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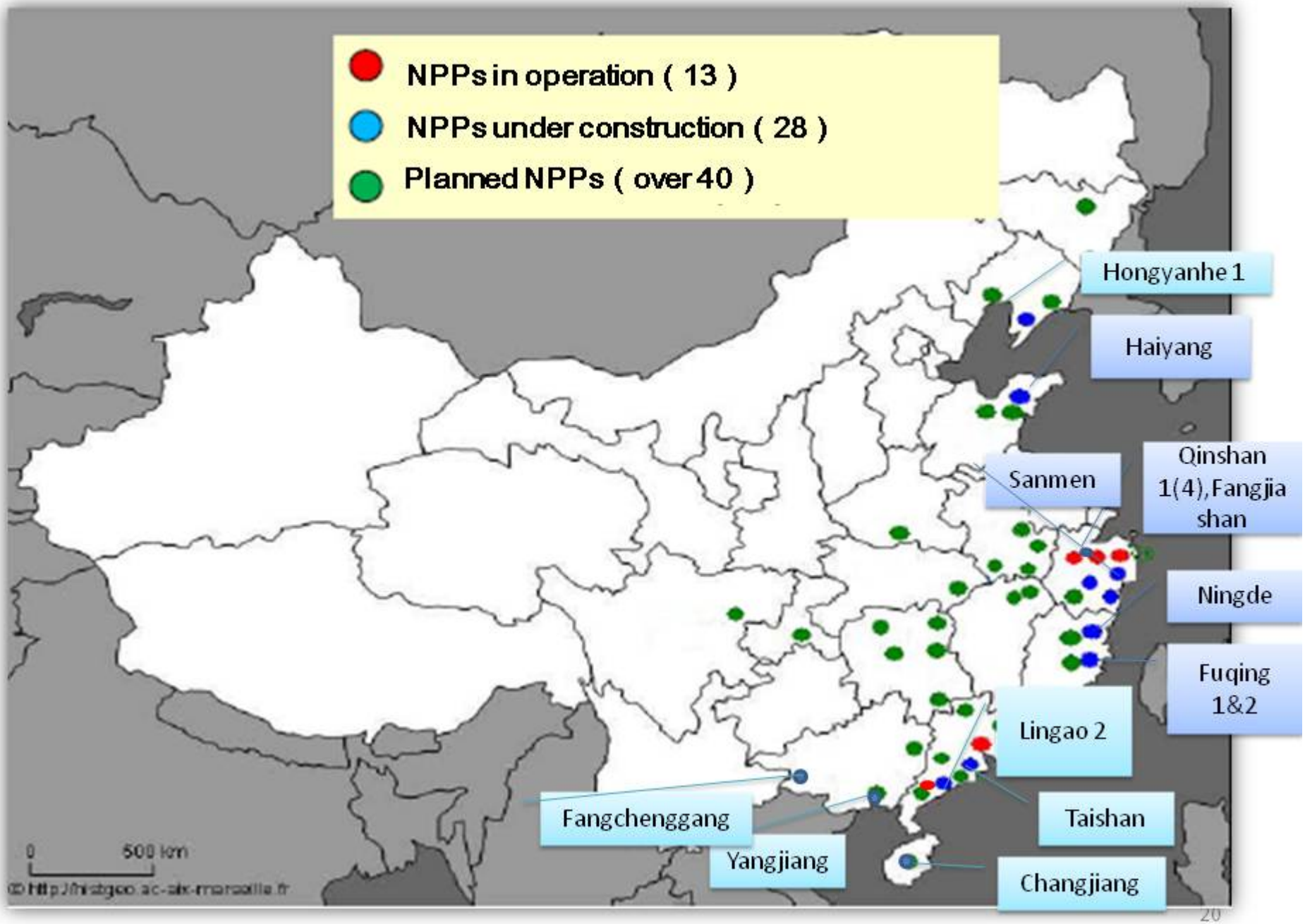
# Cooperation Opportunities in Nuclear Technologies in China

# Agenda

- Main Stakeholders
- Market opportunities
- Joint efforts in the International Market
- Opportunities of the localization
- The Chinese equipment manufacturers
- China Nuclear Base in Zhejiang
- List of NPP projects in China


NPPs in operation ( 13 )
NPPs under construction ( 28 )
Planned NPPs ( over 40 )
Hongyanhe 1
Haiyang
Sanmen
Qinshan 1(4), Fangjia shan
Ningde
Fuqing 1&2
Lingao 2
Taishan
Changjiang
Yangjiang
Fangchenggang
0
500 km

# Main Stakeholders- Holdings and Operators

- China National Nuclear Corporation CNNC
- China Guangdong Nuclear Power Corporation CGNPC
- State National Power Technology Corporation SNPTC
- China Power Investment Corporation CPIC
- Huaneng Power HPC
- Taishan Nuclear Power Joint Venture Company TNPJVC
- In the waiting list: Datang, Huadian, Guodian

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# Main Stakeholders- EPC

- China Nuclear Power Engineering CNPE
- China Guangdong Nuclear Power Engineering Company CNPEC
- State Nuclear Power Engineering Company SNPEC
- China Institute of Atomic Energy CIAE
- Chinergy (CNEC+Tsinghua Holding Group, +CGNPC 15%)

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# Main Stakeholders- Design and Research

- Shanghai State Nuclear Engineering Research and Design Institute SNERDI
- China Nuclear Power Engineering Company CNPE
- China (Guangdong) Nuclear Power and Design Company CNPDC
- China (Guangdong) Nuclear Power Research Institute CNPRI
- Nuclear Power Institute of China NPIC
- Institute of Nuclear and New Energy Technology INET

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# Market Opportunities 1

- SAMG development and research in spent fuel pool severe accident and the development of specific SAGs in SAMG, which is a requirement of NNSA.
- Emergency procedures upgrade from EOP(event-oriented procedures) to SOP(state-oriented procedures), implementation of station black out devices and etc., each of these projects will be at least 10M RMB.
- Isotopes production for nuclear medicine (CIAE has 75% of the market).

# Market Opportunities 2

- The AP1000 is a key technology which requires large support from foreign companies.
- The heavy forging is not at international level.
- The equipment manufacturers cannot match the purchase orders, in particular for Generation 3 NPP.
- Sales of software for training EPC companies.
- Local companies from other industries (oil, aerospace) will enter the nuclear market.
- Involvement in the reprocessing plant.

# Join Efforts in the International Market

- CGNPC will sell its NPP in South East Asia and East Europe
- CNNC will sell its NPP in Middle East, Africa, and South America
- SNPTC will sell the CAP1400 as competitor of Areva, Rosatom, AECL and Kepco.
- Huaneng Group plans to sell the HTR to any country which is looking for heat and energy combined at low cost.

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# Opportunities of the Localization

- Produce and export to international market in order to obtain the HAF 601
- Direct access to the manufacturers
- Reliable partner of the EPC companies
- Major Operators, such as EDF and soon Tractebel source for billions of Euro of equipment in China.
- China creates the first Nuclear Industrial Base

# The Chinese Equipment Design and Manufacturers

- 188 local companies, including 13 JV and 7 WFOE. All the the Chinese part of the JV is often a state owned company
- 90 have design capacity
- 7 have competence in Installation and NDT
- Only 6 Manufacturers have ASME certification (17 ASME certifications in China).
- ~670 HAF 601 (vs. ~260 HAF 604 for foreigners)

# China Nuclear Power Base in Zhejiang

- Zhejiang is the cradle of China's Nuclear Power: In 1982, the first domestic nuclear power station-QinShan 1 was launched in Zhejiang.
- Over the last 20 years, Zhejiang has trained a large number of nuclear engineers and professionals.
- Through long-term cooperation with CNNC, Zhejiang will be the major storage location for equipment and materials for China's nuclear power stations.

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无锡
Wuxi
太湖
Taihu Lake
苏州
Suzhou
虹桥机场
Hongqiao Airport
上海港
Shanghai Port
上海
Shanghai
浦东国际机场
Pudong Int'l Airport
湖州
Huzhou
杭州湾大桥新区
Hangzhou Bay Great Bridge New Zone
嘉兴
Jiaxing
沪杭磁悬浮
嘉兴站
Jiaxing Station of
Maglev Train
金山
Jinshan
大小洋山港
Yangshan Port
乍浦港
Zhapu Port
沪杭高速公路
Shanghai-Hangzhou
Expressway
杭浦高速公路
Hangzhou-Pudong
Expressway
海盐
Haiyan
杭州湾跨海大桥
Hangzhou Bay
Cross-sea Bridge
杭州
Hangzhou
慈溪
Cixi
绍嘉跨江大桥
Jiaxing-Shaoxing
Cross-river Bridge
北仑港
Beilun Port
萧山国际机场
Xiaoshan Int'l Airport
宁波
Ningbo
杭甬高速公路
Hangzhou-Ningbo
Expressway
宁波国际机场
Ningbo Int'l Airport
1小时经济圈
One hour's economic circle

# Nuclear Power Plants (NPP) in Operation in China

| 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, 2007 |
| Ling Ao Phase II, 1 | Guangdong | 1037 MWe | PWR (CPR-1000) | CGNPC | Sept 2010 |
| Total: 13 | | **10,234 MWe** | | | |

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# NPPs 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 |

*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 31 December 2010, 27 under construction: 29,790 MWe; 50 planned: 57,830 MWe (gross).*

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| Plant | Province | MWe gross | Reactor model | Project control | Construction start | Operation |
|---|---|---|---|---|---|---|
| **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 | **7/10**, 2011 | 7/15, 5/16 |
| **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 |
| **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 |
| **Taohuajiang 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 | 9/11, ? | |
| **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? | |

| Plant | Province | MWe gross | Reactor model | Project control | Construction start | Operation |
|---|---|---|---|---|---|---|
| **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 3&4** | Jiangsu | 2x1060 | VVER-1000 (AES-91) | CNNC | 12/12, 8/13 | |
| **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<br>32x1250<br>2x1060<br>2x1200<br>2x1770<br>2x880<br>3x650<br>1x210 | | | | |
| **Total: 77** | | **87,620 MWe** | | | | |

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# Thank you

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