

Administrative and technical solutions on RW management during remediation of the coastal base site in Gremikha

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Abstract

This paper presents RW management issues based on Justification of Investments (OBIN) reports prepared in the framework of "Development of conceptual designs for management of spent nuclear fuel and radioactive waste from VVR and Alpha nuclear submarines and remediation of the TSF site in Gremikha" performed with financial support from the EBRD and CEA (France).

Technical options and schemes of handling various kinds of RW during remediation of the TSF site in Gremikha are considered and analyzed in view of the Russian and international experience in remediation of radiation hazardous facilities.

Specific site conditions are presented; infrastructure facilities intended for management of radioactive waste during remediation of the TSF site in Gremikha are described.

Justification is provided for types and characteristics of shipping containers required for removal of conditioned SRW to the Regional Centre.

Phases of implementing administrative and technical solutions on RW management are outlined, waste conditioning facilities layout solutions and arrangement of additional buildings and shelters in the site general layout are proposed.

List of abbreviations

CMB	Coastal maintenance base
HLW	High-level waste
LLN	Long-lived radionuclides
LRW	Liquid radioactive waste
SLN	Short-lived radionuclides
LLW	Low-level waste
OBIN	Justification of investments
RW	Radioactive waste
ILW	Intermediate-level waste
PPE	Personal protective equipment
SevRAO	Northern Enterprise for RW management
CPS	Control and protection system rod
ME	Machine-building enterprise
SRW	Solid radioactive waste
TUK	Shipping packaging set
SAS	Surface-active substances
PEK	Floating tank
TSF	Temporary storage facility
Open Pad	Area for temporary storage of SRW
FAAE	Federal Agency for Atomic Energy
FSUE	Federal State Unitary Enterprise

General

According to the “Concept of environmental remediation of costal maintenance bases in the Russian North” approved by the Head of Rosatom in 2004, CMB in Andreeva Bay and Chervianaya Bay (Gremikha) will no longer receive SNF and RW from operating Navy ships. The CMB shall be decommissioned with subsequent environmental remediation.

A concept of managing RW at any facility of the Federal Agency for Atomic Energy, including the CMB in Gremikha that was transferred to Minatom in 2001, shall comply with general provisions of the “Concept of the Russian Minatom on radioactive waste management” put in force by the Minister’s Order No. 475 of 03.08.2000 and take into account specific features of a given facility.

According to the concept, the RW management scheme includes:

- collection, sorting, treatment and packaging of RW (conditioning) to meet storage and disposal requirements;
- temporary storage, transportation and disposal of conditioned radioactive waste: short-lived RW packages – in near-surface facilities (above-ground or up to 100 m deep), and long-lived RW packages – in deep geological repositories (300 and more meters deep).

The technical policy in the field of RW management adopted by Rosatom at the moment reduces to efforts focused on implementation of phases of processing, conditioning and temporary storage of RW coming from nuclear energy use facilities, and postponed decision concerning implementation of the disposal phase. As a necessary measure it was decided to temporarily limit the RW management scheme by the storage phase. No development and implementation schedule has been officially set for the disposal phase; therefore regulations define the operating time of storage facilities (storage period) as 30 - 50 years. There are plans to build centralized (regional) long-term storage facilities, so in the near future RW packages will have to be transported outside the respective sites.

The policy described above defines technical solutions for the mentioned RW management phases. Newly constructed facilities are designed for storage of conditioned waste, i.e. RW treated as closed ionization radiation sources. Certified containers shall be used. Container service life (endurance) shall not be less than the storage facility operating time. RW packages will be produced at conditioning facilities, and upon arrival at a storage facility they shall meet overall Federal waste acceptance criteria defined by requirements of storage and disposal phases.

1. Specific features of the facility in Gremikha

When considering specific administrative and technical solutions on RW management in Gremikha, it is important to take into account specific conditions formed as a result of previous operations at the site. The peculiarities include:

- **The facility is subject to decommissioning.** The specified operating time and service life of facility systems and components have expired; the facility is no longer used for its initial purpose. It is not planned to extend the facility life or repurpose the facility. Therefore *the capital construction shall be reduced to a minimum as far as possible.*
- **The existing facility infrastructure does not allow fulfilling specified tasks.** Conventional RW management facilities that might be used are not available at the site. RW is stored in off-design conditions not meeting modern requirements, and so it is a source of radioactive contamination of the environment.
- There are plans to build a centralized complex for high-level processing of SRW and long-term storage of conditioned SRW in Saida Bay in the Russian North. Therefore *it is impractical to plan construction of new facilities for high-level processing of SRW and building the infrastructure required for the new construction in Gremikha.* Only facilities

allowing minimization of RW volumes and safe transportation of the RW to the Regional Centre in Saida Bay shall be included in the site infrastructure.

- **The facility is remote and isolated, therefore on-site waste processing shall be minimized.** The major volume of radioactive waste shall be packed in containers following classification sorting and reduction of volume to be transported (through fragmenting, ordered packing and pre-compacting) and shipped to the Regional Centre in Saida Bay for further processing. When selecting RW management options, *preference should be given to mobile easily demountable plants*, facilities and structures that do not involve capital construction. The plants shall be simple to operate, easy to deliver and install, require minimum auxiliary systems and servicing. In view of the severe climatic conditions, mobile plants shall be installed under cover (in a building).
- **Wide variety of solid waste types.** SRW at the facility differ in storage location, mix, radiation parameters, physicochemical composition and weight and size characteristics. Accordingly, it is important to divide these types of waste into streams and substantiate management of each identified waste stream. *The classification sorting system and its instrumentation* assume fundamental importance for implementation of the optimal RW management scheme. Classification criteria shall be selected and substantiated in order to establish a system of optimal step-by-step RW sorting.
- Significant amounts of very low level waste (VLLW) are expected to arise during remediation of the site and dismantling of buildings and structures. VLLW may also be found among the accumulated LLW which specific activity might decrease due to radioactive decay to a level corresponding to the lower limit of qualifying the waste as RW (or below the limit). *In order to reduce the load on the SRW management system, VLLW streams shall be separated from other RW streams at the sorting stage.* VLLW with the potential hazard period not over 100 years can be disposed of directly on the site in special near-surface repositories of simplified design.
- **SRW at the site include long-lived waste** containing α -emitters and β -, γ -emitters – activation products (^{59}Ni , ^{63}Ni and others). *Long-lived RW shall be treated separately*, since they cannot be placed in near-surface repositories which may be expected to be built as the first phase of solving the disposal problem in Russia. Therefore it is important to separate out streams of this waste during the classification sorting.
- **Large volumes of bulky waste** *shall be fragmented/cut before and/or after the sorting.* Several kinds of such equipment shall be used depending on SRW types.
- **There is a large amount of unpacked SRW**, and water is inside containers with SRW as the containers are leaking, so *a drying unit is required* to remove the water.

2. Purpose and objectives of RW management

The purpose of RW management is to establish a system for environmentally safe management of waste of various activity levels and types that had been accumulated before and are arising in the course of remediation activities provided that the adverse impact of LRW ionizing radiation on the workers, public and environment is limited to the maximum extent possible.

Main RW management objectives include:

- stabilization of the current state of SRW accumulated in open areas;
- refurbishment of the existing site infrastructure or construction of a new minimum required one to provide conditions for safe RW handling operations;
- justification of an optimum RW management scheme in view of specific conditions of the Gremikha site;
- establishment of an on-site system for collection, classification sorting, partial processing and conditioning of waste, including forming of RW packages that would meet RF regulatory requirements in terms of waste acceptance criteria to allow delivery of the waste to the Regional Centre in Saida Bay for high-level processing and/or long-term storage;

- selection of waste sorting and conditioning facilities (technology and equipment) enabling an optimum reduction in the waste volume for delivery the Regional Centre in Saida Bay for high-level processing and/or long-term storage;
- separation of very low level waste (VLLW) from the total volume of radioactive waste and providing conditions for on-site disposal of this group of waste in near-surface repositories;
- making provisions for processing of accumulated and arising liquid radioactive waste in modular treatment plants using simplified processes to produce conditioned waste packages suitable for delivery to the Regional Centre for long-term storage;
- selection and justification of metal and concrete containers to be used for producing RW packages meeting unification, certification, durability and other requirements of the Russian regulations;
- ensuring safe conditions of on-site temporary storage of RW packages before their shipment to the Regional Centre;
- meeting radiation safety requirements at all work stages, including limitation of releases and discharges to the environment subject to ecological conditions and requirements.



3. Characterization of radioactive waste

Solid RW

Solid radioactive waste was produced during operation of the TSF, mainly from refueling of nuclear submarines and SFA handling for removal from the site, and thus far remains on the site. All waste categories by the specific activity level – HLW, ILW and LLW – are represented. The estimated total amount of SRW is shown in Table 1.

Table 1

Estimation of the total amount of SRW at the TSF

SRW location	SRW description	SRW volume, m ³	Mass, t	Specific activity (radiation levels)	Category according to SPORO-2002
SRW storage	Metal containers in the process hall	525		–	LLW, ILW
	Metal containers in the “sarcophagus” 2 containers 1,5 m ³ each (thermocouple cases and CPS)	3		–	HLW ILW
LRW storage	Pipes, fittings, deposits on the floor of the basement and pipe lane	5		Up to 8×10 ⁵ Bq/kg (deposits)	LLW

SRW location	SRW description	SRW volume, m ³	Mass, t	Specific activity (radiation levels)	Category according to SPORO-2002
	Cement-grouted LRW on the first floor – 2 drums 200 l each	0,4		Up to 120 μSv/h	LLW
	Disposable filters from the “Potok” LRW treatment plant	–		Up to 220 μSv/h	LLW
Floating tank PEK-50	LRW tanks	~200m ³	~180 t	Up to 6×10 ⁵ Bq/kg (up to 35 μSv/h)	LLW
Two pits outside the building	Thermocouple cases and CPS	2		Up to 170 Sv/h	HLW ILW LLW
Montejus area	Concrete containers	10	~50 t	Up to 2×10 ⁶ Bq/kg	ILW LLW
	Steel containers				LLW, ILW
Tanks in the SRW storage		Up to 400			
Decontamination area	Container for CPS rods (2 empty containers)				
	Container of type 11 (1 empty container)				
Open Pad	Containers with SRW, bulk SRW	~82			HLW ILW LLW

Solid radioactive wastes accumulated on the site differ in weight and size characteristics, physicochemical composition, specific activity level (low-, intermediate- and high-level waste), and radionuclide composition (long- and short-lived α - and β -, γ -emitter content).

The total volume of accumulated solid radioactive waste is about 1500 m³, about 86% of which is low-level waste, about 13% - intermediate-level waste, and about 0,5% - high-level waste.

By storage methods and places, the following SRW groups may be identified:

- unpacked waste stored in bulk in open areas;
- waste stored in containers in open areas;
- unpacked waste stored in bulk in buried storages (tanks not intended for SRW storage);
- waste stored in buildings and structures that do not have a status of storages.

Secondary SRW generated from handling SNF and SRW containers

Secondary solid radioactive waste arisings are expected during operations at the TSF in Gremikha.

Secondary SRW arisings expected throughout the TSF remediation activities tentatively amount to up to 1000 m³.

Liquid RW

The total amount of liquid radioactive waste accumulated at the TSF

Table 2 below shows the total amount of LRW accumulated on the site based on analysis of data obtained from radiation surveys of LRW storage places in Gremikha.

Table 2

The total amount of accumulated LRW

LRW location	LRW volume, m ³	Category according to SPORO-2002
LRW tanks; pits Nos. 1&2; receptacles 1, 2&4; Open Pad. ¹	260	LLW
	60	ILW
	0,25	HLW

Total amount of arising LRW

The following process and non-process secondary liquid radioactive waste will be generated during operations on removal of SNF and SRW from places of their accumulation and preparation for shipment outside the site:

- LRW from the thawing and drying module;
- Low-level waste: decontamination solutions and waters from decontamination of equipment, vehicles and rooms, shower and other waters from change rooms;
- Low-level storm sewerage waters.

Amounts and characteristics of these LRW are shown in Table 3 below.

Table 3

Amount and characterization of secondary LRW

LRW type	Amount, m ³ /y	RW category	Radiation characteristics
LRW from decontamination of vehicles and containers	70 max	LLW	$3,7 \times 10^2$ - $3,7 \times 10^4$ Bq/l
LRW from decontamination of buildings and structures	250	LLW	
	50	ILW	from 10^3 to 10^7 kBq/kg
Process LRW (from the thawing and drying module)	up to 8	LLW	up to 10^3 kBq/l
	up to 1,5	ILW	up to 10^7 kBq/l
Storm sewerage waters from the Open Pad	240	LLW	up to $3,7 \times 10^2$ kBq/l
Shower and other waters from change rooms	360	LLW	up to $3,7 \times 10^2$ kBq/l
Waters from contamination control stations	400	LLW	up to $3,7 \times 10^2$ kBq/l
Total:	968	LLW	
	51,5	ILW	

¹ Without considering LRW in PEK-50 floating tanks.

At the moment the volume of LRW accumulated on then site is estimated as **at least 320 m³** if LRW in PEK-50 floating tanks is excluded. It is expected that during the facility remediation activities mostly low-level LRW will be generated at a rate of **1000 m³/y maximum**.

4. Administrative and technical solutions on RW management during remediation of the coastal base site in Gremikha

4.1 Conceptual scheme of handling various kinds of RW

Analysis of the peculiarity of the site remediation conditions allowed developing a conceptual framework of the RW management scheme and outlining administrative and technical solutions for implementation of the scheme.

The administrative and technical solutions on RW management were selected on the basis of the following criteria:

- Technologies and processes to be used shall be simple, proven and efficient and along with this shall ensure nuclear and radiation safety.
- Minimum construction of permanent buildings.
- Minimum number of steps in the RW management process along with meeting acceptance criteria and regulations relating to transportation to regional centres for subsequent operations.
- Unification and minimization of a range of containers used in transportation and handling schemes.

The conceptual flow chart of handling RW accumulated and arising at SevRAO Branch No.2 is presented in Fig. 1.

The proposed conceptual scheme provides for the following basic technical and administrative measures:

- LRW treatment in modular plants using simple processes with a final product in the form of cement-grouted LRW concentrate packed in shielding concrete containers certified for transportation to the Regional Centre and long-term above-ground storage at the Regional Centre site;
- Collection (removal from non-organized storage places) and classification sorting of SRW in storage with separation of:
 - high- and intermediate SRW containing LLN,
 - low-level SRW containing LLN,
 - intermediate- and low-level SRW containing SLN,
 - very low-level SRW (VLLW).

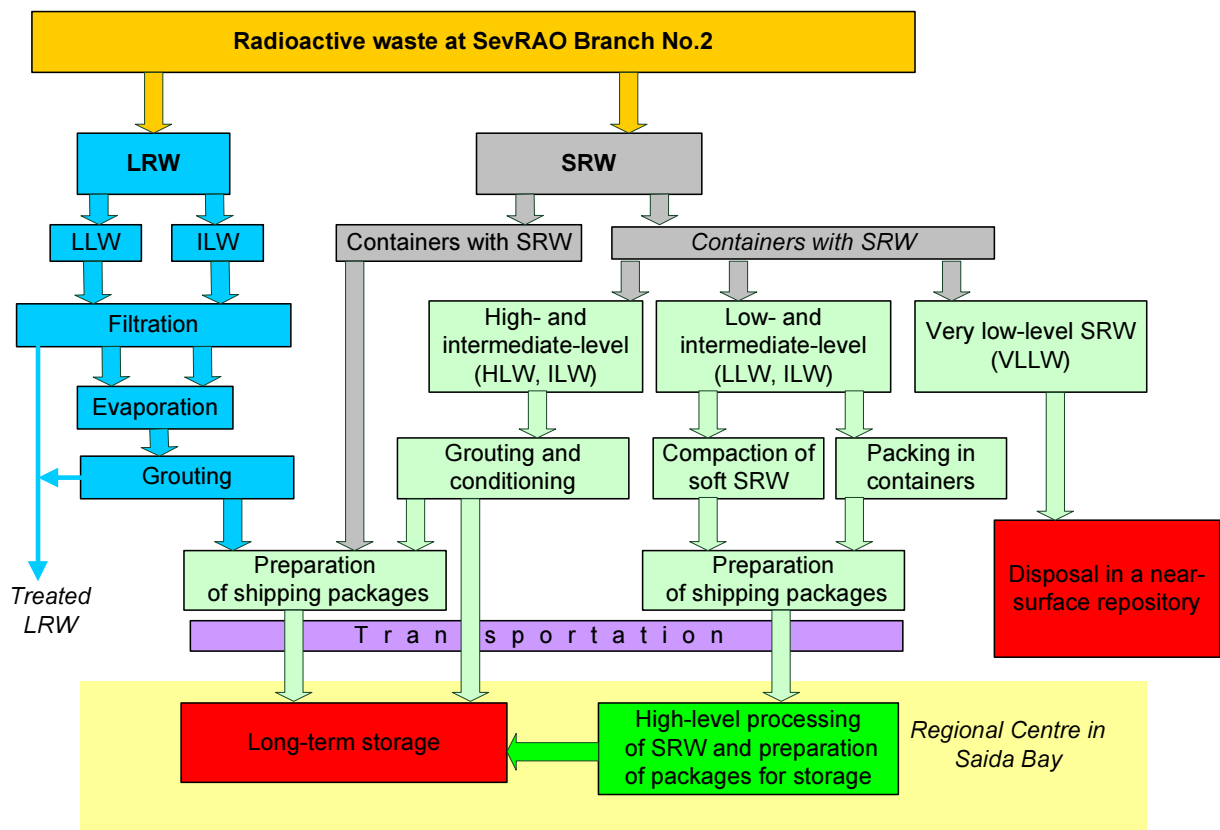


Fig. 1. Conceptual flow chart of RW management at SevRAO Branch No.2

- fragmentation and grouting of high-level SRW and part of intermediate-level SRW containing LLN that are not subject to further processing, and preparation of packages suitable for transportation and long-term storage in Regional Centre storage facilities,
- fragmentation and pre-compaction of a part of low-level SRW containing LLN, and intermediate- and low-level SRW containing SLN (soft SRW), and preparation of packages certified for transportation of this class of SRW to the Regional Centre in Saida Bay for processing,
- disposal of very low-level SRW in a near-surface repository at the Gremikha site,
- packing of containerized SRW having passports of quality in certified shipping casks for delivery to the Regional Centre in Saida Bay for processing there.

4.2 LRW management

According to options adopted in the OBIN when developing technical solutions on LRW management, the following two basic options of LRW management are considered:

- option 1 – removal of all accumulated and arising LRW from the TSF;
- option 2 – processing of all accumulated and arising LRW at the TSF.

The conceptual flow chart for the LRW management options is presented in Fig. 2.

The process of handling low- and intermediate-level low- and high-salt LRW according to option 1 provides for preparation of the LRW for removal by ship to Zvezdochka and/or Atomflot , and includes the following steps:

- collection of LRW;
- interim storage and mixing;
- pH adjustment (if necessary);

Analysis of comparison criteria for the above options has shown advantages of option 2 over option 1 mostly due to significant administrative and technical difficulties with making arrangements for safe transportation of LRW by sea to other facilities for processing.

Based on the estimated total amount of accumulated LRW (at least 320 m³) and volumes of LRW arising annually in the course of remediation activities (1000 m³/y maximum), the average output of the LRW treatment facility was estimated at 300–400 liters per hour.

It is proposed to use a modular evaporation plant as a basic LRW concentration unit. The presence of SAS in LRW may have a significant effect on the evaporation plant performance. Sampling and analysis of accumulated LRW demonstrated the absence of SAS in the LRW. To preclude any SAS content of annual LRW arisings, it is suggested that SAS-free decontamination solutions and detergents should be used in the operations, so that SAS do not affect the evaporation process.

Collection tanks will be used for interim storage and mixing of LRW, and for collection of treated LRW for checking activity prior to discharging into the household sewerage system. As collection tanks, it is proposed to use IMO-5 tank containers of volume 20 m³ available at SevRAO.

When developing LRW treatment flow charts, there was analyzed the possibility of using the existing MUC cementing plant and the EKO-2 LRW sorption treatment (selective sorption) plant. For a number of reasons it was considered that these plants could not be used in the new LRW treatment processes. The MUC cementing plant is designed for operations with cement compound with the highest activity of 10⁶Bq/kg which is insufficient, and the EKO-2 plant does not meet current safety requirements.

It is proposed to install process equipment for LRW treatment according to options 1 and 2 in free rooms of existing building where the EKO-2 plant is located and in a newly constructed annex to this building in place of the existing annex (to be demolished). The layout of buildings and structures of the LRW management system is shown in Fig. 3.

After refurbishment of **the EKO-2 plant building**, it will accommodate:

- a section for unloading of LRW from a tank lorry;
- purified LRW control tanks;
- area for buffer storage of drums with low-level cemented LRW;
- modular gas-cleaning process equipment;
- auxiliary systems equipment.

The annex is intended for:

- modules of plants for LRW preparation for treatment;
- LRW cementing plant;
- area for reloading of drums with cement compound;
- purified LRW control tanks.

The annex will be constructed in place of the old one to be demolished.

The annex will have a through vehicle corridor with a 5-t crane.

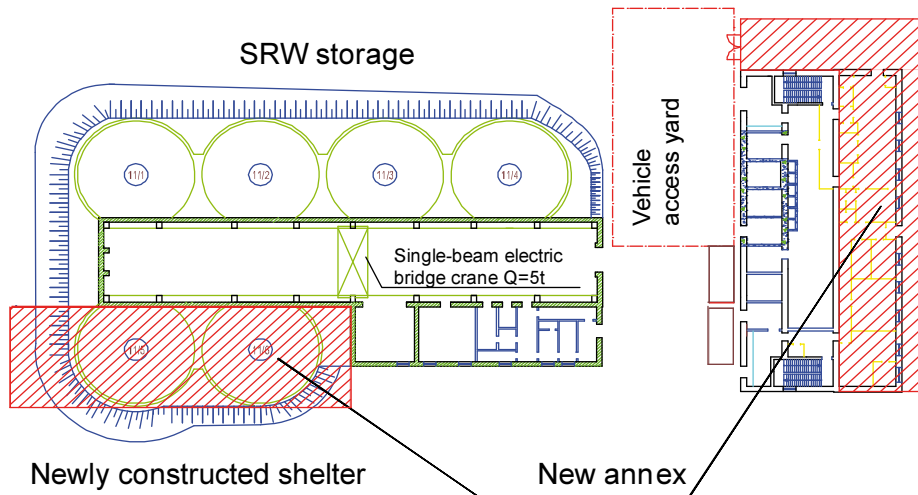


Fig. 3. Layout of buildings and shelters for LRW treatment equipment

As an alternative, there is considered emplacement of LRW treatment modules in the assembly room in the SRW storage building. The layout of buildings and structures of the LRW management system for this option is shown in Fig. 4. Implementation of this option will allow avoiding new construction of the annex and reducing, to a considerable degree, process links between LRW collection tanks to be located in the SRW storage building and LRW treatment plants which can be installed in the assembly room in the SRW storage building instead of the annex.

This option can be considered if over 520 containers with SRW in interim storage in the SRW storage building are removed from the building (in view of the work planned for 2008), and the building is vacated to allow installation of LRW treatment plants. The containers may be transferred for interim storage in the special area under the rock or removed in shipping casks to the Regional Centre in Saida Bay in the first place. These issues, however, shall be further studied in more detail before a final choice of the option can be made.

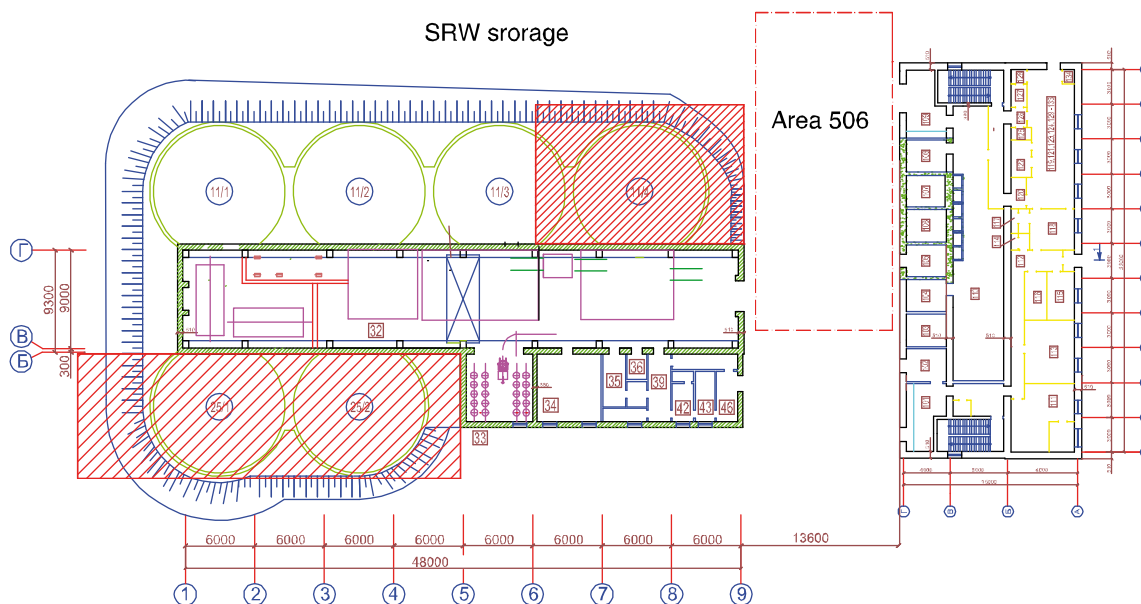


Fig. 4. Layout of buildings and shelters for LRW treatment equipment for the alternative option

4.3 SRW management

One of the phases of Gremikha TSF remediation activities is removal of accumulated SRW from the places of the waste accumulation.

In view of the small amounts of accumulated and arising SRW, and specific requirements of the Gremikha TSF, the SRW management scheme provides for establishment of a minimum required and sufficient SRW management process including SRW conditioning and removal to the Regional SRW Processing Centre in Saida Bay.

The conditioning process consists of classification sorting and certification of SRW according to NP-020-2000 requirements, packing (or repacking) of SRW, and preparation of shipping packages according to NP-053-04 requirements for delivery by container ship to the Saida Bay.

The following two streams of containers will be prepared for removal:

- containers with waste prepared for long-term storage and disposal;
- containers with waste to be further processed.

The conceptual flow chart of SRW management at the TSF in Gremikha is shown in Fig. 5.

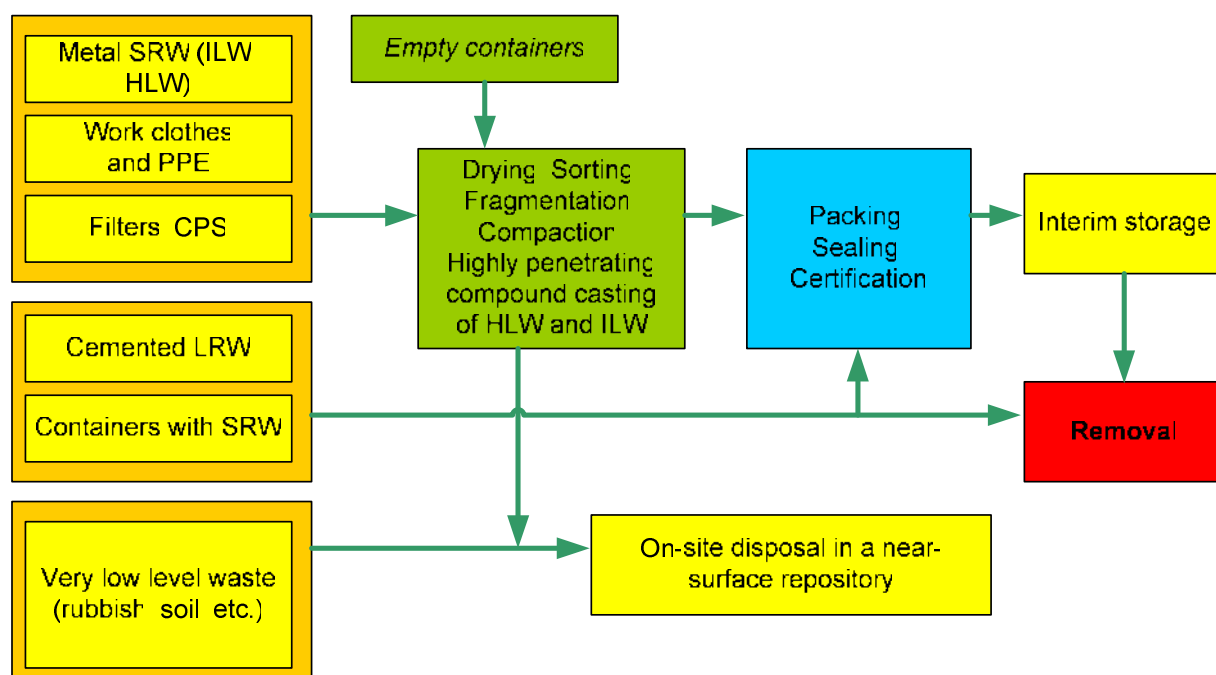


Fig. 5. Conceptual flow chart of SRW management

Classification sorting is the most important process operation in RW management aimed at forming waste streams according to processing, storage and disposal methods.

The proposed solid waste classification system uses the following criteria:

- waste origin (sources);
- radiation parameters: exposure or effective dose rate, specific activity, radionuclide composition, period during which the waste is potentially hazardous;
- physicochemical properties: combustible and incombustible, soft, metal, concrete, soil;
- processing methods: wastes that can be decontaminated, compacted, remelted, fragmented, and non-processable wastes;
- mass and size parameters of waste: large-size equipment that can be fragmented, large-size equipment that cannot be fragmented, long objects, thick-walled and thin-walled metal.

Objectives of the classification sorting include:

- reduction of the radioactive waste volume through identification of the non-radioactive waste category and a part of very low level SRW that can be considered “clean” waste after 100-year storage;
- separation of radioactive wastes into long-lived and short-lived RW;
- SRW grouping by processing methods. Combustible and incombustible; processable and non-processable, low-, intermediate- and high-level wastes form separate streams.

All SRW that can be processed is dried up, sorted into groups and fragmented, and soft low-level SRW is additionally compacted (to reduce the volume to be transported and ensure safety during transportation), certified and packed into containers to be delivered to the Regional Centre in Saida Bay for further processing.

High-level SRW and intermediate-level SRW containing LLN that cannot be effectively processed by existing methods are fragmented, packed into shielding containers in a certain order and immobilized by cement grout to ensure safety during transportation to the regional center for long-term storage and provide additional biological shielding of the waste during transportation and long-term storage.

Very low level SRW (VLLW) identified on the basis of corresponding acceptance criteria in the course of the site remediation activities and during the SRW classification sorting may be disposed of in a near-surface repository of a mound type similar in design to that being developed for the TSF in Andreeva Bay.

To perform this work, it is proposed to establish a RW handling department including an area for handling containers at the Open Pad, and area for SRW conditioning and temporary storage, and an area for concrete preparation. These areas will be operated using the existing infrastructure facilities after their refurbishment, and also construction of new buildings and structures is planned.

SRW conditioning units will be installed in existing buildings after their refurbishment, and in two newly constructed annexes. Layout of structures to be used for SRW conditioning is shown in Fig. 6.

The area for storage of containers with SRW is intended for:

- temporary storage of collection containers with SRW removed from the Open Pad;
- temporary storage of dual-purpose containers with SRW;
- preparation of shipping packages;
- making up a shipment.

The area for storage of empty containers is intended for temporary storage of empty collection containers, dual-purpose SRW containers, and consumables (cement, chemicals, etc.).

The building for SRW management is intended for opening “old” containers, extraction of SRW, and sorting, fragmentation, compaction and conditioning of the SRW. The following process modules will be installed in the building:

- entrance cabin module;
- SRW container transfer module;
- thawing and drying module;
- air plasma cutting module;
- module for extraction of SRW from containers;
- gas cleaning module;
- equipment decontamination module;
- vacuum cleaning module;
- module for compaction of soft low-level SRW;
- container lid installation module;
- lock chamber module.

The SRW conditioning building is intended for preparation of SRW packages. The following process modules will be installed in the building:

- module for SRW fixing and NZK container lid sealing;
- module for making up metal containers;
- module for decontamination of equipment and outer surfaces of containers;
- certification module;
- decontamination solution preparation module;
- active storage of chemicals;
- active storage of cement.

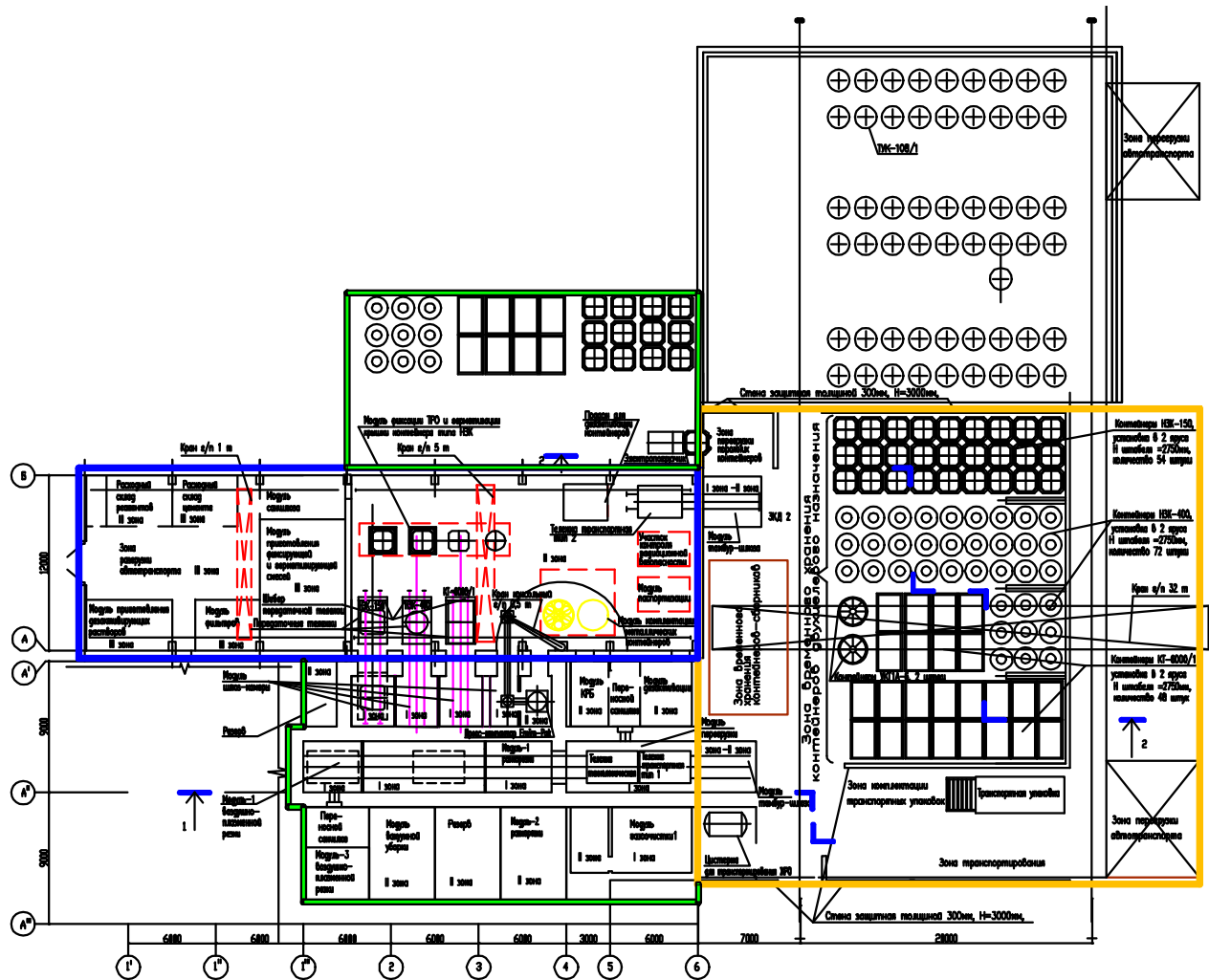


Fig. 6. Buildings and structures for SRW conditioning

4.4 Preparation of shipping packages with different types of solid waste

The final stage of SRW handling consists in placing conditioned SRW in containers and shipping package sets (TUK), sealing and marking of the TUK, radiation control and, when necessary, decontamination of the outer surfaces, and preparation of certificates. Different types of RW packages are produced from conditioning of solid wastes in view of their division into the above types (groups).

These package types may be broken down into the following groups by their purpose:

- non-returnable containers to be delivered to the Regional Centre for long-term storage;
- returnable shipping casks (package of type A) for transportation of SRW in original packages to the Regional Centre for processing;
- additional returnable shipping casks (for making up a package of type B) for other containers according to NP-053-04 requirements.

Table 4 below lists and describes dual-purpose containers for transportation of conditioned RW to the Regional Centre in Saida Bay.

Table 4

List and characterization of dual-purpose containers for transportation of conditioned RW to the Regional Centre in Saida Bay

Description and technical characteristics of equipment	Container type, analogue	Standard, development stage	Place of equipment application	Quantity, pcs.	Note
1. Non-returnable collection container ² V=6 m ³ (5,2), h _{wall} =10 mm Sizes: 2650×1750×1375 mm Material: carbon steel m=800 kg	KT-6000/1	New development	Area 500/1 and Open Pad, buildings 504 and 505, areas 502 and 515	26	For baskets of type 22 and baskets of type 6 containers, traps Л1-31, filters Ф1-3
2. Dual-purpose returnable shipping cask V=2,58 m ³ , Sizes:D=2000 mm, H=1274 mm Material: carbon steel m=990 kg	YKTIA	ГОСТ 16327-88	Buildings 504 and 505, areas 502 and 515	217	For drums БН-0,2 with compactable SRW
3. Non-returnable dual-purpose shielding container Sizes:1650×1650×1375 mm Material: reinforced concrete m=4300 kg	H3K-150-1,5П	ГОСТ P51824-2001	Buildings 504 and 505, areas 502 and 515. At phase II – area 500/1 and Open Pad	905 + 70	For LLW and ILW
4. Concrete insert for container H3K-150 Sizes: 1600x1600x1300 mm Material: concrete m _{S_{wall}=250mm} =7,64(with the lid) V=0,415m ³	–	New development	Buildings 504 and 505, areas 502 and 515. At phase II – area 500/1 and Open Pad	70	Complete with H3K-150 container for HLW.
5. Shipping cask for SRW V=32,2 m ³ Sizes: 6058×2438×2438 mm Material: carbon steel m=2500 kg	20-foot marine container 1C	New development	Areas 502 and 515	20	For containers H3K 150-1,5П, KT-6000/1, YKTIA. According to NP-053-04
6. General-purpose large-tonnage shipping container for low-level waste V=32 m ³ Sizes: 5895×2270×2381 mm Material: stainless steel m=2550 kg	YKTH-24000	TY 3177-0010552243 99-2005	Areas 502 and 515	7	According to NP-053-04; ТИ<10, Belongs to Ecomet S

² In further designing there may be used a container of type “5,2-m³ box” proposed by Actec (Italy) for the temporary storage facility in Andreeva Bay.

This rather long list of package types for transportation of conditioned SRW results from the wide range of SRW types found at the site and by the need to meet all safety requirements during SRW transportation to the Regional Centre in Saida Bay.

So it is proposed to use 6 types of shipping containers for transportation of conditioned SRW:

- containers under Nos. 1 and 3 above will be used as non-returnable containers to be delivered to the Regional Centre for long-term storage;
- containers Nos. 2 and 6 above will be used as returnable shipping casks (package of type A) for transportation of SRW in original packages to the Regional Centre for processing;
- containers No.5 above will be used as additional returnable shipping casks (package of type B) for other containers according to NP-053-04 requirements.

Of interest are foreign design studies and proposals on containers needed for making up RW shipping packages. Only a few containers from the above list have been developed, and certified and are in industrial operation in Russia. The use of existing serially produced foreign containers will essentially advance the starting date of SRW removal from Gremikha to the Regional Centre in Saida Bay. Proposed containers shall meet requirements of RF regulations and demonstrate durability and optimum technical-and-economic indices.

5. Conclusion

By now basic administrative and technical issues relating to management of RW accumulated in Gremikha have been studied as part of development of the "Conceptual design for management of spent nuclear fuel and radioactive waste from VVR and Alpha NS and remediation of the Gremikha TSF site" that is nearing completion.

RW management stages have been outlined, conceptual flow charts of handling various waste groups have been developed, container types for RW storage and transportation are being selected, selection of plants and equipment have been started, layout solutions for waste processing and conditioning plants have been proposed, a location plan of new structures and shelters in the facility general layout is being substantiated.

Prior to starting detailed design development for the RW management complex at the Gremikha TSF, additional studies shall be performed, and a final decision shall be made concerning expediency of deploying LRW treatment areas in the annex or in the SRW storage building with transfer of SRW containers located in this building to a special area for interim storage or with their removal to the Regional Centre in Saida Bay.

To expedite solution of the facility remediation problem, the existing foreign experience in the use of RW management plants and equipment should be taken into account.

It was recommended to use the following criteria when selecting plants and equipment for RW management:

- operating or at the final stage of development;
- mobile version, convenience of transportation, simplicity of assembly and dismantling;
- reasonable cost;
- simplicity and reliability of the conditioning process;
- easy control and operation;
- minimum auxiliary service systems;
- maintainability;
- versatility.