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A HIGH STANDARD ISOLATED INSOLATED PHOTOVOLTAIC EGYPTIAN SAFARI REST RED SEA AREA

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ABSTRACT:

Where renewable energy sources, solar, hydro, wind are available the remote communities and businesses can be provided with the most reliable and affordable source of electrical energy. This paper presents a model of safari rest contains all the necessary services for the interested tourists who visit the safari Sinai desert. The PV energy system provides the rural energy needs of remote communities. A photovoltaic renewable energy system is designed to feed the global Ac and Dc electrical required load of this safari rest. The benefits of photovoltaic renewable energy at rural applications are its versatility and convenience.

This model of safari rest must be taken in consideration by Egyptian Government as it will provide the tourism plane by new interested tourism field which put a big spot on Red sea area: El Ghordaka.

KEYWORDS: Dual electrical supply, stand alone PV system, location safari area, insolated isolated.

INTRODUCTION:

Although, the truly new and emerging energy technologies for the development and use of mini-hydro, geothermal, solar, wind and modern processing of biomass, contribute less than 2% of the world total energy demand, available projections or scenarios of the future of the renewable, indicate that they could potentially contribute more than half the present commercial world energy consumption by the year 2050 or thereafter [1] Moreover, it will have substantial impact on solving the problem of environmental emissions [2].

A solar generating system with batteries supplies when it is needed. How much electricity can be used after sunset or on cloudy days is determined by the output of the PV modules and the nature of the battery bank. Including more modules and batteries increases system costs, so energy usage is carefully studied to determine optimum system size.

Storing electrical energy makes PV systems a reliable source of electric power day and night, rain or shine. PV systems with battery storage are being used all over the world to power lights, sensors, recording equipments, switches, appliances, telephones, televisions and even power tools. During the daytime, the PV modules quietly supply day time energy needs and charge batteries.

This paper presents a design of a model for safari village to serve the tourism section of interested and special areas of Sinai in Egypt.

THE LOCATION:

We choose several interested points at red sea area to carry out the proposed design of safari rest . El Ghardaga and Safaga desert have a very interested Safari area where the rare plants, birds, animals, nature, mountains, natural ground water and very nice site seating.

The visitors start their trip at noon by riding the camels and horses and visit some interested places in the desert.

They bring their coked foods from their hotels. They take their lunch at the big tent at the open area of safari rest.

After that they can do other short tour in the desert and return back to the Rest area to have the dinner and drink the natural hot Sinai drinks, and then sleep .

They weak up at mid night to climb the mountains and arrive at the top to look at the nice stars. They stay at the top until the sunrise to enjoy themselves by watching this very interested instant with clear sky.

THE PHOTOVOLTAIC ENERGY SYSTEM:

To feed the isolated insolated safari desert, the paper presents a stand-alone photovoltaic system provided with battery unit to feed the required global Ac and Dc load day and night hours.

Depending on the variation of insolation intensity and wind speed, the generated Dc power is varied. According to the load curve, the cycle of feeding the load depends on the main source (PV) or secondary source (battery) or both of them. Charging and discharging of battery cycle is occurred according to the global generation system and nature of load and must taking in consideration their safe limits and efficiency.

DESCRIPTION OF THE VILLAGE:

The proposed rest presents a lot of services for the visitors to spend a short time, 1-2 nights, to visit the interested places during day and night.

For that, the proposed rest is composed of:

1- The Motel:

This motel is a mini motel, i.e. it is composed of five small tents or rooms. Each unit is constructed for two persons.

2- Open Area

Close to the Motel, there is a big tent $10x5m^2$ which is prepared to have the three meals, special hot and soft drinks inside it at the open area . This area is designed as a limited restaurant, which, is, provided with hot plate to cook bread and special hot Sinai drinks, tea-coffee, and to reheat the prepared hot foods by using the charcoal.

To keep a healthy open area, a six killer insects must be used there An international phone can be provided to link the rest building with the other areas inside and outside Egypt.

3- The Kitchen

A small kitchen is needed to prepare a light and quick foods.

Thus, it is provided with one small frego, Mixer, kettle, and killer insects.

4- The Rest Room

These two units are prepared as one for men and the other for ladies usages.

5- Thermo Solar System

To gain a hot water inside the bathroom, a thermal solar system is used. This system is composed of normal unit (special absorbed painted plates with special absorbed material and water circular tubes with inlet cold water and out let hot water, and pumping system to raise cold water and push hot water into tanks that located up to the bath room.

6- Pumping system

To provide the system with fresh water. A solar pumping system (360 Dc watt) is used to raise the ground water and reserve in reservoir $(1x1x2\,m^3)$ for drinking and also to irrigate a limited in front garden Also, the kitchen and bathroom can feed by this fresh water.

Electrical Load Curve :

1- Motel: 45 Dc watt (Light)
425 Ac watt (fan)
2- Open Area: 1000 Dc watt (Light, Killer Insects)
3- Kitchen: 1050 Ac watt (Mixer, frego & Kettle)
135 Dc watt (Light, Killer Insects)

Mathematical Model:

To solve this problem, a mathematical model is needed. As the location of Safari area is the desert, thus the main parameters are the solar insolation ϕ , temperature T and wind speed.

Control Problem: The system has multi objective functions: one to maximize the total generated electric energy from the suggested system during the total time. But the second one is to minimize the total cost of the system during same time.

1- Maximize:

$$F_1 = \sum_{i=1}^{n} \sum_{j=1}^{m} E_{ij} \qquad (1)$$

i=1,…. n , j=1,….. m

While E_{ij} is the generated electric Energy from source i (PV system and battery source) during interval j

n = number of energy source =2

m = number of intervals of total time T (8)

2- Minimize

$$F_2 = \sum_{i=1}^{n} \sum_{j=1}^{m} C_j (E_{ij}) \qquad (2)$$

as C_j = is the total cost of the energy of source j

and $C_j = C_{jc} + C_{jr} + C_{jm}$

C_{jc} *and* C_{jm} are the initial and maintenance costs and they have constant values,

C_{jr} is the running costs and it is varied w.r.t E_j and D_j (i.e., load demand within interval period j).

$$\begin{aligned} \therefore C_j &= Const + C_{jr}(E_{ij}) \\ &= Const + C_{pv_r}(E_{pv_r})_i \; C_{Batt_r}\,(E_{Batt})_i \qquad (3) \\ &= Const + r_{pv}\,.E_{pvr_L}\,.\,C_{Batt_i}\,.\,E_{Batt\,i} \end{aligned}$$

b- The System Constraint:

1- The load demand D_{ik}

$$\sum_{i=1}^{n} \sum_{j=1}^{m} E_{ij} \geq \sum_{i=1}^{n} \sum_{k=1}^{l} D_{ik} \qquad (4)$$

where $D_{ik} = D_{i_{tents}} + D_{i_{open\,Area}} + D_{i_{Rest\,Room}} + D_{i_{phone}} + D_{i_{pumping}} + D_{i_{kitchen}}$

2- The Boundary Limits

The safety limits of the electric energy generated

$$_{ij} \leq E_{ij} \leq \overline{E}_{ij}\ \underline{E} \qquad (5)$$

where: $_{ij}$, $\overline{E}_{ij}$ $\underline{E}$ are the minimum and maximum limits for the energy generated from source i during period j.

$$\underline{D}_{ij} \leq D_{ij} \leq \overline{D}_{ij} \qquad (6)$$

3- The PV constraints

$$I = I_L - I_{os}(e^{GV} - 1) \qquad (7)$$

where

$$G = q / ATK$$

$$I_L = \left[I_{sc} + 0.001K_1\left(T_c - 28\right)\right] x \quad \phi$$

$$\therefore \; E_\phi = VI$$

$$= V\left[I_L - I_{OS}\left(e^{GV} - 1\right)\right]$$

$$= V\left\{\left[I_{SC} + 0.001K_1\left(T_C - 28\right)\right] x \phi - \left[I_{OS}\left(e^{GV} - 1\right)\right]\right\} \quad (8)$$

where

I PV array output current

V PV array output voltage

I_L Light generated current

I_{OS} Saturation current $(= 19.97x10^{-6} \; A)$

A Ideality factor (1.92)

K Boltsman's constant

q electronic charge

T_c Cell Temperature in C^o

ϕ Solar insolation

I_{SC} Short circuit current at 28 ^{o}C and 1000 W/m^2 (2.52Amp).

4-The Battery Constraints

$$E_{Batt_{(i+1)}} = E_{Batt_i} + \mu \; \frac{I_b}{c} \qquad (9)$$

where

μ is the average charging efficiency

I_b is charge/discharge current

c maximal capacity

during discharge μ is assumed to be 1. When charging μ is $0.9 \rightarrow 0.8$ E_{Batt} is limited between maximum 100% and minimum 30% .

THE OPTIMAL SOLUTION:

The optimization problem contains a set of system variables: ϕ, V, T

All the equation can be combined in one equation (Lagrange equation) by using set of Multiplies, each of them according to the nature of equations .By applying the suitable programming, this control problem can be solved to realize the objective function and find the optimal values of the state and control variables that will be satisfied the optimality of the problem that under consideration. According to load requirements all results curve can be plotted.

RESULTS

Figures show the highest generated electric energy is according to the highest solar insolation which is also the same peak period to charge the secondary source (Battery).

All the curves show the required daily Ac & Dc load curve, the PV generated energy and the various electrical equipment of each unit of safari rest.

Also the secondary energy source (battery) is plotted to clear it's whole cycle including charging and discharging duration.

The kitchen needs the highest electrical power comparing with other sections of the Rest as it is provided with several electrical equipment.

According to normal usage, the Ac load is higher than that of Dc load. The Dc peak point at 18:00, while that of Ac is occurred at 6:00 9:00 i.e. during preparing breakfast. Both of PV and battery energy sources feed the global load of safari rest.

CONCLUSION:

This PV stand alone system is more efficient system which realizes the continuity of operation (feeding load).

During last few years successful initiatives in different countries have explored new methods of extending electrification to the rural population at least cost, and making use of available renewable resources.

This safari model will extend the interested places to be visited in Egypt as will courage the twists to so a short visit at the safari desert where the necessary services can be found at this safari rest to enjoy themselves.

Therefore, the development and implementation of advanced fossil technologies characterized by near-zero pollutant emissions are required.

This model of Rest place can be used also for other services at rural areas to provide the electrification aims.

It is considered as a healthy safari system which realizes a healthy environment in this rare area with its special nature.

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[4] M.G.Jabxri et at, "A Contribution to the Simulation and Design Optimization of Photovoltaic Systems", IEEE Trans. on Energy Conversion, Vol.6, no.3, pp.401-406, Sept. 1997.

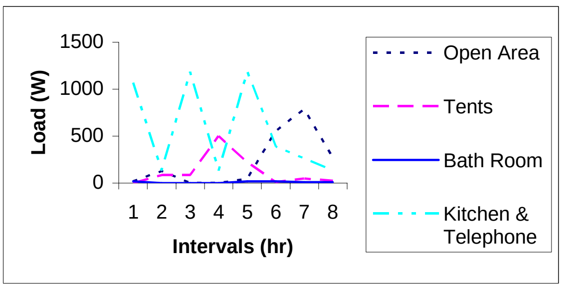

FIG. (1) LOAD VARIATION OF VARIOUS SECTIONS.

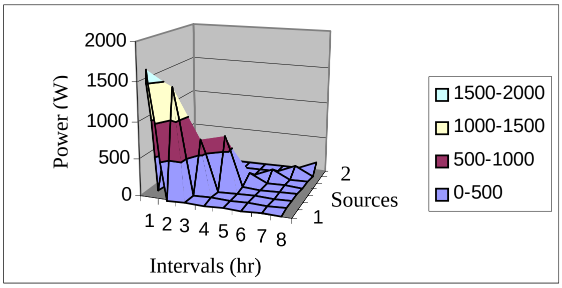

FIG. (2) THE REQUIRED AC LOAD.

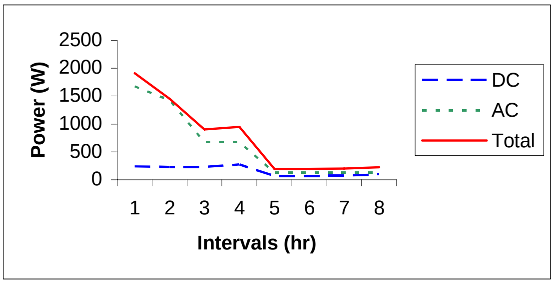

FIG. (3) THE VARIOUS REQUIRED LOAD.

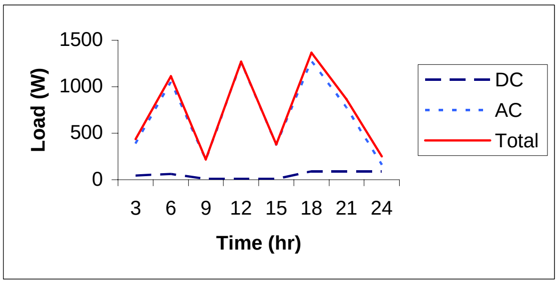

FIG. (3-3) THE VARIOUS REQUIRED LOAD.

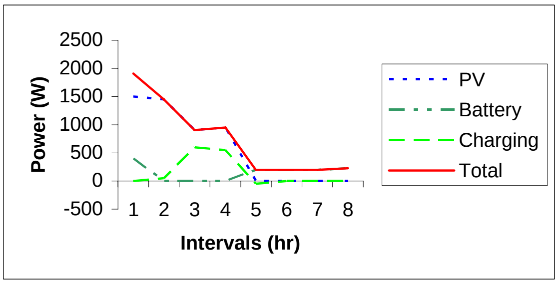

FIG. (4) THE PRIMARY AND SECONDARY ENERGY SOURCES.

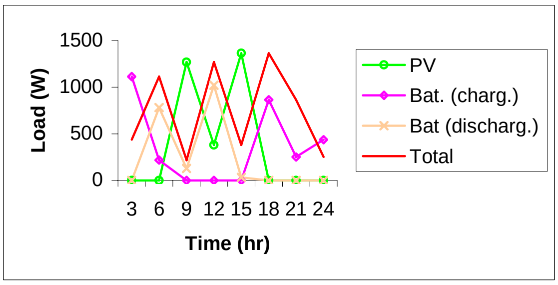

FIG. (4-4) THE PRIMARY AND SECONDARY ENERGY SOURCES.

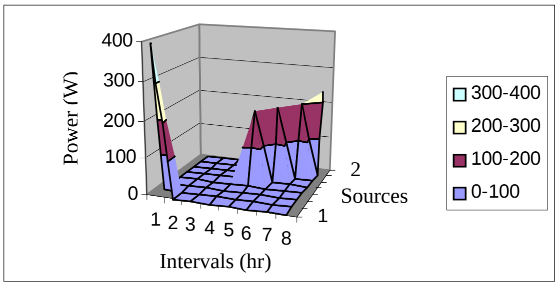

FIG. (5) THE SECONDARY ENERGY SOURCES.

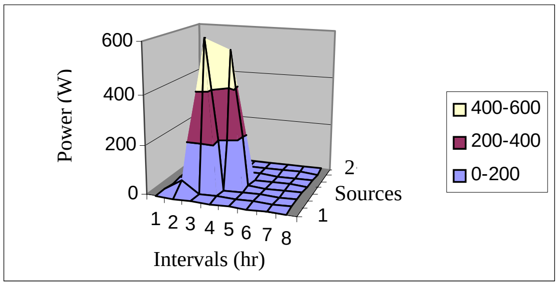

FIG. (6) THE CHARGING INTERVALS DURING PEAKS SOLAR INSOLATION INTERVALS.

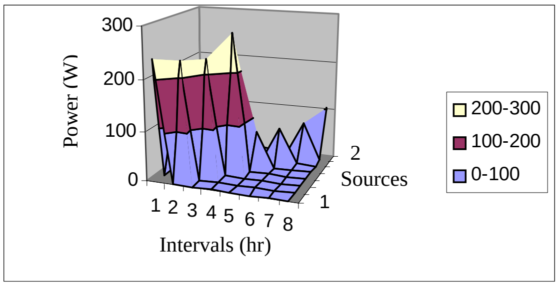

FIG. (7) THE DC ELECTRICAL LOAD.

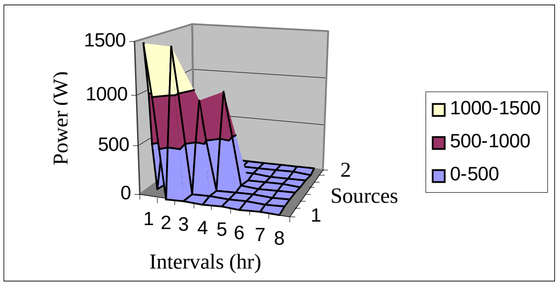

FIG. (8) THE PRIMARY ENERGY SOURCE.

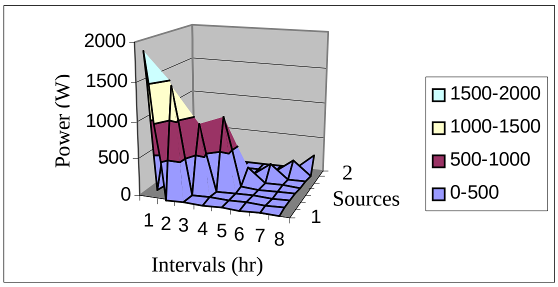

FIG. (9) THE TOTAL DAILY LOAD.