On March 11, 2011 a massive earthquake and accompanying tsunami devastated a significant part of coastal mainland Japan north of Tokyo. The loss of over 25,000 lives and major damage to residential, commercial and industrial parts of Japan have been overshadowed by round-the-clock news coverage concerning the accident at the Fukushima nuclear power plant. Exaggerated accident reports have prompted a debate on the wisdom of nuclear power generation. Thus, they have created a sentiment in Europe and North America discouraging expansion of their nuclear power sectors and encouraging a debate for their scaling down and eventual decommissioning.

These developments will not likely have a significant impact on the expansion of the nuclear power sector in Asia. In fact the Asia-Pacific region is the principle region for new global nuclear reactor projects. The Asian continent is determined to continue expanding its nuclear sector despite the Fukushima accident. The fundamental factors demanding the expansion of the nuclear sector in the pre-Fukushima period are still valid today across Asia; they will likely continue to remain so into the foreseeable future, ensuring Asia's global rank as the main arena for new nuclear power facility development.

Reports on the Fukushima accident have portrayed it as another Chernobyl. This unrealistic picture has been the result of various factors and has helped create fear among many people regarding the accident's negative effect on human health and safety. Hence, it is important to make a distinction between the myth and the reality of the Fukushima accident in order to understand why Asia will remain committed to its nuclear projects despite the accident.

Background

The Fukushima Nuclear Power Plant (FNPP) consisted of six reactors, three of which were inactive at the time of the natural disasters. The other three were successfully shut off when the earthquake shook the facility. The plant survived an unprecedented 9.1 magnitude earthquake only to be damaged by the accompanying tsunami. The tsunami damaged the cooling system and its backup-systems, which caused reactor overheating and subsequently the explosion of built-up hydrogen within the facility (but not the explosion of the rectors' cores containing fuel rods). The existence of containment structures around the cores prevented massive leakage of radioactive material into the environment. This is unlike Chernobyl when the explosion of its core lacking an appropriate containment structure released a large amount of radioactive smoke into the atmosphere. The released (massive) amount of radiation hovered over the surrounding region and eventually drifted into European parts of then the Soviet Union as well as into other parts of Europe. The FNPP's containment structures prevented a similar release of radioactive material, but a leak through the cooling system led to release of such material estimated to be about 10% of that of Chernobyl in a much smaller area in the FNPP's vicinity.

To date, neither the Japanese nuclear authorities nor the International Atomic Energy Agency (IAEA) have reported any deaths, injuries or medical complications caused by radiation exposure among the Japanese population. As a precautionary measure, Japanese authorities evacuated people living in the affected area (a 20 km radius extended in certain areas) and banned the distribution of vegetables and dairy products produced there after above-normal measures of radiation were detected. While clean-up will take a long time (possibly decades in the immediately affected regions), the accident now seems to be under control. To this date,

measurements of radiation in Japan and elsewhere have not detected high levels of radiation dangerous to health. As a result, the Fukushima accident is not a case on par with Chernobyl although it has been significant enough to raise public concerns.

Asian nuclear projects

After decades of decline, certain factors have contributed to renewed interest in nuclear energy as a substitute for fossil energy across Asia, in particular in the Asia-Pacific region which has a fast-growing demand for energy. These factors include the severity of air pollution, global warming (caused mainly by CO2 emitted by fossil fuels) and a heavy reliance on imported oil and to a lesser extent gas with potential economic, financial and political implications for importing nations. This has lead to a recognized need to diversify the region's energy mix. The absence of nuclear-related disasters since Chernobyl has mainly calmed legitimate concerns about the potential safety of nuclear energy.

Asia's revival of interest in nuclear energy has manifested itself in about 100 nuclear projects of various scales. All of these are either under consideration, have already been negotiated and signed off on, or close to implementation. China accounts for the bulk of these projects; it has the largest number of ongoing projects worldwide (24). China is followed by South Korea (6) and India (4). However, there are many others, including Taiwan (2), Pakistan (1) and Japan (1). Other nuclear enthusiasts include Iran, which, despite UN sanctions, finally completed its Bushehr Nuclear Reactor (1000 MW) on 21 August 2010 with Russian assistance. Work continues in Iran on the 360 MW Darkhovin nuclear plant in its Khuzestan Province, and it has also announced plans for other Iranian-designed medium-sized nuclear power plants. Iran has a plan to build enough nuclear capacity to generate 20,000 MW of power over the next 20 years. To put this in perspective this will require constructing 19 more reactors on the scale of Bushehr. In Southeast Asia, Vietnam has embarked on constructing a power plant consisting of four nuclear reactors (4 X 1000 MW light water reactors) with the assistance of Russia (for two reactors) and Japan (for the other two). Preliminary work has started on one Russian reactor scheduled for completion in 2020.

Asian reaction to the Fukushima accident

Fukushima has created a sense of panic in many parts of the world. This is especially true in North America and Europe, which have not been major nuclear enthusiasts for decades. The major exception to this has been France, which produces about 75% of its electricity from nuclear reactors. In the Asia-Pacific region, there is no indication of serious plans to reverse the regional nuclear power program or to downsize it.

Regional countries with active nuclear sectors or serious plans for building them in the region have mainly confined themselves to taking precautionary measures to increase the safety of their programs to appease their respective peoples' concerns. Hence, contrary to the situation in North America and Europe, all of the mentioned Asian countries have remained committed to the continuity of their nuclear programs despite Fukushima. The main reasons for such commitments include a lack of adequate domestic fossil energy resources leading to a heavy reliance on imported fossil energy (oil, gas and/or coal). Other reasons include the financial, economic, political and security implications of such reliance for net energy importers, a rapid depletion of fossil energy-rich countries' domestic reserves, a need for the diversification of the

energy mix in Asian countries and the necessity to decrease greenhouse gas emissions to curb global warming.

A commitment to nuclear energy is evident in the following summary of the reaction to the Fukushima accident in Asia-Pacific region.

China
Having the largest number of nuclear plants under development, China has not stopped their construction. Nor has it made any statement to the effect of its plan to impose a construction moratorium on its approximate 100 projects under consideration for realization over the next two decades. As a precautionary measure, on March 16, 2011 the Chinese government only suspended approval for new nuclear power stations so as to revisit and if necessary revise safety standards in the wake of Fukushima. At a meeting of China's State Council presided over by Premier Wen Jiabao he asked "relevant departments to do safety checks at existing plants." To remove any ambiguity about its long-term objectives, on March 26, 2011 the Chinese government clearly stated its commitment to continue its nuclear program, reaffirming its goal of developing nuclear power as a clean energy source while stressing the safety of the country's nuclear power facilities.

Accordingly, Tian Shujia, director of two nuclear safety centers under China's Ministry of Environmental Protection, stated, "There is a guarantee for the safety of China's nuclear power facilities and (China) will not abandon (its nuclear power plants) for fear of slight risks". This is in tune with the Chinese government's statement made a day after the quake and tsunami in Japan when Vice Minister of Environmental Protection Zhang Lijun stated that China would not change its plans for developing nuclear power.

As reconfirmed by Tian Shujia, China plans to have 66 nuclear power plants by 2020 with a total generating capacity of 66 MW, which will account for 6% of China's total power capacity. Under the 12th Five-Year Plan approved by China's top legislature on March 14, 2011, China will launch new nuclear energy projects with a combined generating capacity of 40 gigawatts.

Taiwan
Taiwan has followed suit with China. It reiterated its commitment to the continuity of its nuclear program on March 15, 2011 when Taiwan's President Ma Ying-Jeou said that there was no need to shut down operations at Taiwan's three nuclear power plants despite public concerns over their safety caused by the Japanese accident. Nor was there any need to suspend the construction of Taiwan's new nuclear reactors. Like the Chinese premier, the Taiwanese president acknowledged the necessity of reviewing safety and response measures in place while assuring the public about the safe operation of its existing three nuclear reactors. President Ma stated his government's awareness of potential threats and that the consensus was to "enhance safety measures." He also stipulated the continued construction of Taiwan's fourth nuclear reactor and emphasized "enhance[ing] the capacity of Taiwan's fourth nuclear power plant....to withstand multiple disasters, such as the combination of an earthquake and a tsunami as seen in Japan."

South Korea
South Korea already meets 35% of its electricity demand from nuclear energy. It has not hinted

at scaling back its nuclear sector either. As announced late last year, South Korea would build 35 nuclear power plants by 2024. If everything goes as planned, nuclear electricity will satisfy about 50% of the nation's electricity consumption thereafter.

With six reactors currently under construction, South Korea has 21 operating nuclear power plants. In the immediate post-Fukushima period, on March 22, 2011 a Korean nuclear authority, Yun Choul-Ho, President of the Korean Institute of Nuclear Safety stated, "There is no change in the government's plan for expansion of nuclear power plants" by reasoning that "there is no alternative to nuclear energy at this stage." Instead of eliminating nuclear energy because of potential risks caused by natural disasters, ensuring the ability of South Korean nuclear reactors to withstand natural disasters like earthquakes and tsunamis has become the major focus of attention for the South Korean government. Consequently, in tune with the regional trend, Yun Choul-Ho announced checking the adequacy of nuclear safety measures in reaction to the Fukushima case both for domestic purposes and also for guaranteeing the export-worthiness of Korean nuclear technology. Hence, "we can take this opportunity for reviewing nuclear safety, as well as for expanding exports of nuclear technology".

The reference to nuclear technology exports reflects the importance of the continuity of South Korea's nuclear program on the country's emergence as a technology supplier to be reckoned with. In light of this observation, it is clear that South Korea has major commercial interests in promoting nuclear power. No wonder that on March 28, 2011, South Korean Minister of Knowledge Economy Choi Joong-kyung reconfirmed South Korea's commitment to expanding its nuclear sector as he assured his country's nuclear industry about his government's continued support when he stated, "Our answer to the nuclear industry is that we need to keep going." This notion was further strengthened by Yun Choul-ho who stated on March 22, 2011 that "part of our manufacturing industry's competitiveness comes from nuclear power thanks to its cheap energy costs. Therefore, it is hard to give up [nuclear power]." South Korea is already in the process of supplying the UAE with four 1000 MW reactors as per its December 2009 contract.

Vietnam

Unlike the other countries already mentioned, Vietnam does not have any operating nuclear plants, but it does have an active program towards that end. Vietnam has reacted to the Fukushima incident by stressing the necessity of ensuring that the highest possible nuclear safety measures are in place. The Vietnamese Ministry of Foreign Affairs echoed this policy in March 2011: "Vietnam puts nuclear safety-related issues as a top priority. This is particularly important in the context of climate change and natural disasters, particularly the earthquake and tsunami that just happened in Japan."

Vietnam's heavy reliance on fossil energy has contributed to severe air pollution in its major cities. Its growing consumption of coal, a resource in abundance in the country, is further worsening pollution. Vietnam's expanding economy demands a growing amount of energy. Hence, both environmental factors (decreasing air pollution) and a concern about heavy dependency on imported fuel are justifying its use of nuclear energy. Vietnam projects to have eight operational nuclear reactors up and running over the next 20 years with Japanese and Russian assistance.

Japan

Notwithstanding mounting concerns among the Japanese about the safety of their nuclear power reactors, even Japan has not made any statement indicating a policy of scaling back its nuclear sector. Of course, the Japanese government has avoided firm statements on the future of this sector given the high level of sensitivity to nuclear energy in post-Fukushima Japan. Prior to the accident, Japan had 55 commercial nuclear power reactors in operation, granting it the world's third rank after the US and France. The sector produced 30% of the country's electricity. Japan currently has a new reactor under construction and there is no report as to the government imposing a freeze on already approved projects. Endorsed in June 2010, Japan's basic energy plan considers nuclear energy as a "core source of energy in the medium- and long-terms." The plan provides for building at least 14 nuclear reactors by 2030, nine of which will be completed by 2020. Understandably, Japanese power-generating companies have decided to slow down on implementing new nuclear projects given the current prevailing negative view about nuclear energy among the Japanese. One example of such a slow-down came on 15 March, 2011, when Chugoku Electric Power Co. announced its decision to temporarily suspend land reclamation to build a nuclear power plant in Yamaguchi Prefecture, saying it would like to "prioritize providing full briefings to nearby residents." It is highly unlikely that Japan will opt for a long-term or permanent freeze on nuclear power given the absence of any comparable alternative technology capable of providing greenhouse-gas emission free energy. Nuclear energy is currently the main indigenous source of energy for Japan.

Countries with no active nuclear program

There are a number of countries across Asia and the Asia-Pacific region that may turn to an active nuclear program at some point in the future. In the pre-Fukushima era, these countries expressed an interest in adding nuclear energy to their energy mix without setting any specific deadline towards that end. These include Thailand (2 reactors planned and 2 proposed), Malaysia (2 reactors planned), Indonesia (2 reactors planned and 4 proposed) and the Philippines (1 to be activated). Negative or cautionary reactions to the Fukushima incident in the Asia-Pacific region have been confined to three of these states, namely Malaysia, Thailand and the Philippines. Yet, none of these regional countries have an active nuclear program or even a serious and realistic plan towards that end. As a result, even abandoning their nuclear programs will not have a tangible impact on the regional nuclear industry.

Interestingly enough, none of these countries have totally removed nuclear energy as an option in the post-Fukushima era. For instance, Malaysia announced last December plans to build two 1,000 MW nuclear reactors without specifying any date for their launch while providing tentative dates for their completion in 2021 and 2022. Since the Fukushima accident it has only announced a delay for an official decision on their actual realization. On March 17, 2011 Malaysia's Energy, Green Technology and Water Minister Peter Chin Fah Kui stated that the proposal to construct nuclear power plants in Malaysia for electricity had not yet been decided upon by the Cabinet. He suggested a pause in any final decision until receiving a full report on the Fukushima case to be presented by Malaysia's nuclear development agency under the Prime Minister.

Unlike Malaysia, which keeps nuclear as an option by pursuing a policy of wait-and-see, Thailand announced a freeze on constructing the country's first nuclear power plants. This

decision has no practical implication as the Thai government has never taken any tangible step towards building them.

By the same token, the Philippines' decision to discard plans to activate the shelved Bataan reactor has not had any practical implication on the region's nuclear sector. The Bataan reactor was built in the late 1970s, but was not commissioned because of "litigation concerning bribery and safety deficiencies." Given the same regional pattern of increasing energy demand, the Filipino government has toyed with the idea of using nuclear energy to reduce its increasing dependency on fossil fuel imports in the form of oil and coal. Having the option of activating the Bataan reactor, in 2008 the government commissioned an IAEA team to determine the feasibility of this project. The IAEA confirmed its feasibility and the safe operation of the nuclear plant for 30 years subject to its refurbishment. The March 2011 decision to give up the activation plan has had no practical impact on the region's nuclear sector while denying the Philippines a means to decrease its dependency on imported fuel for power generation.

Indonesia has not yet decided to give up its envisaged nuclear program. In fact, the Indonesian government has dismissed the Fukushima accident as a strong reason for shelving its nuclear program. Along these lines, on March 18, 2011 Adiwardojo, the head of nuclear energy development at Indonesia's National Nuclear Energy Agency, said that concerns about a disaster like that of Japan's were misplaced because Indonesia's future plants would use technology far more advanced than that of the Fukushima plant built in the 1970s. Stating his country's assessment of potential nuclear sites using "standards and guidance from the International Atomic Energy Agency" he added, "The important thing isn't that Indonesia is on the Ring of Fire or that there are tsunamis, so we can't build. No, the important thing is that we fulfill the requirements." On March 30, 2011 Luluk Sumiarso, the Director General of renewable energy at Indonesia's Energy Ministry, echoed the same policy when he stated plans to build nuclear power plants would go ahead while stressing his country's objective of maximizing the use of renewables, especially geothermal, hydro-energy and bio fuels. Of course, there is still opposition to nuclear energy within the Indonesian government, as there has been since the 1960s. What is important is that Indonesia cannot discard its nuclear option given its rapidly depleting fossil energy resource base. The fact that it is no longer an OPEC member and has become an oil importer through depletion of its domestic oil reserves could well make Indonesia increasingly interested in the nuclear option.

Concluding remarks

Reflecting global realities, Asian nations have long considered nuclear energy as a necessary component of the region's sustainable energy mix. This is especially relevant today given the current level of underdevelopment of clean renewables (e.g., solar and wind). Proponents of a continued use of fossil fuels refer to the limits of renewables in providing reliable base-load power to discourage switching from fossil energy to non-fossil energy. Nuclear energy in its current state can provide large scale power on a reliable basis.

Concerns about the safety of nuclear reactors are legitimate and are being addressed through a variety of policy options. While safety concerns are legitimately raised, this is no argument for dismissing nuclear energy. Other than Three Mile Island, Chernobyl and Fukushima, there has not been any reported case of any nuclear accident of significance since the 1950s when the

commercial use of nuclear energy started. Among these, only Chernobyl has caused death, radioactive-related diseases and damage to the surrounding environment. This is a good record for the 441 plants in operation as of 2010.

Operating 55 nuclear reactors, Japan has had only one major accident. Fukushima was caused not by an exceptionally powerful earthquake, but by the devastating tsunami destroying the plant's cooling systems located underground. Placing cooling systems of similar reactors at a higher altitude can eliminate the possibility of another Fukushima. Japan's experience and that of other Asian countries with major nuclear power sectors indicate that there are workable and tested safety measures that could be put in place to ensure the safe operation of nuclear power generators for years to come. The Fukushima accident caused by a natural disaster has not been a game changer when it comes to the Asian nuclear power sector. Unconvinced by argument equating nuclear energy with nuclear disaster, the Asians have compelling reasons for continuing nuclear power generation and will do so for decades to come.

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