Chapter Four

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Splitting the Atom and Enhanced Cooperation in Asia: Considering Nuclear Energy in the APEC Region

Executive Summary

- The APEC region is poised for a dramatic rise in energy demand, and governments are planning to meet some of it with significant growth in nuclear-power generation.
- Nuclear power poses significant challenges such as safety, security, and weapons-proliferation risks, all of which make international cooperation both more important and, simultaneously, more logical.
- A model for cooperation on safe reactor operation already exists in Europe and should be considered for the APEC region, while opportunities exist to build international cooperation for the nuclear-fuel cycle.

Introduction

The APEC 2012 Summit in Vladivostok occurs at a time of increasing concern about energy security across the Asia-Pacific. Problems related to the reliability of energy supply as well as increasing concerns about pollution from traditional fossil fuels compel us to consider alternative approaches to ensuring the energy supply needed to power the region's economic growth. This chapter will discuss the positive and negative roles that nuclear energy can play in this arena. The discussion will cover the status of nuclear energy today, expected near-term developments, nuclear-weapon risks, and opportunities for cooperation.

Nuclear energy – the energy released when atoms are split through fission – has been held in a certain amount of awe since its discovery in the early 20th century, and it has since been used

as both a terrible weapon and a relatively clean source of energy. Because nuclear weapons and nuclear reactors use the same source of energy, many see a phantom connection between the two. They think that the spread of nuclear technology for energy purposes will increase the proliferation of nuclear weapons. However, history shows this is not correct. When the International Atomic Energy Agency (IAEA) was set up in the wake of the Eisenhower Administration's "Atoms for Peace" program in 1957, three countries had nuclear weapons, but none yet had a functioning nuclear-power industry. Fifty-four years later, there are six more states with nuclear weapons, but 30 countries operating nuclear-power reactors[1] and 56 operating nuclear-research reactors.[2]

State motivations for seeking nuclear energy and nuclear weapons are different. States almost universally have sought nuclear weapons primarily for security reasons. Recent events confirm this. In cases where the security situation has improved, nuclear-weapons numbers have declined, as has happened between the U.S. and Russia since 1990. Whereas in cases where the security situation has remained poor or gotten worse, nuclear weapons numbers have grown, such as in South Asia. Meanwhile, growth in nuclear energy has been a result of increased energy demands overall, and for clean energy in particular. With Asia's projected economic growth over the coming years, there will be a dramatic increase in demand for electrical energy. Given concerns about carbon emissions as well as the high level of air pollution already extant, nuclear energy will likely play a significant part in the greater demand for power. Currently, Asia (excluding the U.S. and Russia) operates 116 power reactors, or 26 percent of the world's total, while having almost 60 percent of the world's population. The Energy Information Agency's 2011 Outlook predicts that this region's growth in nuclear energy will be higher than any other region, rising by 9.2 percent annually through

[1] International Atomic Energy Agency, Power Reactor Information System, http://pris.iaea.org/public/.

[2] World Research Reactors, World Nuclear Association, http://www.world-nuclear.org/info/inf61.html.

2035.[3] That won't happen automatically, however, as there are many factors which could significantly alter this projection. However, it is worth noting that the 9.2 percent predicted growth is higher now than it was before the Fukushima accident. Thus, this paper will place nuclear power in a historical and political context and then assess the role of nuclear power in Asia's future.

Nuclear Energy

Historically, nuclear energy has seen a series of up and down cycles related to incidents at power plants as well as global geopolitical shifts, a pattern that is likely to continue to repeat itself. The original up cycle began in the 1950s, when nuclear energy was seen as a primary source of energy for developed and developing economies, promising electricity "that would be too cheap to meter." Nuclear power always had to overcome fear of the impact of an accident, but designers promoted newer, safer reactor designs and global nuclear power production steadily grew through the 1970s. It should be noted, as well, that strong government support was required in all cases, as uncertainties surrounding spent-fuel disposition, potentially unlimited liability in the case of an accident, and cheaper alternatives in conventional power generation (at least as costs have been traditionally measured) meant that the private sector could not make the investment on its own.

The cycle shifted to the negative with the notorious incident at the Three Mile Island power plant in 1979, which essentially halted U.S. nuclear-energy expansion, and hindered global growth. The subsequent, and much more devastating, fire and explosion at the Chernobyl power plant in 1986 released enormous amounts of radioactive material (an estimated 2 million curies) and virtually ended public interest in expanding nuclear power worldwide for decades.

[3] "Int'l Energy Outlook 2011," Energy Information Agency, http://www.eia.gov/forecasts/ieo/electricity.cfm..

However, a growing awareness of the negative consequences of carbon emissions from burning fossil fuels led to a resurgence of interest in nuclear power beginning in the early 2000s. In 2004, James Lovelock, one of the iconic figures in the global green movement, came out publicly in favor of expanding nuclear power for electricity generation in order to help prevent catastrophic climate change resulting from carbon emissions. Although many in the green movement remain opposed to nuclear power, renewable-energy technology is simply not yet advanced enough (and may never be) to provide large amounts of baseline power generation, something only fossil fuels or nuclear can do at this time. Thus, just prior to the 9.0 earthquake and subsequent tsunami in Japan that led to the catastrophe at the Fukushima nuclear-power plant, the IAEA reported 60 nuclear reactors under construction, 49 of them in Asia.

China is, without question, the most ambitious and furthest along, with 23 reactors under construction. Currently, nuclear power provides a mere 2.2 percent of its electricity, but that is slated to grow to 5 percent by 2020. Looking further out, expanding nuclear power's share of electricity beyond 5 percent is clearly a high priority, as indicated by reports that China's 12th five-year plan (2011–2015) calls for an investment of $121B for a further 10 "mega" reactors.[4] In the immediate aftermath of Fukushima, China announced suspension of construction pending a review of all nuclear-power activities, but it is highly unlikely it will scale back its ambitious construction plans.

Russia has the second-most ambitious plan, with 11 reactors in the works (unless otherwise noted, data below on reactor numbers and construction are from the IAEA's NUCLEUS data center). Given Russia's consistent support for nuclear power in spite of the Chernobyl accident, as well as the simple truth that the nuclear field is one of the few areas in which Russian technology is globally

[4] "China to Build Ten More Mega Reactors," *The Economic Times*, 26 January 2011, http://economictimes.indiatimes.com/articleshow/7365901.cms?prtpage=1.

competitive, it seems unlikely the Fukushima accident will alter the Russian program significantly. Russia is also working on advanced reactor designs, as well as a floating nuclear-power reactor for the commercial market.

India, with 20 nuclear-power plants currently supplying 3 percent of the nation's electricity, looks to significantly augment its nuclear-power capability, with one report indicating it could import up to 40 reactors by 2020, something that was impossible from 1974 to 2008, when India was excluded from the global nuclear-supply chain. The 2008 reintegration of India was the result of an agreement between the U.S. and India on nuclear cooperation, which eventually lead to the July 2008 agreement between India and the IAEA, bringing two-thirds of India's nuclear infrastructure under the international inspection regime and ending 34 years of nuclear-trade isolation. Fukushima will undoubtedly raise a lot of questions in India with regard to the wisdom of nuclear power, but, given the tremendous energy needs there, it seems likely it will build substantial numbers of new reactors. This is shown by the March 2012 renewal of work at the large reactor at Kudankulam.[5]

Finally, South Korea has 21 nuclear-power plants, which generate 31 percent of its electricity, and has five reactors under construction. Although analysts do not expect Fukushima to alter Korea's path long-term, opposition candidates are playing on nuclear fears in the current 2012 political campaign. It seems quite plausible that Korea will scale back the expansion of nuclear power in the short term. However, given the nation's limited resources, most analysts continue to see nuclear energy as an essential for energy security in South Korea.

In addition to the above states that have power reactors, there are several Asian states looking to start nuclear-power programs. Vietnam is farthest along, having signed individual agreements with Japan and Russia to build several reactors and with the U.S. to

[5] "Russians Resume Work at Indian Nuclear Project," *RIA Novosti*, 23 March 2012, http://en.rian.ru/world/20120323/172357225.html.

provide a framework under which commercial interests can build power reactors and other facilities in Vietnam. To date, no explicit deals have been finalized for construction to begin, but all indicators suggest Vietnam will be the first ASEAN nation and the newest APEC member to operate nuclear reactors. Indonesia, Malaysia, the Philippines, and Singapore have also expressed interest in nuclear energy, but it is unclear how rapidly they will move in that direction. Overall, Asia is poised to continue a dramatic growth in the role and scale of nuclear energy in the region. This fits well with prior APEC announcements that have highlighted the need for a mix of power sources and new technologies.

Nuclear Weapons Trends

The situation with regard to nuclear weapons is mixed in the Asia-Pacific. The U.S. and Russia continue to draw down and dismantle their huge legacy stockpiles from the Cold War, but China, India, Pakistan, and North Korea are growing their arsenals, albeit at modest rates compared to the scale pursued in the Cold War between the U.S. and USSR. Geopolitical factors continue to drive this trend and, unfortunately, there is little hope for significant shifts in the near future. Indeed, the rise of ballistic missile-defense capabilities globally may exacerbate the problem and pose the risk of driving China and Russia to pursue large arsenals.

On the Korean Peninsula, expert reports indicate that the North Korean nuclear-weapons facility at Yongbyon likely produced 40 kg to 50 kg of weapons-grade plutonium (WGPu), as of April 2009, and may have been able to produce as much as 17 kg more through March 2011. Diplomatic efforts to roll back the nuclear program have ultimately proven unsuccessful to date and few analysts expect that to change anytime soon. There were some bright moments, such as 27 June 2008, when the cooling tower for its plutonium-production reactor was destroyed. However, diplomatic efforts broke down in April 2009 and North Korea expelled IAEA inspectors and restarted efforts to produce fissile material at

Yongbyon. Then, in November 2010, it revealed a new uranium-enrichment facility. At the same time, tensions between North and South Korea have remained high, with the March 2010 sinking of the South Korean naval ship *Cheonan* and November 2010 shelling of Yeonpyoeng Island being the low points.

The good news is that North Korea's program, including two weapons tests, has not yet sparked South Korea, Japan, or Taiwan to produce nuclear weapons, as many had feared. The bad news is that, given their advanced nuclear-energy capabilities, should either of the three decide to acquire nuclear weapons, there is no doubt they would be able to do so in a relatively short period of time. This, combined with the U.S. drawdown of its own nuclear forces, has given great impetus to U.S. efforts to reassure its allies of its extended-deterrent commitment.

Perhaps more ominously than North Korea, Pakistan is expanding its weapons complex at Khushab and continues to oppose negotiations on the Fissile Material Cutoff Treaty. Although there is no doubt that the Pakistani government is doing its utmost to maintain the surety of its nuclear material, given the nature of Pakistani society today, no objective observer can ignore the very real risk of terrorists gaining access to some material through an insider. As the amount of material continues to increase, this threat increases. Unfortunately, it is a negatively reinforcing, complex causal loop, whereby Pakistan's concerns about its national security drive it to build up its nuclear arsenal, which, in turn, increases international concerns about the potential for war or loss of control, thus increasing pressure on Pakistan and increasing its security concerns. The operation by U.S. commandos to kill Osama bin Laden in Abbottabad, Pakistan, likely increased these fears and added to the cycle.

While there are no strong indicators that India intends to significantly increase its fissile-material stockpile, the 2008 agreement with the Nuclear Suppliers Group and IAEA noted above allows India to purchase uranium fuel again and it has purchased hundreds of tons since 2008. This allows India the flexibility to use

its limited domestic supplies for its weapons program should it choose to do so. Fortunately, domestic and international dynamics do not seem to be driving India to augment its nuclear-weapons arsenal at this time. How long that will remain the case should Pakistan continue its buildup is uncertain.

China has reportedly not produced new fissile material since the late 1980s, and currently has approximately 12 tons to 20 tons of HEU and 1.3 tons to 2.3 tons of WGPu (enough for 480 to 800 and 350 to 450 weapons, respectively).[6] This is far more potential warheads than the various current estimates of the actual number of weapons that various sources place at 240 to 400 weapons. Chinese nuclear policy continues to suggest that they will not grow a large arsenal, although they are increasing the number of nuclear missiles and adding submarine-launched ballistic missiles to their inventory, perhaps in response to advances in U.S. Ballistic Missile Defense programs and conventional precision-strike capabilities. In this context, it is too early to tell if or when China will join a multilateral treaty on nuclear-arms reductions that may follow on from the recently concluded New START Treaty. China has previously stated that it is uninterested in joining negotiations until U.S. and Russian weapons numbers are much closer to China's, while Russia has stated it is unwilling to conclude another reduction with the United States unless China is involved. Given that U.S. and Russian arsenals remain several times larger in strategic weapons alone, innovative negotiations will be required to involve the Chinese in whatever arms-reduction treaty supersedes New START.

In summary, while nuclear-weapons trends for the superpowers have been quite positive overall in the last decade, the foreseeable future is unlikely to see a continuation of that trend. With regard to smaller nuclear-weapons states, trends have been static or modestly negative and are likely to continue on that path.

[6] "Global Fissile Material Report 2010," International Panel on Fissile Material, www.fissilematerials.org, pp. 10 and 18.

Areas for Cooperation

Fortunately, there are more areas for cooperation than conflict in terms of security and nuclear power. One obvious area for enhanced cooperation is in safe reactor design, construction, and operation. A good example is the ongoing cooperation between Westinghouse, Southern Power, and China on construction and eventual operation of AP1000 reactors in the U.S. and China. Excellent information sharing is reported between the Southern Nuclear and Haiyang nuclear-power companies. One benefit is that, as Chinese plants are several years further along in construction, they will allow U.S. plant personnel to observe reactor operation and refueling to apply lessons learned when the U.S. plants are completed.

Another aspect of cooperation would be a regional nuclear society to foster information exchanges and expert knowledge. Europe has such an agency, called the European Nuclear Society, with 27 national members as well as many corporate members. Scientific exchanges between technical experts have proven beneficial in promoting better international relations in the past in other arenas, and this could be a powerful tool for enhanced regional cooperation. Perhaps it is time for there to be an APEC Expert Working Group on Nuclear Power Surety under the Energy Working Group, which would complement the existing five other Expert Working Groups.

A third area for cooperation would be in the nuclear-fuel cycle. Russia has established, and the IAEA is working to establish, an international fuel repository to ensure fuel access for states that operate reactors but don't have enrichment capabilities. The idea is to limit the number of states that pursue uranium-enrichment facilities, arguably the most dangerous part of the fuel cycle for proliferation. The reason is that enrichment facilities for producing low enriched uranium (LEU) for reactor fuel can also easily be used to produce highly enriched uranium (HEU) for use in weapons.

India was the victim of a cutoff in fuel supplies due to U.S. opposition to its nuclear-weapons program, which was revealed with

a nuclear test in 1974. As more states build reactors, fears of losing access to supplies could drive more states to pursue enrichment technology. Currently, in Asia, only the U.S., Russia, China, India, Pakistan, and Japan have the capability to enrich uranium. As Vietnam, Malaysia, Indonesia, and others look at nuclear energy, they will have to consider their vulnerability to supply interruption. Thus, cooperation to ensure fuel supplies could be a powerful tool to limit proliferation of dual-use fuel facilities as well as enhance regional relations and economic interdependence.

Moreover, one can imagine combining cooperation on the front end of the nuclear-fuel cycle (fresh fuel supplies) with cooperation on the back end of the fuel cycle (spent-fuel storage). For example, Mongolia has large supplies of uranium, vast unpopulated areas that could be used for storage, and little need for nuclear power due to its small population. Nearby, Japan has a high need for power, but limited uranium or space to store spent fuel (although, currently, Japan does have an indigenous uranium-enrichment plant). The same holds true for Korea, Taiwan, and a newcomer to nuclear power, Vietnam, none of whom have domestic enrichment capabilities. Russia and China have large and underutilized enrichment capacities. Thus, one can imagine a virtuous, cooperative agreement wherein Mongolia sends uranium in the form of yellowcake to Russia/China for enrichment and fabrication into fuel, which is then sent to power users like Korea and Vietnam, with the spent fuel returned to Mongolia/Russia for temporary storage. What would eventually happen to the spent fuel, whether it is reprocessed and reused or sent to an as-yet-to-be- identified, permanent storage site, will have to be determined later.

Efforts to promote regional cooperation in these areas will require a lot of effort by all parties, and the path will not be an easy one. However, the demand for energy, especially carbon-neutral energy, coupled with the complexities and dangers of nuclear power, demand wise and determined political leadership to ensure successful cooperation, creating a win-win scenario for all involved. This is

reinforced by the final communiqué of the 2012 Nuclear Summit in Seoul, in which the participants stressed "the importance of regional and international cooperation," in order to strengthen nuclear security while allowing states to develop and utilize nuclear power.

Conclusion

This chapter has examined nuclear energy and security in Asia. While there are some trends that give rise to optimism, such as the cooperation in innovative reactor design and construction, there are also a number of areas where there is greater nuclear insecurity than security. Speaking strictly of nuclear power, the tragedy at Fukushima clearly illustrates that nuclear power has risks and many will conclude from Fukushima (as well as Three Mile Island and Chernobyl in the past) that nuclear power is too dangerous. We must confront that emotional response with good analysis. The risks associated with nuclear power are real, and there will be future accidents at nuclear facilities. However, the negative externalities of burning ever more hydrocarbons to fuel the economy are likely even more dangerous than nuclear risks. This means that, rather than eschew nuclear energy, we need to carefully consider how best to implement nuclear energy. Ultimately, Asia is a huge and growing component of the global economy, and all economies run on energy. Asia can and should take advantage of the advances in nuclear physics and engineering to make nuclear energy, with its zero-pollution emissions a part of its energy mix. The 2012 APEC Summit provides an excellent forum within which to do so, while enhancing international cooperation more broadly.