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System Architecture of Wind/Diesel Hybrid Energy System with Sensitivity Analysis for Gsm/Cdma type Mobile Base Station

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Abstract: This paper provides the design plan of optimized Wind and Diesel Hybrid Energy System for GSM/CDMA type mobile base station over typical diesel generator for a selected website in central India. For this hybrid system, the earth science information for one year of hourly wind speed, are taken from Aagar (Longitude 77o.35'and Latitude 23o.28') and therefore the pattern of load consumption of mobile base station are studied and suitably modeled for improvement of the hybrid energy system mistreatment HOMER software. The simulation and improvement result provides the most effective optimized sizing of a wind energy system with diesel generator back up for GSM/CDMA type mobile telephony base station. The performance of this method appears additional environmental friendly over the standard diesel generator like reduced the emission of dioxide and alternative harmful gasses in environments. Since it's additional environmental friendly with eighty one uses of renewable energy (wind energy), over the utilization of a diesel generator backup that is found to produce solely concerning nineteen electricity contribution in adverse climate.

Keywords: Hybrid energy systems, Mobile telephone base station, turbine, Diesel generator, improvement, Sensitivity Variables.

1. INTRODUCTION

For achieving the answer of power supply which can be reliable and cost effective for the worldwide growth of telecom base station into remote areas presents a really difficult drawback. Demand of power supply by grids isn't out there and also the extension of grids is extraordinarily expensive in remote areas. Though initial costs are low, powering these sites with generators need important maintenance, high fuel consumption and delivery costs attributable to day-by-day increase in diesel costs. A property different to power mobile base station in remote areas is to use renewable energy sources. Recent analysis and development of Renewable energy sources have shown wonderful potential as a type of contribution to standard power generation systems [1].

Wind power is intermittent attributable to worst case climate like an extended amount of overcast skies or once there's no wind for many weeks. As a result, wind power generation is variable and predictable. to resolve this drawback, the hybrid wind power with diesel generation has been instructed [2-3]. A hybrid wind diesel is incredibly reliable as a result of the diesel acts as a cushion to require care of variation in wind speed and would continually maintain a median power adequate to the point. The power to get electricity could be a building block of contemporary societies. However, the sector of engineering involved with the coupling of wind power and diesel generators has basically simply begun. With increasing introduction of wind generators in wind-diesel systems, system stability is changing into a vital issue to the facility company. However, the well developed techniques applied to standard generation system dependability analysis, associate mounted capability outputs to generating units and can't be without delay extended to incorporate wind energy sources that have extremely unsteady capability levels [4].

A number of authors rumored a range of models to deal with this issue. of these models is roughly classified by their techniques into 2 categories: the monte carlo Simulation and also the analytical methodology. The analytical solutions projected by some authors use varied attention-grabbing approaches. The Multi-state models [5, 6, 7] build use of wind turbine power output curve and wind speeds to get partial power output states of wind turbine generators, that represent varied energy levels indicating the correlation between unsteady characteristics of wind speed and wind turbine power output. The quantity of those states is set by characteristics of wind knowledge and needed accuracy. Load adjustment approach [8] accounts for unsteady energy by eliminating the facility output from the utility load foremost, and so uses the adjusted load values not together with wind energy to calculate the dependability indices.

In this paper, we tend to present the principal modules of the machine and by employing a hybrid system; we tend to demonstrate a number of the advantages that result from simply understanding the consequences of the designer's modifications to those advanced dynamic systems. In these systems, the voltage and also the frequency are controlled by the diesel generator. Therefore, we tend to regard the diesel generator as a controlled energy source, whereas the wind is an uncontrolled energy source and also the station load is an uncontrolled energy sink. The distinction between the facility consumed by the station load and also the power generated by the wind turbine is balanced by the diesel generator.

This paper offers the look plan of wind/Diesel hybrid energy system with varied sensitivity variables. supported the energy consumption of mobile telephone base station and also the accessibility of renewable energy sources, it absolutely was set to implement an innovative stand alone Hybrid Energy System combining tiny wind turbine and existing diesel generator. Finally elect equipments are shown in figure: one.

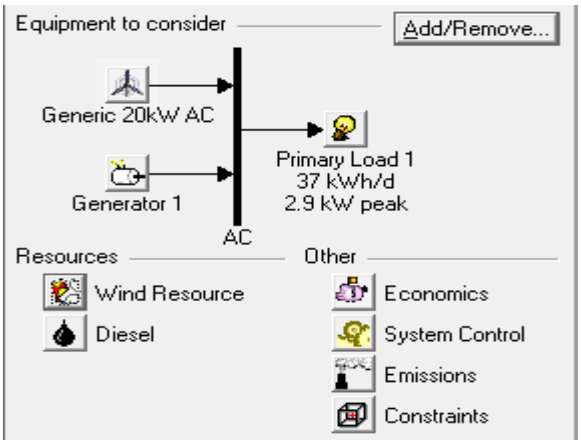


Figure: 1 Schematic diagram of Hybrid system for mobile telephony base station.

National Renewable Energy Laboratory (NREL)'s, Hybrid optimisation Model for electrical Renewable (HOMER version 2.19) [9] has been used because the size and optimisation code tool [10]. It contains variety of energy part models and evaluates appropriate technology choices supported value and accessibility of resources. During this paper the system size [11] is dole out mistreatment HOMER-optimization and simulation code tool. Analysis with HOMER needs info on resources, economic constraints, and management ways. It additionally needs inputs on component types, their numbers, costs, efficiency, longevity, etc. Sensitivity analysis can be finished variables having a variety of values rather than a particular range.

2. Why Wind/Diesel Hybrid System

The advantage of hybrid power systems is that the combination of the endlessly out there diesel power and regionally out there, pollution-free wind energy. With the hybrid facility, the annual fuel consumption may be reduced and at a similar time, the extent of pollution may be reduced. a correct management strategy must be developed to require full advantage of the wind energy throughout the periods of your time it's out there and to attenuate fuel consumption. Therefore, a correct system must be designed, subject to the particular constraints for a specific application. it's to take care of power quality, measured by the standard of electrical

performance, i.e., each the voltage and also the frequency got to be properly controlled. These ends up in a necessity for a simulation study of every new system to substantiate that an impression strategy ends up in desired system performance.

3. Renewable Energy Resources for Hybrid System

The availability of renewable energy resources at mobile base station sites is a crucial issue to develop the hybrid system. These energy sources are intermittent and naturally available; because of this issue our initial option to power the mobile base station are going to be renewable energy sources like wind or star or hydro etc. Weather knowledge are necessary issue for pre-feasibility study [16-17] of renewable hybrid energy system for any explicit site. Here the Wind energy resources knowledge are taken from Aagar (malwa) of the year 2013, (Longitude 77o.35'and Latitude 23o.28') and shown in Table one. In Aagar wind speed is associate average:

Table 1. Weather Data for the Site.

Month	Wind Velocity m/s
January	4.300
February	4.567
March	4.789
April	5.321
May	5.732
June	6.131
July	6.431
August	6.110
September	5.910
October	5.230
November	4.831
December	4.321
Average	5.310
Maximum	6.431
Minimum	4.300

3.1 Wind energy resource

An average wind dataset of 1 year for Aagar ware collected from Aagar station. This is often a median of 1 year and indicates that monthly average wind speed is shown in Figure two. From the higher than given information, wind speed likelihood operate and average monthly wind speed throughout the year is shown in Figure two.

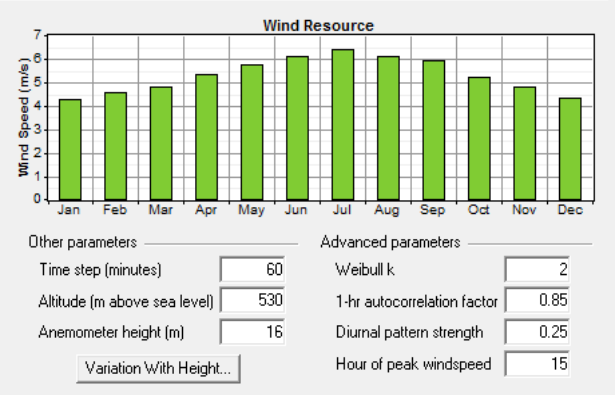


Figure: 2 wind speed probability function and average monthly wind speed.

The autocorrelation issue (randomness in wind speed) is found to be 0.85. The diurnal pattern strength (Wind speed variation over a day) is 0.25 and therefore the hours of peak wind speed is fifteen. Average wind speed within the summer season is slightly above the winter season and therefore the power output throughout the year in line with wind speed is shown in Figure: three.

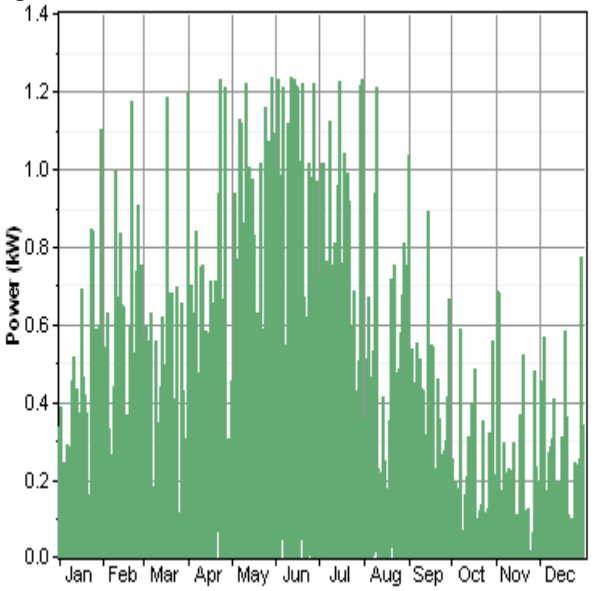


Figure: 3 Power Output Throughout The Year.

4. Load Pattern for Mobile Telephone Base Station:

Cellular telephone service could be a quickly increasing and really competitive business world over together with developed and developing countries like Asian country, America, European countries etc. without delay there are 55,000 completely different kind base stations for medium sector in Asian country and most of them running on diesel generators. However diesel generators are typically expensive to run and quite one diesel generator are put in for uninterrupted service. the various varieties of medium base station are used in line with the technological advancement in telecommunication sector.

Recently the GSM 2/2/2 (2nd Generation global System Mobile telephony base station) are utilized in everywhere the planet. For pre-feasibility study of planning the solar radiation hybrid system thought-about the 2d Generation GSM base station. during this present study think about the ability necessities for GSM telecommunication base station site are about average of 1.54kW. The load demand is approximate 36.9 kWh/d and 2.95 kW peak, as shown in figure: four.

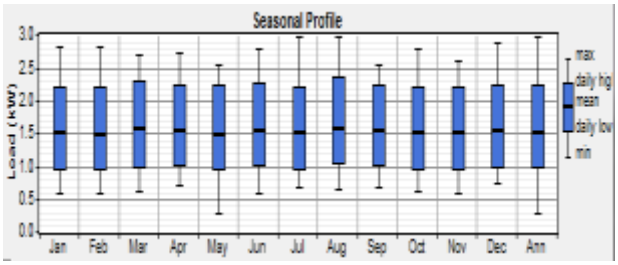


Figure: 4 monthly load distributions throughout the year.

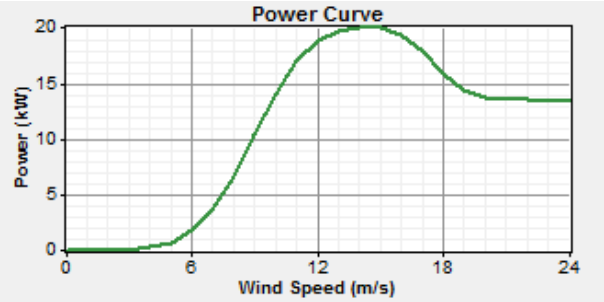
5. HYBRID ENERGY SYSTEM COMPONENTS:

The projected hybrid system consists of the following:

5.1 A twenty kw AC Wind turbine

A Generic twenty kw AC Wind electrical generator is taken for this method. It converts wind energy into current. Availableness of energy from the wind turbine depends greatly on wind variations. Therefore, wind turbine rating is mostly a lot of higher compared to

The average electrical load. it's a rated capability of 20kW AC. As outputs cost of 1 unit is taken into account to be $36167, whereas replacement and maintenance costs are taken as $15000 and $100/year severally. The value analysis is shown in Figure: five (i). The ability curves of wind turbine are shown in Figure: five (ii). To permit the simulation program realize associate degree optimum answer, period of time of a turbine is taken to be fifteen years.



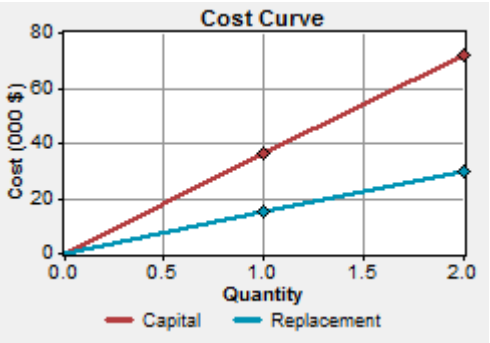


Figure: 5. A 20 kW AC Wind Generator. (i) Power curve, and (ii) cost curve

5.2 Diesel generator:

The fuel consumption annually is approximate 5000 Litter for 5kW Diesel Generator. The five kw diesel generator capital cost, replacement cost, operation-maintenance value are 2803$, 1000$, 0.002$. At present, diesel value is around 0.938$/L and for a really remote location this might increase up to 1$/L. Sizes to be contemplate for getting best hybrid system is 5kW .This analysis shown in Figure: six.

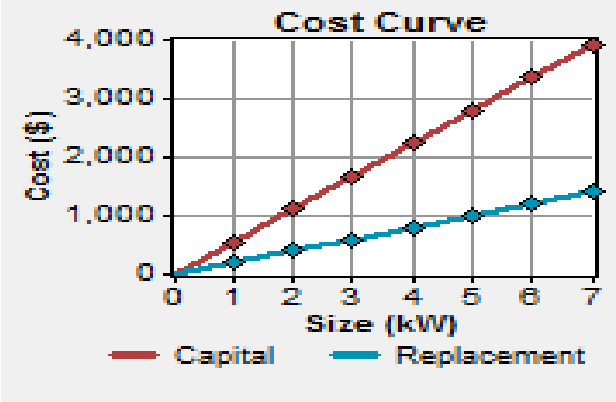


Figure: 6 Cost Curve of Diesel Generator.

6. RESULTS AND DISCUSSION

The higher than projected hybrid system provide the ability to the mobile telecommunication base station incessantly throughout the year. For the analysis of this hybrid system contemplate 2 sensitivity variables (wind speed and fuel cost). For every of the sensitivity values simulate all the systems in their individual. An hourly statistic simulation for each potential system kind and configuration is finished for a annual amount. An best system is outlined as an answer for hybrid system configuration that's capable of meeting the load demand of mobile telecommunication base station.

6.1 optimization Results

From the simulation results the installation of wind diesel hybrid system configuration for numerous locations are best suited power solutions for medium base station network in Indian sites. Considering present analysis of a Wind/Diesel hybrid system is appropriate for complete masses around Aagar. From the optimisation results the simplest best combination of energy system elements are one Generic twenty kw AC windmill and five kw Diesel Generator. Total net present cost (NPC), capital cost and cost of energy (COE) for such a system is $41,181, $37,849 and 3.058$/kWh, severally for one year. The careful optimisation results are shown in Figure: seven.

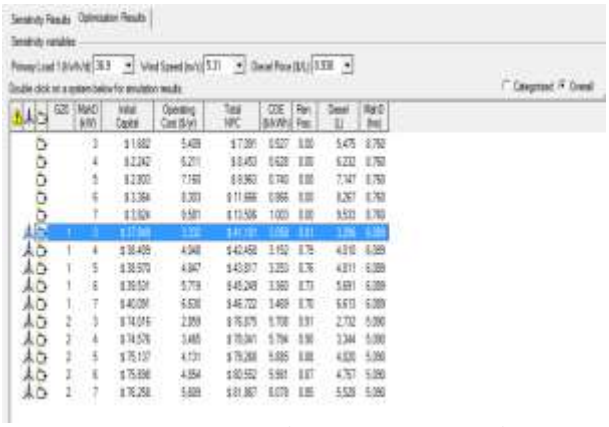


Figure: 7. Optimization Results of Hybrid Energy System for Mobile Telephony Base Station.

6.2 Simulation Results

In this simulation results eliminates all unfeasible mixtures and ranks the possible systems in line with increasing net present cost. It additionally permits variety of parameters to be displayed against the sensitivity variables for distinguishing a best system kind. The Monthly Average Electricity Production of Hybrid Energy System for mobile telecommunication base station is shown in Figure eight. During this system the whole production of current is fulfill the load demand by the mixture of eighty one by Wind and remainder of nineteen by Generator.

Figure: 8 Annual Electricity Production By This Hybrid System.

6.3 Sensitivity Results

i) Total Electrical Production: As long because the wind speed is enhanced, total electrical production additionally enhanced. On the opposite hand there are

not any important changes in primary load and diesel value with the increasing of total electrical production will see in spider graph as shown in figure: nine.

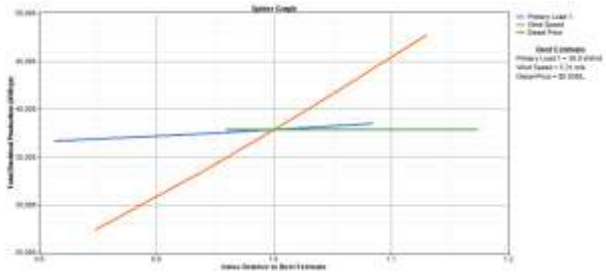


Figure: 9 Total Electrical Production By This Hybrid System.

ii) Renewable Fraction: If the wind speed is increasing the renewable fraction will increase, in such cases system can get extra power via wind turbine and therefore the dependency on the diesel motor can scale back as shown by spider graph in figure: ten

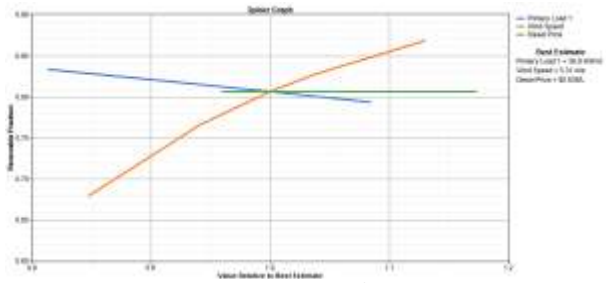


Figure: 10 Renewable Fraction of The System.

iii) Excess Electricity Production: With the enhanced wind speed excess electrical production will increase. This excess electricity will provide to grid for extra blessings, will see in spider graph as shown in figure: eleven.

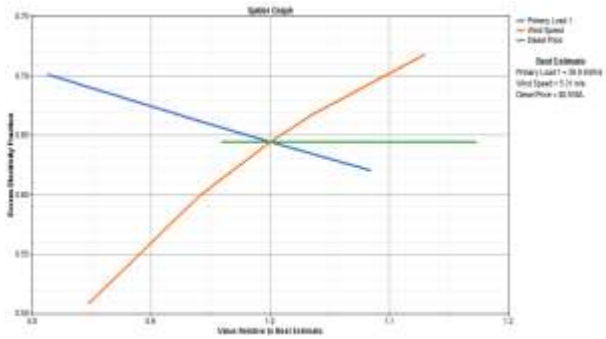


Figure: 11 Excess Electricity Production By The System.

iv) co2 Emissions: With the enhanced wind speed, co2 emission can scale back. In such cases less fuel is burnt on the diesel motor, as a result of most of the ability can achieved by wind turbine as shown in figure: twelve.

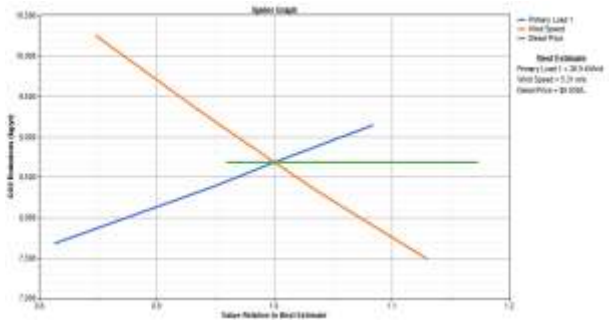


Figure: 12 CO_2 Emitted By This Hybrid System.

7. CONCLUSION:

Power is main issue for remote areas base station; as a result of grid extension isn't possible. In these sites the higher than projected renewable base hybrid system is most effective answer. These solutions of power provide to the medium base station are value effective and out there throughout the year. With the assistance of higher than pre-feasibility study the Wind/Diesel Hybrid Energy System is most effective power solution for mobile base station in Indian sites over typical diesel generator. Though information superhighway present value is high however the running and maintenance value are low as compared to the diesel generator power solution.

The fuel consumption is additionally reduced to approximate eighty two with increasing oil costs, payback times on the investment to hybrid wind/diesel power-driven base station sites are incessantly decreasing. the bottom stations power-driven by the wind/diesel hybrid energy system, with diesel backup are proving to be the foremost environmentally friendly and efficient solutions (total production of current is fulfill the load demand by the mixture of eighty one by Wind and remainder of nineteen by Generator) for several difficult sites with the advantage of excess quantity of electricity made by wind energy, which may be equipped to the ability grid for extra blessings. due to powering the bottom station by Hybrid Renewable Energy System, it'll scale back the carbon (CO and

CO2) and alternative harmful gases emission is regarding ninetieth in environments.

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