Power Technologies for Helping Make New Dreams Come True

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1. Introduction

In recent years, damage to social infrastructure has become a major topic of news as many areas in Japan have suffered large-scale power outages caused by natural disasters. Due to these circumstances, uninterruptible power supplies (UPSs), which have conventionally been installed indoors for power backup of ICT equipment and plant facilities, will be expected to play a new role in society by providing long-term and stable power backup of outdoor equipment in the future.

In addition, renewable energy sources are also attracting more attention around the world as potential candidates to help realize a low-carbon society. For photovoltaic generation systems that have been promoted by the feed-in tariff scheme, there is a growing need for power conditioners (i.e., renewable energy inverters) with isolated output capability that can make use of generated power during power outages caused by natural disasters. In addition to photovoltaic power generation, wind and hydro power generation are also attracting more attention as viable renewable energy sources. Wind and hydro power generation systems require the use of rectifiers to convert the AC power generated by the generation system into DC power for use with power conditioners. We expect that the combination of our power conditioners and a dedicated rectifier can be used in not only wind and hydro power generation, but also in fields new to us such as biomass and geothermal power generation.

Since all of these devices are installed outdoors, they need to be able to withstand environmental changes and have a high level of water and dust protection. They also need to provide maintenance-free operation for long periods of time. In the following sections, we will introduce technologies that are necessary for our products to be used in outdoor applications in new markets to meet these needs.

2. UPS Technologies

Conventionally, our UPSs have mainly been installed indoors and used to back up servers, ICT equipment, and office equipment. They have also been incorporated into industrial equipment. However, due to the proliferation of mobile devices today and the lessons learned from natural disasters including the Great East Japan Earthquake, it is anticipated that there will be increasing demand for power backup solutions for distributed outdoor facilities such as paid parking lots, traffic lights, base stations, outdoor surveillance cameras, and emergency equipment, as shown in Figure 1.

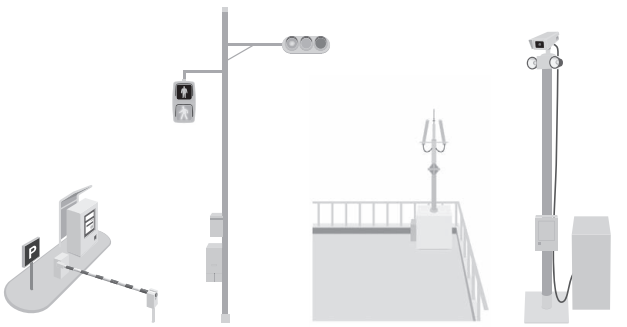

Fig. 1 Examples of equipment used outdoors

The *SANUPS N11B-Li* series, shown in Figure 2, has been designed for outdoor use. It features a wide temperature range (-20°C to +50°C) for safe use in extremely cold and hot regions.

Furthermore, since outdoor installation is usually not conducive to regular maintenance and battery replacement, we designed this product to feature water and dust protection (protection rating of IP65[1]) and lithium-ion batteries that provide long backup time in a small size.

These features enable it to achieve maintenance-free operation. Through the development of this UPS, we have acquired the technical expertise for installing power supply products outdoors.

Fig. 2 *SANUPS N11B-Li* series

(1) IP65 is a protection class defined in "JIS C 0920: Degrees of Protection Provided by Enclosures (IP Code)." It stipulates complete protection from dust and against water spray from all directions.

To install electronic equipment outdoors and operate it safely over a long period of time, it is necessary to improve the equipment's temperature resistance and housing performance.

In the development of this UPS, we used some of the design techniques that we acquired through our previous power conditioner developments and designed it to have a sealed structure with an IP65 protection rating to enable it to be installed outdoors. To that end, we used thermal fluid analysis to simulate internal heat flow and optimized the structure and layout design to effectively circulate and discharge heat to the outside by using the entire housing.

Figure 3 shows one example of thermal fluid analysis.

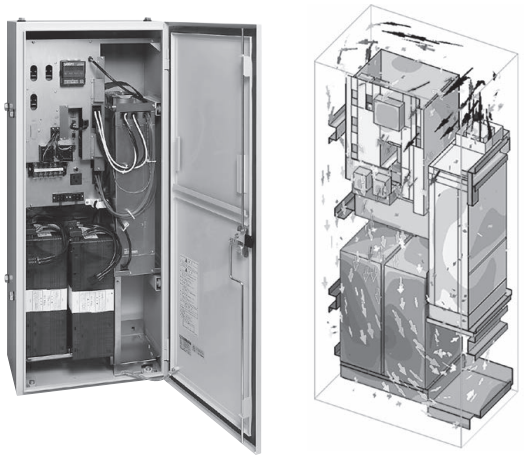

Fig. 3 Thermal fluid analysis model of the *SANUPS N11B-Li* series

The analysis helped us create a sealed structure that prevents heat from building up in particular spots and does not hinder UPS performance and reliability. As a result, we were able to successfully develop a highly reliable outdoor UPS that has an IP65-rated sealed structure.

When installing equipment outdoors, consideration also needs to be given to ensure that the effects of direct sunlight does not impact the equipment. To achieve this, we attached heat shields to the outside of the housing as shown in Figure 4, and optimized the spacing and ventilation structure of the housing and heat shield by conducting exposure tests under hot midsummer sun.

As a result, the surface temperature of the heat shield rose about 15 to 20°C above the ambient temperature due to the direct sunlight, but the effect of the temperature rise on the inside of the housing was limited to about 5°C.

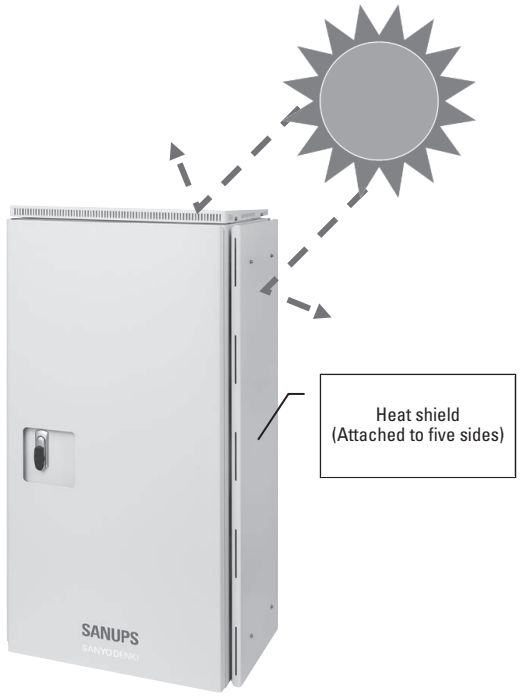

Fig. 4 Heat shield of the *SANUPS N11B-Li* series

3. Renewable Energy Inverter Technologies

In addition to our conventional *SANUPS P73H* and *SANUPS P73J* power conditioners (i.e., renewable energy inverters) for photovoltaic generation systems, we developed the *SANUPS W73A* for wind power and hydro power generation systems. This product comes in two types: a grid-connected type and a grid-connected isolated type that features isolated operation capability.

The grid-connected type power conditioner is unable to supply power in the event of a power grid failure, but the grid-connected isolated type can continue supplying power during times of emergency thanks to its isolated operation capability. This grid-connected isolated type is also expected to be used as an independent power supply in non-electrified areas such as remote islands.

Wind and hydro power generation systems require the use of high-efficiency rectifiers to convert the AC power generated by the generation system into DC power for use with power conditioners.

Therefore, we newly developed the *SANUPS W75A* as a rectifier dedicated for use with 10 kW or lower output wind and hydro power generation systems.

Since the *SANUPS W75A* was designed to be installed outdoors with a power conditioner, it needed to have the same water and dust protection (IP65) as the combined power conditioner to build a robust environmentally durable system.

To this end, the unit makes use of a fanless passive air cooling system. We decided to use large cooling fins for this product based on the results of heat dissipation simulations performed while taking the temperature rise of the diodes used in the rectification circuit into account. By making the cooling fins a part of the housing, this product satisfied the required cooling performance even with a sealed structure and also achieved quiet operation.

We expect that the combined use of our *SANUPS W73A* power conditioner and *SANUPS W75A* rectifier unit will be further introduced in renewable energy power generation systems, including wind and hydro power generation systems, that use AC generators.

From the development of our previous power conditioners and this rectifier unit, we have now acquired the technical expertise for converting the power generated by almost all types of renewable energy generation systems into AC power, as shown in Figure 5.

Moving forward, our products can convert not only photovoltaic, wind, and hydro power, but also various other types of renewable energy sources, such as biomass and geothermal power, into AC power. We also expect that customizing customers' equipment tailored to their needs will further help expand new markets.

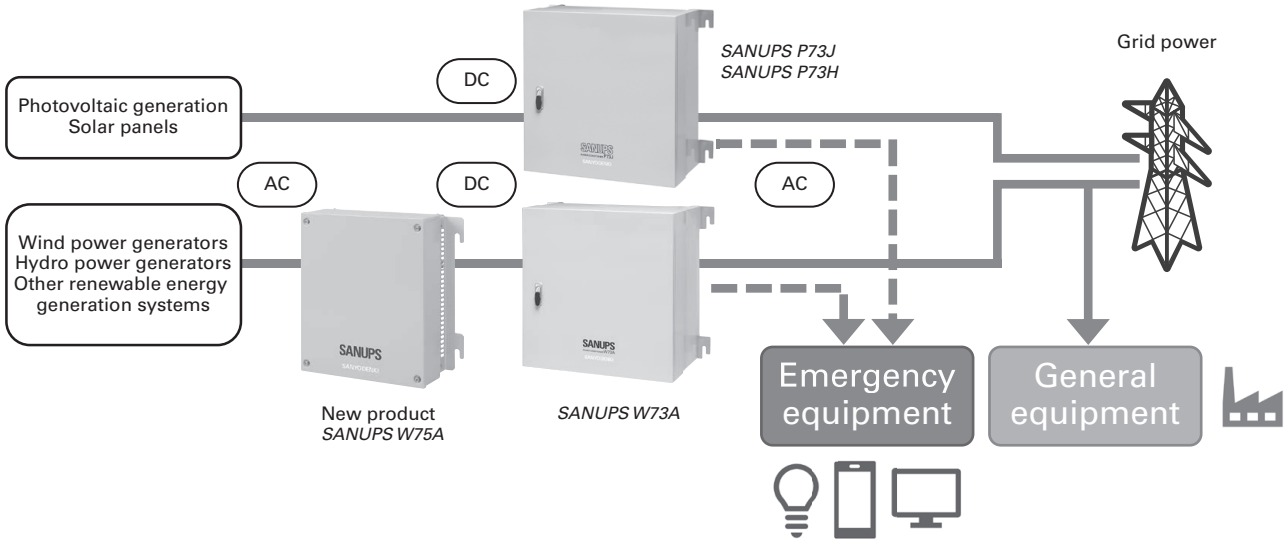

Fig. 5 Power generation system overview

4. Conclusion

We plan to continue to offer UPSs and power conditioners that can safely be used in harsh outdoors environments, so as to meet the expectations of our customers with the aim to contribute to the realization of a low-carbon society.

In addition, we will endeavor to develop new technologies to introduce higher quality power supplies into new fields that require operations in unusually severe environments.

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