

**Technical Secretariat of the Committee on Cooperation
to Assist the Destruction of Nuclear Weapons Reduced
in the Russian Federation**

**Ex-post Evaluation on the Provision of the Floating Facility
“Suzuran” for Processing Low-level Liquid Radioactive
Waste**

(Summary)

September 2, 2008

**Radioactive Waste Management and Nuclear Facility
Decommissioning Technology Center**

1. Outline of the Cooperation Scheme

Country:	Russia
Name of the scheme:	Provision for Russia with the Floating Facility for the Processing of Low-level Liquid Radioactive Waste (LRW) “Suzuran”
Form of cooperation:	Provision of systems
Total cost:	4.146 billion Yen
Project duration:	August 16, 1994 – November 22, 2001
Relevant organizations:	Ministry for Nuclear Energy of the Russian Federation (MINATOM) (currently the State Atomic Energy Corporation “ROSATOM”) Zvezda Shipyard
Other related assistance:	Japan-Russia Cooperation to Assist in the Destruction of Nuclear Weapons, Program for Dismantling the Decommissioned Nuclear Submarine “Star of Hope” (2003 -)

1.1 Background to the provision of the “Suzuran”

In 1993, Russia announced that it had dumped radioactive wastes into the Sea of Japan, the Russian Far East region, which caused serious concerns about radioactive contamination of the Sea of Japan. Against the background of this social situation, the “Suzuran” was provided to Russia based on the Implementing Arrangement concluded between the Committee on Cooperation to Assist the Destruction of Nuclear Weapons Reduced in the Russian Federation (hereafter referred to as “Japan-Russia Committee”) and MINATOM.

1.2 Description of the “Suzuran”

- (1) Dimensions: Barge with length 65m, width 23.4m, height 6.6m and draft (max.) 3.5m (displacement of 5,000 tons)
- (2) Maximum activity of LRW to be received: Low-level liquid radioactive waste (3.7×10^5 Bq/liter)
- (3) Radioactivity concentration of effluent water: Less than the exemption level specified in the Sanitary Regulations on Handling Radioactive Wastes
- (4) Throughput capacity: 7,000m³ /year (design value)

(5) Handover: November 2001

For this cooperation scheme, Russia made available LRW transport container ships and a solid radioactive waste storage facility. Russia also allocated required personnel, conducted their training and funded for operation and maintenance of the facility.

2. Description of the Ex-post Evaluation

The ex-post evaluation was conducted according to the five evaluation criteria of the Development Assistance Committee (DAC).

2.1 Evaluation Method

The evaluation method consists of collecting relevant documents on the provision of the “Suzuran” and interviewing parties concerned. In preparation for the ex-post evaluation, the overall goal, project purpose and outputs of the provision of the “Suzuran” were outlined as shown below.

(1) Overall goal

To eliminate sea dumping of LRW generated from dismantling of nuclear submarines and other sources into the future

(2) Project purpose

To provide Russia with a LRW treatment facility to properly process low-level LRW generated from dismantling of decommissioned nuclear submarines in the Russian Far East and other sources

(3) Outputs

(a) Sea dumping of radioactive waste has been stopped.

(b) Russia has ratified international treaties, including the London Protocol 1996, and developed domestic laws and regulations consistent with international standards.

(b) The dismantlement of nuclear submarines has made a significant progress.

(c) Refined effluent processed at the “Suzuran” has been discharged.

2.2 Outline of the Site Visit

(1) Survey team: Radioactive Waste Management and Nuclear Facility

Decommissioning Technology Center

(2) Survey period: June 15, 2008 – June 22, 2008

- (3) Type of survey: Ex-post evaluation

2.3. Organizations and Facilities Concerned

- (1) FSUE Zvezda Shipyard
- (2) FSUE DalRAO
- (3) Federal Medical and Biological Agency (FMBA)

3. Findings

3.1 Findings based on the DAC's Five Evaluation Criteria

Described below are the findings obtained based on the DAC's five evaluation criteria.

(1) Relevance

The provision of the "Suzuran" is considered to be relevant for the following reasons.

- a. Response to changes in Russian needs after starting the construction of the "Suzuran"

The "Suzuran" was constructed as a barge-mounted floating-type facility according to a strong request from the Russian side. In response to revisions of laws and regulations during the construction, systems (in particular shielding systems) were modified accordingly and the waste treatment process was improved to meet safety standards.

- b. Relevance of the construction costs and increased construction costs and delayed construction schedule due to modification of systems and other reasons

The total cost for the "Suzuran" was 4.146 billion Yen (3.105 billion for construction, 1.008 billion for consultation and other items including the preliminary surveys and dispatching of experts). The increase in the construction cost was 0.59 billion Yen and the delay in the schedule was around three and a half years. This was mainly due to the modification of the key systems in accordance with the revision of laws and regulations (see above (a)) and the stop of work accompanied with the modification. However, the above modification seems to guarantee the current constant operation of the

“Suzuran”.

c. Relevance of the design-base throughput capacity of the “Suzuran”

The design-base throughput capacity of the “Suzuran”, 7,000 m³/year, was determined by the Governing Council of the Japan-Russia Committee with a view to prompt processing (within one year) of low-level LRW (about 2,250 m³), which had been stored in the Russian Far East as well as LRW, which would arise from the dismantling of nuclear submarines by around 1998, the initially planned start of the LRW treatment operation. The throughput capacity based on such a principle might seem to be too large from a purely technical viewpoint, especially in the context of optimizing throughput capacity for processing systems. On the other hand, there is a significant difference between LRW generated from the dismantling of nuclear submarines and other wastes produced in conventional production processes. The former is generally difficult to characterize and the generation rate is difficult to estimate, which would mean that the throughput capacity requires built-in redundancy for the safe and proper operation of the facility. It is also safe to assume that some circumstances may require dilution of LRW with higher radioactivity concentrations than in the design (This has been put into practice by the “Suzuran”). Therefore, the LRW facilities are usually designed to have a larger throughput capacity than would be required for normal operation.

d. Assessment of the “Suzuran” in Russia and Japan

It is generally recognized among the personnel involved that the “Suzuran” is a prerequisite for implementing the dismantlement of nuclear submarines in the Zvezda Shipyard and therefore is one of the largest contributors to the dismantling work. Key Russian persons also expressed their gratitude to Japan for the provision of the “Suzuran”, which seems to mean that they give high marks, both directly and indirectly for the “Suzuran”.

Newspapers in Vladivostok reported on the “Suzuran” and the Japanese assistance in the dismantling of nuclear submarines on the occasion of site visits by Japanese high-ranking officials. The views expressed in the articles are objective and generally favorable.

It appears that there has not been any mention of the achievements or results after the completion of the “Suzuran” in newspapers in Japan, but the implication is that they have a certain expectation that the “Suzuran” could stop the sea dumping of radioactive waste by Russia.

e. Change in risks associated with moored decommissioned nuclear submarines

Russian officials acknowledge that the complete work process of the nuclear submarine dismantlement has been achieved by the international cooperation - the “Suzuran” with Japan and the defueling facilities with the US.

Radiological risks in the region have thus been decreased due to the progress in dismantling of nuclear submarines, to which the “Suzuran” has made a significant contribution. The FMBA also recognized the above tendency and concluded that sources with potential risks of environmental pollution have certainly been reduced.

(2) Effectiveness

The provision of the “Suzuran” is considered to be effective based on the following facts.

a. Comparison between the operational capabilities of the facility and its achievements

According to the results of active commissioning and operation thereafter, the performance of the “Suzuran” has maintained the design specifications in terms of removal of radioactivity. The radioactivity concentrations of the liquid effluent are lower than the limit for discharge specified in the regulations on handling radioactive wastes. The “Suzuran” has not experienced any unplanned shutdown due to abnormal events. The cemented waste produced in the “Suzuran” is categorized as low-level solid radioactive waste (SRW). The radioactivity of the SRW is consistent with international transportation standards and ensures safety.

Actual annual processing volume of LRW is lower than expected in the original processing plan. However, this is not so much due to the system performance of the “Suzuran” but rather to the fact that the total volume of LRW generated

from nuclear submarine dismantlement has been smaller than planned. .

b. Utilization of the “Suzuran” for the treatment of LRW from other sources

There is a need in Russia to process LRW generated from the dismantling of retired nuclear submarines and nuclear-powered vessels in the future, and the “Suzuran” could meet this need.

(3) Efficiency

Efficiency in each stage, from the decision to provide the “Suzuran” to the handover, is difficult to evaluate because of changing circumstances, but efficiency is considered to be appropriate from a long-term perspective for the following reasons.

The start of operation was delayed by three and a half years and construction costs were increased due to the repeated revision of Russian radiological safety standards and the associated modification in the design during the construction phase, the need to respond to the chemically and radiologically complex composition of LRW, the unfamiliar processing systems designed in the US, and the verification of system reliability. However, these measures contributed to establishing radiation protection systems for the public and workers in accordance with the new standards and to ensuring environmental preservation, including the marine environment. As a result, the “Suzuran” has been reliably operated with Zvezda’s own technologies without any significant problems at relatively low cost.

(4) Impact

Following positive impacts are observed:

a. Change in radioactivity in the Sea of Japan before and after the provision of the “Suzuran”

The radioactivity in the effluent discharged after treatment at the “Suzuran” is lower than that specified in the laws and regulations by a factor of 100-1000. There has been no significant release of radioactivity since the provision of “Suzuran”. The radioactivity in Bolshoi Kamen Bay has remained sufficiently below the control limit, which is even lower than the drinking-water level for the

city of Bolshoi Kamen. The radioactivity in the seawater is also lower than the control limit of the Zvezda Shipyard in two bays neighboring Bolshoi Kamen Bay. Radiological contamination of seawater in the Sea of Japan has been monitored at fixed points by the Japan Coast Guard and no abnormal data has been observed.

b. Role of the “Suzuran” in promoting the dismantling of nuclear submarines

The LRW treatment facility “Suzuran” is indispensable for dismantling nuclear submarines. At present, the Zvezda Shipyard intends to dismantle eight more nuclear submarines in the future and the LRW generated from these submarines will be processed in the “Suzuran”. In addition, the Zvezda Shipyard has a plan to dismantle nuclear powered vessels. Presumably, there will not be any significant technical objections to the treatment by the “Suzuran” of LRW generated from dismantlement of these vessels.

(5) Sustainability

Sustainability has been met for the following reasons:

a. Improvement of system performance, replacement of processing systems and procurement of spare parts

The “Suzuran” has not experienced any large-scale modification since it started operation. Engineers from the Zvezda Shipyard have achieved successful operation and LRW treatment that meet technical standards and safety regulations. Although some imported spare parts and consumables are expensive and take a long time to procure, types and replacement frequency of these spare parts have been identified progressively with the accumulation of the operation experiences.

b. Operation management, education and training of operators, procurement of funds for operation and maintenance of the “Suzuran”

Operating manuals of the “Suzuran” have been developed according to the Russian rules and regulations. Qualification process of the operators is based on education and training. A certificate (protocol) is only issued to an operator who passes the examination after receiving the education and training as

operator. Qualification in occupational safety follows the same procedure as that for radiological safety.

The operating costs of the “Suzuran” are funded by the Russian Government according to an ordinance of 1977. The operating costs in 2007 amounted to around 130 million Yen.

c. Record of safe storage and management of SRW

The cemented waste in 200-liter drums produced in the “Suzuran” from processing LRW is categorized as low-level SRW and is kept in storage. 60m³ of LRW, for example, will be solidified into 2 to 3 drums. No SRW has generated with radioactivity levels higher than low-level waste or exceeding the transportation standards.

3.2 Summary Evaluation

(1) The evaluation results for the DAC’s five evaluation criteria can be summarized as shown in the table below.

DAC’s five evaluation criteria	Judgment criteria	Result	Justification
Relevance	The “Suzuran” has been operated reliably; sea dumping has been stopped; dismantling of retired nuclear submarines has progressed; and both Japan and Russia acknowledge the contribution of the “Suzuran”.	Achieved	Meets the criteria
Effectiveness	The operating record of the “Suzuran” and the volume of LRW processed were as planned; and the “Suzuran” has been utilized appropriately.	Basically achieved	Volume of processed LRW remains the half of its throughput capacity.
Efficiency	The functioning and performance of the “Suzuran” have been maintained without any problem and are not affected by changes in international or domestic conditions; and there was no significant increase in operating costs.	Achieved	Meets the criteria

Impact	The nuclear submarine dismantling program has progressed; safety standards based on international standards have been established and observed; and no increase in radioactivity is observed in the Sea of Japan.	Achieved	Meets the criteria
Sustainability	Russia can operate the “Suzuran” safely and properly by itself; no obstacle is foreseen for cementation of LRW and safe storage of cemented waste; and issues affecting utilization during the service lifetime (20 years) and appropriate measures have been identified.	Achieved	Meets the criteria

(2) It is considered that the objectives of the “Suzuran” have been achieved in terms of DAC’s five evaluation criteria as shown in the above table.

The “Suzuran” is an essential prerequisite for the implementation of the program to dismantle decommissioned nuclear submarines “Star of Hope” by the Japan-Russia Committee. The “Suzuran”, combined with other assistances such as that of the US, has constituted important contribution to completing the work process of the nuclear submarine dismantlement at the Zvezda Shipyard, which encompasses the whole range of activities such as management of spent nuclear fuels and radioactive wastes.

The effluent water after processing in the “Suzuran” has been discharged to the sea at the radioactivity level lower than the limits recommended in the safety guidelines established by the international organizations with respect to radiation dose and radioactivity concentration. Thus, the “Suzuran” has greatly contributed to the preservation of the Sea of Japan.

It is confirmed that the “Suzuran” has properly processed LRW generated from the dismantling of nuclear submarines and is currently operating without significant problems under the Russian management, which would suggests sustained achievements of the provision of the “Suzuran” in the future.

4. Recommendations and Lessons Learned

The sustainability of the “Suzuran” has obtained a high mark and the urgent need

for follow-up has not been identified in the above evaluation. Therefore, recommendations described below primarily focus on medium- to long-term measures to be taken, in order to make current achievements of the “Suzuran” sustainable. Lessons learned are also drawn for the future Japan-Russia cooperation program.

4.1 Recommendations

(1) Continued monitoring of the operation of the “Suzuran”

It is desirable to share information between Japan and Russia on the operation of the “Suzuran” (details of significant problems, if any, and measures taken by Russia against them) and monitoring results for radioactivity in the ambient marine environment in order to sustain the effects of the provision of the “Suzuran”. To this end, periodical meetings should be held for technical information exchange between Japan and Russia.

(2) Effective utilization of the “Suzuran” in the period after completing dismantling of nuclear submarines

Since the dismantling of nuclear submarines in the Russian Far East is anticipated to be completed by 2010 with assistances by Japan and other countries if promoted smoothly, the need for the “Suzuran” as a processing facility of LRW generated from the dismantling of nuclear submarines will likely decrease gradually with a peak demand in the coming few years. In this regard, it would be recommended to consider processing of LRW generated from nuclear-powered vessels as one of the utilization options of the “Suzuran” after completing the dismantling of nuclear submarines.

(3) Provision of information on achievements of the “Suzuran”

Deliberations on the provision of the “Suzuran” were initiated by the disclosure of sea dumping of radioactive wastes by Russia, which drew a high level of attention domestically and internationally from the start. Therefore, it is recommended to actively announce the achievements of the “Suzuran” to a whole range of stakeholders concerned including Japanese taxpayers. Updates on achievements of the “Suzuran” should be provided on various occasions, including government-level international conferences, international technical conferences

etc. or on the website of the Technical Secretariat of the Japan-Russia Committee.

4.2 Lessons Learned

(1) Thorough risk analysis at the initial stage of the project

For the construction of large scale and complex facilities similar to the “Suzuran”, domestic regulations and standards of the recipient country as well as their deviations from international ones should be carefully studied at the earliest possible stage of a project, along with the subsequent risk assessment of their potential impacts on the procurement. If revision of domestic regulations is anticipated for complying with international standards and such a revision can cause significant changes to the design during the stage of construction/fabrication (large-impact events), one of the measures would be to design the performance of the facility in compliance with international standards from the initial stage. Such an approach could result in reduced cost and construction period.

(2) Periodical monitoring after handover

For facilities/systems whose primary indicators to measure achievements are its operation performances, it is important to agree on monitoring methods that would allow periodic collection of information on operation performances after the handover to the recipient country.

For similar projects aiming at environmental preservation, in order to assess the project impacts on surrounding environment quantitatively, it is desirable to establish objectively verifiable indicators during formulation of the projects: e.g. radiological monitoring data at fixed points in the neighboring sea area.

(3) Compilation of information relevant to project

The ex-post evaluation of the “Suzuran” was conducted more than 14 years after the conclusion of the Implementing Arrangement, which made it difficult to obtain sufficient information on details of the initial phase of the work on the “Suzuran” from parties concerned. For the efficient implementation of monitoring and/or ex-post evaluation, information on technical details as well as parties involved should be compiled comprehensively from the beginning of the projects.