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DESIGNING RELIABLE HYBRID POWER GENERATION SYSTEM BY INTEGRATING HYDRAULIC POWER, WIND POWER AND SOLAR POWER

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Abstract: This research is to integrate the power generation system by integrating multiple source of power generation. This research is going to simulate the optimum power generation using Hydraulic, wind and solar system. This research would increase reliability and consistency of electricity production. According to proposed model there is no need to depend only on wind and sun. Proposed model would be capable to produce electricity in absence of wind and sun. This system would reduce consumption of fossil fuels and production of greenhouse gases. System is good for remote application: satellites, rural hospital equipment in developing counties, telecommunication equipments, etc. It would reduce the loss of electricity due to power line resistance because it can be sited where the electricity is used.

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Keywords: Hydropower, Solar system, Wind Energy, Matlab, Simulation, Optimization

[1] INTRODUCTION

Electricity has been considered as major requirement for daily life activities. Without electricity the domestic and industrial operation cannot be performed. The electricity generation, transmission and distribution process consist of electricity generation by the power plant, voltage for transmission steps up by transformer, electricity carry at long distances by the transmission lines. Neighborhood transformer steps down the voltage. The Distribution lines carry electricity to houses. Transformers on poles step down electricity before it enters houses. This paper represents the simulation of the optimum power generation using Hydraulic, wind and solar system. This research is going to increase reliability as well as consistency of electricity production. According this research there is no need to depend only on wind and sun. This system has the capacity to produce electricity even when wind and sun are not available. Such system would minimize the consumption of fossil fuels as well as production of greenhouse gases. System would be good for remote application: satellites, rural hospital equipment in developing counties, telecommunication equipments, etc. It would reduce the loss of electricity due to power line resistance because it can be sited where the electricity is used.

[2] Hydrolic simulation

In this section the simulation of hydrolic power system has been made considering factors such as HEAD, FLOW, Weight of water, Power coefficient.The following form has been made in MATLAB to simulate power production by hydrolic system in different circumstances.

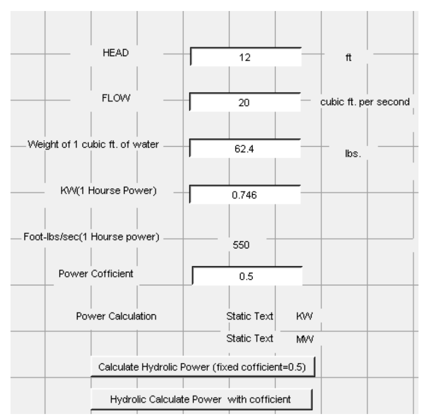


FIG 1 Hydraulic Power Simulation System

In next section, the input has been made in Head, flow, weight of 1 cubic ft. of water along with power coefficient to calculate the power production. In the figure, the result is displayed after input has been made in Head, flow, weight of 1 cubic ft. of water along with power coefficient.

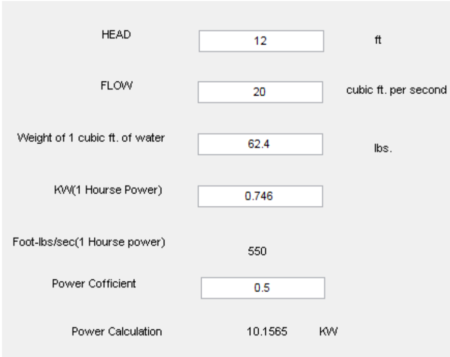


Fig 3 Power calculation after getting Input

The simulator has been developed in such a way that hydrolic power would be calculated with and without coefficient.

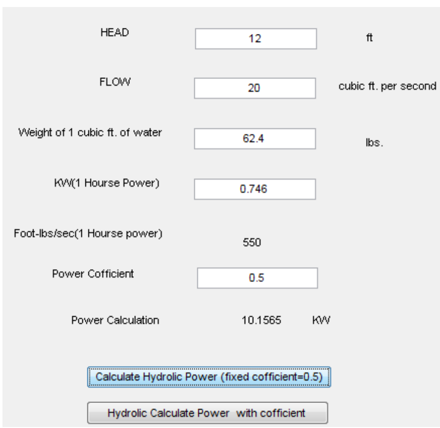
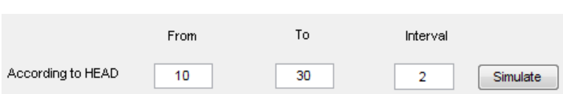


Fig 4 Hydraulic power calculation with and without coefficient.

The different cases for Hydrolic simulation

Case 1: The simulation is made on Head of 10 feet to 30 feet with interval of 2. All other variable such as water weight and flow are constant.



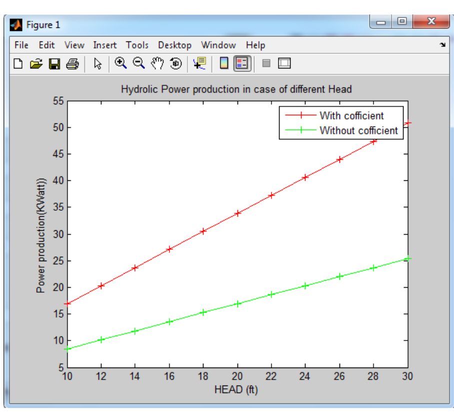
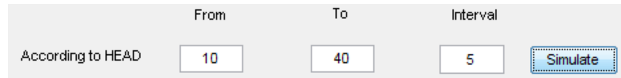


Fig 5 Hydrolic power simulation in case of Head from 10 to 30 feet

Case 2: The simulation is made on Head of 10 feet to 40 feet with interval of 5. All other variable such as water weight and flow are constant.



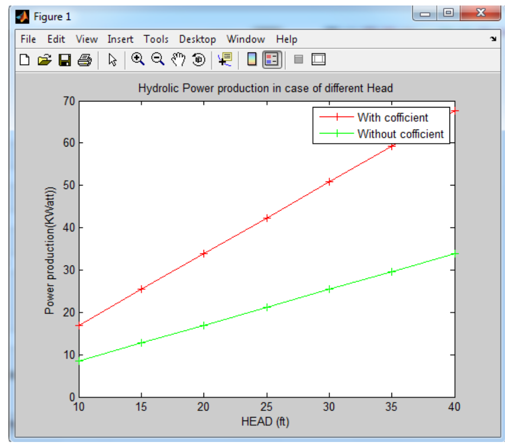
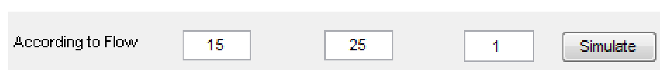


Fig 6 Hydrolic power simulation in case of Head from 10 to 40 feet

Case 3: The simulation is made on flow of 15 to 25cubic feet per second with interval of 2. All other variable such as water weight and Head are constant.



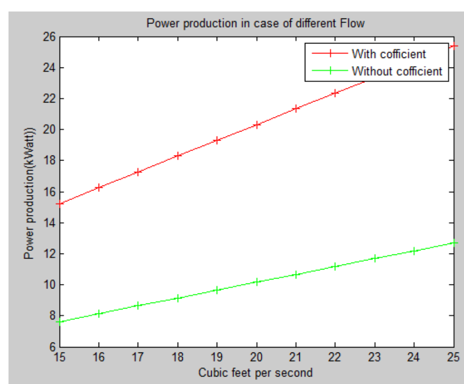


Fig 7 Hydrolic power simulation in case of flow of 15 to 25cubic feet per second with interval of 2

Case 4: The simulation is made on flow of 18 to 20cubic feet per second with interval of 0.5. All other variable such as water weight and Head are constant.

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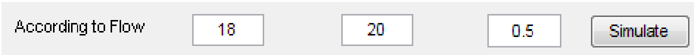


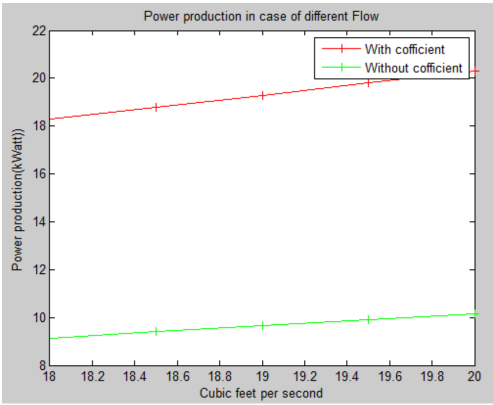
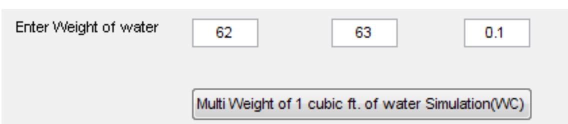


Fig 8 Hydrolic power simulation in case of flow of 18 to 20cubic feet per second with interval of 0.5

Case 5: The simulation is made on weight of water from 62 to 63lbs with interval of 0.1. All other variable such as Headand flow are constant.



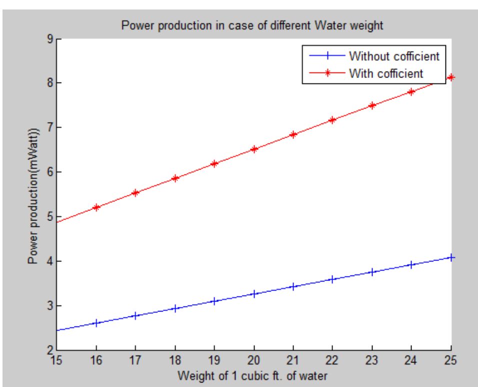
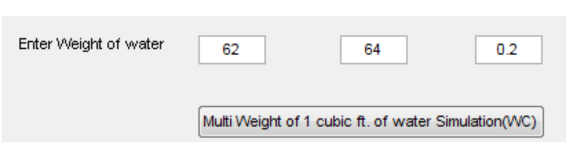


Fig 9 Hydrolic power simulation in case of weight of water from 62 to 63lbs with interval of 0.1

Case 6: The simulation is made on weight of water from 62 to 64lbs with interval of 0.2. All other variable such as Headand flow are constant.



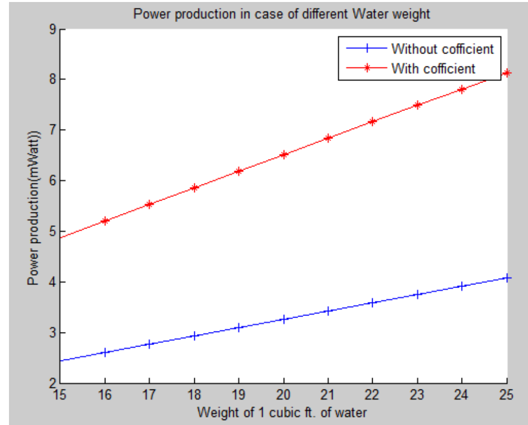


Fig 5.10 Hydrolic power simulation in case of weight of water from 62 to 64lbs with interval of 0.2

[3] Wind power simulation

In our research we made the power calculation according to blade length, wind speed, Air Density and power coefficient. We developed a simulator in MATLAB to calculate power calculated in case of different blade length at different wind speed. Here we have also considered the Air Density and power Coefficient. We took both cases for power calculation with coefficient and without coefficient. In this section we will get watt produced at different blade length, wind speed, swept area, Air Density , Power Coeffient.

Examination of Effect on results within situation

Here we took blade length to 32, wind speed to 12 air density to 1.67 then we get Available power in wind energy 4.64173 KW (if we calculate without cofficient)

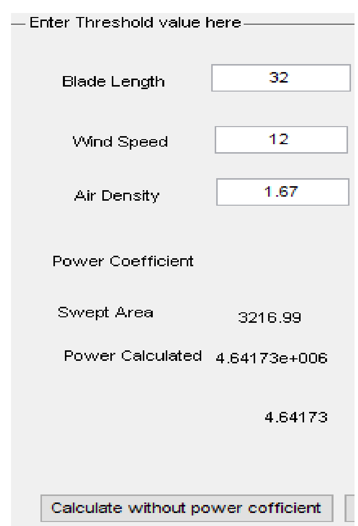


Figure 11 Available power in wind energy

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Here we took blade length to 32, wind speed to 12 air density to 1.67 then we get Available power in wind energy 2.7386 KW (if we calculate with coefficient (0.59))

Power Calculated by wind turbine

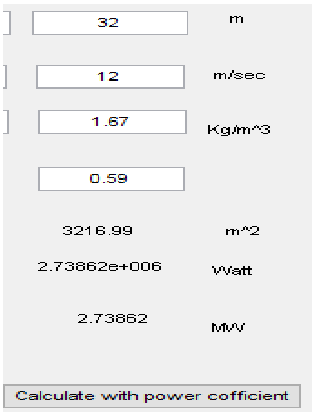

Figure 12 Power calculated by wind turbine

[4] Solar power calculation

Calculation of the annual solar energy output of a photovoltaic system depends on solar panel area, solar panel yield, annual average solar radiation on tilted panels and performance ration.

E = A * r * H * PR

E =Energy(kWh)

A =Total solar panel Area (m^2)

r = solar panel yield or efficiency(%)

H = Annual average solar radiation on tilted panels (shadings not included)

PR = Performance ratio, coefficient for losses (range between 0.5 and 0.9, default value = 0.75)

Detailed losses that gives the PR value are as follow:

Inverter losses (4% to 10 %)

Temperature losses (5% to 20%)

DC cables losses (1 to 3 %)

AC cables losses (1 to 3 %)

Shadings 0 % to 80% !!! (specific to each site)

Losses at weak radiation 3% to 7%

Losses due to dust, snow (2%)

MATLAB CODE TO SIMULATE SOLAR SYSTEM

```
function a=solarsim(A,r,H,PR)
a=A*r*H*PR
end
for i=10:10:100
x(i)=i
y(i)=solarsim(i,15,1250,0.75)
end
plot(x,y)
xlabel('Solar Panel Area')
ylabel('Energy')
title('Energy production by solar panel')
```

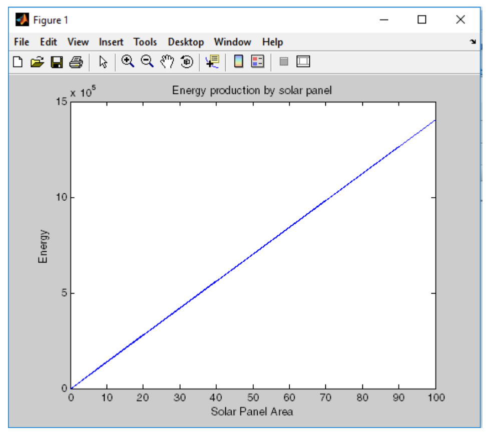

Fig 13 simulation for Solar energy(kWh) according to solar panel area

[5]OPTIMIZATION FOR HYBRID POWER SYSTEM FOR THE PRODUCTION OF MORE THAN 10000 KW POWER

INPUT PARAMETERS

Solar power parameter

PANEL_AREA=20

SOLAR_PANEL_YIELD=15

ANNUAL_AVERAGE_IRRADIATION=1250

PERFORMANCE_RATIO=0.75

Hydrolic power parameter

HEAD=50;

FLOW=20;

W=62.4;
kw=0.746;
fls=550;
POWER_COFFICIENT=0.5;

WIND POWER power parameter

Blade_length=32;
Wind_Speed=12;
AIR_DENSITY=1.67;
POWER_COFFICIENT=1;
SWEPT_AREA=3.14*Blade_length*Blade_length;

Output

SOLAR_POWER = 2813 KW
HYDROLIC_POWER = 42 KW
WIND_POWER = 4639 KW
TOTAL _POWER= 7494 KW

This configuration is not yielding required power from integrated system. Here we have to reduce the cost and increase the power production. The head is 50ft in case of hydraulic in above simulation

Here we have to reduce the cost and increase the power production. The head is 20ft in case of hydrolic in following simulation but here we are going to increase the blade length

Solar power

PANEL_AREA=20
SOLAR_PANEL_YIELD=15
ANNUAL_AVERAGE_IRRADIATION=1250
PERFORMANCE_RATIO=0.75

Hydrolic power

HEAD=20;
FLOW=20;
W=62.4;
kw=0.746;
fls=550;
POWER_COFFICIENT=0.5;

WIND POWER

Blade_length=40;
Wind_Speed=12;
AIR_DENSITY=1.67;
POWER_COFFICIENT=1;
SWEPT_AREA=3.14*Blade_length*Blade_length;
SOLAR_POWER = 2813 KW
HYDROLIC_POWER = 17KW
WIND_POWER = 7249KW
TOTAL_POWER = 10079KW

The above configuration is optimum as it is yielding more the a10000KW power supply. The presence of Hydraulic allow system to provide power even if wind power and solar power is not working. However the maximum energy would be taken solar power and wind power. But in absence of these the input to hydourlic power system is modified.

[6] CONCLUSION

Electricity is major requirement for daily life activities. Without electricity the domestic and industrial operation cannot be performed. But there exists several issues during these processes. However lot of research have been made to solve issues but still there are some problems such as Lack of clean & reliable energy sources, Intraday load & need, no access to electricity, Pollution from thermal power plants, Poor pipeline connectivity & infrastructure, Inadequate last mile connectivity, Average transmission, distribution & consumer-level losses etc. Here the discussion has been made on those issues and the focus is to solve such issues using proposed work. However there are several benefits as well as limitations of hydro electric power generation system. In tradition research SOLAR PV –WIND Hybrid power generation system approach has been used. As it is known that Renewable energy sources such as energy generated from solar, biomass, wind, geothermal, hydro power, and ocean resources have been considered as a technological option. It could help in generating clean energy. But there are certain limitations of tradition work such as solar energy is not available 24 hours. Even in winter the solar production is negligible. There are several issues related to wind energy as limited as there are several factors that could influence the production from wind energy. Wind energy is dependent of intensity of wind and area. Solar energy is dependent of availability of sun as well as intensity of sun rays. Considering the limitation of exiting work proposed work is integration of hydro electricity power, solar system, Nuclear power and wind energy.

[7] SCOPE OF RESEARCH

It would increase reliability and consistency of electricity production. According to proposed model there is no need to depend only on wind and sun. Proposed model would be capable to produce electricity in absence of wind and sun. This system would reduce consumption of fossil fuels and production of greenhouse gases. System is good for remote application: satellites, rural hospital equipment in developing counties, telecommunication equipments, etc. It would reduce the loss of electricity due to power line resistance because it can be sited where the electricity is used. System reduces water consumed in electrical generation processes by displacing electrical demand.

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