Solar AIoT Monitoring & Maintenance

- Over 550MW of cloud monitoring system installations
- AIoT remote monitoring and advanced diagnostic analysis for solar power
- Servicing over 1,500 solar power plants across Taiwan
- Operations and maintenance service centers established in North, Central, South, and East Taiwan

A one-stop integrated operations and maintenance solution for photovoltaic monitoring to enhance asset management efficiency

BILLION Watts

Billion Watts | Carbon Reduction in Action

Your One-Stop Expert for Integrated Energy Systems

The "Taiwan Carbon Credit Exchange" was officially launched on August 7, 2023, marking a significant national policy to help domestic companies achieve carbon neutrality goals. This initiative signifies that the industry's low-carbon strategies are advancing to the next stage. Carbon credit trading encourages companies to reduce carbon emissions and create value from carbon credits. Billion Watts will continue collaborating with strategic partners to assist companies in achieving carbon neutrality while balancing industry growth, supporting the implementation of this national policy.

For businesses, the carbon market offers key considerations:

- Businesses have a cap on carbon emissions and cannot emit carbon indefinitely.
- By reducing emissions below this cap, businesses can generate "carbon credits" that they may sell to others.
- If a business's emissions exceed the cap, it will need to purchase surplus carbon credits from others to meet reduction targets.

Why Should Enterprises Reduce Carbon Emissions?

- The Carbon Border Adjustment Mechanism (CBAM) regulation came into trial effect on May 17, 2023, and is expected to be fully implemented on January 1, 2026.
- Enterprises can treat carbon credits as assets for trading, generating additional revenue.
- Voluntary carbon credit acquisition reflects a company's proactive approach to reducing emissions, capturing carbon, adopting renewable energy, engaging in afforestation, and implementing carbon reduction projects. These efforts can be certified by international carbon reduction verification organizations, leading to the acquisition of carbon credits.
- Carbon credits can be used in ESG reporting, meet supply chain requirements, or support carbon-neutral product declarations, all of which enhance global competitiveness.
- This commitment showcases the company's dedication to sustainable development and green transformation, fulfills corporate social responsibility, and elevates the brand's image.

Solar PV Solutions for Enterprises

Solution	Description
Self-Build and Self-Use	Owner-Funded On-Site Installation for Self-Use Power
GenerationLeasing + Green Power Purchase	On-Site Power Generation Sold to Taipower, with Green Power Repurchased by the Business

What solutions does Billion Watts offer?

Establishing renewable energy generation equipment can serve as a way to offset carbon credits, helping businesses achieve carbon neutrality. This approach supports flexible power usage scheduling, aids in power regulation, and helps reduce high carbon emissions during peak hours, laying the groundwork for participation in the carbon trading market. Billion Watts' comprehensive, one-stop energy integration service is designed to assist businesses in developing carbon reduction plans, enabling them to meet carbon reduction targets while also reducing carbon costs to maintain competitiveness.

Photovoltaic Monitoring and Maintenance Services

- Centralized management for real-time power generation status monitoring
- Collection, storage, and statistical analysis of power generation data
- Detection of power generation anomalies with an efficient notification and maintenance system
- Scheduled/routine on-site maintenance inspections
- Distribution of power generation analysis reports
- Development of an intelligent performance optimization and forecasting system
- Customized cloud-based web interface design for operational management

Photovoltaic Monitoring and Maintenance Architecture

Distributed Power Plant

- PV Module
- Environmental Sensing Box
- Inverter
- DC/AC Panel
- Communication Box

Unit Substation

- Transformer
- AC High and Low Voltage Switchboard
- Protective Relay

Booster Station

- Transformer
- Distribution Panel
- SCADA System

Ultra High Voltage Substation

Monitoring Equipment

- Power Data Collection Box
- PV Monitoring Equipment
- Security Monitoring Equipment

Monitoring Center

- Customer Network Management System
- Taipower Grid Connection Monitoring Center
- Remote Real-time Monitoring System
- Step-up Substation
- Unit Substation

Power Plant Maintenance

- Panel cleaning and maintenance
- Peripheral pipeline inspection
- Mechanical and electrical equipment maintenance

Pixel View

Smart Monitoring - Optimized Asset Management

High Compatibility

Compatible with over 30 mainstream IoT products, including inverters, environmental monitors, transformers, relays, and more. It meets the monitoring needs of owners, EPCs, and Taiwan Power Company (Taipower).

High Value

Effectively supports operation and maintenance services by providing high-resolution data, significantly increasing the power generation capacity of power plants.

High Accuracy

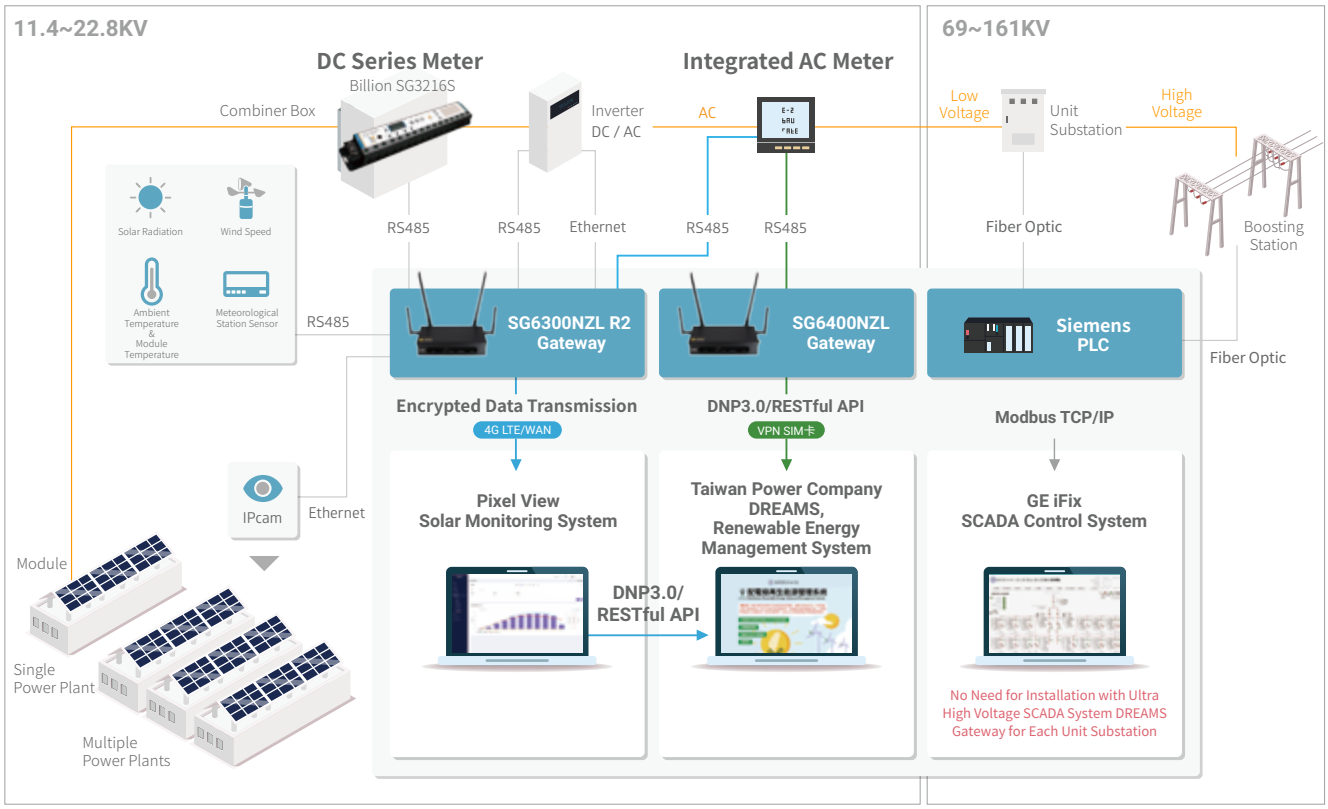
With advanced system architecture, backup mechanisms, and rigorous algorithms, it offers comprehensive data and precise evaluation of system performance and issues.

With the advancement of technology, PV solar energy has gradually become one of the most cost-effective long-term investments. Like any equipment, solar systems must be effectively managed to optimize energy production and efficiency.

To achieve this, we offer Pixel View, a data-driven solar monitoring system that transforms the traditionally complex, manual PV O&M procedures into an automated, flexible, and easy-to-manage monitoring mechanism, ensuring maximum efficiency in solar power generation.

Billion Watts introduces the AIoT Solar Monitoring System with advanced fault diagnosis services. By simply installing the Pixel View monitoring system, users can apply for an upgrade and utilize existing plant data for analysis. Through highly complex algorithms, we interpret and analyze the causes of faults, enabling proactive maintenance and corrective measures. This allows for precise fault localization, better use of maintenance personnel, improved power generation efficiency, optimized maintenance schedules, and reduced O&M costs.

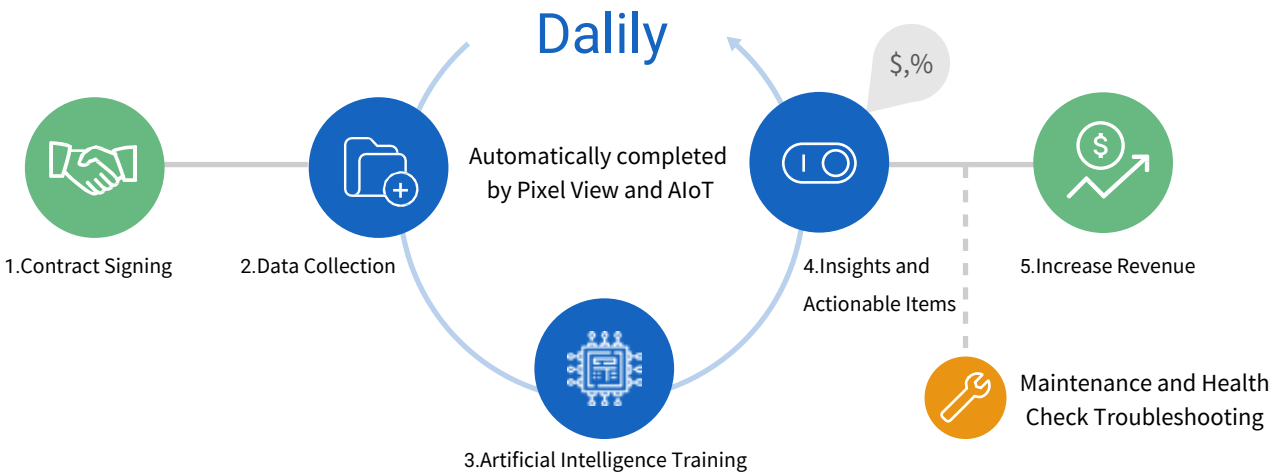
System Architecture



Billion Watts Solar AIoT Monitoring System

Solutions

By integrating advanced AI algorithms with existing power plant data, this AIoT smart monitoring system offers tailor-made professional models and continuous, diverse monitoring



Key Analysis Items

Overall Site-

- Efficiency metrics presentation and trend analysis
- Power generation achievement tracking
- Aging degree analysis
- List of items requiring improvement
- Urgency of improvement items
- Economic loss estimation

Inverters-

- Efficiency metrics presentation and trend analysis
- Dust accumulation and dirt warning
- Improper shading
- MPPT (Maximum Power Point Tracking) anomalies
- Circuit breaker faults
- Equipment overheating and derating
- Insulation issues

String-

- Module defect

Overall Efficiency Indicator Analysis

By using three months of historical data, we establish the overall PR value, theoretical PR value, and system losses. When abnormalities occur, continuous machine monitoring triggers alerts, allowing for early diagnosis and maintaining stable power generation efficiency.

Equipment Efficiency Indicator Analysis

We establish comprehensive efficiency indicators for inverters and string groups. When equipment operates abnormally, continuous monitoring alerts the system to any issues. Power plant managers can prioritize resources based on the severity of the abnormality, ensuring that limited maintenance resources are focused on fixing the most impactful issues.

Precise Health Diagnosis

We create customized monitoring metrics. When there are numerous potential points of abnormality in the equipment, we apply a combination of physical rules and AIoT-based judgment and analysis. This enables detailed diagnosis of the root causes of each failure in the power plant, providing precise fault attribution.

Power Generation Forecasting

We calculate the power generation output at future time points in advance, enabling the renewable energy to be directed into energy storage devices. The goal is to smooth out peak demand and low demand, plan distribution strategies, and maximize economic benefits in the electricity market.

AIoT Automatic Fault Diagnosis

- Automatically evaluates the "health status" of each monitored component daily.
- Customizes monitoring metrics and, through machine learning, adjusts accuracy standards automatically based on environmental changes.
- Enhances labor efficiency – operates like a tireless equipment manager, replacing or assisting with some manual tasks, improving workforce allocation efficiency.
- Improves equipment efficiency – automatically diagnoses faults, shortens troubleshooting time, and increases equipment utilization.
- Boosts economic efficiency – analysis results provide managers with an accurate understanding of equipment operation status, enabling optimized maintenance planning and improving investment returns.

Existing Photovoltaic Monitoring and Rectification Services

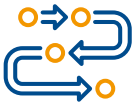
Pixel View Artificial Intelligence: Achieving More with Less Effort

Barrier-Free Transfer with Pixel View for AIoT Diagnostic Monitoring

Billion Watts' Pixel View advanced grid-level solar monitoring system is the foundation for AIoT data collection. Once historical data has been accumulated for over three months on the Pixel View monitoring system, it can be used as a baseline to establish AI efficiency indicators for your power station and perform AIoT fault diagnostics. For customers willing to switch to Pixel View, we offer special discounts for first-time users. Your existing environmental sensors (such as irradiance meters, module thermometers, atmospheric thermometers, and anemometers) and network sources (SIM cards, WiFi, ADSL) can continue to be used after integration. Simply install our data collector (SG6300NZL R2), which can integrate with any third-party weather station and inverter, and transmit all data to the cloud platform, providing better service quality and a wide range of future additional features.

What additional features are included?

AI deep learning diagnostic and analysis capabilities



Uninterrupted AI automatic scheduling for maintenance checkpoints

Customized health diagnostics for entire plant equipment

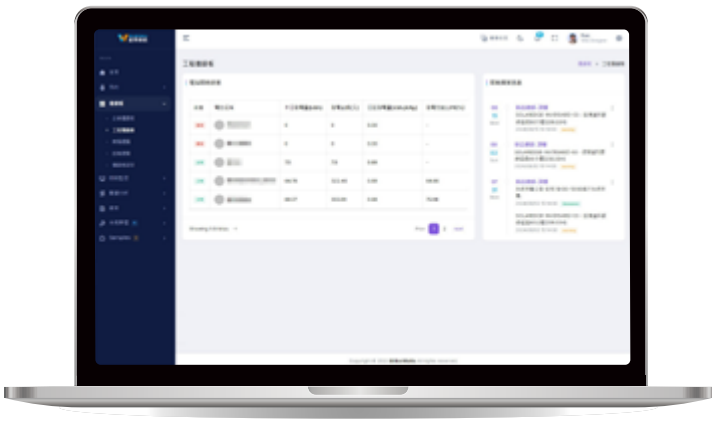
Dust accumulation index calculated from measurement data, enabling remote monitoring

Why is Artificial Intelligence So Important for Solar Power Plants?

Today, we can use artificial intelligence to monitor millions of data points from solar power plants each day for any anomalies. AIoT (Artificial Intelligence of Things) utilizes automated scheduling, physical logic, machine learning, and the creation of indicators to identify the causes of failures and predict the health status of solar power plants, preventing equipment malfunctions. Maintenance engineers can rely on powerful computing systems to provide professional troubleshooting advice, ensuring that no human errors or oversights occur during decision-making. This not only improves the accuracy of operation and maintenance but also boosts power generation efficiency, allowing investors to shorten their payback period and achieve higher returns.

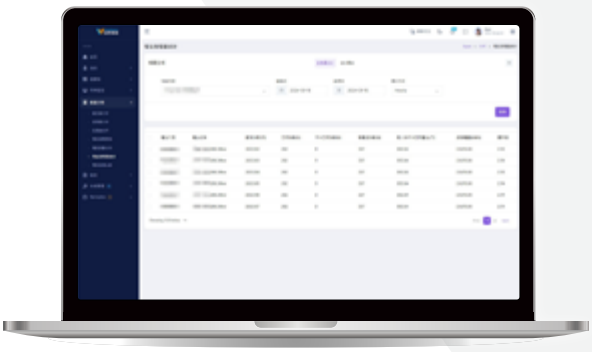
Pixel View System Features

Diverse functionality settings to meet various management needs.



Complete Integration of Key Technologies in Monitoring and Solar Energy

Integrating both large and small power plants with a unified operation interface for easy management. This effectively reduces management costs and enhances operational efficiency through the system's consolidation features. With real-time data on plant operations and equipment performance, there is no need to visit the site in person. You can clearly monitor each critical aspect and improve power plant management efficiency.

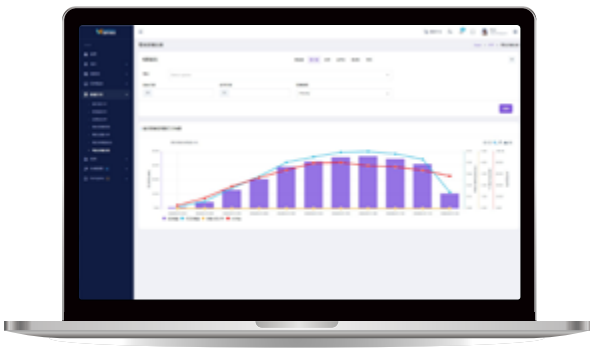


Real-time Data Tracking and Comparison Reports

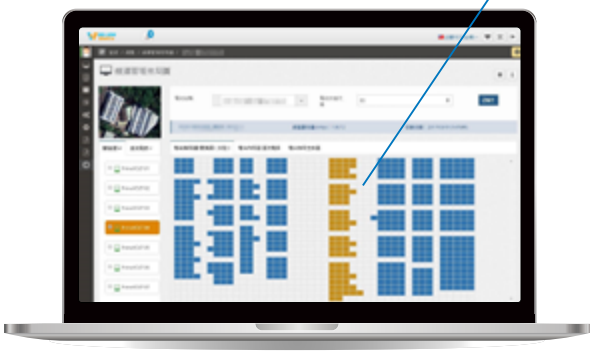
Real-time power generation and environmental sensor data analysis of the power plant, comparing the estimated and actual generation differences in percentage. This provides insights into the operational status of each power plant's equipment, allowing for early detection of issues and reducing the risk of significant losses.

Precise String / MPPT / AC String Monitoring

Pixel View allows you to accurately obtain detailed power generation data and perform analysis and comparisons for each solar string, MPPT, AC, and solar irradiance/temperature. With the ability to see the smallest details, you can seize the opportunity ahead of time.



Pixel View System Features

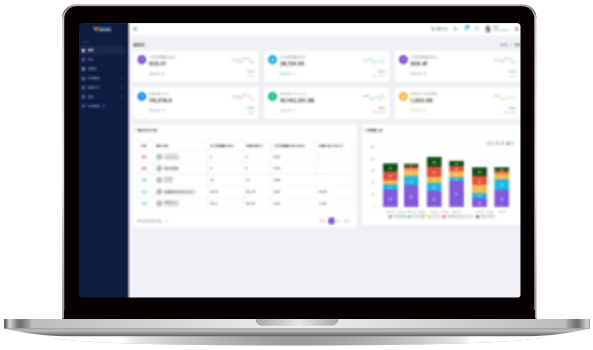


Remote Fault Troubleshooting

Information is transmitted through the "Layout Diagram" and "Operation & Maintenance." Pixel View automatically sets up alert evaluation indicators to send alarm notifications, automatically dispatch tasks, and track status, ensuring the quality of the solar power plant.

Comprehensive Benefit Analysis

In addition to individual data for each power plant, information from different plants can be cross-compared to quickly understand the relevant performance data between them. The content is detailed, and during the integrated planning process, it provides a complete planning blueprint to assist with benefit analysis.



Billion Watts One-Stop Solar Monitoring Solution for Accurate Power Generation Profit Calculation

An advanced management and user-oriented smart operation and maintenance system that allows users to quickly access daily/weekly/monthly/yearly plant information and report processing. This includes power generation statistics, power generation benefit comparisons, electricity revenue, and financial performance.

Support Multiple Inverter Brands

ABLEREX、AISWEI、ABB、AE、ALLIS、DELTA、GOODW、HUAWEI、KACO、LTI、Motech、PRIMEVOLT、SATCON、SMA、SolarEdge、SUNGROW、Growatt

Various Excel Reports

We provide Taiwan Power Company's bi-weekly reports and comprehensive management statistics for power plants and equipment. Additionally, we offer original operational data for equipment, available for download, such as power generation statistics, inverter PR (Performance Ratio), inverter RA (Reliability Analysis), sensor analysis, and original equipment data reports.

Safety

International-grade cloud data center (Tier 3+ IDC) services cover global regions, with hardware network equipment featuring dual redundancy (HA), and websites certified by TWCA security.

Reliability

Raw data is saved every minute, with data reception available 24/7. The system includes a comprehensive data reconnection mechanism and provides error detection and alert push notifications.

Comprehensive

Professional engineers at Billion Watts monitor the operation status of various equipment daily, with over 20 types of reports available. Real-time data for each device is presented, and historical data is fully stored.

User-Friendly

Supports multiple languages and personal style settings, and presents information through a responsive web design (RWD) mode, automatically adjusting page layouts and information presentation for optimal viewing.

Scalability

The software interface can be customized to meet client needs, including tailored browsing features and report presentations. The homepage and organization logo can also be personalized.

All-Encompassing

No need to visit the site in person. Gain clear insights into key operational processes, improving central and decentralized management efficiency, and effectively reducing management costs.

Clear and Intuitive Power Station Information Dashboard

This dashboard integrates real-time generation data, statistical charts, environmental data, and other power station information into a single display. It offers various dashboard styles to choose from, making the power station information easy to understand at a glance.

Pixel View System Features

The use of mobile devices to receive alert and app notifications.

Pixel View APP

Stay updated on the real-time status of your power plant.

- Abnormal alert notifications to stay informed about plant conditions.
- Integration of information from both small and large power plants for easy management.
- Unified interface for easy navigation and clear functions.
- Notifications sent to LINE groups for shared information among multiple users.

Android

IOS

Product and Accessory

Self-Developed PV Gateway+ Cloud System
Certified Supplier by Taipower DREAMS Renewable Energy System Qualification


再生能源監控設備合格廠商聯絡資訊(1/2)


再生能源監控設備雲端資料系統合格廠商聯絡資訊(2/2)

SG6400NZL – LTE PV Gateway

The Smart Monitoring Gateway SG6400NZL can interface with Taipower's DREAMS system platform and receive regulation commands from Taipower. In addition to real-time transmission of power station generation information and intelligent inverter scheduling to ensure power grid quality, it features high compatibility and integration advantages. The single device can simultaneously read and connect inverters from different manufacturers and three-phase digital meters, offering a one-stop integrated service. It also provides localized services such as installation site surveys, connection testing, troubleshooting, and after-sales technical support.

Certified by Taipower DREAMS DNP3.0, compliant with NCC regulations.

High-quality product made in Taiwan (MIT), capable of storing 7 days' worth of data and equipped with GPS functionality. Supports RESTful APIs and remote firmware updates. Features include PV Gateway connection and offline status monitoring, as well as remote configuration of hardware peripherals, including LTE settings, Ethernet settings, RS485 settings, and Time Zone configurations.

Supports multiple communication technologies to meet the needs of different environmental applications.

This product comes with various built-in communication modules, including the latest 4G/LTE module, RS485 module, and 802.11n Wi-Fi module. With the communication capabilities provided by these modules, it is easy to establish bidirectional communication with third-party devices such as inverters and AC meters via wired or wireless connections. For data transmission and internet access, both wired networks and 4G networks can be selected, allowing seamless transmission of all collected data from the power plant to the backend management platform.

The product features flexible networking capabilities and a variety of intelligent operating mechanisms.

It supports multiple wired and wireless connectivity options. Internally, data can be collected via wired RS485, Ethernet, or wireless Wi-Fi. Externally, it offers the option of wired Ethernet through ADSL or Fiber internet, or the choice of 4G connectivity. This allows collected data from the power plant to be transmitted to the backend monitoring system anytime, anywhere. Built-in intelligent operating mechanisms include data storage, data reconnection, and scheduled device rebooting, providing a comprehensive and complete solution for data collection, computation, storage, and transmission.

Product and Accessory Introduction

Smart IoT Gateway Series

Billion Watts IoT Smart Gateways support multiple communication protocols, including RS-485, Ethernet, and 4G LTE. Serving as the communication backbone of the system, they provide reliable network connectivity and transmit collected data to the Pixel View cloud platform for real-time monitoring, enabling unified management.

SG6300NZL R2 Smart Universal IoT Gateway (4G LTE Embedded)

- Built-in 4G LTE module for internet access via broadband or 4G connection.
- Automatic failover between broadband network and 4G LTE connection to ensure stable internet connectivity.
- Built-in RS-485 communication interface for communication with various inverters and RS-485 terminal devices.
- Supports wireless AP mode and client connection mode for linking to existing wireless gateways.
- Supports internal memory to store historical data.
- Supports Real-Time Clock (RTC) functionality.

Billion M 100 Smart Universal IoT Gateway

- Built-in RS-232
- 4G/LTE + GbE WAN dual WAN port interface design, supports network redundancy
- Built-in various VPN security encryption protocols (IPSec, OpenVPN, GRE, PPTP, L2TP)
- Local or remote system management via Web GUI, SNMP, or CWMP (TR-069)
- Supports Modbus/TCP, Telnet server, SSH server, UDP server/client, TCP server/client, and internal memory storage of historical information

AC Smart Meter

Billion Watts IoT Smart Gateway supports multiple communication protocols, including RS-485, ZigBee, Ethernet, and 4G LTE. Serving as the system's communication backbone, it provides reliable network connectivity and transmits collected data to the Pixel View cloud platform for real-time monitoring, enabling unified management.

SG3030(S) 100A ~ 300A Three-Phase Wireless ZigBee/Wired RS485 AC Smart Meter

- Complies with IEEE 802.15.4 and ZigBee PRO standards for power usage data measurement and transmission
- < 1% Wh accuracy with power surge protection
- Supports 1P3W, 3P3W, 3P4W configurations
- Dry contact for external device switch control
- Supports Real-Time Clock (RTC)

SG3015 15A ~ 300A Single-Phase Wireless ZigBee Smart Meter Series

- Complies with IEEE 802.15.4 and ZigBee PRO standards for power usage data measurement and transmission
- < 1% Wh accuracy with surge protection
- Supports 1P3W, 3P3W, 3P4W configurations
- Dry contact for external device switch control
- Supports Real-Time Clock (RTC)

DC Series Monitor

Model		SG3216S	SG3212S	SG3210S	SG3208S	SG3204S	SG3202S
							
Rated Current		16 circuits, 10A per branch, maximum total 160A	12 circuits, 10A per branch, maximum total 120A	10 circuits, 20A per branch, maximum total 160A	8 circuits, 20A per branch, maximum total 160A	4 circuits, 10A per branch, maximum total 40A	2 circuits, 10A per branch, maximum total 20A
Rated Voltage		1000 Vdc				900 Vdc	
Accuracy Class (kWh.W.V.A)	@ TA 0~40°C	0.5% + 0.5% FS				1% + 0.5% FS	
	@ TA -40~70°C	1% + 0.5% FS				2% + 1% FS	
Measurement Display Function	Voltage	150Vdc~1,000Vdc			40Vdc~1,000Vdc		
	Total Current	0.1A ~160A	0.1A ~120A	0.1A ~ 200A	0.1A ~ 160A	0.1A ~ 60A	0.1A ~ 30A
	Total Power	0.1kW ~160kW	0.1kW ~ 120kW	0.1kW ~ 200kW	0.1kW ~ 160kW	0.1kW ~ 60kW	0.1kW ~ 30kW
	Total Energy Generation	0.1kWh ~99999 kWh					
	Branch Power	0.01kW ~ 15kW		0.01kW ~ 20kW		0.01kW ~ 12kW	
	Branch Current	0.01A-15A		0.01A-20A		0.01A ~ 15A	
Operating Interface		4 Push Buttons			DIP Switch Setting		
Display		5-digit LCD Multi-function Backlit Display			-		
Monitoring Loop Quantity and ID Settings		Panel Button Settings			Use panel dip switch for setting		
Lightning Arrestor Action Indicator		Red LED x 1				-	
Communication Interface		RS485 inductance isolation interface (Series)					
Lightning Arrestor Status Detection		Yes					-
Power Supply	PV Power	V	V	V	-	-	-
	External 24Vdc	-	-	V	V	V	V
Power Consumption (at Rated Voltage)		3W			1W	0.5W	
Operating Temperature/ Humidity		-40°C ~ 75°C , 5% ~ 95% RH					
LCD Display Temperature Range		-40°C ~ 70°C					-
Enclosure Material		Made of UL94 V-0, 105°C High-Temperature, Non-Flammable, Fire-Resistant Material					
Dimensions WxHxD (mm)		332(W) x 61(H) x 36(D)	220(W) x 124(H) x38(D)	248(W) x 76(H) x36(D)	212(W) x 76(H) x36(D)	141(W)x 95(H) x 40(D)	

Product and Accessory Introduction

IP55 Rated SUS304 Stainless Steel Smart Communication Box

Considering the diverse needs of different power plants, the internal components of the monitoring box can be customized to include devices such as wired or 4G-enabled smart gateways (SG6300NZL R2/M100), SolarEdge data collectors (SE1000-CCG-G), environmental monitoring instruments, and other monitoring and protection devices based on the plant's requirements. The monitoring box is made from IP55-rated SUS304 stainless steel, offering excellent dustproof, moisture-resistant, and durable properties. Paired with an AC to DC power converter, the box efficiently supplies the necessary DC power to the monitoring equipment, effectively reducing construction time costs and significantly improving work efficiency.

SG3345000 / SG3334000
SG3343000 / SG70CX000 Integrated Solar Power Plant Monitoring Box

- Complies with international IP55 waterproof certification
- SUS304 stainless steel heat-resistant box
- Moderate size, easy to install
- Powder-coated box and door panels
- Built-in timer, SPD, AC NFB, AC outlet, grounding terminal, and DC 24V power supply

Product Specifications

Large Box

Medium Box

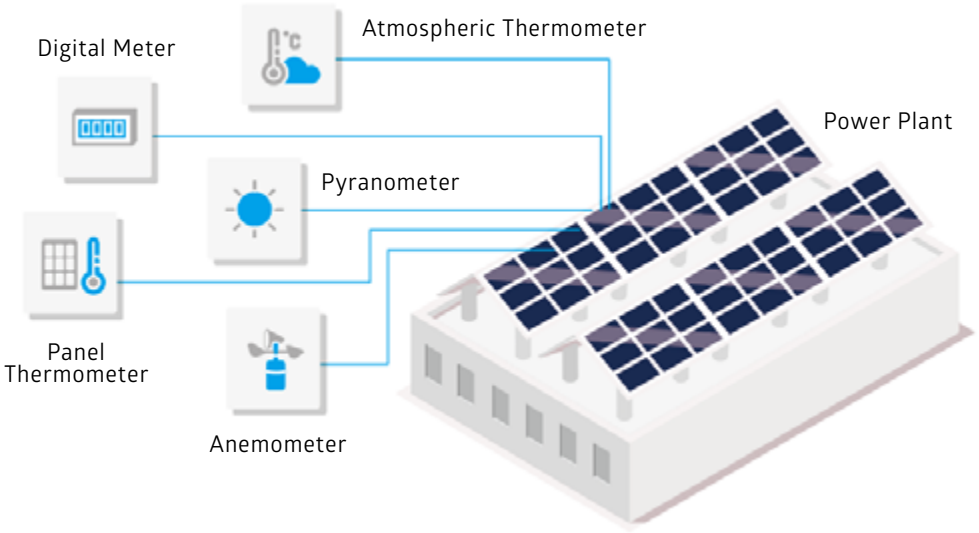
Weatherproof Box

Weatherproof Box

	SG3345000 Large Box	SG3334000 Medium Box	SG3343000 Weatherproof Box	SG70CX000 Weatherproof Box
Power Supply Specification	AC110V / AC220V			X
Box Material / Thickness(mm)	SUS304 Stainless Steel / 1.0t			SUS304 Stainless Steel / 1.0t
Box Dimensions T H x W x D (mm)	460 x 540 x 200	360 x 440 x 200	440 x 360 x 190	200 x 300 x 105
IP Rating	Complies with International IP55 Waterproof Certification			
Installation	Indoor/Outdoor			
Lockable Type	Handle(Lockable)			

Environmental Monitoring

Through a comprehensive environmental monitoring system, real-time environmental data from the solar power plant is collected and transmitted to the Pixel View monitoring system. This not only allows for remote monitoring of the plant's environmental conditions but also enables the system to automatically calculate the plant's health status, ensuring optimal maintenance and dispatch operations.



Provides Complete Environmental Monitoring Sensors

Digital Meter Product Specifications	Pyranometer Model	Panel Thermometer	Atmospheric Thermometer	Anemometer
• Provides High Precision Measurement and Display • Offers Versatile Control 、Alarm 、Re-transmission and Remote Communication Function • CE & RoHS Certified	LP PYRA 03/03AC/03AV	TS-01	ET-01-TH	DNA301

On-site Setup Service

For customers who order Pixel View, Billion Watts will dispatch engineers to the site to assist with setting up electronic equipment communication and collecting all environmental data. They will also create the power plant data and generate layout diagrams on the Pixel View platform.

SCADA
UHV Grid-Connected Monitoring

Complete monitoring and management system, component supply, and fiber optic cabling construction

Large-scale Solar Monitoring and Management System

The large-scale solar monitoring and management system is divided into ultra-high voltage grid connection monitoring and power plant equipment generation management. The former focuses on real-time and secure monitoring, while the latter emphasizes performance and operation & maintenance management. The ultra-high voltage grid connection monitoring uses a PV-SCADA system based on professional graphic control, achieving precise real-time monitoring. The PV generation operation & maintenance management uses a traceability management system, which is simple and efficient, allowing for monitoring of overall plant equipment performance and generation efficiency, ensuring optimal power output.

Hardware Specifications

- SUS 304 2t+ powder-coated, vertical monitoring enclosure, standard instrument rack 42U.
- Built-in high-voltage grid-connected monitoring server, including professional graphical control software and ultra-high-voltage grid connection and substation monitoring system (PV-SCADA).
- Built-in PV power generation operation and maintenance management server, including an industrial-grade database and traceability management system.
- Built-in time synchronization server with GPS antenna, synchronizing SCADA system time to ensure consistent timing between PV-SCADA and Taipower ADCC system.
- Built-in fiber optic converter and two fiber splicing boxes, using a ring topology to connect PLC controllers of each substation.
- Built-in video surveillance server, capable of linking and recording network cameras at key locations around the power plant and entrances.
- Built-in UPS uninterruptible power supply system, single-phase 220V, 5KVA.

System Features

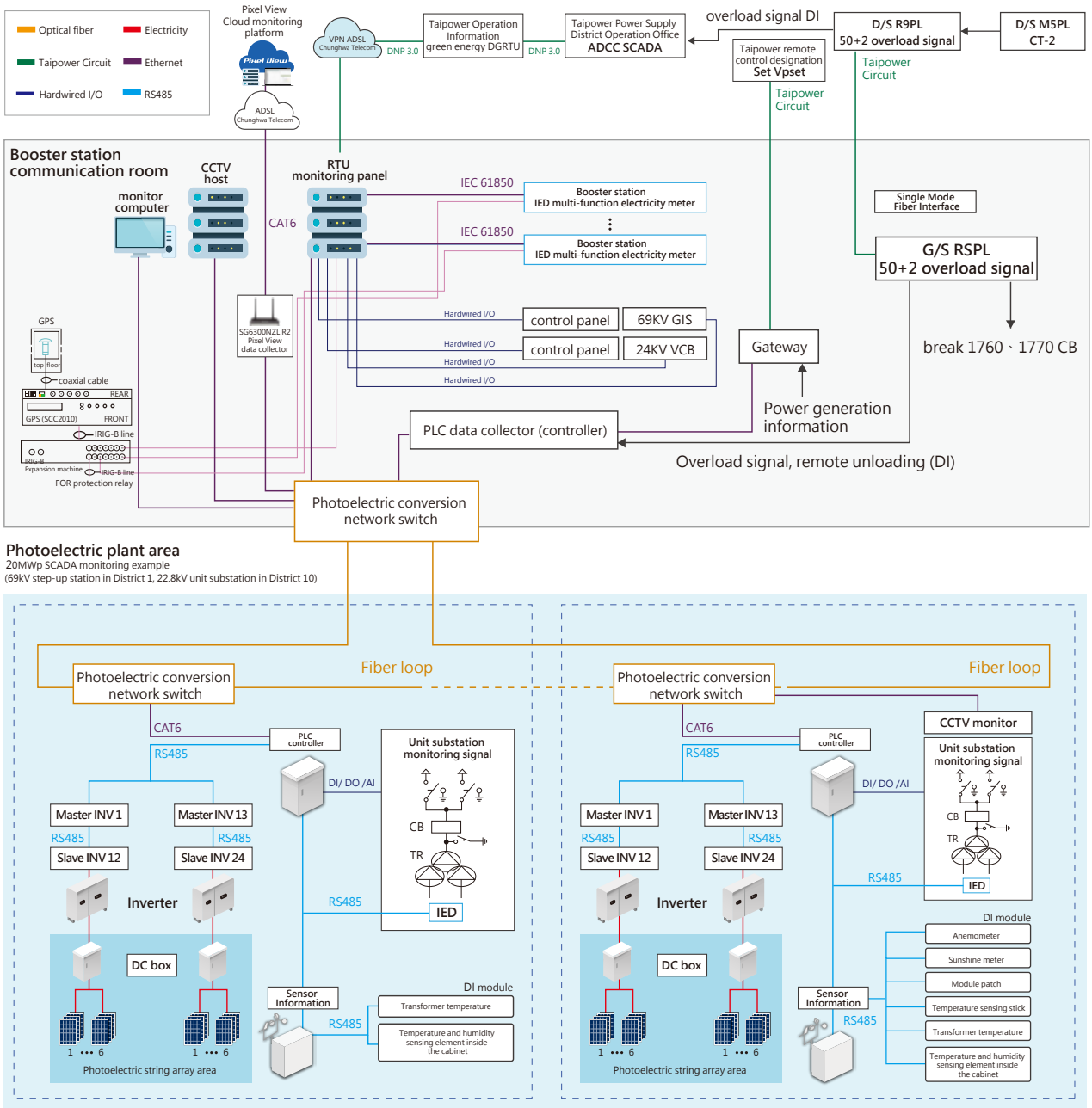
- Displays the switch status, power information from instruments, and control buttons of the ultra-high voltage grid connection system single-line diagram.
- Displays the switch status, power information from instruments, and control buttons of each substation unit.
- Provides a regional overview, showing real-time power generation status and weather information.
- Displays information on all current IEDs (Intelligent Electronic Devices) and relay statuses in a summary table.
- Shows the communication status of the entire fiber optic network, including the optical-electrical converters and the PLC controller connection status of each substation unit.
- Allows real-time plotting of data trend graphs, historical data curves, etc.
- Lists all alarm statuses across the region, with the option to acknowledge individual alarms.
- Lists all events (SOE) with occurrence times for query, with time resolution of 1 millisecond.

Ultra High Voltage Grid-Connected Monitoring Solution

Billion Watts offers monitoring solutions for large-scale solar projects (over 20MW capacity, transmission-level), which must be connected to ultra-high voltage systems (such as 69KV, 161KV, etc.). Due to the vast land required for large PV systems, and for cost-effective configurations, these systems are typically divided into 1-3MW units, with each unit having a high-voltage substation. This substation is responsible for centralizing the inverters in the area and sharing a step-up transformer to increase the voltage to medium and high voltage levels, such as 22.8KV, reducing line losses and facilitating efficient power transmission.

In other words, a large-scale solar power generation system typically consists of one (or two) ultra-high voltage parallel step-up substations, along with several 1-3MW unit substations. Each unit substation is responsible for monitoring the corresponding combiner box, inverter, high-voltage transformer, instruments, switchgear, and collecting meteorological data. Finally, the system is interconnected via a ring fiber optic network.

The system example architecture diagram



Ultra High Voltage Grid-Connected Booster Station

The ultra high voltage parallel Booster station consolidates the high voltage power from each substation and shares a single ultra high voltage transformer to increase the voltage, then connects to the ultra high voltage system designated by Taipower, such as 69KV or 161KV.

Hardware Specifications

- SUS 304 2t + powder coating, designed as a floor-mounted panel for indoor use.
- Built-in dual-redundant high-end PLC controllers responsible for data collection and monitoring of peripheral equipment in the ultra high voltage parallel system.
- Built-in power modules (dual-redundant), DI (SOE) module with 256 points (512 points), standard DI module with 16 points (32 points), DO module with 96 points (192 points), AI module with 32 points (64 points), and 4 sets (8 sets) of RS-485 modules.
- Built-in optical isolation input conversion interface for DI (SOE) with 256 points, general DI optical isolation input interface with 16 points, DO relay control conversion interface with 96 points, and AI input conversion interface with 32 points.
- Taipower power dispatch DNP 3.0 conversion communication interface.
- Smart inverter P, Q control and VP-SET communication control gateway.

Functions

- Collects status, analog, digital, and RS-485 control signals, along with fault records from peripheral equipment of the ultra high voltage parallel system.
- Provides sequence control, ladder, logic, and other control functions, executing system protection features, and issuing alarms when the line-end protection relay is triggered.
- Handles a 512-point event list, including sequence event (SOE) list, with control and monitoring switches, and records all important events from the power plant. Each event is recorded with a timestamp down to milliseconds (ms).
- Manages communication and data exchange integration between the ultra high voltage parallel Booster station and Taipower's ADCC Green Energy C/S RTU system for monitoring purposes.
- Manages communication and control of smart inverters at the ultra high voltage parallel Booster station with Taipower for P, Q regulation and VP-SET functions.

Unit Substation

The unit substation centralizes the power generation of solar panels in a specific area, typically grouping the inverters of that area together. It uses a shared step-up transformer to increase the inverter output voltage to 22.8kV, facilitating power transmission to a distant ultra-high voltage substation, which further steps up the voltage to connect to Taiwan's ultra-high voltage system (69kV or 161kV).

Monitoring Box Hardware Specifications

- SUS 304 2t + powder coating, designed as an outdoor floor-mounted panel with IP66 rating.
- Built-in high-performance PLC controller responsible for data collection and monitoring of the unit substation's peripheral equipment.
- Built-in CPU module, power supply module (dual redundancy), RS-485 communication module, DI module points, DO module points, AI module points (customizable point quantity).
- Equipped with automatic lighting, temperature and humidity sensors, and heating modules.
- Each RS-485 port is protected by an independent surge protector, equipped with lightning protection modules that are replaceable.
- Built-in two fiber optic enclosures and fiber optic converters, linked to the ultra-high voltage parallel control system in a ring network.

Functions

- Executes system protection functions, triggering alarms when inverter or line-end protective relays are activated.
- Collects various power generation data from the inverters and controls derating or unloading operations.
- Collects temperature, switch status, and other measurement data from the transformer in the substation, as well as monitoring equipment data.
- Gathers meteorological data, including sunlight, atmospheric temperature, array temperature, wind speed, and wind direction.
- Collects DC voltage, current, power, cumulative generation, box temperature, and SPD action status data from each string in the DC combiner box.

O&M

Operations and Maintenance Management Service

Why Choose Billion Watts?

Billion Watts has established engineering service locations in Taipei, Yilan, Yunlin, and Kaohsiung, with a team of skilled engineers holding various certifications in fields such as mechanical and electrical engineering, labor safety, and more. We provide professional, safe, and reliable power plant operation and maintenance services. Our services include toolbox meetings, solar module cleaning, equipment inspections (modules, inverters, combiner boxes, structures and supports, cable trays/pipes, AC distribution panels, meteorological systems, monitoring systems, high-voltage electrical equipment, etc.), and we have successfully provided O&M services for numerous large asset management companies.

Billion Watts technicians hold the following certifications:

1. Class A Electrical Technician License
2. Class B Solar Photovoltaic Installation Technician License
3. Occupational Safety and Health Supervisor Certification
4. Rooftop Operations Supervisor Safety and Health Certification
5. First responder safety and health certificate
6. Taiwan occupational safety card

Taipei

7F, No.190, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 231,Taiwan

Yilan (Factory)

No. 8, Dexing 1st Rd., Su'ao Township, Yilan County 270,Taiwan

Yunlin

No. 5-2, Jialu Rd., Douliu City, Yunlin County 640,Taiwan

Kaohsiung

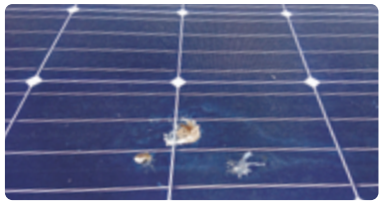
No. 15, Ln. 51, Qingping St., Nanzi Dist, Kaohsiung City 811,Taiwan

Professional Maintenance Team – SolarEdge Certified Technicians

Why Perform Operations and Maintenance?

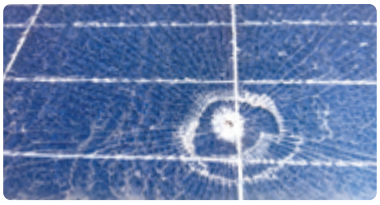
In Taiwan's environment, factors such as air pollution, salt damage, methane gas, exhaust and drainage equipment, and low rainfall can lead to dust, methane, grease, and bird droppings accumulating on solar modules. For power plants using traditional inverters, these issues can lead to serial effects where a single module with low current impacts the output of the remaining 20-21 modules in the same string. Over time, this may increase module resistance and result in hotspots. To mitigate and prevent these issues, regular maintenance by a professional operations and maintenance team is essential.

Founded in 2017, Billion Watts is a subsidiary of Sheng Da Electric, dedicated to providing professional solar power equipment and maintenance services for EPC contractors and power plant investors in Taiwan. We employ advanced global photovoltaic testing instruments, monitoring software, and cleaning equipment to offer customized inspection and maintenance services. By continuously observing power generation data and comparing efficiency performance, we strive to be your trusted local solar asset manager.



Bird Droppings

Dust Deposition

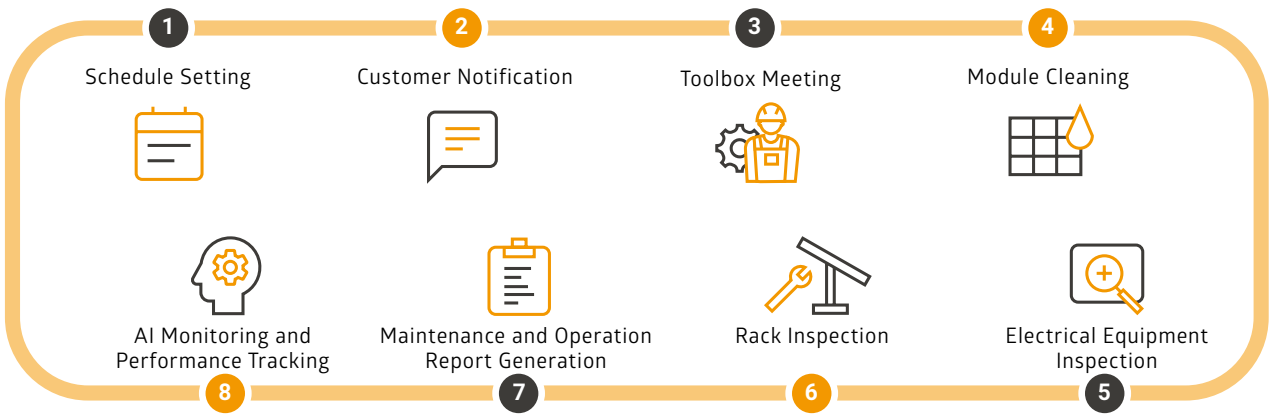


Solar module damage

Regular Operations and Maintenance Items

1. Bracket inspection
2. Photoelectric module testing
3. Inverter testing
4. DC box testing
5. AC panel testing
6. Meteorological system testing
7. Monitoring system testing
8. Trunking inspection
9. Solar module cleaning (tap water, one-time construction method)
10. Failure handling and abnormality exclusion
11. Safety facilities inspection
12. Wholesale electricity meters
13. Islanding effect testing

Operations and Maintenance Process



Standard Maintenance Items

Module Cleaning Instructions

Module Cleaning Precautions

- Cleaning Equipment: Use a Kärcher high-pressure washer.
- Cleaning Liquids: Only water is permitted; do not use other liquids.
- Weather Conditions: Cleaning is prohibited under conditions such as wind speeds above level 4, heavy rain, lightning, or extreme heat.
- Number of Workers: The number of workers, ranging from 2 to 5, should be determined based on the size of the power plant.
- Cleaning Standards: Solar modules should be visually free of stains, with no significant differences in brightness as a standard for inspection.

Safety Equipment Inspection

- Inspection of main safety lock anchor points.
- Inspection of safety walkways.
- Inspection of ladders.
- Inspection of protective cages.

Module Inspection

- Check for glass breakage, back panel scorching, and noticeable color changes.
- Verify that there is no short circuit forming at the edges of the components or between any circuits.
- Inspect for deformation, twisting, cracking, or burning. Ensure terminals are well-connected.
- Visually inspect the module's hollow glass for any condensation or water seepage that may affect the solar panel's light radiation absorption.
- Look for any cracking in the hollow glass, including thermal cracking or spontaneous explosion of tempered glass.
- Check for any cracks in the concrete foundation.
- Brackets or rear bolts used to secure the solar array should not be loose.For solar arrays installed on prefabricated bases, ensure that the bases are stable, aligned, and immovable.
- The primary stress components, connection components, and bolts of the solar array should not be damaged or loose. Welds should have no gaps, and anti-corrosion coatings on metal parts should be intact, with no peeling or rust.
- The overall solar array structure should remain free from deformation, misalignment, or looseness.
- Conduct a grounding resistance test to ensure safety and stability.

Ground Testing Box Inspection

- Inspect the exterior of the box and mounting brackets for any signs of rust.
- Clean the exterior of the box.
- Check for water leakage inside the box and ensure that waterproof gaskets are intact and not detached.
- Inspect the interior for any foreign objects and clean as needed.
- Perform DC grounding resistance testing.
- Perform AC grounding resistance testing.
- Perform lightning grounding resistance testing.

DC Combiner Box Inspection

- Inspect the external appearance and mounting frame for signs of rust or corrosion.
- Clean the external appearance.
- Check the interior for any water leakage and ensure that the waterproof sealant is intact.
- Inspect the interior for foreign objects and clean if necessary.
- Check for any signs of animal intrusion.
- Check for any unusual odors, and examine electrical components for scorch marks or damage.
- Verify that the circuit breakers are operating normally.
- Check if the surge suppressors are functioning properly.
- Confirm that the fuses are intact and conducting.
- Measure the open-circuit voltage of the string.
- Measure the insulation resistance of the string.
- Inspect all connections for looseness or oxidation.
- Perform thermal imaging inspection (additional charge).

Inverter Inspection

- Check the appearance of the inverter body and the mounting frame for any signs of rust or corrosion.
- Check if the display board and indicator lights are functioning properly.
- Check the wire connections for any damage, loosening, or signs of melting.
- Check if the cooling fan is operating normally.
- Check for any unusual noises or smells.
- Check for any animal intrusion.
- Check if there are any burn marks or signs of damage on electrical components.
- Check if the (DC/AC) switches are functioning correctly.
- Check if the inverter temperature is within the normal range.
- Measure the insulation resistance.
- Clean the exterior of the inverter, including the intake and exhaust vents, and the cooling base.

AC Distribution Board Inspection

- Inspect the appearance of the body and the mounting frame for any signs of rust or corrosion.
- Clean the exterior of the body.
- Check the interior of the panel for any water leakage and ensure that waterproof seals are intact.
- Check the interior for foreign objects and clean if necessary.
- Inspect for any signs of animal intrusion.
- Check for any unusual odors or signs of burnt or damaged electrical components.
- nspect the circuit breaker for proper operation.
- Measure the insulation resistance of each phase of the three-phase power supply (inverter includes self-check).
- Check for loose connections or signs of oxidation at contact points.
- Measure voltage values.
- Perform thermographic inspection using an infrared camera (additional charge applies).

Cable Tray (Conduit) Inspection

- Inspect the cable tray (conduit) for any damage and ensure the cover plates are securely fastened.
- Check for signs of corrosion on the cable tray (conduit).
- Inspect the metal flexible conduit for any loosening or damage.

Monitoring System Inspection

- Check for any rust or corrosion on the exterior and mounting brackets.
- Clean the exterior of the unit.
- Inspect the interior for water leakage and check if the waterproof seals are intact.
- Inspect the interior of the enclosure for foreign objects and clean if necessary.
- Check for any signs of animal intrusion.
- Check for any unusual odors, scorch marks, or signs of electrical damage.
- Inspect if the industrial computer or data logger is functioning properly.

Meteorological System Inspection

- Check if the pyranometer is dirty and clean it.
- Ensure the module thermometer is properly attached.
- Check if the anemometer is damaged.
- Ensure the display meter is showing readings correctly.
- Check the interior of the enclosure for foreign objects and clean it.
- Check the interior of the display enclosure for any signs of water leakage and ensure the waterproof seal is intact.

Special Maintenance and Charging

Module Cleaning Inspection

- 5-ton water truck
- Cleaning platforms (scaffolding, aerial work platforms, etc.)
- Special cleaning agents
- Post-typhoon inspection
- Thermal imaging inspection
- Drainage system cleaning
- Secondary Cleaning Methods (scrapers, sponge mops)
- Equipment replacement
- Quick inspections before and after typhoon season (July to September)
- Diagnosis of on-site faults within 24 to 48 hours
- Module string IV curve measurement and analysis

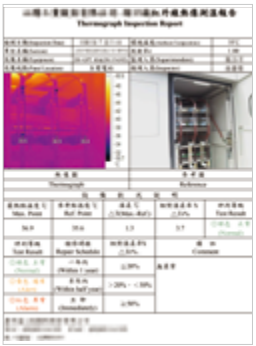
Photovoltaic System Detection

- Module disconnection cable detection
- Grounding equipment fault detection

High Voltage Inspection

Equipment	Equipment
1. High and Low Voltage Electrical Equipment Shutdown Inspection and Maintenance	
DS	Contact Resistance, Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
VCB	Contact Resistance, Insulation Resistance, DC Dielectric Strength, Three-phase Operating Time, Equipment Cleaning and Maintenance
LBS	Contact Resistance, Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
PF	Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
CT	Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
PT	Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
HV-SV	Capacitor Quality Check, Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
TR	Insulation Resistance, DC Dielectric Strength, Oil Type Dielectric Strength and Acid Value for Oil-filled, Equipment Cleaning and Maintenance
Cable	Insulation Absorption, DC Dielectric Strength, Equipment Cleaning and Maintenance
LA	Insulation Resistance, DC Dielectric Strength, Equipment Cleaning and Maintenance
ACB	Contact Resistance, Insulation Resistance, Equipment Cleaning and Maintenance
NFB	Insulation Resistance, Equipment Cleaning and Maintenance
LV SC	Capacitor Quality Test, Insulation Resistance, Equipment Cleaning and Maintenance
IED	Operating Characteristics, DC Trip, Equipment Cleaning and Maintenance
Earth	Grounding Resistance Determination
2. High and Low Voltage Electrical Equipment Infrared Thermal Impact Testing	

Cable Power Cable Testing Report Sample



High and Low Voltage Electrical Equipment Infrared Thermal Impact Testing Report Sample

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