Offshore Wind Turbine Technologies and Business Cases

’21. 5. 13
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- Company Profile
- DHI Wind Biz. Status
- DHI Competitiveness
DOOSAN GROUP (Oldest Company but Fastest Company in Korea)

One of top 10 conglomerates in Korea, active in engineering and manufacturing of power plants, construction equipment, industrial facilities, engines, construction.

Doosan is the oldest conglomerate with 125 years of history: The recent transformation has set up bases for globalization.

Strong aspiration for accelerated global-scale growth, with focus on Infrastructure Support Businesses (ISB)
Profile of Doosan Heavy Industries and Construction

Doosan Heavy Industries & Construction which was established in 1962 with over 50 years history has grown as a global power and water company.

**Vision**

**Global Leader in Power & Water**
- Global Leader: Becoming a global top-tier player in all businesses
- Power & Water: Representing main businesses

**History**

Doosan Heavy Industries & Construction was established in 1962
- Establishment Period (1962 ~ 1979): Erected national power industries
- After Privatization (2001 ~ now): Going global

**General Information**

**Employees**
- 14,615 (6,958 Koreans, 7,657 global staff)

**Head Office**
- Changwon, South Korea
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DHI Wind Power Solution - Highlight

- **Launching Wind Biz in 2005**
  - Doosan has focused on securing of Source Technologies of Wind Biz by internal R&D

- **Focusing on Offshore Wind Power**
  - [2011] Asian First Offshore WTG (3MW)
  - [2019] Completion of WinDS5500 Development
  - [2022] Commercialization of DS205-8MW

- **Pioneer of Korean Offshore Wind Market**
  - Jeju Tamra Offshore Wind Farm (30MW)
  - Jeonbuk Southwestern Demonstration Site (60MW)

- **Shared Growth with Domestic Supply Chain**
  - 70% of Local Contents rate (30% at initial stage)

- **Cultivating Key Components**
  - World Class Blade Length (100m) for 8MW
DHI has been responding to market demand by diversifying model line-up through own technologies and developing new products.
DHI has a Track Record of 240MW

- In Operation (218.5MW)
- Under Construction (21.0MW)

Total: 239.5MW (as of ’20. 12)
- Onshore: 143.5MW
- Offshore: 96.0MW

Planning (234.5MW)

- Yeongheung Phase 1 (6MW)
- Yeongheung Phase 2 (24MW)
- South-west offshore Phase 1 (60MW)
  - Gunsan Offshore (3MW, R&D)
  - Yeonggwang onshore (3MW)
- Jeonnam onshore (42MW)
- West Suncheon (30MW)
- Gyewol-ri onshore (3MW)
- Jangheung Onshore (18MW)
- Shinan onshore (9MW)
- Gimnyeong onshore (5.5MW, R&D)
- Hanlim offshore (100MW)
- Tamra offshore (30MW)
- Sangmyeong onshore (21MW)
- Dae Jeong Offshore (104.5MW)
- Woljeong offshore (3MW, R&D)
- Jeju Hangwon onshore (3MW)
- Woljeong Village onshore (3MW)
- Bukchonseomo onshore (3MW)

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**Quantity by Model**

- 3MW-D91: 32 ea
- 3MW-D100: 21 ea
- 3MW-D134: 25 ea
- 5.5MW-D140: 1 ea
- Total: 79 ea

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*LTSA*: Long Term Service Agreement
Offshore Wind Farm in Korea

DHI is only one company who has capabilities and experiences about offshore wind farm in Korea

Jeju Woljeong (3MW, R&D)
Jeju Tamra (30MW)
Gunsan (3MW, R&D)
Southwestern (60MW)
DHI is promoting shared growth continuously with Korean supply chain

- **Slew bearing** (3%*)
- **GRP cover** (5%)
- **Casting** (5%)
- **Tower** (14%)
- **Blade** (26%)
- **Transformer** (4%)
- **Canning Parts (Nacelle frame, etc.)** (4%)
- **Electric Parts (CMS, Breaker, etc.)** (10%)

* Share by price

About 70% of parts of Doosan WTG are supplied from Korean Supply Chain
Doosan has a plan to improve local contents rate in line with domestic market expansion
Shared Growth Infrastrucure

DHI is cultivating relevant infrastructure also

Offshore Installation

Various Installation Methods

Transportation

O&M Vessel
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DS205-8MW has differentiated competitiveness for low wind area like Korea by maximizing rotor diameter.

<table>
<thead>
<tr>
<th>Category</th>
<th>Korean Condition (Mean W.S: 7m/s)</th>
<th>EU Condition (Mean W.S: 10m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours/year</td>
<td>Days/year</td>
</tr>
<tr>
<td>Non-Production (Wind Speed 0~3 m/s &amp; 25 m/s+)</td>
<td>1,533 hrs</td>
<td>64 days</td>
</tr>
<tr>
<td>Produce (Wind Speed 3~25 m/s)</td>
<td>7,204 hrs</td>
<td>300 days</td>
</tr>
<tr>
<td>Production below Rated Power (Wind Speed 3~10 m/s)</td>
<td>5,713 hrs</td>
<td>238 days</td>
</tr>
<tr>
<td>Production with Rated Power (Wind Speed 11~25 m/s)</td>
<td>1,491 hrs</td>
<td>62 days</td>
</tr>
</tbody>
</table>

*Source: K-Weather*

Wind Speed Distribution:
- <5.0m/s
- 5.0~5.5m/s
- 5.5~6.0m/s
- 6.0~6.5m/s
- 6.5~7.0m/s
- 7.0~7.5m/s
- 7.5~8.0m/s
- 8.0~8.5m/s
- 8.5~9.0m/s
- 9.0~9.5m/s
- >9.5m/s
DHI Competitiveness #2_Comprehensive O&M Service

DHI provide optimum PJT availability (99%+)

**Key Success Factor**

- Own Tech. for WTG Design & Control
- Digital Solution
- Immediate Response System at all time

**Data Management**
- Abnormality Detection, Statistical Analysis

**Components Management**
- Mobile Work Actual, Operation and Components Display

**Wind Supervision**
- Availability, Capacity Factor, Work and Helpdesk Status

**Help Desk**
- Correspondence of Customer Request

**PJT Availability**
- Woljeong: 98.3% ('15.02 ~ )
- Tamra: 99.8% ('17.09 ~ )
- Jeonnam: 99.0% ('17.11 ~ )
- Gyewol: 99.1% ('18.02 ~ )
- Sangmyung: 99.6% ('18.08 ~ )
DHI Competitiveness #3_Total Solution Provider

- Wind Farm Design & Engineering
- O&M Service & Technical Transfer
- Proven/Reliable Product & Own Technology
- Reliable Operation Record (Power, Availability)
- EPC Experience in Onshore & Offshore
- Quality Management & Production System
Wishing for Successful Wind Power Solution with DOOSAN

Thank You !!

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