[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

Technology Information	
Area	1-2 (Select the number from "Areas of Technologies Requested")
Title	① Accumulation of contaminated water (2) Other requirements for tanks
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1. Overview of Technologies (features, specification, functions, owners, etc.)

Introduction:

The purpose is to store in the most secure way and for a low cost a huge quantity of water from which the Cesium was previously removed. This contaminated water should contain only alpha or beta emitters. The issue with beta ray is that 2 shielding layers are required to have a good protection. The first layer has to have a low atomic number in order to reduce the speed of the electron (and then reduce the bremsstrahlung which is the emission of X ray) and a second layer with a high atomic number in order to reduce the residual bremsstrahlung. Because of this, a steel tank with an internal epoxy coating constitutes conventional storage tanks.

This conventional solution presents the disadvantage to be expensive, to have a risk of leak if it is not well assembled and to need heavy earthwork.

The idea proposed hereafter is quite simple and consist to use natural shielding for the second layer.

As plastic and water are very good for minimizing the bremsstrahlung effect, and as there is a lot of water close to the Daiichi NPP, the idea is to use the ocean water as shielding for the second layer.

This proposition is quite innovative and unconventional because the contamination water is stored into the place where the water is not allowed to be released. No solution can be 100% safe, but our approach gives the possibility to reduce at its lowest possible level the risks.

This solution was never tried to store contaminated water, then further studies have to be done in order to confirm its potential.

Description of the technology:

The principle is to submerge flexible plastic tanks into water. The plastic will keep enclosed the water and will reduce the bremsstrahlung and the water of the ocean will end to reduce the bremsstrahlung acting like the second layer.

Safety of the technology:

- **How will the tank react inside the water**

Because the contaminated water put into the flexible tank has same density as the water of the ocean (2nd shield), the pressure inside and outside the tank will be the same. Thanks to this, the walls are not under pressure. The risk for the wall to crack because of a pressure difference is reduced to zero.

- **Area where to put the submerged flexible tanks**

It is important to put the tank in a place where the radiation can be monitored easily and where the ocean movements (waves) are minimum in order to reduce constraints on the flexible tanks. The best place is inside the Fukushima harbor, where the waves are minimum and water contamination is always monitored. In addition, if required, it is possible to build a “gate” at the entrance of the harbor in order to limit the water movements.

- **Interaction with the ecosystem**

This part is of utmost importance because the purpose of this system is the storage of a huge quantity of contaminated water for an unknown period. Therefore any leak into the ocean cannot be tolerated at any time.

- ***How to avoid any leakage into the ocean***

  As the tanks are relatively cheap to construct, adding extra layers to the first shields (plastic membrane) in an onion like manner, will highly reduce the bremsstrahlung and will also minimize the risk for the contaminated water to leak into the ocean.

- ***Monitoring tanks to detect potential leaks***

  Sensors can be placed inside the tanks or between the layers to monitor potential leaks. These sensors can measure for instance salt levels into the stored contaminated water in order to detect if any ocean water enter the flexible tank. Another monitoring system can be to detect the presence of water between the different layers. Some further monitoring systems could also be explored.

- ***Reaction of the tanks in case of a tsunami***

  To avoid any risk of collisions, the flexible tanks are to be anchored to the bottom of the harbor.

Radioprotection:

As the tanks are underwater, there are no risks the workers will be exposed to radiation. Also, the only access to the tank is done by boat and therefore the risk to be exposed to radiation is almost equal to zero.

If operations have to be performed underwater, ROV can be used to easily access any parts of the tanks, which is not the case with on ground tanks.

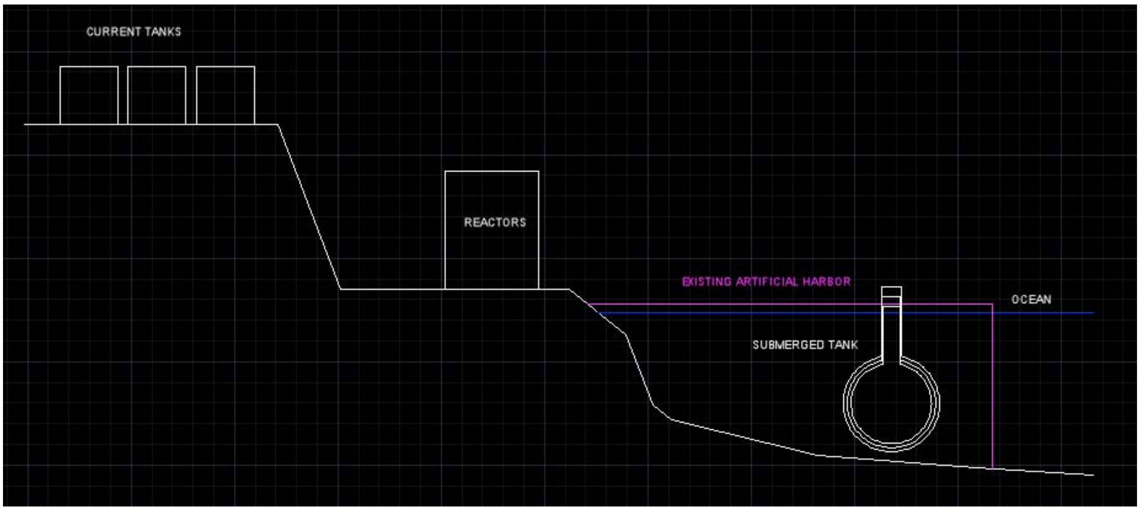
Maintenance of the tanks:

Almost no maintenance is required. Running cost should remain very low.

Dismantling of the tanks:

When the tanks will no more be required, their dismantling will be quite easy. They should be empty, thus just a crane should be required to remove them out of the water. Then grinds them to reduce their volume for easy storage. The decommissioning and dismantling cost of these tanks should be greatly reduced compared to other storage systems.

Scheme of the system:



2. Notes (Please provide following information if possible.)

- Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)

Flexible submerged tanks already exist and are used in projects such as neutrinos research projects for instance. In the case of Daiichi NPP, the correct material has to be found according to the expected activity of the contaminated water.

Thermo welding technologies exist and are reliable. Unlike steel tank, it is possible to realize multiple thermo welding in order to decrease the risk of the leak.

Anti-shell paint also exists.

Anti-perforation fabrics also exist.

- Challenges

Confirm that the anti-shell paint can be applied on flexible tank without affecting its strength.

Investigate on sensor to use to detect contaminated water leak.

Maintain the submerged flexible tank in suspension between the harbor ground and the surface.

- Others (referential information on patent if any)

【Areas of Technologies Requested】

(1) Accumulation of contaminated water (Storage Tanks, etc.)
(2) Treatment of contaminated water (Tritium, etc.)
(3) Removal of radioactive materials from the seawater in the harbor
(4) Management of contaminated water inside the buildings
(5) Management measures to block groundwater from flowing into the site
(6) Understanding the groundwater flow