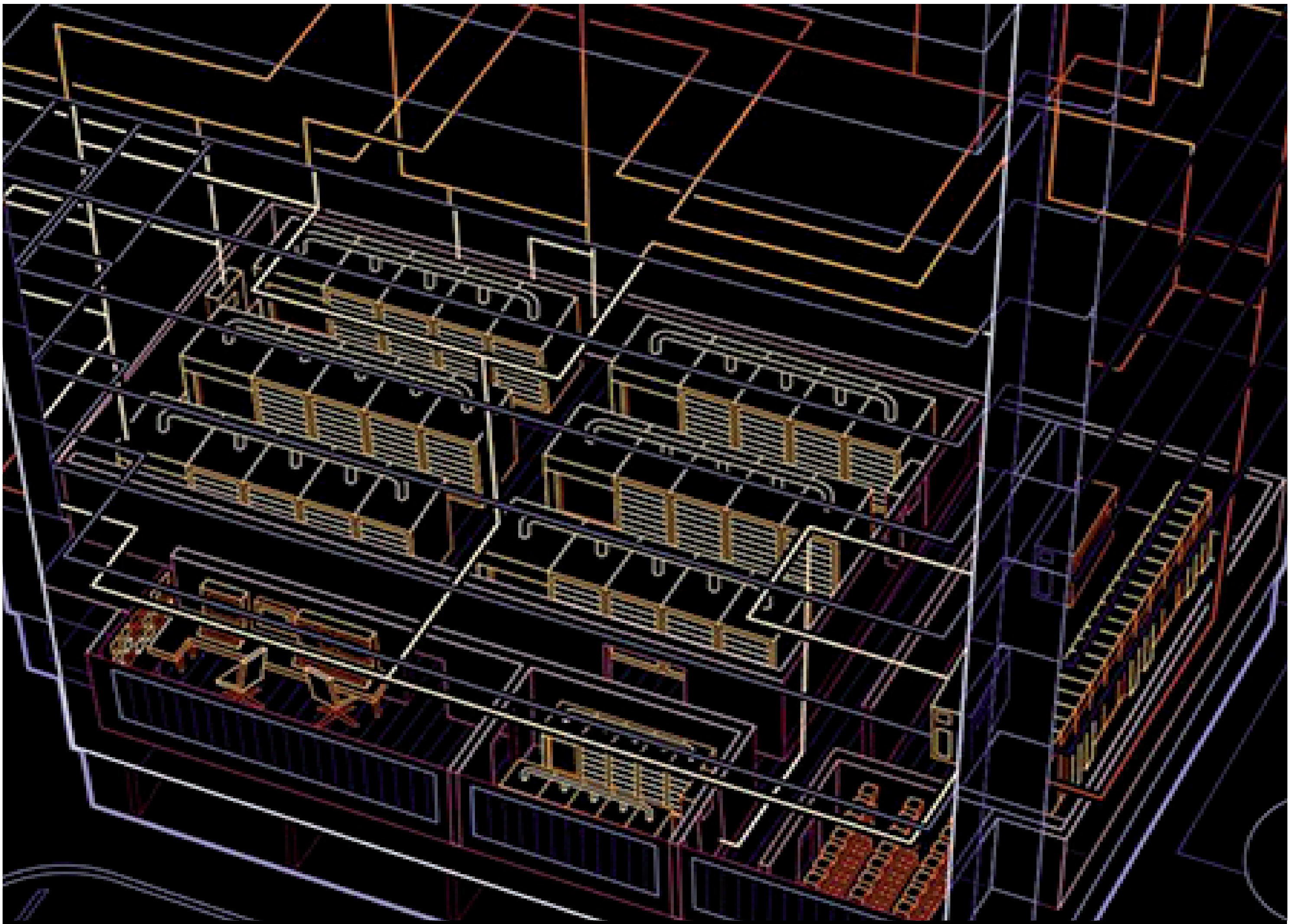

White paper

Improving performance of backup generators

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On June 29, 2012, a sweltering Friday evening before an extended holiday weekend, an intense line of thunderstorms called a derecho swept across the Mid-Atlantic coast.[1] By the time it moved out over the ocean, it had killed at least 20 people and left more than 1.5 million utility customers without power. [2]

Amazon Web Services (AWS) operates more than 10 data centers in the region, one of which experienced two large voltage spikes about 30 minutes apart. Both times, according to AWS itself, the facility's backup generators started successfully. But both times, load was automatically switched over before the generators were providing stable voltage.

In the first incident, the load was quickly switched back to Uninterruptable Power Supply (UPS) units, which supported the servers until utility power was restored a few minutes later.

But the second time, utility power didn't come back. It took about seven minutes for the servers to start losing power, as the demands of the cooling system and servers themselves depleted the UPS. It was another 10 minutes before the generators were stabilized – a short time or near-eternity, depending on one's perspective. [3]

By the time power was restored to all racks, service had been out for 20 minutes – causing a cascading impact as loads were balanced across the network of datacenters. [4]

In the aftermath of the storm, the generators went on to power the data center for more than 30 hours without further incident. But the initial disruption made headlines. AWS has some large and notable customers including Netflix – whose streaming service blacked out as a result of the disruption. Users of Instagram and Pinterest also were affected – temporarily unable to access or share photos. [2]

In its own post-mortem analysis of the event, AWS states that the generators were well maintained and in peak condition. "The generators and electrical equipment in this datacenter are less than two years old, maintained by manufacturer representatives to manufacturer standards, and tested weekly. In addition, these generators operated flawlessly, once brought online Friday night…"

This is the kind of information that keeps data center operators up at night – especially during storms. And it highlights a simple fact that is often overlooked, according to John Levins, business development manager for data centers and infrastructure at ABB: Having well-maintained backup generators does not necessarily assure protection from outages and downtime.

Levins declines to speak directly about AWS, and he emphasizes his only knowledge of these events is from information that is readily available from news reports and other public documents.

But the fact that this outage occurred despite AWS' high degree of care and preparation serves as a suitable backdrop for some important points about gensets – the industry's most common source of long-term backup power.

Full system testing

While generators get most of the attention, they are just one component of an entire backup system that needs to be properly designed, tested and maintained.

"I can go out and start a generator by flipping a switch, but that's not how a generator is going to start during a loss of power," Levins says. "It's incumbent on data center owners and operators to understand the chain of equipment – from the point at which the utility loss is sensed all the way through the transfer equipment, voltage sensing equipment, engine starters and batteries. All those devices are part of the changeover, and you have to test every link."

Many data centers, he says, follow maintenance recommendations from the genset manufacturer, which typically suggest running the generator every month for 30 minutes to an hour.

“This is important. It will exercise the equipment regularly and make sure it’s functioning properly,” Levins says. “But manufacturer maintenance standards are focused on the generator itself. They don’t address the specific intricacies of keeping a data center online.”

Regular testing should begin, he suggests, with a realistic simulation of the kind of occurrence that would require switching over to backup generator power – loss of power or, more realistically, a drop in voltage.

The test should include more than powering up the generators. It should include doing so in a blackout scenario, with an alternative power source to run the starters. It also should include transferring server and system load to UPS units while the generators warm up, and then transferring load to the generators themselves.

“There is an assumption that if your utility power doesn’t work, then your generator will, and you can continue to operate happily the whole way through,” Levins says. “The reality is that backup power systems are complicated and somewhat delicate; they depend on continual maintenance, testing and supervision in order to remain a high-availability asset.”

Specialized commissioning

Another point of vulnerability is whether the backup system is designed for the sensitive equipment that it needs to power.

May data centers – particularly those in ANSI/TIA-942 Tiers 1-2 (reliability standards published in 2005 by the American National Standards Institute and the Telecommunications Industry Association) – rely on the generator manufacturer’s own set-points and thresholds to determine when the backup power will automatically kick in.

But the default values to which generators are set by the manufacturer or installer may not be based on a data center at all, he notes. “Even if a provider has sold thousands of generators into a data center environment, that doesn‘t mean the defaults are set up for a data center.”

This, he says, is one of the more complicated and time-consuming aspects of managing a backup power system. It should be handled internally or – if that skill set isn’t available – by a services firm with specific expertise in the data center environment. Some manufacturers may be prepared for the nuance of this work, but Levins warns against assuming that’s the case.

"When they commission generators, quite often they'll do so by turning off the power. It's a way to find out if everything works and the generator starts up," Levins says. "But what if the problem doesn't involve a complete loss of power? What if the local utility is having generation problems so they've turned down the voltage? What if the problem is caused internally by human error? If you haven't commissioned your generator for these sorts of events, you don't know if it's going to react properly when a real even occurs."

That seems to be in line with what AWS experienced in the June 29 service disruption. In the company's summary of the incident, published on July 2, AWS wrote: "…we will lengthen the amount of time the electrical switching equipment gives the generators to reach stable power before the switch board assesses whether the generators are ready to accept the full power load. Additionally, we will expand the power quality tolerances allowed when evaluating whether to switch the load to generator power." [2]

Understanding system redundancies

Another area of vulnerability is a lack of understanding about redundancies built into the backup power system.

For example, many systems are equipped with a secondary fuel pump in case the primary fails. "But how are they powered," Levins asks. "Are they fed from the same control circuit? If the control transformer fails, then neither pump is going to work.

"Even redundant systems are going to have failure points," he continues. "Understanding these is critical and one of the more overlooked elements of designing and maintaining backup power systems. People tend to think they have a lot more redundancy than they really do."

This level of insight becomes particularly important as runtime from battery systems is trending shorter.

A decade ago, Levins says it was common for data centers to specify 25-30 minutes of UPS runtime. Today that is typically shorter – often to 10 minutes or less.

That's because batteries are costly to buy, maintain and replace, he notes. And as a data center's energy demands increase, the cost to maintain UPS runtime grows too. Most important, according to Levins, there is a realization that if the generator doesn't start up and take over as designed, the chances of solving the problem within 25 minutes are low.

“When backup gensets are switched on to avoid downtime, it’s usually done in the dead of night, or in horrible conditions. Operators recognizer that if they don’t have generator power within the first one to three minutes, then they aren’t going to have generator power for hours. At that point, the purpose of UPS is to perform an orderly shut-down of the servers.”

How can data centers use this knowledge? Those that are installing or updating backup generators can use it to specify a system that will be more reliable in meeting their specific requirements.

Those that already have systems in place can, with little or no further investment, reduce the risk of disruption by building knowledge around these three points.

“If you test and train for real-world scenarios, and make sure the system is set up for the specific needs of your equipment, and really understand its inherent vulnerabilities,” he says, “you’re more likely to achieve what you wanted all along: The generators will simply take over.”

References

[1] The Derecho of June 29, 2012. Retrieved January 30, 2013 from http://www.erh.noaa.gov/lwx/events/svrwx_20120629/

[2] Summary of the AWS Service Event in the US East Region.Retrieved January 30, 2013 from http://aws.amazon.com/message/67457/

[3] Severe storms cause Amazon Web Services outage.Retrieved January 30, 2013 from http://gigaom.com/2012/06/29/some-of-amazon-web-services-are-down-again/

[4] Amazon Blames Generators for Blackout That Crushed Netflix. Retrieved January 30, 2013 from http://www.wired.com/wiredenterprise/2012/07/amazon_explains/?utm_source=Contextly&utm_medium=RelatedLinks&utm_campaign=MoreRecently

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