Specifics of the Multi-Purpose Nuclear Submarine Dismantling at FGUP MP "Zvezdochka" and Needs for Upgrades

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1 General

Initially FGUP MP "Zvezdochka" has been constructed as a ship repair yard, and to present it accumulated more than 40 – years experience in repair of naval ships, including all types of nuclear powered submarines.

The general plan of submarine dismantling has been specified by Government Regulation in 1986. The organizational and technical policy for the sub's dismantling was specified by the RF Government Regulation No.644-47, which also included the assigned base yards. Zvezdochka shipyard was one of them.

"The Federal Special Programme for Industrial Dismantling of Arms and Military Technologies for the period to 2000" was developed and approved by the RF Government Regulation No 548 of 25.05.1994. Then "The Federal Special Programme for Industrial Dismantling of Arms and Military Technologies for the period from 2001 to 2005" has been implemented, which is acting up to present.

In 1998 a RF Government Decree of 28.05.98 No.518 titled "About measures accelerating the dismantling of nuclear powered submarines and NC from reactors" was issued. Besides some additional Government regulations and RF President's decrees have been issued, related to execution of priority works, and giving them the status of President's Programme.

The following Programmes under International Cooperation and financial support from USA and Norway Governments are in progress now:

Nunn-Lugar Programme

It is Cooperative Threat Reduction (CTR) Programme. The Programme is successfully acting for more than 5 years. Under the Programme during 1996-1999 a number of equipment were provided to support dismantling of strategic nuclear submarines (SSBNs), including cutting machines, automatic guillotine baler shears, designed for cutting heavy hull sections, attachable shears, cable shredder etc.

Under CTR Programme and with financial support, provided by the USA Government, in October 2000 the Complex for RW treatment (Bldg. 160/161) was put into operation, and in 2002 – the Construction of the On-Shore Complex for defuelling and interim SNF storage was finished.

Under the Programme the USA Government provided financial support for dismantling of SSBNs with ballistic missiles. In 1998-2000 full-scale dismantling of five Delta-class submarines were performed at Zvezdochka shipyard.

Russia – Norway Cooperation Programme

In 1999 under financial support assisted by Norwegian Government the Complex for transportation and interim LRW storage (Bldg. 159) was modernized.

The International Scientific Engineering Center (ISEC) is working out the Project No. 968 "The Concept of Complex Dismantling of Nuclear Powered Submarines…".

Dismantling of submarines is performed according to the associated state order and under agreements with Naval Fleet and Minatom of RF on the basis of the Schedule, approved by the RF Government. .

The dismantling works are performed in accordance with approved technology, worked out at Onega R&D Technological Bureau, and proved to be the most cost efficient approach to subs' dismantling; and is agreed with all supervising and regulatory authorities for nuclear and radiation safety, labor safety, fire safety and environment protection.

During the period 1990-2000 the yard was eliminating Yankee- and Delta–class SSBNs, which have been decommissioned according to the Conversion or Dismantling Protocol of the Start I (1991) and Start II (1993) treaties.

During the period the yard has performed the following:

- cutting out and liquidation of missile compartments from 24 SSBNs;
- preparation and interim afloat storage of three SSBNs without cutting reactor compartments;
- dismantling of 13 SSBNs with cutting out of reactor compartments and preparation of three-compartment units for interim afloat storage, disassembling of the aft and bow ends. Five of these Delta-class SSBNs were dismantled under CTR Programme (Hulls Nos 338, 339, 353, 355, 373).

2 Three-compartment method of dismantlement

Dismantling of SSBN is very complicated procedure, taking in view its specific features and required SNF discharge. The scheme of SSBN dismantling according to the used technology consists of the following steps:

- Preparation of the sub for dismantling;
- SNF discharge;
- Putting the sub on the slipway;
- Cutting out the three-compartment unit;
- Preparation of the three-compartment unit for interim storage;
- Dismantling of equipment, instruments, pipelines, electric cable;
- Cutting the hull into heavy sections;
- Cutting the hull sections, equipment for metal scrap;
- Cable recycling;
- Putting the three-compartment unit in the water, necessary fitting-out work;
- Acceptance of the three-compartment unit; its transportation to the place of interim storage;
- Accumulation, storage, processing of LRW and SRW;
- Interim SNF storage, loading to special train cars, delivery to the Mayak reprocessing plant.

General process diagram of the NS dismantling at Zvezdochka shipyard is given on Fig. 1.

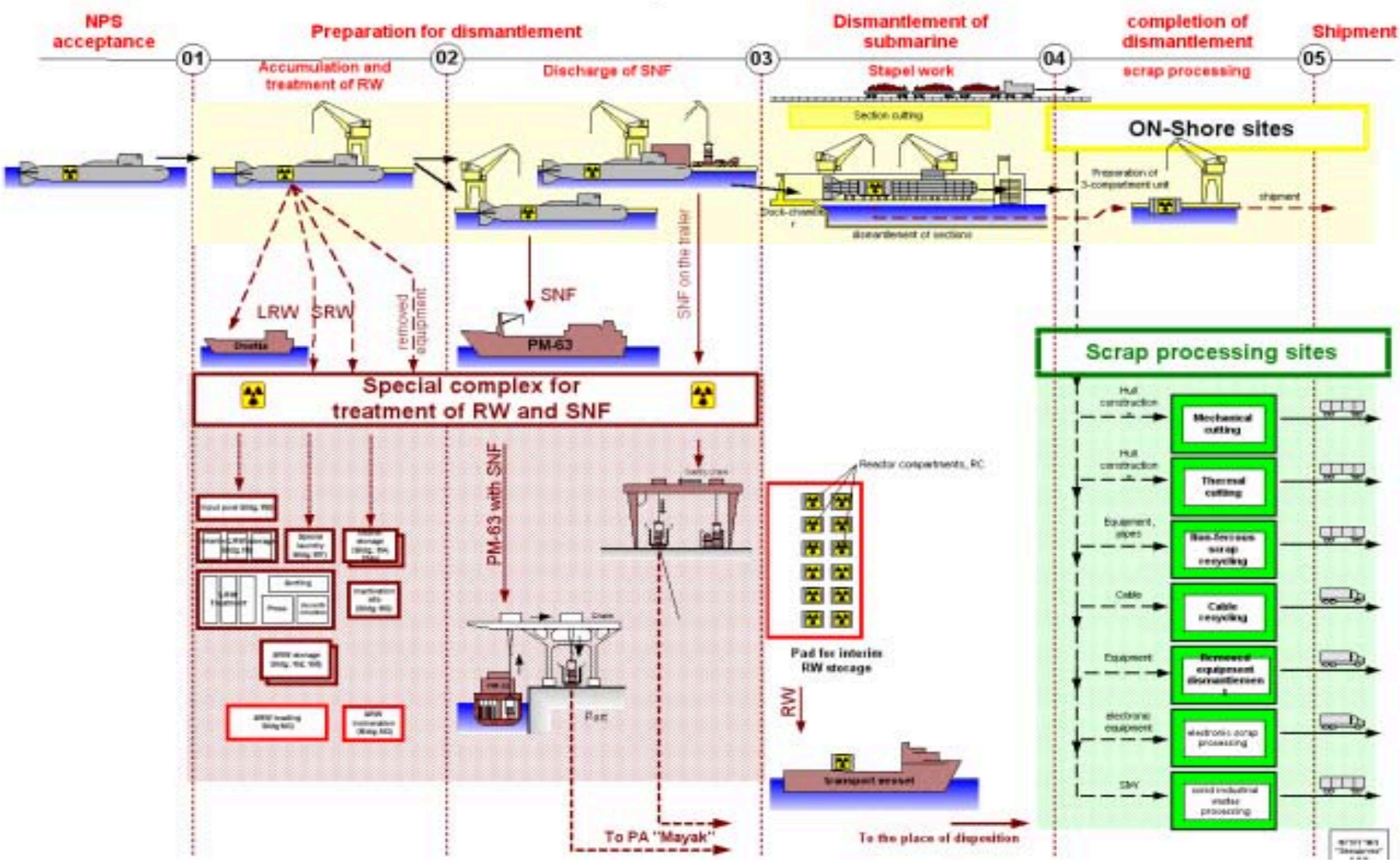

Fig. 1 General Scheme for NS dismantling at Zvezdochka shipyard

The NS dismantling procedure is arranged on the base of step/site method, providing step-by-step dismantlement on different sites. All dismantling operations are performed on 13 sites (stages), covering works, beginning from preparation of sub for dismantling, then its dismantlement, to shipment of final dismantling products. The content of the work, in short, is shown in Table 1.

Table 1

Short list of the dismantling work per site (stage)

No.	Site (stage)	Work description
1	Special quay and the Special Complex	1. Delivery of the sub to the Zvezdochka pier 2. Preparation of sub for dismantling and for SNF discharge 3. Discharge of SNF
		4. Discharge of RW
		5. Preparation of sub for putting on the slipway
2	Dock-chamber	1. Putting the sub on the open slipway
		2. Cutting out of the three-compartment unit
		3. Separation of the units
		4. Dismantling of equipment, pipelines and insulation
		5. Cutting the aft and bow ends into sections
		6. Preparation of three-compartment unit for storage
3	Vessels	1. Transportation of the three-compartment unit
	R/W transport	2. Transportation of the hull sections and equipment
	Motor transport	3. Transportation of metal scrap
		4. Transportation of industrial wastes
4	Thermal cutting site near Bldg. 26	1. Dismantling of hull structures and equipment of ferrous metal by thermal and plasma cutting
		2. Storage of metal scrap
		3. Loading the metals scrap into cars
5	Mechanical cutting site	1. Mechanical cutting of hull and plate structures by Harris shears into European standard pieces
		2. Thermal cutting of sections for further cutting by Harris shears
		3. Metal scrap storage
		4. Metal scrap shipment
6	Site for recycling of non-ferrous metal scrap and alloys	1. Dismantling and sorting of metal scrap
		2. Baling of thin wall structures and pipes
		3. Cutting of structures of plate and pipes by alligator shears
		4. Storage and shipment of metal scrap
7	Cable recycling site (Kansk-2)	1. Cable cutting by shredder with further separation of non-ferrous metal from insulation
		2. Storage and shipment of non-ferrous metal scrap
8	The site for metal scrap shipment	1. Thermal cutting of sections into marten pieces
		2. Accumulation of ferrous scrap per one ship loading (3-4 thousand tons)
		3. Loading the scrap on the ship for delivery to the Buyer

No.	Site (stage)	Work description
9	Tide-water quay, Bldg. 9)	Completion of work, related to preparation of the three-compartment unit for transportation
		2. Delivery of the three-compartment unit to the place of storage
10	The Sea	Transportation of the three-compartment unit to the place for interim storage
11	Facility for accumulation and treatment of wastes:	
	а) Pad for SRW	Accumulation and storage of SRW
	б) Facility for cleaning of industrial wastes	Collection and processing of wooden scaffolding
	в) Sewage works	Accumulation and treatment of sewage
12	Special complex for accumulation and treatment of RW	
	а) Facility for collection and treatment of LRW	1. Accumulation and storage of LRW 2. Treatment of LRW 3. Storage of treated LRW filter cartridges
	б) facility for collection and treatment of SRW	1. Accumulation and storage of SRW 2. Treatment of SRW 3. Storage of compacted SRW
13	Special complex for discharge, storage and shipment of SNF:	
	а) On-shore defuelling facility	1. Discharge and storage of SNF in TK-18 containers 2. Transportation of TK-18 containers within Zvezdochka premises
	б) Interim storage of containers TK-18	1. Loading of containers with SNF into special train cars 2. Delivery of special train cars with SNF to Mayak plant.

3 Main dismantling sites

3.1 Special quay and special Complex for RW and SNF (Fig. 2)

Special Quay and Special Complex for RW and SNF include the following sites:

3.1.1 Mooring facilities (Bldg. 150)
3.1.2 Utilities and switchgears
3.1.3 Power unit (Bldg. 152)
3.1.4 Portal crane
3.1.5 Floating radiation monitoring post
3.1.6 Special channel with input post and pipelines for transportation of LRW to the place for interim storage
3.1.7 Pad for interim contaminated equipment storage (Bldg.154a)
3.1.8 Pad for interim LRW storage (Bldg. 159)
3.1.9 Special laundry (Bldg.157)
3.1.10 Pad for SRW storage (Bldg. 162 and 165)
3.1.11 Osetia tanker
3.1.12 Complex for treatment of RW (Bldg.160, 161)

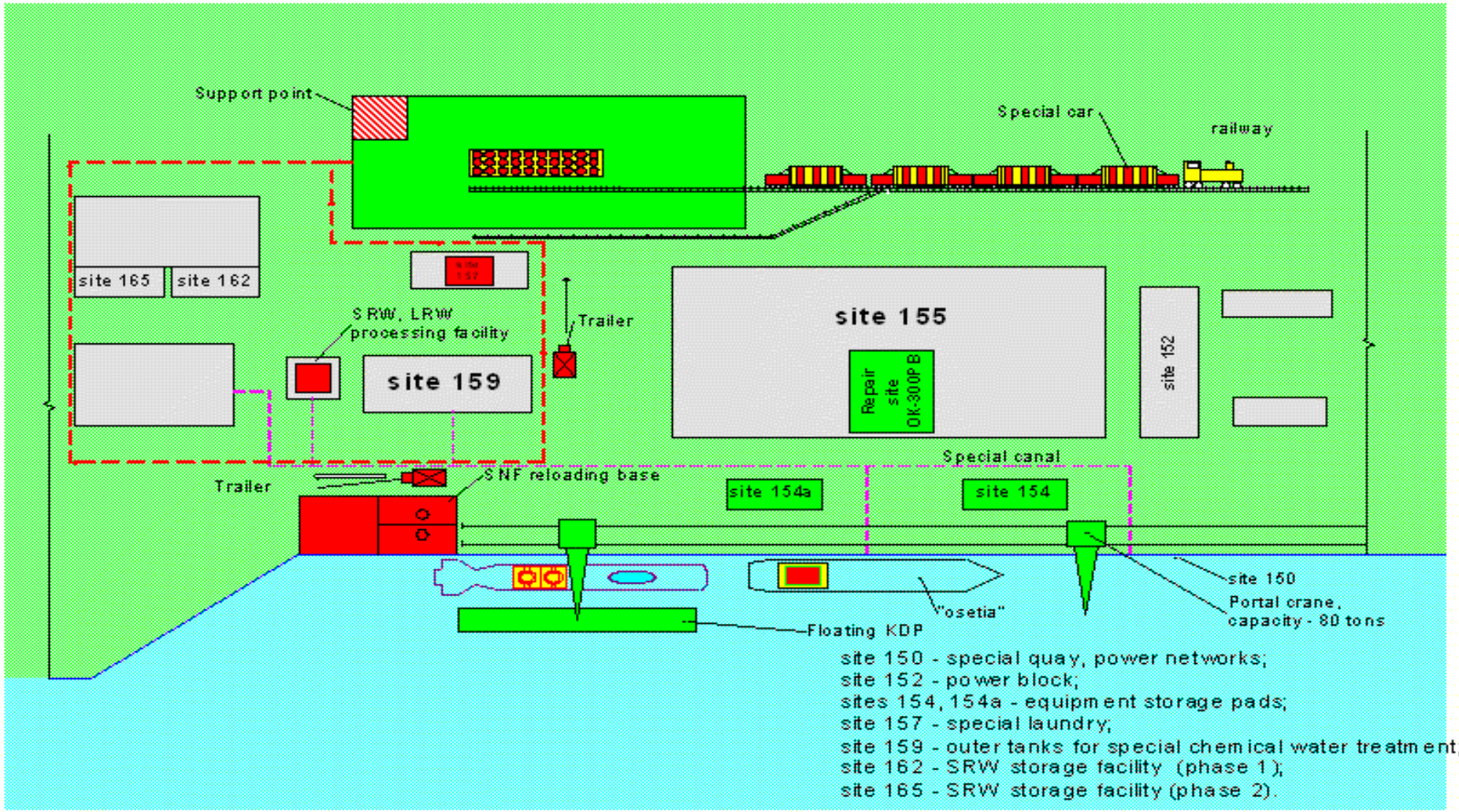

Fig.2 Plan of the SNF and RW management complex

Building 160/161 includes 4 lines for LRW treatment:

– low-salt solutions of the first loop;
– decontamination of salt and mixed solutions;
– solutions from biological protection tanks
– solutions from special laundry

The lines capacity is 4000m^3 of LRW.

3.1.13 SRW treatment sites:
Building 160/161 includes the following sites

– sorting site;
– baling site;
– the site for wastes compacting.

3.1.14 Nuclear service ship PM-63 for SNF discharge.
Diagram of SNF discharge by PM-63 is shown in Fig. 3

3.1.15 The On-Shore defuelling facility includes the following:
Special quay 50m in length, where a new 80-tonne crane is installed, and building for SNF loading into transport containers, close to the special quay in the area of the portal crane operation. The building includes:

– control post for SNF defuelling
– the pad for container loading
– the pad for accumulation, storage and further transportation of LRW
– the pad for preparation of inactivating solutions and for decontamination of equipment

Diagram of SNF discharge by the on-shore defuelling facility is shown in Fig.4

3.1.16 Pad for interim TK-18 container storage

3.1.17 The system of containers with SNF transportation within Zvezdochka premises

– using floating defuelling vessel PM-63 (Fig. 3);
– with the On-Shore defuelling complex (Fig. 4).

3.2 Slipway work

The slipways sites are designed for cutting of the sub aft and bow ends and preparation of three-compartment unit. The slipway facilities include:
3.2.1 Dock-chamber.
3.2.2 Portal crane servicing the dock-chamber.
3.2.3 Utilities and switching gears.
3.2.4 Power unit (Bldg. 61).
3.2.5 Centralized oxygene and propane gasifiers.
3.2.6 Slipway beams and supports.
3.2.7 Scaffolding towers and trestles.
3.2.8 Mobile power units at the sub.
3.2.9 Floating radiation monitoring post.
3.2.10 Ford truck, Mod.F-9000.
3.2.11 Self discharging ARO /APU-IC trailer.
3.2.12 40-feet transport containers for trailer ARO/APU-IC (2 pcs).

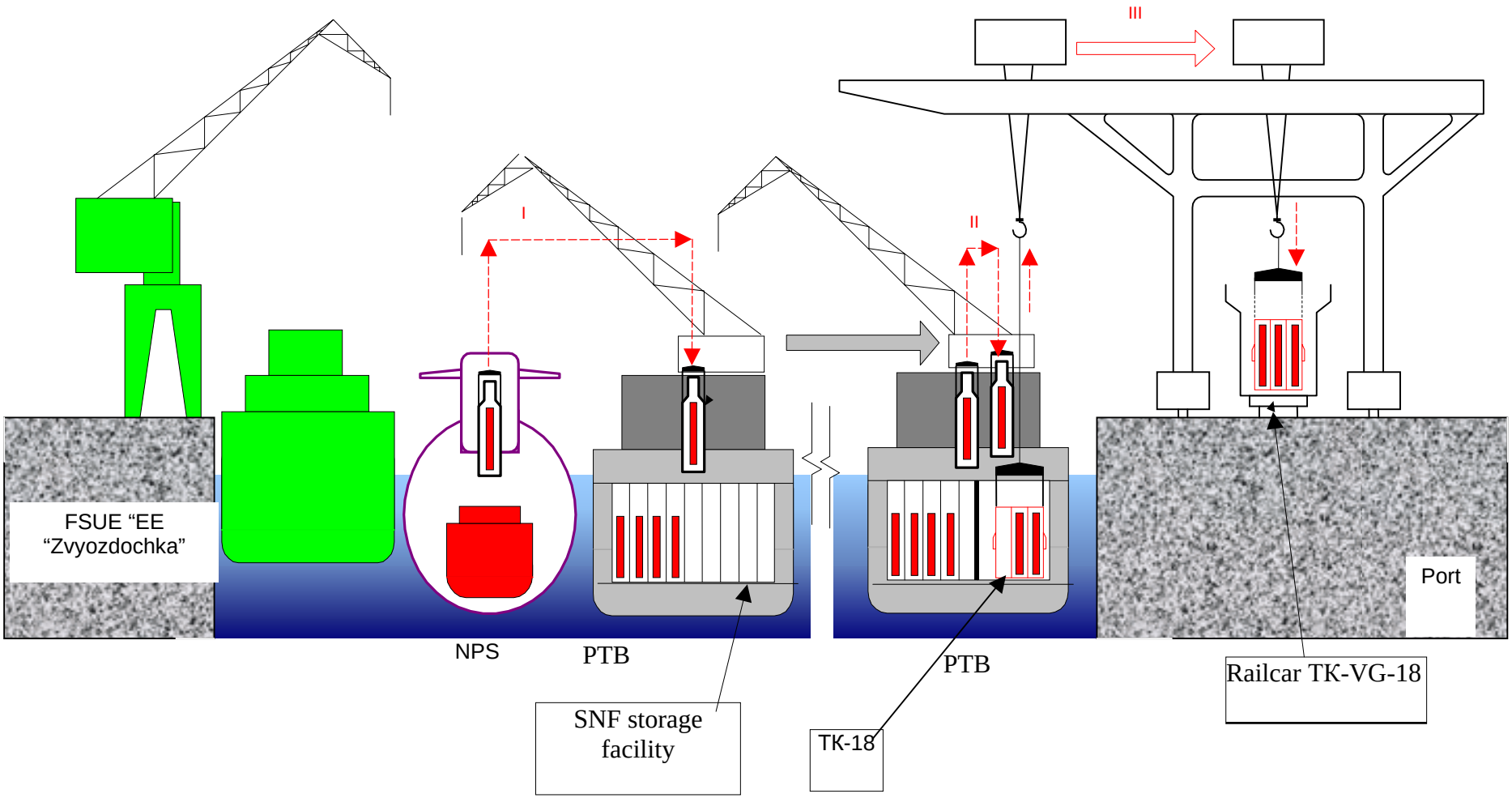

Fig. 3 Diagram of SNF discharge by PM-63 vessel

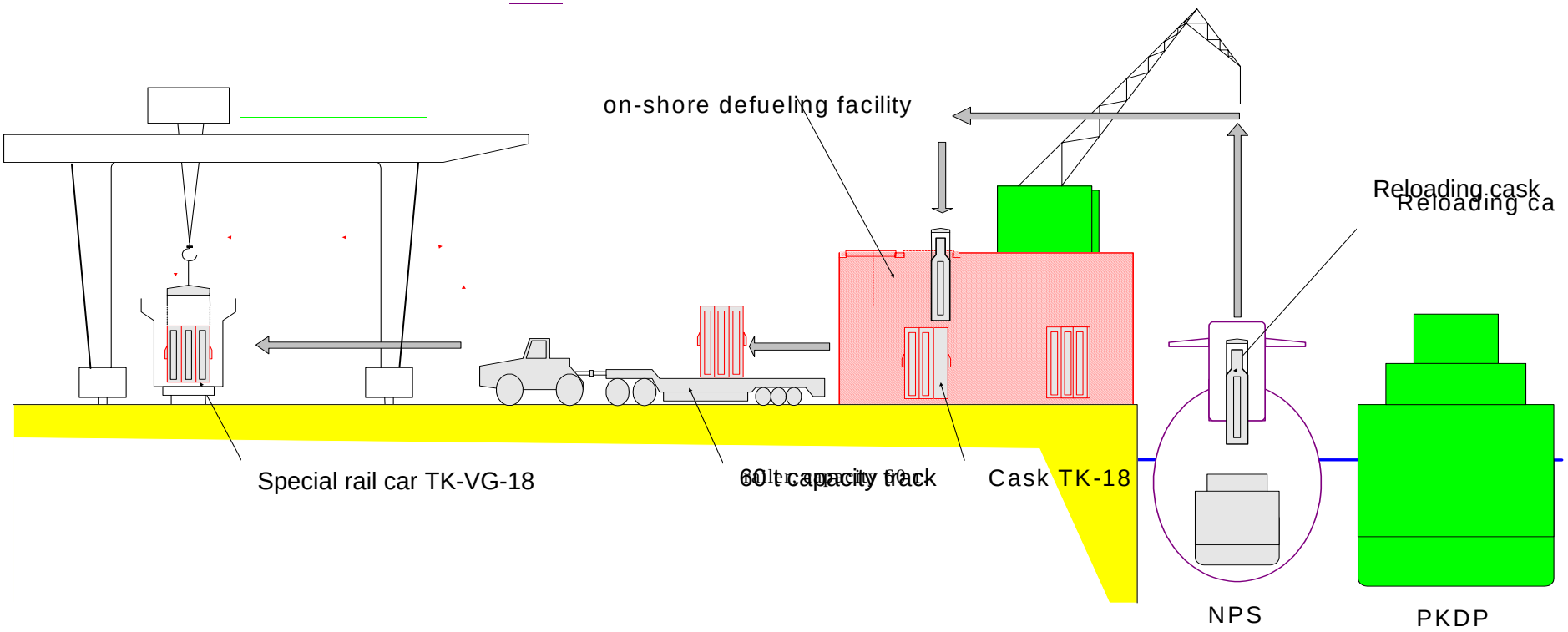

Fig. 4 Diagram of SNF discharge by the On-Shore defuelling facility

3.3 Transport operations

Motor transport is used for trucking equipment, sections, metal scrap and wastes.

3.3.1 The truck KAMAZ-5511

3.3.2 Trailer ChMZAP-5203

3.3.3 Tractor K-701

Rail-way transport is used for transportation of sections, metal scrap and wastes, crane is used for loading.

3.3.4 Diesel locomotive TGM-4

3.3.5 Flat cars

3.3.6 Rail way crane KDE 252

Vessels are used for:

- mooring of sub at the special quay;
- for transportation of sub from special quay to the dock-chamber and for putting on the slipways;
- for removal of three-compartment unit from the dock-chamber to the tide-water embankment for fitting out and preparation for transportation;
- for towing of the three-compartment unit from the embankment to the place for interim storage.

3.3.7 “Sadko” tugboat

3.3.8 Harbour tugboat “Vityaz’”

3.4 Thermal cutting site

The site is designed for thermal cutting of hull sections into furnace pieces according to Eurostandard requirements for further shipment to a Buyer.

3.4.1 Gravel pad

3.4.2 Gantry crane

3.4.3 Utilities and switching posts

3.4.4 Excavator for attachable shears “Caterpillar” 375

3.4.5 Attachable shears for escavator, LaBounty MSD 160

3.4.6 Amenity room

3.4.7 Plasma cutting machine

3.5 The site for mechanical cutting

The site is designed for mechanical cutting of hull sections into furnace pieces according to Eurostandard requirements for further shipment to a Buyer. The site includes:

3.5.1 Automatic baler shears Harris.

3.5.2 Concrete pad with crane tracks.

3.5.3 The site power unit.

3.5.4 Excavator, Caterpillar 375.

3.5.5 Attachable shears, LaBounty MSD.

3.5.6 Mobile crane Mantiss.

3.5.7 Conveyer for Harris guillotine.

3.5.8 Gantry crane КСК-32-2.

3.5.9 Extended concrete pad.

3.5.10 Rail scales.

3.5.11 Low air pressure system with compressor.

3.5.12 Oxygene gasifier with distributing post.

3.5.13 Propane evaporator and distribution system.

3.6 Ferrous scrap treatment site
Designed for recycling of pipes and light weight structures of copper, aluminum and their alloys by mechanical cutting and baling. The site includes:
3.6.1 Trestle concrete pad.
3.6.2 Baler.
3.6.3 Alligator shears.
3.6.5 Power system.
3.6.6 Amenity rooms.

3.7 Cable processing site
The site is designed for processing of all kinds cable.
3.7.1 Cable recycling building (Kansk-2).
3.7.2 Cable shredder Triple/S Dynamics Inc.
3.7.3 Cable cutter.
3.7.4 Electric forklift Hyster E100XL.
3.7.5 Rail scales.

3.8 Metal scrap shipment site
Includes:
3.8.1 Embankment, (Bldg.9).
3.8.2 Portal crane.
3.8.3 Utilities and power units.
3.8.4 Concrete pad.
3.8.5 Oxygene gasifier and distributing system.
3.8.6 Manifold and pipeline for acetylene distribution.

3.9 Site for fitting out of three-compartment unit
Designed for mooring of the three-compartment unit and keeping it afloat
3.9.1 Pier facilities.
3.9.2 Utilities.
3.9.3 15-tonne portal crane, overhang 30 m.
3.9.4 Floating radiation monitoring post.

4 Capabilities of the acting infrastructure for execution of complex dismantling of multi-purpose purpose submarines

To the present the shipyard has performed complex dismantling of 5 strategic Delta I – class submarines (hulls 338, 339), Delta II-class (hull 353) and Delta III-class (hull 355, 374).

Besides, using the infrastructure, the yard has performed dismantlement of launchers from Delta IV– class submarine (hull 381), dismantlement of two Delta I-class subs (hulls 310, 324), and performed defuelling of Typhoon– class sub (hull 712).

In our opinion we should proceed with dismantling of multi-purpose submarines in a way the work has been done for dismantling of strategic submarines under CTR Programme

According to our estimates the cost of dismantling of multi-purpose submarine will amount to 6 million USD. In this case the scope of the Contract will should cover:

- All work, related to development of technological documentation, drawings and technical documents for the work performance and acceptance;

- Expenses, related to development of the design for the sub towing to the designated Zvezdochka's pier;
- The contractor and subcontractor expenses, related to dismantling of multi-purpose submarine;
- All taxes and duties to be paid by the Contractor;
- All contractor's expenses, related to transportation, storage and processing of unsalvageable hazardous materials, and to processing of low active RW (LRW and SRW);
- Overtime work, work on holidays and night time.

5 Handling of radioactive wastes

The repair, modernization and dismantling of nuclear powered submarines at Zvezdochka shipyard result in accumulation of radioactive wastes (RW), requiring environment safe handling. Besides, as the Navies refused to remove RW from the Zvezdochka's confines, the yard had to accumulate them.

The most part of operational facilities, included in the system of RW handling, were constructed during 60-th and don't meet any more the radiation safety requirements. As it was noted above, the shipyard successfully implemented a number of projects, related to environment protection (repair of tanks for interim LRW storage, Bldg.159; construction of complex for RW compacting, Bldg 160/161), which considerably improved the RW handling. But we still have problems, related to the matter.

5.1. The System for LRW handling

The following types of LRW are produced as the result of the yard activity:

- Low salt LRW, as spent coolant;
- Radiation shielding tank water. It is sea water;
- Mixed LRW, including spent salt decontamination solutions and other kinds of LRW. Their activity level is $3{,}7x10^2 – 3{,}7x10^4$Bk/l;
- Laundry water. It is complex mixture of organic and mineral substances and low active water (~500 Bk/l).

After dismantling of 4 submarines per year the output of LRW will be the following:

- Low salt LRW – 700 m^3/year;
- Mixed LRW – 55 m^3/year;
- Mixed water from radiation shielding tanks – 125 m^3/year;
- Laundry water – 1000 m^3/year.

In 1998 the shipyard completed repair of LRW storage facility (Bldg. 159), and it became possible to arrange storage and transportation of LRW types separately.

Complex for RW handling (Bldg. 160/161), which was put into operation in 2001, has the following capacity according to LRW types:

- Low salt LRW – 200 m^3/year;
- Mixed LRW – 600 m^3/year;
- water from radiation shielding tanks – 700 m^3/year;
- Laundry water – 2500 m^3/year.

The system of LRW handling at Zvezdochka shipyard meets now current requirements, and provides their successful treatment.

Operational LRW handling system used at Zvezdochka shipyard is shown in Fig. 5

5.2. SRW Handling System

SRW include:

- non-metal RW (wood, special cloth, means of personal protection, tarpaulin, plastic parts);
- metal RW – heavy equipment (pumps, heat exchanger, stands, pipeline etc), and smaller parts (fixtures, pipe parts etc.);
- ion exchanging resins (sorbents, formed after waste treatment);
- spent ion source inside containers.

According to the Federal Special Programme it is planned to dismantle 30 nuclear powered submarines at Zvezdochka shipyard during 10 years, that is, about 3 – 4 subs per year.

<u>SRW output after dismantling of 4 subs amounts:</u>	
- metal SRW	$75m^3$/year;
- non-metal SRW	$150m^3$/year.
<u>SRW Output: in Bldg 160/161</u>	
- metal SRW	$60m^3$/year
- non-metal SRW	$140m^3$/year
<u>SRW after treatment</u>	
- metal treated and non-treated SRW -	$22,5m^3$;
- non-metal treated SRW	$23,5m^3$;
- dry sediment after LRW treatment	$15m^3$;
Total:	$61m^3$/year.

Treated and not-treated SRW plus dry sediment will be partially loaded into in RC according to adopted requirements (to 15 m^3 SRW in one RC).

Thus, the capacities of all sites for SRW treatment in Bldgs 160/161 will be used for treatment of newly produced SRW after the next sub dismantling, and they will not improve the current problem of storage and treatment of already accumulated SRW.

To decrease the volume of accumulated SRW it is necessary to increase capacity of the treatment facilities, and first to upgrade the facility for burning flammable SRW.

To prepare accumulated SRW for treatment we have to sort and load into containers the accumulated SRW, then to discharge and repair the storage facility (Bldg. 162) for future operation jointly with the new storage (Bldg. 165).

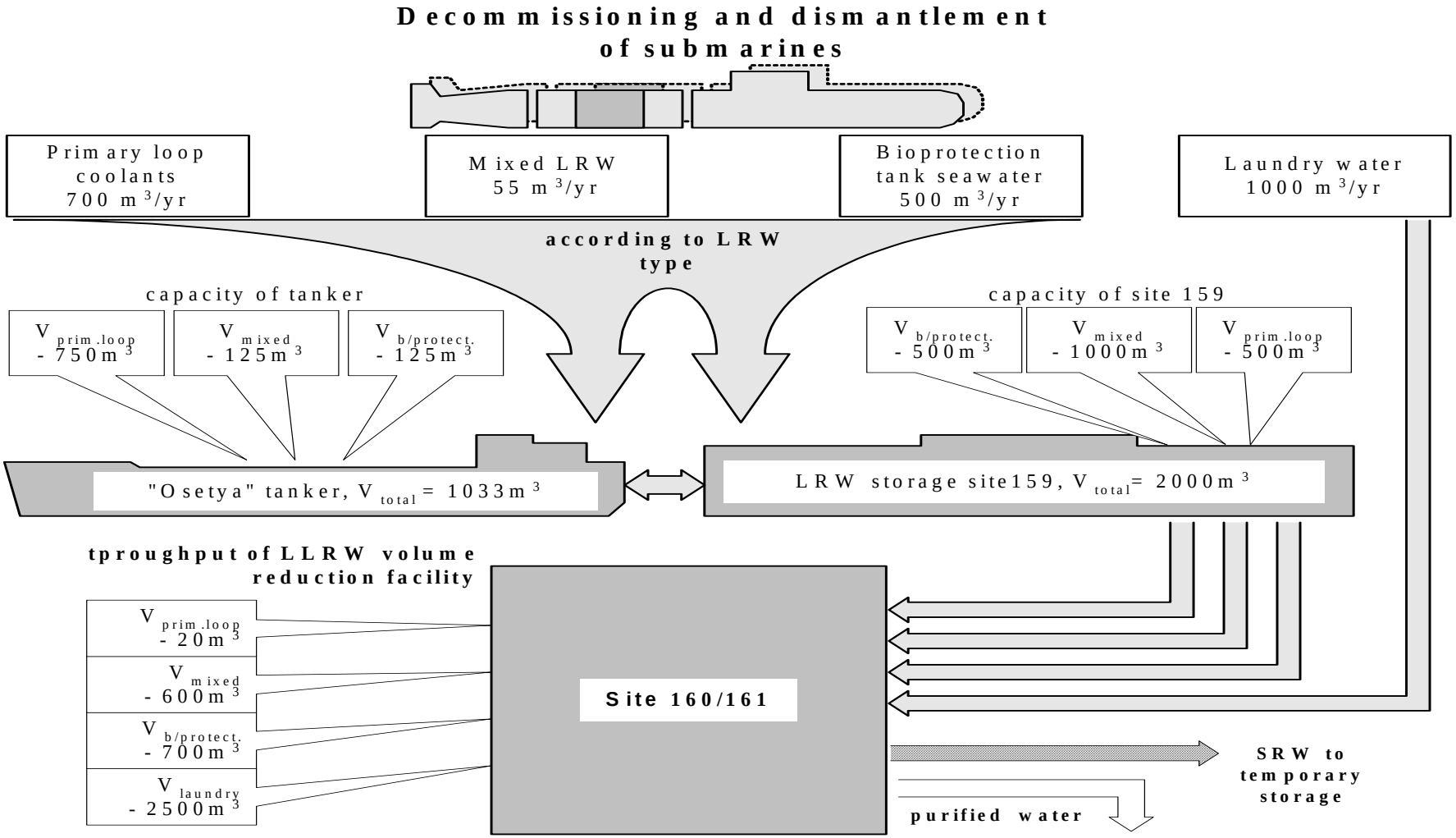

Fig. 5 Operational LRW handling system used at Zvezdochka shipyard

The list of toxic (hazardous) materials produced during dismantling of nuclear powered submarines is the following:

– heat insulation wastes from the main hull		18,5 t
– under paint and paint wastes		13,9 t
– linoleum pieces and plastic elements		3,5 t
– laminated plastic elements		0,3 t
– hermetic, cable residues		10,0 t
– mastic wastes		2,5 t
– porovinyl wastes		11,2 t
Total:	~	59 t

About 240 t of toxic (hazardous) materials are produced annually during dismantling of 4 subs. There is no system for the hazardous (toxic) materials treatment at the yard. To present we have accumulated 3260,6 t of such wastes.

6 Proposals for upgrading of current dismantling infrastructure

6.1. Construction of facility for RC interim storage

At present we use three-compartment method for dismantlement with further keeping the RC afloat. To start with a new "dry", more safe and less costly method of dismantlement, we are planning to construct new facilities for interim RC storage according to the RF Government Decree No. 518 and 149.

The facility for RC interim storage will include:

- a pad for interim RC storage with shelter (12 pcs. for the first phase, and 38 pcs. for the second phase);
- two sections of the special quay for handling operations;
- motor road for RC transportation; from dock-chamber to the place for interim storage, and from special quay to the place for interim storage;
- transport system, consisting of motor driven modules with capacity 1680 t;
- transport vessel for RC transportation for long storage.

The construction of the facility for interim RC storage is an integral part of the whole one-compartment unit dismantling procedure, and would allow to:

- start with more effective method of dismantling;
- avoid not safe keeping RC afloat;.
- increase capacities for treatment and storage of SRW (renovation of Bldg. 162, reconstruction of flammable SRW burning, and renovation of SRW remelting facility).

6.2. Modernization of SRW burning facility

The facility for SRW burning is in operation since 1983. Its purpose is to cut down the volume of flammable SRW by 2—100 times.

The present condition of the facility doesn't meet the up to date requirements, related to its volume, ash removal system, gas cleaning systems, burning system control, and radiation monitoring system. At present it is impossible to assure the safe operation of the facility before its deep modernization. Another reason for the facility reconstruction is conditioning of flammable SRW, discharge from Bldg. 162.

Under cooperation with company “Technicatom” the French party worked out the proposals, related to the facility modernization, including: a new room layout, modernization of incinerator with replacement of old equipment for new ones, implementation of ash cementing, automated operation control, a new radiation monitoring system.

The facility upgrading will result in:

- cutting down the SRW volume, accumulated before and being annually produced;
- decreasing of radiation level and improvement of work conditions for the involved personnel;
- improvement of environment situation due to decreased emissions into the atmosphere.

6.3. Upgrading of SRW storage facility (Bldg. 162)

The facility is in operation since 1963, and is filled to 80%. It is reinforced concrete building (35-12m), including 9 chambers with volume to 330 m^3 each, 12 chambers with volume to 23 m^3 each, with top loading by gantry crane.

The facility is filled with unpacked wastes and is to be repaired, discharged with further loading of wastes into containers. During long period the wastes were loaded in bulk without sorting and packaging.

The facility needs full upgrading, which will include discharge of accumulated SRW out of the facility rooms, sorting, conditioning and packaging, inspection of the building itself, repair and modernization of the facility structures. The discharge is expected to be performed by using of special mobile module.

The facility modernization will result to:

- liquidation of radioactive/hazardous facility and construction of a new conditioned SRW interim storage facility with multiple protection means to avoid environment contamination.
- cutting down of accumulated SRW due to their treatment.

6.4. Modernization of decontamination site, construction of remelting facility

The acting decontamination site is designed for decontamination of the equipment with output to 30 t per year. The site, put into operation in 1965, doesn’t meet the up to date requirements. In view of expected dismantling of multi-purpose subs the number of contaminated equipment and structures to be treated, will considerably increase.

To solve the problem of accumulated metal SRW Zvezdochka shipyard worked out proposals for construction of remelting facility to ensure treatment by separation of the whole volume of contaminated metal into two parts:

– the smallest part as slag, containing 95% activity;
– the largest part as low active or “clean” billets.

Decontamination and remelting facilities will operate as one technological unit, thus solving the problem of metal SRW accumulation.

Zvezdochka shipyard has in its disposal the up to date complex for RW handling due to realization of international Programmes, and can effectively repair and dismantle nuclear powered submarines. However there are some problems to be settled.

The offered measures to improve the SRW handling will allow performing the dismantling work with observing all rules of RW handling. In this case Zvezdochka shipyard will be able to perform deep treatment and conditioning for all kinds of RW, produced at the shipyard, which in turn, will decrease the risk of radioactive contamination of the environment of the whole region. The offered suggestions are rather expensive, but could be successfully realized under joint international cooperation..

The shipyard is searching for more effective processes, is improving the acting infrastructure for the sub dismantling. The associated documents for further development of infrastructure have been worked out to start with full scale dismantling of strategic and multi-purpose submarines.

However the state of the fund allocation from RF budget showed, that dismantling of multi-purpose submarines will take many decades. A large number of multi-purpose submarines waiting for decommissioning, create the risk of nuclear and radiation accidents, as the technical state of all systems and mechanisms, providing buoyancy on the most of the submarines are in emergency condition. The state of ballast tanks and main hulls doesn't meet standard requirements. Their docking intervals are not observed (once each three years according to the acting regulations).

The highly effective complex for dismantling of nuclear powered submarines has been constructed with capacity to 4 subs per year. If we could use the Naval floating defuelling vessel to discharge the spent fuel, the amount could increase to 8 subs per year.

The ways for further improvements:

- Arrangement of additional piers, necessary for displacement of naval submarines for acceptance by the shipyard for dismantling;
- To avoid accumulation of hazardous (toxic) materials, it is necessary to implement their treatment;
- It is reasonable to implement the one-compartment unit method after completion of the pad for interim RC storage;
- To improve the environment it is reasonable to replace thermal cutting for another method, less harmful for the environment. The use of thermal cutting is related with considerable volumes of harmful dust and gas emission into atmosphere. In our opinion it would be important to search for another more safe and environment saving cutting processes.

The trial dismantling of one multi-purpose submarine at Zvezdochka shipyard could be performed on the base of experience gained during dismantling of Yankee - and Delta – class submarines, and utilizing the infrastructure, specially created for dismantling of nuclear powered submarines.