

The Many Applications Of Nuclear Energy

by Marsha Freeman

When access to U.S. nuclear technology was declassified under Atoms for Peace, most nations had neither the industrial infrastructure, nor the scientific and engineering manpower, to begin building nuclear power plants. But beside the more efficient production of electricity from nuclear reactions, fission offered the near-term possibility of qualitative improvements in agriculture, medicine, biology, and industry. Unlike energy created from the burning of fossil fuels, nuclear reactions produced not only higher-quality heat, but radioactivity.

During the 1950s and 1960s, dozens of small U.S. reactors were exported around the world, to be used for research, for the training of scientific and engineering manpower, and for the production of radioactive isotopes.

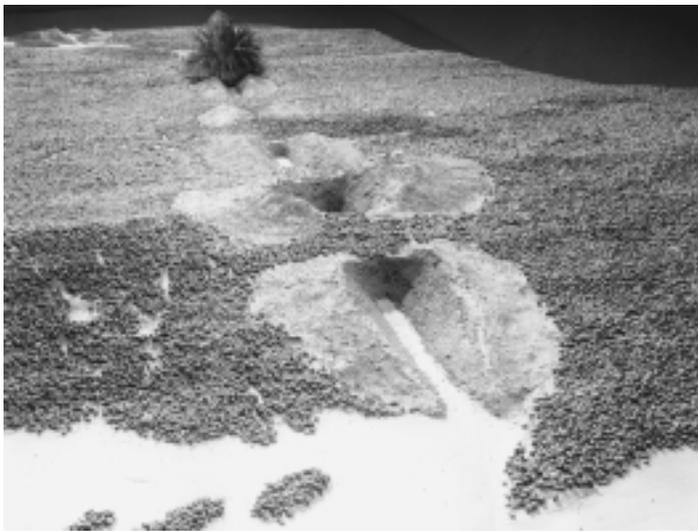
Radiation has been used in a number of ways to cure diseases, such as a variety of cancers, but diagnostic technologies were the earliest medical use, when portable X-rays were used during World War I. Dental X-rays, chest X-rays, mammograms, and many other tests have now become routine uses of radiation. Radiation is also used to sterilize medical equipment.

Radioisotopes are used to test new drugs, where their unique imaging characteristics can track possible side effects, and the effectiveness of a drug's ability to attack a disease. In agriculture, radioactive tracers can be used to determine how efficiently nutrient supplements, such as fertilizers, are absorbed by plants, and irradiation is used to create new crop varieties.

By far the greatest and most immediate impact that radioactivity could have on agriculture, was seen decades ago as its application to the food supply. In 1955, at the first Atoms for Peace conference, the United Nations Food and Agriculture Organization (FAO) promoted the use of radioactivity to preserve food. "Every day nearly 100,000 additional hungry mouths appear at the breakfast table," they reported. Twenty-five years hence, they said, this could be up to 4 billion human beings.

They reported that a very conservative estimate would be that losses from fungal and bacterial infection, and the ravages of pests, destroy 10% of world food supplies, but that the figure would be up to 50% in tropical climates. Such problems could be solved through the application of radiation. The "vast field of potentialities of the peaceful uses of atomic energy has hardly been touched," they concluded.

Similarly, while commercial-scale power plants provide



Peaceful Nuclear Explosions were under investigation in the 1960s for use in large-scale engineering projects. This is a model of the use of PNEs (one is exploding in the background) to create a sea-level Panama Canal. In the foreground is the Atlantic Ocean.

electricity, advanced reactors, which were under development even 40 years ago, could have many applications.

The August 1978 cover story of *Fusion* magazine promoted the deployment of “Nuplex Power for City Building.” In 1967, a group of scientists and engineers at Tennessee’s Oak Ridge National Laboratory, under the direction of the Atomic Energy Commission, had undertaken studies of agro-industrial nuclear-centered complexes, or nuplexes, to be built in developing nations. The stated intent was to allow nations to “leapfrog” in their development, and progress from subsistence agriculture to a nuclear-powered economy.

“The time has come,” stated a 1968 Oak Ridge report, “when the energy derived from nuclear energy can be looked upon very seriously as a key for releasing indigenous agriculture from the bondage” imposed by primitive methods. Input from nuclear power, it stated, “could free these people from Malthusian limitations hitherto imposed upon their indigenous food supply. . . .”

The nuplexes envisioned, which would vary depending upon their location, would be new cities, with electrical energy supplied from one or a cluster of nuclear reactors. Surrounding the city would be industrial complexes; chemical, metals, and material fabrication factories, and others which could use the power, and importantly, high-quality process heat, for industrial production.

In arid regions, nuclear-powered desalination would provide water for the cities and to “make the deserts bloom.” Electricity from the power plant would run the pumps needed for irrigation.

In addition to bringing electricity to rural homes and farms, as Franklin Roosevelt’s Tennessee Valley and Rural Electrification programs did in the 1930s, agriculture could

now benefit from the production of fertilizer, pesticides, mechanized equipment, and other manufacturing inputs, with the goal, as stated by Oak Ridge, of bringing productivity in the Third World up to that of the Imperial Valley in California.

The nuplex studies assumed that the next-generation nuclear technologies would be made available to developing nations. These included breeder reactors, to ensure an available supply of nuclear fuel, and high-temperature nuclear reactors, to provide “waste” heat at appropriate levels for industrial applications.

An article in a subsequent 1978 issue of *Fusion* reported that high-temperature gas-cooled reactors were “on the verge of commercialization,” which indeed they were. Today, however, the only nation that has such reactors in operation, is China, with designs to develop larger-scale commercial advanced reactors.

In the 1950s, Dr. Edward Teller first used the term “geographic engineering,” to describe how nuclear fission would allow man to reshape his environment. In 1957, Project Plowshare was initiated, to investigate whether peaceful nuclear explosions, or PNEs, could be used for the most difficult large-scale remolding of Earth’s geography.

In his 1962 book, *Project Plowshare*, Ralph Sanders—who co-authored the hydrological development proposals in President Eisenhower’s address on the Middle East to the United Nations in 1958—explained that “geographic engineering could help less developed lands where they need it most, in the development of infrastructure.” Peaceful Nuclear Explosions would take on the vast jobs, such as digging new harbors, canals, and dams, that require moving vast tonnages of soil, more economically and quickly than chemical explosives.

Projects that were proposed for study included a second, sea-level Panama Canal, a canal to bring water from the Mediterranean Sea to Egypt’s Qattara Depression, new harbors along the Pacific Coast of South America, the Jonglei Diversionary Canal in Sudan, and a series of dams and canals along the Mekong River in Asia.

In 1962 there were still unanswered questions about the use of nuclear explosions for geographic engineering. The scientists and engineers hoped that the possibility of continuing at least underground nuclear testing would allow them to develop the technology that would reduce emitted radiation. But the real hope was to replace fission with fusion, and virtually eliminate the radiation problem.

Testifying before the Joint Congressional Committee on Atomic Energy, Teller said in 1960: “I can say, not with certainty, but with quite a bit of hope, that we can make nuclear explosives for peaceful purposes so clean that the worry about radioactivity in its peaceful applications may disappear completely.” The research was never done, and the program was discontinued.