

Results and Conclusions of TACIS PROJECT – R4.04/04 Strategy Definition for Russian Federation NPP Back End Radioactive Waste Management, including Draft Legislation and Institutional Framework

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1 INTRODUCTION

This paper summarises the work performed by the Contractor Consortium lead by DBE of Germany and joined by ANDRA of France, COVRA of The Netherlands, SKB of Sweden and UK NIREX of United Kingdom within the Tacis project R4.04/04 “Strategy definition for Russian Federation NPP back-end radioactive waste management, including draft legislation and institutional framework”.

The specific objective of this project is to assist the Russian Federation in the development of a national strategy and the programme for the implementation of this strategy for managing radioactive waste with special emphasis on the back-end long-term storage and disposal. The development of the strategy shall be based on national and international experience and best practices. The project consists of two parts with separate beneficiaries:

Part 1: Development of the Russian Federation overall waste management strategy, draft legislation and institutional framework.

Beneficiary: Federal Agency for Atomic Energy (Rosatom)

Part 2: Development of the Russian Federation NPP back-end waste management strategy.

Beneficiary: Federal State-owned Enterprise “Rosenergoatom”

The project was executed in three phases. The first and the last project phases were common for both project parts, whereas the second phase was executed separately for each project part. The project structure is shown in Figure 1.

The subject of *Phase 1* was Task 0: Kick-off Meeting and Inception Report. The results of this task are laid down in a separate Inception Report.

Phase 2 was devoted to the main scope of technical work for both project parts in order to achieve the project goals. Even though both project parts were executed separately, a joint workshop was held at an early stage after a careful analysis of the present situation and the resulting project needs in order to present a detailed definition of the scope of work to the beneficiaries, customer and other parties involved, to agree on it and to underline the link between both project parts.

Phase 3 of the project dealt with Task 3: Technical Final Report and Workshop. The purpose of the concluding workshop held May 15/16, 2007 in Moscow again jointly for both project parts, was the discussion of the project findings with the beneficiaries, the customer and interested stakeholders. This final report that summarises the project findings was revised taking into consideration the workshop results.

As required by the Terms of Reference each of both project parts (Tasks 1 and 2) was divided into several subtasks.

Task 1.1 – “Current situation of the legal matters and available institutional framework in the radioactive waste management area in RF” belongs to project Part 1 of Phase 2. Its objective was to come up with an adequate description of the situation in the waste management field as a basis for decision making in the course of further project planning.

Furthermore a representative and sufficiently detailed overview on radioactive waste management systems in selected Western European countries was compiled by western experts of the Contractor Consortium. Considering the results of both analyses a first draft of the detailed scope and objectives was prepared. In addition the detailed objectives and scope were the subject of the 1st Workshop on May 31st/June 1st 2006 in Moscow (*Task 1.2*) and these were revised after considering the comments and suggestions made on these occasions.

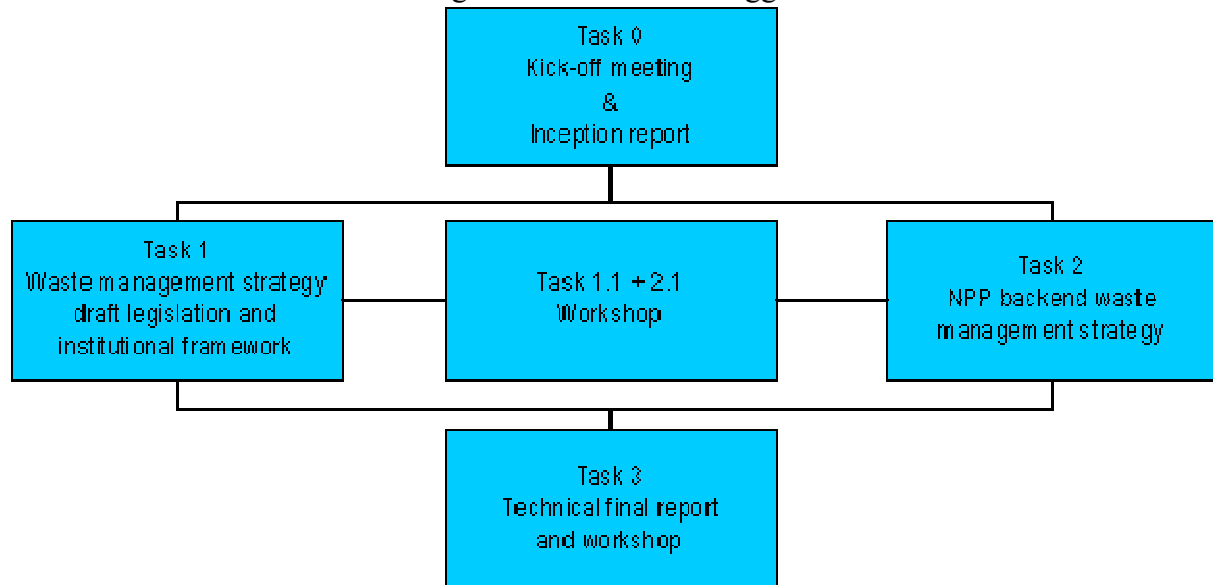


Figure 1: Overall Project Structure

The overall goal of the other three technical tasks:

- 1.3 Legislation,
- 1.4 Waste management organisation (WMO),
- 1.5 Financing (funding) of radioactive waste management activities

were recognised as providing valuable contribution for changing from the recent waste management practice that is often dominated by trouble shooting to implementing a sound self-sustaining waste management system, which considers advanced international experience, is based on an appropriate legal framework, is supported by a self-sustaining funding system and is managed by a capable and authorised organisation.

Project Part 2 started with *Task 2.1 – “Analysis of current waste management strategy and approach at RF NPPs”*. Its goal was to come up with an adequate description of the situation in the NPPs waste management field in order to provide a sound basis for further project work. Furthermore, the western experts of the Contractor consortium compiled an analysis of waste management practices at NPPs in selected western European countries.

Considering the results of both analyses, a first draft of the detailed scope and objectives for the technical tasks within the project Part 2 was prepared and was the subject of the 1st Workshop on May 31st/June 1st 2006 in Moscow (*Task 2.2*) and was revised considering the comments and suggestions made on these occasions.

The overall goal of the other seven technical tasks was determined as drafting recommendations for implementing significant improvements of several radioactive waste management steps as a basis for an advanced NPP waste management strategy.

On October 21st, 2005, the Russian Duma ratified the “Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management”. In this context, this project can be recognised as assistance to the Russian Federation to improve its national radioactive waste management system so as to comply with the obligations of the Joint Convention.

2 PRESENT STATE OF RADIOACTIVE WASTE MANAGEMENT IN THE RUSSIAN FEDERATION

In the Russian Federation there are more than 3,000 facilities, which have to be considered as radioactive waste producers. More than 90 % of the wastes are basically generated and managed at facilities involved in the nuclear fuel cycle (NFC). These include nuclear power installations on ships and nuclear facilities under decommissioning. There are about 100 facilities of this kind.

The average annual amount of radioactive waste generated (taking into consideration the last three years) is:

- 4,3 million m³ of liquid radioactive waste (LRW) with a total activity of $3,72 \cdot 10^{18}$ Bq. These wastes are divided into low level radioactive waste (93,6 % from the total volume, with activity level of $6,72 \cdot 10^{14}$ Bq), intermediate level radioactive waste (6 % - $4,08 \cdot 10^{17}$ Bq) and high-level radioactive waste - (0,4% - $3,31 \cdot 10^{18}$ Bq).
- More than 1 million tons of Solid Radioactive Waste (SRW), 96,2 % of the total mass is low level radioactive waste from ore processing and has an activity of $1,36 \cdot 10^{14}$ Bq. This is only 0,08 % from the radioactivity of all solid radioactive waste generated.

Additionally, as a result of reprocessing, highly radioactive liquid waste is produced. This ends up in about 500 tons of vitrified waste at the Mayak Enterprise each year with a total activity of $1,5 \cdot 10^{18}$ Bq.

The generated radioactive waste is temporary stored in order to decrease the level of activity due to the decay of short lived radio nuclides. After that the waste is transferred for processing, long term storage and disposal.

The temporary storage of radioactive waste is managed at Special Storage Facilities (at NPP, enterprises of nuclear fuel cycle, etc), and at the regional special facilities Radon. Here the low and intermediate level radioactive wastes and spent sources of ionizing radiation from non-nuclear utilization, and also from power and military activities of the Russian Federation are stored.

The main volumes of radioactive waste are stored in 33 districts of the Russian Federation at 69 facilities, in 1,170 temporary storages and disposed at 3 sites in deep geological formations by deep well injection. Liquid radioactive waste is stored in 18 different types of storage facilities and solid radioactive waste in more than 30 types of storage facilities.

The Russian Federation NPPs are recently one of the main radioactive waste producer, particularly of SL-LILW. The following volume of radioactive waste is currently accumulated at Russian Federation NPPs:

- Liquid waste – about 100,000 m³
- Solid LLW – about 121,000 m³
- Solid ILW – about 19,000 m³
- Solid HLW – about 5,000 m³

All this waste is stored at NPPs without consideration of its further disposal. The available storage capacities at Russian Federation NPPs are exhausted to a significant degree. The currently available waste processing technologies at Russian Federation NPPs are particularly obsolete and do not ensure processing of all kinds of waste. No common waste management strategy is established at Rosenergoatom facilities, although currently great efforts for the improvement of radioactive waste management, particularly of waste processing, are undertaken by the individual NPPs. The currently valid regulatory documents related to the NPP waste management processes are not compellingly aligned to further long-term storage and disposal. The absence of Russian Federation radioactive waste disposal concepts affects the establishment of the NPP waste management system, particularly in regard to waste processing and waste characterization.

The most numerous group of the radioactive waste producers are enterprises, organizations and institutions using radiation devices, radioactive substances and sources of ionizing radiation in their activities. Those enterprises are related to various industries and are not connected directly and technologically to the nuclear energy industry (i.e. radioactive waste arising from non-nuclear utilization).

A system of radioactive waste management has existed in the Russian Federation for almost 60 years. Its main elements have been formed during the period of the “Cold War”. The main facilities using nuclear energy were designed, constructed and operated as closed objects taking into consideration conditions of high security. Radioactive waste generated as a result of operation of the facilities was accommodated for storage within the territory of a facility.

Considerable expansion of industry and rapid scientific-and-technical progress connected with the usage of ionizing radiation sources during the 60s of the last century, as well as the need to keep a security regime for the main objects of the nuclear industry, led to the creation of a network of regional special facilities “Radon”. These “Radon” facilities were intended for collecting, processing (conditioning) of radioactive wastes, generated at civil industry enterprises and at research institutions.

Today, this so-called group (or chain) of special enterprises “Radon” is the only one chain of dedicated regional enterprises of federal ownership in Russia. These enterprises are managed by the Ministry of Public Service, and administrations of Russian Federation constituent entities participate in the regulation of their activities. The enterprises provide collection, transportation, treatment, interim storage and disposal of the waste. They render services to small waste producers which are outside the nuclear power and defense sectors. The waste is mostly of low and intermediate activity. Rostekhnadzor, Federal Medical and Biological Agency and authorities with constituent entity administrations supervise Radon activities. The activities are licensed as required by Russian law. Radon enterprises do not take radioactive waste from NPPs, military units, enrichment and reprocessing plants or from scientific

institutes operating research reactors. At the same time Moscow Radon accepts low and intermediate level wastes resulting from land remediation at the Kurchatov Institute.

There are a series of legislative acts and enactments in force in the Russian Federation that regulate radioactive waste management relations. The basic document is the **Federal Law “On the Use of Atomic Energy”** (1995) that establishes the legal framework and principles for regulation of relations arising from the use of atomic energy for peaceful and defense purposes and is aimed at protection of the environment, human health and life.

Federal Law “On Radiation Safety of Population” (1996) is aimed at securing the right of people to radiation safety by means of implementation of a set of measures to prevent radiation effects above levels established by existing regulations, rules and standards. The Law defines the legal framework for assurance of radiation safety of the population with the object of protecting their health. Requirements for prevention against the effects of radioactive substances, set forth in Articles 10 and 20, apply to radioactive waste management as well. However, specialists believe that now the Law does not meet current requirements and shall be essentially updated. To this end, work is underway to develop a legal concept of a new revision of the Federal Law “On radiation safety of population” and to improve, on its basis, existing legislative acts and enactments in the field of radiation protection and radiation safety.

Federal Law “On Funding of Specially Radiation Hazardous and Nuclear Hazardous Processes and Facilities” (1996) includes a provision (that unfortunately does not work) on foundations of guaranteed budget funding of works aimed at assurance of safe and stable operation of such processes and facilities. More relevant nowadays is Article 3 of this Law stipulating that organizations operating specially radiation hazardous and nuclear hazardous processes and facilities shall accumulate centralized funds for financing works performed in order to improve technologies and increase the level of safety in operation of said facilities. Summarizing the present state of radioactive waste management and main legislative acts and other enactments regulating radioactive waste management, we can infer the following:

- a rather extensive legal framework in the field of radioactive waste management exists in the Russian Federation, while basic legislative acts of nuclear and environmental protection law contain for the most part declarative provisions or references on radioactive waste management issues, including those on conditions and methods of disposal, assigning solution of said issues to a subject of regulation by special legislative acts regulating activities in the field of radioactive waste management which do not exist yet;
- conceptual regulations existing in this field do not serve to fulfill tasks on creation of a single state system for radioactive waste management in the Russian Federation;
- analysis allows revealing numerous gaps in the legal regulation of relations pertaining to radioactive waste management, in particular, the legislation does not provide for final responsibility of the state for assurance of safe radioactive waste management; does not clearly distribute duties on radioactive waste management; does not define the procedure of control over turnover of radioactive substances and radioactive waste, including transfer of ownership and responsibility for safe management; also it does not specify radioactive waste management funding sources which in conditions of lack of budgetary funds has an adverse effect on accomplishment of tasks on safe transportation, storage, reprocessing and disposal of radioactive waste;
- the existing regulations are often inconsistent in the system of notions used (terms and definitions of radioactive waste, SNF, etc.), as well as in solution of some of the

management issues; as noted above, what is allowed by the Law on the Interior Part of the Earth concerning underground disposal of liquid radioactive waste is directly prohibited by the Russian Federation Water Code and bylaws issued on its basis (in particular, safety rules and regulations). In order to eliminate the existing contradictions, amendments shall be made to corresponding legal documents, or drafts of their new revisions shall be prepared;

- some of the legislative acts contain unjustified environmental protection and other requirements to radioactive waste storage and management facilities that do not take into account the state of the art in this field.

Thus, a special legislative framework in the field of radioactive waste management that would agree with the current legislation and conceptual documents in the field of atomic energy utilization has not been established in spite of repeated attempts to do so. The Federal Law “On Radioactive Waste Management” has been under development for many years but is not yet enacted. Recommendations resulting from hearings on nuclear and radiation safety regulation in the Russian Federation held by the State Duma emphasize that the delay in enactment of the Federal Law “On Radioactive Waste Management” adversely affects the establishment and functioning of the system for state regulation of safety in the use of atomic energy.

The “Fundamentals of the State Policy on Assurance of the Russian Federation Nuclear and Radiation Security to the Year 2010 and Beyond” signed by the President on 04.12.2003 lists development and enactment of the Law on Radioactive Waste Management as one of the main objectives of the state policy in the field of nuclear and radiation safety assurance (Paragraph 10.2).

Adoption of this legislative act will allow solving the main issues relating to radioactive waste management, including the following:

- creation of a single state system of radioactive waste management in the Russian Federation that would define basic principles and strategy of radioactive waste management and technical policy in the field of radioactive waste management with due regard for international requirements and foreign practices, and development of basic requirements to its efficient functioning;
- setting forth provisions on final responsibility for assurance of safety in radioactive waste management and state guarantees in this field;
- solution of issues of funding management of “legacy” radioactive waste and radioactive waste from ongoing operations;
- establishment of a specialized organization (management company) that would deal with radioactive waste management in the Russian Federation
- development of new regulations and requirements to radioactive waste management tactics, methods and conditions, methods of disposal in view of final isolation in geological structures using a single legislative framework;
- unification and harmonization of the national legislation in the field of radioactive waste management in accordance with international regulations, and employment of the long-standing experience of foreign countries in the field of legal regulation of relations pertaining to radioactive waste management.

3 MAIN DIRECTIONS FOR THE IMPROVEMENT AND FURTHER DEVELOPMENT OF THE RADIOACTIVE WASTE MANAGEMENT SYSTEM IN THE RUSSIAN FEDERATION

3.1 Improvement of the Radioactive Waste Management Legislation

As the first project activity a detailed analysis of the former legal initiatives in the Russian Federation in regard to waste management and disposal was carried out. The project work continued with an overview of Western European legal systems in radioactive waste and spent nuclear fuel management that have been successfully implemented..

On this basis, in turn, the Russian project partners prepared the legal documents necessary for developing a new law in the Russian Federation. The draft legislation follows a particular scheme that results from the legal tradition of the Russian Federation on the one hand and from the ways and means used to implement governmental work and the interaction of the executive with the parliament on the other. To this aim, a number of documents need to be prepared, which include as main elements:

- The Draft Conception of the Federal Law
- The Technical Assignment of the Federal Law

The Title of the law shall be:

"Law on the state system for radioactive waste and spent nuclear fuel management and decommissioning of objects of the nuclear energy use"

The objective of the present Law in Draft is to legalize at the Federal level the legislative grounds of creating and running a Single State System of the Radioactive Waste Management based on the following fundamental principles:

- Final isolation of the radioactive waste is a necessary stage of utilization (creation) of any nuclear and radiological hazardous product, commodity, facility, technology;
- The waste producer is the owner of the waste up to the moment of its transfer to a specialized enterprise for radioactive waste management and bears full responsibility (including financial one) for its management: After this moment the property title of the radioactive waste is transferred to the State;
 - The entire system of radioactive waste management is divided into the three streams: the waste generated as result of current operation of the objects (facilities) of nuclear energy use, the waste arising from future decommissioning of running objects (facilities) of nuclear energy use, and the accumulated waste, including the “Historical Radioactive Waste”. Under the “Historical Radioactive Waste” we understand the waste created as a result of activities carried out in the nuclear sector of the Russian Federation during the previous years. The starting point from which on this approach is to be applied should be defined in the Law in Draft that introduces the new financing system. All radioactive waste and spent nuclear fuel generated before this moment, and all obsolete facilities to be decommissioned as well, are considered nuclear legacy. The expenditures for management of these waste and spent fuel, its removal for storage and disposal should be financed by the State;
 - Decommissioning of the objects (facilities) of nuclear energy use erected for implementation of military defense programs, including carrying out corresponding scientific and research works, is also under State responsibility;
 - Since solving the problem relating to the accumulated radioactive waste, including the “Historical Radioactive Waste”, and decommissioning of the facilities of nuclear energy use erected for implementation of military defense programs is a responsibility

and financial liability of the State, it is necessary to develop specific organizational and financial mechanisms;

- A waste producer is obliged to transfer without any delay its waste to the Specialized Organization on radioactive waste management created in accordance with the provisions explained in the following chapters of the present document;
- The future generations should not be burdened by the “putting off final solution” of the radioactive waste issue. Whenever this is unavoidable the resources necessary to cover the burden issues should be stipulated now.
- The present generation should also be responsible for the radioactive waste burden (that means economic and reasonable operation which leads to waste production and reasonable efficiency while securing the nuclear and radiological management).

3.2 Implementation and Development of a National Waste Management Organization

The experts of the Consortium have provided a comprehensive description of various organisation models and management principles in West European countries. In all countries the ultimate responsibility for managing radioactive waste lies with the State (having the right to make laws). Although the “waste producer pays” principle has generally been adopted it does not, however, allocate responsibility for *carrying out* the waste management activities e.g. conditioning, packaging, transport, interim storage and final disposal. Generally, the responsibility for conditioning and packaging of the waste for transport to disposal lies with the Waste Producer. It is of course possible for the Waste Producer to use contractors to perform waste conditioning and packaging services. The responsibility of the Waste Management Organisations (WMOs) is to provide a destination for RW and SNF away from the Waste Producer’s facility. In some countries it is the Waste Producer’s responsibility to collect, to condition and to transport the RW for final disposal. In other countries the WMO enters the process already at the collection stage.

LILW is typically sent directly from the Waste Producer to the disposal facility (the Netherlands as only exception, where COVRA is responsible for interim storage as well). For VLLW there are different solutions. In Sweden local landfills for VLLW at each NPP site are designed, constructed and operated by the NPP. In France also this waste is centrally disposed of by the WMO.

For interim storage of spent nuclear fuel and HLW there are again different approaches. In the Netherlands, Spain and Sweden this is also a task of the WMO while in France, Germany and the UK interim storage is the responsibility of the Waste Producer.

Four West European countries (F, NL, ES, SE) have established a radwaste management system in which final disposal is managed by one single body, the WMO. Two countries (DE, UK) have chosen to distribute responsibilities for RW management to different organisations. The general approach is one of centralised responsibility on a national level for the final disposal of radioactive waste. No type of organisation can be regarded as unsuitable for the establishment of the WMO. The key issue is that the WMO’s responsibilities and the terms and conditions for its work must be explicitly stated by law, as also the responsibility of the Waste Producer and the Regulator.

The Western experience is that the roles of the waste producer, the waste disposal organisation and the regulator should be clearly separated. For Russia the proposal is to have the WMO be subordinated to Rosatom which also is responsible for the nuclear power plants

(however through its subordinated entity Rosenergoatom) who are waste producers. The regulatory body Rostekhnadzor is subordinated directly to the Prime Minister's office.

Given that the WMO's responsibilities and the regulators tasks are clearly defined by law, and that the two bodies are independent from each other, a process should also be defined in the law that secures the programme advancement over time. This can be done by a provision in the law that the WMO regularly must report results and present plans for review.

It is recommended that the WMO should have a core competence of skills and knowledge on the key tasks of the research and development programmes. Contractors and suppliers for larger volume specialist work are if possible engaged through a competitive procurement process.

Based on the defined responsibilities of the WMO it needs to carry out programmes for LILW disposal, centralised SNF interim storage, HLW disposal and decommissioning. It is obvious that the decommissioning programme should be closely co-ordinated with the LILW and HLW disposal programmes and the SNF interim storage programme, one objective being that the need for building new interim storage facilities should be minimised. The waste from the decommissioning programme should preferably go directly to final disposal.

Since the large waste volumes from decommissioning and clean-up activities will mostly be LILW and the existing LILW storage/disposal facilities are next to full the development of LILW disposal facilities should have the highest priority. The initial task for the WMO should be to prepare a business plan. This work should be made in consultation with external experts and stakeholders, in order to secure a broad acceptance of the plan. The business plan is a long-term document describing the mission of the WMO. It is the basis for preparing detailed annual plans and budgets.

The business plan should include a top-level funding strategy and plan of how the Russian Federation shall finance both the legacy waste (its disposal to be funded by the state), the waste streams coming from the currently operating and from a planned large fleet of new NPPs and nuclear fuel cycle facilities.

A condition for the WMO to be successful in the implementation of the programmes is that the programmes are approved or endorsed by all key stakeholders. It is thus necessary that the WMO carefully plans the stakeholder communication, and that enough time is devoted to the implementation. All key stakeholders must be identified and channels for liaison must be worked out.

Following the above outlined input from the Consortium experts of the Russian counterpart KI-Atomservice drafted a business plan for the WMO, to be the basis for a Draft Work Plan and Budget covering the first 3 years. Although the document outlines several approaches based on influence from the Consortium it needs considerable further work when it comes down to concrete planning.

3.3 Implementation of a Funding System

For the purposes of developing the financing scheme model the following assumptions have been agreed:

- The overriding principle is that of 'Waste Producer Pays';
- There will be three separate accounts within the Fund;

- The organisation will be responsible to ROSATOM.

For convenience the acronym ‘ROSRAO’ is used to denote the waste management organization (WMO) which will have responsibility for waste management, decommissioning and spent fuel storage in Russia. The scheme is illustrated pictorially in Figure 2 Proposed Financing Scheme Model”, which shows the cash flows into and out of the three accounts.

As conceived, all accounts would be under the supervision of the Fund Management Board (FMB). Significant waste producers (i.e. the nuclear power plants) would pay contributions to the Funds based on formulae to be established. In the fullness of time ROSRAO would be permitted to make annual draw-downs to provide revenue for their management costs and associated expenses. It will be necessary to prepare annual budgets and business plans to justify this fund transfer.

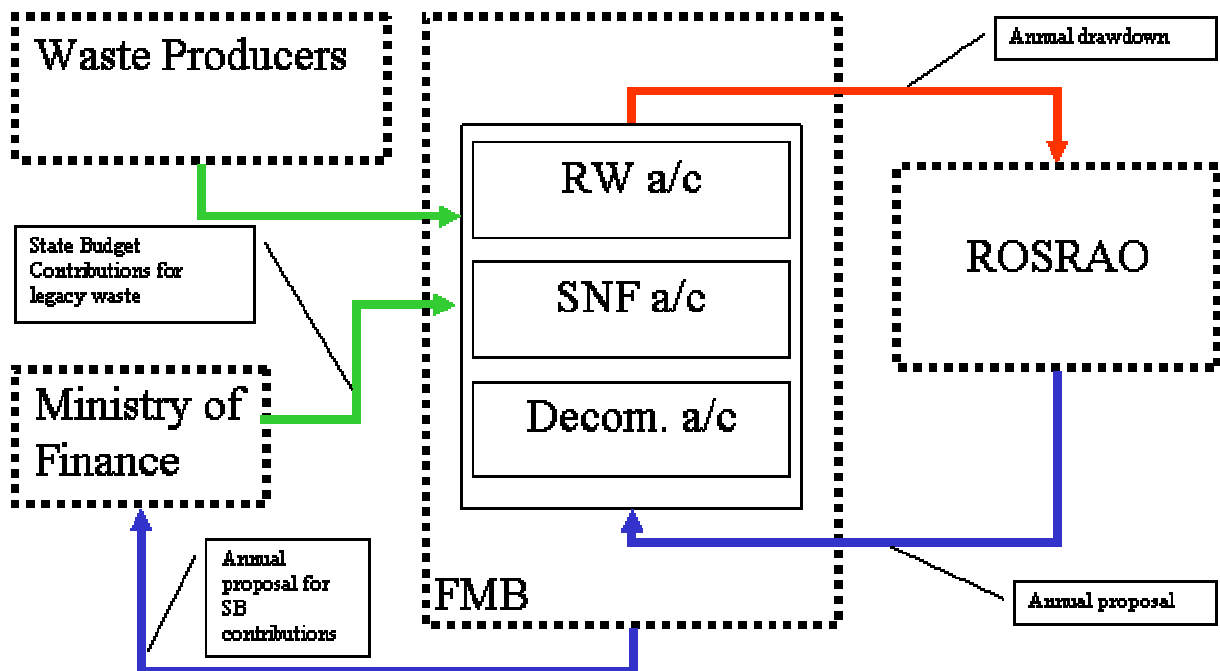


Figure 2 Proposed Financing Scheme Model

The Fund Management Board will also make an annual proposal to the Ministry of Finance for a contribution from the State budget to cover legacy liabilities. These costs would relate to waste management, spent fuel and decommissioning activities and the funds would be transferred to the Board for administration together with other income.

Whilst choosing the financing mechanism it must be recognized that in accordance with the provisions of the Civil Code of the Russian Federation, incomes gained from profitable activities of State Bodies are to be managed independently by the Body itself and must be accounted for separately. Thus ROSRAO must stipulate a system which accounts separately for budget and non-budget incomes and expenditures.

At the same time it would be logical to arrange separate accounting of incomes to be directed for radioactive waste disposal, centralized storage of spent nuclear fuel (SNF) and

decommissioning of nuclear and radiologically hazardous facilities, and income to be used for dealing with the historical nuclear legacy.

Such separation will allow identification of State budget funds and the funds being transferred by the waste producers. This approach will make it easier to provide State and public supervision as well as increased transparency of ROSRAO activities.

Small waste producers and non-nuclear power plant producers (e.g. the rest of the fuel cycle) can pay ROSRAO directly for the services provided at fee rates which are set on an economic basis. The fees could be retained by ROSRAO as part of its income or could be passed through to the Fund.

The model proposed is required to accumulate significant and sufficient funds in the three accounts of its structure, and it should be transparent and independent of other Bodies of the State system.

3.4 Improvement of NPP Waste Management Procedures

- *Waste generation and minimisation*

The analysis of current Russian Federation NPP radioactive waste management practices has showed that minimisation of radioactive waste arising is one of the main priorities mainly driven by shortage of interim storage capacity in connection with limited radioactive waste treatment and conditioning capabilities.

Great efforts for waste minimisation have recently been made. This concerns both organisational and technical measures related to waste source reduction, processing and conditioning as well as recycling and reuse of materials. The analysis of yearly waste generation at Russian Federation NPPs shows a decreasing trend as a result of these measures. The total expenses for measures of waste minimisation at Russian Federation operated NPPs in the years 2002 – 2004 has been estimated of about 1026 mill. Rubles, and from this about 80% is related to liquid waste.

However an analysis of selected western NPPs practices indicated both the necessity and possibilities for further waste minimisation at Russian Federation NPPs. The major recommendations are the following:

- Zoning of Russian Federation NPPs is established according to the corresponding sanitary rules. It is recommended to consider a review of the current zoning at Russian Federation NPPs taking into account not only the sanitary rules but also the variety in the waste streams (from the sources up to storage). This means to establish zoning regulations with a view to separating any sector where waste is actually or likely to be contaminated or activated (nuclear waste zone) from all other sectors where there is no waste-contamination or activation risk (conventional waste zone).
- According to recent waste classification regulations various thresholds exist below which the waste is not considered as radioactive. Thus, it should be verified which limits can be practically applied on NPPs and adapted by the organization in order, to segregate at the source all the waste which are generated out of an activated or contaminated zone.
- In several western European countries a class of very low level waste has been established. This solid waste is disposed of at surface repositories. According to preliminary assessments about 40% of the solid radioactive waste generated at Russian Federation NPPs need not be included in the low and intermediate activity waste just by defining a fourth 'very low level waste' category.

- Analyses are recommended for decision making in the field of reuse-recycling based on Rosenergoatom's experience. Life cycle type analyses may be convenient but need to be implemented. Other types of "budget balance analyses" can also be applied.
- Development of flow diagrams of the waste processing and conditioning, with clear indications of volume reduction or increase would be a useful tool for all Russian Federation NPPs and can give rise to a series of indicators for further waste minimisation
- Current Rosenergoatom's practices to communicate all good experiences on waste minimization to all the NPPs should be expanded based on a clear waste minimization strategy. The central role of the co-ordinator would be more to organize the progress by bringing local staffs together and let them be directly involved in the definition and the implementation of measures.

Waste classification and characterisation

Solid radioactive wastes in the Russian Federation are classified in terms of activity levels in three categories (low, intermediate and high level waste). Waste is considered as radioactive by the dose rate criterion, if the dose rate 0.1 meter from the tank exceeds 1 μ Sv/hour. According to the specific activity criteria, the threshold for low radioactive waste would be 7.4 Bq/g for alpha emitters and 74 Bq/g for beta emitters, which means that below these values, wastes have to be considered as very low radioactive or exempt waste.

Furthermore it is understood also that below a specific activity of 0.3 Bq/g, the waste was allowed to be managed as a conventional waste, this threshold being very much in line with western practices. This means that in practice there is a fourth category of radioactive waste to cover the 0.3 Bq/g-74 Bq/g range. Classification systems in several western European countries include for that case a class of Very Low Level Waste (VLLW), which is disposed of in relatively simple surface repositories due to the short endangering life time of this waste. Unfortunately the existing Russian Federation radioactive waste classification with the different criteria based on dose rate, specific activity and surface contamination do not consider any future disposal routes and requirements.

Waste characterisation at the Russian Federation NPPs is performed corresponding to the state sanitary requirements on radiation protection. Requirements for waste characterisation related to the further waste long-term interim storage and disposal are not defined. This concerns particularly the determination of long-lived radionuclides content, content of gaseous radionuclides, content of gas generating materials.

These findings led to the following recommendations:

- Taking into account disposal requirements a classification based on nuclide life and activity needs to be implemented as suggested by the IAEA standards.
- To create a category of "Very Low Level" waste with no threshold is recommended in compliance with the zoning approach described above.
- The requirement to characterise very early all the nuclides through sampling or measurement in compliance with long-term interim storage and disposal requirements needs to be perceived as a priority in the overall characterisation process at the Nuclear Power Plant site. A centralised approach for a characterisation program is recommended especially for long-lived beta emitters.

Waste processing technologies

Waste processing at the Russian Federation NPPs was not an issue of concern in the past. Liquid waste was evaporated and the evaporation residues stored in tanks. Certain volumes of

liquid waste were bituminised and stored in drums. A small volume of combustible waste has been incinerated. Currently, certain metallic waste is re-melted in a specialised facility. In recent years NPPs have undertaken great efforts to improve the situation.

However, implementation of new waste processing technologies at the individual NPPs is not performed based on an overall waste management strategy taking into account the requirements of long-term interim storage and disposal. Currently, Rosenergoatom undertakes efforts to implement a common waste conditioning strategy based on the use of unified concrete containers.

The following main recommendations for further improvement of waste processing at the Russian Federation NPPs have been developed:

- A single waste conditioning process should be defined for the majority of wastes arising at the Russian Federation NPPs in order to benefit in a maximum extent from obvious synergies.
- Cement encapsulation, combined with the extended use of reinforced concrete waste containers (e.g. NZK as standard type), should be the preferred process for the conditioning of NPP wastes.
- Consideration should be given to the use of ‘common’ centralised and/or mobile facilities in particular for processing and packaging of certain specific waste types.
- A single body should be responsible for the derivation of a standardised definition of properties for waste packages containing NPP wastes. It should establish and manage an independent assessment process for the approval of proposals for the packaging of wastes by NPPs.

Waste storage; Waste Acceptance Criteria

Recommendations for establishing waste acceptance for radioactive waste storage and disposal (RB-023-02, 2002) has been issued by the Russian Federation nuclear authority. This document contains general recommendations for development of Waste Acceptance Criteria based on the relevant IAEA recommendations. However, no Waste Acceptance Criteria for interim storage were developed by Russian Federation NPPs based on the Recommendations. As no operational disposal facilities exist in the Russian Federation no Waste Acceptance Criteria for waste disposal are currently available either.

Moreover, establishing Waste Acceptance Criteria in the Russian Federation is hampered by the absence of a radioactive waste disposal strategy and firm concepts.

In order to correct this unsatisfactory situation following main recommendations are made:

- As a first step the development of Generic Specifications for waste packages based on the NZK-150 container should be progressed, taking into account the needs of all stages of waste management from storage at NPPs to final waste disposal including transport. A methodology for the development of a Generic Specification is outlined in the report on Task 2.6.
- NPP operators should produce specification for storage facilities, which include the definition of the environmental conditions (i.e. acceptable temperature and humidity ranges and levels of aggressive atmospheric pollutants etc) that will be required to ensure the adequate preservation of waste packages during the extended period of storage as well as guidance on the establishment of an inspection regime.

Waste disposal

Currently Rosatom considers construction of several regional repositories mainly in the neighbourhood of large waste producers. Corresponding to the relevant IAEA

recommendation geological disposal of long-lived waste is considered. Following these considerations, several early disposal concepts have been developed both for SL-LILW and LL-LILW/ HLW so far. However, only two concepts consider disposal of waste from NPPs (Leningrad near surface repository and the concept of an underground repository on the Kola Peninsula). The other concepts consider near surface disposal of waste from operation and decommissioning of nuclear powered vessels as well as disposal of HLW and LL-ILW from spent fuel reprocessing, from former plutonium production and of spent fuel, which cannot be reprocessed, in geological repositories.

First considerations for the development of a Russian Federation disposal concept are as follows:

- Development of a radioactive waste disposal concept should be an important task of the Russian Federation state waste management organisation to be established. This work should include:
 - Development of generic repository concepts for near surface and geological disposal
 - Development of preliminary Waste Acceptance Criteria for different disposal concepts
 - Development of a site selection process (Considerations related to the site selection methodology have been developed in the framework of Task 2.8)
 - Development of pilot repository concepts both for a surface/near surface repository and a geological repository
- It is necessary to start disposal of the short-lived LILW as soon as possible, as it constitutes the largest volume of the nuclear waste. The locations for corresponding regional repositories should be selected among sites where the conditions are suitable. If such requirements could be met at the locations of the existing Radon facilities for mainly institutional waste, it would provide organizational and infrastructural benefits.
- In order to reduce the volumes to be disposed of at the LILW repositories the establishment of a new waste category – Very Low Level Waste (VLLW) is desirable
- HLW and LL-LILW from NPPs represent a small fraction of this type of waste arising in the Russian Federation; accordingly it is recommended to plan to dispose this waste together with HLW/LL-LILW from reprocessing.

4 RECOMMENDATIONS FOR IMPLEMENTATION

From the view point of the contractor consortium and local experts the project results, which are briefly summarised above, provide a valuable contribution for upgrading the recent management system for radioactive waste, spent nuclear fuel and obsolete nuclear facilities in the Russian Federation. The project results may enable a transition from the current practice, which often is dominated by urgent needs (“trouble shooting”), to a sustainable, sufficient and self-sustaining management system that complies with international commitments, in particular those of the Joint Convention, and that is in line with advanced international experience.

In this regard the overall project outcome fits extremely well with the European Commissions new instrument for nuclear safety - the Nuclear Strategy Paper and Indicative Programme for Community Assistance Programmes for 2007 – 2013. One of its four priorities is “*safe and sustainable management of nuclear waste, decommissioning and remediation of former nuclear sites*”. Moreover European Commission assistance is evolving from purely technical

support oriented projects and from an exclusive site by site or project by project oriented approach to a more sector oriented approach.

A strict 1 to 1 implementation of the recommendations which have been prepared in the course of the project might not be feasible in all cases. However variations might be required in the result of the administrative decision making process. It is of major importance, that both beneficiaries, Rosatom and Rosenergoatom, do take possession of the overall project results and make practical steps for implementing their rationale.

In this sense Rosatom's tender initiative for drafting a law on radioactive waste management is very much welcomed as a first step for a corresponding legal initiative.

In addition it is recommended to implement an authorised and competent working group of experienced experts for founding the National Waste Management Organisation, which should be explicitly integrated into Rosatom's recent reorganisation plans. Preferably these experts should be released from other burdens in order to allow them to focus on their new tasks and to become the management core of the new organisation. Again Rosatom's recently founded new state cooperation "Nuclear and Radiological Safety" is very much welcomed, since it may provide such an initial staffing core for establishing the National Waste Management Organisation.

In order to assist Rosatom in both activities in the short-term it would be sensible to initiate follow-up projects as high priorities within the new European assistance programme; both should be funded by the European Union.

Further assistance to Rosatom's upcoming waste management organisation by western experts would be useful for developing a Concept and a Programme for Regional Repositories for Short-Lived Low- and Intermediate-Level Waste as well as for a HLW repository. The later one should consider the recent siting activities performed in the Krasnoyarsk region by various Russian Institutes.

These activities should be initiated without any delay. They should provide a justified basis for assessing future disposal costs in order to prepare a reliable financial planning and fixing the waste producers' contributions of to the waste management fund. Decisions on disposal concepts are urgently required in order to overcome recent insufficiencies in pre-disposal waste management.

As regards the improvement of radioactive waste management at NPP sites Rosatom should take initiatives for establishing new waste classification and for developing and implementing preliminary Waste Acceptance Criteria for disposal. A new Very Low Level Waste classification that explicitly considers disposal requirements as well as a economic benefit would obviously require a close cooperation with Rostekhnadzor, whereas the development of preliminary Waste Acceptance Criteria should be an urgent task for the new federal waste management organisation. Both activities require strong coordination with the repository concept development mentioned above. Both subjects are linked with the need to develop common requirements and techniques for waste and waste package characterisation.

In order to underpin the urgency of these issues it should be noted, that recent waste classification is limited to short term storage needs only. No difference between long- and short-lived wastes is made. As a consequence long- and short-lived waste are not treated and

packed separately and no alpha-measurements are performed before conditioning. In fact this situation leads to a new legacy of un-disposable waste.

It would be desirable to establish a common waste treatment and conditioning strategy within Rosatom and to overcome the current practice, where waste treatment and conditioning technology is mainly an individual task for each NPP site, in order to benefit from economic and technologic synergies.

For facilitating the recommendations which have been developed in this project, it would be useful to mobilise advanced international experience in follow-up projects. This fits into the European Commission's new sector assistance approach and may provide substantial contributions to the new European Assistance programme.