

Nuclear Power in China

(Updated 10 December 2010)

- **Mainland China has 13 nuclear power reactors in operation, 25 under construction, and more about to start construction soon.**
- **Additional reactors are planned, including some of the world's most advanced, to give more than a tenfold increase in nuclear capacity to 80 GWe by 2020, 200 GWe by 2030, and 400 GWe by 2050.**
- **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 (Mt) and annual carbon dioxide emissions by 139 Mt. China is well advanced in developing and deploying supercritical and ultra-supercritical coal plants, as well as moving quickly to design and deploy technologies for integrated (coal) gasification combined cycle (IGCC) plants.

The grid system run by the State Grid Corporation of China (SGCC) is sophisticated and rapidly growing, utilising ultra high voltage (1000 kV AC and 800 kV DC) transmission. By 2020, the capacity of the UHV network is expected to be some 300 GW, which will function as the backbone of the whole system, having 400 GWe of clean energy sources connected, 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). Also by 2020, operational transmission losses are expected to be 5.7%, down from 6.6% in 2010. 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

Electricity generation is only one part of China's rapid development; roads, air transport and a 40,000 km high-speed rail system by 2015 are others.

Nuclear power

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 about 2005 the industry moved into 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.

Prior to 2008, the government had planned to increase nuclear generating capacity to 40 GWe by 2020 (out of a total 1000 GWe planned), with a further 18 GWe nuclear being under construction then. However, government targets for nuclear power have been increasing. As of June 2010, official installed nuclear capacity projections were 70-80 GWe by 2020, 200 GWe by 2030 and 400-500 GWe by 2050.

Concerning technology, PWRs are expected to level off at 200 GWe about 2040, and fast reactors progressively increase from 2020 to at least 200 GWe by 2050 and 1400 GWe by 2100.

In September 2010, the *China Daily* reported that China National Nuclear Corporation (CNNC) alone plans to invest CNY 800 billion (\$120 billion) into nuclear energy projects by 2020. Total investment in nuclear power plants, in which CNNC will hold controlling stakes, will reach CNY 500 billion (\$75 billion) by 2015, according to CNNC. In order to fund the company's expansion target, CNNC plans to list its subsidiary, CNNC Nuclear Power Co Ltd in 2011, to attract strategic investors.



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 Westinghouse AP1000 is the main basis of China's move to Generation III technology. The first four AP1000 reactors are being built at Sanmen and Haiyang, for CNNC and CPI respectively, and involve a major technology transfer agreement. At least eight more at four sites are firmly planned after them, and about 30 more are proposed to follow. 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 for the first four units, with this expected to reduce significantly for the following units. The cost of the first four is expected to be less than \$2000/kW, with this reducing to \$1600 for further units. In October 2009, SNPTC and CNNC signed an agreement to co-develop and refine the AP1000 design. (See also section below on [Embarking upon Generation III plants](#)).

EPR

Two Areva EPR reactors are being built at Taishan, and at least two more are planned. (see section below on [Embarking upon Generation III plants](#)). Areva says the reactors are 4590 MWt, with net power 1660 MWe.

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.

In December 2009, the State Nuclear Demonstration Company – a 55-45% joint venture company by SNPTC and China Huaneng Group – was set up to build and operate an initial unit of the larger design, the CAP1400, at Huaneng's Shidaowan site. The new company signed a set of agreements with SNERDI and the State Nuclear Power Engineering Company (SNPEC) in November 2010 to proceed with the project. Construction is scheduled to start in April 2013, and SNPTC hoped to have it operating in December 2017. Westinghouse is to provide technical consulting services to SNPTC for the design. It is to be followed by a CAP1700 design, and China will own the intellectual property rights for these two larger designs. SNPEC is doing the engineering under a team from SNERDI, the Shandong Electric Power Engineering Consulting Institute (SEPECI), and the State Nuclear Power Equipment Manufacturing Company (SNPEMC), which will make the components.

CNP-1000 (also CNP-600, CNP-300)

CNNC had been working with Westinghouse and Framatome (now Areva) at SNERDI since the early 1990s to develop a Chinese standard three-loop PWR design, the CNP-1000. This is developed from the single-loop Qinshan CNP-300 unit (scaled up to the 2-loop CNP-600 units, also at Qinshan), with high (60 GWd/t) burn-up, 18-month refueling cycle and 20 more fuel assemblies than the French-origin units^a. 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 full 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.

Further CNP-600 units are being built at Qinshan and Changjiang, Hainan. CNNC says they are free of French intellectual property rights. CNNC is also developing the design to the ACP600 which it expects to be able to built on Hainan or in the northwest Gansu province about 2013^b.

A new 300 MWe CNP-300 PWR unit is being built at Chasma in Pakistan by the China Zhongyuan Engineering Corporation. It is a twin to that already commissioned in 2000, and similar to Qinshan 1 - China's first indigenously-designed (by SNERDI) nuclear power plant.

CNNC is seeking to sell the CNP-300 to Belarus and in Africa.

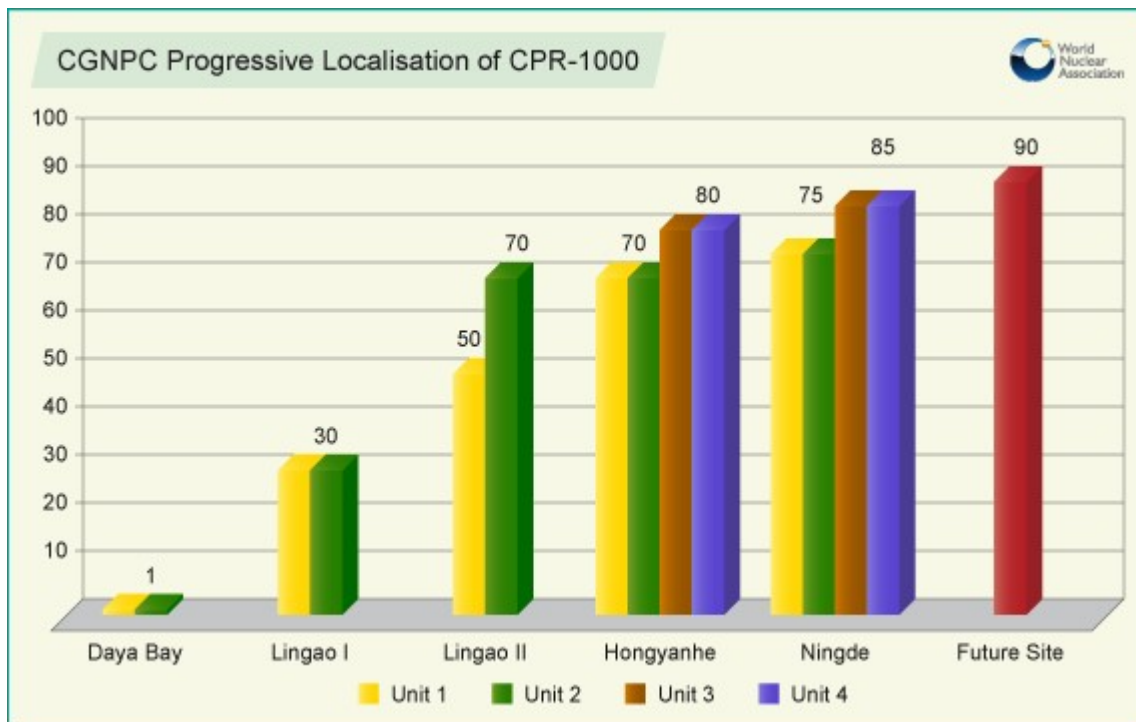
CPR-1000

The CPR-1000 is a significantly upgraded version of the 900 MWe-class French three-loop technology imported for the Daya Bay nuclear power plant in the 1980s. Known as the 'improved Chinese PWR' and designated Generation II+, it features digital instrumentation and control and a design life of 60 years. Its 157 fuel assemblies have core melt frequency of 1×10^{-5} and a release probability an order of magnitude lower than this.

Standard construction time is 52 months, and the unit cost is under CNY 10,000 (US\$ 1500) per kilowatt. With a capacity of 1080 MWe gross (1037 MWe net), Ling Ao Phase II is the first plant to be designated as the CPR-1000 design. The CPR-1000 is being widely and quickly deployed for domestic use.

China Guangdong Nuclear Power Corporation (CGNPC) led the development of the CPR-1000 and has established a nearly complete domestic supply chain. However, Areva retains intellectual property rights, which constrains overseas sales since the Chinese would need agreement from Areva on a case-by-case basis.

CGNPC refers to later units as CPR-1000+, incorporating design improvements which bring it close to Generation III standard. Of more significance is its evolution to the ACPR-1000 with full Chinese intellectual property rights and which CGNPC expects to make available for local build and overseas markets from 2013.



VVER

Russia's Atomstroyexport was 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.

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-PM 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. China Huaneng Group is the lead organization in the consortium to build the demonstration Shidaowan HTR-PM with China Nuclear Engineering & Construction Group (CNEC) and Tsinghua University's INET, which is the R&D leader. Chinergy Co. is the main contractor for the nuclear island. Thermal efficiency of 40%, localisation 75% and 50 month construction for the first unit is envisaged. The initial HTR-PM will pave the way for 18 (3x6) further 210 MWe units at the same site – total 3800 MWe (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 (FNRs) are seen as the main technology, and CNNC expects the FNR to become predominant by mid-century. A 65 MWt fast neutron reactor – the Chinese Experimental Fast Reactor (CEFR) – near Beijing achieved criticality in July 2010.⁵ Based on this, a 600 MWe pre-conceptual design was developed. The current plan is to develop an indigenous 1000 MWe design to begin construction in 2017, and commissioning 2022. This is known as the Chinese Demonstration Fast Reactor (CDFR) project 1.

In addition to CDFR project 1, in October 2009, an agreement with Russia confirmed earlier indications that China would opt for the BN-800 technology as CDFR project 2. The 880 MWe gross BN-800 reactor being built by OKBM Afrikantov at Beloyarsk in Siberia is the reference design and the first two in China are planned to start construction in 2013 at Sanming, Fujian province, with the first to be in operation in 2018 (see see section below on [Sanming](#)).

See also [Fast neutron reactors](#) section in page on *China's Nuclear Fuel Cycle*.

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 construction and equipment contracts

Westinghouse and Shaw Group have an engineering, procurement, commissioning and start-up as well as project management contract with SNPTC for the first four reactors (Sanmen & Haiyang). Also Shaw has a contract with State Nuclear Power Engineering Corp. Ltd, a SNPTC subsidiary, for technical support for the first two Dafan, Xianning units in Hubei province, including engineering and design management, project controls, quality assurance, construction management and project management.

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.

In November 2010, further contracts were signed between SNPTC and Westinghouse, including one for Westinghouse to provide SNPTC with technical consulting services in research and development of the CAP1400 nuclear power plant, to be developed by SNPTC with Chinese intellectual property rights. Westinghouse said that having shared design technology with SNERDI, it expected 100% localization by 2015.

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 for unit 1 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. Construction on the second unit started in April 2010. The first unit should be completed at the end of 2013 and the second in 2015. The major components for unit 1 are imported: the pressure vessel from MHI in Japan and the steam generators from Areva Chalon/St. Marcel in France, but those for unit 2 are all built in China: the pressure vessel by Dongfang Electric (DEC), the steam generators by DEC (2) and SEC (2). 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):

- Ling Ao Phase II (also known as Ling Dong) in Guangdong province, the first CPR-1000 plant and based on the Daya Bay and Ling Ao Phase I nuclear plants.
- 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 Ling Ao. 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.

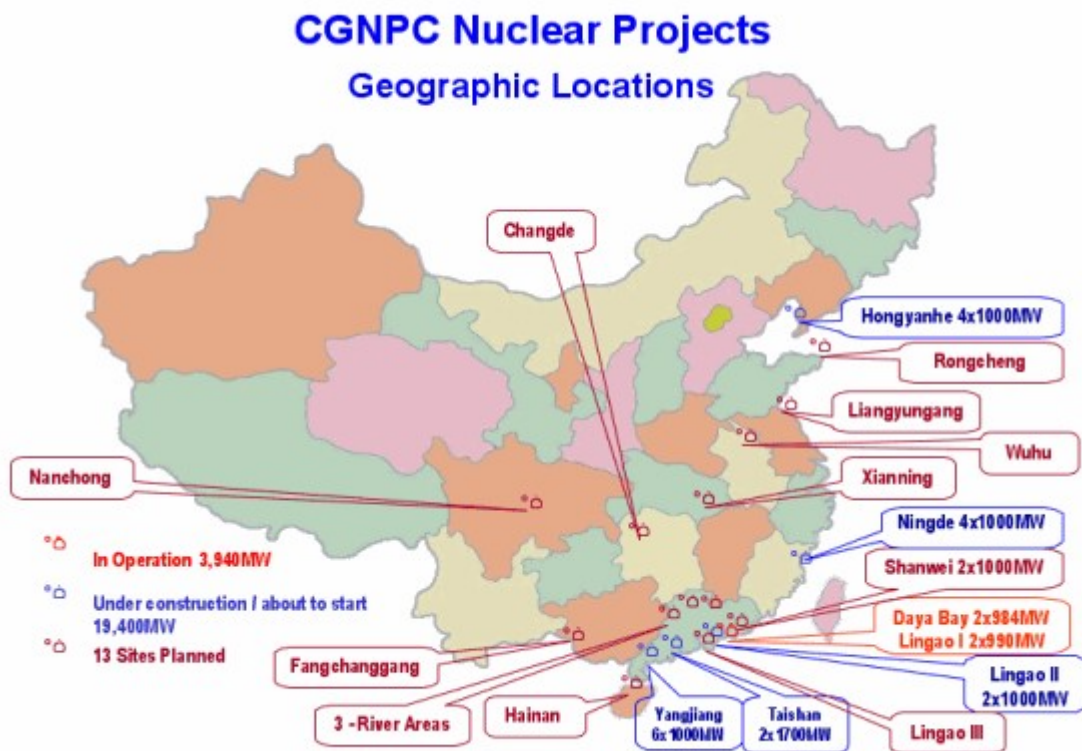
As well as the Sanmen and Yangjiang projects slipped from the 10th Plan, nuclear power

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 by NNSA 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, which is proving a severe constraint on the ambitions of several of the country's largest utilities. CGNPC is increasingly preeminent in 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.⁶

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 (CNP-300)	CNNC	April 1994
Qinshan Phase II, 1-3	Zhejiang	610 MWe	PWR (CNP-600)	CNNC	2002, 2004, 2010
Qinshan Phase III, 1&2	Zhejiang	665 MWe	PHWR (Candu 6)	CNNC	2002, 2003
Ling Ao Phase I, 1&2	Guangdong	935 MWe	PWR	CGNPC	2002, 2003
Tianwan 1&2	Jiangsu	1000 MWe	PWR (VVER-1000)	CNNC	2007
Ling Ao Phase II, 1	Guangdong	1037 MWe	PWR (CPR-1000)	CGNPC	Sept 2010
Total: 13		10,234 MWe			

Daya Bay, Ling Ao Phase I

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^C and 30% to Guangdong.

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

Daya Bay and Ling Ao 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. For Ling Ao Phase II, see below.

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. Local content was 55%. 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. Units 3 & 4 are similar, with local content of 77%. After 53 months construction, unit 3 was grid connected on 1 August 2010, and entered commercial operation 12 weeks later⁷.

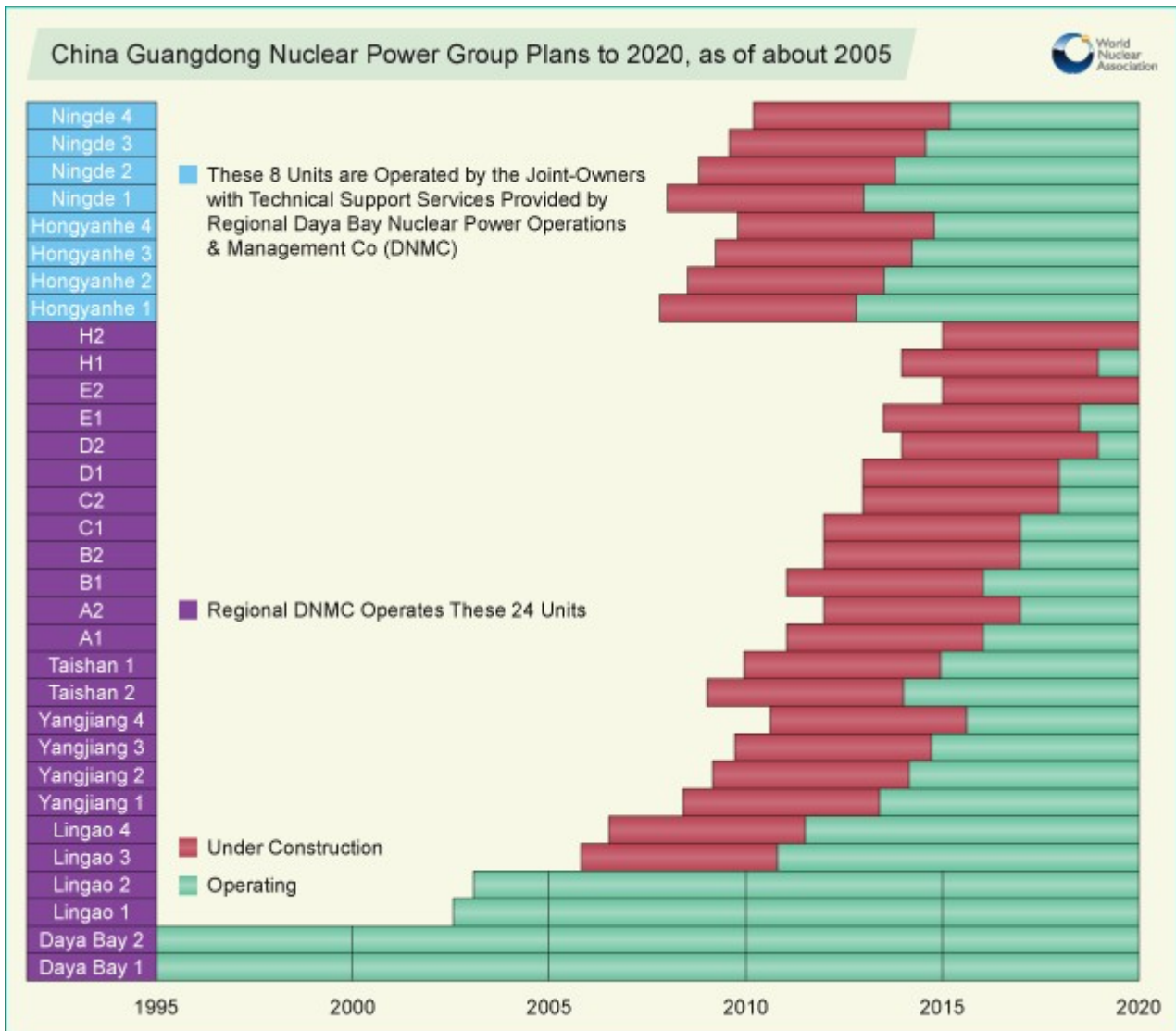
Qinshan Phase III units 1&2 use the Candu 6 pressurised heavy water reactor (PHWR) technology, with Atomic Energy of Canada (AECL) being the main contractor of the project on a turnkey basis. Construction began in 1997 and unit 1 started up in September 2002 and unit 2 in April 2003. They are each about 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) expected to spend \$ 9.5 billion on its Ling Ao 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 others. It also planned to start on the Lufeng plant in Guangdong and Wuhu in Anhui province, but awaited 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.



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
Ling Ao Phase II unit 2	Guangdong	1080	CPR-1000	CGNPC	5/06	8/11
Qinshan Phase II unit 4	Zhejiang	650	CNP-600	CNNC	1/07	2012
Hongyanhe units 1-4	Liaoning	4x1080	CPR-1000	CGNPC	8/07, 4/08, 3/09, 8/09	10/12, 2013, 2014
Ningde units 1-4	Fujian	4x1080	CPR-1000	CGNPC, with Datang	2/08, 11/08, 1/10, 9/10	12/12, 2013, 2014, 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, 11/10, 15/3/11	8/13, 2014, 2015, 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, 6/10	5/14, 3/15
Taishan units 1&2	Guangdong	2x1770	EPR	CGNPC	10/09, 4/10	12/13, 11/14
Hongyanhe units 5&6	Liaoning	2x1080	CPR-1000	CGNPC	2011, 2011	2015
Shandong Shidaowan	Shandong	210	HTR-PM	Huaneng	12/10	2015
Fangchenggang units 1&2	Guangxi	2x1080	CPR-1000	CGNPC	7/10, 2011	2015, 2016
Fuqing units 3&4	Fujian	4x1080	CPR-1000	CNNC	2010, ?	2015-
Fuqing units 5&6	Fujian	2x1080	CPR-1000 or CNP1000	CNNC	?, ?	-
Changjiang units 1&2	Hainan	2x650	CNP-600	CNNC & Huaneng	4/10, 11/10	2014, 2015
Tianwan units 3&4	Jiangsu	2x1060	VVER-1000 (AES-91)	CNNC	2010-11	
Hongshiding (Rushan) units 1&2	Shandong	2x1080	CPR-1000	CNEC/CNNC	Deferred from 2009?	2015
Ningde units 5&6	Fujian	2x1080	CPR-1000	CGNPC		
Xianning (Dafan) units 1&2	Hubei	2x1250	AP1000	CGNPC	2011	2015
Taohuaijiang units 1-4	Hunan	4x1250	AP1000	CNNC	late 2010	4/2015-2018
Pengze units 1&2	Jiangxi	2x1250	AP1000	CPI	early 2011	2015
Xudabao / Xudapu units 1&2	Liaoning	2x1250	AP1000	CNNC with Datang	2011?	
Sanmen units 3&4	Zhejiang	2x1250	AP1000	CNNC		

Haiyang units 3&4	Shandong	2x1250	AP1000	CPI	2010?	
Xiaomoshan units 1&2	Hunan	2x1250	AP1000	CPI	2011?	
Longyou (Zhexi) units 1&2	Zhejiang	2x1250	AP1000	CNNC	2011?	
Sanming units 1&2	Fujian	2x880	BN-800	CNNC	8/2011	2018, 19
Zhangzhou units 1&2	Fujian	2x1250	AP1000	CNNC & Guodian	2011	
Yanjiashan/Wanan/Ji'an	Jiangxi	2x1250	AP1000	CNNC	2011?	
Shaoguan units 1-4	Guangdong (inland)	4x1250	AP1000	CGNPC		
Tianwan units 5&6	Jiangsu	2x1200	VVER-1200	CNNC	?, ?	
Wuhu units 1&2	Anhui	2x1250	AP1000	CGNPC	12/2011	8/2016
Lianyungang units 1&2	Jiangsu	2x1080	CPR-10000	CGNPC		
Shanwei (Lufeng) units 1&2	Guangdong	2x1080	CPR-10000	CGNPC		
		33x1080				
		32x1250				
		2x1060				
		2x1200				
		2x1770				
		2x880				
		3x650				
		1x210				
Total: 77		87,620				
		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. At 22 November 2010, 26 under construction: 28,710 MWe; 51 planned: 58,910 MWe (gross).

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
Lianyungang units 3&4	Jiangsu	2x1080	CPR-1000	CGNPC		
Taishan units 3&4	Guangdong	2x1770	EPR	CGNPC		
Nanchong (Nanchun, Sanba)	Sichuan	4x1000		CGNPC		
Tianwan units 7&8	Jiangsu	2x1200	VVER-1200 (AES-2006)	CNNC		
Yangjiang units 5&6	Guangdong	2x1080	CPR-1000	CGNPC		2017
Xianning (Dafan) units 3&4	Hubei	2x1250	AP1000	CGNPC		
Shidaowan units 1-4	Shandong	4x1250	AP1000	Huaneng	2013?	
Shidaowan units 5&6	Shandong	2x1400	CAP1400	Huaneng	2013?	
Shandong Shidaowan	Shandong	18x210	HTR-PM	Huaneng		
Changjiang units 3 & 4	Hainan	2x650	CNP-600 or ACP-600	CNNC & Huaneng		
Haiyang units 5&6	Shandong	2x1250	AP1000	CPI		
Xiaomoshan units 3-6	Hunan	4x1250	AP1000	CPI		
Xudabao / Xudapu units 3-6	Liaoning	4x1250	AP1000	CNNC with Datang		

Shanwei (Lufeng) units 3-6	Guangdong	4x1080	CPR-1000	CGNPC	
Fangchenggang units 3-6	Guangxi	4x1080	CPR-1000	CGNPC	
Yingtian	Jiangxi	2?		Huaneng	
Nanyang units 1-6	Henan	6x1250?	AP1000 (if CPI)	CNNC or CPI	
Xinyang units 1-4	Henan	4x1080	CPR-1000?	CGNPC?	
Changde (Chenzhou, Hengyang)	Hunan	4x1000?		CNNC & Guodian?, CGNPC	
Subtotal: 74 units		68,000+ MWe			
Jiyang	Anhui	4x?		CNNC	
Sanmen units 5&6	Zhejiang	2x1250	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			
Fuling units 1-4	Chongqing	4x1250	AP1000	CPI	
Jingyu units 1-4	Jilin	4x1250	AP1000	CPI & Guodian	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?	
Haiyang units 7&8	Shandong	2x1250	AP1000	CPI	
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	4x1000		Huadian	
Shizu	Chongqing			CNNC	
Qiaofushan	Hebei			CNNC	
Songzi/Xianning 5&6	Hubei		AP1000	CGNPC	
Guangshui	Hubei	4x1250	AP1000	CGNPC	
Hebaodao	Guangdong			CNNC	
Yibin	Sichuan			CNNC	
Sanming 3&4	Fujian	2x880?	BN-800?	CNNC	2015
<i>Site to be decided</i>	Heilongjiang	4x1000		Huaneng	
Subtotal: about 72 units		32x1250 20x1000 2x880 c.18x210 Approx. 80,000 MWe			
Total: about 140		138,000+ MWe			

All PWR except Shidaowan HTR-PM and Sanming BN-800. 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'

Ling Ao 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 Ling Ao power station (also known as Ling Dong). Construction started in December 2005 with the 1080 MWe (gross), 1037 MWe (net) units. Unit 1 is about 50% localized and unit 2 will be 70% localized, under the project management of China Nuclear Power Engineering Corporation (CNPEC), part of CGNPC. Low-speed Arabelle turbine-generator sets are being provided by Alstom. In June 2009, the first Chinese-made reactor pressure vessel for a 1000 MWe class reactor was delivered for unit 2, from Dongfang (Guangzhou) Heavy Machinery Co. Unit 1 started up in June 2010 with grid connection in mid-July, 54 months after construction start, and entered commercial operation in September. Unit 2 is expected to commence operation in 2011.

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

This is the first nuclear power station receiving central government approval to build four units at the same time, and the first in northeast China. Construction of the first unit of the Hongyanhe nuclear power plant in Dalian, Liaoning, started in August 2007. It is the first nuclear power project in the 11th Five-Year Plan, with owner and operator being Liaoning Hongyanhe Nuclear Power Co, a joint venture of CGNPC and CPI (45% each) with Dalian Construction Investment Group. The National Nuclear Safety Administration (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. Shanghai Electric won a \$260 million contract for equipment and Alstom is to provide the four low-speed Arabelle turbine-generator sets for \$184 million. Localisation is above 70%. Commercial operation is planned for 2012-14. The project incorporates a 10,080 m³/day desalination plant.

In May 2010, the NRDC approved preliminary work on the CNY 25 billion two-unit second phase of the plant (units 5&6), and work began in July. The National Nuclear Safety Administration (NNSA) and the Environment Ministry approved the project in September 2010, construction start is expected 2011. Localisation is to be above 80% and the first unit is expected on line in 2015.

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, for the third early in January 2010 and for the fourth at the end of September 2010. Total cost for four units was put at CNY 51 billion (\$7.2 billion). Dongfang Electric has a contract to supply turbine generators for units 1-4, using Alstom Arabelle low-speed technology. No dates yet known for units 5 & 6.

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 for all six being CNY 100 billion (\$14.6 billion). First concrete for unit 3 was expected in October 2010. 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 Alstom Arabelle low-speed steam turbine generators for the Fuqing and Fangjiashan plants. Late in 2010, CNNC was proposing the CNP1000 for units 5 & 6, noting "pre-project under way".

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 China 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. Construction of the second pair started in November 2010, then the final two (as the second construction phase) are to follow, 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/Ling Ao, will be operated under regional Daya Bay (DNMC) management. In July 2010, Hong Kong-based power utility China Light and Power (CLP) agreed to take a 17% stake in Yangjiang – the equivalent of one reactor.

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 Alstom Arabelle low-speed 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. The pressure vessel and steam generators for unit 2 are being made in China. See section on [Embarking upon Generation III plants](#) above.

Haiyang

Shandong Nuclear Power Company (a subsidiary of CPI) signed contracts with Westinghouse and Shaw for two AP1000 units in July 2007. Work on the site is well underway and first concrete was poured in September 2009 for unit 1 and June 2010 for unit 2. The 5000 cubic metre base mat of each was placed in a single pouring of less than 48 hours. The pressure vessel and steam generators for unit 2 are being made in China. These units are expected to commence operation in May 2014 and March 2015. See section on [Embarking upon Generation III plants](#) above.

The site will eventually have six or eight 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.

Haiyang will be a CPI training base for AP1000 staff, along with a set-up at Yantai.

Taishan

The first two 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 is fabricating major components for both units and expects net capacity to be 1660 MWe each. See section on [Embarking upon Generation III plants](#) above.

Site works are reported to be proceeding for units 3 & 4.

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 Shidaowan Nuclear Power Company Ltd (HSNPC). This joint venture is led by the China Huaneng Group Co – the country's largest generating utility but hitherto without nuclear capacity, and still without NNSA authority to build nuclear plants. Huaneng Power International is investing CNY 5 billion in the project, which received environmental clearance in March 2008. Site work is largely complete, but no NNSA licence has been issued. Subject to this, Huaneng would like to commence construction by end of 2010, for commercial operation in 2015. The EPC (engineering, procurement, construction) contract was let in October 2008, and involves Shanghai Electric Co and Harbin Power Equipment Co. A simulator contract signed in May 2010 was between HSNPC, Chinergy and CGNPC Simulator 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. Thus none of the authorised nuclear utilities is now involved, though Huaneng is linked with SNPTC on the project through the State Nuclear Demonstration Company – a 55-45% joint venture company by SNPTC and CHNG in respect to building the first CAP1400 units (see [Reactor technology](#) section above), two being envisaged after the four AP1000s.

Fangchenggang

The Fangchenggang 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 (45 km from the Vietnam border in south China). Following an agreement in July 2006, the first stage (two 1080 MWe CPR-1000 units out of six planned) of the plant was approved by NDRC in October 2008, and again in July 2010. First concrete was poured in July 2010, and about 87% of the first two units will be sourced in China.

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 2015, the second in 2016. Total budget is CNY 70 billion (\$10.26 billion), with CNY 26 billion (\$3.87 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, and the project is expected to cost \$3.8 billion.

Protracted discussion on pricing for the Russian components of the plant delayed units 3 & 4. Eventually, a contract for the engineering design of Tianwan 3 & 4 was signed in September 2010 between Jiangsu Nuclear Power Corporation and Atomstroyexport, and the general construction contract was signed in November 2010. €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. It will not act as the principal contractor, though it

insists on retaining intellectual property rights. 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. The turbine generator sets will probably be sourced from Dongfang Electric, using Alstom Arabelle low-speed technology.

Meanwhile, Iskorskiye Zavody, part of OMZ, has started making the major components covered by the Russian €1.3 billion part of the plant. It will manufacture two VVER-1000 reactor pressure vessels with internals and upper units. Delivery should be completed in 2014. The company already took part in making the major equipment for Tianwan 1 & 2, including reactor pressure vessels.

In August 2009, the Assets Supervision & Administration Commission announced that Phase 3 of Tianwan (units 5 & 6) would start construction in October 2010 – now delayed. These are likely to be AES-2006 type, and Dongfang Electric has a contract to supply turbine generators using Alstom Arabelle low-speed technology.

Hongshiding (Rushan)

In November 2006, an agreement was signed by CNNC to proceed with the first two units of the Hongshiding nuclear plant at Hongshiding in Weihai or Rushan city, 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, with Shandong Hongshiding Nuclear Power Co. Ltd as developer.

Changjiang

CNNC's Changjiang nuclear power plant on Hainan Island started construction in April 2010 for operation of the first unit at the end of 2014 and the second in 2015. It will eventually comprise four 650 MWe PWR units (CNP-600) based on those at Qinshan Phase II. Total cost of the first pair is put at about CNY 20 billion (\$2.8 billion). Units 3 & 4 will be built as the second phase of construction. Huaneng Power International (HPI), part of China Huaneng Group (CHNG), holds a 30% share in Hainan Nuclear Power Co Ltd. More than 70% of the plant's equipment is to be made in China.

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 (referred to as Chinese Demonstration Fast Reactors) at Sanming city, an inland part of Fujian province. A site survey and preliminary feasibility study had been undertaken in 2007-08. CNNC in April 2010 established Sanming Nuclear Power Co Ltd as a joint venture company with the Fujian Investment & Development Corp and local government, and initiated a full feasibility study. Construction is due to start in 2013, the local content is targeted at 70%, and the first unit is to be in operation in 2018, and the second following about a year later. A second phase, with units 3 & 4, is due to commence in 2015. The plant will be similar to the OKBM Afrikantov design being built in Russia at Beloyarsk 4 and due to start up in 2012.

Xudabao/ Xudabu

CNNC's Xudabao nuclear power station is on Hulu Island in Xicheng City in coastal Liaoning province. The CNY 90 billion (US\$15 billion) Xudabao project will comprise six AP1000 reactors,

with units 1&2 in the US\$4 billion first phase. Site preparation was to begin before the end of 2010 for construction start in 2011. CNNC's Liaoning Nuclear Power Company Ltd owns the plant, and the general contractor is China Nuclear Power Engineering Company Ltd (CNPE). In October 2010, the Northeast Electric Power Design Institute (NEPDI), Changchun, Jilin, a subsidiary of China Power Engineering Consulting Corporation (CPECC), signed a survey and engineering contract for the plant. Pre-project work was reported as under way in November 2010. China Datang holds 20% equity, and State Development and Investment Corporation (SDIC) 10%.

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 Xinxu town, Lianyungang city, 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.

Shanwei (Lufeng)

CGNPC's Lufeng Nuclear Power Corporation is making efforts to start on the first two units (of 6) of the Shanwei plant at Lufeng, Tianwei district in eastern Guangdong, but awaits NDRC approval. It will be a CNPEC project. In 2007, it was in the 12th Five Year Plan.

Zhangzhou

China Guodian's first nuclear power venture, with CNNC holding 51%, will initially have two AP1000 reactors, on the coast in Fujian province.

Inland nuclear power plants

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 plant (four AP1000 units) at Dafan in Xishui county are under way. Construction of the first two units is expected to start late in 2010 or early 2011. The reactor pressure vessel for the first unit is contracted to China First Heavy Industries. Cost of four AP1000 reactors is put at CNY 60 billion (\$8.8 billion). This will be CGNPC's first AP1000 plant. A further phase is estimated to cost CNY 45 billion. Cooling towers are expected to be used.

The large pre-assembled modules that will make up the bulk of the new AP1000s are to come from a new inland facility owned by new firm Hubei Nuclear Power Equipment Company.

Reports of a Songzi plant may refer to later stages of Dafan, though possible projects in Yangxin county have been mentioned.

The Hubei Nuclear Power Co is also reported to be planning a four-unit AP1000 plant at Guangshui city in the northeast of the province.

Zhongxiang

CNNC's Hubei Zhongxiang nuclear power project is at Zhongxiang city in central Hubei, with China

Datang. The 5000 MWe plant is undergoing a detailed feasibility study, but further details are unknown.

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 environmental impact statement was released for public comment in January 2010. The first unit is due on line in 2016.

Jiyang

Besides Wuhu, CNNC was reported as starting a feasibility study on another four-unit 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 on the Zi River in Yiyang city, near Yueyang in inland Hunan province will be China's first inland nuclear power plant. It was expected to start construction in September 2010, and 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; China Erzhong is contracted to supply the main pressure vessel forgings, and Dongfang Electric Corp will supply other major components. Germany's GEA Group is to construct the world's largest cooling tower for unit 1: a natural draft unit some 200 metres high and 160 m in diameter, with 15,000 square metres drenching area. Subsequent towers will have increasing local content.

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 in commercial operation 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-2010 NNSA approval was awaited. Site preparation is underway and first concrete is expected late in 2010. The cost is put at CNY 70 billion (\$10.25 billion) for the first four units, funded by SNPTC and Wuling Electric Power Development Co. (a CPI subsidiary). The Heimifeng pumped storage plant will be associated with it.

Yanjiashan/Wanan/Ji'an

In August 2009, CNNC (51%) signed a joint venture agreement with Jiangxi Ganneng Co. Ltd and Jiangxi Ganyue Expressway Co Ltd (49% between them) setting up Jiangxi Nuclear Power Co to build the Wanan Yanjiashan nuclear power project at Ji'an in the Jiangxi province. CNNC contracted a feasibility study of Yanjiashan nuclear power program in July 2010. Pre-project work was reported as under way in November 2010. (This is also reported as a CPI project.)

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, is involved in the project though it has no nuclear capacity so far.

Nanchun/Nanchong/Sanba, Yibin

In 2005, Sichuan proposed Nanchun/ Nanchong city east of Chengdu as a suitable site for a nuclear power plant and sought approval for it from the National Development and Reform Commission (NDRC), which was not given, possibly because of seismic concerns. In March 2009, the provincial government signed an agreement with CGNPC to pursue the plan for a Nanchun nuclear power plant, involving the Nuclear Power Institute of China (NPIC), headquartered in Chendu. Preliminary plans in 2008 were for a 4000-6000 MWe Sanba nuclear power plant on the Jialing River, at a cost of CNY 25 billion (\$3.7 billion). Majority ownership would be CGNPC.

Another Sichuan agreement for a nuclear power plant project has been signed between CNNC and Yibin city, south of Chengdu.

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.

Longyou/ Zhexi

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. Pre-project work was reported as under way in November 2010.

Jingyu

CPI plans to spend CNY 85 billion to build the six-unit Jingyu nuclear power plant near Baishan, in

Jilin province, with four AP1000 units to be in stage 1. The project is still in the preliminary feasibility stage, though site preparation is now underway.

Nanyang

To be a six-unit CNNC plant in Henan province. Pre-project work was reported as under way in November 2010.

Further Information

Notes

- a. The CNP series of reactors is also referred to as the CP series. [[Back](#)]
- b. The ACP600 design appears to be an advanced version of the CNP-600. CNNC expects to complete development of the ACP600 design by 2013. [[Back](#)]
- c. Hong Kong gets much of its power from mainland China, in particular about 70% of the output from Daya Bay's 1888 MWe net nuclear capacity is sent there. The Hong Kong government plans to close down its coal-fired plants, and by 2020 to get 50% of its power from mainland nuclear, 40% from gas locally and 3% from renewables. Hong Kong utility China Light & Power has equity in CGNPC's Daya Bay and Yangjiang power plants, and may take equity in a further CGNPC nuclear plant. [[Back](#)]

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2. *Platts Power in Asia*, 21 January 2010 [[Back](#)]
3. [International Energy Outlook 2009](#), Energy Information Administration, U.S. Department of Energy, DOE/EIA-0484(2009), available at www.eia.doe.gov/oiaf/ieo/index.html [[Back](#)]
4. [APWR and HTR are listed into the national program](#), CNNC news release (24 February 2006) [[Back](#)]
5. [Criticality for fast reactor](#) World Nuclear News (22 July 2010) [[Back](#)]
6. [2007 Annual Report of China Power Investment Corporation](#) (26 November 2008) [[Back](#)]
7. [Unit 3 at Qinshan Phase II Nuclear Power Station begins operation](#) People's Daily Online (22 October 2010) [[Back](#)]

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Government Structure and Ownership

Nuclear Power in China Appendix 1

(Updated 3 December 2010)

Ministries and Commissions are at the top level under the State Council; Administrations and Bureaus are under these. The national utility companies are largely or wholly state-owned. As well as these high-level entities, there are [specialist service companies with national scope](#), listed in the second section of this page. Below these are listed the [owner companies](#) relevant to each power plant or project.

National organisations and utilities

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, being owned 60% by the State Council and with 10% of shares owned by each of CNNC, CPI, CGNPC, and China National Technical Import & Export Corp. Early in 2007, SNERDI (see below) was removed from CNNC control and assigned to SNPTC 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 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 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 the first phase of Liaoning Hongyanhe nuclear power project, 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 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 had a 30% stake in the Changjiang nuclear plant but transferred this to Huaneng Power International in December 2010. CHNG 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 52% directly and 5% indirectly by China Huaneng Group and set up to develop, construct and operate power plants in China. HIPDC controls **Huaneng Power International (HPI)**, (www.hpi.com.cn/company/index.jsp), a sino-foreign joint stock company incorporated in China, with a 42% shareholding in it. China Huaneng Group also has a further 8.9% direct and indirect shareholding in HPI. The country's largest listed generator, HPI develops, constructs, operates and manages large-scale power plants 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." China Huaneng is focused on Shidaowan development, with HTR demonstration plant and six large PWRs – apparently four AP1000 units and two CAP1400 units. HPI now has 49% equity in Hainan Nuclear Power, which is building the Changjiang plant. [[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. With CNNC it is building the Fuqing plant. [[Index](#)]

China Datang Corporation

Datang Corporation (www.china-cdt.com) is one of the five large generating companies formed from the State Power Corporation in 2002. It has 44% stake in phase one (four units) of the Ningde nuclear power project in Fujian province, and 20% of Xudabao in Liaoning. [[Index](#)]

China Guodian Corporation

Guodian Corporation (www.cgdc.com.cn) is another of the five large generating companies set up in 2002 and now controlling 82 GWe of capacity. Its subsidiary Guodian Power Development Co Ltd is listed on the Shanghai stock exchange. It has signed a strategic cooperation agreement with CNNC and will have equity in Zhangzhou (Fujian province) and Hengyang (Hunan), as well as a stake in Jingyu nuclear power project proposed in Jilin province, with CPI.

The NDRC has announced that China Guodian will invest CNY 20 billion (\$2.9 billion) on power projects in Hunan province within three to five years from 2009, possibly including a major stake in CNNC's Taohuajiang plant. [[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](#)]

Specialist service companies with national scope

State Nuclear Demonstration Company

The State Nuclear Demonstration Co was set up in December 2009 by SNPTC (55%) and China Huaneng Group (CHNG, 45%) to take charge of the project to develop the indigenous and exportable CAP1400 reactor, based on Westinghouse's AP1000. Construction of the first reactor at Shidaowan, Rongcheng city, Shandong was to commence in April 2013, for December 2017 start-up. The State Nuclear Power Engineering Company (SNPEC) is doing the engineering under a team from the Shanghai Nuclear Engineering Research and Design Institute (SNERDI), the Shandong Electric Power Engineering Consulting Institute (SEPECI), and the State Nuclear Power Equipment Manufacturing Company (SNPEMC) which will make the components. A 1700 MWe version would be considered. [[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 (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](#)]

CNNC 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 Group

The China Nuclear Engineering & Construction Group (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](#) and is also responsible for the construction (including that in Pakistan), equipment procurement, trial testing and operational maintenance of nuclear power plants. It has five subsidiaries including China Nuclear Industry Huaxing Construction Company and China Nuclear Industry No.23 Construction Company (CNI 23) for civil engineering, China Nuclear Industry No.5 Construction Company (CNI 5) for installation, and Beijing Huahui Technical Development Co. for software. [\[Index\]](#)

China Nuclear Industry Huaxing Construction Co

China Nuclear Industry Huaxing Construction (HXCC, www.cnhxcc.com.cn) is one of five subsidiaries of CNECC and is a major construction and engineering company which is setting up a CNY 1 billion module base plant near Nanjing in eastern China for pre-assembled structural and equipment modules for Westinghouse AP1000 reactors. It claims involvement with most of China's nuclear plant construction, notably Lingao Phase 2, Hongyanhe, Ningde, and Yangjiang (all CPR-1000). CGNPC subsidiary China Nuclear Power Engineering Group Co. Ltd (CNPEC) holds a 13.7% share of HXCC. [\[Index\]](#)

China Nuclear Industry No.5 Construction Co

China Nuclear Industry 5th Construction (CNI 5) is an installation construction company involved with HXCC in the Haiyang and Sanmen AP1000 projects, and also for Chashma 3 & 4 in Pakistan. [\[Index\]](#)

China Nuclear Industry No.23 Construction Co

China Nuclear Industry 23rd Construction (CNI 23) is a major engineering company concerned with the installation of nuclear power plants. It had a major role in all CPR-1000 projects and Qinshan

phase III, and is preferred contractor for CGNPC. [[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 Taohuaijiang. [[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 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.) Nuclear projects being undertaken by CNPE included: EPC contracting of Fuqing, Taohuaijiang, and Xudabao nuclear power projects. [[Index](#)]

China Zhongyuan Engineering Corporation

This engineering subsidiary of CNNC is the general contractor for the Chashma 3 & 4 nuclear power plant in Pakistan. The project also involves China Nuclear Industry No.5 Construction Company (CNI 5), which helped build units 1 & 2 at the plant. [[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 a project designer and contractor for conventional islands of power plants. It is working with SNERDI on designing Taohuajiang as well as 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), through SDIC Electric Power, in 2009 secured a 10% share of the Xudabao nuclear power project at Huladao (Hulu Island) in northeast 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 (CNI 23, 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. It will also be responsible for CAP1400 components. (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.* It will also be responsible for the CAP1400 project. [[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 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. Siemens has a 40% share in a joint venture with Shanghai Electric to build steam and gas turbines and generators - Shanghai Electric Power Generation Equipment Co Ltd (SEPG). [[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 (90%) in 2004 with Shenzhen Nengzhahui (10%) and plays the leading reactor engineering role in CGNPC. (NB: distinguish from CNNC's China Nuclear Power Engineering Corporation, CNPE.) China Nuclear Power Design Co is a 60% subsidiary (with 40% Guangdong Electric Power Design Institute, GEDI), established in 2005 and 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. CNPEC holds 13.7% of Huaxing and wholly owns Engineering Technology Co (Shanghai). [\[Index\]](#)

Hubei Nuclear Power Equipment Co

Hubei Nuclear Power Equipment Co was founded in August 2010 by subsidiaries of SNPTC, CGNPC and China Shipbuilding Industry Co (Shandong Nuclear Power Equipment Manufacturing Co, China Guangdong Nuclear Power Engineering and Wuchang Ship Heavy Industries, respectively) to fabricate large modules for AP1000 reactors inland for Hubei Nuclear Power Co. [\[Index\]](#)

China Institute for Radiation Protection

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

Chinese Nuclear Society

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

China Guangdong Nuclear Power Simulation Technology, China Nuclear Power (Beijing) Simulation Technology Corporation

China Guangdong Nuclear Power Simulation Technology Co. (CNPSC), Ltd, and China Nuclear Power (Beijing) Simulation Technology Corporation Ltd build simulators for training nuclear power plant operators, e.g. Ningde, Yangjiang, HTR-PM. [\[Index\]](#)

Owner companies and 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 commercial 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 & Guangshui, Hubei

Hubei Nuclear Power Co Ltd was set up by CGNPC and Hubei Energy Group in June 2008 to build the large Xianning AP1000 plant at Dafan in Xishui county, Xianning city, Hubei province. The first two phase involve four reactors, the third phase, four more. The same company is reported to be planning a four-unit AP1000 plant at Guangshui city in the northeast of the province. [[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 or Wenergy Co Ltd (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, now Huaneng Power International (HPI) in particular, 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. [\[Index\]](#)

Taohuajiang

The Hunan Taohuajiang Nuclear Power Co Ltd was set up in February 2007 by CNNC to build the Taohuajiang 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, Xudabao

Liaoning Nuclear Power Co Ltd was set up by CPI in March 2009 to build the Xudabao (Xudapu) nuclear power plant (6 x 1000 MWe) on Hulu Island in Liaoning province with 20% equity from China Datang and 10% from SDIC. Construction was expected to start in 2009, for operation in 2014. Total cost is expected to be over CNY 90 billion. [[Index](#)]

Huaneng Shidaowan

The Shidaowan 210 MWe HTR-PM demonstration plant is being built by Huaneng Shidaowan Nuclear Power Co. Ltd (HSNPC) 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%. Chinergy is also involved in the project, as main contractor for the nuclear island. [[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). None of these have NNSA permission to construct or operate nuclear plants. 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](#)]

Sanming

In April 2010, CNNC established Sanming Nuclear Power Co Ltd as a joint venture company with the Fujian Investment & Development Corp and Sanming municipal government, CNNC retaining a majority stake. CIAE and CNEIC had signed the agreement with Russia's Atomstroyexport for the two BN-800 fast neutron reactors in October 2009. [[Index](#)]

Yanjiashan

In August 2009, CNNC (51%) signed a joint venture agreement with Jiangxi Ganneng Co. Ltd and Jiangxi Ganyue Expressway Co Ltd (49% between them) setting up Jiangxi Nuclear Power Co to build the Wan'an Yanjiashan nuclear power project at Ji'an in Jiangxi province. [[Index](#)]

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China Guangdong Nuclear Power Simulation Technology
China Guodian Corporation
China Huaneng Group
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1. See webpage on China Nuclear International Uranium Corporation on CNNC website (www.cnncc.com.cn) [[Back](#)]