



# SHANGHAI ELECTRIC

## POWER GENERATION GROUP

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# SHANGHAI ELECTRIC

CREATE OUR FUTURE TOGETHER



## GROUP PROFILE

Shanghai Electric has established itself as one of the large comprehensive equipment manufacturers in China, with leading industry covering energy equipment, industrial equipment and other service fields. By the overall advantage of clean, efficient product technology, it can provide the users all over the world with specific clean energy comprehensive solutions.

As one of Shanghai Electric's core businesses, Shanghai Electric Power Generation Group specializes in the manufacture of power generation equipment and the construction, engineering and services of power plants, and the annual output is up to 36 million kW. Its leading products include 50MW~1240MW series of thermal power generation equipment and nuclear power generation equipment, plant environmental protection equipment, plant auxiliaries, AC & DC motors, etc.; its main innovative products cover 1000MW and above ultra-supercritical double reheat thermal power generation units and 1000MW and above nuclear power generation units, gas turbine and steam combined cycle units, etc.. The first 1000MW ultra-supercritical double reheat generator unit in the world, manufactured by the Group, has set new record in the global coal-fired power efficiency, and represented the most advanced technology of thermal power in the world at present.

Shanghai Electric has its plant engineering project all over more than 30 countries and areas in the world, has undertaken more than 90 projects at home and abroad, with installed capacity exceeding 92 million kW and the economic, safe and stable indicators of the units all up to the advanced level among the international like products. In 2017, it is listed at the position No. 141 among the world's 250 largest international contractors of ENR.

The plant services of Shanghai Electric cover the full life cycle of the plant units in the operation, not only include energy saving complete transformation, environmental protection complete transformation, spare parts service, unit overhaul, operation and maintenance, remote diagnosis, gas turbine service, nuclear power generation service, etc., but also provide the users with the emerging services such as zero liquid discharge, fuel coupling, unit flexibility transformation, smart power plant, etc.

In response to the global climate change, Shanghai Electric as one of the world leading power plant equipment suppliers, has actively developed the emerging industries such as solar power generation, seawater desalination, energy storage equipment, air cooled equipment, dust-cleaning apparatus, electric drive, etc. In addition, several industries such as superconducting motor, tidal power generation and ocean current power generation have already reached the technology tracking and cultivation phase.





## ENERGY | THERMAL POWER GENERATION EQUIPMENT

Steam Turbines

Generators

Boilers

Gas Turbines

In the thermal power field, Shanghai Electric has a series of products at all levels from 50MW~1240MW. With an annual production capacity exceeding 30 million kW, it has manufactured the thermal power equipment nearly 300 million kW in total, and become the large thermal power equipment supplier in the world. The first 1000MW double reheat unit – Guodian Jiangsu Taizhou Power Plant, the power generation equipment of which is supplied by Shanghai Electric, has further rewrite the record of the coal-fired power generation efficiency in the world.

Shanghai Electric aims at more safe and reliable, more clean and efficient thermal power product technology, carries out the research and development on 700°C ultra supercritical units, etc., and promotes the continuous improvement of the technology in the thermal power sector.



## Steam Turbines

The steam turbine products provided by Shanghai Electric have the capacity covering 50~1240MW. They are the comprehensive serialization products, with parameters up to ultra-supercritical. At present, the maximum main steam pressure is 31MPa, the maximum main steam temperature is 600°C, and the maximum reheat steam temperature is 620°C, all of which is in a world leading level. The products feature high efficiency, high availability, easy maintenance, long maintenance interval, flexible operation, fast startup, strong peak load regulation capacity, etc., with multiple techniques at the top of the world.

Steam Parameters	Unit Structure	Output Power (MW)													
		100MW	200MW	300MW	400MW	500MW	600MW	700MW	800MW	900MW	1000MW	1100MW	1200MW	1300MW	1400MW
10-15MPa 538-566°C		■													
10-15MPa 538-566°C		■													
13-25MPa 535-566°C		■													
16-25MPa 535-566°C		■				■									
16-28MPa 535-620°C		■				■									
16-28MPa 535-620°C		■				■									
16-28MPa 535-620°C		■				■				■					
二次再热 double reheat		■				■				■					
25-31MPa 600-620°C		■								■					

The amount of various steam turbine products of Shanghai Electric provided has exceeded 1000 sets in total, holding more than 40% market share of the steam turbine market in China, and the ultra-supercritical steam turbine products even up to more than 60% market share. The products have been exported to more than 20 countries and areas in the world such as India, Turkey, Pakistan, etc. They have a large number of benchmarking performances: the first 100MW double reheat unit in the world (Unit 3# & 4# in Taizhou Power Plant), the first reheat temperature 620°C ultra-supercritical unit in China (Unit 3# & 4# in Tianji Power Plant), etc., which have good demonstration and leading effects in the industry.

## Generators

The generator products provided by Shanghai Electric have the capacity covering 50~1240MW, adopt the design concepts of serialization and modularization, use the cooling methods including air cooling, double-water internal cooling, hydrogen cooling and water-hydrogen cooling, have the performance and reliability up to the world leading level, and can meet the demands of different users.

Water-hydrogen cooling	 Level IV	1100 MW-2200 MW									
		1100MW Type (1000 MW-1250MW)	1300MW Type (1250 MW-1350MW)	1500MW Type (1300 MW-1600MW)	2000MW Type (1600 MW-2000MW)						
Hydrogen cooling	 Level II	350 MW-1300 MW									
		350MW Type (300 MW-380MW)	400MW Type (380 MW-470MW)	500MW Type (470 MW-600MW)	660MW Type (600 MW-700MW)	800MW Type (700 MW-860MW)	1000MW Type (860 MW-1100MW)	1200MW Type (1100 MW-1260MW)			
Hydrogen cooling		230 MW-470 MW									
		250MW Type (230 MW-280MW)	300MW Type (280 MW-330MW)	350MW Type (330 MW-380MW)	420MW Type (380 MW-470MW)						
Double-water internal cooling		300 MW-470 MW		600 MW-700 MW							
		350MW Type (300 MW-380MW)	400MW Type (380 MW-470MW)	660MW Type (600 MW-700MW)							
Air cooling		60 MVA-350 MVA									
		60MW Type (50-70MW)	80MW Type (70-90MW)	100MW Type (90-115MW)	135MW Type (115-140MW)	150MW Type (140-165MW)	180MW Type (165-195MW)	210MW Type (195-225MW)	250MW Type (225-265MW)	300MW Type (265-310MW)	350MW Type (310-370MW)

 Product development route  
 Scope of product types and capacities

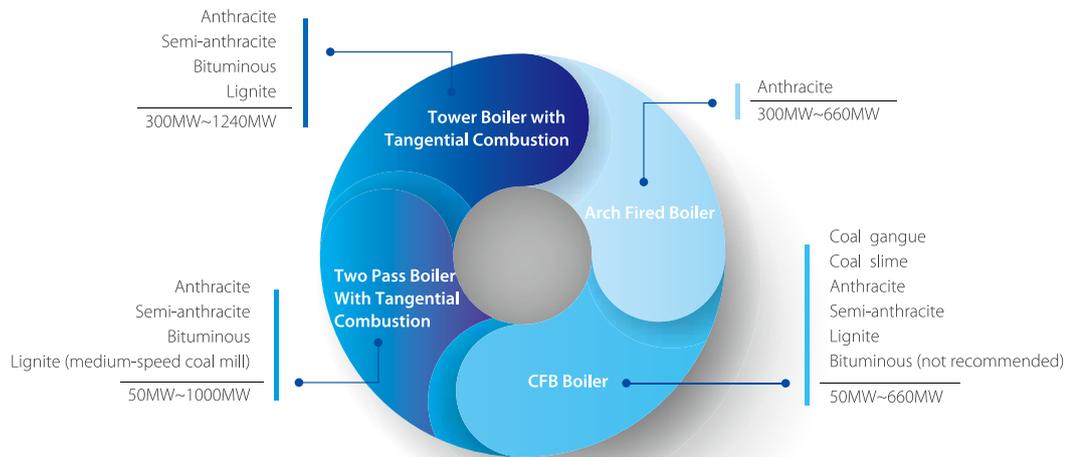
Shanghai Electric has provided more than 1000 sets of various generator products in total, which feature high operation efficiency and good reliability, and also have a large number of benchmarking performances: the first 660MW Level II water-hydrogen cooled generator in China (Ma'anshan Power Plant in Anhui Province), the first 660MW double-water internal cooled generator in China (Zhaozhuang Power Plant in Shanxi Province), the first exported 1000MW unit of China (Chengda's Cilacap Phase III Power Plant in Indonesia), etc., which have good demonstration and leading effects in the industry.



## Boilers

The boiler products provided by Shanghai Electric have the capacity covering 50~1240MW, with parameters up to ultra-supercritical, e.g. the maximum main steam pressure is 33MPa, the maximum main steam temperature is 605°C, and the maximum reheat steam temperature is 623°C, all of which is in a world leading level. Shanghai Electric has the comprehensive serialized boiler products, including tangential firing  $\Pi$  type boiler, tangential firing tower type boiler, CFB boiler, W flame boiler, etc.

Type of Boiler Recommended	Waste Coal	Anthracite $V_{daf}$	Semi-anthracite $V_{daf}$	Bituminous		Lignite Mt,ar	
		4-10%	10-20%	Bituminous	Sub-bituminous	20-38%	>38%
Tower Boiler with Tangential Combustion							
Two Pass Boiler with Tangential Combustion							
CFB Boiler				Not Recommended			
Arch Fired Boiler							



Shanghai Electric has provided more than 1000 sets of various boiler products in total, among them, more than 300 sets of supercritical/ultra-supercritical boiler products. They have a large number of benchmarking performances: the first 100MW double reheat boiler in the world (Boiler 3# in Taizhou Power Plant), the first 623°C ultra-supercritical  $\Pi$  type boiler in the world (Boiler 3# in Tianji Power Plant), the first 660MW ultra-supercritical tower type boiler in China (Boiler 1# in Pinshan Power Plant), the first Sinkiang high alkali coal fired 660MW supercritical tower type boiler in China (Boiler 4# in State Grid's Hami Power Plant), the first maximum coal slime fired CFB boiler in China (Boiler 1# & 2# in National Investment's Panjiang Power Plant), etc., which have good demonstration and leading effects in the industry.



## Gas Turbines

Shanghai Electric has a complete industry chain for gas turbine from research & development, manufacturing, sales to services. It is the heavy gas turbine equipment supplier in China that has H-class, F-class, small F-class and E-class technology, and it has a strong system integration capability.

Shanghai Electric, by international acquisition, has acquired a 40% interest of Ansaldo Energia (Italy), the world leading gas turbine supplier, and established two joint venture companies to carry out deep cooperation. Through the cooperative research & development with Ansaldo Energia and the indirect acquisition of Alstom gas turbine technology, Shanghai Electric has mastered the advanced gas turbine design and manufacturing technology in the world, and realized global R&D platform, global manufacturing base, global sales network and global service team for gas turbine industry together, so that has increased the strength and competitiveness of Chinese gas turbine industry as a whole.

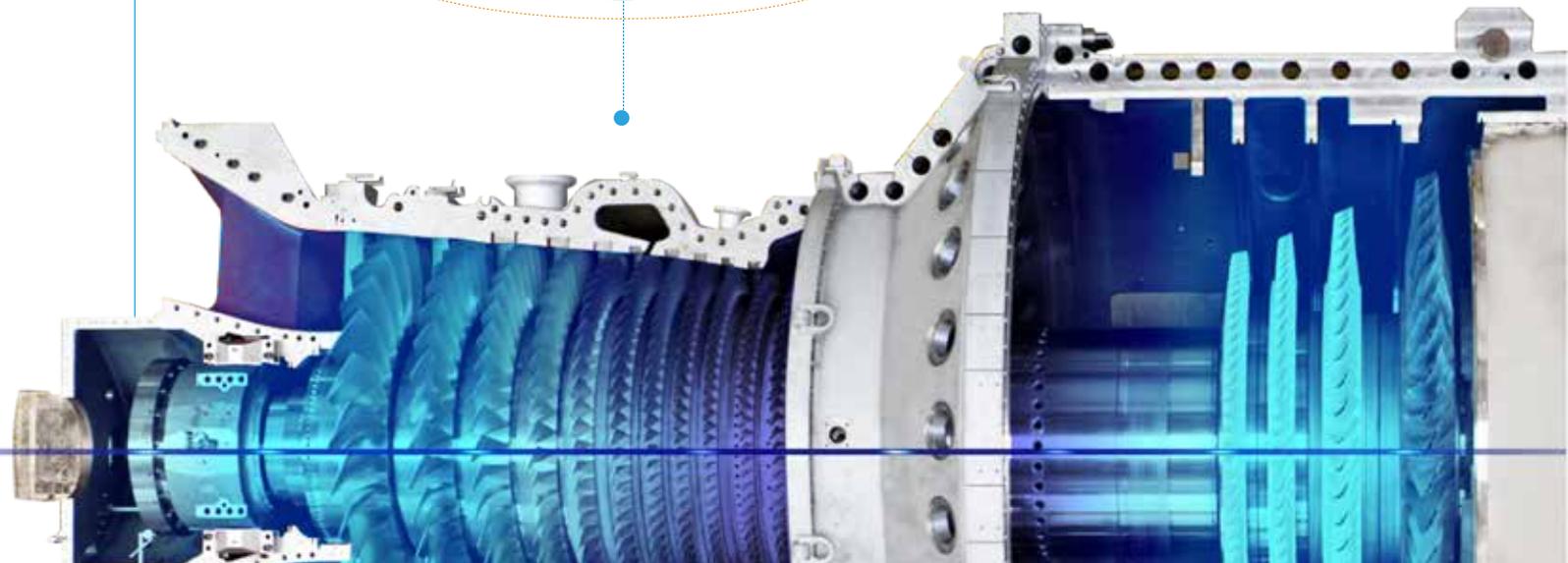
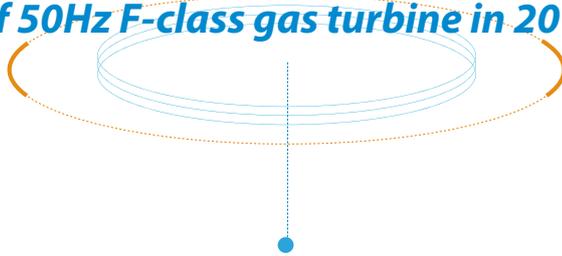
Small  
F class

E class

F class

H class

**SHANGHAI ELECTRIC – ANSALDO**  
held the largest global market share  
**of 50Hz F-class gas turbine in 2016**

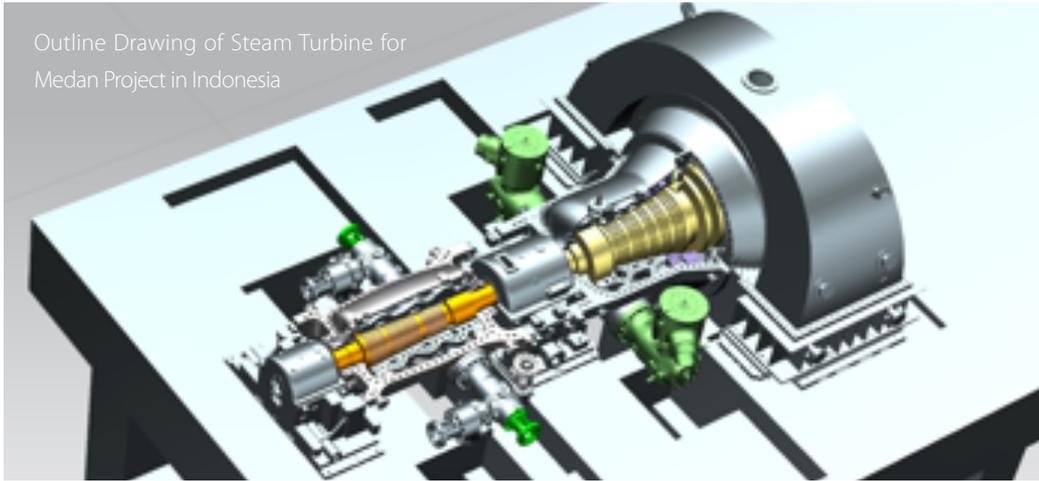


## Typical Project

### Typical Project: 167MW two-casing single flow turbine type (SHT-A50)

SHT-A50 is a reheat, dual-casing, single flow, condensing turbine, and uses high speed design in the HP casing. The turbine is often used in the coal-fired power plant, combined cycle and solar thermal power generation projects. For the Medan project in Indonesia, the HP casing and MP&LP casing of the turbine use the conventional speed design, featuring the international first-class performance level.

Outline Drawing of Steam Turbine for Medan Project in Indonesia



### Typical Project: 660MW (including 1000MW) ultra-supercritical thermal power generation unit using 620°C technology

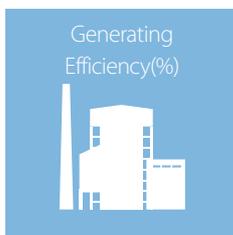
In 2012, Shanghai Electric completed the development work for the project with the reheat steam temperature up to 620°C for the first time in China. In December 2013, the Tianji Power Plant in Anhui Province, with the power generation equipment supplied by Shanghai Electric, was put into operation, and also the beginning of the national high-efficient ultra-supercritical technology. The Tianji Power Plant even has won the first prize among the like units for three consecutive years according to the results of Annual National Thermal Power 600MW Units Contest in 2014/2015/2016 published by China Electricity Council.



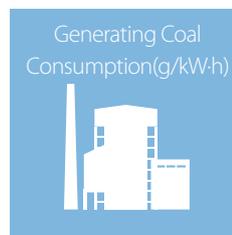


**Typical Project: 1000MW (including 660MW) ultra-supercritical double reheat thermal power generation units**

In 2012, Shanghai Electric started to engage in the research and development of the double reheat unit. Till now, it has undertaken 24 sets of double reheat units (660MW units: 4 sets; 1000MW units: 20 sets), among which, 4 sets have been put into operation. The Guodian Jiangsu Taizhou Project, with the power generation equipment supplied by Shanghai Electric, is the demonstration project of National Energy Administration and the "12th Five-year" planned project of Ministry of Science and Technology, and is also the first 1000MW ultra-supercritical double reheat power generation unit in the world. Its power generation efficiency is up to 47.82% and coal consumption 256.8g/kW·h, which rewrites the global coal-fired power generation efficiency.



**47.82**



**256.8**

## ENERGY | NUCLEAR POWER

Conventional Island

Nuclear Class Equipment



The 1000MW nuclear power conventional island turbine generator unit products, designed, researched and developed by Shanghai Electric itself, have adopted a series of the advanced technology, which provide all-round improvement in the safety, reliability and economy of the turbine generator units. Meanwhile, Shanghai Electric, by combining with the technical advantage of itself, has make the most of social scientific research power to carry out a lot of analysis, research and tests, met the operation conditions and various demands of different nuclear island reactor types and different regions, reduced the CO<sub>2</sub>, SO<sub>2</sub> emissions effectively, and promoted the healthy development of the environment.

At present, several nuclear power conventional island units of Shanghai Electric have been put into commercial operation, featuring excellent technical-economic indicators, safety and reliability. They are Unit 1 to 4 of Yangjiang, Unit 1 & 2 of Fangchenggang, and Unit 1 to 3 of Chashma respectively. And in addition, 9 sets of nuclear power conventional island units are under manufacturing, among which, 6 sets are HPR1000 turbine generator units.

## Conventional Island

Shanghai Electric has the complete nuclear power conventional island power generation equipment processing and manufacturing capacity, and is capable to provide the complete conventional island equipment for the 3rd and 4th generation of nuclear power. Meanwhile, Shanghai Electric has also the complete turbine LP rotor technology, including the processing and manufacturing technology for welded rotor, shrink-on rotor and integral rotor, establishes the international leading long blade design and development technology platform, develops 1420mm, 1710mm and 1905mm series of long blades successfully, which can meet the current 100MW above pressurized water reactors and the configuration requirements of various back-pressure units. The range of the applicable back-pressure for different LP module combination is 2.5kPa~16kPa (including air cooling), which can satisfy the demands of various nuclear power project turbine generator unit at single or double back pressure, from the North to the South, from the onshore to the inland.

The output and vibration of the first 1000MW turbine generator unit of Shanghai Electric for Yangjiang nuclear power plant are better than the design values, which reflect the excellent nuclear power conventional island design and manufacturing capacity of Shanghai Electric.

HPR1000 nuclear power turbine generator unit and the matched auxiliaries of Shanghai Electric have been exported to Pakistan, which is the first set of 1000MW nuclear power conventional island unit with independent intelligent property right that is exported to foreign countries. The export of the 1000MW nuclear power conventional island has greatly widen the international electric power market of Shanghai Electric, generated the prominent economic and social benefits, powerfully promoted the optimization and upgrading of industrial structure in domestic electric power equipment industry, and realize the strategic demands of the power plant equipment industry in China on the sustainable development.

Long Blade Design

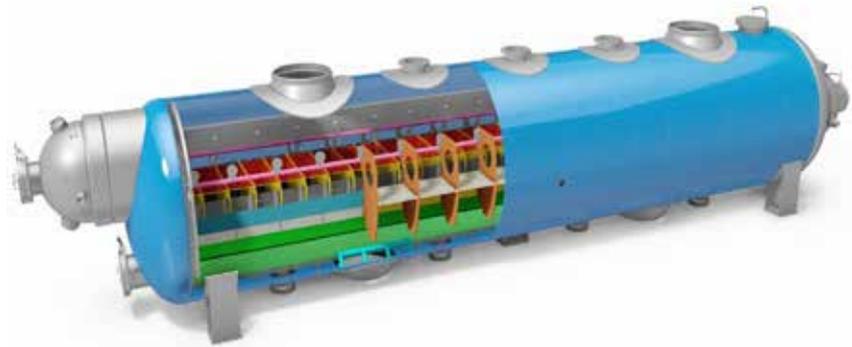
1420<sub>mm</sub> / 1710<sub>mm</sub> / 1905<sub>mm</sub>

1000MW  
Power Generation  
Unit



### Typical Project: HPR1000 nuclear power moisture separator reheater

- With high efficient double hook corrugated sheet separator in V-form arrangement, the steam dryness after separation is more than 99%;
- The reheater adopts double tube form, to simplify the system configuration;
- The reheater adopts the four flow design with blowing and exhaust steam, to avoid overcooling on the tube bundle;
- The reheater tube bundle adopts the flexible jacketing connection method, to ensure no deformation on tube bundle due to thermal expansion of MSR;
- The manhole is set at the separation and reheat segment respectively, to facilitated maintenance and service.



## Nuclear Class Equipment

### Typical Project: Taishan nuclear power EPR accumulator

- The first nuclear power EPR accumulator in China, also the large and thick full stainless steel accumulator in the world.
- Main material Z2CN19.10 nitrogen-containing, manufacturing standard RCC-M 2007, total weight 63 tons.



## ENERGY | CONCENTRATING SOLAR POWER (CSP)



Shanghai Electric, by combining the CSP plant design, construction, operation technology, the world-wide project development capacity and the equipment manufacturing capacity, provides the comprehensive solutions of CSP for customers at home and abroad. Shanghai Electric selects Center Tower (CT) and Parabolic Trough (PT) CSP with thermal energy storage system as the technical routes. Shanghai Electric can undertake design, construction, installation, commissioning, operation and EPC of CSP, enhanced oil recovery, sea water desalinization and ISCC system projects. In addition, Shanghai Electric provides the manufacturing and supply of power generation equipment, including all conventional island equipment, for example, high efficient turbine generator unit and auxiliary equipment, solar field equipment and control system, solar receiver, steam generator system, thermal energy storage system and equipment, etc. Shanghai Electric is the EPC contractor of Dubai DEWA 700MW CSP project.

## Concentrating Solar Power (CSP)

### Heliostat

Shanghai Electric BrightSource Solar Energy Co., Ltd. has designed, produced and assembled the heliostats with effective reflection area 10m<sup>2</sup>~70m<sup>2</sup>, reflectivity >93%, operating temperature -40~60°C, tracking precision <2.5mrad, normal maximum operating wind speed ≤14m/s, controlled maximum operating speed ≤21m/s, and survival status wind speed limit ≤40m/s.

### Turbine generator

Shanghai Electric can produce CSP solar specific, high efficiency, fast startup, sub-critical pressure, two casing single flow, air cooled turbine generator unit, with power 1MW~270MW, pressure 3MPa~17MPa, temperature 450°C~600°C, and efficiency up to 45%.

### Receiver

Shanghai Electric has produced 18MPa, 430MWt solar receiver steam generator (SRSG) with outlet steam temperature 568°C. The molten salt receiver (MSR) is under research and development.

### Thermal energy storage system

Shanghai Electric can offer the molten salt thermal energy storage system solution, the thermal energy storage time of which can be customized to 1~15 hrs. Shanghai Electric can produce the specific steam generator for solar power plant and various heat exchangers.

### Solar field combination

Shanghai Electric has provided the specific integrated control system for solar field, where the thousands of reflectors track the sun orientation in two dimensions, in order to focus the sunlight to the solar energy receivers on the top tower.

### Plant configuration

Shanghai Electric owns the core techniques and IP for CSP, such as heat balance/operating parameter design of solar thermal power plant, receiver, heat storage system design, power plant configuration and operation optimization strategy, light field arrangement and performance, output model, etc.



## ENERGY | POWER STATION AUXILIARY EQUIPMENT

HV & LV Feed Water Heater

Deaerator

Condenser

Direct Steam Generator

Air Cooling System



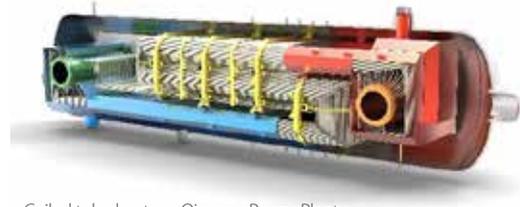
Shanghai Electric, with its early power station auxiliary equipment business started in 1921, is a professional designer and manufacturer for power station auxiliary equipment, and is the large scaled one in China at present, featuring maximum types. It can supply the matched equipment for 50MW~1300MW ultra-supercritical, supercritical, subcritical thermal power and nuclear power units, such as HP heaters, LP heaters, condensers, HP & LP deaerators and water tanks, closed cycle water heat exchangers, nuclear power 2nd & 3rd vessels, accumulators, boron injection tanks, oil tanks, equipment gates, personnel gates and seawater desalination equipment, air cooling systems, etc.

## HP & LP Feed Water Heater

The HP & LP feed water heater is one of the important auxiliaries in the regenerative system of the power plant, and is also a heat exchanger that heats the feed water by steam extraction from the steam turbine, in order to increase the heat efficiency. In recent years, 600MW ultra-supercritical stainless steel HP & LP heaters have been developed on demands of overseas market, which can provide the products that meet the specifications of various countries, such as PED, IBR, ASME, etc. Meanwhile, the coiled tube HP heaters have been launched for 1,000MW and above ultra-supercritical units. This type of HP heater has featured good thermal shock resistance, fast temperature rise, and long service life.



- U-shaped tube heater – the first 1000MW ultra-supercritical single-row high-pressure heater in China for Waigaoqiao Phase III Power Plant Project



- Coiled tube heater – Qinyang Power Plant

## Deaerator

The deaerator and water tank patterns include integrated deaerator, spraying disc type deaerator, etc. The integrated deaerator has effectively combined the functions of deaerator and water tank, and has been the advanced headless single-container deaerator in the world, featuring long service life, compact structure, good deoxidation effect and high reliability.



- Typical Project: the first 1000MW ultra-supercritical unit in China – Waigaoqiao Phase III Power Plant Project

## Condenser

The product series cover the coal-fired unit, gas turbine unit and nuclear units, including 100MW double reheat ultra-supercritical thermal power, CPR1000, AP1000, HPR1000, EPC nuclear power. The heat exchanging performance of the tube bundle arrangement with independent intellectual property right is better than HEI standard and satisfies the back pressure requirements from the North cold region to the South warm climate, from the pure condensing unit to steam extraction unit, as well as from the direct water cooling to the indirect air cooling; the mature single-casing, two-casing and three-casing condensers match the whole series of LP turbine casings; the professional design such as vibration analysis, strength calculation, etc. guarantees the safe operation of the system; the customized make-up water deaerator and the neck design increase the economic efficiency of the system.



- Typical Project: Taizhou Phase II Power Plant – the first 1000MW double reheat ultra-supercritical unit in China

## Once-through Steam Generator

The once-through steam generator is a new evaporator. This product is developed by cooperation with Balcke-Dürr Corporation (German). It adopts the vertical, header + coiled pipe structure, integrates preheating, evaporating and overheating functions, also can be arranged alone to realize any one of the functions flexibly, is a new evaporator with high integration degree, simple overall control and obvious cost advantages, and meanwhile features applicable to critical parameters, long service life, ultra-low damage rate of heat exchanging tubes, satisfying frequent startup and shutdown, etc. The evaporator can be applicable to the power station projects with heat storage function, for example, solar thermal power station, and it is a new solution that is different from the conventional pot or drum type evaporators.

The equipment can also be applied in the solar thermal power stations with charging function, realizes the integration of charging and discharging, and is a totally new solution of molten salt heat exchanging system for solar thermal power generation.

## Air Cooling System

The air cooling technologies of "SEC -SPX" comes from Balcke-Dürr Corporation (Germany) and dry cooling sector of Hamon (Belgium) that were acquired by American SPX in 2002 and 2003 respectively. Due to the research & development and operation for more than 100 years, SPX has obtained several world patents and become the leader in providing innovative solutions for the cooling system of power station.

At present, SEC-SPX has obtained more than 100 air cooling achievements in Chinese market, with market share exceeding 30% in 2016. It also won three international projects SAMRA / IBRI and ATTARAT.

Besides the new built market, SEC-SPX is active in expanding the retrofit market, and owns the world leading air cooling retrofit technologies such as HEXACOOOL, Evaporate Cooling, PCS-SYSTEM, Bundles upgrade etc., can best satisfy the customer with the optimal design and technology.

### *Typical Project: Xinfra 3×700MW air-cooled units*

*SEC-SPX got IBRI project (1x1450MW) in 2016. IBRI is a combined cycle power Project locates in Oman with ACC capacity about 2x764.8t/h(112 fan units in all).IBRI project is the largest overseas order received by the joint venture since it's established.*



## EQUIPMENT | SEAWATER DESALINATION

Shanghai Electric has been concentrated in the seawater desalination technology research & development and engineering application for long time, has owned the two mainstream seawater desalination technology, i.e. heat method and membrane method, and has been capable to provide the seawater desalination package solutions such as independent water plant, dual-purpose power and water plant, thermal membrane coupling and waste-heat utilization, etc. for the customers in the electric power, municipal administration, chemical, iron and steel industries, etc. Shanghai Electric has finished nearly 20 seawater desalination engineering construction, which can produce 300 KT/day fresh water.

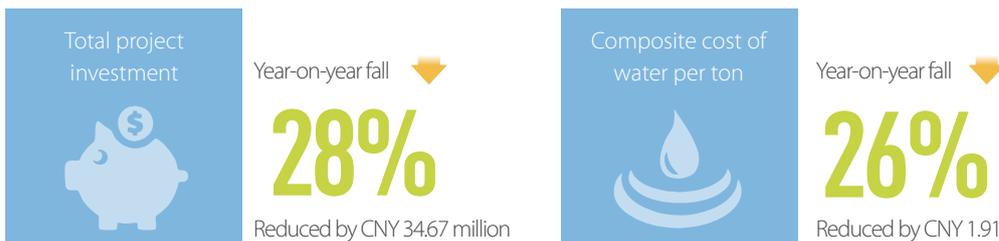
Shanghai Electric has the independent core technology of heat method for seawater desalination, such as low temperature multi-stage distillation, hot water flash, etc., and also the advanced reverse osmosis system integration and three-dimensional plant design technology. Shanghai Electric is capable for engineering design, equipment procurement, installation & commissioning, operation & maintenance, project management and construction of the large-scaled seawater desalination plant.

### Typical Project: Huanghua Phase II 12.5 kilotons/day Project – achieve the zero breakthrough of domestic seawater desalination technology

Huanghua Phase II Seawater Desalination Project is the first 10KT low temperature multi-stage seawater desalination domestic project on the heat method in China. Shanghai Electric is responsible for the independent design & manufacturing and complete supply of the main equipment, and provides the installation and commissioning services for it. The project was put into operation in December 19, 2018, with each performance index achieving the design value, which marks a great breakthrough and development in the domestic technical equipment for low temperature multi-stage seawater desalination on the heat method. Shanghai Electric, through the project implementation, has prepared the design and manufacture company standard, and formed a design, manufacturing and quality assurance system for the complete main equipment.

According to the project as-built data calculated by the user – Cangdong Power Generation Co., Ltd., Huanghua Phase II Project compared with Huanghua Phase I where the equipment applied is imported from French, the total project investment is reduced by CNY 34.67 million, which is year-on-year fall of 28%, and the composite cost of water per ton is reduced by CNY 1.91, which is year-on-year fall of 26%, therefore, the economic benefit of the domestic technical equipment is very remarkable. The project was awarded of the first prize of China Electric Power Science and Technology Prize in 2009 and the first prize of National Energy Technology Progress Award in 2010.

#### Comparison with French Equipment



### Typical Project: Baogang Zhanjiang Seawater Desalination EPC Project – the first seawater desalination EPC project on the heat method in China

The associated 2x15 KT/day low temperature multi-stage distillation seawater desalination project of Baogang Zhanjiang Iron and Steel Base has been awarded to Shanghai Electric as EPC contractor. The project, with total investment about CNY 300 billion, is the first domestic EPC project of seawater desalination on the heat method, and fills up the blank in the operation mode of domestic seawater desalination project.

Shanghai Electric has made innovative design by combining the resource advantage of innovation strategic alliance of seawater desalination industry on the heat method, achieved the first project application breakthrough of domestic duplex stainless steel in seawater desalination on the heat method, and further improved the level of domestic technical equipment for seawater desalination on the heat method and the competitiveness of the upstream and downstream industry chain.



EQUIPMENT | INDUSTRIAL FIELD



Motors

HV & LV Converter

Coal Mill

Metallurgical Equipment

Compressor

Wind Turbines



## Motors

In the motor field, Shanghai Electric has been a key company in the national motor manufacturing industry since the 1950s, has successfully developed and manufactured the first double-water internal cooled turbine generator in the world, has an annual production capacity of 10 million kW that exceeds 25% of the national large and medium scaled AC & DC motors' market shares, as well as has formed a range of 500kW~100000kW for synchronous motors and a range of 0.12kW~30000kW for asynchronous motors. The products are widely applied in the key national projects such as West-East natural gas transmission, south water to north, Dong Shen Project, etc., and exported to many countries in the world.

In recent years, Shanghai Electric has, focusing on the constant transformation and innovation, continuously improved the technical contents of the products according to the extra-heavy, extra-large and extra-professional development ideas. The products are widely applied in various industries, such as thermal power generation, wind power generation, nuclear power generation, water conservancy, metallurgy, petrochemical, mining, machinery, ship, cement, paper making, environmental protection, municipal administration, etc. We works with our clients, takes the responsibility to promote social progress, and launches environmental protection, energy saving, green products constantly. Shanghai Electric is becoming a comprehensive motor manufacturing service provider based on large and middle scaled AC & DC motors, middle and small scaled turbine generators and wind generators, and extended to drive unit, power generation unit and motor full life cycle service, and it is sparing no effort to turning towards the world leading motor manufacturer.



*Typical Project: The first 20MW ultra-high-speed positive-pressure explosive-proof frequency control synchronous motor in China*

*The first 20MW ultra-high-speed positive-pressure explosive-proof frequency control synchronous motor in China is operating in the West-East natural gas transmission project, features ultra-large capacity, ultra-high speed, positive-pressure explosive-proof, frequency control, etc., and is honored as the "crown jewel" in the motor industry.*



*Typical Project: the first IE-level 8,000 kW 10kV emergency diesel generators for nuclear power plants*

*With the performance reaching the advanced level among the like products at home and abroad, they meet the standards such as National Nuclear Safety Regulation, IEC, IEEE, RCC-E, etc., as well as adopt more strict system review and development control for foreign and domestic projects, fulfill the requirement on 60 years' design life, and are applicable to domestic and overseas HPR1000 nuclear power projects.*



## High & Low Voltage Inverter

Shanghai Electric and Fuji Electric, one of the large comprehensive mechanical and electrical product manufacturers in Japan, have established a joint venture, Shanghai Electric Fuji Electric Power Technology Co., Ltd., mainly involving in the design, manufacturing and sales services in the inverter field. The joint venture is mainly engaged in the technology research & development, design, sales and services of high-voltage inverters, low-voltage inverters, PCS (solar inverter and wind power converter), UPS (uninterrupted power supply) and relevant electric and electronic products, and also conducts system integration to the relevant equipment, undertakes and executes the relevant system engineering projects, provides the associated equipment, system engineering solutions, technical consultation, technical and spare parts services, both export and import businesses, etc. It has a product manufacturing base, test base in Wuxi. The base is constructed according to the international first-class standard, with the advanced equipment. During the product manufacturing process, it makes the product quality first, takes the advance management mode, increases the utilization efficiency of raw materials, improves the labor productivity, reduces unreasonable loss, improves the technological process, and expands the scale of production continuously.

### High-voltage IGBT Inverter

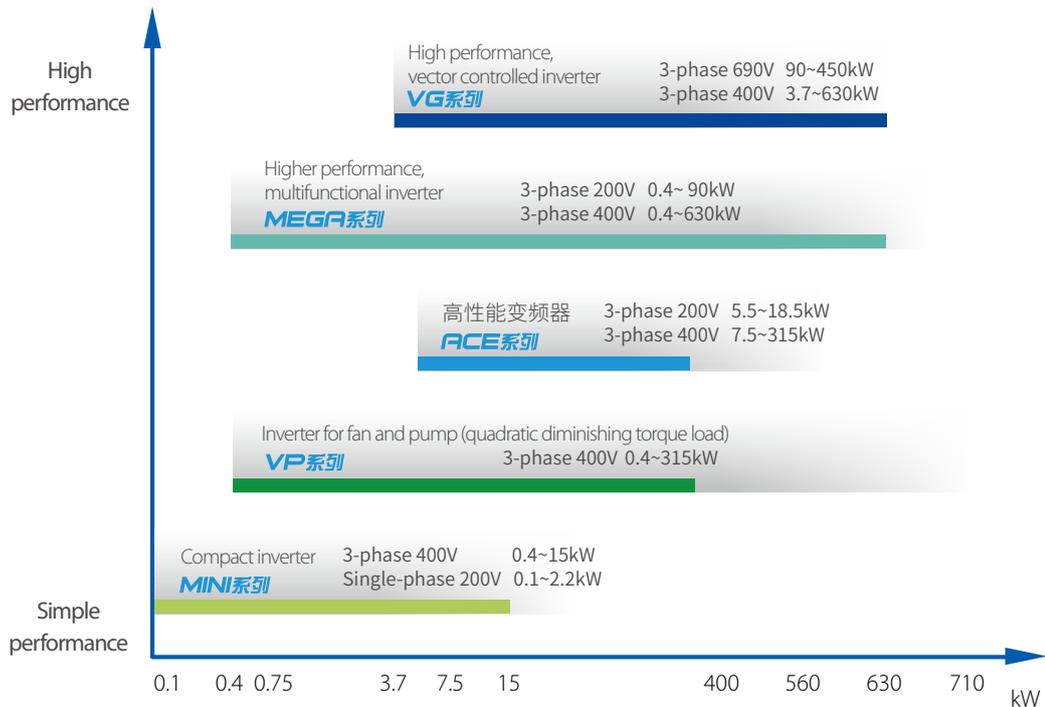
It adopts the specific pulse width modulation technology (PWM) and a new generation of IGBT HV inverter, is applicable to the motor drive control for equipment such as fans, pumps, compressors, rolling mills, etc., and is widely used in many industries such as electric power, metallurgy, petrochemical, municipal administration, building materials, water conservancy, etc., not only achieving good using effect, but also increasing energy efficiency greatly.



4600FM series  
high-voltage  
inverter

## Low-voltage Inverter

It adopts the environment-friendly long service life design (10 years) and meets ROHS directive; by built-in surge resistance to suppress the current, it can reduce the interference to the periphery equipment; it can provide the high performance inverter that makes the most of the fans and pumps; by configuration of new energy-saving operating function, it can minimize the consumed power of inverter and motor itself, with the product series covering simple performance types to high performance types.



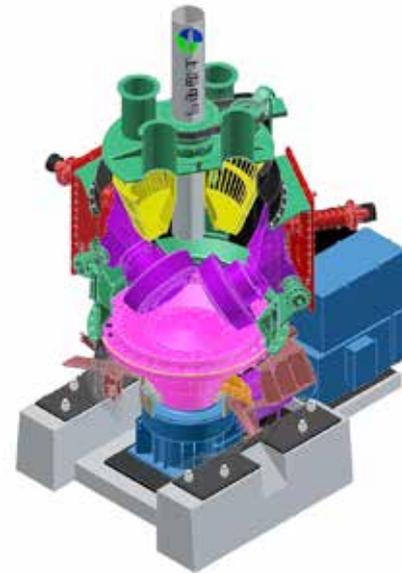
## Typical Projects

- The high-voltage inverter (10kV 4200kVA) for condensate pump of Guangdong Huaxia Yangxi Phase II Power Plant 2x1240MW units has been put into operation smoothly, which has realized the 100MW unit achievement in the electric power industry.
- The high-voltage inverter project for 2x300MW thermal power generation units of Malaysia Balingian Coal Fired Power Plant has been the first project of such unit capacity that uses the circulating fluidized bed boiler in Malaysia, and also a great successful step in the "Going out" road.
- The high-voltage inverter project (10kV 3350kVA) for furnace induced draft fan in 1000 KT/year aluminum oxide production line of Shanxi Huaxing Aluminum invested and constructed by Aluminum Corporation of China Limited has helped the customers to reduce the energy consumption effectively, and the equipped bypass contactor has also improved the system reliability greatly.
- The high-voltage inverter project (10kV 4200kVA) of Shanxi Xinfu Chemical Co., Ltd. (Shandong Xinfu Group) has achieved another major breakthrough due to its quality and service.
- The three large-capacity high-voltage inverters (10kV 2750kVA) project for internal mixer project of Shandong Huasheng Rubber Co., Ltd. has been accepted by domestic procurement of Kobe Steel Group, and achieved a breakthrough in the internal mixer field.

## Coal Mill

### Bowel Mill

The HP coal mills manufactured by Shanghai Electric have received the welcome from users due to the good coal adaptability, high operation reliability, simple maintenance and low service cost. So far, Shanghai Electric has manufactured more than 3,500 sets of HP coal mills in total, which have been used on 50MW~1000MW units of nearly 300 power plants at home and abroad and in good conditions. The HP coal mills manufactured by Shanghai Electric have ranked top in the share of domestic medium speed coal mill market. Besides the domestic market, more than 800 sets have been imported to many countries and areas such as East Asia, South Asia, Southeast Asia, Middle East, South America, etc. According to the power reliability index published by State Power Corporation (entrusted to China Electricity Council), the reliability index of HP coal mill of Shanghai Electric has ranked the top of its kind products in China for years.

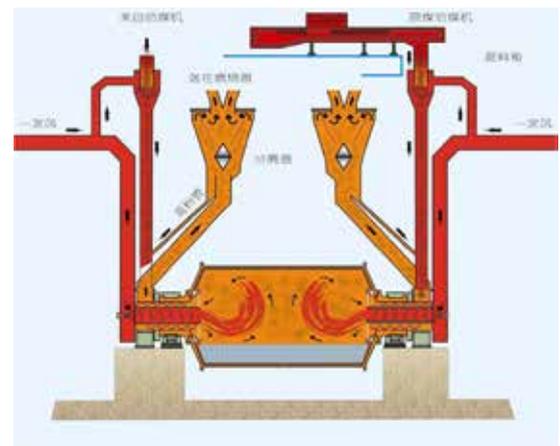


### Double-ended Ball Mill

Shanghai Electric is one of the major manufacturers in China that design and manufacture the double-ended ball mills. It has independently manufactured nearly 500 double-ended ball mills, and has the independent intellectual property right.

The MGS series double-ended ball mills of Shanghai Electric have the functions such as drying, grinding, choosing, sending, etc., are generally used in the direct blowing coal grinding systems, are the main equipment for the coal pulverizing systems of direct blowing coal mills in the thermal power plants, feature the advantages such as high continuous operating rate, convenient maintenance, stable output and fineness, big storage capacity, fast response, flexible operation, lower air-coal ratio, wide coal adaptability, not easy to be influenced by foreign matters, etc., are applicable to grinding the coals of various hardness and strong abrasiveness, and are a type of direct blowing low-speed coal mills with excellent performance among the coal pulverizing machinery for boilers of thermal power plants.

MGS series double-ended ball mills are mainly installed in the coal pulverizing system for boilers of 150MW~1,000MW large-scaled thermal power generation units, and also used as the pulverizing equipment in the chemical, building materials and phosphorite departments, etc. From 2015 till now, the market share of Shanghai Electric has exceeded 70%.



## Metallurgical Equipment

Shanghai Electric has a long history in manufacturing metallurgical equipment, and at present, it can provide the complete sets of heavy plate mill, heavy and medium plate mill, tandem hot mill, tandem cold mill, section mills, nonferrous metal mills and various single stand rolling equipment as well as equipment for various process lines such as continuous pickling, push-pull pickling, continuous annealing, continuous galvanizing, color coating line, skin pass mill, cross-cutting machine, longitudinal cutting machine, recoiling line, etc.; and also include the smelting equipment such as blast furnace, converter, electric furnace, etc. and the metallurgical spare parts such as various roller bearing chocks. Shanghai Electric mainly provides services to the domestic large-scaled steel mills, for example, Baosteel, Ansteel, Baogang, Shandong Steel, Hebei Steel; it keeps the long-term cooperation with the international top-level metallurgical equipment design companies, for example, SMS Siemag, Primetals, Danieli, etc.

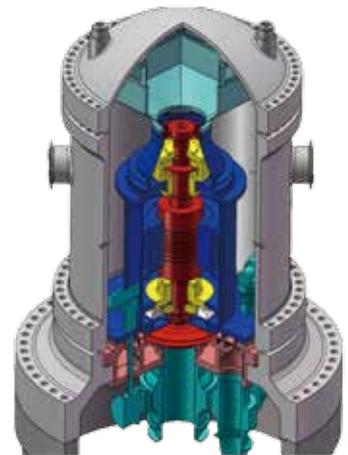
### *Typical Project: Anling 1700mm ASP Hot Continuous Rolling Unit*



## Compressor

Shanghai Electric is one of the manufacturers that manufacture the centrifugal compressors at the earliest in China, and its independently designed and manufactured centrifugal compressors are widely used in the fields of petroleum, nuclear power, chemical industry, chemical fertilizer, metallurgy, environmental protection, wind tunnel, etc. Shanghai Electric has introduced in succession the software for selection, design, analysis and manufacturing of centrifugal compressor, built new centrifugal compressor trial run workshop, compressor manufacturing and assembly workshop and test workshop, added a great deal of key equipment such as CNC machine tool, testing equipment, inspection equipment, computer detecting system, etc., and formed the complete manufacture, inspection and testing methods.

Since 1970s, Shanghai Electric has successively developed the first domestic "three-in-one" unit, air compressor in 300KT/year synthetic ammonia project, compressor for natural gas transportation tubing pipelines from Szechuan to Shanghai, main helium compressor for high temperature gas cooled reactor, as well as the largest feed gas compressor in China for Qian'an and the largest acid steam compressor unit in the world for the desulfurization process system, etc., meanwhile, it has undertaken the compressor units representative in the petrochemical industry, for example, propylene refrigerating compressor for 660 KT/year ethylene transformation of Yanshan Petrochemical, propylene compressor for ethylene transformation project of Jinshan Petrochemical, etc.



## Fans for Power Stations

Shanghai Electric is the enterprise that has introduced the foreign technology in the fan field of the fan industry in China. Its fan technology comes from TLT Corporation (German), the leader in the international fan market.

### Centrifugal Fans

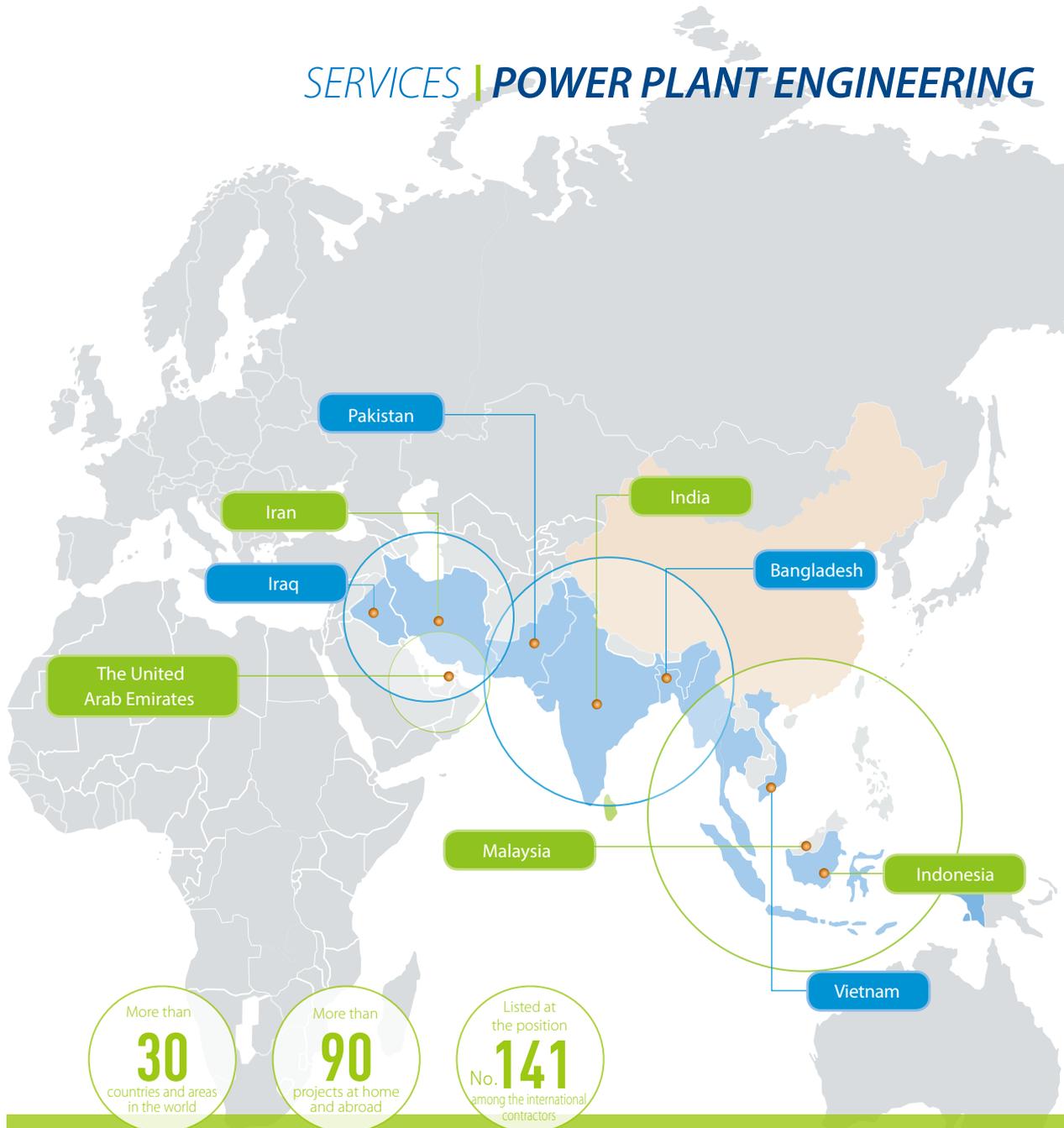
Shanghai Electric has a complete range of centrifugal fans, that is 84 models in total, with the maximum efficiency up to 90%, and it can provide the optimal fans for various cases, to achieve the goals such as low investment cost and low operation cost, high reliability, long service life, low noise, etc. The technical parameters of TLT centrifugal fans are in a wide range, with maximum flow 6 million m<sup>3</sup>/h, maximum pressure 95,000 Pa, maximum temperature 700°C, and dust content up to 150g/Nm<sup>3</sup>. The parameters can cover the full range of industrial centrifugal fans; meanwhile, the method "to act according to actual conditions" is used, in other words, to obtain the type of fan whose parameters are totally matched as per modularization based on the parameters provided by the user, so that the fan operates in the range of peak efficiency, which avoids the limits that the domestic type series with mismatching parameters are forced together and that the pressure is higher but the structural strength fails to meet the requirement of linear speed.

### Axial-flow Fans

The axial-flow fans of Shanghai Electric are the mature products supplied on the basis of a lot of actual operation experiences and after a great deal of aerodynamic model tests. The fans are designed in series, with standardized components and maximum efficiency up to 90%. The technical parameters of TLT axial-flow fans are in a wide range, with maximum flow 15 million m<sup>3</sup>/h, maximum pressure 20,000 Pa, and maximum temperature 300°C. In order to meet the demands of users as best as Shanghai Electric can, it has realized the fans with optimal technical & economical index and safe & reliable structure by changing the rotor-hub ratio, number of blades, length of blade chord and blade angle. Due to the blade angle adjustable in the operation, the fan can meet the flow and pressure requirements of the user.



## SERVICES | POWER PLANT ENGINEERING



The power plant engineering sector of Shanghai Electric is engaged in providing the users with one-stop energy solutions, with products covering the high efficiency and clean energy such as coal fired power generation, gas turbine, nuclear power conventional island, etc. and renewable energy such as distributed energy, wind power generation, solar energy, energy storage, microgrid, biomass power generation, etc., Shanghai Electric is also capable of providing various modes of business operation such as EPC, EPC+F, BTG, BOT, BOO, etc. Shanghai Electric has undertaken more than 90 domestic and oversea projects, which are located in more than 30 countries and areas around the world, and of which more than 70 projects have been under operation, with installed capacity exceeding 92 million kW. Among them, 63 million kW is at abroad and 29 million kW at home, and the economic, safe and stable indicators of the units are all up to the advanced level among the international competitors. In 2017, Shanghai Electric is listed at position No. 141 among the world's 250 largest international contractors of ENR.

### Typical Project: Vietnam Vinh Tan Phase II Project

The Vinh Tan Phase II (2x622MW) Project is the large capacity coal fired power generation unit introduced by Vietnam Electricity Group for the first time, and its highlights are successful application of "II" type drum boiler and "W" flame boiler technology and introduction of the first 600MW subcritical boiler manufactured by FW technology.

After both units have been put into commercial operation, the annual power generating capacity of both units in 2015 was 5.55 billion kWh (annual index 4.9 billion kWh), exceeding the annual power generation index by 13.3%; the annual power generating capacity of both units in 2016 was 7.11 billion kWh, which hit a new high.

Annual power generating capacity in 2015: **55.5** billion kWh

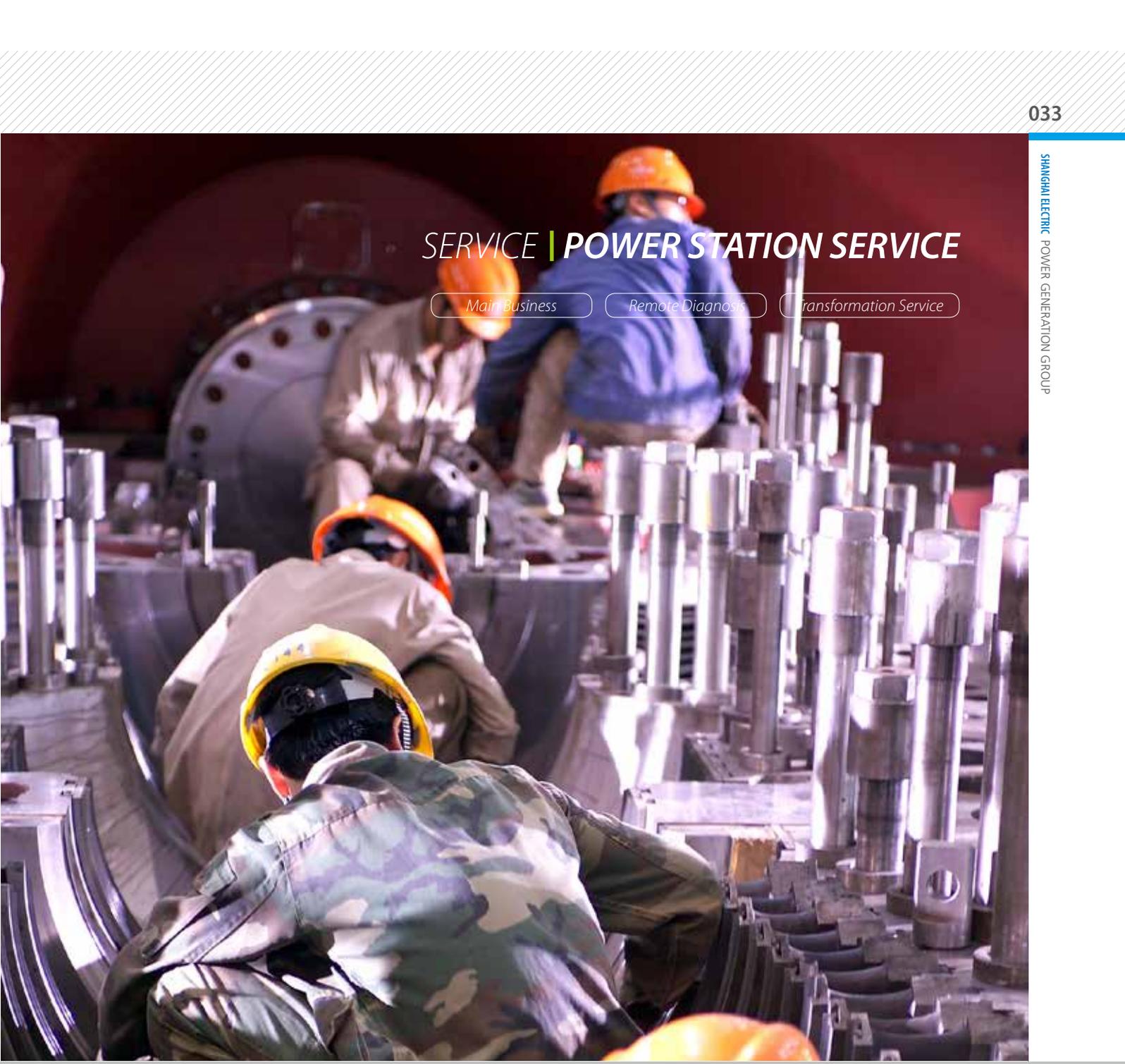
Annual power generating capacity in 2016: **71.1** billion kWh



### Typical Project: Indonesia Pelabuhan Ratu Project

The Pelabuhan Ratu (3x350MW) Project is the largest EPC project of Shanghai Electric in the Indonesian market. Mr. Nasri, the president of Construction Department of Indonesia State Power Corporation has complimented that Shanghai Electric "has implemented a very successful project for Indonesia State Power Corporation". The Pelabuhan Ratu Power Plant has been awarded "the Most Excellent Project" after assessment of 10,000MW package power station projects under construction in Indonesia, held by Indonesia State Power Corporation.





## SERVICE | POWER STATION SERVICE

Main Business

Remote Diagnosis

Transformation Service

The power station service of Shanghai Electric covers the full life cycle of power station unit in operation, not only including energy saving package transformation, environmental protection package transformation, spare part service, unit overhaul, operation & maintenance, remote diagnosis, gas turbine service, nuclear power service, etc., but also providing the customers with the emerging services such as zero liquid discharge, fuel coupling, unit flexible transformation, intelligent power plant, etc. The service products faces 125MW and below, 300MW, 600MW and 1,000MW thermal power (including circulating fluidized bed) units, gas-steam combined cycle units, IGCC units, nuclear power units and power equipment such as environmental protection equipment, etc. Shanghai Electric commits itself to provide the professional power station service solutions for the customers, provides the diversified modern energy services, and creates the maximum benefits and values for the customers.

## Main Business



Energy saving package transformation	Environmental protection package transformation	Spare part service	Unit overhaul	Operation & maintenance	Gas turbine service	Nuclear power service	Other services
Steam turbine flow path transformation	Flue gas de-NOx efficiency improvement transformation	Spare part direct selling	Planning overhaul of various levels	Operation service	Long-term agreement service	Conventional island service	Remote diagnosis
Steam temperature rise transformation	Wide load de-NOx transformation	Spare part kit	Spare parts for overhaul	Maintenance service	Equipment transformation	Equipment transformation	Technical service
Steam turbine's high back pressure heat supply transformation	Low-low temperature electrostatic precipitator transformation	Spare part long-term agreement	Equipment repair	Operation & maintenance (instruction)	Equipment overhaul	Spare parts and components	Unit removing
Steam turbine's steam extraction heat supply transformation	High-efficient electrostatic precipitator transformation	Spare part storage	Emergency repair	Long-term service agreement in one operation cycle	Spare parts and components	Operation & maintenance	Associated equipment
Steam turbine's gland sealing transformation	Wet type electrostatic precipitator transformation	Spare part distribution	Special technical improvement		Operation & maintenance	Technical consulting	Financial leasing
Cold side optimization transformation	Low NOx burner transformation		Unit overhaul EPC		Remote diagnosis		Technical training
Front high pressure heater transformation	Air pre-heater associated SCR transformation				Technical consulting		Installation & commissioning
External desuperheater transformation	Flue gas desulfurization capacity expansion transformation				GE9E/6B service		Performance test
Thermodynamic system optimization transformation	Green island package transformation EPC						
Air cooling system transformation							
Subcritical unit across-generation upgrading transformation							
Boiler auxiliary capacity expansion transformation							
Generator auxiliary capacity expansion transformation							
Inverter transformation							
Energy saving package transformation EPC							



## Remote diagnosis

Under the background of quick changing of internet technology and data analysis technique, Shanghai Electric, by combining the modern digital technology and the conventional equipment manufacturing, has created the digital solutions based on the remote operation & maintenance diagnosis platform Ellumix of power plant. Ellumix adopts the mainstream internet technology, provided several flexible remote diagnosis system platform construction schemes, secured safe transmission of remote data and conformance with the requirements of national regulations and industrial specifications, collected, displayed and analyzed the various performance data of equipment. Ellumix remote operation & maintenance diagnosis platform supports the cooperation between PC terminal and mobile terminal, and meets the various demands of users on mastering equipment data.

The digital solutions based on Ellumix remote operation & maintenance diagnosis platform include not only the state monitoring module that utilizes the methods such as artificial intelligence, machine learning, etc., but also the abnormal diagnosis module that solidifies the design, manufacturing, commissioning, diagnosis experts' experiences, and mixes with self-learning, adaptive algorithms, equipment mechanism model basis, and in addition, the operation optimization module for raising the performance of the equipment. Thanks to the long-term equipment design and manufacturing experiences of Shanghai Electric, each function analysis module on the platform can better fit the actual demands of users, and can realize the functions of equipment performance monitoring & analysis, operation optimization scheme design, abnormal fault early warning, etc. The digital solutions of Shanghai Electric can help the users to achieve their demands on more reasonable unit startup and shutdown process, more optimized unit operation performance, faster unit load response, more comprehensive unit health management, etc.

Ellumix remote operation & maintenance diagnosis platform based digital solutions of Shanghai Electric has the high quality expert support team, who provides the users with professional, accurate and timely decisions and suggestions, pursues the more efficient equipment, more accurate operation & maintenance, lower emission and more convenient maintenance together with the users, and promotes the progress of digital level jointly.



— Illuminate the power equipment with platform, and let the machine no longer operate silently —

## Transformation service

### Energy saving package transformation

The transformation scheme takes the steam turbine flow path transformation as the core, applies the flow path package optimization technique (AIBT) of the international advanced level into the subcritical and supercritical steam turbine transformation, and meanwhile performs the corresponding optimization transformation on boiler, generator and related auxiliaries, so that realizes the best fit between three major equipment performances, increases each performance index of the unit to an extreme, and make the operation of the unit more safe and reliable. The energy saving transformation schemes of Shanghai Electric include many ways, such as conventional flow path transformation, heat supply transformation, main steam, reheat steam temperature promotion transformation, subcritical-to-supercritical cross-generation upgrading transformation, etc. The outstanding advantage of the package service of Shanghai Electric is in full integration of various resources, not only can provide the flexible modular menu type services, but also can provide the package transformation EPC service including system technical transformation, feasibility study, cooperation, overhaul, installation, financing, etc.

### Environmental protection package transformation

Shanghai Electric has the national leading and international advanced furnace low NO<sub>x</sub> burner transformation technology, low-low temperature electrostatic precipitator technology, furnace inside and outside de-NO<sub>x</sub> technology, wide load de-NO<sub>x</sub> technology, dust remover technology, and a series of environmental protection transformation technology such as preheater, desulfurization, induced draft fan, etc. It is engaged in providing the users with a whole package of environmental protection transformation services including design, manufacturing, installation and construction. Through the green island package transformation, the pollutant emission level of coal fired unit, such as NO<sub>x</sub>, SO<sub>2</sub>, fume, etc. has reached the emission standard of gas turbine unit. Shanghai Electric will give full play to the environmental protection service package, and provide the customers with high quality environmental protection service products based on the prospective technology, high quality service and scientific project management.

Furnace low NO<sub>x</sub> burner transformation technology

Low-low temperature electrostatic precipitator technology

Furnace inside and outside de-NO<sub>x</sub> technology

Wide load de-NO<sub>x</sub> technology

Dust remover technology

A series of environmental protection transformation technology such as air pre-heater, desulfurization, induced draft fan, etc.



## SERVICE | POWER STATION ENVIRONMENTAL PROTECTION

*Flue gas de-NOx  
technology*

*Dust removal  
technology*

*Flue gas desulfurization  
technology*

*Power station zero liquid  
discharge technology*

*Power station green  
island*



Shanghai Electric is a high and new technology enterprise in Shanghai, established earlier in China, and engaged in desulfurization, de-NOx, electrostatic precipitator and zero liquid discharge project EPC. It has five mainstream wet type desulfurization technology, several flue gas de-NOx technologies, low-low temperature electrostatic precipitator technology and wet type electrostatic precipitator technology.

Shanghai Electric is qualified of class-A certificate for environmental engineering design and first-class certificate for environmental protection construction. It has a high quality personnel team focus on engineering design and project management, and the team has rich research & development, design, construction, commissioning and management experiences, and is capable to provide the users with various businesses such as project EPC, engineering design, scheme consulting, operation & maintenance, etc.



## Flue gas de-NO<sub>x</sub> technology

In order to integrate the environmental protection industry, Shanghai Electric has Shanghai Boiler Works manage the environmental protection business comprehensively. At present, the Company utilizes such main de-NO<sub>x</sub> technologies of low nitrogen burning (LNB), selective non-catalytic reduction (SNCR), selective catalytic reduction (SCR), and the optimized combination of the above-mentioned de-NO<sub>x</sub> technologies, and can provide more coordinated, more reliable de-NO<sub>x</sub> equipment. The capacity of the single unit in the undertaken projects is from 7MW to 1,240MW, and features the technical advantages such as de-NO<sub>x</sub> outside of furnace combined with boiler, ultra-fine ammonia spraying control, diversification of reactor supports and hangers, etc.

### *Typical Project: Huaneng Nantong Power Plant 2×1,000MW Project*

*The de-NO<sub>x</sub> project of Huaneng Nantong Project is one of the numerous 100MW unit de-NO<sub>x</sub> projects of Shanghai Electric, with de-NO<sub>x</sub> efficiency more than 80%, ammonia escape rate less than 3ppm, and SO<sub>2</sub>/SO<sub>3</sub> conversion ratio less than 1%. It is the first project of Shanghai Electric that uses tower furnace dual de-NO<sub>x</sub> reactors, and also a firm step in the product diversification.*

De-NO<sub>x</sub> efficiency  
more than

**80%**

Ammonia escape rate  
less than

**3**  
ppm

SO<sub>2</sub>/SO<sub>3</sub> conversion  
ratio less than

**1%**

## Dust removal technology

In the face of the severe atmospheric environment and the increasingly stricter emission standard, the dust control meeting higher requirement is of great urgency. The dust removal technology of Shanghai Electric, at present, includes low-low temperature electrostatic precipitator system, bag type dust collector, electric bag filter, wet type electrostatic precipitator and other conventional dust removal technology.

### Dry type electrostatic precipitator technology

Shanghai Electric has obtained its dry type electrostatic precipitator technology from the world leading Balcke-Dürr Corporation (German). Balcke-Dürr Corporation, established in 1894, has nearly 100 years' experiences in production and design of dust removers, and be capable to provide excellent construction and transformation services for the whole series of dust remover systems in the thermal power generation, metallurgy, steel, cement industries, etc. It has realized the achievement of more than 2,000 sets in the world, with the maximum installed capacity of 1,100MW and the lowest emission of 6mg/m<sup>3</sup>. The capacity of pulse bag type dust removal unit is up to 800MW.

Shanghai Electric has three proprietary technology in the dust removal products, i.e. Bi-Corona® (dual corona), Delta Wing® (delta wing) and TVS (dual pulse valve), and its products feature various kinds, wide application scope, large installed capacity and good dust removal effect.

Bi-Corona® (dual corona)

Delta Wing® (delta wing)

TVS (dual pulse valve)

### Typical Project: Malaysia Balingian Project

*Malaysia Balingian Project is the first overseas dust removal EP project acquired by Shanghai Electric. The total installed capacity of the project is 2×350MW thermal power units, which is the first project that utilizing circulating fluidized bed boiler in Malaysia, and is also the first step for the dust removal business of Shanghai Electric into the international market.*



### Low-low temperature technology for wet type electrostatic precipitator

Shanghai Electric imported the low-low temperature electrostatic precipitator system technology from Japan in the early 2013, built a professional team, implemented deep analysis and discussion on the low-low temperature electrostatic precipitator system gradually, made the corresponding technical schemes by combining with the coal quality parameters for different sulfur and dust contents in the domestic power plants, researched and developed second technical route independently, developed the energy saving and environmental protection coupling type flue gas waste heat utilization system, and became the company in China that fully mastered the core technology for low-low temperature dust removal.

#### *Typical Project: 2×1000MW Low-low Temperature Electrostatic Precipitator System Transformation Project for Zheneng Jiahua Unit 7&8*

*The flue gas ultra-low emission environmental protection demonstration project of Jiahua 100MW coal fired unit is the first low-low temperature electrostatic precipitator system in China, and also the first environmental protection demonstration project of National Energy Administration. Through low-low temperature system transformation, the dust concentration at the outlet of dry type dust remover in Jiahua Project is reduced to 15mg/Nm<sup>3</sup>, and the dust concentration at the inlet of stack reduced to 5mg/Nm<sup>3</sup>; meanwhile, the temperature of flue gas at the outlet of flue gas heater is increased to 80°C, which effectively prevents the corrosion of the flue gas to the downstream equipment, and eliminates the "gypsum rain" phenomenon. The low-low temperature electrostatic precipitator system combines the energy saving and environmental protection, achieves excellent comprehensive performance, and is the sustainable technology that reflects the requirement to build a resource-saving, environment-friendly society.*

### Wet type electrostatic precipitator technology

The wet type electrostatic precipitator technology of Shanghai Electric is researched and developed by itself, which is leading in China and advanced in the world due to its high flue gas flow and high efficiency. The Company has two kinds of wet type electrostatic precipitator technologies, i.e. vertical and horizontal, which combines with the desulfurization system to achieve "zero" water consumption of the optimized water system. The capacity of the single unit in the undertaken projects is from 300MW to 1,240MW, which, in the conditions of high flue gas velocity, can meet the rust-removal requirement of ultra-low emission.

#### *Typical Project: Ultra-low Emission Transformation Project for Shanghai Baosteel Power Plant*

*The Ultra-low Emission Transformation Project for Shanghai Baosteel Power Plant is the vertical wet type electrostatic precipitator project of Shanghai Electric that is the first one put into operation. The total installed capacity of the Project is 3×350MW thermal power generation units. Unit 1 & 2 adopt the layout by integrating the wet type electrostatic precipitator and the desulfurizing tower, which breaks through the site limit of the transformation project, meanwhile, combine with desulfurization system, to optimize the system and layout, so that achieve 4mg/Nm<sup>3</sup> dust emission concentration at the minimum cost.*

## Flue gas desulfurization technology

Based on the background of long-term professional power station equipment manufacturer, Shanghai Electric can design the FGD system with simpler structure and more reliable quality according to different fuel type design. It takes into full consideration of flue gas amount and design conditions, optimizes the flue gas treatment system, and realizes the minimum construction and operation cost. At present, the main desulfurization technologies adopted by Shanghai Electric includes limestone-gypsum method, magnesium method, ammonia method, sodium method and seawater method, and the capacity of the single unit in the undertaken projects is from 50MW to 1,240MW.

### *Typical Project: Anhui Huaibei Pingshan Project*

*Anhui Huaibei Pingshan Project is the ultra-clean emission project undertaken by Shanghai Electric. The Project is for ultra-supercritical coal fired units with total installed capacity of 2~660 MW and with SO<sub>2</sub> and NO<sub>x</sub> emission concentration no more than 20mg/m<sup>3</sup>. The desulfurization uses the single-tower high-efficient desulfurization technology that is independently researched and developed on the basis of the original single-tower desulfurization technology, with the desulfurization efficiency up to 99%, which is the leading level in China.*

## Power station zero liquid discharge technology

Shanghai Electric has started the design and research of zero liquid discharge system technology since years ago, and has applied for several patents. At present, it has formed a series of design standards, and can realize different technical routes such as industrial salt output, carnallite output, no salt output, etc., to meet the different demands of the government and the owners.

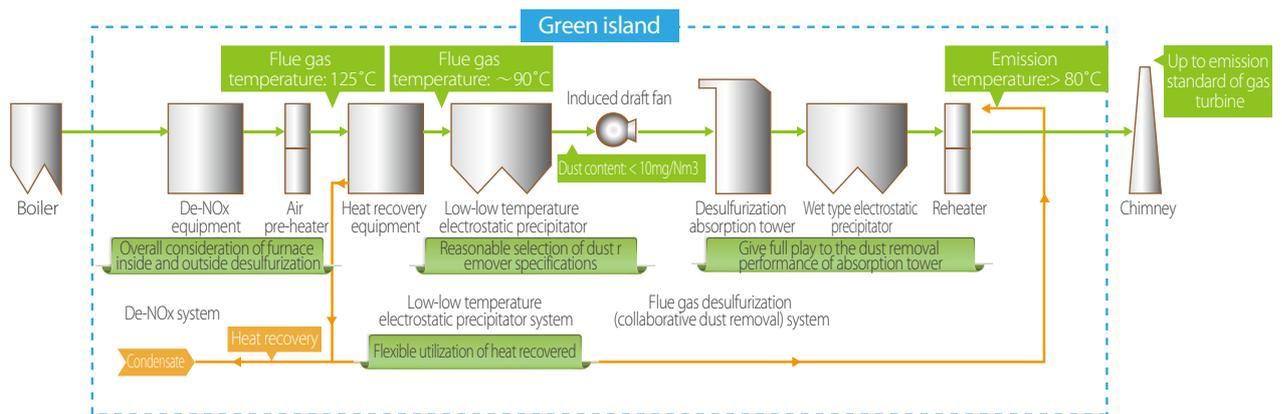
### *Typical Project: Desulfurization Wastewater Treatment System Project of Unit 5 & 6 (2×1240MW) in Guangdong Huaxia Yangxi Power Plant Phase II Project*

*The total wastewater amount of Yangxi Power Plant Wastewater Project is 68t/h, including 20t/h desulfurized wastewater generated by Unit 1, 2, 3 & 4 constructed, and 48t/h desulfurized wastewater generated by Unit 5, 6, 7 & 8 under construction and to be constructed. This desulfurized wastewater project is the one that processes the maximum desulfurized wastewater amount in China at present, and also the first expansion project of zero liquid discharge business of Shanghai Electric.*



## Power station green island

The scope of the power station green island is from the flue gas outlet of the boiler to the inlet of the stack, and mainly includes desulfurization (collaborative dust removal), de-NO<sub>x</sub>, low-low temperature electrostatic precipitator system and wet type electrostatic precipitator system at present; based on the original single technology, provide the customers with boiler island package ultra-clean emission (NO<sub>x</sub>≤50mg/Nm<sup>3</sup>, SO<sub>x</sub>≤35mg/Nm<sup>3</sup>, dust≤5mg/Nm<sup>3</sup>) solutions, in order to achieve the purposes of more optimal performance of environmental protection equipment, lower operation energy consumption, more reliable of system operation, smaller floor area and lower overall construction cost, and according to the different requirements of the customers, adjust the scheme to meet the multiple requirements on energy saving and emission reduction.



### Typical Project: Green Island of Guangdong Yangxi 2×1240MW Project

The green island project of unit 5 & 6 (2×1240MW) in Guangdong Huaxia Yangxi Power Plant Phase II Project is the first and also the largest ultra-clean emission green island integration system that is actually applied in the power plant in China. Each equipment in the system has been taken into overall consideration to ensure the system operating at the best performance point; the environmental protection system has utilized the low-low temperature electrostatic precipitator and high efficient desulfurization technology, to recover heat, save coal consumption, save water, and reduce operation power consumption. The green island has combined the desulfurization and wet type electrostatic precipitator water system, to reduce the wastewater discharge of the island.



## Enterprise directory

Shanghai Electric Power Generation Group

Shanghai Electric Power Generation Equipment Co., Ltd.

Shanghai Electric Power Generation Equipment Co., Ltd. Turbine Works

Shanghai Electric Power Generation Equipment Co., Ltd. Turbine Generator Works

Shanghai Electric Power Generation Equipment Co., Ltd. Power Station Auxiliary Equipment Works

Shanghai Boiler Works Co., Ltd.

Shanghai Electric Group Shanghai Electric Machinery Co., Ltd.

Shanghai Electric Gas Turbine Co., Ltd. (China)

Shanghai Electric Power Generation Engineering Company

Shanghai Electric Power Generation Service Company

Shanghai Electric Power Generation Environment Protection Engineering Co., Ltd.

Shanghai Electric SPX Engineering&Technology Co., Ltd.

Shanghai Electric BrightSource Solar Energy Co., Ltd.

Shanghai Electric Fuji Electric Power Technology Co, Ltd.

Shanghai Electric Blower Works Co., Ltd.

Shanghai Electric SHMP Pulverizing & Special Equipment Co., Ltd.

Shanghai Electric Power Generation Technology Research & Development Center

Lingang Production Base of Shanghai Electric Power Generation Group



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