Policy Forum 11-19: A Crisis of Confidence, But Nuclear Power Is Here to Stay

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Recommended Citation

Jor-Shan Choi, "Policy Forum 11-19: A Crisis of Confidence, But Nuclear Power Is Here to Stay", NAPSNet Policy Forum, July 19, 2011, https://nautilus.org/napsnet/napsnet-policy-forum/a-crisi--of-confidence-but-nuclear-power-is-here-to-stay/

A Crisis of Confidence, But Nuclear Power Is Here to Stay

By Jor-Shan Choi

July 19, 2011

This article was originally published by Global Asia (Volume 6 Number 2).

Nautilus invites your contributions to this forum, including any responses to this article.

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I. Introduction

Jor-Shan Choi, Associate Director of the Berkeley Nuclear Research Center, University of California, Berkeley, argues that the tragedy at Japan's Fukushima nuclear power plant will do little to deter the growth of nuclear power in the region. He writes, "There is no doubt that nuclear power will also survive the Fukushima incident, and can use it as a unique opportunity to refocus on the three fundamentals — human factors, safety, and waste disposal."

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II. Article by Jor-Shan Choi

-A Crisis of Confidence, But Nuclear Power Is Here to Stay

By Jor-Shan Choi

While some European countries have started rethinking their nuclear programs in the wake of the Fukushima nuclear power plant disaster in Japan, emerging Asian nations are not. With a pressing need to ramp up power capabilities to provide for their growing and ever more affluent populations, they know that nuclear power is their only real hope.

It might seem counterintuitive given the recent disaster at Japan's Fukushima nuclear power plant, but that tragedy will do little to alter the fundamentals of nuclear power in Asia. The industry will absorb the setback, pause and refocus on the fundamentals for a healthy and sustainable expansion. Indeed, the pre-Fukushima demand for nuclear power development in Asia has not changed. Nuclear power plants remain the most attractive option where energy demand is growing and alternative resources are scarce, especially at a time when energy security, reducing air pollution and lowering greenhouse gas emissions are a priority. These are the conditions found in most of the emerging economies in Asia.

Many Asian nations are looking to build more nuclear power plants to deal with the twin problems of global warming and rising demand for generating capacity. Nuclear power emits virtually no greenhouse gases. The complete nuclear power chain, from uranium mining to waste disposal, including reactor and facility construction, emits only 2-6 grams of carbon per kilowatt-hour. This is about the same as wind and solar power, and two orders of magnitude below coal, oil and even natural gas.

Asia has become the principal region for new nuclear power projects as a result of increasing populations and rising living standards. With much of the world's manufacturing having shifted to Asia, stable and reliable energy sources must be found to drive this primary engine of growth. A developed country in the West that outsources much of its manufacturing may have the luxury to abandon its nuclear power capacity, but the emerging economies of Asia can't afford to ignore this proven technology. If Asia were to replace all operating nuclear power plants with fossil fuel power plants, the result would be an increase of 300 million tonnes of carbon released into the atmosphere

per year, equal to the total amount of carbon emissions eliminated by the Kyoto Protocol in 2010.

The Fukushima Factor

Fukushima remains a game-changing event, and its near- and long-term impacts are still evolving. In the aftermath of the March 11 earthquake and tsunami that caused the reactors to go dangerously wrong, there were two or three countries in Europe either calling for a complete shutdown, as in Germany, or a rethinking, as in Switzerland, of their respective nuclear programs. Policymakers in Asia, including Japan, have expressed caution but have not changed their commitment to nuclear power. However, public confidence in nuclear power has suffered enormously in the wake of Fukushima and this confidence must be restored.

Over the course of nuclear development, other severe accidents have occurred. The incidents at Three Mile Island in the United States in 1979 and Chernobyl in the former Soviet Union in 1986 were devastating, but many lessons were learned and nuclear energy has progressed from these events. There is no doubt that nuclear power will also survive the Fukushima incident, and can use it as a unique opportunity to refocus on the three fundamentals — human factors, safety, and waste disposal — that are discussed below.

Human Factors: Fukushima shows the human side of a nuclear disaster. I was in Japan when the earthquake and tsunami happened. My tenure as a project professor in the Department of Nuclear Engineering and Management at the University of Tokyo was supposed to be completed at the end of March, but was extended to April because of Fukushima, allowing me to witness first-hand the responses of the government and utility companies to the nuclear emergency. During the first week of the Fukushima incident, I told my colleagues at the university that what was in short supply in Japan, besides electricity, food and water, were trust and leadership. The lack of leadership, manifested in the withholding of information on the unfolding nightmare, was compounded by communication problems. At that critical time, the transmission of information between and from the government and utility officials was so poor that their intent was often misunderstood. For example, when the plant's operator, the Tokyo Electric Power Co. (TEPCO), stated that all personnel other than 50 emergency workers were to be removed from the site, this was interpreted as TEPCO abandoning the plant. The lack of authoritative communication was a large contributor to the widespread mistrust felt by not only foreigners but also the Japanese people.

Japan is a well developed and industrialized country with the world's third biggest nuclear power program. Yet the human resources so crucial to its nuclear program proved lacking in some areas. The need to continuously develop capable human resources is essential to maintaining the viability of nuclear power in Asia.

Nuclear Safety: Fukushima serves as a reminder that safety is of the utmost importance in designing, building and operating a nuclear power reactor. Fukushima is different from Three Mile

Island and Chernobyl in that the accident was caused by two of the worst natural disasters (a 9.0 magnitude earthquake and a massive tsunami) ever recorded in Japanese history. The reactors shut down as designed when the earthquake struck, but the tsunami ripped away the plants' cooling capabilities (sea-water pumps that cooled the plants' residual heat removal system, among others) leading to the core overheating, partial fuel-melting, hydrogen explosions and radioactive releases into the surrounding area.

The power plants in the Fukushima Daichi complex were built in the 1970s when the design criteria were not as stringent as they currently are, and the twin natural calamities exceeded the plants' design basis. In order to provide a viable nuclear power option, restore public confidence, and regain the technology's acceptance in Asia and elsewhere, the nuclear power industry needs to raise safety standards beyond the design basis, make information more accessible and put in place a strong — and trusted — team of independent regulators to supervise safety.

Waste Disposal: Fukushima also exposed the problem of what to do with used fuel that is generated, stored and accumulated in nuclear power stations. This problem is obviously not confined to Fukushima but is common to all nuclear power programs in the world. In fact, the US, with more than 65,000 tons, has the biggest used fuel inventory of all civilian nuclear power programs. Over the long term, the scientific and technical communities generally agree that nuclear waste can be disposed of safely by deep geological burial in suitable hard rock, salt or clay formations. While the US abandoned its controversial 20-year effort to construct a geologic repository in Yucca Mountain, Nevada, Finland and Sweden continue to develop mined repositories to dispose of used fuel.

Debates on nuclear waste management have been focused on the handling of plutonium, a by-product of nuclear fission in reactors. Countries concerned with the possibility of plutonium being misused for nuclear weapons prefer a once-through approach including the direct disposal of used fuel, while other countries consider plutonium a future energy resource for fast reactors and advocate reprocessing and recycling. These debates have ignored the fact that only 0.5 percent of long-lived and heat-generating byproducts in used fuel needs to be disposed of in deep geologic formations. The rest (95 percent of uranium and 3.5 percent of short-lived byproducts) does not pose a sufficient hazard to warrant deep geologic disposal. Plutonium, comprising about 1 percent of used fuel, could be utilized in a fleet of economically viable fast reactors if and when they are available, or it could also be disposed of in deep boreholes within geologic formations. The deep borehole technology, going to depths of 5 to 10 km, has been demonstrated in the oil and gas industry and is readily available. The disposal of long-lived and heat-generating wastes in deep boreholes can permanently isolate such waste from humans in relatively small geographic foot-prints that should minimize or eliminate most public concerns.

Radioactive waste disposal, however, has proven to be an intractable issue that many consider the Achilles' heel of nuclear power. A solution to waste disposal is the biggest confidence-building measure needed for public acceptance of future nuclear power development.

Looking toward the future, in the last two decades Asia has not only been building nuclear-generating capacity but also expanding its technology and nuclear supply capability. The growth of nuclear power will continue in Asia despite the Fukushima accident, and the Asian nuclear industry

will supply nuclear power to both Asia, as shown in the ongoing South Korea-United Arab Emirates nuclear deal, and other parts of the world. The vitality of its developing economies will ensure that Asia continues to be the main arena for nuclear power development in the future. Indeed there is little alternative to a safe nuclear option — nor need there be.

III. Nautilus invites your responses

The Northeast Asia Peace and Security Network invites your responses to this essay. Please send responses to: bscott@nautilus.org. Responses will be considered for redistribution to the network only if they include the author's name, affiliation, and explicit consent.

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