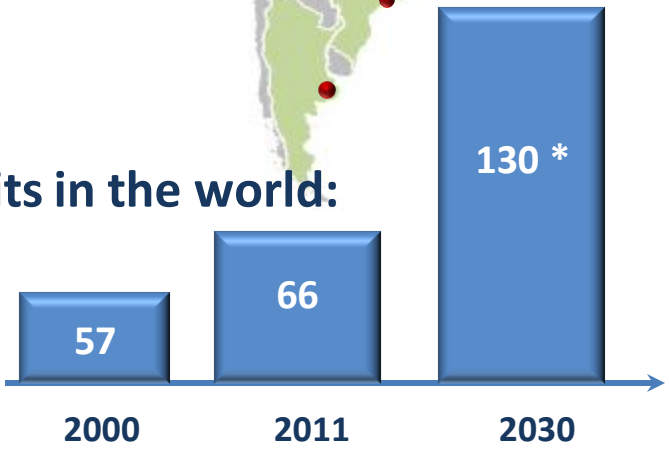
Organisation of maintenance at foreign VVER Units

Technical director of CSC “Rusatom Service”
V. Kuzmin

Moscow, May, 21-23rd 2014

Map of VVER – 2030 year

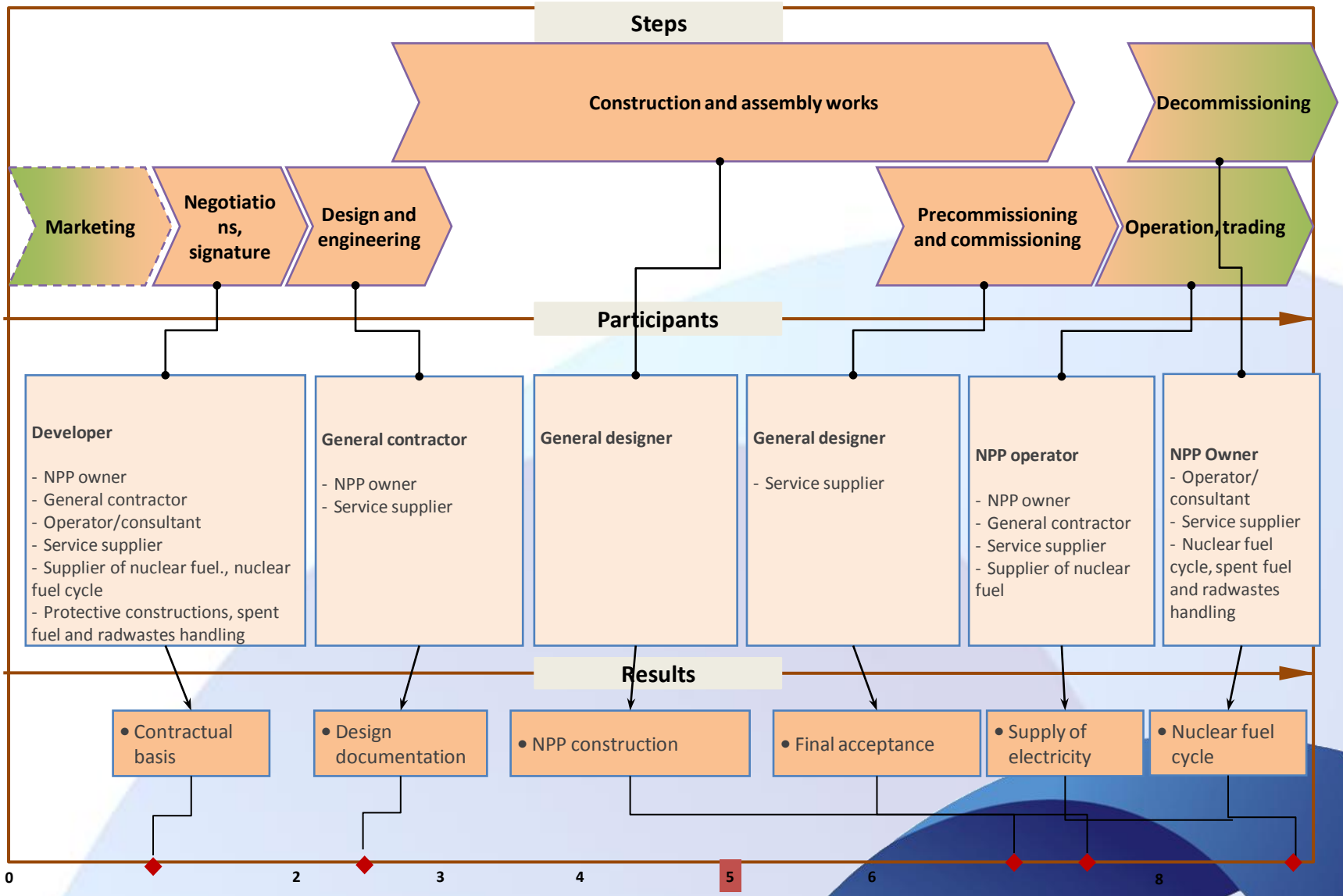
VVER Units in the world:



* Evaluation by SC “Rosatom”

РУСАТОМСЕРВИС

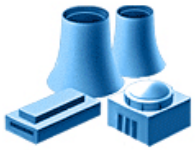
ORGANISATION OF OPERATIONS AT FOREIGN NPS DESIGN



GOALS:

1. To enlarge number of project participants from Rosatom
2. To maximize joint financial result

Engineering decision



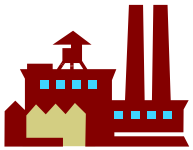
- Modern nuclear power plant designs (generation 3 +)
- NPP construction (equipment, construction and installation, start-up)
- NFC products (natural uranium, PMU / SWU, fuel)
- Service (spares, repairing, upgrading)
- **Services of NPP oepration (O&M)**

Services at the end of nuclear cycle (back-end)

- Spent fuel handling
- Radwstes treatment
- **Decommissioning of nuclear facility (research reactor, NPP)**

Rosatom is a responsible supplier of integrated offers

Industrial decision



- Localization of equipment and services
- Certification of foreign national suppliers
- Participation suppliers in projects of Rosatom in third countries

Regulation and infrastructure

- Development of the regulatory framework
- Supporting the development of the necessary infrastructure of nuclear energy (network infrastructure, NFC facilities, etc.)

Financial decision

- Implementation of projects BOO
- State loans
- Support of ECA

Human resources (knowledge, skills)

- The development of the research base and higher education
- Training of qualified personnel, including operational
- Services on formation of NPP owner competence on operation

Russian scenario

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Subsidiary of the constructed NPP

Concern "Rosenergoatom" - the Russian center of competence on the organization nuclear power plant operation

Key responsibilities:

- Operation of nuclear power plants in Russia
- Communication with regulators and government agencies
- Exchange of information with engineering organizations
- Consolidation and dissemination of experience on operation
- Distribution of human resources
- Quality management system, control and regulation

Scientific and engineering services, consulting

Foreign scenario

NPP owner (customer)

Rusatom service - business services integrator on operation for NPP projects abroad

Key responsibilities:

- Provision of services for organizations operating nuclear power plants abroad to different customers (foreign customers - energy companies / owners, design companies with the participation of Russian stakeholders)
- Performance of the functions of the architect-engineer on the organization of operation for the customer and subcontractors (members of the pool companies: KREA, Atomenergoremont, Atomteheksport etc.)

NB: Foreign legislation does not allow KREA to provide direct services on operation in a format similar to the Russian

SERVICES ON OPERATION OF FOREIGN NPPS

1 Model – competent customer

- In the country of NPP construction there is well developed legal regulation in the field of nuclear power plant
- The future owner and operator of nuclear power plant is competent in operation (including Russian design)
- Possibility to transfer experience on operation at modern Russian projects of nuclear power plant construction (chief support, consulting)

Case: Czech, Hungary

2 Model – country-newcomer

- In the country of NPP construction legal regulation in the field of NPP operation is missing, regulatory body does not have experience in licensing and regulation of NPP
- The future owner of nuclear power plant has no experience in NPP operation
- Required (full) education and training of operating personnel of the future NPP (possibly - by Russian standards, with a parallel implementation of legislation in the recipient country)

Cases: Bangladesh, Belorussia, Vietnam

3 Model – Rosatom – the leader

- In the country no of NPP construction _ legal regulation in the field of NPP operation, the regulatory body (regulator) has no experience in the licensing and supervision of nuclear power plant
- The future owner of nuclear power plant has no experience in NPP operation
- Requires a full-scale education and training of operating personnel of the future NPP (possibly - by Russian standards, with the parallel implementation of legislation in the recipient country)

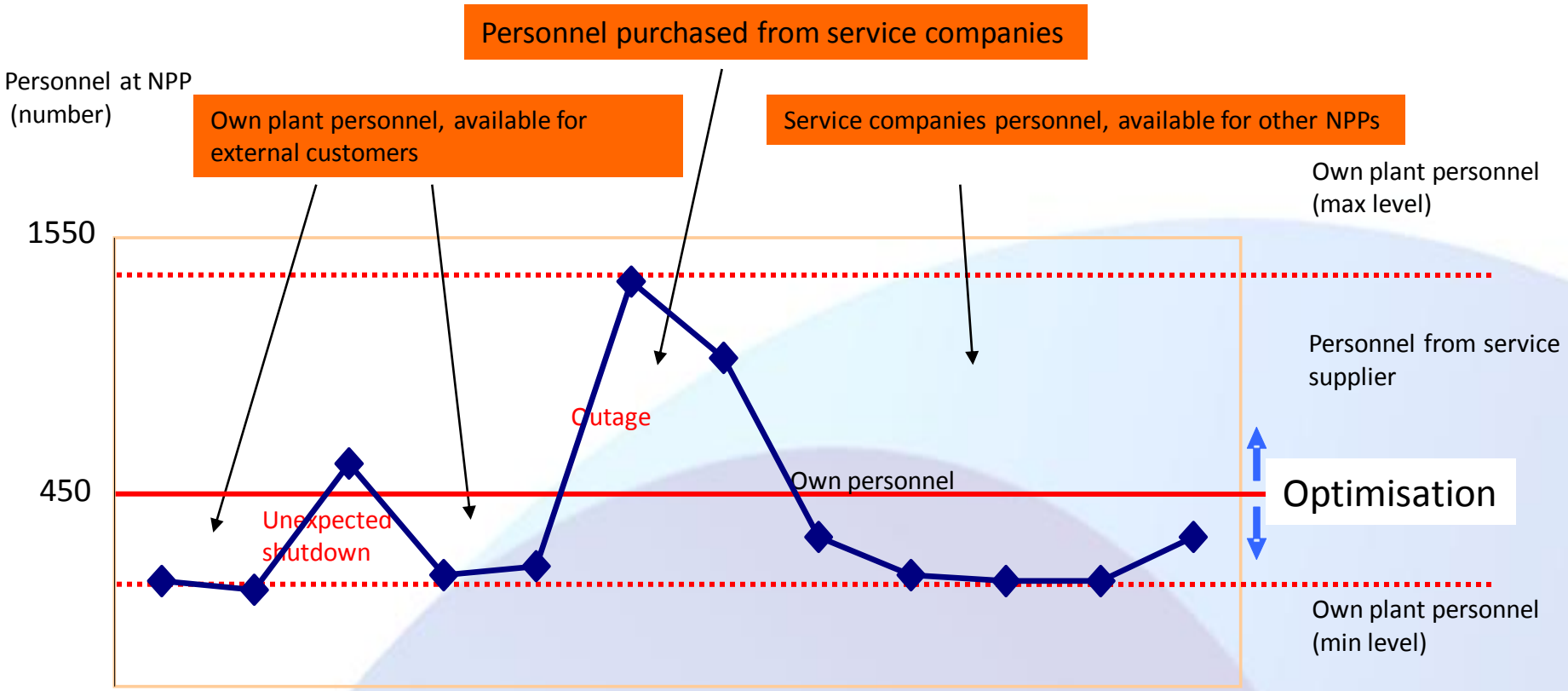
Case: Turkey

4 Model – Rosatom - leaded

- In a country where nuclear power plant will be built, there is a developed legal regulation in the field of nuclear power plant ("not close" technological culture)
- The future owner of nuclear power plant _ has no experience in NPP operation
- Requires a full-scale education and training of operating personnel of the future NPP, according to local (rigid) standards
- Possible high competition in the provision of services to the owner of nuclear power plant on organization of operation from other market players

Cases:

Finland The UK


Personnel purchased from service companies
Personnel at NPP (number)
Own plant personnel, available for external customers
Service companies personnel, available for other NPPs
Own plant personnel (max level)
1550
Personnel from service supplier
Outage
450
Own personnel
Optimisation
Unexpected shutdown
Own plant personnel (min level)
Need of personnel within the year

Model of system outsourcing

"Maximum from outside"

Case of energy companies with a small installed capacity (AKSPO Swiss, Finnish Fortum, American energy company with a small "fleet" of NPPs)

Basic approach:

- Gradual reduction in the number of its own staff after the NPP construction
- Centralization of personnel only on key competences for operation and maintenance. All auxiliary and non-critical functions displayed on outsourcing for cost optimization

Model of self-sustainability

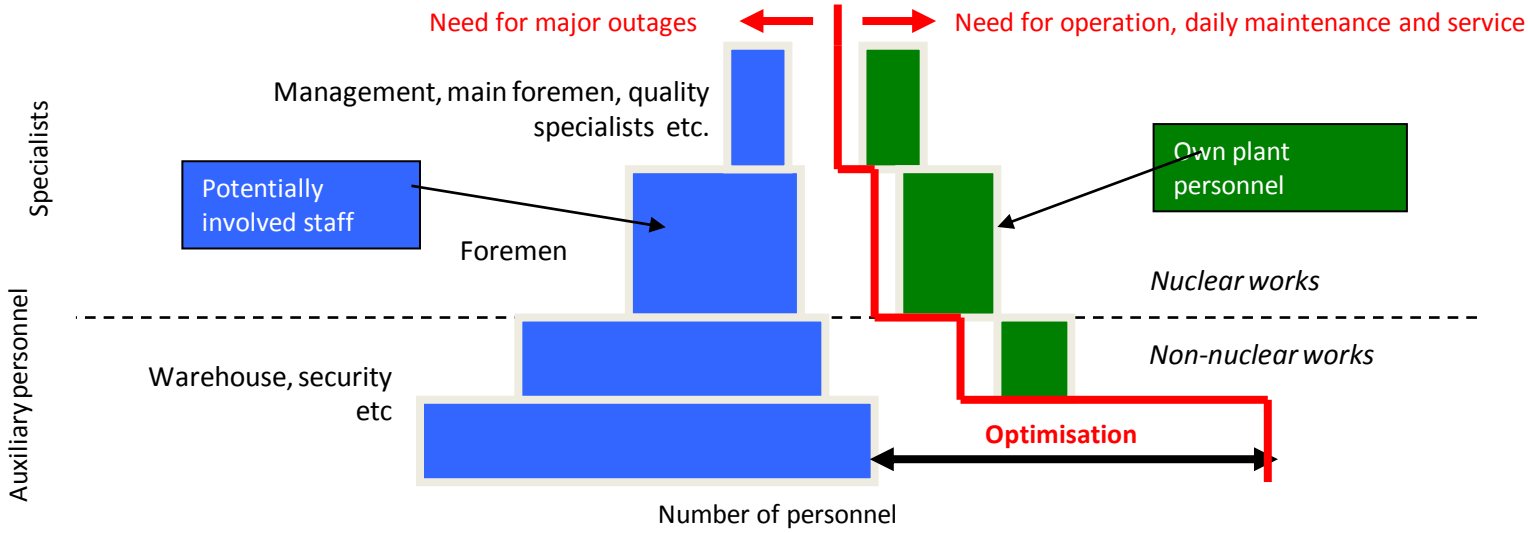
"Maximum inside"

Case of French energy company EDF

Basic approach:

- Significant set of competencies is consolidated in the company, because EdF business includes the design, R & D, service and maintenance of nuclear power plants.
- Monetization of competence - advising on a wide nomenclature that economically justify maintaining a large staff.

KConceptual approach to optimize staffing ratio of NPP operation



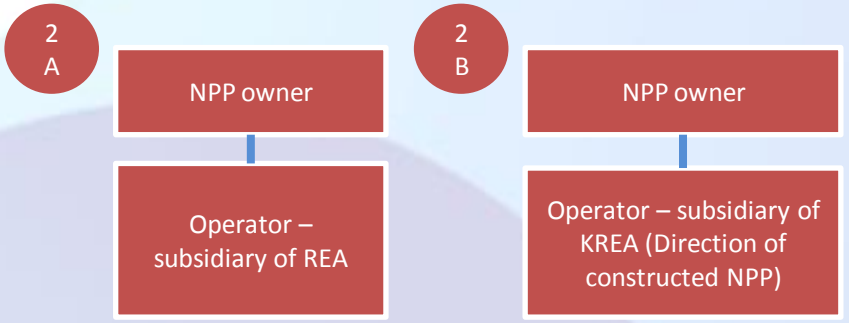
ORGANISATIONAL FLOWCHARTS ON OEPRATION IN FOREIGN PROJECTS

1 Model EPC – competent customer

- nuclear power plant operator - foreign customer
- **KREA - Consultant of the customer**
- Rusatom Service - integrator, architect-engineer
- Example: NPP Tianwan (China)

2 Model BOO

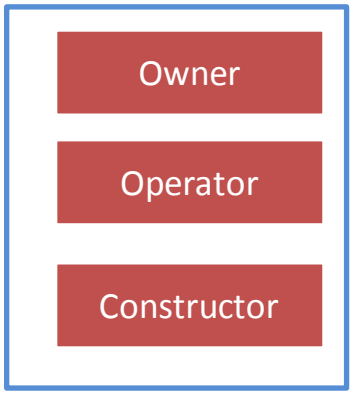
- nuclear power plant operator - design company with equity participation of Rosatom
- **KREA - Consultant**
- Examples: Akkuyu nuclear power plant, nuclear power plants in Jordan and the UK



3 Model EPC, country-newcomer

- nuclear power plant operator - foreign customer
- **KREA - Consultant**
- Rusatom Service - integrator, architect-engineer
- Examples: Bushehr

NB: Countries that are just beginning to develop nuclear energyhave several options for the structure of the 'owner - operator. "IAEA guidelines provide a general description of the roles and responsibilities of owners, operators and license holders, and the country includes these requirements in its laws and regulations.



Model BOO.
PC "Akkuyu," according to the MPS:

- nuclear power plant owner
- operating organization
- responsible for the construction of nuclear power plant

Options on operation will be largely determined by the conditions of the license

According to MPS it is assumed that PC will be the holder of the license for operation

Thus, under the law PC "Akkuyu" has the right to:
1. Get and be the owner of the license to operate nuclear power plant (an operator)
Independently operate nuclear power plant (operating organization based on PC)
Buy operation services (operational support) - i.e. hire different subcontracted organization, for example KREA while maintaining a license to operate for themselves.

2. Operate nuclear power plant through a subsidiary or other related company

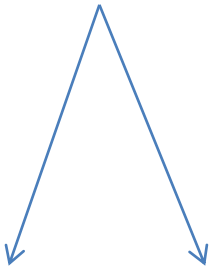
3. Hire operator for NPP operation on a competitive basis or of their own choice (in this case, the selected organization will receive a license to operate a nuclear power plant and will be an operator)

In option 1 and 2, PC "Akkuyu" or subsidiary company or another similar to PC "Akkuyu" is the operator and is responsible for the operation of nuclear power plant

In any of the three options PC controls the operator

РУСАТОМСЕРВИС

Integrator of services on organisation of operation abroad



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Pool of Russian and foreign subcontractors

Business package of operational services:

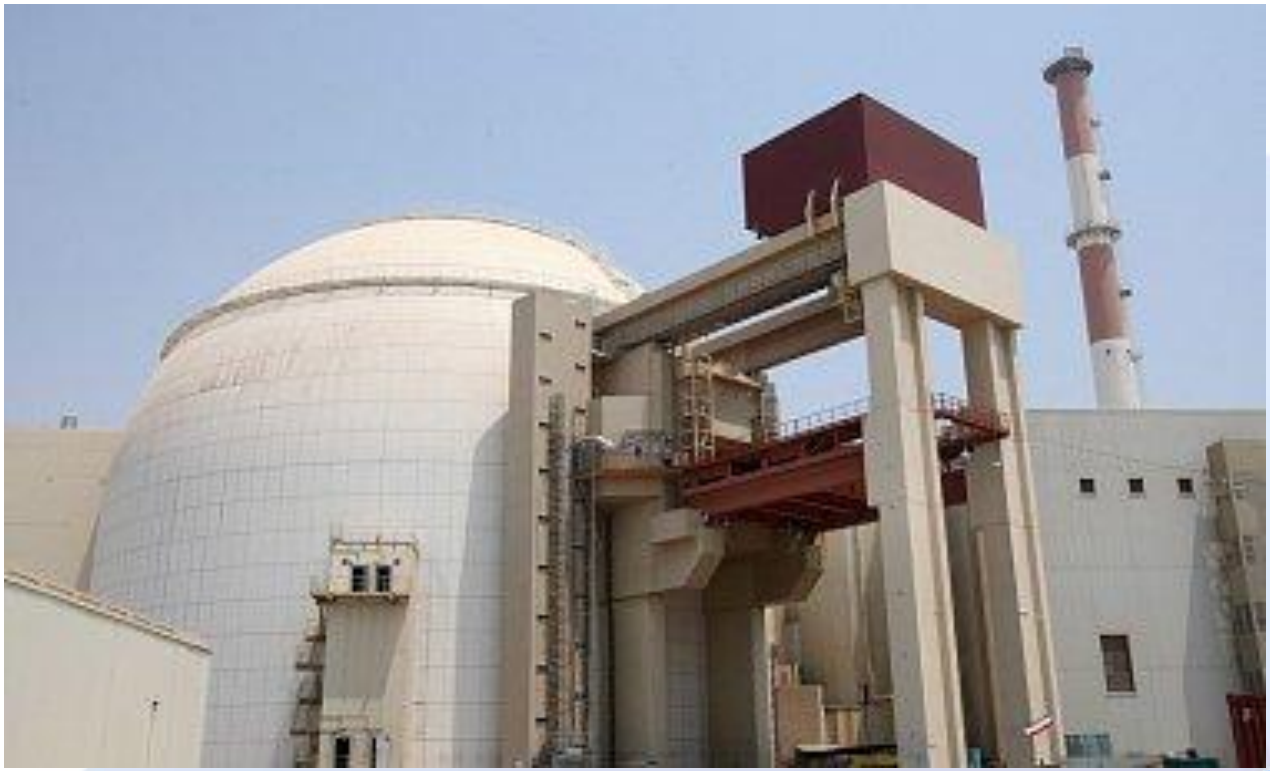
1. Safe operation in all modes of operation and emergency conditions .
2. Adoption of management programs .
3. Development of the policy on nuclear safety and quality assurance , service compliance and other RMD .
4. Allocation of resources, including personnel .
5. Check and control function and control.
6. Establish contacts with authorities and regulators.
7. Establish links with designing , construction , manufacturing and other organizations involved in plant design , to ensure the transmission of data and understanding of the conditions of the plant design , information and expertise.

NB: Foreign legislation does not allow KREA to provide direct services on operation in a format similar to the Russian

- Modernization
- Life-time extension
- Power load upgrade
- Organization and carrying out maintenance and repair
- Technical consulting and audit
- Development of documentation
- Supply of equipment and spare parts
- Training of personnel

- Organization and conduct of two middle maintenance procedures and one overhaul at "Bushehr" NPP (Iran);
- Assess and justify life-time extension of unit 5 at nuclear power plant "Kozloduy" (Bulgaria);
- Upgrading generators of Units 5 and 6 at nuclear power plant "Kozloduy" in order to increase capacity up to 1100MW (Bulgaria)
- Lifetime extension of nuclear power plant "Metsamor" (Armenia);
- Supply of equipment and spare parts for the nuclear power plant in Ukraine, China, Bulgaria, Hungary

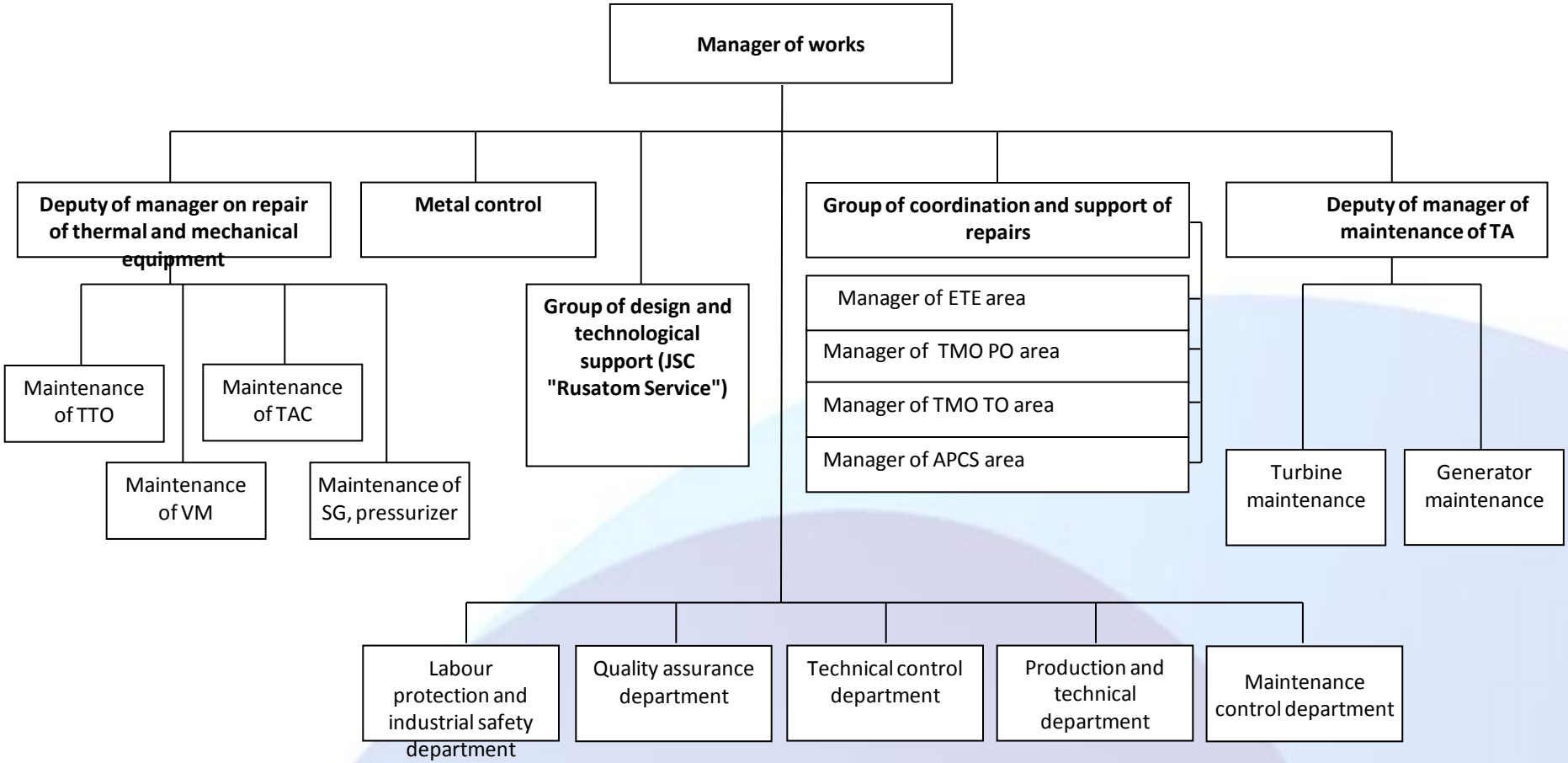
Project “Preventive maintenance at Bushehr NPP”



MAIN PROJECT DATA

- JSC "Rusatom Service" is selected a general contractor on the two middle and one overhaul at "Bushehr" NPP.
- Duration of repair in accordance with the approved schedule - 80 days.
- The scope of the first medium repair:
  - Medium repair of VVER-1000 with additional installation of drives 18 CPS.
  - Overhaul of two steam generator PGV-1000M.
  - Overhaul of two RCP-1391.
  - Overhaul of two motors RCP-1391.
  - Overhaul of LPC-2.
  - Opening of LPC-1, 3 to inspect the blades of the last stage.
  - Overhaul of the generator exciter TVV-1000-2/27T3 with BVD-3400-3000T3.
  - TMO repair and electrical equipment of security channels.
  - Repair and calibration of equipment APCS.
- The remaining amount of work is performed by Iranian contractors headed by TAPNA.

STRUCTURE PF MAINTENANCE CONTROL AT BUSHEHR UNIT 1



FEATURES OF ORGANISATION OF THE FIRST PREVENTIVE MAINTENANCE AT BUSHEHR NPP

- The main feature of the first average repair is that unit construction will be completed during maintenance. Duration of extra work on the obligations of NPP may exceed 1 month.
- Lack of information about the actual duration of the power unit fuel campaign led to a shift in the start of repairs in 15 days.
- The organizational structure of Maintenance of power unit created by BNPP does not allow rapid decision-making and management of the repair process.
- Supply planning system does not allow to analyze the availability of spare parts and make timely purchases, due to what all deliveries are carried out in emergency mode.

Implementation of the project on the evaluation and justification o design life-time extension at Kozloduy NPP unit 5

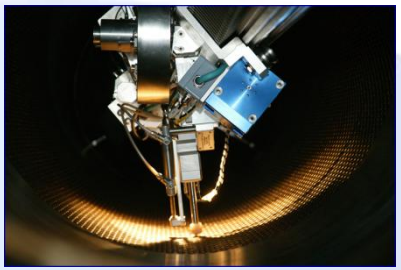
- Currently JSC "Rusatom Service" is working on a comprehensive survey at site of NPP "Kozloduy" with the participation of leading Russian companies, Chief Constructor and Chief designer in accordance with our program and methodology.
- Due date to provide justification for life-time extension of the of power unit № 5 of nuclear power plant "Kozloduy" to the regulatory authority of Bulgaria is the year 2016.

- According to instruction of "Rosatom" ZAO "Rusatom Service" as a general contractor organizes implementation in the period of 2013-2018 a complex of measures on justification of life-time extension of unit № 2 ANPP.
- Action Plan for LTE at ANPP provides for:
  - Comprehensive examination of systems, components and structures (CCM) by type of nuclear power plant equipment;
  - Evaluation of technical condition of the resource and the CCM;
  - Calculation justification of the possibility of lifetime extension, replacement of worn-out items and modernization of the items which are not subject to replacement;
  - Replacing CCM which are worn out;
  - Modernization of the CCM which are not subject to replacement.

- Currently JSC "Rusatom Service" is working on a comprehensive survey at the site of the NPP with the leading Russian enterprises, Chief Constructor and Chief designer in accordance with our program and methodology.
- Due date to provide justification for life-time extension of the of power unit № 5 of nuclear power plant "Kozloduy" to the regulatory authority of Bulgaria is the year 2016.

PERSPECTIVE AREAS OF MAINTENANCE AND REPAIR AT FOREIGN NPPS

- Long-term maintenance contract for new units at NPP "Paks";
- Long-term maintenance contract with new Finnish nuclear power plant;
- Development of maintenance system for new projects of VVER-TOI;
  (For Turkish NPP Akkuyu)
- Implementation at Russian NPPs modern technology of maintenance and repair of equipment



Organization of long-term service maintenance of new foreign NPPs (Hungary and Finland)

- Performed a preliminary estimate of labor costs for a ten years period of service maintenance Unit 1 at NPP "Hanhikivi» (Finland).

- Scope of works on preventive maintenance adopted in accordance with the "Typical statements of scope of routine maintenance and repair at NPPs with reactors VVER-1000 (V-320)".
- Number of staff and duration of its work accepted by peer review, on the basis of similar work at NPPs in Russia and Iran.

- The cost of spare parts and the establishment of minimum reserve are taken in proportion to the scope of work performed on the basis of experience in implementing preventive maintenance at Russian NPPs.

Thank you for attention!