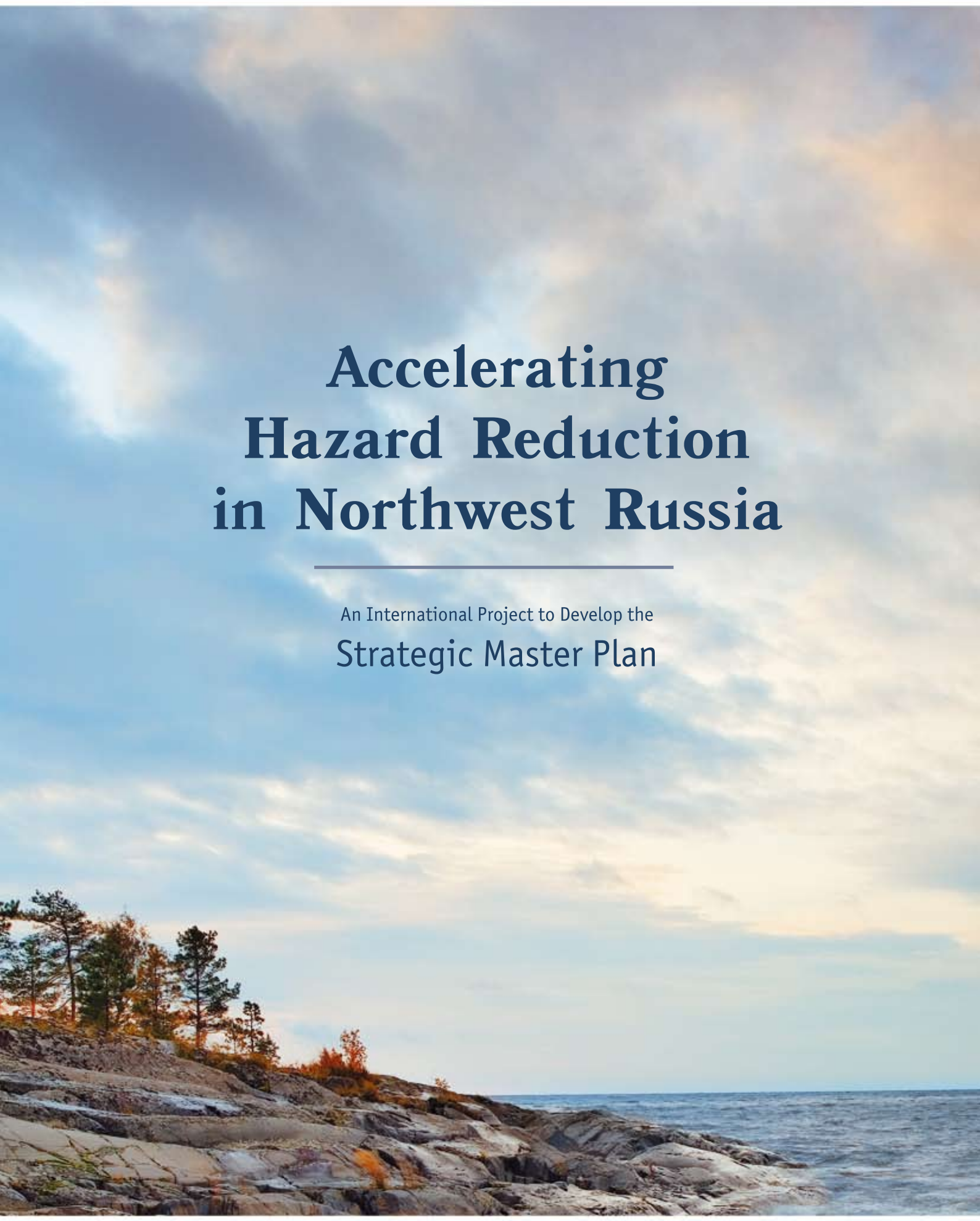
Accelerating Hazard Reduction in Northwest Russia

An International Project to Develop the

Strategic Master Plan



Moscow 2007

Sergey Kirienko
Head of the Russian Federal Agency
for Atomic Energy (Rosatom)

The developed Strategic Master Plan (SMP) is a powerful tool to support making decisions focussed on accelerated elimination of hazards related to the cold war legacy in Northwest Russia and to reduce cost of the decision implementation. Engagement of the researchers and experts from various countries in this scope of activity in Russia, in particular, in the SMP development, demonstrates common commitment of the world community in resolving ecological and non-proliferation problems, which are not constrained by national borders.

Jean Lemierre,
President of the European Bank for
Reconstruction and Development (EBRD)

The Strategic Master Plan is an excellent cooperative achievement which provides for the first time a clear and comprehensive overview of nuclear cleanup needs in the Northwest of Russia. This clarity will be of tremendous value for Russian authorities in charge of dealing with the legacy of soviet nuclear ships, but also to the International Community ready to assist in this complex task and not least to the population in the region. In this respect this public version of the SMP fosters open dialogue and builds on the first ever cross border Strategic Environmental Assessment which was also funded by the NDEP and supported by Rosatom.

Partnership to Address the Cold War Legacy

In the mid-1980's, large numbers of nuclear-powered vessels, nuclear maintenance support vessels, and former coastal maintenance bases for nuclear vessels were withdrawn from service. The Russian Federation and the International Community recognized that eliminating the threats form these various objects could not be resolved within an acceptable period of time without international assistance and efficient international co-operation.

In partnership, the International Community and the Russian Federation took action to help address this growing risk in Northwest Russia.

- In 2001, the Northern Dimension Environmental Partnership (NDEP) Support Fund "Nuclear Window" was established.
- In 2002, the Group of Eight Nations initiated the Global Partnership Programme that provides a basis for further co-operation in addressing these Cold War legacy threats.
- In 2003, eleven countries and two international organizations signed the Multilateral Nuclear Environmental Programme in the Russian Federation (MNEPR) whose purpose is to facilitate co-operation in the area of safety of spent nuclear fuel and radioactive waste management in the Russian Federation.

Achieving the objective of accelerated hazard reduction requires a through understanding of the complex problems and deployment of integrated solutions. With funding from the NDEP managed by the European Bank of Reconstruction and Development, efforts began in 2003 to gain the required information and to establish a comprehensive strategy. The first phase of this Strategic Master Plan (SMP) was completed in 2004. The second phase of Strategic Master Plan development began in October 2005 and was completed in 2007 by the Programme Development Team.

The Strategic Master Plan provides an integrated roadmap and programme plan to accelerate hazard reduction in Northwest Russia. The Strategic Master Plan will be used in Russia as the basis to develop medium- and near-term operational plans, and it provides a basis for Donors to select additional projects for funding.

Global Partnership Programme

"Under this initiative, we will support specific cooperation projects, initially in Russia, to address non-proliferation, disarmament, counter-terrorism and nuclear safety issues. Among our priority concerns are the destruction of chemical weapons, the dismantlement of decommissioned nuclear submarines, the disposition of fissile materials and the employment of former weapons scientists."

Group of Eight Nations
Kananaskis 2002

NDEP Pledging Conference

"The Northern Dimension Environmental Partnership (NDEP) is a very concrete example of the benefits of co-operation between Russia and the EU — and of international co-operation between countries and organisations further afield.

The aim of the NDEP is to co-ordinate international action to tackle the Northern Dimension Area's enormous legacy of environmental damage."

Christopher Patten
EU Commissioner
for External Relations
Brussels 2002

Multilateral Nuclear Environmental Programme in the Russian Federation (MNEPR)

"The Parties hereby establish a framework to facilitate co-operation in the area of safety of spent nuclear fuel and radioactive waste management in the Russian Federation."

Stockholm
2003

Significant progress has already been made:

- 100 submarines already dismantled.
- Seven reactor compartments from NS already placed in the long-term storage facility and 12 more are pending transition to the LSF .
- 104 reactor cores from dismantled submarines worth of spent fuel removed from the region.
- A plan was developed to decommission and dismantle “Lepse”.
- Facility for storage of non-reprocessible SNF from icebreakers constructed and commissioned.

The need for co-ordinated integrated approach to addressing issues in Northwest Russia is recognized:

“Noting that currently cooperative activities are conducted under different multi-lateral and bi-lateral agreements and a new umbrella agreements will be in effect soon, further co-ordination of these projects is necessary in order to eliminate overlapping and duplication, concentrate resources on major priorities and thus increase the efficiency of international co-operation.”

“In discussion of the CEG co-ordination role it was recognised that there is a need to establish strong relations with the new multilateral initiatives such as NDEP and Global Partnership Programme recently launched by G8 countries.”

“It was recognised that long-term planning is important not only for the Russian side but for the donors as well.”

IAEA Contact Experts Group

Understanding the Complex

Retired Naval Vessels

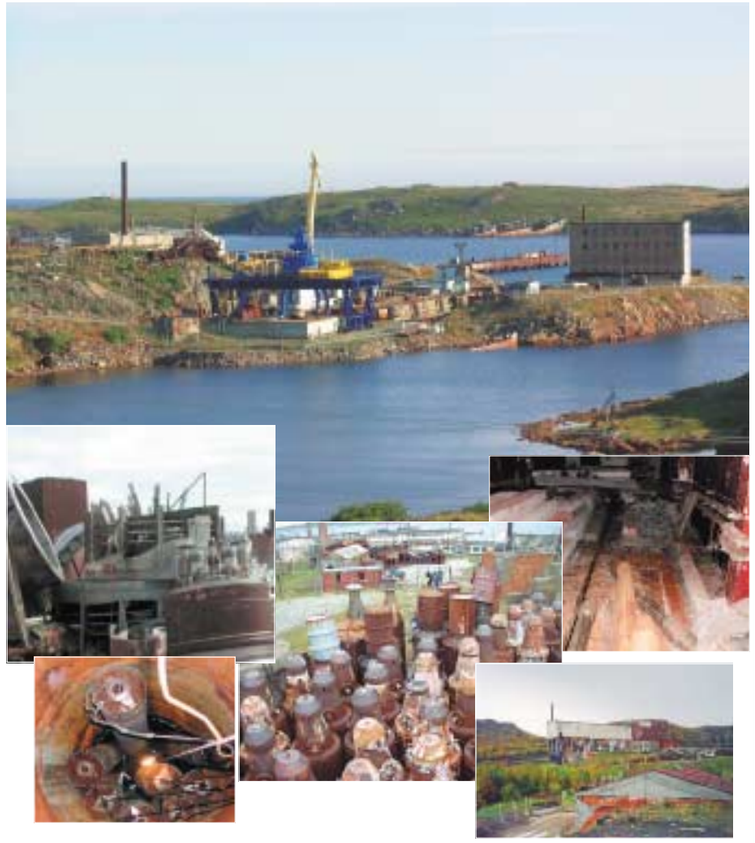
- Over 120 vessels must finish decommissioning and dismantling.
- A sunken nuclear submarine requires decisions regarding its future.
- Some submarines damaged in past accidents are highly contaminated.
- A non-standard submarine (“Papa” class) requires special defuelling and dismantling techniques.
- Spent fuel of liquid-metal coolant reactors (“Alpha” class submarines) require special storage and processing capabilities.
- Contaminated maintenance service vessels are storing damaged spent fuel.
- A retired nuclear-powered cruiser is in poor condition and there is no standard decommissioning and dismantling technology for this vessel.
- Certified time limit to store reactor units afloat is close to expiration.

Issues in North-West Russia

Former Coastal Naval Bases

Temporary Storage Facilities (TSF) in Gremikha and Andreeva Bay

- Spent fuel in an amount equivalent to more than 100 reactor cores is being stored in unsatisfactory conditions.
- Radioactive waste is being stored in failing containers and leaking buildings or at open-air pads.
- Many contaminated buildings require remediation.
- Large areas of contaminated land and aquatic areas are the potential sources of radioactive material release to the environment.
- Roads, facilities, and equipment required to implement hazard reduction projects are lacking require capital upgrade.
- Skilled personnel needed to perform this work are being rapidly lost in these remote regions.



Significant progress has already been made:

- Detailed engineering and contamination surveys completed for Andreeva Bay.
- Reloading facility for spent cores of Alpha-class submarines restored at Gremikha.

Issues (and solutions) that affect multiple sites must be viewed as a whole:

Spent nuclear fuel

- More than 130 reactor cores worth of spent nuclear fuel are stored in various locations within Northwest Russia. This spent nuclear fuel must be safely packaged and shipped to Mayak for further processing.
- Large amount of damaged spent nuclear fuel requires special handling and processing techniques.
- There is inadequate storage capacity for the damaged spent fuel being retrieved for shipment to Mayak.

Radioactive waste

- Solid and liquid radioactive wastes have been accumulating in the region since submarine operations began.
- The stored radioactive waste is located at a variety of locations including Andreeva Bay, Gremikha, and onboard nuclear maintenance vessels.
- There are inadequate existing facilities to properly treat this RW, and there is no long-term storage facility to place the RW until a final disposal option is implemented in Russia.

Toxic Waste

- The problem of toxic waste generated during decommissioning and dismantling vessels and the coastal maintenance bases has had little prior focus.
- Chemical risks for workers exceed radiological risks by more than an order of magnitude.
- In many cases there is no ability at the individual sites to safely manage toxic wastes.

SMP is a plan to achieve the final objectives of decommissioning of nuclear-propelled fleet and remediation of the infrastructure facilities following the principles of cost reduction and optimisation of resource usage at all implementation stages.

SMP should:

- be the basis for the identification of projects of decommissioning and remediation of radiation hazardous objects of the retired Navy and civilian nuclear-propelled fleet;
- form the basis for making strategic decisions by the Government of the Russian Federation;
- support donor countries in evaluating cost efficiency of the project implementation, including safety and security issues;
- facilitate making decisions allowing for interests of Russia and donor countries;
- support co-ordination of measures and monitoring of the implementation results.

Owing to scope of the problem, diversified nature of objects under consideration, and complexity of technological, transportation, and informational links, all stages of the SMP development were based on the system approach.

Unlike other Russian special-purpose programmes, SMP

- considers all retired nuclear and radiation hazardous objects and the corresponding infrastructure irrespectively of the departmental attribution;
- is focussed on achieving the final objectives of decommissioning and remediation rather than on measures within the limited time interval;
- is underpinned by the data of previous investigations and the data obtained through eight special Strategic Studies carried out within the SMP;
- accounts for the best world practice in strategic planning delivered, in particular, by the International Consultant participated the SMP development.

Academician Ashot A. Sarkisov
Scientific Supervisor of the PDT

Objective: Safer Future — *Sooner*

A vision for a safer future was used to guide the development of the Strategic Master Plan. This vision depicts the outcome that could be achieved through successful implementation of this programme:

> "Northwest Russia that is no longer threatened by radiological or toxicological releases that may exceed regulatory criteria from retired nuclear powered vessels, the former military bases, or the retired maintenance vessels. Also, the coastal maintenance bases have been remediated to a condition that is protective of human health and the environment for prospective land use."

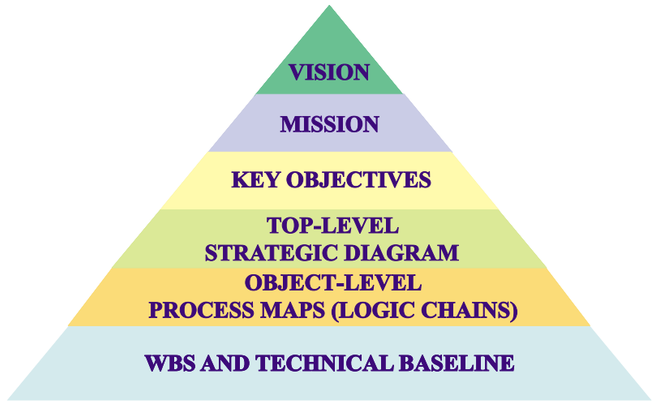
The Programme Development Team (PDT) supported the achievement of this vision through its work to develop the Strategic Master Plan. PDT has a unique mission amongst many organisations and teams associated with achieving the vision for Northwest Russia:

> The PDT mission was to develop an integrated SMP and management system that will enable efficient achievement of the vision and strategic objectives for Northwest Russia. This plan addresses nuclear submarines, nuclear powered vessels, nuclear maintenance vessels, former maintenance bases, spent fuel, radioactive waste, and toxic waste within the scope as determined in the SMP Term of References (ToR).

Systematic Approach to Strategic Planning

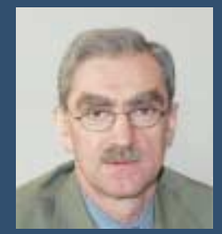
The Strategic Master Plan was developed in a top-down planning approach to ensure the Vision and Strategic Objectives were achieved. This top down approach was modified where necessary to reflect project planning, particularly taking into account on-going projects.

The results of the efforts are multiple layers of strategic planning each with increasing degrees of detail. A top-level integrated strategy for the entire region was developed — the Strategic Roadmap. Beneath this top level, strategies were developed for all individual sites, objects and facilities. Strategies were also developed for spent nuclear fuel, radioactive waste, and toxic waste. The bottom-most layer comprises of individual projects (over 230) that will implement these higher level strategic approaches, including over 70 high-priority projects important to near term hazard reduction in Northwest Russia. The total of these projects forms the SMP Work Breakdown Structure (WBS) and technical baseline.



Guiding principles were also developed to guide selection of cost-effective alternatives from the wide range of possible strategic approaches that might be employed. Based on best international experience, these guidelines provide reasonable assurances that strategic alternatives would be selected that provide lower costs when measured over the entire life of this programme:

- Common technical approaches applied across all sites.
- Tried and tested solutions applied where possible and feasible.
- Maximise use of existing industrial capability and infrastructure.
- Minimise construction of duplicate infrastructure facilities.
- Locate new spent nuclear fuel and radioactive waste management facilities at locations of their greatest concentration.
- Consolidate storage locations for single-type materials, for example, spent nuclear fuel and radioactive waste.
- Dispose of very low-level radioactive waste at the source site.



Establishing the Programme Development Team

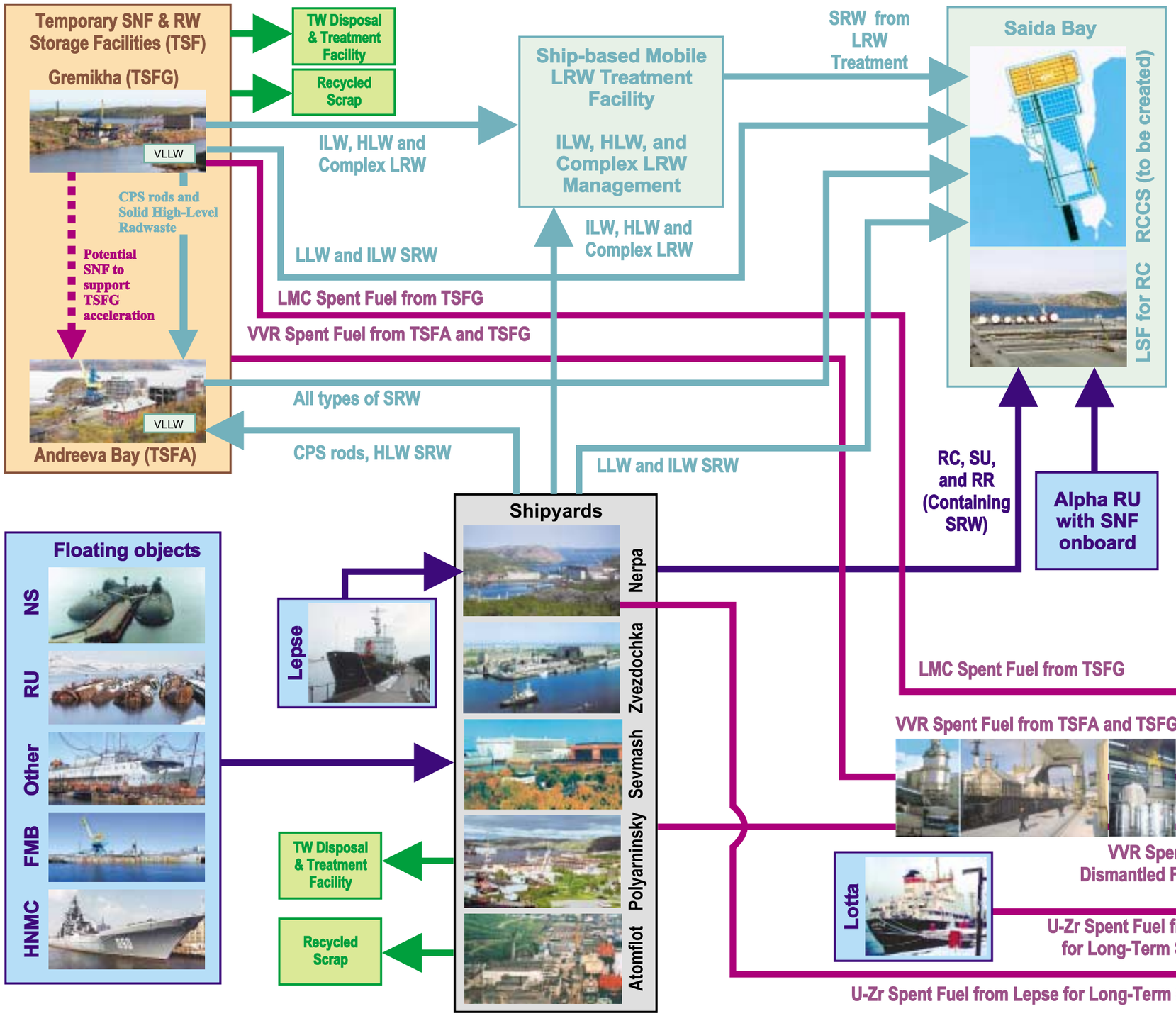
The Programme Development Team (PDT) was comprised of more than 40 experts from leading research and production organisations of the Russian Federation including the Nuclear Safety Institute of the Russian Academy of Sciences (IBRAE RAS), the Russian Research Centre (RRC) "Kurchatov Institute", N.A. Dollezhal Research and Development Institute for Power Engineering (NIKIET), the Research & Design Engineering Bureau "Onega" (NIPTB "Onega") and other organisations in cooperation with the Department for the Management of Spent Nuclear Fuel and Decommissioning of Nuclear Facilities at Rosatom. Uniquely for the Russian projects, the Programme Development Team also included an International Consultant (Fluor Ltd and BNG PS) that made important contributions throughout SMP-2 — Phase 2 of the Strategic Master Plan development.

SMP is one of very few cases when full scope analysis of entire set of problems has been conducted close to the start of the program implementation. Under such conditions, effective collaboration of a team comprising of experts working in various directions and focussed on achieving the common objective can be only achieved through adequate organisation of management and interaction between groups. Equally important is provision of the unified approach to quality requirements and assurance.

The development of the Strategic Master Plan was performed within a quality assurance program consistent with the requirements of international standards ISO 9000/9001, the Quality Management System (QMS). As part of QMS, procedures were established to guide the performance of key processes.

Corresponding Member of RAS
Leonid A. Bolshov,
Head of the PDT

Top-Level Strategy to Achieve SMP Objectives



The integrated approach delivers the following:

- The strategy targets earliest completion of cleanup of Gremikha in order to address the growing social issues with maintaining a work force at this site;
- All submarine reactor compartments, reactor rooms and storage units of other retired naval vessels will be placed in the long term storage facility at Saida Bay;
- Movement of high level wastes and spent fuel willl be minimised by siting facilities at Andreyeva Bay where the vast majority of spent fuel and radioactive waste exist;
- Mobile, modular facilities are proposed for the treatment of the most difficult high level and intermediate level liquid radioactive wastes; and,
- Very low level radioactive waste arising from the remediation of Andreyeva Bay and Gremikha will be disposed onsite in waste disposal facilities that will be constructed.

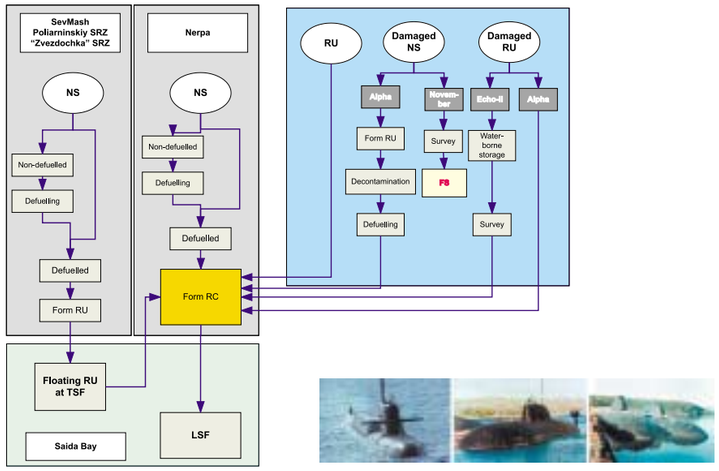
Strategy for Decommissioning

130 floating objects located at various sites in Northwest Russia are pending decommissioning and further disposal for safe, controlled long-term storage.

Among which, there are

- 20 nuclear submarines, 16 have reactor cores worth of spent nuclear fuel;
- 81 reactor units currently stored afloat at the temporary storage facility at Saida Bay;
- Several vessels were damaged in incidents and require individual treatment approaches.

- One heavy nuclear missile cruiser currently located at the shipyard in poor technical conditions.

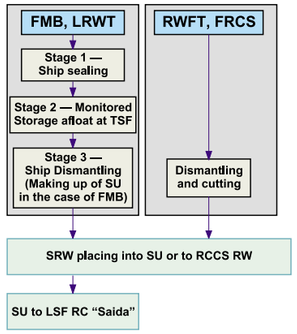


The decommissioning strategy for retired NS and RU is based on implementation of one, or a combination of, the following successive generic process steps:

- NS remain at naval bases for safe monitored storage until transferred to shipyards for defuelling;
- NS will be defuelled using either on-shore defuelling facilities (at "Zvezdochka") or an FMB (in the Murmansk region);
- NS are dismantled by cutting the hull to create either a Reactor Unit (RU) or a Reactor Compartment (RC). The SRW arising from this operation is placed into the RC;
- The RU are temporarily stored at the Temporary Storage Facility (TSF) in Saida Bay awaiting dismantling to RC at "Nerpa" SHIPYARDS;
- RCs are made up and placed at the Long-term Storage Facility (LSF) in Saida Bay for at least 70 years.

The overall decommissioning strategy for the heavy nuclear missile cruiser (HNMC) is basically the same that of nuclear submarines (SNF retrieval, hull cutting, reactor room formation and its storage for 70–100 years at LSF "Saida"). However, decommissioning strategy for NPSS is unique, because there is no experience with decommissioning of ships of such class in Russia and no concept solutions are developed for decommissioning of NPSS. Following the results of the special Strategic Study, the option for hull cutting and reactor room (RR) makeup was chosen, which will use a half-submerged pontoon to be constructed. The pontoon will be also used to transport the formed RR to the LSF at Saida Bay.

# of Retired Naval Vessels



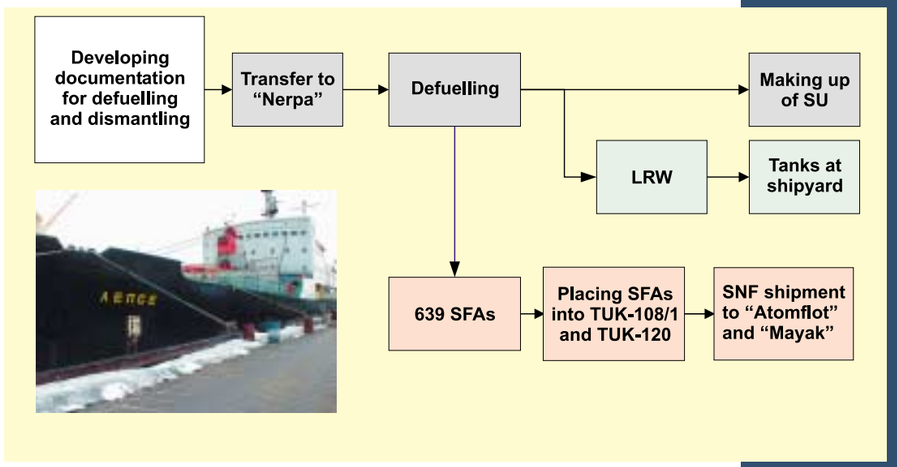
The decommissioning strategy for the nuclear maintenance service vessels (Floating Maintenance Bases (FMB), Liquid RW Tankers (LRWT), RW Floating Tanks (RWFT), and Floating Radiation Control Station (FRCS)) is based on the concept of deferred decommissioning that has three stages:

- Stage 1 — NMS vessel Sealing
- Stage 2 — Monitored Storage Afloat

The goal of the first and second stages of NMS vessel decommissioning is to ensure radiation and environmental safety during the temporary storage afloat until final dismantlement.

- Stage 3 — Ship Dismantlement.

Exceptions to the general strategy exist for specific damaged NS and RU such as *"November"* NS, *"Echo-II"* NS, *"Alpha"* NS and RU of *"Alpha"* NS. These vessels have all undergone incidents, which make them unsuitable for the generic decommissioning strategy. Similarly, FMB "*Lepse*", which is a major environmental threat due to large amount of SNF remaining on board and the deteriorating of the protective barriers and hull of the ship, is also an exception from the general strategy. The adopted process of strategic planning for these exceptions required additional more detailed description in form of the individual process sequences achieving the defined end states, like one shown below for the FMB "*Lepse*".



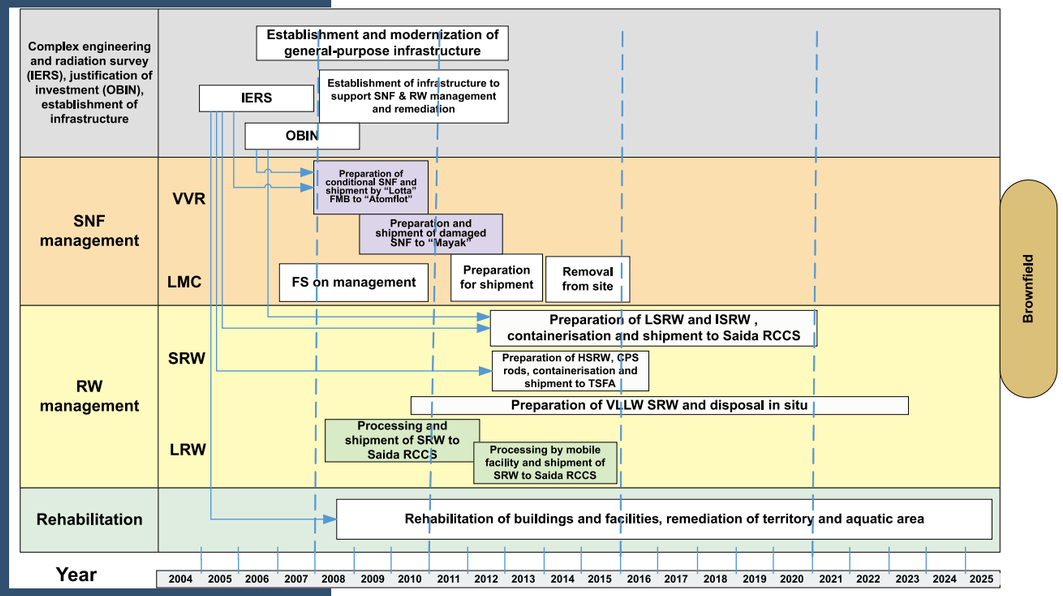
- 28 nuclear maintenance service vessels will produce significant amounts of solid and liquid radioactive waste in course of dismantlement.
- Former floating maintenance base "Lepse" stores significant amount of damaged spent nuclear fuel onboard.

Strategy for Remediation of TSFG

Strategies for remediation of Gremikha and Andreeva Bay have been developed in agreement with the generic approach to the remediation of Temporary Storage Facilities as outlined in the "Concept for TSF SNF and RW remediation" approved by Rosatom of the Russian Federation

The strategy for the remediation of Gremikha depends directly on the end state and the future use of the site. At present, the officially approved end state and potential use for Gremikha has not been determined.

However, taking into account all relevant circumstances it is likely that Gremikha will remain a nuclear licensed site for operations with nuclear and radioactive materials for at least 12–15 years. The special Strategic Study drove to the conclusion that remediation of Gremikha to a "brownfield" state is the most practical option.



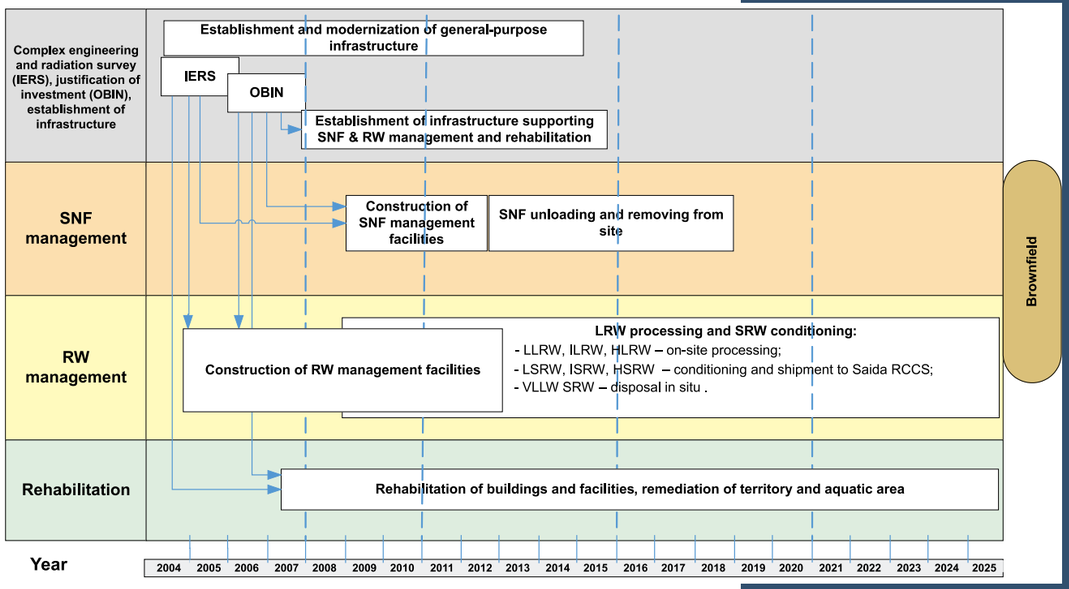
- Gremikha has significant land and building contamination
- Solid radioactive waste, including high level waste, exists in unsatisfactory storage conditions
- Spent fuel and spent removable cores on site present a major hazard due to poor storage conditions.

The integrated roadmap enabling achievement of the above-indicated end state for Gremikha has the following key features:

- Before work can begin on spent fuel and radioactive waste management, general preparatory work is undertaken to provide radiation safety, perform integrated engineering and radiation surveys for all objects, create general infrastructure needed for spent fuel and radioactive waste management;
- Spent nuclear fuel will be removed from Gremikha by 2015;
- The liquid and solid radioactive waste storage facilities will be decommissioned and decontaminated;
- Solid radioactive waste will be shipped to Saida Bay for storage;
- Very low-level waste (VLLW) will be disposed of on site;
- Toxic waste will be treated according to the adopted strategy; and,
- The land and surrounding marine environment at Gremikha will be remediated and cleaned up to a brownfield site level.

Strategy for Remediation of TSFA

A final decision has not been reached on the final end state for Andreeva Bay, but it has been assumed that this end state will be a "brown field". It is likely that Andreeva Bay will remain a nuclear licensed site for 15–20 years, where radiation hazardous activities on SRW and LRW management will need to be carried out (processing, conditioning, temporary storage, preparation for transfer, remediation of the site) after SNF is transferred.



In order to achieve the objective of brownfield status for the Andreeva Bay site and surrounding area, the following activities will need to be carried out:

- In order to progress the remediation of Andreeva Bay some construction of new facilities, restoration of existing buildings and demolition of auxiliary and non-active structures will be necessary;
- All spent fuel will be sent to Mayak for reprocessing except the small amount of non-reprocessible spent fuel that will be sent to Atomflot for long-term storage;
- SRW retrieved from existing pads and stores, and that arising from building remediation, will be processed within a new waste management facility to be built at Andreeva Bay;
- Solid high-level waste from Gremikha and other locations will be transported to Andreeva Bay for processing and temporarily storage until the storage facility at Saida becomes available;
- Conditioned waste will be temporarily stored on site before transfer to long-term storage at Saida Bay;
- Liquid radioactive waste will be processed on site using both existing and new mobile treatment facilities;
- A very low level waste disposal facility will be commissioned on site to accept and dispose VLLW; and,
- Andreeva Bay will be remediated down to brownfield site level to allow for potential industrial use.

Andreeva Bay has significant radiological contamination of land, buildings and coastal areas

The existing infrastructure is not currently sufficient for the timely remediation of Andreeva Bay and the management of radioactive waste on site

Solid radioactive waste, including high level waste, and spent nuclear fuel exists in unsatisfactory storage conditions.

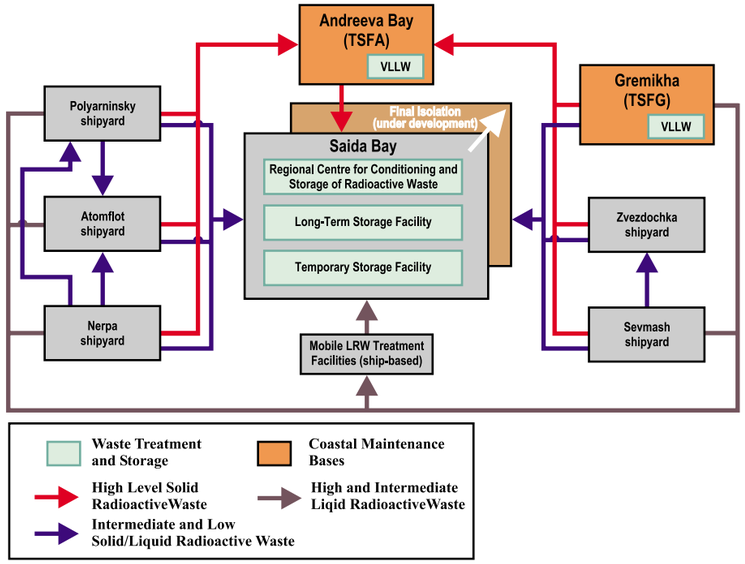
A significant proportion of spent nuclear fuel is damaged

Strategy for Radioactive Waste Management

Large amount of radioactive waste is already accumulated at various locations and will be generated in future by the decommissioning of retired nuclear-powered submarines and other floating objects and by the remediation of former naval bases in Northwest Russia

Management of radioactive waste in a manner that is safe, secure, environmentally sound, cost effective, and timely requires the development of a programme that integrates radioactive waste management activities and facilities across the region

The strategy for radioactive waste management is the long-term safe storage of conditioned solid waste at the regional centre at Saida Bay. Reactor compartments, reactor rooms and storage units loaded with radioactive waste will also be stored at the long-term storage facility (LSF) at Saida Bay.



In order to achieve this, the following conditions need to be satisfied:

- Radioactive waste will be removed from all objects in the region and transferred to a regional centre for conditioning and storage at Saida Bay for long-term storage;
- Solid radioactive waste arising form the dismantlement of NSs, HNMC, and FMBs will be contained within the reactor compartments, reactor rooms or storage units and transferred for long-term storage at Saida Bay;
- A new category of very low-level waste will be defined in legislation. This will allow more viable decommissioning and clean up strategies, reducing the cost of waste processing and waste store construction. Very low-level waste storage facilities will be established at Andreeva Bay and Gremikha;
- All types of solid radioactive waste will be conditioned and placed into containers in accordance with requirements of long-term storage and final disposal using the existing/newly established infrastructure; and,
- Liquid high-level and intermediate-level waste will be processed at the site of origin using a mobile treatment facility. This facility will also have the capability to process complex chemical mixtures.

Regional Centre for RW Conditioning and Storage at Saida Bay (RCCS)

The joint Russian-German nuclear decommissioning project in progress at Saida Bay on Russia's Kola Peninsula envisions the creation of a shore-based long-term storage facility for the storage of reactor compartments, including all necessary infrastructure. The project is aimed at improving and maintaining the safety of the environment and arranging for the material and technical development of the Russian sites involved in nuclear submarine decommissioning for the smooth and dynamic course of the decommissioning process.

Construction will be implemented in two stages:

- Phase I completion will allow storage of 120 Reactor Compartments; and,
- Phase II will accommodate 30 reactor compartments of nuclear submarines and 27 reactor compartments of other nuclear vessels.

At the behest of the project's Russian partners, the German Ministry of Economics and Technology plans to extend the nuclear submarine project into the latter half of the G8 Global Partnership period to construct a regional centre for processing and storage of radioactive waste at Saida Bay.

The centre will manage waste conditioning, interim storage, radiation decontamination and complete removal of residual radioactive materials, radiation control and long-term solid radioactive waste storage. Such a centre will provide the opportunity to perform complete dismantling and decommissioning of reactor compartments and other solid radioactive waste.

"On July 28, 2006, a key milestone was achieved in the disposal of Russian nuclear submarines in northwest Russia: the rollout of the first phase of the long term storage facility for marine reactor compartments at Saida Bay in Murmansk."

**Michael Glos,
The Federal Minister of
Economics and Technology,
Germany**

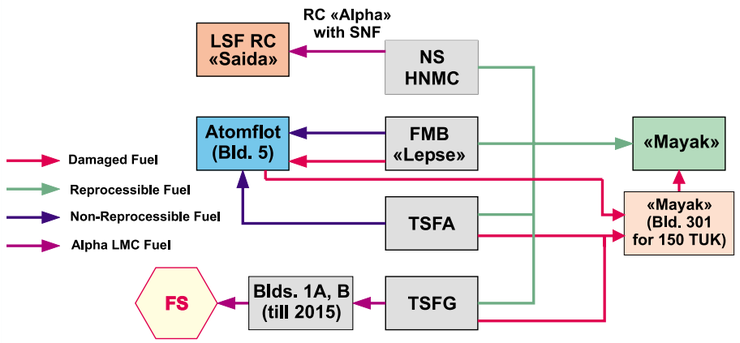
"Construction of this facility will allow for realization of the entire disposal cycle for nuclear submarines, will greatly enhance nuclear security in northwest Russia, and will help restore the region's ecology."

**The Federal Ministry of
Economics and Technology,
Germany**

Strategy for spent nuclear fuel management in NW Russia was developed following the analysis of current spent nuclear fuel management infrastructure, its bottlenecks and problems, taking into account the requirements of the Concept "Providing of Nuclear and Radiation Safety for 2008 and until 2015" approved by the Government of the Russian Federation.

Strategy for Spent Nuclear Fuel Management

The management strategy for spent nuclear fuel is based on first removing reprocessible spent fuel from the region for reprocessing at Mayak because reprocessible fuel represents the vast majority of the radioactive source term in NW Russia. In parallel, technology and structure will be established to address the currently non-reprocessible spent fuel. These currently non-reprocessible spent fuel assemblies will be placed in safe interim storage until this optimized final solution for this type of fuel is implemented. A strategic diagram has been developed to illustrate this logic.



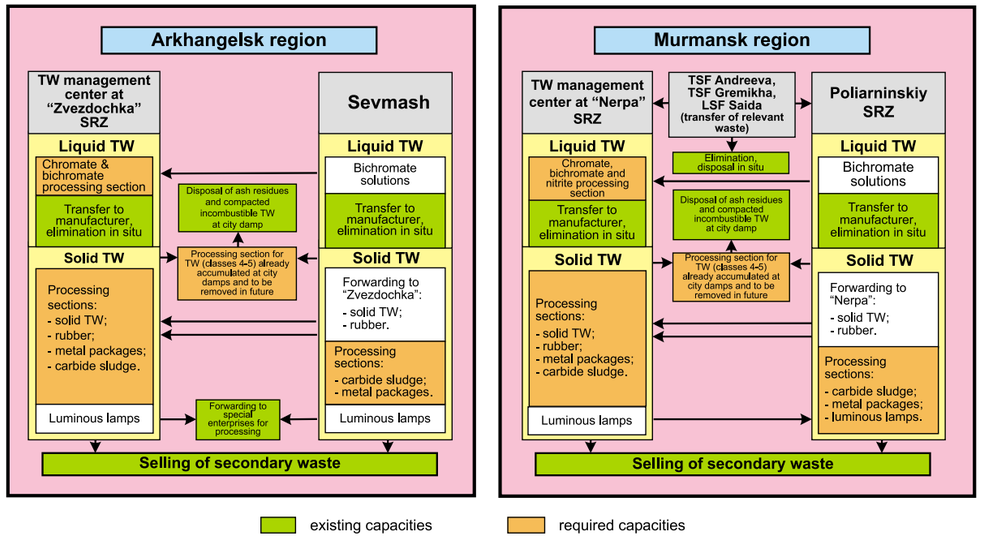
A number of strategic decisions were necessary to generate strategic logic diagrams for the management of spent nuclear fuel in NW Russia:

- All reprocessible spent fuel from retired naval vessels and coastal maintenance bases (Gremikha and Andreeva) in NW Russia will be placed into transport containers and shipped via special trains to Mayak;
- Interim storage pads at Atomflot or Zvezdochka shipyards will be available if required;
- After temporary storage at Gremikha, eight spent reactor cores of *Alpha*-class nuclear submarine reactors are shipped out of the region in special containers for potential reprocessing depending on the outcome of an optioneering study;
- Non-reprocessible uranium-zirconium fuel from all locations is loaded into casks and placed in long-term storage (up to 50 years) at Atomflot;
- Damaged spent fuel of nuclear submarines is placed into thin-walled casks and transport containers and shipped to Mayak for reprocessing; and,
- Severely damaged spent fuel from all storage sites is loaded into special shrouds and containers and shipped to Mayak for storage until a future decision is made regarding its disposition.

Strategy for Toxic Waste Management

In order to properly manage the hazards of toxic waste within this programme, instead of the current practice of accumulating TW at generator sites, this toxic waste strategy includes those actions necessary to ensure the toxic waste is properly stored, reused where possible, and ultimately treated and disposed.

Large amounts of toxic waste arising from activities on decommissioning of retired naval vessels have been accumulated in NW Russia; as the activities continue, the amount of toxic waste will increase.



The following key features have been established for toxic waste management generated as a result of execution of this programme:

- Infrastructure is developed at each decommissioning site for all classes of toxic waste to ensure these wastes can be properly handled, containerized and temporarily stored;
- Two regional centres are developed at Nerpa and Zvezdochka shipyards that are capable of processing their own toxic waste and the toxic waste from other shipyards involved in decommissioning within 3–5 years;
- Third-party enterprises will be used where possible to treat toxic waste to avoid construction of additional toxic waste infrastructure;
- In order to reduce the volume of toxic waste requiring disposal and to recover economic value, toxic waste will be recycled for further use or used for generating heat where possible (i.e., petroleum and combustible materials); and,
- Changes will be sought in regulation to limit the length of time that toxic waste can be temporarily stored at decommissioning sites; and,
- The practice of toxic waste disposal at landfill sites will be halted.

"…it is urgent and essential to set up treatment facilities at Zvezdochka and Nerpa shipyards to process problematic toxic waste generated during nuclear submarines decommissioning."

Strategic Study 7

Radioecological Monitoring,

"The developed system of emergency response is based on state-of-the-art technology for radiation safety and population protection. We will undoubtedly plan the extension of its infrastructure for response to other events of natural and human-caused origin".

**Yu.A. Evdokimov,
Governor of the Murmansk Region**

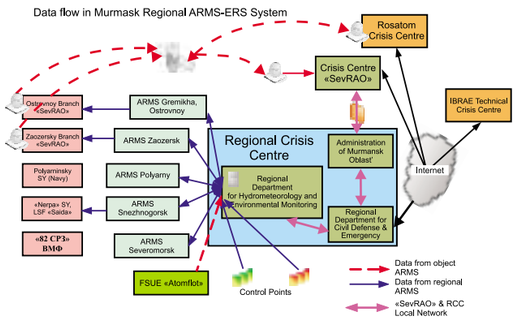
Created situation and crisis centres are equipped with modern hardware and communication systems, mobile facilities for radiation survey. They apply specially developed sophisticated software based on geoinformational systems to support real-time decision making in emergency situations.

Most of the activities planned within SMP on complex decommissioning of retired nuclear-powered vessels and environmental rehabilitation of supporting infrastructure in the Northwest Russia are considered as nuclear and radiation hazardous works.

In case of an accident, remote population and environment can be potentially exposed to negative radiation impact including transboundary transfer. The issues of providing facilities participating SMP implementation and territories where these facilities are disposed with effective radioecological monitoring systems are of high priority.

Radioecological monitoring systems including Automated Radiation Monitoring System (ARMS) and emergency response systems (ERS) at the nuclear and radiation hazardous facilities (NRHF) and in the territories of Murmansk and Arkhangelsk regions require substantial improvement and development.

Currently, the international project "Enhancement of Radiation Monitoring and Emergency Response System in the Murmansk Region" funded by the EBRD is being implemented. Developed system for the first time solves the problems of providing the Murmansk region with radiation control and monitoring system, informational, analytical and real-time expert support of regional administration.

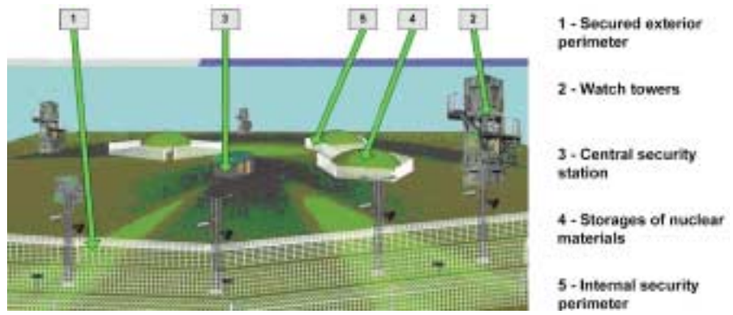


The situation in the Arkhangelsk region is somewhat different. The works on creation of ARMS and ERS for facilities and territories are still at initial stage.

Safety and Security Issues

Physical protection of nuclear materials, spent nuclear fuel and radioactive waste during decommissioning of the retired nuclear-powered and service vessels and environmental remediation of relevant infrastructural facilities in Northwest Russia is an integral and obligatory part of SMP.

- The physical protection systems, which are implemented at the NRHF-classified enterprises involved in the programme of complex decommissioning and TSF remediation, require modernisation and improvement taking into consideration increased terrorist threats.
- Engineered security facilities of physical protection systems are depreciated and obsolete and require replacement with the modern equipment.



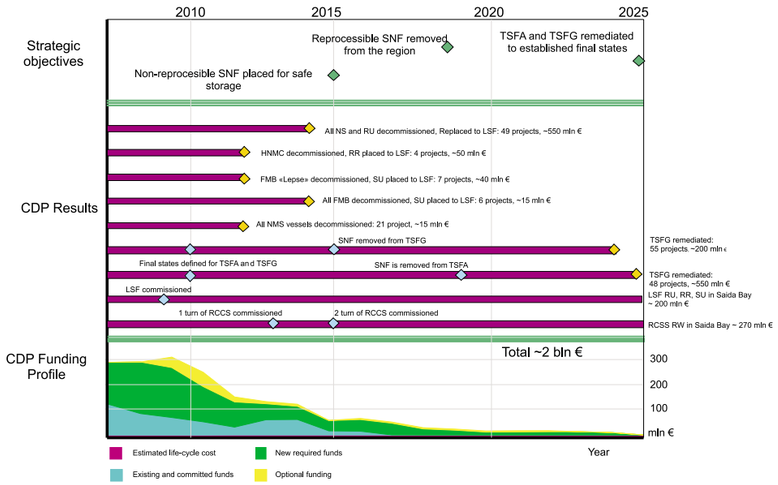
- In order to enhance the physical protection systems to comply with the present-day requirements it is necessary to carry out reconstruction and/or modernization of existing physical protection systems on the basis of integrated project taking into account the accomplished vulnerability analysis of the enterprise as a nuclear- and radiation-hazardous facility.

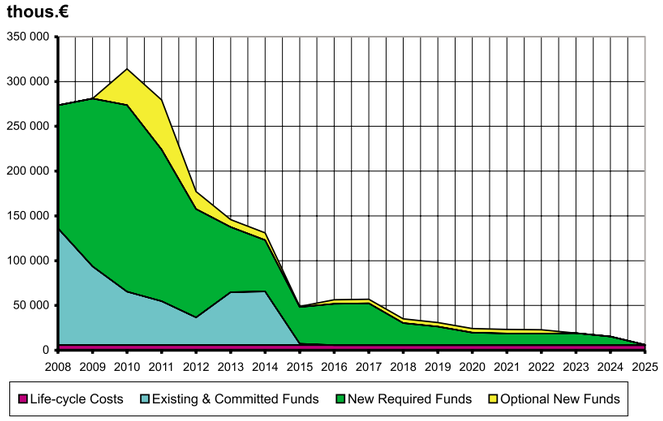
Social and political processes in the country and in the world, which had began in the middle of 1980s, reduction of staff of the Armed Forces, and deteriorated training of draftees under conditions of worsened criminal situation resulted in a need of introducing fundamental changes to methodology of providing safety and security of nuclear-hazardous facilities.

Design of effective physical protection system includes determination of its goals, preliminary designing or identification of characteristics, design review and, in many cases, redesign or improvement of the system.

Implementation Cost and Schedule

The technical baseline developed using the integrated planning process supports achieving the vision and strategic objectives of the Strategic Master Plan by 2025. Key milestones are shown below.





The cost to implement the Strategic Master Plan is estimated to be about €1.8 Billion for the time interval 2008–2025, and the annual estimate of cost is shown in the diagram above.

The objective of the Strategic Master Plan is accelerating hazard reduction in Northwest Russia. Achieving this objective requires larger initial investments in infrastructure and the performance of projects that eliminate these hazards in the initial phases of this programme.

"...it is noted with satisfaction that the cost estimates now cover the time period up to 2025."

EBRD Expert Advisory Group, October 2007

Key drivers for the SMP are the early removal of SNF from the region, and the acceleration of RW processing, stored at different facilities, so that a reduction in risk to environment is achieved. Therefore, in order to achieve the SMP strategic objectives it is important that several major projects be implemented within the next 3 years.

At the same time, SMP cannot assume any delay or interruption in decommissioning projects for floating objects (such as NS, NPSS, NMS vessels, including FMB Lepse). These objects are at significant risk of sinking due to the deterioration of their structural elements and increasing of maintenance costs.

SMP About...

Sophie Galley Leruste
Chairman of the NDEP
Nuclear Operating Committee

The Strategic Master Plan (SMP) is a major step in defining a consistent strategy aimed at dealing with the nuclear legacy in North West Russia. I am proud to have chaired the Nuclear Operating Committee which was instrumental to make this important milestone happen and I am grateful to Academician Sarkisov and his team for the dedication and successful completion of this work. Indeed, the SMP is an accomplishment that will help not only the Russian Federation but also the international community to understand the overall situation and to implement remediation activities in the most efficient way.

Laurence Williams,
Chairman of EBRD
Expert Advisory Group

The EAG considers the SMP to be an important breakthrough regarding the strategic approach to manage the legacy of spent fuel and radiological waste stemming from the operations of the soviet fleet in Northwest Russia.The EAG considers that, despite details which need improvement and the additional work on the final objective for radioactive waste and unreprocessable fuel, the SMP has reached the level at which it has become a useful tool for both the Russian organisation in charge to implement the programme and for the donor governments.

EAG Guidance Note,
October2007

Alan Mathiot,
Chairman of IAEA
Contact Expert Group

CEG noted that SMP presents a unique comprehensive strategy and programme for elimination of the nuclear legacy in the NW Russia and formulates all major tasks that have to be carried out. Development of SMP was based on a sophisticated methodology and systematic approach that enabled developers to justify priorities and take into account inter-relations between different tasks and projects, including those that are already being implemented. CEG acknowledged the importance of the SMP as a document of high strategy level that will be a basis for further development of short-term and long-term programmes of Rosatom dealing with the dismantlement and remediation of sites in the NW Region and also for planning of international cooperative efforts.

Minutes of the 21th CEG Meeting
Bruges, Belgium,
5–7 September 2007

PDT Participants

Nuclear Safety Institute (IBRAE)
Russian Academy of Sciences

Dollezhal Research and Development
Institute for Power Engineering

Russian Research Centre
“Kurchatov Institute”

Russian Navy

Federal State Unitary
Enterprise “SevRAO”

Afrikantov Experimental
Machine-Building Design Bureau

Research and Design Engineering
Bureau “Onega”

Kola Science Centre
Russian Academy of Sciences

Federal State Unitary Enterprise
“Nerpa Shipyard”

Federal State Unitary
Enterprise “Eleron”

Federal State Unitary Enterprise
All-Russia Science Research and Design
Institute of Power Engineering Technology

Federal State Unitary Enterprise
Central Research Institute of
Shipbuilding Technology

Fluor Corporation

British Nuclear Group
Project Service

Managerial board and leading experts of the SMP Programme Development Team:
Sitting (left to right): Nikolay Kukharkin (RRC KI), Remos Kalinin (IBRAE), Ashot Sarkisov (IBRAE), Leonid Bolshov (IBRAE), Vladimir Shishkin (NIKIET), John Williams (Xron Associates, Inc.).
Standing (left to right): Sergey Antipov (IBRAE), Pavel Shvedov (IBRAE), Mikhail Kobrinsky (IBRAE), Boris Stepennov (RRC KI), Valentin Markarov (IBRAE), Alexander Pimenov (NIKIET), Al'bert Vasiliev (NIKIET), Vyacheslav Bilashenko (IBRAE), Vasiliy Mazokin (NIKIET), Sergey Korobeynikov (Zarubezhatomenergosrtoy), Valentin Vysotsky (IBRAE), Taras Pryymak (BNG), Georgiy Ilyushchenko (IBRAE)