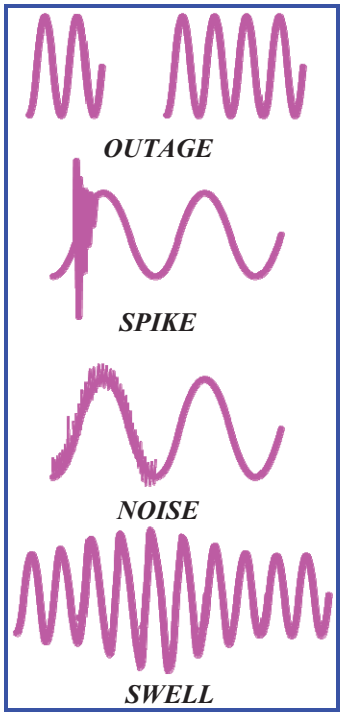
Tech Byte 25: UPS Systems - Key To Ensuring Business Continuity - Part 1

Why Uninterruptible Power Supplies Are A Necessary Component For Protection Of Any Business Critical Application.

"I don't need a UPS system, I have a generator…" This is one of the most common misconceptions that business owners or managers have when evaluating power protection for the critical elements of their business. They often agree that they need protection against outage conditions, but they do not fully understand how stand-by or back-up power systems operate when utility power fails. What does happen when utility power fails? Is your generator normally running at all times? Is it readily available so that when utility power fails, it can immediately provide power to the critical load without an interruption? No, that is not how back-up generator systems operate. Whether you have a generator or not, you will have a load outage when utility power fails, unless you have a UPS system. A generator simply guarantees that you can get back on line AFTER the outage without having to wait for the utility to be repaired. Uninterruptible power supplies perform a critical role in the process of ensuring power availability and power conditioning to a given critical load, that cannot be provided by a generator system or the utility provider alone.

In a nutshell, A UPS system provides the following significant benefits to a business-critical connected load:

- A UPS provides an instant, reserve power source to its connected load upon a utility source failure.
  - *The connected load sees no power loss between the time the utility fails and the UPS engages its back-up power source.*
- A UPS provides a limited duration power source (batteries or flywheels) to either:
  - Ride thru the outage.
  - Hand-off to the facility generator source when faced with an extended duration outage.
  - Or allow for an orderly shutdown in the absence of a facility generator when faced with an extended duration outage.
- Many UPS systems offer complete power conditioning to protect the connected load.
  - This includes protection against sags, swells, spikes, noise, surges, frequency deviations, and single phasing.



Common Power Quality Anomalies, Corrected By Many UPS Systems

Why are these benefits important? They are important because they provide a means to business continuity. They allow for a business to maximize their investments in their critical technology and processes. Downtime of these systems costs businesses money. Unfortunately, the modern power grid does not adequately support critical operations – and it appears to be getting worse. Electricity demand has jumped 30 percent over the past 10 years, while transmission capacity has increased only half that amount. As seen in August 2003, a strain in one location can cause the whole system to buckle. Consequently, each organization must create a power infrastructure that can deliver the power quality and reliability their critical systems require.

Managing the availability of critical systems requires an understanding of the risks and costs of losing access to business critical information or services, balanced against the cost of achieving a certain level of availability. The main challenge is understanding the actual costs of downtime to a business as a whole. Many businesses are still, to this day, unaware of the actual costs of power loss to a critical element of their business. This is mainly because of the ripple effects of the outage, and how downtime of one process affects interlinked levels of the business. Downtime cost considerations need to include:

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- Damage to mission critical data
- Impact of downtime on organizational productivity
- Damages to equipment and other assets
- Cost to detect and remediate systems and core business processes
- Legal and regulatory impact, including litigation defense cost
- Lost confidence and trust among key stakeholders
- Diminishment of marketplace brand and reputation

"Downtime" duration does not often equal utility "outage" duration. The vast majority of critical systems can not be restarted instantaneously. A five second outage can lead to hours of downtime...

It is important to note that power disturbances can disrupt business activities well beyond the actual length of the outage because a majority of critical systems can not be restarted instantaneously. The resulting downtime means lost production, revenue, and/or sales that the business can not always make up later. This also leads to another misconception related to the need for UPS systems: Many individuals associate power outage with downtime. This is most often not the case. We cannot assume that our critical systems will ONLY be down for the duration of time that the utility is out. Downtime represents the amount of time necessary to fully RECOVER systems from the outage event and get them back to full operation. Let's use a simple example: If you were to pull the plug on your PC workstation and then reconnect it in 10 seconds, are you instantly back to the state of productivity you were at before you pulled the plug? Or, do you have to reboot and re-launch your applications in order to get back to your original state of productivity? Also, what if you had not saved your work before the plug was pulled? In reality, it would take a matter of minutes or possibly hours, not seconds, to get back to where to your left off.

Knowing this, consider the same situation applied to a computer room. A hard shut-down of a computer room could take an hour or more to recover from. During this time, the business IT infrastructure would be unproductive and disrupting the continuity of the business.

Perhaps not knowing what the downtime costs are for a particular business, let's look at the costs of downtime from a local, geographic perspective. EPRI (Electric Power Research Institute) created a research paper entitled "*The Cost of Power Disturbances To Industrial & Digital Economy Companies*". In this paper, EPRI breaks down the costs, by state, of outages on Industrial and Digital businesses. As we can see on the table to the right, Michigan ranks in the top 10 nationwide in annual costs incurred due to power outages (over

State	Aggregate Annual Outage Costs for Sectors Surveyed ($millions)	Estimated Annual Outage Costs for All Sectors	
		Low Estimate ($millions)	High Estimate ($millions)
CA	$5,170	$11,489	$17,808
TX	3,124	7,339	11,553
NY	2,983	6,932	10,881
FL	2,297	5,265	8,233
PA	2,087	4,948	7,810
IL	2,015	4,499	6,983
OH	1,910	4,348	6,787
MI	1,559	3,765	5,971
NJ	1,482	3,522	5,562
NC	1,427	3,247	5,067

EPRI: Top Ten States with Highest Annual Outage Costs

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$1.5 billion annually for sectors surveyed, estimated $3.7 billion to $5.9 billion for all business sectors).

Power quality is also a significant factor in unexpected costs facing today's businesses. In the latest report titled *World Transient Surge Suppressor Market* in August of 2010, Frost and Sullivan provides research data pertaining to power quality related costs. The data used was collected from industry participants, industry experts, end users, regulatory organizations, financial and investment communities, and other related sources. The data was compiled and used to illustrate trends in the market place, demand for SPD devices, and to forecast the future of the industry. A significant finding in this report::

State	Aggregate Annual PQ Costs for Sectors Surveyed ($millions)	Estimated Annual PQ Costs for All Sectors	
		Low Estimate ($millions)	High Estimate ($millions)
CA	$766	$1,659	$2,630
NY	470	1,066	1,710
TX	431	986	1,587
PA	321	741	1,196
FL	318	710	1,135
IL	298	649	1,029
OH	269	598	954
MI	235	552	895
NJ	228	527	852
NC	224	498	794

EPRI: Top Ten States with Highest Annual Power Quality Anomaly Costs

- *"Every year, billions of dollars in revenues are lost due to power-related problems. It is estimated that 50% of the data loss at computer installations is attributed to power quality problems. About 40% is due to transient voltage spikes and the remaining 10% is caused by other factors. More than 60% of transient voltages and surges originate within the facility and the remaining 40% occur outside the facility because of harsh weather conditions and utility grid switching."*

In EPRI research paper, "*The Cost of Power Disturbances To Industrial & Digital Economy Companies*", EPRI also details costs associated with ***power quality anomalies***. These are costs due to all other power quality anomalies EXCEPT outages. In the table above, we can see that Michigan still ranks in the top 10 of states suffering the highest costs due to PQ issues ($235 million annually among sectors surveyed, estimated $552 million to $895 million across all business sectors).

Using the low and high estimates of annual power related costs to all business sectors in Michigan, there is a potential cost savings range of $4.3 billion to $6.8 billion dollars by protecting business critical equipment and processes from outages and power quality anomalies. A UPS system addresses both of these needs.

So now that we understand the need for UPS system protection, let's look at how they work and what UPS sizes and form factors are available in the market.

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HOW UPS SYSTEMS WORK

In the context of a complete power quality and outage solution that includes a generator, the UPS works to condition power under normal operation, and acts as a bridge to the generator when utility power fails. The sequence of operation looks like this:

- **Normal Mode**: Utility provides power to the UPS input. The UPS rectifier breaks down AC power to DC, charges the DC plant, and supplies DC power to the UPS inverter. The UPS inverter creates an AC sine wave output, free from anomalies, to feed to the connected load.
- **Utility Failure Mode**: In the event the utility power feed fails or goes outside of its pre-defined voltage and frequency tolerances, the UPS rectifier stops supplying DC power to the UPS DC bus. The DC bus voltage collapses until it reaches the DC power plant open cell voltage. At that time, the DC plant begins discharging DC power to feed the inverter. The output of the UPS sees no degradation in power during this process.
- **Generator Operation**: When the automatic transfer switch (ATS - Which switches between utility power and generator power and feeds the UPS) sees the utility outage, it sends a signal to the generator to start up. Once the generator has started up and reaches the proper voltage and frequency levels, the ATS switches to the generator source. The generator power is then available at the UPS input. At this time, the UPS will qualify the generator source, and begin to walk its rectifier onto generator power. Once the rectifier starts up, the UPS will stop discharging its battery and operate from the generator input source.
- **Operation With No Generator**: In UPS applications where no generator exists, the UPS will supply power to the connected load for as long as its DC plant has adequate stored power. Once the DC plant is depleted and the utility source has not returned, the UPS initiates a shutdown. UPS battery plants typically range from 5-minutes to 1-hour of back-up time at full UPS load.

The time it takes for the generator to come on line once a power outage is identified can be anywhere from 6 seconds to many minutes, depending on whether or not the generator starts on the first try, or if there are any complex paralleling operations that must take place before stand-by power can be switched onto the critical bus. This is the bridge that the UPS spans. It prevents that initial outage from the time the utility fails and the generator comes on line, and allows critical systems to continue operating normally.

"...Every year, billions of dollars in revenues are lost due to power-related problems. It is estimated that 50% of the data loss at computer installations is attributed to power quality problems..."

Summary

Power quality and outage events significantly impact a business's bottom line, resulting in billions of dollars in annual losses across the state of Michigan. A UPS system is a sound investment for protecting critical elements of a business operation from these events, leading to less downtime and increased revenue.

UPS systems are available in a wide range of capacities, form-factors, and topologies. There are small UPS systems that sit on a desk to provide battery power to an individual PC, and there are facility-wide or large datacenter UPS systems that consume entire electrical rooms. There are also a range of offerings in between. Whatever the critical process, physical space, and/or budget, there is likely a UPS solution to fit the need and offer the benefit of business continuity.

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