

Nuclear Power in China

(Updated March 2010)

- **Mainland China has 11 nuclear power reactors in commercial operation, 20 under construction, and more about to start construction soon.**
- **Additional reactors are planned, including some of the world's most advanced, to give a sixfold increase in nuclear capacity to at least 60 GWe or possibly more by 2020, and then a further substantial increase to 160 GWe by 2030.**
- **China is rapidly becoming self-sufficient in reactor design and construction, as well as other aspects of the fuel cycle.**

Most of mainland China's electricity is produced from fossil fuels (80% from coal, 2% from oil, 1% from gas in 2006) and hydropower (15%). Two large hydro projects are recent additions: Three Gorges of 18.2 GWe and Yellow River of 15.8 GWe. Rapid growth in demand has given rise to power shortages, and the reliance on fossil fuels has led to much air pollution. The economic loss due to pollution is put by the World Bank at almost 6% of GDP.¹ In 2009 power shortages were most acute in central provinces, particularly Hubei, and in December the Central China Grid Co. posted a peak load of 94.6 GW.

Domestic electricity production in 2009 was 3643 billion kWh, 6.0% higher than the 3,450 billion kWh in 2008, which was 5.8% more than in 2007 (3,260 billion kWh) and it is expected to rise to 3,810 billion kWh in 2010. Installed capacity had grown by the end of 2009 to 874 GWe, up 10.2% on the previous year's 793 GWe, which was 11% above the previous year's 713 GWe.² Capacity growth is expected to slow, reaching about 1600 GWe in 2020. At the end of 2007, there was reported to be 145 GWe of hydro capacity, 554 GWe fossil fuel, 9 GWe nuclear and 4 GWe wind, total 713 GWe. In 2008, the country added 20.1 GWe of hydro capacity, 65.8 GWe coal-fired capacity, and 4.7 GWe wind.

These capacity increase figures are all the more remarkable considering the forced retirement of small inefficient coal-fired plants: 26 GWe of these was closed in 2009, making 60 GWe closed since 2006, cutting annual coal consumption by 69 million tonnes and annual carbon dioxide emissions by 139 Mt.

The State Grid Corporation of China's grid system is sophisticated and rapidly growing, utilising ultra high voltage (1000 kV AC and 800 kV DC). By 2020, the capacity of the UHV network is expected to be some 300 GW, of which hydropower will account for 78 GW, and wind power from the north a further significant portion. Wind capacity by 2020 is planned to be 100 GWe. At the end of 2009, China had budgeted to spend \$600 billion upgrading its grid.

Among the main listed generators, Huaneng Power produced 203.5 billion kWh from its domestic plants in 2009, 10.2% up on 2008. Datang Power produced 141.9 billion kWh, 12% up on 2008. Huadian Power produced 107.5 billion kWh, 6.75% above 2008. CPI Development produced 43.9 billion kWh, 2.0% above 2008 level.

While coal is the main energy source, most reserves are in the north or northwest and present an enormous logistic problem – nearly half the country's rail capacity is used in transporting coal. Because of the heavy reliance on old coal-fired plant, electricity generation accounts for much of the country's air pollution, which is a strong reason to increase nuclear share. China recently overtook

the USA as the world's largest contributor to carbon dioxide emissions. The US Energy Information Administration predicts that China's share in global coal-related emissions will grow by 2.7% per year, from 4.9 billion tonnes in 2006 to 9.3 billion tonnes in 2030, some 52% of the projected world total. Total carbon dioxide emissions in China are projected to grow by 2.8% per year from 6.2 billion tonnes in 2006 to 11.7 billion tonnes in 2030 (or 28% of world total). In comparison, total US carbon dioxide emissions are projected to grow by 0.3% per year, from 5.9 billion tonnes in 2006 to 7.7 billion tonnes in 2030.³

Nuclear power has an important role, especially in the coastal areas remote from the coalfields and where the economy is developing rapidly. Generally, nuclear plants can be built close to centres of demand, whereas suitable wind and hydro sites are remote from demand. Moves to build nuclear power commenced in 1970 and the industry has now moved to a rapid development phase. Technology has been drawn from France, Canada and Russia, with local development based largely on the French element. The latest technology acquisition has been from the USA (via Westinghouse, owned by Japan's Toshiba) and France. The Westinghouse AP1000 is the main basis of technology development in the immediate future.

The government had planned to increase nuclear generating capacity to 40 GWe by 2020 (out of a total 1000 GWe then planned), with a further 18 GWe nuclear being under construction then, requiring an average of 2 GWe per year being added. In May 2007, the National Development and Reform Commission announced that its target for nuclear generation capacity in 2030 was 160 GWe. In March 2008, the newly-formed State Energy Bureau (SEB) said that the target for 2020 should be at least 5% of electricity from nuclear power, requiring at least 50 GWe to be in operation by then. In June 2008, the China Electrical Council projected 60 GWe of nuclear capacity by 2020. In July 2009, the State Council was reported to be considering raising the 2020 target to 86 GWe installed and 18 GWe under construction.



Nuclear power reactors in mainland China

Reactor technology

China has set the following points as key elements of its nuclear energy policy:

- PWRs will be the mainstream but not sole reactor type.
- Nuclear fuel assemblies are fabricated and supplied indigenously.
- Domestic manufacturing of plant and equipment will be maximised, with self-reliance in design and project management.
- International cooperation is nevertheless encouraged.

The technology base for future reactors remains officially undefined, though two designs are currently predominant in construction plans: CPR-1000 and AP1000. Beyond them, high-temperature gas-cooled reactors and fast reactors appear to be the main priorities.

A major struggle between the established China National Nuclear Corporation (CNNC) pushing for indigenous technology and the small but well-connected State Nuclear Power Technology Corp (SNPTC) favouring imported technology was won by SNPTC about 2004. In particular, SNPTC proposes use of indigenized 1000+ MWe plants with advanced third-generation technology, arising from Westinghouse AP1000 designs at Sanmen and Haiyang (see section below on [Embarking upon Generation III plants](#)). Westinghouse has agreed to transfer technology to SNPTC over the first four AP1000 units so that SNPTC can build the following ones on its own.

In February 2006, the State Council announced that the large advanced PWR was one of two high priority projects for the next 15 years, depending on "Sino-foreign cooperation, in order to master international advanced technology on nuclear power and develop a Chinese third-generation large PWR".⁴ In September 2006, the head of the China Atomic Energy Authority said that he expected large numbers of third-generation PWR reactors derived from foreign technology to be built from about 2016, after experience is gained with the initial AP1000 units.

AP1000

The first four Westinghouse AP1000 reactors are being built at Sanmen and Haiyang. At least eight more at four sites are firmly planned after them, involving substantial technology transfer, and about 30 more are proposed to follow. The AP1000 is to be the main basis of China's move to Generation III technology. These are built from modules fabricated adjacent to each site. The timeline is 50 months from first concrete to fuel loading, then six months to grid connection (see section below on [Embarking upon Generation III plants](#)).

EPR

Two Areva EPR reactors are being built at Taishan, but no more appear to be proposed. (see section below on [Embarking upon Generation III plants](#)).

Nevertheless, in October 2008, Areva and CGNPC announced establishment of an engineering joint venture as a technology transfer vehicle for development EPR and other PWR plants in China and later abroad. The JV will be held 55% by CGNPC and other Chinese interests, and 45% by Areva. It will engineer and procure equipment for both the EPR and the CPR-1000.

CAP1400

Westinghouse announced in 2008 that it was working with SNPTC and Shanghai Nuclear Engineering Research & Design Institute (SNERDI) to develop jointly a passively safe larger design from the AP1000, probably of 1400 MWe capacity for large-scale deployment. This development with SNERDI opens the possibility of China itself exporting the new larger units with Westinghouse's cooperation. Then, in October 2009, SNPTC and CNNC signed an agreement to co-develop and refine the AP1000 design. In December this led to setting up a 55-45% joint venture company by SNPTC and China Huaneng Group to build and operate an initial unit of the larger design, the CAP1400, at or near Huaneng's Shidaowan site. Construction is expected to start in 2013 and SNPTC hopes to have it operating in December 2017. It may be followed by a CAP1700 design, and China will own the intellectual property rights for these two larger designs.

CNP-1000

CNNC had been working with Westinghouse and Framatome ANP (Areva NP) at SNERDI since the early 1990s to develop a Chinese standard three-loop PWR design, the CNP-1000 based on Qinshan units, with high (60 GWd/t) burn-up, 18-month refueling cycle and 20 more fuel assemblies than the French-origin units. In 1997, the Nuclear Power Institute of China (NPIC) at Chengdu became involved in the reactor design and early in 2007 SNERDI was reassigned to concentrate on the AP1000 program. CNNC has been keen to create its own brand of advanced second-generation reactor with intellectual property rights, and wanted to build two initial CNP-1000 plants at Fangjiashan, adjacent to Qinshan near Shanghai, under the 11th Economic Plan, though the design probably would not have been ready. In early 2007, the CNP-1000 development was put on

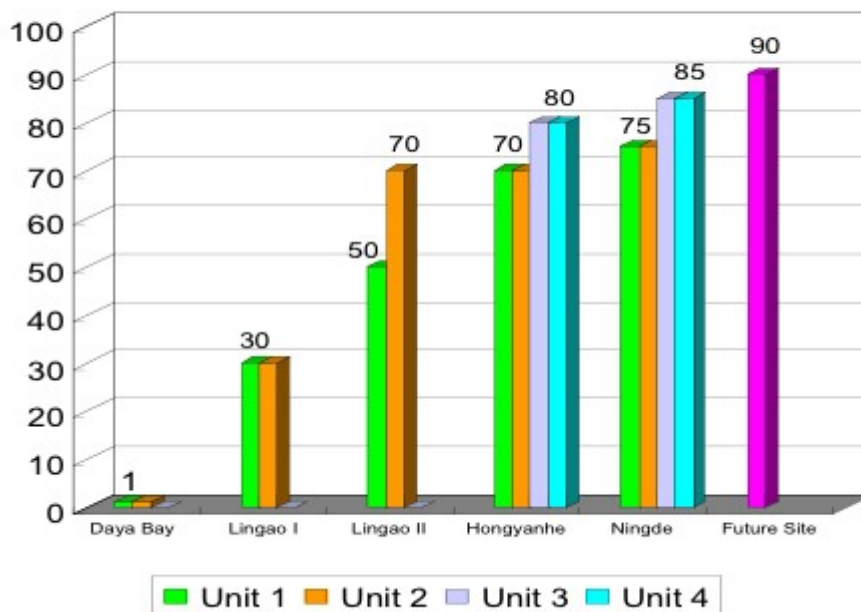
hold indefinitely, though this aborted export plans for two CNP-1000 units to Pakistan.

The China Zhongyuan Engineering Corporation is involved with constructing a 300 MWe PWR unit (CNP-300) at Chasma in Pakistan – a twin to that already commissioned in 2000 and similar to Qinshan 1 – China's first indigenously-designed (by SNERDI) nuclear power plant. Qinshan phase 2 is CNP-600, a scaled-up two-loop version of the same.

CPR-1000

China Guangdong Nuclear Power's (CGNPC's) indigenous focus has been on the French-derived three-loop units such as at Lingao, without major modification, now called CPR-1000, or 'improved Chinese PWR', and designated Generation II+, with digital instrumentation and control, and 60-year design life. It has 157 fuel assemblies. However, Areva retains intellectual property rights for this, which constrains overseas sales since the Chinese would need agreement from Areva on a case by case basis, and this would be unlikely in competition with the Atmea 1 design. The CPR-1000 is being widely and quickly deployed for domestic use under CGNPC leadership. Standard construction time is 52 weeks and the unit cost is under CNY 10,000 (US\$ 1500) per kilowatt. In June 2009, the first Chinese-made reactor pressure vessel for a 1000 MWe reactor was delivered for Ling Ao Phase II, from Dongfang (Guangzhou) Heavy Machinery Co.

CGNPC Progressive Localisation of CPR-1000



VVER

Russia's Atomstroyexport is general contractor and equipment provider for the Tianwan AES-91 power plants using the V-428 version of the well-proven VVER-1000 reactor of 1060 MWe capacity. The reactors incorporate Finnish safety features and Siemens-Areva instrumentation and control systems. Russia's Energoatom is responsible for maintenance from 2009. Tianwan units 3 & 4 will use the same version of the VVER-1000 reactor, and then units 5 & 6 will probably use the VVER-1200.

Protracted discussion on pricing delayed units 3 & 4. Eventually €1.3 billion was agreed for Atomstroyexport to provide 30% of the plant including nuclear island equipment (reactor, steam generator, pressurisers, primary piping *etc.*) and some related equipment. Jiangsu Nuclear Power Corporation is responsible for about 70% of the project, namely, the civil work, turbine island with equipment and related infrastructure on the site.

Candu

In September 2005, Atomic Energy of Canada Ltd (AECL) signed a technology development agreement with CNNC which opened the possibility of it supplying further Candu-6 reactors. AECL built the two-unit Qinshan Phase III plant on schedule and under budget and estimates that it could be replicated for 25% lower cost. Any replication would be on the basis of involving local engineering teams, not on a turnkey basis, but the technology is now well understood and the decades-old Candu-6 design would likely pose fewer problems for technology transfer than state of the art third-generation designs from Westinghouse and Areva NP. (The later Korean Candu-6 plants at Wolsong had 75% local content.) However, the agreement with CNNC – more specifically with SNERDI – looked further forward to collaboration on AECL's new ACR design later. SNERDI is now focused on AP1000 engineering and reassigned to SNPTC, so early in 2008 work on Candu fuel technologies passed to another CNNC entity: the Nuclear Power Institute of China (NPIC).

BWR

Having left the Chinese reactor market to others, in the light of China's preference for PWR designs, GE has been commending its new boiling water reactor designs for future orders there.

HTR

In February 2006, the State Council announced that the small high-temperature gas-cooled reactor (HTR) was the second of two high priority projects for the next 15 years. The small HTR units with pebble bed fuel were to be 200 MWe reactors, similar to that being developed in South Africa, but plans have evolved to make them twin 105 MWe units driving a single steam turbine (see [Shidaowan project](#) below, and [Research and development](#) section in page on China's Nuclear Fuel Cycle).

Fast neutron reactor

Longer-term, fast neutron reactors (FNR) are seen as the main technology, and CNNC expects the FNR to become predominant by mid century. A 65 MWt fast neutron reactor - CEFR - is under construction near Beijing and due to achieve criticality in 2009. Further developments of this were expected to follow (see [Research and development](#) section in page on China's Nuclear Fuel Cycle).

However, in October 2009 a high-level agreement with Russia confirmed earlier indications that China would opt for the BN-800 technology instead of indigenous development. The 880 MWe gross BN-800 reactor being built by OKBM Afrikantov at Beloyarsk in Siberia is the reference design, and the first one in China is planned to start construction in August 2011, after a site is confirmed (Sanming, Fujian is tentative). Negotiations in Moscow were reported to be at a very advanced stage in March 2010.

Embarking upon Generation III plants

In September 2004, the State Council approved plans for two units at Sanmen, followed by six units at Yangjiang (two to start with), these to be 1000 or 1500 MWe reactors pioneering Generation III nuclear technology from overseas. The Sanmen (in Zhejiang province) and Yangjiang (in Guangdong province) reactors were subject to an open bidding process for third-generation designs, with contracts to be awarded in mid-2006 – in the event, mid-2007 – putting them clearly into the 11th Five Year Plan.

Bidding process

This open bidding process underlined the extent to which China is making itself part of the world nuclear industry, and yet at first remaining somewhat ambivalent about that.

Three bids were received for the four Sanmen and Yangjiang reactors: from Westinghouse (AP1000 reactors), Areva (EPR) and Atomstroyexport (VVER-1000 model V-392). The State Nuclear Power Technology Corporation (SNPTC), directly under China's State Council, was in charge of technology selection for new plants being bid from overseas.

The USA, French and Russian governments were reported to be giving firm support as finance and support arrangements were put in place. The US Export-Import bank approved \$5 billion in loan guarantees for the Westinghouse bid, and the French Coface company was expected similarly to finance Areva for its bid. The US Nuclear Regulatory Commission gave approval for Westinghouse to export equipment and engineering services as well as the initial fuel load and one replacement for the four units. Bids for both two-unit plants were received in Beijing on behalf of the two customers: China Guangdong Nuclear Power Co (CGNPC) for Yangjiang, and China National Nuclear Corporation (CNNC) for Sanmen. Bids were for the nuclear portion of each plant only, the turbine tenders to be called for subsequently.

Bids were assessed on level of technology, the degree to which it was proven, price, local content, and technology transfer - which apparently became the major factor. Areva and Westinghouse were short-listed. However, the decision on reactor type was delayed, and came under review at the highest political level, with CNNC evidently pushing for the use of indigenous second-generation designs for both sites.

In December 2006, 22 months after the bids were submitted and after several revisions to them, the Westinghouse AP1000 reactor design was selected for the four units – two each at Sanmen and Yangjiang. Early in 2007, the two units planned for the Yangjiang site were switched to Haiyang in the more northerly Shandong province, making way for two EPR units. Areva was in negotiations to build at Yangjiang. Later in 2007, plans for the EPRs under consideration for Yangjiang were transferred to another Guangdong site – Taishan – since there was pressure to build a lot of capacity quickly at Yangjiang.

Sanmen 1&2 and Haiyang 1&2

A framework agreement was signed at the end of February 2007 between Westinghouse and SNPTC specifying Haiyang and Sanmen for the four AP1000 units. In July 2007, Westinghouse, along with consortium partner Shaw, signed the contracts with SNPTC, Sanmen Nuclear Power Company (51% owned by CNNC), Shandong Nuclear Power Company (61% owned by CPI) and China National Technical Import & Export Corporation (CNTIC) for four AP1000 reactors. Specific terms were not disclosed but the figure of \$5.3 billion for the first two was widely quoted.

Sanmen site works commenced in February 2008 and full construction on Sanmen 1 – the world's first AP1000 unit – officially commenced on 19 April 2009. The reactor is expected to begin operation in August 2013 with the second about one year later. First concrete at Haiyang 1 was in September 2009. The Haiyang units are expected to commence operation in 2014 and 2015.

AP1000 equipment contracts

In April 2007, Westinghouse signed a \$350 million contract with Doosan Heavy Industries in Korea for two pressure vessels and four steam generators for Sanmen 1 and Haiyang 1. The pressure vessels for the other two units are being made by Chinese manufacturers: China First Heavy Industries (CFHI, also known as YiZhong) for Sanmen 2 and Shanghai Electric Group Corporation (SEC) for Haiyang 2. Steam generators for Sanmen 2 and Haiyang 2 are being manufactured by Harbin Power Equipment Co., Ltd. (HPEC) and SEC, respectively.

All four steam turbine generators are being manufactured by Mitsubishi Heavy Industries (MHI). In a \$521 million deal, Sanmen Nuclear Power ordered two turbine generator packages from MHI at the end of September 2007, with Shandong Nuclear Power ordering another two early in 2008. MHI's Takasago Machinery Works is manufacturing the turbines, including rotors and blades. Mitsubishi Electric Corporation is supplying the generators and HPEC, partnering with MHI, is responsible for turbine casings, piping and associated facilities. The turbines will reportedly boost the capacity of the reactors from their designed 1175 MWe to 1250 MWe gross.

Taishan 1&2

In February 2007, EDF entered a cooperation agreement with CGNPC to build and operate a two-unit EPR power station at Yangjiang in Guangdong province. This deal was not expected to involve the technology transfer which is central to the Westinghouse contracts, since the EPR has multiple redundant safety systems rather than passive safety systems and is seen to be more complex and expensive, hence of less long-term interest to China. However, negotiations with Areva and EDF dragged on and in August 2007 it was announced that the EPR project had been shuffled to Taishan (in Guangdong) so that six CPR-1000 units previously planned for that site could be built at Yangjiang as soon as possible.

At a November 2007 ceremony attended by Chinese president Hu Jintao and French president Nicolas Sarkozy in Beijing's Great Hall of the People, Areva initialed an €8 billion contract with CGNPC for the two EPRs at Taishan plus supply of fuel to 2026 and other materials and services for them. The whole project, including fuel supply, totals €8 billion, of which the nuclear reactors themselves were reported to be about €3.5 billion. Steam turbine generators costing €300 million are included in the larger sum. The Guangdong Development Commission quotes the total investment in both units as CNY 49.85 billion (\$7.3 billion). The joint venture partners will put up CNY 16.45 billion and the balance will be borrowed with guarantee from the Central Bank of France. French export credits for the project are reported as EUR 1.7 billion (\$2.4 billion), covering purchase of equipment such as pressure vessel and steam generators from French suppliers.

In August 2008, EDF and CGNPC signed the final agreements for the creation of Guangdong Taishan Nuclear Power Joint Venture Company Limited (TNPC). EDF will hold 30% of TNPC for a period of 50 years (the maximum period permitted for a joint venture in China), CGNPC 70%. TNPC will oversee the building, then own and operate the plant. EDF will pay €600 to 800 million over four years for this share, subject to approval by the National Development and Reform Commission (NDRC) and the Ministry of Commerce. (EDF is project manager and architect for the

Flamanville 3 EPR project in France, and this initiative consolidates its change in corporate strategy outside France as expressed already in the UniStar joint venture set up in mid-2007 with Constellation in USA to build, own and operate a fleet of US-EPRs in North America.)

CGNPC subsidiary China Nuclear Power Engineering Co. and Areva also set up an engineering joint venture Wecan, in December 2009. This is 55% CGNPC and 45% Areva, is based in Shenzhen, and builds on Areva's European experience

CGNPC authorised construction in July 2008 and first concrete was poured on 28 October 2009, though the official inauguration ceremony was not until 21 December. The first unit should be completed at the end of 2013 and the second in 2015. Areva has begun fabrication of major components for both units. The Arabelle steam turbines and 1750 MWe generators are being purchased separately from Alstom and Dongfang Electric Co.

Nuclear growth

In 2007, nuclear power plants provided 62.86 billion kWh - 2.3% of total - and there is now 8.6 GWe (net) installed. The first two nuclear power plants in mainland China were at Daya Bay near Hong Kong and Qinshan, south of Shanghai, with construction starting in the mid-1980s.

China's concerted nuclear expansion began with the National Development and Reform Commission's (NDRC's) Tenth Economic Plan for the years 2001-2005. (China's first economic plan was in 1953 and began China's centrally planned industrialization under Mao Zedong.) The Eleventh Economic Plan for the years 2006-2010 set even more ambitious goals than the Tenth for new nuclear plant construction, and marked a watershed in China's commitment to third-generation reactors, such as the Sanmen plant in Zhejiang province and Haiyang plant in Shandong province (see section above on [Reactor technology](#)).

The Tenth Five-Year Plan incorporated the construction of eight nuclear power plants, though the timeline for contracts was extended, putting the last two into the 11th plan. In May 2004, the China National Nuclear Corporation (CNNC) applied to build eight (four pairs) of new reactors, four of them for China Guangdong Nuclear Power Company (CGNPC):

- Lingao Phase II (also known as Lingdong) in Guangdong province, to duplicate the CPR-1000 Lingao Phase I nuclear plant.
- Qinshan in Zhejiang province, units 3 and 4 of Phase II, duplicating the indigenous CNP-600 units 1&2, upgraded to 650 MWe.

And the following, which slipped to the Eleventh Plan:

- Sanmen in Zhejiang province, using advanced foreign technology and design.
- Yangjiang (originally) in Guangdong province, 500 km west of Hong Kong, also using advanced foreign technology.

In July 2004, the State Council formally approved the two CPR-1000 units at Lingao. The two CNP-600 Qinshan Phase II units 3&4 of 650 MWe were subsequently approved and CNNC announced that the next two there would be 1000 MWe indigenous units (now seen as very unlikely or much delayed, and in effect Fangjiashan, adjacent to Qinshan 1, takes over this role).

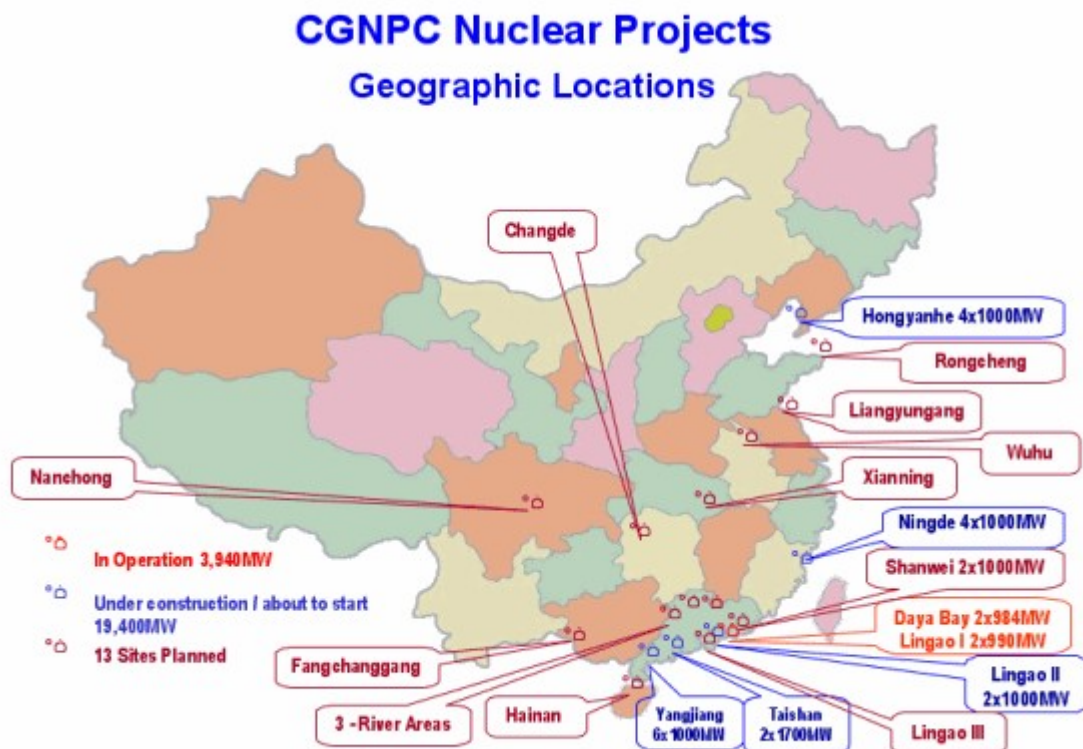
The 11th Five Year Plan (2006-10) has firmer environmental goals than previously, including reduction of 20% in the amount of energy required per unit of GDP, *i.e.* 4% reduction per year.

As well as the Sanmen and Yangjiang projects slipped from the 10th Plan, nuclear power developments originally proposed in the 11th Plan included:

- Four CPR-1000 units at Hongyanhe, Liaoning province in the northeast.
- Two 1000 MWe units at Haiyang, Shandong province (now 1100 MWe AP1000).
- Two 1000 MWe units at Fuqing, Fujian province.
- Two units at Hongshiding, Rushan city, Shandong province.
- Two units at Lufeng in eastern Guangdong province.
- Two units at Taishan in southern Guangdong.

In 2007, it was announced that three state-owned corporations had been approved to own and operate nuclear power plants: CNNC, CGNPC and China Power Investment Corporation (CPI). Any other public or private companies are to have minority shares in new projects. CGNPC is increasingly preeminent in actual nuclear power plants.

By the end of the 12th Five Year Plan (2011-15) some 25 GWe is planned to be operational, and 45 GWe by the end of the 13th Five Year Plan.



More than 16 provinces, regions and municipalities have announced intentions to build nuclear power plants in the 12th Five Year Plan 2011-15. These include Henan and Sichuan, as well as those listed in the [Further nuclear power units proposed](#) Table below - most of which have preliminary project approval by the central government but are not necessarily scheduled for construction. Provinces put together firm proposals with reactor vendors by 2008 and submitted them to the central government's National Development and Reform Commission (NDRC) for approval during 2009. NDRC consideration is via the new National Energy Administration (NEA). A great many proposals were received, many of which will be deferred to the 13th Plan.

In its 2007 Annual Report, CPI said that at the end of the 12th Five Year Plan it expected to have 100 GWe of controllable installed capacity including three nuclear power bases: Liaoning, Shandong and inland.⁵

The complex ownership structure of Chinese nuclear plants is described in Appendix 1: Government Structure and Ownership, and China's considerable heavy engineering and manufacturing capacity is detailed in the information page on [Heavy Manufacturing of Power Plants](#).

Operating nuclear plants

Operating nuclear reactors

Units	Province	Net capacity (each)	Type	Operator	Commercial operation
Daya Bay 1&2	Guangdong	944 MWe	PWR	CGNPC	1994
Qinshan Phase I	Zhejiang	279 MWe	PWR	CNNC	April 1994
Qinshan Phase II, 1&2	Zhejiang	610 MWe	PWR	CNNC	2002, 2004
Qinshan Phase III, 1&2	Zhejiang	665 MWe	PHWR	CNNC	2002, 2003
Lingao 1&2	Guangdong	935 MWe	PWR	CGNPC	2002, 2003
Tianwan 1&2	Jiangsu	1000 MWe	PWR (VVER)	CNNC	2007
Total: 11		8587 MWe			

Daya Bay, Lingao

The Daya Bay reactors in Guangdong province are standard 3-loop French PWR units supplied by Framatome, with GEC-Alstom turbines. Electricite de France (EDF) managed construction, starting August 1987, with the participation of Chinese engineers. Commercial operation of the two units was in February and May 1994. There were long outages in 1994-96 when Framatome had to replace major components. Reactor vessel heads were replaced in 2004. The plant produces about 13 billion kWh per year, with 70% transmitted to Hong Kong and 30% to Guangdong.

The Lingao Phase I reactors are virtually replicas of adjacent Daya Bay. Construction started in May 1997 and Lingao 1 started up in February 2002 entering commercial operation in May. Lingao 2 was connected to the grid about September 2002 and entered commercial operation in January 2003. The two Lingao reactors use French technology supplied by Framatome, but with 30% localisation. They are now designated CPR-1000. They are reported to have cost \$1800 per kilowatt.

Daya Bay and Lingao together comprise the 'Daya Bay nuclear power base' under the common management of Daya Bay Nuclear Power Operations & Management Co (DNMC), part of China Guangdong Nuclear Power Group (CGNPC). Framatome is now Areva NP.

Qinshan

Qinshan 1 in Zhejiang province 100 km southwest of Shanghai, is China's first indigenously-designed and constructed nuclear power plant (though with the pressure vessel supplied by Mitsubishi, Japan). Design of the 300 MWe PWR was by the Shanghai Nuclear Engineering Research & Design Institute (SNERDI). Construction work spanned 6.5 years from March 1985, with first grid connection in December 1991. It was shut down for 14 months for major repairs from

mid-1998.

In October 2007, Qinshan 1 was shut down for a major upgrade. The entire instrument and control system was replaced, along with the reactor pressure vessel head and control rod drives. Areva NP supervised the work, which is likely to lead to life extension beyond the original 30 years.

Qinshan Phase II units 1&2 are locally-designed and constructed 2-loop PWR reactors, scaled up from Qinshan 1, and designated CNP-600. Unit 1 started up at the end of 2001 and entered commercial operation in April 2002. Unit 2 started up in March 2004, with commercial operation in May 2004.

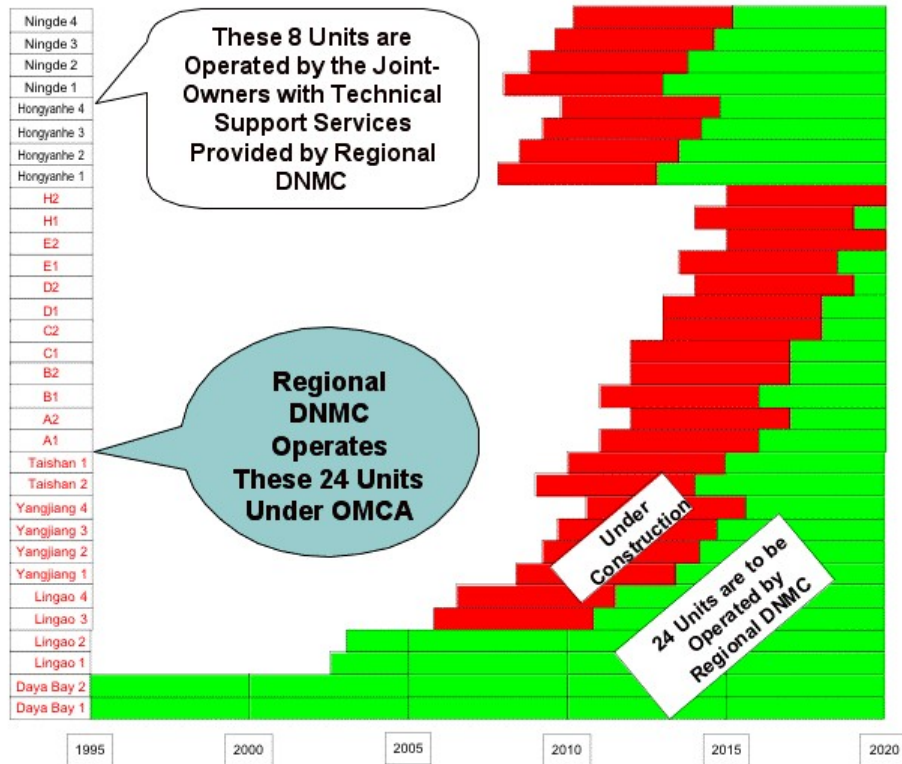
Qinshan Phase III units 1&2 use the Candu 6 pressurised heavy water reactor (PHWR) technology, with Atomic Energy of Canada (AECL) being the main contractor of the project on a turnkey basis. Construction began in 1997 and unit 1 started up in September 2002 and unit 2 in April 2003. They are each about 665 MWe net.

Tianwan

Tianwan Phase I at Lianyungang city in Jiangsu province is a Russian AES-91 power plant (with two 1060 MWe VVER reactors) constructed under a cooperation agreement between China and Russia - the largest such project ever. The cost is reported to be \$3.2 billion, with China contributing \$1.8 billion of this. Completion was delayed due to corrosion in the steam generators which resulted in some tubes having to be plugged with a net loss of capacity of about 2%. The first unit was grid connected in May 2006 and put into commercial operation in June 2007. The second was grid connected in May 2007, with commercial operation in August 2007. Design life is 40 years.

Nuclear plants under construction and planned

China Guangdong Nuclear Power (CGNPC) expects to spend \$ 9.5 billion on its Lingao Phase II, Yangjiang and Taishan nuclear power plants by 2010 and to have 6000 MWe on line by then, with 12,000 MWe under construction. Work is under way at all these sites and also at Ningde. It is also making efforts to start on the Lufeng plant at Shanwei in Guangdong and Wuhu in Anhui province, but awaits NDRC approval. It is expecting to have 34,000 MWe nuclear capacity on line by 2020, providing 20% of the province's power, and 16,000 MWe under construction then. From 2010 it expects to commission three units per year and, from 2015, four units per year. CGNPC is also, due to State Council policy, committed to developing significant wind capacity through CGN Wind Co. It projects a total of 500 MWe by 2020.



China Guangdong Nuclear Power Group plans to 2020, as of about 2005

In 2006, China National Nuclear Corporation (CNNC) signed agreements in Liaoning, Hebei, Shandong and Hunan provinces and six cities in Hunan, Anhui and Guangdong provinces to develop nuclear projects. CNNC has pointed out that there is room for 30 GWe of further capacity by 2020 in coastal areas and maybe more inland such as Hunan "where conditions permit". In October 2007, CNNC's list of projects included Chuanshan (Jiangsu province), Jiyang (Anhui), Hebao Island (Guangdong), Shizu (Chongqing), Xudabao (Liaoning) and Qiaofushan (Hebei) amongst others.

CNNC said in December 2006 that it planned to build four 1000 MWe units at Heyuan, inland in northeast Guangdong, at a cost of US\$ 6.4 billion, but no timing was mentioned.

In mid-2009, Huaneng Nuclear Power Development Co – a subsidiary of China Huaneng Group (CHNG) – said it had opened an office in the city of Yingtan in China's inland Jiangxi province for the development of a new nuclear power plant in the area. This is one of five sites for nuclear plants after Rongcheng which CHNG was reported in May to have selected: Cangnan in Zhejiang province, Huaining in Anhui, Xuyi in Jiangsu, and Xiapu in Fujian being the others.

In November 2007, the NDRC said that the government had budgeted CNY 450 billion (\$65 billion) to build nuclear power capacity by 2020. It had selected 13 coastal sites to accommodate 59.46 GWe.

In December 2009 CGNPC is reported to have signed a CNY 5.3 billion (\$776 million) nuclear island installation contract with China Nuclear Power Engineering Group Co (CNPEC), apparently covering Ningde 3&4 in Fujian, Yangjiang 3&4 in Guangdong, Fangchenggang 1&2 in Guangxi, and Taishan 1&2 in Guangdong. This is the largest contract of its kind in China.

Nuclear reactors under construction and planned

Plant	Province	MWe gross	Reactor model	Project control	Construction start	Operation
Lingao Phase II units 1&2	Guangdong	2x1080	CPR-1000	CGNPC	12/05, 5/06	12/10, 8/11
Qinshan Phase II units 3&4	Zhejiang	2x650	CNP-600	CNNC	4/06, 1/07	2011, 2012
Hongyanhe units 1-4	Liaoning	4x1080	CPR-1000	CGNPC	8/07, 4/08, 3/09, 8/09	10/12, 2014
Ningde units 1-4	Fujian	4x1080	CPR-1000	CGNPC	2/08, 11/08, 1/10, 15/7/10	12/12 - 2015
Fuqing units 1&2	Fujian	2x1080	CPR-1000	CNNC	11/08, 6/09	10/13, 8/14
Yangjiang units 1-4	Guangdong	4x1080	CPR-1000	CGNPC	12/08, 8/09, 15/7/10, 15/3/11	8/13 - 2016
Fangjiashan units 1&2	Zhejiang	2x1080	CPR-1000	CNNC	12/08, 7/09	12/13, 10/14
Sanmen units 1&2	Zhejiang	2x1250	AP1000	CNNC	3/09, 12/09	11/13, 9/14
Haiyang units 1&2	Shandong	2x1250	AP1000	CPI	9/09, 31/7/10	5/14, 3/15
Taishan units 1&2	Guangdong	2x1700	EPR	CGNPC	10/09, 1/7/10	12/13, 11/14
Shandong Shidaowan	Shandong	210	HTR-PM	Huaneng	1/10?	2013 or 2014
Fangchenggang/Hongsha units 1&2	Guangxi	2x1080	CPR-1000	CGNPC	early 2010	2014, ?
Fuqing units 3-6	Fujian	4x1080	CPR-1000	CNNC	2010, ?	
Changjiang units 1&2	Hainan	2x650	CNP-600	CNNC or Huaneng	First half 2010	2014, 2015
Tianwan units 3&4	Jiangsu	2x1060	VVER-1000 (AES-91)	CNNC	10/2010	
Hongshiding (Rushan) units 1&2	Shandong	2x1080	CPR-1000	CNEC/CNNC	Deferred from 2009?	2015
Ningde units 5&6	Fujian	2x1080	CPR-1000	CGNPC		
Dafan, Xianning units 1&2	Hubei	2x1250	AP1000	CGNPC	late 2010	
Xiaomoshan (Jiulongshan) units 1&2	Hunan	2x1250	AP1000	CPI	2010?	4/2015-2018
Taohuaijiang units 1-4	Hunan	4x1250	AP1000	CNNC	9/2010	2015
Pengze units 1&2	Jiangxi	2x1250	AP1000	CPI	2010	2013-14
Haiyang units 3&4	Shandong	2x1250	AP1000	CPI	2010?	
Tianwan units 5&6	Jiangsu	2x1200	VVER-1200	CNNC	10/2010	
Wuhu units 1&2	Anhui	2x1250	AP1000	CGNPC	12/2011	8/2016
Total: 57		63,130 MWe				

Where construction has started, the dates are marked in bold. Those here not under construction are marked as 'planned' in the WNA reactor table when it updated. At 9 February 2010, 21 under construction: 22,960 MWe; 36 planned: 40,510 MWe
Fangjiashan is sometimes shown as a development of Qinshan Phase I.

Further nuclear power units proposed

Plant	Province	MWe gross	Expected model	Project control	Construction	Start up
Zhexi/Longyou units 1&2	Zhejiang	2x1250	AP1000	CNNC	2011?	
Lianyungang units 1&2	Jiangsu	2x1080	CPR-1000	CGNPC		
Sanming units 1&2	Fujian	2x800	BN-800	CNNC	8/2011	
Lufeng /Tianwei units 1&2	Guangdong	2x1080	CPR-1000	CGNPC		
Tianwan units 7&8	Jiangsu	2x1200	VVER-1200 (AES-2006)	CNNC		
Hongyanhe units 5&6	Liaoning	2x1080	CPR-1000	CGNPC		
Yangjiang units 5&6	Guangdong	2x1080	CPR-1000	CGNPC		2017
Dafan, Xianning units 3&4	Hubei	2x1250	AP1000	CGNPC		
Zhangzhou units 1&2	Fujian	2x1250	AP1000	China Guodian		
Shidaowan	Shandong	4x1400?	CAP-1400	Huaneng	4/2013	12/2017
Shandong Shidaowan	Shandong	18x210	HTR-PM	Huaneng		
Haiyang units 5&6	Shandong	2x1250	AP1000	CPI		
Xiaomoshan units 3-6	Hunan	4x1250	AP1000	CPI		
Xudabao	Liaoning	2?		CNNC		
Lufeng units 3-6	Guangdong	4x1000		CGNPC		
Fangchenggang (Hongsha) units 3-6	Guangxi	4x1080	CPR-1000	CGNPC		
Yingtian	Jianxi	2?		Huaneng		
Nanyang units 1-6	Henan	6x?		CNNC		
Xinyang units 1-4	Henan	4x1080	CPR-1000?	CGNPC?		
Sanba/Nanchun/Nanchong	Sichuan	4x1000		CGNPC		
Subtotal: 70 units		60,000+ MWe				
Shaoguan units 1-4	Guangdong	4x1250	AP1000	CGNPC		
Jiyang	Anhui	4x?		CNNC		
Sanmen units 3-6	Zhejiang	4x1250	AP1000	CNNC		
Cangnan	Zhejiang	6x1000		CGNPC/Huaneng		
Zhexi /Longyou units 3&4	Zhejiang	2x1250	AP1000	CNNC		
Haijia /Haifeng units 1&2	Guangdong	2x1000?		CGNPC		
Jinzhouwan units 1&2	Liaoning	2x1000				
Hengyang/Changde/Chenzhou units 1-4	Hunan	4x1000?		CNNC		
Fuling units 1-4	Chongqing	4x1250	AP1000	CPI		
Jinggu units 1-4	Jilin	4x1250	AP1000	CPI	2013?	
Wuhu units 3-4	Anhui	2x1250	AP1000	CGNPC		
Pengze units 3&4	Jiangxi	2x1100	AP1000	CPI		
Heyuan /Jieyang units 1-4	Guangdong	4x1000		CNNC?		

Pingnan/Baisha units 1-4	Guangxi	4x1250	AP1000	CPI
Hengren units 1-4	Liaoning	4x1250	AP1000	CPI
Lanzhou	Gansu	2?		CNNC
Xiangtan	Hunan	4x1250	AP1000	Huadian
Donggang	Liaoning	6x1000		Huadian
Yianjiashan/Wanan	Jiangxi			CNNC
Shizu	Chongqing			CNNC
Qiaofushan	Hebei			CNNC
Songzi/Dafan 5&6	Hubei			CGNPC
Hebaodao	Guangdong			CNNC
Subtotal: about 76 units		34x1250 24x1000 c.18x??		
		Approx 84,000 MWe		
Total: about 150		150,000+ MWe		

All PWR except Shidaowan HTR-PM. Some of these entries are based on sketchy information. For WNA reactor table, 80% of numbers and capacity from this table are listed as 'Proposed'

Lingao Phase II

While the bidding process for the delayed Generation III plants from overseas vendors was in train over more than two years (see section above on [Embarking upon Generation III plants](#)), the Guangdong Nuclear Power Group (CGNPC) signed contracts with Chinese designers and manufacturers for two CPR-1000 reactors as Phase II of the Lingao power station (also known as Lingdong). Construction started in December 2005 and the 1080 MWe units are due on line in 2010 and 2011. Unit 1 will be 50% localised and unit 2 will be 70% localised, under the project management of China Nuclear Power Engineering Corporation (CNPEC), part of CGNPC. Turbine-generator sets are being provided by Alstom. In June 2009, the first Chinese-made reactor pressure vessel for a 1000 MWe reactor was delivered for unit 2, from Dongfang (Guangzhou) Heavy Machinery Co.

Qinshan Phase II-3&4

Construction of the second stage of Qinshan Phase II was formally inaugurated at the end of April 2006, though first concrete had been poured for unit 3 in March. That for unit 4 was poured in January 2007. Local content of the two 650 MWe CNP-600 reactors will be more than 70% and scheduled construction time is 60 months.

Hongyanhe

Construction of the first unit of the Hongyanhe nuclear power plant in Dalian, Liaoning, started in August 2007, though site works had been under way since July 2006. It is described by CGNPC as the first nuclear power project in the 11th Five-Year Plan, with owner and operator being Liaoning Hongyanhe Nuclear Power Co. NNSA issued a construction licence for units 3 & 4 in March 2009, and first concrete for unit 3 was poured soon afterwards. The cost of all four 1080 MWe CPR-1000 units in the first construction phase is put at CNY 50 billion (US\$ 6.6 billion). China Nuclear Power Engineering Corporation (CNPEC), part of CGNPC, is managing the project – the first nuclear plant in the northeast of China. Shanghai Electric won a \$260 million contract for equipment and Alstom is to provide the four turbine-generator sets for \$184 million. Commercial operation is planned for 2012-14.

Ningde

Construction of CGNPC's six-unit Ningde nuclear power plant commenced in 2008. This is on three islands in Fuding city in northeast of Fujian province, and the first construction phase comprises four CPR-1000 units. The project was approved by the National Development & Reform Commission (NDRC) in September 2006, and local content will be about 75% for units 1&2 and 85% for units 3&4. Construction of the first unit started in February 2008, and CGNPC expects commercial operation of it after 58 months, in December 2012, with the others following to 2015. First concrete for the second unit was in November 2008, and for the third early in January 2010. Total cost for four units was put at CNY 51 billion (\$7.2 billion).

Fuqing

Construction of the six-unit Fuqing nuclear power plant 170 km south of Ningde also commenced in 2008 at Qianxe, Fuqing city in Fujian, near Fuzhou. The Fujian Fuqing Nuclear Co Ltd was set up in May 2006 with 49% held by China Huadian Corp. CNNC is responsible for the project which is using CGNPC's CPR-1000 reactors since alternatives are not licensed. First concrete for unit 1 was poured in November 2008, and for unit 2 in June 2009. Commercial operation is expected in 2013 and 2014. Site works are under way for a further four units there, total expected cost being CNY 100 billion (\$14.6 billion). Construction of the project is by China Nuclear Power Engineering Co. (CNPE) and the reactor pressure vessels will be supplied by China First Heavy Industries, as for Fangjiashan. In June 2008, Dongfang Electric Group announced a CNY 5 billion (\$725 million) contract for steam turbine generators for the Fuqing and Fangjiashan plants.

Yangjiang

Yangjiang city in western Guangdong province had originally been earmarked for the country's first Generation III plants (see section above on [Embarking upon Generation III plants](#)). After plans changed in the light of pressing generation needs in the region, Yangjiang will be the second nuclear power base of the Guangdong Nuclear Power Group (CGNPC). Development of all six units of the Yangjiang plant was approved in 2004, with CPR-1000 later confirmed as technology for it. Construction of the first of two units started in December 2008, for commercial operation in 2013. The second pair of units follow closely, with site works started in mid-2009, then the final two (as the second construction phase), with the last being built by 2017. Total cost is put at CNY 70 billion (\$10.1 billion).

Yangjiang 1-6 and a further 14 units, along with the six units at Daya Bay/Lingao, will be operated under regional Daya Bay (DNMC) management.

Fangjiashan

Construction of CNNC's Fangjiashan plant started at the end of December 2008. It is close to the Qinshan plant in Zhejiang province and essentially an extension of it, using two CPR-1000 reactors. Construction of the CNY 26 billion (\$3.8 billion) project is by China Nuclear Power Engineering Co. (CNPE) and the reactor pressure vessels will be supplied by China First Heavy Industries, as for Fuqing. In June 2008, Dongfang Electric Group announced a CNY 5 billion (\$725 million) contract for steam turbine generators for the Fuqing and Fangjiashan plants.

Sanmen

At the end of 2006, the Westinghouse AP1000 reactor design was selected for Sanmen in Zhejiang province (and for Yangjiang in Guangdong province, with the latter site changed to Haiyang). Contracts with Westinghouse and Shaw for two units were signed in July 2007. Site works under CNNC commenced in February 2008 and an engineering, procurement and construction (EPC) contract was signed in March 2009 between SNPTC + CNNC and China Nuclear Engineering & Construction Group (CNEC) for both units, which will be overseen by Westinghouse and Shaw. Other stakeholders are Zhejiang Provincial Energy Group Co Ltd, CPI Nuclear Power Co Ltd, and China Huadian Corp. Construction on Sanmen 1 – the world's first AP1000 unit – officially commenced on 19 April 2009. The reactor is expected to begin operation in August 2013 with unit 2 about one year later. Construction on unit 2 commenced in mid-December 2009. See section on [Embarking upon Generation III plants](#) above.

Haiyang

Shangdong Nuclear Power Company (a subsidiary of CPI) signed contracts with Westinghouse and Shaw for two AP1000 units in July 2007. Work on the site has started and first concrete is expected about September 2009. The first two Haiyang units are expected to commence operation in 2014 and 2015. The site will eventually have six units, and in March 2009, the NDRC approved preliminary works for units 3 and 4 at the CPI site, to be AP1000 units. Construction is expected to start late in 2010. See section on [Embarking upon Generation III plants](#) above.

Taishan

The first two 1650-1700 MWe EPRs planned for Taishan in Guangdong province form part of an €8 billion contract signed by Areva and the Guangdong Nuclear Power Group (CGNPC) in November 2007. The Taishan project (sometimes referred to as Yaogu) is owned by the Guangdong Taishan Nuclear Power Joint Venture Company Limited (TNPC), a joint venture between EDF (30%) and CGNPC. First concrete was poured in October 2009, and unit 1 should be commissioned early in 2014, with unit 2 in 2015. Areva has begun fabrication of major components for both units. See section on [Embarking upon Generation III plants](#) above.

Shidaowan HTR-PM

A demonstration high-temperature gas-cooled reactor plant, with twin reactor modules driving a single 210 MWe steam turbine, was approved in November 2005, to be built at Shidaowan, near Rongcheng in Weihai city, Shandong province, by Huaneng Shandong Shidaowan Nuclear Power Company (HSSNPC). This joint venture is led by the China Huaneng Group Co. – the country's largest generating utility but hitherto without nuclear capacity. Huaneng Power International is investing CNY 5 billion in the project, which received environmental clearance in March 2008 for construction start in September 2009 and commissioning by 2013. The EPC (engineering, procurement, construction) contract was let in October 2008, and involves Shanghai Electric Co and Harbin Power Equipment Co. This will be the demonstration plant for a further 18 modules at the site, total 3,800 MWe. (See also [Research and development](#) section in page on China's Nuclear Fuel Cycle.)

Shidaowan (PWRs)

In November 2007, China Huaneng Group (CHNG) signed an agreement with CGNPC for the Huaneng Nuclear Power Development Company to build four CPR-1000 reactors at Shidaowan, Rongcheng city, in Shandong province in an \$8 billion deal. A letter of intent regarding the first two

was signed in 2008. However, this has now become another AP1000 project and National Development and Reform Commission approval is being sought. In October 2009, the Shidaowan Nuclear Power Development Limited Company was set up with capital contribution 40% CHNG, 30% Huaneng International Power Development Corp. (HIPDC) and 30% Huaneng Power International (HPI) – both being CHNG subsidiaries. Construction is expected to start in 2013. The site is also earmarked for the first CAP1400 units (see [Reactor technology](#) section above).

Fangchenggang (Hongsha)

The Hongsha Nuclear Power Project is located at Hongsha village, in the Beibu Gulf Economic Zone near Bailong in the coastal city of Fangchenggang in the Guangxi Autonomous Region (close to the Vietnam border in south China). Following an agreement in July 2006 for construction of the first two units, the first stage (two 1000 MWe units out of six planned) of the plant was approved by NDRC in October 2008. CPI is keen to see this proceed, site works have been undertaken and first concrete was expected at the end of 2009, but a construction licence is awaited from NNSA. In October 2009, a general construction contract was signed with CNPEC. Guangxi Fangchenggang Nuclear Power Co., Ltd., a joint venture between China Guangdong Nuclear Power Group (61%) and Guangxi Investment Group (39%), is responsible for the construction and operation. The first unit is expected to begin commercial operation in 2014. Total budget is CNY 70 billion (\$10.26 billion), with CNY 27.2 billion (\$4 billion) for stage 1. (There is also a Fangchenggang supercritical 2400 MWe coal-fired power station operated by CLP Guangxi Fangchenggang Power Company Limited, a 70:30 equity-basis joint venture between China Light & Power and Guangxi Water & Power Engineering (Group) Co., Ltd.)

Tianwan Phases II & III

In October 2006, a preliminary agreement for two further 1060 MWe AES-91 reactors as the second construction phase at Tianwan in Lianyungang city of Jiangsu province was signed with Russia's Atomstroyexport. Construction of units 3 & 4 was to start when both the first two units were commissioned, and hence in November 2007 a further agreement was signed by CNNC.

Preliminary approval from NDRC was received in August 2009. Construction is expected to start in October 2010, and the project is expected to cost \$3.8 billion. However, in September 2009 it was reported that negotiations on the price were delaying signing of the construction contract with Jiangsu Nuclear Power Corporation and that Atomstroyexport would not act as the principal contractor, though it insists on retaining intellectual property rights. However, in October agreement was reached on fixing a price ceiling for the plant.

In August 2009 the Assets Supervision & Administration Commission announced that Phase 3 of Tianwan (units 5 & 6) would start construction in October 2010. These are likely to be AES-2006 type. A contract for the engineering design of Tianwan 3 & 4 is expected to be signed in June 2010, and the general construction contract may be signed later in 2010.

Hongshiding (Rushan)

In November 2006, an agreement was signed by CNNC to proceed with the first two units of the Rushan nuclear plant at Hongshiding near Weihai in Shandong province, costing \$ 3.2 billion, with construction to begin in 2009 and first power in 2015. However it appears to have been deferred. Six units totaling 6000-8000 MWe are envisaged at the site.

Changjiang

CNNC's Changjiang nuclear power plant on Hainan Island is expected to start construction in the first half of 2010 for operation by the end of 2015. Site works were well advanced in mid-2009. It will comprise two 650 MWe PWR units, and China Huaneng group (CHNG) will hold a 49% share in Hainan Nuclear Power Co Ltd. More than 70% of its equipment is to be made in China. Cost is put at CNY 17 billion.

Dafan, Xianning

In August 2008, CGNPC and Hubei Energy Group Ltd set up the Hubei Nuclear Power Company as a joint venture and announced plans to build a nuclear power plant in Xianning city of the inland Hubei province. Site works for this Dafan plant (four AP1000 units) in Xishui county are under way. Construction of the first two units is expected to start late in 2010 or early 2011. Cost of first two construction phases (4000 MWe) was earlier put at CNY 50 billion (\$7.3 billion), using CPR-1000 units, but AP1000 reactors are now intended, making it CGNPC's first AP1000 plant. A third phase is estimated to cost CNY 45 billion. Reports of a Songzi plant may refer to later stages of Dafan, though possible projects in Yangxin county and Zhongxiang city have been mentioned.

Wuhu

The Wuhu nuclear plant on the Yangtze River in the Bamaoshan area, Fanchang county, of Anhui province was planned to have four 1000 MWe CPR-1000 units, but is now designated for AP1000s to be constructed in two phases. CGNPC's proposal for two units of phase 1 has been submitted, some preparatory work is under way and the Anhui Wuhu Nuclear Power Co has been set up, with 51% CGNPC ownership. The first unit is due on line in 2016.

Jiyang

Besides Wuhu, CNNC was reported as starting a feasibility study on another nuclear plant in the Anhui province, at Jiyang in Chizhou city, in December 2008.

Pengze

CPI's Jiangxi Pengze Nuclear Power Project in Jiangxi province is to have four AP1000 reactors costing CNY 60 billion (\$8.8 billion). The site has been prepared for the first two units, and safety and environmental approvals were obtained in May 2009. CPI signed the EPC contract framework for phase 1 (units 1 & 2) in August 2009, the engineering project contract was reported to be between CPI Jiangxi Nuclear Power and CPIC. The equipment procurement was reported to be between CPIC and China Power Complete Equipment. CPI aims to start construction in 2010, for 2013 start-up. The project is inland in Juijiang city, on the Yangtze River, and will use cooling towers.

Taohuajiang

CNNC's Taohuajiang nuclear power plant in Yiyang city, near Yueyang in inland Hunan province is expected to start construction in April or September 2010, though site works are under way. (It is also referred to as the Taohua [peach blossom] River project.) CNNC set up Hunan Taohuajiang Nuclear Power Co Ltd. to build and operate the plant. Initially this was to be 4 x 1000 MWe at a total cost of CNY 34 billion, but it will now be a four-unit AP1000 project costing CNY 67 billion. The main contractor is China Nuclear Industry 23rd Construction Co Ltd, and Dongfang Electric Corp will

supply major components. It was approved by the NDRC in November 2005, and in 2008 the project was approved for preliminary construction. The design by SNERDI under SNPTC and SNPDR was submitted to the NNSA in February 2010 for licensing. The first unit is expected on line in April 2015, and the fourth in 2018.

Xiaomoshan

The Xiaomoshan nuclear power plant on the Yangtze River in Yueyang city, Huarong county, Hunan province (inland), is a priority project for CPI. It will eventually have six AP1000 reactors and be built by Hunan Nuclear Power Company Ltd in two phases. NDRC approval was given in 2006 but as of mid-2009 NNSA approval was awaited. First concrete is expected late in 2010. The cost is put at CNY 70 billion (\$10.25 billion), funded by SNPTC and Wuling Electric Power Development Co. (a CPI subsidiary).

Sanming

In October 2009, an agreement was signed by CIAE and CNEIC (a CNNC subsidiary responsible for technology imports) with Russia's Atomstroyexport to start pre-project and design works for a commercial nuclear power plant with two BN-800 fast neutron reactors in China, with construction to start in August 2011. The site is believed to be in Sanming city, an inland part of Fujian province. The plant will be similar to the OKBM Afrikantov design being built at Beloyarsk 4 and due to start up in 2012. In June 2009, Rosatom and CNNC had signed an agreement for construction of two BN-800 demonstration reactors, and St Petersburg Atomenergopoekt said it was starting design work on a BN-800 reactor for China.

Lianyungang

CGNPC's Lianyungang nuclear power project is planned to have four units of 1000 MWe class to be constructed in phases. This is in Jiangsu province close to CNNC's Tianwan plant and involving the Jiangsu Nuclear Power Company. A proposal has been submitted to the NRDC and preparations for the project are proceeding, but prospects in the 12th Five Year Plan are uncertain.

Yianjiashan/Wanan

In August 2009, CNNC (51%) signed a joint venture agreement with Jiangxi Ganneng Co. Ltd and Jiangxi Ganyue Expressway Co Ltd (49% between them) to build the Wanan Yianjiashan nuclear power project at Ji'an in the Jiangxi province. The name is provisional and the detail scant.

Hengyang

Also in August 2009 CNNC signed an agreement with Hengyang city in Hunan province to build a nuclear power plant there or nearby. This is about 200km south of its Taohuajiang project at Yiyang city in Hunan. China Guodian Corporation, one of the country's largest power producers, with 62 GWe installed, is involved in the project though it has no nuclear capacity so far. However, the NDRC has announced that China Guodian Corp will invest CNY 20 billion (\$2.9 billion) on power projects in Hunan province within three to five years, possibly including a major stake in CNNC's Taohuajiang plant.

Sanba

In July 2008, it was announced that Sichuan province in the southwest was planning the 4000-6000

MWe Sanba nuclear power plant at Nanchong or Nanchun city on the Jialing River, at a cost of CNY 25 billion (\$3.7 billion). Majority ownership would be CGNPC. Another Sichuan agreement has been signed between CNNC and Yibin city.

Xiangtan

In December 2009, China Huadian Corp signed an agreement with Xiangtan city government in Hunan to undertake studies for a CNY 60 billion power plant comprising four 1250 MWe reactors. A refined proposal is expected in September 2010. This will apparently be the fourth nuclear project for China Huadian.

Zhexi /Longyou

In October 2008 a project proposal was submitted to NDRC by CNNC and Zhejiang Energy Group Co Ltd for a western Zhejiang nuclear power plant in Hangzhou with four AP1000 reactors, though earlier reports had four 1000 MWe units to be built in two phases from late 2010. The proposed site is Tuanshi, Longyou county.

Jingyu

CPI plans to spend CNY 85 billion to build the six-unit Jingyu nuclear power plant near Baishan, in Jilin province, with four units to be in stage 1. The project is still in the preliminary feasibility stage, though preparatory work is envisaged in 2012.

Further Information

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Government Structure and Ownership

Nuclear Power in China Appendix 1

(Updated 15 February 2010)

National organisations

Ministries and Commissions are at the top level under the State Council; Administrations and Bureaus are under these.

China Atomic Energy Authority

Under the control of the Commission for Science, Technology & Industry for National Defence under the State Council of Ministers, the China Atomic Energy Authority (CAEA, www.caea.gov.cn) is responsible for planning and managing the peaceful use of nuclear energy and promoting international cooperation. Since being split from the old China National Nuclear Corporation (CNNC) in 1998, CAEA has been the key body planning and managing civil nuclear energy and reviewing and approving feasibility studies for new plants. [[Index](#)]

State-owned Assets Supervision & Administration Commission

The State-owned Assets Supervision and Administration Commission (SASAC) of the State Council (www.sasac.gov.cn) was founded in 2003 to take over the responsibilities of the former State Economic and Trade Commission as investor of state-owned assets on behalf of the central government and in guiding state-owned enterprises' reform and management. It aims to speed up restructuring of state-owned economy and push forward reform of state-owned enterprises, as well as harvesting dividends from them. At the end of 2007, 152 major enterprises were subordinate to it, comprising the top two or three in each sector, which gives SASAC great political and economic power. SASAC has a major role in nuclear power expansion, along with the NDRC, and supervises CNNC and CGNPC. [[Index](#)]

National Development and Reform Commission

The National Development and Reform Commission (NDRC, www.ndrc.gov.cn) is the macroeconomic management agency directly under the State Council. It has been finally responsible for assessment and approval of major projects, and is responsible for deciding which major nuclear power projects proceed, and when. However, the reforms early in 2008 mean SASAC will be the primary body approving new projects, with formal approval from NDRC following. [[Index](#)]

National Energy Commission, National Energy Administration

In March 2008, a new National Energy Commission (NEC) was announced to replace the National Energy Leading Group, an advisory and coordination body directly under the State Council. It will draft a national energy development strategy complete with various programs and then monitor and implement its execution. At the same time the new National Energy Administration (NEA) was set up to strengthen government management of the energy sector and implement NEC policy. It is a second tier ministry under the NDRC and replaces the State Energy Bureau under NDRC, which

had been ineffective. Its nine departments, including one planning nuclear and thermal power development, work to integrate NDRC's energy management functions, promote favoured forms of energy and encourage conservation. It is not clear how it relates to other national energy entities, but its first announcement was that nuclear energy should provide significantly more power by 2020 than previously planned. The NDRC - NEC - NEA arrangement is seen as a political compromise and alternative to an Energy Ministry with clearer authority. [[Index](#)]

National Nuclear Safety Administration

The National Nuclear Safety Administration (NNSA) under the CAEA was set up in 1984 and is the licensing and regulatory body which also maintains international agreements regarding safety. It now reports to the State Council directly. At the Second China-US Strategic Economic Dialogue held in Washington in May 2007, a memorandum of understanding between the NNSA and the US Nuclear Regulatory Commission was signed regarding Westinghouse's AP1000 reactor design. The long-standing protocol on nuclear safety cooperation between the two countries was revised to take account of the introduction of the AP1000 and signed in January 2008. Under the revised protocol, the NRC will provide support for safety regulations and standards for the AP1000 design, as well as provide training for NNSA personnel. [[Index](#)]

Ministry of Environmental Protection

The State Environment Protection Administration (SEPA), now elevated to a Ministry of Environmental Protection, (MEP, www.mep.gov.cn) is a department directly under the State Council and is responsible for radiological monitoring and radioactive waste management. A utility proposing a new plant submits feasibility studies to the CAEA, siting proposals to the NNSA and environmental studies to MEP. [[Index](#)]

State Nuclear Power Technology Corporation

The State Nuclear Power Technology Corporation (SNPTC, www.snptc.com.cn) was set up in 2004 to take charge of technology selection for new plants being bid from overseas. This is through its Preparatory Office which draws expertise from other organizations such as CGNPC. SNPTC is directly under China's State Council and closely connected with it. Early in 2007, SNERDI (see below) was removed from CNNC control and assigned to it as an R&D arm, boosting its stature considerably. [[Index](#)]

China National Nuclear Corporation

The China National Nuclear Corporation (CNNC, www.cnncc.com.cn) controls most nuclear sector business including R&D, engineering design, uranium exploration and mining, enrichment, fuel fabrication, reprocessing and waste disposal. It also claims to be the major investor in all nuclear plants in China. Established by the State Council in 1988 as a self-supporting economic entity, it "combines military production with civilian production, taking nuclear industry as the basis while developing nuclear power and promoting a diversified economy." It has numerous subsidiaries, including CNNC International Ltd (www.cnnccintl.com), which is listed in Hong Kong. CNNC designed and built Qinshan Phases I and II, and controls the full Qinshan power plant. It has a payroll of about 1,000,000 and owns shares in many of the nuclear power generation projects (see below). In particular it is a champion of local designs. [[Index](#)]

China Nuclear Energy Industry Corporation

The China Nuclear Energy Industry Corporation (CNEIC) is a CNNC subsidiary established in 1980 as a trading company authorized to carry out import and export trade of uranium products, nuclear fuel cycle and nuclear power and technology equipment. It acted as agent in establishing Qinshan and Tianwan power plants, and signed for the BN-800 fast reactor technology from Russia. [[Index](#)]

China Power Investment Corporation

China Power Investment Corporation (CPI, www.cpicorp.com.cn), is one of five state-owned power generation holding companies formed from the State Power Corporation in 2002 and inheriting all its nuclear capacity. It is a major power generator (controlling 54 GWe at the end of 2009, including only 1351 MWe nuclear) and is the largest state-owned power holding company with nuclear assets. It was at the forefront of discussions on plants for the 11th Five-Year Plan (2006-10).

CPI owns 19 operating power plants above 1000MWe each, a majority of Shandong Haiyang nuclear power project, 45% of Liaoning Hongyanhe nuclear power project phase I, and holds minority shares in five nuclear power plants in operation, and three under construction. It is carrying out preparation for nuclear power projects in Guangxi, Liaoning, Hunan, Jilin and Chongqing.

CPI's wholly-owned subsidiary, CPI Development Corporation, was listed on the Hong Kong exchange in 2004. It also owns Shanghai Electric Power Co. Ltd, Shanxi Zhangze Electric Power Co. Ltd, Chongqing Jiulong Electric Power Co. Ltd, Jilin Electric Power Co. Ltd, and Wuling Electric Power Development Corporation as well as China Power International Holding Ltd. registered in Hong Kong, through which CPI indirectly owns China Power Development Ltd. listed on the Hong Kong Stock Exchange and China-Hong Kong Power Development Ltd. supplying power for Hong Kong. It also owns China Power Complete Equipment Company Ltd., supplying and servicing power equipment. [[Index](#)]

China Guangdong Nuclear Power Group

In Guangdong province and now more widely, the China Guangdong Nuclear Power Group plays the leading role. It comprises some 20 companies with gross assets of RMB 133 billion and net assets of RMB 41 billion. China Guangdong Nuclear Power Holding Company (CGNPC, www.cgnpc.com.cn) leads this Group which is responsible for Daya Bay, Ling Ao, Yangjiang, Hongyanhe and Ningde power stations, as well as further projects in the province and outside it. CGNPC was established in 1994 and is 45% owned by the provincial government (via China Guangdong Nuclear Power Group), 45% by CNNC and 10% by CPI. Despite its relative independence it claims to be "under the supervision of the State-owned Assets Supervision and Administration Commission of the State Council." There is 25% Hong Kong equity in the Daya Bay plant. [[Index](#)]

China Huaneng Group

China Huaneng Group (CHNG, www.chng.com.cn) is one of China's major generators, formed in 1988 when the State Power Ministry was broken up, and it has about 50 GWe in operation, none of it nuclear. In 2005 it set up a subsidiary, **Huaneng Nuclear Power Development Co Ltd** to handle nuclear power projects, initially two projects in Shandong province. It has formed links with both CNNC and CGNPC. It is an independent state-owned but incorporated business entity focused on power generation. It aims to have 80 GWe installed by 2010 and 120 GWe by 2020. [[Index](#)]

Huaneng International Power Development Corporation

Huaneng International Power Development Corporation (HIPDC) is a sino-foreign JV company owned 57% by China Huaneng Group and set up to develop, construct and operate power plants in China. HIPDC controls **Huaneng Power International** (HPI), a sino-foreign joint stock company incorporated in China, with a 42% shareholding in it. HPI is the country's largest listed generator. China Huaneng Group also has a 9% direct shareholding in HPI, which develops, constructs, operates and manages large-scale power plants in China nationwide. It claims to be "one of the largest independent electricity power suppliers in China, [in late 2009] owning a generation capacity of 40,975 MW on equity basis." [[Index](#)]

Huadian International Power Corporation Ltd

Huadian, the country's third-largest listed generator, is identified as having plans to build four AP1000 units at Xiangtan in Hunan province and also the Donggang nuclear plant in Liaoning. [[Index](#)]

China (Nuclear International) Uranium Corporation

China National Uranium Corporation is responsible for CNNC's uranium exploration domestically. In December 2006, China Nuclear International Uranium Corporation, or simply China Uranium Corporation (Sino-Uranium or SinoU), was set up by CNNC to acquire uranium resources internationally, as well as undertaking exploration, development and uranium production abroad.¹ It is setting up a mine in Niger and is investigating prospects elsewhere. [[Index](#)]

CNNC Overseas Uranium Holding

A wholly owned Hong Kong subsidiary of SinoU is CNNC Overseas Uranium Holding Ltd, which in mid-2008 bought a 75% interest in United Metals Holdings, a listed Hong Kong company and changed its name to CNNC International Ltd. This has bought prospects in Mongolia, and in February 2009 made a takeover bid for Khan Resources Inc, with major Mongolian assets. Khan directors recommended acceptance. [[Index](#)]

Sinosteel

Sinosteel Corporation (<http://en.sinosteel.com>) is another state-owned entity with equity in an Australian uranium explorer and 60% joint venturer with it in developing a mine, hoping to sell the product to the Chinese nuclear industry. [[Index](#)]

China Jianzhong Nuclear Fuel

China Jianzhong Nuclear Fuel Co Ltd is a CNNC subsidiary and its main PWR fuel fabricator, at Yibin in Sichuan. [[Index](#)]

China North Nuclear Fuel

China North Nuclear Fuel Co Ltd is a CNNC subsidiary set up in 1998 to run a fuel fabrication plant at Baotou in Inner Mongolia. A joint venture centred on it is being formed to progress research on thorium fuel cycle. [[Index](#)]

China Baotou Nuclear Fuel

CNNC Baotou Nuclear Fuel Co Ltd was set up at the end of 2008 by SNPTC and the two CNNC fuel companies to make fuel for AP1000 reactors in Inner Mongolia. [[Index](#)]

CGNPC Uranium Resource Co

CGNPC Uranium Resource Co Ltd (CGNPC-URC) is a CGNPC entity responsible for mining and purchase of uranium resources, both domestic and imported. A related CGNPC subsidiary set up in 2007, Sino-Kazakhstan Uranium Resources Investment Co, has invested in two Kazakh uranium mines managed by Semizbai-U joint venture, following approval from NDRC. CGNPC-URC has also embarked upon a joint venture (Uz-China Uran LLC) with Uzbekistan's Goskomgeo focused on black shales in the Navoi region of Uzbekistan. Within China, in November 2008 CGNPC Uranium (Xinjiang) Co. Ltd., a JV between CGNPC-URC and Xinjiang Geology and Mineral Resources Bureau, was established. [[Index](#)]

China Uranium Development

China Uranium Development Co Ltd (CUD) is an investment vehicle of CGNPC-URC buying equity in overseas uranium resources, notably by a 70% takeover of Australian uranium exploration company Energy Metals Limited. [[Index](#)]

China Nuclear Engineering-Construction

The China Nuclear Engineering-Construction Corporation (CNEC or CNECC) is a major state entity split off from CNNC in 1998. CNEC is closely linked with the Beijing Institute of Nuclear Engineering (see immediately below) and is also responsible for the construction (including that in Pakistan), equipment procurement, trial testing and operational maintenance of nuclear power plants. [[Index](#)]

China Power Engineering Consulting Group Corporation

The China Power Engineering Consulting Group Corporation (CPECC) includes the East China Electric Design Institute (ECEPDI) which was set up in 1953 and designs non-nuclear parts of nuclear power plants such as Taohuajiang. [[Index](#)]

Beijing Institute of Nuclear Engineering

The Beijing Institute of Nuclear Engineering (BINE) is based in the Haidian university precinct north of Beijing and has 1,800 staff. It is a CNNC subsidiary responsible for basic design of reactors although its focus is shifting towards technology planning as new project design moves from BINE to CNEC. [[Index](#)]

Chinergy

Chinergy Co. Ltd was set up as a 50-50 joint venture between Tsinghua Holding Co. Ltd and CNEC in 2003 as a general contractor for high temperature reactors. In 2007, CGNPC contributed capital to give it a 15% share in the JV. [[Index](#)]

China Nuclear Power Engineering Corporation, China Nuclear Industry 23rd Construction Co.

China Nuclear Power Engineering Corporation (CNPE) was set up by CNNC in 2006 to rationalise design work for new nuclear plants as well as to help win overseas orders for nuclear plants. It is built on the technology basis of BINE and is also responsible for the construction, equipment procurement, trial testing and operational maintenance of nuclear power plants. Project design and management is moving from BINE to CNPE, allowing BINE to concentrate on technology planning. (NB: distinguish from CGNPC's China Nuclear Power Engineering Co Ltd - CNPEC.) A major subsidiary is China Nuclear Industry 23rd Construction Co. Ltd (CNI23). Nuclear projects being undertaken by CNPE included: EPC contracting of Fuqing, Taohuajiang, and Xudabao nuclear power projects. [[Index](#)]

Nuclear Power Institute of China

The Nuclear Power Institute of China (NPIC) is based in Chengdu, Sichuan Province, and is part of CNNC. It was set up in 1958 for nuclear reactor engineering research, design, testing and operation and has 3700 staff.

It originally focused on the nuclear propulsion system for submarines, but now is a major research institute for Nuclear Steam Supply Systems in PWRs. Its R&D now takes in the Candu design used at Qinshan, and in particular, aspects of its fuel cycle, and since 1997 it has worked on the CNP-1000 design. [[Index](#)]

Shanghai Nuclear Energy Research & Design Institute

The Shanghai Nuclear Energy Research & Design Institute (SNERDI) was founded in 1970 as part of CNNC and worked with BINE and NPIC in detailed design work for the AP1000 projects. However, SNERDI was reassigned to SNPTC in 2007 and remains dedicated to AP1000 design work, particularly development of the CAP-1400 reactor based on it. (It also worked closely with AECL on reactor engineering for the Qinshan Phase III Candu reactors.) [[Index](#)]

SNERDI Engineering Consulting and Supervision Management

SNERDI Engineering Consulting and Supervision Management Co. Ltd (SECSMC) is a wholly-owned subsidiary of SNPTC and is construction supervisor for Sanmen, under contract with Sanmen Nuclear Engineering Consulting Management Co. Ltd. [[Index](#)]

East China Electric Power Designing Institute

The East China Electric Power Designing Institute (ECEPDI) is working with SNERDI on designing Pakistan's Chashma 3 & 4 reactors, having cooperated on Chashma 1 & 2 and also Qinshan. [[Index](#)]

China Resources Power Holdings

China Resources Power Holdings Co. Ltd (CRPHC) was founded in 2001 as a subsidiary of China Resources Group in Hong Kong-based and invests in a variety of technologies including a 25% share of CNNC's Taohuajiang project in Hunan. It is keen to invest with CGNPC. [[Index](#)]

State Development and Investment Corporation

The State Development and Investment Corporation (SDIC) in 2009 secured a 10% share of the Xudabao nuclear power project at Huladao (Hulu Island) in NE Liaoning. [[Index](#)]

Shandong Electric Power Construction

The Shandong Electric Power Construction Corp. (SEPCO, www.sepcc.net) in Jinan, Shandong province also trades as Shandong Nuclear Power Construction Group Corp. It co-owns Shenzhen Shandong Nuclear Power Construction Co., Ltd ([SEPCNP](#), see below). [[Index](#)]

Shandong Nuclear Power Equipment Manufacturing

Shandong Nuclear Power Equipment Manufacturing Co Ltd (SNPEMC) was set up in 2007 by SNPTC, which holds a 64% share, with subsidiaries of CNNC holding the remainder [China Nuclear Industry 23rd Construction Corporation (CNI23, 29.33%) and China Nuclear Engineering-Construction Group (CNEC, 6.67%)]. SNPEMC designs and manufactures AP1000 reactor components, containment vessels and equipment. It is responsible for the fabrication of equipment modules, structural modules, primary pipelines and equipment for conventional island, as well as fabrication of equipment for other nuclear power plants. SNPEMC received ASME certification in June 2009. (For [Shandong Nuclear Power Company](#) see next section below.) [[Index](#)]

State Nuclear Power Engineering Corporation

Based in Shanghai, the State Nuclear Power Engineering Corp. Ltd. (SNPEC, www.snpec.com.cn) is a subsidiary of SNPTC responsible for AP1000 project management and control, design, architectural work, commissioning, procurement *etc.* [[Index](#)]

State Nuclear Electric Power Planning Design & Research Institute

The State Nuclear Electric Power Planning Design & Research Institute (SNPDRI) is a subsidiary of SNPTC responsible for designing the Haiyang, Pengze and Taohuajiang AP1000 project conventional islands. SNPDRI was formerly the Shandong Electric Power Engineering Consulting Institute, founded in Jinan in 1958 and transferred to SNPTC in 2007. [[Index](#)]

China Institute of Atomic Energy

The China Institute of Atomic Energy (CIAE) undertakes fundamental research on nuclear science and technology and is the leading body in relation to fast neutron reactors. It is also responsible for R&D on vitrification of high-level wastes. [[Index](#)]

Shenzhen Shandong Nuclear Power Construction

The Shenzhen Shandong Nuclear Power Construction Co., Ltd (SEPCNP, www.sepcnp.com.cn) is a subsidiary of SEPCO, with equity also held by Shandong Luneng Construction Group Co., Ltd. It was the only Chinese contractor to work on the conventional island of the Daya Bay plant and constructed the conventional island of the neighbouring Ling Ao plant. [[Index](#)]

China First Heavy Industries

China First Heavy Industries Corp. (CFHI, www.cfhi.com) is one of China's key industrial enterprises. It produces pressure vessels and pressurisers for nuclear power plants up to 1080 MWe CPR-1000 (*e.g.* Hongyanhe), and components for Qinshan. It has been contracted to supply the pressure vessel for the AP1000 at Sanmen 2. [[Index](#)]

Shanghai Electric Heavy Industries Group

The Shanghai Electric Heavy Industries Group Corporation (SEC, www.shanghai-electric.com) includes heavy engineering and it manufactures pressure vessels, steam generators and pressurizers for PWRs. SEC subsidiaries include Shanghai Boiler Works Ltd and Shanghai Electric Nuclear Power Equipment Co Ltd (SENPE) which is increasing ingot capacity to allow fabrication of both AP1000 and EPR components. SEC has been contracted to supply the pressure vessel for the AP1000 at Haiyang 2.

Areva has a joint venture with Shanghai Electric involving a power transformer factory in Shanghai and two more to be built in Wuhan, Hubei province, and near Shanghai. Complementing this Areva is building an ultra high-voltage R&D centre in Shanghai. [[Index](#)]

China National Erzhong Group; China Dongfang Electric Corporation; China Erzhong Group (Deyang) Heavy Equipment

China National Erzhong Group Co Ltd (China Erzhong) claims to be the largest heavy machine-building base in China, and with related company China Dongfang Electric Corporation (DEC) founded in 1984 is based inland at Deyang in Sichuan. DEC specializes in power equipment manufacturing and had supplied 110 GW of generating equipment over 20 years to the end of 2005. Alstom and DEC are supplying the turbines and 1750 MWe generators for CGNPC's Taishan EPR plant, continuing a long-standing relationship among the three. DEC subsidiary Dongfang Turbine Co suffered major damage in the Sichuan earthquake in 2008. China Erzhong Group (Deyang) Heavy Equipment Ltd appears to be another subsidiary of China Erzhong, supplying main steam pipes for AP1000 units. [[Index](#)]

Dongfang (Guangzhou) Heavy Machinery

Dongfang (Guangzhou) Heavy Machinery Co (DFHM) has equity from both DEC and China Erzhong, with Guangdong investors, and has a plant at Nansha near the coast – its workshop is a replica of Areva's Chalon/St. Marcel plant in France. It is set up to supply CPR-1000 components for CGNPC, and in June 2009 it delivered the first Chinese-made reactor pressure vessel for a 1000 MWe reactor. [[Index](#)]

Dongfang Electric Corporation

Dongfang Electric Corporation Ltd (DEC, formerly Dongfang Electric Machinery Co), is listed in Hong Kong and in April 2009 announced a CNY 5 billion capital raising. Established in 1984, it is located in Chengdu in Sichuan Province. [[Index](#)]

Areva DongFang

Areva has a joint venture with DEC subsidiary Dongfang Electrical Machinery Company Ltd (DFEM), set up in 2005. Areva DongFang manufactures primary reactor coolant pumps. It is supplying pumps to CNPEC for three reactors at each of Ningde and Yangjiang. [[Index](#)]

Dongfang Boiler Group

The Dongfang Boiler Group Co Ltd manufactures large capacity power plant boilers including components of PWRs and is working with Areva to manufacture all heavy nuclear components for Ling Ao Phase II and other CGNPC projects. [[Index](#)]

Harbin Power Equipment

Harbin Power Equipment Co. Ltd (HPEC) is supplying some of the equipment for the 1200 MWe steam turbines and generators for the four Sanmen and Haiyang AP1000 units under licence from Mitsubishi Heavy Industries (MHI). Its subsidiary, Harbin Boiler Company Ltd. (formerly Harbin Boiler Works), is the largest utility boiler manufacturer in the country. Harbin Turbine Company Ltd is another subsidiary of HPEC. [[Index](#)]

China Nuclear Power Engineering Group; China Nuclear Power Design

China Nuclear Power Engineering Group Co. Ltd (CNPEC) was set up by CGNPC in 2004 and plays the leading reactor engineering role in it. (NB: distinguish from CNNC's China Nuclear Power Engineering Corporation - CNPE.) China Nuclear Power Design Co is another CGNPC subsidiary responsible for feasibility studies and designs. Both are part of a consortium with Alstom and DEC which is supplying turbines and generators for Taishan nuclear plant, for which Areva is supplying the nuclear part. Alstom Wuhan Engineering and Technology Co. is supporting the Chinese end of this. [[Index](#)]

China Institute for Radiation Protection

The China Institute for Radiation Protection is responsible for R&D on decommissioning. [[Index](#)]

Ministry of Science & Technology

Planning for major nuclear energy research projects is the responsibility of the Ministry of Science & Technology (MOST). [[Index](#)]

China Nuclear Energy Association

The China Nuclear Energy Association (CNEA) was set up with State Council agreement in 2007 as a trade association. It has membership of over 200 enterprises involved in the whole fuel cycle and its infrastructure. [[Index](#)]

Chinese Nuclear Society

The Chinese Nuclear Society focuses on nuclear science popularization and education. [[Index](#)]

Organisations – power plants

Daya Bay

Daya Bay is owned by Guangdong Nuclear Power Joint Venture Co Ltd, and Ling Ao by the Ling Ao Nuclear Power Co Ltd. Both are subsidiaries of CGNPC. Both sites and Yangjiang are run by Daya Bay Nuclear Power Operations & Management Co Ltd (DNMC), which was formed in 2003 with 50% ownership by each company. In July 2009, its shares were transferred to CGNPC. [[Index](#)]

Qinshan

Qinshan is a CNNC enterprise. Phase I is owned by Qinshan Nuclear Power Co, Phase II (including units II-3 and II-4) is owned by Qinshan Nuclear Power JV Co Ltd, with a minority stake in being held

by CPI. Qinshan Phase III is owned by Third Qinshan Nuclear Power Co Ltd - also part of CNNC but with China Electric Power Group Corporation, Zhejiang Provincial Electric Power Corporation, Zhejiang Provincial Electric Power Development Corporation, Shenergy (Group) Co Ltd and Jiangsu International Trust & Investment Corporation as other shareholders. [[Index](#)]

Jiangsu Tianwan

Jiangsu Nuclear Power Corporation was established in 1997 to construct and operate the Tianwan nuclear plant, with four units planned (Phases I & II) and space for four more. Two units are now operating. CNNC owns 50% share, CPI 30% and Jiangsu Guoxin Group 20%. [[Index](#)]

Liaoning Hongyanhe

Early in 2005, Liaoning Hongyanhe Nuclear Power Company Ltd. (LHNP) was established in Liaoning Province by CPI, and will be responsible for the Hongyanhe nuclear power project in Dalian City. 45% is held by CPI, 45% by CGNPC and 10% by Dalian Municipal Construction Investment Corp. CGNPC will be responsible for construction (through CNPEC) and the first five years operation of the plant. CNPDC did the design. [[Index](#)]

Shandong Hongshiding

The Shandong Hongshiding Nuclear Power Co Ltd is developer of a new plant at Hongshiding, in Rushan city and has 51% holding by CNEC/CNNC, with Huadian Power International Co and two investment companies. [[Index](#)]

Shandong Haiyang

The Shandong Nuclear Power Company Ltd (SDNPC) is a subsidiary of CPI and was established at Yantai in July 2004 to undertake the development, construction, operation and management of the Shandong Haiyang nuclear power project, building AP1000 reactors. CPI owns 61 or 65%, CNNC 5%, with two local entities and two major corporations the balance: Shandong International Trust & Investment Corporation, Yantai Electric Power Development Co, China Guodian Group Corporation, and Huaneng Energy & Transportation Industrial (Holding) Co. Ltd. CHNG is also reported to have some equity in the project. [[Index](#)]

Ningde

Ningde Nuclear Power Co Ltd (NDNP) was set up in 2006 by CGNPC and China Datang Corporation. As of early 2008 CGNPC had 46% of the project, Datang International Power Generation Co. 44% and Fujian Coal Industry Group holds 10% in the joint venture to build the first phase of the 6-unit Ningde nuclear plant in Fuding city in Fujian province. [[Index](#)]

Fujian Fuqing

The Fujian Fuqing Nuclear Co Ltd was set up in May 2006 by CNNC (51%) as a joint venture company with China Huadian Corp (49%) to build the Fuqing plant in Fuqing city in Fujian province. The first two units of six 1000 MWe reactors are estimated to cost US\$ 2.8 billion. [[Index](#)]

Xianning, Hubei

Hubei Nuclear Power Co Ltd was set up by CGNPC and Hubei Energy Group in June 2008 to build

the large Dafan AP1000 plant in Xishui county, Xianning city, Hubei province. The first two phase involve four reactors, the third phase, four more. [[Index](#)]

Guangxi Fangchenggang

Guangxi Fangchenggang Nuclear Power Co Ltd is a joint venture of China Guangdong Nuclear Power Holding Company (CGNPC, 61%) and Guangxi Investment Group (39%). CGNPC (40%), CPI (40%) and Guangxi Investment Group Co Ltd (20%) had signed a framework agreement in July 2006 to invest US\$ 3.1 billion in the first two units of the 6000 MWe Fangchenggang (Hongsha) nuclear power plant at Beibu Bay, near Bailong in Guangxi Autonomous Region of southern China. [[Index](#)]

Sanmen

CNNC owns 51% of the Sanmen Nuclear Power Company, which was set up in April 2005 to build and own the Sanmen project. Other shareholders are the provincial government's Zhejiang Energy Company (Group) Ltd., China Electricity Investment Nuclear Power Company, China Huadian Company Ltd. and CNEC. [[Index](#)]

Yangjiang

Yangjiang Nuclear Power Co Ltd (YJNPC) was set up in 2005 under CGNPC to construct Yangjiang nuclear power station. CNPEC is responsible for the EPC contract and DNMC will take charge of the operating. [[Index](#)]

Guangdong Taishan

Guangdong Taishan Nuclear Power Joint Venture Company is set up as a CGNPC subsidiary with 30% held by Electricite de France (EDF) to build, own and operate the Taishan nuclear plant. [[Index](#)]

Anhui Wuhu

Anhui Wuhu Nuclear Power Co was set up following agreement in May 2007 by CGNPC (51%), Shenergy Co. of Shanghai (20%), Shanghai Electric Power Co (14%) and Anhui Province Energy Group Co (15%) to build the \$2.9 billion first phase (2 x 1000 MWe) of the Wuhu plant to commence operation in 2015. The first four CPR-1000 units are expected to cost \$7.32 billion. [[Index](#)]

Hainan

The Hainan Nuclear Power Company Ltd was set up by CNNC (51%) and China Huaneng Group (CHNG) as a joint venture to build the Changjiang nuclear power plant on Hainan Island, with two 650 MWe reactors. CHNG will take the lead in a second phase of the plant. [[Index](#)]

Hunan

Hunan Nuclear Power Company Ltd was set up about 2006 by CPI (45%) with the Hunan government to build the 4000 MWe Xiaomoshan nuclear power plant in Yueyang city on the Yangtze River. As of August 2009 this apparently did not have development approval. [[Index](#)]

Pengze

CPI's Jiangxi Pengze Nuclear Power Project is in Jiangxi province on the Yangtze River and will use AP1000 technology. An investment agreement was signed in October 2009 so that CPI will contribute 55%, Jiangxi Ganneng 20%, Jiangxi Ganyue Expressway 20% and Shenzhen Nanshan Power 5% to establish the Pengze Nuclear Power Co. [[Index](#)]

Taohuaijiang

The Hunan Taohuaijiang Nuclear Power Co Ltd was set up in February 2007 by CNNC to build the Taohuaijiang nuclear power plant at Yiyang city, in inland Hunan province. CNNC (50%) is in joint venture with China Yangtze Three Gorges Project Corporation (20%), China Resources Power Holdings Co Ltd (CRPHC - 25%) and Hunan Xiangtou Holdings Group Co Ltd (5%) to build and operate a nuclear power plant in two stages. Initially this was to be 4x1000 MWe at a total cost of \$5 billion but in 2009 it was confirmed as an AP1000 project. In 2009, China Resources Power Holdings Co Ltd (CRPHC) took a 25% stake in the project. [[Index](#)]

Liaoning Nuclear Power

Liaoning Nuclear Power Co Ltd was set up by CPI in March 2009 to build the Xudabao nuclear power plant (6 x 1000 MWe) on Hulu Island in Liaoning province with 10% equity from SDIC. Construction is expected to start in 2009, for operation in 2014. Total cost is expected to be over CNY 90 billion. [[Index](#)]

Huaneng Shandong Shidaowan

The Shidaowan 210 MWe HTR-PM demonstration plant is being built by Huaneng Shandong Shidaowan Nuclear Power Co. (HSSNPC) in Rongcheng city. China Huaneng Group (CHNG) is the lead organization in the joint venture with 47.5% share. China Nuclear Engineering & Construction Group will have a 32.5% stake and Tsinghua University INET 20%. Construction is now expected to start in September 2010. [[Index](#)]

Shidaowan

The 4000 MWe Shidaowan nuclear power plant in Rongcheng city, Shandong was to be a joint venture of the Huaneng Nuclear Power Development Corp and CGNPC, with further partners to become involved as State Council approval was sought. In October 2009 the **Shidaowan Nuclear Power Development Company Ltd** was set up with capital contribution 40% China Huaneng Group (CHNG), 30% Huaneng International Power Development Corp. (HIPDC) and 30% Huaneng Power International (HPI). Registered capital is RMB 1 billion for the construction, operation and management of four AP1000 reactors and sale of electricity from them. The total investment is estimated at RMB 5 billion. [[Index](#)]

SNPTC-Huaneng Shidaowan joint venture

In December 2009 SNPTC and the Huaneng group set up a 55-45% joint venture to build a demonstration CAP-1400 reactor at Shidaowan, Rongcheng city, Shandong. No JV name was announced. Construction of the first reactor was to commence in April 2013, for December 2017 start-up. A 1700 MWe version would be considered. [[Index](#)]

Sanming

The corporate structure responsible for the Sanming project in Fujian province is not yet evident. CIAE and CNEIC signed the agreement with Russia's Atomstroyexport for the two BN-800 fast neutron reactors, so it is apparently under CNNC. [[Index](#)]

Index

Anhui Wuhu
Areva DongFang
Beijing Institute of Nuclear Engineering
CGNPC Uranium Resource
China Atomic Energy Authority
China Baotou Nuclear Fuel
China Dongfang Electric Corporation
China Erzhong Group (Deyang) Heavy Equipment
China First Heavy Industries
China Guangdong Nuclear Power Group
China Huaneng Group
China Institute of Atomic Energy
China Institute for Radiation Protection
China Jianzhong Nuclear Fuel
China National Erzhong Group
China National Nuclear Corporation
China North Nuclear Fuel
China Nuclear Energy Association
China Nuclear Energy Industry Corporation
China Nuclear Engineering-Construction
China Nuclear Industry 23rd Construction Co. Ltd
China Nuclear International Uranium Corporation
China Nuclear Power Design
China Nuclear Power Engineering
China Nuclear Power Engineering Corporation
China Power Engineering Consulting Group Corporation
China Power Investment Corporation
China Resources Power Holdings
China Uranium Development
Chinergy
Chinese Nuclear Society
CNNC Overseas Uranium Holding
Daya Bay
Dongfang Boiler Group
Dongfang Electric Corporation
Dongfang (Guangzhou) Heavy Machinery
East China Electric Power Designing Institute
Fujian Fuqing
Guangdong Taishan
Guangxi Fangchenggang
Hainan
Harbin Power Equipment

Hongyanhe
Huadian International Power Corporation Ltd
Huaneng International Power Development Corporation
Huaneng Nuclear Power Development Co Ltd
Huaneng Power International
Huaneng Shandong Shidaowan Nuclear Power Co.
Hubei
Hunan
Hunan Taohuaijiang
Jiangsu Nuclear Power Corporation
Liaoning Hongyanhe
Liaoning Nuclear Power
Ministry of Environmental Protection
Ministry of Science & Technology
National Development and Reform Commission
National Energy Administration
National Energy Commission
National Nuclear Safety Administration
Ningde
Nuclear Power Institute of China
Pengze
Qinshan
Rongcheng
Sanmen
Sanming
Shandong Electric Power Construction
Shandong Hongshiding
Shandong Nuclear Power Company
Shandong Nuclear Power Equipment Manufacturing
Shandong Shidaowan HTR-PM
Shanghai Electric Heavy Industries Group
Shanghai Nuclear Energy Research & Design Institute
Shenzhen Shandong Nuclear Power Construction
Shidaowan
Sinosteel
SNERDI Engineering Consulting and Supervision Management
SNPTC-Huaneng Shidaowan joint venture
State Development and Investment Corporation
State Nuclear Power Engineering Corporation
State Nuclear Power Technology Corporation
State-owned Assets Supervision & Administration Commission
Tianwan
Taishan
Taohuaijiang
Wuhu
Xudabao
Yangjiang

Further Information

Related information pages

Nuclear Power in China

References

1. See webpage on China Nuclear International Uranium Corporation on CNNC website (www.cnncc.com.cn) [[Back](#)]