ELECTRIFICATION SOLUTIONS | DISTRIBUTION SOLUTIONS | JULY 2020

Minimize physical and financial losses from unforeseen events in plant electrification

A focus on power and energy management

Ganesh Kulathu, Global Product Manager, Digital Solutions

Agenda

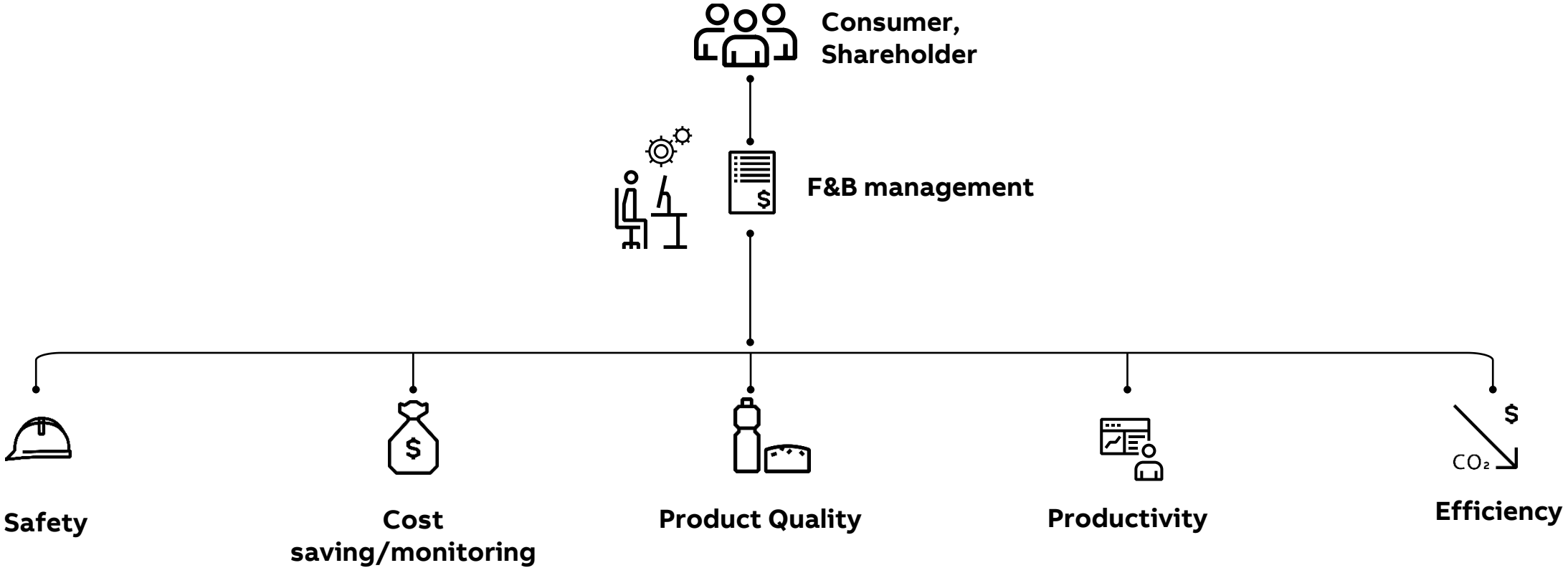
1. Focus areas and KPIs for F&B Industry
2. Deriving the key expectations
3. Mapping expectations to typical solutions
4. Solutions to achieve KPIs
5. Some references
6. Conclusion

Electrification Solutions for a reliable F&B plant operation

1. Focus areas and KPIs for F&B Industry
2. Deriving the key expectations

Electrification Solutions for a reliable F&B plant operation

Focus areas and Key Performance Indicators for a Smart Industry



Electrification Solutions for a reliable F&B plant operation

Needs and trends (Key Performance Indicators)

Safety

- Food
- People and equipment

Cost

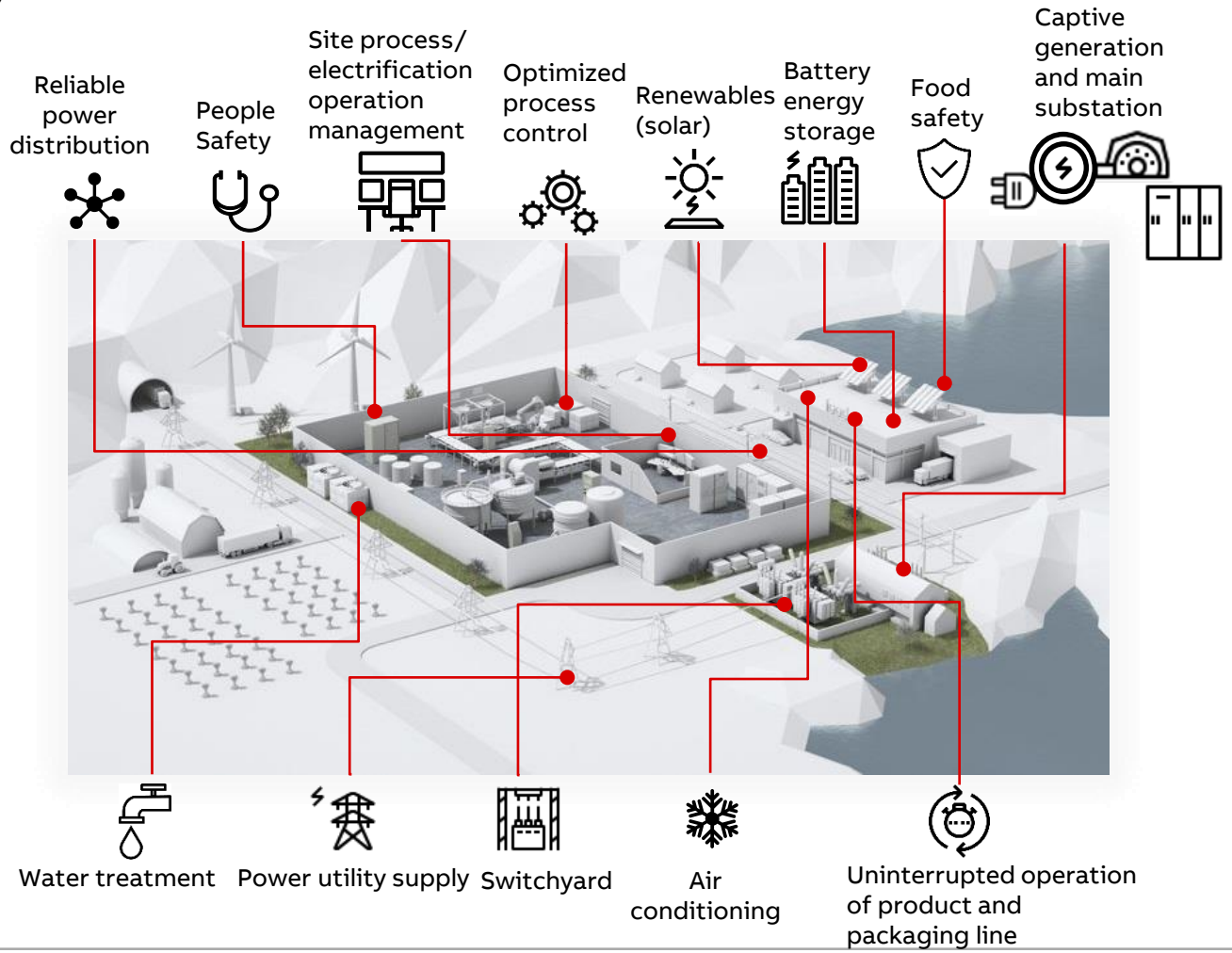
- Optimizing TCO
- Increased asset utilization
- Continuous operation
- Maintenance cost reduction

Efficiency

- Manufactured product quality
- Power quality
- Technologies adapted to variable ambient conditions

Productivity

- Trusted partner (supplier) delivering services



Electrification Solutions for a reliable F&B plant operation

3. Mapping expectations to typical solutions

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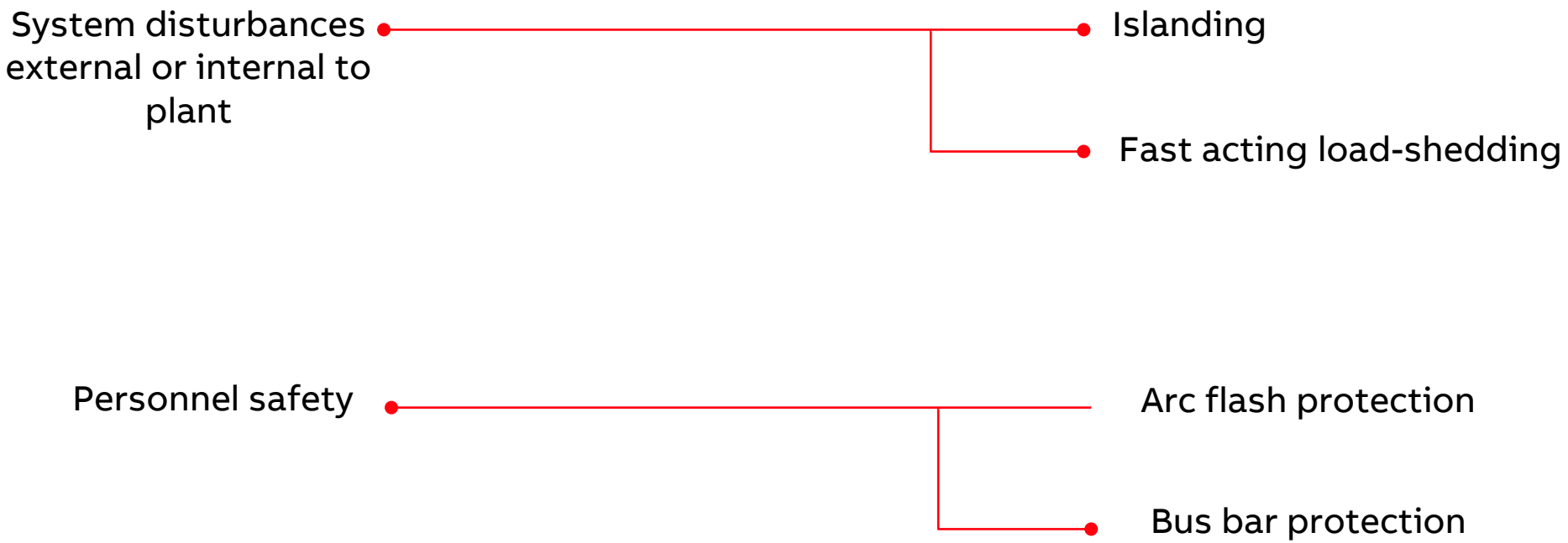
Deriving key expectations

"Minimize physical loss and financial loss from unforeseen events in F&B plant electrification system

- Ensuring continuity of power supply
- Personnel safety
- Safeguarding power assets
- System disturbances external or internal to plant

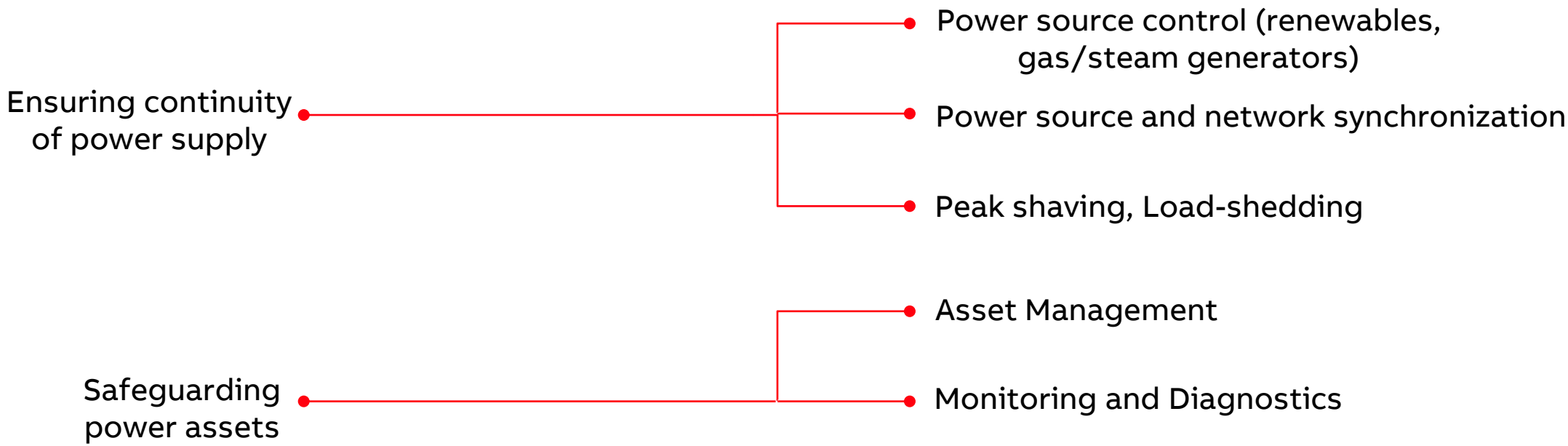
Electrification Solutions for a reliable F&B plant operation

Mapping expectations to some typical solutions (1)



Electrification Solutions for a reliable F&B plant operation

Mapping expectations to some typical solutions (2)

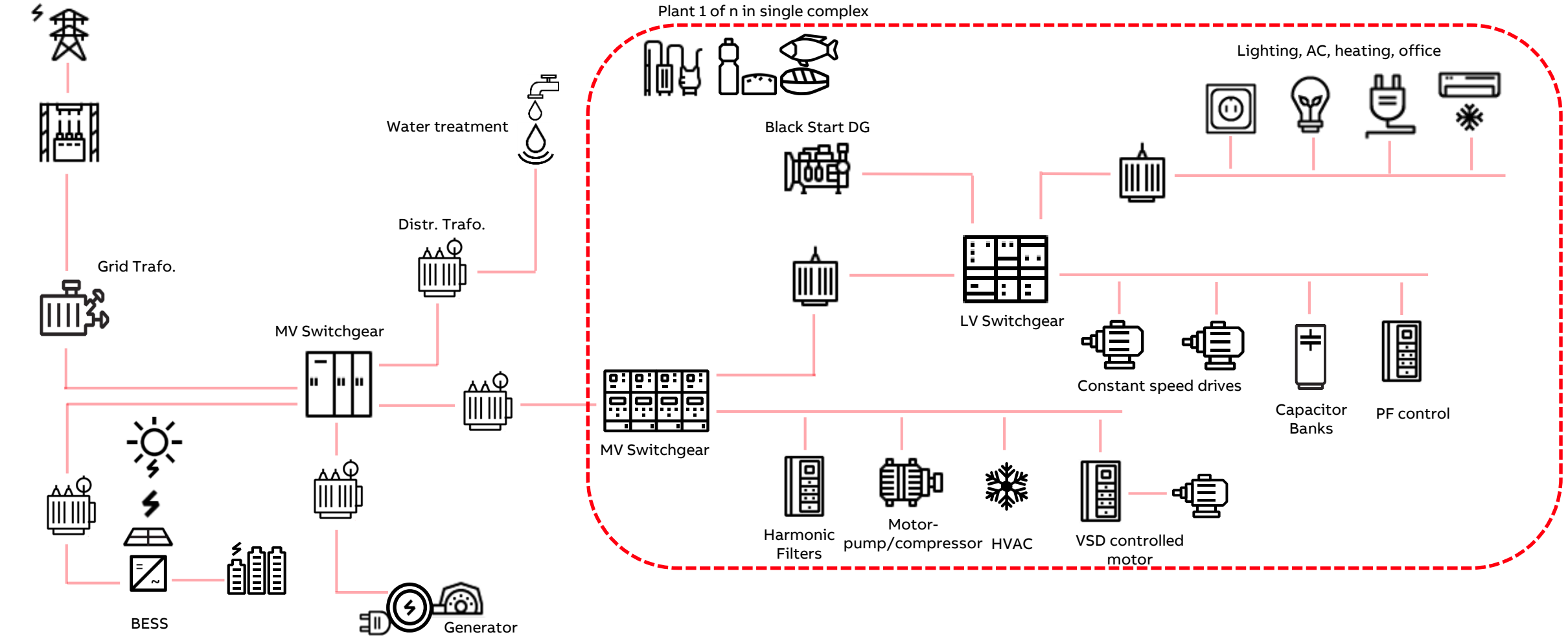


Electrification Solutions for a reliable F&B plant operation

4. Solutions to achieve KPIs

Electrification Solutions for a reliable F&B plant operation

Typical power distribution network

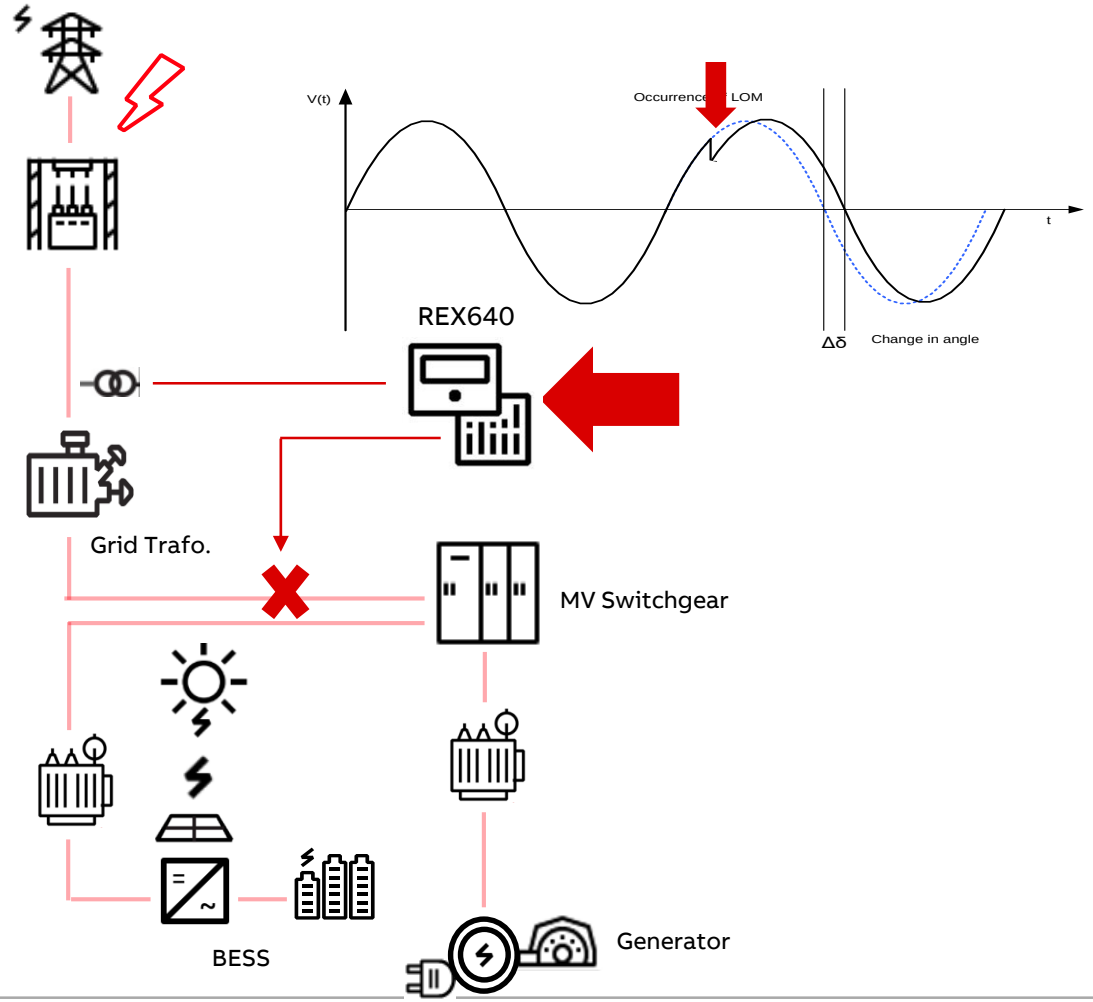


Electrification Solutions for a reliable F&B plant operation

Tackling grid disturbances

System islanding

- Islanding is required:
  - When utility grid & in-plant generation work in parallel.
  - To save plant network from being ‘sucked in’ due to grid side faults.
- Loss of mains (LOM) detection based on:
  - Voltage vector shift (VVS)
  - Under or overvoltage
  - Over or under frequency
  - Rapid fall of frequency (df/dt)
  - Reverse power flow (reactive power)
- Performed by ABB Relion relays, associated with grid transformers.

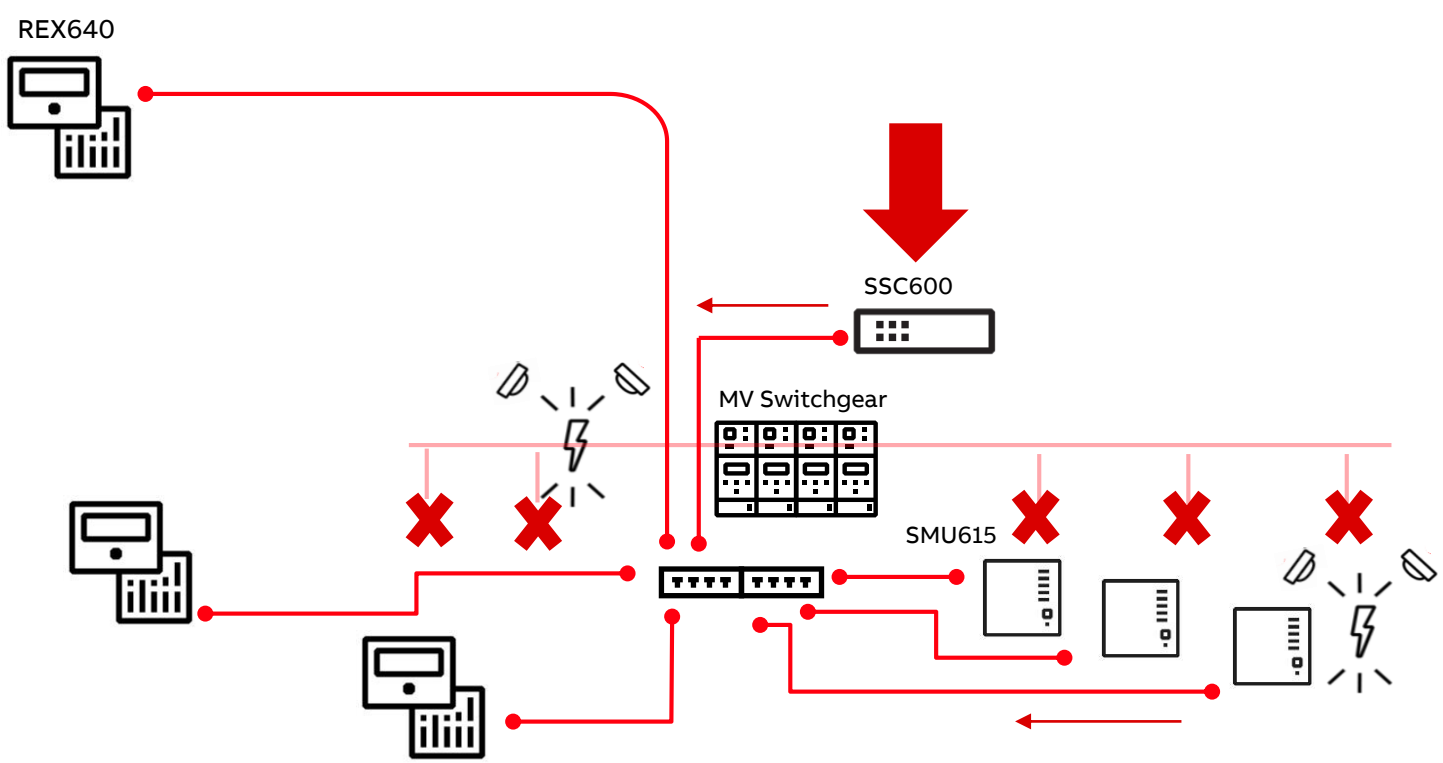


Electrification Solutions for a reliable F&B plant operation

Ensuring personnel safety

Arc flash and bus bar differential protection

- Selective and fast acting arc flash protection, based on:
  - Sensing of light and/or current
  - In cable, circuit breaker or bus bar compartments
- If arc detected in panel, feeder is tripped.
- If arc detected in bus bar compartment or inter-phase fault, bus bar diff. protection operates, tripping all feeders.
- Performed by Centralized protection SSC600, supported by SMU615 merging units, other Relion relays (IEC 61850 based)



Electrification Solutions for a reliable F&B plant operation

Tackling grid and in plant disturbances

Fast load-shedding

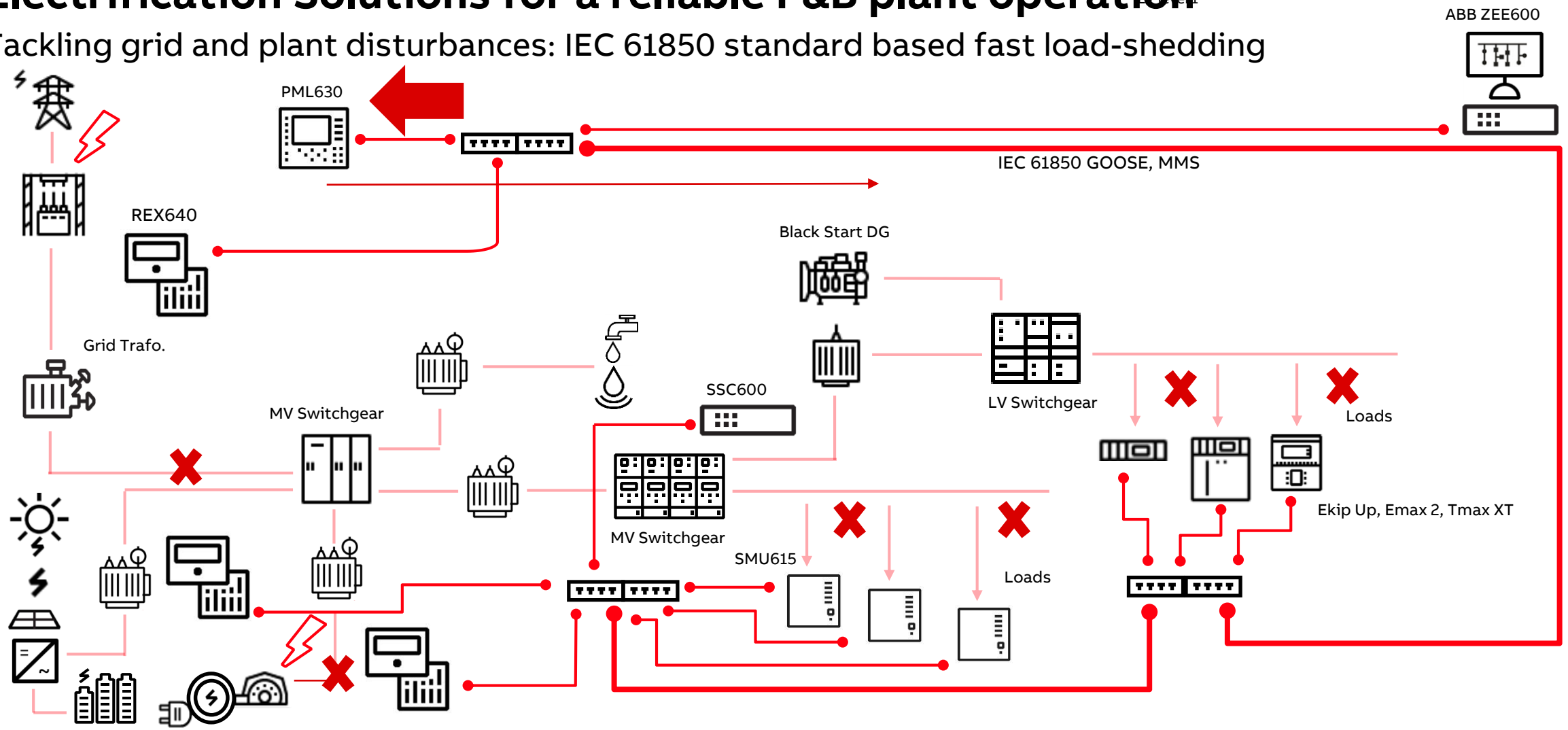
- To prevent costly blackouts
- Post-islanding event or in already islanded network
- When captive power generation is insufficient to meet power demand.
- To maintain power balance by shedding low-priority loads to match loss of power source(s)
- Ensuring power to critical loads in plant
- Performed by Relion PML630 (or AC800M/AC500 PLCs)
  - Supported by cluster of Relion relays, Centralized protection SSC600, SMU615 at MV and Intelligent ACBs (Emax2, Tmax XT) or Ekip Units, ABB ZEE600 HMI SCADA
- Based on IEC 61850 communication

Contd.

- Load feeders shed based on priority, at lowest possible voltage level (typically 400V)
  - Granular
  - Distributed
  - Extent of shedding in accordance with loss of power
- Overall performance:
  - Disturbance detection until load-shed command generation (~ 40 – 60 ms)
  - Load relief achieved ~ 70 - 100 ms

Electrification Solutions for a reliable F&B plant operation

Tackling grid and plant disturbances: IEC 61850 standard based fast load-shedding

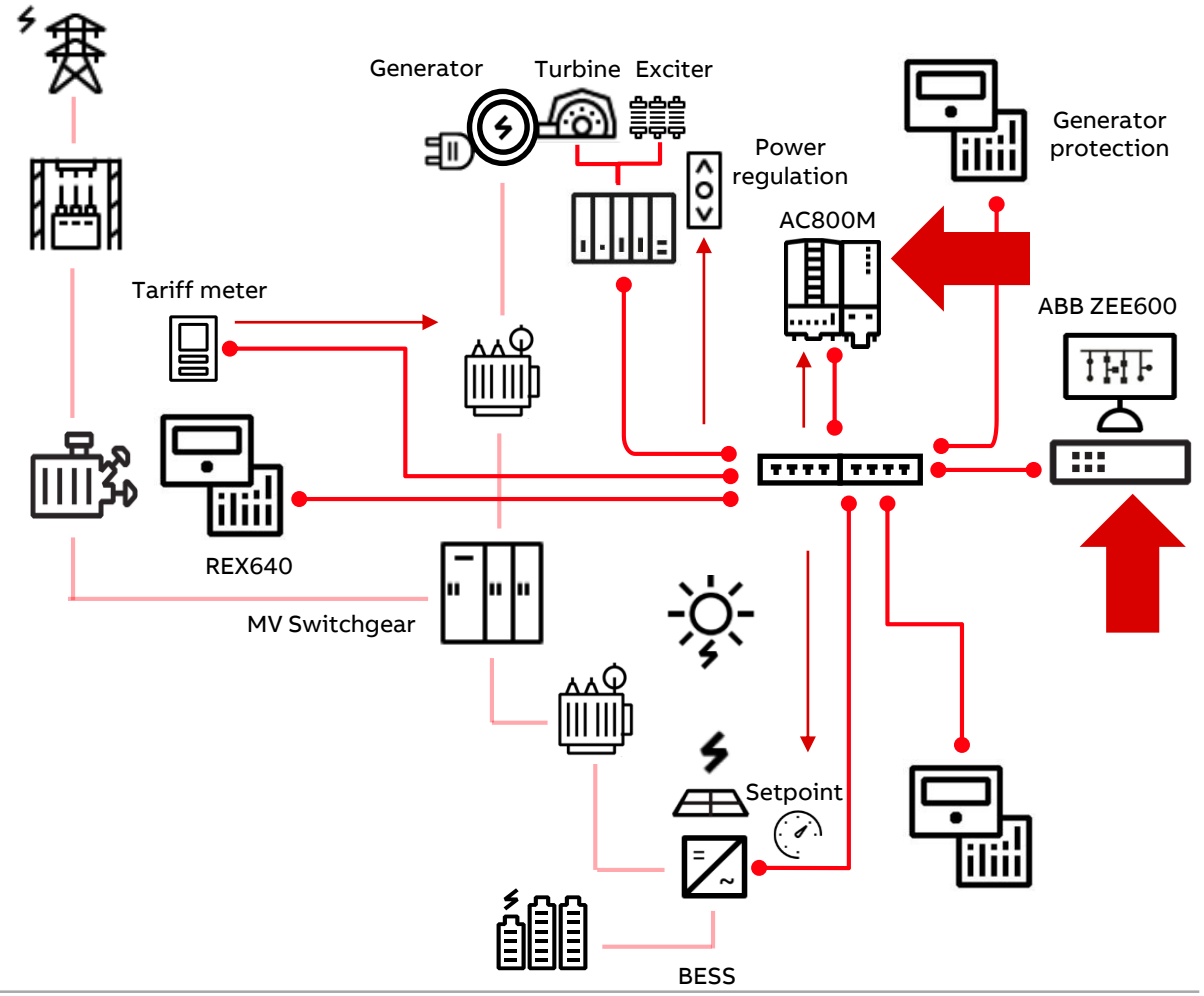


Electrification Solutions for a reliable F&B plant operation

Ensuring continuous power supply efficiently

In-plant power source control

- With multiple (parallel) power sources in islanded or grid connected system
  - To maintain power factor at grid coupling point
  - To maintain voltage, frequency as well as supply loads in islanded system
- Adjust power sources' active/reactive power outputs or set points
  - Based on individual capacities and reserves
  - Ensuring utilization of captive power
- Performed by AC800M PLC
  - Support from tariff meters like SATEC, Relion protection relays, RIO600 units, ABB ZEE600 HMI
- Based on IEC 61850 communication



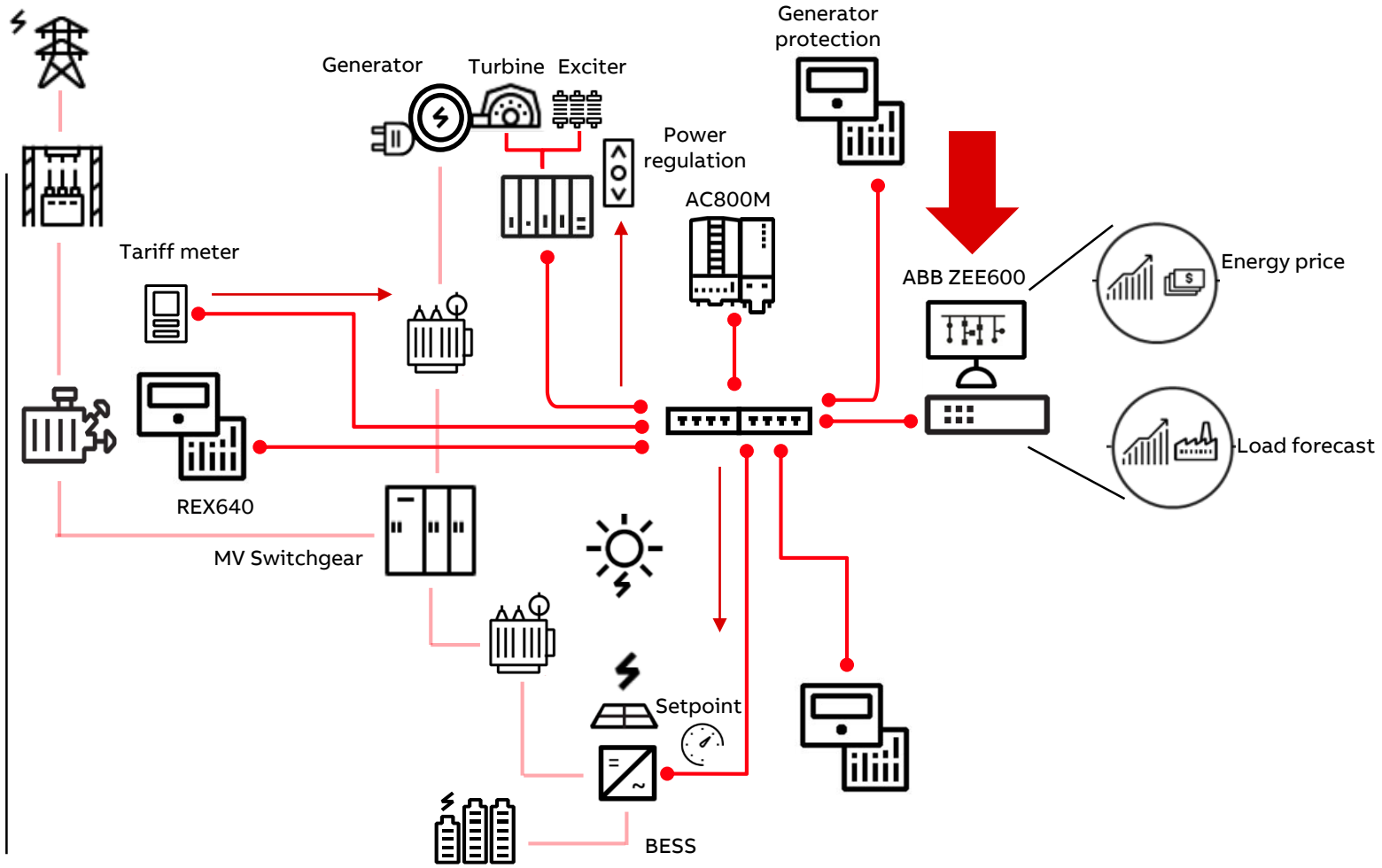
Electrification Solutions for a reliable F&B plant operation

Level 1

Ensuring continuous power supply in a cost-optimal manner

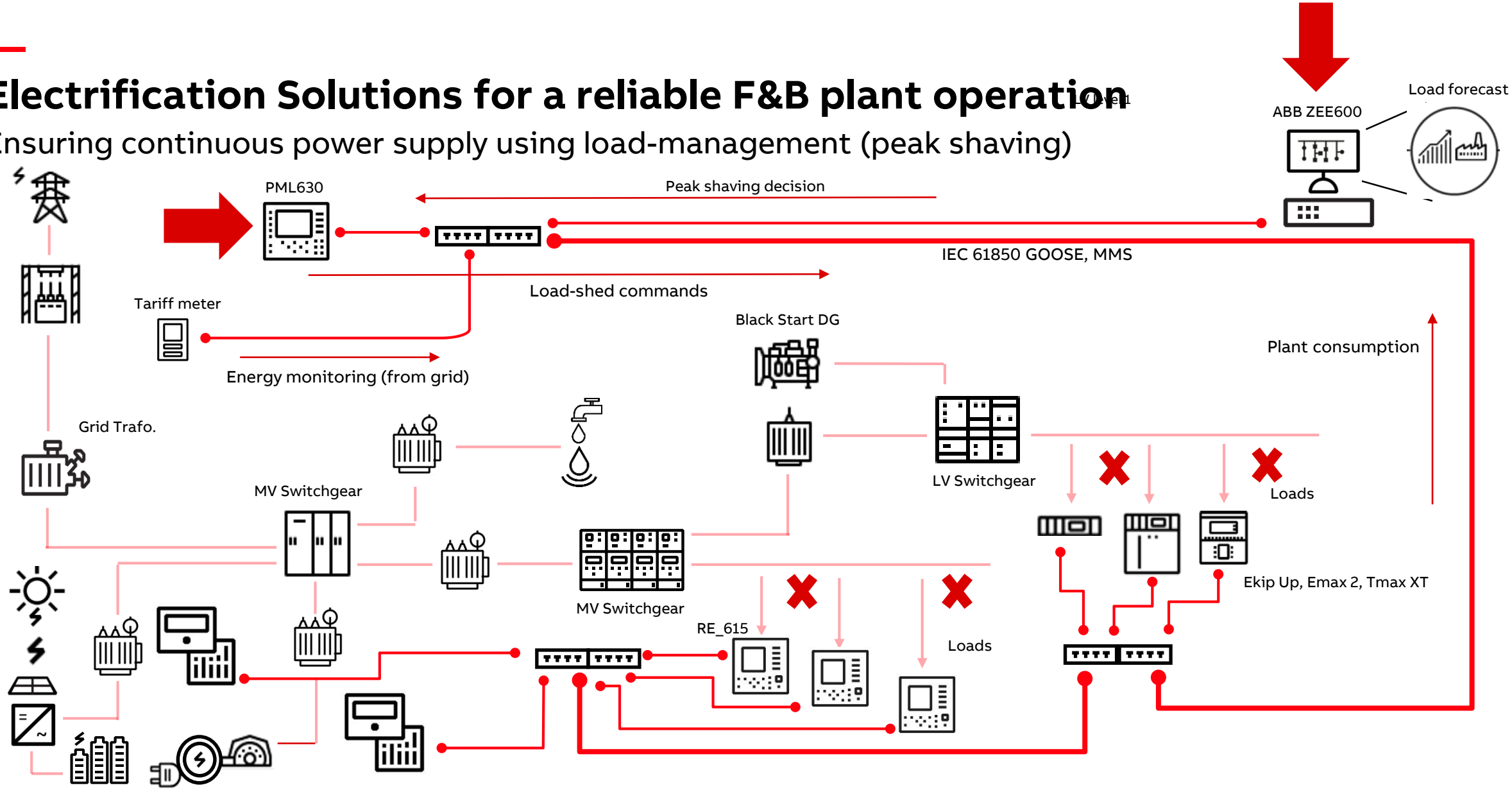
Energy Management

- ABB ZEE600 SCADA for plant visualization and operation
  - Enabled with Energy Management and Optimization feature
- Minimizes total energy cost based on captive power generation and variable energy procurement costs from utility.
- Performs load forecasting based on plant load patterns to limit electricity procurement from utility.
- Controls power output from generator and BESS through AC800M to manage peak load (peak shaving)



Electrification Solutions for a reliable F&B plant operation

Ensuring continuous power supply using load-management (peak shaving)



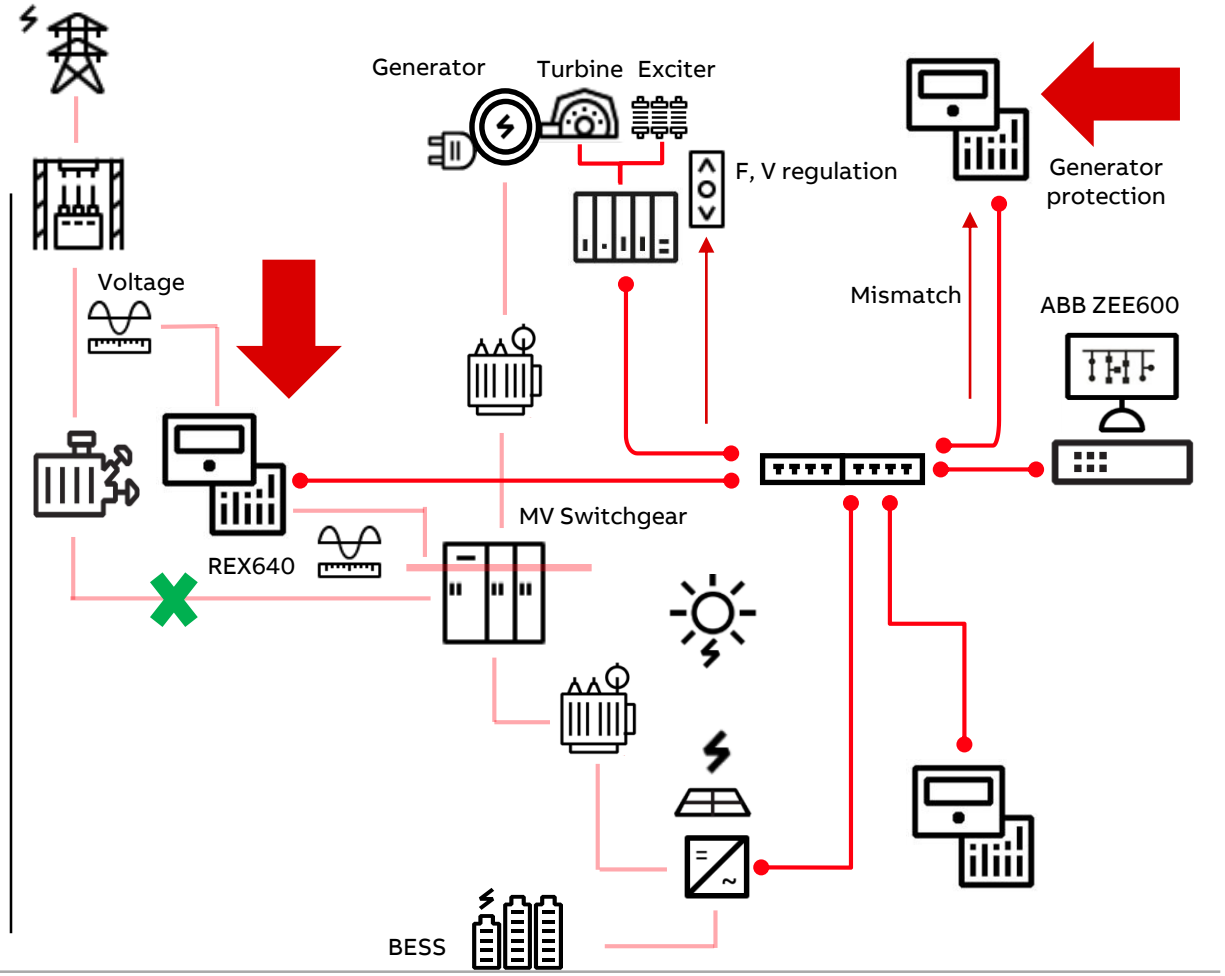
Electrification Solutions for a reliable F&B plant operation

Ensuring continuous power supply by grid connectivity, whenever needed

Network synchronization

Synchronization functionality is required:

- To connect an ‘incoming’ power source (generator, ESS) to the main power evacuation bus bar (after generator trip or total power failure)
- To connect islanded plant power network back with utility grid
- To reconnect two parts of the plant networks (“left side” and “right side”)
- Performed by Relion REX640, associated with utility grid transformers, power sources and bus coupler
- Based on IEC 61850 communication

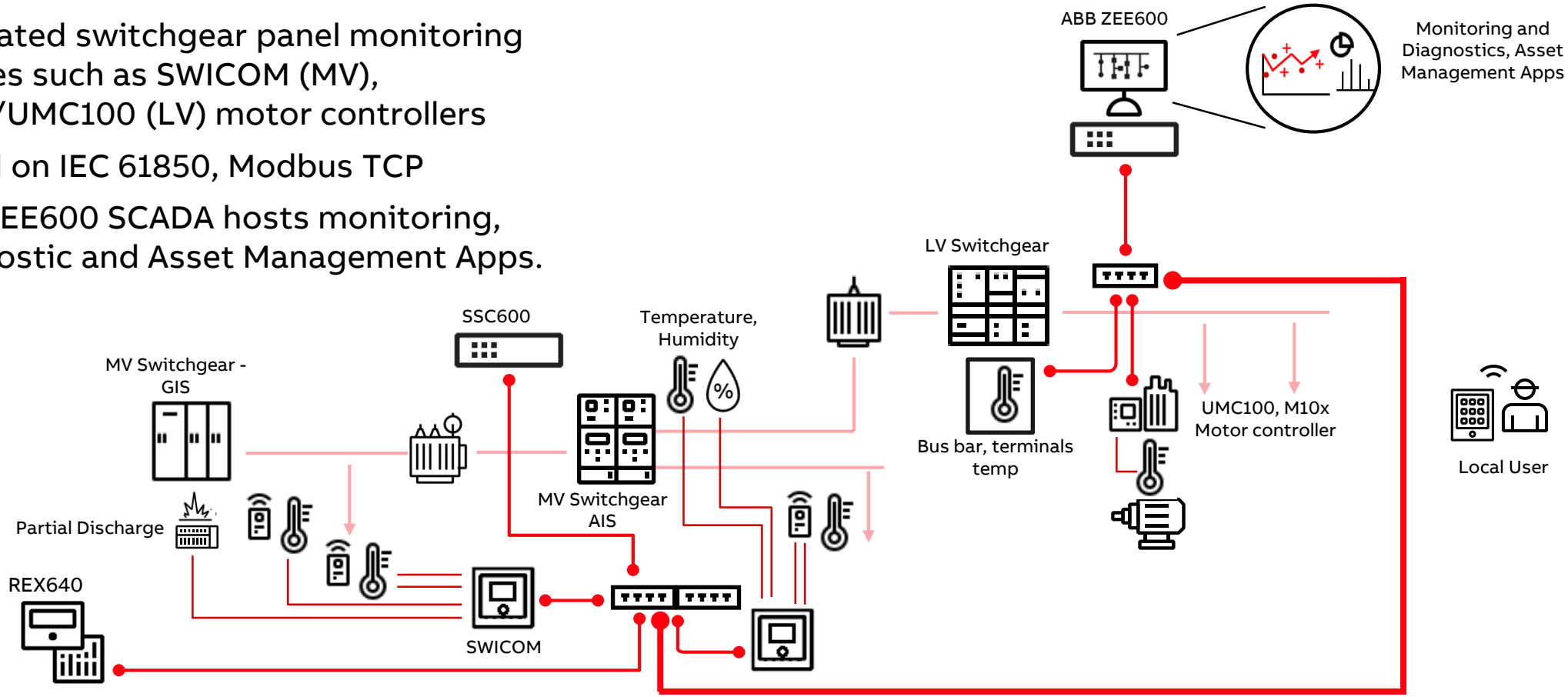


Electrification Solutions for a reliable F&B plant operation

Level 1

Towards safeguarding power assets

- Dedicated switchgear panel monitoring devices such as SWICOM (MV), M10x/UMC100 (LV) motor controllers
- Based on IEC 61850, Modbus TCP
- ABB ZEE600 SCADA hosts monitoring, diagnostic and Asset Management Apps.



Electrification Solutions for a reliable F&B plant operation

5. Some references

Peak-shaving

Customer

Brazil: Sugar and ethanol production with electrical cogeneration

Customer needs

Reliable and secure power supply through minimized downtime for ethanol, sugar production and electricity cogeneration

Level the power consumption avoiding penalties, and supervision of the whole MV and LV electrical system

Solution offering

UniGear ZS1, Relion 615, RIO600, PML630, COM600S

“The compact power management solution does real time power leveling, so avoids utility penalties. We had a fast return on investment in about 7 months.”

- ✓ Improved internal energy cost management with the forecasting possibilities provided by the Data Historian in the COM600S unit.
- ✓ Remote and easy access to the disturbance recordings and editing parameters of the PML630.
- ✓ Ability™ solution easily plugged on digital switchgear (IEC 61850).

Digital switchgear

Customer

Italy: Pizza production

Customer needs

Extend the electrification system in order to expand the product lines

MV/LV selectivity study

Reliable electrification system and communication to electrical control system

Digital offering

UniSec Digital, Relion® 615 Series, featuring IEC61850, GOOSE for logic selectivity.

We have now a state-of-the-art electrical system, fully digitalized, ensuring the continuity and performances of our production.

- ✓ Fast installation and commissioning using IEC 61850 standard.
- ✓ Arc proof switchgear.

Digital switchgear

Customer

Italy: Ice cream production

Customer needs

Maximum reliability of the electricity supply

Complete remote control directly from headquarters

Digital offering

1100101001

UniSec Digital, Relion® 615 Series, featuring IEC61850, GOOSE for logic selectivity, and WebHMI.

“Ensures rapid intervention and configurations for connections to Smart Grids as well as secure remote management for quick troubleshooting”

- ✓ Fast installation and commissioning using IEC 61850 standard.
- ✓ WebHMI embedded in the relays to securely and remotely manage the electricl system.
- ✓ Arc proof switchgear.

Load-shedding

Customer

Thailand: Spices and flavor production

Customer needs

Ensure uninterrupted power to the plant

Integrate a new cogeneration plant

Ensure continuous uptime of the plant’s main process in case of power loss.

Digital offering

UniGear ZS1, PML630, Relion® 615 series, RIO600, MicroSCADA Pro

“ABB compact power management solution easily integrates generators and loads, allows real-time power control and offers easy to configure load shedding ensuring highest critical process continuity”

- ✓ Secures continued power supply to critical loads with compact power management system on top of MV digitalized switchgear.
- ✓ Integrated real-time control functionality from the switchgears to the SCADA system.
- ✓ Fast installation and commissioning using IEC 61850 standard.

Arc protection

Customer

Brazil: Soybean production

Customer needs

Improve safety of existing switchgears

Minimize downtime

Meet insurance and risk certification

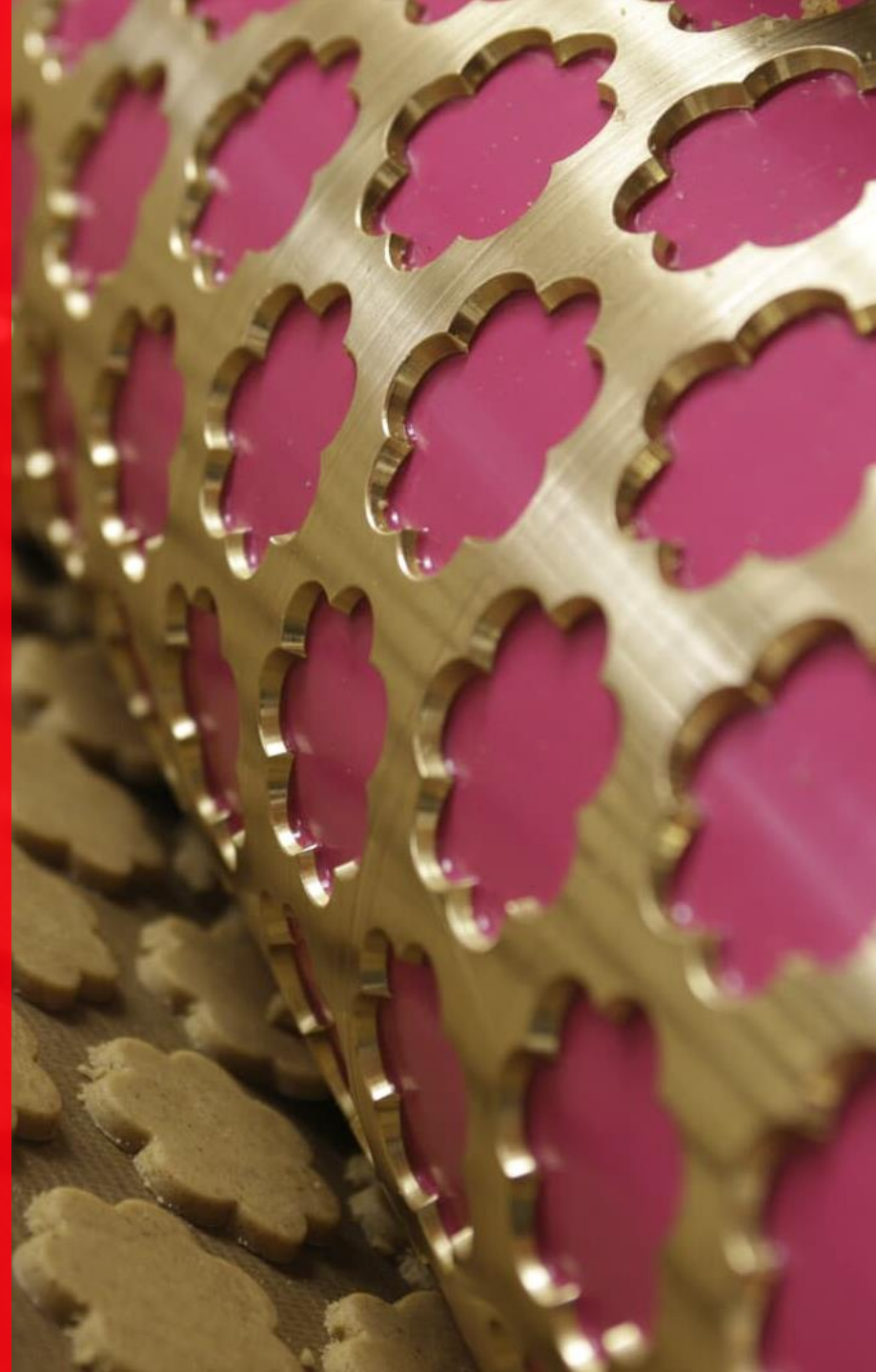
Digital offering

1100101001

REA arc-protection solution

“REA arc-protection solution allows detection of an arc sending trip signal within 2.5 ms.”

- ✓ Improved protection for maintenance staff and avoid larger damage inside the panel, in case of an arc-fault, reducing downtime and restoration costs.
- ✓ Quick installation of the arc-protection system without breaker or relay retrofit.
- ✓ Modular and scalable for MV and LV.
- ✓ Regular self-supervision of the arc protection system and sensor fiber loops.



Electrification Solutions for a reliable F&B plant operation

6. Conclusion

Electrification Solutions for a reliable F&B plant operation

Conclusion

Takeaways

– The identified solutions offer the following:
  - Safeguard investment
  - Enhance operational safety
  - Ensure continuity of production
  - Timely system and asset state information availability for proactive corrective actions
  - High level of system performance
  - Based on open communication standards and offer high levels of interoperability

– ABB’s products and solutions facilitate safer, more reliable and smarter F&B process.

EXTERNAL

JULY, 2020

Minimize losses from unforeseen events in F&B electrification

Power Conditioning Solutions for Food & Beverage manufacturing

Bruce Bennett, Global Channel Manager/ F&B Market Development Manager

Agenda

Customer needs
- Power quality challenges
- Events, symptoms, and causes
- Power quality data

Applications and solutions
- Power conditioning F&B applications
- Power conditioning F&B solutions

Success stories
- Fonterra
- Coca Cola Amatil Ltd.
- Gulf Mushroom Products Co.

Value proposal and collateral
- Why power conditioning for F&B?
- References
- Collateral

Customer needs

- Power quality challenges
- Events, symptoms, and causes
- Power quality data

Power Quality Challenges

Risks

Poor power quality causes unplanned downtime

Tangible costs

- Production wastage
- Machinery repair or replacement
- Non-compliance to quality/regulatory standards
- Cleaning, decontaminating time

Intangible costs

- Late or non-delivery of product
- Aggravated customers
- Opportunity cost

98% of F&B manufacturers say downtime costs >$100k/hr, up to 4% of annual turnover.[1]

[1] Information Technology Intelligence Consulting Corp. (2016, August 2). Cost of Unplanned Downtime Soars. Boston, MA, USA: www.itic-corp.com

Power Quality Challenges

Events, symptoms, and causes

Event (in cost impact order)	Cause	Effects/tripping
Sag/dip or swell/surge	Fault on feeder/weather Connecting/starting large loads as motors	Tripping of VSD's, controls, relays, contactors, switchgear, increased currents, over-current protection tripping
Transients	Lightning Line/cap switch.	Overvoltage tripping, Voltage breakdown, electronic devices malfunction, VSD's fail
Neutral-ground voltages	Poor wiring, grounding	Digital devices malfunction,
Harmonics	Power Electronics - e.g. VSD, SMPS, high eff. Lamps	Motor, transformer, neutral conductor overheating, instrument & PLC malfunction
Noise	SMPS	Zero-crossover device trips, Fast running clocks
Unbalance	1 or 2 phase loads Asymmetrical lines/transformers	Motor heating, rectifier and inverter damage (DC/AC drives)
Notching	Power Electronics e.g. DC-drives, AC-phase contr.	Zero-crossover dev. Trips
Fluctuations	Cyclic loads, cranes, welding, arc furnaces	Light flicker

Distribution System Power Quality Assessment: Phase II—Voltage Sag and Interruption Analysis, EPRI, Palo Alto, CA: 2003. 1001678.

Power Quality Challenges

Events, symptoms, and causes

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Fluctuations	Cyclic loads, cranes, welding, arc furnaces	Light flicker

92% of financial loss due to power quality are the result of voltage sags

Power Quality Challenges

Voltage events

Definitions

Voltage sag/dip and swell/surge = Duration <60s.

RMS voltage Δ>10% nominal

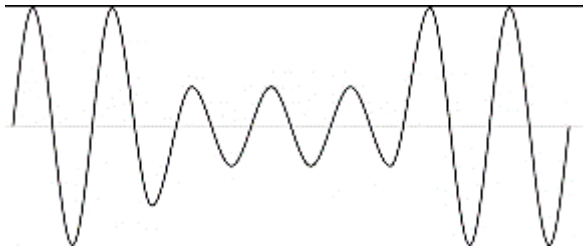
- One Phase
- Two Phases
- Three Phases
- Balanced or unbalanced.

Under or Over voltage = Duration >60s.

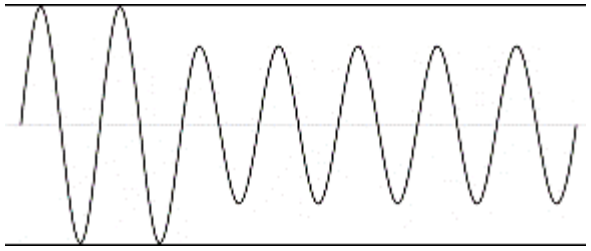
RMS voltage Δ>10% nominal

- One Phase
- Two Phases
- Three Phases
- Balanced or unbalanced.

Voltage sag/dip

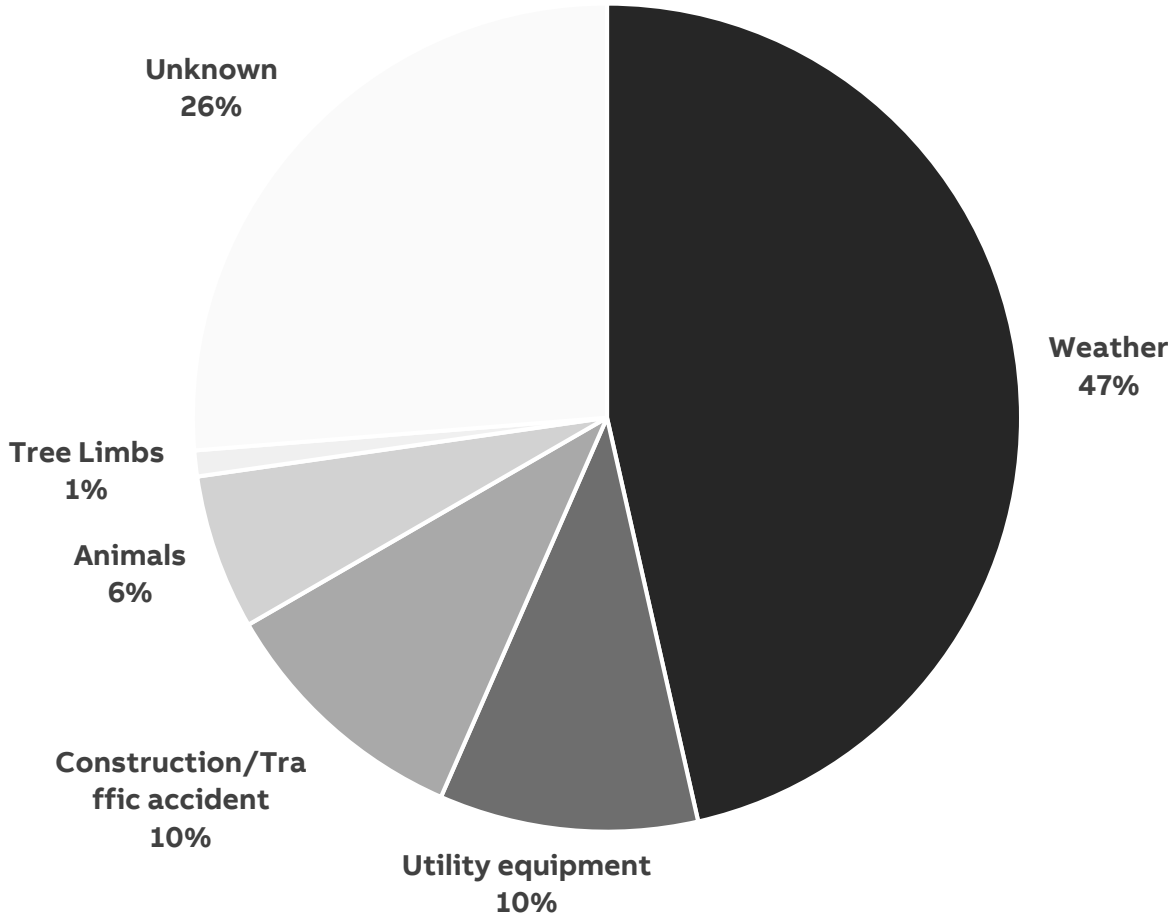


Under voltage



Power Quality Challenges

Causes of voltage sags



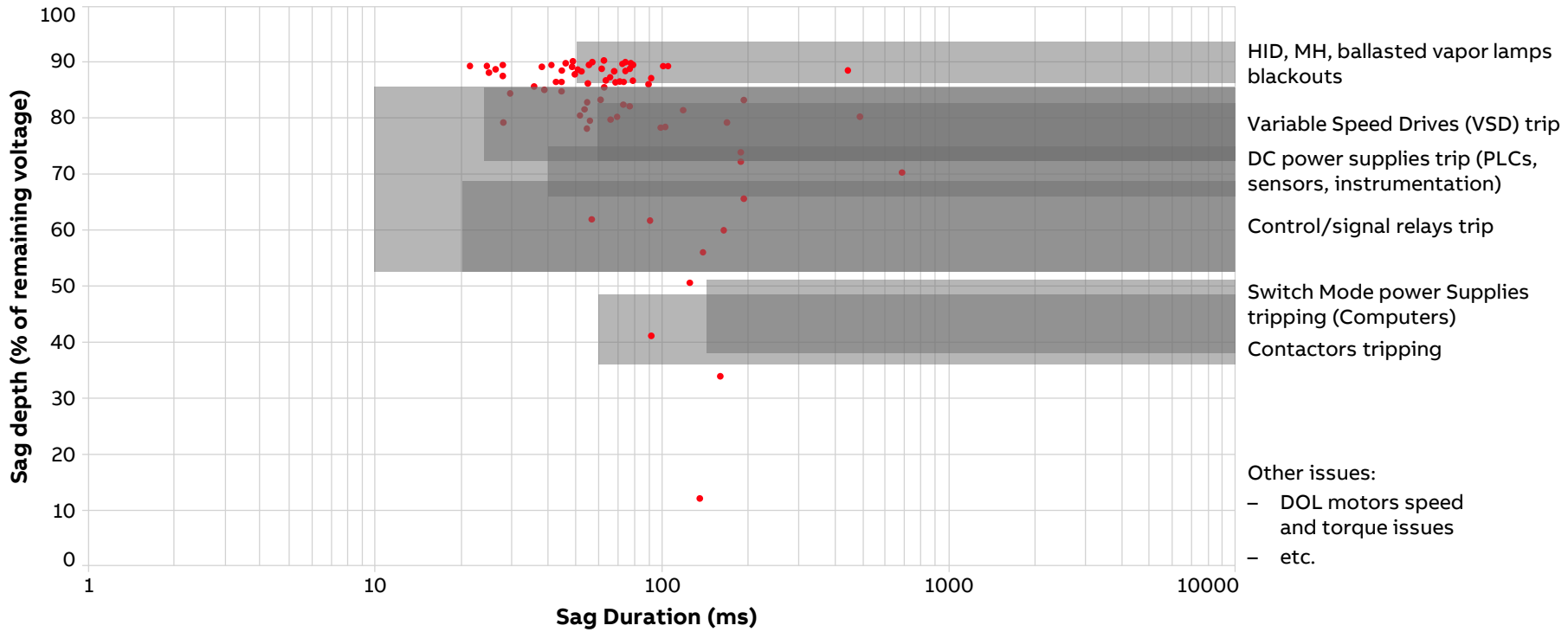
Bingham, Richard P., SAGs and SWELLs. Feb, 1998

Power Quality Challenges

Power quality data

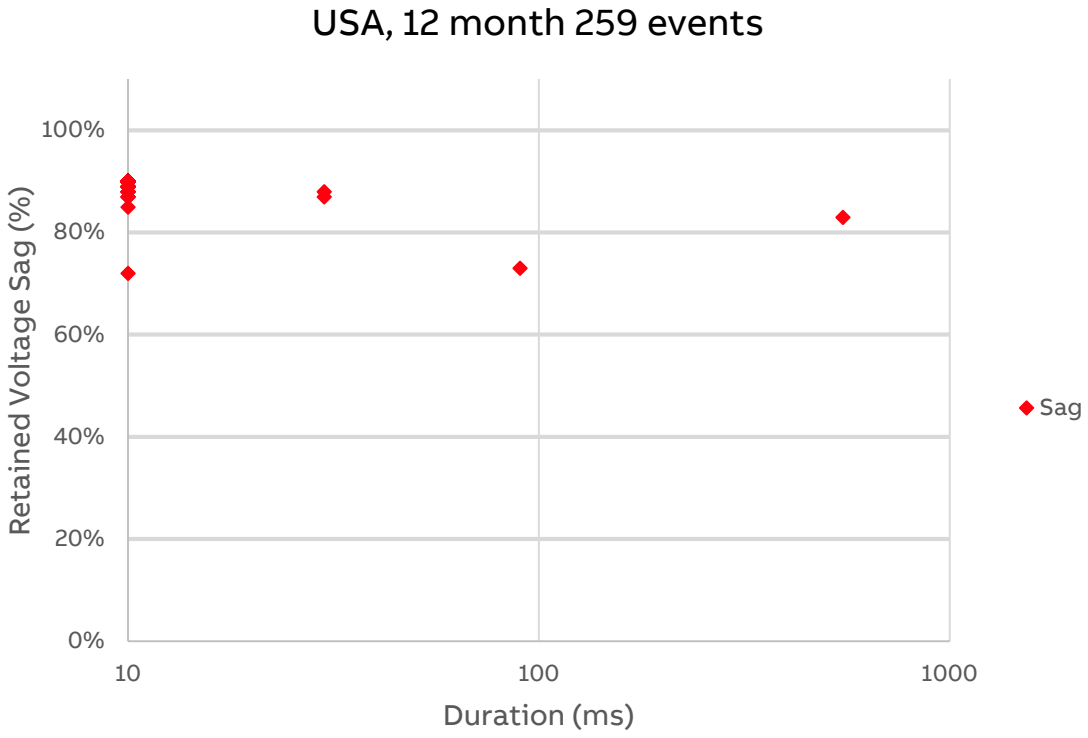
Typical annual network sag events (Philippines 2013)

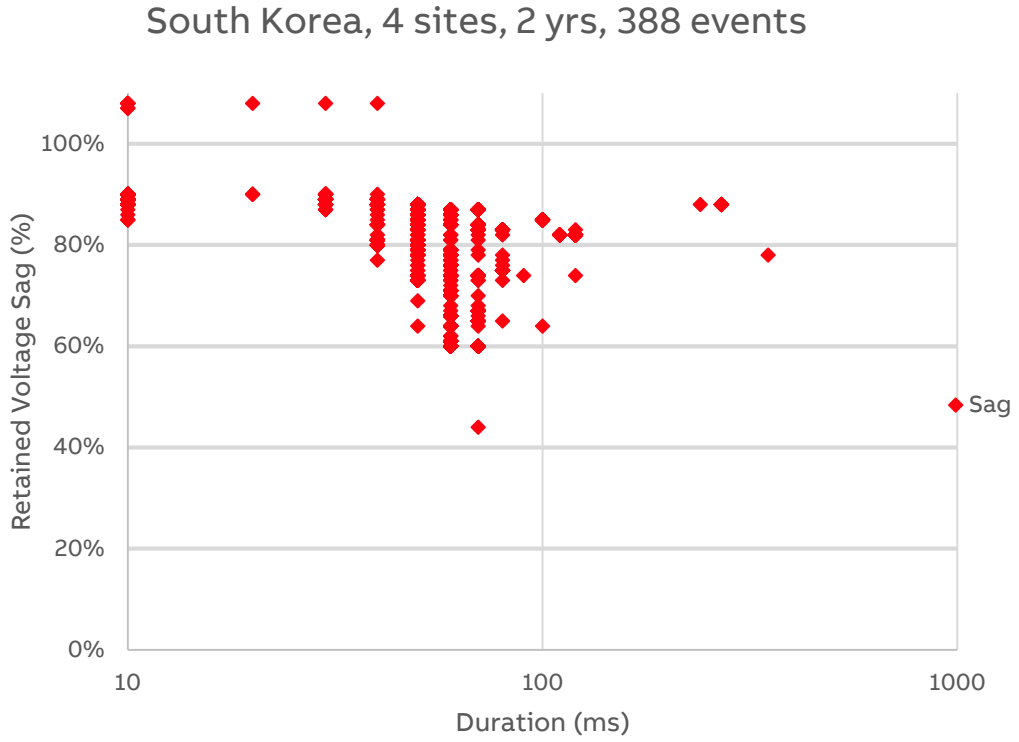
- New VSD footprint reduces ride through ability due to smaller capacitors.
- Control relays release at less field collapse so higher voltage for faster automation applications.
- **Picture is the same for whole world; recorded data shows same situation globally.**



Power Quality Challenges

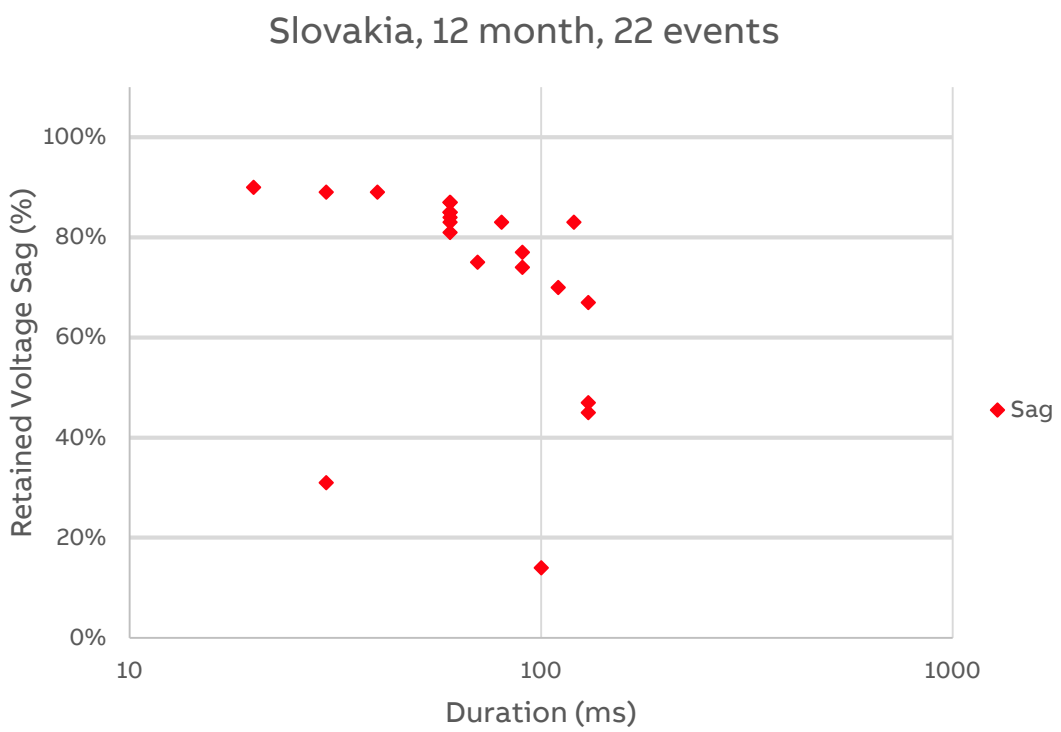
Power quality data

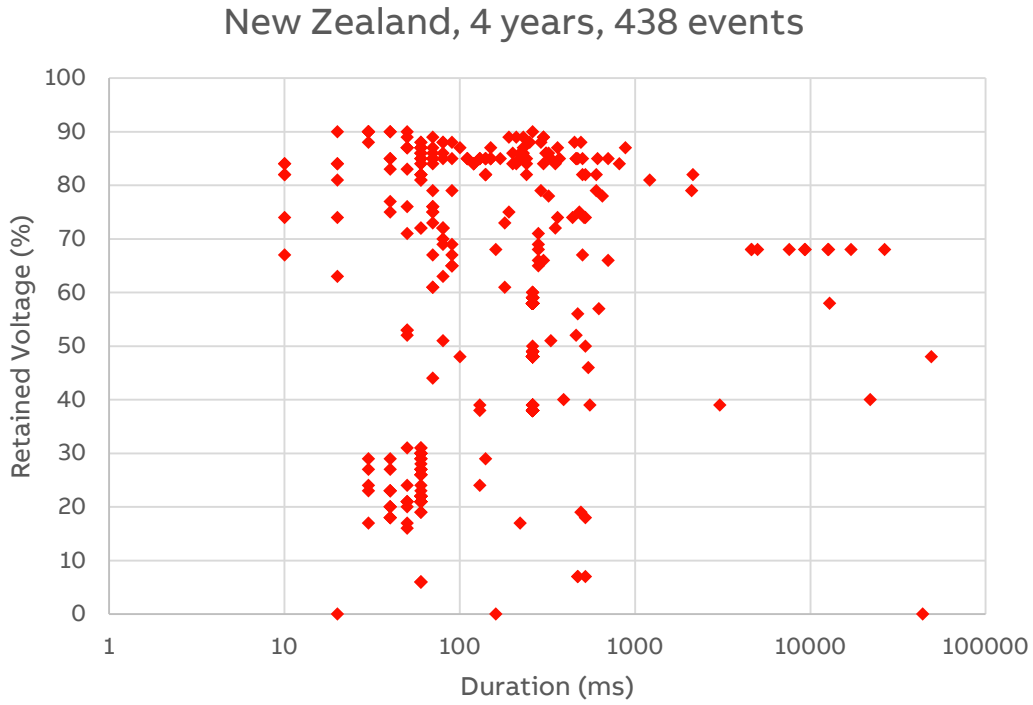




Power Quality Challenges

Power quality data





Power Conditioning Solutions & applications

- Power conditioning F&B applications
- Power conditioning F&B solutions
- Power conditioning value proposition

Power Conditioning Solutions & applications

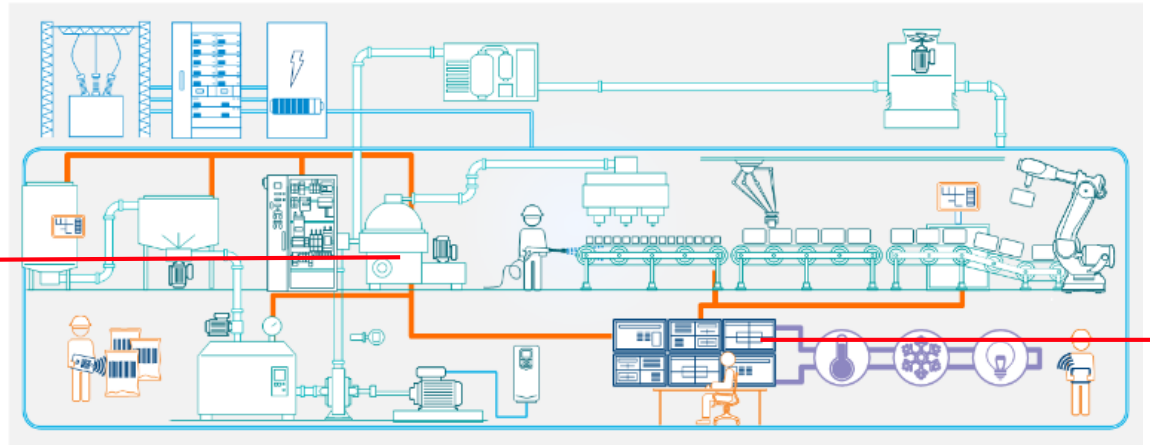
Power protection for F&B applications

Power Conditioning

Mitigation and regulation of voltage and frequency disturbances for **production line processing machinery**

UPS

Mitigation of voltage, frequency disturbances for **digital control system (DCS), IT equipment, communication and security systems**



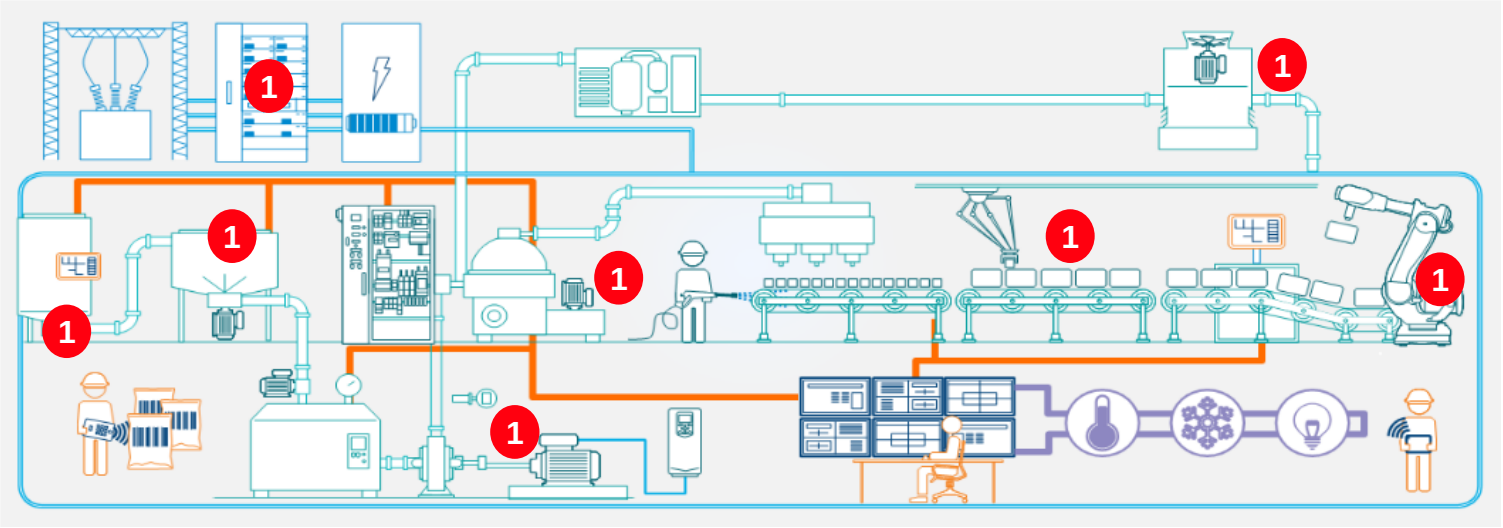
Power Conditioning Solutions & applications

Power conditioning for F&B applications

1 Power Conditioning Solution

- PCS 100 solution for industrial process loads.
- PCS100 solution = no de-rating required.

✓ Packaging	✓ Robots
✓ Filling	✓ Motors
✓ Picking	✓ Pumps
✓ Labelling	✓ Blowers
✓ Centrifuges	✓ Feeders
✓ Dryers	✓ Burners



Power Conditioning Solutions & applications

Power conditioning F&B solutions; PCS100 AVC-20, PCS100 AVC-40

PCS100 AVC

PCS100 AVC-40 for sag and swell correction

- **150kVA to 3600kVA**
- **Full correction <10ms**
- **208-480V**
- **>98% efficient**

Built on a proven and dependable converter platform, provides instant voltage sag and surge correction, ensuring maximum productivity. It offers +/- 10% constant voltage regulation as well as a 100% voltage correction of 3 phase sags down to 60% remaining voltage, single phase to 50% voltage remaining, and partial correction to zero volts.

PCS100 AVC-20 for constant voltage regulation

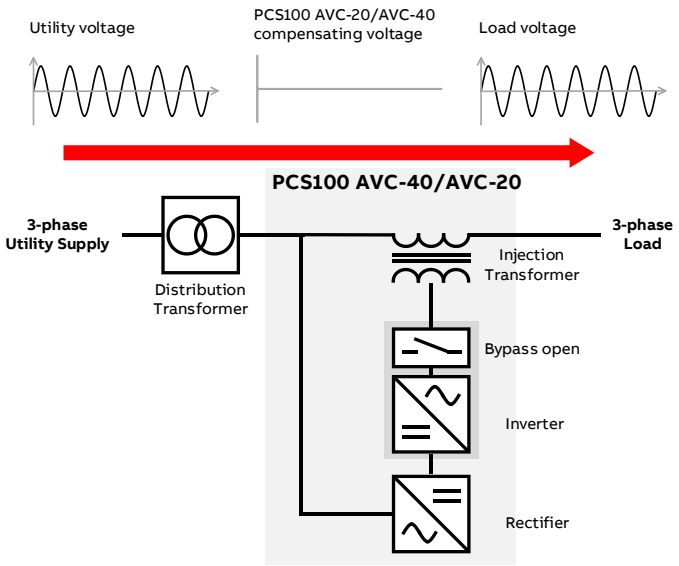
- **250 kVA to 3000kVA**
- **Full regulation <20ms**
- **380-415V**
- **>99% efficient**

Ensures a continual, regulated supply of utility voltage where the electrical infrastructure is stressed, unstable or unreliable. Its constant +/- 20% 3 phase regulation range secures productivity by improving consistency in operations and reducing the impact of fluctuating voltage on equipment.

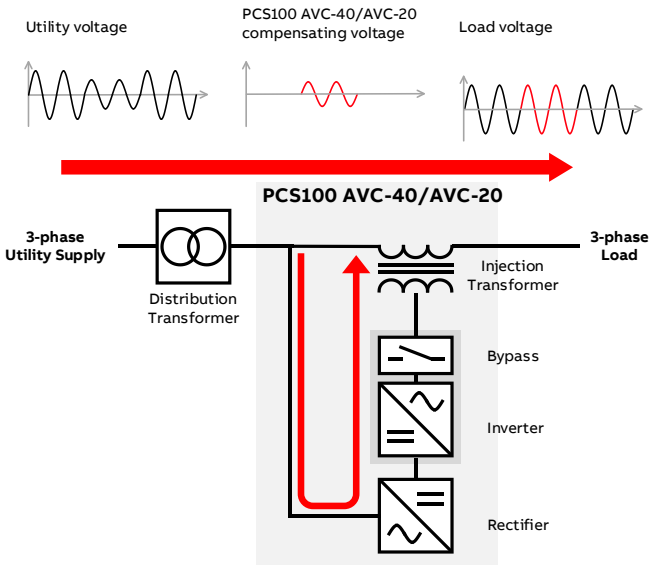
Power Conditioning Solutions & applications

Power conditioning F&B solutions; PCS100 AVC-20, PCS100 AVC-40

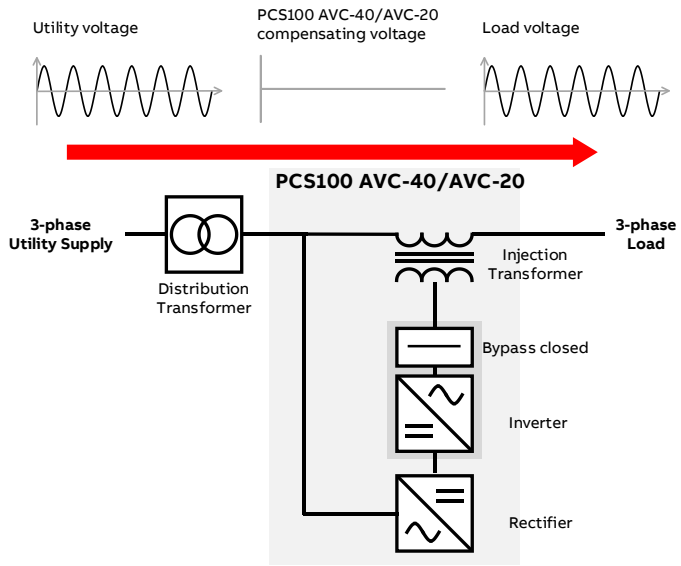
Utility voltage close to nominal level



Voltage event occurs – boost/buck



Internal Bypass operation



Power conditioning success stories

- Fonterra
- Coca Cola Amatil Ltd.
- Gulf Mushroom Products Co.

Power conditioning success stories

Fonterra, Takanini, New Zealand: PCS100 AVC-40

UHT Processing & packing lines

The **Fonterra Takanini** site produces over 22 billion liters fresh milk each year. The facility produces 90% of the UHT milk and cream exported to the Asia Pacific region producing 750,000 liters of UHT milk each day.

A power quality event costs Fonterra 4 hours of downtime on 7 production lines for sterilization and restart of production.

ABB provided pre-sale consultation and support to analyze recorded power quality data to decide the best solution to protect the seven UHT milk processing and packaging lines at Fonterra Takanini facility.

The ABB PCS 100 AVC-40 Active Voltage Conditioner is able to mitigate voltage disturbances in Fonterra's facility, minimizing unwanted downtime, wasted product and non-delivery risk. Protecting the production lines from voltage sags at Fonterra produced annual savings exceeding $500,000 every year. Fonterra were so pleased with the results, the ABB PCS100 solution is now rolled out to other Fonterra production sites.

Protecting the production lines from voltage sags at Fonterra produced annual savings exceeding $500,000 every year.

Power conditioning success stories

Coca Cola Amatil Ltd, Indonesia: PCS100 AVC-20

Specialty bottle and filling

A specialty automated bottle line at **PT Coca Cola Amatil, Indonesia** manufactured by KHS GmbH. has a very small tolerance to voltage variance. The power supply to the plant is 380V, but the filling requires 400V and the utility supply is very unstable

ABB worked with consultant and end-user to specify a high speed voltage regulator to provide continuous, clean, and accurately regulated 400V supply for the filling line.

ABB PCS100 AVC-20 provides continuous regulated 400V supply to machinery correcting sub-cyclic sags and swells that threaten to interrupt processing, as well as long term under or over voltages. The PCS100 AVC-20 has regulated and corrected all events to date preventing any unexpected interruptions.

A similar installation nearby using a similar filling machine, but without ABB PCS100 protection, suffers frequent interruptions and damage to servo motors. Estimated savings exceed USD500k per year in downtime and wastage.

Estimated savings exceed USD500k per year in downtime and wastage.

Power conditioning success stories

Gulf Mushroom Products Co., Barka, Oman: PCS100 AVC-40

Gulf Mushroom Products Co. (S.A.O.G.)
الشركة الخليجية لإنتاج الفطر ش.م.ع.ع

Accurate climate control in the desert

Gulf Mushroom Products Co., the largest hi-tech mushroom farm in the entire middle east region, grows premium quality fresh mushrooms in the desert.

Ensuring that there is a consistent power supply to keep the growing environment at optimum temperature and humidity. Any fluctuation can result in loss of the entire crop and a long period of no supply.

ABB worked closely with the plant engineers to record and analyze the utility voltage supply where more than 30 major voltage sag events every year. Any fluctuation in voltage supply would shut down the climate control system essential for successful growing with lengthy delays to restart and achieve environment specifications.

Since commissioning there has been no interruption to the instruments, motors, controllers and building automation systems thanks to the ABB PCS100 AVC-40. The production manager was very pleased with the results “without the AVC we would have experienced a lot of inconvenient and costly interruptions to our business“.

ABB Power Conditioning prevents over 30 downtime events per year valued at >$50,000 per event

Power conditioning value proposal

References

Global install base ~ 2,000,000 kVA

Value proposal, references and collateral

- Why power conditioning for F&B?
- References
- Collateral

Power conditioning value proposal

Why power conditioning for F&B?

Our experience

“Our mission is to become the world’s most trusted source of nutrition and ABB’s product is a crucial part of that process.”

Peter Williams
Automation and Control Manager, Fonterra Brand Group
New Zealand

Producer
of fresh milk, UHT milk and cultured dairy food

ABB supplied a power protection solution to **prevent downtime**

Saving an estimated **$500,000 pa**

Power conditioning value proposal

Why power conditioning for F&B?

Comprehensive offering

We offer Power Conditioning products for a range of high power applications across most industries

Reliable performance

All of our products, are designed, built and tested for the best possible performance.

Our values

Safe operation

Our products will help you create a safe, resilient working environment.

Innovative and sustainable design

Designed for easy and cost-efficient installation, maintenance and use.

ABB services

All our Power Conditioning products are always supported by our dedicated and skilled worldwide service network.

With a product by ABB you are never alone.

Power conditioning value proposal

Why power conditioning for F&B?

Sustainable, efficient and reliable power :

- prevent “out of stock”
- improve OEE (overall equipment effectiveness)
- maximize utilization of the production facility ensuring continuous operation 24/7

ABB power protection offers:

- engineered products to optimize overall solution
- innovative solution decreasing energy costs
- standardized product to reduce TCO - inventory level and maintenance cost

ABB power protection offering safeguards your equipment, processes and business continuity.

ABB Power Protection

To find out more about

ABB power protection offering

- Power Conditioning home page
- Power Conditioning F&B page
- Power Protection Food and Beverage Brochure

ABB case studies

- Fonterra case study
- Gulf Mushroom case study

ABB Videos

- PCS100 AVC-40 video
- PCS100 AVC-20 video
- Fonterra success story


ABB