

PPMS System Description

Introduction

This section provides General description of each of the primary components used in the installed Prepaid Metering System for the project **APARNA HILL PARK LAKE BREEZE**. In this Project PPMS System has used Modbus RTU protocol for all the devices to communicate to Server using redundant fiber optic ring network.

The PPMS Monitoring Room located in the BMS Room monitors all the electrical parameters from prepaid meter which is installed for all the flats of each block. For details of the equipment connected to PPMS Please refer the PPMS System Architecture.

This Manual also consists of Sequence of operation and Fiber optic cable routing Diagram between each block. This information is very useful at the time of Operation and Maintenance of the PPMS System.

The PPMS system is equipped with three phase direct current prepaid energy meters with RS485 communication, Remote Display Unit(RDU), Ethernet converter, Manageable Ethernet switch with SFP fiber optic ports and 12 port LIU. The respective prepaid meters of each flat in a block is installed in the electrical shaft. The prepaid meters having RS485 output will be looped for every floor in the shaft. The Ethernet converters for prepaid meters will be installed in a IT rack in the basement of each block which has Manageable Ethernet switch with SFP ports and LIU. About 25 nos. Of prepaid meters can be communicated to each Ethernet converter. The Ethernet output from converter will be connected to switch. The fiber optic patch chord will be connected to 12 port LIU. The 6 core Single Mode fiber optic cable covering the entire blocks provides redundant network with ring topology. The Ethernet converter collects data from meters and transfer to the PPMS software which is installed in server PC in BMS room.

This Sytem description comprises of the following description about the PPMS system in this project.

- A. Prepaid Energy Meter
- B. Etherent Converter
- C. Manageable Ethernet switch with SFP port
- D. Prepaid Metering Software

Prepaid Energy Meter

The three phase Direct current PE5120 prepaid meter with RS485 communication installed in the electrical shaft for each flat. The Remote display unit is fixed inside ea flat allowing client to monitor their energy consumption lively. Client shall recharge t amount in the PPS software and can utilize the energy based on the recharged curre value. Features include

- Improved operational efficiencies: The prepaid meters are likely to cut the cost

meter reading as no meter readers are required. In addition, they eliminate administrative hassles associated with disconnection and reconnection

- Reduced financial risks: Since the payment is up-front, it reduces the financial risk by improving the cash flows and necessitates an improved revenue management system
- Better customer service: The system eliminates billing delay, removes cost involved in disconnection/reconnection, enables controlled use of energy, and helps customers to save money through better energy management
- The whole process of billing can be centralized
- Cost of manpower for billing / collection is reduced or Nil
- This avoids the hassles of human intervention as there is no need to enter the data into the meter. This makes the system more users friendly
- Displays balance Energy in the meter, thus enabling the consumer to plan when to recharge

• **Ethernet Converter**

The Ethernet converter collects data from each meter and transfers to PPMS software over Ethernet communication. Each Ethernet converter is assigned with an IP address for which the data of meter can be monitored in the PPS software. The Ethernet converter works with Modbus RTU protocol. Converter can communicate to nearly 25 prepaid energy meters.

• **Manageable Ethernet switch with SFP port**

The 8port Manageable Ethernet switch with 2 SFP fiber optic ports limits the usage of media converters in the system design. The manageable switch helps in providing redundant network where data loss can be avoided as ring network of fiber optic armoured cable runs through the blocks using 12 port LIU. If any of the cable fails, other cables takes the communication with the help of manageable switch. Features include:

- Less no. of components in system design
- Easy Maintenance
- Easy trouble shooting
- Reliable design
- Data Loss is Minimal

Prepaid Metering Software

The Ethernet output from the Manageable Ethernet switch in the BMS room is connected to Server PC. PPMS software installed in the server PC helps user to configure, monitor and billing of energy consumption of each prepaid meter in a flat. The data from Ethernet converter gets stored in the SQL database in server PC.

ELNet PPS Home Screen has 7 Bubble Icons for 7 Modules and the Right & Wrong Indicator shows whether the Module is running or not.

- Service
- Configurator
- Online
- Datalog
- Reports
- EBS – Energy Billing System
- PPS

Customer can configure the channel name, flat name, model in device configuration page. Software provides 4 levels for accessing the software modules which can be configured by user.

Dashboard in Online module allows the user to analyze the energy consumption pattern with the help of trends. Datalog module helps in client to analyze the energy consumption with historical data.

The Energy billing system helps customer in billing their consumption flatwise having flexibility to generate the bill for selected date range Cost entry for the consumption can be entered monthwise. Fixed cost, taxation part, slab rate is user configurable. Payment mode can be configured either cheque or cash. Single bill, consolidated bill can be generated.

Browser Access

ELNet PPS Web Application provides a Browser based UI for users to access the ELNet PPS Server and perform various operations such as Recharge, View Balance, View Reports and View Complaints etc.

Advantages of PPMS System

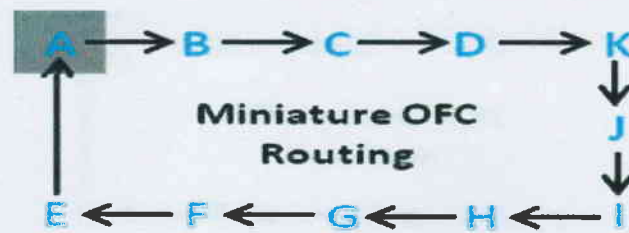
- Recharging option.
- Recharge History.
- Online data viewing.
- Pending recharge details
- Cheque Reconciliation option.
- Customer complaint viewing
- Yearly recharge history report
- On low balance during night hrs and no man hrs auto recharge; Happy hrs .

- EB and DG cost entry option
- Balance deduction based on cost programmed
- Fixed and maintenance cost deduction options with daily, weekly and monthly along with Active energy consumed.
- Live updates

Sequence of Operation

The proposed system helps customer to manage, monitor and bill the energy consumption of individual flats using Elmeasure's Prepaid Metering system with Fiber optic redundant networking.

1. Prepaid meter of respective flats are installed in electrical shaft of each block.
2. Based on the energy consumption by the tenant, balance will deduct in the prepaid meter based on the amount recharged.
3. Remote display unit (RDU) are fixed in the respective flats to display all electrical parameters including balance.
4. Inside the electrical shaft, prepaid meters are looped using Belden cable and connected to Ethernet converter.
5. Maximum 25 prepaid meters are considered per loop to connect to Ethernet converter.
6. IT Rack with below network equipment is installed at the basement of each block.
 - a. Ethernet converters (Quantity varies based Prepaid meters / shaft / block)
 - b. 8 port Ethernet Manageable with 2 SFP (small form-factor pluggable) Ports (1No)
 - c. 12 Port Light Interface Unit (1No)
7. Ethernet converters are connected to 8 port Ethernet Manageable switch using Cat 6 cable. Data transfer between the devices will be using Modbus TCP protocol.
8. 8 port manageable switch ensure the network redundancy using Spanning tree concept.
9. SFP optical transceiver is used to connect Light interface unit (LIU) to Ethernet Switch. It is an input/output switch-over device that plugs into a Gigabit Ethernet port, linking the port with the network.
10. Two 6 Core patch chords are used to connect SFP transceiver to 12 Port LIU. Ring network topology was formed by connecting adjacent blocks through LIU.
11. 6 Core cable was laid between the block as per below routing.



12. Energy parameters and balance parameter will be transferred to centralized server at BMS room using the Fibre optic network.

System Benefits

- Skilled labor is not required.
- Faster and reliable communication with FO network
- Redundancy network with Ring topology ensures no data loss
- Ease of conducting preventive maintenance through detailed reporting and analysis.
- Easy trouble shooting
- Efficient asset management and distribution.

VENTILATION

No specific ventilation is recommended. Meter is capable of working satisfactory at Ambient between -5 to 60 degree C.

3.4.2 WIRING THE PREPAID METER

The inputs to be connected to the Prepaid Energy Meter are clearly indicated on the Front Panel.

Connect the Voltage inputs: For LT Models (415 V AC L-L nominal), connect the voltage inputs directly to the terminals. For HT Models, the inputs should be from the secondary of the Potential Transformer. In a 3-wire system, the Neutral terminal is not connected. In a 4-wire system, the neutral may or may not be connected to the terminal marked 'N'.

Connect the Current inputs: It is important to maintain the direction of the current flow from S1 to S2. If this reversed in one or more phases, the Power computation will be negative in the corresponding element(s). Though the computation is internally corrected to an equivalent positive value, it is not advisable to leave a reversal of current flow uncorrected.

It is important to adhere to phase relationships. Current 'IR' must correspond to the phase that has the Voltage connected to the 'VR' terminal. The same holds good for current inputs 'IY' and 'IB'. If the current and voltage inputs are swapped, the Power and Energy computations may be erroneous.

Wire the Dual Input

The Unit is capable of monitoring electricity consumed from two separate sources. One of these could be the supply from the electricity authorities while the other could be from the in-house generator. For the meter to recognize that the supply is from the alternate source, the meter requires a voltage input between 240 V AC that should go live when the supply is from the alternate source.

Wire the Communication (RS485)

The Prepaid Energy Meter is equipped with an RS-485 Serial Communication Port operates on the MODBUS-RTU protocol.

Wire the Remote Unit

The Prepaid Energy Meter is equipped with Remote Unit, it has four terminals, two terminals for 5V supply to Remote Unit and two terminals for RS485 communication to Remote Unit.

3.4.3 INSTALLING THE METER

The device should be installed in a place where it will not be at risk of damage or near any unauthorized current connection. The sealing of the distributor housing is recommended. The producer is not responsible for any damage caused by improper assembly, service and product maintenance.

INSTALLING A METER IN A NEW LOCATION

To install the Elmeasure's prepaid meter in a new location:

- Remove the terminal cover from the meter
- Install the meter in an upright position, using mounting hardware that is appropriate for the type of surface material
- Connect the line and load wires to the meter terminals, being careful to use the correct phase, neutral, and line/load configuration
- Turn the supply line power to the meter on
- Test each phase line terminal of the meter to make sure power is on to each phase, and that the neutrals are connected to the proper terminals
- Test the load terminals of the meter to make sure power is available to each phase of the load.
- Check the display for proper operation of the meter
- Replace the terminal cover. Apply a seal to the sealing screw if necessary or desired.

REPLACING AN EXISTING METER

To install the Elmeasure's prepaid meter in a existing meter location:

Precaution: Make sure the existing meter and Elmeasure meter meter mounting mechanism

is same.

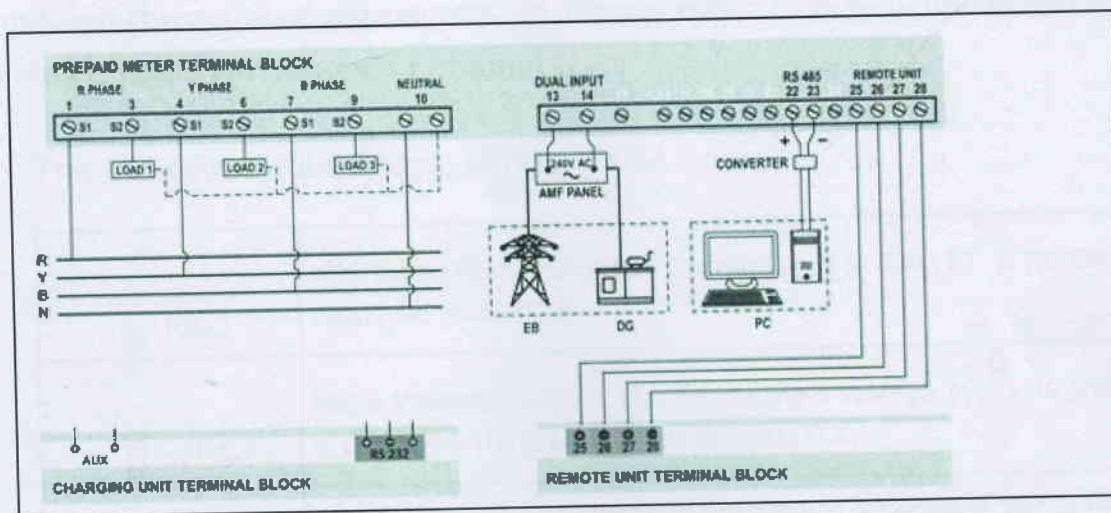
- Turn off the line power to the existing meter
Caution: Test existing meter terminals to be sure the voltage is off.
- Remove the line and load wires from the existing meter terminals. Make sure you label the wires, or have a method to identify the line and load wires of each phase, R, Y, B, and neutral, for proper installation in the new meter
- Remove the old meter
- Install the Elmeasure's prepaid meter in the same location as the previous meter using mounting hardware that is appropriate for the type of surface material
- Inspect the line and load wires to make sure they are not damaged or frayed. (Replace if needed.)
- Connect the line and load wires to the meter terminals, being careful to use the correct phase, neutral, and line/load configuration
- Turn the supply line power to the meter on
- Test each phase line terminal of the meter to make sure power is on to each phase and that the neutrals are connected to the proper terminals
- Test the load terminals of the meter to make sure power is available to each phase of the load.
- Check the display for proper operation of the meter
- Replace the terminal cover. Apply a seal to the sealing screw if necessary or desired. The installation is complete

INSTALLING THE REMOTE UNIT

- Connect the Remote unit power supply and RS485 terminals to Prepaid meter Remote Unit terminals as shown in the connection diagrams
- Connect the EB/DG input to Prepaid meter and output of prepaid meter connected to load

Fig2: Connection diagram for three phase prepaid energy meter with remote and

charging unit



3.4.4 PREPAID METER CONFIGURATION

PREPAID METER PRODUCT DESCRIPTION

Physical Description

FRONT: The front panel of prepaid meter contains the two parts:

1. Display
2. Wiring Diagram

The Display part has one row of six digits/characters each, with auto scaling Kilo, Mega, and minus indications. Two smart keys make navigating the parameters very quick and intuitive for viewing data and configuring the Prepaid meter.

The Display part of front panel contains the following indicators and controls:

7-segment LED display: One row of alphanumeric displays, six digits each, display all parameters simultaneously. For every second the display updated.








Indicators: One row has Kilo, Mega and Minus indicators, Electricity Board, Old energy and DG indicators, communication indicator.

Keys: Two smart keys to scroll through the display pages.

7-segment LED display: One row, six digits, segment LED display. The Energy meter displays

the parameter name prominently right on the large, alphanumeric readouts. In Energy all the 6 digits contains the value of parameters. In Power, Basic first 4 digits correspond to Value and remaining 2 digits corresponds to Name.

The Indicators-Kilo, Mega, Minus, COM

 KILO	Kilo: When lit, indicates that the reading is in Kilo (10^3). 10,000 is displayed as 10.00 K.
 MEGA	Mega: When lit, indicates that the reading is in Mega, (10^6). 10,000 K is shown as 10.00 M. and 1.0 M as 1000 K.
 MINUS	Minus: When lit, indicates that the reading is negative. When PF (power factor) is lead (capacitive load): Both PF and VAR (reactive power) sign will be negative. When current is reversed: W (active power) of that particular phase is negative.
	EB: EB indicator blinking indicates that meter running on electricity coming from Electricity board.
	OLD: OLD indicator indicates the old energy values for both EB and DG OLD separately.
	DG: DG indicator blinking indicates that meter running on Digital Generator.
	COM: Communication indicator indicates the meter communicating with the software or not

LED indications for prepaid meter

LED Status	Meaning
KILO ON	Kilo
MEGA ON	Mega
MINUS(-) ON	Lag
MINUS(-) OFF	Lead
EB ON	Meter displays EB energy
OLD ON	Old energy values for EB and DG separately
DG ON	Meter displays DG energy
EB LED Blinking	Meter is running in EB
DG LED Blinking	Meter is running in DG
COM ON	Meter Communication with software

3.4.5 KEY FUNCTIONS

Smart Keys Operating the energy meter is easy, using the two smart keys to navigate through the display pages. The display shows where you are headed

Smart Keys Functionality

Key	In SET (Programming) mode	In RUN (Measurement) mode
UP	To select the value and accept the value.	To scroll pages in upward direction to look at different parameters.
DOWN	To edit the value/system type down-ward in edit mode and scroll through the parameters	To scroll pages in downward direction to look at different parameters

3.4.6 PROGRAMMING GUIDE FOR 3PHASE (PE5120) PREPAID METER

Step	Actions	Display Reads	Range/Options/Comments
1	Press UP & DOWN keys together to enter SETUP	[SETUP]	
2	Press DOWN key	Row: 0000 PW with first digit "0" blinking	
3	Press DOWN key until it reaches the first digit to "1".	PASSWORD = 1000 (default/factory set).	If any other password is already set using DOWN key to set the right password
4	Press UP key four times to accept the password.	Row: 2056 Yr (RTC year) 2056 Yr (Default)	Defines the RTC year setting.
5	Press UP key to select the RTC year.	Row: 2056 Yr "56" will start to blink and it can be edited using DOWN key.	Egg: Year need to be set as 2014 so press the Up key, the selected mode will start to blink i.e. "56" and change the selected mode to "14" using DOWN key.
6	Press UP key to select the RTC year	Row: 2014 Yr Default: 2056	Program Range for RTC year :2012-2056. If year is set 2014, display return to RTC year acceptance.
7	Press DOWN key to go to the next parameter	Row: 01.01. d	Defines the Month & Date of the clock. First two digits define the month selection & another two digits mention the date.
8	Press the UP key to select the Month & Date	Row: 01. 01. d (default). First two digits blinking which is "month"	Selected mode will blinks and it can be set to the desired range using Down key.

		selection can be edited using down key.	Egg: Month need to be set April , set the selected blink value as "04" using DOWN key
9	Press UP key to accept the edited value for month.	Row: 04.01. d Second digit blinking which is "Date" selection, it can be edited using DOWN key. Press UP key to accept the edited value.	
10	Press DOWN key to go to the next parameter	Row: 00.01. t (Default)	It defines the RTC time settings. It is in HH:MM format.
11	Press the UP key to select the Hour & Minute.	Row: 01.01. t Follow the procedure steps 8 & 9 for set the Hour & minute.	
12	Press DOWN key to go to the next parameter	Row: 52.00 Eb (Default). Over KVA EB	It defines the over KVA tripping value for Eb. Range: 52.00Kilo- 9999 Mega
13	Press UP key to select the over KVA value.	Row: 52.00 Eb. First digit starts blinking can be edited using DOWN key.	(selected mode blinks)
14	Press UP key to accept the edited value for first digit.	Row: 52.00 Eb Second digit blinking, can be edited using DOWN key. PressUP key to accept the edited value. Continue the same method until fourth digit.	Program range for Over KVA: 52.00 Kilo- 9999.0 Mega.

15	Press UP key	<p>Row: 52.00 K Eb.</p> <p>Decimal point blinking. It can be set at appropriate location using DOWN key.</p> <p>Ascertain the correct scale (Kilo, Mega) is selected. Press UP key to accept the edited value.</p>	<p>Egg. To set 11.00 K.</p> <p>Set first four digits (1100) as explained above. Press DOWN key to place decimal point at appropriate location with respective LED (kilo, Mega) indication.</p>
16	Press DOWN key to go to the next parameter	<p>Row: ryb dG. (Default)</p> <p>Phase selection in DG</p>	<p>It defines which phase needs to be work in DG.</p> <p>Ranges: ryb,r,y,b</p>
17	Press UP key to select the edited value.	<p>Row: ryb dG.</p> <p>Selected mode blinks and select any of the phase selection as mentioned in the range using DOWN key. Press UP key to accept the selected mode.</p>	
18	Press DOWN key to go to the next parameter	<p>Row : display 285.0 O.V</p> <p>(over voltage 285.0 O.V (Default)</p>	<p>Defines the over voltage settings between Line to neutral.</p> <p>Range: 80-310 V</p>
19	Press UP key to select the	Row: 285.0v (Over voltage)	
20	Press UP key to accept the edited value for first digit.	<p>Row : 285.0 O.V</p> <p>Second digit blinking, can be edited using DOWN key. Press UP key to accept the edited value. Continue the same</p>	<p>Program Range for Over Voltage : 80V to 310V</p> <p>If value set is above this limit, display returns to the maximum O.V value acceptable.</p>

		method until fourth digit.	
21	Press DOWN key to go to the next parameter	Row: 5.000 d.t (Delay Time). Follow the procedure as described in steps 5 & 6 5.000 (default)	It defines the delay time for relay tripping Range: 1-180 sec
22	Press DOWN key	Row : 9600.b (Baud rate) Communication Speed (9600-Default / factory set)	Defines the Baud rate Option: 2400, 4800, 9600, 19.2k.
23	Press DOWN key	Row : EVEN P (Parity) Even/ Odd/ None	Even(even)/ Odd(odd)/ No(No parity) (Internal Communication error Check)
24	Press DOWN key	Row : 1.000 Id(Device ID) 1.000 (Default)	Defines the ID. Communication identification Number. Option :1- 247
25	Press DOWN key	Row: ----- (Password). User Programmable password, range 1000 to 9999.	If the password is forgotten the meter will be reset and calibrated at factory only.
20	Press DOWN key	Row : rESO E.S (Energy Selection) rESO (Default)	Option: resolution/counter (rESO/COUN).Energy value format i.e., the energy accumulated in the meter to be displayed in resolution or counter format
21	Press DOWN key	Row : 5.000 A.t. (Auto scroll time)5.000 (Default)	Range: 1 to 10 seconds (Display increment during auto scroll.
22	Press DOWN key	R o w : S A V E Row 2: "Y" blinking.	If "n"(no) is selected then Meter enters into RUN mode without memorizing any edited Values in setup

The List of parameters that can be configured and the range is given below

Sl. No.	Parameter	Default setup	Range
1	Over Voltage(L-N) [O.V]	285.0	80V-310V
2	Over KVA	52.00	52-999K
3	Individual phases change on DG	RYB	R (or) Y (or) B (or) RYB (or) No DG
4	Delay Time [d.t]	5.000	1-180s
5	Baud rate [b]	9600	2400 to 19.2k
6	Parity(P)	EVEn	Even/ Odd/ no
7	Device Id (I d)	1.000	1.000 to 247.0
8	Password	1000	1000 to 9999
9	Energy selection mode [ES]	rESO	rESO /COUN
10	Display increment time during auto scroll [A.t]	5.000	1 to 10 seconds

Enabling and Disabling of Auto scrolling:

Enabling Auto Scrolling: Press DOWN key continuously for 5 seconds or until display shows EnAb.Au for downward scrolling. The auto scrolling will be enabled automatically when the meter is OFF and ON.

Disabling Auto Scrolling: Press UP/DOWN key to disable auto scrolling. Display shows dISA.Au and returns to normal mode.

3.4.8 TROUBLESHOOTING

CAUTION

During reparation and maintenance, do not touch the meter connecting clamps directly with your bare hands, with metal, blank wire or other material as you will have the chance of an electricity shock and a possible chance for health damage.

Turn off and lock out all power supplying the energy meter and the equipment to which it is installed before opening the protection cover to prevent the hazard of an electric shock.

WARNING

Maintenance or reparations should be performed by qualified personnel familiar with applicable codes and regulations.

Use insulated tools to maintain or repair the meter.

Make sure the protection cover is in place after maintenance or repair

Due to programming error, site conditions, some problems can cause the Meter malfunction. The fault symptoms and their remedial action for correction is given below.

If the display does not turn ON

- Check that there is at least 1 10 V available in power supply
- Check the link connected or not

Recharging not happening through RS 485

- Check the connectivity for RS485
- Check the meter ID correct or not

- Check the Elnet PPS selection correct or not

Display blinking

- Balance is below the limit
- Load off condition
- Check the balance is zero
- Check the over voltage occur
- Check the over KVA occur

If RS-485 communication does not work:

- Check that the baud rate of the host computer/PLC is the same as Meter
- Check that the device ID of the meter is unique and should not replicate
- Check all communications wiring is complete
- Check that the number of data bits is set to 8, with one stop bit and even parity

3.4.9 DISCLAIMER

Sufficient care is taken to provide all information regarding the product but ElMeasure does not responsible the product which has been damaged due to improper installation, improper handling, improper connections, neglect, misuse, accident, and abnormal conditions of operation and natural calamities or acts of god.

Maintenance and Trouble Shooting of Devices

1. Check all the field devices like Prepaid meter, Ethernet converter etc.
2. Check the electrical connections and tighten periodically (three months / Half yearly).
3. Check the Ethernet converter communication once in a day.
4. Check the Ethernet Switch communication once in a day/week.
5. Clean the Server PC with damp cloth every week.
6. Periodic checking of UPS power on the rack along with switch and Converter is Mandatory
7. For the details regarding the maintenance schedule please refer to the below table

Field Maintenance Schedule

Sl. No.	Description	Period				
		Daily	Weekly	Monthly	Quarterly	Yearly
1.	Check all Ethernet converter s communication	X				X
2.	Check all Equipment for any failure	X				X
3.	Check and replace any physical defect of device		X		X	X
4.	Check and clean all Ethernet converter Panels			X		X
5.	Check for all software Operations		X	X		X
6.	Check for UPS power on the rack		X	X		X