



# 中国核电中长期发展规划的编制与进展

## Preparation and Progress of China Nuclear Power Mid- and Long-Term Development Plan

简靖文  
中国核电技术装备走出去产业联盟  
副秘书长

JIAN Jingwen  
Deputy Secretary-General  
China Nuclear Energy International Development Alliance

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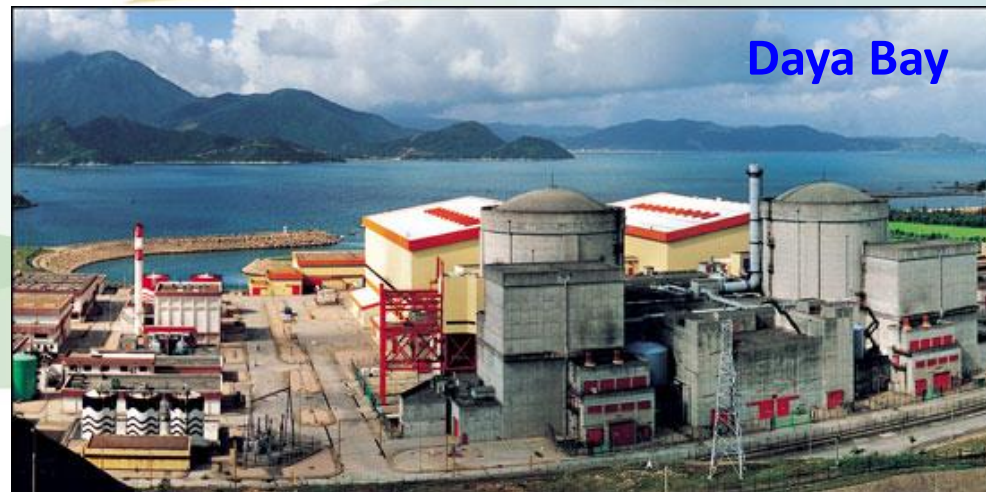
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# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

- China's nuclear power industry officially started from Feb 8 1970, when the government decided to build the 1<sup>st</sup> nuclear power plant – Qinshan NPP.  
中国核电从1970年2月8日正式起步，决定建设中国第一座核电站--秦山核电站
- Qinshan Phase I started construction in 1985.  
秦山一期1985年开工
- Introduce French technology to construct Daya Bay NPP.  
引进法国技术，建设大亚湾核电站
- Put forward the principle of “developing nuclear power moderately”.  
提出适度发展核电的方针



# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

By the end of 2004, China had 6960MW nuclear power installed capacity in operation, 2120MW under construction.

到2004年底，运行核电装机容量696万千瓦，212万千瓦在建。

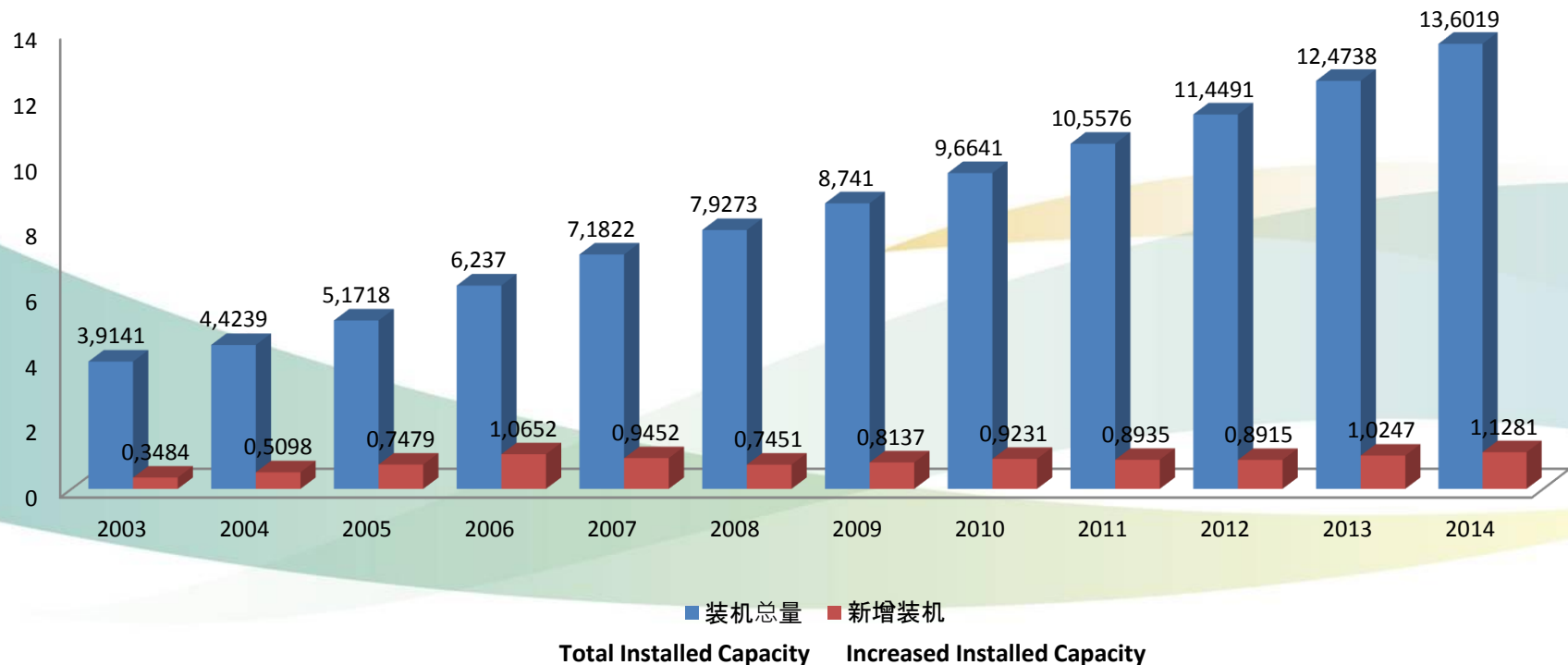


# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

- From 2003, power generation capacity has increased rapidly, China needs to develop nuclear power to secure the power supply.

2003年起，发电装机快速增加，保障能源供应需要发展核电。





# 1. Compilation of the Nuclear Power Development Plan

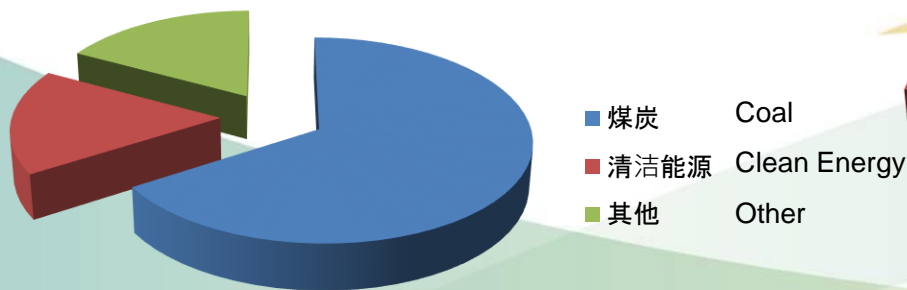
## 核电发展规划的编制

- Coal occupies high percentage in China's energy and electricity consumption, causing high pressure to production, transportation and environmental protection.

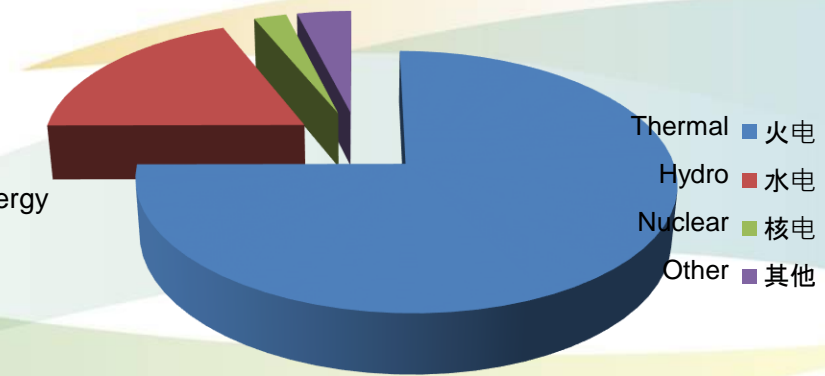
煤炭占能源和电力消费比例高，生产、运输和环保压力大

- Adjusting China's energy structure needs the development of nuclear power.

调整能源结构需要发展核电



2014年中国能源消费构成



2014年中国发电量构成

# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

In 2004, Chinese government proposed the principle of “actively developing nuclear power”, when China is able to actively move forward the construction of nuclear power based on following fundamental conditions:

**2004年，中国政府提出积极发展核电的方针，这时已经具备积极推进核电建设的基础条件：**

- A generally completed nuclear power industry system initially formed.  
初步形成基本完整的核电工业体系
- The capacities of engineering, equipment manufacturing, construction and operation management initially established.  
初步具备设计、设备制造、工程建设和运行管理能力
- Self-designed 300MW and 600MW reactor, partly capable of 1000MW reactor design  
自主设计30万千瓦、60万千瓦，部分掌握100万千瓦设计能力
- Capable of producing 300MW and 600MW complete set of equipment, and capable of manufacturing most of NI and CI equipment.  
可以生产30万和60万千瓦成套设备；具备大部分核岛设备和常规岛设备加工能力

# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

- Established a relatively completed nuclear fuel manufacturing system  
建立了较完整的核燃料加工体系
- Initially formed the nuclear safety regulation system, and the “Central Government – Local Government - Enterprise” three-tier nuclear emergency system.

初步建立核安全法规体系和中央、地方、企业三级核应急体系

- Established the nuclear safety regulation organization which is independent of development organization

建立了独立于发展部门以外的核安全监管机构

- Trained a batch of nuclear power talents

有一批核电人才队伍

- Reserved a lot of sites with good condition

储备了一批条件较好的厂址



# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

March 2006, “Nuclear Power Mid- and Long-Term Development Plan (2005-2020)” (hereafter referred to “Plan”) was approved in principle. Oct 2007, the Plan was approved and officially issued.

2006年3月，《核电中长期发展规划（2005-2020年）》（简称规划）原则通过；  
2007年10月，批准后正式发布

### Main Objectives:

#### 主要目标:

- “Actively Promote Nuclear Power Construction”  
“积极推进核电建设”
- To achieve the self-reliance of engineering design, equipment manufacture, construction, and operation management of advanced PWR, and to establish a relatively completed self-reliant nuclear power industry system.  
实现先进压水堆核电站工程设计、设备制造、工程建设和运营管理的自主化，形成比较完整的自主化核电工业体系
- To have the comprehensive capacity of mass construction of NPP, increasing the nuclear power ratio.  
形成批量化建设核电站的综合能力，提高核电比重

# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

- **Nuclear power construction scale** to reach 40GW installed capacity in operation and about 18GW under construction by 2020.

**建设规模**，至2020年，运行4000万千瓦，在建1800万千瓦左右。

- **Operation and nuclear safety**, ensure the safe and reliable operation of the existing NPPs, their main operation indexes to reach WANO top level. The main design indexes of those new projects starting construction before 2020, to approach or reach URD or EUR equivalent requirements.

**运行及核安全**，确保已投运机组安全可靠运行，主要运行指标达到WANO先进水平。2020年前新开工机组主要设计指标接近或达到URD或EUR同等要求。

- **Construction**, to improve project management capacity, further reduce the construction cost.

**工程建设**，提高工程管理水平，进一步降低造价。

- **Economy**, on the basis of ensure safety and reliability, to achieve a competitive nuclear on-grid price compared with the desulfurization coal-fired price in the same region.

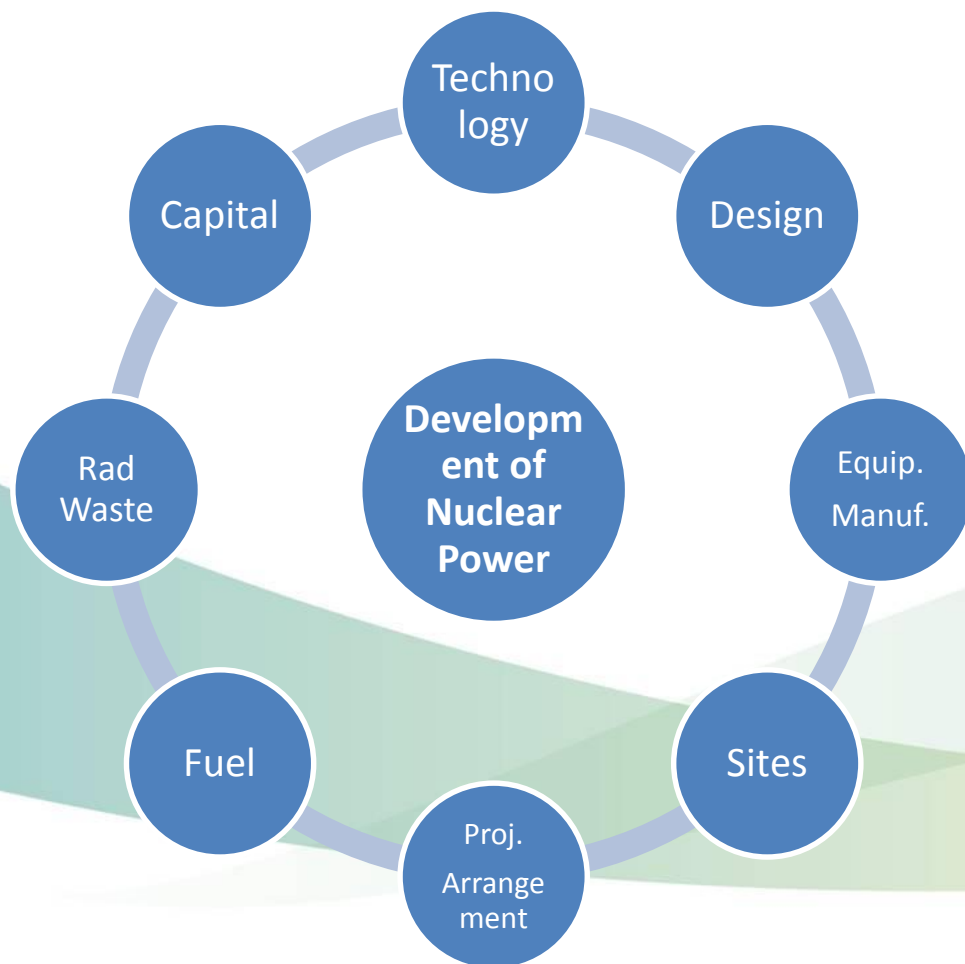
**经济性**，在确保安全性和可靠性的基础上，实现核电上网电价与同地区脱硫燃煤电厂相比具有竞争力。

# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

### Main Contents of the Plan

#### 规划的主要内容



### Safeguard Measures

#### 保障措施

Promote system reformation  
推进体制改革

Strengthen equipment R&D  
加大设备研发

Complete safety system  
完善安全体系

Speed up talent training  
加快人才培养

Tax  
税收

# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

Oct 2012, “Nuclear Power Mid- and Long-Term Development Plan (2011-2020)” (hereafter referred to “Modified Plan”) was approved.

2012年10月，《核电中长期发展规划（2011-2020年）》（简称调整规划）通过。

- Develop nuclear power with high efficiency on the basis of ensure safety  
在确保安全的基础上，高效发展核电
- Add requirement on the measures to response severe accidents and natural hazard.

增加对严重事故和自然灾害的应对措施的要求

- By 2020, the nuclear power installed capacity in operation to reach 58GW, under construction of 30GW.

到2020年核电机组投产5800万千瓦、在建3000万千瓦

# 1. Compilation of the Nuclear Power Development Plan

## 核电发展规划的编制

The total of operational and constructional nuclear power installed capacity will reach 88GW by 2020. By 2030, the operational capacity will reach 150GW, constructional capacity will reach about 50GW.

2020年运行和在建核电装机达到8800万千瓦；2030年达到运行1.5亿千瓦、在建5000万千瓦左右；

年份 (Year)	在运装机（万千瓦） Operational Installed Capacity (10MW)	当年投产（万千瓦） Operational Capacity Each Year (10MW)
2015	2831	821
2016	3678	847
2017	4635	957
2018	4747	112
2019	4855	108
2020	5301	446



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3. **Summary**  
**小结**

## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

- The operational installed capacity rapidly increasing, the construction scale ranking the 1<sup>st</sup> in the world.

在运规模快速增加，在建规模世界第一

- The self-R&D and design capacity rapidly improved.

自主研发、设计能力快速提升

- The equipment manufacture system has formed.

装备制造已成体系

- Top level construction ability

一流的建设能力

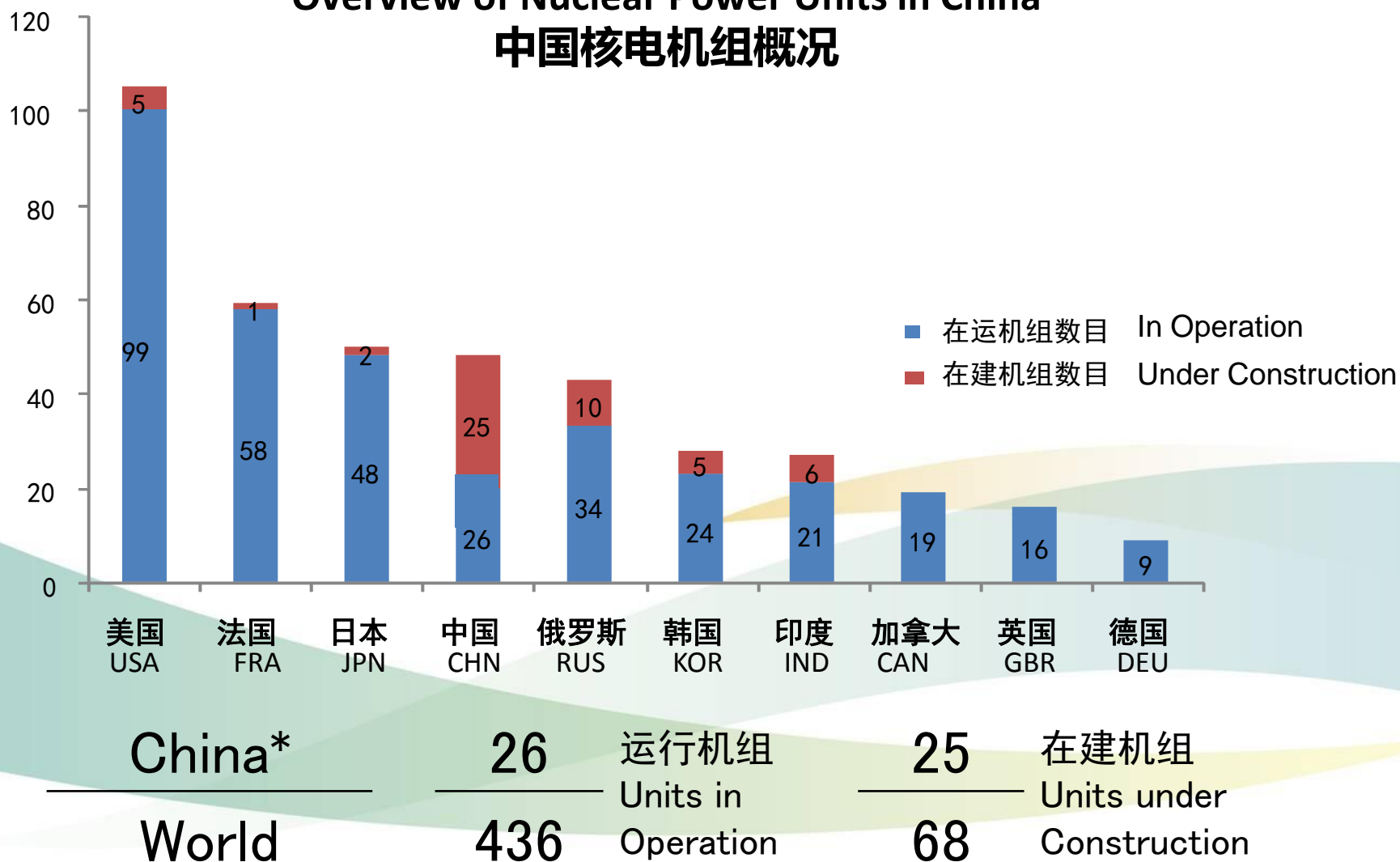
## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

The operational installed capacity rapidly increasing, the construction scale ranking the 1<sup>st</sup> in the world  
在运规模快速增加，在建规模世界第一

- ✓ Operational Units: 26 Units, 24.42GW  
在役机组：26台、2442万千瓦  
24 units of which are PWRs, while the other 2 units are CANDUs  
其中24台压水堆，2台重水堆
- ✓ Under Construction: 25 Units /27.44GW  
在建机组：25台、2744万千瓦  
1 HTGR and 24 PWRs, PWR includes 4 AP1000s and 2 EPRs  
除1台高温气冷堆外，全部为压水堆，其中4台AP1000，2台EPR
- ✓ In 2014, the nuclear power generation was 130.6 TWh, accounting for 2.35% of the total electricity power generation.  
2014年核电发电量1306亿千瓦时，占总发电量2.35%。

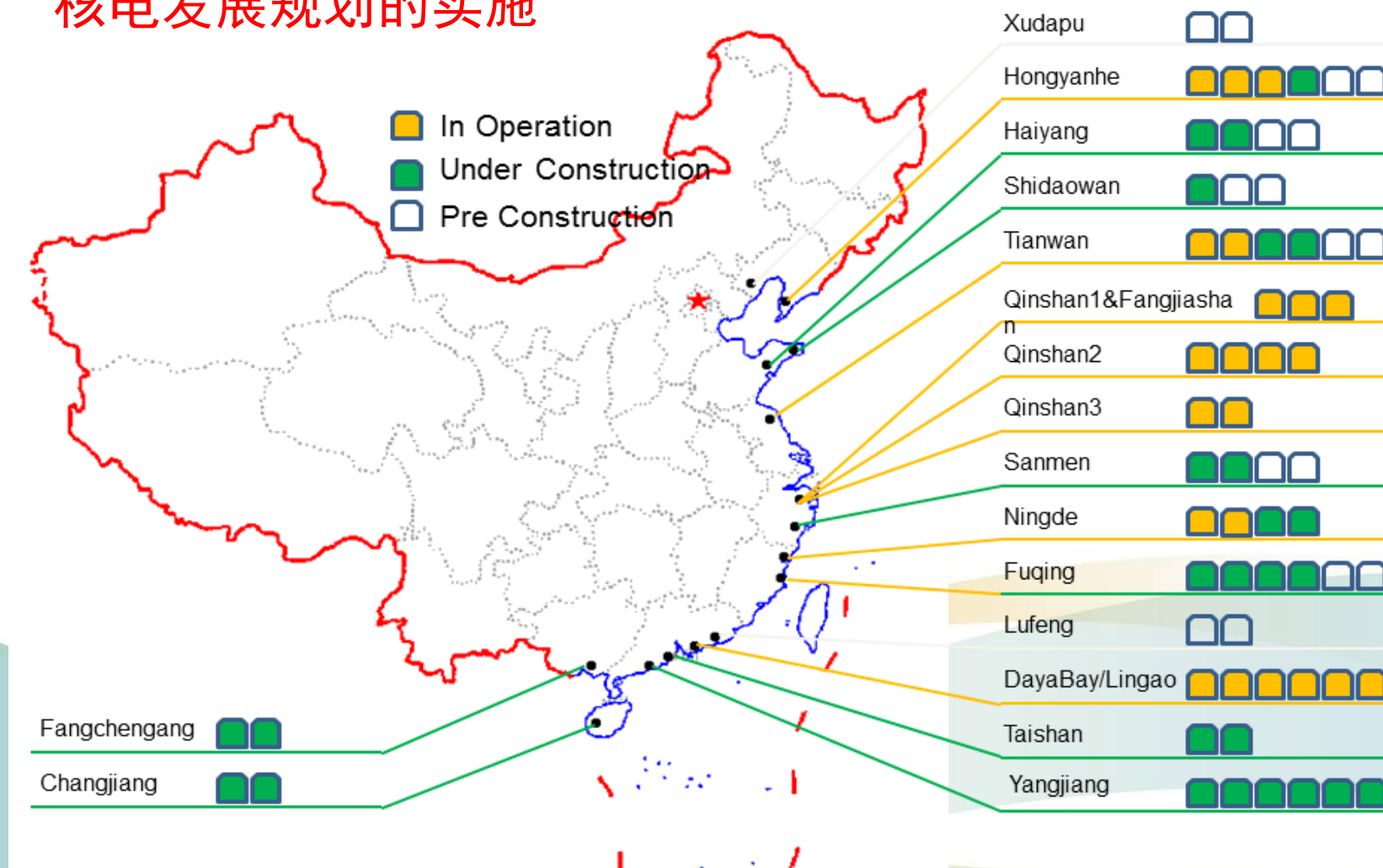
## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

Overview of Nuclear Power Units in China  
中国核电机组概况



•Only in China Mainland, nuclear power units in Chinese Taipei are not included.

## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施



China have 26 nuclear power units under operation ( 24.4Gwe ) , 25 nuclear power units under construction ( 28Gwe ) and 16 in pre-construction now



## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

**The self-R&D and design capacity rapidly improved  
自主研发、设计能力快速提升**

May 2015, Hualong 1 Project started construction in Fuqing, Fujian.

华龙一号示范工程今年5月于福建福清开工



CAP1400 Project has completed site preparation work, is planned to start construction at the end of 2015.

CAP1400示范工程已做好厂址准备，  
预计年底开工建设



## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

HTGR demonstration plant started construction at the end of 2012  
高温气冷堆示范电站2012年底开工建设

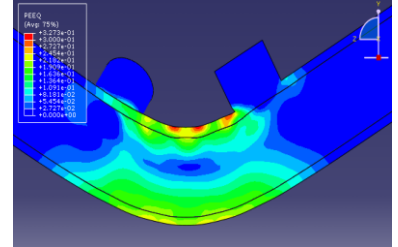




## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

### Characteristics of Supply Chain in China 中国的产业链特点

- Mature technology and process (over 30 years experience)  
成熟的技术和工艺 ( 30余年经验 )
- Top-level hardware and facilities  
一流的硬件及设施
- International QA system and standard (ASME/RCC/IEEE)  
国际QA体系和标准 ( ASME/RCC/IEEE )
- Sufficient capability for 6-8 sets NPP with price advantage  
具备每年建造6-8台核电站的能力，具有价格优势



## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

### China's capability of PWR complete set of equipment manufacture 中国具备压水堆核电机组成套设备的制造能力

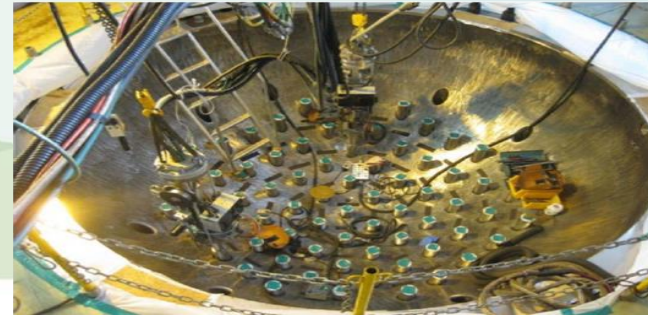
- Chinese equipment manufacture companies, such as First Heavy, Second Heavy, Harbin Electric, Dongfang Electric, and Shanghai Electric, are capable of manufacturing more than 10 set of equipment.
- 一重、二重、哈电集团、东方电气、上海电气等装备制造企业具备年产10台套以上的核电机组能力。



SG组装工作  
SG assemble and install



汽轮机叶片制造  
Turbine blade manufacture



顶盖 焊接控制棒驱动机构  
Coping of control rod drive line



## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

### China's Capability of Equipment Manufacture 中国装备制造能力



整锻低压转子

The whole forging low-pressure rotor



SG水室封头

SG canal head



压力容器顶盖

Pressure vessel head



三代核电主管道

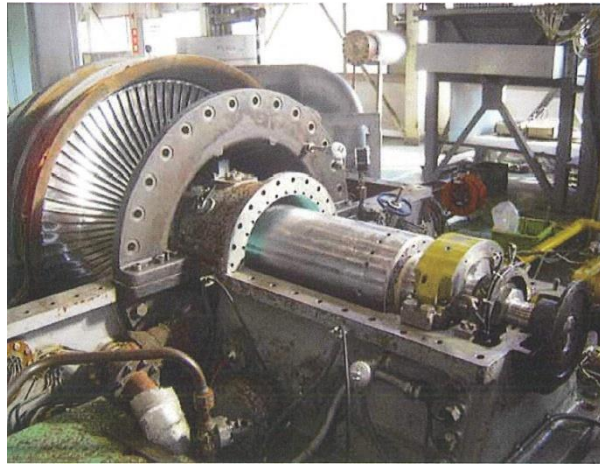
The generation III reactor coolant piping





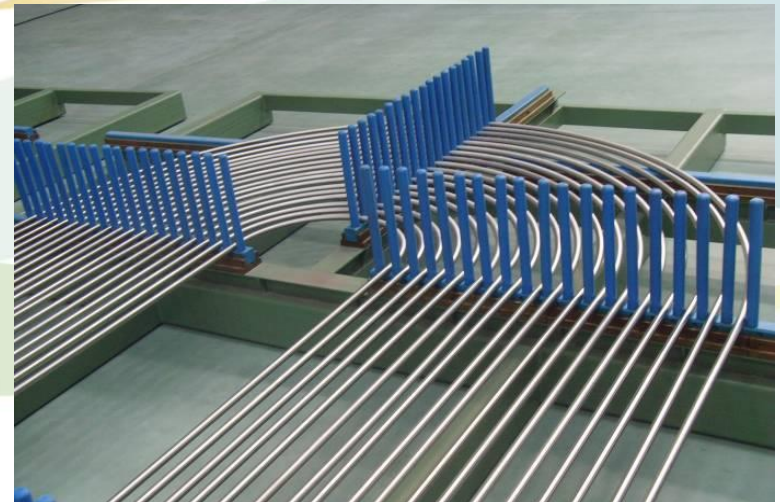
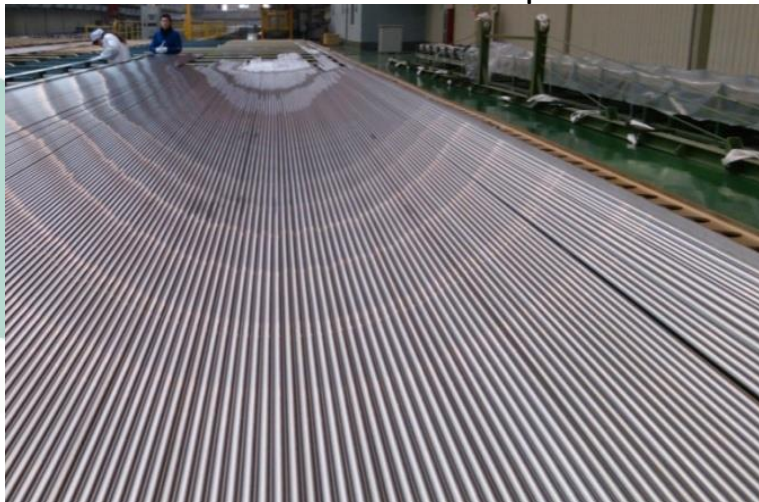
## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

### China's Capability of Equipment Manufacture 中国装备制造能力



核电汽轮机

Nuclear power steam turbine



U型管

U type pipe

## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施

30 consecutive years of nuclear power construction experiences  
具有连续三十年核电建设经验





## 2. Implementation of the Nuclear Power Development Plan 核电发展规划的实施


Mature construction technology  
成熟的建设技术

- ✓ Large volume concrete placing  
大体积混凝土浇注
- ✓ Containment dome lifting  
安全壳穹顶吊装
- ✓ NI shell module construction  
核岛筒体模块化施工



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### 3. Summary

#### 小结

- Chinese government issued the Nuclear Power Development Plan.  
中国政府颁布了核电发展规划
- China has a self-developed and introduction-absorption-renovation combined Gen III nuclear power technology.  
中国具有自主开发和引进消化吸收再创新相结合形成的自主三代核电技术
- China's nuclear power equipment manufacturing capability and construction capability are able to satisfy the demand of nuclear power development.  
中国的核电设备制造能力，建设能力能够满足核电发展的需要
- Chinese government actively promote the development of nuclear power with high efficiency.  
中国政府积极推动核电的高效发展
- Chinese government supports Chinese nuclear power companies and financial organizations to participate in the global nuclear power development.  
中国政府支持中国核电企业和金融机构参与世界核电的发展



**Thank you for your attention!**