

## Demonstration Project for Verification Tests of Tritium Separation Technologies

### 1. Requirements for Project Implementation

Please fill in the form<sup>2</sup>. In filling in the form, please establish the implementation plan in accordance with the Details of Demonstration Implementation, and confirm that system to be installed for the verification is able to satisfy the Basic Requirement.

Additionally, it is required to report the implementation plan, progress, and results of the project, and to prepare and submit the result report when the project is completed.

The purpose of this project is (i) to verify separation performance of tritium separation technology, and (ii) to assess construction costs and operating costs needed for installing the system in the Fukushima Daiichi Nuclear Power Station and for treating water remaining after treatment through the multi-nuclide removal equipment (hereinafter called “treated water”). However, the decision whether or not to conduct tritium separation treatment has not yet been made.

#### < Details of Demonstration Implementation >

With regard to contaminated water arising in the Fukushima Daiichi Nuclear Power Station, efforts to remove 62 kinds of nuclides are ongoing, but it is not possible to remove tritium. In this situation, entities to conduct verification tests of tritium separation technologies are being solicited. More precisely, in order to verify the separation technology, it is required to construct and use system, the scale of which is left to the implementing entity’s discretion, and to conduct verification tests that will enable evaluation of separation performance of the “treated water” (The concentration: from  $6.3 \times 10^5$  Bq/L to  $4.2 \times 10^6$  Bq/L (It varies according to the sampling date.)) arising in the Fukushima Daiichi Nuclear Power Station, construction costs, and operating costs.

#### < Prerequisites >

It is a prerequisite for the implementation of this project that the Tokyo Electric Power Company would offer a minimum quantity of “treated water” needed for implementation of the

verification tests. (The implementing entities are required to obtain the necessary permission.)

The range of tritium concentration of the “treated water” is  $6.3 \times 10^5$  Bq/L -  $4.2 \times 10^6$  Bq/L (it varies according to the sampling date). Additionally, it is assumed that  $7.0 \times 10^{-1}$  Bq/L of Co-60,  $3.0 \times 10^1$  Bq/L of Ru-106,  $9.8 \times 10^{-1}$  Bq/L of Sb-125, and  $4.6 \times 10^1$  Bq/L of I-129 are contained in the “treated water” (it is not required to remove these nuclides other than tritium, however). And it is assumed that the “treated water” contains a few ppm of  $\text{Ca}^{2+}$ , a few ppm to a few tens of ppm of  $\text{Mg}^{2+}$ , and approx. 2,000 to 11,000 ppm of Cl.

Furthermore, it is assumed that the verification tests will be conducted outside of the site of the Fukushima Daiichi Nuclear Power Station. Therefore, it is the implementing entities' responsibility to take (1) the necessary procedures for transportation of the “treated water” to the laboratory (including preparation of some equipment and/or containers which are needed for transportation), (2) the necessary procedures for transportation of the water and containers after tritium separation to the Power Station, in compliance with regulations of concerned countries, although the PMO (Management Office for the Project of Decommissioning and Contaminated Water Management) will support the procedures for bringing the water out of the Power Station. If the implementing entities do not want to return the water and containers after tritium separation, please inform the PMO of it.

With regard to the procedures for transportation, cost related the procedures and the transportation, the decision will be made after coordination of the details with the PMO following the grant decision. Related costs, basically will be covered by the subsidy.

Please note that the purpose of the verification tests in this project is not to make a decision on on-site application of the proposed technology, but rather to utilize the acquired data for a comprehensive evaluation of tritium treatment.

#### <Basic Requirement>

##### i) Separation performance of tritium and its system

With regard to separation performance, it must be shown that the technology is capable of realizing a separation factor higher than 100 of the “treated water” generated in the Fukushima Daiichi Nuclear Power Station. The separation factor is calculated by the formula “Tritium concentration (Bq/L) contained in the “treated water” before the treatment / Tritium concentration (Bq/L) contained in the “treated water” after the treatment”.

Furthermore, the mechanism of tritium separation must be described. The description must also contain generation volume, composition and storage method of tritium concentration liquid which contains enriched tritium and effluent (It means the water which will be generated by the process of conditioning before tritium separation etc, if it is generated) which would be produced through separation of 400 m<sup>3</sup> of “treated water” per day.

The volume of needed “treated water” for implementing the demonstration tests must be described.

#### ii) Treatment capacity

With regard to treatment of the “treated water”, it must be shown that the treatment capacity of the technology can be expanded to more than 400 m<sup>3</sup> per day, which is the same scale of capacity through the multi-nuclide removal system in the Fukushima Daiichi Nuclear Power Station. The description must also contain possible verification steps needed for the expansion, such as additional demonstration tests, implementation scheme, costs, etc. as detailed as possible.

Additionally, with regard to the technology proposed in the implementation plan, the proposal must also include both the treatment capacity in the verification tests and the one which can be achieved through the said expansion (unit: m<sup>3</sup> per day).

#### iii) Construction costs, operating costs in the expansion and construction time period

The proposal must specifically show the proposed separation factor, construction costs and operating costs, including the method of their estimations and the conditions, needed for the system which can realize the treatment capacity of the expansion shown in ii), including maintenance costs for the system and the parts, as well as costs for operation of the system.

Additionally, the proposal must also show construction time period for the system which can realize the treatment capacity of the expansion, as detailed as possible.

#### iv) Necessary site area and height of the system per treatment volume

The proposal must specifically show the necessary site area for treatment per 400m<sup>3</sup> of

the “treated water”, including the method of its estimation and the conditions, with consideration to expandability of the treatment capacity of the technology up to more than 400 m<sup>3</sup> per day. Also, the proposal must specifically show the necessary height of the system (using meter as the unit).

<Points to be additionally added>

i) Tritium separation performance

Points will be added in accordance with the separation performance.

ii) Quantity of effluent

In separation, the less effluent (If it is generated. In the case that it is not generated, please write “0”.) is generated, the more points will be added.

iii) Necessary site area per treatment volume

With consideration to expandability of the treatment capacity of the technology up to more than 400 m<sup>3</sup> per day, the narrower the necessary site area for treatment per 400m<sup>3</sup> of the “treated water” is, the more points will be added.

iv) Time needed for treatment of 800,000 m<sup>3</sup> of “treated water”

The shorter needed days for treatment of 800,000 m<sup>3</sup> of the “treated water” is, the more points will be added, in the case the proposed technology will be expanded at a future date. In the description, please describe the supposed utilization factor, which should be realistic.

v) Presentation of the data

Points will be added to proposals that are able to demonstrate their feasibility with experimental data regarding the basic requirements or points to be additionally added. 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, points to be additionally added will be gained by proposals which are expected to shorten the time period necessary for verification based on the presentation of experimental data.

vi) Necessary scheme for expansion of the technology

In transition to development and demonstration phase, if the proposed technology is applied to expand the treatment capacity, if expected time is short, the process is specific, and the scheme for consideration is sufficiently arranged in expansion of the proposed technology at a future date, the more points will be added.

<Goals to be achieved>

The goals to be achieved for the following items during the project period:

I) Construction of full-scale equipment for verification tests based on the proposal

II) Verification of separation performance using the system

III) Confirmation of the validity of construction costs, operating costs, site area and height (m) of the system which can achieve the proposed treatment capacity

IV) Confirmation of technical feasibility and validity of the items of the basic requirements and of the items for points to be additionally added.

## 2. Project Implementation Period

From the day of the grant decision until March 31st, 2016, at the latest.

Please note that proposals are desirable which observe this duration and for which the necessary project term is short.

## 3. Point Rating Method, Subsidy Amount, etc.

The proposal will be scored based on the point rating method described in Form 3. A proposal which does not meet all of the basic requirements shall not be adopted.

The amount of the subsidy is fixed, and the upper limit is one billion yen. Details of the project, subsidy amount etc. will be decided after coordination with the PMO and with METI. Furthermore, acquisition of lands or construction costs of buildings are not covered by the subsidy.

## [Basic requirements]

Details of the proposal	Allocation of marks (Basic points)
<p><u>i) Tritium separation performance and its mechanism</u></p> <ul style="list-style-type: none"> <li>➤ The technology which can achieve a separation factor more than 100 of the tritiated water arising in the Fukushima Daiichi Nuclear Power Station is described. <ul style="list-style-type: none"> <li>➤ The separation mechanism is described in detail.</li> <li>➤ Generation volume, composition and storage method of tritium concentration liquid containing enriched tritium and effluent (if generated) are described in detail.</li> </ul> </li> <li>➤ The volume of needed “treated water” for implementing the demonstration tests is described.</li> </ul>	5
<p><u>ii) Treatment capacity</u></p> <ul style="list-style-type: none"> <li>➤ It is described that the treatment capacity of the technology can be expanded to more than 400 m<sup>3</sup> per day.</li> <li>➤ Possible verification steps are described in detail.</li> <li>➤ Both the treatment capacity in the verification tests and the one which can be achieved in the said expansion (unit: m<sup>3</sup> per day) are described.</li> <li>➤ The system for achieving the treatment capacity is described in detail.</li> </ul>	5
<p><u>iii) Construction costs and operating costs in expansion and construction time period</u></p> <ul style="list-style-type: none"> <li>➤ Construction costs and operating costs, including the method of their estimations and the conditions, are described in detail.</li> <li>➤ Construction time period, including the method of its estimation and the conditions, is described in detail</li> </ul>	5
<p><u>iv) Necessary site area and height of the system per treatment volume</u></p> <ul style="list-style-type: none"> <li>➤ The necessary site area for treatment per 400m<sup>3</sup> of “treated water”, including the method of its estimation and the conditions, is described in detail.</li> <li>➤ The necessary height of the system is described in detail (using meter as the unit).</li> </ul>	5

[Points to be additionally added]

Details of the proposal	Allocation of marks (Technical points)
<u>i) Tritium separation performance</u> ➤ The separation efficiency of the proposed technology is high.	10
<u>ii) Effluent</u> ➤ Generated effluent is small.	3
<u>iii) Necessary site area per treatment volume</u> ➤ The necessary site area for treatment of 400m <sup>3</sup> of “treated water” per day is narrow.	9
<u>iv) Time needed for treatment of 800,000 m<sup>3</sup> of “treated water”</u> ➤ Days needed for treatment of 800,000 m <sup>3</sup> of “treated water” is short.	3
<u>v) Presentation of the experimental data</u> ➤ The experimental data are with control samples and with data statistically processed and evaluated. (3) ➤ The data are already published as peer reviewed in an academic conference, journal, etc. (3) ➤ The experiment is conducted and the data are analyzed from various points of view to confirm the effect. (2) ➤ Based on the presented data, it is expected to shorten the time period for demonstration. (3)	11
<u>vi) Necessary scheme for expansion of the technology</u> ➤ Whether or not expected time needed for development and demonstration is short, and the process is specific. (2) ➤ Whether or not the scheme for consideration is sufficiently arranged. (2)	4

※For evaluation of the technical points, each item will be scored as A (factor of 5/5), B (3/5), C (1/5), or D (0/5). The technical points are calculated by multiplying the allocated points with the factors of each class.

#### 4. Reference information

##### i) Information on the “treated water”

Please refer to the following information concerning the basic information.

[http://www.meti.go.jp/earthquake/nuclear/pdf/140424/140424\\_02\\_008.pdf](http://www.meti.go.jp/earthquake/nuclear/pdf/140424/140424_02_008.pdf)

##### ii) Status of consideration by the government

Please refer to the following information.

[http://www.meti.go.jp/earthquake/nuclear/pdf/140428/140428\\_01n.pdf](http://www.meti.go.jp/earthquake/nuclear/pdf/140428/140428_01n.pdf)