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Chinese Nuclear Power Development at Home and Abroad□□内外における中国原子力開発

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The Chinese energy sector is dominated by coal, which provides nearly 70% of the country's energy compared to a global average of 27%. Furthermore, with energy demand rapidly increasing, so is coal production which was 3.5 billion tonnes in 2011, more than doubling its 2002 level. The International Energy Agency's current policy scenario predicts that total coal demand in China will increase by 1000 Million tons of oil equivalent (Mtoe) by 2035, up from 2500 Mtoe in 2009. This projected increase is around double the current total consumption levels in the US and would increase CO_2 emissions from approximately 4751 Mt to 10000 Mt in 2035, equal to nearly one quarter of the world's projected total at that time.[1]

China is aware of the resource and environmental implications of its current energy policies and is attempting to address this. In particular the 12th Five-Year Plan (2011-5) proposes to reduce the increase in consumption by improving its energy and carbon intensity by 16% and 17% respectively by 2015 as well as expanding the use of non-fossil fuels so that they provide 11.4% of total energy consumption. Meeting these targets would not fundamentally change the trajectory of Chinese CO_2 emissions in the short run, but it would require unprecedented investment and planning in the relevant sectors in the coming years with long-term implications.

While the main focus of this article is not renewable energy, it is important to note the impressive growth in Chinese renewable energies, in particular wind and increasingly solar PV. In 2001 China had an installed capacity of wind of just 406 MW, but by the end of 2011 it was 64 GW. Five years ago, nuclear power was producing 14 times as much electricity as wind, but by 2011 the difference was less than 30percent.[2] The country's on-grid wind power capacity is projected to reach 100 GWs by 2015 and 200 GWs by 2020, according to the 12th Five-Year Plan for Wind Power Industry. Solar PV has also grown remarkably, both in production capabilities (much of which is used for export) and more recently in installed capacity. At the end of 2011 total installed capacity for solar was 3 GW, up from 300 MW in 2009. However, a recently revised target from 15 to 21 GW by 2015 projects a rapid acceleration of the growth rate.

China only started construction of its first commercial nuclear reactor in 1985, but its nuclear sector is developing fast, and it now hosts 40% of the world's reactors under construction. As of August 2012, China had 16 reactors in operation, which in 2011 provided just 1.85percent of the country's electricity. This compares to a historical maximum of 2.2 percent, since despite increases in the production from nuclear power, electricity demand is growing faster. Until Fukushima, China had an impressive recent history of construction starts. However, during 2011, though three reactors were completed, construction did not start on any further reactors.[3]

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Chinese Nuclear Reactors. World Nuclear Association, 2012

China's Projected Nuclear Power Development

In 2007, the State Council issued the National Nuclear Power Middle and Long Term Development Plan 2005-2020, which proposed that 40GW of nuclear capacity be in operation by 2020 with a further 18GW under construction. A revision to this plan was under consideration in 2010, when some officials predicted that a more likely target for 2020 would be 80GW in operation together with a further 50GW under construction.

In January 2011 the State Council Research Office (SCRO), which makes independent policy recommendations to the State Council, published a report suggesting that the 2020 target should be restricted to 70GW of nuclear power in operation, with another 30GW under construction, so as to ensure quality control in the supply chain. It cautioned against the launch of new Gen-II projects, and emphasised the need for greater deployment of Gen-III+ projects, notably AP1000s.

Safety concerns over the domestic designs were highlighted in a 2008 cable from the US embassy in Beijing, released by Wikkileaks, when it stated that the Gen-II CPR-1000 design were copies "of 60's era Westinghouse technology that can be built cheaply and quickly."[4] Similar concerns have been expressed by Tang Zede a member of the State Nuclear Power Technology Corp (SNPTC) who was reported to have said that the CPR-1000 could not even meet the national safety standards issued in 2004, let alone the most up-to-date international standards. Tang stated that "unless, the constructed Gen-II reactors are renovated, they should not be allowed to load fuel and start operation."[5]

Furthermore, the SCRO report advised that since goals to increase the localisation of AP1000s has proven difficult, efforts were needed to be made to break the bottleneck on the domestic supply chain for AP1000s. In addition, the SCRO recommended that the National Nuclear Safety Administration, responsible for implementing safety regulations, be removed from the authority of the China Atomic Energy Authority, whose aim is to promote the nuclear industry.

Nuclear Power Development after Fukushima

In the aftermath of Fukushima, on March 14th, Xie Zhenhua, vice chairman of the National Development and Reform Commission, stated that "[e]valuation of nuclear safety and the monitoring of plants will be definitely strengthened."[6] An account of a mid-March 2011 State Council meeting chaired by Premier Wen Jiabao states: "We will temporarily suspend approval of nuclear power projects, including those in the preliminary stages of development.... We must fully grasp the importance and urgency of nuclear safety, and development of nuclear power must make safety the top priority."[7] As a result a new China National Plan for Nuclear Safety with short-, medium- and long-term actions was ordered and approval for new plants will remain suspended until it is approved.[8] The China Guangdong Nuclear Power Corporation's (CGNPC) Chairman, He Yu, was reported in

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October 2011 to say that two plants were to be completed by the end of 2012.[9]

On 1 June 2012, the State Council announced it had finished inspecting the country's existing nuclear plants, and gave preliminary approval to both a revised 2020 nuclear strategy and a post-Fukushima safety plan. The revised 2020 nuclear strategy is expected to propose a target of 60-70GW by 2020. The indications are that the new safety plan will reduce the role played by Gen-II reactors in upcoming projects, which in part explains the proposed decrease in the 2020 target capacity

Prior to Fukushima, the 12th Five-Year Plan projected 43 GW of nuclear power in operation by the end of 2015. Meeting this target would have required the completion of all the reactors under construction at the end of 2010, plus those that were planned to be started in 2011. However, the suspension of the start of new construction, the uncertainty over the strategic direction for future designs, along with the problems outlined below, make meeting this 2020 target highly unlikely.

Concerns have been raised about the availability of qualified staff and about the impact of such rapid construction on supply chains, leading a research unit of the State Council to suggest that the rate of growth be limited. Moreover, public acceptance of new reactors can no longer be taken for granted. Historically, nuclear protests mainly occurred in Hong Kong opposing the Daya Bay facility (both before and after the 1997 transfer of sovereignty). However, post-Fukushima, greater public concern coupled with reactors being proposed in up to 16 provinces, makes wider public engagement likely.

China's importance in the global nuclear sector is not solely due to construction numbers; it is also related to the types of reactors being built. Currently, the world's major reactor vendors, including AREVA and Westinghouse, are building their most advanced designs in China. In the case of Westinghouse, the AP1000 is the company's flagship Generation III+ design, and China is its most advanced sale. A key factor in the contract was that it contained a technology transfer not only for the reactor but also for back-end services, particularly waste management. In June 2011 Westinghouse said it was in talks regarding building ten further AP1000 units, and confirmed that as part of the earlier construction agreement it would transfer intellectual property rights.

Construction of these four units, two at Sanmen and two at Haiyang, is underway, although delays of six-twelve months are reported. For the first unit at Sanmen, this is said to be due to design changes post Fukushima, while for the remaining three it is said to be due to supply chain issues relating to the increasing local content. It is suggested that the domestic content across the series of the four reactors will increase from 30% to 70%, with any future reactors built with purely Chinese parts. The estimated construction costs of the AP1000 are also quoted as rising. In 2009, the estimated cost was $1,940/kW, but the latest figures range from $2,300-2,600/kW.[10] While this is far below the estimated costs of any other Generation III+ globally, it is higher than the reported costs for the CRC 1000 at $1800/kW.[11]

In November 2007 AREVA announced the signing of an €8 billion ($11.6 billion) contract with the CGN for the construction of two European Pressurized Water Reactors (EPR) in Taishan in Guangdong Province and that it will provide "all the materials and services required to operate them."[12]

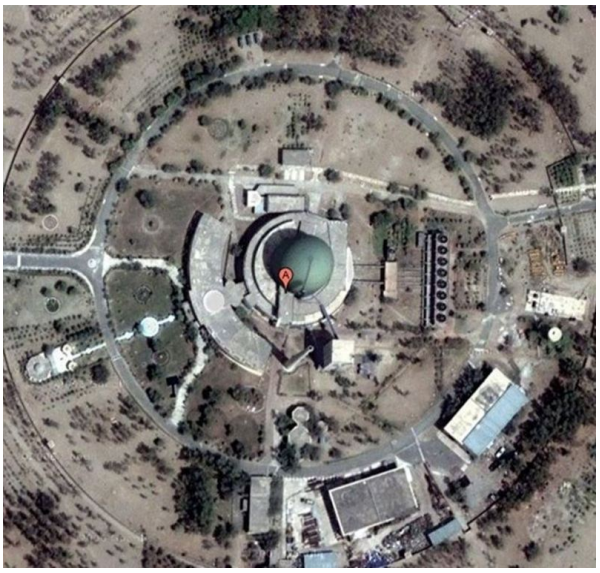
At about the same time, China and France signed an agreement opening the way to industrial cooperation at the back end of the nuclear fuel cycle, committing to undertake feasibility studies for the construction of an 800 ton-per-year spent fuel reprocessing plant in Jiayuguan, Gansu Province. Design, construction, and commissioning were

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expected to take a decade starting from 2010. In November 2010, an industrial agreement was signed that AREVA called "the final step towards a commercial contract" for the project, though this view may be too optimistic.[13]

China's Export of Nuclear Reactors

China has also been engaged in, and is increasing its activity for, the export of nuclear reactors. In Pakistan, which is outside the regime of the Non-Proliferation Treaty, China has supplied equipment for the two reactors at Chashma, the second of which entered commercial operation in May 2011. Construction of units 3 and 4 was said to have begun at the end of 2011 with the engagement of China Zhongyuan Engineering as the general contractor and China Nuclear Industry No 5 as the installer, with finance also coming from China. In October 2011, CGNPC signed a contract agreement with Romania's state-owned Nuclearelectrica to invest in the completion of units 3 and 4 of the Cernavoda plant in Romania.



Chashma Nuclear Power Plant

In recent months the Chinese industry reportedly connected with many other projects around the world. The April 2012 visit of the Turkish Prime Minister Erdogan to Beijing was used to discuss China's assistance for a proposed nuclear power station at Sinop. Other possible deals include the prospect of the sale of a plant to South Africa and a nuclear co-operation agreement in Saudi Arabia. In July 2012, China National Nuclear Corporation (CNNC) were in talks with the Argentinean Government regarding the construction of a fourth unit at the Atucha nuclear power plant. Argentina awarded CNNC a certificate for the preliminary examination of ACP1000 technology application.

China's entry into the international market will increase the competition for the existing reactor exporters. In particular, Chinese companies may well compete with Russia's nuclear sector, which has been active in markets such as Belarus, Turkey and Vietnam.

Cutback in European Nuclear Energy Plans

Several nuclear development plans have been scuppered across Europe in recent years, particularly in the UK. In September 2011, the UK Utility SSE exited the NuGen nuclear group by selling out to partners Iberdrola and GDF-Suez. A second withdrawal from new nuclear projects took place in March 2012, when RWE and E.ON pulled out of their Horizon joint venture citing global economic conditions, a shortage of capital, and the accelerated phase-out of nuclear power in Germany as reasons for their exit.

RWE and E.ON were planning investments of approximately $23 billion to develop 6GW of nuclear power across two approved sites – Wylfra and Oldbury – by 2025. The companies are currently in the process of seeking a buyer for Horizon. At least two consortiums, both involving state-backed Chinese enterprises, have shown significant interest in putting forward a bid. The first involves Westinghouse, the Japanese-owned nuclear reactor

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manufacturer, in partnership with State Nuclear Power Technology Corporation (SNPTC) of China. The second is led by AREVA, the French state-controlled nuclear reactor manufacturer, in partnership with China Guangdong Nuclear Power Corporation (CGNPC). In addition, Russian state-owned Rosatom and, it is believed, US-Japanese joint venture GE-Hitachi have an interest in bidding. However, since the AREVA EPR and Westinghouse AP1000 are the only Gen-III+ designs to have undergone the lengthy process of getting approval from the UK's Office for Nuclear Regulation, it is unlikely that the bids put forward by either consortium could be challenged.

Nevertheless, in contrast to Italy and Germany, both of which have chosen to exit nuclear power, the British government remains determined to proceed. Not only is it supporting the construction of new nuclear plants, but it proposes to guarantee a minimum price for the electricity that is expected to range between 2-3 times the current base load price, without which no utility will build nuclear in the UK.

As with most energy sectors, what happens in China regarding nuclear power has global ramifications. In many quarters there is significant confidence that ambitious targets for domestic construction will be met, but this should be tempered given the remaining strategic questions over nuclear safety standards, engineering bottlenecks, increasing environmental opposition combined with lower electricity demand projections. Globally, Chinese companies are becoming more active and one of the key nuclear test cases will be in the UK, where successive governments have been promising a 'nuclear renaissance' for over a decade. With European utilities pulling out of the bidding process, gaps have opened up and speculation is rife that Chinese investors will step in. However, with high estimated construction costs, the projects will only proceed with significant government financial guarantees – aka subsidies. In these austere times whether the UK Government is willing to grant adequate financial inducement is still unclear. However, if they do, and Chinese companies form part of the consortiums it will no doubt be a milestone for the Chinese nuclear sector.

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Notes

[1] IEA, "World Energy Outlook", International Energy Agency, November 2011

[2] BP, "Statistical Review of World Energy, BP, June 2012

[3] IAEA, "PRIS-Data-base", International Atomic Energy Agency, accessed August 2012

[4] Wikkileaks, "Viewing cable 08Beijing3362, Effective Nuclear Advocacy in China"

[5] "Despite Inspections, Post Fukushima Impact on Newbuild is Minimal," Nuclear Intelligence Weekly, January 30, 2012.

[6] Archana Chaudhary, "Nuclear Accident Forces China Policy Review as India Sees Safety Backlash," 14 March 2011.

[7] "China Suspends Approval for Nuclear Power Plants," The Guardian 16 March 2011.

[8] WNA, "Nuclear Power in China", May 2012,

[9] Dynabond, "China's nuclear safety plan might be completed by the end of this year", 27th October 2011.

[10] "Wang Declares AP1000s Back on Track", Nuclear Intelligence Weekly, March 23rd 2012.

[11] "AP-1000s Delayed by 6-12 Months SNPTC Says," Nuclear Intelligence Weekly, January 17th 2012.

[12] AREVA, "China: AREVA and CGNPC Sign the Biggest Contract Ever in the History of Nuclear Power and Enter into a Long-term Commitment. AREVA and CNNC Strengthen Their Links," press release (Paris: 26 November 2007).

[13] World Nuclear Association (WNA), "China's Nuclear Fuel Cycle," updated January 2011.

https://doi.org/10.1017/S1557466012033128 Published online by Cambridge University Press