ABB Power Grid Innovations & Solutions

What we can do for you

Eddie Gough, GPM, Data Centers
Agenda

Introduction
Innovations; Digital Substations
What ABB Power Grid can do for your Data Center project
There will be 8 billion people by 2020

A study found that in 2015, data centers worldwide consumed approximately 416.2tWh of electricity, compared with the 300tWh it took to power the whole of the UK.

- 5 – 7% increase in data center infrastructure for each 25% leap in the number of connected devices.
- 40-60 GW data consumption energy usage by 2020.
- 400% growth of data center traffic over 3 years.
**ABB Scope of Supply**

**MV power distribution**
- MV switchgear & MCC’s
- Protection relays
- Distribution transformers
- AVC (Active Voltage Conditioning)
- Network management SCADA
- Data communication
- Design and Engineering
- MV Cabling
- Containerised solutions
- Turnkey option

**Building automation**
- RPP’s (Remote Power Panels)
- Power measurement
- KNX/EIB
- Data communication
- Load Management

**HV power distribution**
- HV GIS/AIS Switchgear
- Engineering Interface with Utility
- Protection relays
- Power transformers
- Network management
- SCADA
- Data communication
- Turnkey option

**LV power distribution**
- LV switchgear & MCC’s
- Intelligent PDU’s
- Active filters
- Power factor correction
- Network analyser
- Data communication
- Design and Engineering
- Containerised solutions
- Turnkey option

**HVAC solutions**
- EFF1 electric motors
- VSD (Variable Speed Drive)
- Components for control panels
- PLC’s
- Data communication

**SERVICE SUPPORT**
Available for all the above ABB equipment
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Introduction

Innovations; Digital Substations

What ABB Power Grid can do for your Data Center project
Digital Substation

Digitalization affects all relevant components and aspects of a substation.

Electrical substations rely on miles of copper cabling for point-to-point connections for measurement, protection and control. While reliable, this outdated method of signaling results in expensive testing and maintenance. Meanwhile, valuable and critical substation assets such as transformers and circuit breakers either have no condition monitoring, or have isolated monitoring systems with limited communication that result in islands of information as well as periodic rather than condition based maintenance strategies.

Today’s Digital Substation features digital communications where fiber optic networks replace yesterday’s copper signaling wire. This secure, high performance digital infrastructure is used to drive both the operation of the substation and to relay condition data about grid assets to cloud-based asset health software solutions that use predictive algorithms to improve the effectiveness of enterprise asset management for maintenance.

The net result is reduced expenditure on maintenance, longer asset life, reduced environmental footprint and even improved worker safety. Utilities can drive their grid assets harder by prioritizing maintenance spending, build substations with smaller footprint, and reduce the time needed to build new and upgrade existing substations.
ABB solution for digital substations
Monitoring and Diagnostics for switchgear, transformers and IEDs

From time based to condition/risk maintenance

- Integrated Monitoring and Diagnostics
- Switchgear, transformers and IEDs
- Communication via IEC 61850 and other standards
- Connected to station monitoring and network level system
ABB Digital substation offering
Future proof through standardized interfaces

Compact GIS
Standardized interfaces optimally separate equipment with different design life

**IEC 61850 station bus**
- Vertical communication with station HMI and gateways
- Horizontal communication with IEDs of other feeders

**IEC 61850-9-2 process bus**
- Merging units share sampled current and voltage values with devices in the substation

**Hardwired switchgear interface**
- The hardwired connection between LCC and switchgear optimally separates the primary and secondary equipment with different design life

ICCs come attached, connected and tested from the GIS factory. Site cabling and testing is minimized.
ABB Digital substation offering

UniGear Digital: The smart solution for Distribution

Features:
- Lower losses due to sensors
- Faster delivery due to flexibility
- Environmentally friendly
- Smaller foot-print (no extra metering cubicle)
- Easier engineering, less hard wiring
- IEC 61850 standard
Benefits of a digital substation

- Increased safety
- Backwards compatibility
- Future proof
- Reduced cabling
- Reduced installation time
- IEC61850 standard
- Higher reliability
- Reduced footprint (AIS)
- Software based testing
- Lower CT requirements
- Reduced maintenance
- Eco efficiency
- Improved asset management
- Cyber security
Agenda

Introduction

Innovations; Digital Substations

What ABB Power Grid can do for your Data Center project
What do Large Data Centre and utility clients want from ABB?

Dependant on the contracting entity; end-client or utility, they require some, or all, of the following;

Early engagement – Track record in DtC

Transmission Grid Code knowledge and Distribution systems optimization

Expertise in site power distribution and control

Innovative solutions; control & protection, modular, installation cost and time saving

Engagement with Civil contractor for site layout and Earthing & Lightning grids.

PICW role to minimize HSE exposure.

Have solutions and resources for the rapid time scales, integrated HV/MV/LV solutions rather than, product only basis.

Turnkey contracts to diminish risk, clear supply scope, improved accountability, greater support in the various project phases

Manufacturing capacity, both ABB factories and OEM partners

Maintenance support on site
**Added Value Aspects from ABB;**

- Typically 5-6 months saving on a Substation programme
- Uniform product functionality and support
- Highest Health and Safety standards
- Local installation and Commissioning resources and expertise
- Minimised project risks

As the manufacturer, we have better knowledge of our equipment function and performance, better selection for the specific application.

- Project schedule control; Expediting and optimizing deliveries, documentation
- Value-added engineering to reduce project costs; Digital solutions etc.
- Proven performance with regional teams
- Fast-tracking of projects; focused engineering, manufacturing and PM, SM
- Maintenance support on-site and on-call
Project Scope, Part 1; Sub Station

Design, supply, install, test and commission :-

Network studies

High Voltage Switchgear (GIS or AIS)

Power Transformers

MV Switchgear

Power cabling between GIS and Transformers

PICW role on completion of all Civils.

Station Auxiliary Power Systems, including Batteries, Chargers, DC and AC distribution panels, LV cabling and Fibre Optics.

Electrical and Mechanical fit-out, including Lighting, Small Power, House Transformer, Fire and Intruder Alarm Systems, Heating & Ventilation, Overhead Crane

Protection and Control Systems for HV,MV and LV

Earth Grid and Lightning Protection design; installation usually done by Civil company

Extended 5 year warranty combined with maintenance contract
Project Scope, Part 2; EBoP

Design, supply, install, test and commission :-

MV Switchgear, MV & LV Transformers

Modular solutions

LV Main Switchboards Switchgear, LV MCC’s, LV PDU’s & RPP’s

UPS & D&M

Control & Protection Systems

Discrimination studies

Site management and Logistics

Capacity planning

BIM modelling

Site walk-throughs

Project documentation

Extended 5 year warranty; subject to a maintenance contract
**Typical Resourcing**

<table>
<thead>
<tr>
<th>Type of Resource</th>
<th>Full Time</th>
<th>Contract</th>
<th>Comment</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations Manager</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Project Manager</td>
<td>1</td>
<td></td>
<td>Must have Data Centre Experience &amp; Irish Construction knowledge</td>
<td>Q2</td>
</tr>
<tr>
<td>Contracts Manager / QS</td>
<td>1</td>
<td></td>
<td>Focus on costs, Invoicing, V.O.'s, Cash Flow</td>
<td>Q2</td>
</tr>
<tr>
<td>Site Managers</td>
<td>3</td>
<td></td>
<td>Mattie &amp; James existing +1</td>
<td>Q2</td>
</tr>
<tr>
<td>Comm Engineer</td>
<td>3</td>
<td>25</td>
<td>Contracted per programme. 2871 to resource the 3 Engs.</td>
<td>Q3/Q4</td>
</tr>
<tr>
<td>Installation Staff</td>
<td>50</td>
<td></td>
<td>Contracted per programme</td>
<td>Q3/Q4</td>
</tr>
<tr>
<td>HSE officer</td>
<td>1</td>
<td></td>
<td>T. Flood</td>
<td>Q2</td>
</tr>
<tr>
<td>BIM, CAD, Project Support</td>
<td>1</td>
<td></td>
<td>BIM &amp; CAD Technician, may be contracted</td>
<td>Q2</td>
</tr>
<tr>
<td>Senior Design Engineer</td>
<td>1</td>
<td></td>
<td>Must have Data Centre experience</td>
<td>Q2</td>
</tr>
<tr>
<td>Project Design Engineer</td>
<td>1</td>
<td></td>
<td>Electrical Engineer</td>
<td>Q2</td>
</tr>
<tr>
<td>ABB Project Finance Controller</td>
<td>1</td>
<td></td>
<td>Focus on OCF, ProMis, KPI's.</td>
<td></td>
</tr>
<tr>
<td>Administration H/Q</td>
<td>1</td>
<td></td>
<td>Lisa</td>
<td>Q2</td>
</tr>
<tr>
<td>Documentation</td>
<td>1</td>
<td></td>
<td>Ensure compliance</td>
<td>Q2</td>
</tr>
<tr>
<td>Expeditor/SCM</td>
<td>1</td>
<td></td>
<td>Share cost with LV</td>
<td>Q2</td>
</tr>
<tr>
<td>Administration Site</td>
<td>3</td>
<td></td>
<td>Documentation control etc.</td>
<td>Q2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>86</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mundane tasks such as panel cleaning to be done by non-skilled
Comprehensive service portfolio supported by regional hubs

ABB services span the entire product ownership life cycle:

- Installation and commissioning
- Training, both classroom and online
- Spare parts and spare parts kits
- Preventive and corrective maintenance including condition monitoring
- Retrofit and upgrades
- Replacement and repair
- Technical support, Engineering and consulting
## In summary; ABB can help across all 5 Project Levels

ABB Power Grid can engage on all 5 project levels. With a well structured contract there will be improved performance, less V.O.’s, less budget over-run, faster Commissioning and less project risk for all.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Factory Witness Testing (FWT)</td>
</tr>
<tr>
<td>2</td>
<td>Receipt, installation, post-installation checks</td>
</tr>
<tr>
<td>3</td>
<td>Functional component testing (FCT)</td>
</tr>
<tr>
<td>4</td>
<td>Functional system testing (FST)</td>
</tr>
<tr>
<td>5</td>
<td>Integrated system testing (IST)</td>
</tr>
</tbody>
</table>

**FWT** verifies operation and capacity for the components that are to be installed in the data center, including engine-generator sets, UPS systems, chillers, air conditioners, and switchgear.

**FWT** is carried out in the original equipment manufacturer’s (OEM) factory or in a third-party testing facility. These testing activities should be witnessed by at least one representative of the project team.

**FWT** is performed with conditions and procedures that are in accordance with manufacturer, national, and international standards, as well as the owner’s individual needs. Testing these components in the factory also helps prevent in-process defects, in particular, in long-lead items, from reaching the job site. OEMs must correct the testing failures prior to shipment.

**FWT** reports are generated by the OEM or third-party testing laboratory, provided to the client and Engineer-of-Record, and reviewed by the design and commissioning team.

**Receipt checking** includes inspecting the products upon delivery to the site to ensure the equipment delivered matches what was procured and tested during Level 1 and that the product has not been damaged or altered during shipment.

Installation and post-installation checking includes verifying that each and every component and auxiliary appurtenance has been installed in accordance with drawings, plans, and specifications; accessibility; maintainability; health and safety requirements; local codes; and OEM installation requirements and directives.

**FCT** verifies that the installed component is operable at a basic level. This includes maintaining checklists for mechanical and electrical equipment start-up. FCT often also includes initial performance verification by an OEM representative, which typically starts the warranty period. Mechanical systems should go through a pre-test, adjust, and balance (TAB) effort to ensure accuracy for Level 4 commissioning.

**FST** verifies that each system is ready to be integrated with other systems supporting the data center. During FST, the Cx'A typically performs the TAB of the mechanical systems, to ensure design airflow and water flow rates are achieved. The FST includes load related tests that ensure that related components, equipment, and ancillaries of a defined system operate and function to acceptance criteria. This should include normal, maintenance, and emergency modes of operation, to verify settings, alarms, and performance of associated monitoring and control functions.

**IST** ensures that all of the various data center systems work together under a variety of load conditions as designed. IST verifies the systems’ responses to various actions, maintenance activities, or faults, as per the design sequences of operation. The testing of interrelated components and system verifies that each component and system as a whole will respond as intended to expected and unexpected events.
What we provide

- Expert Project Execution teams in specific markets with proven projects
- Experienced local Data Centre project management and service teams.
- Early engagement; to mitigate against site execution issues. Each party can then better identify their substantive costs and lessen possible cost overruns.
- System and Service differentiators over competitors and OEM’s etc.
- Clear definition of site scope ownership, reduction in waiting time associated with site logistics, Documentation control, reduction in V.O. requests.
- Clear assignment of responsibilities across the 5 project levels.
- For major Regional roll-outs, an ABB Project Director can be provided, with an ABB/Client Steering committee for escalation of any major issues.
What do ABB need from Data Centre clients?

We require;

- EARLY ENGAGEMENT
- Early resolution of T&C’s
  - As a minimum; A Functional design, we can develop the detailed Functional Design Specification
  - Prompt approval on ABB’s Functional Design Specification (FDS) on the Electrical Automation System (EAS)
- Project programme
- Permission to engage with TSO, DSO and the other relevant project entities
- Permission to engage with Civil contractor for site layout and Earthing & Lightning grids.
- Electrical Turnkey package with a clear supply scope; this will diminish risk for both parties and will enable optimum performance throughout the various project phases