上海电气 与创造者共创未来

SHANGHAI ELECTRIC

CREATE OUR FUTURE TOGETHER

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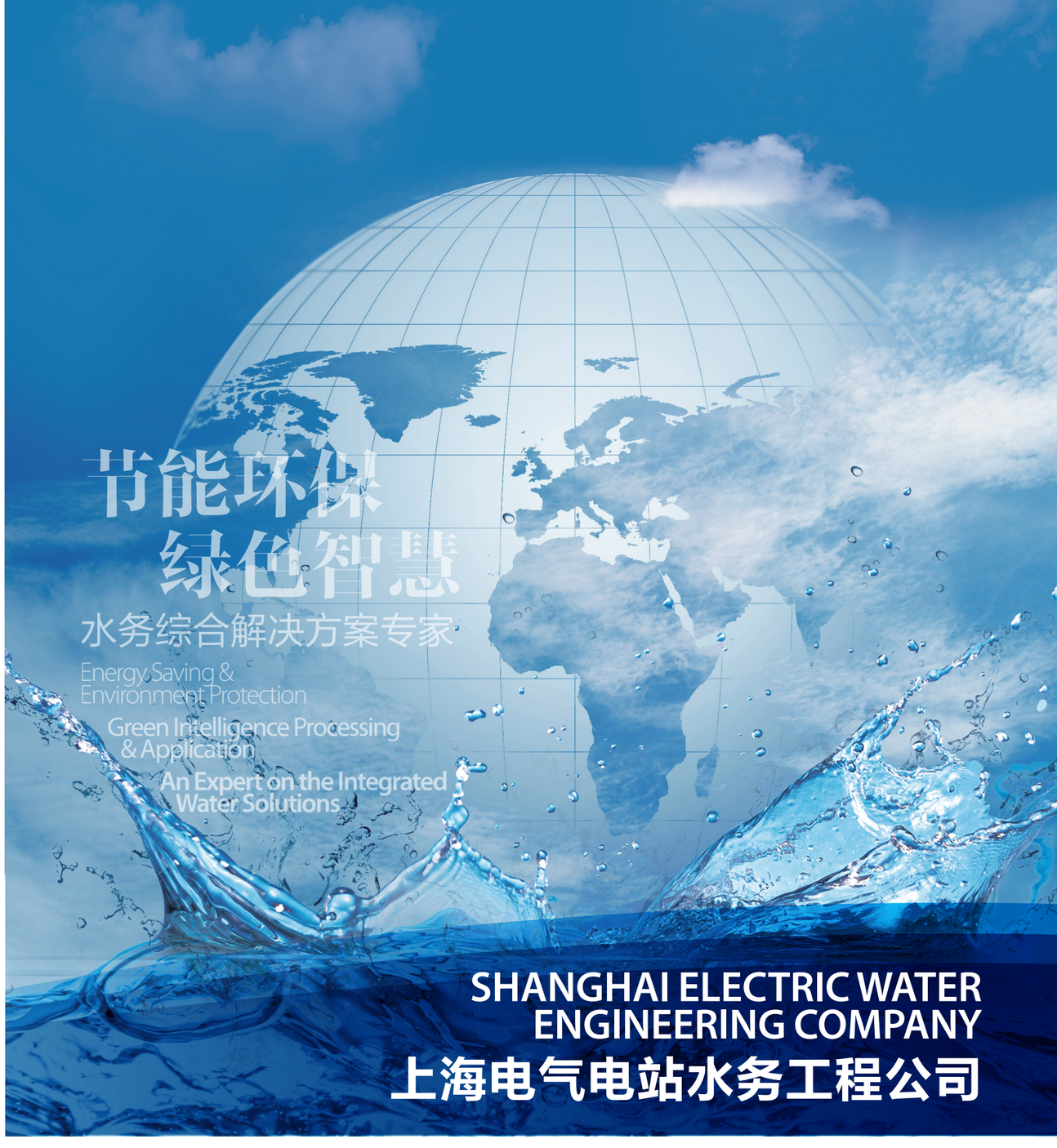


WWW.SHANGHAI-ELECTRIC.COM

上海电气
SHANGHAI ELECTRIC

SHANGHAI ELECTRIC CREATE OUR FUTURE TOGETHER

AN EXPERT ON THE INTEGRATED
WATER SOLUTIONS
水资源综合解决方案

绿水青山 美好生活
BETTER WATER BETTER LIFE

专心致志于水 极致服务于水
FOCUSING ON WATER AND SERVING CUSTOMERS WITH PERFECTION

CONTENTS 目录

COMPANY PROFILE
公司介绍

上海电气是一家大型综合性装备制造集团，主导产业聚焦能源装备、工业装备、集成服务三大领域，致力于为客户提供绿色、环保、智能、互联于一体的技术集成和系统解决方案。产品包括火力发电机组（煤电、气电）、核电机组、海水淡化与废水处理装置、风力发电设备、输配电设备、环保设备、自动化设备、电梯、轨道交通和机床等。

上海电气电站水务工程公司以脱盐技术为核心，过去十多年一直致力于海水淡化与废水处理技术的研发和应用，为用户提供EPC、BOO、BOT等模式的个性化水务综合解决方案。公司目前已拥有多效蒸馏、反渗透、纳滤、离子交换、电去离子、载气萃取和蒸发结晶等多种脱盐技术，为国内外电力、钢铁、石化和水泥等多个行业客户提供一站式淡水资源解决方案，累计工程业绩总规模达37万吨/日，处于国内领先地位。2018年，上海电气进入国际脱盐协会（IDA）评出的全球前十大海水淡化与水再利用项目开发商。

上海电气电站水务工程公司持续储备和自主研发海水淡化与废水处理技术，已攻克多项海水淡化与废水处理领域的核心技术瓶颈，形成了一批具有自主知识产权的科研成果。目前公司成功开发8个专业计算软件、建立5个数据库、搭建5个实验平台、获得授权专利9项、制定12项企业标准，研发成果处于国内领先水平。

Shanghai Electric is a large integrated equipment manufacturing group specialized in energy equipment, industrial equipment and integration services. It is committed to providing customers with solutions to technology integration and systems incorporating green, eco-friendliness, intelligence and Internet. Its products include thermal generator set (coal power, gas power), nuclear power units, seawater desalination and water treatment equipment, wind power equipment, power transmission and distribution equipment, environmental protection equipment, automation equipment, elevators, rail transit, machine tools, etc.

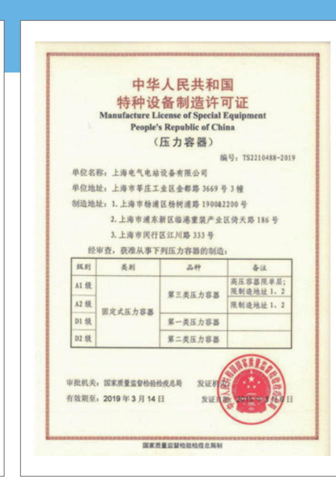
Shanghai Electric Water Engineering Company (SEWE) has been engaged in continuous technical innovation in core desalination technologies. In the past more than ten years, SEWE devoted to the R&D and applications of seawater desalination and industrial wastewater and has the ability to provide services including EPC, BOO, BOT, etc. So far SEWE has owned different desalination technologies in the field of seawater, wastewater and boiler feed water such as MED, RO, NF, IX, EDI, CGE MVR and TVR. The total project capacity is up to 370000 t/d by the end of 2018. In the year 2018, Shanghai Electric was listed in the top 10 project developers of seawater desalination and water reclamation by International Desalination Association (IDA).

SEWE focuses on R&D for seawater desalination and wastewater treatment technology innovation and engineering application. SEWE has made a breakthrough in several key desalination technologies and gained many achievements in intellectual property rights through continuous technical accumulation and improvement. So far SEWE has successfully completed and developed 8 professional computation software, 5 databases, 5 experimental platforms, 9 patents 12 internal company standards.

上海电气为海水淡化与废水处理提供了从技术研发设计、产品制造到项目建设及商业运行模式等全方面的硬件、软件支持。

Shanghai Electric has provided the technology R&D , product manufacture , project management , market sales mode and commercial capital chain , and other aspects of the hardware and software support.

研发 Research → 设计 Design → 制造 Manufacture → 建设 Build → 服务 Service



健全的质量服务保证

PERFECT QUALITY ASSURANCE AND SERVICE GUARANTEE

工业服务将助您充分挖掘潜能。我们可提供涵盖整个项目与设备生命周期的全面而广泛的产品、系统和服务产品，从规划设计、操作运行一直到后期的升级改造。全面提升机组运行的可靠安全性，降低能量消耗，帮助客户有效降低工厂运营成本，实现节能目标，提高竞争力。

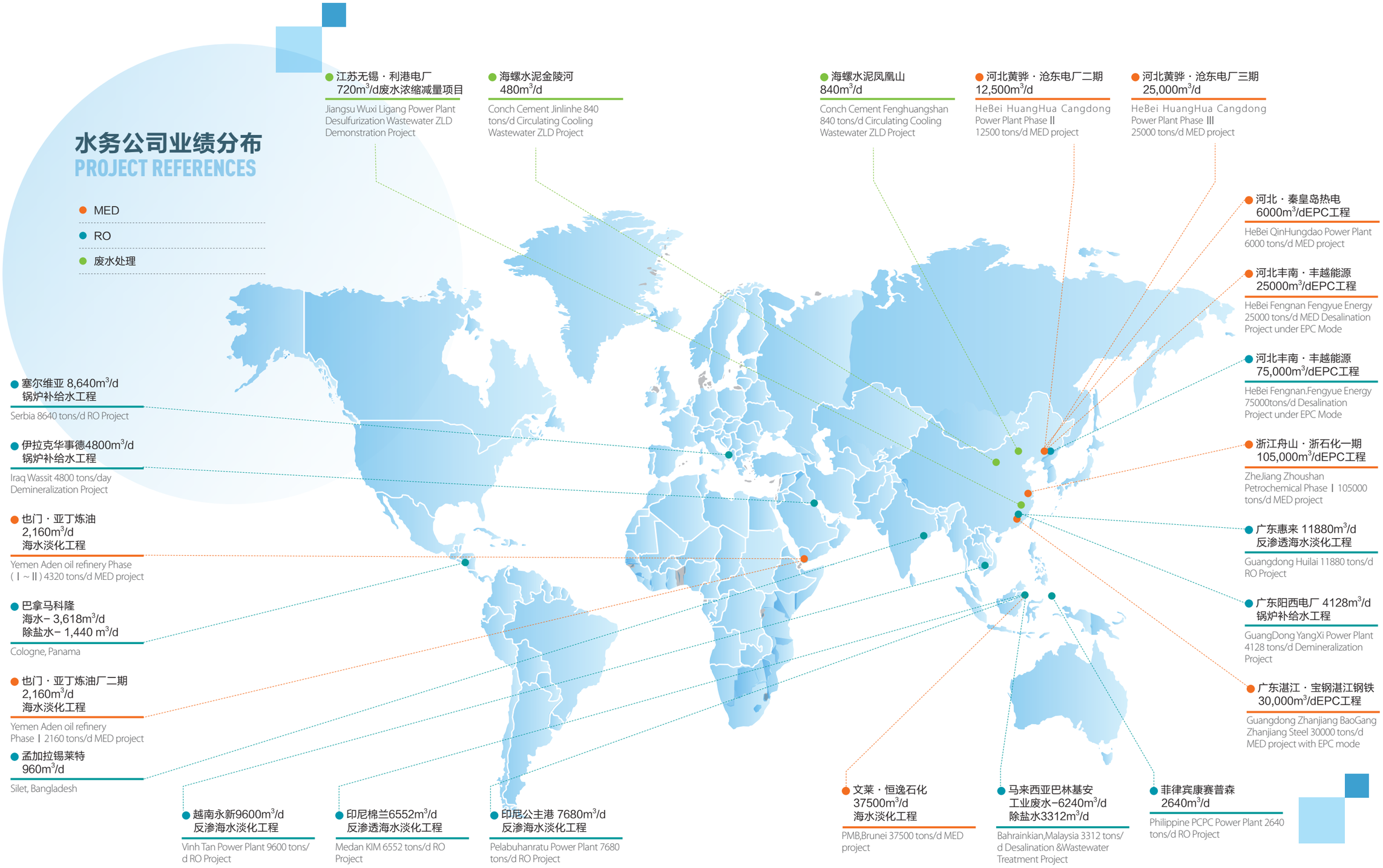
Industrial services will help you fully exploit potential. We can offer a comprehensive and extensive product, process system and service that covers the entire project and equipment lifetime, from the planning and design, operation until the subsequent upgrade. We can comprehensively enhance the reliability of unit operation, reduce energy consumption, help customers effectively reduce OPEX, achieve saving-energy goals, improve competitiveness.

专利清单 PATENT LIST

专利名称	专利号/登记号	类型
一种海水淡化蒸发器管束横套装置 A process for installation of horizontal heat exchange tube bundle for MED evaporator. Patent for utility models	ZL 2008 2 0155269.7	实用新型专利 Patent for utility models
海水淡化用除雾装置 Demist device for seawater desalination Patent for utility models	ZL 2009 2 0214450.6	实用新型专利 Patent for utility models
一种用于低温多效海水淡化喷淋系统的喷嘴 A special nozzle for MED Patent for utility models	ZL 2009 2 0214451.X	实用新型专利 Patent for utility models
多效蒸馏海水淡化装置热力性能计算软件V1.0 Thermal performance calculation software V1.0 for MED. Computer software copyright registration	2010SR033803	计算机软件著作权登记 Computer software copyright registration
海水淡化固定式TVC装置热力性能与结构设计计算软件 Thermal performance and structural design calculation software for TVC. Computer software copyright registration	2012SR100112	计算机软件著作权登记 Computer software copyright registration
一种核电与低温多效海水淡化耦合联产的系统 A hybrid desalination technology about nuclear power and MED. Patent for invention	ZL201310655712.2	发明 Patent for invention
低温多效海水淡化蒸发器多管束布置结构 Mutitube bundle layout structure in MED evaporator Patent for invention	ZL201310723874.5	发明 Patent for invention
一种卧式高效热水闪蒸装置 A horizontal hot water flashing device with high efficiency Patent for utility models	ZL201621150905.8	实用新型专利 Patent for utility models
热水闪蒸与低温多效蒸馏蒸发器一体化装置 An integrated device of hot water flash and MED. Patent for utility models	ZL201621150916.6	实用新型专利 Patent for utility models

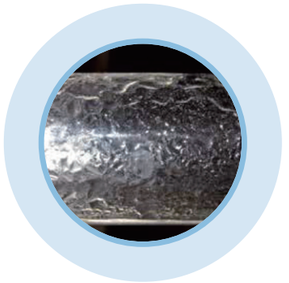
水务公司业绩分布
PROJECT REFERENCES

- MED
- RO
- 废水处理



- 江苏无锡・利港电厂 720m³/d废水浓缩减量项目
  Jiangsu Wuxi Ligang Power Plant Desulfurization Wastewater ZLD Demonstration Project
- 海螺水泥金陵河 480m³/d
  Conch Cement Jinlinhe 840 tons/d Circulating Cooling Wastewater ZLD Project
- 海螺水泥凤凰山 840m³/d
  Conch Cement Fenghuangshan 840 tons/d Circulating Cooling Wastewater ZLD Project
- 河北黄骅・沧东电厂二期 12,500m³/d
  HeBei HuangHua Cangdong Power Plant Phase II 12500 tons/d MED project
- 河北黄骅・沧东电厂三期 25,000m³/d
  HeBei HuangHua Cangdong Power Plant Phase III 25000 tons/d MED project
- 河北・秦皇岛热电 6000m³/dEPC工程
  HeBei QinHungdao Power Plant 6000 tons/d MED project
- 河北丰南・丰越能源 25000m³/dEPC工程
  HeBei Fengnan Fengyue Energy 25000 tons/d MED Desalination Project under EPC Mode
- 河北丰南・丰越能源 75,000m³/dEPC工程
  HeBei Fengnan.Fengyue Energy 75000tons/d Desalination Project under EPC Mode
- 浙江舟山・浙石化一期 105,000m³/dEPC工程
  ZheJiang Zhoushan Petrochemical Phase I 105000 tons/d MED project
- 广东惠来 11880m³/d 反渗透海水淡化工程
  Guangdong Huilai 11880 tons/d RO Project
- 广东阳西电厂 4128m³/d 锅炉补给水工程
  GuangDong YangXi Power Plant 4128 tons/d Demineralization Project
- 广东湛江・宝钢湛江钢铁 30,000m³/dEPC工程
  Guangdong Zhanjiang BaoGang Zhanjiang Steel 30000 tons/d MED project with EPC mode
- 塞尔维亚 8,640m³/d 锅炉补给水工程
  Serbia 8640 tons/d RO Project
- 伊拉克华事德4800m³/d 锅炉补给水工程
  Iraq Wassit 4800 tons/day Demineralization Project
- 也门・亚丁炼油 2,160m³/d 海水淡化工程
  Yemen Aden oil refinery Phase (Ⅰ~Ⅱ) 4320 tons/d MED project
- 巴拿马科隆 海水– 3,618m³/d 除盐水– 1,440 m³/d
  Cologne, Panama
- 也门・亚丁炼油厂二期 2,160m³/d 海水淡化工程
  Yemen Aden oil refinery Phase Ⅰ 2160 tons/d MED project
- 孟加拉锡莱特 960m³/d
  Silet, Bangladesh
- 越南永新9600m³/d 反渗海水淡化工程
  Vinh Tan Power Plant 9600 tons/d RO Project
- 印尼棉兰6552m³/d 反渗透海水淡化工程
  Medan KIM 6552 tons/d RO Project
- 印尼公主港 7680m³/d 反渗海水淡化工程
  Pelabuhanratu Power Plant 7680 tons/d RO Project
- 文莱・恒逸石化 37500m³/d 海水淡化工程
  PMB,Brunei 37500 tons/d MED project
- 马来西亚巴林基安 工业废水–6240m³/d 除盐水3312m³/d
  Bahrainkian,Malaysia 3312 tons/d Desalination &Wastewater Treatment Project
- 菲律宾康赛普森 2640m³/d
  Philippine PCPC Power Plant 2640 tons/d RO Project

CORE TECHNOLOGY AND INDEPENDENT INNOVATION
自主创新的
核心技术



低温多效蒸馏技术

高效、节能、经济、安全可靠的热法脱盐技术

LOW TEMPERATURE MULTIPLE EFFECT DISTILLATION (LT-MED)

HIGH EFFICIENCY, ENERGY SAVING, ECONOMICAL, SAFE AND RELIABLE THERMAL DESALINATION TECHNOLOGY

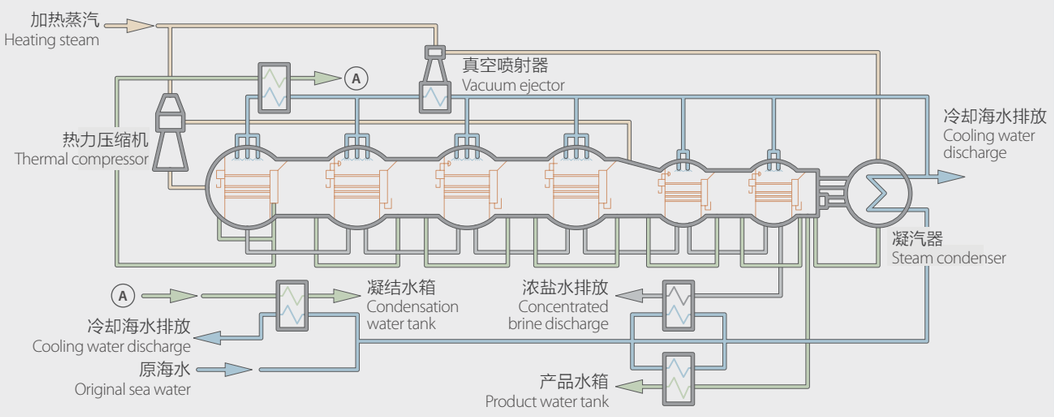
由于MED海水淡化技术具有传热效率高，产品水水质好，负荷调节范围大，操作温度低，结垢腐蚀倾向小等优点，目前已经成为第二代热法海水淡化的主流技术。与电厂结合的大型化MED将是经济可靠的水电联产技术方法之一，是热法海水淡化发展方向。

上海电气长期致力于低温多效海水淡化技术和产品的开发，公司通过不断自主技术研发和技术创新，在系统设计、工艺计算、设备设计制造和工程服务等方面在国内均处于领先地位，目前公司具备单机5万吨/天及以上MED设备成套供应和海水淡化岛工程总包能力。

LT-MED has become the second-generation of thermal desalination technology because it has lots of advantages, including high efficient heat transfer, high water quality, large adjustable load, low operation temperature and low risky scaling trend. It is widely used in the power plant to form cogeneration model with supply reliable power and high quality water at the same time, which is the future development direction of thermal desalination technology.

Shanghai Electric is committed to developing LT-MED technology. The company has taken the leading position through continuous technical development and innovation, especially about system design, process calculation, equipment design/manufacture, and engineering service. It has the ability to design and supply whole set of MED equipment with more than 50000t/d capacity per unit under EPC mode.

TECHNICAL FLOW CHART **技术流程图**



根据国际脱盐协会统计，2017–2018年，上海电气跻身全球海水淡化与水再利用前10名。

Shanghai Electric stand among the top 10 plant suppliers in terms of contracted capacity between 2017 and 2018 International Desalination Association (IDA).

热法海水淡化工程业绩 MED PROJECT REFERENCES

序号 NO.	国家/地区 Country/Region	行业 Industry	项目名称 Project Name	产水量 Capacity	投运时间(year) CommissionTime
1	中国河北 HeBei,China	电力 Electric Power	河北黄骅•沧东电厂二期 HeBei HuangHua Cangdong Power Plant Phase Ⅱ	12500m³/d	2008
2	中国河北 HeBei,China	电力 Electric Power	河北黄骅•沧东电厂三期 HeBei HuangHua Cangdong Power Plant Phase Ⅲ	25000m³/d	2013
3	中国河北 HeBei,China	电力 Electric Power	秦皇岛热电厂 QinHungdao Power Plant	6000m³/d	2017
4	中国广东 Guangdong,China	钢铁 Steel	广东湛江•宝钢湛江钢铁 Guangdong Zhanjiang BaoGang Zhanjiang Steel	30000m³/d	2015
5	中国河北 HeBei,China	钢铁 Steel	河北丰南•丰越能源 HeBei Fengnan Fengyue Energy	25000m³/d	2019
6	中国浙江 ZheJiang,China	石化 Petrochemical	浙江舟山•浙石化一期 ZheJiang Zhoushan Phase Ⅰ	105000m³/d	2019
7	文莱 Brunei	石化 Petrochemical	恒逸（文莱）PMB石化 PMB,Brunei	37500m³/d	2019
8	也门亚丁 Yemen Aden	石化 Petrochemical	也门亚丁炼油厂一期 Yemen Aden oil refinery Phase Ⅰ	2160m³/d	2019
9	也门亚丁 Yemen Aden	石化 Petrochemical	也门亚丁炼油厂二期 Yemen Aden oil refinery Phase Ⅱ	2160m³/d	Est.2020

独家6大技术优势

增加源水处理效率，优化系统装备，保障生产安全可靠

EXCLUSIVE SIX MAJOR TECHNICAL ADVANTAGES
TO INCREASE THE EFFICIENCY OF WATER TREATMENT EQUIPMENT,
OPTIMIZE THE SYSTEM, ENSURE THE PRODUCTION SAFETY

1 小温差高效传热管束结构设计技术
Small temperature difference efficient heat transfer tube bundle structure design technology

2 物料水系统回热设计技术
Design technology of material water return system

3 盐水和淡水闪蒸精确计算模型
The precise model of saline and fresh water flash

4 不凝气计算模型和系统设计技术
Non condensing gas calculation model and non condensing gas system design technology

5 丝网除雾器选型与设计布置技术
Selection and design of the screen mist sprayer

6 防腐防垢组合设计技术
Combined design of corrosion and scale prevention

MED PROJECT
热法项目

国内首套万吨级MED国产化项目
THE FIRST 10,000T/D CLASS MED DOMESTICALLY CONSTRUCTED PROJECT IN CHINA

国家能源及科技进步奖
NATIONAL ENERGY ADMINISTRATION SCIENCE AND TECHNOLOGY PROGRESS AWARD

国家电力科学技术奖
CHINA POWER SCIENCE AND TECHNOLOGY AWARD

HEBEI HUANGHUA CANGDONG POWER PLANT PHASE II 12500 TONS/D MED PROJECT

河北黄骅·沧东电厂二期12500吨/天海淡项目

业主(Owner):

河北国华沧东发电有限责任公司
Hebei Guohua Cangdong Generation Co. Ltd.

容量(Capacity):

12500m³/h

技术方法(Technical Method):

MED-TVC

所在地(Project Location):

河北省沧州市 Cangzhou，Hebei Province

完成时间(Completion Time):

2008年12月 Dec. 2008

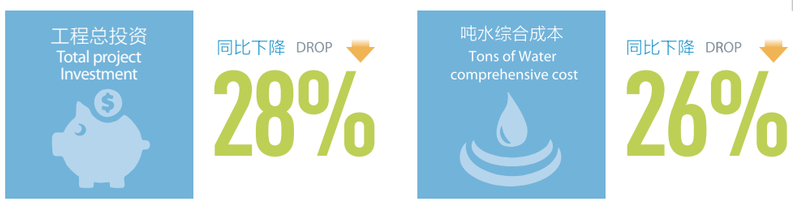
项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	12500
装置数量 Number of Devices	套 set	1
技术工艺 Technical Process	--	MED-TVC
蒸发器效数 Evaporator Effect Number	--	4+2
造水比 GOR	kg/kg	10.2
产品水水质 Desalination Quality	mg/L	≤ 5
负荷调节范围 Load Regulation Range	%	50~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	年 year	30

国华沧东电厂二期海水淡化工程是国内首套万吨级低温多效蒸馏海水淡化国产化项目，其中主设备由上海电气负责自主设计制造、成套供货，并提供安装调试服务。项目于2008年12月19日成功达产，各项性能指标达到设计值，标志着国产化低温多效蒸馏海水淡化技术装备获得重大突破和发展。上海电气通过项目实施编制了设计制造企业标准，形成了成套主设备设计、制造和质保体系。本项目经电厂用户沧东发电有限责任公司工程完工数据测算，二期项目同一期进口进口设备相比，工程总投资大幅降低，同比下降28%，吨水综合成本同比下降26%，国产化技术装备经济效益十分显著。项目于2009年荣获中国电力科学技术奖一等奖，2010年荣获国家能源局科技进步一等奖。

Huanghua phase II project is the first 10,000t/d class MED domestically constructed project in China. Shanghai Electric was responsible for the design and manufacture of the main equipment, the complete set suppling, installation and commissioning. The project successfully reached design capacity on December 9, 2008, all the performance parameters were in accordance with the design value, which marked a significant breakthrough about domestical manufacturing of MED desalination device in China. Shanghai Electric has issued the design and manufacturing enterprise standard, formed the design and manufacturing system of complete sets of main equipment, and quality assurance system through the project implementation.According to client's calculation of measured data, the CAPEX of phase II project has been reduced by 28%, specific cost of distillate has been reduced by 26% compared to imported equipment used in phase I project, which achieved remarkable economic benefits.The project won the first prize of China Power Science and Technology Award in 2009, and won the first prize of National Energy Administration Science and Technology Progress Award in 2010.

与进口设备相比 COMPARED WITH THE IMPORTED EQUIPMENT



MED PROJECT
热法项目

HEBEI HUANGHUA CANGDONG POWER PLANT PHASE Ⅲ
25000 TONS/D MED PROJECT
河北黄骅·沧东电厂三期25000吨/天海淡项目

业主(Owner):	
河北国华沧东发电有限责任公司 Hebei Guohua Cangdong Generation Co. Ltd.	
容量(Capacity):	
25000m³/h	
技术方法(Technical Method):	
MED-TVC	
所在地(Project Location):	
河北省沧州市 Cangzhou，Hebei Province	
完成时间(Completion Time):	
2013年12月 Dec. 2013	

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	25000
装置数量 Number of Devices	**套** set	1
技术工艺 Technical Process	--	MED-TVC
蒸发器效数 Evaporator Effect Number	--	7+3
造水比 GOR	kg/kg	13
产品水水质 Desalination Quality	mg/L	≤ 5
负荷调节范围 Load Regulation Range	%	40~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	**年** year	30

国产化单机最大的热法海淡项目
THE LARGEST PER-UNIT INSTALLED CAPACITY DOMESTICALLY CONSTRUCTED THERMAL DESALINATION PROJECT

中国电力创新奖
CHINA POWER INNOVATION AWARD

该项目填补国产化MED单机2.5万吨/日的技术空白，项目主设备由上海电气负责设计、制造并提供安装调试服务。设计开发团队还突破了换热管的排列、横管传热降膜、蒸汽流动和应，力分析等技术难点，形成多项超大型MED圆筒蒸发器自主核心设计技术。项目的成功标志着上海电气在低温多效蒸馏海水淡化蒸发器主设备国产化的道路上更进一步，其设计制造技术跻身世界先进行列。

The project filled in the technical gap of domestically constructed MED with per-unit installed capacity 25000 tons/day. Shanghai Electric was responsible for the design, manufacture of the main equipment, installation and commissioning. The design and development team overcame the technical difficulties of heat exchange tube arrangements, horizontal-tube falling film heat transfer, vapor flow and stress analysis, mastered a number of independent core design technology about super-large MED cylinder evaporator. The success of the project marked that Shanghai electric is one step further on the way of domestically construction of low-temperature multi-effect distillation seawater desalination evaporator, and its design and manufacturing technology ranks among the world's most advanced level.

国内首创
FIRSTLY INVENTED IN DOMESTIC

MED 蒸发器双管束设计、新型管束设计
MED evaporator double tube bundles design, new type tube bundle design

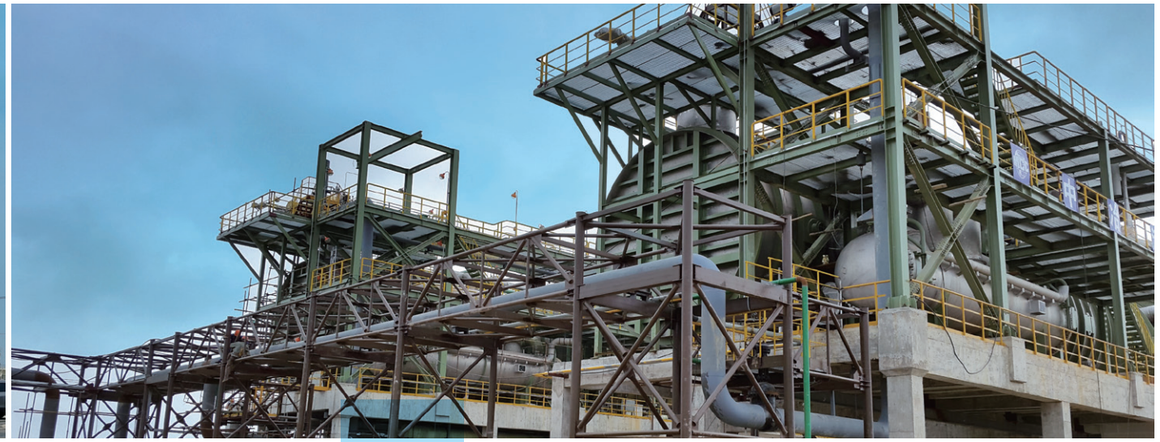
传热效率
Heat transfer efficiency

提高 IMPROVE
5.04%
蒸汽流动阻力损失合计减少 1℃
The resistance loss of vapor flow has been reduced by 1 ℃

设备投资
Equipment Investment

减少 REDUCE
3.52%

MED PROJECT
热法项目



国内首个热法海水淡化EPC项目
THE FIRST DOMESTIC THERMAL SEAWATER DESALINATION EPC PROJECT

GUANGDONG ZHANJIANG BAOGANG ZHANJIANG STEEL 30000 TONS/D MED PROJECT WITH EPC MODE

广东湛江·宝钢湛江钢铁 30000吨/天海淡EPC项目

业主(Owner):

宝钢湛江钢铁有限公司
Hebei Guohua Cangdong Generation Co. Ltd.

容量(Capacity):

30000m³/h

技术方法(Technical Method):

MED-TVC

所在地(Project Location):

广东省湛江市 Zhanjiang，Guangdong Province

完成时间(Completion Time):

2015年11月 Nov. 2015

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	15000
装置数量 Number of Devices	套 set	2
技术工艺 Technical Process	--	MED-TVC
蒸发器效数 Evaporator Effect Number	--	7
造水比 GOR	kg/kg	10
产品水水质 Desalination Quality	mg/L	≤ 5
负荷调节范围 Load Regulation Range	%	50~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	年 year	30

该项目由上海电气工程EPC总承包，填补了国产化海水淡化项目运作模式空白。项目设计团队在技术方案进行创新设计，一方面充分利用钢厂乏汽制水，实现钢厂乏汽零排放目标；另外结合实际取水条件和排水要求，物料水系统设计成高低压物料水系统和配套分级加药系统，不但实现节省电耗和药耗等运行费用，而且大大提高系统长期运行稳定性和可靠性。同时上海电气还充分整合热法海水淡化产业创新战略联盟资源优势，成功实现国产化双相不锈钢材料在热法海淡首次工程应用突破，进一步提升国产化热法海水淡化技术装备水平和上下游产业链竞争力。项目于2015年11月投运，造水比、电耗、产水电导等关键技术指标处于国际一流水平。

The EPC project is contracted by Shanghai Electric, and fills the gap in the business mode of domesticized desalination project. The project team takes an innovative design in the aspect of technical solutions. On one hand, it makes full use of the steel mill's waste steam to produce water so as to achieve the goal of zero emissions of steel mill waste steam; on the other hand, combined with the actual conditions of water intake and the requirements of drainage, the feed water system is designed for two branch system and grading dosing system, which not only lower the operating costs of power consumption and chemical consumption, but also greatly improves the stability and the reliability in the long term operation of the system. Meanwhile, Shanghai Electric fully integrates the resources of thermal desalination industry innovation strategic alliance, successfully realizing a breakthrough that duplex stainless steel materials firstly applied in the thermal desalination of the project in domestic, to further enhance the technology and equipment level of the thermal desalination localization and the competitiveness of upstream and downstream industry chain. The project was put into operation in Nov.2015, whose parameters of GOR, power consumption, product water and conductivity are all in a world- class level.

MED PROJECT
热法项目

出口
规模最大

国内出口规模最大热法海水淡化项目
THE LARGEST EXPORT SCALE MED PROJECT

PMB,BRUNEI 37500 TONS/D MED PROJECT

文莱·恒逸石化37500吨/天海淡项目

恒逸文莱3×12500吨/日低温多效海水淡化EP项目是目前国内出口的最大规模热法海水淡化项目。 在该项目中首次提出并采用了低温多效蒸馏工艺结合热水闪蒸技术制备淡水，通过低品位热水作为热法海水淡化的热源，大大降低了海水淡化的制水成本，进一步扩大了市场占有率，让上海电气海水淡化技术继续保持领先水平。

Hengyi (Brunei) petrochemical construction 3×12500 tons/day of low temperature multi-effect seawater desalination project is so far the largest scale exported EPC project. As LT-MED technology is first time ever converged with hot water flashing technology to produce distillate, the cost is greatly reduced by using low quality hot water as heat resource for distillating in this project. Leading seawater desalination technology keeps Shanghai electric expanding the market share and serves better.

业主(Owner):

恒逸实业（文莱）有限公司
Hengyi Industries Sdn Bhd

容量(Capacity):

37500m^3/h

技术方法(Technical Method):

MED-TVC、F-MED

所在地(Project Location):

文莱 Brunei

完成时间(Completion Time):

2019年

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

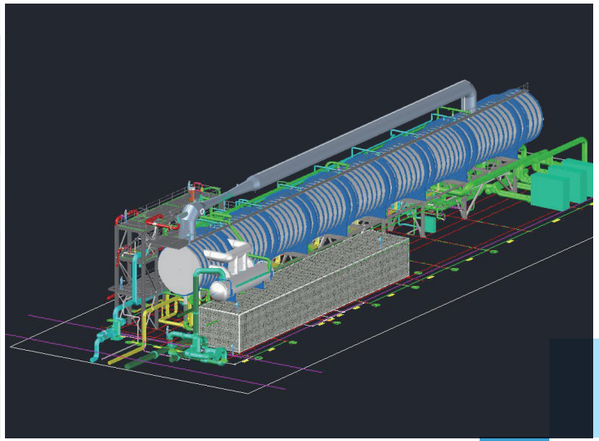
项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	12500
装置数量 Number of Devices	套 set	3
技术工艺 Technical Process	--	MED-TVC/F-MED
蒸发器效数 Evaporator Effect Number	--	6
造水比 GOR	kg/kg	10.4
产品水水质 Desalination Quality	mg/L	≤ 10
负荷调节范围 Load Regulation Range	%	50~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	年 year	30

全球首例
THE WORLD FIRST
工业余热利用MED装置
MED Equipment with industrial waste heat utilization

吨水成本
Total Cost of each cubic distillated water

下降 DROP
50%
与国外同类水平相比
Compared with foreign similar level

MED PROJECT
热法项目



国内化工行业规模最大热法海水淡化项目
LARGEST CAPACITY OF THERMAL SEAWATER DESALINATION PROJECT IN CHINESE PETROCHEMICAL INDUSTRY

ZHEJIANG ZHOUSHAN PETROCHEMICAL PHASE | 105000 TONS/D MED PROJECT

浙江舟山·浙石化一期 105000吨/天海淡EPC项目

业主(Owner):

浙江石油化工有限公司
Zhejiang petrochemical Co., Ltd.

容量(Capacity):

105000 m^3/h

技术方法(Technical Method):

MED-TVC、F-MED

所在地(Project Location):

浙江舟山 Zhoushan，Zhejiang Province

完成时间(Completion Time):

2019年

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	15000
装置数量 Number of Devices	**套** set	7
技术工艺 Technical Process	--	MED-TVC/F-MED
蒸发器效数 Evaporator Effect Number	--	7
造水比 GOR	kg/kg	10.5
产品水水质 Desalination Quality	mg/L	≤ 5
负荷调节范围 Load Regulation Range	%	50~100
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	**年** year	30

浙石化4000万吨炼油化工一体化项目配套7 × 1.5万吨/日低温多效蒸馏海水淡化EPC项目由上海电气工程承包，是国内化工行业最大规模且采用热水闪蒸作为加热汽源的海淡项目，在国内石化行业具有示范作用。海水淡化装置可以实现MED-TVC和F-MED两种模式的切换，满足不同工况的需求。

Zhejiang petrochemical 40 million tons of refining and chemical engineering integration project is assorted with 7×15000 tons/day of low temperature multi-effect seawater desalination project ,in which the engineering and procurement is contracted by Shanghai electric. As the model demonstration in Chinese petrochemical industry, the project not only contains the largest capacity of seawater desalination, but also can be supplied with hot water as the heating resource. The seawater desalination system is designed to meet the request of various operating condition by switching operating mode between MED-TVC and F-MED.

浙江石化项目充分利用炼化工艺过程产生的热水余热资源，配套上海电气自主研发的热水闪蒸一体化专利设计技术，实现了能源的梯级利用。该项目成功实现全球领先的节能环保型国产化热法海水淡化新技术的工程应用示范，对于全面提升国产化热法海水淡化技术装备的国际竞争力具有里程碑的意义。

The project makes full use of the hot water waste heat generated in the refining process, and combined with the patent of hot water flash developed independently by Shanghai Electric, realizing the cascade utilization of energy. The project realizes the engineering application demonstration of the world's leading energy saving and environmental friendly domestic desalination technology, which is a milestone to comprehensively enhance the international competitiveness of domestic thermal desalination technology and equipment.

MED PROJECT
热法项目

国内首个热法海淡改造EPC项目
THE FIRST DOMESTIC RECONSTRUCTION PROJECTS OF SEA WATER THERMAL DESALINATION

HEBEI QINHUNGDAO POWER PLANT 6000 TONS/D MED PROJECT

河北秦皇岛热电厂6000吨/天海淡EPC项目

该项目由上海电气EPC工程总承包，运作模式方面，上海电气发挥开发和整合资源的优势和能力，采用工程集中设计，主体设备全球采购，零部件就近加工，集成现场组装。项目设计团队根据用户实际现场环境条件，管束创新性采用并列布置，蒸发器壳体采用方形设计，壳体采用双相不锈钢材质，换热管选全薄壁钛管，并采用大量降噪措施，以满足项目现场靠近居民区夜间55dB低噪音要求，成为上海电气为客户提供“私人定制”整体解决方案的典范。

The EPC project is contracted by Shanghai Electric . On the management mode, Shanghai Electric taken advantage of integrated resources, such as using the interlocking design, purchasing main equipment globally, accessories manufacturing nearby, and assembling equipment on site. According to the customer's actual conditions, the creative arrangement of parallel of bundle, square type evaporator and material of duplex stainless steel is adopted „e. The evaporator's heat exchange tube is made of whole thin-walled titanium tubes, meanwhile, various measures are taken to reduce the noise, in order to satisfy lower 55dB noise at night close to the residents around project site. So, the project becomes a model of proving a specific solution for different customers to solve different problems.

业主(Owner):

秦皇岛发电有限责任公司
Qinhuangdao Power Generation Co., Ltd.

容量(Capacity):

6000 m^3/h

技术方法(Technical Method):

MED-TVC

所在地(Project Location):

河北省秦皇岛市 Qinhuangdao，Hebei province

完成时间(Completion Time):

2017年1月Jan.2017

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	6000
装置数量 Number of Devices	套 set	1
技术工艺 Technical Process	--	MED-TVC
蒸发器效数 Evaporator Effect Number	--	8
造水比 GOR	kg/kg	12.6
产品水水质 Desalination Quality	mg/L	≤ 5
负荷调节范围 Load Regulation Range	%	50~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	年 year	30

MED PROJECT
热法项目

热法海淡技术装备中东市场
THERMAL SEAWATER DESALINATION TECHNOLOGY HEADING INTO MIDDLE EAST MARKET

YEMEN ADEN OIL REFINERY PHASE (Ⅰ ~ Ⅱ) 4320 TONS/D MED PROJECT

也门·亚丁炼油厂4320吨/天海淡项目

也门亚丁4320吨/日低温多效海水淡化项目是国产化热法海水淡化技术装备进入中东市场的首个项目，由上海电气负责项目工程设计和设备成套供货，并提供安装和调试指导。

Yemen Aden refining and chemical plant 4320 tons/day of low temperature multi-effect seawater desalination project is the first project in which nationalized thermal seawater desalination technology heading into Middle East market. Shanghai electric is in charge of project engineering, supplying complete set and instructions of installation and commissioning.

业主(Owner):

也门国家炼化厂
Yemen national refining and chemical plant

容量(Capacity):

4320 m^3/h

技术方法(Technical Method):

MED-TVC

所在地(Project Location):

也门亚丁市 Aden, Yemen

完成时间(Completion Time):

预计2020年 Est. 2020

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	2160
装置数量 Number of Devices	套 set	2
技术工艺 Technical Process	--	MED-TVC
蒸发器效数 Evaporator Effect Number	--	2
造水比 GOR	kg/kg	7.4
产品水水质 Desalination Quality	mg/L	≤ 10
负荷调节范围 Load Regulation Range	%	50~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	年 year	30

反渗透海水淡化技术

环保、低能耗、高经济效益的膜法脱盐技术

REVERSE OSMOSIS

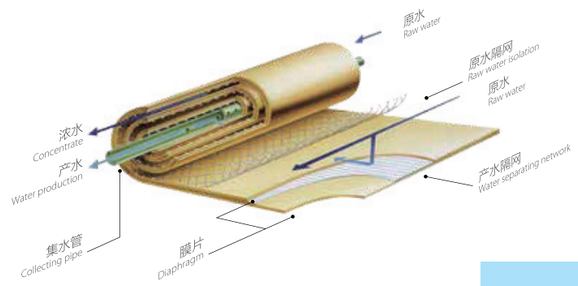
ENVIRONMENTAL PROTECTION, LOW ENERGY CONSUMPTION, HIGH ECONOMIC EFFICIENCY OF MEMBRANE DESALINATION TECHNOLOGY

反渗透海水淡化是利用选择性渗透膜从海水中分离出淡水，其具有投资小、能耗低、建设周期短和适用范围广等特点。反渗透海水淡化核心设备包括反渗透膜、高压泵和能量回收装置等。

上海电气经过持续研发和工程经验积累，在系统设计、设备集成、安装调试和运行维护等方面处于国内领先水平，目前已具备万吨级单膜堆系统设计、工程配套和工程总承包能力。公司能够为市政、电力、化工和钢铁等领域客户提供完整的个性化系统解决方案。

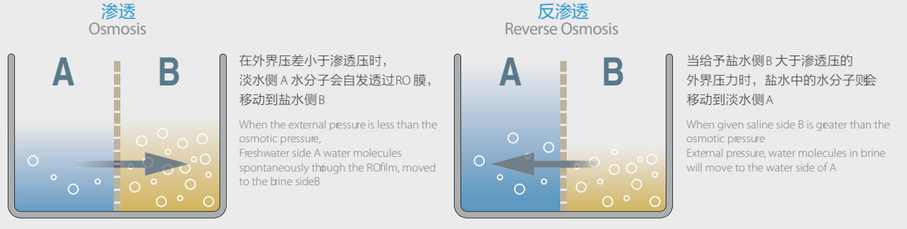
Reverse osmosis technology separates water from seawater by using permeable membrane; it has many advantages , including less investment, low energy consumption, short construction period and extensive application etc. The key RO equipments consist of membrane, high pressure pump and energy recovery device etc.

Through continuous research and the accumulation of engineering experience, SEC has a leading level in system design, equipment integration, installation and commissioning, maintenance, and now has a capability to provide engineering service about the single SWRO stack with permeate capacity of 10,000 t/d s We can provide a complete personalized system solution for customers in municipal, electric power, chemical industry, iron and steel and other fields.



技术原理图

TECHNICAL FLOW CHART



反渗透工程业绩 RO PROJECT REFERENCES

序号 NO.	国家/地区 Country/Region	行业 Industry	项目名称 Project Name	产水量 Capacity	投运时间(year) Commission Time
1	中国河北 HeBei,China	钢铁 Steel	河北丰南·丰越能源 HeBei Fengnan.Fengyue Energy	75000m^3/d	2019
2	中国广东 GuangDong,China	电力 Electric Power	广东惠来电厂 GuangDong Huilai Power Plant	11880m^3/d	2011
3	印尼公主港 Palabuhanratu,Indonesia	电力 Electric Power	印尼公主港电厂 Palabuhanratu Power Plant	7680m^3/d	2012
4	越南永新 Vinh Tan,Vietnam	电力 Electric Power	越南永新电厂二期 Vinh Tan Power Plant Phase Ⅱ	9600m^3/d	2014
5	伊拉克华事德 Wsaait,Iraq	电力 Electric Power	伊拉克华事德电厂二期 Iraq Wsaait Plant Phase Ⅱ	4800m^3/d	2014
6	菲律宾康赛普森 Conception,Philippines	电力 Electric Power	菲律宾康赛普森电厂一期 PCPC Power Plant Phase Ⅰ	2640m^3/d	2016
7	中国广东GuangDong,China	电力 Electric Power	广东华厦阳西电厂二期 GuangDong YangXi Power Plant Phase Ⅱ	4128m^3/d	2018
8	印尼棉兰 Medan, Indonesia	电力 Electric Power	印尼棉兰工业园 Medan KIM Project	6552m^3/d	2020
9	巴拿马科隆 Colon.Panama	电力 Electric Power	巴拿马科隆燃机电站 Panama Gas Turbine Power Plant	3618m^3/d	2020

特有的5大技术优点
降低能源消耗，提升产水水质，提高社会效益

FIVE OWN UNIQUE TECHNICAL ADVANTAGES
REDUCE ENERGY CONSUMPTION, INCREASE THE QUALITY OF PRODUCT WATER, IMPROVE SOCIAL BENEFIT

1 多种预处理工艺组合，针对各种源水水质，保障反渗透系统运行稳定

A combination of various pretreatment process, Ensure the stability of the RO system for all kinds of raw water.

2 专业的计算软件，完整模拟反渗透运行周期

Related software application to completely simulate RO operation cycle.

3 合理配置系统，优化设备结构，满足各种运行工况需求

Rational configuring system, optimization of equipment structure, meet the requirements of various operating conditions.

4 根据现场条件灵活布置，优化管道布局，高效利用空间，节约土建成本

Flexible layout according to the site condition, optimize the piping layout, make the most use of the space, save the cost of civil works.

5 系统自动化率高，降低人力成本和故障风险

Efficient automation control system, reduce manpower costs and risk of failure.

RO-MED HYBRID PROJECT
热膜耦合项目

国内首个热膜耦合海水淡化EPC项目
THE FIRST DOMESTIC HYBRID SEAWATER DESALINATION EPC PROJECT

HEBEI FENGNAN FENGYUE ENERGY 75000TONS/D RO COUPLED WITH 25000 TONS/D MED DESALINATION PROJECT UNDER EPC MODE

河北丰南•丰越能源75000吨/天RO & 25000吨/天MED海淡EPC项目

该项目为国内规模最大热膜耦合EPC项目，充分贯彻落实“余热利用、降低成本、安全可靠”的设计原则，为钢厂提供了稳定可靠、成本低廉的淡水供应，系统运行高效、布置紧凑，其投资和运维成本均处于业内领先水平。

The project applies the largest domestic RO-MED hybrid system under EPC mode, fully implementing the "waste heat utilization, cost reduction, safety and reliability" design principles. Reliable and cost effective fresh water is provided for the steel plant. The efficient and compact system design allows a leading CAPEX & OPEX.

上海电气充分发挥低温多效技术优势和高效热水闪蒸专利设计技术，从钢厂的高炉冲渣废热中提取出热水作为热源。这种低温多效和余热利用相结合的全新设计技术在经济性和可靠性指标达到国际先进水平。

Shanghai Electric makes full use of the MED technical advantages and high efficient hot water flashing patented design technique. The waste heat of the blast furnace slag water is recovered, exerting the hot water flash technical advantages at a maximum degree and reaching an international advanced level in the indexes of economic and reliability.

业主(Owner):

河北丰越能源科技有限公司
Hebei Fengyue Energy & Technology Co. Ltd

容量(Capacity):

75000 m^3/h

技术方法(Technical Method):

混凝沉淀–重力滤池–超滤–两级反渗透

所在地(Project Location):

河北省唐山市 Tangshan, Hebei Province

完成时间(Completion Time):

2019年

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	12500
装置数量 Number of Devices	套 set	6
技术工艺 Technical Process	--	混凝沉淀–重力滤池–超滤–两级反渗透 Clarifier- GSF-UF-SWRO-BWRO
RO回收率 Recovery rate of RO	%	45%(SWRO) 85%(BWRO)

业主(Owner):

河北丰越能源科技有限公司
Hebei Fengyue Energy & Technology Co. Ltd

容量(Capacity):

25000 m^3/h

技术方法(Technical Method):

F–MED

所在地(Project Location):

河北省唐山市 Tangshan, Hebei Province

完成时间(Completion Time):

2019年

项目性能参数表 PROJECT PERFORMANCE PARAMETER TABLE

项目 Item	单位 Unit	技术数据 Technical Data
装置容量 Installed Capacity	m^3/d	12500
装置数量 Number of Devices	套 set	2
技术工艺 Technical Process	--	F-MED
蒸发器效数 Evaporator Effect Number	--	6
造水比 GOR	kg/kg	10
产品水水质 Desalination Quality	mg/L	≤ 5
负荷调节范围 Load Regulation Range	%	50~110
年利用率 Annual Utilization Ratio	%	95
设计寿命 Design Life	年 year	30

工艺流程 TECHNOLOGICAL PROCESS

海水 Seawater → 混凝沉淀 Coagulation sedimentation → V型滤池 Gravity Filtration → 细砂过滤器 Sand Filtration → 海水反渗透 SWRO → 淡水反渗透 BWRO

RO PROJECT
膜法项目

GUANGDONG HUILAI 11880 TONS/D RO PROJECT

广东惠来11880吨/天膜法海淡项目

该工程满足了电厂机组工业、消防、化学水补给水等用水需要；采用两级砂滤的经典预处理工艺，运维简单，配合混凝澄清提高抗冲击能力，出水水质稳定。

The project satisfies the needs for service water, fire water, chemical makeup water. Two passes of sand filtration is typically adopted in the pretreatment process with simple operations, and the coagulation sedimentation process can improve the shock resistance to make a stable output water quality.

SWRO产水量 SWRO CAPACITY

11880m³/d

配套发电机组2×1000MW
Auxiliary generator set 2 * 1000MW

工艺流程 TECHNOLOGICAL PROCESS

海水 Seawater → 混凝沉淀 Coagulation sedimentation → 超滤 UF → 海水反渗透 SWRO

RO PROJECT
膜法项目

VINH TAN POWER PLANT 9600 TONS/D RO PROJECT

越南永新9600吨/天膜法海淡项目

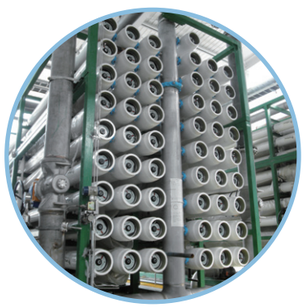
永新二期海淡工程不仅为电厂提供了所需的工业用水，还为后续锅炉补水系统提供了高质量的进水；海水反渗透产水相较传统预处理后的地表水，能够优化后续系统的运行条件，延长设备的使用寿命，且不受旱季河水干涸问题的困扰。

The phase Ⅱ project of seawater desalination in Yongxin not only supplies the necessary industrial water for the power plant, but also delivers the high quality water for the subsequent boiler make up water system; compared with the pretreated surface water by tradilitional technology, the fresh water extracted from seawater by reverse osmosis technology can optimize the operating conditions in the followed system, which can extend the service lifetime of the equipment. And it will be untroubled when the river is dried up during dry season.

BWRO产水量 SWRO CAPACITY

9600m³/d

配套发电机组2×622MW
Auxiliary generator set 2 * 622MW



工艺流程 TECHNOLOGICAL PROCESS

预处理后海水 Pretreated Seawater → 超滤 UF → 海水反渗透 SWRO → 淡水反渗透 BWRO

RO PROJECT
膜法项目

PELABUHANRATU POWER PLANT 7680 TONS/D RO PROJECT
印尼公主港7680吨/天膜法海淡项目

海水淡化产品水作为全厂工业水源，包括锅炉补给水、服务水、消防水等，稳定性要求高。

Pelabuhan Ratu power plant RO projectSeawater-UF-SWRO-BWROThe water produced by seawater desalination as the whole factory's industrial water contains boiler feed make up water, service water and fire water, etc, thus the system require a high stability to production and operation.

BWRO产水量 SWRO CAPACITY

7680m³/d

配套发电机组2×350MW
Auxiliary generator set 2 * 350MW

工艺流程 TECHNOLOGICAL PROCESS

海水 Seawater → 混凝沉淀 Coagulation sedimentation → 重力过滤 Gravity filtration → 超滤 UF → 海水反渗透 SWRO → 苦咸水反渗透 BWRO → 电去离子 EDI

RO PROJECT
膜法项目

PHILIPPINE PCPC POWER PLANT 2640 TONS/D RO PROJECT
菲律宾PCPC 2640吨/天膜法海淡项目

PCPC项目包含完整的工艺流程，多重预处理工艺组合能够应对复杂恶劣的水质条件，为后续反渗透系统提供良好的运行环境；

采用运行更为稳定、产水水质更好的EDI代替传统的离子交换工艺，为电厂提供高质量的工业水和锅炉补给水，对于电厂稳定运行具有重大意义。

PCPC project contains the complete technological process, and the multiple pretreatment combined process is able to deal with complex water quality conditions, and can provide an excellent operating condition for the subsequent reverse osmosis system; in addition, PCPC project uses EDI (electrodeionization) that has the advantages of better stable operation and higher product water quality instead of traditional ion exchange technique, with the purpose of providing the quality industrial water and boiler make up water, making a great significance for stable operation of power plant.

BWRO产水量 SWRO CAPACITY

2640m³/d

配套发电机组2×135MW
Auxiliary generator set 2 * 135MW

工艺流程 TECHNOLOGICAL PROCESS

地表水 Surface water → 活性炭过滤 Carbon filtration → 超滤 UF → 苦咸水反渗透 BWRO → 离子交换 Ion exchange

RO PROJECT
膜法项目

RAQ WASSIT 4800 TONS/DAY DEMINERALIZATION PROJECT

伊拉克华事德4800吨/天锅炉补给水项目

配套伊拉克国内最大电厂，提供锅炉及工业用水应对高含盐量河水，采用反渗透预脱盐，降低后续离子交换负荷；

The project equipped with the largest power plant in Iraq provides boilers make up water and industrial water. To cope with high salt content of the water, the system adopts the reverse osmosis, in order to decrease the load of subsequent ion exchange technique.

BWRO产水量 SWRO CAPACITY

$4800m^3/d$

配套发电机组2×610MW
Auxiliary generator set 2 * 610MW

工艺流程 TECHNOLOGICAL PROCESS

地表水 Surface water → 超滤 UF → 苦咸水反渗透 BWRO → 离子交换 Ion exchange

RO PROJECT
膜法项目

GUANGDONG YANGXI POWER PLANT 4128 TONS/D DEMINERALIZATION PROJECT

广东阳西电厂4128吨/天锅炉补给水项目

为电厂提供工业用水及锅炉补给水，稳定性要求高；

配套超超临界发电机组，产水水质要求高；

In order to provide industrial water and boiler make up water for power plant, the system require a high stability; and the project equips with ultra-supercritical unit, so the quality requirements of product water of project is higher.

BWRO产水量 SWRO CAPACITY

$4128m^3/d$

配套发电机组2×1240MW
Auxiliary generator set 2 * 1240MW

废水处理技术

工艺集成创新、环境友好、成本优势领先的整体解决方案

WASTEWATER TREATMENT TECHNOLOGY

WASTEWATER INTEGRATED SOLUTIONS WITH PROCESS INTEGRATIVE INNOVATION
ENVIRONMENTAL FRIENDLY AND COST ADVANTAGE

上海电气水务致力于为国内外客户提供工艺集成创新、环境友好、成本优势领先的废水整体解决方案。上海电气开发出基于预处理、浓缩减量和末端固化的业内领先的创新型废水零排放工艺路线，并具备提供从专业技术方案咨询，工程方案设计，设备成套供应和工程总承包的能力。

SEWE is committed to offering customers integrated solutions in wastewater with process integrative innovation, environmental friendly and cost advantage. Shanghai Electric has developed a leading innovative wastewater ZLD technical route based on pretreatment, concentration reduction and end-solidification. SEWE provides across the entire chain from professional proposal consultation, engineering design, equipment supply and EPC.

废水处理核心技术

THE KEY TECHNOLOGY IN WASTEWATER TREATMENT

1 高效预处理技术
Efficient Pretreatment Technology

2 深度氧化处理技术
Advanced Oxidation Technology

3 反渗透浓缩技术
RO Concentration Technology

4 蒸发浓缩技术
Thermal Concentration Technology

5 载气萃取浓缩技术
High-concentration Carrier Gas Extraction (CGE) Technology

6 分盐结晶处理技术
Salt and Crystallization Technology

高效预处理技术
EFFICIENT PRETREATMENT TECHNOLOGY

通过技术改进,将各类高效反应、分级过滤、精准加药技术应用于高盐水软化、除硅处理中，极大的提高预处理效率、降低药剂成本、减少设备占地面积、降低设备维护成本。

Through technical improvement, various high-efficiency reaction, grading filtration and precision dosing technology are applied to high salt water softening and silicon removal treatment, which greatly improves pretreatment efficiency, reduces cost and equipment footprint.

深度氧化处理技术
ADVANCED OXIDATION TECHNOLOGY

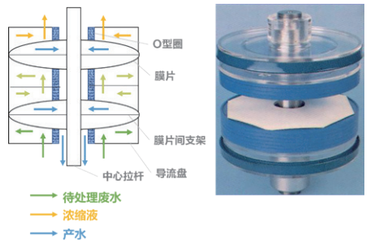
将臭氧催化氧化、电催化氧化等深度氧化技术与杂盐分盐过程充分结合，有效提高分盐效率，极大地降低分盐成本，提高副产盐的回收率。

The deep oxidation technology is fully combined with the salt separation process, which effectively improves the salt separation efficiency and greatly reduces the salt separation cost.

反渗透浓缩技术
RO CONCENTRATION TECHNOLOGY

反渗透浓缩技术是利用反渗透膜将废水浓缩减量，实现纯水回收和浓盐水减量，具有投资低、占地面积小、仅依靠电力驱动等特点。上海电气依托于海水淡化处理中的膜法工程经验，已成功开发出高回收率反渗透浓缩技术，可应用于各类废水的深度脱盐处理，降低整个零排放系统的投资及运行成本。

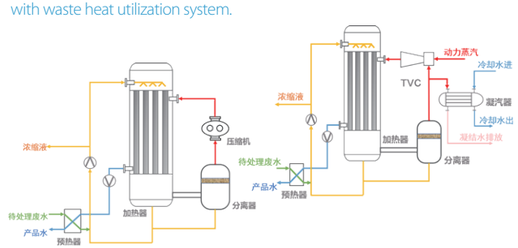
Based on the experience of membrane engineering in seawater desalination treatment, SEW has successfully developed a high-recovery reverse osmosis concentration technology, which can be applied to deep desalination treatment, reducing the investment and operating costs of the entire zero-emission system.



蒸发浓缩技术
THERMAL CONCENTRATION TECHNOLOGY

蒸发浓缩技术是利用热能将部分淡水从废水中分离出来，实现废水的浓缩减量，根据废水水质和热源条件的不同，常用的技术类型包括多效蒸发（MED）、机械压缩（MVC）和热压缩（TVC）。上海电气通过在热法领域不断的探索和创新，将海水淡化工艺中的各类热法技术延伸应用于废水处理，可对厂区各类余热进行深入挖掘，为客户提供低能耗的余热利用系统解决方案。

According to different wastewater quality and heat source conditions, common thermal concentration technologies include MED, MVC and TVC. SEW extends the these technologies in the wastewater desalination process, which can make the most of waste heat in the plant and provide customers with waste heat utilization system.



分盐结晶处理技术
SALT AND CRYSTALLIZATION TECHNOLOGY

结晶处理是将废水进一步浓缩，直到将废水中淡水和结晶盐类彻底分离，最终实现废水的零排放。上海电气拥有纳滤分盐、冷冻结晶分盐技术，可提高杂盐副产收率，实现杂盐资源化。同时还拥有采用烟气余热蒸发结晶技术，可充分利用烟气余热，极大降低结晶单元的投资和运行成本。上海电气根据项目设计条件为客户提供个性化、低成本的结晶方案。

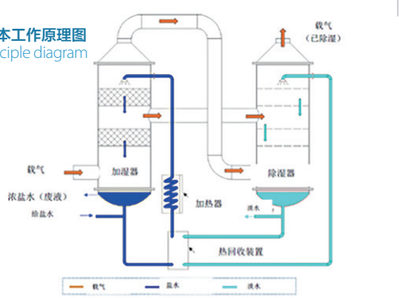
SEW has the technology of nanofiltration and freezing crystallization, which can improve the yield of by-products and realize the resource utilization of carnallite. At the same time, we also adopt flue gas crystallization technology, which can make full use of waste heat in flue gas, greatly reducing the investment and operating cost.

载气萃取浓缩技术
HIGH-CONCENTRATION CARRIER GAS EXTRACTION (CGE) TECHNOLOGY

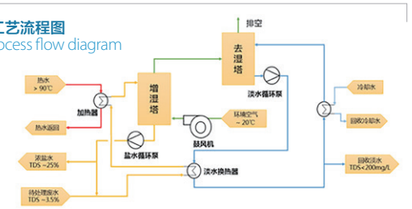
载气萃取（CGE）是一种通过空气的增湿去湿过程实现废水浓缩减量的创新水处理技术，其具有预处理要求低、运行温度低、防腐防垢性能优良、废水浓缩倍数高、传热传质效率高、运维工作简单等技术特点，特别适合于高含盐废水的浓缩减量。CGE技术对热源要求极低，可使用厂区内的各类废蒸汽、热水、烟气余热等，大幅降低运行成本，目前已成功在国内外电厂脱硫废水、页岩气开采废水等领域废水零排放工程中商业化应用。

CGE is an innovative water treatment technology and the characteristics lies in low pretreatment requirements, excellent anti-corrosion and anti-scaling performance, and high concentration of TDS in brine. CGE has extremely low requirements on heat sources, and can use various types of waste steam, hot water, and flue gas in the plant to greatly reduce operating costs.

CGE基本工作原理图
CGE principle diagram



CGE工艺流程图
CGE process flow diagram



TYPICAL ENGINEERING PROJECT
典型的工程案例

FGD WASTEWATER ZLD DEMONSTRATION PROJECT
电厂脱硫废水零排放示范项目

电厂脱硫废水具有含盐量高、水质复杂、波动性大等特点，是电厂处理难度最高的废水。上海电气采用载气萃取技术来实现脱硫废水浓缩减量，该工程是国内首个使用载气萃取技术的工程，可将脱硫废水浓缩至接近饱和，对预处理要求低，并且可充分利用电厂余热，较低成本实现脱硫废水的浓缩减量。该项目于2018年5月开始投运，具有良好的运行稳定性和成本优势。

The FGD wastewater has the characteristics of high salt content, complicated water quality and large fluctuation, which is the most difficult wastewater to be treated in power plants. SEW uses CGE to achieve concentration and reduction of desulfurization wastewater. This is the first project in China that uses CGE technology to concentrate desulfurization wastewater. The project started operation in May 2018 and has good operational stability and cost advantages.

技术路线 TECHNICAL ROUTE

脱硫废水 Desulfurization Wastewater → 预处理 Pretreatment → 载气萃取 Carrier Gas Extraction → 旁路烟道蒸发 Bypass Flue Evaporation

项目技术参数 PROJECT TECHNICAL PARAMETERS

水质特点(Wastewater Quality Characteristics)：

水质波动大，悬浮物浓度高、含盐量高，结垢倾向严重，重金属离子种类多且浓度范围大。

The water has huge fluctuation range, high suspended solid concentration, high salt content, serious fouling tendency, heavy metal ions with various types and high concentration.

完成时间(Completion Time):

2018年5月 May. 2018

产水用途(Water purpose):

回用至脱硫补充水
Reused to desulfurization supplementary water

技术优势 TECHNICAL ADVANTAGES

进水TDS变化范围大 Wide range of feed water TDS	从13,000 mg/L到110,000 mg/L From 13,000 mg/L to 110,000 mg/L
浓缩倍率高 High concentration ratio	浓盐水TDS>250,000 mg/L Concentrated brine TDS>250,000 mg/L
可靠性高 High reliability	设备利用率高，运行稳定性好 High equipment utilization, high operational stability
产水水质稳定 Stable product water quality	产水TDS均小于20mg/L，有很好的适应性和包容性 The TDS of produced water is less than 20mg/L, which is very adaptable and inclusive.

运行成本 OPERATING COSTS

1/3

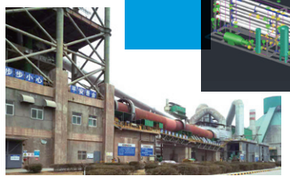
利用余热，吨水处理成本只有常规膜法浓缩的三分之一左右

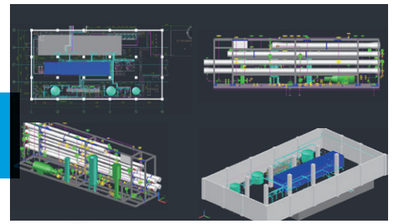
Using waste heat, the treatment cost per ton of water is only about one-third of the membrane method.

技术路线 TECHNICAL ROUTE

循环排污水 Waste Wster → 混凝沉淀 Coagulation Sedimentation → 苦咸水反渗透 BWRO Concentration → 软化沉淀 Depth Softening → 海水反渗透 SWRO Concentration → TVR 蒸发结晶 Crystallization

TYPICAL ENGINEERING PROJECT 典型的工程案例





CEMENT CIRCULATING COOLING WASTEWATER ZLD PROJECT

水泥行业循环冷却排污水零排放

水泥厂余热发电循环水运行过程中，由于水质严重超标，造成凝汽器结垢严重，同时环保要求零排放处理，上海电气采用包含预处理、浓缩减量和蒸发结晶在内的完整零排放技术工艺流程，成功实现循环冷却排污水的零排放。本项目由上海电气负责项目工程设计和设备成套供货，在国内水泥行业具有示范意义。

SEWE adopts complete zero emission technology including pretreatment, concentration reduction and evaporation crystallization. The process has successfully achieved zero discharge of circulating cooling sewage. The project is designed and the equipment is supplied by Shanghai Electric, and has fundamental significance in the domestic cement industry.

项目技术参数 PROJECT TECHNICAL PARAMETERS

水质特点(Wastewater Quality Characteristics)：
悬浮物含量、含盐量和COD含量较高 The circulating sewage has high suspended solids, salt and organic matter.
完成时间(Completion Time):
预计2019年 Est.2019
产水用途(Water purpose):
回用至循环冷却水补充水 Reused to supplement cooling water

技术优势 TECHNICAL ADVANTAGES

高回收率 High recovery rate	膜系统总回收率高达98%，尽量减小进入蒸发结晶的废液量。 The total recovery rate of the membrane system is up to 98%.
特殊的流程设计 Special process design	化学软化放在一段浓缩之后，减小软化沉淀设备规模，降低反渗透和蒸发结晶系统结垢污堵风险。 Concentration is followed by Chemical softening, which can reduce the scale of softening and sedimentation equipment.
零排放与原循环水系统配合 Combine the ZLD system with the original circulating water system	混合部分原水进入循环水系统，降低反渗透产水的“腐蚀性”。 Mix part of the raw water into the circulating water system and reduce the corrosiveness of RO permeate.

技术路线 TECHNICAL ROUTE

矿井废水 Mine wastewater → 一级软化 1st stage softening → 平板陶瓷膜过滤 Flat ceramic membrane filtration → 反渗透 RO → 二级软化 2nd stage softening → 载气萃取 CGE → TVR 蒸发结晶 Crystallization

TYPICAL ENGINEERING PROJECT 典型的工程案例

ZLD PROJECT IN MINE INDUSTRY

煤矿采出水零排放项目

根据国家和地方相关生态环保政策要求，必需实现矿井水零排。该项目采用膜法和热法相结合的零排放处理方案，为应对项目所在地冬季水温较低，特殊设计余热回收系统，减少热耗，降低运行成本。该项目系统配置简单，自动化程度高，整个系统投资和运行成本优势显著。

According to the requirement of national and local environmental protection policies, mine waste water should achieve ZLD. The project adopts a zero-emission treatment scheme combining membrane method and thermal method. The special design (waste heat recovery system) reduces heat consumption and operating costs. The system configuration is simple, the degree of automation is high, and the overall investment and operating cost advantages are significant.

项目技术参数 PROJECT TECHNICAL PARAMETERS

水质特点(Wastewater Quality Characteristics)：
盐度较高，需脱盐处理；硬度较高，考虑到对脱盐单元的影响，需去除部分硬度。 The water has high salinity and hardness.
产水用途(Water purpose):
部分作为全厂自用水，其余作为煤化工工业园补充用水 Supplementary water

技术优势 TECHNICAL ADVANTAGES

工艺路线简单 Simple technical route	系统配置简单，减小运维工作量； Simple system configuration, less operation and maintenance
系统可靠性高 High system reliability	高盐废水工段，操作自动化程度高，平时维护简单方便，可以保证98%以上的运行时间。 High degree of operation automation, simple and convenient maintenance, more than 98% of running time guaranteed.
回收余热，降低蒸汽消耗 Recover waste heat and reduce steam consumption	采用零排放系统内的余热来预热进入反渗透的废水，可降低蒸汽耗量，降低运行成本。 Use waste heat from a ZLD system to preheat the wastewater, reducing steam consumption and operating costs.
选用合适的软化药剂，降低药剂消耗，减小污泥量 Select appropriate softening agent to reduce the consumption of chemicals and the sludge volume	

技术方法 TECHNICAL ROUTE

废水 Wastewater → 化学软化 Chemical Softening → 苦咸水反渗透浓缩 BWRO concentration → 钠离子交换树脂软化 Sodium ion exchange resin softening → 纳滤 NF → CGE CGE → TVR 蒸发结晶 Crystallization

ZLD PROJECT IN IRON AND STEEL INDUSTRY

钢铁行业废水零排放项目

钢厂现有废水直接排海造成了恶劣的社会影响，要求实现零排放。项目为提高副产盐类的资源化利用，上海电气针对其水质制定了分盐的零排放技术工艺流程，产出的淡水作为生产用水，纳滤浓水送往焦化厂消纳，在实现零排放的同时产出氯化钠工业盐。

In order to improve the resource utilization of by-product salt, SEW has formulated a zero-discharge technology process to produce fresh water and industrial salt.

项目技术参数 PROJECT TECHNICAL PARAMETERS

水质特点(Wastewater Quality Characteristics)：
待处理废水来自中央水厂反渗透浓水，含盐量高，钙硬度高，有机物含量高。 The water has high salt content, high calcium hardness and high organic content.
产水用途(Water purpose):
生产补水 Reused to make up water

技术优势 TECHNICAL ADVANTAGES

应用分盐技术 Salt separation technology	采用纳滤分盐技术，副产出结晶氯化钠工业盐。 Using NF and salt separation technology to produce NaCl as by-product.
优化流程设计 Special process design	将软化和混凝沉淀组合，优化预处理单元，减小后续离子交换的规模 Combining softening and coagulation precipitation which can save the installation of pretreatment .

技术路线 TECHNICAL ROUTE

园区综合废水 Complex Wastewater → 旋流沉砂池 Cyclone Desande → 电催化氧化 Electrocatalytic Oxidation → 中和絮凝 Neutral Flocculation → 耐盐工程菌生化处理 Biochemical Treatment → Fenton氧化 Fenton Oxidation → 沙滤器 Sand Filter → 消毒 Disinfection

COMPREHENSIVE INDUSTRIAL WASTEWATER TREATMENT PROJECT

综合工业废水治理项目

工业园区废水处理厂收集处理园区企业排放废水，园区内企业主要包括农药制药厂、冶金、电子及农产品加工等，采用电催化氧化→高效工程菌生化的技术路线。可快速降解废水中污染物同时保持系统的稳定运行。

Chemical Industrial complex Wastewater Treatment Plant collects and treats the wastewater form various industrial plants mainly include pesticide plants, metallurgy, electronics and agricultural plants, using electrocatalytic oxidation engineering bacteria as main technology route. It can quickly degrade pollutants in wastewater and keep the system operating stably.

项目技术参数 PROJECT TECHNICAL PARAMETERS

水质特点(Wastewater Quality Characteristics)：
水质波动范围较大，含盐量高，毒性大，可生化性低。 The wastewater has large fluctuation range, high salt content, high toxicity and low biodegradability.
产水用途(Water purpose):
达标排放（《城镇污水处理厂污染物排放标准》（GB18918-2002）一级A标准）。 Meet standard and discharge, GB18918-2002.

技术优势 TECHNICAL ADVANTAGES

可靠性高 High reliability	系统充分降解水中难降解有机物，保证出水水质稳定 The system can degrades organics in water efficiently and ensure the effluent quality

运行成本低 LOW OPERATING COST

7.22 综合运行成本在7.22元/吨（含污泥干化费用）
The composite operating cost is 7.22 CNY / ton (including sludge dewatering costs)

WHOLE SOLUTION PLAN
整体解决方案

根据用户实际项目设计条件，通过合理技术工艺选择、优化工艺系统和设备方案设计，最终为用户提供技术先进、系统可靠和经济节能的整体解决方案。整合资源，简化客户流程，提高效率，带来更好的客户满意度，进一步加强与客户间的信任，建立了一种区隔性的竞争优势。

According to customer's actual project design conditions, we can provide the advanced ,reliable and economical total solution, through the reasonable technology process selection, optimization of process systems and equipment design. Integrate resources, simplify processes, improve efficiency, bring better satisfaction, further strengthen mutual trust and cooperation.

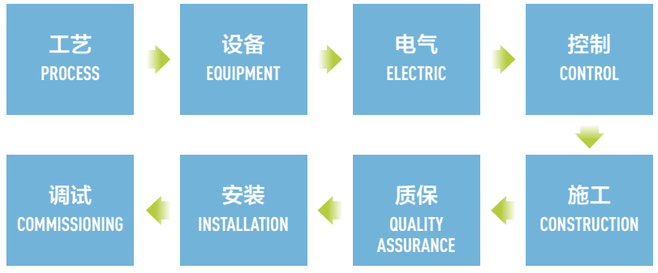
为您所想，解您所忧
为您“量身定做”个性化解决方案

THINK FOR YOU, SOLVE YOUR WORRIES
YOU "TAILOR-MADE" CUSTOMIZED SOLUTIONS

完整的工程设计体系
COMPLETE ENGINEERING DESIGN SYSTEM

企业拥有众多高素质设计及项目管理人员，专业涵盖工艺、设备、电气控制、安装、调试、质量保证及现场施工等。

We own a range of excellent designers and project managers,specializing in process,equipment,electric control,commissioning,installation,Quality Assurance and construction.



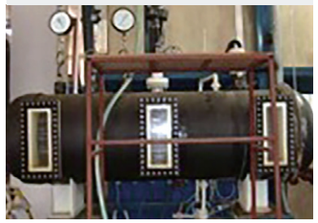
雄厚的技术研发实力
STRONG TECHNICAL R&D CAPABILITY

上海电气电站水务工程公司踏实进行海水淡化及废水处理技术储备和自主研发，已攻克多项海水淡化及废水处理领域的核心技术瓶颈，形成了一批具有自主知识产权的科研成果。目前公司成功开发8个专业计算软件、建立5个数据库、搭建5个实验平台、获得授权专利9项、制定12项企业标准，研发成果处于国内领先水平。

Shanghai electric has been engaged in the development and application of seawater desalination technology, expanding water-electricity cogeneration mode. Within the past ten years, Shanghai Electric has had a step by step technical accumulation and independent R&D, with a breakthrough in several core seawater desalination technology, and got a series of independent intellectual property rights. Successfully developed 8 professional computing software, eshtablished 5 databases, built 3 experimental platforms, and applied for 7 patents, issued 12 enterprise standard.

横管降膜蒸发机理研究实验平台

Research & experiment platform for mechanism of horizontal tube falling film evaporation



卧式热水闪蒸模拟体实验平台

Research & experiment platform for horizontal hot water flash simulator

具有强大的技术研发队伍，拥有研究生以上学历的员工比例为45%

With a strong technical R & D team, with a graduate degree or above, the proportion of employees is 45%

获得国家科技部“十二五”科技支撑重点项目——大型低温多效海水淡化系统集成技术与工程示范

Access to the national Ministry of science and technology "12th Five-Year" key projects of science and technology support - large-scale low temperature multi effect desalination system integration technology and engineering demonstration

牵头成立国内首个热法海水淡化产业创新战略联盟

Led the establishment of the first domestic hot water desalination industry innovation strategic alliance

30t/d F-MED 中试装置
PILOT PLANT FOR F-MED WITH 30 T/D CAPACITY

浓盐水结晶分盐技术实验平台
RESEARCH & EXPERIMENT PLATFORM FOR CONCENTRATE CRYSTALLIZATION AND SALT PURIFICATION TECHNOLOGY

研究利用化工、钢铁等行业丰富的低品位热水余热资源，实现余热回收利用制取淡水，极大的降低了热法海水淡化的制水成本

MAKE FULLY USE OF THE LOW GRADE HOT WATER WASTE HEAT RESOURCES IN CHEMICAL AND STEEL INDUSTRIES, AND OBTAIN FRESH WATER UTILIZING WASTE HEAT RECOVERY, WHICH HAS GREATLY REDUCED THE MED WATER PRODUCTION COST.

卓越的项目管理团队及高效执行

EXCELLENT PROJECT MANAGEMENT TEAM AND EFFICIENT EXECUTION

上海电气电站水务工程公司具有丰富的项目管理经验和众多成功业绩，其中大型EPC项目业绩共有四个，分别是宝钢湛江5万吨热法项目，丰南钢铁10万吨热膜耦合项目，秦皇岛6000吨方形热法项目以及浙江石化一期10.5万吨热法项目。在十多年的实践中，我们培养起一支专业高效的项目经理、现场经理、QC经理和调试经理管理团队，总结了一套行之有效的项目管理体系，确保项目高效执行。

SEWE has a wealth of project management experience and numerous great references, including four large project under EPC mode, such as 50000 tons of Baogang Zhanjiang Steel MED project, 100000 tons of Fengnan RO coupling with MED project, 6000 tons of Qinhuangdao square MED project and 105000 tons of Zhejiang petrochemical Phase MED project. In the past more than ten years of practice, we have trained a professional and efficient management team of project manager, site manager, QC manager and commissioning manager, and summarized a set of effective project management system to ensure the efficient implementation of the project.

我公司执行的EPC项目从任务目标及时间段进行分解，可以分为四个阶段：
The EPC project execution can be divided into four stages:

启动阶段 Start-up Stage → 初步设计阶段 Preliminary Design Stage → 详细设计及采购阶段 Detailed Design & Procurement Stage → 安装调试阶段 Installation & Commissioning Stage

每个阶段的各个部门均有详细的计划（设计计划、项目计划、采购计划、质量计划等等），并采用周报和月报相结合的模式予以追踪考核，确保计划的实施和纠偏。

Each department at each stage has a detailed plan (design plan, project plan, procurement plan, quality plan, etc.), which will be tracked and evaluated by weekly and monthly reports to ensure the implementation and correction.

公司承接EPC项目后,组建专门的项目经理部，配齐资源和人员组织项目实施，按合同、协议要求保质保量完成。

A project management department is set up after undertaking an EPC project. All resources and personnel are allocated to organize the project implementation to complete the project with quality and quantity guaranteed according to the contract and agreement.

完备的质量管理体系及经验丰富的监造队伍

COMPLETE QUALITY MANAGEMENT SYSTEM AND EXPERIENCED SUPERVISION TEAM

为了保证项目有序、高效、高质按期完成，上海电气电站水务工程公司对于每一个项目都制定完整的项目质量保证大纲（PQAP），质量大纲覆盖整个设计、采购、分包商管理、制造、装配、包装、储运、安装和调试阶段。特别是对每个分包部件都单独制定技术采购规范（TPS）和配套的产品质量控制计划（QCP）。公司对海淡主设备的制造和安装焊接质量尤为关注，所有焊接操作人员要通过上海电气焊工考试中心的培训、考试和评定后才能上岗操作。

公司所有的分包商均严格通过技术、制造、人员设备和质保能力进行评审，每半年都要进行供方能力评价，在诸多项目的执行中去芜存菁，形成了一支基本稳定的供应商队伍。

公司拥有一支经验丰富的监造队伍，监造工程师拥有PT、UT、MT和RT等证书，部分人员拥有国际知名监理公司工作经历。所有的主设备采用监造工程师驻厂监造的模式全程监控，并每周出具监造周报，在配套件验收上，监造工程师采用巡检制，基本覆盖出厂验收环节，出具成品验收报告，确保产品质量。

In order to ensure the completion of the project on schedule orderly, efficiently with high-quality, SEWE has developed a complete project quality assurance program (PQAP) for each project, covering the whole design, procurement, subcontractor management, manufacturing, assembly, package & storage, installation and commissioning stages. In particular, technical purchase specifications (TPS) and quality control plans (QCP) are developed for each subcontracted component. The company pays special attention to the welding quality of the manufacturing and installation of MED main equipment. All welding operators can work only after passing the training, examination and evaluation of Shanghai electric welder examination center.

All company's subcontractors are strictly reviewed on the technical, manufacturing, personnel and equipment and quality assurance capability aspects. Subcontractors are optimized by capability evaluation every half a year, forming a basically stable supplier team.

SEWE has an experienced supervision team, supervision engineers have PT, UT, MT and RT certificates, some of whom have international famous supervision company work experience. All the main equipment shall be monitored by the supervision engineer stationed on site to supervise the whole process, and submit supervision report weekly. The inspection system is adopted in the acceptance of accessories, basically covering the factory acceptance.

强大的制造建设能力
STRONG MANUFACTURE AND BUILD CAPABILITY

“国际一流，五十年不落后”的上海电气临港重型装备制造基地，
为大型海水淡化设备的制造和运输创造了条件。
奠定在大规模现代装备制造领域的国内外引领地位，
支撑上海电气装备制造业的可持续发展。

Shanghai Electric LinGang Heavy Equipment Manufacturing Base, world leading with 50 years no backward, has created conditions for the manufacture and transportation of large-scale desalination equipment. Established a leading position in the field of large-scale modern equipment manufacturing, and support the sustainable development of Shanghai Electric manufacturing industry.

临港重型制造总装车间面积达34992平方米,具备320吨的起重能力,拥有1000吨泊位的自备码头和铁路专用线。

The LinGang Heavy Equipment Manufacturing assembly workshop covers an area of 34992 square meters, has 320 tons of lifting capability, and has 1000 tons of berths 、 self-contained wharf and special railway lines.

临港重型制造总装车间具有先进的配套设备，具备百万级核电站凝汽器等大型热交换器和日产2万吨级以上的超大型海水淡化蒸发器的组装能力。

Lingang heavy workshop owns advanced equipment. Assembly capacity of large scale heat exchangers and other large sea water desalination plants with a capacity of 20 thousand ton and more than one million nuclear power station condenser, etc.

1400t 重型厂房起吊能力/码头最大起吊能力
Heavy lifting capacity building / pier maximum lifting capacity

世界一流的钻孔中心
WORLD CLASS DRILLING CENTER

我们拥有 **34992m²** 临港重型制造总装车间

SHANGHAI ELECTRIC CREATE OUR FUTURE TOGETHER