CGN Comprehensive Cooperation Proposal on Nuclear Power Plant Construction in Poland (HPR1000)

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CGN Overviews
CGN

Who are we?

• A leading clean energy provider and server in the world.

• The largest nuclear power enterprise in China, and the third one in the world, with totally installed capacity of 45GWe.

• The largest Nuclear Power constructor in the world, independently developed HPR1000 – Chinese advanced Gen–III nuclear power technology.

• Total asset 100bn $, 40,000 Employees.
Business

“4+X” sectors

Nuclear Power  New Energy  Nuclear Fuel  Finance  X (Nuclear technology …)

3 HK stock listed subsidiaries, 1 A stock subsidiary

CGN Power  1816.HK  CGN New Energy  1811.HK  CGN Mining  1164.HK  CGN Technology  000881.SZ
Achievement in Nuclear Power Plant

Daya bay
2×984MW

Ling’ao NPP phase 1
2×990MW
Ling’ao NPP phase 2
2×1087MW

Taishan NPP
2×1750MW

Hongyanhe NPP phase 1
4×1119MW
Hongyanhe NPP phase 2
2×1119MW

FCG NPP phase 1
2×1086MW
FCG NPP phase 2
2×1180MW

Yangjiang NPP
6×1086MW

Ningde NPP phase 1
4×1089MW

7 units under construction, 21 units in operation
Localization

- More than 30 years experience of NPP localization
- Localization ratio growing from 1% to 100%
02

HPR1000 Technology
Feature

Safe
- Enhanced emergency power & cooling ability based on feedback of Fukushima Accident;
- Combination of active and passive safety systems;
- Complete severe accidents prevention and mitigation measures;

Economic
- Build-up cost is competitive in the similar type of NPPs;
- Taking advantage of China’s batch construction of NPP;

Proven and Approved
- Proven design technology, suitable for existing industry system;
- Demo plant, FCG units 3 &4, to be put into Commercial Operation in 2020;
- GDA & EUR assessment
## Key Parameters

<table>
<thead>
<tr>
<th>Items</th>
<th>HPR1000</th>
<th>URD</th>
<th>EUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDF (Core Damage Frequency), / (reactor·year)</td>
<td>$6.9 \times 10^{-7}$</td>
<td>$&lt; 1 \times 10^{-5}$</td>
<td>$&lt; 1 \times 10^{-5}$</td>
</tr>
<tr>
<td>LRF (Large Radioactive Release Frequency), / (reactor·year)</td>
<td>$7.3 \times 10^{-8}$</td>
<td>$&lt; 1 \times 10^{-6}$</td>
<td>$&lt; 1 \times 10^{-6}$</td>
</tr>
<tr>
<td>Fuel Thermal Margin</td>
<td>$&gt; 15%$</td>
<td>$&gt; 15%$</td>
<td>$&gt; 15%$</td>
</tr>
<tr>
<td>Design availability Factor</td>
<td>92%</td>
<td>$\geq 87%$</td>
<td>$\geq 90%$</td>
</tr>
<tr>
<td>Safe shutdown earthquake</td>
<td>0.3g</td>
<td>0.3g</td>
<td>0.25g</td>
</tr>
<tr>
<td>Operator grace time</td>
<td>$\geq 30$ min</td>
<td>$\geq 30$ min</td>
<td>$\geq 30$ min</td>
</tr>
<tr>
<td>Solid waste, m$^3$/ (year·unit)</td>
<td>$&lt; 50$</td>
<td>$&lt; 50$</td>
<td>$&lt; 50$</td>
</tr>
<tr>
<td>Design lifetime, year</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>
Technical Description

Three trains

- Three independent trains of safety systems, physically separated;
- 3X100% redundant;
- CDF decreased compared with the traditional 2 trains system;
- Better resistance to internal and external hazards.
Technical Description

177 Fuel Assemblies

- 177 Fuel Assemblies (12 ft);
- Fuel thermal margin >15%;
- Lower linear power density;
- Higher core thermal power;
Passive

Secondary Passive Residual Heat Removal System

Ensuring long-term cooling of plant by natural circulation in case all active system disabled.

Passive Reactor Cavity Injection System (IVR)

Ensuring cooling of In-Vessel Retention during severe accidents.
HPR1000 in the world

- Batch construction in China domestic
- 2 units under construction in Pakistan
- To be constructed in British.
Welding Technology in HPR1000
**Welding Technology**

For the quality, cost and schedule consideration, HPR1000 has taken many technologies for plant construction, such as:

- Modular structures.
- Automatic welding of significant piping and stainless steel lining.
- Prefabrication for equipment and piping system.
Welding Technology

For each welding technology, the main work include:

- Quality control management of welding.
- WPS and WPQ management.
- Welder training and certificate.
- Sub-contractor management.
- NDT technology.

CGN has rich experience of NI&CI installation on site.

CGN has plenty of suppliers in China for fabrication and installation.
Harmonized Standards

Code and Standards for HPR1000

• The fabrication and installation of the most component is carried out according to RCCM Code.
• The pre-service inspection (PSI) and in-service inspection (ISI) is executed according to RSEM Code.
• The most supporting standards of RCCM and RSEM code are EN or ISO standards, few of them are NF standards or ASME/ASTM/AWS standards.

Advantages

• The related organizations (Owner, regulator, supplier, etc.) could prepare themselves in a very short time and join the work of HPR1000 construction due to the favorable code and standards.
• The potential enterprises in Poland or EU for manufacturing equipment and products as well as rendering services could join the chain of the qualified suppliers.
# Harmonized Standards

<table>
<thead>
<tr>
<th>Items</th>
<th>Typical Standard for nuclear components fabrication and installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing</td>
<td>ISO9016(impact test), ISO4136(tensile test), ISO5173(bend test),</td>
</tr>
<tr>
<td></td>
<td>ISO9015(hardness test), ISO17639(macroscopic and microscopic test)</td>
</tr>
<tr>
<td>Welding consumables</td>
<td>Carbon steel: EN ISO 2560, AWS A5.1, A5.18, A5.17, A5.20;</td>
</tr>
<tr>
<td></td>
<td>Low alloy steel: AWS A5.5, AWS A5.23;</td>
</tr>
<tr>
<td></td>
<td>Stainless steel: EN12072/AWS A5.9; EN1600/AWS A5.4; EN12072/AWS A5.9</td>
</tr>
<tr>
<td></td>
<td>Nickel based alloy: AWS A5.14/5.11</td>
</tr>
<tr>
<td>Welding procedure</td>
<td>EN ISO 15609</td>
</tr>
<tr>
<td>specifications</td>
<td>.EN ISO 15614</td>
</tr>
<tr>
<td>Welder qualification</td>
<td>EN ISO9606 (manual, semi-mechanical/automatic)</td>
</tr>
<tr>
<td></td>
<td>ISO14732 (fully mechanical &amp; automatic)</td>
</tr>
<tr>
<td>Non destructive</td>
<td>ISO 3452(PT), ISO17637(VT), ISO 17638(MT);</td>
</tr>
<tr>
<td>testing (NDT)</td>
<td>ISO17636(RT), ISO17640(UT)</td>
</tr>
<tr>
<td>NDT qualification</td>
<td>EN473/EN ISO 9712</td>
</tr>
</tbody>
</table>
## Welding of CI & BOP

<table>
<thead>
<tr>
<th>Items</th>
<th>Typical Standard for piping system and components installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical material types</td>
<td>Carbon steel and casting with C%≤0.35%(GB/T 700, GB/T 711, NB/T 47008); Carbon-Manganese steel(GB/T 713, GB/T 1591, GB/T 1502); Manganese-Vanadium steel(GB/T 1591); Chrome-Molybdenum steel(GB/T 713, GB/T 5310)</td>
</tr>
<tr>
<td>Welding procedure</td>
<td>DL/T 752-2010  The code of the welding on dissimilar steel for power plant</td>
</tr>
<tr>
<td>specifications</td>
<td>DL/T 869-2012  The code of welding for power plant</td>
</tr>
<tr>
<td>Welding procedure</td>
<td>DL/T 868-2014  Qualification standard for welding procedures</td>
</tr>
<tr>
<td>qualification</td>
<td>TSG Z6002-2010  Examination rules for welding operators of special equipment</td>
</tr>
<tr>
<td>Welder qualification</td>
<td>DL/T 679-2012  Code for welder technical qualification</td>
</tr>
<tr>
<td>Non destructive testing(NDT)</td>
<td>NB/T 47013-2015 Nondestructive testing of pressure equipment</td>
</tr>
</tbody>
</table>

These Chinese national and industry standards are also applicable for thermal power station, which can be replaced by local harmonized standards.
Special Requirements

ESPN / PED /CE Marking

- The design, manufacture, conformity assessment and the installation operation of Nuclear Pressure Equipment shall be performed according to ESPN Orders.
- The design, manufacture, conformity assessment of Pressure Equipment shall be performed according to PED.
- CE Marking of the HPR1000 equipment or product.

Agreed Notified Body (ANB)

- For approval and monitoring of the manufacturer’s quality assurance system or for direct product inspection.
- In charge of the conformity assessment of the nuclear Pressure Equipment.
- ANB agreed by the regulator.
- Certification approved by ANB of sub-contractor.
Proposal and Suggestion
□ CGN’s Proposal in Polish Nuclear project

• Provide the proven, approved and practically realistic technology HPR1000 with its latest modifications.

• Enhanced quality, cost and schedule control to achieve a competitive power price, with the benefit from batch construction of HPR1000 in the world.

• Comprehensive cooperation with local industrial chain, including engineering, manufacture, construction and technical service, to maximize localization ratio up to 40%.

• Take advantage of Chinese investing and financing.

• Make the best of CGN’s experience in NPP construction and operation, as well as Chinese regulatory and surveillance system.
Options of Participants

- Suppliers: Provide equipment, products or service for HPR1000 by themselves.
- Sub-suppliers: Provide equipment, products or service for HPR1000 under the cooperation with CGN or Chinese supplier.
- Rendering companies: Provide technical personals or engineers.
- Certification service: Provide PED certification for Chinese suppliers.

Some Suppliers in EU or Poland for NPP Construction in China

- Supplier of welding consumables and base metal: ESAB, Sandvick, Bohler, Air Liquid, METRODE; Outokumpu, Creusot Forge, Valinox Nucléaire, CEFIVAL……
Suggestion

• It is suggested for supply chain that some necessary work, such as licensing, certificating, and employee training, should be commenced as early as possible.

• CGN is willing to share our experience in construction and operation of nuclear power plants with Polish counterparts.
THANK YOU

You can contact this email if any question
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