Backing up performance

ABB emergency power systems for data centers

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Data centers are one of the least visible but most crucial parts of our modern infrastructure. The data they contain – bank details, medical histories, company data, pension records, tax returns, social media treasures (Facebook receives over 300 million new photos each day) and a plethora of other data – are, to different degrees, important to modern life. So reliant has society become on data centers that 100 percent uptime is now often an essential aspect of their operation. Despite all the precautions taken during the design and operation of data centers, situations can arise in which external power is totally lost for a significant period. Such blackouts result in data loss, nonavailability of essential services, risk to hardware and, potentially, financial losses of millions of dollars. For these reasons, highly dependable emergency power systems are increasingly mission-critical for the data center industry.

1 ABB gensets provide reliable backup power for data centers.

External threats to the power grid are difficult, or impossible, to control. Every year, storms and adverse weather conditions – for example, the recent superstorm Sandy in the United States – cause major power interruptions and stretch many emergency power systems beyond the limits of their capabilities. Construction-related incidents are another major cause of utility outages. Even without such events, utilities have to cope with power grids that are aging, increasingly decentralized and unpredictable. For a data center, therefore, a highly dependable emergency power system is a must.

Quality is paramount

Most data centers employ uninterruptable power supplies (UPSs) combined with diesel generator sets ("gensets") to safeguard against power interruptions or total loss. However, design and installation of gensets and emergency power control systems are often oversimplified and only poorly executed. This results in internal and "homemade" threats which are underestimated or even overlooked altogether. Critically, nonstandardized control systems and nonmatching or low-quality system components can introduce a single point of failure, thus increasing the risk of malfunction exactly when reliable power is needed most. Inferior installation practices can be costly too: One global Internet-based supplier was recently fined over half-a-million dollars for installing and repeatedly running diesel generators without obtaining the required standard environmental permits on a site in the state of Virginia, in the United States [1]. Poorly installed gensets are generally becoming a matter of concern.

In short, the performance, functionality and reliability of any emergency power system are highly dependent on, and determined by, the capabilities of the control system, the quality of all system components and the professionalism with which the system installation is carried out. Further, when developing world-class emergency power system concepts, all needs and benefits must be considered, not just the technical features → 1.

At the heart of the ABB emergency power concept lies the programmable logic controller (PLC).

Scalability

Scalability is absolutely essential when designing modern backup power systems: Control and power systems have to grow seamlessly with increasing energy demand and adapt to changing customer needs and priorities. This has to be achieved without compromising quality or reliability, or introducing the need for system downtime.

Data center business cases often allow for expansion in several stages over time. A modern emergency power system has to be designed to provide full functionality from the initial operation levels right up to the final data center expansion stage. This requires thorough design of the supply concept, communication structure, control systems and building infrastructure. Standardized components with upstream and downstream compatibility and long-term availability allow for changes and extensions over a period of many years without the need to replace entire systems.

ABB system concepts are designed to allow for step-by-step extensions or changes without the need for system downtime and they accommodate independent testing of new stages without

Title picture
Data centers that aim for 100 percent uptime need a highly reliable diesel generator backup for the eventuality that the external power fails for a length of time. Just what are the characteristics of such an emergency backup system?

2 ABB control cabinets lie at the heart of the emergency power concept.

The performance, functionality and reliability of any emergency power system are highly dependent on the capabilities of the control system, component quality and the professionalism with which the system installation is carried out.

risk to the ongoing data center operation.

New criticality paradigms

Power criticality concepts and philosophies vary widely between industries and, in many cases, are unique to individual customers. Further, consumer groups can no longer be simply categorized according to whether they are merely UPS-supported or require emergency power or are supplied by the grid only. Rather, it is now essential to distinguish between consumers who can tolerate medium-length, short or no power interruptions. This changes the emergency power system concept, and selection and sizing of system components. Reliability can be further increased by reducing or removing less-critical consumers while providing power to essential servers only.

Controlling emergency power

ABB's emergency power activities include entirely new installations and modernizations of complete control systems that manage both emergency power groups and main distribution systems. At the heart of the ABB emergency power concept lies the programmable logic controller (PLC) → 2–4. The task of the PLC is to control the diesel engines and generators belonging to the emergency power groups and communicate with other control systems, individual consumers, UPSs, switchgear and the process control systems. The performance and reliability of a power supply system is highly dependent on, and, more importantly, limited by, the quality and capability of the control system and its components.

The PLC is a vital part of any critical power concept and represents a single point of failure – a failure that could have potentially catastrophic consequences. To mitigate this risk, ABB control systems are based on standardized components and offer compatibility with all other relevant ABB products. This allows conceptual changes, functionality upgrades and capacity expansions to be made at any time without interruptions, and without system availability and reliability being compromised.

Reliability and availability

ABB designs and supplies fully integrated emergency and backup power products and complete turnkey systems. Having one port of call for planning, engineering and installation of the complete system, including auxiliaries, allows for seamless integration, easy future expansion, simplified service and maintenance, while reducing the number of interfaces and thus increasing reliability. Bundling electrical system components such as low-voltage and medium-voltage switchgear, transformers and control systems with auxiliaries like fuel systems, exhaust systems, ventilation and cooling under one contract offers peace of mind for supply, integration, commissioning, maintenance and service.

High-quality standardized products also significantly reduce intervention time during maintenance or in the event of failure – components can be changed quickly and easily, service is simplified and some modules can even be hot-swapped.

3 Control cabinets can be easily modified and extended to accommodate data center expansion.

For a data center, a highly dependable emergency power system is a must.

Advanced technology

ABB is able to design emergency power concepts based on a range of technologies. A highly capable and scalable control system allows for the use of technologies such as diesel rotary uninterruptable power systems (DRUPSs) or even the integration of compressed-air power storage solutions.

Financial flexibility can be nearly as important as technical specifications. For instance, leasing and full-service models allow for accurate operational expense planning and maintain the highest level of reliability.

The most modern data center power technologies are based on direct current (DC). One of the top information and communications technology (ICT) service providers in Switzerland, green.ch, has chosen ABB to design and install an advanced, DC power distribution system in a new state-of-the-art data center (see also pages 16–21 of this edition of *ABB Review*). DC technology trims power conversion losses and is 10 to 20 percent more energy efficient than traditional alternating current (AC) technology when used for electrical distribution in data centers. DC systems are also less complex and require less space – reducing equipment, installation, real estate and maintenance costs. This can result in savings of up to 30 percent on the total facility costs. The green.ch data center uses ABB emergency power gensets ➔ 5.

The advanced AC500 PLC at the heart of the ABB Master control system provides an interface to ABB's data center infrastructure management (DCIM) system, Decathlon. Integrated fiber-optic communication rings enable the emergency

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power controller to continuously communicate with upstream and downstream systems and components. Customers have the ability to monitor, analyze and control emergency power systems locally, and to increase supply security and optimize operations remotely, as required.

Remote monitoring and notification services have been developed to relay critical information to mobile devices including mobile phones. This allows an immediate response to threats and facilitates the planning of preventative measures to ensure that 100 percent availability is not compromised. Furthermore, remote access ability allows utility operators to access and purchase additional power during peak periods.

High-quality diesel engines

ABB utilizes only high-quality diesel engines from well-regarded original equipment manufacturers (OEMs). This enables ABB to meet and exceed the most stringent environmental requirements. Diesel exhaust systems can be designed to further reduce emissions and noise pollution.

ABB gensets comply with the stringent structural integrity obligations laid out by the International Building Code (IBC). The IBC is a broad collection of structural building requirements that help prevent injury and damage from earthquakes and other such phenomena. The IBC and other building codes are now written so that, in the event of a catastrophe, mission-critical systems will be able to withstand the same forces the building housing them can. A unit that complies with IBC seismic standards will have been certified through seismic analysis and tri-axial shake table testing.

4 Control cabinet interior

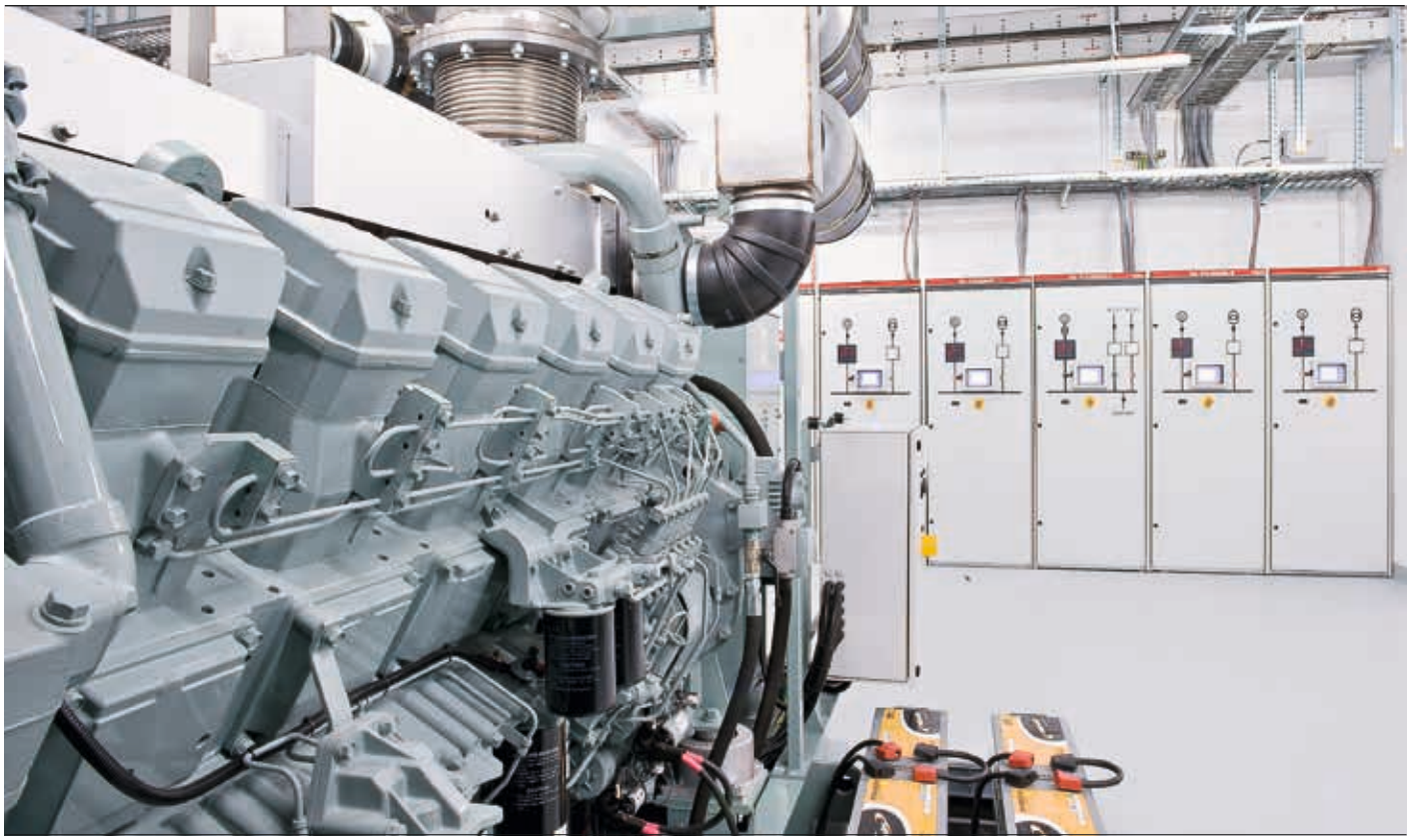
The IBC has been widely adopted in North America and ABB has already implemented many of its standards into its products.

All ABB industrial gaseous liquid-cooled (IGLC) and industrial diesel liquid-cooled (IDLC) stationary gensets meet the IBC wind resistance requirements. These requirements vary depending on exposure category and occupancy category – for example, a life-critical building such as a hospital requires a higher safety factor than a manufacturing plant or mall. Mathematical modeling of various scenarios and the stresses inherent in those scenarios has been performed on the gensets to determine their ability to withstand the wind under different situations.

ABB generators also comply with the Underwriters Laboratory (UL) UL 2200 standard for safety.

UL 2200 is the most widely adopted safety certification in the United States. If the genset operates at 600 V or less and is intended for installation and use in ordinary locations in accordance with the National Electrical Code NFPA-70, it can be designed to meet UL 2200 standard. This means that the unit has gone

5 Genset and master control cabinets (in the background) as supplied to green.ch. A redundant fiber-optic bus system is included.



Scalability is absolutely essential when designing modern backup power systems.

through rigorous testing to ensure it has a longer uptime, meets higher safety standards and will be less likely to fail than an equivalent noncertified unit.

Business models

Data center emergency power systems are significant investments so delivery and financial flexibility can be nearly as important as technical specifications. For instance, leasing and full-service models allow for accurate operational expense planning and the avoidance of unexpected costs, while maintaining the highest level of reliability. Other financial models accommodate upgrades, extensions and new technology platforms. Rental models avoid large capital expenditure, aid swift project execution, leave flexibility for future growth and provide clear and easy control of finances.

Technical and financial concepts also cater for interim solutions: Additional demand can easily be met with the addition of temporary power units and containerized systems can comfortably bridge the gap during extension phases without the need of risky and costly shutdowns and compromised availability.

As data centers increase in number and size, the emergency power systems that support them will grow in sophistication and capability. ABB will continue to develop this technology to ensure that data centers continue to conform to regulations and that its customers can continue to operate with 100 percent uptime.

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Reference

[1] New York Times (2012), “Power, Pollution and the Internet,” retrieved from http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?pagewanted=all&_r=0 (2013, August 1).