

Mobile Solar Water Pumping System cum Off Grid Power Pack

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Abstract - A unique combination of Old Bus & Solar Water Pump. The solar panels shall be fixed in the roof top of an old 24 seated Bus. The output of solar panels shall be connected to Variable Frequency Drive & off Grid Inverter with suitable Battery Backup. The system will work either in pump or Inverter mode. This is designed to run 5 HP agricultural bore-well pump & 3 KVA off -Grid Inverter with 6 Hr. battery back. This moveable system will run agricultural water pump in day time & also supply electricity to rural house load during night time.

Key Words: Mobile Solar Water Pumping System, Off-Grid Solar Power Pack, Photo Voltaic System.

1.0 Rural Agricultural Power Cut

India is an agricultural depended country, agriculture, mostly depends upon rain water & lift irrigation. The availability of rain water lasts only for 2 -3 months, balance months the agriculture depends on lift irrigation (electrically driven water pumps).

Now a day's most of the states have power shortage, resulting in power cut in rural area. Most of the time in a day the pumps are idle due to non-availability of power, even though the power is available, lasts for few hours only. This is affecting irrigation & drinking water. How to tackle this problem?

2.0 State Transport Department Old Bus

Every year the State Transport Department of all over India discards the old buses. These buses are 15 to 20 year's old and highly polluted vehicle. These Buses are useless for Transport Department. If we think above two problems, as an individual case there will be some solution, but if we combine these two, there will be better solution .Then, how? If, we utilize these old Buses for electricity generation from sun light during daytime in rural area, it will become a novel idea.

3.0 Unique Solution for both Problems

Everybody knew that Photo Voltaic modules are used for generation of electricity from sun light. These solar panels are to be ground mounted or to be roof top mounted. This requires space & once mounted/fixed cannot be movable. These panels are to be utilized for nearby water pump only. Suppose, we make the panels movable, foldable & portable, then the panel can be utilized for other pumps at other location also. This way we save the same resources in different location. This will come to idea of **Mobile Solar Water Pumping System**.

4.0 Combination of Old Bus & Solar Water Pump

If, we fix these solar panels on the roof top of an old 24 seated Bus, the solar panels becomes foldable, movable & portable power source for the fixed pumps at different location, so one array of solar panel can be utilized to run pumps located at different locations. The solar panels of 250 Wp/260 Wp connected in series to generate 500 to 600 VDC source of 4.68 KWp, which will inject the power to DC Bus of the VFD (Variable Frequency Drive). The AC output of the VFD will be connected to 5 HP submergible water pump. This will be sufficient to drive 5HP common bore well water pump used in lift irrigation for agricultural purpose.

4.1 Operational Philosophy:

During day time from 7:30 AM to 4:30PM, as soon as the solar radiation will be available, the solar panels will cater the power to the water pump. The rpm & flow of the water pump will vary, proportional to the solar radiation, means in full solar radiation the pump will run in full rpm & flow. In low solar radiation, the pump will run in low rpm & less flow. The water flow will varies from lower to higher rate based on solar radiation. During a full sunny day, the pump can run the water pump for 9 Hr., which is sufficient for an agricultural bore well pump. The pump can also run on both DC (Solar) & AC supply (grid). During night or during very low solar radiation, we can also operate the pump on grid supply.

5.0 Hybrid System

Suppose, we will add an Inverter into the circuit with some battery backup & also with a DC change over switch, it will become a **Hybrid System**. It will acts as **Solar Water Pumping System cum Off Grid Power Pack**. But the system can operate either in Pump or in Inverter mode only. During day time we can operate the pumps, if water pumping is not required, we can change the mode from Pump to Inverter mode. In inverter mode, it will charge the battery and also cater 3 KW domestic loads.

5.1 Operational Philosophy in Inverter mode

The DC selector switch shall be selected to Inverter mode. During day time with availability of solar radiation, the solar panel shall cater the load as well as charge the batteries, in event of variation in radiation, shall take care by batteries. The batteries will acts as buffer. But in case very low solar radiation or absence of the solar radiation, the load will be automatically transferred to the batteries for 6 Hr. back up(as designed) & after back up time the load will be automatically transferred to the grid supply if connected as optional provision.

6.0 Components of Mobile Solar Water Pumping System cum Off-Grid Power Pack

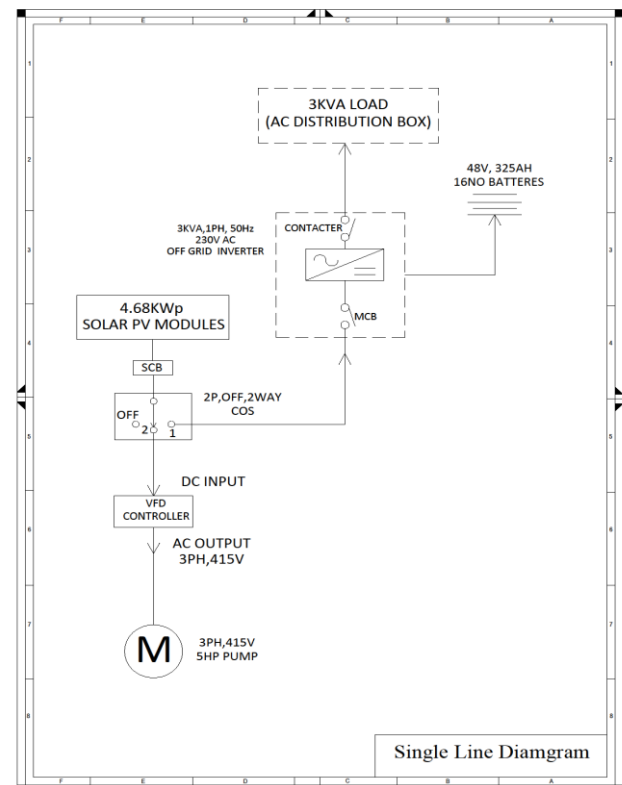
- ❖ Total 18 nos of 260Wp/250 Wp solar modules are connected series/parallel to achieve 4.68 KWp/4.5 KWp solar powered system deigned to run 5HP water pump cum 3 KW Off Grid Power Pack with 6Hr. battery backup.
- ❖ The system is designed to run one of the systems at a time either in Pump or Inverter mode.
- ❖ The solar arrays shall be fitted on bus roof top & both side of a 24 seated Mini Bus.
- ❖ The VFD, Batteries, Inverter & AC Distribution Box will be fixed inside the Bus. The electrical wiring from roof top to inside of the Bus shall be laid through PVC conduit.
- ❖ 7 nos of solar panels shall be mounted on roof top of the Bus and balance 11 (5+6) nos of panels to be mounted on both the side of the Bus using hinged frame.
- ❖ The solar panels at the both side of the Bus shall be folded as per **Position-1** during shifting of the Bus from one place to other & shall be opened as per **Position-2** during operation as shown in the Solar Panel arrangement Drawings.
- ❖ 6 nos of solar panels will be connected in series to form string. There will be 3 strings, one on top & two on both sides of the bus.
- ❖ The string will be connected in series to cater the power to the Pump & shall be connected in parallel to cater the power to Inverter.
- ❖ The series & parallel connection shall be done through DC change over switch.

- ❖ Module Efficiency is approx. 16 %
- ❖ The Single Line diagram for 4.68/4.5KWp system is shown above.
- ❖ The Inverter Output will be 3 /4 KVA, 1 Ph, 230VAC ideal to run Light & Fan load.
- ❖ A suitable Battery Bank of 48V (12v x 4nos) x 4nos of 135Ah shall be sufficient for 6 Hr. backup. The Battery bank consists of 16 Nos of 12V, 135 Ah@C10 Batteries.
- ❖ The Output of the inverter will be connected to the AC Distribution Board for Loads.
- ❖ End user's location: Rural India (as designed)
- ❖ Solar Radiation: Annual average 5.07 kWh/M²/day
- ❖ Sun Light availability: 7:30 AM to 4:30 PM

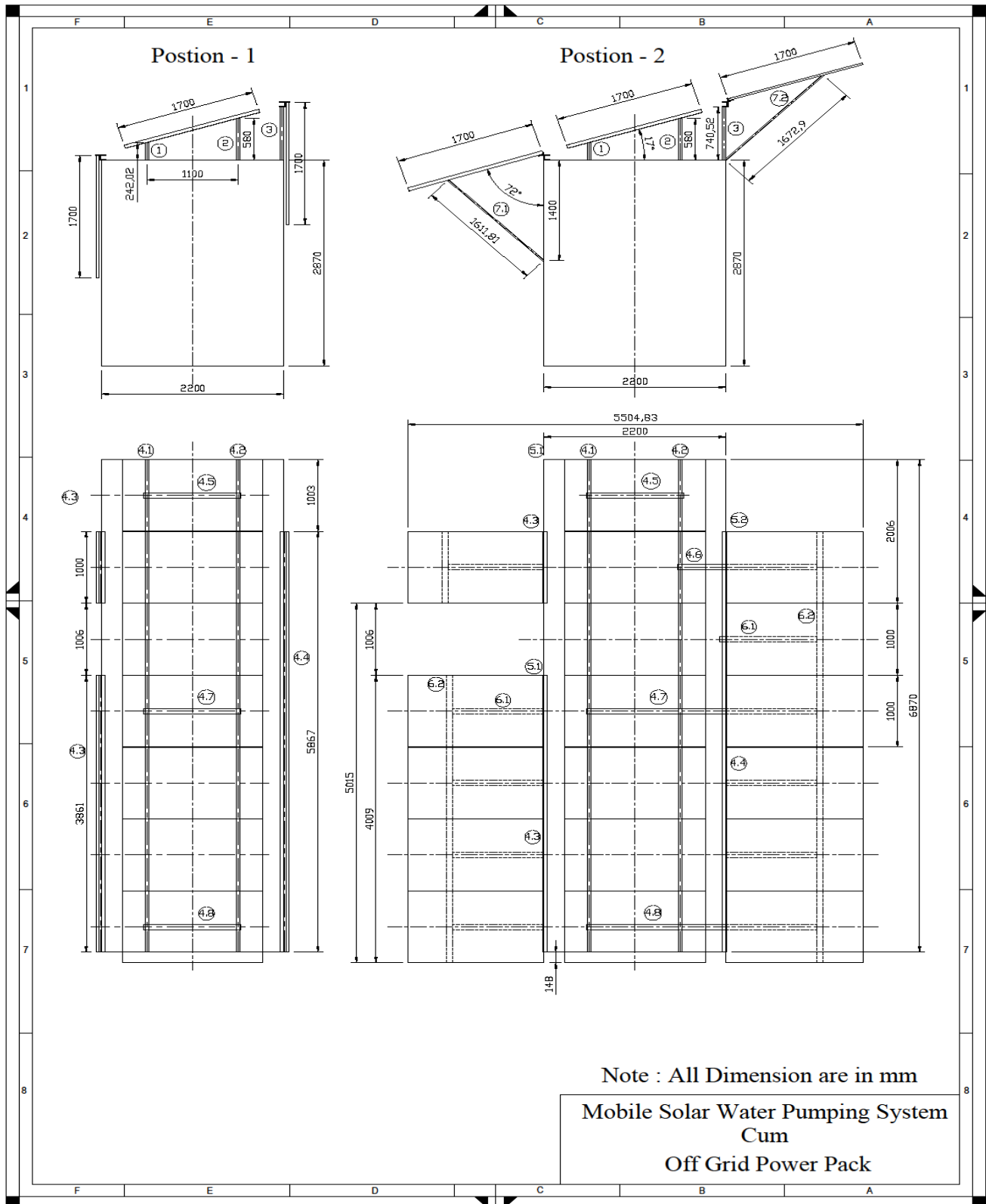
7.0 Price

- ❖ Supply, Erection & Commissioning for 4.68/4.5 KWp Solar Water Pumping System for 5 HP is INR 3.5 lacks
- ❖ Additional) Price for supply of 3/4 KVA Off Grid Inverter with Batteries & AC DB will be INR 2.5 Lacks
- ❖ Price is exclusive of all taxes & duties, transport and transit insurance will be extra.
- ❖ Price of the 24 seated Bus is not included in the Price, which shall be supplied as free supply(Old Bus from State Transport Department)

8.0 Single Line Diagram



8.1 Solar Panel arrangement Drawings



8.2 Bill of Quantities

Sl.No	Description	Qty	Unit
5HP Solar Water Pumping system			
1	Solar Multi Crystalline Photo Voltaic Module of 250 Wp/260 Wp	18	Nos
2	Variable Frequency Drive 5.5 HP) Panel with complete wiring.	1	Nos
3	SPV Modules Mounting Frames/Structures	1	Lot
4	Modules interconnecting connectors	20	Lot
5	1C x 6Sq.mm or 1C x 4 Sq.mm Modules interconnecting Cu unarmoured cables	60	Meters
6	3C x 6Sq.mm Cu. Armoured Cables (AC Supply)	20	Meters
7	Glands and Lugs	1	Lot
8	GI / PVC Pipes for cable laying and supporting clamps	30	Meters
Erection & Commissioning			
1	Welding, drilling & structural fitting works	1	Lot
2	Installation and commissioning	1	Lot
3/4 KVA Off Grid Inverter with 6 Hr. Battery Back up			
1	Inverter (3/4 KVA)	1	Nos
2	Battery (12 V,135 AH)	16	Nos
3	DC Change Over Switch	1	Nos
4	AC Distribution Box	1	Nos

9.0 CONCLUSIONS

If, we will plan properly, the thousands of old vehicles shall be utilized as asset for the rural India. We must act fast for utilization of garbage/waste before it will become a burden to us.

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REFERENCES

1. Solar Module Data Sheet (250 Wp/250 Wp Make: Akshaya Solar, Canadian Solar)
2. Variable Frequency Drive (Siemens make, Sinamics V20 model)
3. Inverter: Power One Micro System 3 KVA Inverter
4. Batteries: Luminous Solar LPT121135H , 12V 135AH

8.3 Structural Details

SI NO	Description	Dimension (mm)	Length (mm)
1	Column Post-A	75x40x15x3.0	242
2	Column Post-B	75x40x15x3.0	580
3	Column Post-C	75x40x15x3.0	740
4.1	Rafter(C-Channel)	75x40x2.5	6870
4.2	Rafter(C-Channel)	75x40x2.5	6870
4.3	Rafter(C-Channel)	75x40x2.5	5870
4.4	Rafter(C-Channel)	75x40x2.5	5012
4.5	Rafter(C-Channel)	75x40x2.5	1175
4.6	Rafter(C-Chanel)	75x40x2.5	590
4.7	Rafter(C-Channel)	75x40x2.5	1690
4.8	Rafter(C-Channel)	75x40x2.5	1690
5.1	Purlin(L-Channel)	60x40x2.5	5870
5.2	Purlin(L-Channel)	60x40x2.5	5012
6.1	Purlin(C-Chanel)	60x40x2.5	12023
6.2	Purlin(C-Chanel)	60x40x2.5	11000
7.1	Purlin(C-Chanel), Suport-1	25x10x2	9672
7.2	Purlin(C-Chanel), Suport-2	25x10x2	8365
8	Base Plate	150x150x4	9 Nos
9	Hinge(S.S.)		36 Nos
10	Nut Bolt & fastener (S.S.)		5 kg

BIOGRAPHIES



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His interests are Power & Solar Project, system operation, integration of alternative sources, distributed generation, Control & Instrumentation.