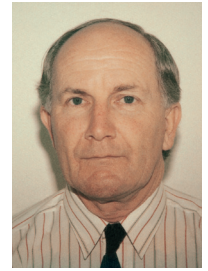


Increasing Nuclear Power in the Asia-Pacific Area

By Ross STOCKALL



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Asia-Pacific Nuclear Power before March 2011

Several factors have influenced recent interest in nuclear energy. Among them are a reliance on imported fossil fuels, desirability of diversifying the energy mix, ambitions to reduce greenhouse gas emissions, increased energy demand, and the need to maintain economic growth.

Before the disastrous effects of the Great East Japan Earthquake most major countries included nuclear power in their energy policies, but there was a wide variation in countries in the Asia-Pacific region. As the only nuclear power growth market for more than 10 years, Asia had been considered as the future nuclear powerhouse. Nevertheless, nuclear energy remains a minor part of the region's energy profile (Tables 1 & 2).

General Reactions after March 2011

Reports on Fukushima resulted in European actions to deter the increased use of nuclear power and in some cases decommissioning, but many analysts believe there will be no major impact in Asia, the main region for new projects. The reactions in Asia have been restricted mainly to learning from Fukushima, examining reactors' safety and reviewing regulations.

As Peter Hayes noted ('Global Perspectives on Nuclear Safety and Security after 3-11,' *The Asia-Pacific Journal*, Vol. 10, No. 3, April 2012), the earthquake and tsunami of 3.11, 2011 exposed several design flaws in current technology. Don Higson of the Australasian Radiation Protection Society noted that a factor influencing the inclusion of nuclear power in energy strategies was that public acceptance had recovered from the Three Mile Island accident (1979) and the Chernobyl disaster (1986). This changed after March 2011 as the anti-nuclear lobby became reinvigorated and the nuclear energy debate gained momentum.

TABLE 1
Nuclear power, selected countries, 2010

Country	Nuclear electricity generation (a)	Nuclear electricity generation as % of total generation
Canada	85.5	15.1
China	71.0	1.8
India	20.5	2.9
Japan	280.3	29.2
Mexico	5.6	3.6
Pakistan	2.6	2.6
South Korea	141.9	32.2
Taiwan	39.9	19.3
US	807.1	19.6

Source: World Nuclear Association
(a) billion kW/h

Government decisions on nuclear power are based on many economic and political factors including the relative costs, extent of public acceptance and the flexibility of greenhouse gas emission reduction policies. According to the World Nuclear Association, while many countries using nuclear power reviewed their policies, the majority are firmly committed to their programs but are keen to learn from Fukushima (Table 3). Some countries planning to begin a nuclear program have postponed their plans, for example Thailand.

Country Responses

Before Fukushima, nuclear energy provided Japan with about 30% of its electricity and under the June 2010 Basic Energy Plan (BEP) it was to increase to about 50% by 2030. After 3.11, 2011, Minister for Economy, Trade and Industry Yukio Edano said he favoured replacing nuclear energy with renewable energy and suggested that Japan will not be relying on nuclear energy this summer. Japan also introduced a new law requiring the decommissioning of aging plants with continued operation allowed at regulators' discretion. In mid-April 2012, Minister Edano confirmed the government's objective to eventually reduce Japan's nuclear energy to zero. The last of Japan's reactors was closed for maintenance on 5 May 2012. Japan is attempting to maintain its electricity requirements by increasing the use of liquefied natural gas (LNG) and renewable energy together with efficiency and conservation measures.

China has experienced consistent growth, expansion of the economy and a corresponding increase in energy demand. About 80% of electricity has been coal-fired and given the anticipated electricity demand to 2035, China is addressing both supply security and greenhouse gas emission issues. Before Fukushima, China had embarked on an expansive program for nuclear energy and this is continuing. In mid-March 2011, China suspended approvals for new nuclear power plants to examine safety

TABLE 2
Energy mix of Asia-Pacific, consumption (a)

Source	Asia-Pacific	World	Asia-Pacific share, %
Oil	1,267.8	4,028.1	31.47
Natural gas	510.8	2,858.1	17.87
Coal	2,384.7	3,555.8	67.07
Nuclear	131.6	626.2	21.02
Hydro	246.4	775.6	31.77
Renewables	32.6	158.6	20.55
Total	4,573.8	12,002.4	38.11

Source: Based on data in BP Statistical Review of World Energy 2011
(a) million tonnes of oil equivalent

standards but confirmed its intention to maintain its nuclear program. China is confident it will meet its nuclear energy capacity target by 2020.

South Korea's nuclear sector is extensive and supplies over 30% of its electricity requirements. There are no changes to plans to increase nuclear capacity. South Korea is focusing on improving plants' ability to survive natural disasters rather than reducing nuclear energy capacity.

Vietnam's expanding economy requires significant increases in electricity but the absence of operating reactors and reliance on fossil fuels have caused substantial pollution in major cities. The government has confirmed its commitment to its nuclear power program, assisted by Russia and Japan.

The 20 existing nuclear reactors in India have low output and account for less than 3% of generating capacity. India has confirmed plans to quadruple nuclear power from 4,650 to 20,000 megawatts by 2020 but will review safety systems and designs.

In other Asian countries the situation varies: Malaysia announced plans for two reactors but appears to be waiting for detailed reports on Fukushima before making a final decision; Taiwan has confirmed it will continue its nuclear program but recognized the need to review its safety and response program; before Fukushima, Thailand had five reactors proposed but has frozen further action; Indonesia intends to continue with its nuclear program, claiming its technology is more advanced than that used at Fukushima; and Pakistan has plans to increase its nuclear energy capacity but will review safety systems.

To reduce its reliance on natural gas Mexico has given some support to increasing nuclear energy but this has slowed because of lower gas prices. In Canada, the Nuclear Safety Commission has concluded that its nuclear power plants are safe but it is introducing design improvements for severe accident management. The US has the largest number of nuclear power plants and in February 2012 public support for nuclear power was described as robust. The Nuclear Regulatory Commission has authorised construction of the first new plant since the early 1980s.

Australia has no nuclear generated electricity but has about 33% of the world's reasonably assured uranium reserves. Australia is a major exporter of uranium oxide to countries which must meet strict non-proliferation and safety conditions. Changes in nuclear energy capacity in the Asia-Pacific region impact on Australia in several ways. With the increase in nuclear energy plans there has been a renewed interest in ensuring uranium supply. For example, in the current negotiations with Australia on Free Trade Agreements, Japan and China have moved to have energy security

included. As Australia exports to several countries in the Asia-Pacific area, a decrease in nuclear power generation would have a negative impact on uranium mining. As at least part of any reduction in nuclear generation would need to be replaced by fossil fuel, the Australian LNG and coal sectors are likely to benefit. Australia is the world's largest coal exporter and the major coal source and second-largest source of LNG for Japan.

Australia's concern extends past trade matters to weapons' proliferation and safety issues. Given Australia's role as an important uranium exporter and possibly the largest future producer, it has an interest in ensuring that nuclear energy technologies and materials are not diverted for weapons use and that global nuclear governance is effective. As emphasised by Trevor Findlay (*Nuclear Energy and Global Governance: Ensuring Safety, Security and Non-Proliferation*, Routledge, 2010), Australian policy towards nuclear energy in its region needs to show that it is not seeking to deny any country the perceived benefits of a technology that Australia has, for the foreseeable future, rejected for itself.

Economic Growth

Asia's rising population, increased urbanization and industrial production, and expected economic growth are major challenges to providing increased electricity and reducing greenhouse gas emissions. In the decade to 2010, primary energy demand in Asia increased by 73% but electricity consumption doubled. In China for example, electricity demand tripled while in Vietnam it increased by 400%. In the same period, China alone accounted for about half the world's increased electricity demand. Asia now accounts for about 45% of world energy consumption.

Many governments, energy research organizations and analysts believe that nuclear power needs to make a contribution to the increasing demand for electricity. Because of the increased competition between Asian countries for oil and gas some consider nuclear energy will be necessary for survival. South Korea, for example, has emphasized that the competitiveness of its manufacturing sector is due partly to the lower cost of its nuclear energy. In Japan, as visiting University of Tokyo professor Kazutomo Irie noted in a seminar at Australian National University ('Changes in Japan's Energy Policy and its Implication for Australia,' 9 March 2012), departure from the BEP with further energy conservation and higher-cost renewable energy may accelerate the transfer of industries from Japan.

Climate Change

Coal-fired electricity would consume about 3 million tonnes of coal per year to produce electricity for a city of 1 million and release about 10 million tonnes of carbon dioxide. A nuclear reactor would use 1 tonne of uranium-235 to produce the same electricity.

Increased use of nuclear power is not the complete answer to reducing greenhouse gas emissions. Other approaches including renewable energy, improved efficiency and developing technologies such as carbon capture need to make a contribution. Renewable energy is increasing. For example, wind power generation worldwide increased at an annual rate of 26.5% from 2005 to 2010 and photovoltaics by about 50%. Renewable energy (excluding hydro) in the Asia-Pacific region presently accounts for about 20% of the world's generation by renewables (*Table 2*). Many who support reductions in greenhouse gas emissions believe that nuclear energy should only be considered when renewables have been used to the maximum.

TABLE 3

Nuclear power reactors, Asia-Pacific, as at March 2012

Country	Existing	Under construction	Planned	Proposed
Bangladesh	0	0	2	0
Canada	17	3	3	3
China	15	26	51	120
India	20	7	16	40
Indonesia	0	0	2	4
Japan	54	2 (a)	10 (b)	5 (b)
Malaysia	0	0	0	2
Mexico	2	0	0	2
Pakistan	3	1	1	2
South Korea	23	3	6	0
Taiwan	6	2	0	1
Thailand	0	0	0	5
US	104	1	11	19
Vietnam	0	0	4	6

Source: World Nuclear Association and Irie, 2012

(a) Suspended (b) Deferred or being reconsidered

TABLE 4

Nuclear proliferation status, selected countries

Status	Country
Non-Proliferation Treaty recognized nuclear weapons	China, Russia
Nuclear armed countries outside Non-Proliferation Treaty	India, North Korea, Pakistan
Latent nuclear weapon capability	Japan
Nuclear infrastructure to make weapons	South Korea, Taiwan
Research facilities which could form basis of latent nuclear weapons program	Australia, Indonesia, Kazakhstan

Source: Based on Ferguson, 2010

National Security

Governments favoring nuclear power and the nuclear industry have for many years attempted to separate issues related to security and safety, but anti-nuclear groups view nuclear electricity generation as an undesirable move towards nuclear weapons. Many see the present situation as an opportunity for renewed action against proliferation. The increase in nuclear energy in the Asia-Pacific area will impact on the potential for the proliferation of nuclear weapons. A crucial issue is whether governments will move into fuel preparation and processing which will provide the ability to proceed to nuclear weapons. This capacity is a necessary but not a sufficient condition for proliferation. The political inclination to pursue proliferation is the key driver (Charles Ferguson, 'The Implications of Expanded Nuclear Energy in Asia,' *Asia's Rising Power and America's Continued Purpose*, The National Bureau of Asian Research, Washington DC, 2010).

Some analysts, such as Ferguson, are concerned that the fast growth in plant construction may outstrip a country's ability to provide skilled personnel to ensure the highest standards of safety and security. Ferguson noted that although attention has focused on Iran in relation to nuclear proliferation, the security environment in Asia is more complex (Table 4).

A recent study (*Disarming Doubt - The Future of Extended Nuclear Deterrence in East Asia*, eds Rory Medcalf and Fiona Cunningham, Lowy Institute, Sydney, 2012) emphasizes that Asia is in the midst of strategic change with nations left to review their defenses. Policymakers in many countries are seeking to end the function of nuclear weapons in international security. The study suggests that these trends are cutting across each other in unpredictable ways, leading to new doubts about the US policy of extending nuclear deterrence over its East Asian allies. The Obama administration has made substantial efforts to assure its allies that its nuclear disarmament vision and the challenges to the present regional order from China and North Korea will not reduce its commitment to their security. However, the Asian debate about the future of deterrence is far from settled.

The Future

The complete economic and environmental impacts of the Fukushima disaster have not yet emerged, but there have been no major changes to the nuclear power policies in most of the Asia-Pacific region, which

remains the major region for nuclear energy increases. As justifiable as concerns about nuclear reactor safety are, they have not been used as a justification to completely abandon nuclear energy in the region. Since Fukushima there has been an increase in opposition to nuclear energy, particularly in Japan and India. Governments will need to convince the public that mistakes will not be repeated.

The factors which contributed to the expansion of nuclear power in the Asia-Pacific area still apply: increasing electricity demand; the need to diversify energy sources; uneasiness over the price and availability of oil and gas and unrest in many of the exporting countries; and the desire to reduce greenhouse gas emissions. Also, there are already major electricity shortages in many Asian countries. Nuclear power has been seen as a means of increasing energy security. As highlighted at the Pacific Energy Summit in Hanoi on March 20-22, 2012, rising electricity demand in Asia has not been accompanied by new investment in generation or expansion of transmission/distribution capacity and this could threaten economic growth. Nuclear energy's future is also influenced by proliferation fears and waste disposal problems.

Since March 2011 there has been some uncertainty over the future of nuclear energy in Asia, although understandably there has been a focus on Japan. It is difficult to forecast the combined effect of decisions by the nuclear industry, governments and generators but Asia's electricity demand is forecast to increase by about 150% by 2035 and account for 60% of the world's electricity growth (*Asia/World Energy Outlook 2011*, Institute of Energy Economics, Japan, October 2011).

At the Nuclear Security Summit in Seoul on March 26-27, 2012, it was acknowledged that since Fukushima there had been a questioning of the use of large-scale reactors and a more rational approach was suggested - for example, the use of small modular reactors, increased local generation, and internationally managed nuclear fuel services. Many analysts note that the increase in Asia's energy demand means there are few options but to pursue nuclear power. Despite Fukushima, a total of 60 nuclear power plants are under construction worldwide. Some believe that significant increases in nuclear power can be achieved only if other generating methods increase in cost or nuclear energy becomes less expensive.

Some (for example, Gioietta Kuo, 'Energy in 2030 and Conservation,' *World Future Review*, Vol. 3, No. 3, 2011) think that of the alternative energies nuclear energy has the brightest future. One reason for this optimism is the new generation Pebble Bed Reactor (PBR) being developed in China. PBR is a gas-cooled, high temperature technology using uranium dioxide. It is less complex, with improved safety.

Even with the significant number of reactors planned and proposed, governments will continue to confront challenges such as possible terrorism, the relative attractiveness of other energy options, long-term waste disposal, and increased public concerns. Economics is usually considered as the most important aspect in the decision process but in the immediate aftermath of Fukushima, regardless of technological advances, reductions in unit generating costs, improvements in safety, enhanced regulatory frameworks, and nuclear energy's perceived attractiveness in terms of greenhouse gases, decisions on the use of nuclear-powered electricity in many countries are likely to be based more on political factors. **US**

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