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Why Fukushima Won't Kill Nuclear Power

Today's most advanced designs move toward the goal of 'walk-away safety'—reactors that shut down and cool themselves without electricity or any human intervention.

By RICHARD K. LESTER

The accident at Japan's Fukushima Daiichi nuclear power station is still far from resolved. A major public health disaster seems to have been avoided, and the long-term impact on health and safety will be dwarfed by the devastating loss of life caused directly by the huge Tohoku earthquake and tsunami. But the nuclear crisis has badly scared people around the world.

Predictably, longtime antinuclear activists are calling for an end to any further nuclear development. Equally predictably, spokesmen for the industry say the Japanese earthquake was a once-in-a-millennium event and point to the greater safety of newer reactors.

In the U.S., the most urgent need in the wake of the accident is to assess the safety of existing nuclear power plants. Plans to extend the operating life of some 40-year-old reactors for another two decades should be reviewed, and costly upgrades may be required. We must also revisit the longstanding issue of how and where to store spent nuclear fuel. The sensible solution would be to store it in dry concrete casks at one or two central locations. Instead, decades of political dithering have produced only gridlock, so spent fuel remains in increasingly densely-packed storage pools at dozens of sites around the country.

Still, the overall impact of the accident will be fairly small here. The so-called nuclear renaissance wasn't really going anywhere in the U.S. even before the Japanese earthquake. For most utilities, new nuclear plants are simply too big and expensive to contemplate. Only a few such plants would have been built over the next decade. Now some of those may be scrapped.

But that's hardly the end of the story. This year is the 100th anniversary of the discovery of the atomic nucleus, and a little over 70 years since nuclear fission was first demonstrated. In historical terms, that puts the field of nuclear engineering today roughly where electrical engineering was in 1900. Consider what followed: the creation of the electric power grid, television and telecommunications, the revolutions in microelectronics and computation, and much more. None of it was anticipated by the electrical engineers of 1900.

Likewise, no one today can foresee the future of nuclear energy technology at the end of the 21st century. All that can be said with confidence now is that the nuclear power plants of the year 2100 will have about as much resemblance to today's workhorse light-water reactors as a modern automobile has to a 1911 Model T.

In the aftermath of Fukushima, some new technologies already in the pipeline look more promising. New fuel "cladding" materials are being developed that don't react with high-temperature steam to produce hydrogen—the cause of the shocking explosions in Japan. Other new plant designs rely on natural heat conduction and convection rather than electric-powered pumps and valves and human intervention to cool the fuel in reactors that have shut down.

Today's most advanced designs go even further toward the goal of "walkaway safety," that is, reactors that can shut themselves down and cool themselves off without electric power or any human intervention at all. Longer-term possibilities include lifetime fueling, which would allow a single charge of fuel to power a reactor for its entire life—making it, in effect, a nuclear battery. Integrated power plant/waste disposal systems are another promising concept. Here, used fuel never leaves the site and is disposed of directly in stable, dry bedrock several kilometers below the earth's surface (more than 10 times as deep as the controversial Yucca Mountain nuclear waste facility in Nevada.)

Huge gains in computing power already enable far more precise simulations of nuclear-reactor behavior than ever before. Computational advances will also make it possible to design radiation-resistant materials literally atom by atom and, perhaps, specially tailored nanostructures that could store long-lived nuclear waste safely for tens of thousands of years. All of this can be foreseen today, and much greater advances surely lie over the horizon.

The innovators here will not be today's industry leaders or officials at the U.S. Nuclear Regulatory Commission, but rather the young men and women who for the last decade have been entering university nuclear engineering programs in growing numbers. They see great engineering challenges in designing new nuclear power systems that are safe and economical, and they see an opportunity to help ameliorate the grave threat of climate change. They know that nuclear energy is the only low-carbon energy source that is already generating large amounts of electricity and can meet the world's fast-growing appetite for power.

After the accidents at Three Mile Island in 1979 and Chernobyl in 1986, many of the brightest nuclear scientists and engineers left the field. The management of existing nuclear reactors improved, but technological innovation was slow and incremental.

We shouldn't allow that experience to be repeated. This is not the time for the nuclear industry to circle the wagons: The need for intellectual vitality, flexibility and creativity has never been greater. An already safe technology must be made demonstrably safer—and less expensive, more secure against the threats of nuclear proliferation and terrorism, and more compatible with the capabilities of electric power systems and the utilities that run them. The advantages of nuclear power in displacing fossil fuels are simply too great to ignore.

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