



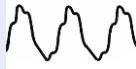
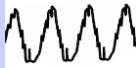
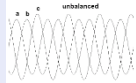



Alan Cooper, 11.09.2015

The Challenges of power protection for industrial applications

Power Quality Challenges

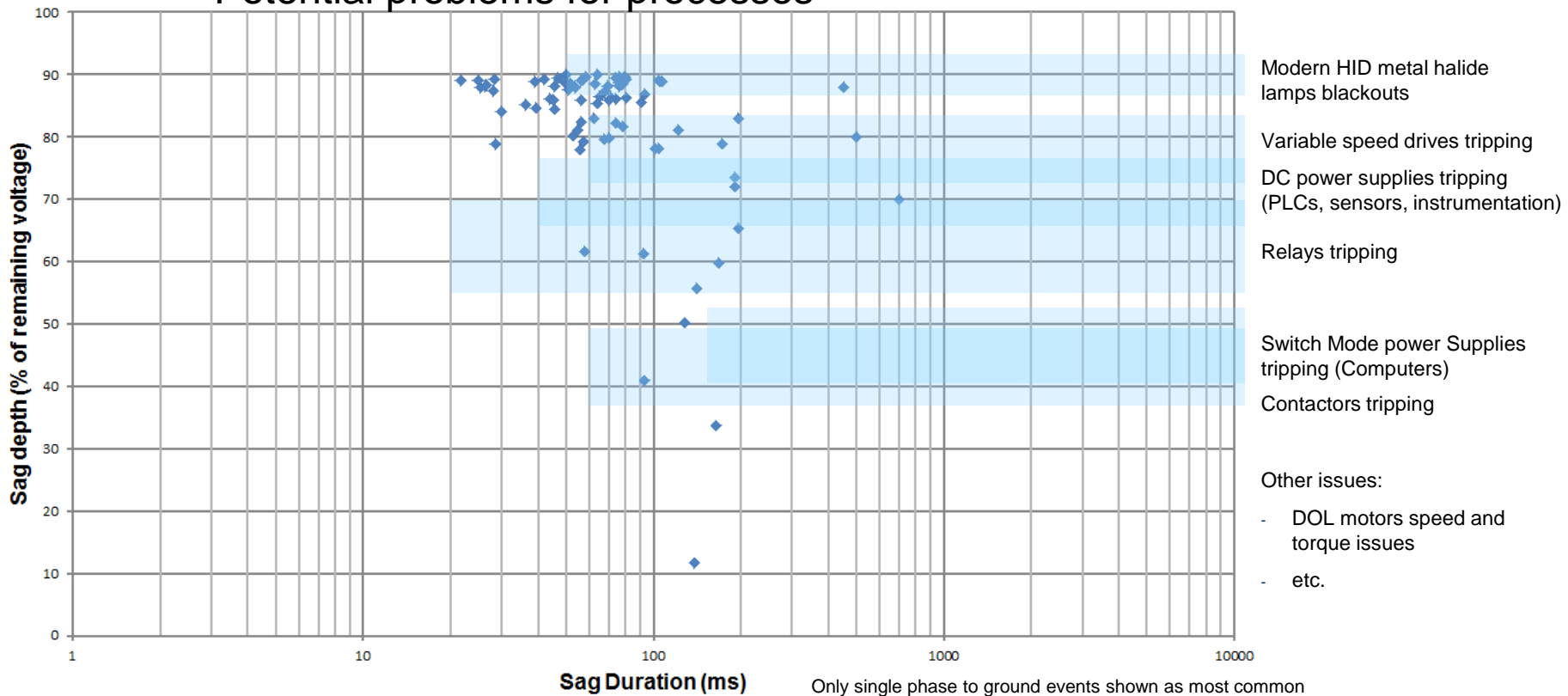
Events, Originator, Effects

Event (sorted by cost impact)	Originator	Cause	Effects/tripping
Sag 	<ul style="list-style-type: none"> •Supply system •Customer Inst. •Distr. via supply 	<ul style="list-style-type: none"> •Fault on feeder/weather •Connect. large loads as motors 	Tripping of VSD's, controls, switchgear, increased currents, over-current protection tripping
Transients 	<ul style="list-style-type: none"> •Supply system •Customer inst. •Distr. via supply 	<ul style="list-style-type: none"> •Lightning •Line/cap switch. 	Overvoltage tripping Voltage breakdown, Electr. devices malfunction, VSD's
Neutral-ground voltages	<ul style="list-style-type: none"> •Customer Inst. 	<ul style="list-style-type: none"> •Poor wiring, grounding 	Digital devices malfunction,
Harmonics 	<ul style="list-style-type: none"> •Customer Inst. •Distr. via supply 	<ul style="list-style-type: none"> • Power Electr. like VSD, SMPS, high eff. Lamps 	Motor, transformer, neutral conductor overheating, Instrum. & PLC malfunction
Noise 	<ul style="list-style-type: none"> •Customer Inst. •Distr. via supply 	<ul style="list-style-type: none"> •SMPS 	Zero-crossover dev. trips Fast running clocks
Unbalance 	<ul style="list-style-type: none"> •Supply system •Customer Inst. •Distr. via supply 	<ul style="list-style-type: none"> • 1 or 2 phase loads • Asymmetrical lines/transformers 	Motor heating, rectifier and inverter damage (DC/AC drives)
Notching	<ul style="list-style-type: none"> •Customer Inst. 	<ul style="list-style-type: none"> • Power Electr. like DC-drives, AC-phase contr. 	Zero-crossover dev. Trips
Fluctuations 	<ul style="list-style-type: none"> •Customer Inst. •Distr. via supply 	<ul style="list-style-type: none"> •Cyclic loads, cranes, welding, arc furnaces 	Light flicker

Power Quality Challenges

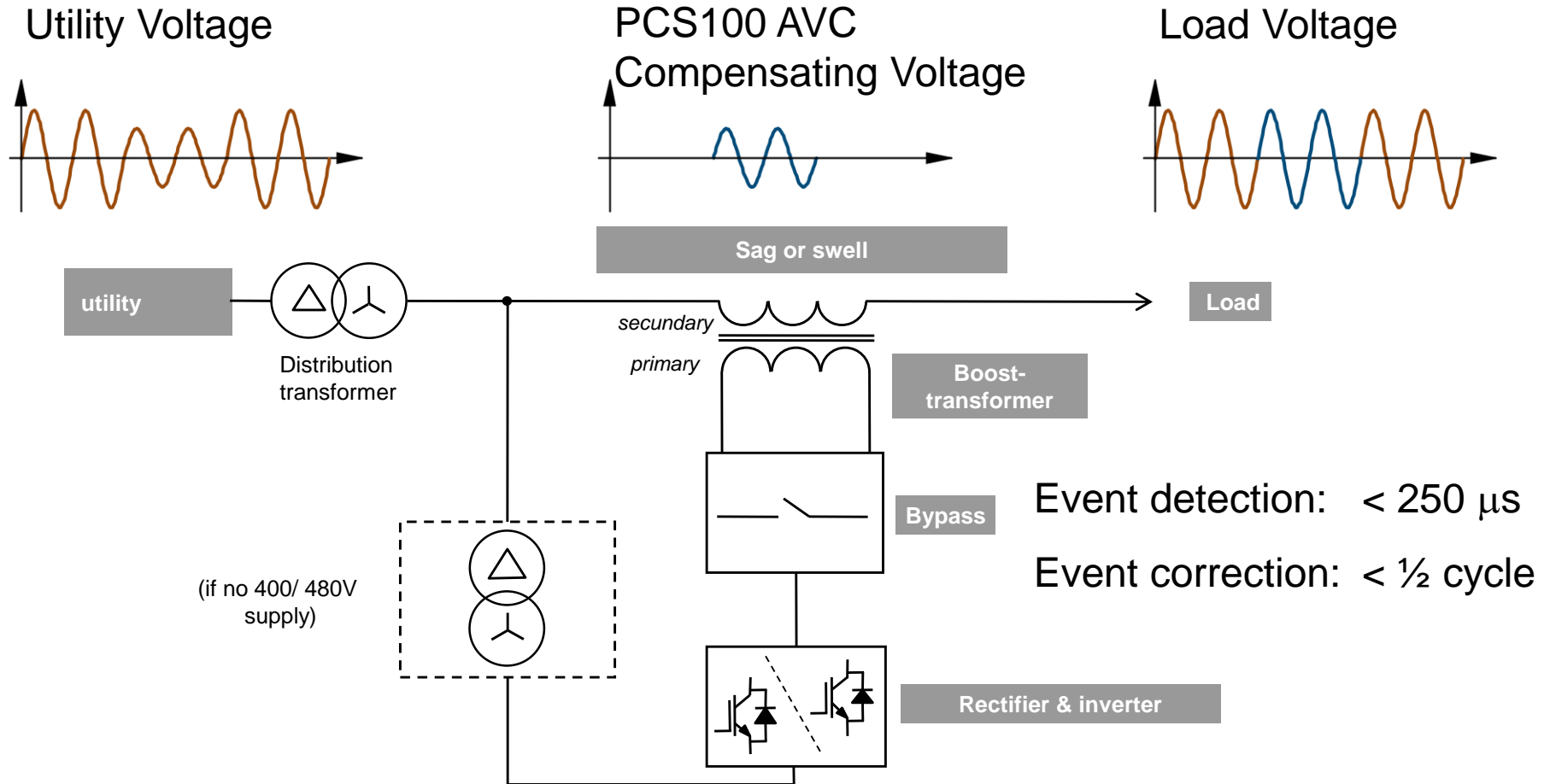
Typical Utility Supply

- Typical annual HV utility supply sag events
- ~20 events below 80%
- Potential problems for processes



Power Quality Challenges

The PCS100 AVC, active voltage conditioning



PCS100 AVC-40

The Performance

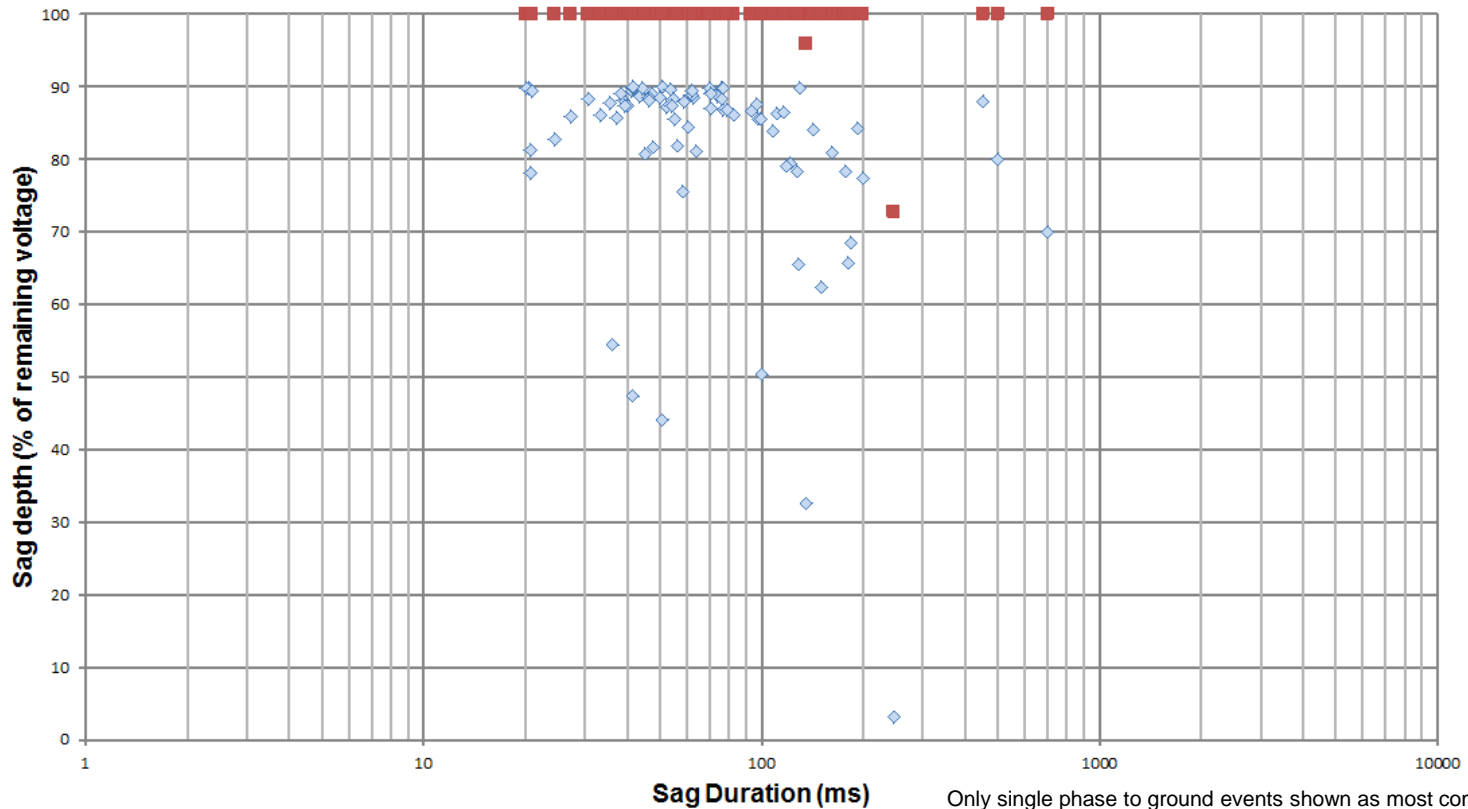


- Full correction
 - Three-phase sags down to 60 percent retained voltage
 - Single-phase sags down to 40 percent retained voltage
- Partial correction
 - Three-phase sags down to 30 percent retained voltage
 - Single-phase sags down to 0 percent retained voltage
- Continuous regulation of utility voltage $\pm(10-15)\%$
- Voltage vector phase angle error correction
- Voltage imbalance correction

Power Quality Challenges

The Performance

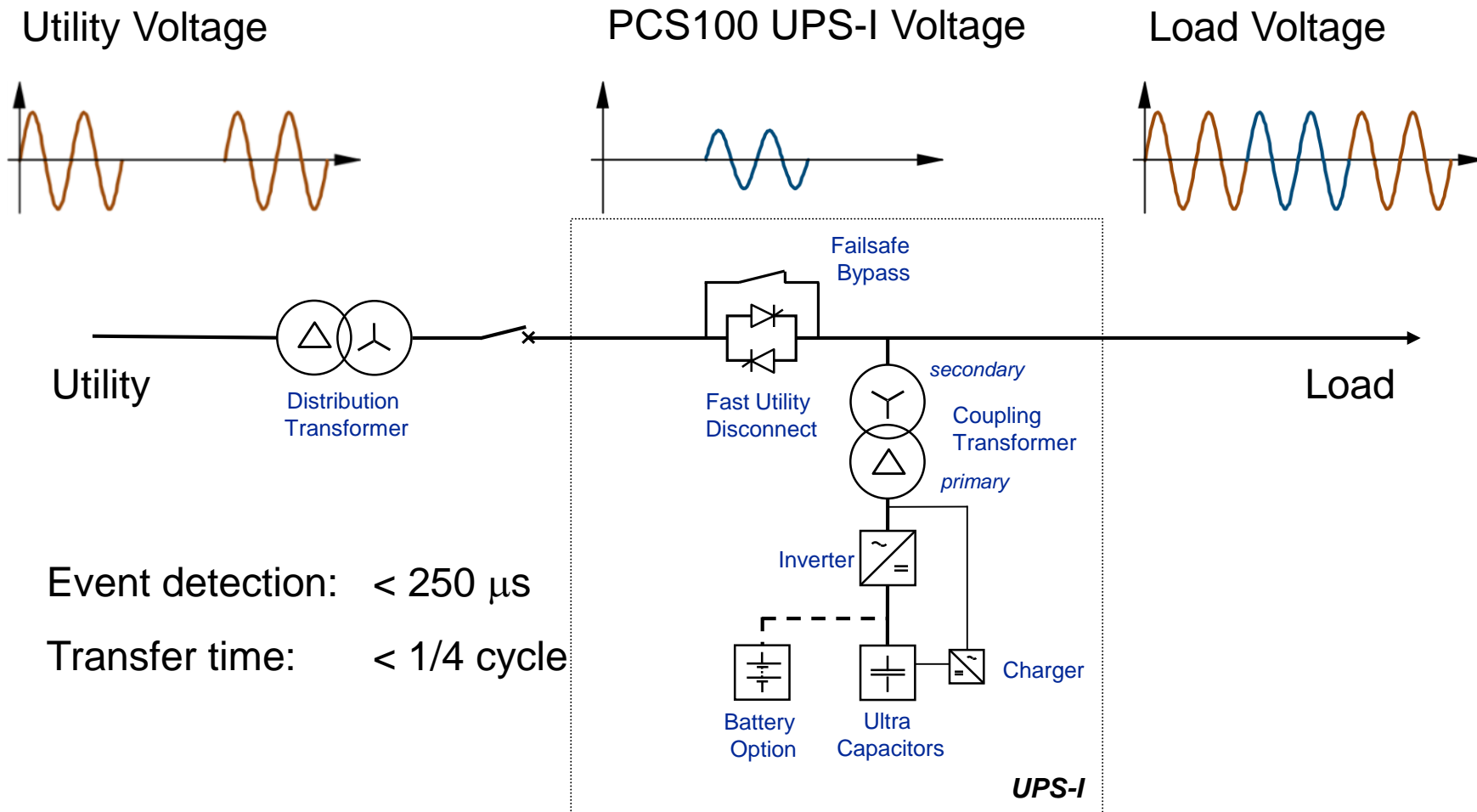
>95% most common power quality events can be solved with PCS100 AVC



Only single phase to ground events shown as most common
PCS100 AVC 40% performance shown

Power Quality Challenges

PCS100 UPS-I, PCS100 MV UPS, Operation



Power Quality Challenges

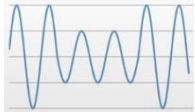
The PCS100 UPS-I, Performance



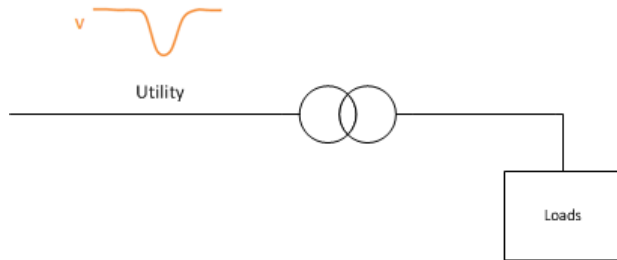
- Industrial loads
 - DOL motors
 - Drives
 - Transformers
 - Tools
- Redundant modular design
- Fail-safe design

Power Quality Challenges

Reactive Power Conditioning, PCS100 RPC

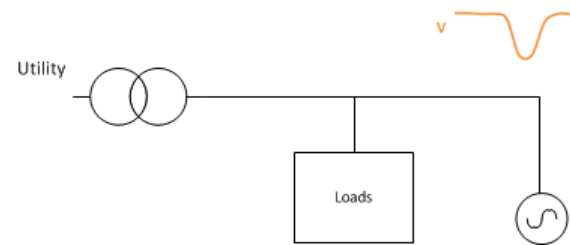


Power quality problem from outside (grid)

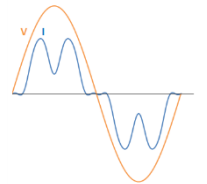


PCS100 AVC
PCS100 UPS-I

Power quality problem from inside (loads)



PCS100 RPC

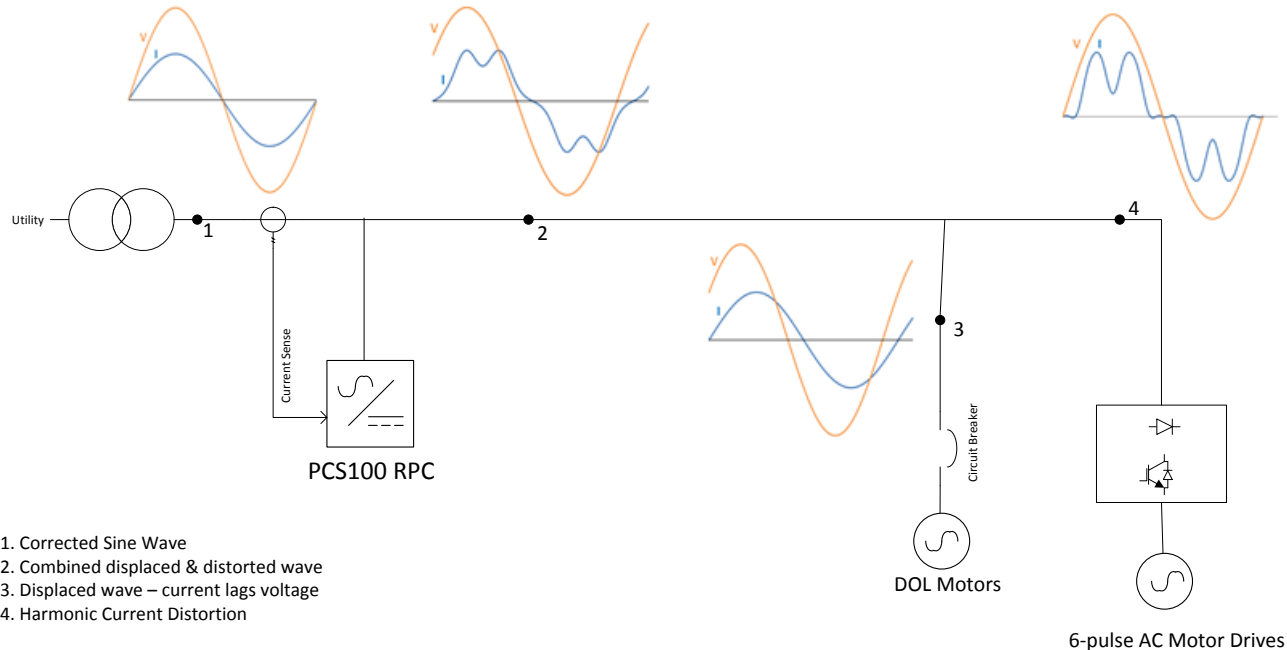


Power Quality Challenges, Solutions, Case Studies

True Power Factor Correction



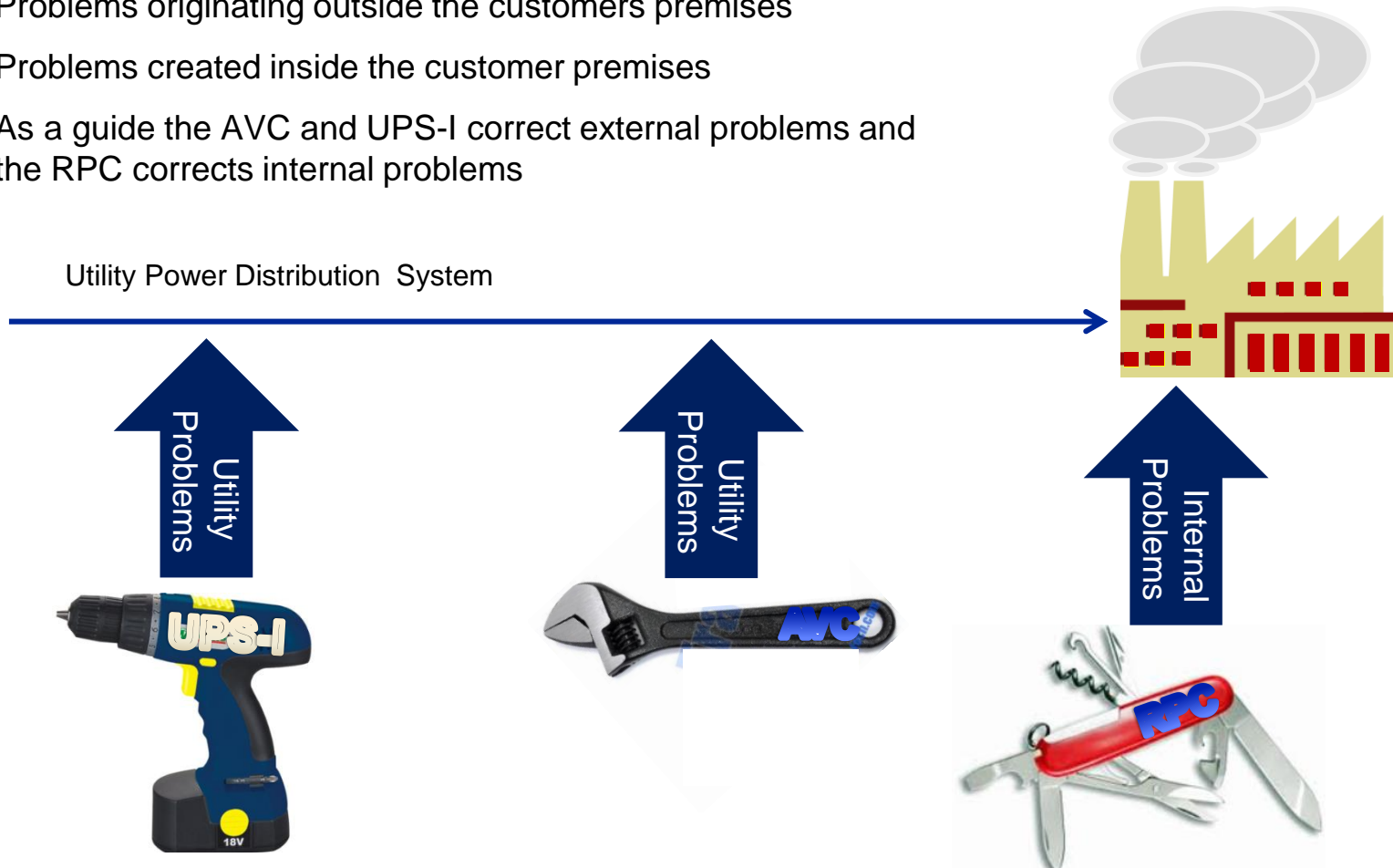
- Save money on reactive power costs by true power factor correction
- Reduce loading and heating by lowering total kVA
- Filter dominant low order harmonics (5th & 7th)



PCS100 Family of Power Protection Tools

How to select the correct tool for the job?

- Power system problems can be divided in to two types:
 - Problems originating outside the customers premises
 - Problems created inside the customer premises
- As a guide the AVC and UPS-I correct external problems and the RPC corrects internal problems



Case Study AVC

Flight Simulator for major European Airliner

- **Customer & Application Profile**

A Major European Airliner - Lab with High end data services in Munich, Germany

- **Problem**

One of the biggest flight simulator training centers in the world to renew pilot licenses. Problem were interruptions / blue screens during the sessions, lost log-files, schedules not met → impact on airline schedules, penalties besides defective equipment

- **AVC Solution - 500 kVA / 30%**

The AVC has solved all these problems. No more lost time with re-booting of simulation SW and lost log files. Not a single defect on controllers, power supplies or PLCs, since the AVC has been installed

- **Similar Applications:** research institutes, universities, super-computer, digital movie & sound production studios



Case Study AVC

Gülermak - CNC Machine application



- **Customer & Application Profile**

A global player in engineering and construction of heavy industrial steel constructions. Located in Turkey
Advanced and specialized steel components made on CNC machines

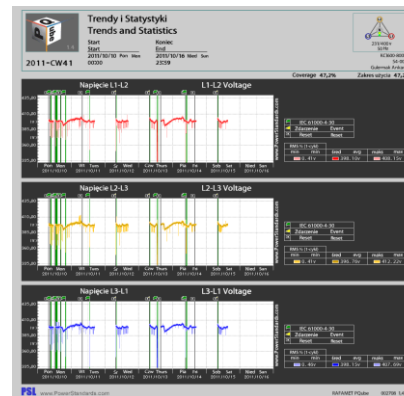
- **Problem**

Work in progress damaged → can be scrapped, CNC Tools damaged (main issue!)
Measurement on power supply concluded voltage fluctuation and sags of 35-40%.

- **AVC Solution - 325 kVA / 40%**

The AVC has solved their problems. Better and continues production. Quality improvement and not so much lost material.

- **Similar Applications:** laser cutting,



Case Study AVC / UPS-I

AstraZeneca - Pharmaceutical

- **Customer & Application Profile**

A global player in pharmaceutical, critical manufacturing process

- **Problem**

A continuous process that is manufacturing an organic drug in batches spanning 4 to 6 months, the system cannot be shut down or suffer any disturbance or product will be lost during this period. After the manufacturing period the process is shut down for maintenance and cleaning.

- **AVC Solution - 500 kVA / 40%**

The AVC offers high efficiency protection with the failsafe bypass to allow the process to continue in the event of a overload or internal problem in the AVC

- **Similar Applications:** F&B, semiconductor or solar cell production, wire or cable manufacturing, extrusion



Case Study AVC & UPS-I

Automotive Industry - Robotics

- **Customer & Application Profile**

Car manufacture. Quality critical manufacturing process, used for painting, welding, presses etc.

- **Problem**

Painting system shuts down more than 20 times per year due to unexpected voltage sags. The timeframe associated with restarting the process were more than one hour per event. Another major concern were quality issues and scraped material from unfinished production.

- **AVC Solution**

The AVC offers fast and accurate voltage sag and surge correction as well as continuous voltage regulation.

- **Similar Applications:** press shop, engine shop (CNC), assembly line (welding robots), any other robot application, welding of electrical or electronic components

- **References:** VW, KIA Motors, Hyundai, Mazda, Toyota



Case Study AVC

Medical Equipment – (MRI, CT, Xray etc.)

- **Customer & Application Profile**

Samsung Medical Center, cancer treatment machines were prone to shutting during voltage sags.

- **Problem**

Medical equipment often has significant starting currents making it difficult to apply standard UPS. Any interruption during a treatment is a risk for patient and equipment.

- **AVC Solution**

2 x 300 kVA, 2 x 600 kVA, The AVC offers fast and accurate voltage sag and surge correction as well as continuous voltage regulation.

- **Similar Applications:** press shop, engine shop (CNC), assembly line (welding robots), any other robot application, welding of electrical or electronic components

- **References:**

Multiple hospitals in NZ (150 kVA) for Toshiba Medical
Repeat orders for Samsung Medical



Case Study AVC

Water Treatment with ultraviolet light

- **Customer & Application Profile**

Water/waste water utilities, water treatment by UV (ultra violet) light

- **Problem**

Trend to go away from chemical (chloride etc.) treatment/sterilization to alternative methods not impacting the taste of the water like UV light. UV lamps are very sensitive to voltage fluctuation/sags and for secure treatment it must be ensured that only sterilized water is supplied. The UV lamps always have to be longer active than any pumps.

- **AVC Solution**

The AVC offers fast and accurate voltage sag and surge correction as well as continuous voltage regulation. The failsafe bypass allows the process to continue in the event of a overload or internal problem in the AVC.

- **Similar Applications:** stadium lighting (HID), magnetrons / micro waves used for glue drying etc.

References water treatment:

Montreal, Canada, 2 x 2 MVA / 600 V

Baltimore, USA, 12 x 350 kVA / 480 V

Melbourne, Australia, 260 kVA / 415 V

References magnetrons/micro waves:

CHH (Carter Holt Harvey), NZ, 1 MVA / 400 V

Nelson Pine, NZ, 3 x 150 kVA, 400 V



Case Study AVC & UPS-I Fibre Manufacturing

- **Customer & Application Profile**

Hexcel, USA produces carbon fibre used for composites in aerospace industry (e.g. A350)

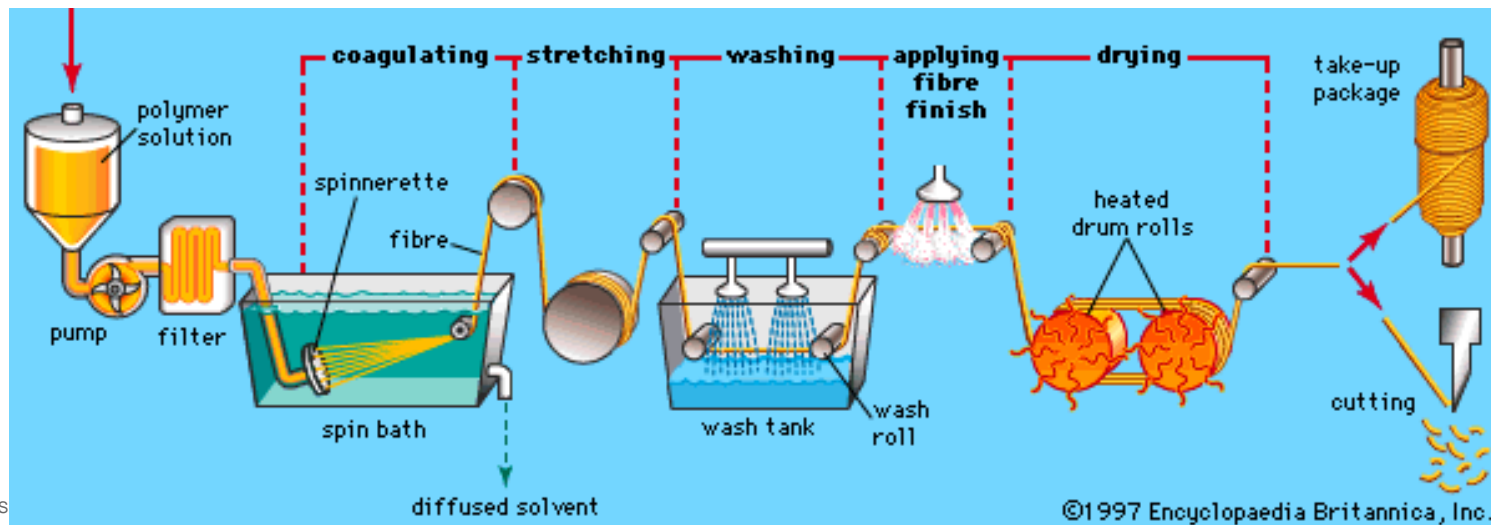
- **Problem**

Wet spinning process with high quality expectation to the products due to constructional strength needed. Endless process very sensitive to voltage fluctuation

- **AVC & UPS-I Solution**

The AVC offers fast and accurate voltage sag and surge correction as well as continuous voltage regulation. The failsafe bypass allows the process to continue in the event of a overload or internal problem in the AVC.

- **Similar Applications:** textile fibre (e.g. Lycra), cellulose fibre (tobacco filter)



Case Study AVC, UPS-I & RPC

Thin Film Manufacturing

- **Customer & Application Profile**

Kaneka, Japan/Malaysia produces thin film for displays to make them shine brighter

- **Problem**

Special film with high quality expectation due to the application.

Endless process very sensitive to voltage fluctuation. Material loss, time to clean machinery ~4+ hrs

- **AVC & UPS-I Solution**

The AVC offers fast and accurate voltage sag and surge correction as well as continuous voltage regulation. The RPC maintains power factor and reduces harmonics.

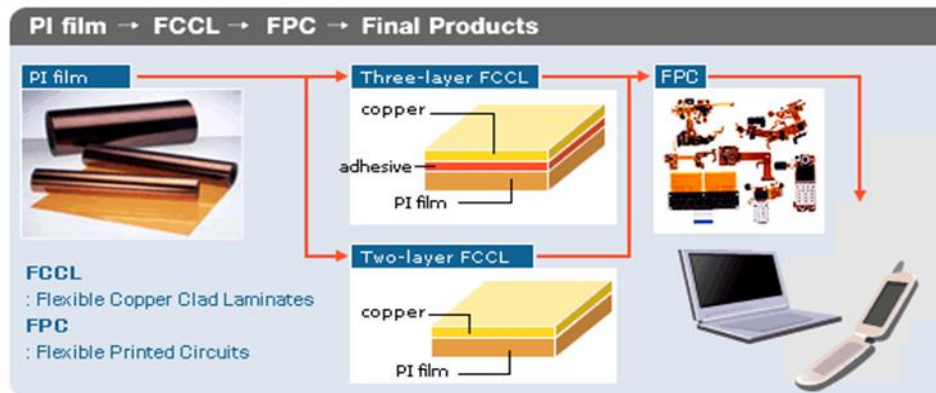
- **Similar Applications:** wrapping foil (e.g. food, packaging)

Uses and Typical Applications



Miniaturization and more advanced features of information and telecommunication devices

Used in electronic materials such as those for cellular phones, HDD wireless suspensions, and optical pickups



Case Study AVC

High Speed Printing

- **Customer & Application Profile**

High speed multi-colour printing press in Florida, USA

- **Problem**

A large number of voltage sag events during storm season. The costs per event are not high but the number of events are plus risk of not meeting delivery schedules for newspaper. After each event a significant time of clean-up and restart is needed (colour matching etc.).

- **AVC Solution**

A 3 MVA PCS100 AVC was installed in an outdoor enclosure by our local partner. The AVC offers fast and accurate voltage correction as well as continuous voltage regulation.

- **Similar Applications:** high speed bottling, high speed packaging, high speed distribution (logistic)



Case Study AVC & UPS-I Food & Beverage

- **Customer & Application Profile**

Fonterra Brands NZ (world no.1 dairy company), Takanini facility, UHT milk processing & packaging lines

- **Problem**

3-8 voltage sag events per year, that shut down production. 28 hours of downtime per event for sterilisation and restart of production/packaging lines.

- **AVC Solution**

A 1200 kVA PCS100 AVC was installed. After 4 months in operation the investment had amortised!

- **Similar Applications:** high speed bottling, high speed packaging, high speed distribution (logistic)

- **References** TetraPak, MorningStar (USA), Shelsea Sugar,



Fonterra's processing line protected by PCS100 AVC



Fonterra's packaging line

Case Study AVC

Regenerative Loads, cranes, lifts

- **Customer & Application Profile**

Airport container terminal in Hong Kong

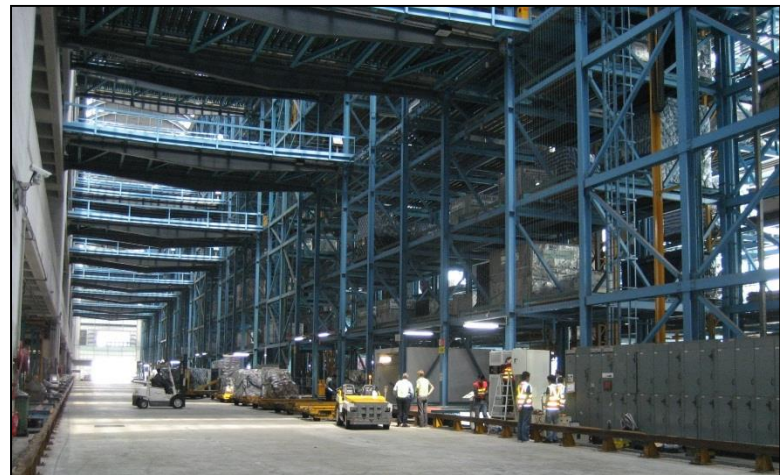
- **Problem**

The air cargo handling uses automatic stacker / reclaimer cranes. Voltage sags during thunderstorms cause crane tripping especially while lowering. Crane has to be either manually reset or repaired (dc drives), staff has to enter crane, damages to container, airline penalties (\$\$) when cargo gets delayed or misses flight.

- **AVC Solution**

PCS100 AVC for 300 kVA, 400 V/50 Hz was installed. The AVC offers fast and accurate voltage correction also for regenerative energy flow.

- **Similar Applications:** logistic centers, lifts, cranes, solar, protection of co-gen. from utility voltage sags,



Case Study RPC

Fluctuating Loads, DC-drives

- **Customer & Application Profile**

Wellington cable car

- **Problem**

Cable car is run by a dc drive, Constant start /stop causes PF & harmonics fluctuation. Waveform looks so bad that utility would not incentivize regenerative braking energy.

- **RPC Solution**

PCS100 RPC for 100 kVAR, 400 V/50 Hz was installed. The RPC corrects for dynamic PF change and mitigates the low order harmonics.

- **Similar Applications:** ski lifts, cranes, centrifuges, extrusion, production lines



Case Study AVC

Hospitality Industry

- **Customer & Application Profile**

Chatrium Hotel, Yangon, Myanmar

- **Problem**

Voltage fluctuation led to tripping equipment (lifts, chiller, HV a/c) and sometime total power down. Reputation/comfort for guests/customers and increased

- **AVC Solution**

2 x 1500 kVA ,The AVC offers fast and accurate voltage sag and surge correction as well as continuous voltage regulation.

- **Similar Applications:** hotels/resorts, office building/small businesses, airports, sport/event facilities, embassies



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for a better world™

