works for unit preparation for extended operation period



---

Parallel to comprehensive assessment of unit elements, works were commenced on preliminary evaluation of feasibility of main reactor unit equipment LTE and modernization of systems and equipment

### Safety improvement -

modernization of ECCS and sprinkler system to ensure unit safety in case of design basis accident with initiating events:

- leak of heat transfer fluid from primary circuit with equivalent diameter of DN100 mm;
- guillotine rupture of pressurizer surge pipeline, DN209 mm.

### Modernization of systems and equipment

- RAW handling complex modernization
- Modernization/replacement of control rods electrical equipment
- Cooling towers
- Modernization of turbine units
- Modernization of turbine generators
- Modernization/replacement of unit transformers

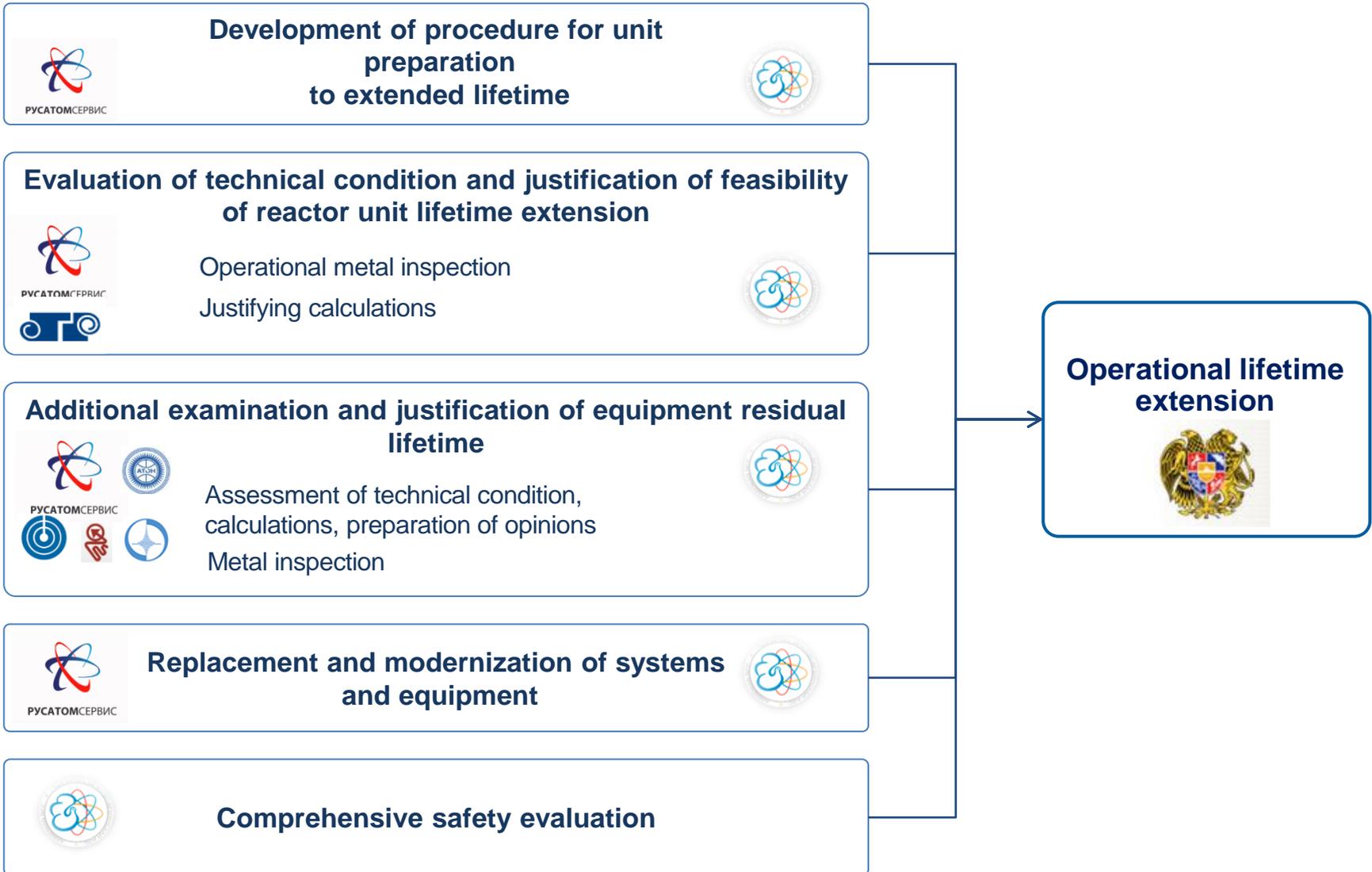
### Replacement of unit elements

- IT system
- In-core Instrumentation System
- Intermediate rods
- Industrial Seismic Protection System
- Heat insulation of reactor unit equipment and piping





# Pending work performance phases





РОСАТОМ



## CONTACTS

**Thank you for your attention!**



РУСАТОМСЕРВИС

**Tel. +74959957680**

**Fax +74959957682**

**[info@rusatomservice.ru](mailto:info@rusatomservice.ru)**

