

How to design the power supply for data centres and airports while megawatts of loads rise fast

Traditional LV vs MV Distribution

The first choice for service and distribution voltage is almost always 480 volts. Why is that? Well, it's because it's traditional, it has a safe design and specifications are already written around 480 V. UPS and backup aggregate equipment are readily available at 480 V. It seems that everything fits. But it's not. Let's take a closer look at why this does not work well for all facilities.



Despite the economic slowdown worldwide, one area of business investment that continues to post strong growth, year in and year out, is mission-critical applications, such as **data centres and hospitals** – which inevitably increases the infrastructure's size.

As energy prices continue to rise, harnessing power-related costs has never been more essential. Now is the time for companies to take a closer look at those tools specifically engineered to ensure such facilities maximize their power needs.



Think about the typical everyday data consumption of businesses and people: Nowadays, everyone expects their Netflix to start streaming instantly, their Amazon buy to go smoothly, real-time education software, education courses, video chats with Grandpa, and regular email with attachments. This data needs to be created, handled, and kept.

The modern user wants their information now, but they don't necessarily comprehend or appreciate **the massive infrastructure required to keep it all or send it around the world.**

Any supporting power infrastructure must have the backup required to minimize damage. An effective uninterruptible power supply (UPS) system and backup generator are the foundation of the system.

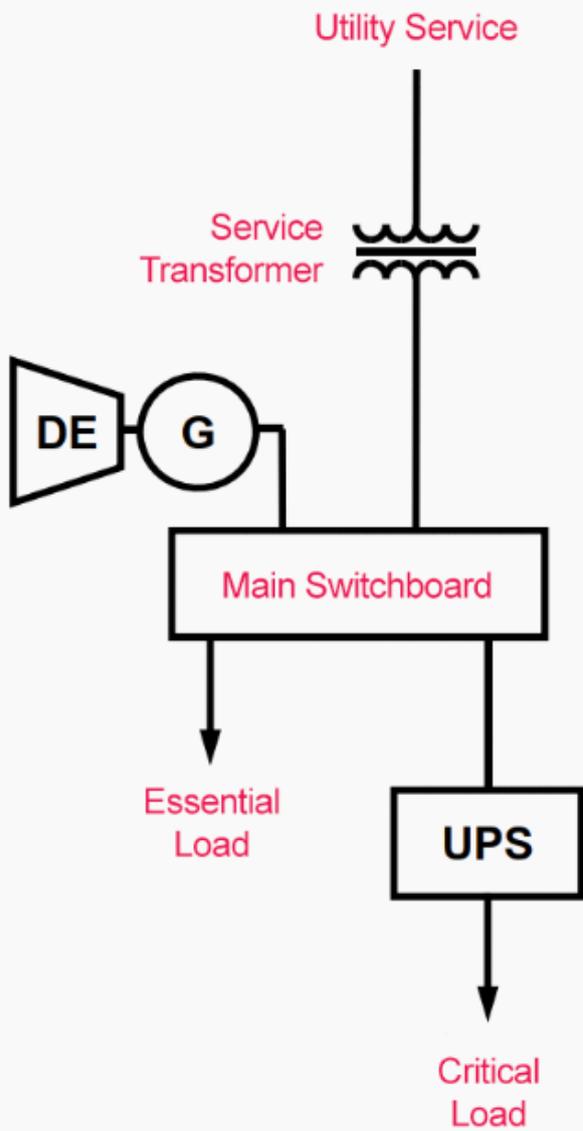
A device called a UPS, sometimes known as "**battery backup**", allows data centres to continue operating while switching to a generator or another dependable power source.

1. Typical Commercial Design of Power Supply

Typical commercial design of facility power supply comprises a utility service (commonly medium voltage), pad-mounted or [distribution step-down transformer](#) with LV underground secondary feeder, main switchboard with service-main breaker and optional backup diesel engine generator and transfer devices.

Some facilities optionally might have a UPS system to carry critical loads through switching transfers.

Figure 1 – Typical commercial design of a facility power system



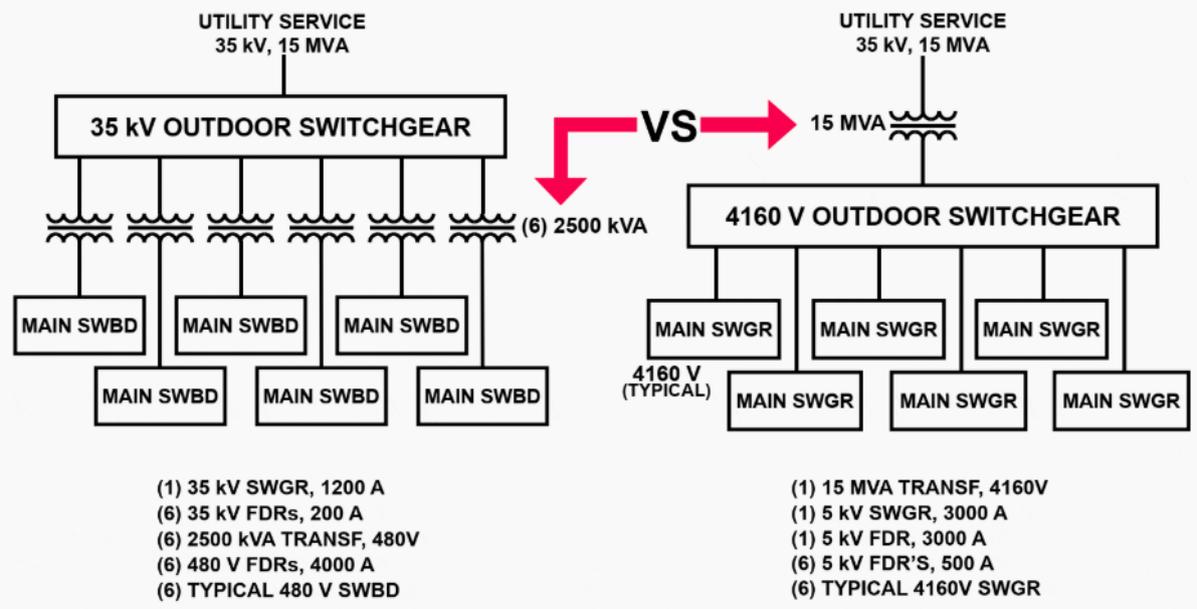
2. Medium Voltage UPS Technology

The trend in the internet and IT industry toward big data centres necessitates an increase in the need for high dependability electricity at single locations. Large, crucial industrial processes are becoming more and more dependent on a degree of power quality **that is not available from the public grid**.

Because a low voltage distribution with its high current levels is **technically and financially impractical**, the electrical power distribution within those installations is carried out using medium voltage technology.

Figure 2 outlines how large systems allow transformer consolidation and lower costs due to the different configuration.

Figure 2 – Comparison of power supply designs



Similar to the medium voltage UPS, a centralized high power uninterruptible power supply (UPS) system is a practical technological option, especially if it is built with an integrated diesel rotary UPS (DRUPS).

Due to the fewer required transformers, **medium voltage UPS technology decreases space requirements and distribution losses downstream of the UPS**. Using a high grade UPS system keeps short circuit currents to a tolerable level while maintaining a high level of power distribution dependability.



By paralleling two or more high power UPS or DRUPS systems on a single common output bus in a **N+x configuration**, the MV distribution eliminates the need for a sizable number of low voltage switching devices to provide redundancy.

The grid-to-load interface of a line interactive UPS can be switched from low voltage to medium voltage components using its [modular design](#), but the UPS's core components and storage remain the same. This maintains the positive and comfortable experience with the operation and upkeep of a trustworthy LV UPS.

Aspects of space and electrical loss are described, along with designs that have been implemented in the actual world for a data center, an airport, and a semiconductor factory.

3. Power Demand & Distribution in Today's High Power Applications

Over the past ten years, the enormously expanding E-commerce industry has increased the amount of physical space and electrical power needed to run data centres. Then, when the power density in kilowatts per m² increases, consequently, **cooling power becomes a pressing concern**. Customers and operators of those data centres demand an uninterruptible power supply (UPS) system to provide a safe and dependable power supply.

Because of the possibility of thermal runaway, UPS frequently provides all required electrical power. One to three megawatts were needed for a typical data center in the early 90s, but currently, ten to fifty megawatts per installation are quite common.



Additionally, businesses in the chemical, food, and semiconductor industries need a safe power supply more frequently because **they cannot accept significant production losses** brought on by mains interruptions.

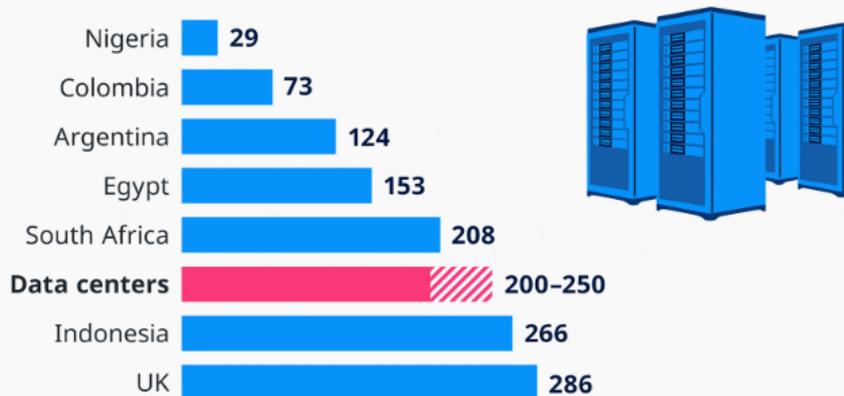
The need for a secure power supply of up to 40 MVA has increased as single locations have gotten bigger. Additionally, the manufacturing area is frequently spread out, necessitating the distribution of a large amount of electrical power across the space.

Long distances in the power distribution also have to be overcome in applications like [airport runway lighting system](#).

Figure 3 – Comparison of electricity consumption among countries and datacenters

Data centers use more electricity than entire countries

Domestic electricity consumption of selected countries vs. data centers in 2020 in TWh



4. Limits of LV Distribution in High Power Applications

What would be the solution?

At low voltage system levels of **400 or 480 volts**, the common bus quickly reaches its maximum capacity of about **5 MVA**. The capacity of busbars and breakers, which is around **6000 A** on one side, and the switchboards, which normally have a short circuit capability of **100 kA** on the other, are what limit the power to **5 MVA**.

Higher ratings for both will cause the switchgear's costs and dimensions to soar, and the market's supply of the parts will be severely constrained.