Equipment Manufacturing Capability, Localization and AVL process of Doosan
Contents

1. Overview of Doosan
2. Experiences and Capabilities
3. Equipment of APR1400
4. Localization and AVL process
Part 1 Overview of Doosan
Introduction

Who we are

Doosan Heavy Industries is one of **global leading companies in equipment manufacturing** for nuclear power plant

History

- 1962 Established
- 1981 Acquired ASME certificates
- 1987 Selected as the main contractor for Hanbit 3&4
- 2006 Received order for the 1st APR1400, Shin-kori 3&4
- 2007 Received order for 2 units of AP1000 from China
- 2008 Received order for 6 units of AP1000 from U.S
- 2010 Received order for 4 units of APR1400 from UAE
- 2011 Received order for 2 units of APR1400, Shin-hanul 1&2
- 2014 Received order for 2 units of APR1400, Shin-kori 5&6

Shareholders/ Sales

**SHAREHOLDERS**

- Doosan Corp. 36.8%
- Public 63.2%
- 106 mil Shares

**SALES**

- Industry & Construction 73.7%
- Casting & Forging 10.7%
- Water 7.1%
- Power Plant 6.5%
- USD 4.7bn
Quality Assurance

- BG : Business Group
- NSSS : Nuclear Steam Supply System
- T/G : Turbine Generator
- BOP : Balance of Plant
- EPC : Engineering, Procurement, Construction
Global Network

28 Branches
15 Subsidiaries
5 R&D Centers
DOOSAN has an integrated manufacturing facility which is capable from raw material production to final assembly of components for nuclear power plants.
Casting and Forging Shops

(3) Forging Press
(3) Forging Manipulator

(2) Electric Arc Furnace
(1) Vacuum Ladle Refining & Holding Furnace
(1) Vacuum Stream Degassing Equipment
Turbine / Generator Shop

(11) Horizontal Lathe : 3,000 Dia. x 18,000 L x 250 tons
(11) Vertical Boring Machine : 10,000 x 2,200 H x 400 tons
(11) Horizontal Boring Machine : 400 Dia. x 3,800 x 13,000
(9) Plano Miller Machine : 7,100 x 7,000 x 500 tons
Nuclear Shop

(2) Over Head Crane
(3) Semi Gantry Welding Machine
(7) SAW Strip Cladding Machine
(2) 3 Spindle Deep Hole Drilling Machine
(1) 6-Spindle Broaching Machine
(1) Vertical Boring Machine
(1) Horizontal Boring Machine
(3) Automatic J Groove Welding Machine
Dock Facility

(1) Gantry Crane
(1) Transporter: Multi-wheel Loader
(1) Crawler Crane
## Major Products

### Nuclear Steam Supply System
- Reactor Vessel and Internals
- Steam Generator
- Reactor Coolant Pump
- Control Element Drive Mechanism
- Pressurizer
- Integrated Head Assembly
- Fuel Handling System

### Balance of Plant
- Containment Post-tensioning System
- Containment Liner Plates
- Stainless Steel Liner Plates
- Condenser and Heat Exchangers
- Pressure Vessels & Tanks
- Gas Stripper, Boric Acid Concentrator
- Containment Polar Crane, etc.
- New and Spent Fuel Racks
- Spent Fuel Transportation Cask / Canister

### Nuclear Service
- Replacement Service - RSG, RRVCH
- Repair & NDE Service - RVCH, SG, PZR
- Maintenance - RCP Internal & Refueling System
- Upgrade & Modification Service - FHS, IHA. High Density Fuel Rack, etc.
- Technical Advisory Service

### Turbine / Generator System
- Turbine
- Generator
- Moisture Separator Reheater, etc.

### I&C
- NPP I&C total Package
  - Safety System / Non-Safety System
  - Cable Assembly, etc.
- Upgrade of I&C in operating NPPs
  - I&C Digital Upgrade
  - Control Rod Control System
  - Automatic Seismic Trip System
Part 2 Nuclear Experiences and Capabilities
Doosan’s Role in NPP

- Doosan has been responsible for supply of NSSS and T/G
Experience in New Plants

| Type / year | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1400 MWe    | Completed | Terminated/Suspended | Under construction | Overseas PJT | 1400 MWe (APR1400) | Shin-Kori 5&6 | UAE APR 1400 1~4 | Shin-Hanul 1&2 | Shin-Kori 3&4 |
| 1000 MWe    | Completed | Terminated/Suspended | Under construction | Overseas PJT | 1000 MWe (OPR1000) | PWR | KEDO 1&2 | Hanul 5&6 | Hanul 3&4 |
| 1000 MWe    | Completed | Terminated/Suspended | Under construction | Overseas PJT | 1000 MWe (AP1000) | U.S Levy County (2 units) | U.S. V.C.Summer (2 units) | U.S. Vogtle (2 units) | China AP1000 (2 units) |
| 900 MWe     | Hanul 1&2 | Terminated/Suspended | Under construction | Overseas PJT | 900 MWe | Hanbit 1&2 | Qinshan II 3 |
| 600 MWe     | Terminated/Suspended | Under construction | Overseas PJT | PHWR | 600 MWe | Wolsong 3&4 |
| 700 MWe     | Terminated/Suspended | Under construction | Overseas PJT | PHWR | 700 MWe | China Qinshan III | Wolsong 2 |
## Replacement Projects

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</table>

- **RSG**: Replacement Steam Generator
- **RPZR**: Replacement Pressurizer
- **RRVH**: Replacement Reactor Vessel Head

**Notes**
- Completed
- Under construction
- Overseas PJT
Experience in Supply of Major Equipment

**REACTOR VESSELS**

- Completed (~'05 ~ '06 ~ '16 ~ '16 ~ '20)
  - ~ '05: 13
  - '06 ~ '16: 19
  - Sum: 32
  - '16 ~ '20: 2

- Under fabrication

**STEAM GENERATORS**

- Completed (~'05 ~ '06 ~ '16 ~ '16 ~ '20)
  - ~ '05: 58
  - '06 ~ '16: 50
  - Sum: 108
  - '16 ~ '20: 12

- Under fabrication
Export of Equipment and Technology to Overseas

- Doosan supplied major components (SG, RV) to overseas (U.S, UAE, China)
- It transferred manufacturing technology to China (2007 ~ 2011)

**CHINA**
- QINSHAN II 3
- QINSHAN PHASE III 1
- SANMEN 1
- HAIYANG 1
- LUFENG 2

**UAE**
- BARAKA 1,2,3,4

**U.S**
- ANO 2
- WATERFORD 3
- INDIAN POINT 2,3
- PALO VERDE 1,2,3
- WATTS BAR 1
- SEQUOYAH 1,2
- VOGTLE 3,4
- V.C SUMMER 2,3
- LEVY COUNTY 1,2
- WATTS BAR 2
- VC SUMMER 1
Advanced Power Reactor 1400
## NSSS equipment list

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>I. Reactor Coolant System</td>
<td>K. Reactor Refueling System</td>
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<tr>
<td>1. Reactor Vessel Assembly</td>
<td>L. General</td>
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<td>2. Reactor Vessel Support Structure</td>
<td>1. ICI Holding Frame</td>
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<td>3. Reactor Vessel Insulation</td>
<td>2. CEA Tools</td>
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<tr>
<td>4. Reactor Vessel Shipping and Erection Equipment</td>
<td>3. ICI Tools</td>
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<td>B. Reactor Vessel Internals</td>
<td>M. Chemical and Volume Control System</td>
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<td>C. Control Element Assemblies with Drives</td>
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<td>E. Surveillance Specimen Compartment Assembly</td>
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**Category I**

**Category II**

**Category III**
## T/G equipment list

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<td>- Buckets</td>
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<td>11. STATOR LEAKAGE MONITORING SYSTEM</td>
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<td>7. M.S.R WITH RELIEF VALVES</td>
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<td>8. TURNING GEAR ASSEMBLY</td>
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Part 4 Localization and AVL process
Equipment Localization Process

- Equipment localization would follow the steps described below:

**Identification**
- Preparation of localization Plan
- Survey capabilities of local companies
- Identification of local companies’ needs
- Selection of local companies

**Preparation**
- Technical Cooperation Program
  - Facility Upgrade
  - QA Program
    (ASME Certification)
- Support for Approved Vendor Registration

**Execution**
- Technical support & Transfer of documents
  - Manufacturing
  - Quality Plan
  - Welding requirement
  - Dispatch engineers, etc.
- Training (CRT, OJT)
The technical cooperation program should be implemented with:

- Providing technical documents
- Providing training (Class room, OJP, OJT)
- Dispatching consultants to Czech Republic

Technologies to be provided to Czech Republic are:

- Manufacturing
- Project Management
- QA/QC
Building a factory or upgrade facilities

- Provide consulting to build a factory or upgrade facilities in Czech Republic
- Survey and evaluate local company’s facility and capability
- Share experiences and know-how of construction and improvement in manufacturing facility including;
  - Manufacturing shop layout
  - Facilities (machines)
  - Test facility
  - Handling and shipping, etc.
Quality assurance

- Support to establish / improve QA system of local companies

- Establish and/or improve local company’s QA program
  - QA system
  - International certificate (ASME)
  - Quality supply chain
  - Sub-supplier evaluation program
Doosan’s AVL process

- Doosan maintains vendor evaluation system for competitive supply chain

- **Vendor Information Report**
  - QA manual & company details, etc
  - Vendor submit it to procurement team

- **Evaluation for Technical Capability**
  - Applied to new vendors
  - Evaluate capability for implementation of contract

- **Evaluation for Quality Capability**
  - Performed by qualified lead auditors
  - Site survey, records/history review etc.

- **Acceptable?**
  - No
    - Return to procurement team
    - Inform to the vendor

- **Register on the Approved Vendor List (AVL)**
  - Quality level, approval duration, approved QA manual, Certificate etc.

- **Maintenance of Vendor Qualification**
  - Periodic evaluation by site survey, performance assessment etc.

- **Distribution of AVL**
  - Distribute through ERP system
**Doosan’s manufacturing capability**

- **Experience**
  - Continuous experience over 30 years
- **Technology**
  - Most recent and advanced fabrication technology
- **Quality**
  - QA program qualified by international institute
- **Delivery**
  - Reputation for on-time delivery
- **Capacity**
  - In-house forging shop and integrated manufacturing facility
Thank you