

# Power protection for the next-generation data center



The quantity of data in our society is growing exponentially. Social media, e-commerce, Industry 4.0, business transactions, leisure, public administration and social security are just some of the aspects of modern life that generate a torrent of terabytes around the globe each and every day. This deluge of data has to be stored in a safe and rapid way, and has to be retrievable just as rapidly - 24/7 and 365 days a year - so it can be utilized in one of the many different applications upon which our day-to-day life depends.

What happens in the space of one minute in this world of data is truly astonishing: 16 million text messages and 156 million e-mails are sent, over \$750,000 spent online, more than 3.5 million terms searched on Google, 450,000 tweets exchanged - and these represent just a tiny fraction of the many thousand transaction and interaction types hosted by the Web. As the

population continues to grow in number and wealth, and as the number of ways in which data is used multiplies, so too will this ocean of data.

Our participation in this data world is often unconscious but, nevertheless, we are experiencing the beginning of a Data Era and the participation of each and every individual in this new era contributes to its further development, progress and shaping.

Fundamental information technologies such as virtualization or cloud services enable improved utilization of the existing infrastructure so that increasing data traffic demand can be managed better. Nevertheless, the exponential growth of data volumes forces us also to build new data center infrastructures.

The inescapable fact is that more data will require more physical memory locations and these memory locations will require more electrical power distribution equipment capable of supplying continuous power at the right power quality level. In the world of data storage, the imperative is to guarantee 24/7 instant data availability. Everyone expects their data to be available – now!

Whether we are talking about telecom data center spaces, enterprise solutions, co-locations or cloud/business services providers (the latter - typically hyper-scale environments - show the highest growth rate according to the latest market research), all data centers spaces and operators have a set of common requirements, the most important being:

- Business continuity and zero downtime: All systems have to be always up and running, and whatever happens on the infrastructure side, load-drops are not an option. This is to guarantee a safe data transaction, storage and recovery.
- Reduction of the investment costs through higher energy efficiency. Better efficiency reduces energy losses and operational costs, and at the same time eliminates the capital investment that would be needed to purchase higher-performance temperature conditioning systems (which heavily impact upfront investments).
- State-of-the-art general electrical performances to guarantee the highest level of electrical power quality, the highest level of voltage stability at the servers' input, the lowest level of harmonic pollution on the electric mains, circular power diagrams to reduce the system level oversizing needed should the system operating power factors drift off unity factor.
- Easy operation and serviceability, enhanced by condition monitoring, remote diagnostics, and simple man-machine interfaces.
- Cyber security.

Also, there are many other specific requirements, which vary by customer, region and segment and which will influence the product development roadmaps for the next five to 10 years for all players active in the field of power protection and critical power equipment. Examples of these requirements are:

### Customer-driven requirements:

- The top 10 data center space players are showing more international presence (some of them are already global players) and this leads to a requirement for a certain level of "systems standardization" to enable faster deployment when building new facilities, as well as to overcome local electrification differences. Ideally, electrical power systems will be designed to flexibly cover any voltage, any frequency and any electrical configuration.

- As data flow increases, so does the data center power requirement and, consequently, the power levels that have to be supplied by the power protection equipment. While a few years ago a 10 MW data center would have seemed large, today 50 to 60 MW facilities are becoming standard. These facilities are typically structured into several data halls that each consume around 3 MW – a level likely to be exceeded in the next three to five years.

### Regional requirements

- It is a fact: space has become a real issue, especially in Europe and Asia. In Singapore, Shanghai, London, Frankfurt, etc., buildings cannot easily expand horizontally and vertical expansion is also limited. Therefore, for all major UPS players, power protection equipment form factor has become a fundamental parameter that determines design complexity.
- In some regions - eg, the EU - there is increased interest in elastic infrastructures that can dynamically optimize the power consumption distribution based on real-time server loading conditions, without compromising system availability.
- Requests are now being made more often to use data center energy storage capabilities to interact with the public mains and support or facilitate ancillary functionalities like grid frequency regulation, peak power shaving, and reactive/active power conditioning for smart grid integration.

### Segment requirements

- Many data center operators insist that the equipment they bought is validated at full design power during the FAT. Further, validation is often also required within the overall power distribution train – ie, together with upstream/downstream distribution equipment, static transfer switches and generator sets (to validate UPS synchronization on gen-set kick-in).
- Industrial operators insist that power protection equipment suppliers validate the sold systems under all possible variable loading conditions (including load steps, transitions, power factors, etc.), in addition to validating the performance of the overall system, including overloads, at higher operating temperatures (a very critical requirement in, for example, offshore O&G).

Most likely, the next generation of UPS products will include all the abovementioned requirements – and certainly some additional ones. This raises another issue: Suppliers of critical power products will have to be equipped appropriately so they can properly validate the equipment they sell against very demanding site acceptance test specifications.

It is to fulfill this emerging demand that we at ABB have invested heavily over the past 18 months in our new test arena. Our new facility will enable us to validate - in front of our customers - all sold equipment against the most challenging site acceptance test specifications and customer special wishes.

Objective, Innovation and Future Trends. These are the three-fundamental values we have been thinking of while addressing the concept design phase of the newly introduced test arena:

### Objective

- We aimed to create a facility that enables us to test:
  - All voltages, frequencies and network configurations found in low-voltage distribution networks around the world:
    - Starting from 120 V to 480 V and passing through 400 V and 440 V.
    - At 50 or 60 Hz or any other value that could be of interest for the customer.
    - Three phases with three wires, three phases with four wires and even single-phase configuration.
    - Any power factor ranging from 0.5 to unity, leading or lagging.
  - Any full system or combined test configuration
    - Not only focusing on the UPS but eventually integrating a full data center power distribution system including upstream distribution, downstream distribution, static transfer switches, PDUs, generators, etc.

### Innovation

- We aimed to have a “green” architecture, as we wish to preserve our future: Thanks to a power circulation loop, we can minimize the actual power consumed from the public network.
  - The power taken from the public mains is, at maximum, only 10 percent of the actual power circulated into the UPS.
- We introduced remote FAT functionalities and possibilities.
  - Businesses are becoming more global. Our customers are located all around the globe, which means that some customers might prefer to run their FAT via our IT/video-streaming system. This way, they can sit comfortably in their own facilities while the system is under test in Switzerland. This is ABB Ability.
- We wanted to have a power infrastructure that is state-of-the-art in terms of electrical safety and comfort for our operators and our customers so long testing programs, which can exceed three working days, are made easier.
  - We designed the test arena in such a way that the FATs could be assisted by our customers from a comfortable and safe environment (conference rooms) without them missing any important part of the FAT.
  - The operators will remotely control the overall system through an automation layer, implemented on a LabView platform.

### Future Trends

As critical power applications are becoming more and more power hungry, we wanted to have a:

- Versatile environment that could enable us to test any UPS size spanning from a few tens of kW to a multi-MW system, including overload conditions
- Test area versatile enough to enable the implementation of important future requirements for smart grid Integration
- Test area real enough to demonstrate our systems’ behaviors while connected to any energy storage (batteries, Li-Ion, flywheels, external generators) in common or independent strings configuration.

The construction of our test arena was an exciting and complex journey, very fruitful in its brainstorming phase, to make sure that all possible important customer values were properly captured and implemented in an innovative way. We wanted to have an environment that is:

- Flexible not only from a customer perspective but also for our daily operational needs, which includes the capability of running more than one system level test at the same time.
- Able to meet different customers’ specific requirements, independent of the final application segment (data centers, industrial, transportation, etc.) and region and to accommodate all voltage and frequency levels that appear in low-voltage applications around the world.
- Green: to commit to our society for a smarter and better utilization of energy resources
- Available - achieving 100 percent uptime through modularity to enable 24/7 validations, with no production stops or delivery delays.
- Capable of integrating ABB Ability functionalities.
- Ergonomic and safe for our customers.

Today, we are proud to say, “we made it.”

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