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

Technology Information	
Area	2 (Select the number from "Areas of Technologies Requested")
Title	Vorsana Water Treatment for Fukushima
Submitted by	Wilmot McCutchen

1. Overview of Technologies (features, specification, functions, owners, etc.)
2. Vorsana Water Treatment for Fukushima
3.
4. Tritiated water may be separated centrifugally from H2O in a radial counterflow recirculating reactor of very simple design (the McCutchen Processor). This is a dual centrifugal pump where the centrifugal impellers counter-rotate and shear the feed.
5.
6. The 22:18 molecular weight ratio of tritiated water to H2O causes a net migration of tritiated water radially out into a shrouding tank. Vortex separation is at very high g because the largest eddies that can exist between the impellers become very small toward the erihery of the impellers. H2O, because of its lower molecular weight, concentrates in the vortex cores of a free shear layer between the counter-rotating coaxial centrifugal impellers. H2O flows radially inward through the connected vortex network in the shear layer. A pump sucks H2O out of the reactor along the axis of rotation of the impellers. The axially extracted H2O has a low enough tritium content to be in condition for discharge. The apparatus is described in US Pat. 5,688,377 (1997) to McCutchen http://www.freepatentsonline.com/5688377.pdf
7.
8. Large eddy g gets big as the impellers converge in a taper.
9.
10. TEPCO and GE-Hitachi are cordially invited to discuss the proposal in more detail.
11.
12. Vorsana has detailed drawings by Otto Fritz for an industrial scale machine, which was never built. At least it's a start, and is freely offered for your inspection.
13.
14. CFD simulation of single phase (water) radial counterflow in this open von Karman geometry has been done by Dr. Tao Xing of the University of Idaho. He and his Masters student Joseph George will be extending this work to two-phase simulation, which could be H2O-tritiated water. Our proposal is that Japan support this CFD work by Dr. Xing's team and build on the Otto Fritz drawings to adapt the McCutchen Processor disclosed in the patent to evacuating the Fukushima brine concentrate tanks and Vortex separation of tritium from fresh water should be feasible, given a long enough residence time.
15.
16. An improvement on the McCutchen '377 patent would be bladed impellers. More vigorous radial advection of the heavy fractions about the axis of impeller rotation would increase the radially inward advection of the light fraction, H2O. Out beyond the impellers, in the shrouding tank, the tritium concentrate recirculates in the tank. The outside radial vortices are fine pores of a virtual filter. Long enough residence time would provide the required separation.
17.
18. Another improvement is to preserve a constant cross-sectional area of annular

control surfaces between tapering impellers.

19.

20. One adaptation might be floating the shrouding tank and its enclosed centrifugal disk impellers in a tank of RO concentrate. Or submerge everything in the tank. Concentrate trickles into the shrouding tank as H2O is axially extracted to discharge. Concentrated tritiated water collects in the shrouding tank. The coaxial counter-rotating disks disposed in the tank allow only dischargeable H2O to pass radially inward between them to axial extraction.

21.

22. By the time the shrouding tank settles to the bottom of the evacuated concentrate tank, it contains tritiated water at high enough concentration to be useful for D-T and T-T events. Acoustic frequency (high intensity) hydrodynamic and electrodynamic cavitation would probably happen in a reactor such as Vorsana's Cavitation Water Purifier.

23. http://www.freepatentsonline.com/8268136.pdf

24.

25. For pretreatment of feed to sorption stages, to get out scale and salt and a significant part of the trace metals, Vorsana offers an RF assisted crystallizer that uses the above-described recirculating extractive flow. http://www.freepatentsonline.com/8025801.html

26.

27.

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

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

- Challenges

- 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