Letter From the Desk of David Challinor
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When a nation is at war, the energy of its citizens is harnessed and directed towards the primary goal of defeating the enemy. For my generation, World War II epitomized such an effort, for it was supported by the vast majority of Americans. Complex political issues were clearer then than now and there was little doubt in identifying the "bad guys": Germany, Japan and their allies. A remarkable example of dedication to a single goal was the successful construction of the atom bomb, an awesome device whose use many felt was the primary cause of the Japanese surrender on 15 August 1945.

Although the atom bombing of Hiroshima and Nagasaki may have ended the war without a costly allied invasion of the home islands, it killed several 100,000 Japanese as well as some U.S. prisoners of war. No atom bombs have been dropped since then, but thousands still remain in the arsenals of the world -- a great potential threat to humanity. This letter is about some of the long-term costs of harnessing the atom that were not considered carefully in our race to construct the bomb before the Germans and the Soviets, then our allies. The problems of disposing of nuclear waste during and right after the war were understandably considered a relatively low priority despite knowing how hazardous to life it would be for tens of thousands of years.

After the nuclear tests on remote Pacific atolls, the United States in the late 1960's initiated Operation Ploughshare – an effort to exploit peaceful use of nuclear energy. For about 25 years nuclear power plants were put on line throughout North America and Europe with high hopes for a durable and cheap energy source. Nuclear accidents at Three Mile Island and Chernobyl, however, brought home the dangers of operating nuclear power plants. In the U.S. today, necessary safeguards have become so expensive that no new plants are planned and existing ones are being decommissioned. Even the $20 million spent in the late 1960's to investigate the feasibility of using nuclear devices to excavate a sea-level canal in Central America was for naught. It soon became apparent that about a decade must elapse after each of ten excavation explosions planned across the isthmus of Panama for the local level of radioactivity to drop enough for people to re-enter the construction site.

During the last 20 years, as spent nuclear fuel rods from power plants (both utility and naval propulsion) and weapons-grade plutonium from disassembled missiles steadily accumulated, Congress heeded the warnings of the nuclear establishment to develop a place to store safely this radioactive material. Although no one wanted it in "their backyard," something had to be done and done soon. Government scientists are unanimous in recommending that nuclear waste be deposited in deep underground salt caves. When the Great Plains were part of an ancient sea bed (270 mya), salt basins developed as the seas successively flooded and

evaporated. These ancient basins now lie about 1000' below the surface and are not only rock solid, but are also impermeable to water. A water-free storage chamber is essential for nuclear waste storage because salty water will, in time, corrode storage canisters. A leaky chamber, furthermore, could allow contaminated liquids to reach potable water tables.

In 1970 the Atomic Energy Commission (AEC) selected an abandoned salt mine in Lyons, Kansas as a potential repository for radioactive waste. When the excavated test chamber was carefully inspected, it was found to be full of holes from past oil well drilling. Thwarted by the inadequacy of this former salt mine, the AEC asked the U.S. Geological Service and the Oak Ridge National Laboratory to find a suitable site. In 1973 they recommended salt beds in the Delaware Basin of southeast New Mexico. Although the New Mexico state government was not enthusiastic about the choice of site, the politicians did not generate the strong opposition that arose in Nevada when Congress selected Yucca Mountain in 1987 as the storage site for spent fuel rods and other highly radioactive material. Yucca Mountain is on government land adjacent to the bomb-testing area on the Flats. Initially, Yucca Mountain was only one of a number of sites being considered by the Department of Energy. Geologically, Yucca Mountain is proving to be a questionable choice because cracks in the subsurface rocks there could allow rainwater to penetrate at least to the level of the proposed storage chamber almost 10,000' below the surface. A reasonably safe storage location is still being sought there.

The relatively low level of opposition in New Mexico, compared with that in Nevada, is partly attributable to how the selection process was followed. In New Mexico, an independent scientific advisory board set up in 1978 reviewed all decisions and recommendations of the government scientists. Having such a group, independent of both the state and the federal government, created an aura of fairness and impartiality as the board sought to resolve the problems that arose with each new test drill into the salt beds. Unexpected geological formations were discovered in New Mexico soon after tests began at the proposed site. What first was thought to be a typical 600 m thick horizontal salt bed overlain with about 300 m of clay and sedimentary rock turned out to be one that was tilted almost vertically. The complex geology rendered this initial site inappropriate for excavating a safe storage chamber. Below the tilted salt bed the drill hole penetrated a pool of brine under high pressure which immediately spouted to the surface -- a dangerous condition for a site designed to contain nuclear waste for 25,000 years. Wendell Weart, the head geologist who had spent 20 years on this search for a suitable site, announced to the public his findings -- that the Delaware salt beds at this test site were not a safe storage place.

Another test hole was drilled six years later (1981) and that too brought pressurized brine to the surface. This second unexpected disaster might have killed the search in that area had not the independent oversight committee suggested that the government scientists do a detailed hydrological study of the brine that was reaching the surface. It turned out that the brine was coming from an isolated sealed pool and that by moving the site a relatively short distance away, a safe storage cavern could be built in the subterranean salt bed. Further studies followed and in May 1998, after 25 years of research, the Environmental Protection Agency (EPA) certified that

the storage site could be reasonably expected to contain virtually all of its low level radioactive waste (contaminated clothing, tools, containers, etc.) for the next 10,000 years, and indeed it could be safe for as long as a million years. The bed, after all, had lain there undisturbed for 250 million years. The greatest danger for surface contamination from the underground stored material would be from an accidental piercing of the chamber with a drill thousands of years hence, when the site location might be forgotten. Even should this happen, whatever radiation might then escape would be low enough not to be dangerous.

I have gone into such detail to illustrate the extraordinary effort it has taken just to find a site to dump low level contaminated material, but how about the really "hot" stuff such as the spent cores from power plants and from nuclear powered naval vessels? Such cores are accumulating in temporary surface repositories at Hanford, Washington and elsewhere. How worried should we be? The answer seems to be that nuclear waste disposal is a global problem that will only become greater. Progress is evident. On 25 March 1999, The New York Times published a brief story about nuclear waste from Los Alamos being shipped to the site 40 km east of Carlsbad. This first nuclear (low level) waste depository finally cleared all the legal and technical challenges and is now accepting shipments. Its storage capacity, however, is relatively small and other locations will still have to be found.

Meanwhile, a Minnesota utility has sued the Federal Government for $1 billion because of the delay in establishing a high level nuclear waste repository. The Energy Department signed a contract with utility companies that operate nuclear plants to bury their wastes starting in January 1998. The companies in turn have been paying 1/10 of a cent into a fund for each kilowatt-hour produced by nuclear power. The Energy Department announced that the Yucca Mountain repository will not be ready before 2010. The Minnesota utility will run out of space to store spent rods by 2007 and the Minnesota legislature, nervous about the danger of the current above-ground waste storage, has limited how much more can legally be kept there. In 2007, it appears the utility company's only option will be to shut down the plant. The Minnesota plant is but one of more than 100 nuclear power stations which, combined with at least another 100 reactors on ships and in research facilities, means that temporary surface storage will soon run out.

Despite this imminent threat of not having proper storage facilities for spent fuel rods, the Nuclear Energy Institute in Washington, D.C. took out a large color ad in The New York Times of 10 April headlined "Healthy Air to Healthy Patient – Nuclear makes it happen." The text reads:

> "…nuclear technology enhances our lives… It's the same technology that enables more than 100 nuclear power plants to produce valuable electricity and help keep our air clean. That's one reason why the majority of Americans believe nuclear power … should continue to play an important role in our energy future."

My reaction is: What is the evidence that "the majority of Americans believe…"? If this assertion is true, why is it that there has been so little political pressure to build new nuclear power plants in our country? Nowhere in the ad is there any mention of the waste storage problem. We can no longer keep our heads buried in the sand, for the day of reckoning is fast approaching. A catastrophic leak from one of the present temporary storage facilities would surely generate action, but most people agree that a careful and methodical approach to the problem is best. What can we do? My friend, retired R. Adm. Gene La Rocque, suggests that the U.S. Government invite all nations that have to store nuclear waste to meet and exchange ideas on how best to solve this problem. It is truly a global threat and can only be met internationally. Although no ideal solution may arise from such a meeting, it would publicize that all humanity is in this predicament together and we must cooperate now. We can never live in a risk-free world, but we are obliged to reduce risks as much as possible, and to do so promptly.

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