ALTERNATIVES FOR CREATION OF A TEMPORARY STORAGE SITE FOR REACTOR COMPARTMENTS AT MACHINE-BUILDING ENTERPRISE "ZVIOZDOCHKA"

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ABSTRACT

The present paper contains basic solutions on creation of temporary storage site (RC TSS) for reactor compartments, generated in the course of nuclear submarines dismantlement by prospective "one-compartment" approach, at "Zviozdochka" enterprise, Severodvinsk, Russia. Two variants of RC TSS construction with estimation of duration and cost of works are presented in this work.

INTRODUCTION

The reactor compartment (RC) after unloading of spent nuclear fuel (SNF) represents a container with intermediate and high level radioactive wastes (inner contaminated constructions and equipment). At the present time RCs from dismantled nuclear-powered submarines are being stored afloat. Two adjacent compartments provide the necessary buoyancy of RC. The "3-compartments" approach of dismantlement of submarines is being used.

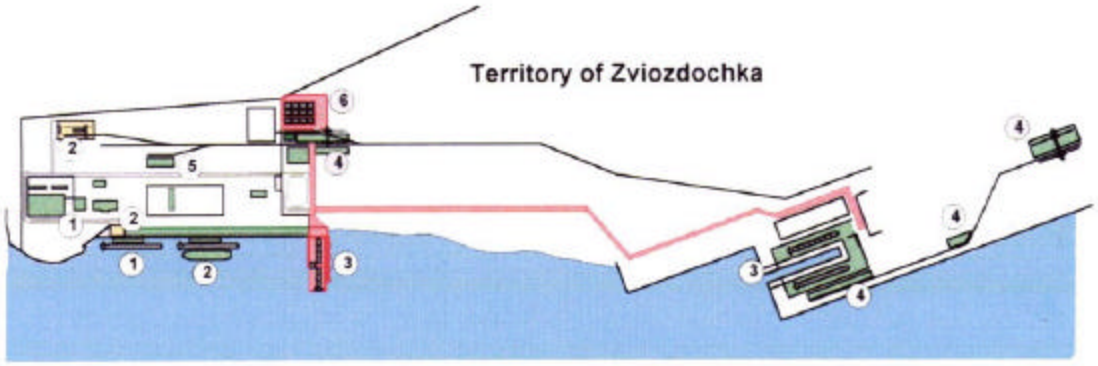
With the aim of application of the more ecological safe and less expensive dry storing approach, it is planned by the Government orders No. 518 and 149 to create the regional long-term storage site for RCs and local temporary storage sites (TSSs) at the enterprises engaged with submarines dismantling.

In pursuance of aforesaid orders, technical divisions of Federal State Unitary Enterprise "Machine-building Enterprise "Zviozdochka" have developed proposals on variants of arrangement and construction of the TSS with estimation of cost and duration of TSS construction and the necessary purchases. These proposals were developed with respect of "Feasibility researches on the problem of reactor compartments management" by MINATOM.

PROCESS OF SUBMARINES DISMANTLEMENT AT "ZVIOZDOCHKA" ENTERPRISE

Federal State Unitary Machine-building Enterprise "Zviozdochka" is the most equipped Russian shipyard being involved in dismantlement of nuclear submarines. Sixteen submarines have been dismantled with the use of "8-compartments" and "3-compartments" approach.

The dismantlement system is composed of the following subsystems (Fig.1):



Step (position)	Name of work	Name of facilities	In use	Under construction	Prospective
1	Subs receiving, dismantlement Radwaste removal	Special quay Radwaste management system	■		
2	SNF unloading	Depot ship Onshore defueling facility	■	■	
3	Dismantling on ship-ways Dismantlement	Basin dock Floating dock PD-90	■		■
4	Cutting of hull constructions and equipment	Gas-cutting sites, shearing site	■		
5	Cable cutting	Special cable-cutting facility	■		
6	RC return to long-term storage	Port RC TSS	■		■

Fig. 1. The Federal State Unitary Enterprise "Zviozdochka". Layout of dismantling facilities.

Receipt of submarines, preparation for dismantlement, unloading of radioactive wastes. Zviozdochka has liquid radwaste (LRW) and solid radwaste (SRW) storages, LLRW volume reduction system, special pipelines for transportation of liquid radwaste from submarine to liquid radwaste storage, special LRW tanker, and mobile LRW treatment unit.

SNF unloading. This activity is provided with special depot ship. Construction of onshore SNF facility funded by US DOD is being carried out now. After putting into operation of this facility in 2001, it will be possible to carry out up to eight SNF unloading processes per year.

Ship-way works. The building berth of basin dock is purposely equipped for dismantling works and provides dismantlement of one submarine within three months. This facility can also provide dismantlement of four submarines per year.

At the present time Zviozdochka is striving to obtain the floating dock project 19371U, that is specially designed for dismantling of submarines. Having got this dock, Zviozdochka will be able to increase throughput of shipways up to eight submarines per year. Application of high-production "modular" dismantling approach also will be possible.

Onshore facilities. There are torch-cutting and shearing dismantling facilities, as well as cable cutting and shipment facilities at Zviozdochka.

The submarine dismantling system at Zviozdochka provides now dismantlement of four submarines per year and, after putting into operation of onshore defueling facility and obtaining of floating dock pr.19371U, will be able to carry out dismantlement of up to eight submarines a year.

Considering the absence of reactor compartments temporary storage site, the dismantling process is carried out only with "3-compartment" approach.

LOCATION AND COMPOSITION OF REACTOR COMPARTMENTS TEMPORARY STORAGE SITE

Location.

It was taken for granted that the reactor compartments temporary storage site shall be located inside the area for works with radioactive materials or near such area, the area planned for construction shall be free of another buildings (for cost decreasing), and shall be located near the quay (easy transportation in the case of RC transfer to long-term storage site). After consideration of several variants, the variant of TSS location near the hull parts dismantling site (guillotine "Harris") has been chosen.

RC TSS composition

RC TSS shall include:

- RC storage area;
- Transferring terminal for reception and return of RCs;
- Road connecting the storage area and terminal;
- Transportation subsystem;
- Floating dock pr.19371U.

Basic requirements

RC storage area.

This area shall have 12 places equipped with jigs for RC placing (weight – 1,600 metric tons, diameter – 11.8m, length – 13m). All places shall be provided with shelters to ensure protection against atmospheric precipitates. Storage area shall be enclosed with fence with gates for RC transportation. The intrusion protection system, radiation monitoring system, and necessary supply systems shall be provided.

The storage site shall have auxiliary rooms for accommodation of operating and security personnel, and for equipment installation.

Transferring terminal for RC reception and return of RCs to long-term storage site.

This terminal with length of 50m is to be the new part of the existing quay and shall also have a pier for mooring of the floating dock (length of about 100m, located perpendicularly to the quay line). Lifting surface ability of the terminal is to be 10 tons/m^2.

Road for RC transportation.

Lifting surface ability – 10tons/m^2.
Width of the road – 16 m.

Transportation subsystem.

The RC transportation will be carried out with the help of self-propelled modular transporters (SPMT), namely:

- 6-axial units with lifting capacity 180t – 8 items;
- 4-axial units with lifting capacity 120t – 2 items;
- power units (Fig.2).

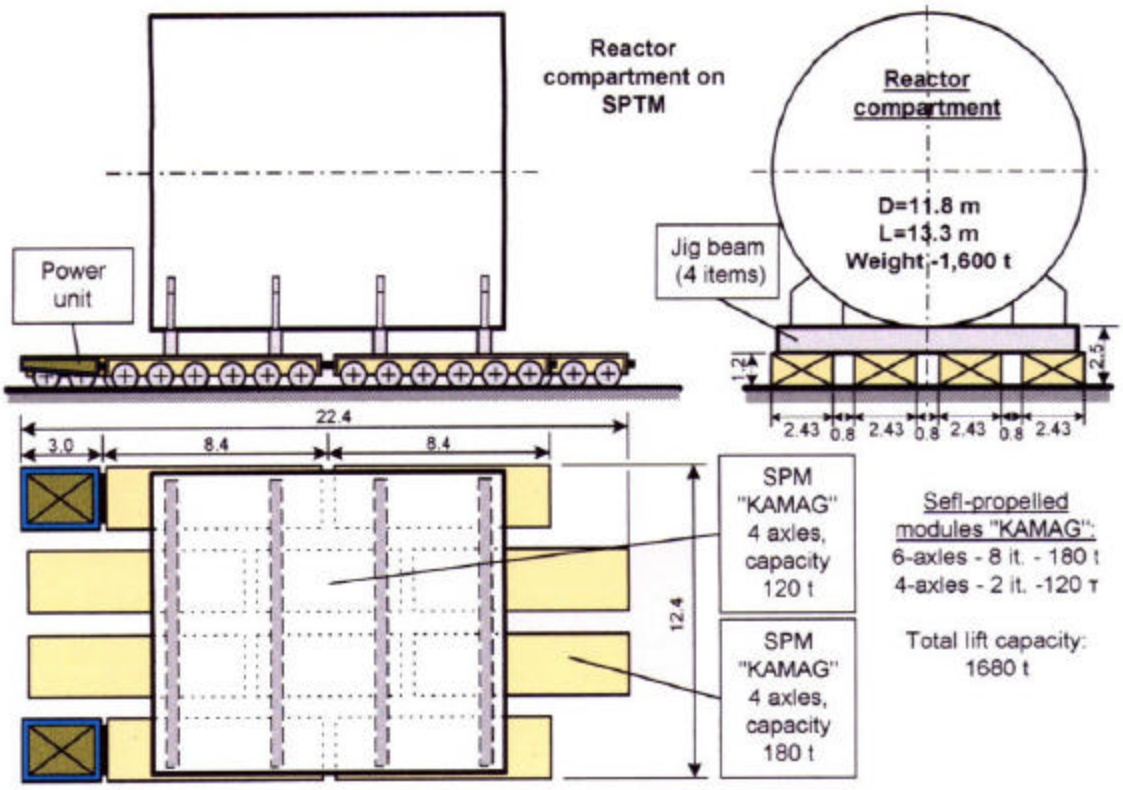


Fig. 2. Reactor compartment installed on self-propelled modular transporter

It is also possible to carry out the transportation by means of special-designed rail system. This system is less expensive than SPMT, but it will be necessary to lay the rails and to

construct submerged support for the floating dock. These additional works will annulled all the money saving.

Floating dock PD-90 project 19371U.

Type	– floating, box-type, one-pontoon, composite.
Load capacity	– 13500t.
Dock floor length	– 144m.
Outer width	– 50m.

It is planned to use the floating dock for dismantling of submarines. This dock can be also used for transportation of RCs to the long-term storage site.

VARIANTS OF THE RC TEMPORARY STORAGE SITE

Two variants of TSS are developed:

- **Variant 1** – RC storage area is connected only with transferring terminal (Fig.3).

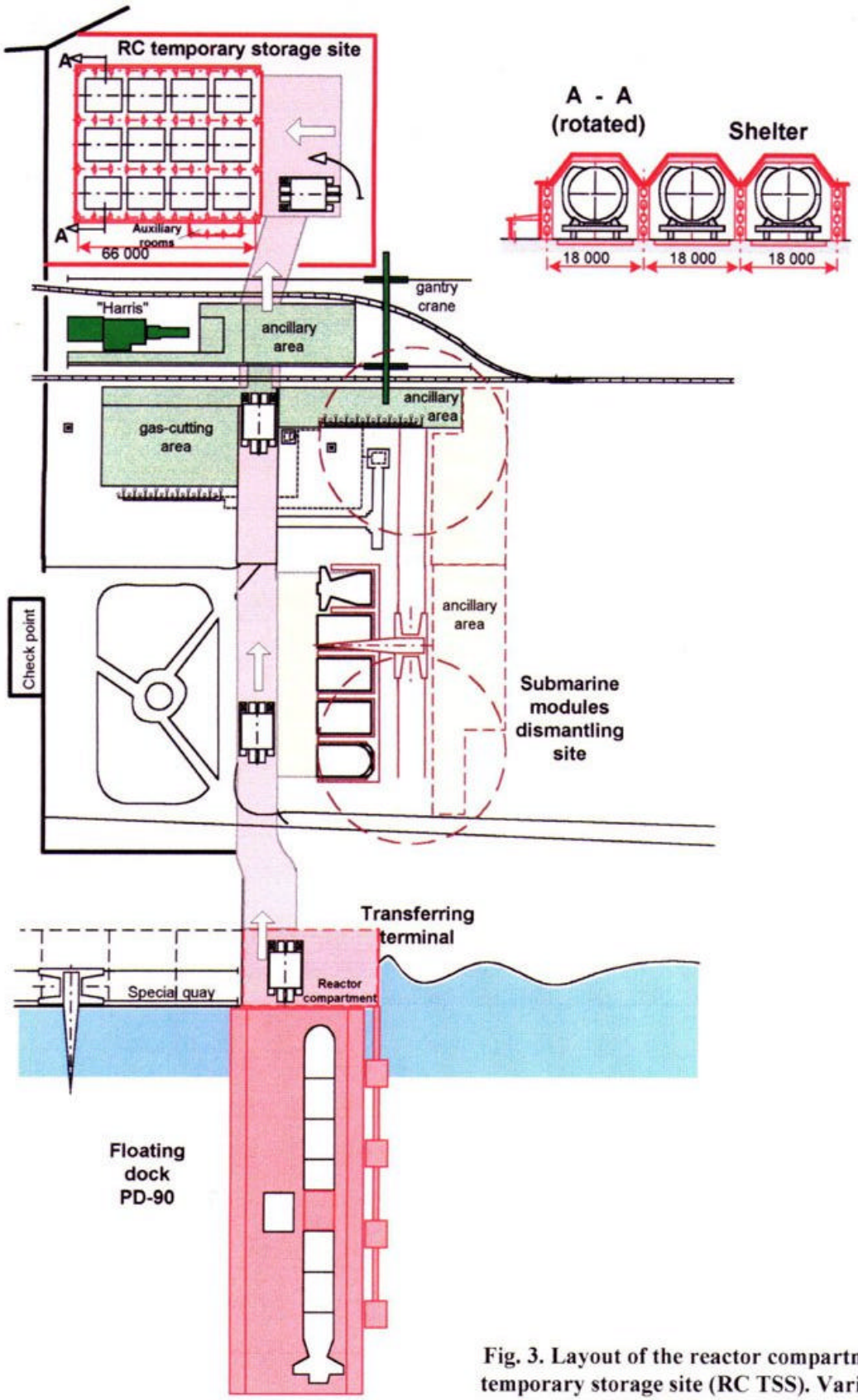


Fig. 3. Layout of the reactor compartments temporary storage site (RC TSS). Variant 1

– **Variant 2** – RC storage area is connected by road with both transferring terminal and basin dock (Fig.4).

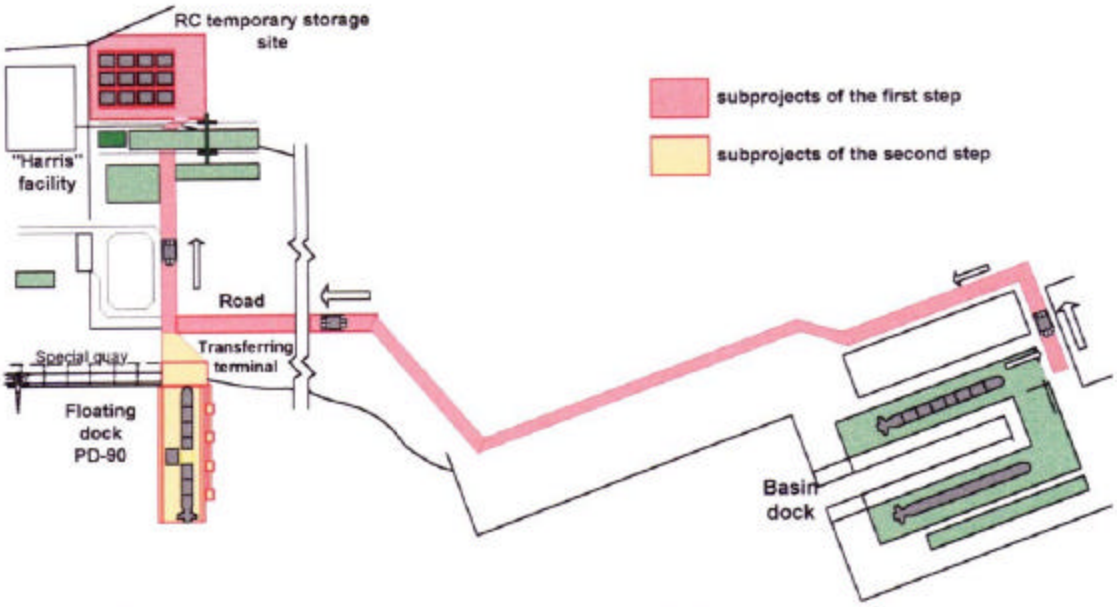


Fig. 4. Layout of the reactor compartments temporary storage site (RC TSS). Variant 2

Variant 1 is stipulated with obtaining of the floating dock PD-90 and will provide the one-compartment dismantlement only in this dock, i.e. up to 4 submarines per year. Storing of reactor compartments will be possible only after completing of all construction works.

Variant 2 will provide the one-compartment dismantlement not only in the floating dock but also in the basin dock. It is possible to create the TSS by two steps and begin conversion to one-compartment approach after the completing of the first step, not awaiting for completion of the second step (construction of transferring terminal and obtaining of the floating dock). Variant 2 shall provide the possibility to carry out dismantling of 8 submarines per year by one-compartment and modular dismantling approaches.

ESTIMATION OF COST AND DURATION OF WORKS

Preliminary estimation of cost of two variants of the project is given in Table I.

Preliminary schedule of work execution is given in Table II (see below).

Table I. Estimation of cost and duration of works

?	Subproject and its content	Scope	Cost, thousands USD		Duration, months	Cost by variants, thousands USD		
			One piece	Total		I variant	II variant	
							I step	II step
1	**Research and development works**			1229	12	1229	1229	-
2	**RC storage site:**			1993		1993	1993	-
	– Storage area;			1148	12			
	– Auxiliary rooms;			187	7			
	– Supply systems;			658	10			
	– Security & monitoring system							
3	**Road**	500m		516	9	516	-	-
		2700m		2581	15	-	2581	
4	**Transportation system:** – 2 units 120t; – 8 units 180t; – 2 power units			3860		3860	3860	-
5	**Transferring terminal**			9785	24	9785	-	9785
	– quay	50m	0.053					
	– pier	120m	0.0036					
	– dredging works	80000 m^3						
6	**Purchase and maintenance of floating dock** – transportation to ZV – maintenance			262		262	-	262
				USD, thousands		**17 645**	**9 663**	**10 047**

Table II. Schedule of works (two variants)

Name of subproject	Duration, mnts	Year 1					Year 2					Year 3				
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4	
Variant ? 1																
Research & development works	**12**															
RC storage site	**12**															
Construction of storage area																
Auxiliary rooms	**7**															
Supply systems, security&monitoring	**10**															
Road	**9**															
Transportation system																
Transferring terminal, pier	**24**															
Purchasing of floating dock																
Variant ? 2																
I Step																
Research & development works	**12**															
RC storage site	**12**															
Construction of storage area																
Auxiliary rooms	**7**															
Supply systems, security&RM	**10**															
Road	**9**															
Transportation system																
II Step																
Transferring terminal, pier	**24**															
Purchasing of floating dock																

SUMMARY

For application of more ecological safe dry-storing approach instead of the existing “store afloat” approach of management with reactor compartments, it is necessary to create the RC temporary storage site at the “Zviozdochka” enterprise.

Two variants of RC TSS are taken into consideration:

– **Variant 1** envisages transportation of reactor compartments to TSS only from the floating dock PD-90.

– **Variant 2** envisages transportation of reactor compartments to TSS not only from the floating dock, but also from the basin dock.

The estimated costs are:

- Variant 1 – 17.645 million USD;
- Variant 2 – 1 step – 9.663 million USD;
  2 step – 10.047 million USD.

Total duration of the project will be 33 months. However, the first step of the second variant, after that the one-compartment approach can be accepted, can be completed within 21 months, i.e. one year before the time conditioned by the first variant. The implementation of the first step of the second variant does not depend on obtaining of the floating dock.