Nuclear Industry Localization Practices and Recommendations

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Cape Town

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China Guangdong Nuclear Power Group
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1. Nuclear Power Development in China
2. CGNPC Overview
3. Localization of Nuclear Power Industry in China
4. Ingredients of a Successful Localization Program
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Nuclear Power Development in China

- Strict regulatory process and qualification of nuclear operators and constructors
- 13 units, 9.6GW in operation
- 29 units, 31GW currently under construction; 22GW+ under planning
- Expected total nuclear installed capacity exceeding 70GW by 2020
- Three current approved nuclear power operators:
  - CGNPC (China Guangdong Nuclear Power Group)
  - CNNC (China National Nuclear Corp.)
  - CPIC (China Power Investment Corp.)
China Guangdong Nuclear Power Holding Corporation (CGNPC) is a state-owned enterprise, a clean energy company in nuclear, solar, wind and hydro power generation.

China Nuclear Power Engineering Co., Ltd (CNPEC), a subsidiary of CGNPC, is building 16 nuclear power units with a total capacity up to 17,400MW, which contributes to over 20% of the world’s reactors under construction.
Projects under construction (FCD) | Reactor Type | Units | Unit Capacity
--- | --- | --- | ---
Ling Ao II | CPR1000 | 1 | 1000 MWe
Hongyanhe | CPR1000 | 4 | 1000MWe
Ningde | CPR1000 | 4 | 1000MWe
Yangjiang | CPR1000 | 3 | 1000MWe
Fangchenggang | CPR1000 | 2 | 1000MWe
Taishan | EPR | 2 | 1700MWe
Total | | 16 | 17400MWe

- Planned Installed Capacity to 2030: over 30GWe
- Technologies: CPR1000, AP1000 and EPR
- 6-8 units begin construction every year, with capability to build more than 25 units at the same time

The IRP 2010 is an ambitious and exciting plan. It demonstrates South African’s willingness and determination to develop a clean energy, including nuclear power, and also displays the magnificent goal and prospect of South African nuclear power development in the future.
CGNPC fully understands that a steady localization scheme is necessary for South Africa to build up a self-reliant nuclear industry in the long run, to support the long-term nuclear development program.

CGNPC is willing to be involved in building up the self-reliance in South Africa. CGNPC is willing to share the experience of localization in China.
CGNPC has started the study of South Africa manufacturers, suppliers, contractors and design institutes to have a complete understanding of the local capabilities.

As a result of such study, CGNPC has concluded that the industry in South Africa already has some favourable foundations and conditions necessary for realizing certain kind of equipment localization and engineering self-reliance associated with the nuclear power program.
Localization of Nuclear Power Industry in China

Leading effects of nuclear power on domestic industry

- Material, Metallurgy
- Machinery, Equipment
- Chemical, Environment
- Electronic, Instrumentation
- Digital control, IT System
- Construction, transportation, etc.

High tech
Intensive Industry

Technological Innovation
Localization creates job opportunities

- Nuclear power plant engineering, equipment manufacturing and construction requires large numbers of skilled local staffs.
- During construction of the 4 units, more than 80,000 direct job opportunities will be generated each year due to localization of engineering, procurement, civil work and erection, equipment and materials.
- The design and manufacturing of nuclear equipment represents the most advanced level of manufacturing industry. It will enhance the quality and development of other segments of industry.
Localization of Nuclear Power Industry in China

Component Localization Progress

- Daya Bay: 1%
- Ling Ao I: 30%
- Ling Ao 2: 50%
- Hongyanhe: >70%, >80%
- Ningde: >75%, >85%
 Localization of Nuclear Power Industry in China - How We Did It

- Do a thorough study on domestic manufacturing companies, assess their capabilities and potentials, identify equipment or products could be manufactured by these companies.
- Identify technology upgrading required of local manufacturers and monitoring its progress.
- Impose “Safety & Quality First” nuclear culture to manufacturers. Provide quality assurance training and QA program set up.
- Promote cooperation between local manufacturers and foreign suppliers in technology transfer.
- Create pilot program in offering opportunities for qualified new comers
Localization of Nuclear Power Industry in China - How We Did It

- Institute strong QA-QC program and on-site inspection to assure the quality meeting specifications.
- Establish dedicated localization promotion task force within CGNPC to facilitate the localization program.
- Form industry alliance union with more than 50 manufacturing companies to share the localization experience and serve as a platform for cooperation in technology enhancement and quality improvement to perform joint research and development.
- Provide continued support and training to local manufacturers in QA-QC, codes & standards, design and specifications.
- Establish a qualification center to coordinate testing, qualification, quality control and experience feedback.

- Based on the extensive and deeper insight of domestic manufacturing companies, and the implementation of previous localization, CGNPC formulated the Route Chart and Schedule of Key Equipment & Material Localization which has been defined as a goal of localization for the entire group.
# Route Chart and Schedule of Key Equipment Localization

<table>
<thead>
<tr>
<th>Overall Localization Ratio</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. NI Primary Equipment</td>
<td>60%</td>
<td>70%</td>
<td>75%</td>
<td>80%</td>
<td>85%</td>
<td>90%</td>
</tr>
<tr>
<td>1.1 RPV</td>
<td>70%</td>
<td>80%</td>
<td>85%</td>
<td>85%</td>
<td>87%</td>
<td>88%</td>
</tr>
<tr>
<td>1.2 Steam Generator</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>1.3 Reactor Vessel Internals</td>
<td>70%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2. Large Forging and Key Material</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>30%</td>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>3. Pump &amp; Valve</td>
<td>5%</td>
<td>40%</td>
<td>40%</td>
<td>60%</td>
<td>60%</td>
<td>70%</td>
</tr>
<tr>
<td>3.1 Class 2 Pumps</td>
<td>10%</td>
<td>40%</td>
<td>45%</td>
<td>60%</td>
<td>60%</td>
<td>70%</td>
</tr>
<tr>
<td>3.2 Valve</td>
<td>20%</td>
<td>60%</td>
<td>75%</td>
<td>75%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>4. DCS</td>
<td>60%</td>
<td>75%</td>
<td>85%</td>
<td>85%</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>5. CI Half-Speed T/G</td>
<td>10%</td>
<td>30%</td>
<td>60%</td>
<td>80%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>6. Miscellaneous</td>
<td>30%</td>
<td>45%</td>
<td>60%</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>6.1 Emergency Diesel Generator</td>
<td>0%</td>
<td>70%</td>
<td>85%</td>
<td>90%</td>
<td>95%</td>
<td>100%</td>
</tr>
<tr>
<td>6.2 Nuclear Fuel Handling System</td>
<td>70%</td>
<td>80%</td>
<td>85%</td>
<td>90%</td>
<td>95%</td>
<td>100%</td>
</tr>
<tr>
<td>6.3 Electric Penetration Items</td>
<td>0%</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>6.4 Cable</td>
<td>40%</td>
<td>50%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>6.5 MV&amp;LV Distribution Panel of NI</td>
<td>0%</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>7. Primary Instrument</td>
<td>40%</td>
<td>50%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
</tr>
</tbody>
</table>
中广核设备国产化工作实践
中广核集团CPR1000核电项目
主设备供应及大型铸锻件/核级泵阀联合开发协议
签约仪式
Achievements

- Reactor pressure vessel
- Steam generator
- Pressurizer
- Steam turbine rotor
- Generator
- Moisture separator reheater
Achievements

Reactor Internals
CRDM

Reactor Pressure Vessel

Steam Generator

Fuel Handling Machine
Large Forgings for Key Equipment

- Through a union research and development of forgings of primary equipments among CNPEC and several local heavy machinery company, the heavy forgings could be localized completely since Hong Yan He Project.
Key Equipment

Based on the localization of key equipments in LingAo II, the reactor pressure vessel, steam generator, pressurizer, reactor vessel internals, air cooled condenser, boron injection tank, control rod drive mechanism, main pump, main piping and polar crane since HongyanheProject have been supplied by Chinese manufacturers.
Classified Pumps and Valves

- Through a joint research and development of Class 2 pumps, a critical breakthrough has been achieved in its localization. All the 7 types of class 2 pumps are qualified completely and contracted for supply.
- More than 90% of valves, stop valves and checking valve could be localized. Meanwhile, some of classified safety valve and pneumatic valve, all the butterfly valve and ball valve, 95% diaphragm valve could be produced locally.
Electrical Equipment

- The localization is realized for main transformer, station transformer, auxiliary transformer, and high voltage breaker device, CRDM power supply system and the emergency diesel generator.
Ingredients of a Successful Localization Program

- Strong Government Support
- Long Term Planning
- Adequate Incentives (tax benefit)
- Sustainable Market (scale of economy, fleet of plants)
- Technology Transfer
Ingredients of a Successful Localization Program

- Matching partners
- Nuclear Culture – Safety & Quality First
- Streamlined Licensing Process & Simplified Regulations
- Standardized Codes and Standards (adopt Country of Origin Concept)
Our Approaches and Recommendations

- To offer fleet approach for a sustainable localization program
- To work with local partners to facilitate the process and create win-win opportunities
- Institute technology transfer and training programs to get local partners ready for the project and localization plan
- Pre-qualify potential local suppliers to get Quality Assurance Plan in place for nuclear projects
- Allocate work to local suppliers and contractors
- Maximize local contents to degree possible
- Share our experience in localization program
EPC-Consortium

Consortium Management
Led by CGNPC

CGNPC
Engineering
Design
Procurement
Project management
Start-up

South African Contractor
Construction of CI+BOP+Preliminary works

Chinese Contractor
Civil work of NI & Local participation

Chinese Contractor
Erection work of NI & Local participation

Others
Our Approaches and Recommendations

- Engineering
  - The localization can be achieved by the primary contractor of the plant:
    - To set up a subsidiary/branch company in South Africa by employing local engineers to participate in engineering; or
    - To set up a joint design office together with a South Africa company to perform the design work jointly; or
    - To subcontract part of the design work to an engineering company of South Africa.
## Our Approaches and Recommendations

### Equipment & Material

- The following localization process suggested will be carried out (in percentage):

<table>
<thead>
<tr>
<th>Units</th>
<th>NI nuclear-class equipment</th>
<th>NI Non-nuclear-class equipment</th>
<th>CI equipment</th>
<th>BOP equipment</th>
<th>Bulk material</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>---</td>
<td>10</td>
<td>20</td>
<td>40</td>
<td>80</td>
<td>30 ± 10</td>
</tr>
<tr>
<td>3-4</td>
<td>10</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>90</td>
<td>40 ± 8</td>
</tr>
<tr>
<td>5-6</td>
<td>30</td>
<td>50</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>60 ± 8</td>
</tr>
<tr>
<td>7-8</td>
<td>50</td>
<td>70</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>70 ± 5</td>
</tr>
<tr>
<td>9-10</td>
<td>70</td>
<td>85</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>80 ± 5</td>
</tr>
</tbody>
</table>
Based on studies on South Africa industry, the following scope can be localized for the first two units:

- Centrifugal pumps, Sump pumps;
- Electric overhead traveling cranes;
- Fuel racks;
- Condensate polisher system;
- Demineralized water treatment system;
- Compressed air production system;
- HVAC units;
- Feedwater heaters, Heat exchangers;
- Auxiliary pressure vessel;
- Gate, globe, check valves, Diaphragms valves, Ball valves;
- Instrumentation primary valves;
- Filters;
- Auxiliary transformers;
- Switchgears;
- Cabinets;
- Cables;
- Lighting system;
- Tube fittings;
- Instrumentation;
- Pipe supports;
- Bulk materials.
Civil Work & Erection

- Project Management capability development: CGNPC will transplant the advanced, mature and reliable project management methods to local enterprises in South Africa, to establish a management system integrating the six controls system on cost, quality, schedule, safety, environment and technology. CGNPC will also assist South African local suppliers in developing relevant procedures and management rules to guide the civil works & erection and in establishing an effective experience feedback system.

- Technical skill development: CGNPC is willing to provide unreserved support in developing the technical skills and competence for the South African local suppliers.

- Local supply of construction & erection facilities and tools: The facilities and tools required for construction & erection works could be procured or rented from South Africa.
Our Approaches and Recommendations

- External Funding – Sources of Financing
  - Sino-Africa Development Fund – 1 billion USD on energy projects
  - China Development Bank
  - The Export-Import Bank of China
  - Industrial and Commercial Bank of China (ICBC) – Standard Bank
  - Others
China & South Africa: Partnering for a Successful Nuclear Program