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A Comparative Analysis of Ptc Based Thermal and Wind Plant

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Abstract

Hybrid power generation system is good and effective solution for power generation than conventional energy resources. It has greater efficiency. It can provide to remote places where government is unable to reach. So that the power can be utilize where it generated so that it will reduce the transmission losses and cost. It only need initial investment. It has also long life span. Overall it good, reliable and affordable solution for electricity generation. PTC-wind And PTC thermal hybrid energy systems needs only initial investment. It will compete well in generation with the conventional energy sources. When accounted for a lifetime of reduced or avoided utility costs. We have compared of PTC based two hybrid power plant like as wind and thermal using MATLAB software. Hence we conclude by different parameters like as Efficiency, power generation and regulation etc. Hence we comparison of both plant find efficiency 88% for PTC with thermal and 71.23% PTC with wind. To identify more efficiency for PTC with thermal plant minimum transient.

Keywords:Hybrid, PTC, power, wind, Thermal.

I. INTRODUCTION

While renewable energy systems are capable of powering houses and small businesses without any connection to the electricity grid, many people prefer the advantages that grid-connection offers. A grid-connected system allows you to power your home or small business with renewable energy during those periods (daily as well as seasonally) when the sun is shining, the water is running, or the wind is blowing.

Any excess electricity you produce is fed back into the grid. When renewable resources are unavailable, electricity from the grid supplies your needs, eliminating the expense of electricity storage devices like batteries. Some of the things you need to know when thinking about connecting your home energy system to the electric grid include: Equipment required connecting your system to the grid Grid-connection requirements from your power provider State and community codes and requirements

II. EQUIPMENT REQUIRED TO CONNECT YOUR SYSTEM TO THE GRID

Aside from the major small renewable energy system components, you will need to purchase some additional equipment (called "balance-of-system") in order to safely transmit electricity to your loads and comply with your power provider's grid-connection requirements. You may need the following items:

1. Power conditioning equipment
2. Safety equipment
3. Meters and instrumentation.

Because grid-connection requirements vary, you or your system supplier/installer should contact your power provider to learn about its specific grid-connection requirements before purchasing any part of your renewable energy system. See our page on balance-of-system equipment requirements for small renewable energy systems [1,2].

- Grid-Connection Requirements From Your Power Provider:

Currently, requirements for connecting distributed generation systems—like home renewable energy or wind systems—to the electricity grid vary widely. But all power providers face a common set of issues in connecting small renewable energy systems to the grid, so regulations usually have to do with safety and power quality, contracts (which may require liability insurance), and metering and rates.

1. Hybrid energy system

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as "Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system." Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system PTC and wind power is used for generating power. PTC, Hydraulic and wind has good advantages than other than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find special location to install this system [3,4].

2. PTC Energy

PTC energy is that energy which is gets by the radiation of the sun. PTC energy is present on the earth continuously and in abundant manner. PTC energy is freely available. It doesn't produce any gases that mean it is pollution free. It is affordable in cost. It has low maintenance cost. Only problem with PTC system it cannot produce energy in bad weather condition. But it has greater efficiency than other energy sources. It only need initial investment. It has long life span and has lower emission.

2. Wind Energy

Wind energy is the energy which is extracted from wind. For extraction we use wind mill. Ii is renewable energy sources. The wind energy needs less cost for generation of electricity. Maintenance cost is also less for wind energy system. Wind energy is present almost 24 hours of the day. It has less emission. Initial cost is also less of the system. Generation of electricity from wind is depend upon the speed of wind flowing.

III.DISTRIBUTION OF PTC RADIATION

From the above Figure 3.1 of PTC radiation, Earth receives 174 peta-watts (PW) of incoming PTC radiation at the upper atmosphere. Approximately 30% is reflected back to space and only 89 pw is absorbed by oceans and land masses. The spectrum of PTC light at the Earth's surface is generally spread across the visible and near-infrared reason with a small part in the near-ultraviolet. The total PTC energy absorbed by Earth's atmosphere, oceans and land masses is approximately 3,850,000 EJ per year [5-9].

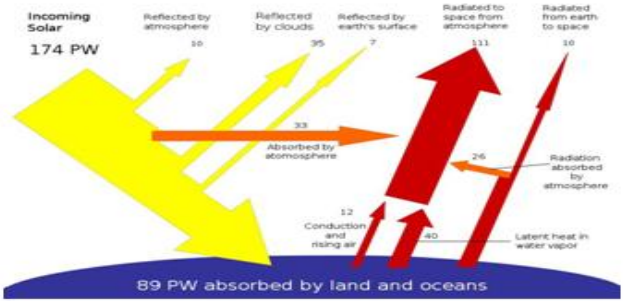

Figure 3 Ptc Radiation Reaching Earth Surface.

1369 watts per square meter is known as PTC Constant. It is important to realize that it is not the intensity per square meter of the Earth's surface but per square meter on a sphere with the radius of 149,596,000 km and with the Sun at its centre.

The total amount PTC radiation intercepted by the Earth is the PTC Constant multiplied by the cross section area of the Earth. If we now divide the calculated number by the surface area of the Earth, we shall find how much PTC radiation is received in an average per square meter of the Earth's surface [4-5-6]. Hence the average PTC radiation R per square meter of the Earth surface where S is the PTC constant (1369*10-9), r is the earth radius. The Handy formula which is used to calculate PTC energy received by earth.

E=3.6*10-9*S*n*r2*ת
Where E is the PTC energy in EJ.

S is the PTC Constant in W/m2.
N is the number of hours.
R is the Earth's radius in km [10].

IV.PARABOLIC TROUGH COLLECTOR DESIGN DEPENDENCY

A parabolic trough is a type of PTC thermal collector that is straight in one dimension and curved as a parabola in the other two, lined with a polished metal mirror. The sunlight which enters the mirror parallel to its plane of symmetry is focused along the focal line , where objects are positioned that are intended to be heated. In a PTC cooker, for example, food is placed at the focal line of a trough, which is cooked when the trough is aimed so the Sun is in its plane of symmetry [15].

For other purposes, a tube containing a fluid runs the length of the trough at its focal line. The sunlight is concentrated on the tube and the fluid heated to a high temperature by the energy of the sunlight. The hot fluid can be piped to a heat engine, which uses the heat energy to drive machinery, or to generate electricity. This PTC energy collector is the most common and best known type of parabolic trough .When heat transfer fluid is used to heat steam to drive a standard turbine generator, thermal efficiency ranges from 60-80%.

The overall Efficiency from collector to grid, = (Electrical Output Power)/(Total Impinging PTC Power) is about 15%, similar to PV (Photovoltaic Cells) but less than Stirling dish concentrators. Large-scale PTC thermal power plants need a method for storing the energy, such as a thermocline tank, which uses a mixture of silica sand and quartzite rock to displace a significant portion of the volume in the tank. It is then filled with the heat tran Parabolic Troughs (PTs) are a class of PTC concentrators that are curved as a parabola and placed in a straight line as show in Figure 4.1.sfer fluid, typically a molten nitrate salt.

Figure 2 PTC Parabolic Troughs [2].

Some of the common applications where parabolic trough systems are used are:

1. Boiler feed water preheating.
2. Air conditioning.
3. Milk pasteurization.
4. Industrial process heat.
5. Power generation.

Reflectors are parabolic in shape, such that they concentrate PTC radiation over a line focus as shown in Figure 4.1. The trough is positioned such that its aperture plane is perpendicular to the sun's rays. It tracks the sun in a single axis to transfer energy to fluid circulating through receiver pipe.

V.PROCESS MODELING AND SIMULATION

Mathematical models are effective tools for analyzing systems or processes. They can be used to develop a new system or to evaluate the performance of an existing one. Mathematical modeling is widely applied to the solution of engineering problems. Modeling usually describes a system using a set of variables and equations and sets up relationships among the variables. Mathematical models are found to be very useful in solving problems related to process energy efficiency and can be utilized for both static and dynamic systems. MATLAB [10],

A process modeling software package, has been found to be very effective for analyzing plants for efficiency improvement. It has been used in Australia by a number of process industries, consulting companies and universities as a tool for simulating plant. Therefore, MATLAB has been employed in this study for modeling and simulating the said coal-fired power plant.

1. Modeling Ptc And Thermal Plant Matlab

MATLAB can work in both static and dynamic modes. In static mode, it can perform process balances known as MATLAB process modeling in is illustrated in Figure 5.1. It shows the overall approach of developing a process model in MATLAB. A process model is generally treated as a project in MATLAB. A project may have one process flow sheet or a number of flow sheets. In a project, the flow sheets can interchange data and can be interlinked. MATLAB uses typical graphical techniques to construct a process flow diagram (PFD). Before constructing a PFD in MATLAB flow-sheet, the scope of the project and data required to perform modeling needs to be defined as shown in the Figure 5.1. In MATLAB there are many built-in process components known as unit models.

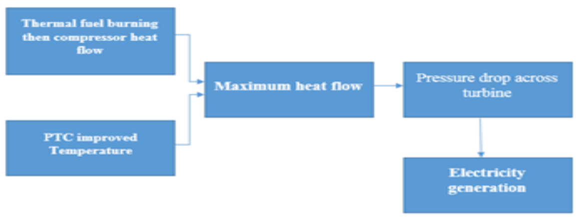

Figure 3 Thermal with PTC proposed block diagram.

VI. RESULT AND SIMULATION

6.1 Ptc Characteristics Matlab:

```
T=28+273;
Tr1=40; % Reference temperature in degree fahrenheit
Tr=((Tr1-32)* 5/9)+273; % Reference temperature in kelvin
S=[100 80 60 40 20]; % PTC radiation in mW/sq.cm
%S=70;
ki=0.00023; % in A/K
Iscr=3.75; % SC Current at ref. temp. in A
Irr=0.000021; % in A
k=1.38065*10^(-23); % Boltzmann constant
q=1.6022*10^(-19); % charge of an electron
A=1.00;  %Effective area
Eg0=1.166;
alpha=0.473;
beta=636;
Eg=Eg0-(alpha*T*T)/(T+beta)*q; % band gap energy of
Np=4;
Ns=60;
V0=[0:1:300];
fori=1:5
Iph=(Iscr+ki*(T-Tr))*((S(i))/100);
Irs=Irr*((T/Tr)^3)*exp(q*Eg/(k*A)*((1/Tr)-(1/T)));
I0=Np*Iph-Np*Irs*(exp(q/(k*T*A)*V0./Ns)-1);
P0 = V0.*I0;
figure(1)
plot(V0,I0);
axis([0 50 0 20]);
xlabel('Voltage in volt');
ylabel('Current in amp');
hold on;
figure(2)
plot(V0,P0);
axis([0 50 0 400]);
xlabel('Voltage in volt');
ylabel('Power in watt input');
hold on;
figure(3)
plot(I0,P0);
axis([0 20 0 400]);
xlabel('Current in amp');
ylabel('Power in watt Output');
hold on;
end
```

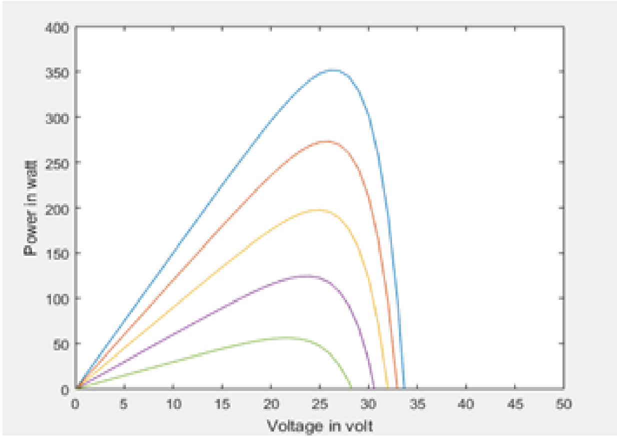

Figure 4 Power Vs Voltage generation different type of radiation as a inputs.

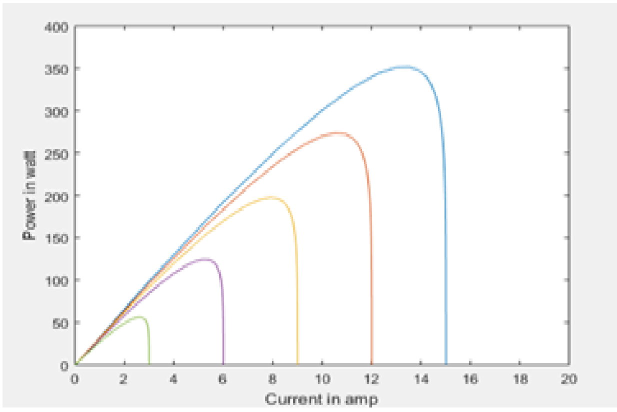

Figure 5 Power Vs Current generation different type of radiation (200-1000) as a inputs.

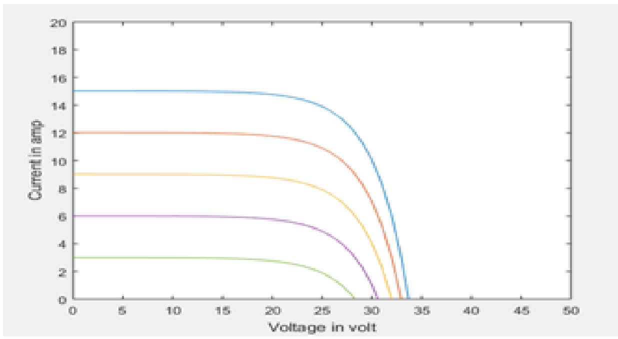

Figure 6 Voltage Vs Current generation different type of radiation (200-1000) as a inputs.

2. Result of Thermal With Ptc Plant

This work is based on live data collection using two bleeds steam at pressure of 5 bar and 1 bar respectively and find out the efficiency of existing turbine at these bleeds stage. Also find out the efficiency of the turbine based on the data given in the following table and respective calculation are based on three condition one bleeding, two bleeding and without bleeding. Following table show the collected from plant. When generation at 11.5MW:

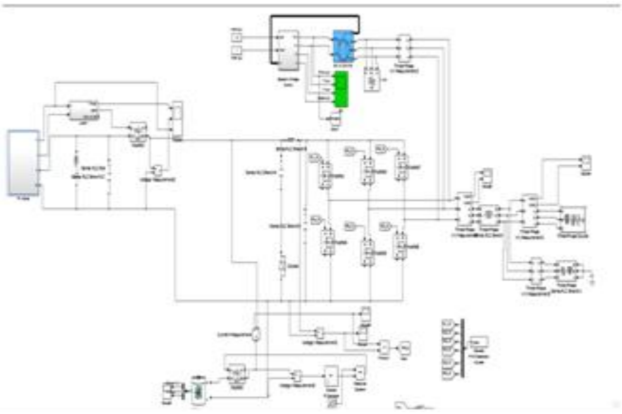

Figure 7 MATLAB Modeling.

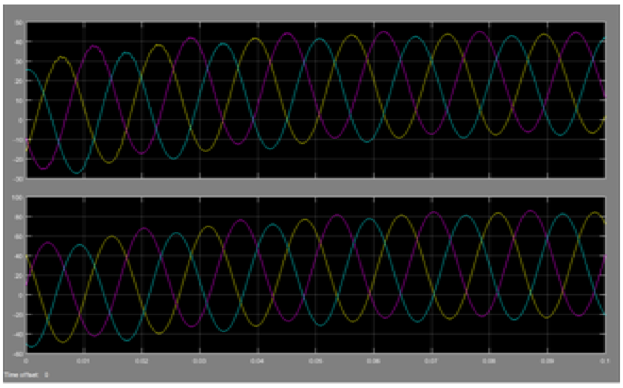

Figure 8 PTC and Thermal Plant Outcomes.

Table 1 show the collected from plant.

Parameters	Values
Electrical Efficiency hybrid	88.86%
All system cost	191492.187 rupees
PV(KWH)	9867(KWH)
Fuel Consumed	6588T
Total cost of fuel	$2.365x10^4$rupees
CO2 generation	$6.407x10^4$ PM
Nox Generation	1426 PM
PM factor	57.32 PM
Total power(A)	3933a
PID response time	0.5s

3. Result of Wind With Ptc Plant:

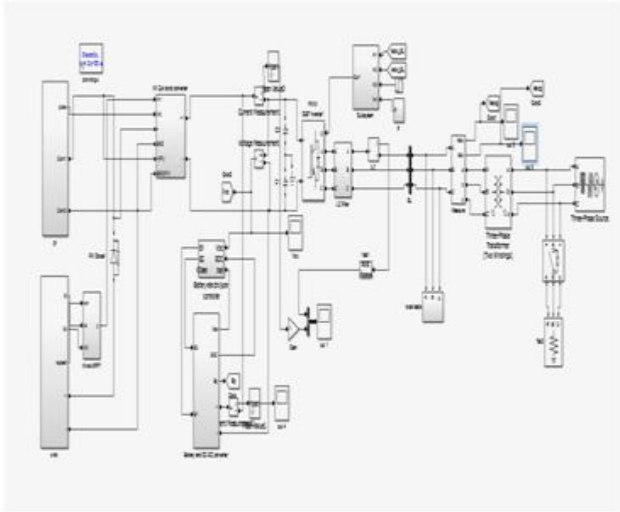

Figure 9 Wind with PTC Modeling MATLAB.

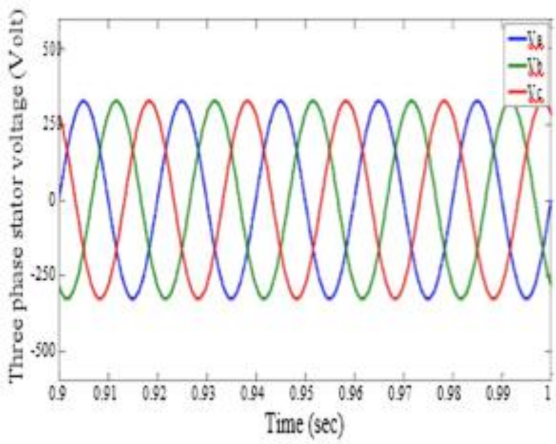

Figure 6.7:PTC and Wind Plant Outcomes.

Table 2 Comparison Between Both Plant Efficiency (11kmwatt):

S.N.	Plant Type	Plant Efficiency	Input Source
1.	Ptc With Thermal	88.86%	6588T
2.	Ptc With Wind	71.23%	-

VII. CONCLUSION

We have compared of PTC based two hybrid power plant like as wind and thermal using MATLAB software. Hence we conclude by different parameters like as Efficiency, power generation and regulation etc. Now these model are representing some points for given blow.

1. Thermal with Ptc:

This Work presents the performance evaluation of efficiency of steam turbine of 11.5 MW of MSW based power plant. Steam Turbines are one of the main energy consuming equipments, even though not much attention is paid to them. Bleeding parameters of steam turbine are responsible for efficient operation of the turbine. The steam turbine efficiency at 11.5 mw, MSW based power plant has been evaluated and obtained with & without bleeding system used for regenerative purpose. It has been observed that the efficiency at turbine increases when number of bleed increases at specified inlet steam flow, pressure and temperature as it's shown in above that

- If two bleeds are used the efficiency of the turbine is increase by 1.2% subject to that the turbine runs on If its full load i.e 11.5 MW.
- If one bleed is used the efficiency of the turbine is increase by 1.9% subject to that the turbine runs on its full load i,e 11.5 MW.
- If there is no bleeding the efficiency of turbine comes to around 34.4% because of that the amount of steam has not been taken out by bleeds which were passing through regeneration system.
-

2. Wind With Ptc:

In this modeling are representing of Wind air as a input for 10p that gives 3kw power but these are given higher fluctuation hence transient time. Hence we concluding of comparison of both plant find efficiency 88% for PTC with thermal and 71.23% PTC with wind. To identify more efficiency for PTC with thermal plant minimum transient time.

VIII. FUTURE WORK

Future work is increase the efficiency of steam turbine of Power Plant to provide bleeds system. Maximum three bleeds use upto pressure 50 bar. It has been suggest to concerting plant.

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