

Demonstration Project for Seawater Purification Technologies

1. Requirements for Project Implementation

An implementation plan should be made based on the details of the demonstration implementation described below, and the functional conditions of the equipment installed for the demonstration should be confirmed using the basic conditions, and necessary information should be written in the relevant items in Form 3(1).

In addition, it is required to attend public conferences and to report on the implementation plan, progress, and results of the project. Also, upon completion of the project, a report on the implementation of the project must be prepared and submitted.

< Details of Demonstration Implementation >

In order to demonstrate the decontamination performance of the purification technology of seawater to remove mainly radioactive cesium, radioactive strontium, etc, demonstration tests must be carried out.

<Basic Conditions>

(1) Basic concept of the purification system

The technology must be capable of radioactive purification without pumping up seawater. Note: Regarding the removal of radioactive substances from seawater, the following methods are envisaged: Absorption of radioactive substances, aggregation and precipitation of radioactive substances, and others.

(2) View regarding the elimination goal

The proposal must specify a target for removal performance, assuming seawater with cesium 134 concentration between about 5 and 15 Bq/L, cesium 137 concentration between about 10 and 35 Bq/L and a total beta-emitter concentration between 100 and 1000 Bq/L.

(3) Concepts for maintenance

The proposal must include suggestions to reduce the maintenance frequency.

(4) Concepts for secondary waste

The proposal must include suggestions to reduce the secondary waste.

<Items for Additional Points>

(1) Elimination efficiency

Proposals with high performance in the elimination efficiency of radioactive substances will gain additional points.

(2) Sustainability of elimination effects

Regarding proposals that present views on the sustainability of the elimination performance proposed in purifying seawater, those with longer sustainability will gain additional points.

(3) Suppression of secondary waste generation

Regarding proposals that present views on the secondary waste generated in purifying seawater, those with a smaller volume of generation will gain additional points.

(4) Presentation of experimental data

Points will be added to proposals that are able to demonstrate their feasibility with experimental data regarding the basic conditions or additional point items. Extra points will be added for the data presented if they have already been published in a peer-reviewed form, such as in an academic conference or journal, etc. Furthermore, additional points will be gained by proposals which are expected to shorten the time period necessary for validation based on the presentation of experimental data.

<Goals and objectives>

Technical feasibility and validity of the items concerning the basic conditions and the additional point items are to be confirmed during the contract term.

2. Project Implementation Period/Subsidy Amount

From the Decision Date of Grant to March 31, 2015

In this project, it is planned that the demonstration of technologies will be carried out for the one-year period of FY2014.

3. Point Rating Method

The proposal will be scored based on the point rating described in Form 3(1). A proposal which does not meet all of the basic conditions shall not be selected.

The amount of the subsidy is a fixed amount, and its upper limit is 400 million yen. The details of implementation, the amount of the granted subsidy, and other details shall be decided by negotiation with METI and the Project Management Office.

[Basic conditions]

Details of the proposal	Allocation of marks (Basic points)
<p><u>(1) Basic concept of the purification system</u></p> <ul style="list-style-type: none"> ➤ The technology for radioactive purification without pumping up seawater is presented. ➤ The mechanisms to eliminate radioactive materials are concretely described. 	5
<p><u>(2) Target for the amount of elimination</u></p> <ul style="list-style-type: none"> ➤ The targets for the amount of elimination are presented for each radioactive material. 	5
<p><u>(3) Concepts for maintenance</u></p> <ul style="list-style-type: none"> ➤ The devices to decrease the frequency of the maintenance are concretely described. ➤ The sustainable periods of elimination efficiency are presented for certain conditions (e.g. tide condition, height of wave, and concentration of radioactive materials). ➤ The mechanisms to confirm the sustainable period are concretely described. ➤ The methods and the number of workers required for maintenance are concretely described. 	5
<p><u>(4) Concepts for secondary wastes</u></p> <ul style="list-style-type: none"> ➤ The mechanisms to suppress the secondary wastes are concretely described. ➤ The methods to retrieve the secondary wastes are concretely described. ➤ The methods to process the secondary wastes are concretely described. ➤ The methods to store the secondary wastes are concretely described (methods and degree of ease). 	5

[Items for Additional Points]

Details of the proposal	Allocation of marks (Technical points)
<p><u>(1) Elimination efficiency</u></p> <ul style="list-style-type: none"> ➤ The elimination efficiency of the proposed technology (eliminated amount per used materials for elimination or per time) is high. ➤ The kind of eliminated radioisotopes (radioactive elements) is much. 	<p>10 (7) (3)</p>
<p><u>(2) Sustainability of elimination effects</u></p> <ul style="list-style-type: none"> ➤ The period to sustain the elimination performance is long. ➤ The number of workers for maintenance is small. ➤ The methods for maintenance are easy. 	<p>8 (4) (2) (2)</p>
<p><u>(3) Suppression of secondary waste generation</u></p> <ul style="list-style-type: none"> ➤ The amounts of secondary wastes are small. ➤ The volume of secondary wastes can be reduced easily. ➤ The secondary wastes can be withdrawn easily (The additional dose to the workers by this work is not high) 	<p>8 (4) (2) (2)</p>
<p><u>(4) Presentation of experimental data</u></p> <ul style="list-style-type: none"> ➤ The experimental data are with control samples and with data statistically processed and evaluated. ➤ The data are already published as peer reviewed in an academic conference, journal, etc. ➤ The experiment is conducted and the data are analyzed from various points of view to confirm the effect. ➤ Based on the presented data, it is expected to be shorten the time period for demonstration. 	<p>14 (4) (4) (2) (4)</p>

The evaluations for technical points are classified into four classes; A (factor is 5/5), B (3/5), C (1/5), D (0/5), and the technical points will be calculated by multiplying the allocated points with the factors of each class.

4. References

- (1) Information on the detailed composition of the seawater inside open conduits

Please confirm the latest information at the URL below.

http://www.tepco.co.jp/en/nu/fukushima-np/f1/smp/2014/images/2tb-east_map-e.pdf

The following are the upper limits of the radionuclide concentrations required by law in Japan.

Cs-134: 60 Bq/L; Cs-137: 90 Bq/L; Sr-90: 30 Bq/L

- (2) Amounts of the seawater inside open conduits

Area around water intake channel of Units 1 to 4

Amount of seawater: approx. 0.16 million m³

Depth: approx. 4 to 5 m

- (3) Composition of seawater to be purified

<General abundance of elements in seawater>

Mg: 1.35×10^3 mg/L; Ca: 4×10^2 mg/L; Sr: 8 mg/L; Cs: 5×10^{-4} mg/L

<Concentration of radioactive nuclides in seawater>*,**

Sr-90

$8.62 \times 10^{-21} \times 90 \times (29 \times 365 \times 24)(\text{g/Bq}) \times 2 \times 10^2 (\text{Bq/L}) \times 10^3 = \underline{3.9 \times 10^{-8} (\text{mg/L})}$

(amount of Sr-90 is about one hundred-millionth (10^{-8}) of stable Sr)

Cs-137

$8.62 \times 10^{-21} \times 137 \times (30 \times 365 \times 24)(\text{g/Bq}) \times 40 (\text{Bq/L}) \times 10^3 = \underline{1.2 \times 10^{-8} (\text{mg/L})}$

(amount of Cs-137 is about one ten-thousandth (10^{-4}) of stable Cs)

* With the assumption that the concentration of Sr-90 is 2×10^2 Bq/L and of Cs-137 is 40 Bq/L.

** Calculated using the following formula:

$\text{g/Bq} = \text{half-life (in seconds)} \times \text{atomic weight} / 6.022 \times 10^{23} \times 0.6931$