



VERTIV™

DC POWER SERVICES

Ensuring Reliable and Safe
DC Power System Performance



Optimized Power Performance Requires AC and DC Power System Reliability

Electrical power is the force that drives your business. It ensures the continuous flow of operations, production processes, and service delivery. The reliability of that power is dependent on the health and maintenance of both the AC and DC supply systems of your power chain. From the transformers, switchgear, relays, circuit breakers, and motor controls to the DC batteries, chargers, and UPS, your system depends on the optimal performance of each piece of equipment. In the event of a power failure, it is the coordination between these two systems that maintains critical loads where needed.

DC Power Performance Ensures Operational Dependability

The DC power system's UPS and batteries are your last line of defense. They are the most critical and vulnerable set of components in the power distribution system. Yet, the DC power system often receives secondary consideration when it comes to regular maintenance and upgrades. As DC power has become increasingly important to operations, regulating bodies including the North American Electric Reliability Corporation (NERC), Institute of Electrical and Electronics Engineers (IEEE), National Fire Protection Association (NFPA), and Occupational Safety and Health Administration (OSHA) have increased their specifications for installation and maintenance. This, along with the advancement of technology, is making it increasingly difficult to manage DC power systems of varying sizes and configurations across facilities.

Invest in DC Power Expertise for Improved Availability

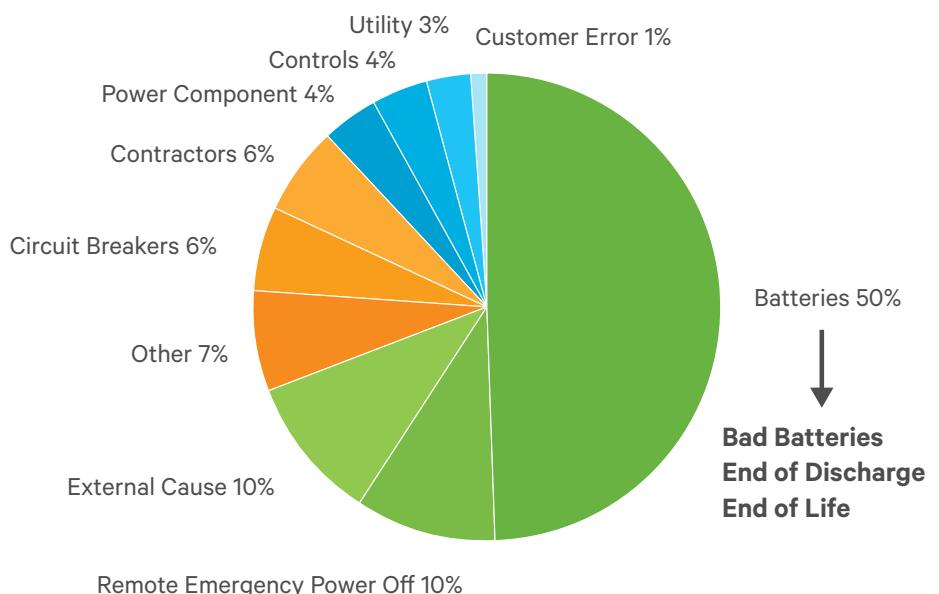
Studies show that the DC power system is a leading cause of unplanned downtime and that the high rate of UPS battery failure is responsible for load loss 50 percent of the time. For operations that require emergency power and uninterrupted power, load drops or even current fluctuations can have serious consequences such as production disruption, chemical instability, critical service interruption, damage to processing equipment, or in some cases the complete shutdown of a facility. Even a single misoperation can cost millions of dollars in lost productivity, infrastructure damage and regulatory fines.

The odds are high that your business will experience a power failure and unplanned downtime this year.

Among U.S. industrial businesses, the average cost per hour of downtime ranges from \$30,000 to \$250,000. With annual downtime averaging 15 hours per company, DC power maintenance is a wise investment.

With so much at stake, it's important to protect your power by performing routine maintenance and upgrades to your DC power system. Facilities that add a DC power preventive maintenance program to their power chain management plan have the highest assurance of operational reliability. A routine maintenance plan will maximize performance and increase the mean time between failures, while maintaining a safe work environment for personnel. Equally important is choosing the right partner with the knowledge and expertise to perform maintenance and upgrades and get the longest service life out of your DC power system.

Causes of UPS System Failure



Plug into Our Expertise

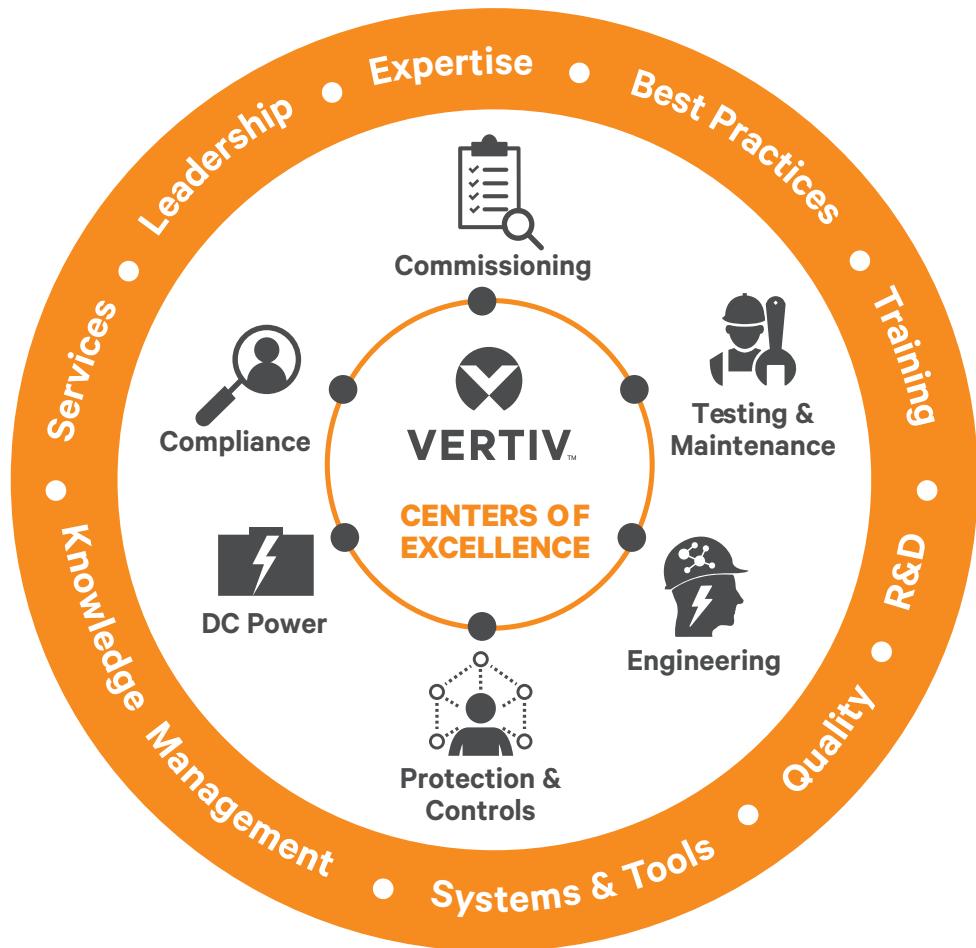
Vertiv's Electrical Reliability Services drives innovation, best practices, and industry-leading solutions through our specialized Centers of Excellence. These Centers of Excellence bring together dedicated experts, proven processes, and investment in the right technologies to deliver smart, powerful solutions that drive world-class satisfaction.

Our Centers of Excellences are comprised of cross-functional teams who work together to meet your specific power challenges in all stages of your facility's lifecycle.

DC Power Services Are Critical to Total Power System Management

The members of our DC Power Center of Excellence are uniquely qualified to support your operation's standby, emergency, and uninterrupted power needs. We have the technical training and field experience that is needed to ensure the maximum reliability of your DC power battery systems and UPS equipment. Our highly qualified team is comprised of DC power specialists and NETA-certified technicians. These team members use their experience and knowledge to coordinate a comprehensive DC power system maintenance program with your total power maintenance plan.

As a NETA Accredited Company, we provide unbiased testing services that ensure your compliance with regulatory requirements from IEEE, NERC and NETA. We lead the industry in designing battery maintenance plans that meet or exceed these requirements, including the first-ever required testing protocol on batteries and battery chargers for utilities (NERC PRC-005).



Rely on Dependable, Quality Service from a Dedicated Team of Experts

As your DC power system management partner, Vertiv's Electrical Reliability Services is committed to providing the most experienced technicians and highest quality service possible. We believe that being an effective partner means understanding your toughest challenges and determining the best ways to address them through a focused approach. For each customer, we assign a dedicated team, outfitted with the latest test equipment and proprietary data collection system, to safely and accurately deliver customized services based on your facility's needs.

With access to proprietary product information and industry trends, our DC specialists can better anticipate product issues and address them before they become problems. They are also knowledgeable on new technologies and understand when and how to integrate them when it is time for system upgrades and modernization.

Maximize Operational Goals by Utilizing a Comprehensive Portfolio of DC Power Services

Ensuring business continuity, operational efficiency, and improved safety starts with design engineering and installation — selecting the right DC system configuration and choosing the right batteries and UPS equipment to support the needs of your facility. This is followed by customized routine preventive maintenance with ongoing replacement and upgrade services, creating a strong lifecycle management program.

Vertiv's Electrical Reliability Services offers a broad set of DC power design engineering, installation, maintenance, and replacement services to partner with you in managing your power chain. We offer a high level of availability and scheduling flexibility to readily meet your timelines and emergency needs.

Design Engineering and Installation

Designing the right DC power system and choosing the right batteries and UPS equipment are critical to providing optimal support for your facility. Engaging our design engineers when you are considering expanding your DC power needs will ensure you have the right configuration to maximize system reliability. We will leverage our strong relationships with battery and UPS manufacturers and draw on our expertise with multiple brands to install and commission the best system for your facility's budget, space and growing power needs. Our design engineering and installation services include:

- System planning and design
- System evaluation
- Application engineering
- Battery and UPS installation
- Acceptance testing
- Startup and commissioning
- Removal and recycling

Preventive Maintenance Services

To develop the right maintenance strategy for your DC power system, our DC power specialist consider environmental conditions, operating frequency, and the criticality of the equipment and operations your system supports. We offer a variety of maintenance plans to ensure compliance with industry standards.

Our services include:

- Regular inspections
- Battery, charger, UPS maintenance
- Capacity testing
- Mobile DC power services
- Battery monitoring
- Spare parts

Replacement and Upgrade Services

Adopt a proactive battery and UPS component replacement plan. Based on our experience and extensive industry data, we know that the actual life of your DC power system is almost always shorter than the design life. Our replacement and upgrade services center on assessing the health of your components and replacing batteries and UPS equipment before they fail, ensuring your system will always deliver.

Our technicians have the knowledge and the tools to evaluate where your system is in its lifecycle and our engineers will work with you to establish proactive upgrade and modernization timelines for better management and budget planning. Our replacement and upgrade services include:

- Application engineering and evaluation
- End-to-end battery replacement
- Cell change-outs
- UPS refurbishment
- Battery and UPS installation
- Startup and commissioning
- Removal and recycling

Mobile DC Power Services Unit

When facilities can't afford to compromise critical power, a mobile power solution that is safe and secure is ideal for performing DC system maintenance and capacity testing. With our Mobile DC Power Services Unit, our DC power specialists can confidently perform all required battery inspections, tests, and replacement services without risk of power dips or load drops.

Our mobile unit includes the following equipment:

- State-of-the-art power and ancillary safety equipment
- DC battery strings and a universal charger
- Albér® test set, load bank, sensor lead cables and monitor
- Power transfer cable system
- AC and DC circuit protection
- Voltage selectors support multiple power requirement ranges
- Diesel generator



Battery Monitoring

Using the Albér monitoring system and qualified battery monitoring specialists to assess your battery strings around the clock increases mean time between failures by more than double compared to preventive maintenance alone.

Our 24x7 remote monitoring services help you detect and diagnose problems that may otherwise go undetected such as leaking water, failing batteries, and more. Our services also include emergency service for rapid incident response, as well as monthly trending and reporting for better battery management.



DC POWER SERVICES



Why Vertiv?

As your DC power services partner, we are committed to delivering unmatched expertise, the highest level of safety, regulatory compliance, and quality service delivery.

Technical Experience

- DC power specialist technicians
- NETA-certified technicians
- NETA Accredited Company
- Testing compliant with NERC and IEEE
- Multiple brand knowledge and experience
- Access to proprietary industry data on all brands and operating trends
- Unbiased, third-party testing

Unmatched Safety and Compliance

- Very low OSHA Incident Rate
- Adherence to safety regulations (OSHA, EHS & NFPA 70E)
- NFPA 70E technical training
- Certifications in cardiopulmonary resuscitation (CPR), automated external defibrillator (AED) and first aid
- Documented safety programs for each project
- Semi-annual safety audit program

Quality Service Delivery

- AC and DC total system knowledge and experience
- Dedicated team of DC power technicians assigned to every customer
- Preventive and proactive maintenance services
- Proactive replacement and upgrade planning and installation
- Excellent track record in meeting timelines
- Regular communication and scheduling updates throughout the project
- Standardized analytical reporting, supported through PowerDB systems
- Acceptance and maintenance test data management software system

Expertise You Can Trust

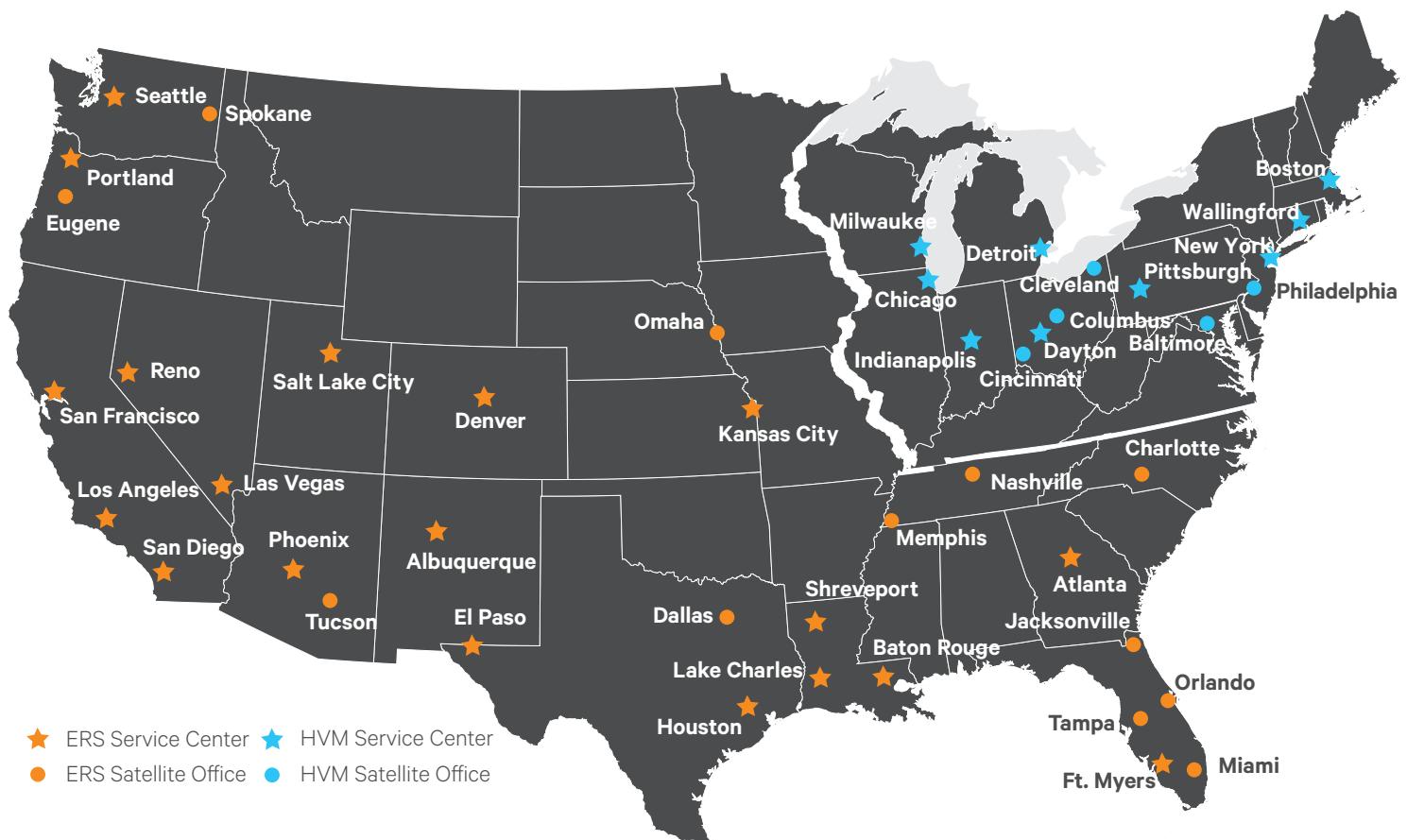
Active Memberships

Vertiv actively participates in numerous national organizations to assist in the development of standards important to our industry. With more than 45 years of experience in electrical testing, maintenance, and engineering, we are a trusted partner in promoting safety and reliability management. Below are some of the organizations in which our managers, field technicians, and engineers are involved:



National Coverage

Whether it's an emergency or a typical service event, you need a partner who can respond where and when you need them. Vertiv supports you through a network of two service organization including Vertiv's Electrical Reliability Services and its sister company, High Voltage Maintenance Corp. With strategically located service centers across North America, you have access to resources for local, regional, and interstate projects. This ensures continuity of service across all your facilities, no matter where they are located.





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