



核 电
Nuclear Power

Shanghai Electric is one of the leading comprehensive nuclear equipment manufacturing conglomerate with the longest history, the richest experience and the widest product scope in China.



核电综述

NUCLEAR POWER BUSINESS

上海电气是国内核电制造领域中历史最久、业绩最多、配套最全的制造集团之一。



经过三十多年发展，上海电气的核电设备制造产业链包括核岛的压力容器、蒸汽发生器、稳压器、堆内构件、控制棒驱动机构、主泵到核二、三级泵、核二、三级容器和装卸料机，到常规岛的汽轮机、汽轮发电机和主要辅机，以及大型铸锻件和仪控仪表等。

After the latest 30 years' development, Shanghai Electric nuclear supply chain covers reactor pressure vessel(RPV), steam generator(SG), pressurizer(PZ), reactor vessel internal(RVI), control rod drive mechanism(CRDM), reactor coolant pump(RCP), class 2 & 3 pump, class 2 & 3 vessel and fuel handling machine in nuclear island, turbine, turbine-generator and main auxiliary equipment in conventional island, large nuclear castings & forgings, and nuclear control & instrumentation etc.

上海电气核电产品技术涵盖300MW、600MW到1000MW等级的二代加和三代压水堆核电技术，包括AP1000、EPR和CAP1400、华龙一号以及具有第四代核电技术特征的高温气冷堆技术等。

上海电气已成功实现了二代加及三代AP1000核电主设备产品的批量化、配套化交付。与此同时，响应国家“核电装备走出去”战略发展要求，2015年，上海电气与全球核电巨头AREVA集团合作，承担了南非Keoberg核电站6台更换蒸汽发生器的设备供货任务，标志着上海电气核岛主设备供货在出口巴基斯坦基础上有了新的国际起步。

Shanghai Electric's nuclear technology ranges from 300MW, 600MW to 1000MW of the 2nd generation plus to the 3rd generation types including AP1000, EPR, CAP1400, HuaLong-1, and High Temperature Reactor with the 4th generation characteristics.

Shanghai Electric has realized the mass production and complete set delivery of nuclear major equipment with the 2nd generation plus or the 3rd generation technology. Meanwhile, as a response to the government call, "Nuclear Power Equipment Going Abroad" development strategy, Shanghai Electric signed the subcontract with AREVA, the global famous nuclear group in 2015 to manufacture 6 replacement steam generators for Keoberg nuclear power station in South Africa. It marks that Shanghai Electric has a new step in international nuclear major equipment export after Pakistan's project.

核电组织 机构 ORGANIZATION

上海电气共有14家生产核
电产品的企业

Shanghai Electric has 14 subsidiary
companies to supply nuclear power
equipment.



上海电气核电设备有限公司
Shanghai Electric Nuclear Power Equipment Co., Ltd.

上海电气凯士比核电泵阀有限公司
SEC - KSB Nuclear Power Pumps & Valves Co., Ltd.

上海第一机床厂有限公司
Shanghai No. 1 Machine Tool Works Co., Ltd.

上海核电技术装备有限公司
Shanghai Nuclear Power Technology Equipment Co., Ltd.

上海电气核电集团
Shanghai Electric
Nuclear Power
Group

上海重型机器厂有限公司
Shanghai Heavy Machinery Plant Co., Ltd.

上海电气重工集团
Shanghai Electric
Heavy Industry
Group



上海电气电站设备有限公司汽轮机厂
Shanghai Electric Power Generation
Equipment Co., Ltd. Turbine Works

上海电气电站设备有限公司发电机厂
Shanghai Electric Power Generation
Equipment Co., Ltd. Generator Works

上海电气电站设备有限公司电站辅机厂
Shanghai Electric Power Generation Equipment
Co., Ltd. Power Station Auxiliary Equipment Works

上海电气集团上海电机厂有限公司
Shanghai Electric Group Shanghai
Electric Machinery Co., Ltd.

上海电气电站工程公司
Shanghai Electric Power Generation Engineering Company

上海电气电站服务公司
Shanghai Electric Power Generation Service Co., Ltd.

其它配套企业
Others

上海自动化仪表股份有限公司
Shanghai Automation
Instrumentation Co., Ltd.

上海鼓风机厂有限公司
Shanghai Blower Works Co., Ltd.



上海电气
Shanghai Electric



核电产品

NUCLEAR POWER PRODUCTS



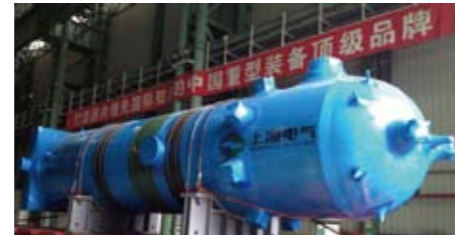
驱动机构
Control Rod
Drive Mechanism



堆内构件
Reactor Vessel Internals



压力容器
Reactor Pressure Vessel



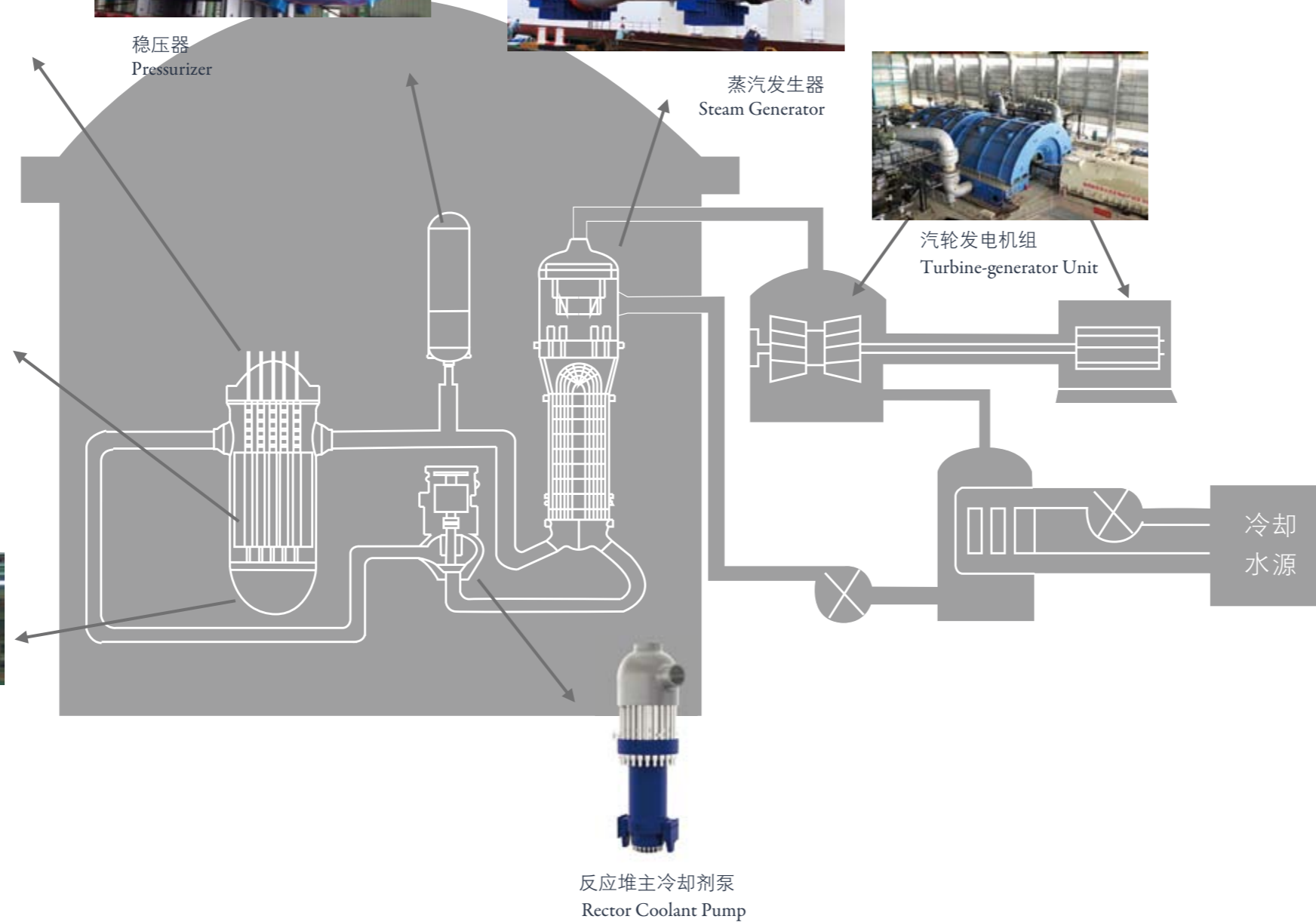
稳压器
Pressurizer



蒸汽发生器
Steam Generator



汽轮发电机组
Turbine-generator Unit



反应堆主冷却剂泵
Reactor Coolant Pump



核二三级泵
Class 2 & 3 Pump



装卸料机
Fuel handling Machine



核二三级容器
Class 2 & 3 Vessel



热交换器
Heat Exchanger



核电锻件
Forgings



仪器仪表
Instrumentation



基地介绍

BASES

三个 “世界之最”

The Three World's Records



临港基地

Lingang Heavy Equipment Manufacture Base



临港基地是上海电气新建的特大、特重、超限装备的制造基地，临港基地一期工程于2008年投产，并于当年出产蒸汽发生器等一批重型设备。临港基地二期扩能规划于2009年7月正式启动，2011年底完成。具备年产10套堆内构件和控制棒驱动机构、6套压力容器和蒸汽发生器、12台核电主泵、32台/套核二、三级泵、6套常规岛半速汽轮机发电机组的制造能力。通过百万千瓦级核电汽轮机低压焊接转子、套装转子等技术改造项目，已形成年产12根低压焊接转子、5根套装转子的生产能力。

Lingang base is a super large, heavy and over limited equipment manufacture base. Lingang base phase I operated in 2008 and is symbolized with the delivery of steam generator and other heavy components. Lingang base phase II extension started construction on July 2009 and ended at the end of 2011. It has the manufacturing capacity of annually 10 sets of reactor vessel internals and 10 sets of control rod drive mechanism, 6 sets of reactor pressure vessel and steam generator, 12 reactor coolant pump, 32 class 2 & 3 pumps and 6 sets of half-speed turbine-generator unit. Meanwhile, Shanghai Electric has the capacity of 12 low pressure welded rotors and 5 shrunk on rotors annually through a technique-reforming project regarding the low pressure welded rotor and shrunk on rotor for 1000MW class nuclear turbine.

闵行基地

Minhang Base

上海电气完成了核级大型铸锻件能力的改造，以满足包括三代技术在内的百万千瓦级核电主设备向超大、超重、高技术发展的大型铸锻件需求。创造了三个“世界之最”：世界最大的1.65万吨自由锻造油压机、250吨/630吨·米锻造操作机和450吨电渣重熔炉。实现铸锻件最大钢锭600吨、最大铸件450吨、最大锻件350吨；可年产6套1000MW级核岛容器类重型设备（压力容器、蒸发器、稳压器和主管道）配套锻件、25套1000MW反应堆堆内构件锻件。

Shanghai Electric completed the capacity improvement of large nuclear castings and forgings to meet the requirements of 1000MW nuclear major equipment, including the 3rd-generation type, with the development trend of super large, super heavy and high technology level. It created three world records, the world largest 16500 tons oil press, 250 tons/630 tons-m manipulator and 450 tons electro slag remelting furnace. It can provide the ingot of maximum 600 tons, casting of maximum 450 tons and single forging of maximum 350 tons, and has the annual capacity to manufacture forgings for 6 sets of 1000MW class nuclear island heavy equipment referred to reactor pressure vessel, steam generator, pressurizer and main pipe, and for 25 sets of reactor vessel internals

产品介绍 PRODUCTS

核岛 Nuclear Island



百万千瓦级压力容器、蒸汽发生器、稳压器 1000MW Reactor Press Vessel, Steam Generator, Pressurizer



上海电气已实现三代AP1000百万千瓦级核岛重型容器—压力容器、蒸汽发生器、稳压器、堆芯补水箱和EPR蒸汽发生器等设备的交付，标志着上海电气已完全具备了三代百万千瓦级核岛重型容器的国产化能力，实现了核岛重型容器制造能级从60万千瓦到100万千瓦、技术能级从二代加到三代技术的重大突破。

目前上海电气正在加紧国内自主三代的CAP1000、CAP1400示范电站和200MW高温气冷堆的设备加工。出口南非Koeberg核电站的6台蒸汽发生器也将投产制造，走出国门。

Shanghai Electric has realized the delivery of the 3rd generation AP1000 nuclear island heavy components—reactor pressure vessel, steam generator, pressurizer, core coolant tank and EPR steam generator etc. It marks Shanghai Electric has the localization capability to manufacture the 3rd generation 1000MW class heavy components of nuclear island and realized the two important breakthroughs, both in manufacturing capability from 600MW to 1000MW class and technology from the 2nd generation to the 3rd generation.

At present Shanghai electric is stepping up the components manufacturing of domestic independent 3rd generations including CAP1000 and CAP1400, and 200MW high temperature reactor. The six steam generators export to Koeberg nuclear power station in South Africa will also be put into manufacturing in this year.

堆内构件和控制棒驱动机构 Reactor Vessel Internals & Control Rod Drive Mechanism



上海电气已成功实现300MW、600MW、1000MW等级堆内构件及控制棒驱动机构的批量化交付，市场占有率95%以上。

2015年上海电气将完成AP1000国产化依托项目和EPR台山项目的堆内构件和控制棒驱动机构的加工，实现向三代核电的全面过渡；200MW石岛湾高温气冷堆项目也有望首台完工。CAP1400示范电站、华龙一号等自主三代项目也已陆续开工。

Shanghai Electric has realized the mass delivery on 300MW, 600MW and 1000MW class reactor vessel internals and control rod drive mechanism and hold more than 95% market share.

In 2015 Shanghai Electric will finish reactor vessel internals and control rod drive mechanism manufacturing of localized AP1000 supporting project and EPR project. It marks Shanghai Electric achieves the full transition to 3rd generation. 200MW ShiDao Bay HTR project unit 1 is expected to be completed in this year. CAP1400 and HuaLong I etc., the localized 3rd generation projects, has been started one by one.

产品介绍 PRODUCTS

核岛 Nuclear Island

常规岛 Conventional Island

汽轮发电机组 Turbine-generator Unit

上海电气提供为阳江核电站提供6套百万千瓦级汽轮发电机组。阳江1号机组已于2014年3月25日投入商业运行，发电负荷达1104MW，该汽轮发电机组的性能大大超过同类其它产品。

Yangjiang unit-1 has been in commercial operation since Mar. 25th 2014, which is one of the 6 turbine-generator unit orders Shanghai Electric got. The output power can reach as high as 1104MW. It shows that the turbine-generator unit is more efficient than any other same products.



焊接转子 Welded rotor

上海电气拥有50余年焊接转子的研究开发和生产应用史，拥有比较完备健全的焊接转子结构设计、强度分析、焊缝设计、焊接工艺和焊接设备、材料技术、无损检测、转子安全性评价等技术体系。2008年上海电气实现了异种钢转子的焊接；2009年实现了超超临界百万等级火电汽轮机低压转子焊接生产制造；2010年实现了AP1000核电低压试验转子的焊接制造。至今上海电气已累计焊接各类转子467根，其中432根已经投入商业运行。百万千瓦等级核电汽轮机低压试验转子的焊接制造已完成，各项指标均满足产品设计要求，现已应用于采用华龙一号技术的巴基斯坦卡拉奇项目。

Shanghai Electric has over fifty years' history in the field of researching and producing of welded rotors, and Shanghai Electric also has a rounded system for welded rotors' structural design and strength analysis, welding joint design, welding technology, welding equipment, welding material technology, nondestructive examination, rotor safety evaluation and so on. In 2008 Shanghai Electric developed the technology of welding between different kinds of steels. In 2009 Shanghai Electric began to produce low pressure welded rotors for ultra-super critical turbine of 1000MW class. In 2010 Shanghai Electric produced a test welded rotor for AP1000 nuclear power plant. Up to the present, Shanghai Electric have supplied 467 different kinds of welded rotors to the customer, among which 432 rotors have been put into commercial operation. The low pressure welded test rotor of 1000MW class nuclear steam turbine has been finished manufacturing and each index meets the requirement of product design, which has been used for Hualong-1 Karachi project in Pakistan.

核电主泵 Reactor Coolant Pump

上海电气引进德国KSB集团先进的主泵技术，提供具有国际领先技术水平的轴封型主泵及湿绕组电机主泵。为昌江核电站提供的4台轴封型主泵已于2015年交付现场。为CAP1400示范工程提供的4台湿绕组主泵已开工，样机试验将在2015年完成。上海电气正在积极研发CAP1000/CAP1700 50Hz湿绕组电机主泵，努力开拓新的核主泵市场。

Shanghai Electric introduced KSB AG's advantage reactor coolant pump technology and provides RCP and RUV with the international leading technology. Shanghai Electric delivered 4 RCPs for Changjiang nuclear power station in 2015. 4 RUVs for CAP1400 project have already started to manufacturing and prototype test will be finished in 2015. Shanghai Electric is actively developing CAP1000/CAP1700 50Hz RUV and efforts to develop new nuclear power reactor coolant pump market.



产品介绍 PRODUCTS

常规岛
Conventional Island



低压长叶片 Low Pressure Long Blade

上海电气建立了排汽面积按一定比例间隔配置的低压长叶片模块系列，开发了排汽面积为20m²的1420mm高度末叶片、排汽面积为26m²的1710mm高度末叶片以及排汽面积为30m²的1905mm高度末叶片。可满足现有百万级以上压水堆、各种背压机组的配置要求。

Shanghai Electric develop low pressure long blade series whose exhaust areas conform to certain proportion interval configuration and developed 1420mm blade with exhaust area 20 square meters, the 1710 mm blade with exhaust area of 26 square meters and the 1905 mm blade with exhaust area of 30 square meters, which can meet the configuration requirement of over 1000MW class pressure water reactor, and various kinds of back pressure units.

核电仪控仪表 Control and Instrumentation

上海电气提供了近10万台核电仪表和盘箱柜、近百套各类核电系统装置给秦山核电、大亚湾核电、岭澳核电、田湾核电、红沿河核电、宁德核电、阳江核电、台山核电、防城港核电、昌江核电、方家山核电、福清核电、巴基斯坦恰希玛核电站、AP1000依托项目（三门核电、海阳核电）以及清华大学高温气冷堆、中国实验快堆、中国先进研究堆等试验堆工程项目。上海电气正通过对第三代核电技术的消化、吸收和国债项目“大型压水堆核电站全数字化仪控系统及核电调节阀类产业化”的实施，开发新一代系统与仪表。项目完成后具备提供大型压水堆核电站数字化控制系统与保护系统平台、自主知识产权的核电专用系统装置以及核级仪表、核级盘箱柜、核电调节阀类系列（核级电动执行机构与核级调节阀）等产品能力。

Shanghai Electric has supplied more than hundred thousands of nuclear instruments and cabinets, and nearly one hundred of nuclear system devices successfully used in plenty of nuclear power plants, such as Qingshan, Daya Bay, Pakistan Chashma, AP1000 Sanmen and Haiyang, and Tsinghua University HTR, CEFR and CARR etc. Shanghai Electric is developing new generation of control systems and instruments by assimilation and absorption of the third-generation AP1000 technology and implementing the national debt project - "New complete digital control system and control valve industrialization for the large-scale PWR nuclear power plant". After the completion of the project, Shanghai Electric will have the capability to supply the digital control system and protection system platform for the large size PWR nuclear power plant, and special control device with independent intellectual property rights, control valves for nuclear power plant (motor actuator in nuclear level and control valve in nuclear level).



设备名称 Product	数量 Quantity	项目名称 Project
堆内构件 Reactor Internals	300MW堆内构件 300MW Reactor Internals	4套 sets 秦山、恰西玛C1、C2、C3 Qinshan, Chashma I, II, III
	600MW堆内构件 600MW Reactor Internals	5套 sets 秦山二期、秦山二期扩建、昌江 Qinshan-II, Qinshan-II Extension, Changjiang
	1000MW堆内构件 1000MW Reactor Internals	20套 sets 岭澳一期、岭澳二期、红沿河、宁德、阳江、福清、方家山 Lingao, Lingao II, Hongyanhe, Ningde, Yangjiang, Fuqing, Fangjashan
	10MW高温气冷堆堆内构件 10MW HTR Reactor Internals	11套 sets 高温气冷堆 Tsinghua HTR
	小计 Total	30套 Sets
控制棒驱动机构 Control Rod Drive Mechanism	300MW控制棒驱动机构 300MW CRDM	4套 sets 秦山、恰西玛一期、二期、秦山顶盖更换项目 Qinshan, Chashma I, II, Qinshan Upper Head Replacement Project
	600MW控制棒驱动机构 600MW CRDM	6套 sets 秦山二期、秦山二期扩建、昌江 Qinshan-II, Qinshan-II Extension, Changjiang
	1000MW控制棒驱动机构 1000MW CRDM	19套 sets 岭澳一期、岭澳二期、福清、方家山、阳江、红沿河、宁德、三门、海阳 Lingao, Lingao-II, Fuqing, Fangjashan, Yangjiang, Hongyanhe, Ningde, Sanmen, Haiyang
	10MW高温气冷堆控制棒驱动机构 10MW CRDM for HTR	1套 sets 高温气冷堆 Tsinghua HTR
小计 Total	30套 Sets	
压力容器 Reactor Pressure Vessel	600MW压力容器 600MW Reactor Pressure Vessel	3台 Units 秦山二期、昌江 Qinshan-II, Changjiang
	1000MW压力容器 1000MW Reactor Pressure Vessel	2台 Units 宁德、海阳 Ningde, Haiyang
	10MW高温气冷堆压力容器 10MW Reactor Pressure Vessel for HTR	1台 Unit 高温气冷堆 Tsinghua HTR
	小计 Total	6台 Units

设备名称 Product	数量 Quantity	项目名称 Project
蒸汽发生器 Stream Generator	300MW蒸汽发生器 300MW Stream Generator	4台 units 秦山核电站、恰西玛C1 Qinshan, Chashma I
	600MW蒸汽发生器 600MW Stream Generator	8台 units 秦山二期、秦山二期扩建、昌江 Qinshan-II, Qinshan-II Extension, Changjiang
	1000MW蒸汽发生器 1000MW Stream Generator	30台 units 红沿河、宁德、方家山、阳江、台山、三门、海阳 Hongyanhe, Ningde, Fangjashan, Yangjiang, Sanmen, Haiyang
	10MW高温气冷堆蒸汽发生器 10MW Stream Generator for HTR	1台 Unit 高温气冷堆 Tsinghua HTR
	小计 Total	43台 Units
稳压器 Pressurizer	300MW稳压器 300MW Pressurizer	3台 units 秦山、恰西玛C1、C2 Qinshan, Chashma I, II
	600MW稳压器 600MW Pressurizer	1台 Unit 秦山二期 Qinshan-II
	1000MW稳压器 1000MW Pressurizer	3台 Unit 红沿河、三门 Hongyanhe, Sanmen
	小计 Total	7台 Units
主泵 Reactor Coolant Pump	600MW主泵 600MW Reactor Coolant Pump	4台 Units 昌江 Changjiang
	小计 Total	4台 Units
汽轮机 Turbine	300MW汽轮机 300MW Turbine	5台 Units 秦山、恰西玛C1、C2、C3、C4 Qinshan, Chashma I, II, III, IV
	1000MW汽轮机 1000MW Turbine	6台 Units 阳江、防城港 Yangjiang, Fangchenggang
	小计 Total	11台 Units
发电机 Generator	300MW发电机 300MW Generator	5台 Units 秦山、恰西玛C1、C2、C3、C4 Qinshan, Chashma I, II, III, IV
	600MW发电机 600MW Generator	2台 Units 秦山二期扩建 Qinshan-II Extension
	1000MW发电机 1000MW Generator	6台 Units 阳江核电站、防城港 Yangjiang, Fangchenggang
	小计 Total	13台 Units

核电业绩

PERFORMANCE

截至2015年3月底 until March 2015

Shanghai Electric
Nuclear Power

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设备名称 Product	数量 Quantity	项目名称 Project
核二三级容器 Class II & III Vessel	安注箱 Accumulator Tank	16台 Units 三门、海阳、台山 Sanmen, Haiyang, Taishan
	正常余热排出热交换器 Residual Heat Removal Heat Exchanger	8台 Units 三门、海阳 Sanmen, Haiyang
	其它核二三级容器 Others	1536台 Units 岭澳、秦山、红沿河、宁德、福清、阳江、防城港等 LingAo, Qinshan, Hong Yanhe, Ningde, Fuqing, Yangjiang, Fang Chenggang etc.
	小计Total	1560台 Units
常规岛辅机 Auxiliary Equipment	高压加热器 High Pressure Heater	29套 Sets 岭澳、秦山、红沿河、宁德、福清、方家山、昌江、海阳、恰希玛等 LingAo, Qinshan, Hong Yanhe, Ningde, Fuqing, Fang Jiashan, Changjiang, Haiyang, Chashma etc.
	低压加热器 Low Pressure Heater	27套 Sets 岭澳、秦山、红沿河、宁德、福清、方家山、昌江、海阳、恰希玛等 LingAo, Qinshan, Hong Yanhe, Ningde, Fuqing, Fang Jiashan, Changjiang, Haiyang, Chashma etc.
	小计Total	56套 Sets
	除氧器 Oxygen Extractor	31台 Units 岭澳、秦山、海阳、福清、方家山、阳江、昌江、恰希玛等 LingAo, Qinshan, Haiyang, Fuqing, Fang Jiashan, Changjiang, Chashma etc.
	凝汽器 Steam Condenser	13台 Units 秦山、阳江、防城港、恰希玛等 Qinshan, Yangjiang, Fang Chenggang, Chashma etc.
	汽水分离再热器 Moisture Separator Reheater	13台 Units 秦山、阳江、防城港、恰希玛等 Qinshan, Yangjiang, Fang Chenggang, Chashma etc.
小计Total	57台 Units	

设备名称 Product	数量 Quantity	项目名称 Project
装卸料机 Fuel Handling Machine	300MW装卸料机 300MW Fuel Handling Machine	3台 Units 秦山、巴基斯坦恰希玛C1、C2 Qinshan, Chashma I, II
	600MW装卸料机 600MW Fuel Handling Machine	4台 Units 秦山二期、秦山二期扩建 Qinshan-II, Qinshan-II Extension
	1000MW装卸料机 1000MW Fuel Handling Machine	9台 Units 宁德、福清、三门 Ningde, Fuqing, Sanmen
	小计Total	16台 Units
环行起重机 Polar Crane	1000MW环行起重机 1000MW Polar Crane	4台 Units 韩国新谷里核电站 Korea Shin-Kori
	小计Total	4台 Units
仪控仪表 Control and Instrumentation	300MW、600MW、700MW、1000MW核电站仪控仪表 300MW、600MW、700MW、1000MW Control and Instrumentation	逾万台 more than 10,000 秦山、秦山二期、秦山二期扩建、秦山三期、巴基斯坦恰希玛一期、二期、岭澳一期、岭澳二期、田湾、红沿河、宁德、阳江、方家山、福清、三门、海阳等 Qinshan, Qinshan-II, Qinshan-II Extension, Qinshan-III, Chashma, Chashma-II, Lingao, Lingao-II, Tianwan, Hongyanhe, Ningde, Yangjiang, Fangjiashan, Fuqing, Sanmen, Haiyang

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