reactor fuel is accumulating here and there at a rate of 2,000 tons annually. At West Valley, N.Y., there is an additional pool of 600,000 gallons of "high-level" waste—the leftovers of a 1966–72 project to salvage plutonium and uranium from spent fuel by reprocessing it.

Nobody is even sure how long wastes must be stored before they are safe, notes Zurer, a *Chemical & Engineering News* reporter. The U.S. Environmental Protection Agency says 10,000 years; the National Academy of Sciences' estimate is 20,000 years. Until *that* question is settled, scientists cannot accurately judge the merits of various underground sites: The possibility of earthquakes or volcanic activity, the likelihood of groundwater contamination, and the characteristics of different kinds of rock must all be factored in.

Also at issue is the proper method of waste treatment. The DOE recently decided that encapsulating radioactive byproducts in special "borosilicate" glass is the way to go, but some scientists and manufacturers argue that high-tech ceramics used in the same way are more reliable and cheaper.

To complicate matters even further, many specialists now favor burying containers of wastes under the ocean floors, which are geologically stable and remote from human activity. And Zurer observes that Washington some day might want to retrieve such spent fuel to extract its plutonium.

Politics must also be considered. Few citizens in the states where repositories might logically be put—Nevada, Washington, and Louisiana—are likely to welcome them. Even though Congress has given itself the power to override objections by the states, private citizens could tie up any decision for years in the courts.

Meanwhile, the DOE is already starting to make some choices about waste storage—e.g., narrowing down the possible sites—even though the federal deadline is 15 years away. But, Zurer says, the stakes are too high (up to $40 billion in disposal costs over the next four decades) and there are too many unanswered questions. Prudence argues for delay on any final plan.

The Tides' Power

"Harnessing the Tides" by James A. Fay, in *Technology Review* (July 1983), Room 10-140, Massachusetts Institute of Technology, Cambridge, Mass. 02139.

In colonial America, hundreds of small grain and lumber mills along the New England coast were powered by the tides. Today, North American engineers are thinking about using the tides again, this time to generate electricity.

Only two tidal generating plants are now in operation: a 15-year-old, 240-megawatt (about one-fourth the output of a large nuclear reactor) French facility and a far smaller one at Kislaya Guba in the Soviet Union. Fay, an MIT engineer, notes that the plants work by trapping water behind a dam at high tide and channeling it back to the sea through a turbine at low tide. (Special reversible turbines can be used to harness incoming tides as well.)

Most coastal areas are unsuited to tidal power schemes—the difference between the water levels at high and low tides (the "tidal range") averages only three feet around the world. But on the New England coast, the range reaches 20 feet; in Nova Scotia's Bay of Fundy, up to 40 feet.

The Canadian government is studying a plan to build a five-mile-long dam across the Minas Basin at the head of the bay. More than 100 turbines would generate some 4,000 megawatts of electricity, enough to supply the state of Nevada. But Fay believes that the environmental costs of such "megaprojects" are too high. Not only would the dam disrupt the vast mudflats of the bay, damaging fish and animal life, but it could raise the tidal range by up to one foot from Cape Cod to Nova Scotia.

Small-scale tidal generators of one to 100 megawatts, Fay contends, could do the same job for about the same cost per megawatt. The idea is already catching on. In Annapolis Royal, Nova Scotia, an 18-megawatt plant is nearing completion; Maine's Passamaquoddy Indians have in hand a preliminary plan for a 12-megawatt project that would cost $3–4 million per megawatt—roughly the same as a nuclear plant.

The technology of tide-generated electricity is ready and awaiting wider use. In the future, another method of tapping the ocean tides may well become more practical. Underwater "windmills" anchored offshore would pose no foreseeable environmental hazards and could be located practically anywhere in any ocean.

Success Story?

"Milk" by Daniel Jack Chasan, in *Science 83* (July-Aug. 1983), P.O. Box 10790, Des Moines, Iowa 50340.

At about age 35, in many areas of the world, humans' physiological machinery switches off production of the enzymes needed to digest milk. Not in America.

That fact, says Chasan, a freelance writer, may help to explain the strong, if declining appetite of U.S. adults for milk, cheese, ice cream, and butter. Americans consume the equivalent of 541 pounds of milk per person annually. And the dairymen keep increasing productivity. Wisconsin, home to 46,000 dairy farms, still leads in output, but California's farms are larger and more efficient. Some dairymen in the West milk as many as 6,000 cows, although the average state herd numbers 400. Wisconsin's average is 50. A typical California cow yields 15,000 pounds of milk annually, 3,000 more than its Wisconsin counterpart.

Technological advances (and hard work) account for today's high dairy farm output. Cows still convert grass, hay, and grain into milk,