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Major Healthcare Data Center undergoes Unique Tier IV Infrastructure Renovation to solve Critical Power Problem

by

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This article describes some rather unique construction efforts at the main data center for one the nation's largest health plan providers. We have been asked not to name the data center location or client name due to confidentiality concerns. This data center supports almost 500 hospitals & medical offices through the USA. Of primary concern to this client were the organization's electronic health records whereby members & doctors have access to their comprehensive health information in any medical setting, at any time. Updating and managing these digital records, as well as many other patient billing, R&D, and other functions demands a great deal of real time processing power, power which had run out. So Mission Critical West was called in to handle the fast track critical facilities construction project management effort.

Mission Critical West (MC West) is a highly specialized consulting and construction services firm whose project history is almost exclusively existing live Tier III-IV data centers and similar critical facilities. MC West also ranks as one of the world's leading authorities on UPS & CPS systems, having helped design, install or test hundreds of MW-level battery and flywheel backup systems for Fortune 100 clientele. In this case, MC West was asked to serve as Construction Project Manager through SHG for the accelerated infrastructure additions required at the site.

The data center relied on a 2N+1 solid state UPS system featuring both dual inputs and dual outputs per UPS module as well as parallel flooded lead acid (FLA) battery systems. The total UPS plant was 7.5 MVA not including a separate 2 x 750 UPS plant also installed. These were backed by a 5 x 1750 KW diesel electric generation system and a series of programmable ATS systems. Additions and modifications were also made to PDUs, CRACs, Chillers, EPO, flooring, controls, monitors, fire suppression, etc.

The First Step – Roll-up UPS

First and foremost on the agenda for all parties was relief of the critical load overage that was compromising redundancy, and therefore, reliability of the electrical systems. We needed to immediately off-load or find capacity for some two hundred KW of critical load while maintaining client requirements for system + system redundancy. Several approaches were considered but the one with the most promise involved immediate deployment of roll-up UPS systems. Rental battery-backed UPS was not tenable for this short duty application due to lead acid sensitivity to high temperatures and rigors of rental

yard storage & transit. We therefore decided to go with flywheel-backed UPS with dedicated roll-up gensets & ATS. Large flywheel UPS has some definite disadvantages (short reserve, bearings, lots of moving parts), but these were manageable within the operating matrix we drew up. The temporary UPS configuration allowed a maximum of 240 KW of critical load to be transferred on to two separate UPS-ATS-Genset strings operating in 2N redundant fashion. Loads chosen for transfer were largely R&D rather than production loads since the roll-up flywheel solution was known to be somewhat less reliable than the main 2N+1 site UPS plant.

Roll-up UPS, dedicated Genset & support AC (1 of 2)

Interior of Roll-up UPS Module

Next Step – "Stop Gap" Permanent UPS

Once the overload on the Central UPS was relieved to within acceptable redundant capacity levels, the next step was to insure a reliable incremental UPS plant to accommodate the next year's fast-rising critical loads while the main UPS plant was being upgraded. A new 2N solid state UPS system was designed & installed requiring two new 750/675 UPS modules, support HVAC, switchgear adds, and two new 15 minute FLA battery systems. All went well during this phase of the Design work until we discovered an error made on early approved plans for the existing battery room. FLA battery systems routinely are installed two high on racks two wide, often with two cell jars. 2N adds another "2". It seems that the early designers missed a two somewhere in their calculations and the existing battery room was already well overloaded with existing batteries totaling over a quarter of a million lbs. By the time the new Stop Gap and main UPS battery additions were made, this total would be pushing a half million pounds, well beyond the floor capacity. The slab was undersized but the building's column capacity was more than enough

Over or Under? – A Unique Solution to a Live Battery Room Problem

After much thought and after ruling out any other possible locations for an addition battery room, it was decided to reinforce the slab floor in the existing battery room. But this floor had mountains of 4" & 6" UPS conduit & other pipe hung underneath. So how could we reinforce without risk severe interruptions to data center operations? We devised a unique solution that, to the best of our knowledge, has never been attempted before in a live data center environment. We would use W6 steel to traverse column points and reinforce above slab. At first, this sounded suspect since the battery plants in this high criticality data center needed to stay "up" during any work. But the more we brainstormed it and pre-tested our assertions, the more confident we became in a successful outcome.

Main UPS Battery Room – before reinforcement

We would need a very special hydraulic lifting system, capable of lifting an entire loaded rack in small discrete steps uniformly. And we would need to do so in such a way as to safely withstand an ill-timed seismic event during the lift. The team's riggers & steel erectors came up with a perfect answer, a 50 ton manifolded hydraulic ram system originally built for mission critical aerospace work. We designed failsafes along with seismic movement bracing, scripted and pre-tested, and began the reinforcement work.

Manifolded Hydraulic Lift System

Single rack rams in place

Start of lift

Lift complete – W6 steel installed

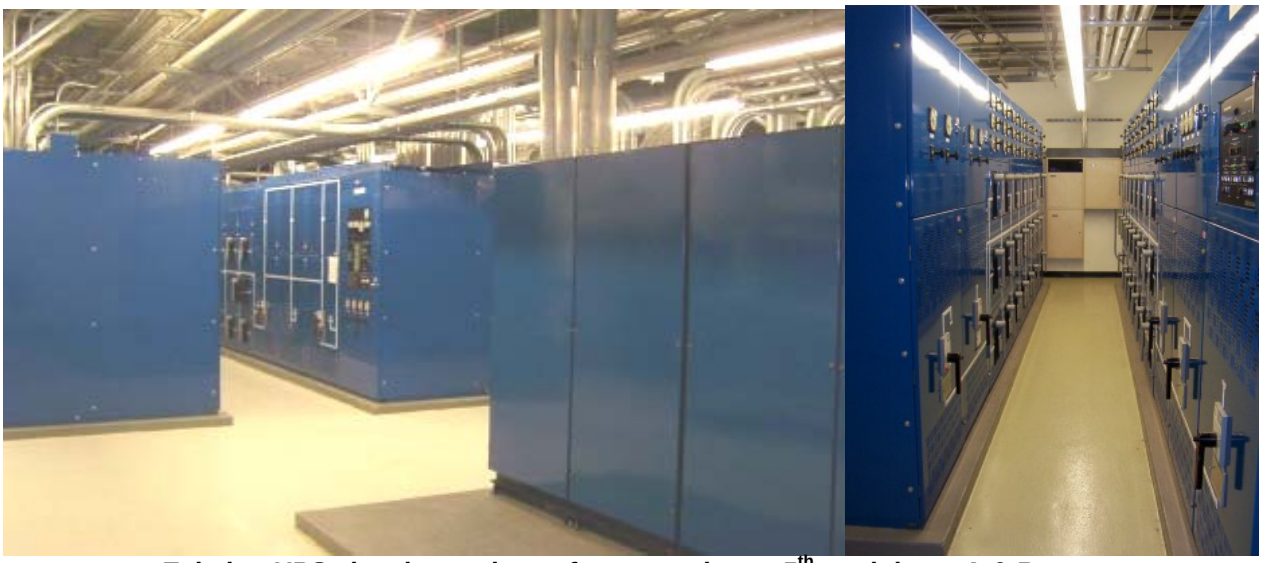
The battery plant was designed using parallel flooded battery strings for both A and B UPS banks. Therefore, some downtime for each bank was necessary to complete work within the DC paralleling boards. The rise in floor height also necessitated modifying the room's HVAC system as well as relocating support systems such as space cell charging stations and the upgraded battery monitoring system.

Addition of grating

Reinforcement complete

The Central UPS Plant

With the battery room problem now resolved, we turned our attention to the main UPS plant. The data center's UPS system was originally designed to be 2N+1 / system plus system. This configuration offers the highest possible reliability and availability to client's critical dual cord IT loads. The existing 2 x 4 x 750 KVA UPS paralleling and bypass switchgear was sized to allow the addition of a 5th UPS module on both A & B buses. We now needed to execute that expansion to accommodate increasing loads while maintaining required system reliability. This system had special option dual input and dual output capability at the module level unusual in systems of this vintage but offering flexibilities in maintenance & availability beyond what single input/output modules offer. We were able to line up two compatible refurbished and re-warranted modules using the services of a team that included the original factory designer/inventor of that technology. The modules were essentially rebuilt and fully tested before shipment to the site.



Existing UPS showing pad area for expansion to 5th module on A & B systems

Finishing up

In order to complete this project, many other upgrades had to be done. New dual input PDUs & RPPs were added. New CRACs and some chilled water system alterations were implemented. Existing Halon fire suppression had to be relocated. EPO and monitoring systems were upgraded. A series of new breakers & switchgear, including new closed transition ATS systems were added. All floor penetrations had to be X-rayed prior to coring, equipment had to be seismically secured, and all work scripts had to be approved by client council prior to execution. Since the infrastructure was over ten years old, extensive re-commissioning was done on virtually all facets of the critical power system.
The final critical power system made operational included 9 MVA of UPS power reflecting a much-needed 3 MVA add from pre-construction to final client turnover.

Conclusion

This project certainly ranks as one of more challenging and more unusual Mission Critical West has ever done. Very fast track but highly complicated critical facilities construction was successfully completed for this client in a live data center environment requiring techniques and resources rarely if ever used in that environment. The combination of real world urgency, Tier IV criticality, extensive client-required scripting & approval, and multiple technical hurdles rank this project near the top of our projects list.

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The Author
Dennis DeCoster is Managing Principal of Mission Critical West Inc., Redondo Beach, CA. Mr. Decoster's articles & publications have been featured in Consulting-Specifying Engineer, Power Quality Magazine, IEEE-IAS, Pure Power, Availability.com, EC&M, the Power Quality Conference, Battery Products & Technology, and many other forums. He can be reached by email for questions or comments at dd@mcwestinc.com or at www.mcwestinc.com on the net.