



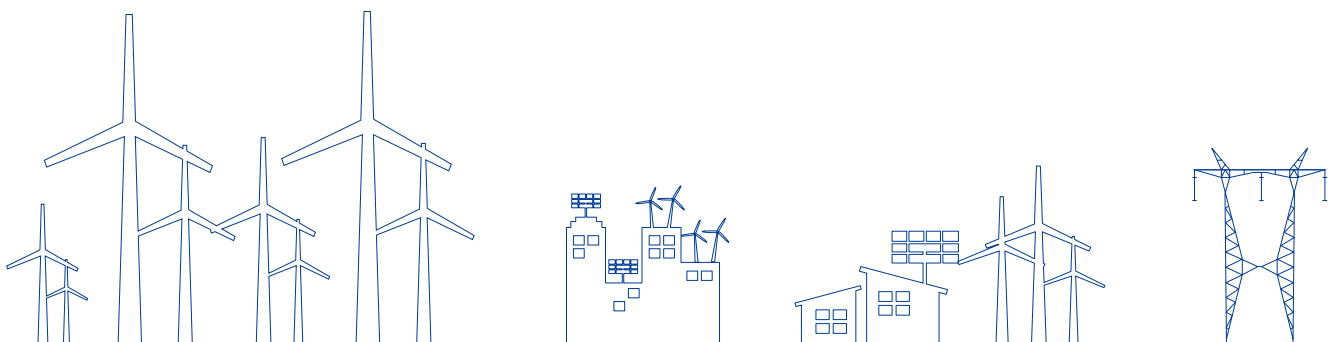
ZG-dSVG动态无功 补偿装置产品手册

ZG-dSVG Dynamic Reactive Power
Compensation Device Product manual

广州智光电气技术有限公司
Guangzhou Zhiguang Electric Technology Co., Ltd.

综合能源技术与服务提供商

Integrated Energy Technology & Service Provider



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一、公司简介

广州智光电气技术有限公司成立于2002年，注册资金2亿元，是广州智光电气股份有限公司【股票代码：002169，以下简称智光】的全资子公司，是智光在综合能源技术与服务战略发展方向专业从事柔性电力技术研究的核心成员企业。

公司自成立以来一直专注于以大功率电力电子为核心技术的电气控制装备技术研究，在智能电网、分布式微网、储能、电机控制与节能、电能质量控制、先进电源技术等开展技术与产业化应用。主营产品包括动态无功补偿装置（SVG）、高压有源滤波器（HAPF）、储能PCS系统、配网中性点接地装置、高压变频调速装置、港口岸电系统、低压电能治理及大型工业智慧型UPS等。

公司产品已在全国实现地区性覆盖，并远销至数十个海外国家和地区，为全球节能减排及绿色电能事业做出了贡献。公司以私有云平台、大数据为技术手段，充分发挥互联网+的优势，建立了以重点行业、重点区域、大客户为中心的营销与服务平台，为包括新能源、电力、建材、冶金、化工、煤炭、港口、市政等行业数千个客户提供产品、技术及综合技术解决方案，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、中国建材、中石化、中石油及宝钢钢铁集团等大型中央企业集团。



Company Profile

Guangzhou Zhiguang Electric Technology Co., Ltd., established in 2002 with a registered capital of 200 million yuan, is a wholly-owned subsidiary of Guangzhou Zhiguang Electric Co., Ltd. [stock code: 002169, hereinafter referred to as Zhiguang]. It is a core member company of Zhiguang, which is specializing in flexible power technology research in the direction of integrated energy technology and service strategy development.

Since its establishment, the company has been focusing on the research of electrical control equipment technology with high-power electronics as its core technology, and conducting technical research and industrial applications in the fields of smart grid, distributed micro-grid, energy storage, motor control and energy conservation, power quality control, advanced power technology, etc. The main products include Distribution network neutral point grounding device, High-voltage variable frequency converting system , Energy storage power conversion system, Static Var generator(SVG), Intelligent high and low voltage shore power system, Low-voltage power quality management and Large industrial intelligent UPS.

The company's products have achieved regional coverage in the country and are exported to dozens of overseas countries and regions, contributing to the global energy conservation and emission reduction and green energy industry. The company uses the private cloud platform and big data as its technical means to give full play to the advantages of the Internet +, and establishes a marketing and service platform centered on key industries, key regions and major customers, providing products, technologies and comprehensive technical solutions to thousands of customers in the power, building materials, metallurgy, chemical, coal, port, municipal, and new energy industries. Typical customers include China State Grid Corporation, China Southern Power Grid, Five Major Power Generation Groups, China General Nuclear Power Group, China National Building Materials Group Corporation, Sinopec, Petro China and Baowu Iron and Steel Group.

二、ZG-dSVG简介

ZG-dSVG Introduction



2.1 产品简介 Product Introduction

ZG-dSVG动态无功补偿装置不再采用大容量电容、电感器件,而是通过电力电子器件的高频开关实现无功能量的变换,在补偿效果、功率密度和运行效率等技术指标上具有传统无功补偿设备无法比拟的优势,是目前电能质量综合治理的最佳解决方案,有效提高电网电压暂态稳定性、抑制母线电压闪变、补偿不平衡电流、滤除谐波及提高功率因数。

ZG-dSVG no longer uses large-capacity capacitors and inductors, but realises the conversion of reactive energy through the high-frequency switching of power electronic devices, which has the incomparable advantages of traditional reactive power compensation equipment in terms of technical indexes such as compensation effect, power density and operation efficiency, and it is the best solution for the comprehensive management of power quality at present, which can effectively improve the transient stability of the grid voltage, inhibit the flicker of the bus voltage, compensate the imbalance current, filter out the harmonics, and improve the power factor.

2.2 应用场景 Application Scenario

SVG系列产品可广泛应用于石油化工、新能源行业、煤炭行业、冶金、电气化铁路、城市建设等电力行业中,为各种电动机、照明设备、发电机、电焊机、轧钢机、电阻炉等设备提供高质量、高可靠性的无功补偿的解决方案。

ZG-dSVG series products can be widely used in petrochemical industry, new energy industry, coal industry, metallurgy, electrified railway, urban construction and other electric power industries to provide high-quality and reliable reactive power compensation solutions for various motors, lighting equipment, generators, welding machines, rolling mills, resistance furnaces and other equipment.

石油、化工、矿山、码头、重型工业 Petroleum, chemical, mining, dock, heavy industry



- ⚡ 稳定供电电压；
Stabilisation of supply voltage;
- 🏠 大型电机的无功就地动态补偿；
local dynamic compensation of reactive power for large motors;
- 🔊 减少牵引传动装置的无功波动与谐波。
Reduction of reactive power fluctuations and harmonics in traction drives.
- 🔌 给较多中低压电机供电的变电站集中补偿；
Centralised compensation in substations supplying power to a larger number of medium and low voltage motors;
- 🔌 相关用电设备的无功进行集中补偿；
Centralised compensation of reactive power of relevant power-using equipment;

钢铁、冶金 Steel, metallurgy



- ⚡ 稳定母线电压；
Stabilise busbar voltage;
- 🔌 降低电压波动，抑制闪变，提高生产效率；
Reduce voltage fluctuation, inhibit flicker, improve production efficiency;
- ⚖️ 平衡负序。
Balance negative sequence.
- ⚡ 提高功率因数降低无功损耗；
Improve power factor to reduce reactive power loss;
- 🛡️ 滤除谐波，保障设备安全；
Filter out harmonics and ensure equipment safety;

城市配网及农网供电 Power supply to urban distribution networks and agricultural networks



- ⚡ 提高功率因数降低无功损耗；
Improve power factor to reduce reactive power loss;
- 🔌 稳定受电末端电压；
Stabilise the voltage at the receiving end;
- 🛡️ 保护用电设备不由无功电流过大导致安全事故。
Protect the electric equipment from excessive reactive current leading to safety accidents.
- 🔌 解决波动性负荷产生的电压波动与闪变；
Solve the voltage fluctuation and flicker generated by fluctuating loads;
- 🔌 适合对多个用户的无功与谐波集中补偿；
Suitable for the centralised compensation of reactive power and harmonics for multiple users, especially where there are more shock-type loads;

新能源接入

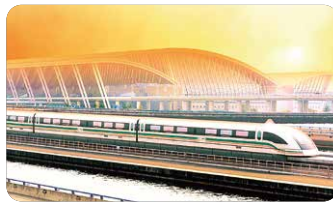
New energy access



- 控制风电、光伏发电设备电源接入点无功，防止无功倒送；
Control reactive power at the power access point of wind power and photovoltaic power generation equipment to prevent backward transmission of reactive power;
- 维持接入点电压，满足高低压穿越功能；
Maintain the access point voltage to meet the high and low voltage crossing function;
- 补偿主变以及传输电缆的残留无功减少传输损耗；
Compensate the residual reactive power of the main transformer as well as the transmission cable to reduce transmission loss.
- 稳定电网电压，减少发电功率波动造成的电压波动；
Stabilise the grid voltage and reduce voltage fluctuations caused by power generation fluctuations;
- 及时吸收发电设备在高低电压穿越恢复后多发的无功；
Timely absorb the excess reactive power generated by the power generation equipment after the recovery of high and low voltage ride-through, and protect the power generation equipment;
- 完美控制功率因数，分布式发电设备接入后，控制电网接入点的功率因数。
Perfect control of power factor, distributed generation equipment access, control the power factor of the grid access point.

电气化铁道及城市轨道交通行业

Electrified railway and urban rail transit industry



- 牵引供电系统的谐波综合治理，改善电能质量，提高牵引能力，节能降耗；
Harmonic comprehensive treatment of traction power supply system, improve power quality, improve traction capacity, energy saving and consumption reduction;
- 抑制由牵引系统启动或制动时产生的无功冲击所引起的电压闪变现象；
Suppress the voltage flicker phenomenon caused by the reactive power shock generated when the traction system starts or brakes;
- 平衡机车负荷产生的负序电流；
Balance the negative sequence current generated by locomotive load;
- 稳定母线电压提高功率因数。
Stabilise busbar voltage and improve power factor.

2.3 构成 Structure

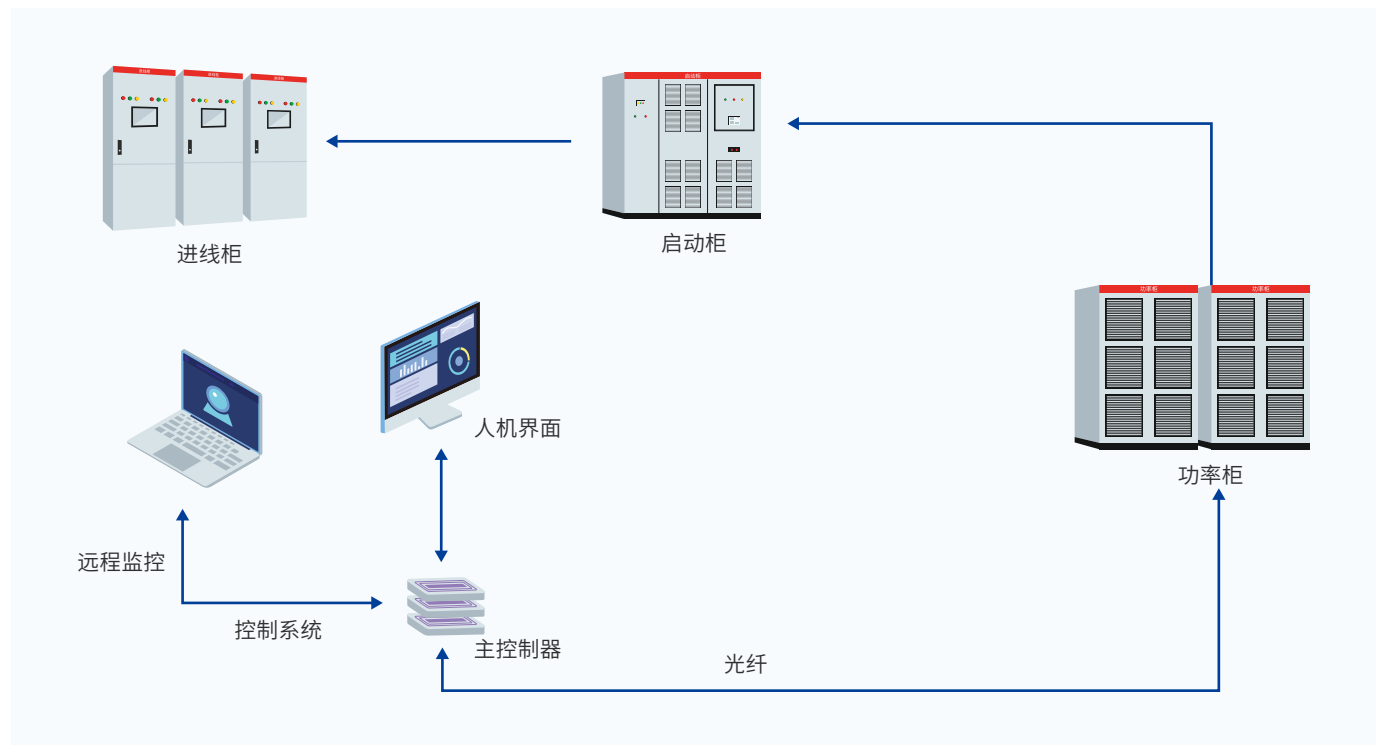
ZG-dSVG动态无功补偿装置的主回路采用功率单元级联链式结构。系统可分为：进线部分、启动部分、功率部分、控制部分、冷却部分。分柜体式或分体框架式。

ZG-dSVG main circuit adopts power unit cascade chain structure. The system can be divided into: inlet part, starting part, power part, control part, cooling part. Split cabinet type or split frame type.

► 主回路 Main Circuit

主回路包括进线柜、启动柜和功率柜。进线柜内装有隔离开关K、启动开关、预充电限流电阻R，连接电抗器L，功率分柜内装有换流链，通过完全相同的功率单元体级联而成，功率单元体内包含直流支撑电容Cd和IGBT构成的换流电路。

The main circuit includes the inlet cabinet, the starting cabinet and the power cabinet. The inlet cabinet is equipped with isolation switch K, start-up switch, and pre-charging current limiting resistor R, connecting reactor L, and the power cabinet is equipped with a current converter chain. This is achieved by cascading identical power units, which contain the DC support capacitor Cd and the commutator circuit composed of IGBTs.



• 预充电限流电阻 Pre-charge Current Limiting Resistor

预充电限流电阻R能有效限制装置启动前的电流，保护IGBT和直流支撑电容。该电阻具有极大的热容量，可在短时间内承受反复冲击电流。

The pre-charge current limiting resistor R effectively limits the current before the device starts, protecting the IGBTs and DC support capacitors. The resistor has a great thermal capacity and can withstand repeated inrush currents for a short period of time.

• 连接电抗器 Connecting Reactor

换流链通过连接电抗器L接入电网，该电抗器将换流链的输出电压转化为电流注入电网，平滑换流链产生的纹波。该电抗器采用优质材料和低磁密设计，具有高线性度、低损耗和抗谐波的特点。

表 不同电压等级对应的功率单元体

Table Power units for different voltage levels

序号NO.	电压等级voltage	功率单元数量No. of power units
1	6kV	6~8
2	10kV	10~12
3	35kV	36~48

The converter chain is connected to the grid through the connecting reactor L. This reactor converts the output voltage of the converter chain into current for injection into the grid, smoothing the ripple generated by the converter chain. The reactor is designed with high quality materials and low magnetic density, featuring high linearity, low loss and harmonic resistance.

► 控制系统 Control System

主控制系统包括主控制器、功率单元驱动板、辅助控制电路、人机界面及后台监控系统。

The control system includes the main controller, power unit driver board, auxiliary control circuits, human-machine interface and background monitoring system.

· 主控制器 Main Controller

主控制器由各个功能板卡组成,完成交流信号采集、开关量控制、PWM脉冲分配、状态检测和系统保护等工作。

The main controller consists of various functional boards to complete AC signal acquisition, switching control, PWM pulse distribution, status detection and system protection.

· 功率单元驱动板 Power Unit Driver Board

功率单元驱动板安装在功率单元内,通过光纤与主控制器相连,将控制信号转化为IGBT的驱动信号,同时反馈功率单元的状态。

The power unit driver board is installed in the power unit and is connected to the main controller via optical fibre to convert the control signals into drive signals for the IGBTs and to provide feedback on the status of the power unit.

· 人机界面HMI

ZG-dSVG采用液晶触摸屏,具有完备的数据显示(表格、曲线、棒图)、信息存储和历史数据查询功能;友好的界面设计保证运行人员可以安全、便捷地操作设备。

ZG-dSVG adopts LCD touch screen with complete data display (table, curve, bar graph), information storage and historical data query function; friendly interface design ensures that operators can operate the equipment safely and conveniently.

► 冷却系统 Cooling system



· 风冷系统 Air cooling design



· 水冷系统 Water cooling system

三、规格和技术参数

Specifications and Technical Features

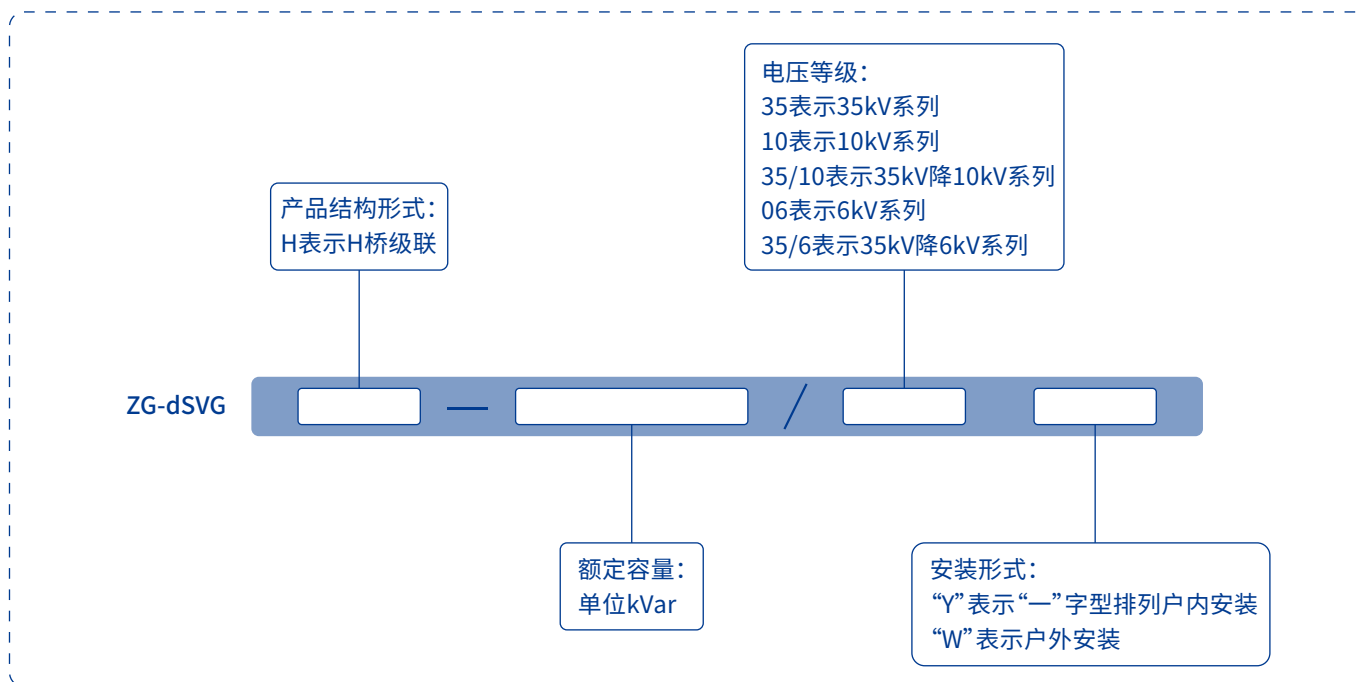
3.1 型号说明 Model Description

产品分类如下：

The products are categorised as follows:

- 安装形式：“Y”表示“一”字型排列户内安装，“W”表示户外安装
- 电压等级：35表示35kV系列；10表示10kV系列；35/10表示35kV降10kV系列；06表示6kV系列；35/6表示35kV降6kV系列
- 额定容量：单位kVar
- 产品结构形式：H表示H桥级联
- Installation form: "Y" for indoor installation in "one" arrangement, "W" for outdoor installation.
- Voltage level: 35 means 35kV series, 10 means 10kV series; 35/10 means 35kV step-down 10kV series, 06 means 6kV series; 35/6 means 35kV step-down 6kV series.
- Rated capacity: unit kVar
- Product structure form: H for H-bridge cascade

广州智光电气技术有限公司高压动态无功补偿装置



高压动态无功补偿装置命名方式

示例：额定电压为10kV，额定补偿容量为±10000kVar的系统，H桥级联拓扑方式，采用“一”字型排列户内安装，其型号可表示为ZG-dSVG-H 10000/10Y。

Example: A system with rated voltage of 10kV, rated compensation capacity of ±10,000kVar, H-bridge cascade topology, and "one" type arrangement for indoor installation, the model number can be expressed as ZG-dSVG-H 10000/10Y.

3.2 技术参数 Technical Parameter

技术指标 Technical Indicators	技术参数 Technical Parameter
额定电压 rated voltage	6~35kV
补偿容量 compensation capacity	0.3~150Mvar
调节范围 Adjustable range	额定感性无功到额定容性无功连续无极调节 Continuously and infinitely adjustable from rated inductive reactive power to rated capacitive reactive power
额定频率 rated frequency	50Hz
响应时间 response time	<4ms
过载能力 overload capacity	1.1倍持续3分钟 1.1x duration 3 minutes
谐波特性 harmonic characteristic	输出谐波电流总畸变率小于2% Output harmonic current total distortion rate is less than 2%
冷却方式 Cooling method	风冷/水冷/空水冷 Air-cooled/water-cooled
运行模式 operating mode	恒功率因数/恒无功/恒电压/恒电流/电压无功综合/负荷补偿 constant power factor/constant reactive power/constant voltage/constant current/ voltage reactive power synthesis/load compensation
安装方式 Installation	户内柜式、户外集装箱式 Indoor cabinet, outdoor container
环境温度 environmental temperature	-40°C~45°C
海拔高度 altitude	<3500m

3.3 技术特点 Technical Features

响应速度快, 电压闪变抑制能力强 Fast response time and high voltage flicker suppression capability

ZG-dSVG响应时间: $\leq 4\text{ms}$, 可以在极短的时间内完成额定容性到额定感性无功的相互转换, 可满足对冲击性负荷的补偿, 有效抑制电压闪变, 防止电网事故。

ZG-dSVG response time: $\leq 4\text{ms}$, can complete the mutual conversion of rated capacitive to rated inductive reactive power in a very short time, which can satisfy the compensation of inrush loads, effectively inhibit the voltage flicker, and prevent grid accidents.

运行效率高, 谐波特性优异

High operating efficiency and excellent harmonic characteristics

级联型的ZG-dSVG采用低损耗全控型功率器件, 结合专用的控制算法, 保证性能且损耗较小, 装置效率 $\geq 99\%$; 可有效抑制高频谐波注入, 在补偿无功时输出电流畸变率 $< 2\%$ 。在容量足够的条件下兼有抑制低次谐波和补偿不平衡功能。

Cascaded ZG-dSVG adopts low-loss fully-controlled power devices, combined with special control algorithms to ensure performance and low loss, and the efficiency of the device is $\geq 99\%$; It can effectively inhibit high-frequency harmonic injection, and the output current distortion rate is $< 2\%$ when compensating reactive power. Under the condition of sufficient capacity, it also has the functions of suppressing low harmonics and compensating unbalance.

散热能力强

High heat dissipation capacity

ZG-dSVG风冷散热系统采用具有专利技术的中间风道设计, 柜顶风机采用长寿命、免维护外转子电机、低噪音设计的离心风机, 保证整体系统的安全性和可靠性。

ZG-dSVG air-cooled cooling system adopts intermediate air duct design with patented technology, and the cabinet top fan adopts long-life, maintenance-free external rotor motor and centrifugal fan with low-noise design, which ensures the safety and reliability of the overall system.

故障检测与保护能力强

High fault detection and protection capability

待机时具有霍尔检测以及单元自检功能, 系统运行后具有电压、电流、温度等方面的自检与保护功能, 可及时发现并自动隔离故障, 确保系统不会对电网以及负载端设备造成影响。另外具有旁路功能的ZG-dSVG产品, 可在故障隔离时保持稳定运行。

With Hall detection and unit self-test function in standby, and self-test and protection function in voltage, current and temperature after the system is running, faults can be detected in time and isolated automatically to ensure that the system will not affect the power grid and the equipment at the load side.

In addition, ZG-dSVG products with bypass function can maintain stable operation during fault isolation.

系统功能多样化

Diversified system functions

ZG-dSVG除了常规的恒功率因数补偿、恒无功补偿功能外还具有恒电压补偿模式; 具备应对新能源发电的高低电压穿越功能; 具备高压自检自启动功能, 应对电网极度不稳定的现场; 具备多台并列运行技术, 应对超大容量以及多段母线多套系统的现场, 并取得了专利技术。(选配功能)

ZG-dSVG has constant voltage compensation mode in addition to the conventional constant power factor compensation and constant reactive power compensation functions, and high and low voltage traversing functions to cope with new energy power generation; High-voltage self-checking and self-starting function to cope with extremely unstable power grid;

Possessing multiple parallel operation technology to cope with the site of super-large capacity as well as multiple busbars and multiple systems, and obtaining the patented technology. (Optional functions)

四、应用案例

Application Cases

4.1 部分项目业绩表 Part of the Project Performance Table

序号 NO.	项目名称 project name	容量 capacity (kVar)	电压 volotage (kV)	套数 set	应用场景 application scenario
新能源行业 累计1200+台套运行 New Energy Industry Cumulative 1200+ units in operation					
1	2023年度华能集采华能海南分公司临高海上风电场项目 2023 Huaneng Collective Procurement Huaneng Hainan Branch Lingao Offshore Wind Farm Project	60000 (大容量并联 Large-capacity parallel connection 180MVar--+180MVar)	35	3	海上风电 Offshore Wind Power
2	国电投集采广西藤县新庆农光互补光伏发电项目 Guodian Investment Centralized Procurement of Guangxi Agricultural Photovoltaic Complementary Power Generation Project	54000	35	1	陆上风电 Onshore Wind Power
3	景泰新能源2023年度集采陆上风电SVG高安祥符风电基地项目 Jingtai New Energy's 2023 Collection of Onshore Wind Power SVG Ga'an Xiangfu Wind Power Base Project	28000	35	1	陆上风电 Onshore Wind Power
4	内蒙古霍煤鸿骏火电灵活性改造150MWp光伏项目 Inner Mongolia Huocoal Hongjun Thermal Power Flexibility Improvement 150MWp Photovoltaic Project	40000	35	1	改造含工程 Retrofit Inclusion Project
5	金昌市金川区西坡330kV汇集升压站及330kV送出线路工程项目 Jinchang Jinchuan District Xipo 330kV Gathering Booster Station and 330kV Transmission Line Project	30000	35	4	汇集站 Gathering station
6	国电投内蒙古通辽科尔沁40兆瓦光伏分布式项目 Guodian Investment Inner Mongolia Tongliao Horqin 40 MW PV Distributed Project	1250	10	1	分布式光伏 Distributed Photovoltaic
7	上汽大众南京分公司分布式光伏发电项目 Distributed Photovoltaic Power Generation Project for SAIC Volkswagen Nanjing Branch	1000	10	1	分布式光伏 Distributed Photovoltaic
8	乌兰禾源网荷储一体化风光发电项目一期工程 Phase I of Urho Source Grid, Load and Storage Integration Wind Power Generation Project	24000	35	1	源网荷储 Source, Network, Load and Storage
9	乌兰察布12万千瓦分散式风电项目 Ulaanchabu 120,000 kW decentralized wind power project	4000	35	1	分布式风电 Distributed wind power
10	乌兰察布12万千瓦分散式风电项目 Ulaanchabu 120,000 kW decentralized wind power project	1000	35	1	分布式风电 Distributed wind power
11	河南伊川光伏电站动态无功补偿装置(SVG)改造项目 Henan Yichuan Photovoltaic Power Station SVG Retrofit Project	10000	35	1	设备升级改 Equipment upgrading
12	河南泌阳光伏电站动态无功补偿装置(SVG)改造项目 Henan uyang photovoltaic power station SVG retrofit project	600	35	1	设备升级改 Equipment upgrading
13	蓝山楠市农光互补项目EPC总承包工程 EPC General Contracting for Agricultural Photovoltaic Complementary Project in Lanshan Nan City	SVG:15Mvar FC:4+6	35	1	带滤波电容器组 Capacitor bank with filter
14	新疆农六师煤电第六师五家渠市源网荷储一体化项目配套电网工程 Xinjiang Sixth Agricultural Division Coal and Electricity Sixth Division Wujiaqu City Source Grid Load and Storage Integration Project Supporting Power Grid Project	36000	35	8	新能源 源网荷储 New Energy Source, Network, Load and Storage
15		24000	35	1	
16		20000	35	1	
17	中广核西藏谢通门光伏项目 CGN Tibet Xaitongmen PV Project	5000	35	1	新能源高海拔 New Energy High Altitude

*续表一

序号 NO.	项目名称 project name	容量 capacity (kVar)	电压 volotage (kV)	套数 set	应用场景 application scenario
钢铁行业 累计420+台套运行 Iron and steel industry Cumulative 420+ units in operation					
1	立恒220kV变电站#4主变压器增容工程 Liheng 220kV Substation #4 Main Transformer Capacity Increase Project	40000	35	1	主变补偿 Compensation of main transformers
2	中新钢铁集团220kV新华宏变电站10KV SVG无功补偿改造工程 Zhongxin Iron & Steel Group 220kV Xinhua Hong Substation 10KV SVG Reactive Power Compensation Reconstruction Project	15000	10	2	主变补偿 Compensation of main transformers
3	重庆望变新材料#3开关站SVG项目 Chongqing Wangchang New Material #3 Switching Station SVG Project	12000	10	2	硅钢片生产 Silicon steel sheet production
4	鞍钢铸钢水冷角型SVG项目 Water-cooled angular SVG project for Anshan Steel Casting Co.	12000	10	1	电渣炉角接 Electroslag Furnace Angle Joint
5	沙钢集团安阳永兴特钢110kV变电站无功项目 Shagang Group Anyang Yongxing Special Steel 110kV substation reactive power project	6000	10	2	配电变变电站 Distribution Grid Substation
6	四川省达州钢铁集团有限公司搬迁项目轧钢工程 Sichuan Dazhou Iron and Steel Group Company Limited Relocation Project Steel Rolling Project	SVG:6000 FC:6000 (5、7、11)	10	2	轧机 Rolling mills
7	印尼德信1780mm热轧带钢项目DXN 780mm Hot Strip Project in Indonesia	12000	10	2	轧机 Rolling mills
8	闽源特钢 Minyuan Special Steel SVG+FC	SVG:15000 FC:7000	35	2	精炼炉 Refineries
9	龙门钢铁年产100万吨精品板带项目高压无功补偿及滤波装置 Longmen Iron & Steel annual output of 1 million tons of high-quality sheet and strip project high-voltage reactive power compensation and filtering device	SVG:10000 FC:6000 (5、7、11)	10	1	轧机 Rolling mills
10	包钢长材厂摩根轧机增加减径定径机组项目电气高压系统项目 Electrical High Voltage System Project for Addition of Reducing and Sizing Unit at Morgan Mill, Baosteel Long Products Mill	SVG:4000 FC:4000 (5、11)	10	2	轧机 Rolling mills
11	立恒LF精炼炉二期35kV配电室新建工程 Liheng LF Refining Furnace Phase II 35kV Power Distribution Room New Construction Project	SVG:15000	35	2	精炼炉 Refineries
12	上若泰基韩城镀锌带钢年产65万吨优质高速棒材搬迁改造项目 Shangruo Taiji Hancheng galvanized strip steel annual output of 650,000 tons of high-quality high-speed bar relocation and reconstruction project	SVG:6000 FC:6000 (5、7、11)	10	2	轧机 Rolling mills
13	安阳龙腾钢铁热处理材料φ114连轧项目 Anyang Longteng Iron and Steel Heat Treatment Material φ114 Continuous Rolling Project	8000	10	1	轧机 Rolling mills
14	晋南钢铁二期110kV变电站新建工程 Jinnan Iron & Steel Phase II 110kV Substation New Construction Project	12000	10	4	多工艺供电 Multi-process power supply
15	赤峰中唐特钢炼钢项目LF精炼炉35kV补偿装置 Chifeng Zhongtang Special Steel Steelmaking Project LF Refining Furnace 35kV Compensation Device	SVG:15000 FC:15000(2\3\4\5)	35	2	精炼炉 Refineries
16	湖南攀达250万吨薄板项目 Hunan Panda 2.5 million tons thin plate project	6000	10	2	轧机 Rolling mills
17	湖南攀达120万吨型钢项目 Hunan Panda 1.2 million tons of steel profile project	5000	10	1	轧机 Rolling mills
18	重庆攀华板材1580热轧生产线SVG项目 Chongqing Panhua Plate 1580 Hot Rolling Line SVG Project	8000	10	2	轧机 Rolling mills
19	联峰三炼钢新增LF-120t精炼炉 Lianfeng three steelmaking new LF-120t refining furnace	22000	35	1	冶金精炼炉 Steel Industry Refineries
20	常州东方特钢轧线无功补偿项目 Changzhou Dongfang Special Steel Rolling Line Reactive Power Compensation Project	6000	6	4	轧机 Rolling mills

*续表二

序号 NO.	项目名称 project name	容量 capacity (kVar)	电压 volotage (kV)	套数 set	应用场景 application scenario
21	晋南钢铁型钢四车间工程\五车间工程 Jinnan Iron & Steel Section Steel Fourth Workshop Project \ Fifth Workshop Project	SVG:5000 FC:5000(5\7\11)	10	4	轧机 Rolling mills
22	重庆钢铁无缝钢管环保搬迁项目附属配套工程 Chongqing Iron & Steel Seamless Steel Pipe Environmental Relocation Project Ancillary Projects	SVG:4000 FC:4000(5\7\11)	10	2	钢铁公辅 Steel Industry
23	承德建龙钢铁钒钛高科中棒项目 Chengde Jianlong Iron & Steel Vanadium-Titanium High-Tech Medium Bar Project	3000	10	2	轧机 Rolling mills
24	宝武集团鄂城钢铁有限公司精整热处理区新增SVG项目 New SVG Project in Finishing Heat Treatment Area of Baowu Group Echeng Iron & Steel Co.	SVG:1000 FC:1000(5)	10	4	轧机 Rolling mills
25	达钢搬迁升级项目-轧钢单元-高线标段EPC总承包工程 Dagang Relocation and Upgrading Project-Rolling Unit-High Line Section EPC General Contracting Project	SVG:2000 FC:2400	10	4	轧机 Rolling mills
26	日照市昱岚新材料有限公司高端涂镀项目 High-end Coating Project of Rizhao Yulan New Material Co.	SVG:5000 FC:5000(5\7\11)	10	4	精密轧机 Rolling mills
27	四川省达州钢铁集团有限公司搬迁项目轧钢工程 Sichuan Dazhou Iron and Steel Group Company Limited Relocation Project Steel Rolling Project	SVG:6000 FC:6000(5\7\11)	10	4	轧机 Rolling mills
28	唐山东华钢铁1580mm热轧宽带钢项目高压无功补偿 High-voltage reactive power compensation for Tangshan Shanhua Iron & Steel 1580mm hot-rolled broadband steel project	SVG:4000 FC:4000(5\7\11)	10	2	轧机 Rolling mills
铝加工行业 Aluminum processing industry					
1	新疆荣泽铝箔二期无功补偿及谐波治理设备采购合同 Xinjiang Rongze Aluminum Foil Phase II Reactive Power Compensation and Harmonic Treatment Equipment Procurement Contract	SVG:4000 FC:3000	10	2	铝深加工 Aluminum deep processing
2	西南铝无功补偿改造项目 Southwest Aluminum reactive power compensation renovation project	15000	6	2	铝深加工 Aluminum deep processing 轧机Rolling mills
3	鼎盛铝业泰国新建厂房轧机SVG项目 Dingsheng Aluminum Thailand New Plant Rolling Mill SVG Project	10000	10	1	铝加工 Aluminum processing
煤矿行业 累计300+台套运行 Coal mining industry Cumulative 300+ sets in operation					
1	山西帽山煤业二期变电站SVG项目 Shanxi Maoshang Coal Industry Phase II Substation SVG Project	3000	10	2	煤炭配电 Coal distribution
2	西山煤电屯兰矿六回风井SVG+FC项目 SVG+FC project of Xishan Coal and Power Tunlan Mine's six wind shafts	SVG:2100 FC:2100	6	2	煤炭配电 Coal distribution
3	巴州东辰工贸有限公司阳霞矿区塔里克区二号矿井35kV变电所 Bazhou Dongchen Industry and Trade Co., Ltd. 35kV Substation of No.2 Mine, Tariq District, Yangxia Mining Area	4000	10	2	煤炭 Coal
4	新疆神新阳霞矿业有限责任公司35kV变电所 35kV Substation of Xinjiang Shenxin Yangxia Mining Co.	5000	10	2	煤炭 Coal
5	淮河能源顾桥矿中央变电所SVG系统改造工程 Huaihe Energy Guqiao Mine Central Substation SVG System Modification Project	17000	10	2	中央变电站角接 Central Substation corner connection
6	龙佰攀枝花矿产品有限公司SVG项目 SVG Project of Longbai Panzhihua Mineral Products Co.	3000	10	1	磷矿 phosphate ore
7	伊旗新庙乡石场湾煤矿有限公司项目 Project of Yqi Xinmiao Township Shichangwan Coal Mine Co.	2000	10	1	煤炭 Coal
8	淮南矿业泊江海子矿内蒙古银宏能源公司地面110kV变电所 Huainan Mining Pojianghaizi Mine Inner Mongolia Yinhong Energy Company Ground 110kV Substation	6000	10	2	煤矿 Coal

*续表三

序号 NO.	项目名称 project name	容量 capacity (kVar)	电压 volotage (kV)	套数 set	应用场景 application scenario
9	陕西陕煤铜川矿业(局)有限公司华井后沟风井变电所35kV变电站 Shaanxi Coal Tongchuan Mining (Bureau) Co., Ltd. Huajing Hougou Wind Shaft Substation 35kV Substation	5000	10	1	煤矿 Coal
10	陕煤韩城西彭35kV变电站SVG项目 Shaanxi Coal Hancheng Xipeng 35kV Substation SVG Project	SVG:2000 FC:2000	6	2	煤炭配电 Coal
11	新疆公司红沙泉露天煤矿地面生产系统二系统二期EPC总承包工程EPC general contracting project of Phase II of surface production system of Hongshazhuan open-pit coal mine of Xinjiang Company	1200	10	4	煤炭 Coal
12	若羌志存瓦石峡矿业有限公司选矿厂110kV变电站工程 Ruoqiang Zhicun Washixia Mining Co., Ltd. ore dressing plant 110kV substation project	15000	10	1	矿业开采 Mining
13	东露天矿原煤运输系统改造工程EPC总承包项目EPC General Contracting Project for Raw Coal Transportation System Rehabilitation Project of East Open Pit Mine	3000	10	2	露天煤矿 open-pit coal mine
14	紫金公司高低压配电系统补偿节能技改项目 Zijin High and Low Voltage Distribution System Compensation and Energy Saving Technology Reform Project	2000	10	2	矿业生产 Mining production
15	云南锡业股份有限公司锡业分公司 10kVSVG项目Yunnan Tin Industry Co., Ltd. tin branch 10kVSVG project	1500	10	2	锡业生产 Tin production
16	府谷县宏华煤矿有限公司35kV变电站新建工程 Fugu County Honghua Coal Mine Co., Ltd. 35kV substation new construction	3000	10	2	煤矿 Coal
17	榆神煤炭榆树湾煤矿10kV高压SVG无功补偿装置 Yushen Coal Yushuwan Coal Mine 10kV high-voltage SVG reactive power compensation device	3000	10	2	煤矿 Coal
18	平煤五矿地面电站SVG项目 SVG Project of Ground Power Station of Ping Coal Five Mines	4000	6	1	煤矿 Coal
半导体生产 Semiconductor manufacturing					
1		35000	35	2	半导体 semiconductor manufacturing 工业硅生产 Silicon production
2	内蒙古东立光伏年产4.8万吨硅料项目 Inner Mongolia Dongli Photovoltaic Annual Output of 48,000 tonnes of Silicon Material Project	23000	35	2	
3		12000	10	2	
4	昆明东川宇泽半导体有限公司年产20GW单晶硅拉棒生产线项目 Annual output of 20GW monocrystalline silicon rod production line project of Kunming Dongchuan Yuzhe Semiconductor Co.	8000	10	8	
5	浙江旺荣半导体年产24万片8吋功率器件半导体项目 Zhejiang Wangrong Semiconductor annual output of 240,000 pieces of 8-inch power device semiconductor project	1200	10	2	半导体生产 semiconductor manufacturing
6	宁夏盾源聚芯半导体科35kV站高压SVG补偿项目 Ningxia Dunyuan Juxin Semiconductor Co. 35kV Station High Voltage SVG Project	5000	10	2	半导体生产 semiconductor manufacturing
石油化工行业累计200+台套运行 Petrochemical industry accumulated 200 + sets of operation					
1	辽宁臻德化工辽东湾公司SVG改造项目 Liaoning Zhende Chemical Liaodong Bay Company SVG Retrofit Project	2000	10	2	精细化工 fine chemicals
2	安徽天铁锂电新能源年产5.3万吨锂电池用化学品及配套产品项目 Anhui Tiantie Li-power new energy with an annual output of 53,000 tons of lithium battery chemicals and ancillary products project	1000	10	1	锂化工 Lithium chemical
3	新疆新冀能源化工有限公司150万吨 SVG项目1.5 million tons SVG project of Xinjiang Xinji Energy Chemical Co.	1500	10	8	煤化工 coal chemical

*续表四

序号 NO.	项目名称 project name	容量 capacity (kVar)	电压 volotage (kV)	套数 set	应用场景 application scenario
4	江苏油田压裂用SVG设备采购 Procurement of SVG Equipment for Fracturing in Jiangsu Oilfield	2500	10	1	油田生产 oilfield production
5	河南开祥精细化工有限公司2#6kV无功补偿装置技改项目 Henan Kaixiang Fine Chemical Co., Ltd. 2#6kV reactive power compensation device technical reform project	5000	6	2	精细化工 fine chemicals
6	新彭楠焦化新建变电站无功补偿SVG项目 New substation reactive power compensation SVG project of Xinpangnan Coking Co.	12600	10	2	炼焦 Coking coal to coke, coke oven gas and others
7	开滦化工23年第一批煤矿改SVG采购 Kailuan Chemical 23rd year the first batch of coal mine conversion SVG procurement	10000	6	4	化工 Chemical
8	10万吨级碳利用研发平台SVG设备采购项目 Procurement of SVG equipment for 100,000-ton carbon utilization R&D platform	1500	10	1	化工 Chemical
9	乌石17-2/23-6油田群联合开发工程项目 Ushi 17-2/23-6 Oilfield Cluster Joint Development Project	4000	35	1	石油开采 oil exploration
10	中原油田白庙浅层储气库项目地面工程 Ground Engineering for Baimiao Shallow Gas Storage Project in Zhongyuan Oilfield	5000	10	2	石油开采 oil exploration
11	湖南尔康制药10kV配电工程 Hunan Erkang Pharmaceutical 10kV Power Distribution Project	4000	10	1	制药 pharmaceutic
12	中煤旭阳化工SVG改造项目 China Coal Xuyang Chemical SVG Retrofit Project	4000	10	1	化工 Chemical
13	龙华煤业尿素综合利用项目动力站 Power Station of Longhua Coal Industry Urea Comprehensive Utilization Project	5000	10	2	煤化工 coal chemical
14	龙华煤业尿素综合利用项目动力站 Power Station of Longhua Coal Industry Urea Comprehensive Utilization Project	6000	10	2	煤化工 coal chemical

4.2 电力配电网的应用 Application of Power Distribution Network

金昌市金川区西坡330kV汇集升压站 Jinchang Jinchuan District Xipo 330kV Gathering Booster Station

金昌西坡330kV汇集输电工程,本期建设2台330kV变压器,每台主变低压侧35kV母线上装设2套补偿容量为±30Mvar的SVG装置。可动态跟踪电网电压变化及负载变化,并根据变化情况动态调节无功输出,实现高功率因数运行,动态响应时间不大于10ms,保护用电设备不由无功电流过大导致安全事故。

Jinchang Xipo 330kV converging transmission and substation project, the construction of this phase of two 330kV transformers, each main transformer low voltage side 35kV bus installed on two sets of compensation capacity of 30Mvar SVG device. It can dynamically track the changes of grid voltage and load, and dynamically adjust the reactive power output according to the changes to realize high power factor operation, with dynamic response time of no more than 10ms, and protect the electric equipment from safety accidents caused by excessive reactive power current.



广东电网某变电站动态无功补偿项目 Guangdong Power Grid Substation Dynamic Reactive Power Compensation Project

智光自主研发的ZG-dSVG-H8000/10Y高压动态无功补偿装置在广东电网某变电站正式上电投运。此变电站具有两台240MVA的主变压器,6回220kV母线出线,10回110kV母线出线,24回110kV母线出线,其中一段110kV母线出线引向城轨变电站。城轨采用直流供电启动无功冲击大容易引起母线电压闪变,运行时会产生谐波电流以及母线电压波动的现象。该项目在变电站主变10kV母线侧加装一套8MVar的ZG-dSVG动态无功补偿装置,有效提高电网电压暂态稳定性,抑制母线电压闪变。

ZG-dSVG-H8000/10Y high-voltage dynamic reactive power compensation device independently developed by Zhiguang was officially put into operation in Guangdong Power Grid substation. This substation has two 240MVA main transformers, six 220kV bus outlets, 10 110kV bus outlets, and 24 110kV bus outlets, of which one section of 110kV bus outlets leads to the urban railway substation. The DC power supply of the urban railway is used to start the large reactive power shock easily caused by bus voltage flicker, operation will produce harmonic currents and bus voltage fluctuations. The project installs a set of 8MVar ZG-dSVG dynamic reactive power compensation device on the 10kV bus side of the substation main transformer, which effectively improves the transient stability of grid voltage and suppresses bus voltage flicker.



4.3 新能源发电的应用 Application of New Energy Power Generation

华电集团某风电场动态无功补偿项目

Huadian Group Wind Farm Dynamic Reactive Power Compensation Project

智光自主研发的35kV直挂式±8MVar高压动态无功补偿装置与7MVar FC感性无功补偿装置在华电集团某风电场正式投运。该风电场建设规模为49.5MW，拥有33台单机容量为1500kW的风电机组，风电场海拔3500米。一方面通过FC感性无功补偿装置补偿固定的感性无功，另一方面通过SVG电网的残留无功进行动态补偿，满足现场对无功补偿的需求，稳定功率因数；节约更大容量无功补偿装置、场地以及相关的施工费用。

Zhiguang's self-developed 35kV direct-hanging ±8MVar high-voltage dynamic reactive power compensation device and 7MVar FC inductive reactive power compensation device were formally put into operation at the wind farm of Huadian Group. The construction scale of this wind farm is 49.5MW, with 33 wind turbines of 1500kW capacity, and the wind farm is at an altitude of 3500 metres above sea level.

On the one hand, the fixed inductive reactive power is compensated by the FC inductive reactive power compensation device, and on the other hand, the residual reactive power of the SVG grid is dynamically compensated, which meets the demand for reactive power compensation at the site and stabilises the power factor, and saves the cost of larger capacity reactive power compensation device, site and related construction costs.



华能集团某风电场水冷高压动态无功补偿项目

Huaneng Group Water-cooled High Voltage Dynamic Reactive Power Compensation Project for Wind Farms

智光自主研发的35kV直挂式40MVar水冷高压动态无功补偿装置SVG在华能集团某风电场100MW正式上电投运。风电发电项目受天气影响，电压跌落幅值波动较大，功率因数低。该项目根据现场的实际情况在35kV母线侧加装ZG-dSVG水冷无功补偿装置，抑制电压波动，提高母线功率因数。

Zhiguang's self-developed 35kV direct-mounted 40MVar water-cooled high-voltage dynamic reactive power compensation device SVG was officially put into operation at Huaneng Group's 100MW wind farm. Wind power generation projects are affected by the weather, with large fluctuations in voltage drop amplitude and low power factor. The project installed ZG-dSVG water-cooled reactive power compensation device on the 35kV bus side according to the actual situation of the site to suppress voltage fluctuation and improve the bus power factor.



宁夏某光伏电站多套高压动态无功补偿装置并联运行项目

Ningxia photovoltaic power station multiple sets of high-voltage dynamic reactive power compensation device parallel operation project

智光自主研发的具有多套并联运行功能的6套35kV直挂式24MVar水冷SVG在宁夏某光伏电站正式上电投运。该220kV光伏升压站安装有2台360MVA的主变压器，两段35kV母线。根据现场并网容量大、母线分两段的情况，在每一段35kV母线侧各加装3套ZG-dSVG水冷动态无功补偿装置，同时采用中心屏对网端母线无功进行计算，实现3套SVG的同步运行，满足现场抑制电压波动，提高母线功率因数的要求。

Six sets of 35kV direct-mounted 24MVar water-cooled SVGs with multiple parallel operation developed by Zhiguang were officially put into operation at a Ningxia PV power station. The 220kV photovoltaic booster station is installed with two 360MVA main transformers and two 35kV busbars. According to the situation of large grid-connected capacity and two sections of buses, three sets of water-cooled dynamic reactive power compensation devices are installed on the side of each section of 35kV buses, and at the same time, the centre screen is used to calculate the reactive power of the buses at the grid end, so as to realize the synchronous operation of three sets of SVGs, which can satisfy the requirements of suppressing voltage fluctuation and improving the power factor of buses at the site.



4.4 工业负荷的应用 Application of Industrial Load

河北某钢铁热轧系统动态无功补偿项目

Hebei Iron & Steel Hot Rolling System Dynamic Reactive Power Compensation Project

智光自主研发的10kV直挂式 ± 6 MVar SVG与6MVar FC滤波装置在河北某钢铁热轧厂正式上电投运。该现场负荷冲击较大、电压跌落幅值较大、功率因数低、且多次谐波超标。FC补偿母线多次谐波，SVG补偿电网无功以及谐波补偿时容性无功，有效地抑制钢铁热轧工艺所带来的电压波动，稳定母线侧的功率因数。

Zhiguang's self-developed 10kV direct-hanging ± 6 MVar SVG and 6MVar FC filtering device was formally put into operation at Hebei Iron and Steel Hot Rolling Mill. The site has large load shocks, large voltage dips, low power factor, and many harmonics exceeding the standard. The FC compensates for many harmonics in the bus, and the SVG compensates for grid reactive power and capacitive reactive power during harmonic compensation, effectively suppressing voltage fluctuations brought about by the steel hot rolling process and stabilising the power factor on the bus side.



淮南矿业动态无功补偿项目

Huainan Mining Industry Dynamic Reactive Power Compensation Project

智光自主研发的10kV±7MVar SVG与3MVar FC滤波装置在淮南矿业上投运。该现场负荷冲击较大、电压跌落幅值较大、功率因数低、且多次谐波超标。FC补偿母线多次谐波，SVG补偿电网无功以及谐波补偿时容性无功，有效地抑制电压波动，稳定母线侧的功率因数。

Zhiguang independently developed 10kV±7MVar SVG and 3MVar FC filtering device was put into operation in Huainan Mining Industry. The site has large load shocks, large voltage dips, low power factor, and many harmonic exceedances. FC compensates for many harmonics at the busbar, and SVG compensates for grid reactive power as well as capacitive reactive power during harmonic compensation, effectively suppressing voltage fluctuations and stabilising the power factor at the busbar side.



山西某钢铁优钢35kV变电站动态无功补偿项目

Shanxi Iron & Steel 35KV Substation Dynamic Reactive Power Compensation Project

山西某钢铁优钢35kV变电站新建工程采用2套10Mvar的10kV动态无功补偿装置。该现场电压波动较大、谐波污染严重、三相不平衡等问题导致整体的功率因素偏低，故动态无功补偿装置有效降低电压波动，稳定母线电压，提高功率因数，降低无功损耗。

The new construction of 35kV substation of Shanxi Steel adopts two sets of 10Mvar 10kV dynamic reactive power compensation devices. The site voltage fluctuation is large, harmonic pollution is serious, three-phase imbalance and other problems lead to the overall power factor is low. Therefore, the dynamic reactive power compensation device effectively reduces voltage fluctuation, stabilises bus voltage, improves power factor and reduces reactive power loss.



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