Ex-post Evaluation of Cooperation Program for Construction of a Long-Term Storage Facility for the Reactor Compartment Units of Dismantled Nuclear Submarines in the Russian Far East

Summary Report

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Radwaste and Decommissioning Center

1. Outline of the program

Country	: Russian Federation
Name of the program	: Cooperation Program for Construction of a Long-Term Storage Facility for the Reactor Compartment Units of Dismantled Nuclear Submarines in the Russian Far East
Area	: Nuclear disarmament and environmental protection
Form of cooperation	: Provision of equipment
Program cost	: 4.494 Billion JPY
Implementation duration	: October 2009 – May 2012
Targeted organization	: State Atomic Energy Corporation ROSATOM DalRAO, Far Eastern Branch of RosRAO

1.1 Background of the program

After the end of the Cold War, most of more than 250 nuclear submarines (hereinafter referred to as “NS”) constructed by the Soviet Union have been decommissioned and they have been moored at the bases in Russian North West and Far East. But the dismantling of these decommissioned NSs has progressed slowly because of disorder arising after the collapse of the Soviet Union. In the Russian Far East, more than 70 NS have been decommissioned by the end of 1990’s. Many of these have been moored, while loaded with spent nuclear fuels, in the area near Vladivostok, on the opposite side of the Sea of Japan, or in the Kamchatka region. As such, prompt and safe dismantling of such decommissioned NS has become an urgent issue from the viewpoints of nuclear disarmament, nuclear non-proliferation and environmental protection.

Meanwhile, following the terrorist attacks in September 2001 in the USA, G8 countries launched the "G8 Global Partnership against the Spread of Weapons and Materials of Mass Destruction" (hereinafter referred to as “G8GP”) at the Kananaskis Summit in Canada in 2002.
They agreed to focus on assistance to Russia, which has been seen as a country with a high proliferation risk, and assigned the dismantlement of Russian decommissioned NSs as one of the highest priorities.

In dismantling decommissioned NSs, though it was recognized from the beginning that the reactor compartments are more preferably stored on land in terms of safety, they were stored afloat as a temporary settlement on the sea in a 3-compartment reactor unit (hereinafter referred to as “3CRU”). It is comprised of the reactor compartment, and the compartments in front and behind, which works as floating compartments, after water-sealing treatment.

However, in case of long-term storage afloat on the sea, there is a risk of accidents due to seawater corrosion and hydrographic conditions. Consequently, in approximately 2003, Russia has determined to promote on-shore storage, aiming at increasing safety and stability. They launched the construction plan of a long-term on-shore storage facility of reactor compartment units (hereinafter referred to as “on-shore storage facility”).

The Russian government decided to construct the on-shore storage facility at Cape Ustrichny, Razboynik Bay, Primorsky Krai in the Russian Far East. Since its construction was lagged behind that in the Russian North West at that time, the Russian Government requested support from the international community.

One such support request was for Japan to provide a floating dock, tugboat and two jib cranes (hereinafter referred to as "the equipment") necessary for operating the facility. On receiving the request, the Japanese Government decided in January 2007 to provide the equipment.

After the basic design of the equipment, the Committee on Cooperation to Assist the Destruction of Nuclear Weapons Reduced in the Russian Federation (hereinafter referred to as "Japan-Russia Committee") and the State Atomic Energy Corporation "ROSATOM" signed the Implementing Arrangement on launching the Cooperation Program for Construction of a Long-Term Storage Facility for the Reactor Compartment Units of Dismantled Nuclear Submarines in the Russian Far East (hereinafter referred to as "program" to provide the equipment. The Implementing Arrangement was signed when Prime Minister V. Putin (at that time) visited Japan in May 2009. Figure 1 shows how the implementation structure of the program was organized.

1.2 Description of the program

This program includes provision of one floating dock, one tugboat and two jib cranes, necessary for operating the on-shore storage facility to be constructed in Razboynik Bay.

Purposes of the equipment are as follow;

- Floating dock for docking and lifting the 3CRUs from the sea to the shore pad
- Tugboat for towing the 3CRUs to the floating dock, as well as supplemental work such as berthing of the floating dock and maintenance of 3CRUs during waterborne storage.
- Two jib cranes (32/5 ton and 10 ton) for loading scrap metal, generated when forming a single CRU from 3CRU, to the transportation ship.

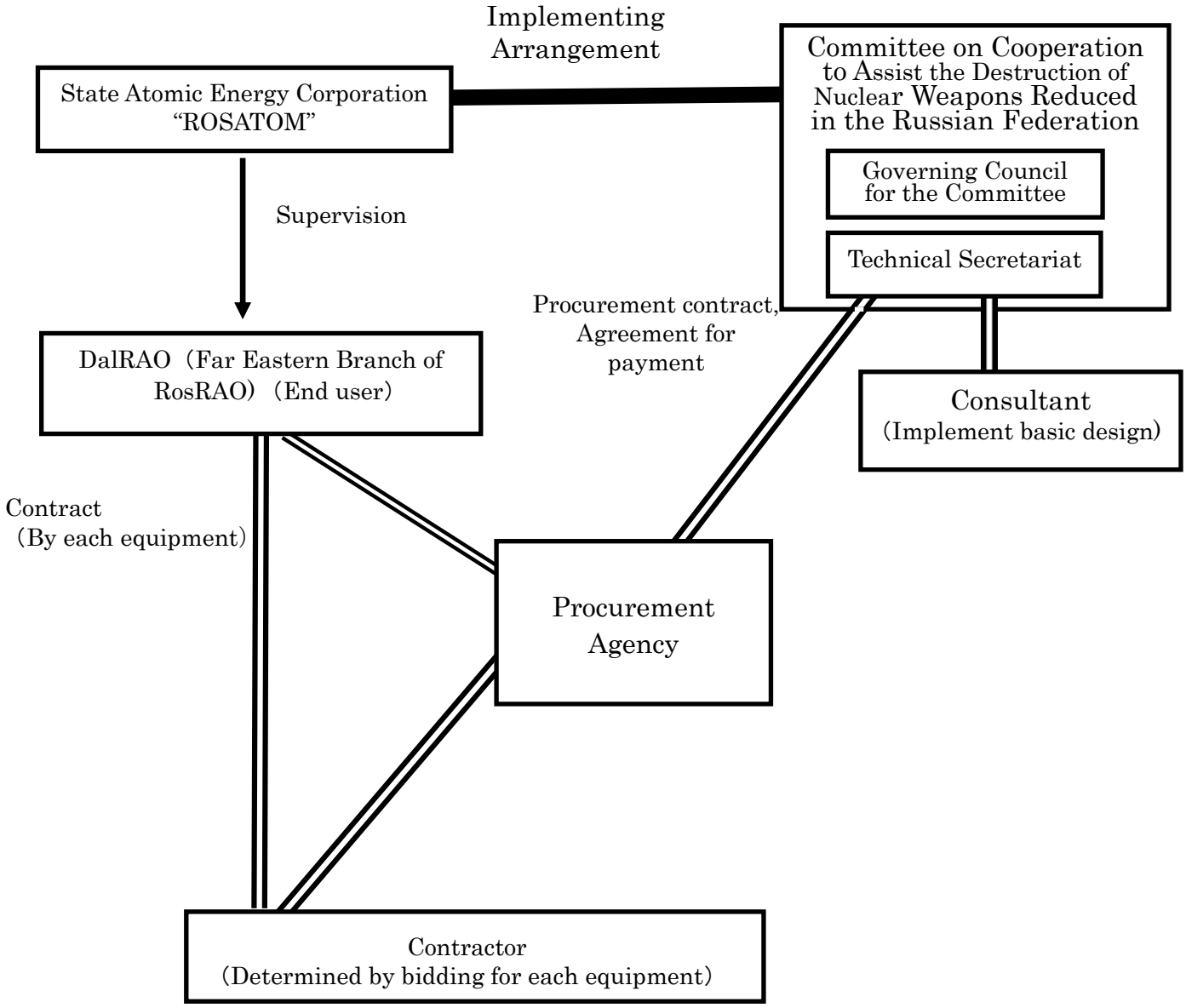
The basic design of the equipment was conducted by the consultant. The Technical Secretariat called for bids to select a procurement agency to cover procurement of the equipment through a bidding process (in October 2009).

The procurement agency worked on the details of the draft contract and specification with the end user, DalRAO. Then the procurement agency called for bids for each item and concluded contracts among three parties, including DalRAO.

Contractors, descriptions, delivery months and costs of the provided equipment are shown in Table below. The outlook of the equipment is shown in Figure 2.

Table Description of the provided equipment

	Floating dock	Tugboat	Jib crane	
Contractor	Fuji Kaiji Kogyo Co., Ltd.	Kitahama Zosen Tekko Co., Ltd.	IHI Transport Machinery Co., Ltd.	
Description of equipment	Length : 76 m Width : 34.1 m Depth max.: 22.1 m Capacity : 3500 t Draught : 20.8 m	Length : 21 m Width : 6.6 m Capacity : 92 t Towing capacity : 8.4 t Speed : 9.5 kn Main engine power : 386 kW (524 HP x 2)	① 32 ton crane ・Nominal load x radius : 32 t × (8-17) m (32-16) t × (17-30) m ・Lifting speed : 0 - 7 m/min (5ton hoist: 8 m/min)	② 10 ton crane ・Nominal load x radius :10 t × 8 m (Min.) 10 t × 30 m (Max.) ・Lifting speed :0 - 21 m/min
Delivery month	May 2012	July 2011	November 2011	
Cost	2.538 B JPY	0.35 B JPY	1.27 B JPY	



* It consists of representatives of the Japanese and the Russian governments. The Japanese Ambassador to Russia and Deputy President of ROSATOM were representatives for each side at the project implementation.

Note) RosRAO is a subsidiary of ROSATOM that specifically involves radioactive waste treatment. DalRAO is a Far-Eastern Branch of RosRAO.

Figure 1 Implementation structure of the Cooperation Program for Construction of a Long-Term Storage Facility for the Reactor Compartment Units of Dismantled Nuclear Submarines in the Russian Far East

Figure 2 Provided equipment (Floating dock, Tugboat and two Cranes)

2. Outline of the ex-post evaluation

2.1 Objective of the ex-post evaluation

The objective of this evaluation is to review and assess the level of achievement of the program goal, status of operation, and maintenance of the provided equipment comprehensively based on the five evaluation criteria of the OECD/DAC*. The evaluation also provides recommendations and lessons learned for future activities.

* Organization for Economic Co-operation and Development, Development Assistance Committee (OECD/DAC)

2.2 Procedures and criteria for the ex-post evaluation

2.2.1 Evaluation Procedures

The evaluation took the following procedures;

(1) Collection and compilation of information
(2) Preparation of evaluation table
(3) Preparation and sending of questionnaires
(4) Site visit
(5) Assessment
(6) Lessons learned and recommendation

2.2.2 Criteria for evaluation

The assessments are based on the 5 evaluation criteria of the OECD-DAC. These assessment criteria are shown below for each evaluation item.

(1) Relevance

The program has met policies and needs in addressing nuclear legacy issues of the Russian Government, has been consistent with other denuclearization programs by the Japanese Government, and has been in concert with efforts by the international community such as G8GP.

(2) Effectiveness

The equipment have been operated and the on-shore storage has been implemented in accordance with the plan. The work has been operated safely, considering radiological and industrial aspects.

(3) Efficiency

Program duration and program cost of the equipment have been in accordance with a plan and a series of work, such as: manufacturing, transportation, on-site installation, test operation, personnel training and licensing. All have been implemented under appropriate management. Preparation for on-site infrastructure and securing operators for the equipment have been appropriately conducted by DalRAO.

(4) Impact

Does the program have a direct or indirect influence on actions/programs by the Russian Government and by other donors and does it have adverse effects on environment? What was the response of the on-site stakeholders to the construction and operation of the on-shore storage facility? Did the program have positive effects on the local economy?

(5) Sustainability

The issues here are: whether the maintenance system, such as regular inspection and maintenance, has been established to maintain functions of the equipment including antifreeze measures during midwinter, skillful engineers have been trained and allocated to work, regular inspections have been provided, required parts have been secured, appropriate financing has been ensured for the continued operation of the on-shore storage, and whether future demand is expected.

3. Results of evaluation

3.1 Relevance

This program can be judged to have met the policies and needs of the Russian Government in addressing nuclear legacy issues in the Russian Far East, and is consistent with efforts in the denuclearization cooperation programs by the Japanese Government, as well as has been implemented effectively in concert with efforts by the international community. Therefore, this program is assessed to be highly relevant. Below is the assessment result for each item.

3.1.1 Consistency with the policies and needs of the Russian Government

This program has met and is consistent with the policies and plans in addressing nuclear legacy issues, guidelines for the safe handling of the reactor compartments of NS, and plans for the construction of the on-shore storage facility by the Russian Government.

3.1.2 Consistency with efforts taken by the Japanese Government

The program can be assessed to be consistent with the basic efforts taken by the Japanese Government for nuclear disarmament and nuclear non-proliferation in former Soviet Union countries. It is also deeply related to objectives of the assistance programs such as the Cooperation Program for Dismantling Decommissioned Russian Nuclear Submarines "Star of Hope" to assist Russia to solve nuclear legacy issues.

3.1.3 Consistency with efforts by the international community

The program is included in the areas to which the G8GP is committed to financially support Russia, which promotes integrated NS dismantling aimed at preventing the spread of weapons of mass destruction. Therefore, the program can be assessed as being conducted in concert with the efforts by the international communities, such as the G8GP and the CEG*.

* Contact Expert Group: A forum consisted of experts, established to coordinate cooperation with Russia at the seminar "International Cooperation on Nuclear Waste Management in the Russian Federation", organized by the IAEA.

3.2 Effectiveness

In the program, works such as lifting the 3CRUs from the sea, the formation of single CRUs and their storage work, have mostly progressed in accordance with the goal. In addition, the equipment has operated smoothly without any significant trouble, and a safety management structure has been established for the on-shore storage facility. Therefore, the program is judged to be highly effective.

3.2.1 Achievement level of the goals of work within the Program

The equipment has been used as an important one in the work at the on-shore storage facility, and played an important role in effective implementation of the on-shore storage program. Fourteen single CRUs and three storage containers of nuclear service ships were stored at the time of the site visit. Figure 3 shows the on-shore storage.

It was found that DalRAO has significantly increased its dismantling capacity of 3CRU to 12 units per a year. It has a plan to move all 76 3CRUs, which were in waterborne storage, to the facility by 2020. Therefore, the level of achievement can be assessed highly.

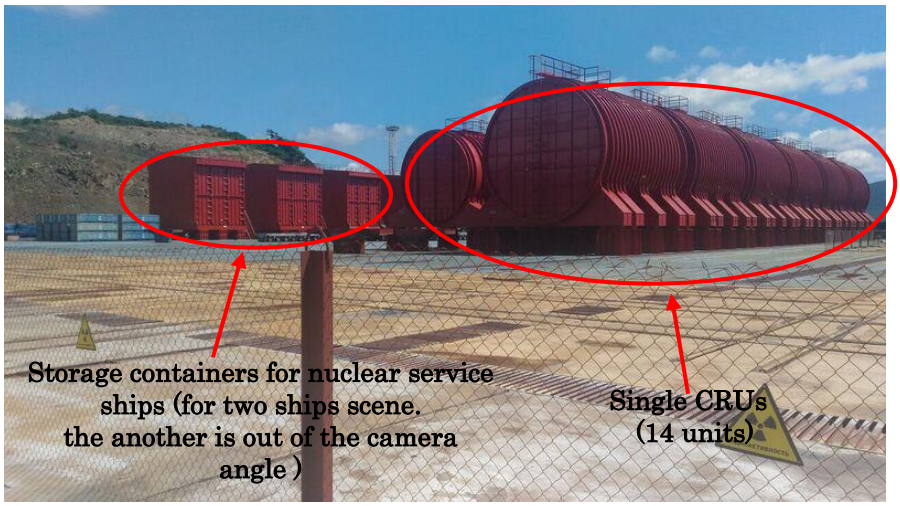


Figure 3 On-shore storage: Single CRU and storage containers for nuclear service ships (Photo at the site visit)

3.2.2 Operation status of the equipment

On-shore storage of single CRUs has progressed in accordance with the plan. The inspection at the site visit made it clear that the equipment has been used not only for the on-shore storage of 3CRUs, but also for on-shore storage containers of dismantled nuclear service ships. Thus, the provided equipment has been sufficiently utilized for the on-shore storage.

Except for the 32-ton jib crane, the equipment encountered no significant trouble. The 32-ton jib crane had a failure of the load limiter in the 5-ton hoist. It should be noted that the procurement of a load limiter is in progress, but there was no substantive impact on work because an alternative measure was taken, using the two-ton truck crane.

3.2.3 Safety management of the work

The safety management of the work was properly done based on the fact that the radiological and industrial safety management was provided for the on-shore storage works according to the specified management manual. Safety education and training were provided to all employees regularly, and a work qualification system was introduced for the operators. Thus, it was judged that safety management was adequately provided.

3.3 Efficiency

The proper procurement management was provided during manufacturing the equipment, and the equipment function and performance has been maintained since the handover. DalRAO effectively prepared site infrastructure and secured personnel necessary for the equipment. The procurement agency, the contractors and DalRAO effectively resolved the technical problems (difficulties) that took place after each of the equipment was transported to Russia. Consequently, the program period of the tugboat

and the cranes were as planned. For the floating dock, though the delivery was extended due to the repair work of a deformation found just before the delivery, the dock was delivered by the time of the start of operation of the on-shore storage work scheduled after the harbor ice of Razboynik Bay had melted. Below is the assessment result for each item.

3.3.1 Procurement of the equipment

The procurement agency inspected the manufacturer of the equipment at appropriate stages. The results of the inspections indicated that the equipment had functions and performances specified in the contract documents and the specifications, and that the appropriate process management was provided to minimize the impact of the Great East Japan Earthquake. Education and training of operators had been conducted properly for each piece of equipment before its delivery. Thus, it was judged that the procurement management of the equipment was proper.

3.3.2 Russian preparation in the reception of the equipment

DalRAO has completed the preparation for the infrastructure, such as the pier for the floating dock, the underwater seats, and the rail foundation for the crane and securing operators necessary for the operation before reception of the equipment. It was judged that Russian side preparation was quite good.

3.3.3 Program period

The tugboat and the jib cranes were transferred smoothly to Nakhodka, an entry port. The delivery to Razboynik Bay, however, had been suspended until the permit was finally issued by the border authorities.

For the floating dock, a deformation was found at the pontoon deck during the submerging operation at Razboynik Bay site. The cause was considered to be incorrect way of ballasting. The delivery was extended from the original schedule. The repair and reinforcement work for the deformed part was started in December 2011 and completed in January 2012. But the submerging operation could not be conducted because of frozen seawater in the bay due to extraordinary cold weather for the first time in 15 years. As a result, a period was considered to be the period of Force Majeure. The contract was extended approximately six months in total. The submerging operation was conducted in May 2012 after ice in the bay melted, and test of the floating dock was passed. The equipment was delivered to DalRAO in the same month.

Despite the troubles mentioned above, the equipment has been delivered in time for the start of operation of the on-shore storage facility. Thus, almost no substantial delay occurred.

3.3.4 Program cost

The budget was executed in accordance with the procurement management plan.

3.4 Impact

The floating dock has also been used for lifting nuclear service ships from the sea. The operation that the 3CRUs lifted from the sea by using the floating dock has influenced the operation in the on-shore storage program in the Russian North West. The equipment, together with the transport equipment provided by Germany, has had a synergistic effect on the transportation of the 3CRUs. The presence of the on-shore storage facility has had a positive effect on the local economy, such as an increase in employment and in revenues of participant companies in the city of Fokino. Thus, a positive impact has been observed. Below is the assessment result for each item.

Figure 4 Nuclear service ship in the floating dock (stern showing out of the floating dock)

3.4.1 Effects on other actions and programs

The equipment has been utilized in other activities of the integrated NS dismantling program in Russia. The examples include the floating dock was utilized in lifting from the sea the three decommissioned nuclear service ships, which are longer than the dock, and the operation method in the Russian Far East has been employed in the Russian North West in which a single CRU was formed after one 3CRU was docked and lifted. In addition, this program has had a synergistic effect such as in the on-shore storage facility ;Germany, in conjunction with this program, has provided the transporting equipment on land and engaged in technical cooperation. Thus, it was judged that the spillover effect of this program was significant.

3.4.2 Whether there is adverse effects on the natural environment

Contamination, especially by bilge water generated in the ships and sewage, could be an adverse impact of operation of floating dock and tugboat on natural environment. But according to a visual inspection at the site, no bilge water was observed in the tugboat

and floating dock. The sewage and wastewater from toilets were stored in the tank temporarily and transported to the harbor and then treated ashore. Thus, it was judged that proper measures were taken against sea contamination.

3.4.3 Other impacts

DalRAO has made sufficient efforts to obtain the understanding of the local community on the provision of the equipment. Positive impacts of implementing the on-shore storage program on the local economy were observed, such as promotion of local employment, increase in the income of participant companies, and tax revenue in the city.

3.5 Sustainability

In order to implement the on-shore storage program of single CRUs, DalRAO has maintained the equipment appropriately, as well as has provided operators with education and training to maintain their skills. They have established an industrial safety system, including radiological safety, headed by the president.

The Russian government, by establishing the national program that specified the completion of the on-shore storage at the Razboynik Bay site by 2020, has continued to make efforts to prepare and expand the infrastructure necessary for the facility after completing of the delivery of the equipment. It was confirmed that the Russian government has plan to utilize the equipment for on-shore storage work for NSs which will be retired in future. Below is the assessment result for each item.

3.5.1 Maintaining the function of the equipment

The inspection has indicated that the function of the equipment and the skill of operators has been maintained well, under the management and training systems. Thus, it was assessed that the function of the equipment used in the on-shore storage work will be maintained in the future.

3.5.2 Maintenance status

Inspection and maintenance have been provided regularly to the equipment. Safety education and operator training have also been implemented regularly. Thus, the equipment was assessed to be effectively inspected and maintained to continue their safe operation in the future.

3.5.3 Budgetary measures

The inspection during the site visit made the Russian implementation cost for construction of a long-term storage facility clear, but it did not make clear the specific budgetary plan. However, we think that the budget would be appropriated, though there is uncertainty regarding economic effects. This is because the national program states that the dismantling of all 3CRUs in the waterborne storage will be completed by 2020. Even after 2020, the budgetary arrangement for dismantling newly retiring NSs will be possibly taken into account by the Russian government.

3.5.4 Future demand for the equipment

Inspection during the site visit indicated that the demand for using the equipment is

expected to continue until the completion of the on-shore storage of all 3CRU in the waterborne storage in the Russian Far East, including the Kamchatka region.

As stated in section 3.5.3., the equipment is expected to be utilized effectively beyond 2020, to the extent that the rest of operating NSs are decommissioned.

4. Lessons learned and recommendation

Lessons learned through the program are summarized below.

Lesson 1

Example to shorten the on-site construction period:

In this program, the jib crane was manufactured and assembled at Kure, Hiroshima, and sent to the site using a large barge as a unit as completed, to avoid possible procurement risks in Russia such as time consuming custom clearance of crane components and subcontracting of the assembling works to unskilled locals entities. This approach allowed the procurement agency to keep up with the onsite construction schedule.

This might be a good practice to minimize the risk associated with the construction at the site where limited information is obtained about procurement condition.

Lesson 2

Example of importance of regular inspection:

During monthly inspection a problem was found on a load limiter of 5-ton hoist of the 32-ton jib crane at the regular inspection. It suggested the validity of the preventive maintenance system and its implementation method. It would be a good example that showed the importance of regular inspection to ensure the functions and performance of the equipment.

Lesson 3

Support of supply of important parts:

The DalRAO confirmed that they had trouble in procuring some foreign-made components that are critical for operation of the equipment, such as the load limiter of the 5-ton hoist.

Upon the delivery of the equipment it is therefore necessary to provide the end-user with appropriate guidance on preventive maintenance including supply routes of indispensable components.

Lesson 4

Thorough instruction on handling method of equipment:

The deformation was found at the pontoon of the floating dock when it was subjected to the submerging operation at the site. The program period was extended for its repair. Contactor suggested that direct cause of the deformation was an incorrect way of ballasting.

When significant damage may be anticipated by mistakes in operation, it should be

notified or attended to at the delivery. In parallel, it should be described in the operation manual and provided with sufficient instruction to operators of the end-user.

Even when serious risk cannot be excluded by possible human error, measures should be taken in advance in the system so that operation mistakes do not lead to significant problems.

Lesson 5

Delivery in the area where entry is restricted:

Problems occurred in the delivery of both tugboat and jig cranes. After the tugboat sailed into the Nakhodka port, it took long time (nearly one month) to be permitted by relevant authority for the transfer of the tugboat to the site at Razboynik Bay. A permit was also not issued to the barge that loaded the jib cranes because of the foreign ship flag. It took also a long time to be cleared to sail.

If delivery is made to the area where entry is restricted, it is extremely important to investigate sufficiently in advance the responsible authorities and permit conditions and delivery route or required permit, etc. If no clear prospect was obtained on gaining the permit, the delivery at the entry port should be considered as one of options, as the case of provision of tugboat in this program.

Recommendation

Information exchange with regional centers

Radioactive solid waste generated in forming the reactor compartment units will be treated by decontamination, volume reduction, and waste conditioning, in regional centers to be constructed nationwide in Russia. According to the explanation by Russians during site visit, radioactive treatment technologies developed by Russia will be used in the centers. Since there is no concentrated waste treatment center in Japan, like the regional centers in Russia, information on the center may be useful and significant for Japan with respect to the concept of facilities and operation methods. It is considered useful to establish a continued collaborative relationship through information exchange of future plan of facility and system design, and exchange of technologies with respect to developed Russian technologies. Therefore, the information exchange between waste treatment development sections in Japan and regional centers is recommended.