After Fukushima Daiichi, What's Nuclear Energy's Future?

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It is ironical that an era heralded as a prospective nuclear renaissance will actually turn out to be a renaissance for anti-nuclear activists. Equally ironical is that just as nuclear power was achieving grudging acceptance, if not an embrace, by many environmentalists as a needed element of "green power," that acceptance was swept away by an earthquake/ tsunami which appears to justify much of the earlier trepidations. The fates turned against the anticipated "renaissance."

The development of shale gas has made gas-fired power plants more economically attractive than nuclear power plants, which still require direct or indirect subsidies to be competitive. The construction costs of nuclear plants had already risen before the tragedy of the Fukushima-Daiichi plant. Inevitably that leads to further review or, as in Germany, the closing of nuclear plants. In democracies—where public opinion rules—the prospects for nuclear power have fallen under a heavy cloud. Instead of the expected renaissance of nuclear power, there may even be a shrinkage here in the United States. Boards of directors, fearful of lawsuits and prudency hearings, will be increasingly hesitant to authorize new nuclear construction.

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To be sure, authoritarian governments, such as China, have more latitude to proceed with new plants, since public opinion or lawsuits need not be a deterrent—though a retreat to coal-fired plants may readily be justified. Thus the prospects for nuclear power look unpromising at least for the near future. The hoped-for "renaissance," always exaggerated, both by the industry and by governments attempting to reconcile energy growth with aspirations for controlling carbon dioxide emissions, will inevitably turn out to be a major disappointment. ◆

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The tragic nuclear accident at the Fukushima Daiichi nuclear power station, FNPS-1, will undoubtedly cause all countries to review the ability of their nuclear facilities to withstand severe natural disasters at the limit that can reasonably be imagined to occur. It is unrealistic to think that the nuclear power industry can go forward as if nothing has happened. The public is unlikely to be swayed by reaffirmation that either nuclear power is an essential part of the energy future, or that the Japanese disaster confirms the unsuitability of nuclear power. The public deserves, and good government demands, objective study of implications of the Japanese experience for the level of risk of catastrophic damage to which the public is exposed from extreme natural disasters.

Some questions need to be addressed. First, is the design basis threat still a valid concept? Construction and operating licenses are granted on the basis of engineering analysis that a plant design can withstand an accident scenario judged to be at the limits of severity and likelihood. An adverse, improbable realization of a hazard that exceeds this limit is bad luck and not a compelling reason to either reject the design basis concept or raise the design basis level. It is a reason to reexamine whether the design basis set for each existing plant is still appropriate given current knowledge; if not, are practical remedial actions possible? A more rigorous safety design basis taking into account combined stressing events may be appropriate for new reactors.

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Second, do boiling water reactors present a greater risk than pressurized water reactors or other reactor technologies? My view is that all existing nuclear reactor technologies can be engineered (at some cost) to as high a safety level as desired, but this does not guarantee safety in all eventualities.

Third, are there adequate provisions for backup power? The failure of onsite backup power at FNPS-1 was a principal cause of the extensive damage, and signals the need to review backup power provisions at every reactor site.

Fourth, are onsite spent fuel pools an excessive risk? For many years, the prevailing practice has been to rely on onsite spent fuel pool storage, progressively loading the pools more densely. The FNPS-1 accident shows that if the ability to circulate water is impaired, and the pool contains hot fuel, exposed fuel can burn, releasing radiation to the atmosphere. A shift to long-term centralized dry storage for spent fuel storage is likely.

Fifth, how realistic is emergency preparedness? The Japanese utility and government did not seamlessly work together as the accident developed. This underscores the importance of emergency response, and federal and state regulatory agencies are sure to call for more diligent attention to planning and exercises.

These and other questions have answers. The surest way to restore confidence in nuclear power depends upon completing a thorough safety review through a transparent process with the opportunity for public comment. Done well, the result will be a safer system, but inevitably at greater cost of power and more regulation. Done poorly or rushed, there is a significant chance the public in the United States and other countries will once again turn against nuclear power, foregoing an important energy source. ◆

Cattenom Nuclear Power Station, France.

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The Fukushima nuclear disaster will delay increased use of nuclear power by decades. The industry's future—if it has one—depends on the construction and successful demonstration of new advanced technologies, such as the pebble bed reactor. The era of the current light water technology used in Europe and the United States is over.

Experts from the nuclear industry no doubt have other views. However, they do not recognize the public's deep distrust of the energy industry. The public's lack of confidence in and unwillingness to believe information given out by the nuclear industry is only trumped by one other sector: tobacco, according to annual Harris Poll surveys. Under current circumstances, the general populace will never be talked into accepting continued use of conventional nuclear power plants in the United States or Europe.

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The future of nuclear power thus falls to China. Chinese companies are pushing forward with advanced plant designs such as the above-mentioned pebble bed reactor. These plants are designed to shut down by themselves if something goes wrong rather than melt down. The industry may have prospects going forward if firms in China or some other country can build and operate these facilities successfully.

Demonstrating the safety and reliability of advanced reactors will resolve only one of the industry's Achilles' heels, however. Governments and the industry must also address the issue of processing or storing spent fuel. The shutdown presents an opportunity to deal with this challenge. Whether this will happen remains an open question.

In any case, it will take decades to solve these problems cost effectively. Nuclear power may be reborn again in the United States and Europe around 2050, but until then the industry has no future. ◆