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

Technology Information	
Area	4 and 5 (Select the number from “Areas of Technologies Requested”)
Title	**Komuso of Enlightenment** **虚無僧悟りの**
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1. Overview of Technologies (features, specification, functions, owners, etc.)

Problems need to be defined before suitable technological remedies can be developed.

Put simply, the main features of the existing problems with regards to groundwater flow into the buildings and the associated management of contaminated water within them, as I understand them, are as follows:

- A sensitive balance is being maintained between the external groundwater level and the highly contaminated water within the buildings. The balance is sensitive because:
  - (i) it is desirable to maintain the external groundwater level as low as possible in order to reduce the quantity of groundwater flowing into the buildings, and
  - (ii) it is essential to maintain the external groundwater level above the level of the highly contaminated water within the buildings in order to prevent the highly contaminated water flowing from the buildings into the natural external groundwater.
- This balance is maintained by:
  - (i) continuous pumping of natural groundwater from wells positioned around the buildings with extracted water being discharged remotely via a network of pipes, and
  - (ii) continuous extraction of contaminated water from within the buildings and onward transfer to multiple storage tanks for future treatment.
- Maintenance of this balance is made more difficult by the hydro-dynamic characteristic of the groundwater pressure emanating from nearby elevated land.
- This process is unsustainable as it involves a massive 400m^3 of natural groundwater

entering the buildings, becoming contaminated, and then being extracted for long-term storage every single day.

- Although the water within the building provides some radiological shielding, the area remains highly radioactive and is prohibitive to normal working practices.
- The circulating effect caused by the groundwater ingression has the benefit of cooling the existing contaminated water within the building.
- There is an existing proposal to mitigate the risk of environmental contamination by forming an extensive impervious wall of ice within the ground around the buildings to control groundwater flow.

The two main innovative features of my proposal (as first raised at the Call for Technologies on Contaminated Water Workshop of the International Research Institute for Nuclear Decommissioning (IRID) held in the UK on 10 October 2013) are as follows:

A. To freeze the contaminated water within the building, and
B. To realise and use properties of the steel reinforcement that are inherently contained within the existing reinforced concrete walls and floors of the buildings in unconventional ways.

The main advantages of these proposals are:

A. Freezing the contaminated water within the building (in conjunction with external pumping of groundwater):
    - Remedies the problem at source.
    - Prevents significant groundwater ingress and any associated contamination of groundwater.
    - Substantially relieves the ever-growing need for long-term storage of massive quantities of contaminated water.
    - Provides alternative means of cooling the contaminated water within the building.
    - Could work in combination with the proposed impervious wall of ice solution, but potentially reduces the scale of the wall and associated problems of construction.

B. Realising and using properties of the steel reinforcement that are inherently contained within the existing reinforced concrete walls and floors of the buildings in unconventional ways:

- The reinforcement bars intermesh with each other to provide a hidden basket (or '**Komuso'**) of steel that envelops and contains the whole building. It also penetrates and reaches the narrow areas between the Reactor Buildings, Turbine Buildings, service trenches and other similar inaccessible areas.
- Although the primary design purpose of this steel is to provide strength and stability to the structure of the buildings, it also has other properties (e.g. good thermal and electrical conductivity) that could be innovatively used in unconventional ways to assist with this difficult situation.

It is the real potential for this hidden '**Komuso of Enlightenment'** to be used in resolving some of the difficulties at Fukushima Daiichi that is most innovative in my proposal. In principle, its ability to universally conduct and distribute heat, cold and electrical charge could prove to be a very useful asset.

In its concept on 10 October 2013, the idea was to use the steel reinforcement to act as an all-embracing basket to extract heat from the walls and floors of the buildings, thereby freezing and encapsulating all the contaminated water, and entirely inhibiting groundwater flow into the buildings (see Fig 1).

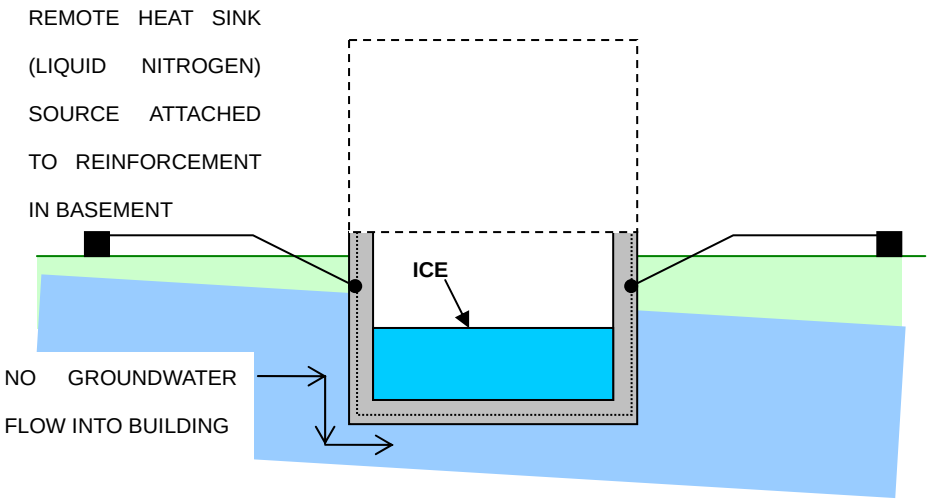
REMOTE HEAT SINK
(LIQUID NITROGEN)
SOURCE ATTACHED
TO REINFORCEMENT
IN BASEMENT
ICE
NO GROUNDWATER
FLOW INTO BUILDING

FIGURE 1

Having realised this potential, the initial concept can now be improved and enhanced to provide more refined schemes (such as those presented below) from which detailed design solutions can be developed.

Alternative Scheme 1: Partial Freezing of Contaminated Water Within the Buildings

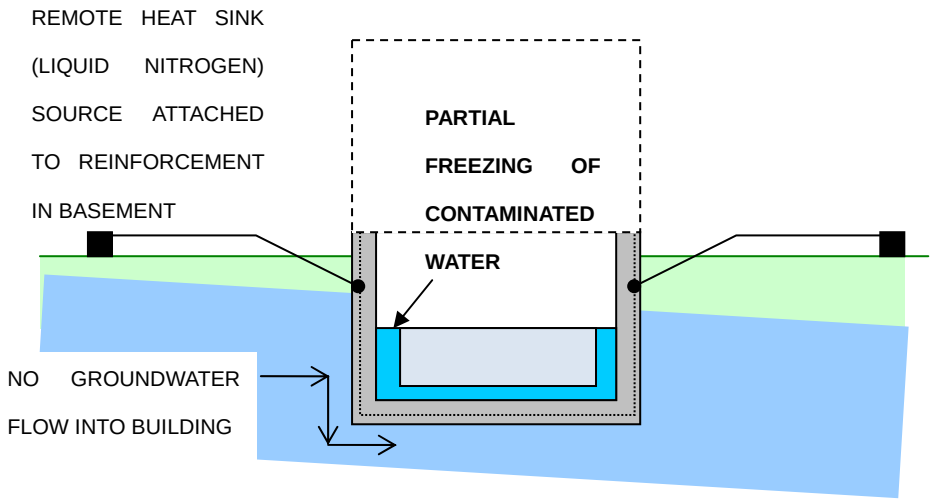

FIGURE 2

The advantages of this refinement is that it would require less energy to maintain an impervious barrier to resist groundwater ingress into the buildings, and it would have less risk of causing damage to the concrete of the building structures.

Alternative Scheme 2: Activated Carbon Capture, Electrolytic Separation and Partial Freezing of Contaminated Water Within the Buildings

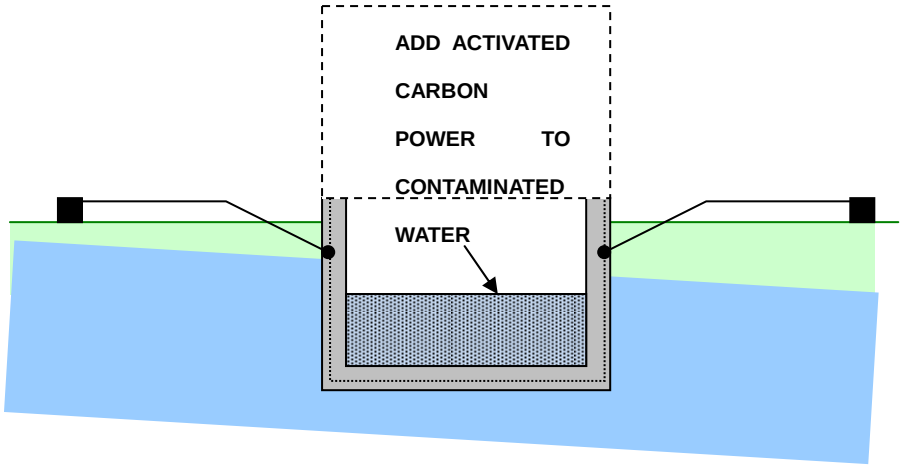

FIGURE 3

Add activated carbon powder to the contaminated water and permit contaminants to be absorbed. The activated carbon is a natural product which holds a negative electrical charge and possesses a very large surface area in contact with the water. These properties provide good absorption of contaminants within the water.

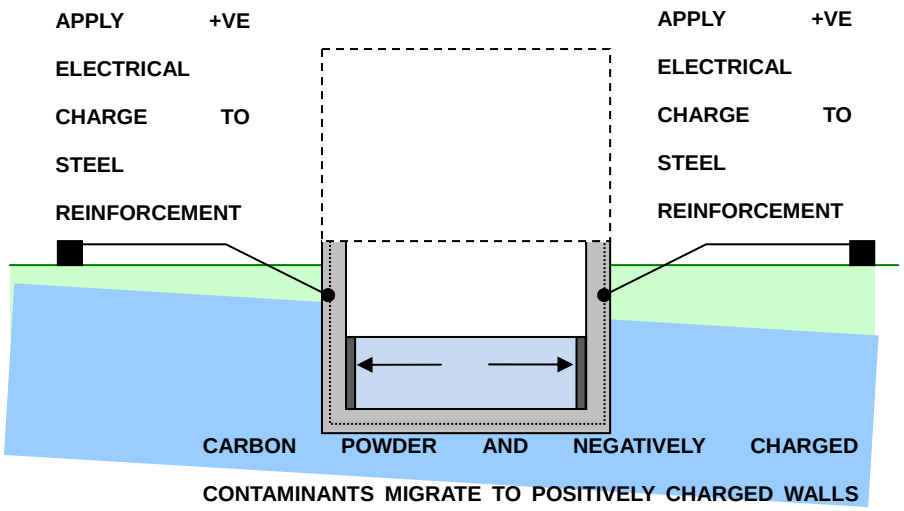

FIGURE 4

Apply a positive electrical charge to the steel reinforcement of the building structure to attract the negatively charged contaminants and carbon powder towards the walls and floors.

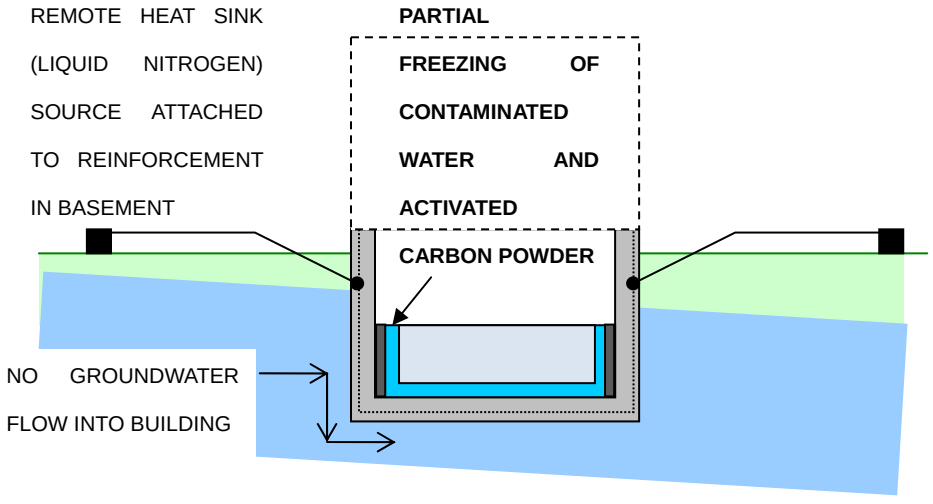

FIGURE 5

Use the steel reinforcement to act as an all-embracing basket to extract heat from the walls and floors of the buildings, thereby partially freezing and encapsulating the contaminated carbon powder and entirely inhibiting groundwater flow into the buildings.

The fundamental principles and concepts of these innovative ideas may be further used to develop other similar schemes.

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

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

  Technologies for remote non-manned installation of electrical cabling and insulated piping for coolant are relatively readily available, including moling technology for underground installation.

- Challenges

  One of the main challenges will be the development of remote technologies for the removal of concrete to locally expose steel reinforcement and the associated connection of cabling and coolant conduit to the reinforcement.

  Research is also necessary to determine optimum layouts, energy use, coolant quantities, activated carbon powder concentrations, etc.

- Others (referential information on patent if any)

I do not hold any formal patent. My ideas, innovations and concepts are fundamentally provided on the basis of good will and in the hope they are used to the benefit of mankind and the environment we share as a whole. Legal rights are only reserved in case of commercial use.

Please accept my sincere apologies for not presenting this information in Japanese.