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

Technology Information	
Area	3
Title	Removal of Cs and Sr from Harbor Seawater
Submitted by	CB&I

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

Based on the sample concentrations identified in the harbor and other adjacent non-groundwater locations, only low decontamination factors (DFs < 10) are necessary to bring contamination levels (Cs) to within the "density limit specified by the rule for the installation operation" ("drinking water standards" are inapplicable). Localized removal of the volume of water exhibiting contamination levels exceeding limits

Treatment for Cs Contamination

Ion Exchange Technology utilizing IE-96 or chabazite zeolite as found in the SARRY process with a pre-filtration step is proposed for the removal of cesium.

Treatment for Sr Contamination

Following the Cs removal step, a nonradioactive $SrCl_2$ solution followed by a base is added to the process stream and the calcium (between 50 and 60%) and magnesium will precipitate and require separation by gravity settling. This process step will not precipitate/remove any Sr although a small fraction (< 5%) may be adsorbed on or interstitially included in the precipitate. Carbonates will then be added to the process fluid to precipitate the bulk of both strontium and the remaining calcium (a minimal amount Mg will be precipitated in this step). This second precipitate will be collected for disposal. This step will provide a DF< 10 for the removal of Sr. If a greater Sr DF is desired than the second precipitation provides, then the $SrCl_2$ solution addition will be deleted and an inorganic Sr specific ion exchanger used to effectively remove the strontium contamination. After processing for Sr removal, the first calcium and magnesium precipitate will be re-introduced into the process stream, acid added to neutralize the fluid and the treated seawater re-introduced into a different area of the bay for release as an effluent (a waste holdup tank may be desired for effluent sampling)..

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 technology for Cs removal is already used on-site although for the removal of higher levels of contamination.

The technology for Sr removal is based on standard water softening technologies except when higher DFs are required. The Sr removal resins are based on the mMST titanium oxide material developed at SRS, the SrTreat (a hexacyanoferrate exchanger) resin by Selion Oy, Finland and other similar inorganic ion specific resins developed for the nuclear industry.

If chabazite as the zeolite and precipitation processes are acceptable for use in the Cs and Sr removal technologies, implementation time would be limited to designing the system including any shielding and personnel protection, the required water intakes/discharge points, sizing and getting vessels and pumps delivered, equipment setup, pre-testing and process setup.

If more extensive DFs were to be required, the limiting step would be procurement and delivery of large volumes of specialized resins which have limited availability and manufacturing capability.

- Challenges

Design of a high flow process which would entail several parallel processing trains to address potentially very large ocean volumes and that satisfies both political and regulatory requirements.

Use of chemicals considered benign that can be readily returned to the ocean without further processing or disposal.

- Others (referential information on patent if any)