

Nuclear Reactors, Screw-Ups and Mao's Grandchildren

The regime in Beijing wants to free the land from the curse of coal with nuclear power plants. China is thus taking great security risks - which are then exported to Europe.

By Nina Trentmann
Shanghai

This week the people of Beijing were able to follow on their mobiles how their lives were being put in danger. In real time, smartphone apps show the residents of the Chinese capital the current smog index and individual air values, such as the concentration of PM2.5, particularly dangerous and fine dust particles. The air worsened dramatically over the span of six days, high-rises vanished in the smog, people wheezed, eyes watered. An "Airpocalypse" - the airborne disaster that regularly makes its home in Beijing, especially in winter - was the main topic of discussion on social media.

Just in time for the beginning of the climate conference in Paris on Monday, the smog index rose above the 600 mark - on a scale that actually ends at 500. Far lower values are already considered dangerous for all demographic groups, not just the elderly, the sick, and children. One reason for the smog is the central combined heat and power stations which have been running at full blast since 15 November, and which burn coal. As of this date, Chinese living north of the heating line set by Mao Tse-tung, which runs along the Huai River and the Qin Mountains, no longer have to freeze but rather struggle for air. Due to its geographic location, Beijing becomes heavily cloaked in continuous smog during poor weather conditions. The government then closes schools and factories, and asks the city's residents to stay at home with the windows and doors shut.

Yet such measures do not resolve the issue. China's government must reduce its dependence on coal if it does not want cancer and asthma levels to increase further, or the populace's anger to grow and be directed back at the government. The regime in Beijing sees the solution in renewable energy - and nuclear power. These are to be expanded quickly with domestically manufactured reactors. And because this comes with the potential for a lot of revenue, China's nuclear companies are being urged to engage in international business before the first Made-in-China reactor is complete and the security of the reactors has been half-way verified.

By 2030 China will construct up to 100 new nuclear power plants, predicts the market research institute Bloomberg New Energy Finance. In doing so the country is taking significant risks, according to experts. He Zuoxiu, one of the first atomic engineers in the country's history, has already warned of a possible accident multiple times. "China does not have enough experience to reliably estimate if accidents could occur," he said in May. Both the number of reactors as well as the operating time play a role, he says. "They want to construct 58 gigawatts of capacity by 2020, and 120 or 200 later on. That's insane."

Premier Li Keqiang rather openly addressed the problem this past spring. "Security is imperative, and should be ensured during the entire process," he said, "from design up to operation." At the same time the industry should construct as cheaply as possible. "I wish for the best quality to be offered at the best prices," Chinese media quoted the government head as saying.

Beijing not only wants to cover its own energy needs and improve air quality with its nuclear power plants, but also to make a grand entrance into the international power generation business. Hualong One is the name of the first nuclear power plant, and it is solely the intellectual property of the Chinese, even if the pressurised water reactor looks very similar to the American and French designs. "Hualong One would be inconceivable without cooperation from the French," says Mark Hibbs, nuclear expert at the Carnegie Foundation in the USA. "There was a very aggressive transfer of technology from France and the USA to China."

The first plant has been under construction in Fuqing, Fujian Province since May. "Hualong One is proof of the Chinese people's nuclear knowledge," touted Liu Qing, deputy head of the national energy authority, at the beginning of construction. "We want to supply many countries with this technology." In 2014 the International Atomic Energy Agency granted basic certification, and the Chinese reactors are currently awaiting the European recognition procedure - a process that takes about three years. "With Hualong One, it is very clearly about keeping the patents in Chinese hands, not international ones," says Jost Wübbeke of the Mercator Institute for China Studies (Merics) in Berlin.

The Chinese are pursuing a two-pronged strategy concerning export partners. Initially they are involving themselves financially in the construction of a reactor based on foreign technology - and in turn they are securing themselves the contract to construct a Hualong One. An intelligent play, says Chris Gadomski, head of the nuclear department at Bloomberg New Energy Finance. "For the Chinese it makes sense to obtain corresponding contracts in two steps."

In the UK, for instance. Here the Chinese are bearing a portion of the costs for the construction of the new nuclear power plant in Hinkley Point, Somerset, in order to subsequently construct a Hualong One reactor in Bradwell, Essex. "This gives them a reference reactor in a developed, Western country," says Gadomski. "Every country in Africa, every country in the Middle East will now say that the technology is safe enough."

The country's nuclear power firms hope to earn a lot of money by exporting the Hualong technology. Qian Zhimin, manager at the largest nuclear power company in the country, the China National Nuclear Corporation (CNNC) calculates that the export of a nuclear unit will bring approximately 30 billion renminbi (4.4 billion euros) in revenue.

According to the CNNC's own statements, the company is in negotiations with dozens of foreign governments in Europe, Latin America, Africa, and South Asia. China General Nuclear (CGN), the second largest nuclear power company, aspires to extend internationally. "We have our foot in the door in the UK", said Zheng Dongshan, vice-president of CGN, during a recent visit there. "That could help us open doors in other countries."

Just in mid-November CNNC had struck a similar deal with the Argentinian government. The Chinese are obligated to first construct a Canadian Candu-class reactor before they build a Hualong One. The approximately 15 billion dollars in capital required for the construction largely comes from China. "It's a lucrative deal for both sides," says Bloomberg expert Gadomski. "The financing costs in Argentina are currently at over 20 per cent, and back home the Chinese are only getting three per cent interest for their money." Now the Argentinians are paying six per cent in interest to the Chinese for their credit - an attractive deal for both parties.

However, Argentina and the UK are supposed to be just the start, with two other clients on deck in Romania and Kenya. "The Chinese have long-term, strategic plans, unlike the Europeans and Americans," says Gadomski. "They act aggressively and opportunistically."

The fact that the Hualong One in China is not yet operational appears not to have impacted its attractiveness abroad. Western experts feel this is problematic. "The way forward is difficult, indeed it is unclear how much the design will have to be altered during construction," says Antony Froggatt, senior research fellow for energy issues at the London think tank Chatham House. Problems such as those of the French nuclear power company Areva in Finland are looming. The EPR reactor under construction there in Olkiluoto is the first of its kind, but due to severe technical problems its completion has been delayed for years.

China's nuclear power companies are aided by the crisis of its Western competitors. In early November CNNC and Areva signed an agreement that also earmarks minority interest by the Chinese. Areva had previously recorded a loss in the billions. At the same time CNNC is obtaining access to technological know-how. In September the company signed an agreement with TerraPower, an American energy company with such figures as Microsoft founder Bill Gates behind it. Both parties claim that CNNC and TerraPower want to develop a so-called travelling wave reactor.

Within a few years, power relations in the global nuclear industry have reversed. The atomic age has begun much later in China than in other countries. While Germany's first nuclear power plant, the Kahl experimental plant, went operational in 1962, it took China until the early '90s before the Daya Bay reactor in the country's south began regularly producing power. The technology for the first reactors came from overseas, and Deng Xiaoping declared a contract for the delivery of two reactors after meeting with the French Trade Secretary in 1978. Areva and energy giant EDF have since continued selling power plants to China. The American Toshiba subsidiary Westinghouse was also able to take over part of the Chinese market for itself.

Westinghouse founded multiple joint ventures with Chinese state-owned companies and in turn had to provide some of its technology to the Chinese to construct power plants. "The technology transfer was a major element in constructing the AP1000 units in Sanmen and Haiyang," says Bruce D. Schlueter, China CEO of Westinghouse. "The majority of the transfer is complete." Russia also delivered nuclear technology to China. Tianwan Nuclear Power Plant, one of the largest plants in the country, was constructed with Russian assistance.

The Chinese national nuclear industry is a complicated construct of companies that each hold an interest in one another and which have incorporated subsidiaries. According to CNNC, the company has more than 100,000 employees, among whom 36,000 are technology specialists and 34,000 are technicians. Its competitor CGN is much smaller: the company based in Shenzhen, southern China has around 30,000 employees. However, this staff size will not suffice if the number of new power plants is to increase as heavily as planned. "There is not enough supply of people who can supervise the nuclear power plants," warns Merics specialist Wübbecke. This view is shared by Carnegie employee Mark Hibbs: "The danger lies in the number of nuclear power plants increasing faster than the number of qualified workers."

Although both companies employ technology that they acquired from observing their joint venture partners, security experts also warn of excessively rapid expansion of the Chinese nuclear industry for technical reasons. "It's dangerous to build too many reactors in too short a time," says Froggatt. "Especially if these objectives are stated from the top down by management." Jost Wübbecke confirms this: "If the assignment is, 'as much as possible as quickly as possible', then the likelihood that careless mistakes will be made is great." Wang Yinan, a Chinese woman from the State Council Research Centre - the highest administrative body in the People's Republic - has already expressed her doubts numerous times. She says that the "state decree for nuclear security", reference number HAF 102, does not sufficiently guarantee that power plants will be evaluated for resistance against major plane crashes.

On top of that is the lack of independence of the Chinese regulatory authorities on the nuclear power companies. According to Merics the companies and the monitoring authorities have become too closely associated. The British government is attempting to dispel these worries by referring to the clearance of all reactors by its own regulatory authorities. The Office for Nuclear Regulation (ONR) and the Environment Agency are responsible for this.

Along with a so-called generic design evaluation, the ONR says that each new reactor must produce a licence, environmental permit and construction permit before construction commences. Should the Hualong One pass the British authorities' test, this could be very beneficial when selling the technology. "This will be a crucial PR argument when selling to other foreign customers," says Chatham House expert Froggatt.

China wants to deliver the majority of components for reactors overseas on its own, and 85 to 95 per cent are supposed to be manufactured in the People's Republic. However, it is doubtful that the supply chain is actually secure, as there have already been cases of components being poorly constructed by uncertified vendors. "Local components can be a security risk," says Merics researcher Wübbecke.

Since the nuclear disaster in Fukushima the Chinese authorities have increased the security requirements for their power plants - out of their own interest. China cannot afford any major accident if it truly wants to lower its dependence on coal. "The government needs to get the filth out of the air. If the worst case scenario should happen, it won't achieve that goal," says Hibbs.

Hualong One has since been given a double shell so that the reactor will withstand a plane crash, according to chief developer Xing Ji. "We have improved all of our

emergency plans to guarantee security during construction and operation," he said to Chinese media this spring. After a temporary halt construction has commenced once more, and new construction permits were granted. "The Chinese did the right thing after Fukushima," says Bloomberg expert Gadomski. "They slowed down development and assessed the locations." Regardless, residents are increasingly afraid of the risks of nuclear power. "The nuclear disaster had a big impact on the Chinese population," reports one study published in the technical publication "PNAS" by a group of scientists from the Universities of Atlanta, Nanjing and Harvard in 2013. "Their perception of the risk has changed above all else, it has increased."

The risk actually increases with new locations. First nuclear power plants require a lot of water for cooling, and China's interior is very dry in many areas. Secondly, the country has a lot of unsettled land in the west, but it must be ensured that a new power plant can be quickly reached in the event of a crisis. "They need roads, airports, a water supply," Hibbs points out.

The experts doubt that China will reach the 58 gigawatt mark by as early as 2020. "Nuclear ambitions need to be put into perspective," says Bloomberg analyst Gadomski. "Until recently China was putting a new coal-fired power plant on stream almost every week. The number of nuclear power plants remains small in comparison." It will also be some time before Beijing no longer has to suffer from its winter smog - and gas masks, air filters, and smog apps are a thing of the past.