



Doosan Heavy Industries & Construction

Equipment Manufacturing Capability, Localization and AVL process of Doosan



April 27th, 2017
Doosan Heavy Industries & Construction Co., Ltd.

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- 2. Experiences and Capabilities**
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Part **1** **Overview of Doosan**

Introduction

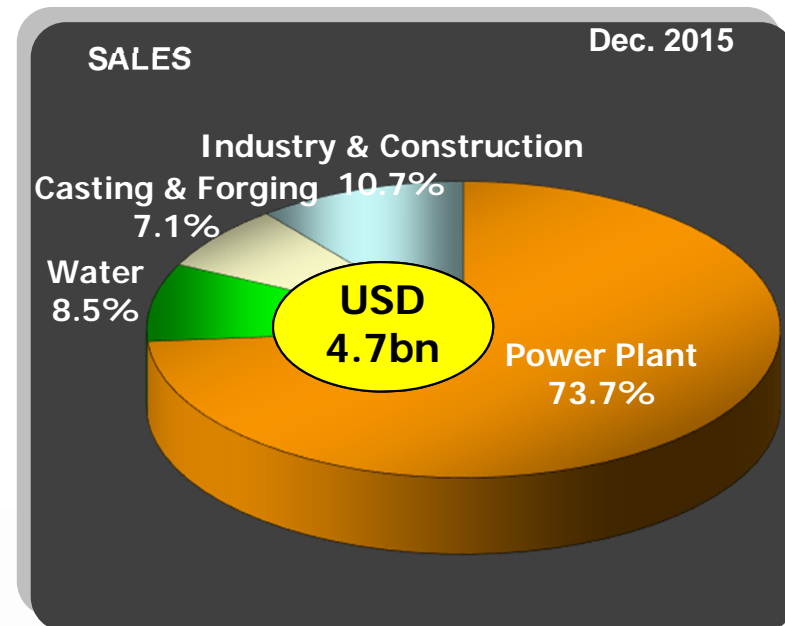
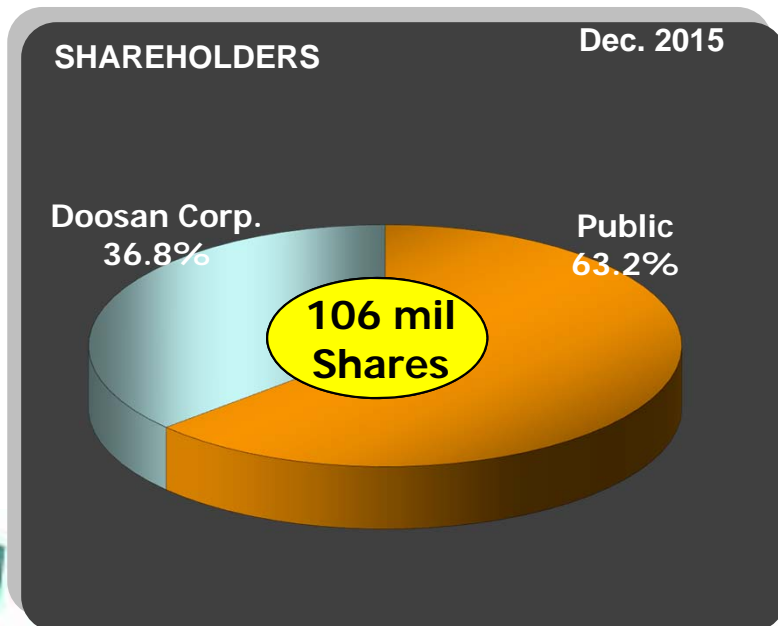
Who we are

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

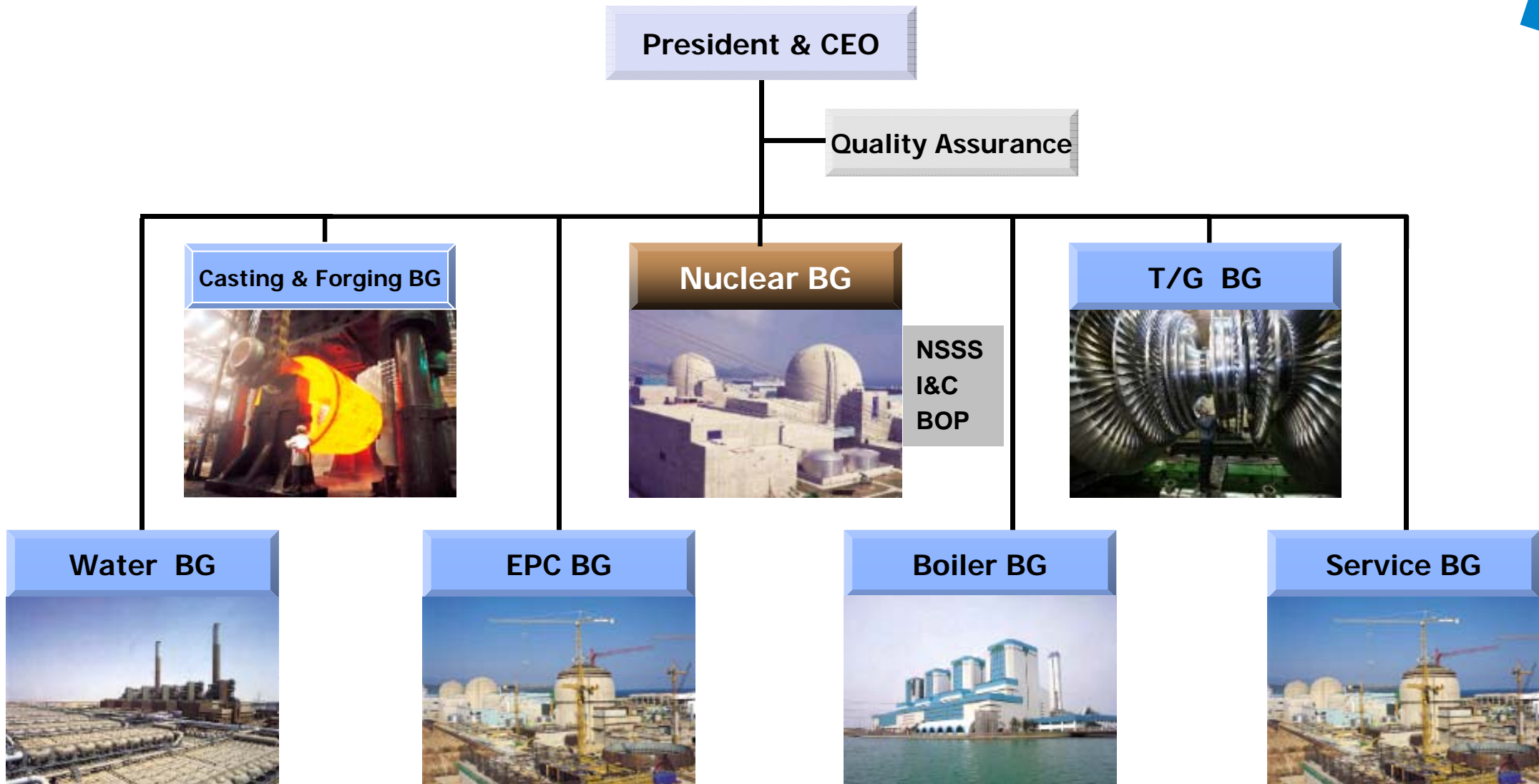
History

- 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



Organization



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

Global Network



Manufacturing Complex

- 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



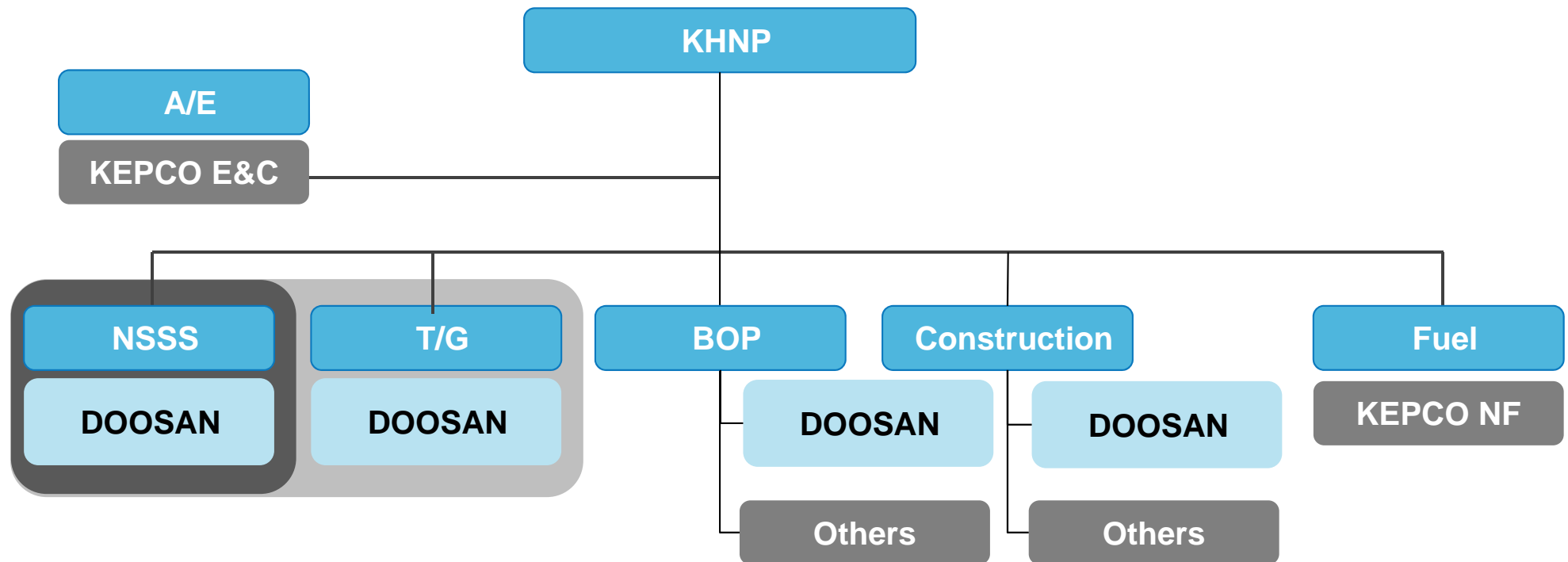


Part **2** Nuclear Experiences and Capabilities



Doosan's Role in NPP

- Doosan has been responsible for supply of NSSS and T/G

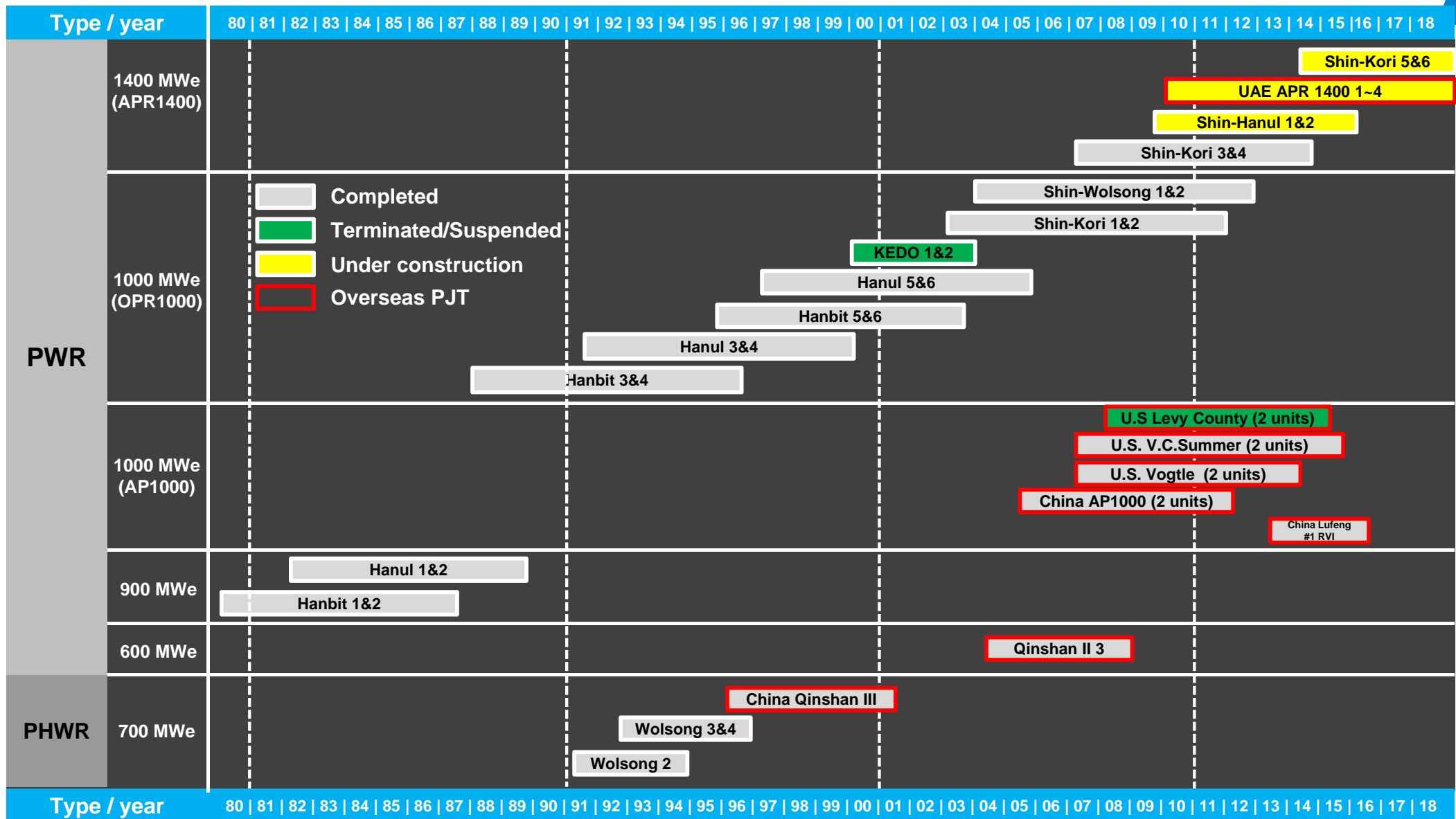


A/E: Architecture Engineering
NSSS: Nuclear Steam Supply System

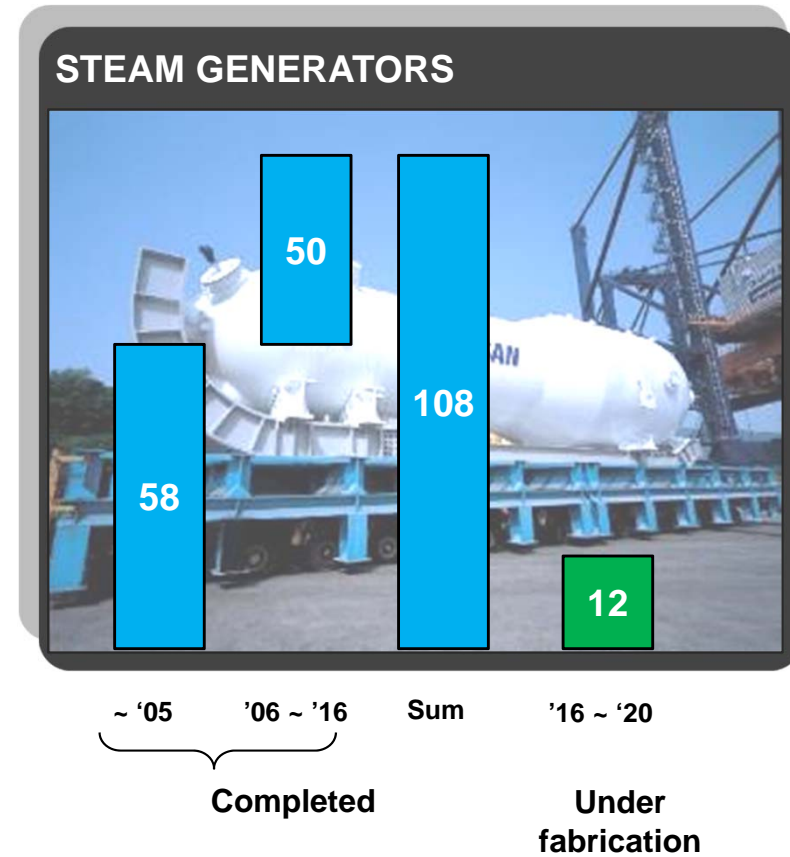
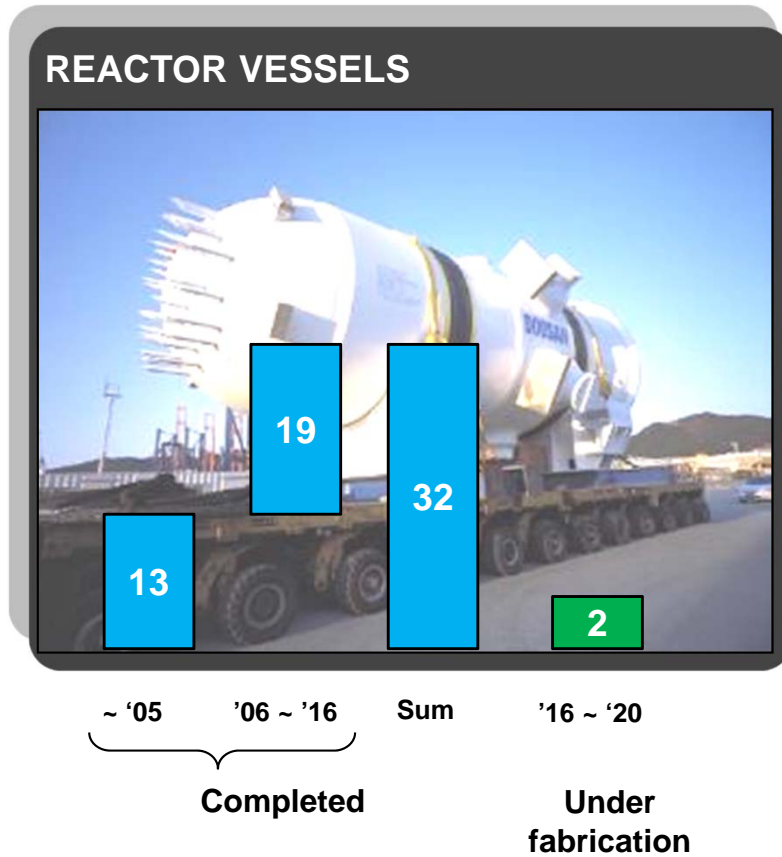
T/G: Turbine and Generator
BOP: Balance of Plant

KHNP : Korea Hydro & Nuclear Power Co
KEPCO E&C : Korea Electric Power Co. Engineering & Construction Co.
KEPCO NF: Korea Electric Power Co. Nuclear Fuel Co.

Experience in New Plants



Experience in Supply of Major Equipment



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



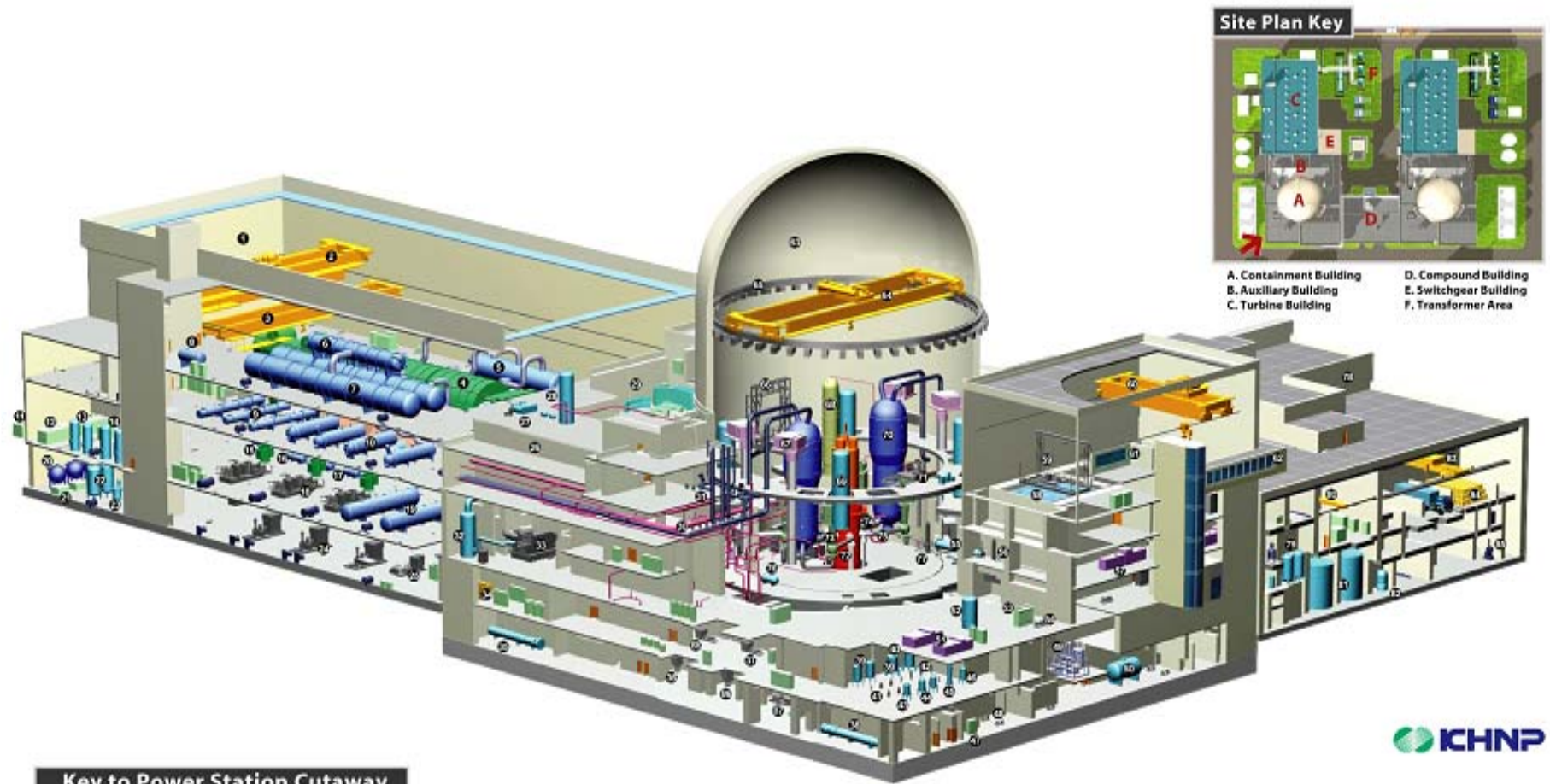
U.S

- 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



Part **3** **APR1400 Equipment**

Advanced Power Reactor 1400



Key to Power Station Cutaway

- | | | | | | |
|------------------------------------|---|---------------------------------------|--|---------------------------------------|--|
| 1. Turbine Building | 16. Moisture Separator Drain Tank | 31. Main Steam Safety Valve | 46. Deborating Ion Exchanger | 60. Fuel Handling Area Overhead Crane | 75. Reactor Coolant Piping Cold Leg |
| 2. Main Overhead Crane | 17. Stage Reheater Drain Tank | 32. Exhaust Silencer | 47. Process Radiation Monitor | 61. Viewing Area | 76. RCP Lube Oil Collector Tank |
| 3. Aux. Overhead Crane | 18. Feedwater Pumps Turbine "A" "B" "C" | 33. Diesel Generator | 48. Holdup Pump | 62. Walkway | 77. Fuel Transfer System Upender |
| 4. Generator | 19. HP Feedwater Heaters | 34. 480V PHS Loadcenter | 49. Boric Acid Conc. | 63. Containment Building | 78. Compound Building |
| 5. Moisture Separator Reheater | 20. Cond. Polishing Mixed Bed Vessels | 35. CS Heat Exchanger | 50. Equip. Drain Tank | 64. Polar Crane | 79. Charcoal Delay Beds |
| 6. Deaerator | 21. Cond. Polishing Resin Traps | 36. CS Pump | 51. Aux. Bldg. Controlled Area Exhaust ACU | 65. Crane Rail | 80. Suspension Crane |
| 7. Deaerator Storage Tank | 22. Cation Regen. & Hold Tanks | 37. Motor Driven Aux. Feedwater Pumps | 52. Volume Control Tank | 66. CEA Change Platform | 81. Long Term Storage Tank |
| 8. TBCCW Surge Tank | 23. Ammonia Day Tank | 38. SC Heat Exchanger | 53. SFP Cooling Exchanger | 67. RCFC Duct | 82. Low Activity Spent Resin |
| 9. LP Feedwater Heaters | 24. Feedwater Booster Pumps | 39. Spent Fuel Pool Clean-up Demin | 54. SFP Cooling Pump | 68. Pressurizer | 83. Traveling Bridge Crane |
| 10. HP Feedwater Heaters | 25. Start-up FW Pump | 40. SG Blowdown Mixed Bed Demin | 55. Fuel Transfer Tube | 69. Safety Injection Tank | 84. Waste Drum Storage Area |
| 11. Closed Loop Cooling System | 26. Auxiliary Building | 41. Reactor Drain Filter | 56. Fuel Transfer Carriage & Upender in Fuel Handling Area | 70. Steam Generator | 85. Solid Waste Compactor |
| 12. Air Compressor | 27. D/G Room Emergency Exhaust Fan | 42. SGBD Filter | 57. Fuel Handling Area Emer Exhaust ACU | 71. Refueling Machine | 86. SC Pump |
| 13. Air Receivers | 28. CCW Surge Tank | 43. Pre-Holdup Ion Exchanger | 58. Spent Fuel Pool | 72. Reactor Vessel | 87. SI Pump |
| 14. Service Air Receiver | 29. Main Control Room | 44. Purification Ion Exchanger | 59. Spent Fuel Handling Machine | 73. Reactor Coolant Pump | 88. Turbine Driven Aux. Feedwater Pump |
| 15. Feedwater Pumps Turbine Driven | 30. Main Steam Line | 45. Boric Acid Cond Ion Exchanger | | 74. Reactor Coolant Piping Hot Leg | |

NSSS equipment list

REACTOR COOLANT SYSTEM	AUXILIARY SYSTEMS	II. NSSS I&C
A. Reactor Vessel	K. Reactor Refueling System	1. NSSS Integrity Monitoring System
1. Reactor Vessel Assembly	L. General	2. Power Control System(PCS)
2. Reactor Vessel Support Structure	1. ICI Holding Frame	3. NSSS Process Control System(NPCS)
3. Reactor Vessel Insulation	2. CEA Tools	4. NSSS Process Instrumentation
4. Reactor Vessel Shipping and Erection Equipment	3. ICI Tools	5. Reactor Coolant System Instrumentation
B. Reactor Vessel Internals	M. Chemical and Volume Control System	6. Core Monitoring System
C. Control Element Assemblies with Drives	1. Heat Exchangers	7. Plant Protection System (PPS)
1. Control Element Assembly	2. Ion Exchangers	8. Radiation Monitoring
2. Control Element Drive Mechanism	3. Tanks	9. Wide Range Boronmeter System
D. Neutron Sources	4. Pumps and Drives	10. RCP Shaft Speed Sensing System
E. Surveillance Specimen Compartment Assembly	5. Filters and Strainers	11. Auxiliary Process Cabinets
F. Steam Generator	6. Boric Acid Concentrator	12. QIAS-P
1. Steam Generator Assembly	7. Gas Stripper	13. Heated Junction Thermocouple
2. Steam Generator Support Structure	8. Boric Acid Batching Eductor	14. DC-AC Inverter
3. SG Shipping and Erection Equipment	9. Valves	15. Diverse Indication System
4. Steam Generator Servicing Equipment	10. Chemical Addition Package	16. Nuclear Application Programs System
G. Pressurizer	11. Orifices	JJ. Man-Machine Interface System - BOP
1. Pressurizer Assembly	N. Safety Injection/Shutdown Cooling System	1. Consoles and Cabinets
2. Pressurizer Heaters	1. Shutdown Cooling Heat Exchangers	2. DCS and Other Non-Safety Systems
3. Pressurizer Shipping and Erection Equipment	2. SCP Miniflow Heat Exchanger	3. Channelized Safety Systems
4. Pressurizer Servicing Equipment	3. Safety Injection Tanks	4. Multi-channel Safety Systems
5. Pilot Operated Safety Relief Valve	4. Pumps and Drives	
H. Reactor Coolant Pumps and Drives	5. Valves	
1. Reactor Coolant Pumps	O. Main Feedwater System	
2. Reactor Coolant Pump Drives	1. Feedwater System Control Valves	
3. Reactor Coolant Pump Support Structures	2. Flow Elements (ASME PTC 6.1)	
I. Reactor Coolant System Piping	5. Feedwater Bypass Control Valves	
J. Valves		

 Category I
 Category II
 Category III

T/G equipment list

<u>Turbine</u>	<u>Generator</u>
1. HP TURBINE ASSEMBLY	1. STATOR FRAME
- Casing	2. STATOR CORE ASSEMBLY
- Diaphragms	3. STATOR COIL
- Rotor	4. TERMINAL BOX
- Buckets	5. END SHIELD & BEARINGS
2. LP TURBINE ASSEMBLY	6. ROTOR
- Casing	7. POTENTIAL SOURCE EXCITATION SYSTEM
- Diaphragms	8. SEAL OIL SYSTEM
- Rotor	9. HYDROGEN CONTROL SYSTEM
- Buckets	10. STATOR COOLING WATER SYSTEM
3. TURBINE FOUNDATION PLATE	11. STATOR LEAKAGE MONITORING SYSTEM
4. ROTOR COUPLING ASSEMBLY	12. SHORTED TURN EQUIPMENT FLUX PROB WITH ANALYZER
5. TURBINE STEAM PIPING	13. TEMPERATURE DETECTOR MONITOR AND NEUTRAL TIE ASS'Y
6. MAJOR STEAM CONTROL AND PROTECTIVE VALVE	14. SPECIAL TOOLS
7. M.S.R WITH RELIEF VALVES	
8. TURNING GEAR ASSEMBLY	
9. STEAM SEALING SYSTEM	
10. LUBE OIL SYSTEM	
11. HYDRAULIC FLUID SYSTEM	
12. THERMAL INSULATION	
13. APPEARANCE LAGGING	
14. ROTOR LIFTING DEVICE SPECIAL MAINTENANCE TOOLS	
15. FRONT AND MID STANDARD	
16. INSTRUMENTATION AND CONTROL SYSTEM	
17. OTHER TURBINE INSTRUMENTATION	

- Category I
- Category II
- Category III



Part **4** Localization and AVL
process



Equipment Localization Process

- Equipment localization would follow the steps described below;



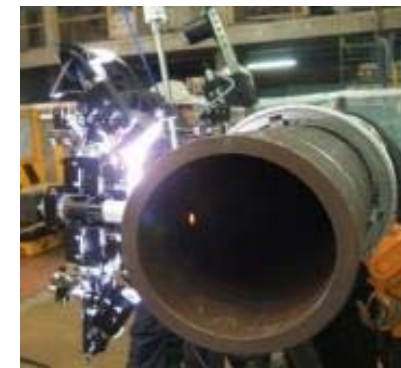
Technical cooperation program

- 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

Project Name	DOOSAN	Page Number	1	Page	
Customer	DOOSAN	Total Pages	1/1	Page	
PLANT/WORK NAME	NEW 1541 1542 2000 2000	ASSEMBLY	ASSEMBLY	STATUS	GREEN
Component	Power Generator				
Design Model Number	ME-211AN-001	Revision	0		
Title	Design Report of Steam Generator for OJEP/KOJ Nuclear Power Plant Units 3 and 4				
DESIGN ORGANIZATION	DOOSAN HEAVY INDUSTRIES & CONSTRUCTION				
Drawing	See Appendix D				
Prepared by	C. H. YO	DATE	2011/11		
Checked by	Y. S. YO	DATE	2011/11		
APPROVAL STATUS : COMPLETE					
The design and/or construction of this document has been verified and approved for use as indicated.					
By: [Signature] Date: 2011/11/10					
This Design Report is intended to be in compliance with the requirements of ISO 9001:2008 and ISO 14001:2004 and shall be used as a reference for the design and construction of the Steam Generator Plant Units 3 and 4.					
Approved by	[Signature]	Checked by	G. A. KIM	DATE	2011/11/10
		Prepared by	C. H. YO	DATE	2011/11/10
		Checked by	Y. S. YO	DATE	2011/11/10



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.



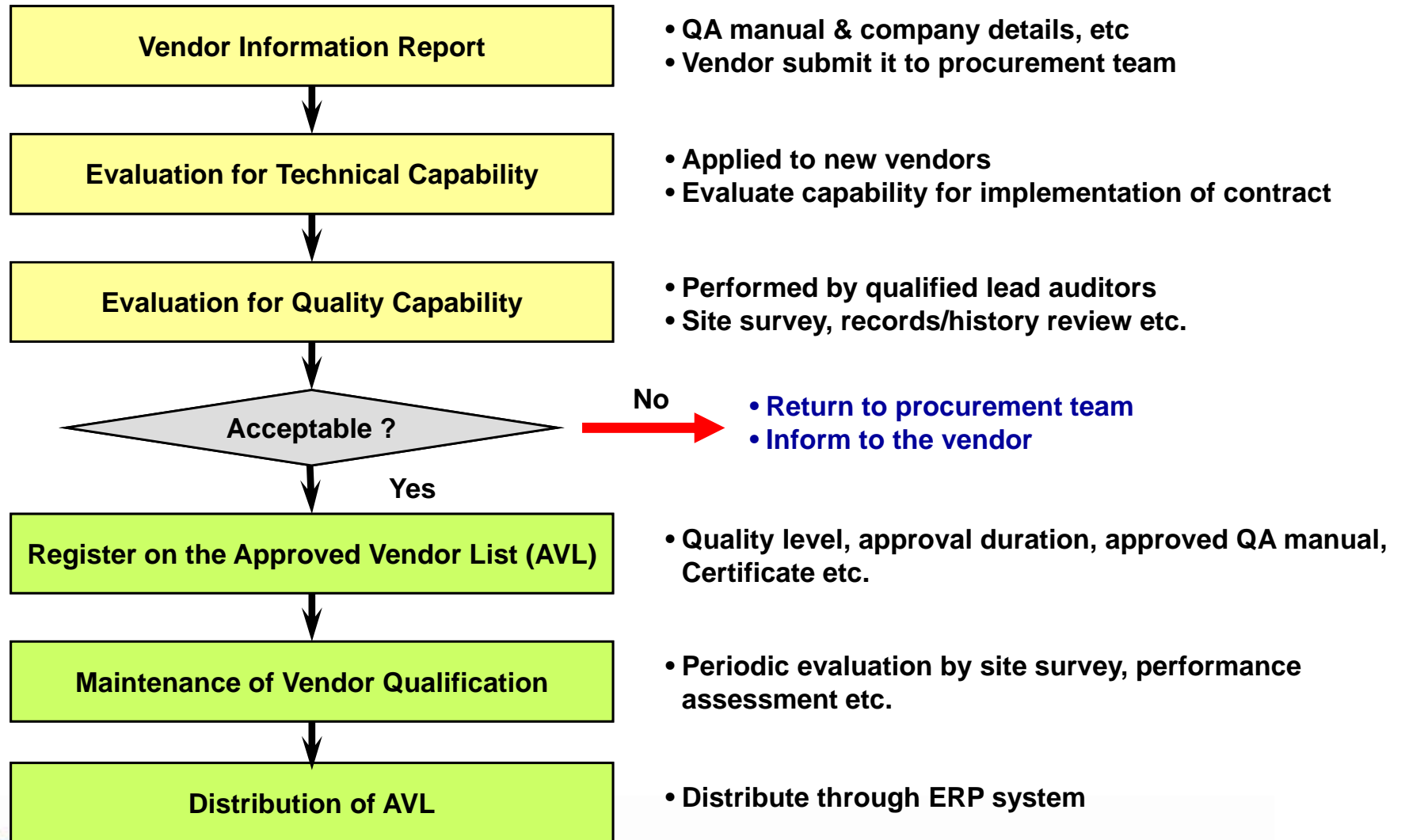
Quality assurance

- 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



Doosan's manufacturing capability

- We are prepared to share our experience and technology with Czech Republic based on

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



Doosan Heavy Industries & Construction