



PROJECT

«Preliminary studies for the decommissioning of the reactor compartments
of the former Paldiski military nuclear site
and for the establishment of a radioactive waste repository»

INTRODUCTION MEETING

FCNRS –Managing Company of the Back End Business Group,
a unified engineering and manufacturing complex
at the final stage of the nuclear fuel cycle

Tatiana Makarchuk
Head of a Department, FCNRS

The Republic of Estonia, Tallinn, 14th of November, 2014

JSC FCNRS

Federal Center for Nuclear and Radiation Safety



The company was founded in 2007 to address process tasks related to ensuring nuclear, radiological and environmental safety when managing SNF and radwaste and decommissioning hazardous nuclear facilities.

FCNRS has been authorised by the RF Government to transact international business in repatriating SFAs of foreign reactors.

A management company for the Back End Business Group was established on the basis of FCNRS in 2013.

Company personnel

over 200 employees

Licenses, permissions







25

Key of business

- Management of International Technical Assistance Projects in the RF;
- Repatriation of SNF of Russian production from foreign NPP & Research Reactor for interim storage and reprocessing;
- Coordination of activities under the intergovernmental targeted program 'Remediation of Uranium Mining Facility in the Central Asian Countries'

ROSATOM Back End Business Group

Back End Business Group Companies

| Company | | Specialization profile |
|-------------------------------|---|--|
| FCNRS |  | The management company formulates and develops the key of activity of the Business Group; manages the Business Group activities in the field of radwaste, SNF management and decommissioning |
| Mining and Chemical Combine |  | Leading company with complete technological complex in the field of SNF treatment |
| RosRAO |  | Specialised entity for radwaste management |
| RADON |  | Specialised centre for development of radwaste treatment technologies and equipment |
| V.G. Khlopin Radium Institute |  | R&D and manufacturing core of the Back End Business Group with unique trial facilities that enable research and application activities |
| DNR Center |  | An entity specialising in decommissioning of nuclear facilities |

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3

FCNRS International Activities



24 countries and international organisations

76 projects

over **100** contracts

appr. **200** employees

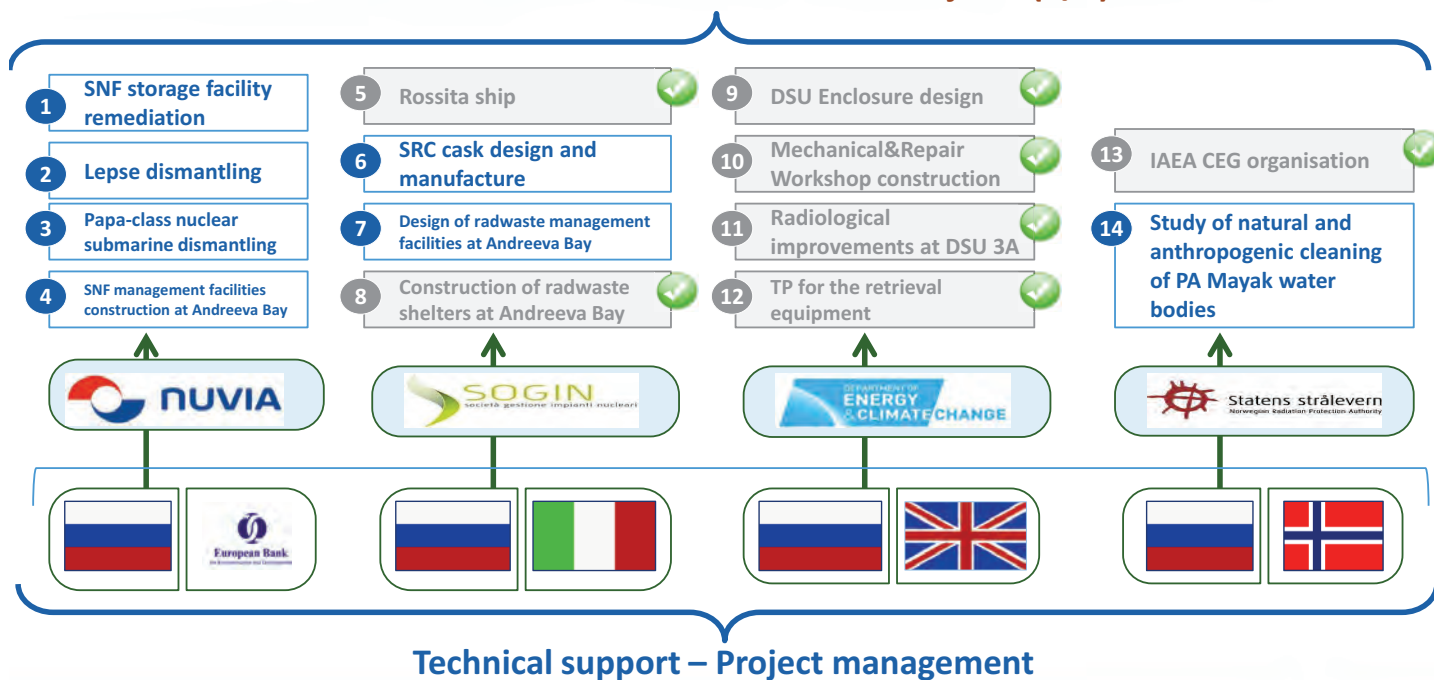
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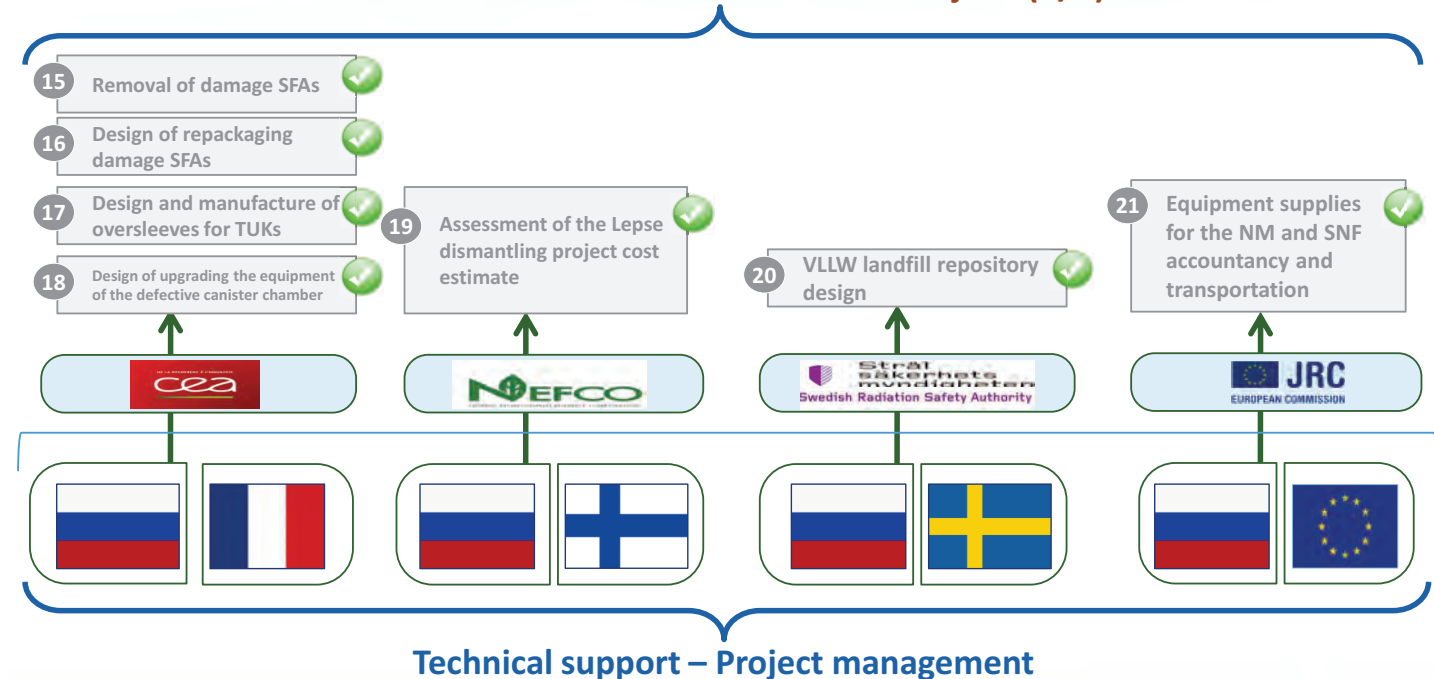
FCNRS International Activities

International Technical Assistance Projects (1/1)



FCNRS International Activities

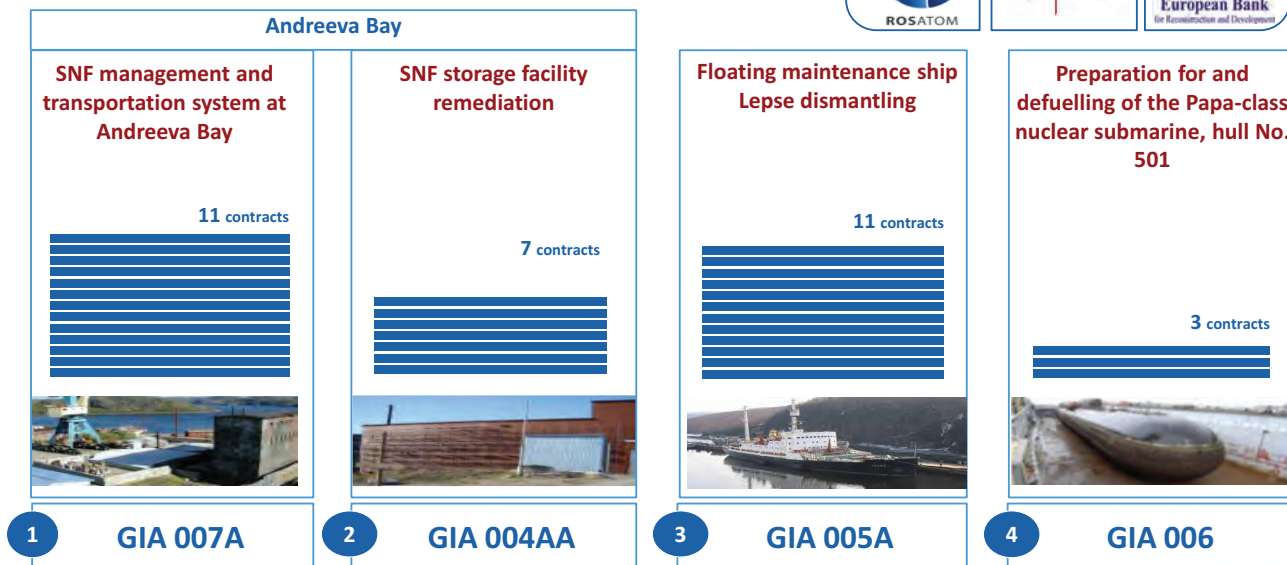
International Technical Assistance Projects(1/2)



FCNRS International Activities

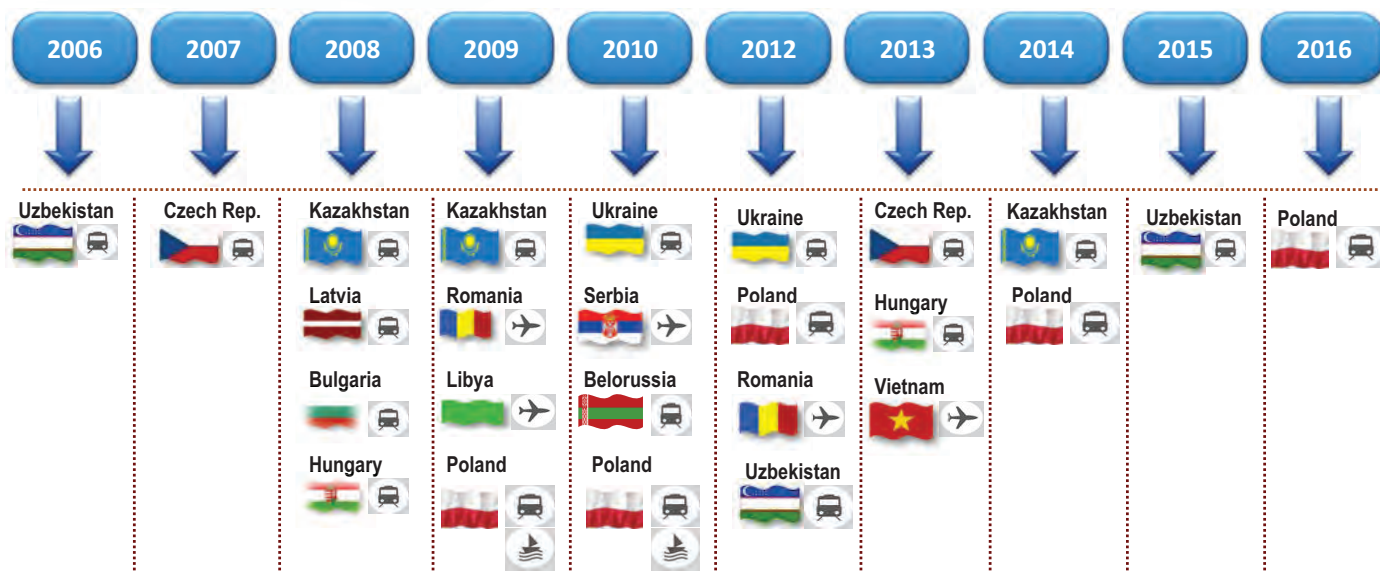
Implementation of ITA projects as exemplified by cooperation with EBRD

31 contracts



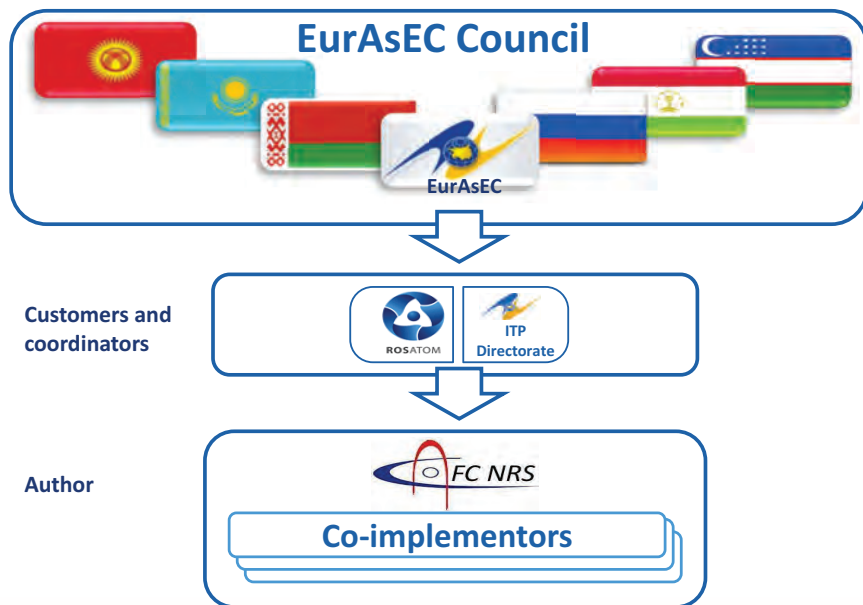
FCNRS International Activities

SNF Repatriations (RRRFR Program)



Over 5,000T of SNF from NPPs and research reactors built with technical support from the Soviet Union have been returned to the RF in the framework of the repatriation program

Intergovernmental Targeted Program (ITP) 'Remediation of Uranium Mining Facilities in Central Asian Countries' (EurAsEC Member States)



There are approximately a hundred of tailing dumps in the Republics of Tajikistan and Kyrgyzstan, with radionuclides posing potential hazard for the population of both these Republics and neighbouring countries.

FCNRS has developed the ITP 'Remediation of Uranium Mining Facilities in Central Asian Countries'.

The EurAsEC ITP has been approved and endorsed by the governments of the EurAsEC member states.

The ITP implementation started in 2013 and is scheduled for 2013 to 2018.

Development Strategy at the International Market

Geography of the Back End Business Group Interests

The Back End Business Group in the course of its international business development will focus its activities on:



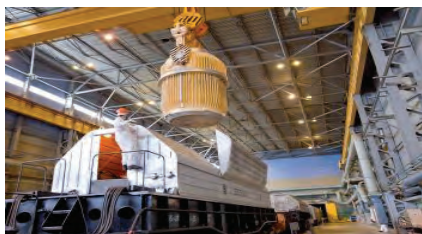
1. Countries operating nuclear facilities built according to designs and with technical assistance of the former Soviet Union and the Russian Federation (Eastern Europe and CIS);
2. Countries where Rosatom's projects are implemented (China, India, Iran, Turkey, Finland, Bangladesh, Vietnam)
3. Other countries interested in developing nuclear power energy (South America, UAE, Western Europe, Egypt, Japan)

SNF Management

Entities of the Back End Business Group provide a full range of services in the area of spent nuclear fuel management in the Russian and foreign markets



Products and Services for SNF Management



Operation Services

Entities of the Back End Business Group provide a full range of engineering, information, production and methodological services for SNF management:

- SNF preparation for transportation off site
- transportation (by air, rail, water, road)
- storage (including casks)
- reloading
- reprocessing
- development and introduction of new products
- HLW storage

Products and Services for SNF Management



Process Solutions, Equipment Supply

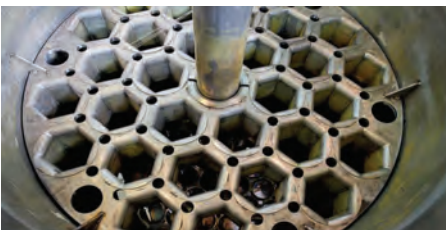
PROCESS DESIGN, R&D:

- development of process, logistic schemes and solutions
- process design of infrastructure facilities
- generation of permissive documentation package
- development of policies, concepts and strategies

EQUIPMENT SUPPLY:

- development and fabrication of casks, transportation means and service equipment
- fabrication of equipment for cooling pools and storage facilities
- transport and process equipment
- supervised installation, commissioning

SNF Management



Main Customers and Partners

- Concern "Rosenergoatom" (Russia)
- SE NNEGC "Energoatom" (Ukraine)
- "Paks" NPP (Hungary)
- "Kozloduy" NPP (Bulgaria)
- National Nuclear Center (Kazakhstan)
- Institute of Nuclear Physics in the Academy of Sciences (Uzbekistan)
- National Research Institute for Nuclear Physics and Nuclear Engineering "Horia Hulubei" (Romania)
- RW Management Enterprise (Poland)
- The Vinča Institute of Nuclear Sciences (Serbia)
- Dalat Nuclear Research Institute (Vietnam)
- Rossendorf Research Centre (Germany) etc.

SNF Management



Projects/ Main Facts

- 194 NPS of the Russian Navy were unloaded and shipment for interim storage or SNF reprocessing in the framework of the Program “Utilization of Nuclear Submarines, Nuclear Powered Surface Ships, Nuclear Maintenance Vessels”
- More than 5 000 tons of SNF from NPPs and RRs constructed with the technical assistance of the Soviet Union and the Russian Federation were repatriated in the framework of Intergovernmental Agreements
- Routine unloading and transportation of SFA of Russian NPPs for centralized storage and reprocessing
- Unloading, transportation and reprocessing of NPP and NPS defective fuel

RW Management

Entities of the Back End Business Group provide a full range of services for RW management, including collection, transportation, treatment, conditioning and long-term storage



Products and Services for RW Management



Operation Services

- Collection of RW and isotope products
- Assortment and categorization
- Conditioning
- Treatment:
 - LRW: filtration, ultra filtration, evaporation;
 - SRW: decontamination, fragmentation, compacting, incineration;
- Transportation
- Container shipping, certification
- Long-term safe storage
- Preparation for disposal

Products and Services for RW Management



Process Solutions, Equipment Supply

- Development and fabrication of packages, containers for RW shipping and storage
- Development and fabrication of transportation means and service equipment
- Process design of the infrastructure facilities
- Refinement of process modes
- Remediation of radiation hazardous areas and site decontamination
- Agreement with the supervision authorities, obtaining permits, certification
- Radiological and ecological monitoring

RW Management



Main Customers and Partners

- State Corporation “Rosatom”
- Russian Ministry of Defense
- Moscow Government
- MSU by M.V. Lomonosov
- NRC “Kurchatov Institute”
- JSC Zvezdochka Shipbuilding Center
- ANDRA (France)
- AS A.L.A.R.A. (Estonia)
- Belgatom (Belgium)
- Mitsubishi Research Institute Inc. (Japan)
- ENVINET a.s. (Czech Republic)
- United States Department of Energy, DOE (US) etc.

RW Management



Projects/ Main Facts

- Remediation of the industrial site of JSC “Mosrentgen”, Moscow region, 2014
- Radiation-remediation works at the site of RRC “Kurchatov Institute”, Moscow
- Projects for purification of LRW at the Navy sites, Murmansk
- Supply of equipment for purification of LRW and decontamination of surfaces in the framework of the IAEA projects
- Remediation of the site of JSC “Podolsk Nonferrous Metals Plant” (PZTsM), Moscow region
- Verification of technologies for purification of NPP “Fukushima-1” contaminated water from radioactive tritium

Decommissioning

The Back End Business Group entities carry out works on decommissioning of nuclear facilities



Decommissioning Services



Operation Services

- Removal of NM and SNF from site
- CERSA
- Process equipment and systems dismantling
- RW removal and conditioning
- Decontamination of contaminated surfaces
- Development of additional engineering safety barriers
- Building structures dismantling
- Decommissioning of RW storage
- Remediation of contaminated areas

Decommissioning Services



Main Customers and Partners

- State Corporation “Rosatom”
- JSC “Concern Rosenergoatom”
- FSUE “PA” Mayak”
- JSC “TVEL”
- ANDR (Romania)
- NUKEM Technologies GmbH (Germany)
- EBRD
- Ansaldo Nukleare (Italy)
- Sogin (Italy)
- others

Decommissioning Services



Projects/ Main Facts

- Works on preparation for decommissioning and actual decommissioning: - PUGR (JSC “DNR Center”, FSUE FNO “MCC”)
- Works on preparation for decommissioning, Stage 1 of Beloyarsk NPP
- Disposal of RW repositories of “kurgan” and “gasholder” type
- Disposal of cooling towers and unused buildings
- Technical assistance in evaluation of the documentation for decommissioning plan of the VVR-S research reactor “Horia Hulubei” (Romania)
- Preliminary study on decommissioning of reactor compartments of the former military nuclear site Paldiski and construction of RW disposal facility (Estonia)

Decommissioning Services



Process Services

- R&D to ensure safety during decommissioning and RW management
- Development of technologies for decommissioning (modeling, mock-up trials)
- Development of process technologies and Method Statements for decommissioning
- Design and manufacture of equipment for remote visual monitoring and works under conditions of high ionizing radiation field
- Services to ensure NRS (radiation monitoring, metrological support of measurements)

Decommissioning Services



Projects/ Main Facts

- Decontamination technologies for surface and volumetric contamination by various methods
- Technology for creating internal engineering safety barriers by void-free filling of reactor space cavities with barrier material
- Technology for creating external safety barriers for RW storage sites
- Technology for solidification of RW in matrix material
- Technology for dismantling Beloyarsk NPP graphite stack
- Technology for dismantling cooling towers "from below"



STATE CORPORATION "ROSATOM" GROUP OF COMPANIES

THANK YOU FOR ATTENTION !

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PROJECT

«Preliminary studies for the decommissioning of the reactor compartments
of the former Paldiski military nuclear site
and for the establishment of a radioactive waste repository»

INTRODUCTION MEETING

**Organization chart for the project implementation with the Russian
subcontractor – JSC FCNRS and tasks 2 and 3**

Alexander Kvar
Expert, FCNRS

The Republic of Estonia, Tallinn, 14th of November, 2014

Project



1962 – 1991 The USSR Navy training center in Paldiski

1995 The Center was transferred to the possession of the Republic of Estonia under the interstate agreement with Russia

1999-2001 The European Union project «The Evaluation of Management Routes for the Paldiski Sarcophagi»

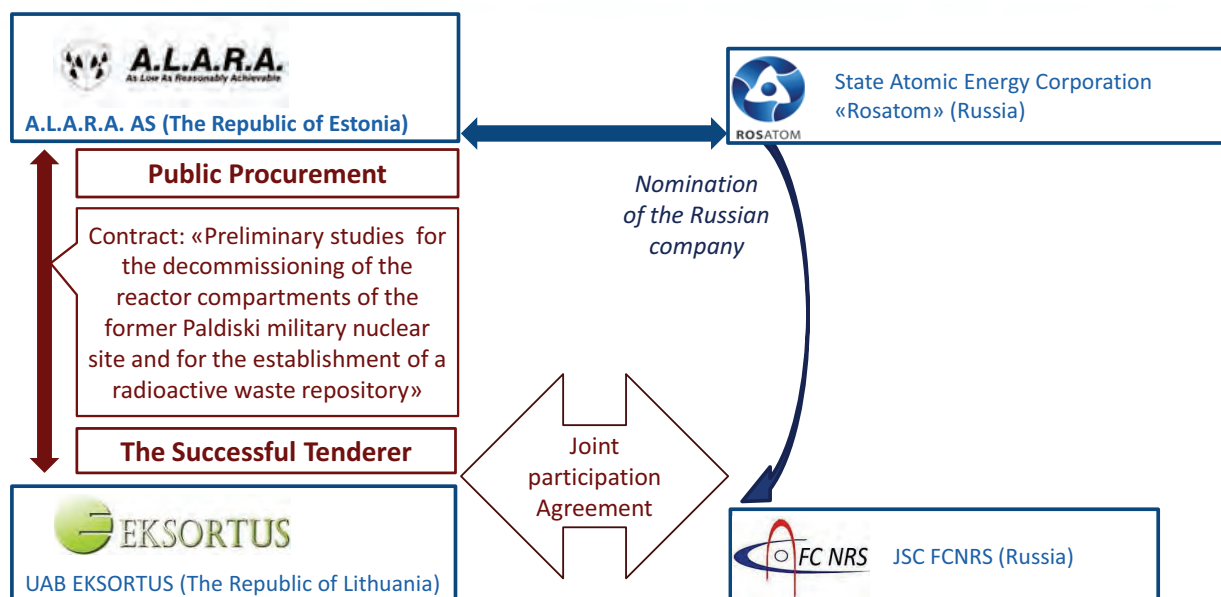
2005-2008 The European Union PHARE project «The Safe Long-term Storage of the Paldiski Sarcophagi & Related Dismantling Activities»

2014 PROJECT: «Preliminary studies for the decommissioning of the reactor compartments of the former Paldiski military nuclear site and for the establishment of a radioactive waste repository»

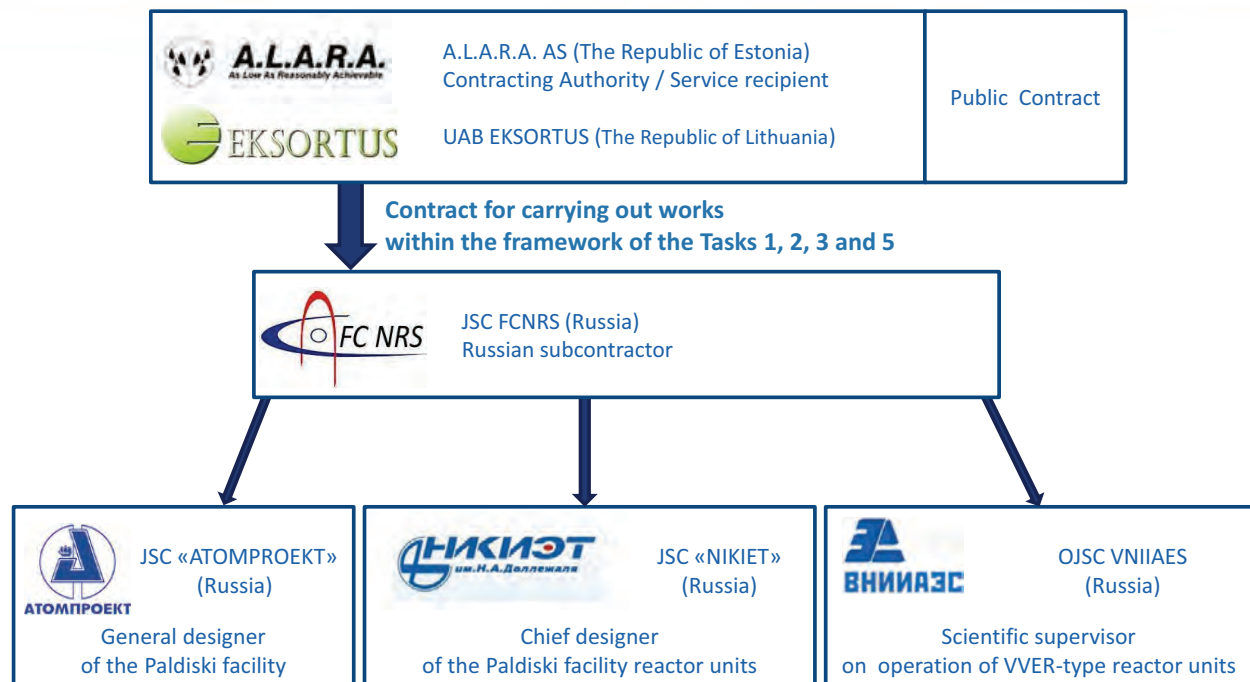
PROJECT MISSION: To carry out the preliminary technical studies and the collection of the required data to provide a basis for planning further activities, making decisions and commencing environmental impact assessments, necessary for the decommissioning of the reactor compartments of the former military nuclear site (Paldiski, The Republic of Estonia)



Organization chart



Organization chart



Task 2. Collection of data and overview of national and international requirements

2.1. Collection and analysis of the available data concerning the reactor compartments and other related aspects

- Preparation and application of a data collection procedure. Preparation of a list of the main parameters to form the basis for the implementation of decommissioning and waste disposal activities.
- Collection of the available data – results of previous studies, reports, safety assessments, environmental impact assessments etc.
- Analysis and updating of an overview of the existing and estimated future waste quantities. In regards to future waste quantities, consideration must be given to the possibility of a nuclear power plant being established in the territory of Estonia (with the capacity of up to 1,000 MW and the presumption that spent nuclear fuel will be sent back to the producer) and to the resulting waste streams, including from the future decommissioning of the plant. That possibility will be added to the continued ordinary waste stream and the waste generated in decommissioning the Paldiski reactor compartments.
- Assessment of the need for further information. The analysis must also include an assessment of the volume of the necessary data and the uncertainties related to the data.
- The aforementioned activities are also aimed at determining, on the basis of the collected materials, whether the collected materials are reliable and sufficient for making decisions required for subsequent work (environmental impact assessments) or whether additional (geological and hydro-geological, laboratory and other such) studies have to be conducted. If a need for additional studies is identified, such studies must be listed and described.

Task 2. Collection of data and overview of national and international requirements

2.2. Overview of international and national recommendations and legal acts on the decommissioning of reactor sections

- Preparation of a list of relevant requirements and recommendations to be used as the basis in performing the works specified under Tasks 3 and 5. Assessment of the need to amend the applicable legislation in Estonia and estimation of the time required for that.

2.3. Overview of international and national recommendations and legal acts on the disposal of radioactive waste

- Preparation of an overview of relevant requirements and recommendations to be used as the basis in performing the works specified under Tasks 4 and 5. Assessment of the need to amend the applicable legislation in Estonia and estimation of the time required for that.

Task 3. Determining the possibilities of decommissioning the reactor compartments

3.1. Assessment of different methods used for decommissioning reactor compartments

- An overview of international experience in the decommissioning of reactor compartments. Possible decommissioning options together with practical examples have to be provided. Among other things, the overview must cover the relevant studies conducted in Russia (as the country of production of the reactors), considering the options of both cutting the reactors up and disposing of the reactors as a single unit in the assessment of decommissioning methods.

3.2. Comparative assessment of alternative methods used for decommissioning reactor compartments

- Taking into account the results of activities 2.1 and 3.1, a decommissioning method suitable for the Paldiski reactor compartments must be selected with the approval of the Contracting Authority.

Task 3. Determining the possibilities of decommissioning the reactor compartments

3.3. Development of the concept of decommissioning selected as a result of the assessment

- Preparation (on the basis of the assessment) of a detailed implementation plan which includes the selected concept of decommissioning and covers various related areas and is later used as the basis for the environmental impact assessment (EIA). Among other things, the quantities of different types of waste to be generated in the course of decommissioning and the need and method for the management of such waste must be assessed. It also has to be determined which buildings must be constructed to ensure the treatment and storage of the generated waste in accordance with requirements.
- The plan must also include a list of studies/activities to be conducted prior to decommissioning in chronological order, together with a description of how the study/activity would be conducted.
- The plan must be prepared in consideration of the applicable national strategies – the principles of radioactive waste management specified in the Radiation Act and the National Radiation Safety Development Plan 2008-2017 – as well as other international and national recommendations and legal requirements concerning the decommissioning of reactor compartments covered by activity 2.2.

Task 3. Determining the possibilities of decommissioning the reactor compartments

3.4. Description and assessment of the waste to be generated in the course of the decommissioning works

Assessment of the radioactive, ordinary and hazardous waste to be generated in the decommissioning of the reactor compartments, taking into account the concept selected under activity 3.3. The assessment must cover the following aspects:

1. radionuclides and their activity;
2. division of radioactive waste by types of waste on the basis of the applicable classification;
3. assessment of the possible quantities of waste with short-term and long-term activity and of the methods of management thereof, taking into account international recommendations and the possibilities available in Estonia;
4. rationality of storage and disposal of waste, including the rationale for choosing a particular option;
5. assessment of the quantities of waste before and after treatment (including after packaging necessary for final disposal), taking into account the recommended treatment methods. Possibilities for minimising the quantities of waste;
6. assessment of the quantity and volume of the ordinary and hazardous waste (non-radioactive waste) to be generated;
7. possibilities of sorting and treatment of ordinary and hazardous waste;
8. possibilities and logistics of utilising ordinary and hazardous waste (if so, when and how to be stored in the course of decommissioning) in accordance with national legal acts and practices (concrete, metal, liquids, other materials etc);
9. logistics of radioactive waste (if so, where and how to be stored in the course of decommissioning) in accordance with national legal acts and practices.

Task 3. Determining the possibilities of decommissioning the reactor compartments

3.5. Decommissioning safety assessment, taking into account the waste quantities to be generated

- Determination of the relevant safety criteria; an analysis of risks present in regular decommissioning activities and an analysis and impact assessment of the potential risks arising from extraordinary events and accidents.
- Preventive and mitigating measures, risk assessment, comparison of analysis results with the relevant safety criteria, taking into account the international and national recommendations and legal acts on safety assessments.



ENTERPRISE OF STATE ATOMIC ENERGY CORPORATION "ROSATOM"

Thank you!

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Joint Stock Company Federal Center for Nuclear and Radiation Safety

www.fcncrs.ru



ВНИИАЭС

Всероссийский научно-исследовательский
институт по эксплуатации атомных
электростанций

VNIIAES

All Russian Research Institute for NPP operation

13 - 14 November 2014, Tallinn, Estonia

Mission



Achieving leadership in scientific and technical support and technical activities at all stages of NPP life cycle :

- development of requirements for new projects, project verification
- operation, maintenance and repair, modernization and prolongation of operating life of existing NPPs,
- decommissioning, including technologies of radioactive waste treatment



Along with constant improvement of technologies to manage research activities, scientific and technical information, knowledge and personnel development.

Spectrum of activities



1. Research and information:

- Development and maintenance of databases on NPP operation and decommissioning
- Disturbance and failure analysis
- Preparation of analytical reviews

2. Expertise:

- Examination of technical documentation and facilities
- Justification of technical solutions, preparation of safety justifications.

3. Normative and methodological:

- Development of guidelines, standards and techniques
- Preparation of process procedures.

4. Research and development:

- Calculations
- Simulation of processes
- Measurements and experiments

5. Technological:

- Development of technologies to improve dynamic stability of units
- Development of technologies for maintenance and repairs
- Development of methods of technical diagnostics
- Improvement of water-chemical regime technologies
- Development of technologies for nuclear waste treatment.
- Development of technologies for NPP decommissioning.

6. Design of:

- Systems of water-chemical treatment
- Liquid radioactive waste treatment
- Unit top level system (UTLS)
- Control and protection systems (CPS)

7. Training:

- Certification of physicist-estimators employed on NPPs with VVER
- Advanced training and retraining of NPP personnel
- Development of computer-based training programmes and systems to monitor worker skills

Main areas

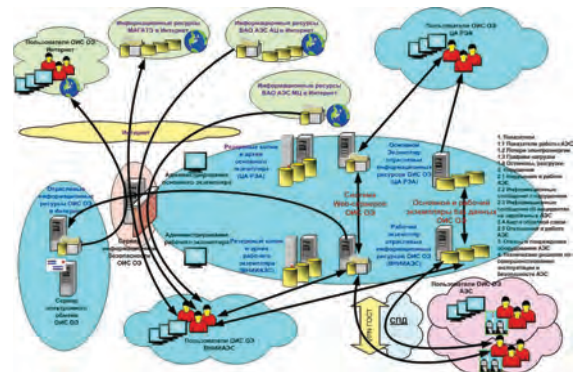
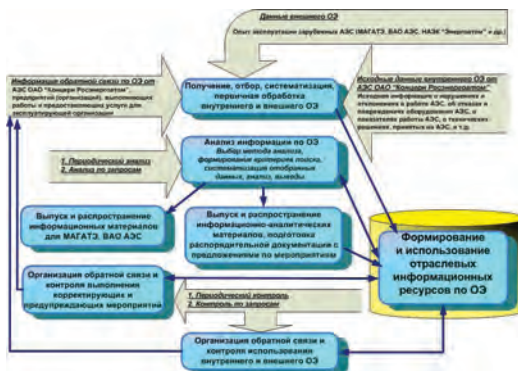


- ☐ Analysis of NPP equipment and systems' operating experience .
- ☐ Mathematic modeling of neutronic and thermohydraulic processes in reactor installations and units in general.
- ☐ Development of regulatory, operational, methodological and other documentation for different stages of NPP life cycle.
- ☐ Increasing the efficiency of nuclear fuel usage.
- ☐ Assessment of residual life of equipment and systems on operating NPPs.
- ☐ Scientific and technical support to ensure radiation safety, ecological management, occupational health and safety on NPPs.
- ☐ Scientific and technical support of activities ensuring radioactive waste and spent fuel management and of NPP decommissioning .
- ☐ Scientific and technical support to ensure optimal water-chemical regime on NPPs.
- ☐ Development of training hardware (computer-based systems, training and methodological support of NPP personnel).

Analysis, accumulation and dissemination of NPP operating and decommissioning experience



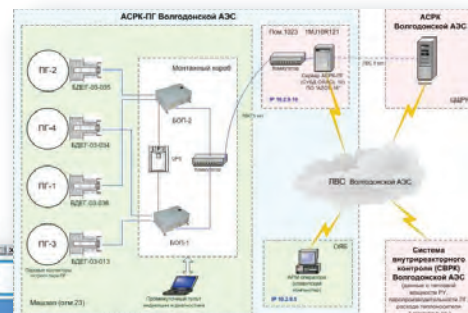
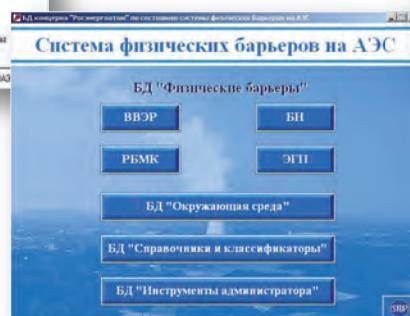
- ❑ VNIIAES ensures active and efficient use of operating experience, based on centralized accumulation, formation, storage, processing, analysis, exchange and dissemination of information on operating experience of Russian and foreign NPP.
- ❑ Branch informational and analytical system of JSC Concern Rosenergoatom on NPP operating and decommissioning experience is set up, being used and developed in the institute based on the advanced information and communication technologies.



Nuclear safety, ecology and occupational health on NPPs



- ❑ Scientific and methodological provision of nuclear safety at all stages of NPP life cycle
- ❑ Scientific and technical provision of ecological safety, environmental protection and environmental management
- ❑ Scientific and methodological support of activities on occupational safety and health on NPPs.



Most significant activities in D&D and waste management



- ☐ Rosenergoatom concept on radioactive waste treatment as part of the state unified system of radioactive waste treatment has been developed and approved.
- ☐ Rosenergoatom concept on NPP units decommissioning
- ☐ Development of concept on radioactive waste treatment on NPP, editions 1998 and 2010.
- ☐ Development and implementation of programmes on organizational and technical measures to reduce the amount of radioactive wastes.
- ☐ Integration of decontamination technologies and equipment allowing to clean metal and compartments up to background values using electrochemical, gas-dynamic and hydro-abrasive installations (Novovoronezh NPP).
- ☐ Integration of technologies and equipment for membrane cleaning of liquid wastes (Novovoronezh NPP).
- ☐ Feasibility study of decommissioning options for unit 3 of Novovoronezh NPP
- ☐ Project D7.1 – Feasibility Study for the Management of V1 NPP Primary Circuit Components, Slovak Republic,
- ☐ Cost estimation of Rosenergoatom NPP units decommissioning program
- ☐ Decommissioning plan for 1,2 units on Beloyarsk NPP
- ☐ Decommissioning plan for 1,2 units on Novovoronezh NPP



Thank you for attention