



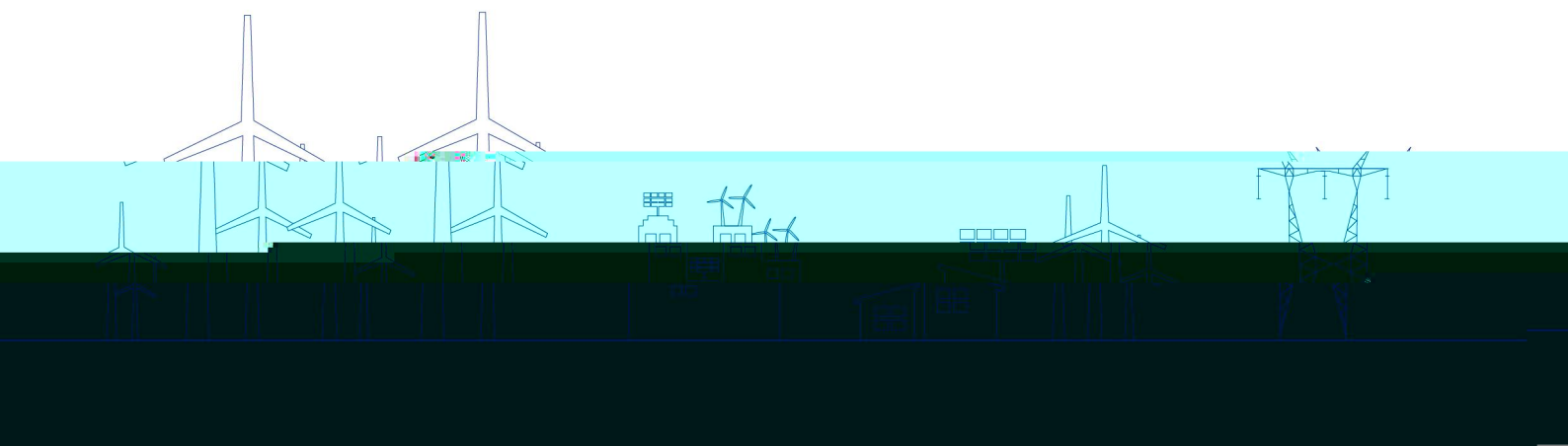
智光电气
Zhiguang Electric
智能船舶岸电系统

ZG-SPS智能高压岸电系统

广州智光电气技术有限公司

综合能源技术与服务提供商

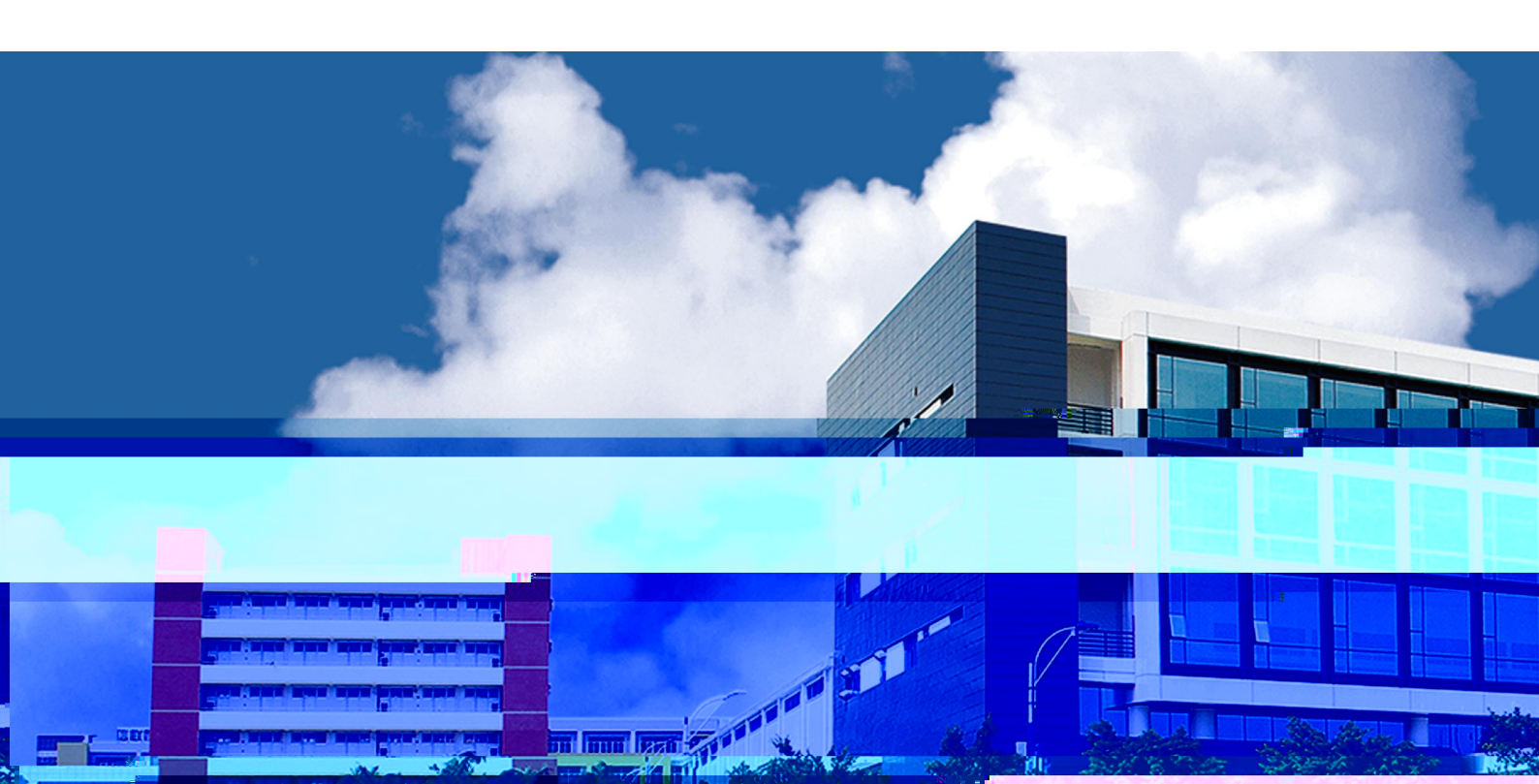
Integrated Energy Technology & Service Provider



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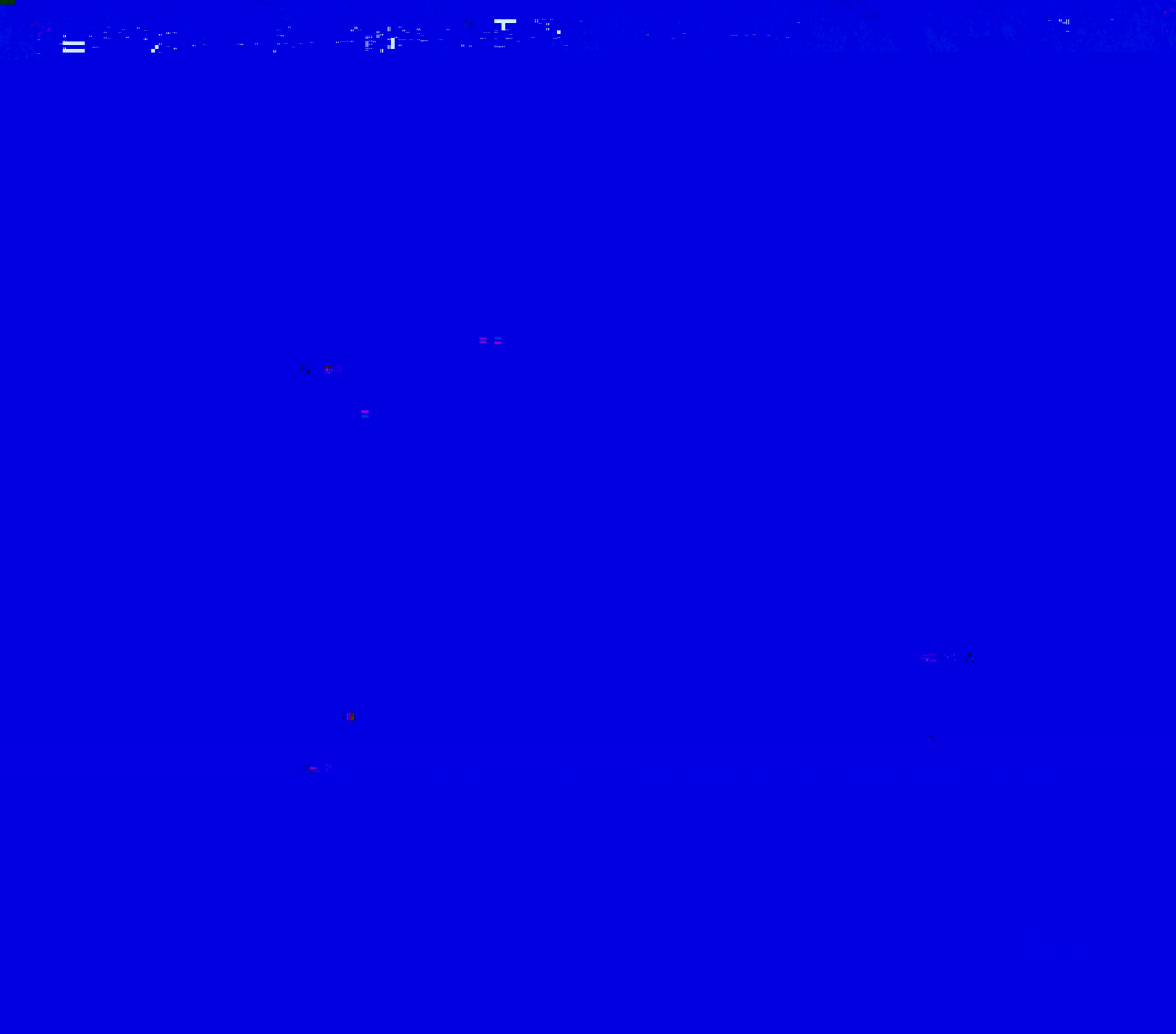
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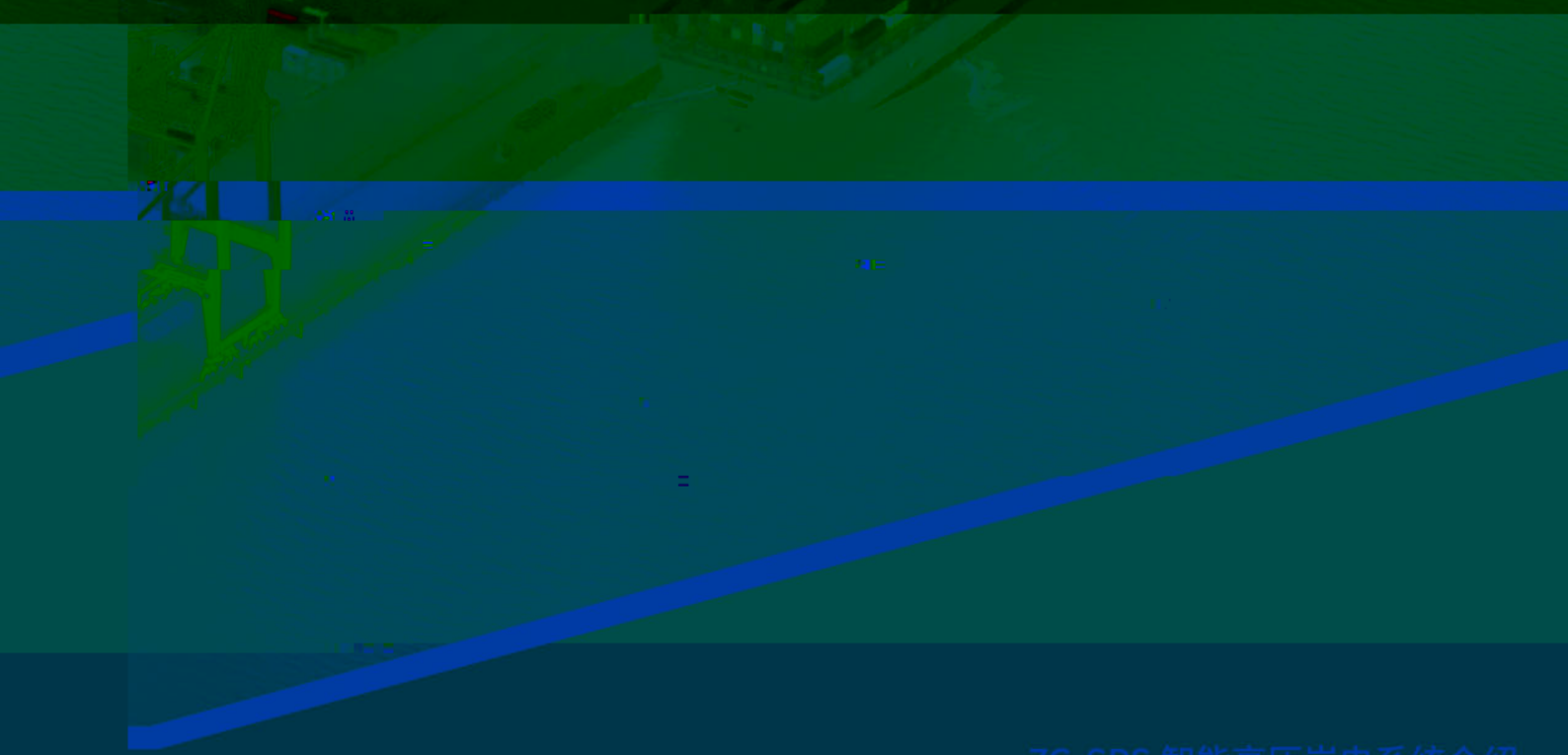
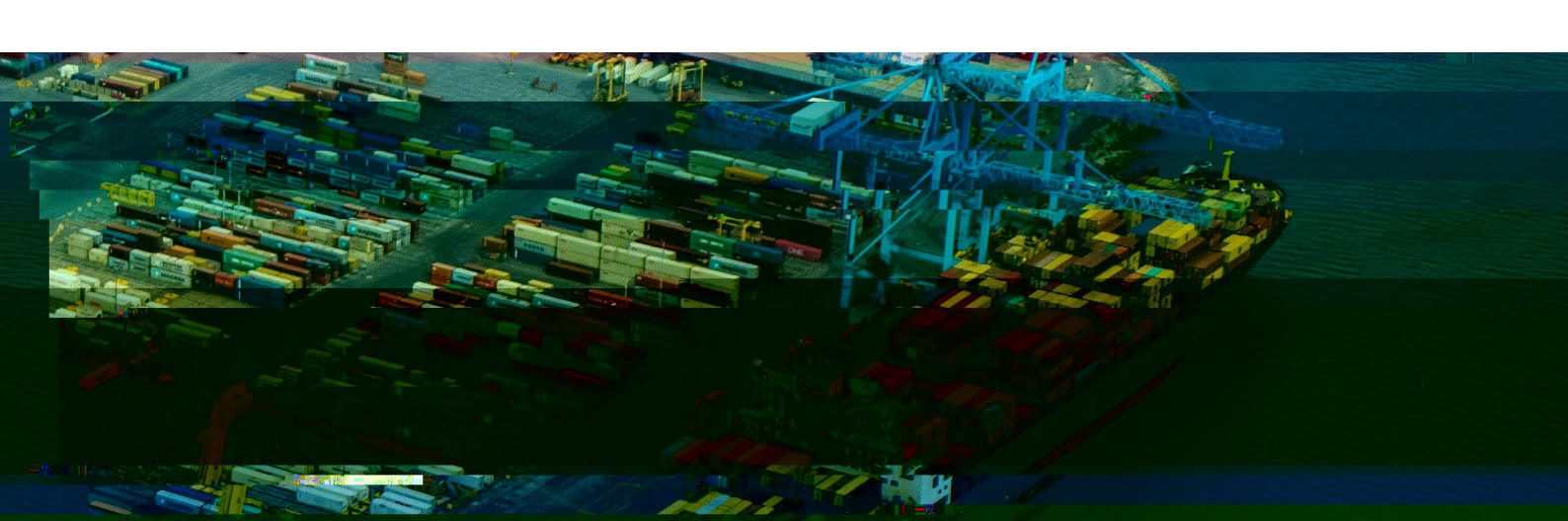


公司简介

Company Profile

方案，典型客户包括中国国家电网公司、南方电网、五大发电集团、中广核、中国建筑、中石油、中石化、中石炼化宝武钢铁集团等大型中央企业集团。





ZG-SPS 智能高压岸电系统介绍

Introduction of ZG-SPS Intelligent High-voltage Shore Power System

The ZG-SPS intelligent high-voltage shore power system is a cutting-edge technology designed to provide efficient and reliable power to large vessels at the port. It features a modular architecture that allows for easy integration and expansion. The system is equipped with advanced control and protection mechanisms, ensuring safe and stable operation. By combining with flexible and diverse modular sub-systems, it can adapt to various voltage and frequency requirements.



2.1 電子系統介紹

The Introduction of Elect. Systems

系統功能及介紹

Project: 2023/03/20 - 2023/03/20

The power distribution system of the building is designed according to the specifications of the commercial power distribution system. The power distribution system is designed according to the specifications of the commercial power distribution system. The power distribution system is designed according to the specifications of the commercial power distribution system.

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变频稳压子系统

Variable Frequency Voltage Regulator Subsystem

变频稳压子系统的核心设备是高压变频电源，其功能特点如下：

The core equipment is a high-voltage variable frequency power supply, and its functional characteristics are as follows:

无滤波装置谐波小

Low Harmonics without Filter Device

采用多脉波、移相整流技术，输出电压谐波低于1%；采用多电平移相叠加变压变频技术，可直接输出接近正弦波的6.6kV和11kV电压。

Using multi-pulse, phase-shifting rectification technology, the output voltage harmonic is less than 1%. The multi-level transformer and frequency conversion technology realized by phase shift can directly output 6.6kV and 11kV voltages close to a sine wave.

频率电压一键切换

One-click Switching of Frequency and Voltage

多脉波整流技术

Multi-pulse Rectification Technology

智能高压岸电系统采用多脉波整流技术，电网侧谐波污染小，~20%负载以上工况下，输入功率因数 >0.97 ，无需功率因数补偿及谐波抑制装置，即可满足国家标准。

Intelligent high-voltage shore power system adopts multi-pulse rectification technology; it generates less harmonic pollution to the grid side. Under working conditions above 20% load, input power factor >0.97 . It can meet national standards without power factor compensation and harmonic suppression device.

逆功率处理与保护

Reverse Power Processing and Protection



电压叠加形成高压输出原理结构

Voltage Superimposed to Form a High-voltage Output Principle Structure



六级串联系统输出波形

Six-stage Series System Output Waveform

变压及电网隔离子系统

Transformer and Power Grid Isolation Subsystem

隔离变压器采用Dy11接法的设计，50/60Hz双频工作模式，额定电压按照60Hz电制设置，通过设置变频电源输出电压，可在任意频率范围内实现电压幅值调节。

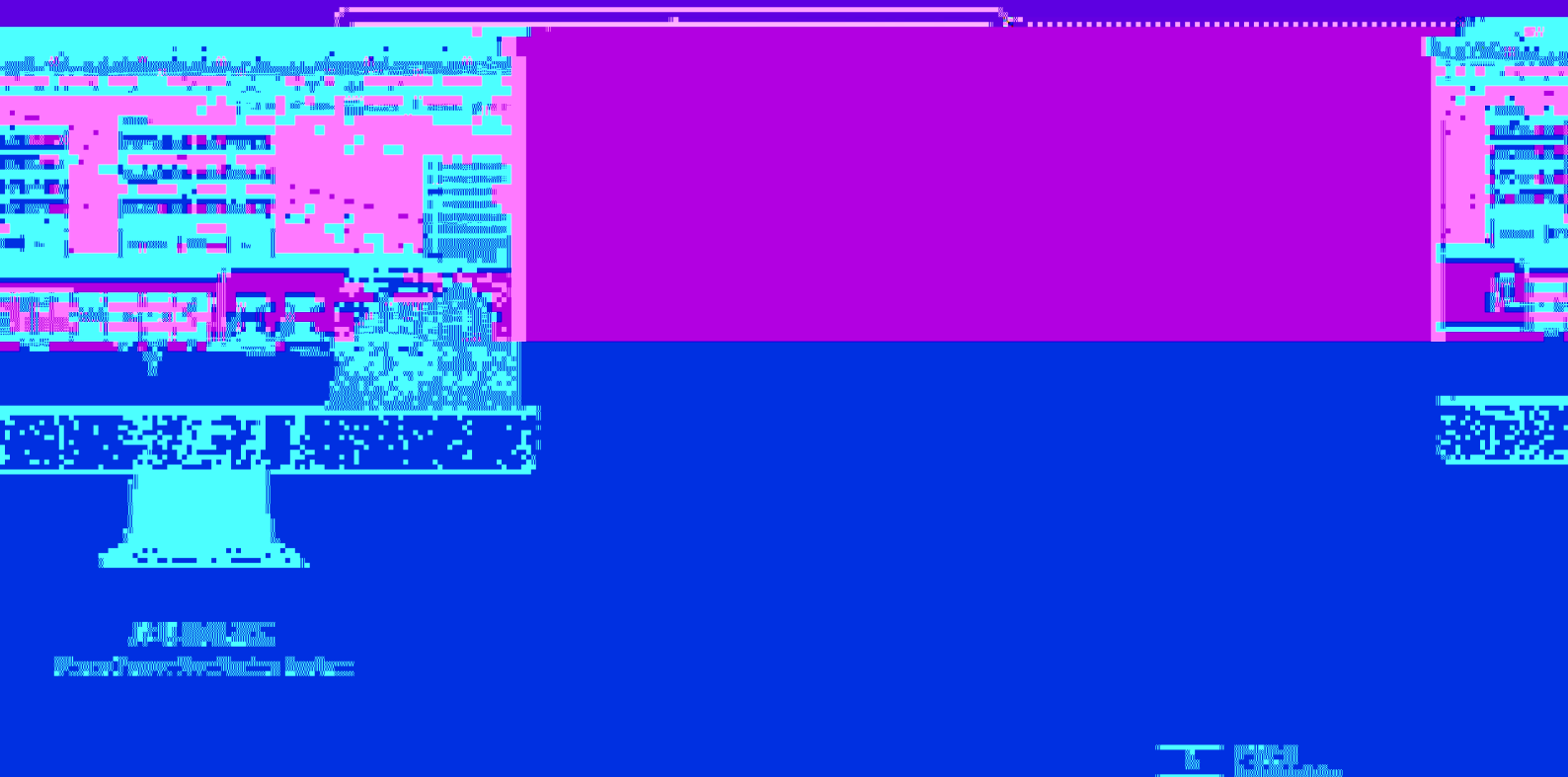
The isolation transformer adopts a Dy11 connection design, 50/60Hz dual frequency working mode, rated voltage is set according to 60Hz power system, and the system can realize the voltage regulation in different frequencies by setting the output voltage value of the variable frequency power supply.

数据综合监控系统

Data Integrated Monitoring Subsystem

数据综合监控系统为变电站综合系统，实时采集站内的数据信息，并可操作站内设备运行状态。系统能够实时监控站内输出电压、电流、功率、频率等信息，并可对电网运行状态进行实时监控，及时发现异常。

The data integrated monitoring system is a comprehensive system for the substation, which can collect data information in real time and operate the running status of the equipment in the station. The system can monitor the output voltage, current, power, frequency and other information in the station in real time, and can monitor the running status of the power grid in real time, so as to find the abnormality in time.



中性点安全接地子系统

Neutral Point Grounding Safety Subsystem

隔离变压器中性点采用电阻接地，并通过中性线与船壳连接，限制岸电供电过程中船侧接地时的故障电流，为船上设备和人员提供安全保护。

The neutral point of the isolation transformer adopts resistance grounding and is connected to the ship's hull through the neutral line to limit the fault current when the ship side is grounded during the shore power supply process and provide safety protection for the equipment and personnel on board.

电气综合保护子系统

Electrical Integrated Protection Subsystem

该子系统包含以下十大保护系统：光纤故障保护、双重过热保护、缺相保护、输出单相接地保护、船岸安全回路保护。



系统温度控制子系统

Temperature Control Subsystem

系统内部大量的电力电子器件对工作温度比较敏感，因此必须对系统运行的环境温度进行实时监测和控制。在多个设计环节均采用独特高效的散热方案。

A large number of power electronic components inside the system are sensitive to the operating temperature, so the ambient temperature of the system operation must be monitored and controlled in real time. Unique and efficient heat dissipation schemes are adopted in multiple design links.



变频电源柜体冷却设计

Cooling Design of Variable Frequency Power Cabinet

系统采用独特的功率单元侧布置设计方案，缩短空气流程，降低空气阻力，提升系统散热效率。



功率单元冷却设计

Cooling Design of Power Unit

功率单元采用独特的侧布置设计方案，缩短空气流程，降低空气阻力，提升系统散热效率。

The power unit adopts a unique side layout design scheme, shortening the air flow, reducing the air resistance, and improving the heat dissipation efficiency of the system.



功率单元侧布置冷却设计

Cooling Design of Power Unit Side Layout

功率单元采用独特的侧布置设计方案，缩短空气流程，降低空气阻力，提升系统散热效率。

The power unit adopts a unique side layout design scheme, shortening the air flow, reducing the air resistance, and improving the heat dissipation efficiency of the system.

船岸连接子系统

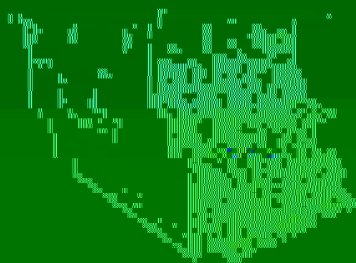
Ship-shore Connection Subsystem

船岸连接子系统主要包括码头插座箱和电缆管理系统（部分船型需要）两部分。码头插座箱安装在码头前沿，通过插座电缆与建造船舶岸电回路（缩短连接时间，码头插座箱检修

方便）。

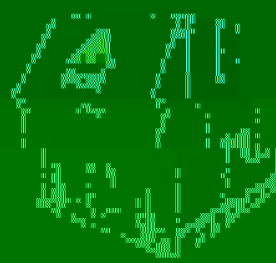
On-ship shore connection cable management system includes two parts: shore socket boxes and cable management systems (part of ship type requires). The shore socket boxes are installed at the front of the dock, and the cable management systems are installed by plugging the shore connection cables. The shore socket boxes are provided with manual switch and an external corresponding support system to facilitate the operation of the shore connection.

The cable management system includes power line management, cable support system, safety and security and other functions. The system can be used to manage the shore connection cables and the cable management system can be used to manage the shore connection cables.



集装箱船岸电插座箱

Shore socket boxes for container ships



集装箱船岸电插座箱

Shore socket boxes for container ships



集装箱船岸电连接系统

Shore connection system for container ships

2.2 功能特点 Features



电能质量优异

Excellent Power Quality

输出电压畸变率 <math>< 1\%</math>
Output voltage distortion <math>< 1\%</math>

三相输出电压不平衡度 <math>< 1\%</math>
Three-phase output voltage unbalance <math>< 1\%</math>

负载效率 $> 98\%$

Load efficiency $> 98\%$

谐波总畸变率 <math>< 5\%</math>
Total harmonic distortion <math>< 5\%</math>



2.3 船岸并网关键技术 Key Technologies for Ship-to-shore Grid Connection

可靠的相序检测与整定技术

Reliable Phase Sequence Detection and Rectification Technology

ZG-SPS智能高压岸电系统默认输出为正序，具备手动调整和自动检测调整输出电压相序的功能。

The default output of ZG-SPS is positive sequence. The system is capable of manually adjusting or automatically detecting and adjusting the output voltage phase sequence.

低电压穿越技术

Low-voltage Ride-through Technology

ZG-SPS智能高压岸电系统在岸上电网电压突降时具备低电压穿越能力，保证供电期间船上设备不受岸侧电网电压暂降的威胁，最大限度地兼顾供电连续性和设备安全性。

The ZG-SPS is capable of low-voltage ride-through capability in case of sudden voltage drop in the on-shore power grid, ensuring that the ship's equipment is not affected by the transient voltage drop in the shore-side power grid during the power supply period, maximizing both power supply continuity and equipment safety.

高精度稳压稳频控制技术

High-precision Control Technology for Voltage and Frequency Regulation

ZG-SPS智能高压岸电系统实时检测输出电压、频率，

并根据岸上电网电压、频率波动，自动调整输出电压、频率，

确保输出电压、频率精度，满足船舶用电需求，保障船舶用电安全。

船岸无缝切换技术

Seamless Ship-to-shore Switching Technology



2.4 系统安装方式

System Installation Form

7C SPS智能高压岸电系统

室内安装

Indoor Installation

Indoor Installation

室内安装示意图

The indoor installation is suitable for sites with large spaces. The system is installed in the onshore power supply room or terminal front substation, and there is plenty of space for on-site maintenance and operation, but the equipment can't be moved.



室外集装箱安装

Outdoor Container Installation

Outdoor Container Installation

室外集装箱安装方式,适用于场地有限、不适合建设永久配电房的场合,系统占地面积相对较小。

The outdoor container installation method is suitable for occasions where the site is limited and is not suitable for the construction of permanent power distribution rooms. The system covers a relatively small area.



3.1 青岛邮轮母港 16000kVA/11kV 智能高压岸电系统

Qingdao Cruise Terminal 16000kVA/11kV Intelligent

High Voltage Shore Power System

16000kVA/11kV 智能高压岸电系统

16000kVA/11kV Intelligent High Voltage Shore Power System

16000kVA/11kV 智能高压岸电系统

16000kVA/11kV Intelligent High Voltage Shore Power System

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16000kVA/11kV Intelligent High Voltage Shore Power System

16000kVA/11kV 智能高压岸电系统

16000kVA/11kV Intelligent High Voltage Shore Power System

3.2 辽宁营口港 2000kVA /3000kVA 智能高压岸电系统

3.2.1 Yingkou Port 2000kVA /3000kVA Intelligent High-voltage Shore Power System

2016年, 辽宁营口港分别安装了一套2000kVA和一套3000kVA容量的智能高压岸电系统, 连接该岸电系统的运营船舶采用6kV高压上船模式, 在船上配有降压变压器, 船上电网电压为低压400V。并网时船侧发电机输出功率360kW。

In 2016, a 2,000 kVA and a 3,000 kVA capacity intelligent high-voltage shore power system were installed at Liaoning Yingkou Port. The operating vessels connected to this shore power system use a 6kV high-voltage embarkation mode. The ship is equipped with a step-down transformer, the ship's grid voltage is low voltage 400V. When connected to the grid, the generator output power on the ship side is 360kW.



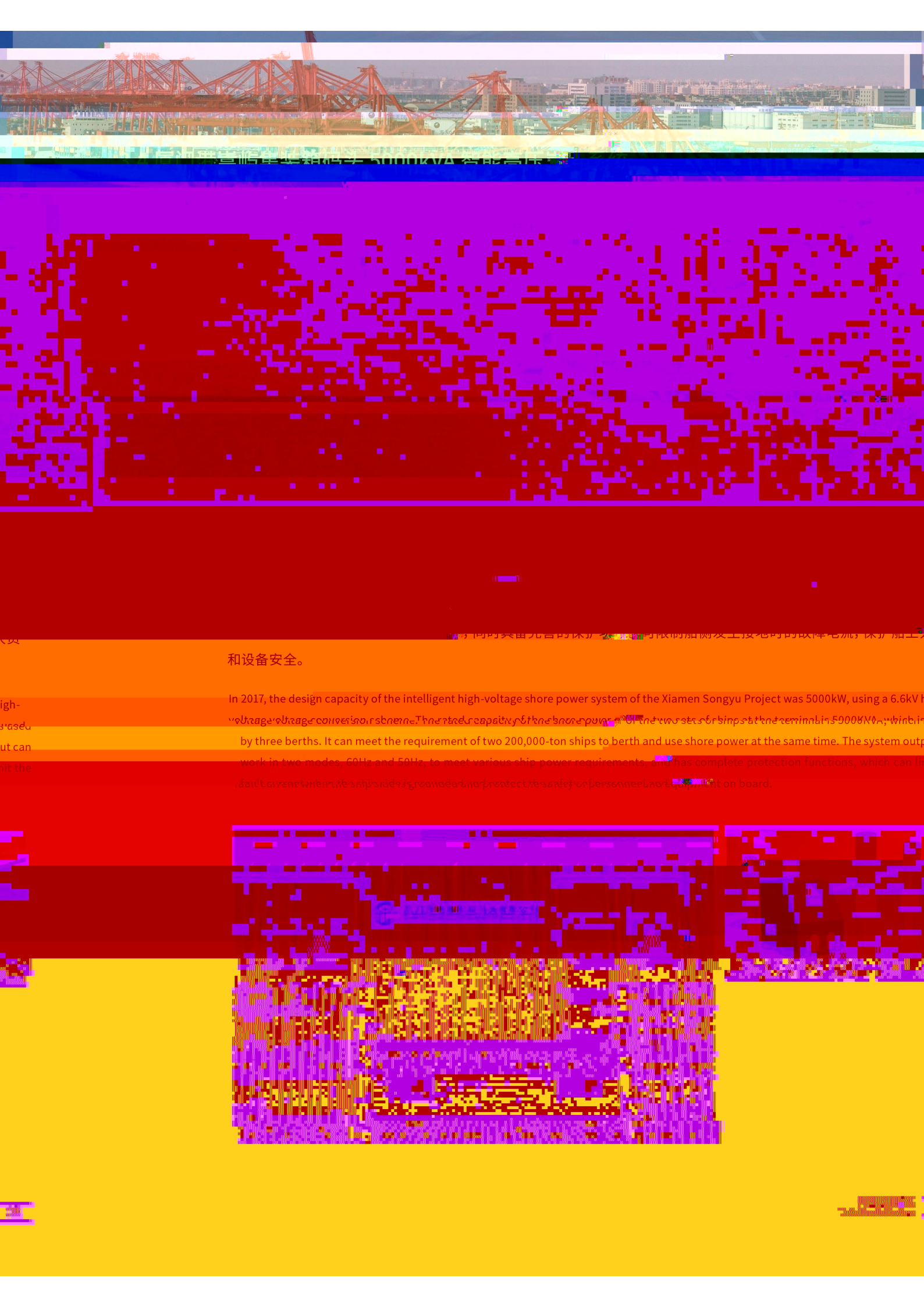
3.3 青岛港前湾港区 103 泊位 500kVA 智能高压岸电系统

Qingdao Qianwan Port Area 103 Berth 500kVA Intelligent



...that integrates power conversion technology, neutral grounding and protection technology, real-time cable monitoring and control technology.





厦门嵩屿三期码头 5000kVA 智能高压岸电系统

和设备安全。

In 2017, the design capacity of the intelligent high-voltage shore power system of the Xiamen Songyu Project was 5000kW, using a 6.6kV high-voltage shore power converter system. The rated capacity of the shore power system of the two berths is 5000kVA, which can be used by three berths. It can meet the requirement of two 200,000-ton ships to berth and use shore power at the same time. The system can work in two modes, 60Hz and 50Hz, to meet various ship power requirements, and has complete protection functions, which can limit the fault current when the ship is idling, so as to protect the safety of personnel and equipment on board.

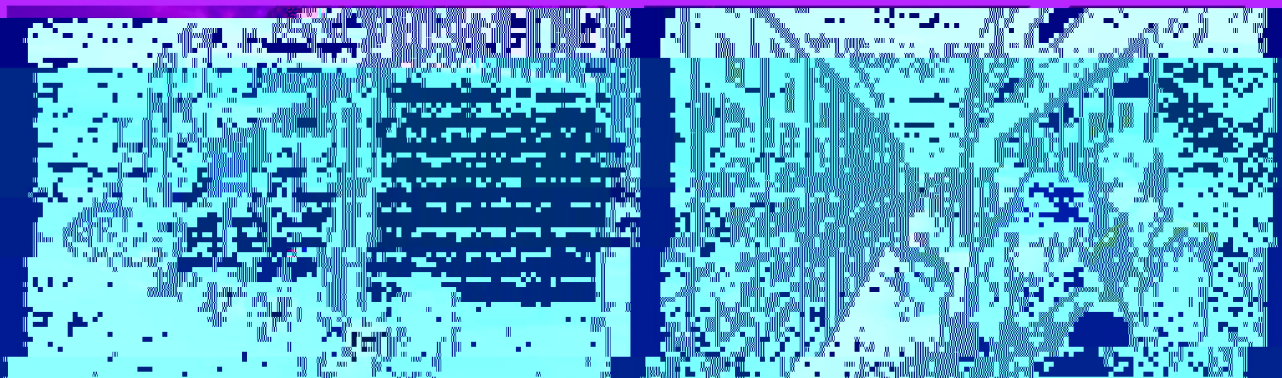


3.5 深圳蛇口集装箱码头 4000kVA 智能高压岸电系统

Shenzhen Shekou Container Terminal 4000kVA Intelligent High-voltage Shore Power System

2019年，深圳蛇口集装箱码头使用一套4000kVA智能高压岸电系统，采用6.6kV级高压船舶港口岸电系统，可根据船舶电网参数，调整供电频率和供电电压，设置系统输出电压和频率，使岸基电源与船舶发电机实现无冲击并网和负荷转移。

In 2019, a set of 4,000kVA intelligent high-voltage shore power system adopted by Shenzhen Shekou Container Terminal uses a 6.6kV high-voltage ship port shore power system, which can adjust the power supply frequency and supply voltage and set the system output voltage and frequency according to the ship's power grid parameters, so that the shore-based power supply and the ship's generator can achieve non-impact grid connection and load transfer.



四、丰富的连船供电实践经验

Extensive Practical Experience in Power

Supply with Connected Ships

中远集团拥有全球规模最大的连船供电系统，该系统已广泛应用于全球各大港口，为众多大型集装箱船、散货船、滚装船、客滚船、邮轮等提供稳定的电力供应。

Among many other extremely large container ships (13000 TEU), as well as bulk cargo and ro-ro passenger ships, details are as follows:

成功连接至高电压变频岸电的各类轮船(部分)

Various types of ships (parts) successfully connected to ZG-SPS

中远海运法国号 (13386TEU)

COSCO Shipping France (13386TEU)

中远海运荷兰号 (13386TEU)

COSCO Shipping Netherlands (13386TEU)

中远星座级人马座号 (20000TEU)

COSCO Constellation Sagittarius (20000TEU)

中远星座级室女座号 (20000TEU)

COSCO Constellation Grand Virgo (20000TEU)

马士基爱丁堡号 (13000TEU)

Maersk Edinburgh (13000TEU)

马士基恩塞纳达号 (13000TEU)

Maersk Ensenada (13000TEU)

古帝马士基号 (13000TEU)

Maersk Gudri (13000TEU)

马士基埃森号 (13000TEU)

Maersk Essen (13000TEU)

地中海MCC DANIELA (14000TEU)

Mediteranean MCC DANIELA (14000TEU)



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