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Power stability for manufacturers

Manufacturing is a critical aspect of many economies. However, many places lack power grid stability, which leads to production disruption. ABB's PCS100 family of power protection products ensures a continuous supply of good-quality power to industrial processes, even in the face of drastic voltage sags.

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For years, companies have pursued various techniques to improve productivity and lower manufacturing costs. Success in this endeavor makes further gains harder to achieve – the law of diminishing returns. As a result, many companies are automating ever more processes in an effort to meet targets and remain competitive. This movement toward mass automation is driving a commoditization of manufacturing machinery – and, in some cases, of entire manufacturing plants.

Although possibly more efficient, new machinery can place further strain on an already-loaded generation, transmission and distribution network.

More automation demands more power

Principles proven over decades of lean manufacturing, such as waste reduction by equipment breakdown minimization or the deletion of non-value-adding activities, remain unchanged. But the digitization of manufacturing made possible by increased computing power delivers more advanced analytics, data collection from more sensors, better automation technologies (such as touch-interactive robotics), and more machine performance information that the manufacturing company can use to refine existing processes.

All of this improved technology and process analytics requires electrical energy. Where the power supply is unreliable or prone to being out of specification, there is a very real risk of improper operation of equipment that may produce questionable, inaccurate, or possibly false, data.

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01 A reliable power supply is critical for modern production techniques, especially in developing countries where manufacturing can lift an economy out of agricultural subsistence.

Further, even very short variations in the power supply can cause fatal machinery damage or shut down a manufacturing process or entire facility →1. Apart from production losses, non-delivery of product to the customer and possible equipment damage, unscheduled interruptions can be very costly in other ways. For example, in hygienic production environments such as dairy or food processing, hours may be spent clearing, cleaning, decontaminating and restarting.

As production demands increase, more and bigger machinery may be added. Although possibly more efficient, this new machinery can place further strain on an already-loaded generation, transmission and distribution network. The result of this additional load is a further reduction in stability and a consequent increased risk of interruption due to events on the network.

The cost to manufacturers of unscheduled process interruptions due to power events has been estimated to be as high as 4 percent of the company turnover [1]. Such an impact can quickly negate any gains in throughput, unit production cost or quality that have been made through investment.

The ABB PCS100 product line

All electricity networks will suffer power quality issues to some degree. These disturbances come in many forms – blackouts, noise, frequency variation or harmonics – but 90 percent of instabilities affecting manufacturing facilities are voltage sags, where the supply voltage drops markedly for a brief period. Most voltage sags are caused by external factors, such as high winds, heavy rain, snow and ice buildup, traffic accidents and excavation miscalculations. These events are beyond the control of the plant engineer and so protection against them must be planned for.

From continuous voltage regulation, through sag protection, to supplying the load during outages, the PCS100 product line provides clean, balanced and phase-corrected voltage that remains within specification.

ABB offers manufacturers a portfolio of power conditioning solutions that provide power event protection to machinery, production lines, or an entire facility. These solutions deliver an energy supply that is consistently within specification and that lowers the risk of process interruption or fatal machinery damage. From continuous voltage regulation, through sag protection, to supplying the load during an outage event, the PCS100 product line provides a customer's load with clean, balanced and phase-corrected voltage that remains within specification.

PCS100 AVC-20

The PCS100 AVC-20 is an online continuous voltage regulator. It regulates the incoming supply voltage to 100 percent of nominal even when the grid-supplied voltage varies as much as ±20 percent continuously.

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For example, in a network in which the infrastructure capacity lags demand and large customer loads are connected, there are often periods of a minute to several hours duration in which the voltage drops well below the nominal supply voltage.

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02 PCS100 AVC-40. The PCS100 family is suitable not only for developing countries with weaker infrastructure, but also for developed countries, where even marginal gains in productivity can bring a significant competitive advantage.

These undervoltages often occur during peak demand times when industrial plants are drawing the highest load. In a three-phase 400 V nominal network in which such events occur, the AVC-20 will boost the voltage from as low as 320 V back up to the nominal 400 V for as long as the grid-side low voltage exists so that any load connected downstream of the PCS100 AVC-20 is not affected by the undervoltage. In the same manner, the PCS100 AVC-20 will buck an overvoltage of as much as 20 percent when, for example, a large network load ceases operation and the voltage climbs rapidly.

Not only does the PCS100 AVC-20 regulate voltage continuously, but it is also capable of regulating extremely rapidly: from instability detection to full regulation typically takes under 20 ms – less than one cycle on a 50 Hz network.

PCS100 AVC-40
In a plant where severe sags are present, the PCS100 AVC-40 will correct a sag of 40 percent in the nominal voltage →2. For example, a three-phase 400 V network voltage could drop to 240 V and the PCS100 AVC-40 will restore it to 400 V – in less than 18 ms. To provide such a high level of voltage correction, the PCS100 AVC-40 limits the correction duration to 30 s (due to thermal constraints). The continuous regulation ability of the PCS100 AVC-40 is ±10 percent.

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The PCS100 AVC-40 will correct a sag of 40 percent in the nominal voltage.

Single- and two-phase sags can also be corrected by the AVC-40 and any resulting phase-angle shifts corrected as necessary.

There is no need for batteries or other energy storage as the PCS100 AVC-40 draws energy from the connected utility (and thus relies on it remaining connected).

PCS100 UPS-I
Manufacturing plants connected to supply networks that often suffer outages or blackouts, and that have a backup power source such as a second transmission-level connection or a generator, can be protected from interruption by ABB's PCS100 UPS-I →3.

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Designed to bridge the period from the moment the utility supply drops below a preset voltage, or disconnects completely, until the backup comes on line, the PCS100 UPS-I will supply an industrial load from an energy storage source connected to the UPS-I controller. This controller manages the transfer to the secondary source and back to the utility once power is restored and within specification. Depending on the backup type, the UPS-I energy storage may be batteries or ultracapacitors. When transferring to a standby generator, batteries provide a minimum of 30 s full load autonomy – sufficient time to start and bring most generators online.

The PCS100 UPS-I bridges the period from the moment the utility supply drops below a preset voltage, or disconnects completely, until the backup comes on line.

In the case of a plant supplied by two transmission-level systems, for example, two 110 kV feeders from two generation sites, ultracapacitors are used to supply the load for up to 2 s during the automatic transfer switch operation.

In all cases, the load is continuously supplied from the moment the supply goes out of specification until the backup is successfully up and running. The UPS-I manages this transfer and synchronizes the UPS-I output and network supply accordingly.

Delivering protection at plant supply level, the PCS120 MV UPS is connected at a distribution voltage of either 11 or 22 kV.

Protection at medium-voltage: the PCS120 MV UPS

ABB'S PCS100 portfolio of products provides protection from common power events at tool, line or plant level with models rated from 150 kVA to 3,600 kVA. As plant load and complexity increase, broader protection strategies are required and reliable power conditioning systems are needed at a higher level. Therefore, ABB has introduced a medium-voltage power protection product - the PCS120 MV UPS →4. Delivering protection at plant supply level the PCS120 MV UPS is connected at a distribution voltage of either 11 or 22 kV. One unit is rated at 2.25 MVA and units can be connected in parallel to protect loads up to the limit of available fault protection and switching devices.

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03 PCS100 UPS-I.

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04 PCS120 MV UPS.

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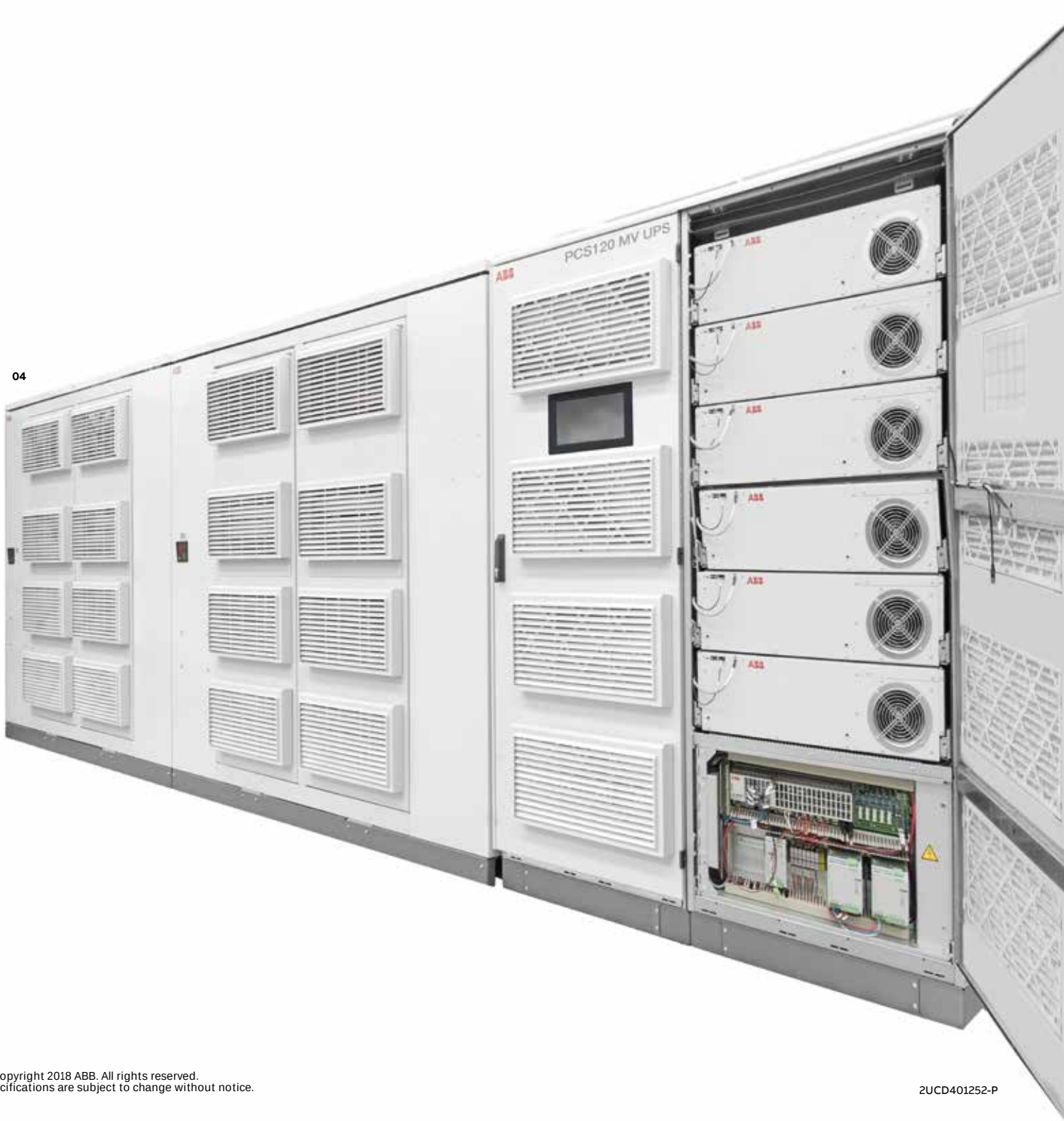
Reference
[1] Copper Development Association, "The Cost of Poor Power Quality," ECI Publication No Cu0145, October 2015. Available: http://admin.copperalliance.eu/docs/librariesprovider5/power-quality-and-utilisation-guide/21-the-cost-of-poor-power-quality.pdf?sfvrsn=4&sfvrsn=4

Energy storage strategies similar to the PCS100 UPS-I are employed and secondary supply sources are managed by the MV UPS. This product is currently being promoted in the data center industry as the PCS120 MV UPS is suited to large industrial loads where entire plant level protection is desirable.

In their efforts to remain competitive, modern manufacturing plants are employing more automation, technology and electronically-driven processes and equipment.

ABB power conditioning products give plant engineers and managers a way to avoid costly unscheduled interruptions while protecting expensive technologies from damage caused by repeated power supply events beyond their control. They also enable complex and exacting manufacturing processes to run trouble-free, continuously and accurately, thus maintaining the company's competitive edge. ●



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