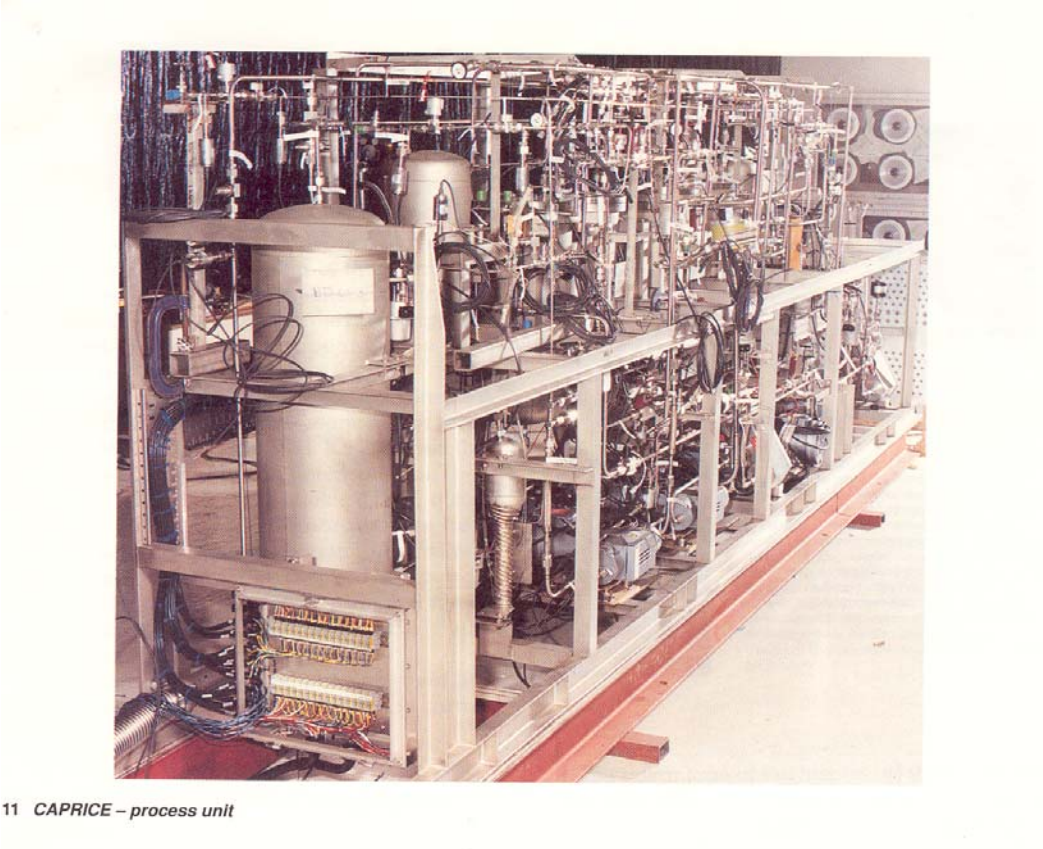
[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

Technology Information	
Area	**2. Treatment of Contaminated Water**
Title	**Water Detritiation Plant**
Submitted by	**AMEC**

1. Overview of Technology (features, specification, functions, owners, etc.)

According to our expertise, the nuclear industry usually takes gaseous forms of tritium and converts them to tritiated water which they then release to the ocean under consents that have been granted by the appropriate regulatory authority. This is very different to the situation at the Fukushima Daiichi NPP where the traditional end point is the start point for the problem.

AMEC has designed many tritium handling plants as describe by the two attachments and has expertise in two geographical areas, UK and Canada.



11 *CAPRICE – process unit*

Example of Tritiated Plasma Exhaust Purification System (Caprice)

In undertaking all this work, AMEC has created a very strong capability and understanding of tritium. In addition, AMEC has a very strong understanding of the industrial and academic

experts that could be used to try and address the tritium problems at the Fukushima Daiichi NPP.

Based on our expertise we believe that it could be possible to create a plant to detritiate water but this needs further exploration in terms of practicality (cost, size and time). The separation of tritiated water (HTO) from non-active water (H_2O) is difficult owing to the similarity of the physical and chemical properties of the two isotopic species. In principle, an electrolysis process would produce HT and H_2 at the cathode and a cascade process could be used to separate the isotopes. The cascade process could be (a) a gas chromatography process, or (b) a palladium membrane separation process. For example,

(a) Gas chromatographic separation of hydrogen isotopes on the combined column of 5 Å molecular sieve and Al_2O_3 at cryogenic temperatures has been investigated previously. Experimental results show that the purity of deuterium reached above 99.9% through a combined separation column. The method can be used for the separation of hydrogen and deuterium, deuterium and tritium, and hydrogen and tritium.

(b) The viability of using palladium alloy membranes in cascade to separate the hydrogen, deuterium and tritium produced in a fusion reactor has also been investigated. Values of the permeation separation factor can be estimated for Pd-20%Ag from available data and corresponding estimates for the necessary number of stages and the total membrane area can be calculated for the required isotopic purification.

Having separated the tritium and hydrogen, both gases would be catalytically oxidised to tritiated water and ordinary water respectively. The ordinary water could be discharged, leaving a concentrated form of tritiated water of much smaller volume for disposal. The main practical issue in Japan is the large volume to be processed and the current production rate of tritiated water. The cost of the required plant is expected to be significant.

However, we believe that the issue associated with Fukushima Daiichi NPP is driven by the Japanese political environment where it is currently unacceptable to discharge the tritium contaminated water in to the ocean. In order to change public perception AMEC believe that a possible route is to set up an <u>international</u> working group which considers the technical and economical feasibility of creating such a plant. In addition, a survey of practices worldwide on the handling/discharge of tritium would create a compelling argument that could be used to provide independent international justification to either construct the plant or discharge the tritiated water to sea.

AMEC are proposing that as an EPC company with expertise in this area we are in a strong position to provide leadership in this area. Our proposal is to undertake a feasibility study on the manufacture of such a facility with input from many industrial experts, both industrial and academic.

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

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

AMEC expertise in this technology is included in the two attachments.

The purification of tritiated water in such large volumes is unprecedented and as such it is believed that no existing practical technology exists. The production of a plant to undertake the purification process is predicted to be very expensive and large and the timescales also need to be determined. This proposal is for AMEC to coordinate a world expert forum to ascertain the feasibility of a solution.

The production of an international report could be used by the Japanese nuclear market to make an informed decision on the best way forward in dealing with the issue of the vast quantity of tritiated water currently being stored.