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TECHNICAL SPECIFICATION

1.0 Executive Summary

The hospital is located in Palamau district head quarters and is connected to the local Jharkhand State Electricity Boards (JSEB) grid for supply of power. The quality of the grid power is un-reliable with frequent power outages and tripping. Tripping and outages are more prevalent in the evenings due to poor regulation and excessive loads that are beyond the end user control. There is an urgent need to provide an effective internal power management system that will provide clean regulated and un-interrupted power to the pre-identified critical loads.

1.1 Objectives

- Provide reliable, clean, regulated, un-interrupted power on demand to the pre-identified critical loads in the hospital, improving the over all service in the hospital.
- System should be self re-generating, provide backup power for 4 hours on an average day.
- System to provide low life cycle cost and maximise savings to the institution.
- System would be an operating model for further replication in other hospitals and application.

1.2 Proposed Design Philosophy

JREDA proposes Solar – Mains Hybrid power system that would use a suitably designed solar arrays, power conditioner and battery bank. In order to achieve the project objective, some field-tested concepts have been incorporated into the project.

- Integrated control system to co-ordinate and optimise interaction between the solar array, battery bank, grid power and site load.
- Solar array will have the highest order of merit, all solar power generated will be prioritised and consumed.
- High Efficiency Power conditioner to maintain highest system efficiency.
- Battery will be maintained at a minimum 50% SOC at all times. It would be our endeavour to maintain the battery at float state for as long as feasible.
- Automated scheduling of the system to avoid complete station “Black out”.
- Battery bank would act as a “Spinning Reserve“, with a design life of 7+ Years.
- Data logging and remote monitoring for system performance monitoring.
- Use energy efficient lamp with electronics ballast of 28 /14 W capacity in place of 40W Tube Lamps with conventional choke, which consumes 80W. This will provide substantial power saving.
- Provide energy efficient lighting to ensure sufficient illumination in diagnostic area, driveways, corridors and in / outpatient wards by using energy efficient luminaries.
- Proposed system will exclude loads such as water pumps, air conditioners and other connected dynamic high capacity loads.

JREDA would need Solar-Mains–Battery based hybrid system with a margin of 40% in capacity for future load growth. Solar and battery units are modular and can be added without any major modification to the system. The recommended back up power system for the hospital shall be configured with:

- Solar Array of minimum 1500Wp rating.
- Suitable frames to mount the solar array with the required tilt.
- Flooded tubular battery bank of 120V / 200Ah.
- Hybrid Power Conditioner of 5kVA continuous rating

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- Required energy efficient lighting.
- The system shall carry an over all warranty of 2 years.

2.0 DESIGN CONSIDERATION

2.1

Description	Qty	Load (W)	Connected Load (W)	Av. Outage Hours	Total Eergy / day (kWhrs)
E+ Energy Efficient Lights - 4 Feet	48	28.00	1344.00	4.00	5376.00
E+ Energy Efficient Lights - 2 Feet	18	14.00	252.00	4.00	1008.00
E+ Energy Efficient (Yard Light)	6	56.00	336.00	4.00	1344.00
Vaccine Storage Equipments	1	300.00	300.00	4.00	1200.00
Other Medical Equipments	1	300.00	300.00	4.00	1200.00
Other Misc Loads	1	100.00	100.00	4.00	400.00

2.2 Load Calculation

The total connected load in the system is 2.6kW, the total energy requirement during the outage hours is estimated at 10528kWhrs. A solar PV array of 1500W will produce a daily average power of 1500 x 4.5 effective sunshine hours = 6750Whrs. Contribution of Renewable Energy in the total energy will be 64%. Balance load of shall be supplemented from the main supplies, when available. The battery bank of 200AH capacity would be able to cater to the break down period not exceeding 4 hours at a given time.

2.3 Operational Philosophy

The system shall supply electricity from Gird and Solar Panels (renewable source). Energy storage in the form of a battery bank provides a buffer and control flexibility to allow optimum use of the renewable energy source without jeopardising the robustness and quality of power delivered to the customer. The way in which this is achieved is described below.

The system controller shall monitors and measures how much energy is being produced by the solar array, it has the ability to turn the PV array off if required. The controllability of the PV is provided to ensure that in the event of large available solar power (highly unlikely in this system) and very low system loads it will be possible to reduce the output from the PV array in small increments.

Energy storage system shall consist of a bi-directional inverter that can charge or discharge a battery bank. Battery bank shall run the system for about 4 Hrs at a load specified load. This capacity the system can cover for the sudden loss of PV in the system. The battery bank also allows excess solar energy to be stored and used later on when required. In effect the battery bank provides system flexibility and supply robustness so that grid can be varied continuously or turned off as the solar input varies without jeopardising the supply of electricity.

TECHNICAL SPECIFICATION

High load, minimal solar
In this mode the grid primarily supplies the system energy. Operation is optimised to make best use of the battery bank.
High load, high solar
In this situation the solar behaves in effect as a negative load. The power system will see a reduced demand but the demand will still be large enough to require the operation of the grid.

Low load, high solar
When significant amount of solar energy is available and the load is close to that which can be supported by the PV array it shall be possible to internally turn off the grid completely. The inverter and battery bank shall cover for any mismatch between the PV array and the system load. If the battery bank starts to run low, depending on the availability the grid will automatically cut-in. Thus the battery bank shall be able to supply power to the system via the inverter to cover the load in the event of a reduction in PV array output due to a reduction in solar insolation. This allows the system to ride through temporary reductions in the solar output without drawing on the grid.

Low load, low solar
In the event that the system load is significantly below the inverter rating it shall be possible to run the system just from the inverter. As the load increases and the battery runs down grid power needs to be drawn.

As can be seen from these different modes, the system shall be very flexible in covering for different situations of varying load and solar output. At all times the system is maximising the usage of the solar energy and optimising the selection of other sources for robustness of supply.

3.0 Photovoltaic Array

The solar array shall have a total installed capacity of 1500Wp. The array shall be made of basic block of 750 Wp – 10 modules of 75W connected in series. The total nominal DC input voltage shall be 120 VDC. Redundancy has been built into the system, with multiple arrays connected in parallel to the inverter. Solar array shall be mounted on cold rolled galvanised steel frames onto which the solar modules would be secured with nuts and bolts. The array structures would be mounted on concrete footings either on ground or on the roof – depending on shadow free space availability. Each sub-array steel structure supports 10 framed PV modules. Each string is equipped with a string disconnect for ease of servicing and the entire solar array is terminated into the Power conditioner through a DC breaker located in the DC junction box.

4.0 Hybrid Power Conditioner

The multi-function power conditioning system combining the functionality of a grid-interactive solar inverter with a true on-line single conversion UPS. The SMD shall allow for the first time, the option of combining renewable energy sources with the functionality of a commercial UPS system.

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Principal features and benefits

The principal features of the SMD system shall include the following:

- Conditioning of voltage supplied to the load using a highly efficient true on-line single conversion topology
- "No-break" transfers to battery and renewable energy power in the event of grid failure
- Minimisation of harmonics on JSEB grid – SMD can improve the quality of the utility grid.
- Integrated data, event, and fault logging.
- Remote access via a telephone to all monitoring and control functions.
- Integrated PWM solar charge regulator.

Standard Operation - Grid Interactive Mode: Under normal circumstances, the grid powers the load with the power conditioner minimising voltage sags, swells, spikes and noise. The SMD charges the battery, ensuring it will be available in the event of grid failure.

Inverter Mode: In the event of failure or extreme fluctuations in the grid, the SMD transfers the load to battery power. When the grid is available again, system transfers back to the grid and recharges the batteries.

System Specifications

OPERATING PARAMETER	INFORMATION
Output Voltage	▪ 230 V Nominal ▪ Inverter to follow grid to +10% -15% of the nominal output voltage before switching to stand-alone mode ▪ Synchronisation window operator-adjustable via system set-points
Output Frequency	▪ Grid synchronised operation ▪ Synchronisation window can be operator adjusted via system set points ▪ Maximum Range: 47Hz to 53Hz
Continuous Rating	5kVA
Waveform	Sine-wave
Front Panel Interface	40x4 LCD panel with keypad displaying: ▪ Supply Voltage / Frequency ▪ Output Voltage / Current ▪ Output Power summation ▪ Input Current / Voltage ▪ Input Ah ▪ Accumulated output kWhrs ▪ Temperature / Solar radiation (optional – extra)
THD	Less than 5%
RFI	Designed to minimise both conducted & radiated RFI emissions
Efficiency	Maximum 94%

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Internal Protection System	▪ Inverter overload ▪ Peak current (short circuit) protection ▪ Over temperature ▪ Over / Under voltage protection ▪ Over / Under frequency protection
Alarm Signals	Via system fault relay (voltage free contact)
Grid Interface Protection	▪ Over / Under Voltage ▪ Over / Under Frequency ▪ Grid loss protection ▪ Islanding protection ▪ Circuit breakers
Earthing Provisions	AC bypassing to earth on inverter and DC inputs
Control Type	Voltage source, microprocessor assisted output regulation
Power Control	Phase Controlled Pulse Width Modulation (PWM)
DATA LOGGING	
Computer Ports	RS232 referenced to ground (non-isolated)
Within Inverter	One logging port available. MODICON Mod Bus interface for local or remote SCADA communications User adjustable averaging period from 1 minute to 24 hour results using 62.5 millisecond samples Internal storage capabilities configurable for 12 days storage PC based software to control and monitor the control system locally or remotely via modem
Parameters Include:	Average Output Voltage, Amps, Freq., Power summation Average Output Frequency Average Grid Voltage, Frequency, Amps Average DC Voltage Average Renewable Amps Average ambient or panel temperature (degrees C) Average solar radiation Historic time stamped event and fault diagnostics for the previous 32 actions and/or faults
External Logging	▪ Remote communications package ▪ Online graphical trending, including comprehensive system logging including those points described above ▪ Ability to transfer data to PC filing system ▪ Ability to store and restore system set point configurations remotely
Communications Method	Protocol MODICON Mod Bus (RS232)

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ENVIRONMENTAL	
Operating Temperature	5-50 degrees Celsius
Humidity	0-90% non condensing
Enclosure	Rated for IP30

5.0 Battery Bank

A battery bank shall include in the power system as a "spinning reserve". The battery bank shall be designed to provide power for approximately four hours to a 50% depth of discharge (DOD). Flooded tubular battery bank shall be provided. These batteries have to be maintained on a regular basis by the Vendor. Typical maintenance would include application of petroleum jelly, topping of battery with distilled water and general cleaning.

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COMMERCIAL TERMS & CONDITIONS

1.	Preferred Payment Terms	:	90% against receipt of materials at site. 10% within 30 days after I&C and PBG for one year.
2.	Delivery	:	FOR site
3.	Guarantee / Warranty	:	The equipment supplied would be covered by our standard warranty terms for a period of 24 months from the date of turn on.
4.	After Sales Service	:	As per JREDA terms.
5.	Taxes and Duties	:	All taxes, duties and other charges should be quoted in figures as per prevailing rates. If no taxes & duties are mentioned the same will be treated as "NIL". Taxes & duties should be given in techno-commercial bid only.
6.	Tender Evaluation	:	As per normal procedure.
7.	PBG	:	10% of materials value for 1 year.
8.	Type of Bid	:	Two part bid.

Important Note : Two part should be submitted in two parts.

1. Technical cum Commercial Bid in a sealed envelope and superscribing **"Tender No.:…….. Due on :……. "TECHNO-COMMERCIAL BID"**

2. Price Bid in a sealed envelope and superscribing **"Tender No.:…….. Due on :……. "PRICE BID"**

Both the envelopes can be put in a single cover and should be superscribed as : **"Tender No…….. Due on :…….. "THIS COVER CONTAINS (A) TECHNICAL CUM COMMERCIAL BID IN A SEPARATE ENVELOPE (B) PRICE BID IN A SEPARATE ENVELOPE"**

Director

JREDA

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Name of Bidder : ……

Address : ……

COMMERCIAL BID

Sl. No.	Description	Unit	Qty,	Unit cost FOR	Taxes & Duties	Inst. Cost	Service Tax	Sub Total Ax(B+C+D+E)
			(A)	(B)	(C)	(D)	(E)	
1.	Manufacture, supply, fitting & fixing of Module-Mounting structure & other related Balance of Systems	Sets						
2.	Solar High Mast Lighting Systems	No.						

Signature of Bidder

Designation

SOLAR HIGHT MAST LIGHT

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Technical Specification

Solar Module 74 Wp x 2

- 36 monocrystalline / Multicrystalline solar cells connected in series with redundant interconnects.
- Laminates enclosed in a non-corrosive Aluminium frame.
- Electrical output of the Modules shall be terminated in a weather proof Junction Box.
- Supersaturate construction with toughened glass top surface to withstand wind up to 200 km/ hour.
- Provision for the addition of diode in the Junction Box.
- Protection against moisture ingress for the solar cells by lamination.

Electrical and Mechanical Features

Sl. No.	Typical Parameters of solar module	Unit	Value
1.	Peak Power (Wp)	Watt peak	74
2.	Open circuit voltage (Voc)	Volt	21.0
3.	Short circuit current (Isc)	Amp	5.0
4.	Voltage at Max. power point (Vmp)	Volt	17.0
5.	Current at Max. power poin t (Imp)	Amp	4.4
6.	Length	mm	1200
7.	Width	mm	530
8.	Depth	mm	38
9.	Weight	Kg	7.6

Charge Controller

The solar charge controller should charge the battery by the SPV Module till it reaches the final voltage (full charge condition).

Sl. No.	Parameters of Charge Controller	Unit	Value
1.	Battery over charge condition	Volt	14.2
2.	Battery deep discharge condition	Volt	11.0
3.	Short circuit condition	-	Protection
4.	Indicator for charging	-	Provided
5.	Indicator for deep discharge condition	-	Provided
6.	Under no load condition - Protection	-	Provided

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Technical Specification

INVERTER

Micro controller based

Digital Inverter has a micro controller based circuit that increased the efficiency and accuracy of inverter. This technology makes possible a high level of internal inverter management and control.

Auto Reset

Inverter has auto reset function in case of overload and short circuit. It will reset itself.

LED Indications

The LED indications on the front panel of the digital inverter give all information / display on battery charging, inverter ON, over loading, short circuit, main fuse blown etc.

Protection Circuitry

- Inverter is protected from high battery voltage, low battery voltage and over current conditions.
- State-of-the-art micro controller based technology
- The technology used in inverter is micro controller based using MOSFETS.
- Automatic low battery cut-out
- Inverter protects the batteries from damage caused by over discharging by automatically shutting itself off when battery voltage falls to a preset level.

Sl. No.	Parameters of Inverter	Unit	Value
1.	Inverter output	Volt	220 ± 10
2.	Wave form	-	Quasi wave form
3.	Input voltage range	Volt	11.0 – 14.5
4.	Length	mm	215
5.	Width	mm	150
6.	Height	mm	195
7.	Weight	Kg	7

Battery

Features :

1. Ironclad Tubular Technology
2. Electrolyte level indicator
3. High acid volume per ampere hour
   Deep cycle design

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Technical Specification

5. Resistance to abuse
6. Common side venting
7. Conform to IS-13369-1992

Type	Capacity in AH at 27ºC at C/20	Dimensions in (mm)			Approx. weight in Kg.± 5%		Qty. acid (1.220 Sp Gravity)
		L ± 3	W ± 3	H ± 3	Dry	Filled	
IT 500	150 AH	500	187	430	34	61	23.8
			OR				
INVARED	75 AH	400± 3	65± 3	200± 3	26	33	7

Lamp

- All electrical accessories such as electronic ballast lamp holder are provided to a terminal block and mounted on an easily detachable gear plate.
- Hanging arrangement for acrylic bowl for ease of maintenance conformance to IP-65 protection.
- Conformance to IS 10322 specifications
- High Power factor > 0.92
- High purity aluminium brightened and anodised reflector

Sl. No.	Lamp detail	Operating voltage (Volt)	Watt (s)	Dimensions (MM)	Lumen	Life
1.	4x14w TS	150-300	60	710x375x175	5824	Lamp = 18000 Ballast = 50000

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