Nuclear Desalination

Artist's depiction of a modern seawater desalination tower. It is proposed for a location on the Pacific Coast of California. The structure houses a multi-effect distillation process (vertically stacked evaporators) for large-scale output (284,000 cubic meters daily).

Fourth-generation nuclear reactors are now ready for mass-scale introduction, with designs that are mass producible, super-safe, and nearly 50% more efficient than conventional reactors. These reactors are ideal for supplying the energy to produce potable water from seawater.

Two of these modular fourth-generation reactors are now in development: The German-developed pebble bed modular reactor (which uses fuel pellets the size of tennis balls) is under construction in South Africa, with fully tested components for safety and output; and the San Diego-based General Atomics company, which pioneered the idea for using fuel particles (small, ceramic-encased spheres of fission fuel ("mini-containment vessels") is jointly developing a modular high-temperature helium-cooled reactor with Russia, to burn weapons-grade plutonium as fuel.

A desalination plant coupled to a 135 MW fast breeder reactor has operated in Kazakstan since 1973, and Japan has several small desalination units attached to its operating nuclear plants.

In the 1980s, General Atomics was involved with desalination plans for the Metropolitan Water District of Southern California, which serves the large desert population of more than 15 million people. A report was prepared titled, "MHTGR Desalination for Southern California" (December 1988), through a U.S. Department of Energy contract to General Atomics, Bechtel, Inc., and Gas-Cooled Reactor Associates. MHTGR was General Atomics' earlier design of a modular high-temperature gas-cooled reactor.

As designed in the 1980s, each de-salting plant would consist of four modular nuclear reactor modules (350 MW each), using helium gas as coolant. The low-temperature heat output would fuel eight seawater desalination "trains," based on the horizontal-tube, multiple-effect distillation process. This would yield 401,500 cubic meters per day of freshwater, enough to supply 1.5 million people with sufficient potable water for domestic use. Strategic siting of 10, 20, or more such plants, on the Pacific or Gulf coasts, would mean volumes of newly created freshwater, sufficient for supplying 15-30 million or more people with their domestic water needs, or equivalent volumes for other purposes.

The UN's International Atomic Energy Agency estimated that: "A desalination plant with a capacity of 1 million cubic meters per day could supply an urban concentration of 3-4 million people with sufficient potable water for domestic use. Such a desalination plant, using the reverse osmosis process, would require a nuclear plant having an installed capacity of about 300 MW-electric (MWe). The same urban concentration of people also would require between 4,000 to 6,000 MWe of installed capacity to provide their corresponding electricity needs. Hence, nuclear power plants in the upper end of the small and medium-size power range—and certainly the large-size nuclear power plants—would only constitute suitable choices when they are intended to supply electricity to consumers in addition to energy for seawater desalination. Thus, there is no reason that nuclear reactors could not supply both requirements simultaneously, and take advantage of the economic benefits accuring to large-size nuclear plants."

—Marcia Merry Baker