The essential Data Centre design; planning for disaster avoidance

By Imtiaz Issadeen, Senior Data Centre Project Director; Tokyo, JAPAN

Data Centres (DC) are not similar to the common-or-garden building on sees constructed for office, hotels, apartments or shopping centres. They are simply huge windowless towers, not unlike a monolith.

The role of the DC is imperative to the secure and stable operation of essential services in any country. With the digital era well and truly in place, nearly everything is now controlled by computers. Housing these computers in an optimum environment requires DCs that are well planned, can provide a long useful life and be flexible enough to accommodate a variety of server racks, large memory systems such as SANS or EMC and even the older generation main frame computers.

In designing a DC, the primary task is to determine the power density, the floor loading, the cooling system and security. Many other factors come into play but the previous four are the most essential ingredients that we need to understand, size and plan from day one.

Computer servers are increasing in power demands every few months. With the advent of blade servers, the power per rack today is about 400% of what it was just 10 years ago. An average rack today needs to be sized for 5kVA of power. Probably provided with 2 power sources and even 3 phase power supply for large switches and memory modules.

Such high power demands bring with it other complex issues such as continuous cooling, hot aisle / cold aisle configuration, power and temperature monitoring and fire containment.

Disaster prevention would entail planning redundant power supply routes, Generators, UPS, Static Transfer Switches (STS), uninterrupted cooling systems and a reliable security system.

Let me illustrate a typical design that would be considered essential for a DC today and provide the operators with a stable environment with a life span of at least 15 years.

With cooling under the floor, the raised floor height impacts on the clear height above the rack. Space that is required for the cable trays and in some cases power bus ducts to supply the racks with the different power combinations.

Factors to consider are:

1. The DC Hall slab to slab height which should be designed to a nominal 5.5 meters or more, allowing for 900mm under the raised floor.
2. The Floor loading for any DC Hall should be 1,000 kg/m² on the slab allowing around 25 servers to be loaded into a 47U rack.
3. The Power Density needs to be sized for 1.8kW/ m², which will provide 5kVA per rack, in today's terms this can serve blade or multiple server racks with ease.
4. Power must be supplied from Dual UPS units to the STS and then to the Power Distribution Unit (PDU).
5. Power to the racks will then be supplied from multiple Remote Power Panels located in the server area per se.

Essential Design criteria:

1. Each UPS module will be provided with dual battery strings to support a backup power requirement of 10 minutes end of life capacity. Batteries for each module will be configured in two rows of racks, aligned back-to-back. Each string will have a separate DC circuit breaker to allow for concurrent maintenance without need to shutdown the UPS.
2. Batteries will be 100% rated at full capacity at the time of site acceptance testing.
3. Hydrogen detector systems in battery rooms are required and should be coupled to ventilation systems.
4. Battery Room exhaust system design criteria shall be done with dedicated fans and the required ventilation.
5. The installation of STS units is required to ensure continued power supply to client areas even if there is a failure of the UPS system or in the event of maintenance shutdowns.
6. Electrical Power Monitoring is required at the PDU and RPP level. The ability to monitor power consumption will be highly regarded.
7. All essential equipment should be key lockable with a master key system where possible.
8. The standby power system for each phase will consist of multiple continuous rated, 6.6kV gas turbine generators configured in an N+1 redundant topology. Generators shall be selected in the most economical size taking into consideration service costs.
9. Fuel tanks for the generators shall be sized to provide 72 hours of continuous operation in the event of a power failure.
10. High Voltage Transformers shall be sized to provide the required power to the DC Halls and the support areas even at the maximum power density.
11. Power to the building shall be brought in through the Utility companies mains 66KV loop and the two High Voltage termination rooms separated from each other at either ends of the building or by a two hours fire rated wall.
12. Grounding will be designed in accordance with applicable building codes and telecommunications standards. Grounding system impedance should be no greater than one-ohm, maximum.

13. A grounding loop buried at the building perimeter shall be provided with test wells at each building corner and midpoints to allow for periodic testing of earth impedance.
14. A ground bus shall be installed near a column in each of the computer rooms, electrical rooms, battery rooms, and generator rooms. The ground bus shall be bonded to the ground grid and to the embedded reinforcing steel on the column.
15. A lightning protection system shall be provided in accordance with local standards.
16. The embedded grounding grid shall be extended vertically at each perimeter column and serve as the lightning protection system down-lead conductor for the lightning protection system air terminals located on the roof.
17. The design must include a security system with finger vein biometric recognition system, 10-key pads with scramble and CCTV in appropriate locations.
18. The cooling shall be sized for 1.8kW/ m^2 Power Density in any given Hall.
19. The DC Hall Cooling systems shall be of the chilled water type.
20. Redundancy level shall be N+20%.
21. Single failures of equipment, piping and control systems shall not result in failure of the total mechanical systems to perform the required functions.
22. Component or device failures shall not result in the failure of the mechanical systems to perform their required functions.
23. The Data Center Halls shall be protected by a double shot gas fire suppression system sized to suit the Data Center Hall areas.
24. Where required, under floor gas heads may be required.
25. An early warning VESDA detection system is also required with proper sniffer piping installed over critical areas in the Data Center Halls.
26. A direct digital building automation system for the monitoring & control of the building automations shall be provided to monitor and control all critical and non-critical electrical, mechanical and plumbing systems.
27. The BMS system should run on a secure operating system environment. Windows 2008 for the server and Windows Vista or Windows Seven for the workstations at the minimum.
28. BMS shall interface to the Electric Power Monitoring System to accept critical alarms.
29. The BMS shall interface with the Chiller systems and CRAH temperature monitors etc. to provide required controls and alarms.

Footnotes:

Imtiaz Issadeen has extensive construction experience in Japan and Australia. He has built several Data Centres in Japan and is currently assigned as the overall Project Director to build a Tier 4 class DC for a US client. This will be the most advanced DC in Japan, not just in terms of power density or floor loading but also from an environmental perspective.