

Improved Design of Solar Thermal Power Generation Unit



Submitted by:

Zunair Asghar-12017019171

Awais Sabir-111619232

Waqar Ali-12017019008

Zain Khalid-12017019027

Supervised by: Prof. Ahmed Malik

Department of Electrical Engineering
School of Engineering
University of Management and Technology Lahore
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Project Advisor

Co-Advisor

Director
Undergraduate Studies

Department of Electrical Engineering

School of Engineering

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Declaration

I declare that the work contained in this thesis is my own, except where explicitly stated otherwise. In addition this work has not been submitted to obtain another degree or professional qualification.

Signed: _____

Date: _____

Acknowledgment

Thank Allah for giving us the courage. Special thanks to our Project Advisor Sir Ahmed Malik and Co-Advisor Sir Mustafa Shahid for helping us whenever help was needed.

Dedicated to the teacher of the universe Prophet Muhammad Peace
And Blessings Be Upon Him.
Our Parents
And Our Teachers

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Abbreviations

CSP (Concentrated Solar Power)
PTC (Parabolic Trough Technology)
PV (Photovoltaic)
LFR (Linear Fresnel Reflector)
NSO (Nevada Solar One)
SEGS (Solar Energy Generating System)
HTF (Heat Transfer Fluid)
OT (Once Trough)

ABSTRACT

In the modern era, most improved and cheap technology for renewable electrical energy resource is Concentrating Solar power (CSP).In our project we are producing thermal energy, through solar energy using Parabolic Trough Technology (PTC). We are even using tracking system to get maximum sun intensity during day. The energy that is produced is stored in storage tank for further use. The knowledge applied on this system is based upon the course we studied. Our work will ultimately be demonstrated to validate the project design. Obstacles and possible improvements will also be presented.

CHAPTER 1: INTRODUCTION

1.1 LACK OF FOSSIL FUELS

There is concern of population increase, the human community growth is increasing continuously and the required energy is increasing in the opinion of people's utilization. Oil, coal is very old and humans have been using fossil fuels since ancient time. North Sea oil fields are approximately 150 million years old, while most coal of Britain began to form there more than three hundred million years ago. It is clear that fossil fuel reserves are limited; it is only a question of time when they run out. Worldwide each year we presently use up the identical of over 11bn tons of oil in fossil fuels. Crude oil reserves are disappearing at the rate of 4 billion tons per year - if we continue at this rate, without any increase in our population our known deposits of oil will disappear in 2052. And also the coal that is reserved will only give us energy till 2088.

1.2 WORLD GOING TOWARDS RENEWABLE ENERGY

It is know that oil and coal are the main sources for production of energy during these days. Additionally, solar energy is limitless. The energy that is obtained from natural resources is call Renewable energy that include technologies that use renewable energy sources. Renewable energy technologies include Bio-energy, geothermal energy, hydropower, ocean energy, solar energy and wind energy. Renewable are important source of energy worldwide, according to a United Nations Program for the Environment published in March. Driven by rapid expansion in expanding countries, new renewable power plants installations in 2014 exceeded 100,000 megawatts of magnitude for the first time according to report. It seems that renewable energy is now in the market on a scale that is relevant in terms of the energy industry - and at a competing price with fossil fuels and World is going towards renewable.

1.3 SOLAR ENERGY

The fundamental requirement of the time is to produce energy by the help of utilizing our renewable resources. Electricity generation from renewable energy except from fossil fuels provide health benefits to public. It will also be cheaper as compared to the other means of producing energy and would run for longer time. If we compare technologies of fossil fuel technologies, which are typically mechanized the renewable energy industry is more labor-intensive. In those countries where the sun shines for the around 2/3 of the day is the best suited for the generation of power by using the sunlight as a source. As we know Pakistan is the country where the summer runs for at least eight months a year. Our part of the world is the best suited for the generation of electricity, areas which are mostly covered with desert like Bahawalpur, Cholistan and Rahim Yar Khan Etc. This makes these areas perfect for generation of energy through Concentrated Solar Power and Photovoltaic technologies.

The converting of sunlight into electricity is called solar power and it is the most available energy source on earth and it offers large total current energy demand. There are two ways of conversion of sunlight in electricity.

Concentrated Solar Power (CSP) and Photovoltaic (PV). CSP and PV both are popular these days. PV is useful in many applications, and CSP provides advantages for a large scale of applications. We also know that CSP power plants these days are the most cost efficient way to generate electricity. However if we talk about which technology is better from both of them then there is no competition between both but they have to be seen as complementary technologies. Plant load factor of CSP is in the range of 20% to 30 % and the Plant load factor of PV is in the range of 15% to 20%

1.4 CONCENTRATED SOLAR POWER

Technologies of Concentrated Solar Power (CSP) use reflecting materials to focus the sun's energy and then convert it into high temperatures to create steam to operate turbine that will generate the electrical power. As it is stated above sunlight is the major source in CSP technology, it utilizes focused sunlight and electrical power is generated by using small reflecting materials to focus the sun's energy to convert it into warmth heat. That heat is then transmits through a generator. Plant that is built to generate thermal power consists of two suitable parts. The one that collects the solar energy and then convert it into heat and the other one is that convert the heat energy into electricity. In few countries like in the United States Electrical power is generated using CSP plants for more than 15 years.

1.4.1 CONCENTRATED SOLAR POWER TYPES

There are different types of concentrating collectors used in CSP technology. These concentrated or focusing collectors intercept direct radiation over a large area and direct it into a small absorber area.

- Parabolic Trough System
- Dish Engine
- Power Tower
- Fresnel Reflector

These types are CSP and are very sufficient for generating electricity from concentrated thermal heat. We are using Parabolic Trough System. Trough system use large U shaped reflectors or focusing mirrors that have fluid pipes running along their center or focal point. Sometimes transparent glass tube envelopes the receiver tube to reduce the heat loss. The mirrors are tilted towards the sun, focusing sunlight on tubes or receivers that run the length of the mirrors. The hot liquid is actually used to boil the water in a steam turbine generator to produce electricity. Temperature at the receivers can reach 400°C and produce steam for generating electricity.

As we are generating electricity from concentrated solar power, our intention is to expand and magnify the quantity of energy that is collected by the arrays during the day. For the maximization of our systems total output; solar trackers are often used. They are automatically adjusted so that with the movement of sun they move accordingly.

CHAPTER 2: CONCENTRATED SOLAR POWER

2.1 DISH ENGINE

The dish engine gathers the solar energy directly from the sun. The concentrated solar radiation is reflected onto a thermal receiver that collects the solar heat. The dish is structured in a way that tracks the sun light throughout the day, to get the maximum sunlight possible on to the thermal receiver. The dish engines were first designed in 1816 as a safer alternative to steam engines. Robert Stirling invented the engine named after him with workers safety in mind. The dish engine is made up of the thermal receiver and the generator. The thermal receiver is interlinked between dish and the generator. It observes the concentrated rays of solar energy and converts it to heat. A thermal receiver can consist of thermal fluid tubes usually which has a degree of boiling between 100-110 degree centigrade. The engine system takes heat from the receiver and uses it to generate electricity. Stirling engine is the most common type of engine used in the dish system. The pistons are moved by means of the heated fluid to generate mechanical energy, which is finally converted into electrical energy.

Dish Stirling CSP technology uses mirrors to approximate a parabolic dish to effectively reflect the solar radiation onto the receiver.

Stirling engines are cleaner and low cost to manage than fossil fuels powered engines. The biggest disadvantage of dish engines is that they are slow to respond to changes. All in all, dish engines are interesting and exciting area of research in the alternative energy world.

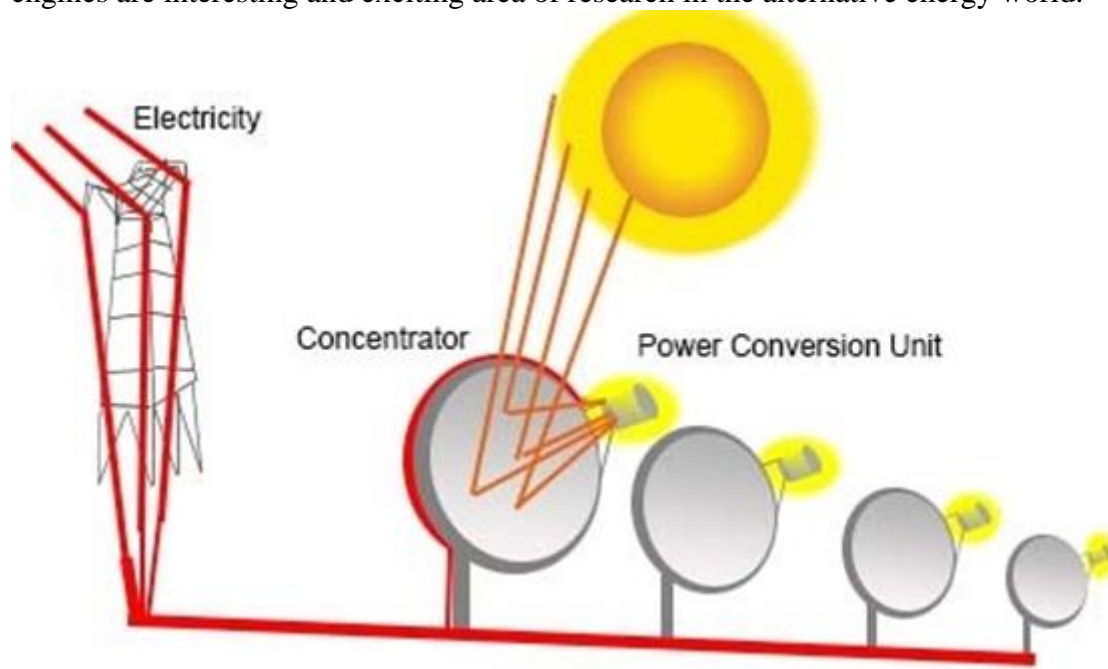


Figure 1: Stirling Dish Engine

2.2 POWER TOWER

Concentrated solar power (CSP) can also be made by using the Heliostat technique. This method is named as 'Central Tower' power plant or 'Heliostats' power plant. The basic theme of this technique is that we use a tower as a receiver to receive the sunlight which is being focused on the tower.

During this process, for the purpose we use mirrors to focus the sunlight to the tower which is operated at the center between the mirrors. In this procedure we can use salt or water to generate steam which will then move our turbine. The selection of water or salt depends upon the situation and their boiling points. For instance if we consider that we are going to use salt for this motive then we will put the salt in the receiver and start the procedure. The mirrors will collect the sunlight and will focus on the tower which is working as receiver. By the time, the temperature of the receiver will begin to rise and when it will reach the boiling point of the salt which we are using then the salt melts. The melted salt will move to the hot salt storage tank. After that the hot salt in a pipe will go through the heat exchanger, also called a boiler. There is another pipe in which water flows in the boiler. In boiler the hot salt will transfer its heat to the water and water starts boiling because of the continuous heat which is being projected to the water. After transferring heat to the water, the salt is cooled down and then sent to the cool salt storage tank to reuse it again. The cool salt is then sent to the tower to repeat the operation. This boiled water will pass through the small narrow pipe which then produces steam and this high temperature steam will drive the turbine, right next in front of this steam. Then steam comes back to the condenser through certain arrangement. Condenser is a device that converts steam which is in gaseous state to liquid state, here it means water, by cooling it. Then this cooled water again passes through the boiler to produce the steam again and it is recycled. The movement of turbine then runs the generator which is followed by turbine. The generator will convert mechanical energy into electrical energy and produces electricity. Then electricity is given to the towns or it will turn on the electric bulb, if it is on smaller scale, depending upon the situation or requirement. Once this process starts then it is continued on its own because water and salt are recycled in this process and we can have continuous production of electricity.

The drawback of using this technique is that its demo is not easy at all to give because of its physical structure. The other one is that the power generated by this technique is not so efficient at the level at which we are making this.

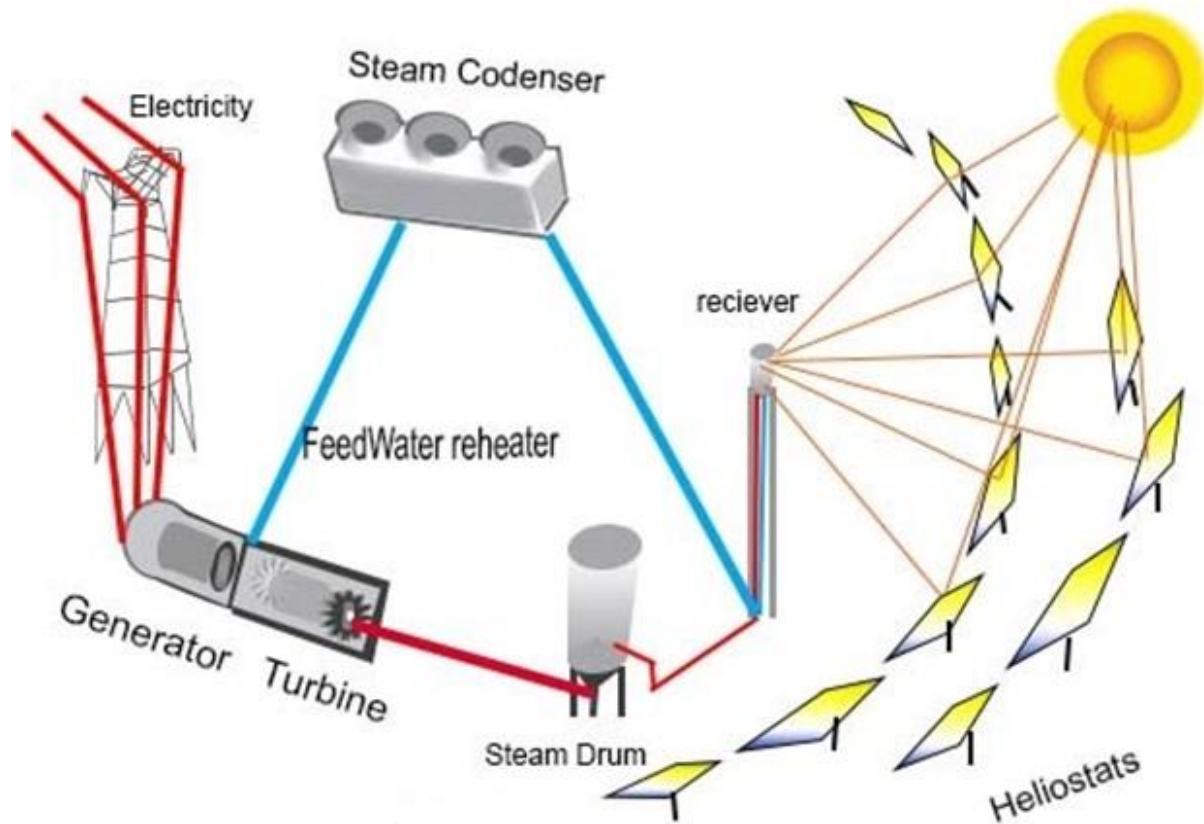


Figure 2: Solar Tower

2.3 FRESNEL REFLECTOR

A CSP scheme known as “Linear Fresnel Reflector” is similar to the parabolic trough in a way that both use a collector tube. It has an array of flat mirrors horizontally and vertically aligned. All horizontally aligned mirrors reflect sun light towards a central receiver tube. The receiver tube also has a sun ray capturing shade which is used to capture the sun rays that does not fall directly on the receiver tube. All flat mirrors are to be aligned at a different angle in order to reflect the sun light accurately towards the receiver. The sun tracking system is also required for each individual mirror. Such a scheme becomes difficult to demonstrate as a Final Year Project as it requires a lot of mirrors aligned in parallel with each other and they should be reflecting at the receiver with an appropriate angle. Such a scheme is not portable rather it require all the construction to be done on a permanent land. The other thing is that such a scheme wasn't made by the previous group; the scheme adopted by the previous group is parabolic trough. Hence, it would be beneficial if we work on the improvement of the current scheme rather than working again from the scratch.

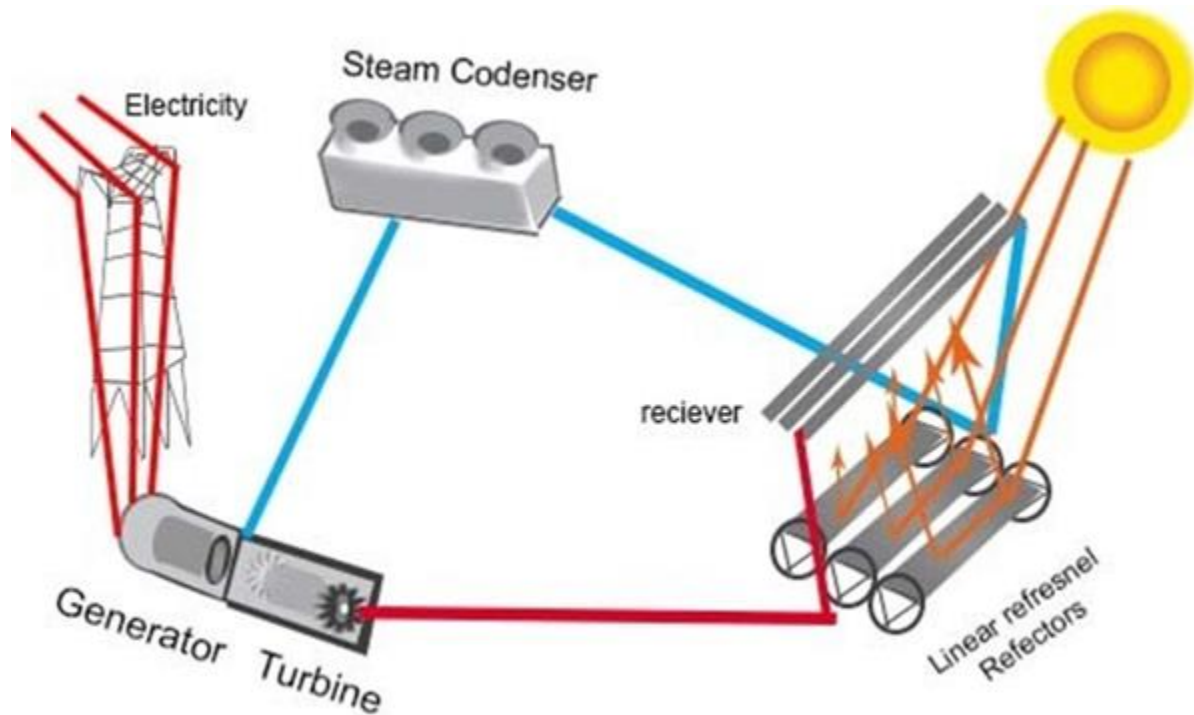


Figure 3: Fresnel Reflectors

2.4 PARABOLIC TROUGH

Parabolic trough is a type of CSP that is curved as parabola plate and metallic mirrors are placed above it. It was first invented by John Ericsson in 1880, to power a hot air engine.

In this technology we have parabolic trough to concentrate solar radiation through mirror to receiver. Receiver contains thermal fluid which is heated to its boiling point i.e. 100-110 degree centigrade and converted to steam. The steam is used to drive the steam turbine, which is connected to prime mover of generator which converts the mechanical energy to electrical energy. This electrical energy is supplied to grid station. The hot fluid is passed through the condenser to reuse thermal fluid; this recycling process will minimize the loss of resources.

The receiver tube is the main component of parabolic trough. It contains an inner steel tube, coated by an anti reflective glass tube. The main purpose of receiver tube is to maintain the heat of the thermal fluid and to trap solar energy. The receiver tube must be an excellent thermal insulator.

Reflector must be a great reflectance to concentrate maximum solar radiation towards receiver. Reflector contains mirrors made from low-iron float glass with high solar radiation transmittance.

The performance and functions of commercial grade parabolic trough are well understood and proven. It is remarkable efficient because it has been evaluated and optimized over many design generations. Modularity is important for achieving low cost through high

volume production of components and sub systems. It has smooth and predictable output. Parabolic trough is the only proven CSP technology that is working for over 25 years with performance and reliability.

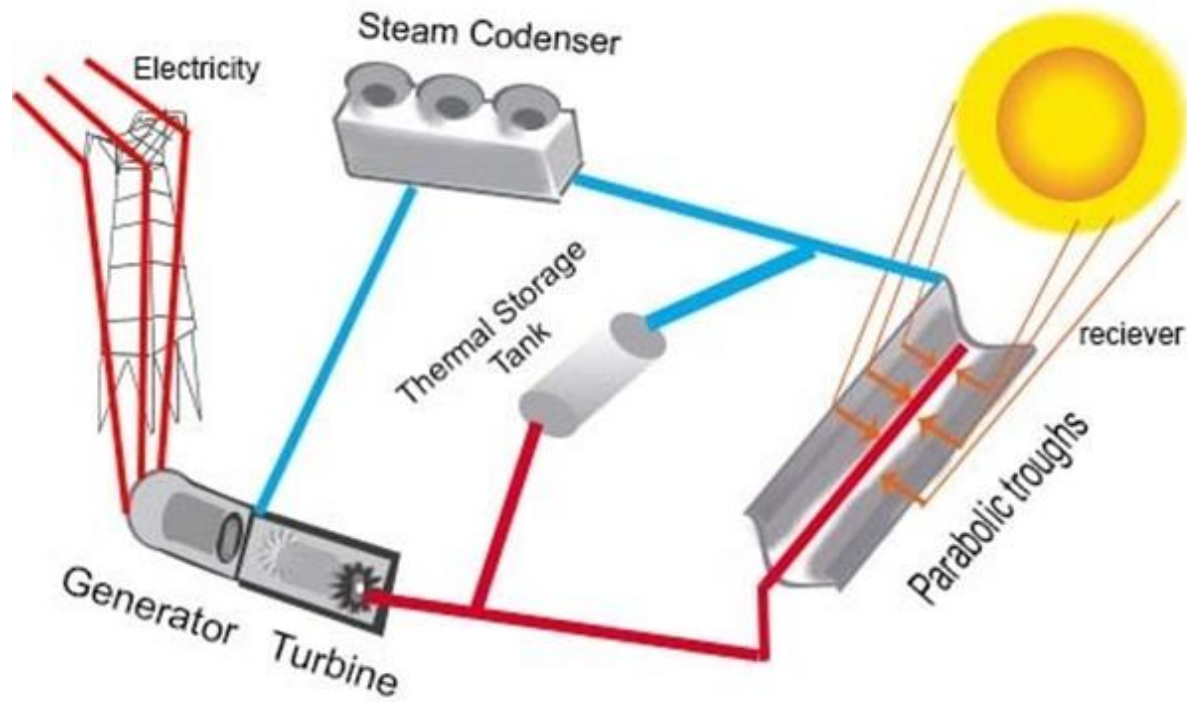


Figure 4: Parabolic Trough

CHAPTER 3: THE PARABOLIC TROUGH

3.1 WHY PARABOLIC TROUGH

Parabolic trough have been in wide use for power generation network quality since mid-1980. From the years, other CSP technologies like motor plate, Fresnel tube, and the tower central receiver has received considerable attention in the world to meet the need to deliver effective cost of electricity. Although each of these designs has its own particular qualities and performance characteristics that make it a very attractive option but only parabolic trough has thirty years experience in the commercial market ; and it has been funded by the Bank many times over. Therefore, it was the ideal technology for Sky fuel to develop widespread integration into the global energy market.

3.1.1 COMMERCIALY SATISFIED

Working and operation of the parabolic trough of commercial solar thermal power plants are well understood and beyond doubt. In the U.S, more than 350 MW of systems parabolic trough have been operating in the cluster state U.S California since the early 1980s. Another 64 MW of parabolic trough, Nevada Solar One (NSO) has been in operation in Nevada since 2007, and Martin (MSP) in Florida solar plant since 2009. In Spain, thanks to government subsidies for solar energy feeders as tariffs; more than one watt of Gig (GW) of parabolic trough solar power plants (CSP) was built between 2007 and 2013. Most of these plants using molten salt thermal energy storage.

3.2 POTENTIAL IN PARABOLIC TROUGH

It has a great capability to work as a primary source of energy in the near future.

3.2.1 REMARKABLY EFFICIENT

Experiences in the Solar Energy Generating System (SEGS) and Nevada Solar One (NSO) and new data leaving Spain plants allow continuous improvement in system design parabolic trough and performance. All channel components, including frames and supporting structures, the reflector, receiver tubes, solar tracking systems, control systems and fluid systems heat transfer have been optimized for most of the generations of design. The information obtained from these tests as experience has resulted in improving the capacity of long-term performance and lower cost for parabolic trough unit. Half a century after the first trough being used, year of solar energy production of the first plants SEGS is greater today than when plants are used commercially for the first time, due to increased operating and efficient procedures and component updates. In addition to this, the history of long-term operation of the unit's parabolic trough shows that working and maintenance costs are understood and well predictable. Parabolic trough is inherently efficient. Efficiency is important for achieving low cost through high production of components and systems. The potential simply add more rows of parabolic trough to increase to produce hundreds of megawatts (MW) more plants of parabolic trough the best choice for solar energy grade ago. Regarding depressions based glass; sky-trough can be installed economically in very small solar fields, due to the simple installation process.

The design components of a parabolic cylinder can be checked at the level of an individual module. Once the performance of a module has been verified, the performance of a solar whole plant can be definitely predicted. For the vast plant parabolic trough, the basic unit of modularity is mounting, which consists of eight identical parabolic modules.

3.2.2 BASIC DESIGN

The basic design of a plant parabolic trough involves connecting 2, 4, 6 or 8 solar collector assemblies to form a series of "loop" or parallel loops and several are combined in the field of symmetry heat fluid solar energy transfer. Header pipes carry the heat transfer fluid (HTF) loops to and from a steam generator for a steam initiate this produce electricity. Typically, the output of a solar thermal unit parabolic trough is increased by adding more loops in parallel.

3.2.3 PREDICTABLE AND SMOOTH OUTCOMES

Parabolic solar plants also have minimum free energy inherent stroboscopic, depending on the size of the system that allows electricity production to continue just after the sun has been covered by a cloud. Depending on the size of the system, such central impulse heat can last 15 minutes or even more. This means that the electrical output of the plant can remain constant for the duration of cloud cover or as the sun sets completely; utilities giving you a long time to switch to another cover or as the sun sets completely; giving enough time to switch to other sources of standby battery time i.e. Such inherent energy storage is the result of the heat that has been collected and used in the system of heat transfer fluid. Other energy technologies that convert a renewable resource directly say electricity from wind and photovoltaic cell (PV) have a continuously down in the production of a minute to minute or even second to second on cloudy days, and this you can develop serious challenges for transmission systems. The constant output of a parabolic cylinder is an important benefit in obtaining the reliability of the power grid.

The ability to store hours of output in system dedicated thermal energy storage, as indicated by projects in Spain, allows clock generation of firm power.

3.2.4 FINANCIALLY SUITABLE

Finally, all the qualities of the system of parabolic trough make it more attractive and efficient for the banking community, which is extremely; the financial crisis worldwide. Parabolic trough CSP technology is currently only bankable technology.

3.3 EQUATIONS OF PARABOLIC TROUGH

Major equations are given below:-

$$\text{Equation } y = ax^2 \quad \text{where } a = \frac{1}{4f}$$

$$\text{Surface Area } S = \pi \frac{(D^2 a^2 + 1)^{3/2} - 1}{6a^2}$$

$$\text{Depth } d = \frac{D^2}{16f}$$

$$\text{Focal Length } f = \frac{D^2}{16d}$$

$$\text{Area of Aperture } A = \pi \left(\frac{f}{2N} \right)^2 \text{ where } N = \frac{f}{D}$$

$$\text{LengthOfParabolicSegment } L = \pi \frac{\ln \sqrt{(D^2 a^2 + 1)} + aD}{4a} + \frac{D \sqrt{(D^2 a^2 + 1)}}{4}$$

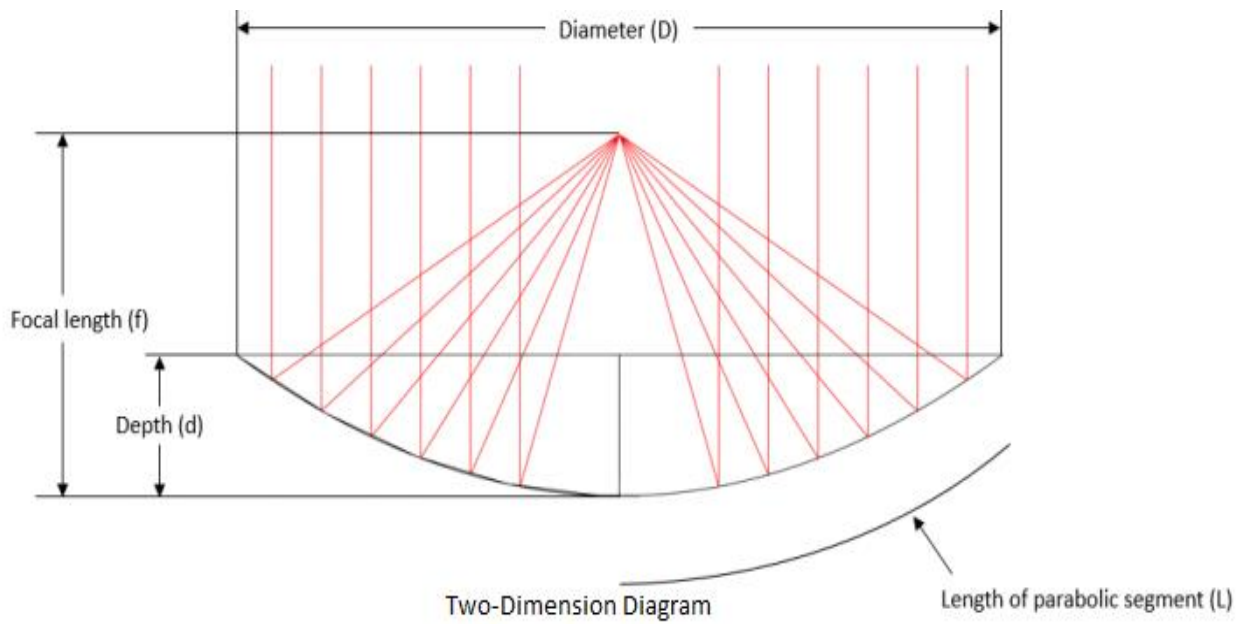


Figure 5: Parabolic Trough Diagram

CHAPTER 4: PARABOLIC TROUGH POWER PLANTS

Parabolic trough has a great potential for generating bulk amount of power in areas where sun light i.e. solar irradiance is just perfect.

4.1 POWER PLANT WORKING

Some of us do not think much about where our electricity comes from. Only that it is available and abundant. The electricity generated by burning fossil fuels like coal, oil and natural gas emits carbon dioxide, nitrogen oxides and sulfur oxides - gases scientists believe contribute to climate change. Energy (heat) Solar thermal is a renewable alternative to carbon-free energy that we produce with fossil fuels like coal and gas. Usually we generate electricity from these steps.

1: Parabolic Trough Collector

Solar radiation beams on the Parabolic Collectors which concentrate on the central receiver tube through which water is heated at very high temperature.

2: Steam Generator System

The water is pumped through the piping system to the steam generator, where it is vaporize.

3: Steam Turbine

The steam produce at high pressure is used to move the turbine.

4: Electrical Transformer

The turbine is connected to an alternator that's generates electric power.

5: Condenser

The steam realize from the turbine condenses into water that is again used in cycle.

6: Cooling Towers

They provide the cooling, needed to condense the steam turbine exhaust.

7: Heat Exchanger

When there is excess of thermal energy in the solar field, it stored. This is done by diverting some of the water to the exchange, where it comes into contact with the salts, transferring its heat to them.

4.2 TYPES OF PARABOIC TROUGH POWER PLANTS

4.2.1 HTF INDIRECT STEAM GENERATION

Indirect method of steam generation refers to the use of HTF to absorb the heat that is reflected from the parabolic trough. HTF is used instead of water. As HTF goes along the array of parabolic trough it attains high temperatures but isn't anywhere near boiling. After it attains adequate amount of heat it given two paths in first path it goes to the heat exchanger and transfers it's heat to water where water gets heated up and then afrrer passing from a steam generator the produced steam is trowed on the blades of the steam turbine which causes the blades to rotate which then eventually rotates the armature of the generator as well to generated power

4.2.2 WATER DIRECT STEAM GENERATION

4.2.2.1 ONCE THROUGH

One through is the most simplest method of all in which we use water in the receiver tubes and then allow it to heat up on the focal point of the collector. As the water goes along the array of parabolic troughs it gets heated until it becomes a steam, which is eventually used to throw in the turbine blades to create a rotational motion.

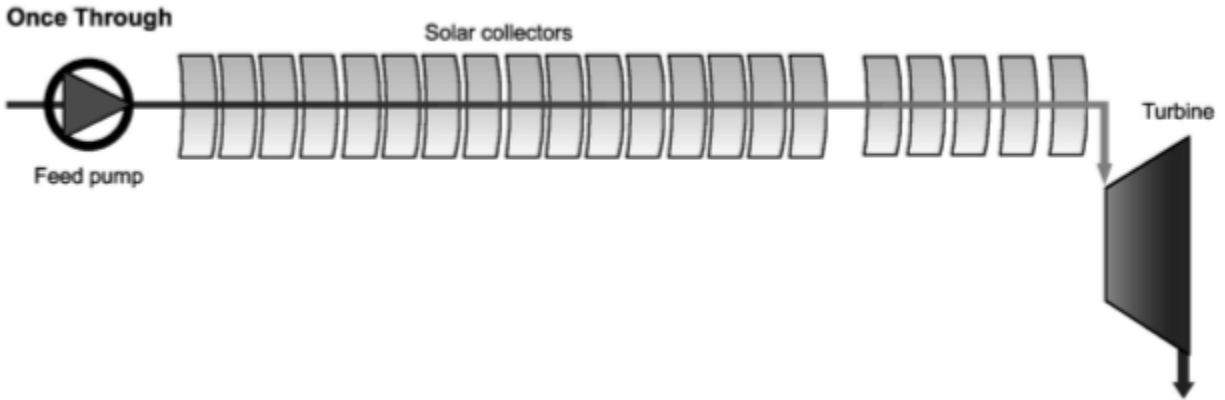


Figure 6: Once Through

4.2.2.1 INJECTION

In the injection scheme the water that has been once used to generate steam and then to rotate the turbine blades is recycled. But the steam after condensation is still hot to utilize its heat so it is injected back into the cycle but not from the beginning of the cycle but from the second half of the remaining cycle. As the water is injected from the middle so the scheme is called injection.

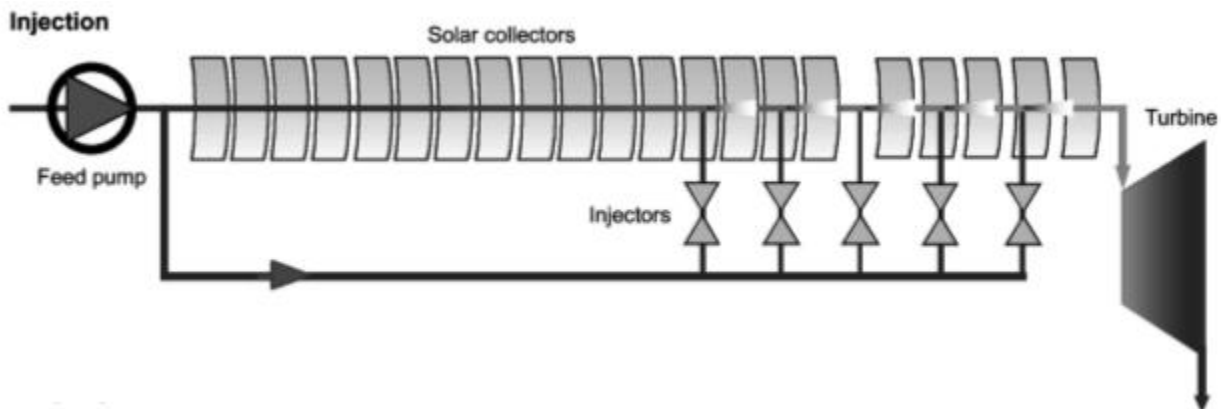


Figure 7: Injection

4.2.2.1 RECIRCULATION

Recirculation is similar to injection, the only difference is that the water once used to generate turbine is recycled from the start of the loop. This an efficient way as the water that comes after striking the fins is already hot so when this water goes through the receiver tube it converts into steam right there which keeps on rotating the turbine. Hence, we get a non stop rotation of the prime mover.

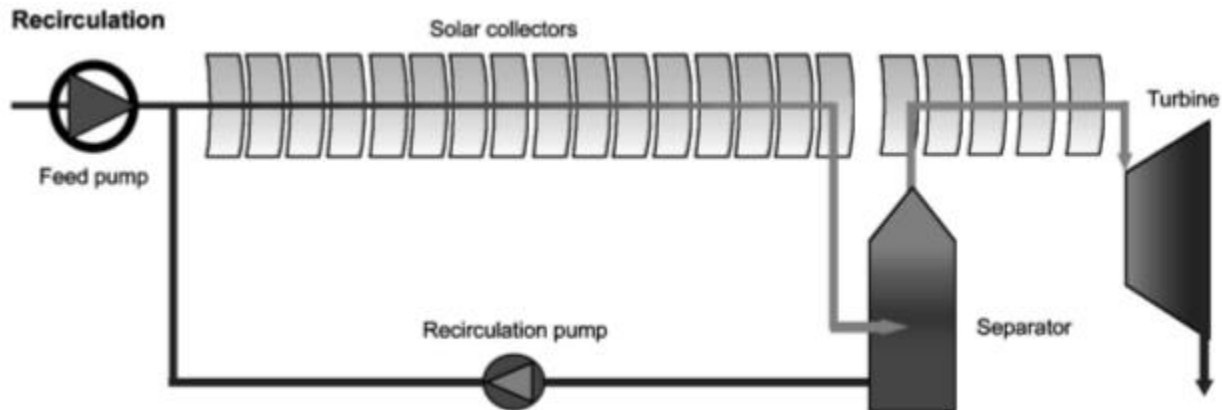


Figure 8: Recirculation

4.3 OUR TECHNIQUE

Water Tank

Water storage tank we used in our power plant is 19 liter. It is being used for the usage of water through pumping system.

Commercial Electric Pump

The steam after being converted into water is then recycled through commercial electrical pump for further use of water into the cycle.

Circular coil (pre-heater)

It's a long copper pipe about 12 ft and wound like circular coil used to pre heat the water and that pre heated water is going towards beaker for further heating.

Convex lens frame

Convex lens frame is used to vaporize the water coming from circular coil through copper piping system.

Parabolic trough

Parabolic trough is used to super heat the steam that is coming from beaker through copper pipe. And the working principle of parabolic trough is explained above. And Our calculations are written below.

Focal length= 0.22m

Surface Area= 0.4838m²

Area of Aperture= 0.4198m²
Length of Parabolic Segment= 0.403m

Pressure cooker

Pressure cooker is used to generate the pressure. Also it has pressure gauge and thermometer on it for monitoring the pressure and temperature of our super heated steam.

Steam turbine

Steam turbine is used; it is actually a DC motor having fins attached on its shaft. Superheated steam from cooker is then used to drive the turbine fins to generate electric power.

Euler's Turbine Equation:

Q = Fluid flow rate

ρ = Fluid intensity

q = Fluid velocity

β = Incidence angle

V = Tangential fluid velocity

$V = q \cos(\beta)$

r = Turbine radius

ω = Turbine rotational speed

T = Torque

P = Power output

Torque $T = \rho Q(r \text{ in. } V \text{ in} - r \text{ out. } V \text{ out})$

Power $P = \omega \rho Q(r \text{ in. } q \text{ in. } \cos \beta \text{ in} - r \text{ out. } q \text{ out. } \cos \beta \text{ out})$

4.3.1 LIST OF MAJOR COMPONENTS

The list of major components is mentioned below:-

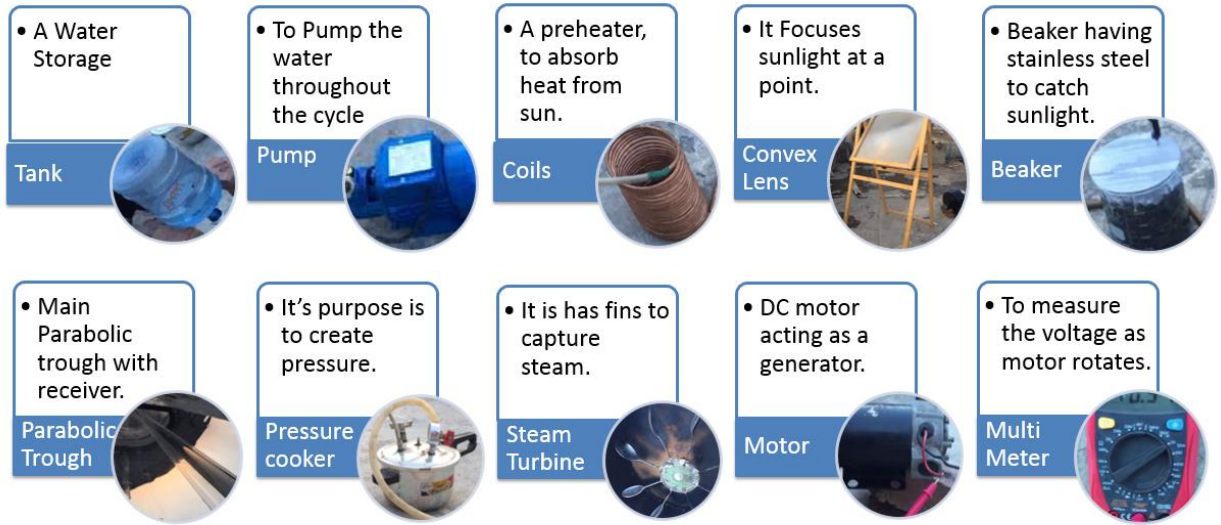


Figure 9: List Of Components

4.3.2 COMPLETE PICTURE

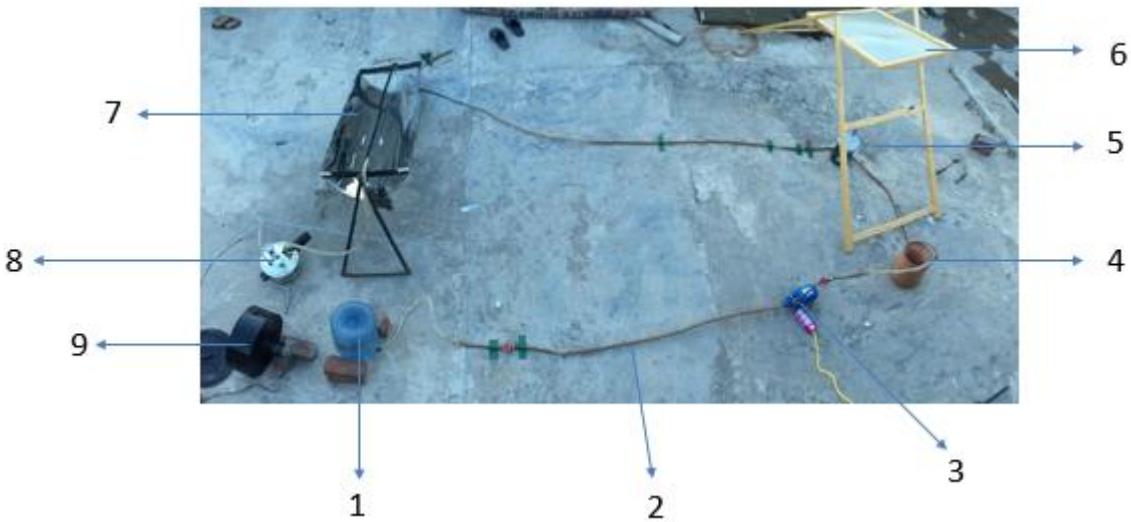


Figure 10: Complete Diagram

1. Water Tank
2. Copper pipes
3. Pump
4. Pre Heater
5. Beaker as boiler
6. Convex lens
7. Parabolic Trough
8. Pressure Cooker
9. Steam Turbine

4.3.3 CONVEX LENS FRAME AND LENS EQUATION

Convex lens that is used was framed in wooden frame for the ease to use and perfection of focal point,

Lens Equation indicates the relationship between object distance (d_o), image distance (d_i), and focal length (f). The equation is as follows:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

The magnification equation relates the ratio of the image distance and object distance to the ratio of image height (h_i) and object height (h_o). The magnification equation is stated as follows:

$$M = \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

These two equations can be merged to provide knowledge about the image distance and image height if the object distance, object height, and focal length are known.

Figure



Figure 11: Convex Lens

CHAPTER 5: MARKET RATES AND AREA OF POWER PLANTS

5.1 MARKET RATE

We have surveyed the market in order to make the Parabola Trough for our final year project. We have several ways to make a Parabola Trough. We can make a Parabola Trough with Iron stand and stainless sheet which is used to focus the sunlight from the Sun onto the receiver tube. Another possibility is that we make a Parabola Trough with a wooden stand and stainless steel. We have find out the prices of both these possibilities which are mentioned below. The prices which are given below are not from only a particular place, infect it is the resultant average of prices that we have found out from different places, shops and markets.

Stainless Steel: 10,000

Iron Stand: 15,000

Wooden Stand: 7,000

Parabola Trough (stainless steel with iron stand): 25,000

Parabola Trough (stainless steel with wooden stand): 22,000

We have also visited the online market to find out our project's component. While visiting online market we find out a website called Alibaba.com and then searched it. We have investigated the components of our project and then contact with the dealers to discover their prices and also track the procedure that how we can buy them online. The details of the component's prices along with proof, in the form of picture, individually mentioned beneath.

5.1.1 COLLECTOR

We visited online market and find out different companies which can supply us the components of our final year project. For further process we contacted a company and tell them about our needs. We demand collectors and also asked the prices of these collector from them. They inform us that they have a set of collectors in which three collectors are together and their combined area is twenty three meter square and their price is six thousand four hundred and eighty US dollars. That means if we use a set of three collectors then it costs us 6480 US dollars and if we use a single collector in our experiment then is costs us 2160 US dollars and its area will be eight meter square. The further detail of price is given below.

Set of Collectors (23 meters square): 6,480,00pkr

Single Collector (8 meters square): 2,160,00pkr

5.1.2 RECEIVER TUBE

Receiver is the component of our project that receives concentrated heat from collector. We continued our online research and catch another website named as Shandong Beaconergy Associated Equipment Corps.Ltd. We contact this company to find out our receiver and its price as well. We have come to know that the receiver price is one hundred and ten US dollars and its length will be 2060mm. The delivery of receiver will be within seven to fifteen working days. The further detail along with proof is given beneath.

Receiver (2060mm): 1,100,00pkr

5.2 AREA OF PARABOLIC TROUGH POWER PLANT

The area of the parabolic trough is which we are using is 1.1972 meter square that is length of parabola is 1.64 meter and diameter is 0.73 meter. According to this area which is declared above it will be able to generate 60 watt. If we use two Parabolic Troughs or doubled the length and diameter of Parabolic Trough then area will be 4.7888 meter squares. The Parabolic Trough with an area of 4.7888 meter squares will be able to generate 240 watt. Similarly for three parameters and so on are described in the following table.

If we use double parameters or two Parabolic Troughs combined together then we generate 1000 watts by using 4.1667 doubled parameters connected together. If we collectively used 6.25 modules with double Parameter then it will be able to generate 1500 watts. Similarly if we want to generate 5000 watts then we have to use 21 doubled parameter modules combined together.

CHAPTER 6: SIMULATION ON POLYSUN

It gives the results in such a way that you tell the temperature that is required and it will design and tell you the area required by the solar water heating units to achieve that temperature.

Wizard: Project

Project Template Hot water Solar Heat generator

New project
Polysun is creating a new project. Define a new name and location for the project.

Project

Project name: Solar Thermal FYP

Comments

Location selection

From database From map

Location

Latitude: 47.23

Longitude: 8.82

Elevation: 417

Location name: Rapperswil SG

Map: Open map

polysun[®]
SIMULATION
SOFTWARE

Back Continue Accept Cancel

Figure 12: Polysun Screenshot

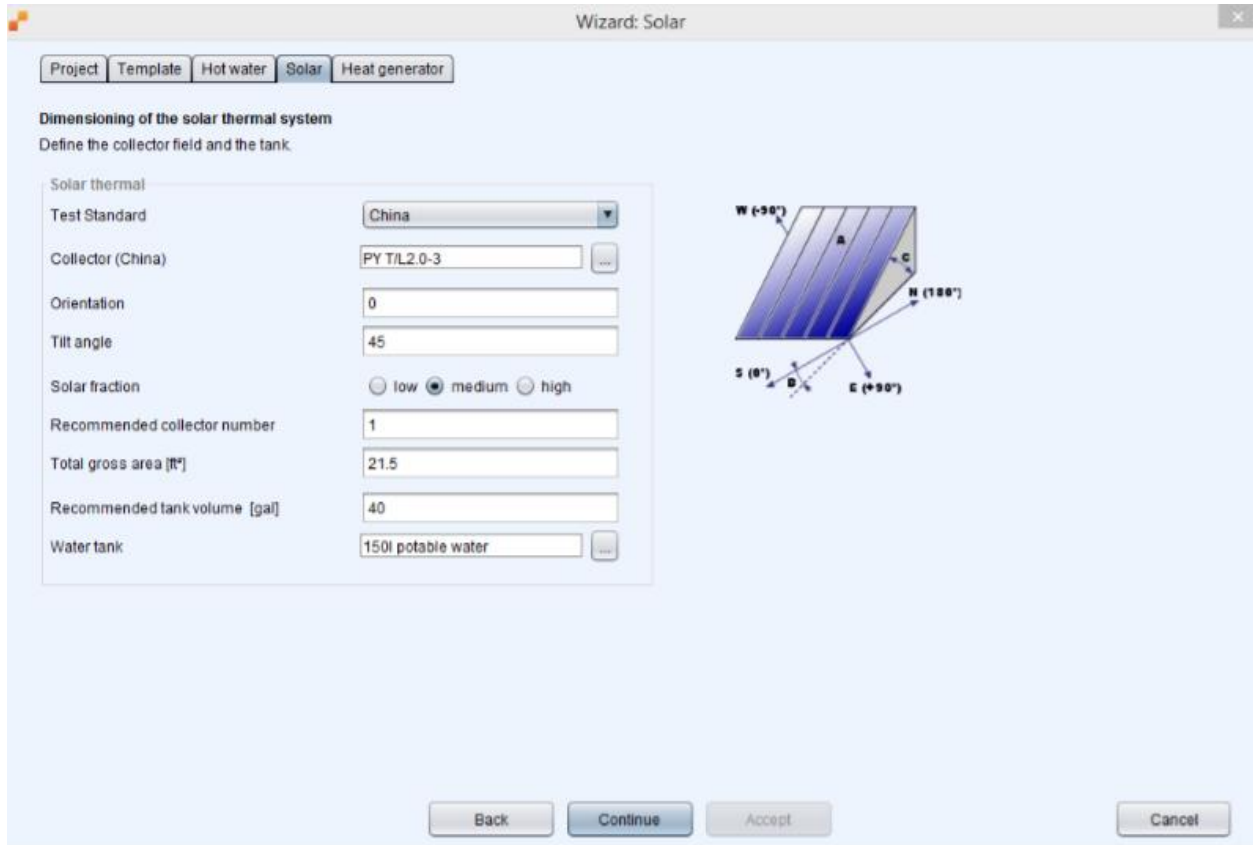


Figure 13: Polysun Setting

6.1 SIMULATION RESULTS

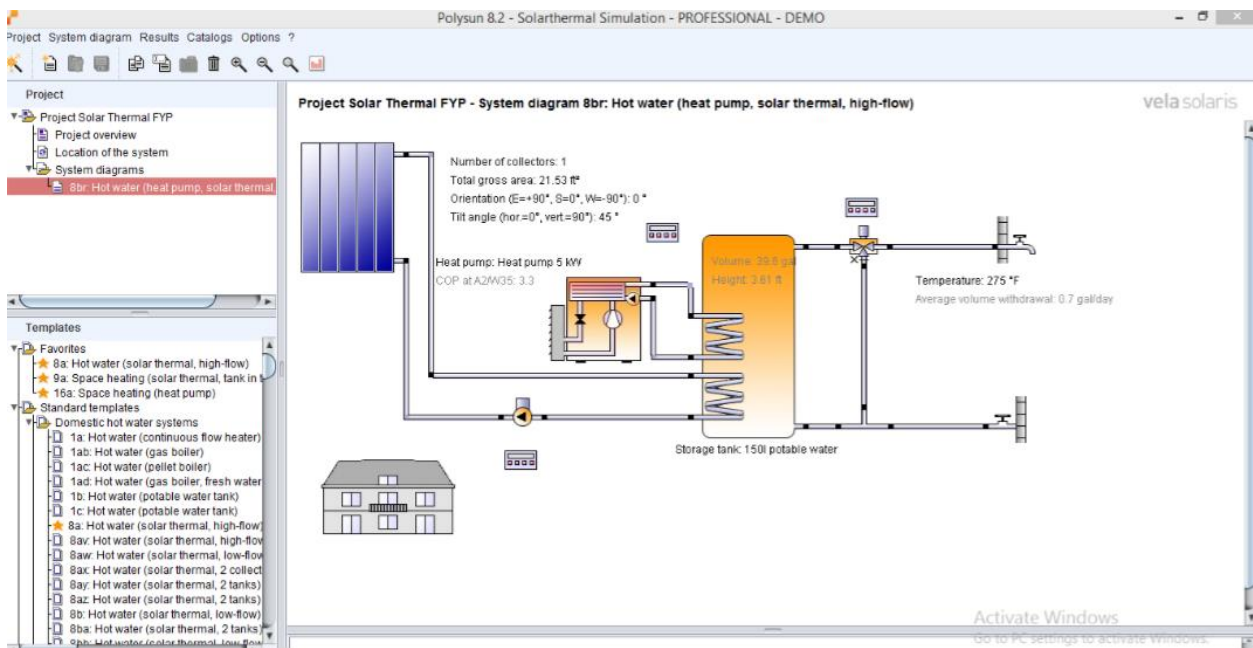


Figure 14: Polysun Results

6.3 STEAM TURBINE RESULTS

Using a steam turbine calculator we can have the following results:-

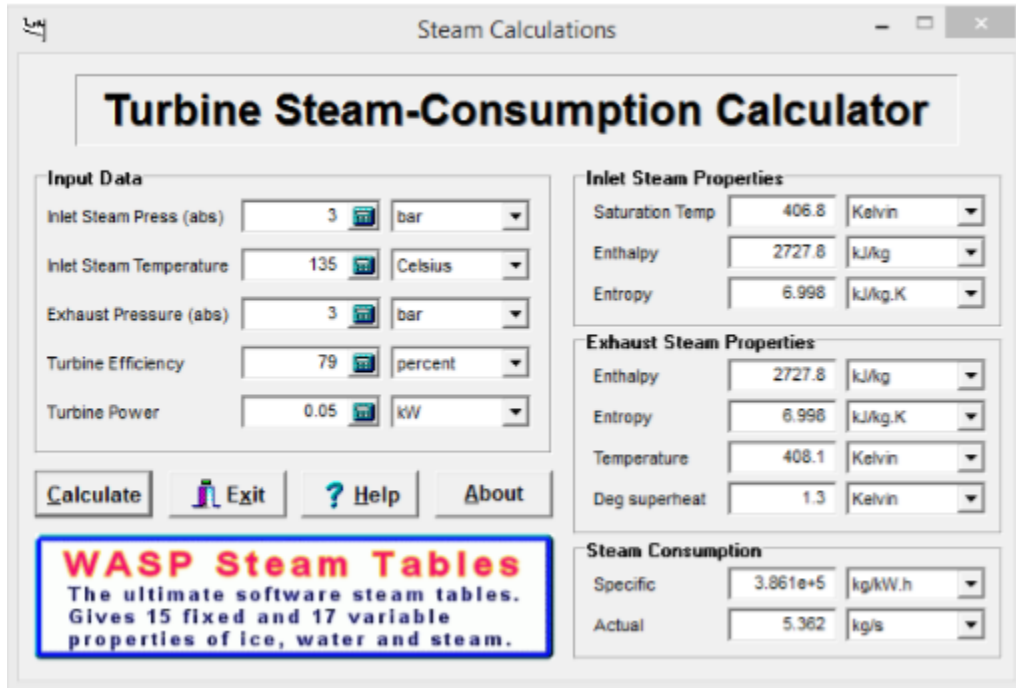


Figure 15: Turbine Results

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