



Guaranteed power

Smart modular UPS designs provide flexibility
and increase availability

SOPHIE BENSON-WARNER – Uninterruptible power supplies (UPSs) have been ensuring a flow of continuous, clean power to industrial and commercial equipment for many years. Few other products find their way into such a huge range of applications: data centers, computer rooms, all kinds of industrial production processes (semiconductor, automotive, etc.) and even sensitive medical equipment. Historically, UPS systems were designed as monolithic devices with limited flexibility, scalability, maintainability and availability. Often, these monolithic designs did not meet customer expectations, so a new UPS design philosophy, based on a modular approach, has been developed in recent years. ABB has a long history in the supply of power and power protection equipment, including modular industrial UPS products. ABB's modular UPS range has been further strengthened by the acquisition of the Swiss company Newave Energy and their range of innovative medium- and high-power UPSs.



The sheer ubiquity of UPSs in so many areas of industry and commerce means that as technological progress drives change, UPSs have to be flexible enough to accommodate the new challenges created. Criticality, cost and energy efficiency are important factors that have to be taken into account. These factors have largely driven the uptake of modular UPS solutions. A modular architecture delivers scalability and the latest high-efficiency designs facilitate major reductions in electricity consumption and CO₂ emissions. Additionally, they provide the flexibility required for planners to design power and space for both immediate and future needs.

Title picture

Much of our modern society depends on critical infrastructure, like this data center. Modular UPS design provides a robust and flexible foundation to keep good, clean power flowing and to maximize availability.

Newave Energy, a leading manufacturer of uninterruptible power supply solutions, was acquired by ABB in March 2012. This pioneering company introduced modular and transformer-less UPS technology in 2001. Today, these concepts form the foundation of the most important architectural trends in the UPS market.

Although Newave has a comprehensive product portfolio containing both traditional free-standing and modular UPS, the majority of its sales are now of modular three-phase UPS. Today, close to 70 percent of its sales are of modular UPS systems.

These products complement ABB's range of industrial voltage conditioners and UPSs. Also using a modern and highly efficient modular topology, the PCS100 family of active voltage condi-

tioners (AVCs) and the Industrial UPS (UPS-I) target industrial applications [1, 2].

PCS100 active voltage conditioner

The PCS100 AVC protects sensitive industrial plant and loads against voltage sags, imbalances and regulation issues → 1. By continuously monitoring the

Some of the world's largest semiconductor manufacturers rely on this technology to protect their critical loads.

incoming supply and comparing it with perfect sinusoidal reference waveforms, voltage vectors can be created using power electronics and injected in real time to provide a conditioned supply. Offering online voltage conditioning performance, ABB's PCS100 AVC has been widely applied in some of the most demanding industrial applications, includ-



ing the automotive and semiconductor industries → 2.

The PCS100 AVC does not include any supercapacitors or batteries for energy storage, but instead takes energy from the remaining supply at unity power factor, with little impact. As voltage sags typically make up more than 90 percent of the problems that impact plant performance, the AVC provides a reliable, efficient and compact solution for industrial plant protection.

Certain critical industrial loads, particularly in process control, warrant outage protection that the AVC cannot supply and this is where the complementary PCS100 UPS-I solution is implemented. Both products can be found supporting different load types in many industries.

The PCS100 AVC contains a redundant bypass that ensures continuity of supply in the unlikely event that the AVC power electronics fail. This ensures very high levels of availability and reliability. Some of the world's largest semiconductor manufacturers, with particularly high demands on plant availability, rely on this technology to protect their critical loads.

The PCS100 AVC ensures quick and full correction of three-phase voltage sags down to 70 percent of the nominal volt-

age and of single-phase voltage sags down to 55 percent of the nominal voltage. In the case of deeper voltage sags, it undertakes a partial correction, which will often prevent load shedding. In addition, all models are able to continuously correct voltage variations of ± 10 percent in the mains voltage. This takes care of imbalances, which are a particular problem for direct online motors and variable speed motor drives.

PCS UPS-I

The PCS100 UPS-I is a highly efficient modular design that utilizes a line-interactive topology → 3. The PCS100 UPS-I product is designed to operate with motors and drives. The very rugged design suits even the most demanding industrial loads. A static switch (utility

One of the challenges in industrial load protection is to determine appropriate discrimination settings in the protection systems. Due to the unique topology of the UPS-I design and the rugged rating of the static switch, significant fault capacity is available for the electrical system designer to work with. With an efficiency of around 99 percent, the UPS-I has very low losses, which means a low cost of ownership and low cooling requirements, making it both an economic and environmentally friendly solution.

The UPS-I can utilize traditional lead acid batteries as a storage medium, although many of ABB's customers select high-performance supercapacitors that offer up to 500,000 duty cycles and require only minimal preventive maintenance.

This means that the lifetime of the storage medium will not be reduced by "real" use of the system, which is often the case with batteries. In many industrial applications, storage is only required to ride through deep

The PCS100 active voltage conditioner protects sensitive industrial plant and loads against voltage sags, imbalance and regulation issues.

disconnect) with a high rating powers the load under normal conditions, with the modular inverter supplying the load when the supply voltage goes outside tolerance.

voltage sags or power switching events, so many applications need only have a few seconds of storage time.



A redundant bypass ensures continuity of supply in the unlikely event that the AVC power electronics fail. This ensures very high levels of availability and reliability.

Whereas the Newave commercial UPS products are based on a highly redundant, decentralized modular design, ABB has selected a centralized modular design topology for their PCS100 UPS-I range of products due to fault clearing requirements in many industrial applications. The static switch is designed to cope with the high level of overloads (motor starting, welders, etc.), harmonics (motor drives, electronic rectifiers, etc.) and faults commonly found in industrial environments. If any inverter module were to fail, the system remains available at reduced capacity. Although the static switch could be seen as a single point of failure, it is backed by a failsafe electromechanical bypass. This

means that very high levels of reliability are achieved.

Power factor

Many of the challenges associated with the application of UPSs come from the loads they supply. Load challenges are present even in datacenter and computer room applications: Many of the modern switched-mode power supplies used in computer server loads will cause leading power factor and light-loading conditions when operating in their normal regime. Leading power factor is a major problem for legacy UPS designs and it results in inverter overload and the need for significant de-rating. ABB's commercial UPS technology and industrial PCS100 UPS-I products are designed for a much wider range of load power factors and they thus remove the hidden cost associated with de-rating and the need to oversize the UPS selected.

Leading power factor is also a major problem for the standby diesel generator systems that feed many facilities. The PCS100 UPS-I sister product, PCS100 STATCOM-I, is an economic solution to this problem as it provides fast correction of leading VARs, imbalanced current and low order harmonics – all problems for the alternator systems found on these generator systems.

When selecting an ABB UPS, the particular technical requirements of each application must be looked at very carefully so that the most appropriate UPS can be chosen. Although the raw power requirements, as measured in kilowatts (or kVA), of two applications may be similar, the nature of the loads and the power quality problems present on the supply may be very different. The comprehensive range of power protection solutions and application expertise available from ABB means the correct power protection solution can be applied to ensure reliable and cost-effective protection of critical loads.

Sophie Benson-Warner

ABB Discrete Automation and Motion
Napier, New Zealand
sophie.benson-warner@nz.abb.com

References

- [1] R. Hoffmann, "Power fitness: Reliable voltage protection of sensitive loads," *ABB Review* 1/2012, pp. 30–33.
- [2] S. Benson-Warner, "Eliminating downtime: Keeping the power flowing during grid instabilities," *ABB Review* 1/2012, pp. 27–29.