

Photovoltaic (PV) System with Storage

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Abstract

A Photovoltaic (PV) system with storage was installed at the New Meiden Engineering Center called “Manabi-ya” (a “Learning Place under One Roof” in Japanese) on the premises of Meiden Numazu Works in Numazu City, Shizuoka Prefecture, Japan. This system is a package combining a Power Conditioner System (PCS) for Solar (solar PCS), a Battery Energy Storage System (BESS-PCS), an Energy Management System (EMS), and a battery storage system.

When the power grid is normal, the power generated by the solar panels is transmitted, and peak shaving is performed by charging and discharging the storage battery. In the event of a power outage in the grid, the BESS-PCS and the solar PCS can be operated in an islanding operation mode, so that power corresponding to solar radiation and storage battery capacity can be supplied to emergency loads such as outlet power and lighting power as a Business Continuity Plan (BCP) power source independent of the power grid system.

1 Preface

In recent years, efforts toward the Sustainable Development Goals (SDGs) included in “the 2030 Agenda for Sustainable Development” adopted at the UN Summit have been actively pursued in Japan. Efforts that consider the environment are effective not only for sustainable development but also for improving corporate value.

Each major company in Japan is installing Photovoltaic (PV) systems in their factories to achieve the SDGs. These PV systems increase the use of renewable energy resources and can be used as an emergency power source. This paper introduces a PV system equipped with an energy storage battery. It was installed at the New Meiden Engineering Center called “Manabi-ya” (a “Learning Place under One Roof” in Japanese) on the premises of Meiden Numazu Works in Numazu City, Shizuoka Prefecture, Japan. We will also show how the system operates.

2 System Overview

Fig. 1 shows the configuration of the PV system with storage battery installed at Manabi-ya. In addition to supplying PV power, this facility can per-

form a planned peak shaving by charging and discharging the storage battery during normal operation of the system. In addition, by utilizing the islanding operation function of the Battery Energy Storage System (BESS-PCS) during a power outage, it is possible to supply the discharged power of the storage battery and the photovoltaic power to the emergency load. The main equipment is as follows.

(1) Solar panels

Category: Mono-crystal silicon solar batteries

Type: REC320TP2M

Photovoltaic module capacity: 3200 W/module

Configuration: 15-series 21-parallel, 315 units in total

(2) Photovoltaic conditioner (PCS) (Made by Meiden)

Category: PCS for PV

Type: SP-320-100T-N

Capacity: 100 kW

Voltage: 3-phase 200 V

(3) Batteries

Type: Lithium-ion battery (LiB)

Photovoltaic module capacity: 221 kWh/module

Configuration: 9-series 5-parallel (2 battery panels)

(4) BESS-PCS (Made by Meiden)

Category: PCS for energy storage batteries

Type: YALP-251/500

Capacity: 100 kW

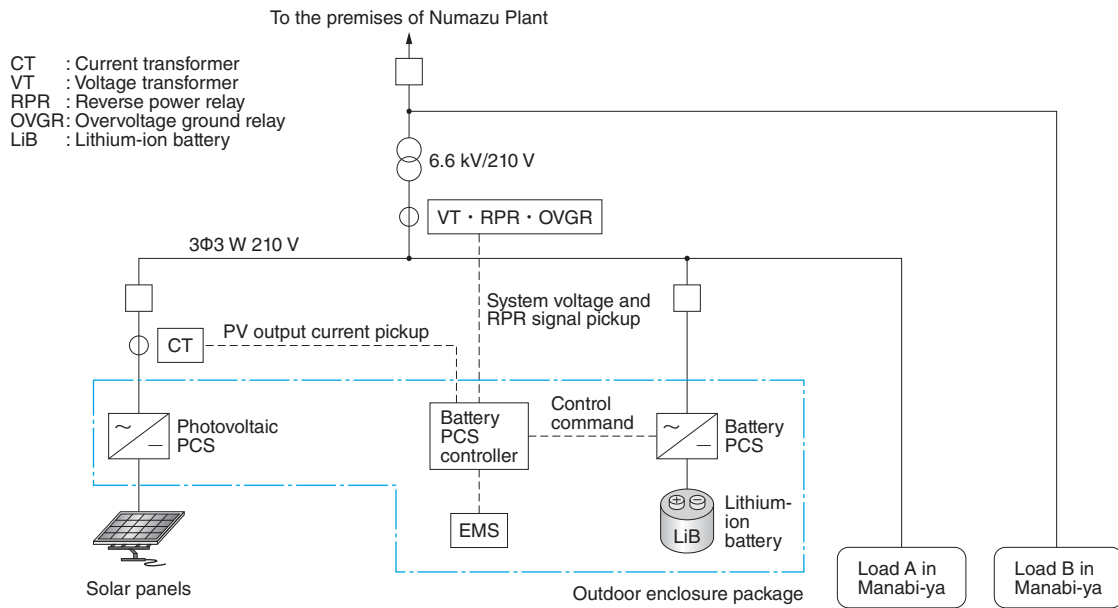


Fig. 1 Configuration of PV System with Storage at Manabi-ya

Configuration of the PV system with storage is shown. A solar PCS, a battery energy storage system PCS, an EMS, and a battery system (equivalent to 100 kWh) are accommodated in an outdoor enclosure package. For the grid protection, the RPR and OVGR signals are picked up from the external system. For the purpose of telemetering and control, the PV host CT and VT signals are picked up. In this system configuration, the local load A is regarded as an emergency load and the local load B is regarded as a regular load.

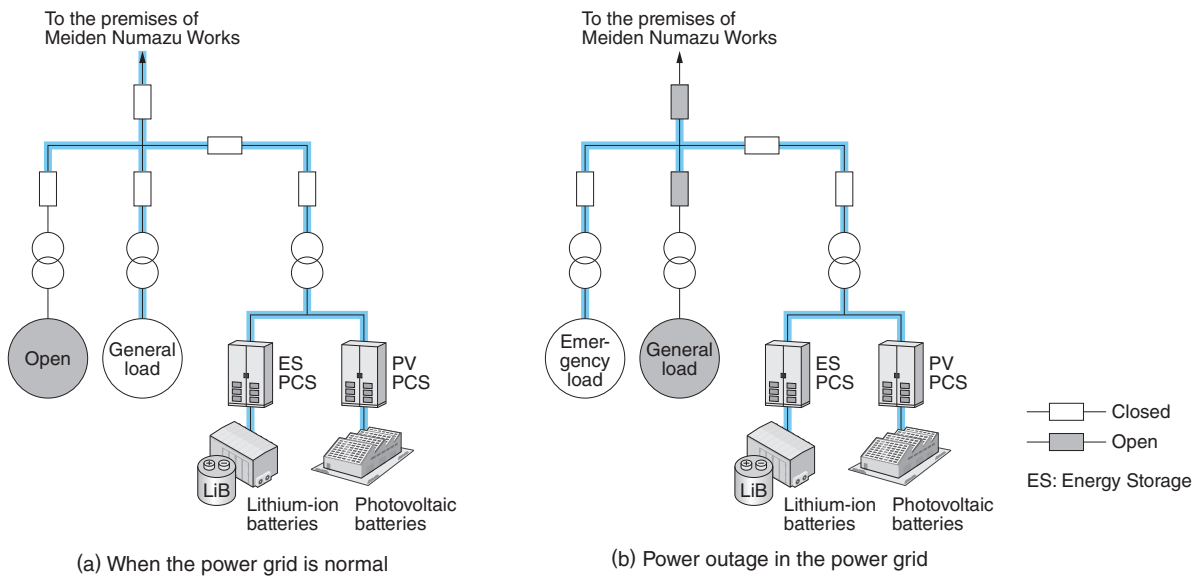


Fig. 2 Image of Power Supply of PV System with Storage

An image of power supply of the PV system with storage is shown. When the power grid is normal, each PCS is operated with grid connection. If there is any power outage in the power grid, however, the BESS-PCS and the solar PCS become independent of the grid system (islanding operation) and supply electric power to essential emergency loads.

Voltage: 3-phase 200 V

(5) Energy Management System (EMS) for energy storage batteries (Made by Meiden)

Category: Industrial computer

Type: μ PORT M5A

3 Examples of System Management

3.1 Example of Normal Grid-Connected Operation

Power generated by the solar panels is supplied to the load equipment by the solar PCS accord-

ing to the amount of solar radiation. The storage battery PCS installed alongside can be operated in a planned charging/discharging pattern by combining with the EMS. Furthermore, it is also possible to calculate the storage battery charging command value from the output current value of the PV PCS host and charge the storage battery only with PV power.

3.2 Example of Operation during Grid Failure (Islanding Operation)

When the grid is interrupted, power can be supplied to the emergency load through a circuit independent of the grid using the BESS-PCS islanding operation function. At this time, the solar PCS can be operated by connecting to the BESS-PCS. If the PV power is greater than the emergency load, the surplus power can be charged to the ener-

gy storage battery to extend the duration of islanding operation. **Fig. 2** shows an image of the power supply of PV system with storage.

4 Postscript

This article introduced a PV system with energy storage battery. By adding an energy storage battery system to a PV system, we were able to make the added value of a peak shaving and an emergency power source by the renewable energy system. This is a part of our efforts to achieve the SDGs.

In the future, we intend to propose this equipment to factories and local governments in Japan.

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