Typical Data Center Basis of Design

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This guide is based on the typical requirements for an Uptime Tier III type Data Centre with a Power Density of 1800w/m2 and a floor loading 1000kg/m2. Each Hall =500Sq.M.

This document is to serve as a guideline only and the Architects are required to apply their experience in improving any items herein. Further the Architects are expected to provide items that would normally be provided in a Data Center building. The items below must be considered to be incomplete at all times and to be used as a guide only.

Architectural

1. Construction will be of Reinforced Concrete with an exterior finish preferably of ceramic tile
2. The Ground Floor would ideally be for heavy equipment such as High Voltage Transformers, Chiller plant and so on.
3. The “wet” sections of the ground floor must be recessed by 300mm and properly drained.
4. The Data Center floors will commence from the 2nd floor up to the desired height.
5. The DC Hall slab to slab height shall be designed to a nominal 5.4 meters.
6. Each Data Center Hall shall be approximately 500 Sq.M.
7. The Floor loading for any DC Hall shall be 1,000 kg/Sq.M on the slab.
8. The DC Hall design shall provide for a service corridor to permit maintenance, service and replacement/addition of equipment such as CRAHs, PDUs, UPS etc. without entering Client server areas.
9. Segregated space for the primary UPS units shall be provided on the same floor as the DC Hall. The space shall be contained within a fire walled area of at least 2 hour fire rating.
10. Area provided must allow for the UPS unit that can support a power density of 1800w/Sq.M, supporting AC and DC panels, batteries etc. to be comfortably contained within the space and providing enough room for maintenance and removal/replacement of any of the UPS equipment without impacting on other pieces of equipment in the same area.
11. Where the Halls are clearly separated into 500 Sq.M areas, the UPS units shall also be contained in separated areas, divided by a 2 hour fire rated wall.
12. Connecting doors to ease maintenance and equipment carry-in is permitted; provided these doors conform to the same level of Fire resistance.
13. Future construction will include the completion and fit out of Halls on other floors as required.
14. The design should include appropriate number of toilets and at least one toilet for handicapped use.
15. A loading dock with a hydraulic lifter is required.
16. Adjacent to the loading dock a short term storage room, garbage room and recyclable materials room will be required.
17. Stair wells shall be designed to prevent ease of egress from all floors but prevent unauthorized access to floors.

Elevators

18. Elevators shall be installed as discussed.
19. One passenger unit of 1.3 tons or similar and one passenger cum freight unit of 2.0 tons shall be installed.
20. The selection of the Elevator shall be such that an external roof top motor house will not be required.
21. Elevators shall come with the monitoring systems that can be installed in the BMS monitoring room.
22. Where available, remote communication with the Elevator manufacturer's call center would be a desirable feature and manufacturers who provide such features should be given preference.
23. Interphone systems, seismic automatic stop at next floor, fire marshal key switch and other normally available features shall be installed.
24. The Elevators shall be connected to the Generators and sequenced in the order required by Code.
25. The Elevators shall be equipped with emergency lights of at least 30 minutes duration.
26. The 2 ton elevator should be equipped with a recessed roof to the rear of the cabin to permit tall items such as ladders to be transported in the elevator.
27. Both elevators shall be equipped with hooks for cabin protection sheet to be suspended when goods are being transported. Floor protection is also a desirable feature.
28. One elevator shall be equipped for handicapped persons per code.
29. Security card readers shall be installed in both elevators to prevent unauthorized access to floors.

Electrical

30. The Power Density shall be sized for 1800w/ Sq.M in any given Hall.
31. However the option to upgrade the power density to 2200w/Sq.M must be inbuilt into the infrastructure
32. This would be for a limited section of the building and **not** of the entire Electrical system.

UPS

33. The selection of UPS equipment shall be in accordance with the UPS room area provided as detailed above.
34. Secondary (Backup) UPS units in a 4:1 Block redundancy configuration shall be located in the Machine room or Mezzanine floor as appropriate.
35. If space permits, the backup UPS units could be located in the UPS room on a given floor.
36. Power to the UPS shall be supplied via Bus Ducts and such Bus Ducts contained in dedicated Electrical shafts where possible.
37. Maintenance Bypass and/or Overload power to the UPS shall be supplied from a common bus duct which is sized to handle the full load of any two UPS at any time.
38. A dedicated switchgear lineup will be provided for each UPS room and will serve as the input switchboard feeding the module input circuits.
39. Planned maintenance activities on the UPS systems will utilize the maintenance bypass substation feeder to support or backup the critical load thus maintaining the redundant active power paths to the critical load.
40. 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.
41. UPS rooms shall be provided with the necessary cooling in N+20% configuration.
42. Air circulation in these areas must be maintained to prevent any hot spots.

Batteries

43. Batteries will be 100% rated at full capacity at the time of site acceptance testing.
44. An approved battery monitoring system shall be provided and should be capable of remote monitoring and integration with the general monitoring system.
45. Hydrogen detector systems in battery rooms are required and should be coupled to ventilation systems.
46. Battery Room exhaust system design criteria shall be done with dedicated fans and the required ventilation.

STS, PDUs and RPPs

47. 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.
48. Both systems have UPS output boards (UOS) that feed 415V static transfer switches to feed step down transformers with secondary distribution (called PDUs) , which in turn feed the RPPs in the DC Hall proper.
49. The combination Static Transfer Switch (STS) - PDU units are located in the service corridors adjacent to the raised floor area to minimize secondary cable runs to the RPPs.
50. These 415V STS units shall allow transfer between two sources 180 degrees out of phase, with transformer on the secondary and maintain a clean secondary wave form.
51. The appropriate 7 tap PDU units for a primary voltage of 6.6 kV and a secondary voltage as required to provide power to the sever racks at 100V single phase, 208V single phase and 208V three phase shall be installed in the Service corridor.
52. The RPPs shall be custom built and must be of single voltage design with 42 MCCBs of 50 frame, 30 A (or similar).
53. MCCBs in the RPPs should be of a design that permits removal and replacement without the need to shut down the RPP.
54. Electrical Power Monitoring is required at the PDU and RPP level. The ability to monitor power consumption will be highly regarded. Powerlogic is recommended.
55. All essential equipment should be key lockable with a master key system where possible.

Generators and Fuel tanks

56. The standby power system 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.
57. Each generator will be provided with a duplex output / isolation switch or breaker. Switches will provide feeds to each of the generator switchgear (GS) boards. Failure of any one GS switchgear will allow automatic connection to the alternate switchgear to carry the entire load. Feeders to GS A and GS B shall be installed in separate routes to ensure that they are redundant to one another.
58. Each generator control system will be configured with redundant PLC based controls throughout. There shall be no single point of failure for any communication or control cable path. Loop configuration is preferred.
59. The Generators shall be capable to parallel with Tepco power (if permissible) for short duration “soft loading” such that after a utility outage the return to utility or transfer to generators from utility during maintenance procedures power will not be disconnected. This will increase the UPS battery life and avoid the shut down and restart up of mechanical systems during these transfers.
60. These Generators shall be located outside the building on purpose built concrete bases and surrounded by a security wall.
61. Fuel tanks for the generators shall be sized to provide a minimum of 72 hours of continuous operation in the event of a power failure.
62. Such tank size shall take into account the full number of generators that will be installed in the data centre.
63. If tanks can be retrofitted at a latter date, such installation shall then be phased in keeping with the increase in the number of generators during each fit out phase.
64. Fuel oil storage tanks shall be pre-engineered, factory fabricated, true 360-degree double wall steel, with a FRB outer wall specifically designed and approved for buried service.
65. Fuel oil storage tanks shall be provided with a combined in-tank product inventory and leak monitoring system. All tanks shall be monitored from one system.
66. An automated alarm system that can be monitored off site is required.
67. The day tank shall be sized for a minimum one hours of generator operation.
68. Fuel transfer and handling system shall include fuel tank oil leak detection system for alarm escalation and emergency shutdown valves, solenoids and relays- associated with pump skid and coaxial piping distribution.
69. NS shall determine if local codes mandate a system to be independent or faster responding system than the 6.6 kV standby system. Life safety code requirements for egress lighting, fire alarm and emergency paging will be supplied from a dedicated central battery system or a small UPS system.

High Voltage Transformers, Tepco power supply

70. 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.
71. These transformers shall be equipped with provisions for fans to increase capacity, if necessary in the future. The primary of each transformer shall have a dedicated vacuum circuit breaker and metering instrumentation. All equipment upstream of the service disconnect is to be provided by the utility company and all downstream equipment provided. The details of 66kV switchgear shall be coordinated by the Architects and Tepco.
72. Utility service transformer secondary feeders will feed 6.6kV main distribution switchgear (MDS) in 2N configuration.
73. The HVT shall be in a N+N configuration and the units located in the machine room in segregated rooms properly ventilated and a fire wall established where required.
74. Sufficient room for the HVT breakers and other ancillary equipment shall be provided and the necessary work space for service, maintenance and replacement provided in the design of the machine room area.
75. Power to the building shall be brought in through a Tepco 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.
76. Electrical systems for the data center will be provided in manner which allows for complete concurrent maintainability and fault tolerance through the use Block redundant systems.
77. Each switchgear lineup shall receive power from both HVT-A and HVT-B boards. Main breakers shall be interlocked such that only one of the two power feed breakers can be closed at any time.
78. Switchgear shall be provided with surge arresters and surge capacitors.

Medium voltage and general supply

79. 6.6 kV switchgear will be provided for the following loads and others where required:
    - Primary UPS systems for the data center Halls
    - Block Redundant reserve UPS systems
    - Maintenance bypass equipment
    - Chillers and supporting equipment
    - House and mechanical equipment
    - Any other equipment that may require 6.6kV supply.
80. Electrical Power Monitoring is required at the PDU and RPP level. The ability to monitor power consumption will be highly regarded.
81. House and Mechanical power switchgear will be provided to serve the mechanical loads and general lighting and power loads for the facility and central plant. Where required, redundancy shall be included in the switch gear design.
82. Receptacles will be provided throughout the entire facility for general maintenance purposes as well as in all public spaces, office areas, and raised floor areas.
83. Weather proofed receptacles shall also be provided along the building's exterior.

Illumination

84. Raised floor computer room areas will be illuminated utilizing fluorescent light fittings located over the equipment aisles, all such lights shall be controlled by PIR systems to turn off after a set period of human inactivity.
85. Machine room, UPS rooms, and switchgear rooms will be illuminated with suspended industrial fluorescent lights with reflectors located along equipment aisles. Ease of relocation must be provided.
86. Exterior pathways, roadways, and parking areas will be illuminated with pole-mounted lights.
87. Rooftop areas will be illuminated using fixtures mounted along handrails and cooling tower support steel. Lighting will be provided at levels appropriate for personnel safety and video surveillance.
88. All exterior lighting will be designed with full cut off fixtures in order to minimize light pollution onto adjacent properties and glare on video surveillance cameras.
89. All exterior lighting shall be controlled by photocells via the low voltage lighting control system.
90. All emergency lighting shall be provided in accordance with applicable building codes and shall be fed from a dedicated UPS system.

Grounding

91. Grounding will be designed in accordance with applicable building codes and telecommunications standards. Grounding system impedance should be no greater than one-ohm, maximum.
92. 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.
93. 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.
94. The ground busses shall be located 300 mm above floor level in all areas unless otherwise specified.
95. Where required, a High Frequency Grounding Grid should be provided.

Lightning Protection System.

96. A lightning protection system shall be provided in accordance with local standards.
97. 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.
98. Roof mounted air terminals shall be provided with adequate identification and protection to prevent damage to themselves and others.

Security system

99. The design must include a security system with finger vein biometric recognition system, 10-key pads with scramble and CCTV in appropriate locations.
100. CCTV shall be installed at all emergency doors and machine hatches on the ground level.
101. Cabling for CCTV for each Data Center hall shall be provided for future cameras.
102. Perimeter security to cover the fence and grounds is to be further discussed.
103. Security is to be incorporated into the elevator carriage with only authorized persons being allowed access to the relevant floors.
104. Entry security with metal detection and one flapper gate is desired.
105. Adjacent to the flapper gate a secured door is to be provided for wheel chair access.
106. The design must include a reception desk area with rear or side access to the security monitoring area.
107. Self illuminating color video interphones shall be connected to the main gate, the loading dock, the rear of the building near the fuel area and one point on the roof.

HVAC & Plumbing

108. The cooling shall be sized for 1800w / Sq.M Power Density in any given Hall.
109. However the option to upgrade the cooling for a power density to 2200w/Sq.M must be inbuilt into the infrastructure for a part of the cooling system.
110. The DC Hall Cooling systems shall be of the chilled water type.
111. Where required, auxiliary cooling to racks may be required and the Architects shall provide the flexibility to install such systems, be it refrigerant or chilled water.
112. The design intent shall be to provide mechanical systems which shall be concurrently maintainable and fault tolerant to meet Tier 3+ standards.
113. CRAH units shall be furnished with both supply air and return air temperature sensors. The units will be controlled from the supply air sensor and the 2-way unit control valve shall modulate to maintain supply air set point. Return air shall be monitored.
114. The CRAHs shall be located in equipment galleries adjacent to the Data Center Halls.
115. Return airflow from the Data Center Hall to the gallery shall be used to provide cooling for the PDUs located in the same gallery service corridor areas.
116. Chilled water supply and return headers shall be installed below the gallery raised floors.
117. Redundancy level shall be N+20%.
118. Where a 2N Cooling system is required, the CRAHs will be fitted with supply and return headers from each chiller plant so there are 2 paths of chilled water to the CRAH units.
119. Drain valves shall be provided at each CRAH unit for maintenance work.
120. CRAH unit fans shall be provided with variable speed drives and the speed shall be controlled to maintain under floor static pressure.
121. The server racks in the Data Center Halls shall be arranged in a “cold aisle/hot aisle” fashion.
122. An appropriate system shall be provided to prevent recirculation between hot and cold aisles.
123. Single failures of equipment, piping and control systems shall not result in failure of the total mechanical systems to perform the required functions.
124. The design shall provide for space in the machine room for the installation of the Chillers on purpose built concrete bases or other appropriate base.
125. The Chillers shall be fed from the primary side through a header manifold and on the secondary side shall supply through a header manifold.
126. Cooling towers are to be installed on the roof and need to be appropriately sized.
127. Stainless steel is to be used for the slats instead of PVC coated slats.
128. An automated Legionella anti bacterial fluid feeder pumping system shall be provided. One system is to be provided for each cooling tower. The fluid tank should be sized to provide

enough capacity for at least 3 months.

129. Component or device failures shall not result in the failure of the mechanical systems to perform their required functions.
130. Piping to the various floors should be designed to be able to be shutdown by section without impacting on the whole system.
131. By pass piping and valves must be properly incorporated.
132. Manual air vents shall be provided in all high points of the piping system for purging air during the system fill and startup.
133. Including drain valves where appropriate is important and the design must include for test valves to enable Testing and Commissioning to be performed without any effect on a live DC environment.
134. Chilled Water Thermal Storage shall be provided to ensure continuous availability of chilled water in the event of power failure.
135. The tank shall be of the closed vessel type of steel, polymer or concrete construction.
136. Chilled water storage shall be a minimum of 20 minutes or other amount as suggested by the Architects.
137. Humidification shall be of the ultrasonic type. A Reverse Osmosis or De Ionized system shall be required for treating domestic water for humidifier use. Treated humidification water shall be piped in PVC or other compatible polymer tubing.
138. Liquid Leak Detection Monitoring
    - Liquid leak detection will be provided utilizing a continuous cable type leak detection sensor located along the bottom of the chilled-water piping trench and along the path of the chilled water piping branches and lateral piping.
    - Leak detection will be provided around the computer room air conditioning units.
    - The leak detection will report a digital location that corresponds to a calibrated map of the cable layout.
    - The leak detection system will connect to the BMS and show the location of the leak.

Plumbing

139. Provide Pantries in the appropriate areas
140. Provide Janitorial areas and sop sinks as required.
141. Provide wash down areas in the garbage room.
142. Provide outdoor garden faucets at appropriately spaced intervals
143. Provide the necessary toilets on each floor and one unisex handicapped toilet.
144. If more handicapped toilets are required by law, they should be constructed in such away as to be available to all users.
145. Male toilets to be equipped with electronic flush urinals, one washlet fitted toilet and one wash basin and mirror.

146. Female toilets to be equipped with one washlet fitted toilet, one wash basin and vanity mirror.
147. Wall mounted Air hand dryers are to be included in place of paper towels in any toilet.
148. A hot water system with circulating pump may be required; the Architects are required to consider this matter.
149. Any overhead fluid piping in electric rooms to be provided with pitched drain pans and spot leak detection. Low point of drain pan to be piped to a floor drain or sump equipped with an alarm.

Fire detection

150. The Data Center Halls shall be protected by a double shot gas fire suppression system sized to suit the Data Center Hall areas.
151. Where required, under floor gas heads may be required.
152. Where required by Code, the UPS rooms, Battery areas, other electrical areas shall be protected with the same type of system.
153. There are several types of Gas available and the Architects are required to make a recommendation to the owners.
154. An early warning VESDA detection system is also required with proper sniffer piping installed over critical areas in the Data Center Halls.
155. The Fire detection system is a complex area that is essential to the safe operation of this Data Center. The Architects must ensure that they consider all available systems and provide specifications for a robust system which is modular in design and is readily expandable.
156. Fire extinguishers in the type and size approved by the Fire Marshall shall be located as agreed with the Fire Department.
157. Where required by Code, Fire hydrants / hoses shall be provided.
158. Where required by Code, external Fire hydrants with approved Siamese connections shall be installed outside the building with easy access to Fire pump vehicles.
159. 40 Tons of water, or the quantity required by Code shall be provided in the sub basement of the Data Center.

BMS

160. 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.
161. The BMS system should run on a secure operating system environment. Windows 2008 for the server and Windows 7 Ultimate for the workstations at the minimum.
162. The BMS vendor will need to include all software; operation consoles PC's and printers as required and also cover these areas.
    - Hydrogen detector systems in battery rooms
    - Refrigerant leak detection systems in chiller rooms
    - HVAC control panels
    - FCP - fuel control panels and fuel monitoring systems
163. BMS shall interface to the Electric Power Monitoring System to accept critical alarms.
164. The BMS shall interface with the Chiller systems and CRAH temperature monitors etc. to provide required controls and alarms.
165. BMS shall provide pager output to facility maintenance staff.
166. The BMS shall also be configured to provide Email notification to pre determined and authorized personnel.
167. System to operate on a Web-based communications network with redundant power feeds from electrically separated UPS power sources with connectivity to approved remote sites.
168. The system should be configured to provide pre determined reports in English and Japanese in HTML or RSS format. Access to such reports will be controlled by the Data Center owner / operators.
169. Continuous condition monitoring of equipment to monitor trends and alarms shall be provided.
170. Distributed control modules provided at each mechanical component.
171. Redundant control panels and processors provided as required to insure uninterrupted control. Relays, where required, powered by same source as equipment being controlled.
172. The BMS system is a complex area that is essential to the proper operation of this Data Center. The Architects must ensure that they consider all available systems and provide specifications for a robust system which is modular in design and is readily expandable.
173. Future phase expansions and other buildings on the same property must be taken into consideration.
174. The ability to relocate the BMS to an outside building within the property is required.
175. The ability to monitor and operate the BMS from a second site is required.

Others

176. The Architects are expected to provide their extensive experience in making further suggestion to these basic specifications and improving and expanding on same.
177. At all times, these specifications must be considered as a guide only and should not be viewed as a final document.