East-North Africa economic summit, hosted by the Jordanian government in Amman. Jordan had in 1994 signed its own peace treaty with Israel, in which water projects were included. But when the issue of nuclear desalination was raised, in the relevant workshops and press conferences, it was denounced as ludicrous, outrageous, and so forth, not only by the World Bank types, but also by Jordanian water experts.

Although no one at the U.S. State Department would argue that the Hashemite Kingdom of Jordan is a "rogue state," the policy here, too, is denial of nuclear technology. The widely advertised fact that Israel possesses nuclear technology, does not perturb anyone. The fact is, the liberal free-market fanatics, who have politically pushed through the World Bank's hijacking of the economic policymaking in the regional peace process, are committed to denying advanced technologies, including nuclear, which could render nations truly independent and sovereign. As for water policy in particular, the name of the game is "privatization," and this comes from the very top.

None other than Secretary of State Madeleine Albright outlined the policy on April 10 in remarks regarding this year's Earth Day. Identifying the water shortage problem as an international phenomenon, Albright proposed three ways to handle it: through technical means (to improve water-use efficiency), through eliminating waste, and through diplomacy. On the matter of waste, Albright said, "In many societies, water is wasted because it is underpriced." She explained, "Direct and indirect subsidies are common in both developed and developing countries." Paying lip service to the need to consider social considerations, as well, in pricing policymaking, she went on to assert, "But a system that reflects the full cost of treating and delivering water—and that enforces the collection of bills and requires polluters to pay—will get far more value from the resources than a system riddled with subsidies."

Albright continued to elaborate how the third means, diplomacy, should be used to achieve this shift away from subsidies, i.e., state control over policy. The United States, she said, should intervene diplomatically, to solve water problems regionally. Not coincidentally, Albright chose the Middle East as the area where the United States, which "chairs a working group on water resources," can establish a precedent, for cooperation. Specifically, she proposed a "global alliance for water security in the twenty-first century," in the "spirit of last month's World Water Forum" held in The Hague, a forum which also promoted the privatization of water. The goals of the alliance, she said, "must be to dramatically improve the management of transboundary water resources." Finally, Albright announced that the United States would be hosting a conference of donor countries in early summer to "help others deal cooperatively with water issues," and reiterated, in the same breath, that the government "strongly supports efforts by the World Bank and private foundations to see that investments in water-related projects reflect and encourage sound management practices."

Thus, anyone seeking an explanation for why the concept of nuclear desalination has not been promoted by the United States in Clinton's peacemaking efforts, need look no further. Unless this problem at the State Department is eliminated, there will be continuing sabotage of the only technologically and economically viable solution to the water crisis.

Generating Water, Power: Beautiful, and Necessary

by Marcia Merry Baker

The accompanying artist's depiction of a modern seawater desalination tower, is proposed for location on the Pacific Coast of Southern California, a region very similar to the eastern Mediterranean littoral. The structure houses a multi-effect distillation process (vertically stacked evaporators), for large-scale output (284,000 cubic meters daily). The artwork was done for the frontispiece of "Seawater Desalination Plant For Southern California" (Preliminary Design Report No. 1084), of the Metropolitan Water District of Southern California, Los Angeles, October 1993.

The tower, and Figure 2 and Table 2, illustrate the idea of locating a number of large-scale nuclear-powered desalination installations on advantageous sites—mostly the seacoasts in the Mideast, as part of a "Phase I" program to create new water resources and, at the same time, inexpensive, plentiful energy supplies for economic development throughout the region.

Where should plants be located? The symbol of the atom/drop of water, is located at 16 points on the map, to identify some favorable locations. Ten are shown on the Mediterranean coast (Syria, Lebanon, Israel, and Gaza); one on the Gulf of Aqaba (Jordan); one on a proposed Red-Dead Sea Canal (Jordan); and three on a proposed Med-Dead Canal, whose Mediterranean starting point might be in Gaza. The three plants on the canal are shown inland, illustrating that one facility might produce water for Gaza and the West Bank, and the other facility along the canal, for Israel. The third plant is shown at the terminus of this Med-Dead Canal route, representing an installation to provide water for Jordan.

In the north, a proposed seawater conveyance route is shown, to signify a potential tunnel from the Mediterranean to the Jordan Valley, where the conduit could supply seawater feedstock to a desalination facility for Jordan. (The route was shown in the October 1994 Government of Israel report, "Development Options for Regional Cooperation," submitted to the Economic Summit for the Middle East and North Africa. The report proposed such a seawater tunnel, running south of Haifa and north of Mt. Carmel, to feed a desalination facility

near Bet She-an, using the potential of the pressure of falling water at the steep drop into the Jordan ravine, to desalt water by using advanced membrane technology.)

How much water? How big should the plants be? These questions, including location, are for the engineers and hydrologists to answer, and governments to decide. There is the additional consideration involved of how best to guarantee security of operation, through regional cooperation and international institutional participation. (See the discussion of this in the feature article.)

Apart from political questions, the physical geography of the Mideast presents especially challenging conveyance and materials questions posed by the prospect of undertaking large-scale water generation and management projects. For example, there is a 400 meter difference between the Mediterranean and Red Seas and the Dead Sea. A particular challenge is the question of underground hydrostatic pressure, among other conditions. The Jordan Rift Valley region is very complicated.

Table 2 presents what seems to be a fabulous prospect of "new" water volumes to be added to the region. But the calculations are in line with technology, population needs, and the fact that the existing water resource base right now is being depleted.

Using the International Atomic Energy Agency (IAEA) proposal (see box) of a per-plant output level of 1 million cubic meters a day, 16 facilities could provide 5.8 billion cubic meters a year to the region, where 34 millions of people reside. It is a seemingly fabulous amount, but it represents the range needed to guarantee meeting all domestic needs for 34 million people, *plus* plentiful supplies over and above that for select agricultural and manufacturing priorities, and potential for future water security.

A smaller number of these large-scale nuclear desalination plants, e.g., ten IAEA-guideline facilities, could produce 3.65 billion cubic meters—enough for the residential needs of the area with little overage.

If the 16 facilities shown on the map make use of a smaller-scale design than the IAEA implies, then the water production is accordingly smaller. Consider the modular high-temperature gas-cooled reactor design (MHTGR), coupled with an advanced desalination technology. The combined output of 16 such plants would add up to around 2.35 billion cubic meters a year. There are safety and "manageability" features of the MHTGR design proposals that are especially desirable for the Mideast.

The point is that, whatever the specific dimensions and designs, *technology can provide a whole new resource base*.

Think about this in comparison to Saudi Arabia, the large desert country where more than 21 million people live. There, desalinated seawater provides 70% of the country's water consumption. Another way to say this, is that the annual Saudi "withdrawal" (use of water for all purposes in the country) of 497 cubic meters per capita a year, is *165% of its water resource base!* In other words, the nation is manufacturing its own water resource base! (See Table 1, for per capita "withdrawal" water use comparisons.)

An artist's rendition of a modern seawater desalination tower. The structure houses a multi-effect distillation process (vertically stacked evaporators), for large-scale output (284,000 cubic meters daily).

It is urgent that "water-manufacturing" be undertaken elsewhere in the Mideast, and in other parts of the world. Except for Lebanon and parts of Syria, where precipitation rates, run-off, and underground sources make water available in localized areas, at present, the water supplies for the region can and must be manufactured.

What's the cost? The electricity from nuclear-generated power is the most economical way to desalinate salt water on a large scale. The key cost element of all of the various types of modern desalination methods (distillation, reverse osmosis, membrane, etc.) is the expense of electricity. The point is made by looking at Saudi Arabia, home to the largest output of desalinated seawater in the world. Some of the most advanced desalination technology is in use in Saudi Arabia, but all powered, of course, by conventional fossil-fuel-generating plants—a circumstance limited to the Persian Gulf states, where such fuels are plentiful and cheaper.

In Saudi Arabia, to make the current annual desalinated water output of 1.97 billion cubic meters, 25 desalination plants are in operation. There are three new plants under construction; long-term plans are under study to build 20 more plants, that would add close to another 1 billion cubic meters a year water production capacity.

Thus, if the total desalinated water output of Saudi Arabia were to increase to the projected 2.97 billions of cubic meters a year, it would be done by 45 to 50 conventional-powered desalination plants. Saudi Arabia at present has the fossil fuel riches to do it.

The same amount of annual water output can be produced by nuclear-powered desalination—anywhere in the world there is saltwater feedstock, with only eight large-scale facilities. Why not do it?