Modular Power and Cooling Utility in a Box

Driving Efficiencies through Rapidly Deployed and Right-Sized Power and Cooling

White Paper 101

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Objective

This paper discusses the reliability improvements, efficiency and financial gains to be had in an integrated continuous power system. The system is focused around a flywheel UPS system electrically coupled with a standby generator using standard switchgear. This type of approach can be deployed in a ISO container as a system level approach.

Introduction

With the cost of electricity and data center power consumption exponentially rising, it's no surprise industry is turning towards green initiatives. Organizations that deploy environmentally sensitive technologies are doing their part to reduce the impact on the environment. But at what cost? According to a recent Gartner report, U.S. companies spend as much as 10 percent of their total IT budget on power and cooling. With such a substantial amount spent on just power and cooling, data center operators are under tremendous amount of pressure to make a solid business case for going green. Will the installation of green products reduce energy costs and lower total cost of ownership?

And what makes a data center green? Is the data center green just because the organization states it is? Of the 61 billion kilowatt hours consumed in 2006, 11 billion kilowatt hours is attributed to uninterruptible power supply (UPS) losses as a result of underutilized or simply inefficient UPS systems. The vast majority of these losses can be reduced by as much as 86 percent in best case scenarios. This sort of savings would perk the ears of any CIO and CFO, but to realize these savings operators need to focus on designs that center on system efficiency, interoperability, right-sizing and the use of renewable energy sources. These four factors serve as guidelines to achieving a green data center.

System Efficiency

System level efficiency is critical in achieving a high overall efficiency and a number of energy efficient UPS systems are available on the market today. The challenge is to see past the 100 percent load efficiency number listed on the specification sheet and focus in on the partial load efficiency. To be fair, most UPS systems in an Uptime Institute classified tier IV facility run at loads of 40 percent or less due to redundancies and failover strategies. Electronic Power Research Institute (EPRI) research suggests the average load factor of UPS systems in the field is 37.8 percent which results in efficiencies as low as 81 percent. In contrast, an integrated flywheel UPS system is 98 percent efficient at 100 percent load and 94 percent efficient at a partial 40 percent load.

According to The Green Grid, UPS losses represent 18 percent of overall consumption. Deploying high efficient UPS systems alone will not address the complete issue. In engineering, 1 + 1 always equal 2. In marketing, 1 + 1 should equal 3 or more. In the data center, 1 + 1 often equal 1.5 or less.

Similar to SUN's Project Blackbox, a pre configured, fully contained data center, power and cooling technology has evolved in much the same manner. Containerized power and cooling systems that include UPS, switchgear, standby generator and chiller systems are nothing new. What is new is sustainable and highly efficient containerized power and cooling systems. The inherent Achilles heal of a containerized power system has been the chemical batteries. By nature of the design, a containerized power system is more often than not deployed outside, exposed to the environment. The telecom industry is painfully aware of the challenges with chemical batteries, fluctuating temperatures and frequent discharge cycles.

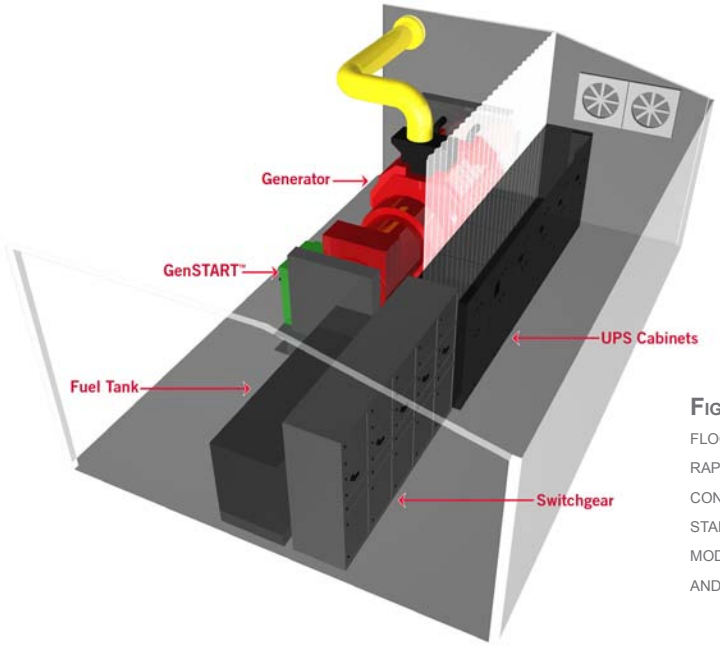

Figure 1: To maximize revenue generating floor space, operators are turning to a rapidly deployable, streamlined, space saving containerized package made up of fuel-fired standby generators, UPS, generator starting modules, switchgear, power distribution units and more.

The integrated flywheel based UPS system, on the other hand, exhibits no level of degradation as a result of the environment due to its ability to operate in a wide ambient temperature range (0 to 40 degrees Celsius). Additionally, a mechanical and dynamic system is far more predictable given its vast network of more than 150 telemetry points, providing an accurate picture of system performance for every flywheel revolution. At 98 percent efficiency at full load and 94 percent at a partial 40 percent load, it is far superior to most of its legacy peers.

Interoperability

Interoperability between systems is often an ignored area from an efficiency standpoint, but is paramount when ensuring the reliability of the system. The bath tub reliability curve receives significant scrutiny and rightly should given the mission critical nature of the data center. The mistake is often made to couple two or more efficient products together to create a system. However, the end result from an efficiency standpoint is much worse than where one started. For example, two 92 percent efficient systems connected in series equals (0.92 x 0.92) 85 percent!

The deployment cycle of a 10, 50 or even 100 megawatt data center can be 18 months or longer. Economies of scale on up front costs are achieved by constructing larger power systems. However, this approach often results in installed capacity that is in orders of magnitude larger than the demand or IT load. Partial loads result in very low system efficiencies, although close to full capacity (40 percent) will be reached at some point in time in the data center lifecycle.

Interoperability between the integrated flywheel UPS, switchgear, standby generator and chiller is ensured by a pre-fabricated containerized system where design, quality control, testing, construction and verification is done at the factory rather than on-site. This saves valuable time during the implementation and deployment of the system on site.

Right-sizing

The ability to manage and optimize IT loads in smaller and isolated blocks makes up for a significant savings. In fact, Active Power studies show an accumulated savings of more than $3.2 million over 10 years on efficiency improvements alone is realized when right-sizing the infrastructure using containerized and modular power infrastructure deployed in as demand grows. Right-sizing the infrastructure to the load has the most impact on physical infrastructure electrical consumption. The greatest challenge in right-sizing is that brick and mortar build outs take time, a lot of time. By the time permits are pulled, constructed, verified, tested and commissioned for the next phase in a data center, power demand would be equivalent to the following, third, fourth or fifth phase.

Right-sizing using a brick and mortar approach is far less agile than standardized, rapidly deployed containerized power and cooling systems. Individual sizes can range from 200 kilowatt up to 3 megawatt depending on the extent and pace of the deployment. Rapid deployment is partly achieved through relief from construction permitting and avoiding potential labor and union issues, but generally attributed to the lack of brick and mortar.

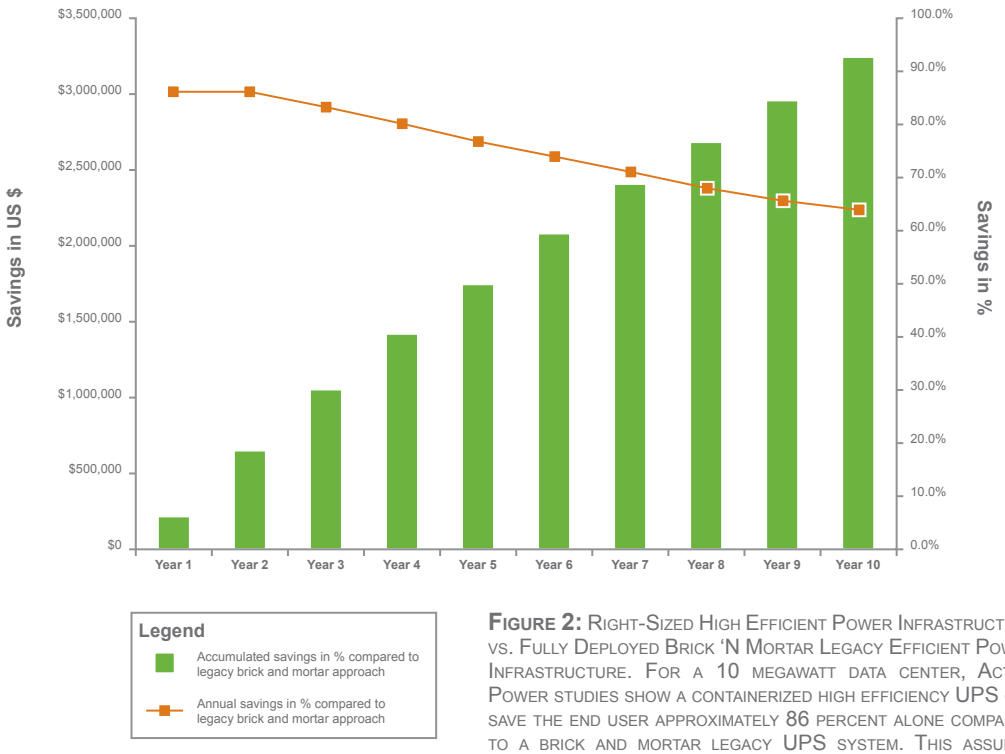

Figure 2: Right-Sized High Efficient Power Infrastructure vs. Fully Deployed Brick 'N Mortar Legacy Efficient Power Infrastructure. For a 10 megawatt data center, Active Power studies show a containerized high efficiency UPS can save the end user approximately 86 percent alone compared to a brick and mortar legacy UPS system. This assumes energy prices remain constant, which would further increase savings if anticipated increases were factored in.

Renewable energy sources

61 billion kilowatt hours cost approximately $4.5 billion or about $0.07 per kilowatt hour. Reversing the rampant energy consumption trend and ultimately realizing a reduction in kilowatt hours consumed may be great for the environment, but may not do anything to the $4.5 billion spent. With oil prices at approximately $90 per barrel, a reduction in cost per kilowatt hour is unlikely in the near future.

Coal power production will reduce dependence on foreign energy sources, but will become burdened with the costs associated with carbon capture and storage to reduce climate impact. Nuclear power is likely to become a more significant contributor to U.S. energy production, but its ability to do so with predictable cost remains to be seen. Public sentiment on the development of new nuclear power plants has not been tested in nearly thirty years and heightened security and environmental concerns associated with radioactive waste disposal will continue to put pressure on this industry. One thing for certain is future electricity costs will continue to rise. Renewable energy sources such as solar, wind and hydro power are often purchased at a premium. However, fossil or nuclear fuels will reach a level where renewable energy sources will become attractive as a 100 percent replacement or, probably more likely, as a substitute in what would be peak-shaving.

Renewable energy sources play an important role in containerized system design. Coupled with a containerized data center, organizations help replace the dependence on fossil or nuclear fuels or as a partial substitute and/or peak shaving to reduce grid power consumption and cost per kilowatt hour.

Figure 3: A containerized power and cooling system in conjunction with a mobile containerized data center such as SUN's Project Blackbox can be strategically positioned anywhere in the world to achieve maximum benefit from available renewable energy sources such as solar, wind and water power.

A containerized power and cooling system utilizing an integrated flywheel UPS at 98 percent efficiency combined with a standby generator and chiller plant cater to all four factors in achieving greenness in the data center – systems efficiency, interoperability, right-sizing and the use of renewable energy sources.