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Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation

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Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation

Overview

Interest in nuclear power is rising in Southeast Asia. Indonesia is set to lead the way, followed by Vietnam, Thailand, and potentially the Philippines and Malaysia. But nuclear power development in the region faces questions about its economics and safety, as well as nuclear weapons non-proliferation. A key issue is whether countries will embark on sensitive segments of the fuel cycle. Approaches to help allay such concerns include international fuel supply mechanisms and the possibility of a co-operative approach to nuclear power development within ASEAN.

Southeast Asia's nuclear energy aspirations connect with Australia's role as a major world uranium supplier. Australia will also want to ensure that nuclear power in the region develops safely and in a context of international co-operation. This could involve using existing frameworks for technical assistance as well as greater attention in high-level regional forums such as the East Asia Summit.

Introduction

Nuclear power is emerging as an additional and significant energy source in Southeast Asia to meet very large increases in power supply required over the medium to longer term. Indonesia is set to lead the way with a first plant planned to be in operation by 2016/17 followed by Vietnam in 2020. These could be the precursors to a much greater commitment to nuclear power generation.

The main reason, as with elsewhere in the world, is the potential for nuclear to provide additional energy security in the face of fossil fuels' rising costs and possible supply restrictions in the longer term. Less pressing in the Southeast Asian context is nuclear power as a means of reducing greenhouse gas emission growth, but longer term that could well be an important factor.

Many questions and issues about nuclear power development face governments in the region. There are concerns about its economics, environmental impact and safety, and security implications in terms of weapons proliferation and terrorism. Indonesia and Vietnam, those countries most advanced in their plans, have acknowledged these concerns and have been strengthening their legal, management and human resources capabilities in preparation for nuclear power. But much more needs to be done by policy-makers and planners in the region. Certainly, there are signs of growing public fears about nuclear power that governments will have to address.

Nuclear energy development in Southeast Asia will touch directly on Australian interests in multiple ways. Australia has commercial and economic interests as a major world supplier of uranium oxide, the basis for nuclear fuel. However, Australia's interests extend well beyond this to environmental, safety and weapons proliferation and security matters.

Frameworks exist for Canberra to work with countries in the region to

established sound international standing in regards to their policies and actions on non-proliferation.

Initially, it is envisaged that nuclear fuel for power plants in Southeast Asia would be imported from existing processing facilities in Europe, the US or Canada. The first plants would almost certainly be developed under turnkey sr (ernational stan4.9lear(Soulic)6 woJT±0.0003 Tc0.2006 6w[(US)sup

Aspirations for civilian nuclear power in the region are not new. They build on a 40-year history of scientific and medical nuclear research. The region's first small nuclear research reactors were established in the early 1960s in several countries – Indonesia, the Philippines, Thailand and the then South Vietnam – assisted by the US Atoms for Peace Program. National development of nuclear energy appealed to countries newly free from colonial rule as symbolic that they could be modern and technologically sophisticated states.

This early interest in the potential of nuclear power has been maintained, especially in Indonesia. By the mid 1990s, Indonesia advanced proposals for nuclear power generation, but these were abandoned in the wake of the 1997-98 crisis. Vietnam, too, has tentatively had nuclear power on the drawing boards for some years, but again it is only since 2004 that

power is seen as a means of strengthening energy supply security (for electricity) and diversifying beyond reliance on fossil fuels. Much less of a driver in planning, at this stage, is concern over reducing greenhouse gas emissions and the threat of climate change. Of course, arguments for nuclear power can be made on the basis of its far lower output of carbon dioxide and other greenhouse gases.[10] But the reality in Southeast Asian states, which do not face mandatory emissions reduction targets under the present Kyoto accord to the UN Framework Convention on Climate Change, is that climate change concerns do not impact very much on power sector planning. The very large planned increases in coal-fired power generation in the region attest to this.

While much international attention is focused on the huge projections for China and India (both of which have ambitious nuclear power programs), the electricity needs of Southeast Asia over the next two to three decades are also very large when considered in aggregate and also when looking individually at the larger countries and economies. Meeting future power demand on this scale has enormous implications for fuel choice, finance and the environment. And even where ambitious projections are met, on a per capita basis Southeast Asian power production and consumption will still be low compared to current levels in OECD countries. Commensurate with this, Southeast Asia's contribution to greenhouse gas emission will also rise markedly in aggregate terms although on a per

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Natural gas is often seen as the best course, as gas-fired combined-cycle plants can operate efficiently and cleanly. The region has generous gas reserves, and there are enormous reserves of natural gas in Australia and the Middle East which could also be drawn upon. Liquefaction and shipping of gas to markets from these regions and also from within Southeast Asia itself to the main urban and industrial demand centres is one way to help meet future fuel demand for power, though it is an expensive option. Still, plans for LNG import development are underway in Singapore, Thailand (Bangkok region) the Philippines (Manila and Luzon) and Indonesia (Jakarta and Surabaya in Java).

But both the harnessing of domestic/regional gas resources and LNG import is stymied by the slow pace of development of domestic and regional pipeline supply infrastructure. As a result, there is increasing reliance on coal in power development planning for baseload generation, especially in Vietnam and Indonesia but also by Malaysia and Thailand – despite the strong public opposition to coal in Thailand. Hydropower is another option, especially in the greater Mekong region, but here there are fears of environmental damage and dislocation to local communities through poorly planned large-scale hydropower dams.

Alternative and non traditional energy sources, such as solar and biomass, while offering the prospect of useful supplementary power sources at the margins, cannot be alternatives to large baseload power generation. Unless there is a revolutionary reconfiguration of power supply and consumption systems and patterns, there seems no alternative to reliance on large baseload power generation.

Thus the constraints on, or objections to, the use of natural gas, coal and hydro give rise to arguments that nuclear energy is the only alternative. Its advocates say nuclear power plants can be cost competitive, with fuel supply based on uranium ore readily available internationally – although no known commercial reserves have been identified in Southeast Asia. In addition, they argue that advanced nuclear technology is safe.[11]

Issues, concerns and fears

Economics

The economics of nuclear power are not as simple as they may seem. While the fuel operating costs of a nuclear power plant are very low, compared with a gas or coal-fired plant, the capital costs are high compared with coal and especially gas-fuelled plants. A 1,000 MW plant would cost something of the order of $US2.5 billion, and take much longer to build, especially compared to the construction period for a gas-fuelled plant. Nuclear power generation is a high capital and low fuel cost option. The fuel cost as a proportion of total output costs, that is, including non-fuel operations and maintenance costs and amortised constructions costs, is about 10-12 percent of total output costs. In comparison, the fuel component in coal combustion plants is about 25-30

The same technology that is used for civilian purposes can be used for military ones, though weapons-grade enriched uranium needs to be at 90 percent or more U-235. But a much smaller tonnage of concentrate is needed to make a nuclear weapon compared with supporting a power plant. The minimum quantity of uranium ore concentrate as U_30_8 required for production of a nuclear weapon is around seven tonnes. By contrast, 200 tonnes of concentrate are required to operate a 1,000 MW nuclear power plant for one year. As with conversion, the enrichment market is also very concentrated, structured around a small number of suppliers in the US, Europe and Russia with Japan and China also having capabilities.

Finally, the enriched uranium is then fabricated and assembled into reactor fuel. UF_6 is transformed first to another oxide of uranium, UO_2. This powder is compressed into small pellets which are sintered and then ground into a precise shape and loaded into thin zirconium alloy or steel tubes to create fuel rods. The rods are bundled into fuel assemblies for insertion into the reactor. The fuel fabrication market is characterised by customisation, with the specification dependent upon reactor design and the fuel management strategy of each power utility, though there is a trend worldwide towards standardising around a small number of designs.

Currently three main suppliers provide approximately 80 percent of global fuel demand – France's Areva, BNFL Westinghouse (owned by Toshiba of Japan), and Global Nuclear Fuels (GE of the US, and Toshiba and Hitachi of Japan). Forecasts suggest that capacity significantly exceeds demand. Fuel fabricators are typically associated with reactor vendors who supply the initial core and in many cases refuel the reactor.[12]

How economical nuclear power is as an option for Southeast Asian countries will continue to be debated even as the first plants move ahead. Certainly, it would not make economic sense to engage in fuel preparation. There will be financing challenges. It would seem very unlikely that the World Bank and Asian Development Bank, major sources of infrastructure finance, would provide all the funds for nuclear power ahead of support for non-nuclear energy and other infrastructure. Meanwhile, governments and utilities themselves would still be hard-pressed to find funding on the scale needed for nuclear generation from other budgetary and revenue sources. That said, export-import credits could be expected from countries whose companies are employed to build and supply equipment for plants.

Safety and waste disposal

Opponents are wary of claims of the safety of nuclear power technology, especially in earthquake zones such as in Indonesia – although Japan, a country subject to earthquakes, has long had a large nuclear power industry. There is a powerful fear of the potential human and ecological cost of a serious nuclear plant accident if there were a significant

support from the international community. In theory, however, fuel enrichment for Southeast Asian countries and other countries entering the nuclear energy club would be carried out under the auspices of the IAEA in a limited number of locations. The IAEA would then act as a guarantor for supply to power generation plants. Such a multilateral framework would also include treatment of spent fuel and common waste storage. The concept is not new but it has been given life again by the renewed enthusiasm for nuclear power.

The US is promoting a variation of this approach through its Global Nuclear Energy Partnership (GNEP) under which major Western and Japanese producers of nuclear fuel and reactor technology would undertake to provide other countries with reactors and fuel for the life of plants with the provision to take back spent fuel. The GNEP was put forward in February 2006. Since then the GNEP concept has been developed and further countries, including Australia, have become members beyond the initial partners, the US, Russia, China, France and Japan. There are now 21 members of the GNEP, although none from Southeast Asia. Australia became a member in September 2007; the Rudd Government is yet to present a clear sense of direction publicly on where it wants to take Australia's GNEP participation. There have also been various other proposals, calls and schemes for enrichment centres under international control, most recently, one presented to the IAEA by the German government in February 2008.[17]

Legal and regulatory conditions and safeguards

Plans for nuclear power generation in Southeast Asia are not beginning in an institutional and regulatory vacuum, though there may be questions as to the adequacy of the frameworks that now exist. These can be developed, strengthened and focused.

As far as broad trends of security and cooperation are concerned, there is the ASEAN tradition of consultation and cooperation as it has evolved for several decades, and in particular the 1976 Treaty of Amity and Cooperation in Southeast Asia in which all ASEAN member states commit themselves to peaceful settlement of disputes. More particularly, all Southeast Asian countries have ratified or acceded to the Nuclear Non-Proliferation Treaty (NPT). All except Brunei and Cambodia are members of the IAEA.

security concerns. Already the major nuclear companies are positioning themselves to do business in Southeast Asia and are being supported in many cases by their home governments – Russia, France, the US, South Korea and Japan. Among other companies showing interest in nuclear in Southeast Asia is US equipment supplier, GE, and power utilities with nuclear power expertise, such as Electricité de France, South Korea's Kepco and Japan's Tokyo. In Vietnam, various Russian companies working with Rosatom are also seeking business.[20]

An ASEAN nuclear power authority?

Severino's comment underlines the argument that, given the various concerns discussed above, there should be a regional, co-operative approach to nuclear power development under the auspices of ASEAN. Southeast Asian countries and ASEAN could follow the example of the European Union, where there is a joint approach to the development and regulation of nuclear power under the 1957 European Atomic Energy Community (Euratom) Treaty. This is implemented and monitored through the European Commission.[21] Nuclear power generation in Southeast Asia might similarly be managed and regulated through an ASEAN nuclear power authority, which would seek to complement and support the role of the IAEA in adoption, implementation and monitoring of international standards and safeguards. Indeed, the idea of an 'Asiatom' was proposed by the Philippines in the 1990s although it did not gain much attention then, when nuclear power seemed a very distant vision for most in the region.

Just how Southeast Asia might best go about nuclear power development has entered the ASEAN agenda. The question of how the thrust for nuclear power in the region should be best managed was prominent at the ASEAN leaders' summit in Singapore in late November 2007, and the associated meetings between ASEAN leaders and those of Japan, China

At the bilateral level there is a good history of bilateral co-operation between the Australian Government's Australian Safeguards and Non-Proliferation Office (ASNO), the Australian Nuclear Science and Technology Organisation (ANSTO), and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and counterpart government agencies in the region.

ASNO, for example, supports Australia's regional outreach on non-proliferation issues as one of the organisation's core business functions. Major goals include providing assurance that regional counterpart organisations are able to fulfil their obligations under the NPT and Convention on the Physical Protection of Nuclear Material (CPPNM). In the case of Indonesia, ASNO has a longstanding working relationship with its Indonesian counterpart BAPETEN and the Indonesian nuclear research agency BATAN in the area of safeguards development.[26]

Australia, through ASNO, has proposed strengthening Southeast Asian safeguards through a wider Asia-Pacific safeguards association and meetings between senior officials of ASNO and their counterparts elsewhere in the region. Australia has gained support for this concept through meetings of APEC energy ministers in 2006. The proposed association would support safeguards authorities in the region by: identifying training, professional development and related needs; co-ordinating bilateral and multilateral co-operation and assistance; facilitating joint projects; and providing a forum for exchange of views and sharing of experience. The association would contribute to capacity building in regional countries and promote the most effective co-

for other emerging nuclear states by declaring their support for this course.

For Australia, this debate may ultimately lead to sensitive domestic questions: in any multilateral arrangements to limit fuel enrichment and manage reprocessing, should Australia look to play an industrial role? That is, should Australia, as a major world supplier of uranium ore, seek to host conversion, enrichment, and fabrication and waste treatment facilities? From a commercial/economic point of view, some argue that Australia should do this, although there are significant commercial and technological barriers to entry to these industry segments. Present Australia law prevents these activities. Moreover, there is strong public and party political opposition (as the 2007 election campaign underlined) to the idea of Australia's developing a nuclear fuel industry. Opponents of nuclear power generation in Australia fear it would lead to that outcome and also reject the idea of Australia's ever providing storage for high-level nuclear waste.[29]

Conclusion

So far, declared ambitions for nuclear power generation in Southeast Asia are fairly limited when considered against total projected power demand. But these first plants may be the precursors to a much greater commitment to nuclear power generation if initial plans are successfully implemented.

This development raises a range of issues for Australia extending well beyond commercial/economic interests as a uranium supplier to environmental/safety and security/non-proliferation matters. Importantly, these do not simply arise just because it happens to be Australia's neighbourhood, Southeast Asia, embarking on commercial nuclear power. They are interests and concerns that Australia already pursues internationally and they are already being addressed generally in its foreign, security and trade policies.

But it is also true that Southeast Asia's proximity to Australia and the intertwining of nuclear questions with other aspects of Australian relations with the region and the world mean that Australia now needs to focus much more attention on ensuring that nuclear power generation in Southeast Asia develops and operates as safely as possible.

While there are already good frameworks for scientific and technical co-operation and assistance, Australia should seek a focus on nuclear power and associated issues at the level of high policy discussion in regional forums. The East Asia Summit is one place to start.

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Annexure

Table 1: Southeast Asia and Other Asia Nuclear Power Outlook[1]
(Number of reactors and capacity, megawatts, MW)

	Operation		Construction		Planned		Proposed		Uranium demand 2008 (tonnes)
	No	MW	No	MW	No	MW	No	MW	
Bangladesh							2	2,000	
China	11	8,857	5	4,540	30	32,000	86	68,000	1,396
India	17	3,779	6	2,976	10	8,560	9	4,800	978
Indonesia					4	4,000			
Japan	55	47,577	2	2,285	11	14,945	1	1,100	7,569
N Korea					1	950			
S Korea	20	17,533	3	3,000	5	6,600			3,109
Pakistan	2	400	1	300	2	600	2	2,000	65
Taiwan	6	4,884	2	2,600					n.a
Thailand							4	4,000	
Vietnam							8	8,000	
Total Asia	111	83,030	19	15,701	63	67,655	112	89,900	13,117
World Total	439	372,002	34	27,798	93	100,595	226	197,095	64,615

Note: [1] Building/Construction = first concrete for reactor poured, or major refurbishment underway. Planned = Approvals, funding or major commitment in place, mostly expected in operation within 8 years. Proposed = clear intention or proposal but still without firm commitment.

Source: World Nuclear Association, January 2008, and author.

ns, 2002-2030[1]

	20	2030
	260	367
	6.01	1,668.14
	0.51	616.06
	6.16	2,707.76
	973	1,278
	,505	7,162
	,404	1,436
	8.69	4,987.47
	171	179
	,210	1,312
	125	120
	,680	10,933.33
	,074	1,248
	,129	5,851
	337	361
	9.58	16,207.76
	66	77
		398
		25.0
		15,920

Table 3: Carbon Dioxide Gas Emissions from Electricity Production in Southeast Asia and International Comparisons, 2002-2030[1]

	2002	2010	2020	2030
Southeast Asia[2]				

End Notes

[1] A good overview of nuclear energy and power generation worldwide, including statistics, updates on expansion plans by country, profiles of the industry and its various segments, and legal and regulatory frameworks and discussion of issues can be found at the websites of the World Nuclear Association, http://www.world-nuclear.org, the Nuclear Suppliers Group, http://www.nuclearsuppliersgroup.org, and the United Nations International Atomic Energy Agency (IAEA), http://www.iaea.org.

[2] In Thailand today, the government nuclear research centre is known as the Office of Atoms

Southeast Asia and for the rest of the world. Another useful statistical source is BP 2007;

With the Commission there is the Safeguards Office which carries out physical and accounting checks in all nuclear installations in the EU. As far a fuel supply is concern, there is a common approach to ensure equal access to sources of fuel, carried out through the Euratom Supply Agency, which was established in 1960, operating under the supervision of the Commission. The agency has the right of option on ores, source materials and special fissile materials produced in the territories of Member States and an exclusive right to conclude contracts relating to the supply of ores, source materials and special fissile materials coming from inside the Community or from outside. In order to be valid under Community law, supply contracts made by individual power utilities in the EU must be submitted to the Supply Agency for conclusion. The Supply Agency and the Commission pursue the objective of long-term security of supply through a reasonable diversification of supply sources and the avoidance of excessive dependency on any one supply source, and ensure that in a context of fair trade, the viability of the nuclear fuel cycle industry is maintained.

Nuclear power generation plants in individual EU countries are operated by state power utilities. (except in the case of Finland where there is now a private sector, independent power producer operating a nuclear plant). Although the power industries in the EU have under gone privatisation and liberalisation of various degrees, nuclear power generally is seen as a segment that should be operated by the state, given the special concerns surrounding nuclear energy. Relevant also for the operation of nuclear power plants in the EU are efforts to achieve a common and competitive power market analogous to the common market for goods and services. Fuel supply conversion, enrichment, and fabrication are carried out by a mixture of state and private companies. One leading group, Urenco, is a multi-country, private-sector consortia operating enrichment plants in