eco-atomic consultants ltd

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

Technology Information	
Area	2 & 3 (Select the number from "Areas of Technologies Requested")
Title	2A **Use of Dounreay high volume flowrate water filter and ion exchange cartridge design with associated flasking arrangements**
Submitted by	eco-atomic consultants ltd

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

In the 1990s UKAEA Dounreay installed several water treatment units for fuel storage ponds containing unacceptable levels of caesium in particular. The water treatment units were an unusual design in that they used high water flowrate such that the whole pond contents were treated over a short period of time. This allowed the pond contamination levels to be reduced even though the caesium leakage source remained in the pond.

The high flowrate capacity was achieved by a special radial flow cartridge design for both the particulate filter and the ion-exchange beds. Other special features of the design were:

- The cartridges were designed to fully drain when circulation was stopped
- Used cartridges could be dried before being consigned to intermediate level waste
- Cartridges could be changed without exposing operators to dose using an appropriately designed shielded flask.
- Seals that ensured the leaktightness of the cartridge mounting could be replaced
- Modular construction was used with a single skid carrying the ion-exchange and filter unit pair, together with the circulating pump and the necessary pipework and valves.

The engineering designs for all of the system should be available from the UK Nuclear Decommissioning Authority (NDA), which is the current owner of the Dounreay site.

The design could be applied to the processing of water withdrawn from the reactor buildings (alongside the current ALPS system or in place of it if the ALPS system does not already have the capability for fully shielded transfer of loaded cartridges).

By using much higher circulation flows it would be possible to reduce the radioisotope concentration of the water in the reactor basement and hence reduce the risk of contamination of surrounding ground by outleakage from the basement. For example, if the total flow circulating through the basement were increased by a factor of ten (to 8000 m^3/day) with all of the flow

passing through an effective filter/ion exchange unit then the concentration of radioisotopes in the basement would be reduced by a factor of about ten. This is not necessarily an impractically high flowrate because the water is being removed from and returned immediately to the basement.

A similar high flowrate approach could also be applied to the removal of contaminants from the seawater in the harbour. Since the rate of removal of contaminants is calculated by multiplying the volume flowrate treated, the concentration of the contaminant and the decontamination factor, it is clear that increasing the volume flowrate increases the rate of removal. In many nuclear applications much effort is placed on improving the decontamination factor of the treatment process but in the case where the treated effluent is returned to the water body the decontamination factor is not the key performance parameter.

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

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

The whole system design was used in more than one installation at UKAEA Dounreay and the design could be adapted for re-manufacture to suit TEPCO requirements. The ion exchange medium used was clinoptilolite procured from BNFL but other media could be used in the same configuration. From memory, I think a small unit treated 4 m^3/hr using 150 mm diameter filter and ion exchange cartridges.

- *Challenges*

The design would need to be obtained from NDA and reviewed for suitability. The cartridge size would possibly need to be re-optimised to suit TEPCO waste management facilities and the overall capacity required.

Note that the ion-exchange cartridges release significant quantities of short-lived Ba-137m in operation when charged with Cs-137. This can interfere with any radiological monitoring at the outet of the ion-exchange unit that is used to detect breakthrough.

- *Others (referential information on patent if any)*

The site where the equipment was installed is now operated on behalf of NDA by:

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