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
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Focus areas and Key Performance Indicators for a Smart Industry

- Safety
- Cost saving/monitoring
- Product Quality
- Productivity
- Consumer, Shareholder

Efficiency
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
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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
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Mapping expectations to some typical solutions (1)

- System disturbances external or internal to plant
- Islanding
  - Fast acting load-shedding
- Personnel safety
- Arc flash protection
- Bus bar protection
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Mapping expectations to some typical solutions (2)

Ensuring continuity of power supply

- Power source control (renewables, gas/steam generators)
- Power source and network synchronization
- Peak shaving, Load-shedding

Safeguarding power assets

- Asset Management
- Monitoring and Diagnostics
Solutions to achieve KPIs
**Electrification Solutions for a reliable F&B plant operation**

Tackling grid disturbances

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

- Grid Trafo.
- MV Switchgear
- Grid Trafo.
- PML630
- Black Start DG
- LV Switchgear
- SSC600
- Loads
- Ekip Up, Emax 2, Tmax XT
- ABB ZEE600
- IEC 61850 GOOSE, MMS

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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

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

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.

- Monitoring and Diagnostics, Asset Management Apps
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Electrification Solutions for a reliable F&B plant operation

5. Some references
ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.

Patrick Fragman
Managing Director, ABB, Power Grid, Grid Integration

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

Peak-shaving

✓ 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).

"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."
ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.

Patrick Fragman
Managing Director, ABB, Power Grid, Grid Integration

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
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 electrical system.
✓ Arc proof switchgear.
ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.

Patrick Fragman
Managing Director, ABB, Power Grid, Grid Integration

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

Load-shedding

“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.”
ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.

Patrick Fragman
Managing Director, ABB, Power Grid, Grid Integration

Customer
Brazil: Soybean production

Customer needs
Improve safety of existing switchgears
Minimize downtime
Meet insurance and risk certification

Digital offering
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

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.
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 application
- 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

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

# Power Quality Challenges

## Events, symptoms, and causes

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<th>Event (in cost impact order)</th>
<th>Cause</th>
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<td>Sag/dip or swell/surge</td>
<td>Fault on feeder/weather Connecting/starting large loads as motors</td>
<td>Tripping of VSD’s, controls, relays, contactors, switchgear, increased currents, over-current protection tripping</td>
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<td>Poor wiring, grounding</td>
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<td>Motor, transformer, neutral conductor overheating, instrument &amp; PLC malfunction</td>
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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.
Power Quality Challenges

Causes of voltage sags

- Weather: 47%
- Utility equipment: 10%
- Construction/Traffic accident: 10%
- Animals: 6%
- Tree Limbs: 1%
- Unknown: 26%

Bingham, Richard P., SAGs and SWELLs. Feb, 1998
Power Quality Challenges

- 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.

Typical annual network sag events (Philippines 2013)
Power Quality Challenges

Power quality data

USA, 12 month 259 events

South Korea, 4 sites, 2 yrs, 388 events
Power Quality Challenges

Power quality data

Slovakia, 12 month, 22 events

New Zealand, 4 years, 438 events
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 ✓ Feeders
✓ Centrifuges ✓ Burners
✓ Dryers
Power Conditioning Solutions & applications
Power conditioning F&B solutions; PCS100 AVC-20, PCS100 AVC-40

PCS100 AVC

PCSO100 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.

PCSO100 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.
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

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

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

$500,000 pa

Saving an estimated
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.

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

Our values

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

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.

Our values
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