

Feasibility analysis of energy efficient pumping and solar pumping for house hold applications

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Abstract - Inefficient and bad design of motor-pump combinations for domestic and industrial operations will leads to unnecessary wastage of power and money. Excess capacity, changing operating conditions, inefficient control, and inadequate maintenance are some of the more common sources of wasted energy. In many cases, significant energy savings can be made by systematically applying existing technology to reduce pump energy consumption.

Substantial savings can be achieved by replacing standard and inefficient motors with energy efficient ones. The savings and payback are a function of the size and hours of operation. After getting the energy efficiency standards to the motor and pump sets and solar pumping technical parameters can be analyzed for the standards of Green buildings.

This paper reviews the available pump energy saving methods applicable to Green buildings with present application guidelines for both new pumping designs and retrofit into existing installations. The approach of this project is to assess the energy conservation standards applicable to GIET campus and later how these technologies can be adopted for Solar pumping systems.

Key Words: Simulation, Solar Pumping, PV syst, reen buildings

1. INTRODUCTION:-

Inefficient and bad design of motor-pump combinations for domestic or house hold application may leads to unnecessary wastage of power and money. In many cases significant energy savings can be made by systematically applying renewable energy source instead of conventional energy by the help of energy efficient motors. The savings and payback are a function of the size and hours of operations. After getting the energy efficiency standards to the motor and pump sets and solar pumping technical parameters can be analyzed for the standards of house hold application.

Feasibility analysis means the parameters which are in favour with or required in solar based pumping system for the house hold application. So according to the context the first thing that should be considered is "By what means to generate the power with photovoltaic cell" For power

generation the imperative thing that ought to be considered is RADIATION and THE VALUE OF RADIATION.

Based on the site condition and solar availability data a table is given below :

| month | Horizotal radiation | Tilt, azimuthal, shadow factor | KWh/m ² day | * | Kwh/m ² |
|-----------|---------------------|--------------------------------|------------------------|----|--------------------|
| january | 4.1 | 1.4 | 5.74 | 31 | 177.94 |
| february | 5.32 | 1.3 | 6.91 | 28 | 193.48 |
| march | 5.8 | 1.2 | 6.96 | 31 | 215.76 |
| april | 6.4 | 1 | 6.4 | 30 | 192 |
| may | 6.72 | 0.9 | 6.046 | 31 | 187.48 |
| june | 5.3 | 0.9 | 4.77 | 30 | 143 |
| july | 4.48 | 0.9 | 4.032 | 31 | 124.9 |
| august | 4.2 | 1 | 4.2 | 31 | 130.2 |
| september | 4.76 | 1.1 | 5.236 | 30 | 157.08 |
| october | 4.4 | 1.3 | 5.72 | 31 | 177.32 |
| november | 3.6 | 1.2 | 4.68 | 30 | 190.4 |
| december | 3.6 | 1.5 | 5.4 | 31 | 167.4 |

2. ENERGY EFFICIENT MOTORS:-

An energy efficient motor, simply put, is a motor that gives the same output strength by consuming less amount of power.

Difference between standard motor and energy efficient motors :-

- In energy efficient motor the copper material used is more than the normal motor.
- It has reduced fan losses
- Energy efficient motors activate with productivities that are classically 2-6% higher than standard motors.

COST:

Usually it is of standard cost and a touch supplementary than the normal motors. It is usually 15-30% more than the normal motors.

In future, the preliminary cost may be available at the same cost as a standard motor when the inhabitants of energy efficient motors escalations.

ADVANTAGES:-

The EEM operate more satisfactorily under abnormal condition than that of normal motors.

The electric power saving is more than that of normal one. Operating temperature is less and noise level is also lower.

DISADVANTAGES:-

It is not portable.

Initial cost of installation is more.

MAIN EQUIPMENT REQUIRED IN SOLAR PUMPING SYSTEM:-

1. Solar panels
2. Pump
3. Charge controller
4. Batteries

1.SOLAR PANELS :- Solar cell is the smallest part of the PV panel. When the PV panel is exposed to the light the direct current is produced from the semiconductor layers of the PV panel. Later on the current is collected by the wiring system of the panel and supplied to the dc pump used for the household application.

2.PUMP : Positive displacement pumps seal water in cavities inside the pump and force it to upward. The varying light conditions also cannot affect the lift capacity of the pumping system. The example of positive displacement pumps are jack pumps, diaphragm, vane and screw pumps.

For low-lift or high-lift volume systems we use centrifugal-type pumps. This type of pump starts gradually and the output also varies with the amount of current flows.

3. CHARGE CONTROLLER:-

A charge controller is a stratagem which avoids overvoltage, designed for which battery performance may degrade day by day. Charge controller is a ploy which sustains proper stability between the PV panel and the pumping system.

4.BATTERIES : Battery stores the excess amount of energy created by the PV panel and mainly used either when the main supply is off or during most of the part when sun rays are not available. The battery capacity is generally measured in ampere-hours.

CASE STUDY:-

Gunupur is located in the southern most part of the Odisha state in India having co-ordinates of 19.08°N and 83.82°E. Gunupur is located at an altitude of 83m above the sea level. The ground water level in Gunupur is approximately 100ft. The solar water pumping project will provide thousand litres of water per day. The water font has been recognized to ensure abundant flows rate thru dry seasons

Pump selection considering the load demand:-

The hydraulic energy(Eh) needed can be calculated by the following equation:

$$Eh = (p * g * h * v) / (3.6 * 10^6)$$

Where,

P (rho) = density of water (1000 kg/m³)

g = gravitational acceleration (9.81m/sec²)

h = total dynamic head (45 m)

v = volume of water required in m³

So, the total hydraulic energy required is calculated as Eh=0.122625 KWh/day.

Dividing this by number of sun peak hours of 4, we find the pumps total power required is 30.65 w.

Pv panel selection according to the pump specification:

The PV panels particular for this system must be able to provide the minimum get-up-and-go prerequisite to run the pump. As planned above, the lowest power required is 30.65 w.

However, the panels must have some additional capacity due to some possibility of any potential reduction in supremacy due to high heat, dust, age etc. so, it is recommended to growth the minimum peak power value by 25-30 % to interpretation for these environmental factors. Therefore, the PV panels will be sized to afford a minutest output of 40w (1.25*30.65=38.31).

A PV panel is selected in order to have the peak power harvest of 240 w at 29.54 v and 8.13 A.

Pump controller:

The primary job of a pump controller in a battery united pumping structure is to helping hand the voltage of the battery bank to contest the desired voltage to the pump. Under load state two PV panels connected in series produce 30-35 value of voltage, even though two fully charged batteries in series produce just 24-26 volts. A pump with a minimum functional voltage of 30 volts would pump water tied directly to the PV panels rather than connected to the batteries. So in the batteries case a pump regulator with a 24 volt input will step the voltage to 30 volts which would increase the volume of water pumped by the system.

A surplus amount of solar radiation is available in the location site, in Gunupur a record of overall 300 days of total sunshine days are available in a year. The output of solar pumping is very dependent on good system design derived from accurate site and demand data.

Water pumping has elongated been the most reliable and economic presentation of solar electric systems. Most PV systems is unswerving on the batteries, hence total measure should be taken to keep the life and efficiencies of batteries. In this venture a total 1000 litre of water to be haul out in a day.

Power required:-122 Wh/day for a only pump.

No of pumps used:-single dc submersible pump.

Solar power rating:-240 watts (29.54 volts and 8.2 amperes).

The panels came with more than 20 year of performance warranty. Maintenance of solar panels are slight and only needed is to remove of the dust sporadically. Also solar panels provide energy with zero clatter and zero carbon emanations gases.

3. Simulation Results

3.1 Introduction

PVsyst V5.0 is a PC software raft for the study, sizing and data analysis of complete PV systems. It arrangements with grid-connected, stand-alone, thrusting and DC-grid (public transportation) PV systems, and includes wide-ranging

meteo and PV systems kits databases, as well as all-purpose solar energy tools.

3.2 PROJECT DESIGN

It aims to make a thorough coordination design using detailed hourly recreations. Within the framework of a "project", the user can perform unlike system simulation runs and equate them. He has to explain the plane orientation (with the risk of tracking planes or shed mounting), and to indicate the specific system components. In a second step, the manipulator can specify more detailed parameters and scrutinize fine effects like thermal behavior, wiring, module quality, divergence and incidence angle dead, horizon (faraway shading), or limited shadings of near objects on the arrangement, and so on.

For pumping systems, several system designs may be tested and linked to each other, with a detailed analysis of the behaviors and efficiencies. Results include several masses of simulation variables, which could be exhibited in monthly, daily or hourly values, and even relocated to other software. The "Loss Diagram" is habitually useful for ascertaining the paleness of the system design. An engineer report may be in black and white for each simulation run, including all limitations used for the simulation, and the main results.

3.3 GEOGRAPHICAL SITE PARAMETER

Our geographical site is defined by:

GIET, Gunupur, India, Asia, with geographical co-ordinates: latitude (19.05), longitude (83.83), altitude (58) and time zone (5.5).

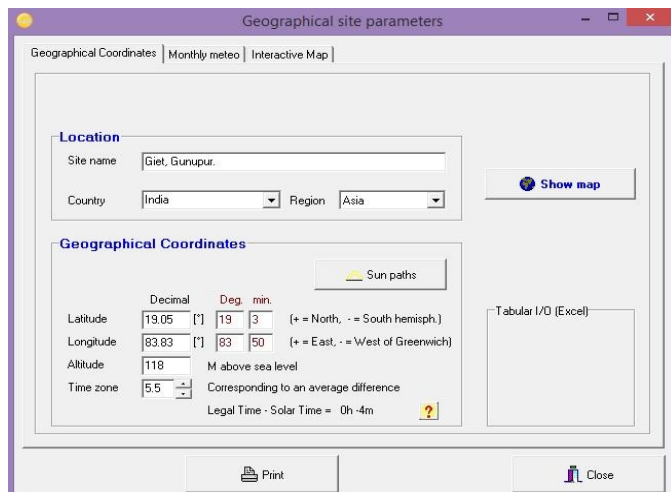


Fig 1- Geographical Coordinates

2 Monthly Metro

Fig 2- Monthly Metro

User's Needs ("Load")

The programme propositions great give to express the needs of the manipulator (or the "load" of the structure). You can choose among the following options:

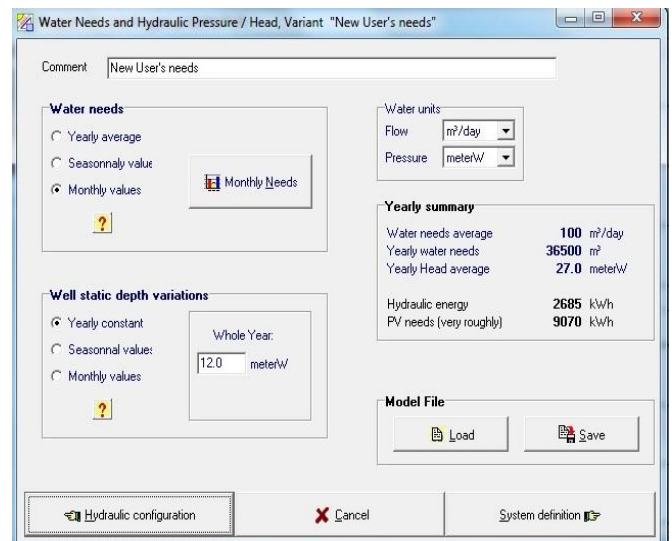


Fig. 2: User's Needs

Pumping Systems Sizing

When sizing a PV pumping system, the basic constrictions are the accessibility of solar energy during the year, and the satisfaction of the user's water requests. The problem to be explained is the optimization of the size of the photovoltaic generator and the pumps, enchanting the head and the electric PV-Pump same into reason, as well as the chosen system formation.

Pv-Array Sizing

Yet again as a thumb rule, we canister choose the minimal PV STC power as approximately 20%-30% concluded the pump nominal power. Oversizing the PV-array will upshot in fallow energy by clear weather. Under sizing it will operate the pump at junior powers, where its efficiency may drop or the thresholds theatrically affect the yield by cloudy, or morning-evening surroundings.

When consuming direct coupling configurations, the array voltage is also essential. Exhaustive optimizations can only be given by a set of exhaustive simulations, using real devices.

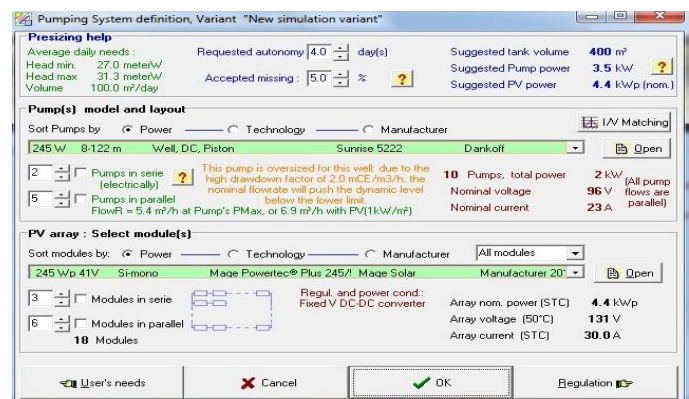


Fig. 3: Pv-Array Sizing

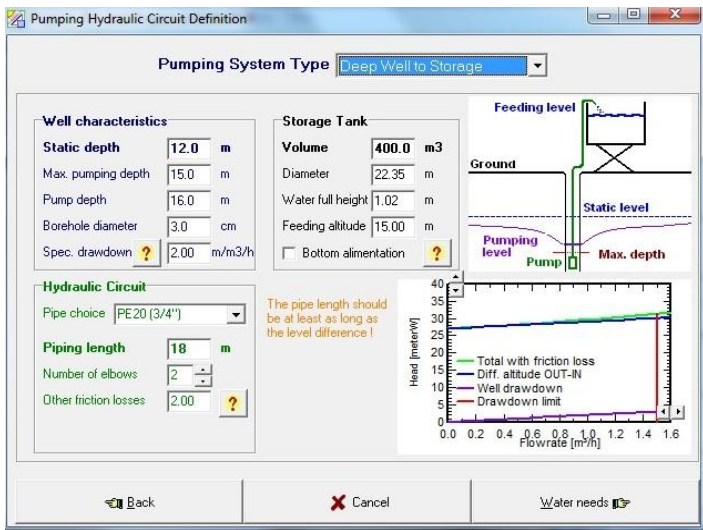


Fig. 4: Pumping Systems

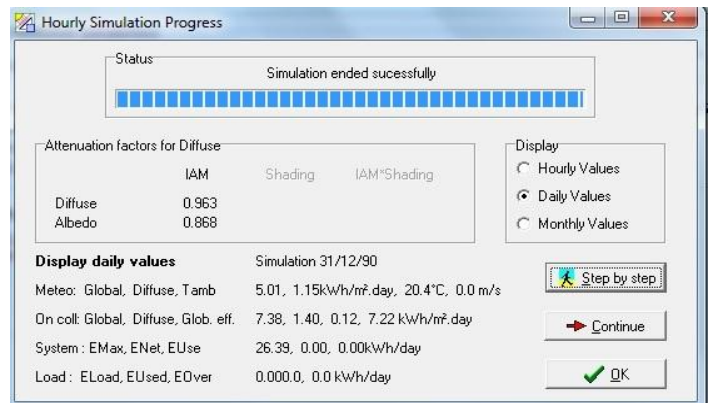


Fig. 6: Simulation Process

Results

The simulation results are undersized in a printable "Report", which clamps an in-depth table of all parameters used during the simulation, as well as a short photo of the main results.

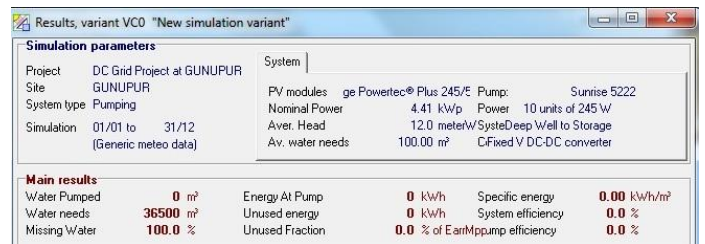


Fig. 7: Results

Module Layout

The Module Layout is a tool for the explanation of the PV modules geometrical procedure in your system, and their interconnections.

This is necessary for an true calculation of the electrical effects of the limited shadings of near articles in Si-crystalline modules. It is not indeed suited for electrical designs with thin film segments, someplace each cell is a long narrow strip; you ought to think about its appositeness from case to case

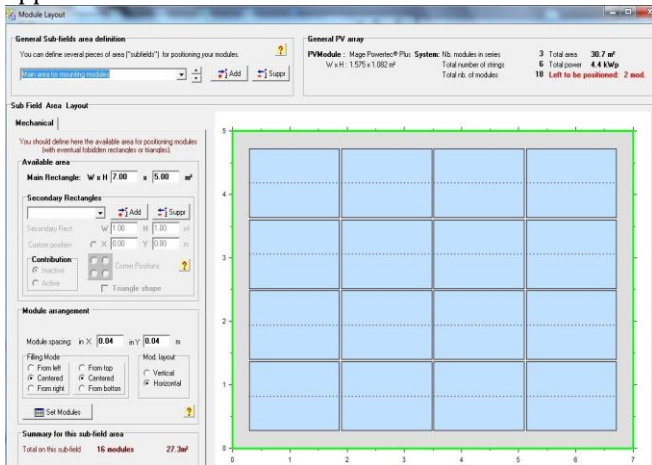


Fig.5: Module Layout

Simulation Process

In any case, and for any seriatim hour, the simulation has to determine the Flow rate well-found by the pump, as a function of the Head and the presented electrical energy (from PV array, or in time battery). As the bonce at the pump is hooked on on the flow rate (due to friction losses, and in due course drawdown level), this calculation always results of an iterative progression.

4. Conclusion

Energy-efficient motors now offered in India activate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the provisions, energy-efficient motors are designed to operate without loss in efficiency at oodles between 75 % and 100 % of rated dimensions. This may product in major reimbursements in varying load submissions. The power factor is about the same or may be complex than for standard motors.

Solar Water Pumping System involving of Solar PV array harnesses the sun’s energy to afford clean energy that is used for running pumps for irrigation as well as drinking water purposes. Both induction motor as well as DC motor pumps can be wrought using this energy. For operation of induction motor pump, an other inverter circuit is essential to convert the DC supply from the Solar PV array to AC supply. Nevertheless the use of induction motor pumps is chosen because of their jaggedness and better efficiency equaled to DC motor pumps.

In this paper a broad study has been worked out towards selecting or switching a proper EEM and Pumps for restored performance. This interruption is a major alarm for working for solar pumping systems. While optimizing the pumping energy with dynamism efficient motors will be a better option for solar pumping arrangements.

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