

## History of VSEP used in Radioactive Applications

- Rancho Seco, California

The Rancho Seco nuclear power plant located near Sacramento, California began decommissioning work in 1999. During the decommissioning process, equipment was washed and removed for disposal. This resulted in various poor quality waters that were segregated and stored. Some of the contaminated water was treated using conventional reverse osmosis (RO) membrane systems, while cleaner water was treated using a portable demineralizing unit.

Liquid concentrates from various processes including the RO system and other more concentrated wastewaters were collected and were destined for evaporation via drum dryer. This became a very slow process. In 2001, a VSEP LP RO unit was brought in to pre-treat this radwaste water ahead of the drum dryer. The result was that the VSEP removed 50% of the water cutting the evaporation time in half. The VSEP permeate was sent to the demineralizing unit for further polishing and the VSEP concentrate was sent to the drum dryer.

In 2002, surrogate testing was completed at New Logic's lab near San Francisco, California. The testing simulated floor drain sump wastes and boric acid concentrate wastes. 90% recovery (10X concentration) was achieved for both streams, leaving just 10% of the starting volume as concentrate. Nanofiltration (NF) and RO were tested, but RO exhibited the best boron rejection. The NF membrane removed 52% of the boron, while the RO removed 74% at pH 7.1

Subsequent onsite pilot testing on actual radioactive material resulted in 95% volume reduction. During this testing using a RO membrane, boron and soluble cesium were concentrated ten-fold, and insoluble cesium was concentrated 100-fold.



Rancho Seco Power Plant in Herald, California

- *Peach Bottom, Pennsylvania*

New Logic performed ultrafiltration (UF) simulation testing at its testing lab near San Francisco using 1200 mg/L Iron Oxide. The test simulated radwaste from a boiling water reactor (BWR). The final reject left from the VSEP concentration had 84,000 mg/L (8.4%) total solids representing a 70x concentration factor.

Subsequent work done at the power plant removed more than 99% iron. The results also showed virtually complete removal of manganese-54, cobalt-60, silver-100, and cesium-137 isotopes.



Peach Bottom Atomic Power Plant in Peach Bottom, Pennsylvania

- Limerick, Pennsylvania

UF testing was done at New Logic's lab to simulate spent powdered resin condensate containing 0.15% total solids. The feed material was concentrated leaving 8% of the volume left as a concentrated reject having 1.96% total solids representing a 13x concentration.



Limerick Generating Station in Limerick, Pennsylvania

- Hope Creek Station

UF simulation testing was done at New Logic's lab using 1700 mg/L Iron Oxide to mirror BWR radwaste. New Logic's lab testing indicated positive results.



Hope Creek Nuclear Generating Station in Lower Alloways Creek, New Jersey

- *Kashiwazaki-Kariwa Summary*

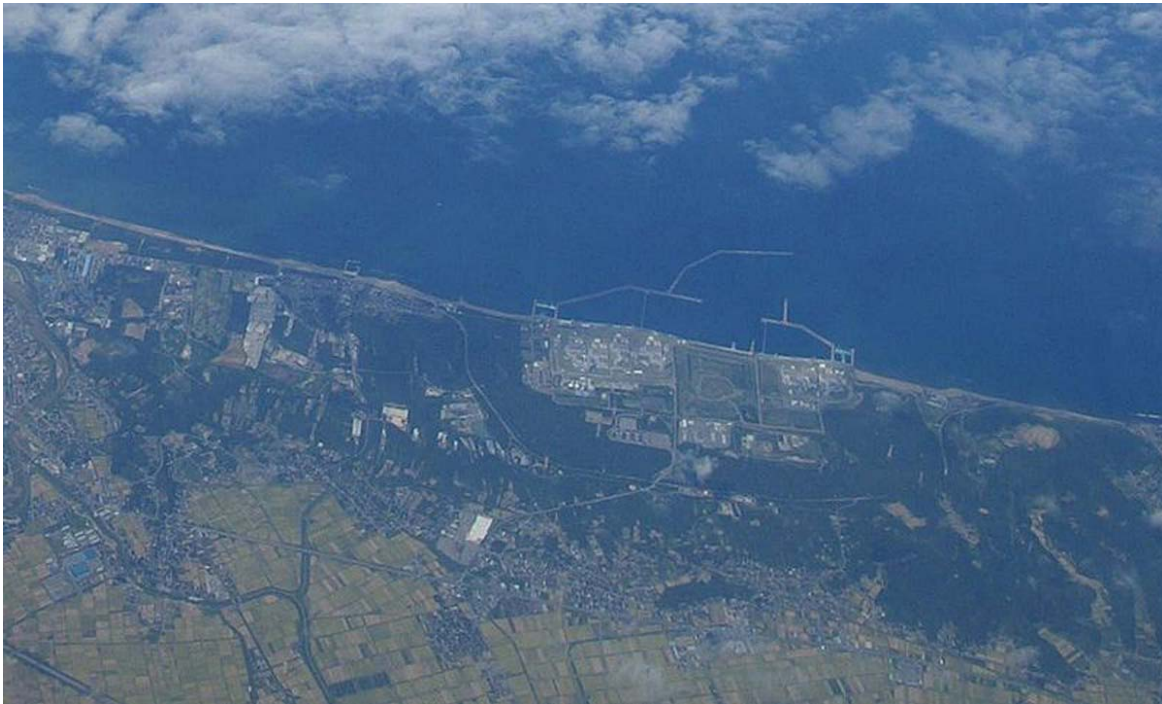
Onsite RO VSEP testing was completed in 2001 on cleaning wastewater. The feed contained the following radioactive materials:

Manganese Mn-54 ( $5.3 \times 10^{-2}$  Bqui/ml)

Cobalt Co-58 ( $2.2 \times 10^{-2}$  Bqui/ml)

Cobalt Co-60 ( $69.0 \times 10^{-2}$  Bqui/ml)

Chemical oxygen demand (COD) from soap was also present with sodium chloride (NaCl). The final VSEP permeate had non-detect levels of cobalt and manganese, and less than 30 mg/L of COD.



Kashiwazaki-Kariwa Power Plant in Niigata Prefecture, Japan