


# Nuclear Safety Concerns with China's Growing Reactor Fleet

 The NAPSNet Policy Forum provides expert analysis of contemporary peace and security issues in Northeast Asia. As always, we invite your responses to this report and hope you will take the opportunity to participate in discussion of the analysis.

---



---

## Recommended Citation

David Von Hippel and James H. Williams, "Nuclear Safety Concerns with China's Growing Reactor Fleet", NAPSNet Policy Forum, October 28, 2014, <https://nautilus.org/napsnet/napsnet-policy-forum/nuclear-safety-concerns-with-chinas-growing-reactor-fleet-2/>

---

David Von Hippel and James H. Williams

Nautilus Institute

28 October 2014

This paper was originally published with support from the Hanyang University's [Energy, Governance](#)

David Von Hippel is a Nautilus Institute Senior Associate working on energy and environmental issues in Asia, including on nuclear spent fuel management issues. James H. Williams is Chief Scientist at Energy+Environmental Economics, focusing on greenhouse gas emissions reduction and related issues in China and the US.

## **Nuclear Safety Concerns with China's Growing Reactor Fleet**

In the aftermath of the March 2011 tsunami-induced accident at the Fukushima nuclear plant in Japan, with its widespread releases of radioactive material and tense days of worry that the disaster could take an even worse turn, many governments around the world took the opportunity to review their nuclear power programs. In some nations—Germany is an example—the result has been a commitment to phasing out nuclear power. In Japan, all of the nations' reactors were taken off-line for extensive safety checks, and a panel was convened to look at different nuclear futures (including nuclear phase-out) for Japan, though a new government is now revisiting the phase-out plan. In China, the Fukushima accident spurred the government to undertake what turned out to be a relatively rapid review of reactor sites and nuclear development plans before resuming construction of China's reactor fleet. In almost any scenario of global nuclear power development, China will be building the majority of the world's new reactors. With electricity generation capacity in China growing at an average of 80 GW (gigawatts, or million kilowatts) or more annually over the last decade (equivalent to the current ROK **total** installed capacity as of 2013), and given the considerable environmental impacts—ranging from greenhouse gas emissions to local air pollution—of the coal-fired power that provides 80 percent of China's electricity needs, China's nuclear energy ambitions seem understandable. Recently, however, questions have been raised about not only the pace of China's nuclear build-out, but whether the resulting reactor fleet will provide China with the safe, clean power that is expected. Nuclear experts, including former government nuclear physicist He Zuoxiu, have been raising concerns about the potential of major nuclear accidents in China's reactor fleet, based in part on the statistical history of nuclear accidents worldwide, and in part on issues particular to China, such as the fragmented nature of the Chinese nuclear industry, the relative lack of maturity of Chinese institutions overseeing the nuclear industry, and the lack of coordination between planning for nuclear power capacity additions and planning for the electricity transmission and distribution improvements needed to safely support the new reactors.

### **Lessons of History**

A review of plans for nuclear plant construction in China, prepared for Nautilus by Professor Liu Xuegang, suggests that, even post-Fukushima, China will by 2025 have between 67 and 90 GW of nuclear power, of which well over 90 percent will be light water reactors (LWRs). Based on a similar expansion path, and examining the historical record of major reactor accidents per reactor-year of operation, He Zuoxiu estimates that China will "most probably" suffer a major reactor accident within 69 years, even if past accidents caused by human error are not considered. He Zuoxiu points out, however, that accidents have historically happened early in a country's nuclear program (at Three Mile Island in the United States and Chernobyl in the USSR, for example), before substantial experience had accrued, and that China's nuclear program is, relatively speaking, in its infancy. Moreover, China plans to build dozens of "third generation" reactors over the next decades, including a model (the Westinghouse-design "AP1000") that has not, to date, been built anywhere in the world. Lack of Chinese and international experience with this design, argues He Zuoxiu, increases the probability of accident dramatically—suggesting to him that a major accident will probably occur in China between 2020 and 2030.

## **Many Cooks, Many Recipes, Insufficient Oversight or Coordination**

China's massive nuclear construction program is not driven by a single entity or even a well-coordinated policy. Rather, nuclear power in each province is planned and constructed by a combination of provincial authorities keen to support growth in the local economy, in partnership with Chinese state-owned enterprises and, typically, one or more foreign reactor/technology vendors. The result is that at least six different nuclear technologies are and will be represented among China's commercial reactor fleet. The variety of somewhat different technologies—even though most are LWRs—exacerbates the lack-of-experience factor, and the probability of accidents major and minor. Further, the development of agencies responsible for the oversight of the nuclear industry in China, including the National Nuclear Safety Administration (NNSA), has not kept up with the needs for regulation of the industry either in terms of overall manpower or training in safety. Moreover, since NNSA operates under the China Atomic Energy Authority, it is (according to the World Nuclear Association) “perceived to be insufficiently independent of the CAEA, which plans new capacity and approves feasibility studies for new plants.” A report by China's State Council Research Office indicated that NNSA staff should, in order to adequately carry out its duties, quadruple by 2020, and that NNSA should report directly to the State Council, independent of the CAEA. Although the National Development and Reform Commission (NDRC) sets overall goals for nuclear development in China, there is, in fact, little coordination between the entities actually planning and building specific power plants, and therefore insufficient attention to issues such as coordination and common practices in nuclear safety compliance, handling of nuclear materials, and accident preparedness, despite a clear intention at the national level to strongly pursue nuclear safety goals. Moreover, many of the planned reactors, including many of the third generation reactors, are planned for inland sites, meaning (typically) that they must be cooled with river water. This puts the operation of those plants at risk from the impacts of climate change on water flows and temperature, a growing concern for thermal power plants worldwide.

## **Connecting to the Grid**

Nuclear power units must have redundant connections to reliable and relatively large electrical grids in order to be operated safely. When an LWR “trips” and goes off-line, it requires the availability of substantial quantities of back-up power to run the cooling pumps that keep the reactor from overheating, even after the nuclear chain reaction is stopped. Although China has made monumental strides in recent years in knitting together what had been a collection of regional grids, coordination between the grids remains incomplete, and, perhaps more importantly for nuclear power development, insufficient effort has gone into coordinating transmission grid planning and planning for nuclear capacity. As such, and given the pressure from provincial authorities and other members of reactor consortia to get reactors on line as soon as possible, it is possible that some reactors are being built in advance of construction of a transmission system sufficient to support them. This mismatch in schedules could lead to safety problems over time.

## **China's Nuclear Future**

Given its huge needs for electricity to fuel development, it is inevitable that China would pursue a range of power options, and indeed it is already among the world's leaders in solar, large hydroelectric, and wind power, as well as leading the world in additions of nuclear and its domestic staple, coal-fired power. The combination of the pace of growth, patchwork institutional framework, and inadequate coordination and oversight of its nuclear program, however, suggest that the growth in nuclear capacity is insufficiently matched with growth in the support systems needed to build and operate the reactor fleet safely. It is clear that a number of activists in China, many of whom are former nuclear industry insiders, are keenly aware of this mismatch and are lobbying for change, and that some government agencies are also aware of the situation. Whether those voices will be

heard above those of the interests promoting Chinese nuclear power in time to allow China to escape learning nuclear safety lessons the same hard way as did the United States, the USSR, and, most recently, Japan, remains to be seen.

---

## References and Further Reading

Cui Zheng (2012), "Ex-officials Battle Plan to Build Nuclear Project", CaixinOnline, dated March 9, 2012, available as <http://english.caixin.com/2012-03-09/100366298.html>.

He Zuoxiu (2013), "Chinese nuclear disaster "highly probable" by 2030", Chinadialogue, dated March 19, 2013, available as <http://www.chinadialogue.net/article/show/single/en/5808>

Liu Xuegang (2012), China's Nuclear Energy Development and Spent Fuel Management Plans, Nautilus Institute Special Report, dated October 16, 2012, and available as <https://nautilus.org/napsnet/napsnet-special-reports/chinas-nuclear-energy-development-and-spent-fuel-management-plans/#axzz2PFWFHEv9>

Michele Van Vliet et al (2012), "Vulnerability of US and European Electricity Supply to Climate Change," Nature Climate Change, Vol.2, Issue 9, and available as <http://www.nature.com/nclimate/journal/v2/n9/full/nclimate1546.html>

World Nuclear Association (2013), "Nuclear Power in China", updated 21 March 2013, and available as [http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/#.UVtIvlf\\_GWw](http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/#.UVtIvlf_GWw)

Xu Yi-chong (2010), The Politics of Nuclear Energy in China, Pelgrave MacMillan, November, 2010

---

View this online at: <https://nautilus.org/napsnet/napsnet-policy-forum/nuclear-safety-concerns-with-chinas-growing-reactor-fleet-2/>

Nautilus Institute  
608 San Miguel Ave., Berkeley, CA 94707-1535 | Phone: (510) 423-0372 | Email:  
[nautilus@nautilus.org](mailto:nautilus@nautilus.org)