Project Proposals for Preparing Infrastructure to Reactor Cores Unloading at the Gremikha Site

by V.N. Panteleev
Federal State Unitary Enerprise)
«Northern Federal Radwaste Management Company» (SevRAO)

Abbreviations

ARE	- all-purpose refuelling equipment
ARM	- automated radiation monitoring
AS	- accident situation
BC	- bridge crane
CRS	- control rod system
CUC	- coastal unloading complex
DD	- dry dock
FVA	- filtering and ventilation aggregate
IPPE	- Russian Federal Research Centre "Institute for Physics and Power Engineering"
LMC	- liquid metal coolant
NIKIET	- N.A. Dollezhal Research and Development Institute for Power Engineering
NPI	- nuclear power installation/ reactor
NS	- nuclear submarine
OKB	- design and drawing office
OKBM	- office for machinery design and drawing
OVOS	- environmental impact assessment
RMK	- rotary module compressor
RW	- radioactive waste
SevRAO	- Northern Federal Radwaste Management Company
SRC	- spent reactor core
SNF	- spent nuclear fuel
SPC	- sea portal crane
TOB	- technical safety justification
VNIPIET	- Russian Research and Development Institute for Power Engineering
WMR	- water-moderated reactor
23rd GMPI	- the 23rd State Marine Design and Development Institute

1. Background Information

Alpha-class submarines are considered special among a diversity of other submarines designed by Russian research institutes. Their main peculiarity lies in the type of their power installation, a liquid metal-cooled reactor. Besides a considerable difference from water-cooled reactors in terms of operation, a reactor with metal coolant also requires a particular handling under the repair and/or unloading of the spent reactor core. The main peculiarity while reloading the core is a necessity to maintain a rather high temperature of the coolant. Thus, a special facility was required to perform the said work. As a result, a service naval base was established in Gremikha. The facility complex to support reactor core management was designed and built between 1959 and 1965; it was used for this purpose until 1992. During this period a number of reactor cores were unloaded and placed for storage. It should be noted that core management procedure during the period demonstrated the appropriateness of the engineering solutions developed.

A top-priority objective of the Gremikha Site now is to unload the cores from NSs and floating NS compartments and to transfer them into on-shore stores, since this activity leads to minimising a risk that contamination can escape into the Barents Sea.

2. Overall Infrastructure and Separate Infrastructure Units

Infrastructure facilities intended to unload LMC spent reactor cores were constructed in compliance with the operational regulations. Originally, all management activities were carried out so that the reactor operability could be restored after the core had been recharged, i.e. the spent core was to be replaced by a new one. In the late 1980s a decision was taken to decommission Alpha-class submarines. The cores were unloaded, and the submarines were dismantled. Operational regulations applied at that period confined themselves to the part that covered SRC unloading and placing for storage. It must be mentioned that these operational regulations were acceptable as the reactor was maintained heated which facilitated such management operations.

Due to a large number of faults and troubles that began to occur to the systems, which sustained a permanent temperature of the reactors, NPI designers had to start to decrease the temperature of the heat-carrying agent. Additional operational requirements and regulations were developed and outlined to unload ‘frozen’ reactor cores. In the 1990s submarine safety control systems were used during the core unloading. The latest unloading operation was performed more than 10 years ago. The submarines systems have degraded and are practically beyond repair; therefore, supplementary engineering safety monitoring procedures have been developed and added to existing operational regulations. Overall technical facilities have practically remained the same.

2.1. Unloading Complex

The reactor core unloading complex comprises buildings, facilities and installations intended to support specific management activities in accordance with the operational regulations. The complex includes:

- the SD-10 dry dock;
- a reactor refuelling building (bdng 1A);
- a SRC storage facility (bdng 1B);
- an all-purpose refuelling equipment;
- hoist units;
- a boiler shop;
- a system of neutronic monitoring of the reactor and the core;
- an automated radiation monitoring system;
- a TV monitoring system;
- a special ventilation system module;
- a special filter unit module;
- a technological shelter;
- a power supply system;
- a gas supply system.

2.2. Description of the Unloading Complex Facilities

SD-10 Dry Dock

A dry dock is a hydraulic facility where a submarine is placed to have the reactor core unloaded. The said facility consists of a dock chamber, a bulkhead gate separating the dock from the harbour basin, windlasses, a pumping station, a main sea water system, a fire alarm system, and a technological water supply system (Fig.1 and Photos 1 and 2).

Keel blocks for submarines are installed on the slipway floor. In order to dock a submarine the dry dock is filled with water through the main sea water system. Then the bulkhead gate opens, and windlasses drag the submarine in. After the gate has closed the dock chamber is emptied, and the vessel is centred and positioned on the keel blocks. By request of the submarine designers aiming at safety improvement, the submarine is to be supported with stanchions that abut against the dock walls. After all these operations completed preliminary works can start. In the niches in the dock walls there are inlets to connect detachable engineering service conduits to the submarine.

This year most repair work in the dock will be completed. Only certain defects in the leakage pumping system and the main sea water system have to be fixed after which it will be possible to use the dry dock.

Reactor Replacement Building (1A)

Building 1A is the principal facility, where the main equipment associated with the control, implementation and support of SRC unloading is located. The structure of the facility is rather complex (General view in given in Fig. 2). The building consists of three modules. The right module houses a control unit and supporting systems (ventilation, heating). The middle part of the facility is intended for storing all-purpose refuelling equipment (ARE) as well as spent reactor cores. In the left wind of the building there are radiological monitoring and radiochemical laboratories. Several rooms situated on two of the four levels can be seen on Fig. 3 and 4.

Unloading control equipment is located at the control unit. Unloading implementation equipment is located in the room for preparation of the refuelling equipment with the decontamination station. Means for provision of the unloading are located at the SRC neutronic monitoring rig, where a radiochemical laboratory is also located. Besides, SRC storage facility is located also in the Building 1A, which houses the principal radiation safety unit, i.e. the personnel radiation checkpoint.

A number of workshops on the ground floor are envisaged for storing and preparing all-purpose refuelling equipment, i.e. maintaining it, preparing for transfer onto the submarine, decontaminating it after use in the reactor compartment, and prepare it for storage until the next unloading operation.

All-purpose refuelling units are held in a special-purpose facility in the Building 1A, which is equipped with hoisting devices (Fig. 4). In the upper part of the facility there are engineering process hatches for equipment acceptance from and transfer to the submarine (Photo 3). The equipment is decontaminated in a special workshop with facilities for decontamination, a liquid radwaste collection system and special ventilation.

The unloading control unit occupies a separate facility. The control station includes a console for the remote control of the defuelling cask. Operation and control of the defuelling can be surveilled via TV monitoring, automated radiological monitoring and communication systems.

Рис. 1 Сухой док **Fig. 1. The dry dock**

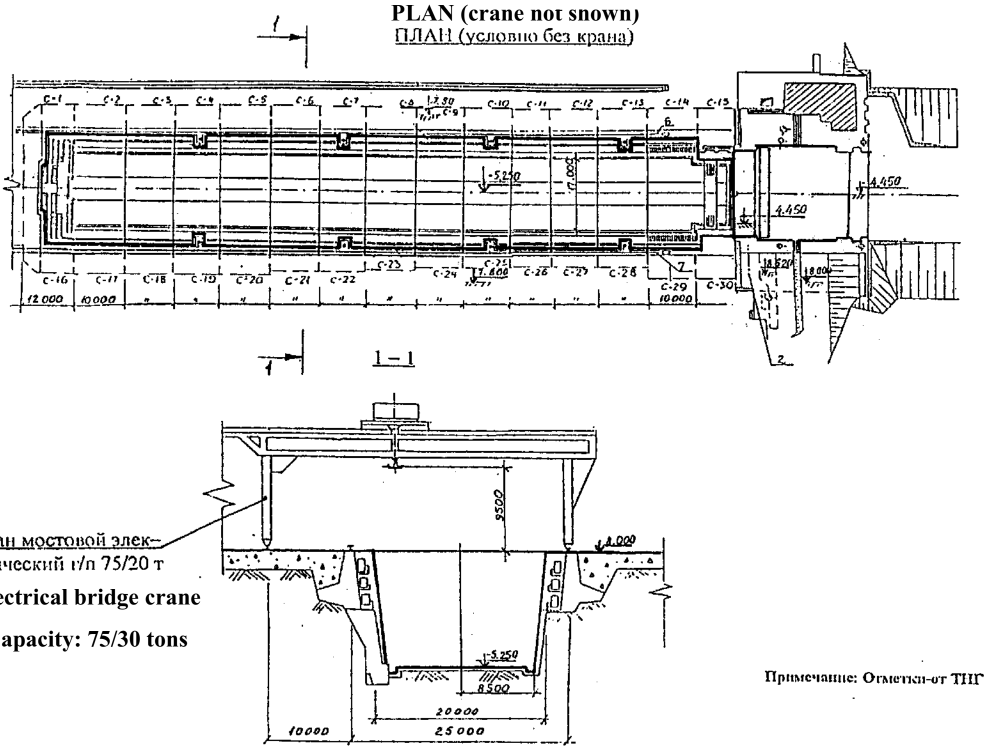


Figure 1. SD-10 Dry Dock

Photo 1. The dry dock and the portal crane

Photo 2. The dry dock and the MK bridge crane

Рис.2 Здание перезарядки АПЛ с ЖМТ (соор. 1А)

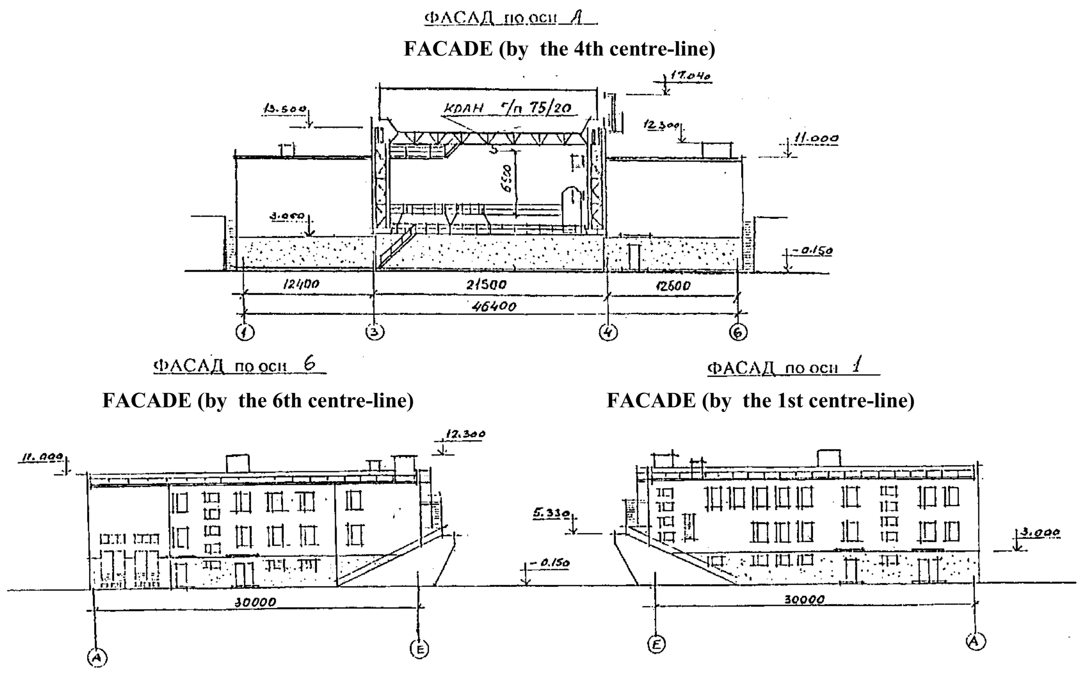


Figure 2. Facility for Replacing Liquid Metal-Cooled Reactors on Submarines (bdg 1A)

Рис.3 Внутренее помещение соор. 1А

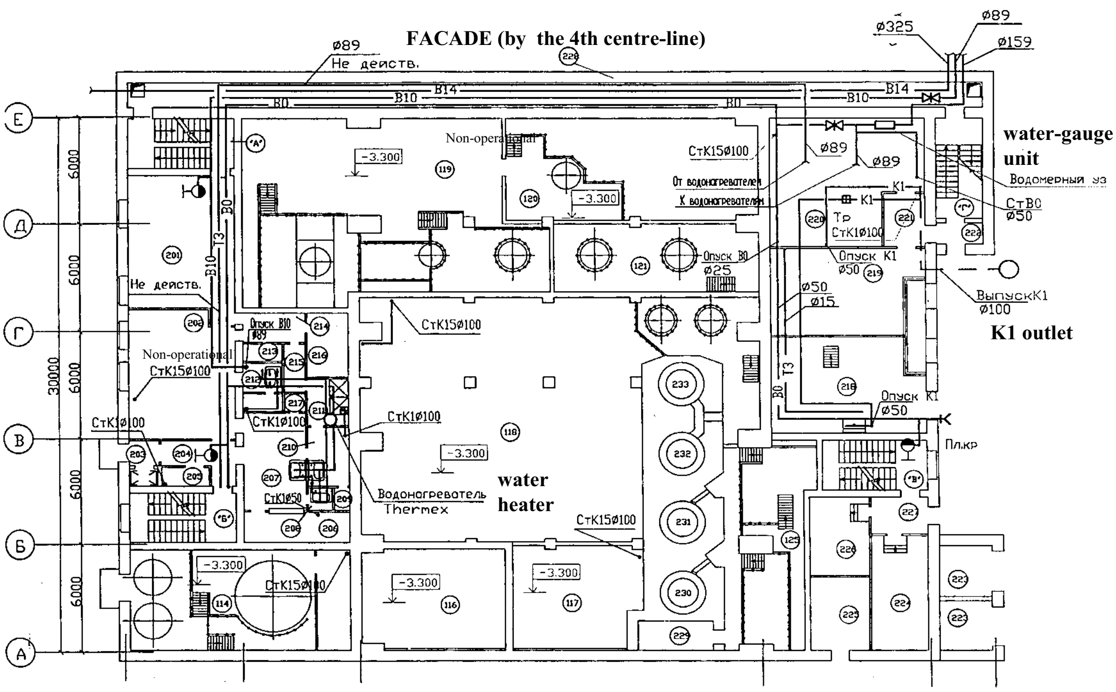


Figure 3. Building 1A interior

Рис. 4 Внутренние помещения сооружения 1А с ГНУ

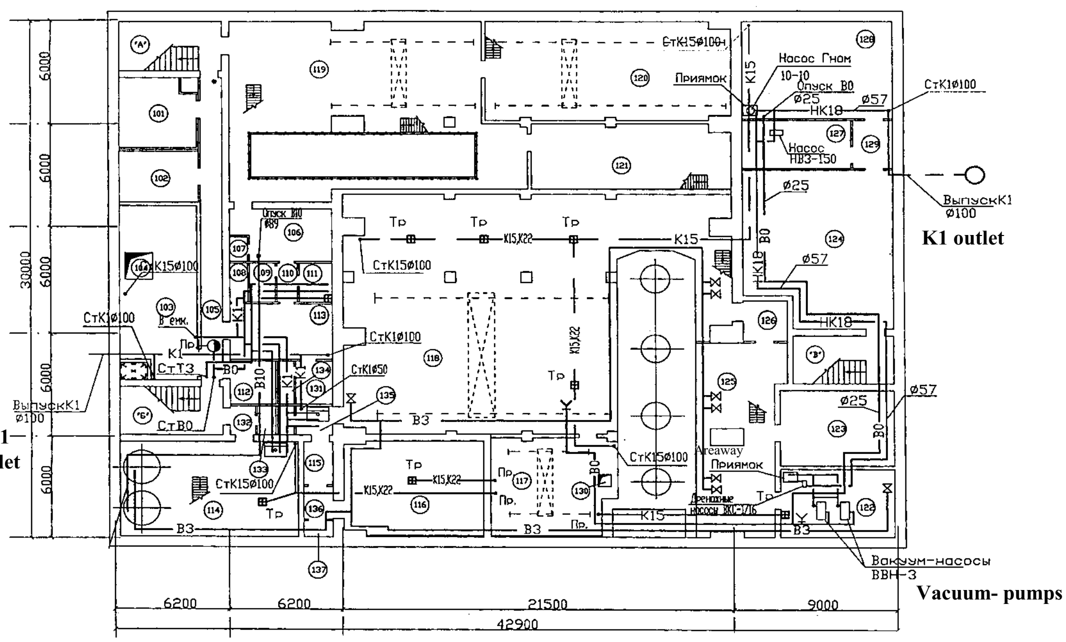


Figure 4. Building 1A Interior with the refuelling equipment

Photo 3. Process hatch covers

Neutronic state of the reactor core is also monitored in a separate room. Safety monitoring system includes sensors installed both in the reactor and the defuelling cask, communication networks, and nuclear material instrumentation as well.

SRC Storage Facility (Building 1A)

The store facility contains a cell into which a storage tank is placed. The facility serves to prepare the storage tank for the acceptance of submarine reactor cores, and to freese the coolant after the spent reactor core has been placed into the tank. For these purposes the store is equipped with an air heating and cooling system as well as a temperature and neutron flux control system. The air heating and cooling system is remotely controlled from the unloading control unit.

Radiochemical Laboratory

The laboratory is intended to analyse air, aerosols, coolant, liquid and solid waste contamination parameters using equipment that enables carrying out the said analyses.

Radiation Checkpoint

The facility is located on the ground floor and consists of changing rooms (clean and ‘contaminated’ ones) for all workers taking part in all operations on board the submarine, and dosimeter units. Upon docking a submarine a strict regime/ controlled access area is defined, and the radiation checkpoint becomes the principal facility in the area.

On the whole, the state of the building and its facilities can be considered as satisfactory. Nevertheless, practically all rooms need repair, wiring needs partial replacement as well as the steam heating system, which has to be substituted for electrical. Current radiation situation is normal. When works associated with the SRC unloading from all the three reactor units have been completed, the building will be used to support reactor core storage in the facility.

Spent Reactor Core Storage Facility (Building 1B)

The SRC storage facility consists of several cells, where the cores are kept. The access to the facility for the purposes of inspecting outer cells with the cores is available via a radiation checkpoint. Besides, the facility houses a compressor shop, a ventilation chamber and a room for part of the all-purpose refuelling equipment. SRC storage sells have a warning system to monitor the temperature. Data concerning the temperature are transmitted to the control unit in the same building. Compressors were envisaged to provide the nuclear reactor with gaseous media – nitrogen and helium. The general view of the building is given in Fig. 5.

In the late 1990s the foundations under the face and compressor station walls sank as a result of soil washout. Building constructor companies reinforced the ground, and the deterioration ceased. All equipment has been removed from the compressor shop.

The current engineering state of the building can be characterised as satisfactory, and it can be used to store SRC. Nevertheless, interior redecoration has to be completed, lighting system need repair, a system for monitoring spontaneous chain reaction must be installed. Radiation situation is assessed as normal.

Рис. 5 Хранилище ОВЧ с ЖМТ (соор. 1Б)

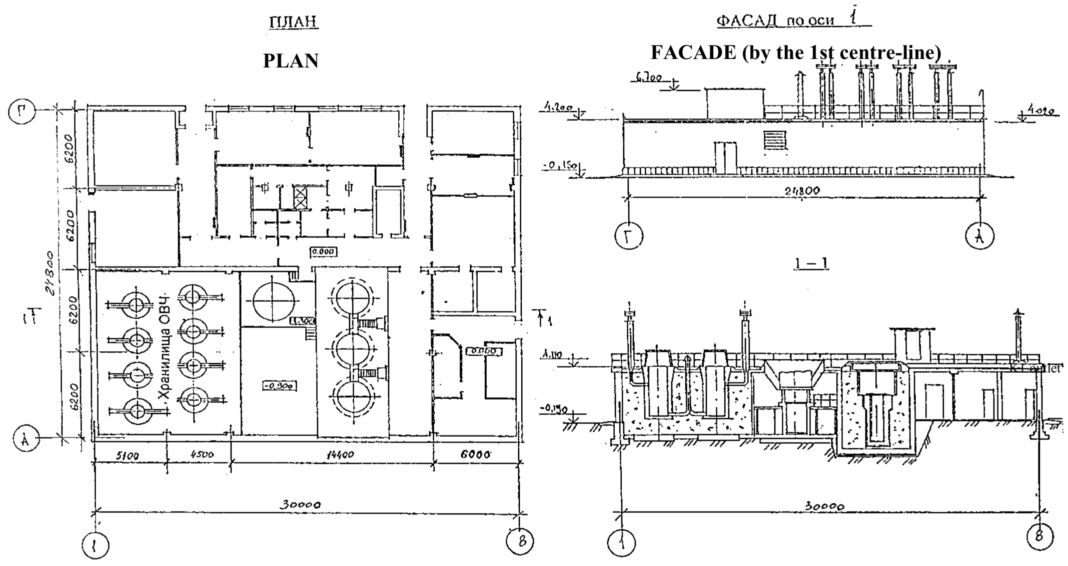


Figure 5. SRC Storage Facility 1 B

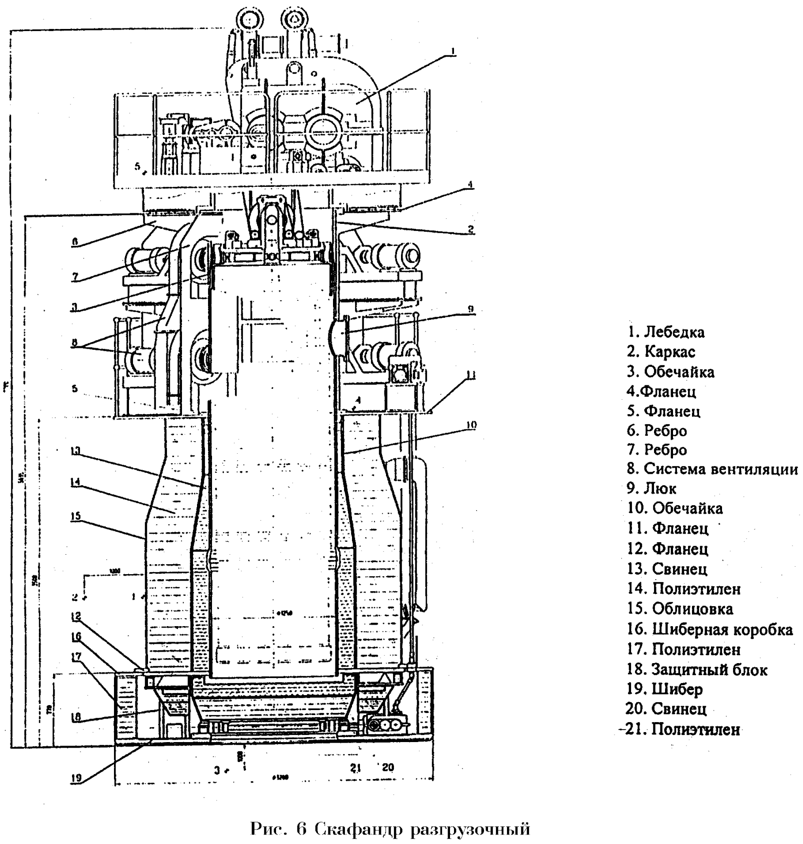
All-Purpose Refuelling Equipment

The main component of the unit is an unloading cask (Fig. 6) transferring the spent reactor core from the submarine to the SRC storage 1A. The unloading cask has special control, monitoring and safety arrangements. A hoist for lifting the core, a gate control gear, and a special ventilation system are installed on this unloading cask. The unloading cask equipment can be controlled both remotely and manually. Remote control is enabled via a special cable line connected to the control board. The control board in the driver's cabin of the MK 75/20 crane may serve as an additional reserve remote control station.

The all-purpose refuelling equipment also includes devices for removing the reactor closure, installing and maintaining a tore sealing cutter as well as devices for hoisting the cores.

A special comprehensive check-up is held to follow the running order of the all-purpose refuelling equipment. The procedure of such a comprehensive checkups is outlined in the technological instructions. For the purposes of examination the unloading cask must be extracted from storage, positioned on the surface plate and connected to the control console with a special cable line. A separate inspection is possible without extracting the unloading cask from the storage facility. An operation of this kind has been successfully implemented.

The engineering state of the ARE is estimated as satisfactory. After the comprehensive check-up the information may be updated. It is obvious at present that a set of sealing rubber gaskets that provide leak-tightness of the crossover joint between the unloading cask and the frame installed onto the reactor vessel should be procured. The difficulty here is that a small-scale production has to be developed to manufacture such gaskets, as a special mould needs to be made.



1. Hoist
2. Frame
3. Shell
4.Flange
5. Flange
6. Rib
7. Rib
8. Ventilation system
9. Hatch
10. Shell
11. Flange
12. Flange
13. Lead
14. Polyethylene
15. Liner
16. Damper box
17. Polyethylene
18. Shielding block
19. Damper
20. Lead
21. Polyethylene

Figure 6. Unloading cask

Hoist Units

The principal hoist units used for unloading operations are a MK-75/20 bridge crane, a MK-20/5 bridge crane and a KPM-10 portal crane.

The carrying capacity of the MK-75/20 crane is 75 tons (Photo 2). The crane is used to transfer a discharged core, an unloading cask, unloading units and detachable parts of the NS hull. The crane is one of the main devices supporting SRC unloading operations. The crane is moved by electric drives. There is a standby power line to the crane components. The unit moves in two directions: along and athwart the dry dock in case of works with the unloading equipment and the SRC. Crane rails have been mounted for this purpose. It is the sliding carriage that moves athwart. It slides along the crane bridge, and then turns onto Building 1A crane trucks. The crane is controlled from the driver's cabin, which contains the unloading cask control consol.

The crane was manufactured and erected on the site in 1961, which accounts for the necessity of thorough repairs. At present the repairs are coming to an end and are to be completed in May 2004. The complexity of this work is that the special part of the crane, which enables unloading cask control during SRC unloading, needs replacement after which the Russian State Authority for Hazardous Industrial Facilities Supervision will allow using the crane under the SRC handling activities.

The state of the crane rails along the dry dock is essential for the MK-75/20 operation, that is why they were repaired in 2003 to correct the defects having occurred during the operation period.

The carrying capacity of the MK-20/5 crane is 20 tons (Photo 4); the unit is applied for works with process hatches plugs in the Building 1A facility, where the unloading equipment is prepared and the cores are stored. The crane is moved by electric motors and controlled from the driver's cabin. The rails are mounted on the bearing structures of the building. In 2002 the crane was repaired and allowed for use without constraints by the Russian State Authority for Hazardous Industrial Facilities Supervision.

The carrying capacity of the KPM-10 portal crane is 10 tons. It is intended to support activities on the slipway floor under dock preparation, mounting the scaffolding, detachable service conductors and other utility works. The crane is driven by electric drives along the tracks parallel to the eastern side of the dock and is operated from the driver's cabin. In 2002 the crane was repaired and allowed for use without constraints by the Russian State Authority for Hazardous Industrial Facilities Supervision.

Boiler Shop

The boiler shop is intended to enable heating the coolant in the reactor with steam before unloading the core. A specially designed boiler unit served the purpose before. The heating source was chosen on the basis of heat-carrier characteristics. In this connection the parameters of the steam coming off the boiler should exceed those required for the reactor steam supply.

The steam from the boiler shop is supplied to the dock through the pipelines (Fig. 7). A detachable service connection from the dock to the steam pipe inlet flange of the submarine is installed. Then the steam pipe is divided into different sections of the reactor heating system. In compliance with the operational regulations the upper part of the reactor is the first to be heated. The said operation enables dismantling activities, reactor head removal and installation of the device to extract the core. Then the lower part of the reactor is warmed up. When the reactor has been heated the steam is emitted into the steam extraction line and released into the condenser unit on the slipway floor through the installed temporary pipeline. The condensed liquid is discharged into the dock runoff ditch.

It is clear from the description above that the system operates in an open cycle.

Since the operation is a key one, the regulations require that another standby heating source should be provided. Under the heating operations described above boilers from surface vessels were used.

Photo 4. The MK 20/5 bridge crane

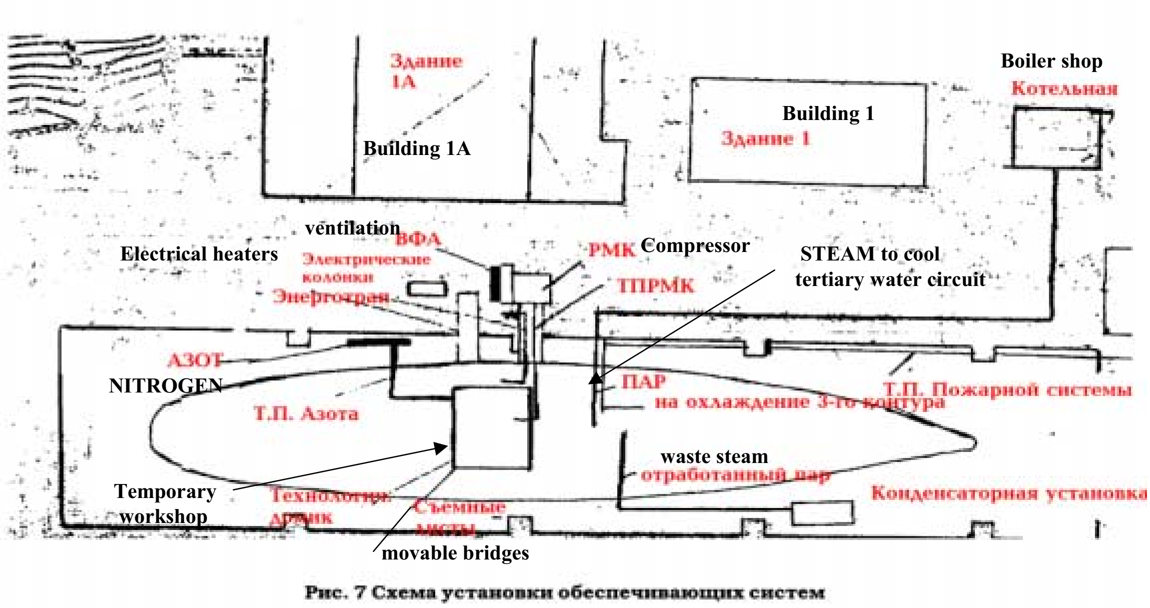


Figure 7. Layout of the Support Systems

Reactor and Core Neutronic Monitoring System

The system is the key means that ensures nuclear safety when the SRC is unloaded. It is intended to monitor the reactor state during concurrent activities (dismantling of the control rod drives, installation of the heating pipes, reactor and the coolant alloy heating). The reason for using this system is that the standard control system is less sensitive. The system comprises a sensor positioned in the reactor compartment before the concurrent works. The signal from the sensor is transmitted to the neutronic monitoring station where monitoring and control instruments are mounted. In case of changes to the neutron flux the physicist should immediately stop the work, arrange that the movable reactor parts should return into the initial position and commence identification of the situation reasons. The system has been developed, manufactured and tested by IPPE as a monitoring & control system designer.

Automated Radiological Monitoring System

The automated radiation monitoring system (ARM) is currently lacking in spite of the radiation protection requirements; however, the design of the system has already been developed by the V.G. Khlopin NPO Radium Institute. A schematic diagram of the system can be seen in Fig. 8. The purposes of the system are to monitor gamma dose rate on the technical site and facilities supporting SRC unloading operations, to inform the staff about radiation situation on the site and its deterioration. The system comprises a set of monitoring sensors in different facilities, stations for collecting and processing data transmitted from the sensors, an alarm and an information board. The system monitors both the site territory and separate facilities.

Within the topic considered hereunder the ARM system consists of monitoring sensors installed in the reactor compartment of the submarine, on the outside walls and inside the Building 1A, including the SRC storage facility. The data from the sensors are transmitted to the monitoring stations in the duty shift house and, under unloading operations, to the unloading control unit. For this purpose the system has connectors to a monitor and engineering data processing units. When dose rates exceed the threshold values acoustic alarm switches on, and the places where radiation has increased, are displayed on the monitor. The project is planned for implementation in 2004.

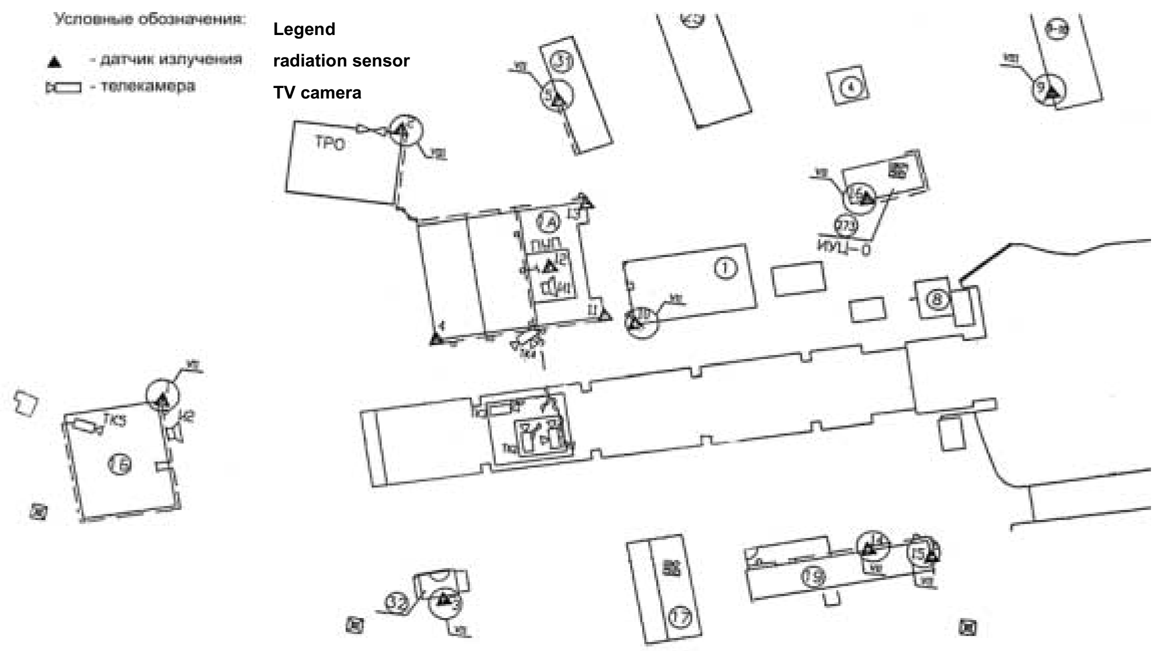


Рис. 8 Схема систем АРК и теленаблюдения за процессом выгрузки ОВЧ

Figure 8. Automated Radiological and TV Monitoring Systems to Monitor SRC Unloading

TV Monitoring System

The system is to be used for the visual inspection of works in the reactor compartment, transportation of the unloading equipment, and activities in the SRC storage facilities in Buildings 1A and 1B as well. The system has fallen into disrepair and cannot be restored due to the lack of the element base, which has become obsolete. This accounts for a new TV monitoring system designed. The new design envisages five TV cameras: two in the reactor compartment and one camera in each of the following facilities: Buildings 1A and 1B, the core storage in Building 1B. The data from the cameras are transmitted to the unloading control unit monitor.

Special Filter Unit Module

The objective of the module is to extract the air from the submarine compartments through special filters and to supply the air to the said compartments. It consists of two ventilators (exhauster and extractor), a heating pad, a filter unit and pipelines. Such a configuration allows maintaining appropriate environmental conditions at the place of work and purifying the air in the compartments. All the equipment is installed in a frame, which can be transported across the site. Under preparation for unloading the frame with the equipment is placed near the dock and connected to the submarines with detachable service conduits. The module works until the operations have been completed. The filter unit module is currently in working order.

Industrial Vacuum Cleaner

The vacuum cleaner is intended to extract aerosols, gases and dust from the reactor compartment under associated works and the depressurisation of the reactor coolant circuit and control and safety system gears. The vacuum cleaner is a metal container with an electrovacuum pump installed on the framework. Cooling is provided by a fresh water system. The set includes an aerosol filter with a distribution device for four air receding points. The industrial vacuum cleaner is useable.

Technological Shelter

The shelter has been constructed to protect the reactor compartment against rain and snow precipitation and to allow associated works after the technological sheet of the pressure hull has been removed. The shelter looks like a metal structure mounted onto the submarine hull after the detachable sheet has been taken away. The roof of the shelter is detachable which enables to carry out works associated with lifting the dismantled equipment from the compartment and to use the unified reloading equipment. The shelter is connected to a power supply system that supplies electricity to portable instruments and devices, applied under associated works, and a lighting system.

At present the shelter equipment is disassembled. The restoration is carried out by the company performing associated works.

Power Supply System

The system provides electricity to energy consumers at all facilities used under core preparation to unloading and the SRC defuelling itself. The parameters of the energy are 380V, 50 Hz. This energy type is consumed by such power devices as pump, ventilator, winch engines and crane gears. Lighting systems and monitoring instruments have different parameters: 220V, 50 Hz.

Most of the energy is transmitted through a power transmission line and distributed to separate consumers by distribution devices.

A standby power source comprises three 500 kW diesel generators. When the SRC is being unloaded the diesel generators are constantly ready for start-up. In case of energy failure the diesels switch on and the facilities are switched over to the standby source.

Earlier 400V, 400 Hz power was required when the submarines were fit for operation. At present the submarine energy networks are not powered, and when the works are carried out in the reactor compartment a temporary lighting network is mounted. It facilitated work related to preparing a power supply system as there is no need to repair high frequency commutators and power network.

The power supply system at the storage site is assessed as satisfactory. The operational maintenance activities are carried out that will allow receiving a permission from the Russian Supervision Authorities to unload the cores.

Gas Supply System

A peculiarity associated with core and LMC management is a necessity to maintain a neutral medium at all the facilities (the sliding carriage, the unloading cask, the 1A storage), where the works are performed. That is why at particular work stages certain systems and volumes are blown with nitrogen as a neutral gas. It fills the reactor, safety and control system gears and other volumes.

A gas supply system is used to supply gas to the above-mentioned facilities. It consists of nitrogen cylinders interconnected with pipes, which, in their turn, join each other to form a common pipeline. It is through that pipeline that nitrogen is supplied through detachable service connections.

Nitrogen generation plant is not available now; therefore, suppliers will deliver nitrogen in pressure tanks.

3. Justifications for the Urgency of the Project on Preparing SRC Unloading Infrastructure

The main factors determining the urgency of the project on preparing the infrastructure for unloading the cores are the technical state of the submarines, the condition of the unloading complex and the availability of qualified staff resources.

The physical state of the Alpha-class submarines deteriorates year by year. Reactor installations on the submarines are safe; however, maintenance of the submarines afloat is a matter of permanent concern. The issue is a serious one since the submarines have to cover a considerable distance by sea to have their reactor cores unloaded. The operation in question is rather hazardous.

The long-term radwaste and spent fuel storage site in Gremikha is the only one in the Russian northwest, where reactor cores can be unloaded. At present a great amount of preliminary work has been done at the main supporting facilities. The rest of works will be completed in 2004. By that it will be possible to make conclusions concerning the readiness of the complex for the SRC unloading.

This event should be considered essential for the unloading operations. However, when the repairs have been completed, it does not mean that the devices will not require maintenance and care in the future. Most of the equipment, tools and devices have been used for a longer period of time than their service life. They were repaired under preparation for core unloading, but old parts were only partially substituted for new ones. According to Russian safety regulations repaired devices should be examined by specialised companies more often than new machinery. If inter-repair time for new components varies between 5 and

10 years, thoroughly repaired devices should undergo regular checkups every 2 to 3 years. Therefore, postponement of unloading results in increased funding of their maintenance.

Staff resources to support reactor core unloading are insufficient. Unfortunately, the situation is complicated by the fact that the Governmental Programme for Resettling the Population is applied in the Gremikha region. All the staff at the site is queuing for accommodation in other parts of Russia. In case they obtain lodging in the centre of Russia, two or three years later there will be no experts who took part in unloading before. A worthy substitution is practically impossible. Therefore, it should be noted that it would be feasible to start the work in the immediate future.

The Russian Minatom has currently spent several million Euros to prepare spent reactor cores for unloading.

The analysis of the three factors determining the urgency of the SRC unloading makes it evident that the most suitable time to start the activities is the year 2005. Here there may be several options to unload the cores from three vessels:

- one SRC a year;
- all the cores in 2005;
- two SRCs in 2005 and dockage of the last submarine to have the SRC unloaded in 2006.

Each option has its strong and weak points. Their discussion and choice of the main one, estimated costs and cost effectiveness can be an aspect for joint international cooperation in the project.

4. Works and Activities to Be Carried Out before Unloading Spent Reactor Cores

Infrastructure preparation for SRC unloading has been a top-priority aspect of the Russian Minatom's activities since 1999. To supervise work progress a coordination centre has been established at NIKIET to plan and analyse work progress in all sectors, to coordinate activities of organisations participating in preparation for SRC unloading and to work out Minatom leaders' decisions concerning all burning issues.

The issues regarded above mainly concerned engineering matters. The consideration of the SRC unloading project will be incomplete if we do not mention a number of issues addressed at the present period, which lay the foundation for an overall plan annually approved by the Russian Vice-Minister of Atomic Energy.

The first and foremost aspect certainly deals with the preparation of engineering supporting facilities. The next issue of no less importance is the state of documentation concerning SRC unloading. The third and crucial under any circumstances is the human factor or, to be more precise, availability and qualification of the staff. The last set of issues concerns organisation.

When the four sets of issues have been addressed, the organisation will ensure the SRC unloading.

Below are time schedules for completing the principal work activities.

Time Schedule for Preparing Engineering Facilities

Ref. No.	Description	2003	2004				2005	
		IV quarter	I quarter	II quarter	III quarter	IV quarter	I quarter	II quarter
1.1	Hoist units preparation	■	■	■				
	Crane preparation							
	Crane rails preparation	■						
1.2.	All-purpose refuelling equipment preparation	■	■	■				
1.3.	SD-10 dry dock preparation	■	■	■	■			
1.4.	Heating source preparation	■	■	■				
1.5.	Preparation of the storage facilities for work activities:							
	Building 1B	■	■					
	Building 1A							
	Unloading control console			■				
	Radiochemical laboratory		■	■				
	Core storage facility	■						
	ARE storage technological facilities			■				
1.6.	Systems preparation:							
	ARM system preparation	■	■	■				
	Communication system			■				
	Information system		■	■				
	TV monitoring system		■	■				
	Power supply system	■	■	■				
	Fire alarm system in facilities	■						
	Control system modernisation	■						
1.7.	Technological shelter							■
1.8.	RMK and FVA restoration	■						
1.9.	First-aid point repair			■				
1.10.	Supplies of materials and machinery					■	■	

Time Schedule for Documentation Preparation

Ref. No.	Description	2003	2004				2005	
		IV quarter	I quarter	II quarter	III quarter	IV quarter	I quarter	II quarter
1.	Regulations on unloading complex							
2.	TOB (technical safety justifications) preparation							
3.	OVOS (environmental impact assessment) preparation							
4.	Plan on AS confinement and elimination							
5.	Documentation inventory layout							
6.	Techniques of carrying out operations							

Time Schedule for Staff Education/Training

Ref. No.	Description	2003	2004				2005	
		IV quarter	I quarter	II quarter	III quarter	IV quarter	I quarter	II quarter
1.	Recruitment							
2.	Development of training/education programmes for:							
	Physicists							
	Managers, operators, mounters							
	SRC Unloading complex workers							
3.	Working out a time schedule for training/education							
4.	Education/training							
5.	Workers admission							
6.	Admission of non-regular staff							

Time Schedule for Addressing Organisational Issues

Ref. No.	**Description**	**2003**	**2004**				**2005**	
		IV quarter	**I quarter**	**II quarter**	**III quarter**	**IV quarter**	**I quarter**	**II quarter**
1.	Work follow-on							
	Fire safety							
	Medical safety							
	Radiation safety							
	Safety ensuring in engineering accident situations							
	Hazardous facilities maintenance							
2.	Licensing (Risk insurance)							
3.	Preparedness inspection by an interdepartmental commission							

Overall Time Schedule

Ref. No.	**Description**	**2003**	**2004**				**2005**	
	Preparation of:	**IV quarter**	**I quarter**	**II quarter**	**III quarter**	**IV quarter**	**I quarter**	**II quarter**
1.	Engineering supporting facilities							
2.	Documentation							
3.	Staff							
4.	Addressing organisational matters							

Project Description

When considering a set of issues dealing with preparing infrastructure for the SRC unloading it can be concluded that a joint cooperation might be started in any sector.

Preparation of the Engineering Supporting Facilities

At the end of the current year and early in the next year the work will be focused on installing the heating source, preparing the MK-75/20 bridge crane for work with discharging cargo, repairing and equipping the radiochemical laboratory, mounting of the automated radiological monitoring system and the TV monitoring system.

Documentation Preparation

An objective appraisal of the state of documentation required ensuring unloading activities demonstrate that the majority of the documents are already available. However, such documents as the *Environmental Impact Assessment when Unloading Spent Reactor Cores* (OVOS) and the *Technical Safety Justifications for Spent Reactor Core Unloading* (TOB) are still under development. The OVOS is being worked out under the direction of IPPE, whereas OKB Gydropress is in charge of TOB development. Joint international cooperation is possible in this sphere on condition that the parties have been interested in the effort.

Staff Training/Education

This issue, similarly to those described above, is to be addressed by the Russian Minatom. These activities have produced tangible results: under the direction of the training centres at IPPE and OKBM (Nizhniy Novgorod) training programmes for all staff categories have been worked out. The training has not been held, and the process might be interesting for international partners.

Organisational Issues

As can be seen from the time schedule, organisational issues are to be addressed in the distant future since, e.g. the license can be applied for only on condition that the equipment has been repaired, the documentation has been prepared and the staff have been qualified and admitted to work. Nevertheless, preliminary arrangements for addressing organisational issues have already started. The arrangements confine themselves to defining organisations allowed to be in charge of corresponding supplies in compliance with the Russian legislation. The peculiarity here is that not every organisation is capable to implement its activities in back lands. Many of them will have to incur certain extra costs and SevRAO is calculating the amount of such costs required to ensure safe work implementation to define a sum that Minatom will allocate for these purposes. Therefore, it seems possible to discuss international cooperation in determining functions ensuring comprehensive accountancy when preparing to unload reactor cores.

Table 1 contains a list of probable joint international projects on SRC unloading.

Table 1

Ref. No.	Description	Cost, Euros, K	Implementation period
1.	Heating source	1,000	before August 2004
2.	ARM and TV monitoring systems	160	before 1st July 2004
3.	Radiochemical laboratory	181	before 1st July 2004
4.	MK-75/20 crane modernisation	195	before 30th May 2004
5.	TOB development	121	before 30th July 2004
6.	OVOS development	135	before 30th July 2004
7.	Staff training/education	152	before 30th August 2004
8.	Supply ensuring	667	before 30th March 2005

Project Status

Heating source: A boiler shop option has been selected, the design of boiler siting has been planned and approved, and the project peer review has been completed. What needs to be done: to develop working documentation concerning connecting the boiler shop to water, fuel, power, water discharge and steam systems. At present delivery and sitting of the boiler shop on the technical area can be discussed. Project status: implementation.

Automated radiation monitoring system: A system option has been selected, the system itself has been deigned and the installation design has been elaborated. The ARM system has been manufactured and rig tested. Project status: implementation.

Radiochemical laboratory: The laboratory cannot be equipped in any other place due to the peculiarity of activities to be performed. The liming of the rooms and systems under repair has been carried out. Cost estimates have been drawn. Part of the laboratory equipment has been purchased. The final scope of equipment documentation is under preparation for approval by supervision authorities. On the completion of equipping the laboratory complex certification is n to be done preceding permission for the laboratory use. Project status: implementation.

Modernisation of the MK-50/20 bridge crane: any other option for applying other hoist units appears unacceptable. It has been examined and assessed by the authorities after thorough repairs. However, the equipment supporting SRC unloading activities needs modernisation (the cable plume jumper, the consol for controlling the unloading cask equipment). In this respect the project is at a design development stage in compliance with the engineering conditions of carrying out the work agreed with the designer of the all-purpose refuelling equipment. This stage will be followed by implementation.

Technical Safety Justifications when Unloading Spent Reactor Cores: Requirements for the document have been developed and approved. The principal sections of the document are under elaboration after which it will be reviewed. Project status: implementation.

Environmental Impact Assessment for Spent Reactor Core Unloading: Requirements for the document have been developed and approved. The principal sections of the document are under elaboration after which it will be reviewed. Project status: implementation.

Staff training/education: Training variants for each staff category have been defined and training/education programmes have been outlined. SRC unloading managers are to be trained at the OKB and IPPE training centres and on-site, in Gremikha. Physicists will be prepared at the IPPE training centre, whereas ARE maintenance experts will be taught by OKBM instructors in Gremikha. Time schedule for 2004 is under completion. Project status: implementation.

Supply ensuring: Project status: development of project proposals for supporting organisations to be submitted to the Russian Minatom.

Design documentation

The major part of the design documentation concerning the implementation of each infrastructure preparation project is available. The principal documents in each project include:

- technical specifications;
- detailed design.

A Feasibility Study (TEO) for preparing the infrastructure for the SRC unloading is not required.

Project Participants

Before the construction, the documents have to be approved by the following authorities:

1. Ministry of the Russian Federation for Atomic Energy (Minatom)
2. The State Architectural and Construction Appraisal Board
3. The State Sanitary and Epidemiological Supervision Authority
4. The State Fire Inspection
5. The State Natural Resources Committee
6. The State Labour Protection Inspection
7. The State Supervision Authority for Safe Operation of Power Engineering Installations
8. The State Mining Inspection

The documents under development are to be approved by:

1. Ministry of the Russian Federation for Atomic Energy (Minatom)
2. The Federal *Medbioextrem* Authority, the Russian Ministry of Health
3. The State Nuclear and Radiation Safety Authority, the Russian Ministry of Defence
4. The State Natural Resources Committee
5. The State Mining Inspection
6. Administration of the Ostrovnoy Town
7. The Principal Authority for Emergency Situations

5. Conclusions

SRC unloading infrastructure will be ready to be put into operation in May 2005. The option of SRC unloading from all submarines depends upon the state and proper provision of the infrastructure.