Nuclear Power in China and First AP1000 Nuclear Power Projects

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Nuclear Power Plants in China
Nuclear Power Plants in China

From 1970 to 2012


- In 1985, the construction of China’s first NPP started.

- As of 2012, 15 units of 12.5GWe in operation accounts for 1.1% of China’s total installed capacity and 30 Units of 32.7GWe under construction.
### Nuclear Power Plants in China (Cont.)

#### 15 Units in Operation in China

<table>
<thead>
<tr>
<th>NPP</th>
<th>Reactor Type</th>
<th>Capacity (MWe)</th>
<th>Design</th>
<th>COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qinshan I</td>
<td>PWR</td>
<td>1 × 310</td>
<td>China</td>
<td>1994</td>
</tr>
<tr>
<td>Qinshan II-A</td>
<td>PWR</td>
<td>2 × 650</td>
<td>China</td>
<td>2002, 2004</td>
</tr>
<tr>
<td>Qinshan II-B</td>
<td>PWR</td>
<td>2 × 650</td>
<td>China</td>
<td>2010, 2011</td>
</tr>
<tr>
<td>Qinshan III</td>
<td>HWR\text{CANDU6}</td>
<td>2 × 700</td>
<td>Canada</td>
<td>2002, 2003</td>
</tr>
<tr>
<td>Daya Bay</td>
<td>PWR\text{M310}</td>
<td>2 × 984</td>
<td>France</td>
<td>1993, 1994</td>
</tr>
<tr>
<td>Ling Ao I</td>
<td>PWR\text{M310}</td>
<td>2 × 984</td>
<td>France/China</td>
<td>2002, 2003</td>
</tr>
<tr>
<td>Ling Ao II</td>
<td>PWR</td>
<td>2 × 1080</td>
<td>China</td>
<td>2010, 2011</td>
</tr>
<tr>
<td>Tianwan</td>
<td>PWR\text{VVER}</td>
<td>2 × 1060</td>
<td>Russia</td>
<td>2007</td>
</tr>
</tbody>
</table>
Nuclear Power Plants in China

30 Units under Construction in China

- 23 units designed by China
  - 20 × 1080 MW units (PWR\textsubscript{Gen II+})
  - 2 × 650 MW units (PWR\textsubscript{Gen II+})
  - 1 × 200 MW units (HTGR)
- 4 × 1250 MW units (AP1000)
- 2 × 1750 MW units (EPR)
- 1 × 1060 MW unit (VVER)
AP1000 to China
Government’s Decision on Gen III

- A safer and more efficient development of nuclear power.
- To introduce Gen III nuclear power technology to China.
- To speed up China’s NP self-reliance on advanced nuclear power technology through “introduction, assimilation and innovation” path.
Gen III NP Technology to China

A Tendering Org. established for Project Tendering and TT

- May 2003, Tendering Organization established.
- Dec. 2006, Westinghouse Consortium selected as Preferred Bidder.
- Dec 2006, NDRC and DOE signed a **MOU Concerning Cooperation in the Area of Advanced PWR Nuclear Power Projects in China and Related Technology Transfer**.
- May 2007, NNSA and NRC signed a **MOU on nuclear safety cooperation in AP1000 Reactor**.
Gen III NP Technology to China

SNPTC was established on State Council’s decision

- May 2007, SNPTC was established
- SNPTC’s Mission & Role
  - Introduce Gen III advanced NP technology to China.
  - EPC contractor with WEC Consortium for first 4 AP1000 units in China.
  - Organizer for AP1000 Technology Transfer and equipment localization.
  - Develop and build China’s larger Advanced PWR.
First AP1000 Projects under Construction in China
First AP1000 Projects under Construction in China

- SM& HY sites selected to construct 4 AP1000 units as China’s Gen III NP Self-reliance Program Supporting Projects.

- The largest energy technology cooperation project between China and US.
First AP1000 Projects under Construction in China (Cont.)

A passive safety technology and a modular construction project
First AP1000 Projects under Construction in China (Cont.)

2007, Original Appearance at Sanmen
First AP1000 Projects under Construction in China (Cont.)

Feb. 2008, Excavation at Sanmen
First AP1000 Projects under Construction in China (Cont.)

March 2009, FCD of SM Unit 1
First AP1000 Projects under Construction in China (Cont.)

Dec. 2009, Placement of CVBH at Sanmen
First AP1000 Projects under Construction in China (Cont.)

March 2010, CV First Ring of SM Unit 1 Set
First AP1000 Projects under Construction in China (Cont.)

March 2010, CA01 Module of SM Unit 1 Set
First AP1000 Projects under Construction in China (Cont.)

Sept. 2010, CV 3rd Ring of SM Unit 1 Set
First AP1000 Projects under Construction in China (Cont.)
Main Equipments Installation at Sanmen

- Sept. 2011 RV set
- Dec. 2012 SG 1A set
- Jan. 2013 SG 1B set
- Jan. 2013 Polar Crane set
First AP1000 Projects under Construction in China (Cont.)

June 2012, Simulation of SM Unit 1 to Site
First AP1000 Projects under Construction in China (Cont.)

Jan. 29 2013, CVTH of SM Unit 1 Set
First AP1000 Projects under Construction in China (Cont.)

Different Responsibilities

- **WEC Consortium**: engineering design and partial NI key component supply.

- **Chinese Co-purchaser**: project management, partial NI component supply and site construction.

- **SM/HY Owners**: CI&BOP

- **JPMO and 2 SPMOs** established by SNPTC and WEC Consortium to oversight the works of NI and to interface the CI&BOP.
First AP1000 Projects under Construction in China (Cont.)

Project Management

[Diagram showing the project management structure with flow of management and supply between various stakeholders such as SNPTC, SNPEC, Owners, JPMO/SPMO, NI, WEC Consortium, Non WEC Consortium, Vendors, and Constructors.]
Project Management (Cont.)

NI overall high-level project management
   (design, engineering, procurement, construction, commissioning, start-up)

Develop/maintain the NI Project Schedule &
   Level 1, Level 2 overall schedule

Monitor independently the project
   construction constructor

Develop a procurement team and monitor the
   procurement

Shadow training to local JPMO personnel
   (Locals)
Project Management (Cont.)

Project Review Meeting

- Quarterly - Quarterly Coordination Meeting (face to face).
- Monthly - Site Construction Meeting (each site).
- Monthly - Site Procurement Meeting (each site).
- Monthly - JPMO Staff Meeting.
- Monthly - Consortium Interface Meeting.
Project Management (Cont.)

Implementation of Quality Assurance Program

- Document development
- Implementation
- Verification
- Lesson Learn
First AP1000 Projects under Construction in China (Cont.)

Procurement

A global qualified suppliers chain with component localization is critical to the success of the first AP1000 units.

SNPTC coordinates China’s manufacturers to fabricate and deliver partial key components.
First AP1000 Projects under Construction in China (Cont.)

Procurement (Cont.)

- Within the current state of the art and manufacturing capability/Ensuring availability of qualified suppliers to meet the new design
- Conformance to Standards
  - Get certified
  - Implement program in procedure, work flow
  - Craft people
- Deliver on Quality
  - Meet Standard
  - Consistent with drawings, documentations
- Deliver on Schedule
  Without component delivery on time, the plant can’t be built on time
Procurement (Cont.)

A global qualified supply chain for Gen III built up through first AP1000 projects within 5 years.

79 qualified suppliers with Mechanics, Electric, Instrument, Pump, Valve, Material and Installation covered.
Experiences from the construction of the First AP1000 Projects

- Effective communication
  Effective communication among vendors, licensees and regulator are of great benefit.

- Nuclear safety culture is a must for every manager and every worker of owners/vendors/constructors.

- Adequate completion of design and engineering work prior to start of construction, especially for modular construction project is extremely important.
Self-reliance

Training

- 390,000 man-hours (TT).

- NI design, digital I&C, fuel & material, operation & maintenance, project management, equipment design & manufacturing.

## Self-reliance (Cont.)

### Component Localization

Equipment Supply From China 55% in average and 70% for Haiyang 2#

<table>
<thead>
<tr>
<th>Equipment/Component</th>
<th>SM1#</th>
<th>HY1#</th>
<th>SM2#</th>
<th>HY2#</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCP</td>
<td>US</td>
<td>US</td>
<td>US</td>
<td>US/SHE, HEC</td>
</tr>
<tr>
<td>RPV</td>
<td>Korea</td>
<td>Korea</td>
<td>CHFI</td>
<td>SEC</td>
</tr>
<tr>
<td>SG</td>
<td>Korea</td>
<td>Korea</td>
<td>HEC/ENSA</td>
<td>SEC</td>
</tr>
<tr>
<td>RVI</td>
<td>Korea</td>
<td>US</td>
<td>SEC</td>
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<tr>
<td>CRDM</td>
<td>US</td>
<td>US</td>
<td>SEC</td>
<td>SEC</td>
</tr>
<tr>
<td>IHP</td>
<td>US</td>
<td>US</td>
<td>SDNPC</td>
<td>SDNPC</td>
</tr>
<tr>
<td>Polar Crane</td>
<td>US</td>
<td>TYHI</td>
<td>DHI</td>
<td>TYHI</td>
</tr>
<tr>
<td>Refueling Machine</td>
<td>US</td>
<td>DHI</td>
<td>SEC</td>
<td>DHI</td>
</tr>
<tr>
<td>CV</td>
<td>US/SNPTC</td>
<td>SNPTC</td>
<td>SNPTC</td>
<td>SNPTC</td>
</tr>
<tr>
<td>RCL Pipe</td>
<td>CSIS</td>
<td>CNE</td>
<td>CNE</td>
<td>CSIS</td>
</tr>
<tr>
<td>PRZ</td>
<td>SEC</td>
<td>DEC</td>
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<td>SEC</td>
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<td>CMT</td>
<td>SEC</td>
<td>HEC</td>
<td>SEC</td>
<td>HEC</td>
</tr>
<tr>
<td>RPV / SG / PZR support</td>
<td>CNE / DEC / DEC</td>
<td>CNE / DEC / DEC</td>
<td>CNE / DEC / DEC</td>
<td>CNE / DEC / DEC</td>
</tr>
</tbody>
</table>
Self-reliance (Cont.)

CAP1400 development

CAP1400, a larger passive safety PWR development is progressing.

- Conceptual design completed in 2010.
- Basic design completed in 2011.
- Design review started in Dec. 2012.
- Site for demonstration plant chosen.
Conclusion

- China’s nuclear power development is moving forward.

- Emphasis on a strong nuclear safety culture for the entire industry.

- First AP1000 NPP is a challenge, a process, a commitment, and finally an achievement.

- Partnering for success: his success is my success, and my success is his success.
Thank you!