

Hybrid Power Considerations for Today's Telecommunications

A White Paper by
Liebert Corporation

Modern telecommunications facilities are faced with the dilemma of how to power a variety of equipment as reliably and economically as possible. With the convergence of information technology and telecommunications networks, equipment input power requirements are no longer standardized around -48VDC. Alternative approaches have been devised to power modern telecommunications facilities having both AC and DC-powered equipment. The use of standby generators in lieu of long battery back-up times is also a consideration. This white paper presents the advantages and disadvantages of the various design approaches along with application-specific guidelines, that is, what circumstances favor one approach over another.

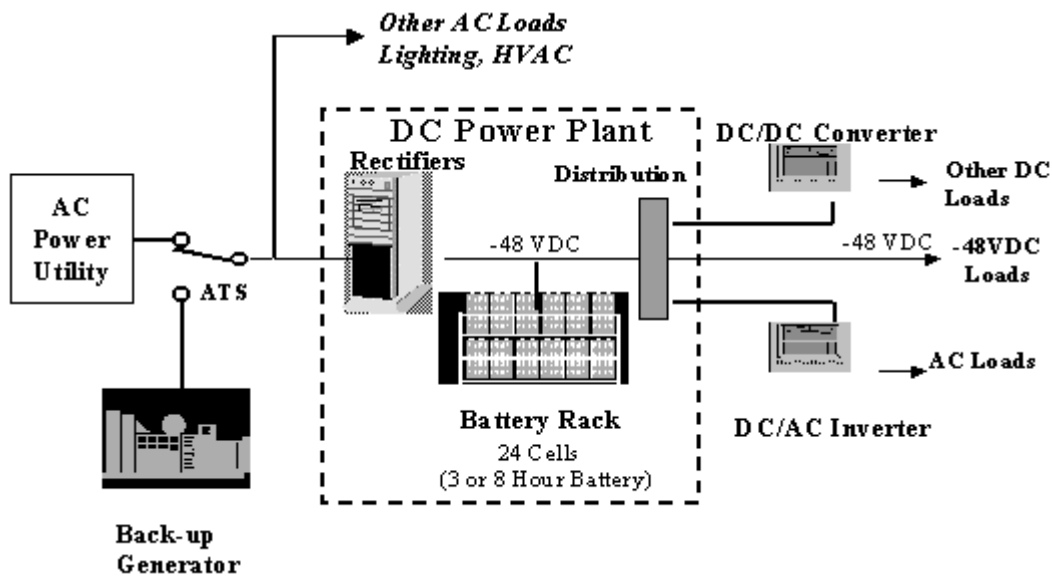
48VDC – The Traditional Standard

Since it first came into being almost two centuries ago, the electronic media for point-to-point communications remain the undisputed lifeline of most businesses. The basic anatomy of telecommunications, as the telephony system came to be called, has changed significantly. In most cases, telecommunications systems transmit data by wire, radio, or fiber. What has changed most dramatically is the importance, the type, and amount of data transmitted. The growth and complexity of telecom applications has sharply increased, with no end in sight. The interruption of voice communication can be significant enough, but add in the huge masses of data created by millions of computers tied together into global networks, and the impact of downtime spins from inconvenient to unconscionable.

Reliable, continuous power is at the heart of continuous telecommunications operations. Traditional telephony applications – from central office exchanges to PBX networks – have standardized around a -48VDC source. There are many reasons for this. First, its negative polarity reduces corrosion problems with underground cables and conduits. The low voltage made it easy to implement, as well. Systems using less than 72V generally did not require licensed electricians nor were they governed by the NEC. As opposed to commercial AC, DC power is the “standard” for carrying voice signals. DC is considered more reliable because it is more easily stored than AC power.

Figure # 1 - DC Power Plant

Configuration 1 - DC Power Plant



The typical DC power system is shown in Figure 1. Redundant rectifiers are used to convert the AC power to –48VDC power used to charge the batteries and support the critical load. If voltages other than –48VDC are required, converters and/or inverters connected to the –48VDC power system are used. The batteries are sized to protect against power interruptions caused by AC power or rectifier failures. Back up generators may or may not be permanently sited.

The Communications Convergence

Two factors have combined to change the power protection needs of telecommunications applications forever. One, as mentioned, the critical nature of the applications has increased. Certain operations simply can not be shut down for any reason, for example, a “911” call center. Two, the convergence of information technology and telecommunications networks has created a whole new “communications” environment, and therefore a new set of challenges. Instead of supporting telephony services across a geographic area, that same local telephone network may now provide access to the Internet. Similarly, telephone services can now be provided through cable. Modern telecommunications facilities are faced with a dilemma: powering this new variety of equipment as reliably and economically as possible, protecting against threats to these convergent systems that are many and diverse. The birth of co-location facilities is an example of the growing need for both AC and DC power in a secure, configured space. *Identifying the threats.* The first concern of virtually any facilities manager is the ability to ride through power outages. Another factor is proper cooling. When computer systems left the security of the “glass house” computer room, they also left behind the environmental protection that was so vital to their proper operation.

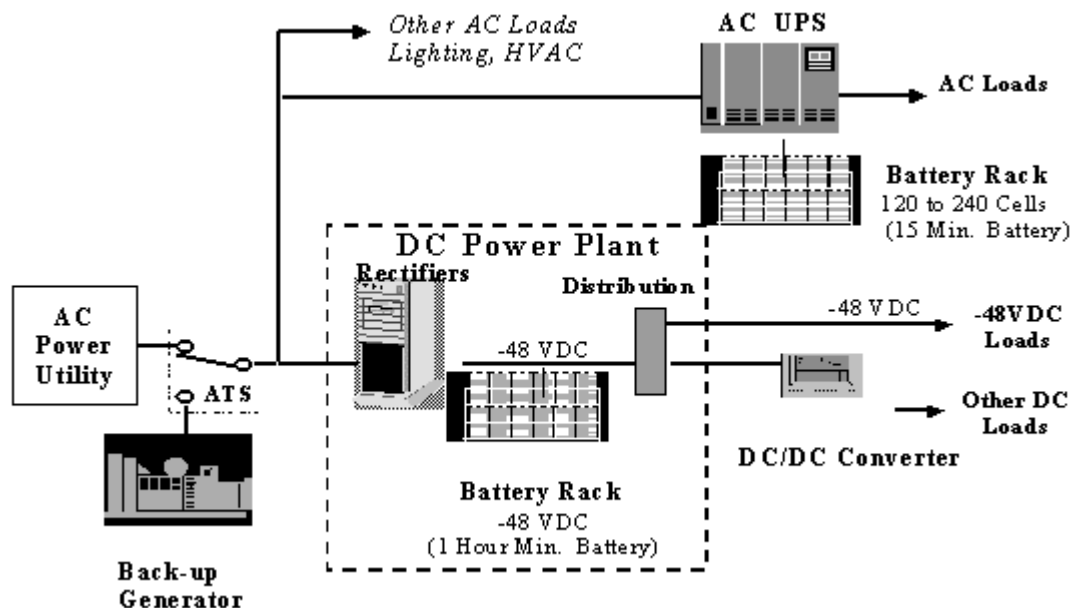
Telecommunications equipment is sensitive to environmental threats as well. Excessive heat can damage or impair the operation of critical systems and peripherals. Constant uptime of networks that include both computer and telecommunications cannot be achieved unless environmental protection considerations are factored into the equation. Simply put, sensitive computer and telecommunications equipment works better in an optimal environment. This can be far different from the “comfort” air-conditioning experienced by people. It doesn’t necessarily require a glass house, but it does often demand an environmental protection system that delivers round-the-clock performance.

Developing a power protection solution. Today’s converging communications networks often requires facilities managers to accommodate equipment that requires an AC power source. The AC power can be derived by way of inverters powered from the –48 VDC power system. An alternative is the use of an AC UPS, which is often more straightforward, efficient, and lower cost. In comparison to DC systems, AC UPS uses higher voltage batteries, provides regulated voltage output, is available in higher power capacities, and allows for longer power distribution distances.

But it isn't as simple as placing any AC UPS into your existing set up. As networks grow with stunning speed and unpredictability, power quality and environmental factors become much more complex issues. It is important that the AC UPS provide power as reliably as the associated DC power system. In many systems, the DC powered equipment is not fully operational without the AC powered equipment and vice versa. It is, therefore, important to take a total systems approach.

Next Page: Figure # 2 - DC Plant & AC UPS

Configuration 2 - DC Plant & AC UPS



The conventional telecommunications power system approach employs inverters powered from the -48VDC power plant to supply the AC-powered loads. To achieve high levels of power reliability and availability, four or eight hour battery back-up times are typical. This approach is not always appropriate for facilities where a significant amount of electronic loads require AC input power. The conventional information technology facility relies on AC UPS systems with 15 minutes of battery back-up time supplemented by permanently sited standby generator systems. Clearly, a systems approach to the entire facility power requirements is needed to optimize the costs and provide the desired level of reliability and availability at facilities having both AC- and DC-powered equipment.

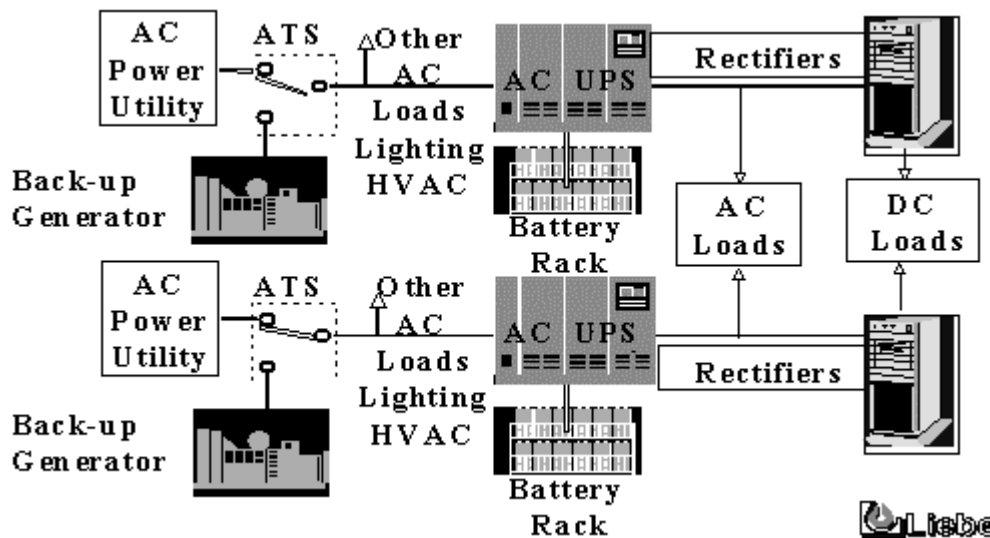
A System Approach - Today's best solutions

To avoid compromising the availability of load equipment, the power system needs to be about 10 times more reliable than the load equipment. Therefore, redundancy in the power system is required. To facilitate implementation of the power system redundancy, a number of critical telecommunications and information technology equipment is available with dual input power connections.

In its basic form, distributed redundancy involves creating two (redundant) power protection system busses and redundant power distribution systems. This eliminates as many single points of failure as possible, all the way up to the load equipment's input terminals. In order to provide "fault tolerance," some method of allowing the load equipment to receive power from both power protection busses must be provided. To protect against fast power system failures, such as circuit breaker trips or a power system fault, either dual input load equipment or very fast transfer switches need to be applied between the two independent power sources to eliminate any common failures. A number of distributed redundant power distribution configurations have been devised. For today's large convergent telecommunications facilities, that is, those with large, high-availability information technology equipment, dual redundant UPS system with redundant AC power distribution have been deployed.

Figure # 3 – Dual Bus, Distributed Redundant AC UPS System

Configuration 3 - Dual AC UPS Hybrid



With large, convergent telecommunications facilities, an emerging power system configuration is the use of small distributed, redundant DC rectifier systems supplied from large dual redundant AC UPS systems (see Figure 3 above). Small, self contained DC rectifier systems along with AC Power Distribution Units (PDUs) can be located throughout the information technology data center to supply either AC- or DC – power to the load equipment. The “best practices” of large information technology data centers are merged with the DC power systems of telecom facilities to optimize the cost and reliability. Redundant, standby generators can be used to provide dependable power in the event of a sustained commercial AC power failure.

The Importance of Support

Specifying and maintaining a high level of power availability absolutely require access to a number of support services. Preventative maintenance is critical to long-term effectiveness of a power protection program. This includes regular testing, checking the battery plant, verifying that the UPS and rectifiers are operating properly, and a thermographic survey of selected equipment and connections to prevent failures in the electrical systems. Telecommunications sites, particularly if they are unmanned or remote, need thorough periodic reviews. These reviews should be included in an effective power protection program, to prevent problems or recommend corrective actions.

Summary

Different applications require different solutions. Applications involving almost exclusively – 48VDC powered equipment, like central office applications, need to follow the traditional telecom DC power system Model. Applications involving almost exclusively AC – powered information technology need to follow the traditional AC UPS power system Model. In applications where there is a significant mixture of co-dependant AC - and DC – powered equipment, hybrid power systems are required. A systems approach borrowing the “best practices” of both AC and DC power systems need to be employed to achieve a cost effective and reliable hybrid power system.

About Liebert Corp.

Liebert Corporation (www.liebert.com) is an independent subsidiary of Emerson Electric Co. (NYSE: EMR) and is headquartered in Columbus, Ohio. Liebert designs, manufactures and distributes systems that control temperature and humidity, condition power and guard against outages in data centers, telecommunications facilities and Internet hosting facilities that all house sensitive electronic equipment. With strategic locations in 150 countries and the largest dedicated representative and service network in the world, Liebert continues to lead the industry. Frost & Sullivan reports that among UPS end users, Liebert is the leading manufacturer in brand use among *Fortune 500* companies. In precision air conditioning, Liebert is the supplier of choice for the *Fortune 1000*.

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