

	<ul style="list-style-type: none"> Each Genset with 1000 Lit Day Tank which is fitted with level detection sensors and automatic fuel call system. The total storage capacity of the underground tanks is designed to supply the electrical system during total black-out with 24 hours backup capacity and N+1 configuration for each Wing of the building. The fuel infill system is dedicated with 1 no. of inlet to each tank. Fuel System will be serving up to 48 nos. of Generators' Day Tanks. <p>5 nos. 110,000L (effective capacity) underground tanks for Left Wing and 5 nos. 110,000L (effective capacity) underground tanks for Right Wing shall be provided to supply the system with 24-hour backup capacity and N+1 redundancy.</p>
TVSS – Transient Voltage Surge Protection	<p>Type 1 Surge Protection dedicated for main High and low voltage switchboards.</p> <p>Type 2 Surge Protection dedicated for low voltage sub-boards and distribution boards.</p>
Equipment maintainability and accessibility	<p>Concurrent maintainability is assured at all the electrical system but not limit to the following:</p> <ul style="list-style-type: none"> 33kV HT Switchboards 33kV/415V Transformers Gensets LV Switchboards Uninterrupted Power Supplies, UPS Busbars Data hall IT loads supplies Air-Con loads for Data Hall and Critical operation room Security & BMS System <p>Easily maintainable and/or easily removable components shall be included in the design where concurrent distribution is limited.</p>
Fireman Switch Remote Power off systems	<p>Fireman Switch Remote Power off system shall be provided to shutdown Electrical Switchboards in the case of emergency and to comply with Local Code and Authorities Requirement.</p>
Power quality	<p>Power quality shall comply with IEEE 519.</p> <p>Server power quality must remain within the ITIC computer power tolerance curve. Frequency shall remain within +/-5% of nominal frequency. Total Harmonic Voltage Distortion (THDv) shall remain below 5% VTD peak under steady state conditions. Total Harmonic Current Distorting (THDi) shall remain below 5% at full load current condition.</p> <p>Where the above cannot be met, a harmonic filter shall be installed per equipment and sized to meet the above requirement.</p> <p>Power factor must remain unity to 0.85 lagging at full load operation for the building system, and IT server loads can be expected from 0.9 lagging to</p>

	<p>0.9 leading power factors. System design must be designed to handle this without impact.</p> <p>Where the above cannot be met, a capacity bank shall be installed per equipment and sized to meet the above requirement.</p>
Data Center IT Racks/ ELV Grounding (Clean Earth System)	<p>A comprehensive grounding grid for all the data halls, MDF rooms, Meet Me Rooms, ELV rooms shall generally conform to TIA 607, IEEE 1100 Chapter 8.</p> <p>Clean Earth bars shall be interconnected with each other to provide redundant paths.</p> <p>Clean Earth grid shall be designed to achieve a one- ohm resistance to earth.</p>
Earthing System	<p>Electrical Earthing System is designed to comply with BS7430, TN-S Earthing System.</p> <p>Earthing shall be catered for all electrical and mechanical equipment, switchboards, containment & IT server racks, all exposed and extraneous conductive parts.</p> <p>Electrical Earth bars shall be interconnected with each other to provide redundant paths.</p> <p>Electrical Earth grid shall be designed to achieve a one- ohm resistance to earth.</p>
Lightning Protection System	<p>Lightning Protection System is designed to comply with MS IEC 62305 standards.</p> <p>Lightning down conductors shall be connected to structural rebars and foundation to create equipotential mesh and multiple current pathways.</p> <p>LPS Earth grid shall be designed to achieve a ten - ohm resistance to earth.</p>

6.0 MONITORING DEVICES FOR POWER QUALITY MANAGEMENT SYSTEM

The Contractor shall be responsible for all the Electrical Power Meters to be interfaced with Power Quality Monitoring System (PQMS) in accordance with the generic point schedule and tender drawings given in this Particular Specification. The Contractor's tender price is deemed to include all the works which are necessary to enable required interfacing and monitoring of the entire electrical system. All necessary interfacing works with PQMS shall be included in this Sub-contract. The PQMS related equipment such as DDC/controller panel, interfacing modules, network cablings shall be by others (PQMS Sub-contractor).

- 6.1 The High voltage input side needs to be equipped with an advanced power quality meter, and the power meter or relay has a fault recording function for fault reset; the High voltage circuit breaker should have a remote-control function.
- 6.2 A high-precision meter and power quality must be used on the low-voltage input side, and an automatic switching device must be installed on the low-voltage busbar connected to the two sections.
- 6.3 Measuring point requirements:
 - 6.3.1 Power distribution system to all the outgoing loads from Main Switchboards: switch status, current, voltage, active power, power factor, harmonic content, IT power consumption, data centre power consumption to derive the PUE.
 - 6.3.2 Bus-bar tap-off units for IT Loads: switch status, current, voltage, active power, power factor, IT power consumption, data centre power consumption to derive the PUE.
 - 6.3.3 The power distribution cabinet must have the function of monitoring and recording the maximum current of the previous day, which is used for the investigation of the over-power of the cabinet.
 - 6.3.4 Diesel generator system: fuel tank oil level or oil quantity display, diesel engine speed, output power, frequency, voltage, power factor, monitoring of air valve sampling points between diesel generators.
 - 6.3.5 Uninterruptible power supply system: input and output power, voltage, frequency, current, power factor, load rate; battery input voltage, current, capacity; synchronous/non-synchronous state, uninterrupted voltage system/bypass power supply state, mains failure, UPS power supply system failure status.
 - 6.3.6 Data such as cell voltage, cluster-level voltage, and current of lead-acid batteries need to be uploaded to the monitoring system through the convergence module.

- 6.4 Other requirements:
- 6.4.1 Self-maintaining: When the monitoring system fails, the controlled equipment shall not be affected; when control system fails, equipment shall remain at the last control command.
 - 6.4.2 Network Time Protocol (NTP): protection and backup automatic switching devices, diesel generator parallel machines, low-voltage backup automatic switching devices, power distribution cabinets, UPS, battery monitoring and other major equipment need to have the NTP protocol for time synchronization with server time.
 - 6.4.3 When the system status changes, the third-party monitoring software (Modbus Poll) needs to receive new messages within 5 seconds. For example, the Modbus TCP device needs to collect all the points of the IP, such as the Modbus RTU device needs to collect all the points of the entire busbar.
- 6.5 The requirements for the standby automatic switching system are as follows:
- 6.5.1 External power monitoring: The main controller connects to the relay through dry contacts or communication methods to monitor the voltage and current of the external power (if any phase has no voltage, the main controller considers it to be no voltage)
 - 6.5.2 Circuit breaker monitoring: dry contact or communication methods, respectively monitor the local remote status, open status, closing status, and fault status of the five automatic switching cabinets (both the open status and the closing status are monitored)
 - 6.5.3 Opening and closing output: realize the opening and closing control of incoming line cabinets, bus coupler cabinets, and all feeder cabinets through dry contacts or communication methods, and feeder cabinets.
 - 6.5.4 Selection of the main controller: The main controller of the standby automatic switch can be a PLC or a relay protection device.

7.0 POWER QUALITY METER SPECIFICATIONS

Comply

- 6.1 Power quality Meter must be used for all incoming HV and LV Switchgears compartments. This advanced metering device will be used to monitor feeder circuits for purposes of network management, energy cost allocation, power quality analysis, operational efficiency and compliance reporting.
- 6.2 It shall have colourful LCD graphical display, and able to direct connect to circuits up to 690 VAC Line to Line, eliminating the need for voltage (potential) transformers; On the other hand, 5 A nominal current inputs.
- 6.3 The proposed meter shall comply with IEC62053 class 0.2S or compliance with SAC-SINGLAS certification with passed with accuracy class of 0.2 standard. The communication to BMS system shall be via Modbus TCP/IP connection.
- 6.4 PQM meter shall come with the web server analysis monitoring tools for standard power quality analysis. The functions of web server software all include but not limited to:

Comply

- 6.4.1 Weekly analysis report
- 6.4.2 Transient / Sags/ Swells events download
- 6.4.3 Export of event information into COMTRADE format
- 6.4.4 Viewing of harmonics up to at least 63rd order
- 6.4.5 Analysis of flickering, rapid voltage changes and etc
- 6.4.6 Automatic weekly EN50160 report generation

6.5 General Specification

Comply

- 6.5.1 Class A Power Analyser
- 6.5.2 Monitoring the quality in accordance with DIN EN 50160
- 6.5.3 Measurement accuracy according to IEC62053-22 C1 0.2S
- 6.5.4 Instantaneous values, L-N voltage, L-L voltage, frequency, power, power factor, THDV, THDI
- 6.5.5 Support IEC61850
- 6.5.6 Comes with 8GB Internal Memory **2 GB for ION9000, 512 MB for PM8000.**
- 6.5.7 Build in Modbus TCP/IP communication
- 6.5.8 SNTP Time sync available
- 6.5.9 8 Digital Inputs (DI), 4 Relay Outputs (RO), 2 Digital Outputs (DO)
- 6.5.10 Operating temperature -10°C to +55°C
- 6.5.11 IP52 at front; IP30 at Side and Back
- 6.5.12 Measured circuit breaker ON / OFF and TRIP status shall be linked to PQM for status monitoring

6.6 Power Quality Analysis

Comply

- 6.6.1 THD and TDD up to 63rd order
- 6.6.2 EN50160 statistic function
- 6.6.3 Unbalance Voltage-, current- and zero sequence
- 6.6.4 Voltage/Freq. Deviation Setpoint alarm and record
- 6.6.5 Rapid Voltage Alteration Trigger DO point, waveform record
- 6.6.6 High resolution failure record with 1024 points / cycle

Comply

- 6.6.7 Able to support up to 1024 PQ Records with time resolution of 1ms
- 6.6.8 Voltage Sag / Swell Waveform record available
- 6.6.9 20 μ s for transient disturbance record
- 6.6.10 Configurable waveform recording mode:
 - a. 1024 points / cycle @ 50 cycles
 - b. 512 points / cycle @ 100 cycles
 - c. 256 points / cycle @ 200 cycles
 - d. 128 points / cycle @ 400 cycles
 - e. 64 points / cycle @ 800 cycles
 - f. 32 points / cycle @ 1600 cycles
 - g. 16 points / cycle @ 3200 cycles
- 6.6.11 Sag Source Location locate power supply side load side abnormal and fault
- 6.6.12 ITIC Curve/SEMI F47/SARFI Index analysis shall be included

6.7 Accuracy

Comply

- 6.7.1 Voltage / Current $\pm 0.1\%$
- 6.7.2 Active Power $\pm 0.2\%$
- 6.7.3 Reactive Power $\pm 0.2\%$
- 6.7.4 Apparent Power $\pm 0.2\%$
- 6.7.5 Active Energy Class 0.2s
- 6.7.6 Reactive Energy Class 2
- 6.7.7 Power Factor $\pm 0.5\%$
- 6.7.8 Frequency $\pm 0.005\text{Hz}$
- 6.7.9 Harmonic Class A
- 6.7.10 Voltage Unbalance $\pm 0.1\%$ IEC 61557-12 Class 0.2
- 6.7.11 Current Unbalance $\pm 0.5\%$
- 6.7.12 Voltage Deviation $\pm 0.1\%$
- 6.7.13 Frequency Deviation $\pm 0.005\text{Hz}$
- 6.7.14 Flicker $\pm 5\%$

Comply	6.8	Electromagnetic Emission
	6.8.1	Dielectric strength - 2kV voltage, 1 minute
	6.8.2	Insulation resistance - no less than 100MΩ
	6.8.3	Impulse voltage – 6kV, 1.2/50us
	6.8.4	Electrostatic Discharge immunity - IEC 61000-4-2
	6.8.5	Immunity to Radiated Fields - IEC 61000-4-3
	6.8.6	Immunity to Fast Transients - IEC 61000-4-4
	6.8.7	Immunity to Surge - IEC 61000-4-5
	6.8.8	Immunity to Conducted disturbance - IEC 61000-4-6
	6.8.9	Immunity to Magnetic Fields - IEC 61000-4-8
	6.8.10	Immunity to Voltage Dips - IEC 61000-4-11
	6.8.11	Electromagnetic disturbance limit – CISPR11 Not relevant.
Comply	6.9	Certifications
	6.9.1	All the meter's accuracy shall be complied with IEC62053-22 with 3rd party lab certification
8.0 DIGITAL POWER METER SPECIFICATIONS		
Comply	Digital power meter record and indicate electrical parameters for electrical network, not only in the electricity transmission and power distribution system including bus-bar tap-off units for each IT racks (Branch Circuit Monitoring System), but also in the power consumption measurement and analysis. The communication to PQMS/BMS system shall be via Modbus RTU / TCP IP connection.	
	The proposed meter shall comply with IEC62053 class 0.5S or compliance with SAC-SINGLAS certification with passed with accuracy class of 0.2 standard.	
Comply	8.1	General Specification
	8.1.1	Measurement accuracy according to IEC62053-22 C1 0.5S
	8.1.2	Instantaneous values, L-N voltage, L-L voltage, frequency, power, power factor, THDV, THDI
	8.1.3	Harmonics up to 63rd order
	8.1.4	Memory Recording for energy, demand, max demand & max/min record
	8.1.5	Real time clock
	8.1.6	Build in Modbus RTU communication

Comply	8.1.7	6.4kHz sampling (128 Samples/cycle)
	8.1.8	Operating temperature -25°C to +55°C
Comply	8.2	Accuracy
	8.2.1	Apparent power 0.5%
	8.2.2	Reactive power 1%
	8.2.3	Power factor 0.01 Class 0.5
	8.2.4	Active energy IEC62053-22 Class 0.5S
	8.2.5	Active energy IEC 61557-12 Class 0.5
	8.2.6	THD 1% Class 2
	8.2.7	Voltage VL-N 0.2%
	8.2.8	Voltage VL-L 0.2%
	8.2.9	Current 0.2%
	8.2.10	Frequency 0.1%
Comply	8.2.11	Active power 0.5%
	8.3	Electromagnetic Emission
	8.3.1	Electrostatic Discharge - IEC 61000-4-2
	8.3.2	Immunity to Radiated Fields - IEC 61000-4-3
	8.3.3	Immunity to Fast Transients - IEC 61000-4-4
	8.3.4	Immunity to Impulse Waves - IEC 61000-4-5
	8.3.5	Conducted Immunity - IEC 61000-4-6
	8.3.6	Immunity to Magnetic Fields - IEC 61000-4-8
	8.3.7	Immunity to Voltage Dips - IEC 61000-4-11
	8.3.8	Radiated Emissions - EN55011 Class A Not relevant
Comply	8.3.9	Conducted Emissions - EN55011 Class A Not relevant
	8.3.10	Harmonics - IEC 61000-3-2
Comply	8.4	Certifications
	8.4.1	All the meter's accuracy shall be comply with IEC62053-22 with 3rd party lab certifications

9.0 INTEGRATED BUILDING MANAGEMENT SYSTEM AND INTERFACES

The Contractor shall be responsible for all the Electrical Equipment to be interfaced with Integrated Building Management System including Power Quality Monitoring System (PQMS) in accordance with the generic point schedule given in this Particular Specification. The generic point schedule only serves as guidance. The Contractor's tender price is deemed to include all the works which are necessary to enable required interfacing, monitoring and control of the entire electrical services. All necessary interfacing works with BMS/PQMS shall be included in this Sub-contract. The BMS related equipment such as DDC panel, interfacing modules, BMS cabling shall be by others (BMS/PQMS Sub-contractor).

9.1 Leak Detection System

9.1.1 Fuel leak detection provision at

- a) Fuel pump room
- b) Genset enclosures
- c) Underground fuel tank enclosures
- d) Day tank Fuel Storage enclosures

9.1.2 All the above leak detection provisions shall be linked to Building Management BMS system

9.2 Electrical Power Monitoring System (EPMS)

9.2.1 The High voltage input side needs to be equipped with an advanced power quality meter, and the power meter or relay has a fault recording function for fault reset; the High voltage circuit breaker should have a remote-control function.

9.2.2 A high-precision meter and power quality must be used on the low-voltage input side, and an automatic switching device must be installed on the low-voltage busbar connected to the two sections.

9.2.3 The diesel generator system, parallel system, and control panel are equipped with dual power supplies, and at least one path must be UPS power supply. Diesel engine parallel & fuel automatic control: should be built with redundant PLC, and realize the dual redundant configuration of PLC, touch screen and communication module.

9.2.4 Measuring point requirements:

- a) Power distribution system to all the outgoing loads from Main Switchboards: switch status, current, voltage, active power, power factor, harmonic content, IT power consumption, data center power consumption to derive the PUE.
- b) Bus-bar tap-off units for IT Loads: switch status, current, voltage, active power, power factor, IT power consumption, data center power consumption to derive the PUE.
- c) The power distribution cabinet must have the function of monitoring and recording the maximum current of the previous day, which is used for the investigation of the over-power of the cabinet.
- d) Diesel generator system: fuel tank oil level or oil quantity display, diesel engine speed, output power, frequency, voltage, power factor, monitoring of air valve sampling points between diesel

generators.

- e) Uninterruptible power supply system: input and output power, voltage, frequency, current, power factor, load rate; battery input voltage, current, capacity; synchronous/non-synchronous state, uninterrupted voltage system/bypass power supply state, mains failure, UPS power supply system failure status.
- f) Data such as cell voltage, cluster-level voltage, and current of lead-acid batteries need to be uploaded to the monitoring system through the convergence module.

9.2.5 Other requirements:

- a) Self-maintaining: When the monitoring system fails, the controlled equipment shall not be affected; when control system fails, equipment shall remain at the last control command.
- b) Network Time Protocol (NTP): protection and backup automatic switching devices, diesel generator parallel machines, low-voltage backup automatic switching devices, power distribution cabinets, UPS, battery monitoring and other major equipment need to have the NTP protocol for time synchronization with server time.
- c) When the system status changes, the third-party monitoring software (Modbus Poll) needs to receive new messages within 5 seconds. For example, the Modbus TCP device needs to collect all the points of the IP, such as the Modbus RTU device needs to collect all the points of the entire busbar.

9.2.6 The requirements for the standby automatic switching system are as follows:

- a) External power monitoring: The main controller connects to the relay through dry contacts or communication methods to monitor the voltage and current of the external power (if any phase has no voltage, the main controller considers it to be no voltage);
- b) Circuit breaker monitoring: dry contact or communication methods, respectively monitor the local remote status, open status, closing status, and fault status of the five automatic switching cabinets (both the open status and the closing status are monitored);
- c) Opening and closing output: realize the opening and closing control of incoming line cabinets, bus coupler cabinets, and all feeder cabinets through dry contacts or communication methods, and feeder cabinets;
- d) Selection of the main controller: The main controller of the standby automatic switch can be a PLC or a relay protection device.

10.0 Related Trade Testing

10.1 Subcontractor shall provide and deploy the appropriate number of manpower and coordinate with other trades for all relevant levels of testing.

10.2 Related trades maybe Interface with electrical boards, UPS, other electrical works like lightning protection, earthing, fuel supply, BMS, Fire Protection, etc.