SEC -- A KEY EQUIPMENTS SUPPLIER IN CHINA FOR NUCLEAR POWER INDUSTRY

- MAY 15-16, 2018
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- SHANGHAI ELECTRIC NUCLEAR POWER GROUP

2017-2018 REGIONAL WORKSHOP SERIES
TECHNICAL & REGULATORY ISSUES FACING NUCLEAR POWER PLANTS
LEVERAGING GLOBAL EXPERIENCE
I. Background & Outlines
SEC: A LARGE DIVERSIFIED EQUIPMENT MANUFACTURING GROUP

**New Energy & Pro-environment**
- Nuclear Equipment
- Wind Equipment
- Pro-environment

**Industrial Equipment**
- Elevators
- Compressors
- Industrial Robots

**High-Efficiency & Clean Energy Equipment**
- Coal-fired Power Generation
- Gas-fired Power Generation
- Transmission & Distribution Equipment

**Modern Services**
- Power Plant Services
- International Trade
- Financing
Nuclear power: A key business in SEC

Qinshan-1 NPP is the first NPP in China in 1980s with the domestic design, manufacture and development. SEC supplied a large number of critical equipment such as Steam Generators, Pressurizer, Reactor Vessel Internal, Control Rod Drive Mechanisms, Turbine-generator Unit and I & C etc. for this project. Since then, nuclear business has been on the way in SEC for more than 30 years.

Major Projects SEC Joined Before A Busy NPP Construction Wave In China Starting In 2007
Due to the latest 30+ years’ development, SEC has become the nuclear equipment supplier with the most extensive coverage of product chain. The technology ranges from 300MW, 600MW to 1000MW of Gen 2+ to Gen 3 types including AP1000, EPR, CAP1400, HPR1000 and 200MW HTR.
ORGANIZATION: 13 SHARE CONTROLLED SUBSIDIARIES AND 2 SHARE HOLDED COMPANIES

Nuclear Power Group
- Shanghai No.1 Machine Tool Works Co., Ltd.
- Shanghai Electric Nuclear Power Equipment Co., Ltd.
- Shanghai Electric-KSB Nuclear Pump & Valve Co., Ltd.
- Shanghai Nuclear Power Technology & Equipment Co., Ltd.
- Shanghai Electric Shanghai Heavy Casting & Forging Co., Ltd.

Power Generation Group
- Shanghai Turbine Works
- Shanghai Generator Works
- Shanghai Power Station Auxiliary Equipment Works
- Shanghai Electric Machinery Co., Ltd
- Shanghai Electric Power Generation Engineering Co.
- Shanghai Electric Power Generation Service Co., Ltd
- Shanghai Blower Works Co., Ltd

Qindao Donka Environmental Protection Engineering-Tech. Co., Ltd.

10% Ownership

40% Ownership

ANSALDO ENERGIA
- ANSALDO Nucleare, Italy
- ANSALDO Nuclear Engineering Service, United Kingdom
Production Line: The most extensive coverage of domestic NPP equipment supply

Nuclear Power Group

Power Generation Group

Other Company

CRDM
Reactor Pressure Vessel
Reactor Vessel Internals
Reactor Coolant Pump
Fuel Handling Machine
Castings & Forgings
Main Pipe
Pressurizer
Steam Generator
Class II & III Pump & Valve
Vessel & Heat Exchanger
Turbine
Generator
Polar Crane
Cable
Motor
Fan
I & C
MSR
Purchasing Order: Covering all Chinese new build NPPs, abroad in steps

<table>
<thead>
<tr>
<th>Pro</th>
<th>Ord</th>
<th>Del</th>
</tr>
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<tbody>
<tr>
<td>RPV</td>
<td>19</td>
<td>8</td>
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<td>SG</td>
<td>80</td>
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<tr>
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<td>CRDM</td>
<td>59</td>
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<td>PRZ</td>
<td>16</td>
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<td>G</td>
<td>27</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>305</strong></td>
<td><strong>165</strong></td>
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</tbody>
</table>

**Domestic marketing (70 units)**

**Offshore marketing (8 units)**

- **Pakistan: 12 sets**
  - Chashma NPP: SG, PZ, RVI, CRDM, T&G
  - Karachi NPP: RVI, T&G

- **South Africa: 6 sets**
  - Koeberg NPP: SG (Replacement)

Data updated by Dec. 30th, 2017
Workload: New Round of Intensive Delivery of Peak Years Upcoming

Data updated by June 30th, 2017
Achievement: Accumulated first-of-a-kind practices contribution to Gen III

| 1st set Worldwide | AP1000 Pressurizer  
|                   | AP1000 Accumulator Tank  
|                   | AP1000 Core Make-up Tank  
|                   | HTR200 Reactor Pressure Vessel  
|                   | HTR200 Reactor Vessel Internals  
|                   | S. D. W  
|                   | Unit 1  
| 1st set Localization | AP1000 Control Rod Drive Mechanism  
|                   | AP1000 Reactor Vessel Internals  
|                   | SANMEN  
|                   | Unit 2  
| 1st batch Localization | EPR Control Rod Drive Mechanism  
|                   | EPR Reactor Vessel Internals  
|                   | TAISHAN  
|                   | Unit 2  
|                   | AP1000 Steam Generator  
|                   | AP1000 Reactor Pressure Vessel  
|                   | HAIYANG  
|                   | Unit 2  
|                   | EPR Steam Generator  
|                   | TAISHAN  
|                   | Unit 2  

www.shanghai-electric.com
Certificates: Commitment to the effectiveness of Quality Assurance System

Design and Manufacturing License of Nuclear Equipment by NNSA

ISO 9001:14001:18001 Certificates

ASME Code Stamps N, NPT

Qualified by:
- CNPEC, CNNC, SNPTC
- AREVA, Westinghouse, ESKOM
# Manufacturing Technology: Various Reactor Types For Gen II to Gen IV

<table>
<thead>
<tr>
<th>NPP Type</th>
<th>Gen</th>
<th>Reactor Type</th>
<th>RPV</th>
<th>SG</th>
<th>PZ</th>
<th>RVI</th>
<th>CRDM</th>
<th>RCP</th>
<th>FHM</th>
<th>T</th>
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<td>CNP650</td>
<td>II plus</td>
<td>PWR (650MW)</td>
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<tr>
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<td>CAP1400</td>
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<td>PWR (1530MW)</td>
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<tr>
<td>HPR1000</td>
<td>III</td>
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<td>GHTR (10MW)</td>
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<td>HTR200</td>
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<td>GHTR (211MW)</td>
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<td>CEFR</td>
<td>IV</td>
<td>SFR (65MW)</td>
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<tr>
<td>CFR600</td>
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<td>SFR (600MW)</td>
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<td>TMSR(2MW)</td>
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</table>

**Note:** Codes and Standards cover RCCM, ASME, EN, GB, etc.
Our Strategy: Famous-brand Integrated Nuclear Equipment and Service Supplier

Collaboration Type

- Technical Transfer
- Technical Support
- Training
- Joint Team
- Outsourcing
- Joint Venture

Integrated Nuclear Equipment and Service Supplier

Nuclear Equip. Fabrication & Testing
Nuclear Equip. Design & Verification

Non-standard NPP system & tool OEM
NPP Maintenance & Upgrading

ILLW cask and spent fuel cask purpose for transport and storage
Radioactive waste management and nuclear facilities decommissioning
II. Manufacturing Capability
Facilities: 2 nuclear bases in need of domestic NPP rapid development

From 2005, SEC has invested 7.2 billion RMB on new building Lingang Base and upgrading Minhang Base to improve its nuclear manufacturing capacity by 2 phases.

Minhang Base (Upgraded) focus on large casting & forging

Lingang Base (New build) focus on critical equipment
Minhang Base: Large forgings to enhance the ability of equipment supply

- 165MN Oil Press
- 0.04M Ton Molten Steel Qty./Year
- 0.09M Ton Forging Qty./Year
- 0.2M Ton Max. Molten Steel
- 700 Ton Max. Double Vacuum Ingot Weight
- 600 Ton Max. Forging Weight
- 250 tons and 630 tons-meter manipulator
- 700 Ton Casting Qty./Year
- 350 Ton Forging Qty./Year
- 450 tons electro slag remelting furnace
- Flange Shell
- Integrated Head
- Tube-sheet
Lingang Base: NI Equipment manufacturing capacity

- **Welding & Measuring Test Center**
- **RCP Functional Test Loop**
- **CRDM Functional Test Loop**

**6 Sets of RPV and SG annually**

**8 Sets of RVI and CRDM and 6 Sets of FHM annually**
Lingang Base: Nuclear Pumps & Valves manufacturing capacity

- RCP full load test bed for both shaft seal type and wet winding type
  - Flow: 2000~30000 m³/h
  - Design Temp.: 350 °C
  - Design Press.: 180 bar
  - Max. Power: 10 MW

- Horizontal & Vertical Class 2,3 Pump test bed
  - Flow: 50-1600 m³/h
  - Design Temp.: 200 °C
  - Design Press.: 20 MPa
  - Max. Power: 1250 kW

Safety Class 1 Pumps
- Flow: unspecified
- Design Temp.: 350 °C
- Design Press.: 180 bar
- Max. Power: 10 MW

Safety Class 2,3 Pumps
- Flow: unspecified
- Design Temp.: 200 °C
- Design Press.: 20 MPa
- Max. Power: 1250 kW

Non-Safety Class Pumps

Valves
- 12 Sets of Class 1 Pumps and 50 Class 2,3 Pumps annually
Lingang Base: Conventional Island Equipment manufacturing capacity

Turbine-Generator Unit 3D Model

Generator

Turbine

Class II & III Vessel

Auxiliary
III. International Cooperation
Partnership: Good foundation to enter into the global nuclear power supply chain
### Mode: Comprehensive Cooperation with technology and project concentrated

<table>
<thead>
<tr>
<th>Global Partner</th>
<th>Type</th>
<th>Project - Product</th>
<th>Duration</th>
</tr>
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<tbody>
<tr>
<td>Westinghouse</td>
<td>TS</td>
<td>Qinshan-II - SG</td>
<td>1996-2000</td>
</tr>
<tr>
<td></td>
<td>OSV</td>
<td>Korea Shin-Kori - Polar Crane</td>
<td>2004-2009</td>
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<td>TT</td>
<td>Sanmen-II, Haiyang-II AP1000 - RVI, CRDM</td>
<td>2008-2014</td>
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<td>AREVA</td>
<td>OSV &amp; TS</td>
<td>Qinshan-II, II Ext. &amp; Lingao-I,II - RVI, CRDM</td>
<td>1998-2010</td>
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<tr>
<td></td>
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<td>Taishan-II EPR - SG, RVI, CRDM</td>
<td>2010-2014</td>
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<tr>
<td></td>
<td>OSV</td>
<td>Qinshan-I RPV Head replacement</td>
<td>2005-2010</td>
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<td>South Africa Koeborg – SG replacement</td>
<td>From 2015</td>
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<tr>
<td>MITSUBISHI</td>
<td>TS</td>
<td>Qinshan-II - RPV</td>
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<td>TT</td>
<td>Sanmen-II, Haiyang-II AP1000 - SG, RPV</td>
<td>2008-2014</td>
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<td>Gensu</td>
<td>JV &amp; TT</td>
<td>Changjiang-I &amp; CAP1400 - RCP</td>
<td>From 2008 until now</td>
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<td>KSB</td>
<td>JV &amp; TT</td>
<td>Fang Chenggang-I,Yangjiang-I,II,III - T-G</td>
<td>From 2008 until now</td>
</tr>
<tr>
<td>Siemens</td>
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</table>
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