The Impact of the Fukushima Nuclear Accident on the Future of Nuclear Power

By Rob Graber and Margaret Harding*

The Fukushima nuclear accident will likely have a limited impact on the future of nuclear power globally for one very simple reason: its role in the world's energy economy was already diminished prior to the accident on March 11th.

According to the U.S. Energy Information Administration's International Energy Outlook 2010[1] nuclear power is expected to comprise about 6% of the world's primary energy supply over the period 2010 to 2035 with little growth expected, particularly in the OECD countries. Natural gas and renewables will comprise most of the energy growth in the OECD countries. In the non-OECD countries, coal and renewables supply the growth; but with a higher nuclear growth rate than in the OECD countries. However, nuclear is growing from a smaller base than the other energy resources. Nuclear is simply not expected to be a factor in meeting the world's energy needs, nor abating atmospheric carbon dioxide (CO_2)[2].

The source of nuclear energy's diminished role is not hard to find. In spite of the fact that the new GEN III reactors were seen to herald in a new age of nuclear with safer, simpler and more efficient technologies, the capital costs were seen as a large barrier to implementation; and the time required to license, construct and commercialize nuclear reactors has not improved from the earlier new build era (1970-1990). These factors belied the initial claims of the industry that the new generation would be considerably cheaper than the GEN II technology, at least in the U.S. and Europe. Outside these regions, capital costs are, in fact, living up to billing, particularly in China, India and Russia.

The response to the accident varied by country; but where a country had aggressive build plans there was little immediate (and probably long term) impact of the accident on scheduling. This is shown in the accompanying table.

As can be seen from the table, except for Japan and Germany, there are no immediate plans to shut down reactors. Of countries with large nuclear fleets, or aggressive construction projects underway only the U.S. and China are holding up new reactor licensing for a period of time to absorb lessons learned. However, these stoppages are likely to be relatively short.

On the international front, the accident has revealed some shortcomings which will likely be reflected in new policies at the IAEA, and NRC in the U.S., and which were actively discussed at the G8-G20-NEA meeting in Paris on June 7th. First and foremost, and long overdue, there is a proposal for more IAEA monitoring and for stress testing of countries' nuclear plants, as well as obligatory peer reviews.

What can account for such a relatively tepid response to the accident—the third one in the last 32 years?

First of all, the disaster was initiated by a series of external events that border on the improbable and which exceeded the design basis of the reactor; not by any design or operational flaws (as was the case for both Three Mile Island and Chernobyl). In fact, the entire disaster could have been prevented with very basic measures, such as increasing the elevation of the emergency diesel generators that are designed to maintain power to the reactor pumps in the event of a station blackout. Further, most countries quickly concluded that the chances for such an event were relatively small, particularly countries not bordering the seismically active Pacific basin. For example, In the U.S. only 4 out of 104 units could be immediately affected by the same series of events.

Secondly, the reactors at Fukushima Daiichi are not in any way representative of the newer GEN III or GEN III+ nuclear reactors. The GEN III designs are the ones that initiated the so-called nuclear renaissance because they are simpler and safer to operate. These plants, especially the GEN III+ plants have incorporated the lessons learned from the GEN II era of plants. For instance, both the Westinghouse AP1000 and the GE Hitachi ESBWR have passive safety designs that can maintain cooling water for up to 72 hours under complete station blackout conditions and without any operator intervention. The core damage frequencies of these newer plants are at least an order of magnitude lower. These passive safety plants will make up a large proportion of new plants, perhaps more so following the accident.

And finally, most countries have climate change commitments for which only nuclear power, wind and solar technologies will be practically available in the near to medium term to stem the production of CO_2. While there are technologies in development that could use fossil fuels, such as coal gasification with carbon capture and sequestration, they are unproven at the required scale and will take a decade or more to enter commercialization, if they are proven economically viable. Of the three technologies mentioned, only nuclear is capable of continuous output; both wind and solar are intermittent resources that require backup, usually natural gas

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See footnotes at end of text.

facilities, or advanced energy storage technologies that are not yet available.

There is little doubt, however, that the Fukushima accident will be a turning point in the history of civil nuclear power. The sheer scale of the accident (affecting directly 4 of the 6 nuclear units on the site), and the Japanese response (both TEPCO and the government) indicate that serious weaknesses were present in the Japanese regulatory system (and which are still being investigated) and may be present in other countries' regulatory regimes. In contrast, while Chernobyl demonstrated that an accident in one country can affect others, the unique design and non-standard operation contributed to a muted response in developing stronger international controls.

Fukushima, while an older design, is certainly not unique. Around the world there are dozens of reactors of similar vintage and design. While other countries, such as South Korea, Canada, the U.S. and most European countries operate a large number of reactors with few incidents—even when there are challenges such as earthquakes—there is concern that countries interested in implementing nuclear energy, but lacking a strong history in the technology may not be able to respond to similar disasters effectively. These concerns are driving increased international controls and oversight.

The Fukushima Daiichi nuclear accident will not materially influence the role of nuclear power in meeting the world's energy requirements. Countries with significant growth in energy needs and climate change commitments will continue to develop nuclear power, in spite of the accident, although international and national regulatory regimes are likely to change in the wake of the accident.

Country	Reactors Shut Down[3] (Immediate impact)	Halted/Delayed New Reactors (Impact 3-5 years)	Reduced Future Nuclear Role (Impact 5-20 years)	Affected PLE (Impact Immediate to 10 years)[4]
Argentina	No	No[5]	No	No
Armenia	No	No	No	
Belgium	No	None	None planned	
Brazil	No	No	No	
Bulgaria	No	Yes[6]	No	
Canada	No	No	No	
Chile	None	No[7]	No	
China	No	Yes	No	Yes[8]
Czech Republic	No	No	No	
Finland	No	No[9]	No	
France	No	No	No	Yes
Germany	Yes	None	Yes[10]	Yes[11]
Hungary	No	None	No Plan	No
India	No	No	No	No
Iran	No	No	No	None
Italy	None	Yes	Yes	None
Japan	Yes	Yes	Yes	Yes
Kingdom of Saudi Arabia	None	No	No	None
Mexico	No	None		
Netherlands	No	No	No	
Pakistan	No	Unknown	Unknown	Unknown
Romania	No	No	No	
Russia	No	No	No	No
Slovakia	No	No	No	
Slovenia	No	None	No	Not applicable
South Africa	No	No	No	Not applicable
South Korea	No	No	No	Unknown
Spain	No	None	Unknown	Unknown
Sweden	No	No[i]	No	Unknown
Switzerland	No	None	Yes	Yes
Taiwan	No	Yes[ii]	Under review	Yes
Turkey	No	Yes	No	
Ukraine	No	No	No	
United Arab Emirates	None	No	No	None
United Kingdom	No	Partial	No	
United States	No	Yes	Unknown	Unknown
Venezuela	None	Yes	Yes	None

Footnotes

[1] U.S. Energy Information Administration, "International Energy Outlook 2010 (Reference Case Projections)", http://www.eia.gov/oiaf/ieo/index.html

[2] See, for example, Rothwell, G., Graber, R., "The Role of Nuclear Power in Climate Change Mitigation", Generating Electricity in a Carbon-Constrained World, Sioshansi, F. (ed), Elsevier (2010)

[3] Platts Nucleonics Week, May 12, 2011

[4] "PLE" is Plant Life Extension

[5] http://www.cnechile.cl/?page_id=2756

[6] Platts Nucleonics Week, April 21, 2011

[7] http://www.bbc.co.uk/news/world-latin-america-12768148

[8] Platts Nucleonics Week, April 14, 2011

[9] Platts Nucleonics Week, May 5, 2011

[10] Platts Nucleonics Week, April 28, 2011

[11] Platts Nucleonics Week, March 24, 2011

[12] http://www.stralsakerhetsmyndigheten.se/In-English/About-the-Swedish-Radiation-Safety-Authority1/News/Press-release-Lessons-from-Fukushima-for-safety-work-in-Sweden/

[13] http://www.bloomberg.com/news/2011-04-12/taiwan-halts-plans-to-build-atomic-reactors-after-japan-crisis.html