Sustainable and scalable technologies
Diana Garcia, Christiane Mueller
Data Center Sustainability Series. Every Watt Counts

Five part webinar series

- **Critical power: back to the basics**
  - April 22, 2020
  - 9:00 or 18:00 CET

- **Scalable and sustainable technology**
  - May 6, 2020
  - 9:00 or 18:00 CET

- **Are microgrids the future?**
  - May 20, 2020
  - 9:00 or 18:00 CET

- **Digital Data Center Operations (DDO)**
  - June 3, 2020
  - 9:00 or 18:00 CET

- **Rethink your service strategy**
  - June 17, 2020
  - 9:00 or 18:00 CET

Register at new.abb.com/data-centers/data-center-sustainability-webinar-series
Introduction

Your speakers today

Christiane Mueller
Head of Product Marketing, MV Gas Insulated Switchgear for primary distribution
Ratingen, Germany

Diana Garcia
Global product manager Mid-high power UPS Electrification Smart Power
Switzerland

Agenda

– Data Center sustainability strategies

– Advantages of GIS technology
  • Advantages of digital switchgear concepts
  • Advantages of the use of eco-friendly isolating gases

– Industry leading efficient UPS
  • ABB respond: sustainable and scalable modular UPS
  • The concept of the modular UPS
  • Modularity to accommodate evolving energy demand
  • ABB modular UPS best-in-class efficiency and dynamic energy response
What does sustainability mean to data centers?

2020...

Responsible sourcing
- Source of energy
  - Renewable generation (PPA)
  - Grid participation

Efficient consumption
- Optimized topologies
  - Design, engineering
  - Workloads and utilizations
  - State of the art technologies

Lifecycle responsibility
- Asset performance
  - Circular economy & end of life management
Data Center Power Infrastructure

Every watt counts.

2(N+1) Configuration (A – B)

- Utility 1 Power
- Main Switchgear
- UPS Input Switchboard
- UPS Output Switchboard
- Distribution Switchboard
- PDU’s
- Critical Load (A – Feed)

- N+1 Generators
- Paralleling Gear
- Main Switchgear
- UPS Input Switchboard
- UPS Output Switchboard
- Distribution Switchboard
- PDU’s
- Critical Load (B – Feed)
Data Center Power Infrastructure

Every watt counts
Data Center sustainability strategies
Drivers for GIS Technology

**Increased safety**
- Arc-resistant design
- No access to HV parts
- Interlockings prevent incorrect operation

**Increased reliability**
- Reduced failure rates
- Increased availability
- Repairability

**Reduced life cycle cost**
- Space-saving design
- Maintenance-free power parts
- Flexible digital switchgear concepts allow adaptation to changing grid parameters

**Environmental sustainability**
- Minimizing material use
- Closed SF6 life cycle
- Eco-friendly alternative isolating gas

GIS - **Gas-Insulated Switchgear**

AIS - **Air-Insulated Switchgear**
Increased safety for operating personnel
Drivers for GIS Technology

How can GIS technology improve safety?

Reduced fault rate:

• Hermetically sealed gas compartments
• Fixed mounted circuit breaker design and integral grounding

Increased operator safety due to:

• Arc-resistant design.
• Optional pressure relief duct to the outside safely vents away hot gases and toxic byproducts in the very unlikely event of an internal arc.
• No access to HV parts located inside gas-filled compartments.
• Sequential interlocking prohibits male operation.
Increased reliability
Drivers for GIS Technology

How sensitive are your processes/network?

- **Sealed-for life gas compartments:** Switchgear performance and aging behavior is independent of environmental influences. There is no penetration of foreign bodies like dust, small animals or moisture.
- **Low maintenance** switching device. All parts inside gas compartment and busbars are maintenance free.

Statistics of failure causes in Air Insulated Switchgears

- **Exposure to Moisture:** 17.7%
- **Exposure to Dust or Other Contaminants:** 11.4%
- **Exposure to Chemical or Solvents:** 9.8%
- **Normal Deterioration from Age:** 7.1%
- **Severe Weather Condition:** 2.8%
- **Other causes:** 51.2%

**Up to 50%** of failure causes are not applicable to GIS

Source: Failure-Contributors-MV-Gear-IEEE-Nov2002
**Reduced life cycle cost**

Drivers for GIS Technology

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Cost assessment – looking at the bigger picture

**Low infrastructure cost**
- Very compact design
- Optimized substation layout

**Low operating cost**
- Reduced frequency, time and cost for maintenance
- Reduced cost for downtime due to failures
- Reduced cost for spare parts on stock

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Source: Footprint compression of 36kV ABB AIS (ZS2) and GIS (ZX2)

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up to **70%** savings in footprint
### Reduced life cycle cost

Drivers for digital switchgear concepts

<table>
<thead>
<tr>
<th><strong>Delivery time</strong></th>
<th><strong>Flexibility</strong></th>
<th><strong>Reliability</strong></th>
<th><strong>Safety and Security</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>– Quicker commissioning possible</td>
<td>– Time-saving reconstruction</td>
<td>– GOOSE communication</td>
<td>– No possibility of exploding</td>
</tr>
<tr>
<td>– Accelerate processes</td>
<td>– No costs incurred due to</td>
<td>– More efficient processes</td>
<td>transformer</td>
</tr>
<tr>
<td>– Earlier profit generation</td>
<td>reconstruction</td>
<td>– Save process costs</td>
<td>– Higher personal safety</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Safer commissioning</td>
</tr>
</tbody>
</table>
Reduced life cycle cost

What is a digital switchgear?

Key components

- Current and voltage sensors
- IEC 61850 communication
- REX 640

Other Solutions:

Hybrid Solution (sensors + transformers)
AirPlus with sensors
Environmental sustainability
Characteristics of GIS Technology

Characteristics of SF6

- Colorless
- Odorless
- Non-toxic
- Non-Flammable
- Chemically inert gas
- ~5 times heavier than air
- ~3 times better dielectric strength than air
- Closed SF6 life cycle incl. recycling at end of life
- Global warming potential of 23500 t CO2eq
- Atmospheric life 3200 years

SF6 is a green house gas
Environmental sustainability
Alternatives to SF6 - What is AirPlus made of?

**AirPlus composition for MV**

- More than 80% dry air
- Less than 20% C5 Fluoroketones (C5 FK), 3M™ Novec™ 5110 Fluid

**C5 FK molecule**

**Dielectric properties of C5 FK**

- Pure C5 FK gas with better dielectric strength than SF$_6$
- In the AirPlus™ mixture, dielectric strength is close to SF$_6$
Environmental sustainability

Alternatives to SF6

Characteristics of AirPlus

- Similar dielectric strength than SF6
- Global warming potential of <1 t CO2eq
- C5 FK is very robust inside switchgear. Exposed to strong UV radiation in the higher atmosphere: Lifetime of 16 days.

AirPlus is an eco-efficient SF₆-alternative
Environmental sustainability
Summary eco-efficient switchgear

**Take aways**

- The 'SF₆-free' journey has started
  - 100% Dry Air for voltages up to 12 kV
  - AirPlus for voltages up to 36 kV
- An alternative to SF₆-GIS - not a replacement
  - ABB still offers users to choose the best technology for their ecological and economic needs: AIS, SF₆-GIS, Eco-efficient GIS with AirPlus or Dry Air.

**Benefits**

- Climate-friendly
  Eco-efficient SF₆-alternative, GWP < 1
- Keeping all SF₆-GIS benefits
  Just as compact, safe & reliable
- No SF₆ regulations
  No cost for certificates or reporting
- One MV solution
  For common RMU & Primary SWG designs

**AirPlus™ – All GIS advantages combined with a GWP < 1**
Data Center Power Infrastructure
Every watt counts
Every watt counts.
Data Center sustainability strategies

Drivers for ABB modular UPS

Drivers

Reduction of operations impact
✓ carbon emissions associate with the operations
✓ Optimization of data center footprint
✓ Modular design

Dynamic energy response
✓ Increase energy utilization
✓ Scaling back capacity when the expected demand fails
✓ Reduce energy waste
✓ Grid support

Reduction of energy consumption
✓ Optimization of the efficiency
✓ Effective monitoring and management of the energy

Environmental sustainability
✓ Minimizing material use
✓ Re-use of components
✓ Recycling
The concept of modular UPS support your DtC operations

Provides reliable power to safeguard your IT equipment

**Continuous uptime**

- Each UPS module can operate fully independently
- Single points of failure are eliminated
- Online swappable UPS module for continuous uptime

**Add power resiliency**

- Redundant power configuration (N+1) will support the vital load
- Smart load sharing
- Fail-safe control and monitoring by ring communication bus

Patented decentralized parallel architecture (DPA) minimizing points of failure
Our response: Sustainable and scalable uninterruptible power supply (UPS)

UPSs play a vital role in providing power continuity for on-site infrastructure

<table>
<thead>
<tr>
<th>DPA 250 S4 IEC</th>
<th>DPA 500 IEC</th>
<th>MegaFlex DPA IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double conversion online modular UPS</td>
<td>Double conversion online modular UPS</td>
<td>Double conversion online modular UPS</td>
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<tr>
<td>300 kW</td>
<td>500 kW</td>
<td>1,000 kW - 1,500 kW</td>
</tr>
<tr>
<td>VFI 97.4%</td>
<td>VFI 96%</td>
<td>VFI 97.4%</td>
</tr>
</tbody>
</table>
Modularity to accommodate evolving energy demand

Scalable power from 250kW to 1,500kW

Power frame with 3 x UPS modules

Power frame with 4 x UPS modules

250 kW to 750 kW
1.000 kW N+1 to 1,500 kW

500 kW N+1 to 1,000 kW
Optimization of data center footprint

ABB modular UPS design is looking for optimal installations

35% space saving

<table>
<thead>
<tr>
<th></th>
<th>Width [mm]</th>
<th>Footprint [mm²]</th>
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<tbody>
<tr>
<td>DPA 500 UPS</td>
<td>1'580</td>
<td></td>
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<tr>
<td></td>
<td>3'160</td>
<td></td>
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<tr>
<td></td>
<td>4'740</td>
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<tbody>
<tr>
<td>MegaFlex DPA UPS</td>
<td>1'500 kW</td>
<td>4.45</td>
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<td>Mega DPA</td>
<td>1'500 kW</td>
<td>3'045</td>
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May 7, 2020
Large colocation protected by ABB modular UPS

Reduce the energy consumption and energy waste

97.4 %
market-leading efficiency in double conversion mode

>97%
In double conversion mode with variable IT load

40%
reduced energy losses

427 tons
CO2 emissions reduction over the product lifespan

MegaFlex DPA UPS
# Dynamic energy response

Reduced energy waste

<table>
<thead>
<tr>
<th>UPS standard modes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VFI – double conversion mode</strong></td>
<td>The default operating mode – <strong>efficiency up to 97.4%</strong> (recommended for all critical applications)</td>
</tr>
<tr>
<td><strong>VFD – ECO mode</strong></td>
<td>Alternative operating mode – <strong>efficiency up to 99%</strong> (for ultimate efficiency savings – double conversion on demand)</td>
</tr>
<tr>
<td><strong>Bypass mode</strong></td>
<td>Alternative operating mode – efficiency up to 99% (manual selection/automatic transfer in case of, eg, overload)</td>
</tr>
<tr>
<td><strong>Battery mode</strong></td>
<td>Load supplied from energy storage solution</td>
</tr>
</tbody>
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<table>
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<th>UPS Xtra modes</th>
<th>Description</th>
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<tr>
<td><strong>Xtra VFI – double conversion mode</strong></td>
<td>Double conversion mode with enhanced efficiency when load is low compared to total capacity (best choice for demanding applications where efficiency is important)</td>
</tr>
</tbody>
</table>

![Diagram showing VFI, ECO, Battery, and XTRA-VFI modes with corresponding efficiency percentages: VFI: 97.4%, ECO: 99%, Battery: 97%, XTRA-VFI: > 97%]
Dynamic energy response
XTRA-VFI maximizes efficiency at low-load conditions

The UPS system autonomously decides which UPS module goes into stand-by mode. The system shall rotate/swap the power blocks between the double conversion mode and the stand-by mode to extend the operating life and equalize aging.
Dynamic energy response
Optimize the energy consumption and reduce energy waste

<table>
<thead>
<tr>
<th>ABB Modular UPS</th>
<th>Legacy UPS</th>
</tr>
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<tbody>
<tr>
<td>Power load</td>
<td>650kW</td>
</tr>
<tr>
<td>UPS efficiency</td>
<td>97.4%</td>
</tr>
<tr>
<td>Average energy consumption 1 year</td>
<td>142'350 kWh</td>
</tr>
<tr>
<td>Power load</td>
<td>650kW</td>
</tr>
<tr>
<td>UPS efficiency</td>
<td>96%</td>
</tr>
<tr>
<td>Average energy consumption 1 year</td>
<td>219'000 kWh</td>
</tr>
</tbody>
</table>

\[ +1.4\% \text{ efficiency} = 35\% \text{ Reduced energy losses} \]
Dynamic energy response

Optimize the energy consumption and reduce energy waste

**ABB Modular UPS**
- Energy efficiency 50% load: 97.4%
- Energy efficiency 25% load: 97%
- Average energy consumption 1 year: 125,857 kWh

**Legacy UPS**
- Energy efficiency 50% load: 96%
- Energy efficiency 25% load: 95%
- Average energy consumption 1 year: 198,469 kWh

+1.6% efficiency = 37% Reduced energy losses
Monitoring of the energy consumption
Improving operations and reduce waste

ABB UPS’s interfaces allows the operator to observe measurements, events and alarms onscreen for a comprehensive overview of operations.

- Up to 8 programmable input/outputs dry ports
- Dry inputs for remote shutdown, Generator, maintenance bypass switch, battery temperature sensor
- Castell interlock function
Life cycle responsibility
Maximizing the product life design

360° for easy maintenance
Removable power module for safe services

Design life of up to 15 years
reduces total cost of ownership cost

Intelligent consumable monitoring
over the whole lifespan
- AC capacitor filter
- DC capacitor filter
- Fans

10 years
Spare parts availability after product phase-out

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