Technical Appendix 1:

CORE SITES INFRASTRUCTURE ENHANCEMENT PROJECT – PHASE II

MIC 2 - TECHNICAL SPECIFICATIONS

This document will cover the technical specifications of the systems to be installed in the core infrastructure enhancement project. Systems are as follow:

- ATS
- MDB
- UPS
- Cooling
- Firefighting system
- Civil works
- Electrical systems and works

ATS: Automatic transfer switch

1) Scope

Supply and install automatic transfer switches (Tier 3 ATS, dual redundancy with multiple input (three at least, one for TX and two for Generators)/output, and parallel connection mode or equivalent) with four poles, 380/220 V, and withstand current ratings as the following:

- 1000A ATS x2 in Justice Site (swap the existing one, full cabling installation to MDBs) with the following outputs:

- **4x1000A 1 CB**
- **3x63A 2 CB**
- **3x50A 1 CB**
- **2X20A 3 CB**

- 1000A x 2 in Bir Hassan (swap the existing one, full cabling installation to MDBs) with the following outputs:

- **4x1000A 1 CB**
- **3x100A 1 CB**
- **3x50A 1 CB**
- **2x20A 3 CB**

- 800A x 2 in Tripoli (swap the existing one, full cabling installation to MDBs) with the following outputs:

- **4x750A 1 CB**
- **3x63A 1 CB**
- **3x50A 1 CB**
- **2x20A 3 CB**

The automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

1.1 Codes and Standards

The automatic transfer switches and accessories shall conform to the requirements of:

A. UL 1008 - Standard for Automatic Transfer Switches
B. CSA C22.2 No.178 – 1978
C. NFPA 70 - National Electrical Code
D. NFPA 99 – Health Care Facilities
E. NFPA 110 - Emergency and Standby Power Systems
F. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby
G. NEMA Standard ICS10-2005 (formerly ICS2-447) - AC Automatic Transfer Switches
H. NEC Articles 700, 701, 702
I. International Standards Organization ISO 9001: 2008
J. IEC 60947 – 6 – 1

PART 2: PRODUCTS

2.1 Mechanically Held Transfer Switch

A. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include over current disconnect devices will not be accepted. The switch shall be mechanically and electrically interlocked to ensure only one of two possible positions, normal or emergency.
B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

C. All main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.
D. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
E. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
F. Where neutral conductors must be switched, the ATS shall be provided with fully- rated neutral transfer contacts.
G. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

2.2 Microprocessor controller

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from - 55 to +85 degrees C. Additionally, dual battery chargers for the generators batteries taking source from the main only shall be integrated in case the generator didn't for a long period.
C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi- layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built- in pocket for storage of the operator's manuals.
D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
1. EN 55011:1991 Emission standard - Group 1, Class A
2. EN 50082-2:1995 Generic immunity standard, from which:
EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity ENV 50140:1993 Radiated Electro-Magnetic field immunity EN 61000-4-4:1995 Electrical fast transient (EFT) immunity EN 61000-4-5:1995 Surge transient immunity
EN 61000-4-6:1996 Conducted Radio-Frequency field immunity

2.3 Enclosure

A. the ATS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.
B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

PART 3: OPERATIONS

3.1 Controller Display and Keypad

A. Four lines, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration (Open transition, closed transition, or Delayed transition) All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.2 Voltage and Frequency Sensing

Parameter	Sources	Dropout/Trip	Pickup/Reset
Under voltage	N & E 3Φ	70 to 98%	85 to 100%
Overvoltage	N & E 3Φ	102 to115%	2% below trip
Under frequency	N & E	85 to 98%	90 to 100%
Over frequency	N & E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.
C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.
F. The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

1.3 Time Delays

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
C. Two-time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0-to-5-minute time delay in any of the following modes:
1. Prior to transfer only.
2. Prior to and after transfer.
3. Normal to emergency only.
4. Emergency to normal only.
5. Normal to emergency and emergency to normal.
6. All transfer conditions or only when both sources are available.

F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:
1. 1-to-5-minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.
3. 0 to 5 minutes time delay for the load disconnection position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.4 Additional Features

A. A three-position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
F. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
G. An IN-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
H. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
I. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
1. Enable or disable the routine.
2. Enable or disable transfer of the load during routine.
3. Set the start time
- Time of day
- Day of week
- Week of month (1st, 2nd, 3rd, 4th, alternate or every)
4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

The following feature shall be built - into the controller, but capable of being activated through keypad programming or the communications interface port.

Note: The transfer switch will operate in a non-automatic mode with this feature activated.

J. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
K. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position.
For example,
Normal Failed Load on Normal
TD Normal to Emergency 2min15s
Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
L. Self-Diagnostics - The controller shall contain a diagnostic screen for detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
M. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
1. Event Logging
1. Data and time and reason for transfer normal to emergency.
2. Data and time and reason for transfer emergency to normal.
3. Data and time and reason for engine start.
4. Data and time engine stopped.
5. Data and time emergency source available.
6. Data and time emergency source not available.
2. Statistical Data
1. Total number of transfers.
2. Total number of transfers due to source failure.
3. Total number of day's controller is energized.
4. Total number of hours both normal and emergency sources are available.
N. Communications Module – Shall provide remote interface module to support monitoring of vendor's transfer switch, controller and optional power meter. Module shall provide status, analog parameters, event logs, equipment settings & configurations over embedded webpage and open protocol. Features shall include:
1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User will be able to view the dynamic one-line; ATS controls status, alarms, metering, event logging as well as settings.

4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app, monitor (view only), control (view and control) and administrator (view, control and change settings). 128-Bit AES encryption standard shall be supported for all means of connectivity.
5. Shall allow for the initiating of transfers, retransfers, bypassing of active timers and the activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment.
6. An event log displaying a minimum of three hundred (300) events shall be viewable and printable from the embedded web pages and accessible from supported open protocols.
7. Four (4) 100 Mbps Ethernet copper RJ-45 ports, five (2) serial ports, Termination dip-switches and LEDs for diagnostics.

8. DIN rail mountable.

O. External DC Power Supply – An optional provision shall be available to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead.
P. Power Meter – The Power Meter shall conform to the requirements of:
1. UL 3111-1-Electrical Measuring and Testing Equipment
2. CAN/CSA-C22.2 No. 23-M89-CSA Safety Requirements for Electrical and Electronic Measuring and Test Equipment
3. The Power Meter shall be capable of operating without modification at a nominal frequency of 45 to 66Hz.
4. The Power Meter shall be rated for an operating temperature of -4°F to 158°F and a storage temperature of -22°F to 176°F, and shall be rated for an 85% non-condensing, relative humidity.
5. The Power Meter shall accept inputs from industry standard instrument transformers (120 VAC secondary PT's and 5A secondary CT's). Direct phase voltage connections, 0 to 600VAC nominal, shall be possible without the use of PT's.
6. The Power Meter shall accept single, 3 phase, or three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.
7. The Power Meter shall contain a built-in discrete contact to wire an ATS 14A auxiliary contact to indicate switch position.
8. The Power Meter shall accept AC voltage from the sensing lines for operation. Additional provisions shall be provided for external DC voltage input range 9-36 VDC with a nominal of 24 VDC.
9. The Power Meter shall be equipped with a continuous duty, long –life, 4 line x 20 character green backlit LCD
10. All setup parameters required by the Power Meter shall be stored in non- volatile memory and retained in the event of a control power interruption.
11. The Power Meter shall be flush mountable on a surface.
12. The Power Meter enclosure shall be sealed to IP-51 (NEMA 1) and the faceplate shall be sealed to IP-65 (NEMA 4). All push buttons shall be sealed tact switches.
13. The Power Meter shall send, when prompted, information to a central location equipped with a manufacturer supplied critical power management system or 3rd party monitor through manufacturer supplied communication modules. All 3rd party monitor must utilize industry standard open protocols Modbus/RTU.Modbus/TCP or SNMP.

14. An embedded RS-485 port will be provided which will enable communication at 9600, 19.2K, 38.4K, or 57.6K baud. DIP switches will be provided on the RS-485 port allowing a user to select 2-wire or 4-wire communication as well as the option to activate a terminating resistor on the port.
15. The Power Meter shall help facilities comply with NEC 220. It shall provide Maximum Demand calculations for the past 24 months, as per standards with 15-minute averages.
16. The following data will be available on the display and Modbus registers of the Power Meter:

- Line-to-neutral voltages (VAN, VBN, and VCN)
- Line-to-neutral voltage average (VAVE)
- Line-Line voltage average (VLAVE)
- Current on each phase (IA,IB,and IC)
- Current on the neutral conductor (IN)
- Average current (IAVE)
- Active power, KW per phase and total (WA,WB,WC, and WT)
- Apparent power, KVA per phase and total (VAA, VAB, VAC, and VAT)
- KWHours importing, exporting and net (KWHIMP, KWHEXP, and KWHNET)
- KVARHours leading, lagging and net (KVARHLEAD, KVARLAG, and KVARHNET)
- Power factor (PF)
- Signal Frequency (Hz)
- Digital Input
- Line to line voltages (VAB, VBC, and VCA)

17. The Power Meter shall offer an LCD which can display no less than nine different languages.
18. Displaying each of the metered values shall be done through the use of menu scroll buttons. There will be an escape button which will be used to take the user back to the previous page or to cancel a setting change. Pressing escape, no more than three times will return the user to the home screen.
19. For ease of operator viewing, the display can be configured to remain on continuously, with no detrimental effect on the life of the Power Meter.
20. The display's contrast shall be configurable in intervals of 10% (ranging 0%-100%).
21. Setup of system requirements shall be allowed from the front of the Power Meter.

4) ATS Remote Annunciators

4.1 General

Provide and install ATS Remote Annunciators for monitoring and control of automatic transfer switches remotely over Ethernet.

A. Hardware Specifications

The ATS Remote Annunciator shall be listed to cUL-60950-1 and UL 1008 and include the following features and ratings:
User-configured labels with ATS names and power sources
Dual 10/100 Base-T auto sensing and auto crossover Ethernet ports
LED indication of source acceptability, switch position, common alarm, time delay and Ethernet link activity
Push button for transfer/retransfer control operations and time delay bypass Push buttons for Alarm Silence and Lamp Test

Key lock to enable and disable the transfer push button
Audible and visual alarm to indicate Communication Error ATS Locked out Failure to Synchronize Extended Parallel and any of the 8 user-configured discrete inputs
Programmable watchdog timer that can generate a system reset upon timeout (minimum 1 sec) Factory reset capability
100 ms power ride-through

B. Software Specification

The ATS Remote Annunciator shall contain embedded web pages accessible via various web browsers with the following capabilities:
Configuration for protocol and communications management with the ability of auto discovering transfer switches on network
Ability to create and print customized labels for ATS names and power sources
The ability to choose a continuous or periodic audible alarm with customizable interval time View detailed packet status counters i.e. transmitted received and dropped packets with the
ability to reset counters
ATS source name configuration page which allows users to configure power source names and print labels
Upgrade firmware from Ethernet network without interrupting equipment operation

C. Communications

Dual 10/100 Base-T (RJ-45) Ethernet ports are provided to support TCP/IP communications for up to eight automatic transfer switches via individual remote connectivity modules or daisy-chained serial modules into a single Connectivity Module. Additional features include:
Supports Full Duplex Flow Control (IEEE 802.3x)
3.3V power supply with 5V I/O tolerance
Supports 3 LEDs to indicate traffic link speed and collision

D. Mounting

The ATS Remote Annunciator is suitable for:
Surface mounting using mounting screws studs
Flush Mount from behind a cutout section (Enclosure Door Mounting) Flush Mount from the front of a cutout section (Enclosure Door Mounting)

E. Power Supply

The ATS Remote Annunciator shall be capable of accepting 24VDC, 120 VAC or 240 VAC power source.

F. Environmental

The ATS Remote Annunciator shall have an Ambient Operating Temperature range of -4 º to 158 º F (-20 º to +70 º C) @ 5~85% humidity and Ambient Storage Temperature of -40 º to 185 º F (-40 º to 85 º C).

PART 5: ADDITIONAL REQUIREMENTS

5.1 Withstand and Closing Ratings

A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of over current protection shown on the plans.

5.2 Tests and Certification

A. The complete ATS shall be factory tested with 2 years warranty to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings comply with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. the ATS manufacturer shall be certified to ISO 9001: 2008 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2008.

5.3 Service Representation

A. The ATS manufacturer shall maintain a national service organization of company-employed personnel. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
B. The manufacturer shall maintain records of switch shipments, by serial number, for a minimum of 20 years.
C. For ease of maintenance, the transfer switch nameplate shall include drawing numbers and serviceable part numbers.

6) List of Spare parts:

The following list of spare parts is to be provided:

- ACB x2 + Interlock
- ATS controller x 1
- MCB x1 for each MDB

MDB: Main Distribution Board

1) Specifications

• All distribution boards, panel boards and components shall be supplied by one manufacturer. Distribution boards shall be of the type suitable for accepting single, double and triple pole M.C.B.'s in any combination. The neutral block shall have the same number of ways as the maximum number of single pole breakers that can be fitted. The neutral conductors in all distribution boards shall be connected in same order as the 'live' conductors are connected to the fuse way. All insulated barriers shall be provided between different poles.

• The main distribution boards shall be suitable for operation on 3 phase, 4wire, 50Hz, 415 volts A.C. supply. The panels shall be cubicle type suitable for wall mounting or free standing, comprising of isolators and MCCB's. The minimum fault level of the panels' main breaker shall be 25KA for 3 seconds.

• The panel boards shall be factory assembled to comply with BS 5486 Part-2. The boards shall have corrosion resistant zinc-coated sheet steel enclosure with electrostatically deposited light gray power paint finish. Degree of protection IP 20 to BS 5420 and IEC 144 having dead front construction for added safety Form-3 BS 5486 part-1

• The bus bars shall be of electrolytic copper, PVC sleeved and supported on non- hygroscopic insulating supports conforming to BS 159.The boards shall be provided with removable gland plate fitted both at top and bottom. The boards shall be equipped with name plates to identify the feeders and also danger boards.

• M.C.B.'s as fitted in distribution boards shall be of the thermal magnetic type. They shall comply with BSEN 60898 or IEC 898 having M10 short circuit rating with Type C, single or triple pole types. The Distribution boards shall be indicating for the number of ways incoming and outgoing MCB etc. SLDs to be laminated on each MDB door

• Each distribution board shall have an earth connection bar mounted within the board and shall have a minimum number of cable terminations equal to the number of circuits that the distribution board had been designed to take.

• On each distribution board and on each corresponding isolator controlling the above, the Works Contractor shall provide and fix a suitably engraved 'traffolyte' label in accordance with the description of the unit. Circuit schedules shall be provided for all distribution boards and test boxes. The schedules shall clearly describe the nature and position of the load connected to each circuit viz. Number of points, lighting and power sockets, machines, contacts, etc., together with wattage, kW loadings and location. The individual ways within the distribution boards shall be clearly labeled to identify and relate them with the circuit schedules.

• Miniature Circuit Breakers shall be of an approved type and comply with BS3871with magnetic or temperature compensated thermal overload trips with inverse time delay magnetic short circuit trips. It shall be single pole rated for an ambient temperature of 50℃on the outside of the enclosure in which the breaker is mounted with a minimum breaking capacity of 9KA.

• The frame size of all MCB's shall be identical so that they can be easily interchanged. The MCB's shall either be of the plug-in or bolt-on type. Screw-cap type of breaker shall not be employed. Circuit breaker dollies shall be of the trip free pattern to prevent closing of the breaker on a faulty circuit and shall be engraved to indicate the ONN/OFF positions.

2) Scope:

Kindly refer to the attached SLDs for the MDBs to be installed in **Tripoli RNC**

Cables

Supply new power cables (TIA-942/ANSI compliance) to ensure power availability and redundancy from power sources to equipment, passing through the ATS and the MDB in five sites: Justice, Jdeideh, Bir Hassan, Tripoli and Saida. To note that quantities will be estimated during site survey and as per estimated BOQ.

UPS SYSTEM

1) SUMMARY:

These specifications describe requirements for an Uninterruptible Power System consisting of one or more multi-module UPS units connected in parallel with a centralized mains bypass static switch (MSS) and complete cabling procedures to the existing entities. The UPS shall automatically maintain AC power within specified tolerances to the critical load, without interruption, during failure or deterioration of the mains power supply. The proposed UPS shall be the new version from the manufacturer.

The proposed UPS system consists of each section of two modular UPSs feeding with N+1 redundancy and guaranteed for 2 years. Any one Unit/module functioning shall be able to maintain uninterrupted power to the load connected. All the materials required for this swap/installation & operation will be the responsibility of the contractor. Each Unit or Module shall be equipped and connected with individual battery backup bank properly sized for 30 minutes backup each.

The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental, and space conditions at the site. It shall include all equipment to properly interface the AC power source to the intended load and be designed for unattended operation.

The UPSs shall be provided with indications and alarms for failure of Fans other than all other required system Alarms.

The required units/equipment shall be supplied and installed for the synchronization of the UPSs at the output.

The required UPS to be installed are as the following (10% of spare parts to be provided):

- Justice: 2x120 kW (max capacity) modular UPS with modules integrated in each with 15 min batteries backup autonomy at 100 kW load (including swap and full cabling from MDB to UPSs to Peripherals, complete old equipment dismantling)

- Justice: 2x40 kW (max capacity) UPS with 15min batteries backup autonomy at 30 kW load (including swap and full cabling from MDB to UPSs to Peripherals, complete old equipment dismantling)

- Bir Hassan: 2x60 kW (max capacity UPS with 15 min batteries backup autonomy at 30 kW load (including swap and full cabling from MDB to UPSs to Peripherals, complete old equipment dismantling)

- Tripoli RNC and Saida RNC: 2x40 kW (max capacity) UPS with 15 min batteries backup autonomy at 20 kW load (including swap and full cabling from MDB to UPSs to Peripherals, complete old equipment dismantling)

2) Standards:

The UPS and all associated equipment and components shall be manufactured in accordance with the following applicable standards:

- EN 50091-1-1 (incorporating EN 60950)
- EN 50091-2 (incorporating) IEC 801-2, Level 4
  IEC 801-3, Level 3
  IEC 801-4, Level 4
  IEC 801-5, Level 3
- ENV 50091-3
- EN 60146-4 / IEC 146-4
- EN 60529 / IEC 529
- IEC 364 / CENELEC HD 384

The UPS shall be CE marked in accordance with EEC directives 73/23 "low voltage" and 89/336 "electromagnetic compatibility."
The Quality System for the engineering and manufacturing facility shall be certificated to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics.

3) System Description:

3.1) Design Requirements:

A. For non-redundant operation the UPS system shall be sized to provide a minimum of KVAs output listed above.
Load voltage and bypass line voltage will be 415 VAC, three phase and neutral. Input voltage will be 415 VAC, three phases +/- 6%.
The battery system shall have a minimum capacity to back up the system (consider inverter efficiency) for at least 30 minutes at 25ºC and will be installed on open racks

3.2) Mode of Operation:

The UPS system shall operate as a true on-line system in the following modes:
A. Normal: The critical AC load is continuously powered by the UPS inverters. The rectifier/chargers derive power from the mains AC power supply source converting this to DC power to supply the inverters, while simultaneously float charging the battery system. Power supplied by the UPS inverters is, to within close tolerances, at rated voltage and frequency.
B. Emergency: Upon failure of the mains AC power supply source, the critical AC load is powered by the inverters which, without any switching, obtain power from the battery system. There shall be no interruption in power to the critical load upon failure or restoration of the mains AC power supply source.
C. Recharge: Upon restoration of the mains AC power supply source, power to the rectifier/chargers initially is restricted by a gradual power walk-in. Following this relatively short power walk-in period, the rectifier/chargers power the inverters and simultaneously recharge the battery. This shall be an automatic function

D. Bypass: If the UPS system must be taken out of service for maintenance or repair, the static bypass switch shall transfer the load to the bypass source. The transfer process shall cause no interruption to the critical load.

E. Off-Battery: If the battery system only is taken out of service for maintenance, it is disconnected from the rectifier/charger and inverters by means of external disconnect breaker. The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

3.4) Performance Requirements:

The UPS is to be VFI classified (according to CEMEP / ENV 50091-3) producing an output waveform that is independent of both the input supply frequency and voltage.

3.5) Multi-Module UPS AC Input:

A. Voltage Range: ±15%
B. Frequency Range: ± 3 HZ
C. In-rush Current Limiting: 20% to 100% of full rated current over 10 seconds.
D. Power Factor: 10% rated load without the input power factor going leading.
E. 2-Step Input Current Limit: Maximum of 125% normal full load input current. (100% for generator operation.)
F. Temperature Compensated Charging: Above 25ºC the battery charge voltage shall reduce by 2mV per cell per ºC in order to optimize on the battery lifetime.
G. Current Distortion: less than 4% THD at full load – provide input filters to achieve this condition.

3.6) Multi-Module UPS Output:

A. Load Rating: 100% continuous load rating at 40ºC for any combination of linear and non-linear loads.
B. Voltage Regulation: 1% steady state for balanced load, 2% for 100% unbalanced load.
C. Frequency Regulation: ± 1Hz synchronized with bypass source, ± 0.01Hz free running or on battery operation.
D. Frequency Slew Rate: 0.1Hz per second.
E. Phase Imbalance:
120º ±1º el. for balanced loads
120º ±1º el. for 100% unbalanced loads
F. Voltage Transients: ± 5% for 100% output load step.
G. Transient Recovery Time: To within 1% of steady state output voltage within 20ms
H. Voltage Distortion (at 100% rated load with crest factor 3:1) :
<3% Ph/Ph voltage total harmonic distortion (vTHD)
<5% Ph/N voltage total harmonic distortion (vTHD)
I. Overload Capability at Rated Output Voltage: 110% of rated load for 60 minutes.
125% of rated load for 10 minutes.
150% of full load for a minimum of 1 minute.
J. Current Limit:
150% of rated three phase current for up to 5 seconds (in accordance with EN 50091-1-1.)
290% of rated single phase current for up to 5 seconds (in accordance with EN 50091-1-1.)

3.7) UPS System Bypass:

A. Voltage Range: ±15% (adjustable ±1% to ±99%)
B. Frequency Range: ± 3HZ
C. Overload Capability: (specified without fuses)
14.0 times rated current for 10ms
12.0 times rated current for 20ms
11.0 times rated current for 50ms
10.0 times rated current for 100ms
9.0 times rated current for 200ms
8.0 times rated current for 500ms
7.0 times rated current for 1s
6.0 times rated current for 2s
5.0 times rated current for 5s
D. Neutral Conductor Sizing: 1.5 times rated current.

3.8) Earthing

The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment earth terminal. Provisions for local bonding are to be provided.

3.9) ENVIRONMENTAL CONDITIONS

Operating Ambient Temperature UPS: 0ºC to 40ºC without derating.
Battery: 25ºC for optimum battery performance.
10.4.2 Storage/Transport Ambient Temperature UPS: -20ºC to 70ºC.
Battery: 20ºC for optimum battery storage.
10.4.3 Relative Humidity
0 to 95%, non-condensing.
10.4.4 Electrostatic Discharge
The UPS shall be able to withstand an electrostatic discharge compliant to IEC 801-2 level 4 without damage to equipment or the connected load.

4) UPS Delivery Submittals:

The specified UPSs shall be supplied with one (1) user manual to include details of:
A. Functional description of the equipment with block diagrams.
B. Detailed installation drawings, including all terminal locations for power and control connections for both the UPS and battery system.
C. Safety precautions.
D. Step-by-step operating procedures
E. General maintenance guidelines
The UPS shall be supplied with a record of pre-shipment final factory test report.

5) Fabrication:

5.1) Materials:

All materials of the UPS shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All electronic components shall be accessible from the front without removing sub-assemblies for service access.

5.2) Wiring:

Wiring practices, materials and coding shall be in accordance with the requirements of IEC. All electrical power connections shall be torqued to the required value and marked with a visual indicator.

Provision shall be made in the cabinets to permit installation of input, output, and external control cabling. Control cable termination shall be achieved with using crimp terminals and no bare wire connection will be accepted. Provision shall be made for either top or bottom access, allowing for adequate cable bend radius, to the input and output connections.

5.3) Construction:

The UPS shall be housed in an IP24 enclosure, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling. Maximum cabinet height shall be 1.9 meters.

5.4) Cooling:

Adequate ventilation shall be provided to ensure that all components are operated well within temperature ratings. The cooling system shall consist of high-quality fans and shall have full redundancy.

Temperature sensors shall be provided to monitor UPS internal temperature. Upon detection of temperatures in excess of manufacturer's recommendations, the sensors shall cause audible and visual alarms to be sounded at the UPS control panel. A separate room ambient temperature sensor shall be provided to allow control of the battery charging voltage with change of temperature.

6) EQUIPMENT:

6.1) UPS System:

The UPS system shall consist of an appropriate number of multi-module units for capacity and redundancy a Mains bypass Static Switch (MSS), battery disconnect breaker(s) and battery system(s).

A. Each multi-module unit shall consist of a rectifier/charger and three-phase inverter with associated transformers, static transfer output switch, protective devices, and accessories as specified.

B. The MSS cabinet shall contain the mains bypass static switch, synchronizing equipment and maintenance bypass circuit.

6.2) Configurations:

The UPS system shall consist of one or more multi-module units (MMU) of the same KVA rating operating in parallel. All MMUs shall operate simultaneously and share the load. The system shall be redundant or non-redundant as stated elsewhere in this specification.

A. Non redundant system: all the modules making up the UPS shall supply the full rated load. If a module malfunctions, the load is to be transferred, automatically and uninterrupted, to the bypass line by the use of the static mains bypass switch.

B. Redundant system: the UPS system shall have one or more module(s) than required to supply the full rated load. The malfunction of one of the modules shall cause that module to be disconnected from the critical load and the remaining module(s) shall continue to carry the load. Upon repair of the module, it shall be reconnected to the critical load to resume redundant operation. Any module shall also be capable of being taken off the critical load manually for maintenance without disturbing the critical load bus. Module redundancy level shall be a predefined number of modules that are required to supply the full rated load. With the number of connected modules equal to this value, a malfunction of another module shall cause the load to be transferred automatically and uninterrupted to the bypass line by the use of the static mains bypass switch.

6.3) System Protection:

The UPS shall have built-in protection against: surges, sags, and over-current from the AC source, overvoltage and voltage surges from output terminals of paralleled sources, and load switching and circuit breaker operation in the distribution system.

The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting current limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off line. The load shall be automatically transferred to the bypass line uninterrupted, should the connected critical load exceed the capacity of the available on- line modules. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

7) Components:

7.1) Rectifier/Charger

The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert AC to regulated DC for input to the inverter and for charging the battery.

A. Input Current Total Harmonic Distortion:

The input current THD shall be less than 8.5% THD at full load current; Input filter shall be provided to reduce this input current distortion to less than 4% THD at full load.

B. AC Input Current Limiting:

The rectifier/charger shall include a circuit to limit AC input current to 125% of the full input current rating. An optional secondary circuit shall provide limiting to 100% on receipt of an external low voltage signal, i.e., during generator operation.

C. Battery Charge Current Limiting:
The rectifier/charger shall include a circuit to limit the battery charging current to 25% of maximum battery discharge current. An optional secondary circuit shall reduce the charging current to 0% on receipt of an external low voltage signal, i.e., during generator operation.
D. Battery Charge Compensation:
The rectifier/charger shall automatically adjust the battery float charging voltage by ±2mV per cell per ^{o}C when used in conjunction with an optional remote temperature sensor.
E. Input Power Walk-in:
The rectifier/charger shall provide a feature that limits the total initial power requirements to 20% of rated load, and gradually increases power to 100% of full rating over a 10 second time interval.
F. Input Isolator:
The rectifier/charger shall have an input isolator and shall be fuse protected. The isolator shall be of the frame size to supply full rated load and recharge the battery at the same time, and shall withstand a short circuit current of up to 100 kA rms.
G. Fuse Protection:
Each AC phase shall be individually fused with fast acting fuses so that loss of any semiconductor shall not cause cascading failures.
H. DC Filter:
The rectifier/charger shall have an output filter to minimize ripple current in to the battery. The AC ripple voltage of the rectifier DC output shall not exceed 1% rms of the float voltage. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter without the battery connected.
I. Battery Recharge:
In addition to supplying power to the load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

7.2) Inverter:
The term inverter shall denote the equipment and controls to convert DC from the rectifier/charger or battery to provide AC power to the load. The inverter shall be solid-state, capable of providing rated output power. For increased performance, the inverter shall be a pulse width modulated (PWM) design and utilize Insulated Gate Bipolar Transistors (IGBTs), switching at high frequency in order to minimize output voltage distortion.
A. Overload Capability: The inverter shall be able to sustain an overload across its output terminals up to 150% with ±2% output voltage regulation. The inverter shall be capable of supplying at least 150% current for short circuit conditions. If the short circuit is sustained for a period of up to 5 seconds, the load shall be transferred to the bypass source and the inverter shall disconnect automatically from the critical load bus.
B. Output Frequency: The inverter shall track the bypass mains supply continuously providing the bypass source maintains the rated frequency (of either 50 or 60Hz) ±1Hz. The inverter will change its frequency at 0.1Hz per second (adjustable 0.1 to 1.0Hz per second) to maintain synchronous operation with the bypass. This shall allow make-before-break manual or automatic transfers of the load between the inverter and the bypass mains supply. If the bypass mains supply frequency falls outside of these limits, the inverter shall revert to an internal oscillator which shall be temperature compensated and hold the inverter output frequency to within ±0.01Hz of the rated

frequency for steady state and transient conditions. Drift shall not exceed 0.1% during any 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1Hz from the rated frequency.

C. Phase-to-Phase Balance: System logic shall provide individual phase voltage compensation to obtain phase balance ±1% under all conditions including up to 100% load unbalance.

D. Fault Sensing and Isolation: Fault sensing shall be provided to isolate a malfunctioning inverter from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits. The inverter output static switch shall be switched off to isolate a malfunctioning module from the critical load.

E. Battery Protection: The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Shutdown of the inverter shall be initiated when the battery has reached the end of discharge (EOD) voltage. The battery EOD voltage shall be calculated and automatically adjusted for reduced load conditions to allow for extended autonomy periods without damage to the battery. Automatic shutdown control shall not be a function of discharge time.

7.3) Mains Static Switch (MSS):

The UPS system shall be provided with separate free-standing mains bypass static switch for time when maintenance is required or when the inverter cannot maintain voltage to the load due to sustained overload, current limiting or malfunction. The MSS static bypass circuit shall provide for isolation of the inverter(s) and provide a path for power directly from an alternate AC (bypass) source. The UPS control shall constantly monitor the availability of the inverter bypass circuit to perform a transfer. The MSS static switch shall operate in conjunction with the inverter output static switch. The static switches shall denote the solid-state devices that, operating simultaneously, can instantaneously connect the load to the alternate AC source.

A. Manual Load Transfers: A manual load transfer between the inverter output and the alternate AC source shall be initiated from the control panel. A means to perform manual transfers remotely shall be made available as an option.

B. Automatic Load Transfers: An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload or short circuit condition is sustained for a period in excess of the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load back to the inverter only after the load has returned to a level within the rating of the inverter source.

C. Back feed Protection: The static bypass shall be provided with detection and control circuits, to be used in conjunction with external automatic switchgear, in order to disconnect the bypass line in the event of a short-circuit being detected in the solid-state devices that form the bypass static transfer switch. The purpose of this requirement is to prevent the risk of electrical shock on the distribution system when the normal source of power is disconnected or failed.

7.4) MSS Maintenance Bypass:

A fully rated bypass circuit shall be fitted in the MSS to provide an alternative path for power flow from the alternate AC supply to the critical load for the purpose of maintaining all the UPS modules while they are completely powered down. The appropriate switch shall be manually locked during normal operation.

7.5) Display and Controls:

A. UPS Display and Control Panel: Each multi-module UPS or MSS shall be equipped with a 4 x 20-character alphanumeric display. This shall automatically provide all information relating to the current status of the UPS or the system, respectively, as well as being capable of displaying metered values. The display shall be menu-driven, permitting the user to easily navigate through operator screens.

B. Metered Values: A microprocessor shall control the display functions of the monitoring system. All three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate (±1%) representation of non-sinusoidal waveforms typical of computers and other sensitive loads. The following parameters shall be displayed:

Output Voltage (LINE-LINE) Output Voltage (LINE-NEUTRAL) Output Current (LINE)
Output Real Power (LINE) Bypass Frequency
Inverter Frequency
Bypass Voltage (LINE-LINE) Battery Voltage (mmu only) Battery Current (mmu only)
Output AppARENT Power (LINE) Input Voltage (LINE) Temperature (transformer) Temperature (air out) Temperature (air in) Temperature (battery room)
% LINE Load
Battery Autonomy (mmu only)
% Battery Charge (mmu only) nUMBER OF MODULES IN FAULT

C. Power Flow Mimic: Each multi-module UPS shall be equipped with a mimic to indicate power flow to the critical load along with an indication of the availability of the rectifier mains supply, battery supply and the alternate AC mains bypass supply. Each MSS shall be equipped with a mimic to indicate power flow to the critical load along with an indication of the availability of the inverter and mains bypass supplies. Under normal operation, the UPS mimic shall also display the amount of charge stored in the battery system. During mains failure, the battery charge indication will alternate to identify the remaining battery autonomy time; as well as indicating low battery voltage conditions.

D. Alarms and Status Information: Alarm and status conditions shall be reported at the multi-module UPS system (MMU) or at the MSS (MSS) or both (B). The display and control panel shall report the alarms and status information listed below. Each alarm shall be visually displayed in text form and an audible alarm will sound for each alarm displayed.

BYPASS SWITCH OPEN (mss) OUTPUT SWITCH OPEN (mmu) RECTIFIER SWITCH OPEN (mmu)
BATTERY C.B. OPEN (mmu) MANUAL BYPASS CLOSED (mss)
Bypass: ABSENT (mss)
Bypass: OVERVOLTAGE (mss) Bypass: UNDERVOLTAGE (mss) Bypass: FREQUENCY ERROR (mss)
Bypass: PHASE ROTATION ERROR (mss) Output: OVERVOLTAGE (b) Output: UNDERVOLTAGE (b)
Output: NO VOLTAGE (b) Output: WAVEFORM ERROR (b) Output: FREQUENCY ERROR (b)
Battery: UNDER TEST (mmu) Battery: TEST FAILED (mmu) Battery: ON LOAD (mmu)

Battery: END DISCHARGE (mmu) Battery: BOOST TIME EXPIRED
(mmu)
DC Bus: SLOW OVERVOLTAGE
(mmu)
DC Bus: UNDERVOLATGE (mmu)
Bypass: SCR FAILURE (mss) Bypass: OFF (mss)
Bypass: OFF VIA DISPLAY (mss) LOAD ON BYPASS (mss)
Rectifier: OFF (mmu)
Rectifier: OFF VIA DISPLAY (mmu)
Rectifier: BLOCK (mmu) Rectifier: INPUTCURRENT LIMIT (mmu)
Rectifier: OVERTEMPERATURE (mmu)
Rectifier: FUSE FAILURE (mmu)
Inverter: OFF (mmu)
Inverter: OFF VIA DISPLAY (b) Inverter: BLOCK (mmu)
Inverter: CURRENT LIMIT (mmu)
Inverter: OVERTEMPERATURE
(b)
Inverter: UNSYNCHRONIZED (b)
Inverter: OVERVOLTAGE (mmu)
Inverter: UNDERVOLTAGE (mmu) Battery: FUSE FAILURE (mmu) DC Bus: FAST OVERVOLTAGE
(mmu)
Bypass: TRANSFER COUNT BLOCK (b)
OVERLOAD SHUTDOWN (MMU) OVERTEMPERATURE SHUTDOWN (MMU) EMERGENCY STOP (b) OVERLOAD (b)
BACKFEED FAULT (b)
bATTERY GROUND FAULT
(mmu)
SYNCHRONISATION INHIBITED
(mss)
PARALLEL BUS OPEN (mss) nUMBER OF ups NOT ACTIVE
(mss)
Inverter: FUSE FAILURE (mmu) Inverter: PARALLEL ERROR (mmu)
Inverter: OVER CAPACITY (mss)

E. Inverter ON/OFF: Each UPS module shall be equipped with an inverter ON/OFF switch which will transfer the load from all UPS modules to the bypass mains supply, if it is available. The inverter ON/OFF switch shall be protected against accidental operation.

F. BMS Monitoring Facility: The system shall include all required modules to extend, monitor & measure all conditions from the BMS system installed within the Centralized monitoring station.

7.6) Communications

The following shall be a standard feature (not Optional)

A. Remote Alarm Monitor: Status and alarm conditions shall be made available at an optional remote alarm monitor (RAM) panel which is driven by volt-free alarm status contacts (from an optional relay alarm board.) A separate RAM shall monitor each UPS or MSS, which may be installed up to 200 meters away.

B. UPS Monitoring Software: Monitoring software shall be available for monitoring all status, alarm and metered information at the UPS. All such information shall also be available as a data history file, comprising periodic trending data as well as alarms that have activated. The software shall provide a live copy of the UPS display mimic information. The software shall be available for running on a PC running Microsoft Windows 95/98/XP/VISTA/NT4 from which external communication to another remote PC via TCP/IP or dial-up networking may be executed. The software shall provide communication of alarm status information to out-of-band devices such as pagers or SMS compatible mobile phones. The software shall provide setting of the UPS parameters, including on/off control of the inverter, rectifier and bypass static switch, and operation and setup of automatic or manual execution of a battery test. The software shall permit shutdown of servers running either of Windows 95/98/XP/VISTA/NT4, AS/400, VMS or UNIX.

C. SNMP/HTTP Network Interface Card: The UPS shall have an internally fitted, network interface card to provide all alarm status information as SNMPv1 traps for connection to a 10-baseT Ethernet connection. In addition, the same card will also transmit the same status information and all measured parameters for display at a web browser.

7.7) Battery Circuit Breaker (BCB):

Each UPS module shall have a properly rated circuit breaker (1000 VDC) to isolate it from the battery. This breaker is to be housed in a separate enclosure, or mounted inside an optional battery cabinet. When the BCB is open, there shall be no battery voltage inside the UPS enclosure. Each UPS module shall be automatically disconnected from the battery by opening its breaker when it reaches the minimum discharge voltage level or when signaled by other control functions and the control of this shall be a part of the UPS.

7.8) The system batteries:

The Batteries shall be Sealed Lead Acid high-rate discharge, Valve regulated Gas Recombination, and Maintenance free blocks with minimum 10 year guaranteed life or equivalent. Each Battery cells shall be tagged with date of initial charge, storage information and due date of next charging required. The Battery sizing calculation to provide (separate Battery Banks for each UPS) net output for 30 minutes must be submitted with the offer **(two strings are needed in Justice and Jdeideh, and one string in the other locations).** The Batteries shall be manufactured as per Europe or USA standards and shall be manufactured during the current year.

7.9) UPS Power Distribution Units (PDU):

Proposed PDUs shall comply with the international standards applicable for the purpose. UL-891, C-UL & CE certifications are the minimum requirements.

- Power Requirements

Input: 415V AC 50 Hz 4 Wires + Ground Connection. Output: 3Phase/1Phase out feed capability.

- Cable Access

Unit shall be bottom access cable entry with provision for adequate conduit landing at the base and under floor junction box for cable termination and capable to accept power from two independent sources for further distribution.

- Service Access & Clearance

Service access shall be from either side to suit to be located in the rack area and required clearance should not contradict with the rack space requirements.

- Input connection shall be protected with Circuit Breakers.
- Ampere reading shall be provided for each line fed to the unit.
- Isolated neutral & Safety ground
- All the components, including neutral, sized to withstand 150% over load.
- The foot print area should not be more than that of standard floor tile.

8) Spare parts:

The following parts are to be supplied with the UPS:

- one power module (for each model if modular unit is used)
- one Controlling screen interface (for each model)
- 1 set of basic manufacturer recommended spare parts list

Cooling:
CRAC Units – Precision ECU and split duct type

1) Precision Environmental Control Units:

Each ECU shall be designed and selected to give minimum 15 TR Actual cooling capacity at Return air Conditions (Min 560 CFM/Ton), ESP 50 Pa, and 22 Deg. C & 50 % RH @ 46 Deg Ambient depending on the selected site as the following:

- **9x15TR DX, bottom discharge units in Justice:** dismantling of old units and installation of new units with related cabling, piping, insulation and drainage
- **10x15TR DX, bottom discharge units in Jdeideh:** dismantling of old units and installation of new units with related cabling, piping, insulation and drainage
-

For technical evaluation, the Contractor shall submit selection sheet at 48 Deg C ambient also. The Units shall be capable to run satisfactorily at 52 Deg C ambient without tripping on high head pressure.
The environmental control system shall be a self-contained factory assembled unit with down flow air delivery.
The units shall be suitable for power supply 380 Volt, 3 Ph, 50 Hz, **dual power supply, variable speed (inverter)** and with Refrigerant R410 or equivalent approved with enhanced efficiency **(Rigid copper pipes between indoor and outdoor units are only accepted)**.
The Units shall have built in Unit to Unit Communication System so as to configure the operation of units as all working and 1 Standby or as advised by engineer in charge. The Units shall have provision to shut down the units on receipt of a signal from the fire alarm system.
The unit construction shall be suitable for highly corrosive environment and the condenser coil shall have factory applied anticorrosive coatings with guaranteed life of 5 years.
The unit shall have the following built in components:

1.1 Cabinet Frame Construction

The frame shall be constructed of Heli arc welded tubular steel. The exterior panel shall be insulated with a minimum 1", 1.5 lbs. density fiber insulation. All panels shall have captive 1/4 turn fasteners and shall be removable for service access.

1.2 Filter Chamber

The filter chamber shall be integral part of the system, located within the cabinet serviceable from either end of the unit. The filters shall be rated not less than 45% efficiency (based ASHRAE 52-76).

1.3 Fan Section

The Units shall be equipped with Energy saving EC Fans and shall be statically and dynamically balanced as a complete assembly. The fans should have easy access to replace or maintenance.

1.4 Humidifier

As per manufacturer

1.5 Electrical Reheat

The electric reheat coils shall be low watt density, fin tubular construction, protected by thermal safety switches. The heating capacity shall be proposed by manufacturer to ensure the environmental conditions are maintained as specified. However, the reheating shall be electronically controlled in three stages.

1.6 Disconnect Switch (Locking Type)

The non-automatic molded case circuit breaker shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible from outside of the unit with the access panel closed and prevent access to the high voltage electrical components until switched to the off position.

1.7 Compressors

The unit shall be equipped with high efficiency and heavy duty multi compressors (for 20 TR units) as per manufacturer standard. The individual compressor (AC compressors, no inverter, and scroll type) shall be located in individual compartment and shall have easy access for maintenance. The compressors shall be with a suction gas cooled motor, vibration isolator, overload protection, manual reset high pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication or as manufacturer standard.

1.8 Two-Step Refrigeration System

The environmental control system shall have multi compressors and type as per manufacturer's standards hermetic compressors. In response to the return air temperature, the microprocessor control shall activate the liquid line solenoids such that two stages of refrigeration cooling are obtained. The stages shall be:

a. One compressor fully loaded.
b. Two compressors fully loaded.

On a call for dehumidification. The microprocessor control shall insure that at least one compressor is on full for proper humidity control.

1.9 A-Frame D. X. Coil

The evaporated coil shall be an A-frame design and 4 rows deep. It shall be constructed of copper tubes and aluminum fins and has maximum face velocity of 2.5 m/s.

Refrigerant of each system shall be distributed throughout the entire coil face area. The Units shall have stainless steel condensate drain pan with adequate insulation on it, if required.

1.10 Fan Speed Control - Condenser

The air cooled condenser shall be the low profile, slow speed, and multiple direct drove propeller fan type. The condenser shall have two separate refrigeration circuits to balance the heat rejection of each compressor at 52º C ambient, the condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for up flow air discharge. The condenser coil shall have factory applied anticorrosive coatings with guaranteed life of 5 years.

The unit shall also be capable of continuous operation in an ambient temperature of 52º C at reduced capacity, without shutdown on excess head pressure/temperature or mechanical failure.

The variable speed motor shall operate from 0 to 240 volts, single phase or 0 to 380v three phases, 10 to 1050 RPM. It shall be designed with ball bearings, permanent lubrication internal overload protection, 40ºC rise at full speed, 65ºC rise at 10 RPM.

The control system shall be complete with transducer, thermostat and electrical control circuit, factory prepackaged in the integral condenser control box.

The transducer shall automatically sense the highest head pressure of both operating compressor and control the variable speed fan on the air-cooled condenser to properly maintain the head pressure. The fan speed control system shall provide positive start-up and operation in ambient temperature as low as -28.9ºC (200F) the air cooled condenser shall have a 380 volt 3 pH, 50 Hz power supply.

1.11 Air Cooled Condenser Disconnect switch

Provide a disconnect switch factory mounted and wired to the condenser control panel, accessible from the exterior.

1.12 Floor Stand

The floor stand shall be constructed of a heliarc welded tubular steel frame. The floor stand has adjustable legs with vibration isolation pads and to be mounted on concrete cubes. (A factory field mounted turning vane shall be provided)

1.13 Control Processor

The control processor shall be microprocessor based and allow programming of temperature and humidity set points, alarm parameters, provide monitoring of operational status and maintain a database (save) of room conditions and environmental system operational status. Unit shall have MODBUS Interface to communicate, control and monitor thru BMS system.

1.14 Control

The Control system shall allow programming of the following room conditions: Temperature set point 10 -28 deg C.
Temperature sensitivity (+/-1, +//5 in 0.10 increments). Humidity set point (40-60% TH).
Humidity sensitivity (+/-1, +/-10% RH in 0.1% increments).

All set points shall be adjustable from the individual unit front monitor panel, the hand-held service terminal, or a site monitoring device. The temperature and humidity sensors shall be capable of being calibrated using the front monitor panel controls to coordinate with other temperature and humidity sensors in the room.
The control system shall always be capable of predictive control of temperature and humidity.

1.15 Temperature Anticipation

The micro compressor shall have the capability of responding to varying rates of temperature change in the conditioned space. The control system shall delay heating or cooling response to very low rates of change and shall advance heating in response to rapid temperature changes.

1.16 Humidity Control

The microprocessor shall calculate the moisture content in the room and prevent unnecessary humidification cycles by responding to changes in dew point temperature. In addition, the system shall allow programming of the following internal controls.

1.17 Compressor Short Cycle Control

The control system shall present compressor short cycling by incrementally expanding the control hysteresis of the compressor stages when compressor cycles approach to cycles per hour. Timer based short cycle controls are unacceptable.

1.18 Automatic Compressor Sequencing

The microprocessor shall automatically change the lead/lag sequence of the compressor after each start to lengthen compressor-on cycles and even compressor wear.

1.19 System Auto Restart

For startup after power failure, the system shall provide automatic restart with a programmable (up to 10 min. in 6 seconds increments) time delay. Programming can be performed either at the unit or from the site monitoring system or site scan system.

1.20 Sequential load Activation

During start-up, or after power failure, the microprocessor shall sequence operational load activation to minimize inrush current. System allowing multiple loads to start simultaneously is unacceptable.

1.21 Monitor

The micro compressor shall provide a monitor panel to display operational status, alarms and permit calibration and programming of operation parameters all indicators shall be in language from no symbols or codes shall be acceptable.

1.22 Monitor Panel- Display

The internal monitor panel shall be provided with a three-digit, 0.43 inch high, seven segment led numerical display to indicate temperature, humidity, percent capacity (cooling heating humidification de-humidification and econ-o-cycle), temperature and humidity set points and sensitivities, and humidifier flush rate. Operational status (heat cooling humidification and de-humidification and alarm conditions shall be indicated by color red Led's.

1.23 Alarms

The microprocessor shall activate an audible and visual alarm in event of any of the following conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- High Compressor Head Pressure
- Low Compressor head pressure
- Humidifier Problem
- Loss of Air Flow
- Under floor water

In addition, the micro compressor shall provide four customer accessible local alarms to be indicated on the front panel. They shall be capable of being programmable activation time delays.

1.24 Audible Alarms

The audible alarm shall have adjustable volume to match the surrounding ambient sound level.

1.25 Common Alarm

A programmable common alarm shall be provided to interface alarms with a remote alarm system / device.

1.26 Remote Monitoring

All alarms shall be communicated to the site scan system with the following information: date and time of occurrence, unit number and present temperature and humidity.

1.27 Data Collection

The micro compressor shall provide the capability of maintaining a log of system performance and environmental conditions. This data shall be communicated and displayed at a remote monitoring and control device.

The following information shall be included in the log, complete with time and date:

Temperature (present, minimum and maximum for last 24 hours), humidity (present, minimum and maximum for last 24 hours) compressor operating hours, alarm occurrence.

1.28 Diagnostics

All electronic circuiting shall be provided with self-diagnostics to aid in trouble shooting. Each printed circuit board shall be diagnosed and reporter as pass/not passes.

1.29 Communications

The microprocessor shall be compatible with all remote monitoring and control devices thru MODBUS communication and flexible to work with other protocol.

1.30 Smoke Detection

The Unit shall be interlocked with smoke detection / fire alarm system to shut down the unit immediately and activate the alarm system.

2) Split duct type Air Conditioning Units:

The Split units shall be composed of an indoor unit with refrigerant circuit and an air-cooled outdoor unit for application with R410 refrigerant or equivalent. The electrical supply to the Units shall be 380 volts, three Phases 50 Hz. The unit shall be **inverter type** base and have facility to restart automatically on power interruption and coming with wired thermostat.

Total of 15 x 5TR units and 1 x 3TR with estimated pipe length (Rigid copper pipes are only accepted) of 45m each and 45m of power and control cables

2.1) Indoor Unit (Floor Standing / Wall Mounting)

The indoor Floor Standing or Wall Mounting or ceiling type A.C. unit shall comprise of an evaporator, evaporator fan, fan motor, air filter (G4 rated), liquid and gas inlets, strainer/drier, controls, internal wiring and piping all housed in a decorative sheet steel cabinet with baked resin paint. The cabinet interior shall be fully insulated to prevent sweating and to muffle the sound.

The evaporator coils shall be the multi-pass, cross-finned tube type, equipped with aluminum plate fins, mechanically bonded to seamless oxygen free copper tubes. The fins shall be spaced at not more than 16 fins per 25.4 mm. The coil shall be cleaned, dehydrated and tested for leakage at the factory.

The evaporator fan shall be forward curved, centrifugal type, statically and dynamically balanced and directly driven by the motor. The fan motor shall be permanently lubricated. The evaporator fan must be selected to operate quietly with no overloading of fan motors. The air filter panel should be easily removable to provide access for servicing.

The refrigerant circuit shall have one shot coupling for liquid and gas inlets, a strainer, a capillary tube and an evaporator coil.

2.2) Outdoor Unit

The outdoor unit shall comprise of air-cooled condenser, condenser fan and fan motor, suction and discharge outlets, liquid line shut-off valves and necessary safety controls such as crank-case heater, solid state motor protector, anti-recycling control, fan pressure control, phase sequence overlapping protection etc., all as per manufacturer's standard. The outdoor unit shall be factory assembled, piped internally, pre-wired, charged with R410 refrigerant and shall be designed to operate at outdoor ambient temperatures as high as 52°C.

The cabinet shall be constructed of steel, finished with baked synthetic resin paint. The fan guard wire net shall be mounted on top or side of the unit and shall be adequately protected against corrosion.

The unit shall contain a hermetic multi-cylinder reciprocating Scroll compressor from the same manufacturer. The hermetic compressor shall be welded shell type and spring suspended internally. The compressor shall be protected for over current and an in-built thermal overload protection.

The condenser coil shall be the multi-pass, cross-finned type, equipped with aluminum plate fins (max. 14 fins per 25.4 mm) mechanically bonded to seamless oxygen free copper tubes. The coil shall be cleaned, dehydrated and tested for leakage at the factory. The condenser fan shall be propeller type with aluminum / PVC blades, statically and dynamically balanced and driven directly by the motor for up flow or horizontal air discharge. The motor shall be permanently lubricated and shall be protected from water invasion. The refrigerant circuit shall be composed of a gas inlet, one shot coupling, a condenser coil and a liquid outlet one shot coupling.

2.3) Unit Control

The indoor unit shall be equipped with an operation switch, fan speed selector switch and a thermostat mounted on the remote-control switch for wall mounted units. The operation switch shall have the function of OFF-FAN-COOL. The operation control shall have auto re-start facility once power interruption. The unit shall be restarted by resetting the operation switch if any one of the protection devices trips.

2.4) Protection Devices

The magnetic switch box incorporated in the outdoor or indoor unit shall contain magnetic contactor for all motors, including condenser fan motor, over current relays and auxiliary relays.

3) Refrigerant Piping

Refrigerant pipe work between the condensing unit and indoor unit shall be installed as per applicable ASHRAE standards and to the satisfaction of the Engineer.

Refrigerant quality seamless cold drawn copper piping shall be used. Silver brazing alloy shall be used for making joints and Nitrogen injection should be done during welding to avoid carbon deposits on the pipe internal circumferences. The pipe work will be run in proper GI Tray / Trunking as per instructions.

As the refrigerant piping is fabricated at site, the system shall be pressure tested with nitrogen to at least 1½ times the working pressure for leaks, vacuum dried and then charged with refrigerant in accordance with manufacturer's recommendations.

Factory supplied, pre insulated, pre-charged refrigerant piping kit may be used for the split unit of smaller capacity (up to 2.5 TR nominal). But this refrigerant piping shall be additionally wrapped with glass cloth and finished with two coats of vapor barrier compound.

All coring required to piping should be executed by the supplier. Moreover, piping length is to be determined and installed by him also.

3.1 Thermal Insulation for Pipes

The thermal insulation shall be non-corrosive to the metal, water repellent and fire resistant. Refrigerant suction lines and liquid lines (wherever required) shall be insulated with 19 mm thick foam rubber insulation. The insulation materials shall be submitted to the Engineer for approval prior to ordering.

All pipe surfaces shall be thoroughly cleaned before applying insulation.

Insulation shall be covered externally with 200 gm/sq.m. Quality glass cloth and painted with two coats of approved weather proofing compound.

3.2 Pipe Supports

All refrigerant piping shall be running in GI Tray / Trunking as approved by the engineer and supported to prevent deflection, buckling and vibration.

All pipe work passing through the walls, floors and roof slabs shall be provided with pipe sleeves of adequate size to allow the passage of insulation and the remaining portion shall be closed with high density foam of approved make.

4) Condensate Drain Piping

UPVC Pipes as per the approved drawing and approval of engineer shall carry the condensate drain piping. The adequate slope shall be ensured for smooth drain. The cleanout shall be provided wherever necessary. The Pipes shall be insulated by rubber foam and covered externally with 200 gm/sq.m. Quality glass cloth and painted with two coats of approved weather proofing compound (Foster 30-36 AF). All coring required to drain piping should be executed by the supplier

5) Automatic Changeover Panels (ACCPs)

Air Conditioning Change over Panel shall be provided as indicated so as to have to have units on duty cycle. The ACCP shall initiate the stand by machine to start in case of higher room temperature from the set limit. ACC shall shut down both the units in case of fire alarm in that area. The ACCP shall have the provision to extend the room temperature and unit status to the BMS.

6) Spares parts

The contactor shall supply the following spares for each Model of Environmental Control unit. The contractor shall submit breakup unit rate and only summary shall carry forward to BOQ:

1- 20% of fan condenser motor (as per the quantity of supplied motor fan)
2- 10% of expansion valve with all related accessories.
3- 20% of evaporator fan motor (complete set).
4- 10% control board for each switch.
5- 20% filter drier.
6- 10% high and low pressure.
7- 20% air filter.

Split Type Units (For Each Model)

17. Compressor 1 No.
18. Condenser fan Motor 1 No.
19. Indoor fan motor 1 No.
20. PCB 1 No.

7) Factory Inspection / Test

The Environmental Control Units shall be inspected at factory before dispatch and the performance test shall be witnessed by 2 Engineers at designed conditions for one of the type unit. The Contractor shall be responsible for complete travel cost including to & from tickets, lodging and boarding as per general conditions of the contract.

During Performance test, the following performance criteria shall be witnessed.

a. Cooling Capacity of Type Unit @ designed conditions
b. Air Flow capacity @ designed static 50 Pa
c. Total Power Consumption
d. Reheat & Humidification Operational Test.

8) Painting and Finishing

All steel work in connection with pipe and equipment's supports is to be painted with two coats of a rust preventive paint approved by the Engineer, preferably Zinc Rich primer, followed by one undercoat and one topcoat.

After completion of the installation, the entire work shall be checked for finish and appearance. Any portion of work found damaged, unpainted or not finished to the satisfaction of the Engineer shall be rectified, painted and finished satisfactorily.

9) Inspection, Testing and commissioning

All works shall be inspected at any stage during the progress of work and after the completion of works.

The Engineer shall check if he so requires all parts of the installation and materials. Any part rejected shall be immediately dismantled, removed from site and replaced or repaired to conform to the specification and to the full satisfaction of the Engineer.

Any interim approval given by the Engineer does not relieve the Contractor of his obligations under this contract.

All works shall be tested and commissioned in accordance with the relevant British Standards, Specifications and Codes of practice to the entire satisfaction of the Engineer. The contractor shall carry out all the performance tests initially before requesting the Engineer to witness the test.

It shall be ensured that the system is free from any dirt, welding snag or any other foreign matters before the system is finally filled with working fluid.

During the tests, all the readings of refrigerant pressures, temperature, current consumption of A/C compressors, evaporator/condenser motors shall be tabulated and at least two copies submitted to the Engineer.

10) O & M Manuals & As Built Drawings

Prior to issue of the Practical Completion Certificate the contractor shall submit for the Engineer's approval draft copies of the O&M Manual and as built drawings for checking / comments. Following receipt of the Engineer's approval, the contractor shall submit 3 sets of hard Copies (Original + 2 Copies) and One Soft copy (CD). The Certificate of Practical completion shall not be issued until the O&M Manuals are submitted.

11) Label Identification & Color Coding

All the Units, Equipment, Piping and associated works shall be identified with proper labeling with color code as per engineer advice & approval.

12) Site Clearance

After the completion of the Contract works, all unused materials, equipment and plant shall be removed from the site and the workplace shall be left in a tidy and clean condition, including the cleaning down of all equipment and the removal of all marks and stains.

13) Warranty Period

The Warranty Period shall be as per MIC 2 Standard relevant clauses. However, the Complete works with all associated equipment / Units shall be guaranteed for a period 2 years from the date of Satisfactory Practical Completion of works and Handover to MIC

The Contractor shall submit the Manufacturer Warranty Certificates in original of all the equipment supplied under the contract scope and contractor shall not be relieved from the responsibility in any way by submitting the manufacturer warrantee certificate. It is the responsibility of contractor to get the defects rectified and ensure efficient operation of system and equipment.

Firefighting system:

The firefighting scope of work will be limited to

- Installation of redundant FM 200 cylinders exactly matching the existent cylinder as per the attached BOQ in each site with manual switching station between cylinders in each site
- Integrity test execution of each site

1.0 GENERAL

1. MIC 2 proposes to provide fire alarm / firefighting systems at Equipment area to satisfy adequately the fire protection and detection measures.
2. The Fire System shall be designed to protect the risk area within the premises by giving warning of a fire condition when detected by an automatic detector or by the operation of a break glass call point.

- DESIGN STANDARDS

1. The fire system shall be supplied and installed in complete compliance with the recommendations of the British Standard BS 5445, part 1, BS 5446, 5839: Part 1: 1980, BS 3116, Part I.
2. The fire system shall fully comply with the National Fire Protection Association (NFPA) standard provided it is installed to comply with the limitations established by the list of Factory Mutual Research Corporation or Underwriters Laboratory Inc. The proposed system and extinguishing media shall also comply to NFPA-12, NFPA-12A wherever applicable.
3. The proposed extinguishing media shall also comply in all aspects to Montreal protocol for the Ozone Depletion precautions.
4. The proposed fire extinguishing media is also to be accepted and approved by the local Civil Defense Authority.

TECHNICAL SPECIFICATION

- ACTUATING CONTROLS / ELECTRICAL SOLENOID

1. The solenoid valve shall be specially designed for use with the proposed extinguishing media. The valve shall be normally closed, and opens upon electrical energy being supplied, thus relieving the pressure above the main piston to atmosphere and causing the container valve to open.

2. The detachable solenoid valve shall be fitted with a swivel union nut for mechanical connection to and from the cylinder valves which have a solenoid valve connection port with built in check valve. Electrical connection shall be made using flexible conduit to allow convenient removal of the solenoid valve from the attachment to the cylinder valve when the cylinder is serviced or recharged. Necessary safety precautions are to be taken into consideration not to allow the gas to be released while servicing the extinguishing container or refilling the same.

3. The release solenoid shall be connected to the fire extinguishing panel (FEP) and control equipment compatible with and listed by UL and FM for the use with the proposed fire extinguishing systems. The entire electrical system shall be under constant supervision.
4. The automatic actuation of the extinguishing system shall be accompanied by activating two separate zones of detectors (cross-zoning) in order to eliminate fire extinguishing release actuation by a transient condition which may cause a single detector to operate or by false alarming case.
5. Any break in the solenoid circuit will result in fault signal at FAP. The FAP shall operate upon actuation of any of the following types of accessories of or combinations of,

- Optical smoke detector (double knock from two different zones)
- Manual call point.
- Manual release provision at the SIP, where applicable.

- **PRESSURE SWITCH**

1. The pressure switch shall be used to perform interlock function, such as sounding discharge alarms or shutting down electric motors or other equipment in case the extinguishing discharge is activated through the system piping. The setting of the pressure switch shall be as per the system manufacturer's / supplier's recommendations.
2. The pressure switch shall be pneumatically or electrically operated by the gas release action where applicable.
3. The pressure switch shall also be activating the Xenon flasher at the area entrance.

- **FIRE FIGHTING AGENT (EXTINGUISHING GAS)**

1. The agent shall be a liquefied gas / chemical extinguishing that interferes with the combustion process by breaking the chain reaction which propagates fire and flame. The system covered by this specification is for the "Total Flood" type. The extinguishing media - which shall be stored in steel containers - shall be injected into the protected area in steel pipe work and nozzles to establish an extinguishing concentration throughout the serviced area.

2. Extinguishing media shall be released within 8-10 seconds as per the BS in this aspect to make re-ignition unlikely provided that the initial concentration is maintained for a short period, enough and adequate to suppress fire.

3. The extinguishing system shall be super-pressurized with oxygen free nitrogen to certain pre-calculated pressure to provide quick discharge via the system pipe work nozzles. The operating temperature range shall be between 0°C to +54.4°C. The internal pressure of the agent container shall not be more than 25 bar at 22°C.

4. The proposed agent shall be zero ozone depletion as per Montreal protocol for the environment protection. The agent shall fully comply with NFPA-12 & NFPA-12A wherever applicable.

- **FIRE FIGHTING AGENT (EXTINGUISHING GAS)**

1. The agent shall be FM 200 similar to the existing agents that interferes with the combustion process by breaking the chain reaction which propagates fire and flame. The system covered by this specification is for the "Total Flood" type. The extinguishing media - which shall be stored in steel containers - shall be injected into the protected area in black steel pipe work and nozzles to establish an extinguishing concentration throughout the serviced area.

2. Extinguishing media shall be released within 8-10 seconds as per the BS in this aspect to make re-ignition unlikely takes place provided that the initial concentration is maintained for a short period, enough and adequate to suppress fire.

3. The extinguishing shall be super-pressurized with oxygen free nitrogen to certain pre-calculated pressure to provide quick discharge via the system pipe work nozzles. The operating temperature range shall be between 0°C to +54.4°C. The internal pressure of the agent container shall not be more than 25 bar at 22°C.

4. The proposed agent shall be zero ozone depletion as per Montreal protocol for the environment protection. The agent shall fully comply to NFPA-12 & NFPA-12A wherever applicable.

Civil Works Scope of Work:

This section will include a brief description about the civil works (installation and demolition where needed) that might be needed to execute this project along with an approximate estimation about the BOQ of the materials or works to be done. Noting that all leftovers and debris are to be fully displaced by the contractor.

Description:

1) **Suspended ceilings**

600 x 600 x 0.7mm thick, solid pans factory finish electro statically applied powder coated plain metal (aluminum sheer) false ceiling system from an approved manufacturer might be required; suspended on standard exposed recessed grid system; allow for additional supports and hangers to accommodate services and associated fittings including access panel and fixing to concrete or structural members.

2) **Wall partitioning and openings:**

Supply and install full height double walls Partition with Rockwool insulation. Wall shall be made of Fire rated gypsum boards manufactured according to ASTM C- 36 beveled, 12.5mm thick each. (Partition wall thickness to reach 10cm in total). Contractor to provide opening within the partition where needed or as required by other services passing thru between equipment rooms or to them. Adequate sealing (foam, silicone…) to be executed as per MIC 2 engineer.

3) **Fire rated doors:**

Providing and fixing of Hollow metal fire rated doors as per IS 3614 part-1 & part-2 for stability and integrity with Pressed Galvanized steel confirming to IS 277 for maximum rating of 2hrs. Manufacturer test certificate shall cover doors both single and double leaf. Door frame shall be double rebate profile made out of 1.60mm (16gauge) minimum thick galvanized steel sheet. Frames shall be field assembled with self-tabs. Rubber door silencers should be provided on the striking jamb. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening or double gypsum walls partitioning. Once frame installed it should be grouted with cement & sand slurry necessary for fire doors on the clear masonry opening. Door leaf shall be 46mm thick fully flush double skin door and shall be manufactured from 1.2mm (18guage) minimum thick galvanized steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core.

All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. All doors and frames shall be finished with polyurethane aliphatic grade paint of approved color (light gray in general).

4) **Plastering, Painting and cleaning:**

Apply smooth plastering layer where needed and prepare and apply' Vinyl Silk Emulsion' paint system comprising one coat acrylic primer sealer, one coat PVA wall filler and two coats of Acrylic Emulsion paint by an approved manufacturer (Noula, PPG, Dulux) for all internal walls where required. All sites cleaning is needed (vacuum cleaning, debris removal, left overs removal…)

5) **Steel frames:**

Steel chassis might be needed to be used as a frame support to the batteries string or to hold the outdoor condensers unit (based on the survey). Chassis are to be made from heliarc welded angular steel capable to withstand the batteries weight and painted with primer and two anti-corrosive epoxy layers.

6) Water proofing:

Correct waterproofing is essential to avoid damage, rising damp, mould, leakage or corrosion of rebar that affects the structural integrity of the DC.

STEP by STEP water proofing execution is to be strictly followed such as Floor smoothening and cleaning, Primer applying, Gaps filling, Masking tape usage where needed, Agent applying (with PU, epoxy or membrane)…

7) Raised floor:

A) Specifications

- The access floor panels shall be made of high density particle board material type 5 (2000kg/m2), 38mm thick with high pressure laminate antistatic covering reinforcement with 0.5mm galvanized steel sheet backing. Panels shall be protected all around by fire resistant material. Anti-static epoxy layers to be added under the pedestals
- Panel/Tile size should be (60x60)cm with 3.8 to 4 cm thickness
- Understructure shall be made of HDG steel pedestals adjustable in height (50cm as nominal height unless otherwise specified) with gasket for panel fixing & base plate to be glued on floor and shall be bonded to the earthing system as per MIC 2 engineer instruction. Stringers & additional pedestals shall be used for increasing stability & bearing capacity.
- Perforated panels shall be provided according to the below BOQ
- European or US tiles are only accepted: Mero, Lindner, Uniflair Schneider…

B) BOQ:

Description	Quantity
Raised floor panels with understructure installation & earthing and bottom floor epoxy painting	As per BOQs
Supply of top Tiles only to replace the existing damaged tiles or the missing ones	As per BOQs
Supply of perforated tiles	As per BOQs

ELECTRICAL MAINS & SUB MAINS CABLE INSTALLATION

1) Installation of cables

The price quoted by the contractor for the cabling works shall include for all necessary related works such as Cable Tray with covers, Cable Duct etc as required to have a complete installation meeting relevant standards and local regulations.
All cable entry/ exits to building shall be sealed with water resistant sealing compound to avoid water ingress into the building.
All necessary opening for entry of cables and making good these openings shall be carried out by the electrical contractor.
All necessary ducting, openings etc as required shall be carried out in coordination with the civil works contractor. A cable schedule indicating the Cable type, size, length shall be submitted for approval. All work associated with the installation of cables shall be carried out by the Works Contractor who shall include for the supply and installation of all cable jointing materials, cable supports, steel racking and making of necessary cable joints, cable tiles, cable identity discs.
Where cables pass through walls or floors, purpose made fire barriers (comprising fixed frame with adjustable seals and clamping device) shall be installed.
All needed cabling works, as stated before, will be measured and executed and quoted by the contractor. This will include the complete wiring installation of the generators systems (GCP to ATS), from EDL counter to ATS, the ATS system (ATS to MDBs, dual circuit), the UPS system (BB, UPSDB, PDU, sockets…), rectifiers system (DCDB…) etc…

All the obsolete cables dismantling (power, radio, data) in all the five sites is to be made by the contractor also in presence and support of MIC 2 staff. Quoting is to be made based on an organized sites visit.

External cables
External cables shall be PVC/SWA/PVC or XLPE/SWA/PVC type and shall be laid in trenches or ducts;
Armored PVC and XLPE insulated cables shall be 600/1000 Volt grade to BS 6346 or 5467, as appropriate, with each conductor of the same cross section. All neutral conductors shall be full size. Conductors shall be formed from high conductivity plain annealed copper wires, insulated with polyvinylchloride (PVC) or crosslinked polyethylene (XLPE) and protected with armoring consisting of a single layer of galvanized steel or wire armored with an extruded layer of PVC generally in accordance with BS 6346 and 5467.

Cable glands shall be of the brass compression type designed for the cable to which it is fitted complete with PVC shrouds and earthing rings. Special attention shall be given to ensuring complete continuity of the steel wire armoring used as the earth conductor and armoring of cables to be separately bonded to switchboards etc. by means of copper tape and armor clamps.
The end of the tails shall be provided with heavy duty, solderless cable lugs of high conductivity copper, electro tinned and applied to the conductor by means of a hydraulic crimping tool for connection to the switchgear terminals. All cable sockets must be made in accordance with the appropriate British Standard.

Support and fixings for cables

Where the cables are run on walls, ceilings, etc. the cables shall be supported in position by means of claw type nylon or alloy cleats, securely bolted to the walls and/or mild steel ceiling brackets or on cable tray.
All cable hangers shall be provided by the Works Contractor who shall also carry out all fixings of the 'rawl bolt and plug' type. Cleats shall be spaced 400mm horizontal and 500mm vertical maximum and arranged so that the cable is not less than 15mm from the face of the structure.
All cable bends shall be in accordance with Manufacturer's Recommendations and spacing of brackets and cleats shall not exceed 900mm.
Where rising from trenches, ducts, etc. through walls or floors, the cables shall be sleeved to permit easy passage of the cable. Sleeving provided through floors shall be extended a distance of at least 75mm above floor level. Where cables rise vertically on the surface of walls to switchgear, etc. the cables shall be gripped firmly by clamps of approved pattern and protected by means of a galvanized steel sheet cable guard securely fixed in position to prevent damage thereto etc. No sharp edges of metal will be permitted and hardwood caps shall be fitted where necessary - the guards to be installed to a height of 2m from floor to bottom of unit.
Large multiple cable runs shall be supported by perforated cable tray. The tray shall not be less than 1.6mm thick (16 s.w.g.) mild steel with returned edges with under slung galvanized steel angle supports. Tray supports shall be spaced according to the number and size of cable being carried on the tray but nowhere shall they be at greater than 0.9-meter intervals.
The Works Contractor shall include for all work associated with fixing cable supports to the structure of the building including cast in fixings.

Identification of cable runs

Cables shall be provided with identification labels at all positions where cables change direction and where cables are in multiple runs labels shall be at 10 meters intervals including each end of the cables. Labels shall be manufactured from brass plated engraved (minimum of 5mm lettering) to show the size of the cable and the equipment being fed.

Perforated Cable Trays
Perforated cable tray shall be of hot dip galvanized steel manufactured of the following minimum dimensions, etc.

75mm to 250mm 1.6mm G 12mm flange
300mm 1.6mm G 20mm flange
375mm to 600mm 2.0mm G 50mm flange

The minimum width of cable trays shall be 75mm but in all cases the width of cable trays shall be 25mm greater than necessary for cables being installed thereon.
Where cable trays are jointed either to other lengths or to standard bends and tees, the Works Contractor shall ensure that no rough edges are left that could cause damage to cables being drawn along their surface. On site manufactured bends and reducers will only be permitted to meet special requirements where standard fittings are not suitable.

No cable fixing bolt shanks shall project into the cable carrying side of the tray. Nuts shall be positioned on the rear of the tray and where the tray is suspended from ceilings, the bolts shall not project through the retaining nut. The tray shall be fixed at intervals of not greater than 900mm. A minimum clear space of 25mm shall be left behind all cable trays.
Where cables pass through slots cut in the tray or tray flange, the slots shall be sleeved with sheet lead, neoprene or similar insulant cut neatly to frame the slot. All adjacent lengths shall be electrically bonded together. All external cable trays in the roof shall be covered with sunshade.

Cable baskets:

1) General
Cable Basket shall be manufactured from hot dip galvanized steel wires, welded together and bent into final shape prior to surface treatment.
A total length of 100m (WxDxL): (30x5x300) cm might be needed
Surface Face Treatments:
a) Electro zinc plated to BSEN 12329-2000 for interior use (level 2) or Stainless Steel AFNOREZ CND 17.2 (AISI 3 16L).

2) Steel Wire Cable Basket Widths & Depths:
a) Cable Basket measured dimensions are all internal.
b) Depths of 35mm, to 150mm might be needed and 3000mm long
c) Widths of 50mm to 900mm might be needed and 3000mm long.

3) Specification
a) Cable Baskets will be manufactured and constructed with a 50mm x 100mm mesh configuration.
b) All Cable Basket fittings (e.g., changes in direction, level and size) shall be constructed on site, to the manufacturer's instructions, using side action bolt croppers and fastened using 25mm and 30mm counter clamps with M6 bolts and nuts, all surface treated as the tray
c) Cable Baskets will be coupled together using either a fast-spring coupler or a 25mm/30mm counter clamp combination with supporting lateral splice plate on trays over 300mm width. d). Cable Basket Trays shall be supported at a maximum span of
2.5m by trapeze, wall, floor or channel mounting methods and will not exceed maximum load as specified by the manufacturer.

4) Tests, Certification and Conformity
a) Loading and deflection characteristics of the tray should be tested and the results published in accordance with the European Standard CEI/61537.
b) Suitability of the support of Cat6 data cabling should be demonstrated by the way of independent test verification.
c) Fire test certification should be published in accordance with the E30/E90 standard.
d) Electrical continuity across a coupling should be demonstrated by means of a published test method and result.

Fiber runner

Fiber Runner is the optical fiber routing system.

A- Reference Codes:

1. American Society for Testing and Materials (ASTM):
2. National Fire Protection Association (NFPA): 70, "National Electrical Code."

B- Specifications:

- Fiber Runner shall be used to route, segregate and protect fiber optic communication cabling.
- It shall have a 2" minimum ben radius through-out the pathway
- It shall be made from an impact resistant and flame retardant PVC material
- Color yellow
- It shall include all mounting hardware, waterfalls, directional fittings and other accessories required for installation

Server Cabinets and related 0U PDUs:

A. All materials shall comply with the applicable sections of the following Codes for installation of telecommunications cabling:

1. Uniform Building Code (UBC)
2. National Electrical Code (NEC/NFPA 70)
3. National Electrical Safety Code (NESC IEEE C 2)
4. Local Codes, amendments, and ordinances.

B. Specifications of Cabinet

1. 42U 800x1200mm or 600x1200mm Wide Cabinet with Modular cable management fingers easily mount to the front and/or back of all four cabinet posts
2. 69% cabinet perforated door
3. Adjustable rear equipment rails with infinite positioning
4. Electrically bonded cabinet with a single ground connection to guard against EMI and ESD
5. Equipment rails have printed rack space numbering that can be oriented numbers up or down
6. Durable coating Cabinets are powder coated in a durable polyester paint available in black
7. Easy maintenance powder coat finish
8. RoHS Compliant
9. Doors include keyed swing handles
10. If the castor is required the same shall be installed using leveling feet adjustment mechanism without tilting the cabinet
11. Welded and assembled steel frame construction
12. Side panels include keyed quarter-turn latches
13. Dual hinge door for maximum accessibility between adjacent cabinets
14. Cabinet supplied with high density cable management fingers
15. Cable entry holes are equipped with plastic sealing plugs
16. All cabinets shall be equipped with vertical cable manager, MDF & Data center cabinets shall be equipped with horizontal cable manager

C. Specifications of 0U PDUs:

A. PDU OUTLETS

1. PDU Shall be provided with 20 or 30 Amp IEC-C13 & IEC-C19 receptacles; L6-20P or L6-30P plug connection, 3 input power cord.

B. PDU MONITORING

1. PDU systems shall be provided with web based remote monitoring via a direct IP network connection.

2. Each power strip module must provide the monitoring functionality described below:

a) Remote Monitoring of overall PDU Power and Energy usage

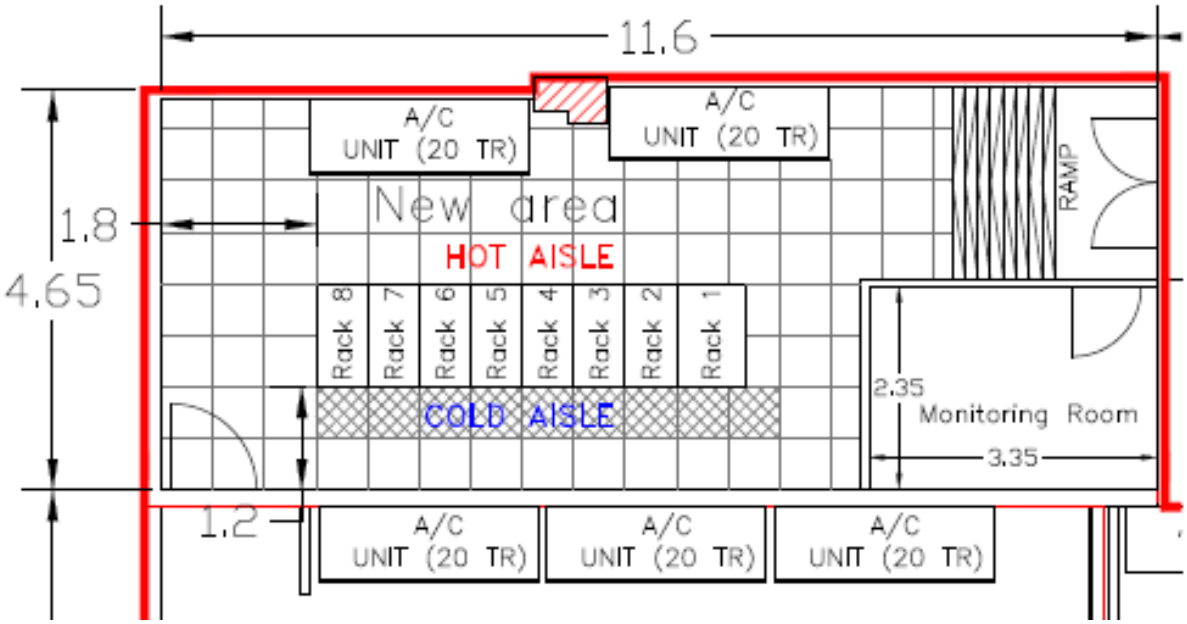
b) Measure in real time and provide trend analysis for Volts/Amps/Watts/Power Factor & kWh

c) Measure and record how much energy an individual power outlet is taking

d) Remote turn off and on of individual sockets on a power strip

e) Environmental monitoring Measures in-cabinet temperature, humidity, airflow and dew point remotely to prevent environmental factors that can cause equipment to overheat or malfunction

f) Alarm messaging capability Provides user-defined alarm/messaging capabilities for specific events that exceeded thresholds to help minimize network downtime



Industrial Sockets

The industrial sockets are to feed the data equipment within the data center and shall be surface mountable type. These shall be consisting of 2P+E & 3P+E as many numbers as required. The sockets shall meet IEC 60309 (formerly IEC 309) and relevant various standards. (Including BS 4343 and BS EN 60309-2)

The cabling from PDU to the sockets shall be done by fire rated cables meeting international standards and installed by the contractor.

LIGHTING INSTALLATION

The Contractor shall supply, install and connect the complete LED lighting installation where needed and shall be suitable for 240V, 50Hz, 1phase supply.
Generally, wiring shall be carried out using PVC cables in GI trunking, conduit as surface or in PVC conduits in concealed as per site conditions. The conduit system shall be wired on the loop-in system to allow for rewiring at a later date.
Final connections to each luminary shall be made via a besa box mounted, 10 amp rated (minimum) 3 pin clips in type ceiling rose arrangement at high level. Heat resisting 3 core flexible cables shall be used for connection between each luminaire and the ceiling rose. (Maximum length of flexible cable to be 2m).
Where conduits are installed above the suspended ceiling, they shall be fixed to the structural ceiling in the same manner as for a surface installation and terminate above the luminaire in a besa box. Conduit drops to switches shall be installed beneath the plaster finish. The ceiling rose shall be of plug-in type. All lighting fixtures shall be supported independent of false ceiling through chains.
The conduit system shall be concealed beneath the surface of the plastered walls and partitions and above the suspended ceilings and cast in slabs where necessary in all areas except plant rooms & external locations where a surface GI conduit system shall be employed.
The Works Contractor shall allow enough length of cable for final connection of each lighting point in order to move the final location of fixture within 2m diameter if conflicting with other services.

- All luminaries shall be provided by the Works Contractor who shall include for taking delivery, fixing and connecting them.
- All luminaries shall be complete with LED lamps in line with original catalogue of the proposed supplier as applicable for each designated area.

Lamps

- The Works Contractor shall allow for supplying all LED lamps
- LED lamps shall be cool white or equivalent color rendering.
- The Quality of Lamps shall be certified to BS 5750/ISO 9000 and further meet the relevant BS or IEC Standards.

Lighting Switches

- Lighting switches shall be 20 amp single pole, one way, two way or intermediate, single or multi-gang and shall be complete with adjustable grids complying with BS 3676.
- They shall be flush mounted in sherardized sheet metal boxes.
- Weatherproof switches, shall be used in all outside and damp areas and shall comprise of 20 amp switch, metal clad, surface mounted to BS 3676 with IP 65 to BS 5490.
- Where two different phases are brought to one switch box a special barriered type box shall be installed in accordance with IEE Regulations.
- Where indicating switches are required, they shall be similar to the switches previously specified but complete with neon indicating lights mounted on the same switch plate. Neon lights shall be arranged to switch on when the switch is in the “ON” position.
- All lighting switch plates are to be brushed stainless steel or similar to the existing switches.

Emergency Lighting:

- Emergency lighting shall be provided by including an integrated battery pack and inverter to the luminary so as to have a 3-hour emergency backup in case of power failure.
- All emergency luminaires shall contain a sealed nickel cadmium battery, charger unit, static switching and high efficiency LED lamp with automatic changeover arrangements in the event of a supply failure. They shall be complete with a proving circuit with an indicating lamp to show that both the main lamp filament and supply is in working order.

3) SMALL POWER INSTALLATION

- The Works Contractor shall supply, install, test and commission the small power installation
- All wiring shall in full compliance to local regulations. The wiring generally shall be carried out in PVC single core copper cables and shall be installed generally as a flush or surface installation to match the lighting installation previously specified. When the outlets are shown on floor, they shall be installed in flush floor service outlet box and wiring shall be carried out through one of the compartment flush floor trunking with 2m length of cables extra for each point for future relocation if required.
- Socket outlets for the general services unless otherwise specified shall be 16-amp capacity, rectangular pin-type and comply with BS 1363 Part 1. Where a surface installation is used, the switch plates shall be the same size as the conduit box in which they are mounted.
- Cover plate shall match the lighting switches previously specified. Socket outlets for UPS/ Computer application shall be of non-standard type with facility for clean earth connection.

Documents to Accompany the Offer:

The Project being a Time Critical one, the offer shall include the following details to have a clear understanding and technical details of the offer made. Accordingly, the offer shall include the following:

A. UPS UNITS:

- Proposed Unit, Model & Country of Origin
- Technical details of the proposed Unit
- Battery Sizing Calculation
- Compliance Statement to Specifications
- Equipment Layout Plan.
- Earliest Day of Factory Delivery
- Maintenance Call Out & Service Back Up

B. ATS PANEL and DB PANELS

- Proposed Manufacturer & Country of Origin
- Technical details of the proposed Panel
- Type Test Certification Details
- Dimensioning of Panel – EACH STRING
- Earliest Day of Factory Delivery
- Maintenance Call Out & Service Back Up

C. CRAC UNITS

- Proposed Manufacturer & Country of Origin
- Technical details of the proposed Panel
- Type Test Certification Details
- Dimensioning of units
- Earliest Day of Factory Delivery
- Maintenance Call Out & Service Back Up

Program of Work or project implementation plan

The program of work shall be provided with the best possible dates in consultation with the Factory.

The program shall include the following based from the date of placement of order.

- Factory Dispatch
- Shipping (Both for Air Freight & Sea Freight)
- Clearing & shifting to site.
- Installation
- Testing
- Commissioning.
- The program shall indicate all dependencies not included in the scope that are critical.
- Site Activities independent of equipment delivery

END