

CSE Webcast: Specifying the Right Links: Emergency Power for Data Centers
20-Sep-07

Answers to questions not answered during the live Webcast

Note: some unanswered questions have been removed because they were not answered by the panelists.

Question	Responses by Brian Renner, PE, LEED AP, A. Epstein and Sons International, Chicago	Responses by Dennis DeCoster, Executive Principal, Mission Critical West, Redondo Beach, Calif.
Do generators still need to be sized at 1.5x the total UPS capacity?	As a rule of thumb this is a conservative starting point - but consult with your UPS and Generator Sales Rep	Many new generation UPS systems use active front ends employing IGBT rectification. This eliminates filters, THD & capacitance issues on gensets so you can close-size at 1.2 or less.
Does UL 1008 also apply to Medium Voltage Transfer Switches?	No - only to 600 Volts and Below	Low voltage only.
Do you have any experience with High Speed Transfer Switches. We are installing a 11MW switch fed by different substations on different utility feeds. Are these effective in place of a UPS system?	In my experience - no, this is not an effective substitute for UPS or other backup systems.	Historically, there have been problems with large freestanding 1/4 cycle STS. Many of these had to do with applications involving motor loads which are not suited for these due to field hold-up. Other issues involve implied independence of dual feeds only to find they in fact share paths at some point.
If generator alternator is 3 phase 4 wire, but the interconnect to the main switchgear does not use the neutral, should I bond the neutral and ground at the generator?	Yes	Correct.
Are generators for data centers normally specified as standby or continuous rated, vs prime?	Standby is my experience	Since prime ratings are lower, many specify prime as an additional derating factor but standby ratings should be used if proper UPS & load compatibility has been insured.
How often should stand-by generators and ATS be load-bank tested?	Monthly at a minimum in accordance with NFPA 110	Make sure you run at load long enough to reach recommended stack temp (700-750 degrees typically - check with genset provider)
How are phase relationships maintained when paralleling generators?	Synchronizing relays in the gear or in the controllers of the generators	
fuel sizing equation again ?	Rule of thumb 7 gal/hr for every 100kw .	Allow for catastrophic event logistics when planning refuel options and vendor delivery guarantees.
How does an open cell in a parallel battery remove all reliability?		It occurs when a 2 string, <u>non-redundant</u> lead acid battery is used to meet capacity at a 5 to 15 minute reserve. With one string open, the other will not have enough energy to provide any reserve time, not even 15 seconds.

<p>How do the 1000's of components in an flywheels overcome the reliability of a battery?</p>		<p>It is all relative. Many battery systems also have 1000 or more components when straps & connectors are considered. Some flywheels are less reliable than others, but none have the exponential reliability drop-off of aging VRLA batteries.</p>
<p>What is common design watt/square Ft is been used for data center theses days?</p>	<p>It can range significantly and can be tricky 75-250watts or more are seen</p>	<p>Depends upon type of server, floor utilization, cabinet fill, business projections, etc. Some extreme designs actually exceed 300W/ft, but most we see today are designed in the 100-150W/ft range though operating centers typically sit at half that loading.</p>
<p>How do you differentiate between System Design and Equipment Failure?</p>		<p>Not sure I understand the question entirely, But one might say that the design side is at fault if equipment failure levels which should have been reasonably accounted for in reliability projections were not.</p>
<p>Can't generator UPS coordination be benefited by using a UPS with IGBT inverters and converters rather than SCR based units. This would provide low THD as well as eliminating the potential for excess capacitance?</p>	<p>This would be one method. Chokes, filters are others.</p>	<p>IGBT front ends would always be preferred since no "tuning" or excess capacitance or reflected THD is at issue. However, on the largest module UPS building blocks of high criticality data centers, they are not yet available.</p>
<p>Do you recommend flywheel system instead of static UPS system for data center? What is the downtime for maintenance of flywheel compare to static UPS?</p>		<p>Some flywheels need bearings changed every 3 year, some 5, some not at all. Downtime, when required, is anywhere from 3-4 hours to several days for the largest CPS systems.</p>
<p>Are the new UPS systems using power inverter front ends, IGBT's that do not require filtering a solution for the older UPS and cap/filter issues?</p>	<p>YES</p>	<p>Yes.</p>
<p>What about DC bus data equipment?</p>	<p>Being considered, and open to debate at this time.</p>	
<p>I have a 20kW single phase generator feeding a 10kVA UPS. The load on the UPS is 5kW. When transferring to generator, the generators' voltage regulation goes 'wild'. What do you recommend?</p>		<p>Not enough information. Could be the UPS rectifier, generator impedance (subtransient reactance), governor, regulator or a combination. Checkamp inrush & THD to start.</p>
<p>How robust are NiMH or LiOn batteries these days?</p>		<p>Compared to lead alternatives, very robust. Lithium has a slight energy density edge, but nickel is safer & greener. Historically, nickel has an "A" rating not just in critical power, but on laptops, hybrid cars, and many other applications.</p>
<p>Can a UPS be used to keep life support equipment (in a hospital) running until the generator gets on-line in an ICU?</p>	<p>YES</p>	<p>Yes, but be on guard that some UPS vendors do not endorse their products for life support applications.</p>

<p>How can I locate a Fuel cleaning vendor? & How often should the fuel be cleaned?</p>	<p>Check with your local generator sales rep. Cleaning depends on additives used, age, use, and climate.</p>	
<p>Have you considered diode shunts around the batteries for continued capability to deliver power with a open cell in a string</p>		<p>Not worth the cost or complexity in VRLA battery systems which the problem is most prevalent. More cost effective to add redundant strings & change out before too late in life cycle.</p>
<p>When paralleling 3 or more generators connected to a common bus, is it best not to mix 3 pole and 4 pole transfer switches downstream due to the grounding differences required for the generators? i.e., the generators for 4 pole ATS's are treated as a separately derived system and the generators for 3 pole ATS's are not to be solidly grounded as a separately derived system.</p>	<p>If the 3 poles do not have a neutral (i.e. 3 phase 480 systems) it should be fine. If your using them in 480/277 then don't mix grounding schemes.</p>	
<p>Which costs more - battery or flywheel UPS systems per the same kva size?</p>		<p>Complicated answer, but try for a simple rule here. On installed cost, flooded LA battery is about the same as some flywheels, both much more than VRLA. LCC/COO costing varies sharply with applications. Typically, VRLA is the choice under 100 KVA, all three worth a look at 100-500 KVA. Flooded LA, flywheels & nickel more cost-effective at high KVA.</p>
<p>What is the minimum, and maximum optimal ambient temperature range for LA battery systems. Clifford Paulsen Lotte Inc.</p>		<p>Rated performance is typically at 25 C, sizing varies slightly with temp (see IEEE485). Above this, service life gets cut in half for every 8 degrees C so early changeouts become key. At elevated temps, VRLA batteries also face increased risk of thermal runaway. NiCad or NiMH are much better bets at temp extremes.</p>
<p>Pertaining to Tier IV, please explain the difference (if any) between a 2N, system + system installation versus 2 (n+1) which is defined by the Uptime Institute.</p>		<p>A 2N+1 allows extra module redundancy for concurrent maintenance and cooler (derated) operation at higher cost in capital, space and inefficiency over 2N. The problem we have seen with some 2N clients is that with one side down, they become very jittery running non-redundantly (as well they should when "N" is 3 or more!)</p>
<p>How do you deal with high fault currents associated with multiple large paralleled generators as well as MTM systems and closed transition transfers? I have seen a shift away from multiple large paralleled generators lately. Have you noticed this as well? Jim Dayringer, PE Taylor Systems Engineering</p>		<p>In many sites, available fault current from standby gen systems is considerably larger than utility available fault current due to impedance from transformation & distribution with obvious impact on KAIC ratings & bracing. Two redundant gen systems at 2+1 are clearly better than a single 4+1 gen system on both reliability and KAIC, but cost uptick is high.</p>

<p>How do you handle ground fault on load side of large multi-module UPS systems (UPS separately derived system requiring ground fault protection). It seems many designs ignore ground fault under the cover of continuity of service. Doesn't the code as a minimum require some form of ground fault on the load side of the UPS system (greater than 1000 amps)</p>	<p>Your need to do a fault study. GFP is only required on service entrance disconnects and does not apply. Many have avoided GFP to reduce chances of tripping breakers, however the argumnet can be made that if you have it on your main service switch you don't want a downstream unprotected groun dfault tripping the main so adding downstream GFP can reduce this if it is properly coordinated.</p>	<p>Coordination and re-commissioning is key. We have seen more load loss from improper GFP than we can count.</p>
<p>Does the addition of static transfer switches in the power distribution units in a 2N design increase or decrease overall reliability</p>		<p>In our experience, there is minimal advantage and more likely disadvantage from complexity, inrush, sub-cycle sensing and parts count when compared to simplistic non-STS 2N UPS supply to dual cord server loads. In the days when data center loads were largely single-corded, you could make a case.</p>