ANJUMAN – I – ISLAM'S
KALSEKAR TECHNICAL CAMPUS,
NEW PANVEL

A Report On

''ELECTRIFICATION USING CONCENTRATED MINI SOLAR THERMAL POWER GENERATION''

DEPARTMENT OF ELECTRICAL ENGINEERING

UNDER GUIDENCE OF

PROF. SAYED KALEEM

2020-2021

AFFILIATED TO

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A PROJECT REPORT

ON

ELECTRIFICATION USING CONCENTRATED MINI SOLAR THERMAL POWER GENERATION

SUBMITTED IN PARTIAL FULLFILMENT OF REQUIREMENTS

FOR AWARD OF

BACHELOR'S DEGREE IN

ELECTRICAL ENGINNERING

BY

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UNDER GUIDENCE OF

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ANJUMAN - I – ISLAM'S

KALSEKAR TECHNICAL CAMPUS

NEW PANVEL

ELECTRICAL ENGINEERING (2020-2021)

CERTIFICATE

This is to certify that the project entitled

"ELECTRIFICATION USING CONCENTRATED MINI SOLAR THERMAL POWER GENERATION "

Submitted By

This is to certify that **ANIKET WADKAR- 18DEE30, RAVINDRA PATIL – 18DEE21, RAJ KHANVILKAR - 18DEE14, PALLAVI UTEKAR - 18DEE29, SHAIKH SAJJAD AHMED – 15DEE26** of 8th Semester Bachelor Degree in Electrical Engineering (Full time) have satisfactory completed their work in course of PROJECT & SEMINAR on topic of **"ELECTRIFICATION USING CONCENTREATED MINI SOLAR THERMAL POWER GENERATION"** during the academic year 2020-21

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ABSTRACT

The development of solar thermal power generation has been implemented in various places in India. Activities are proposed on research, design and development in the area of solar thermal energy with a view to lead deployment and commercialization of technologies for power generation. We surveyed about India and to know that even today many area are not electrified of some states. And in Maharashtra there are some pockets were still electricity is not been reach effectively. There are 88 remote villages are still not electrified. And in Maharashtra we located a village named as Goradi which is located in district of Nandurbar. So we surveyed Goradi village and we came to know about the Geographical condition, Location, Land, etc of the area. And we came to know that this place is suitable to setup a solar thermal plant. So we collected information about concentrated solar thermal and we and our guide thought that this project can be made for the social awareness. And then we studied about this project's equipment, calculations, future scopes, drawbacks, applications. Then we made Mini Solar Thermal Power Plant with help of a video, reference books and previous surveys . And for the solar thermal energy consumption we replicated the Goradi village to make a model. We have prepared the model of Actual Village in which we have shown towers, poles, transformers and houses. And we want to show how solar thermal energy is suitable to generate and transmit energy to a non electrified village.

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CHAPTER NO: 01

INTRODUCTION

The need of ELECTRICITY in our day to day life is very essential .we are now dependent on electricity for everything , it has became one of the basic priority of a human being after food , clothing and shelter . A developing nation like INDIA has to have a proper and stable electric supply . Electricity can be considered the most important factor which effects the growth , welfare , lifestyle and development of a society .

As we know INDIA is a developing nation so there should be abundant supply available all over the county. But still there are some areas in INDIA where electricity is not available and development of such parts of country has stopped.. Electrification of such areas is to be done .it can be done by many means

1) We can lay transmission line to such areas from the nearest power plant
2) We can make the area adequate for stand alone power generation

It is uneconomical to lay new transmission line for a long distance and maintenance of that line is also very difficult due to jungle and hills and valleys coming in between the transmission line . The cost of this is very high as compared to the stand alone generation method .

We can use natural \renewable source for electrification of that specif area and it is more economical then first method.not only with the economical factor but seeing the present situation we shall prefer non-conventional sources for production of electrical energy .and not only solar thermal generation we can use biomass , biogas , wind to generate electricity

1) PROBLEMS AND THEIR SOLUTIONS & NEED OF ELECTRIFICATION IN INDIA.

Rural electrification is the process of bringing electrical power to rural and remote areas.

Electricity is used not only for lighting and household purposes, but it also allows for mechanization of many farming operations, such as well-pumping, threshing, milking, and hoisting grain for storage. In areas facing labour shortages, this allows for greater productivity at reduced cost. One famous program was the New Deal's Rural Electrification Administration in the United States, which pioneered many of the schemes still practiced in other countries.

At least a billion people worldwide still lack household electric power - a population equal to that of the entire world in the early 19th century.

As of the mid 2010s an estimated 200 to 300 million people in INDIA.

As many as 73% of the 18,452 villages that the government identified for electrification in 2016 now have power supply, but only 8% of these villages had all their households electrified, according to the government’s own data.

As of May 25, 2017, 13,523 villages have been electrified, but 100% household connectivity has been achieved in only 1,089 villages, according to data in the power ministry’s Grameen Vidyutikaran (GARV) dashboard.

Besides, 25% (45 million) of rural households across the country still have no electricity. In Uttar Pradesh, Nagaland, Jharkhand and Bihar, fewer than 50% of rural households have electricity, three years after the goverment was sworn in at the Centre having promised “electricity for all”.

“Two challenges to electrifying households are: One, many poor households cannot afford to pay the upfront cost of connection, which ranges from Rs 2,000-3,000 depending on the state, And second, even if they get connections, the supply is far from reliable; so there is no incentive for rural households above the poverty line.”

one National Grid with an installed capacity of 382.15 GW as on 31 march 2021. Renewable power plants constituted 17.3% of total installed capacity.

Draft National Electricity Plan, 2016 prepared by the Government of India states that India does not need additional non-renewable power plants till 2027 with the commissioning of 50,025 MW coal based power plants under construction and additional 100,000 MW renewable power capacity. The improvements in solar thermal storage power technology in recent years has made non-polluting and cheaper solar power plants undisputed choice to replace all fossil fuel fired power generation

2) PROBLEMS AND THEIR SOLUTIONS & NEED OF ELECTRIFICATION IN MAHARASHTRA

In 2003, MSEB had projected that in 2013, Maharashtra would have a demand of 24,000 MW. They had also projected that Maharashtra would generate 30,000 MW and would therefore be 6,000 MW in surplus. The actual situation in 2013 turned out to be vastly different; Maharashtra had a demand of around 18,000 MW while the generation was only around 15,000 MW, which meant that the state had a deficit of about 3,000 MW. The situation isn't a whole lot different a couple of years later in 2015.

The generation capacity has not grown as expected and is only half of the projected capacity. That is obviously a cause for concern. But the demand is much less than predicted and that is more disturbing and disheartening because it means that the existing industries didn't grow as expected and the number of new industries that came to Maharashtra wasn't anywhere near the expectations; on the contrary, Maharashtra has lost many industries to Gujarat and Karnataka. The gradual growth in demand correlates strongly with the gradual growth in the population rather than a sharp growth in industrial consumption.

A) PRESENT SUITATION

Even in today's day and age, there are around 1.5 crore people in Maharashtra who don't have access to electricity living under load shading. That's almost 10% of Maharashtra's population! While most of these people are in the rural areas, some of them are not more than 20 kms from Mumbai, the financial capital of India! Unbelievable but true.

If you accept that all these people should have access to electricity, then the actual deficits are much higher.

- All the renewable energy companies are finding the going very tough.Most of the action in the renewable energy space in Maharashtra has been in the area of wind energy. But the rates for wind energy have plummeted.
- O MSEB has to buy the energy produced by the wind energy companies but they don't like to do that since most of it is generated during the night, when there isn't much demand.
- O Solar PV has the potential to take care of the daytime consumption of industrial and commercial consumers but nothing much is happening on that front barring a few big projects that have been commissioned.

B) State is in a financial mess

- Maharashtra state is in a big financial mess as well; the outstanding debt of the State is supposedly close to Rs.5 lakh crores! And therefore, out of every Rupee that the State earns, only 14 paisa is available for development projects. This is a sad state of affairs and something that constrains the present government severely in developing the electricity sector. Therefore, it is a big problem

C) Renewable energy sources have to be adopted but they are more expensive

- Climate change is a reality that cannot be ignored anymore. And why is it happening? Because of the burning of fossil fuels combined with the fact that forest covers are getting depleted more and more with every passing day. As simple as that. But while there's no doubt whatsoever that our present way of life is responsible for the present situation,

can we change it completely starting today? Can we make a U-turn? Is switching off (lights, mobiles, computers, motors, pumps) the solution? I don't think so.

Fortunately, we don't have to switch off because there are plenty of renewable energy sources that we can tap and stay on the path that we are on. Sustainable development isn't just a pipe dream; it can very much become a reality. However, renewable energy sources are more expensive than conventional energy sources, and cannot be adopted unless the electricity sector is healthy. The whole premise of RPO is that a part of the energy generated by obligated entities – and all discoms including MSEDCL are obligated entities – should come from renewable energy sources.

CHAPTER NO: 02

SURVEY

Household electrification status as on December 10, 2018

State	Total Households	Electrified Households as on 10th Oct,2017	% of Un-electrified HHs as on 10th Oct,2017	Household Electrified w.e.f 11th Oct,2017	% of Balance Un-electrified HHs as on 10th Dec, 2018	HH Electrification as on 10th Dec, 2018 (%)
Kerala	9813032	9813032	0%	0	0%	100
Goa	128208	128208	0%	0	0%	100
Punjab	3689970	3689584	0%	386	0%	100
Tamil Nadu	10285848	10283678	0%	2170	0%	100
Gujarat	11414532	11373215	0%	41317	0%	100
Himachal Pradesh	1855651	1842778	1%	12866	0%	100
Puducherry	95616	94704	1%	912	0%	100
Andhra Pradesh	11427855	11281072	1%	146783	0%	100
Haryana	3467290	3415291	1%	51999	0%	100
Maharashtra	24292265	23303595	4%	986168	0%	99.99
Karnataka	10239824	9784868	4%	254485	2%	98.04
West Bengal	15057882	14325592	5%	732290	0%	100
Telangana	6522278	6084656	7%	437622	0%	100
Uttarakhand	2047937	1844305	10%	203632	0%	100
Mizoram	241712	213909	12%	27803	0%	100
Sikkim	95613	83868	12%	4913	7%	92.85
Chhattisgarh	5664705	4955330	13%	664543	1%	99.21
Jammu & Kashmir	2439547	2072861	15%	366686	0%	100
Madhya Pradesh	12621007	10636743	16%	1984264	0%	100
Rajasthan	12947931	10859210	16%	1517356	4%	95.59
Arunachal Pradesh	306969	255185	17%	6618	15%	85.29
Tripura	788800	652463	17%	136337	0%	100
Manipur	453112	349347	23%	101350	1%	99.47
Bihar	13973122	10714081	23%	3259041	0%	100
Odisha	9600149	7212901	25%	2124607	3%	97.26
Jharkhand	6606871	4892589	26%	1197690	8%	92.18
Assam	6551345	4687929	28%	1029507	13%	87.27
Meghalaya	620753	435963	30%	50845	22%	78.42
Nagaland	434765	302267	30%	79766	12%	87.87
Uttar Pradesh	33151353	21205726	36%	6410433	17%	83.3
Total	**216835942**	**186794950**		**2,18,32,389**		

The 10 States/UTs with the highest number of un-electrified villages as on 10-12-2018 were: Rajasthan, Odisha, Jharkhand, Arunachal Pradesh, Uttar Pradesh, Meghalaya, Assam and Chhattisgarh, Nagaland, Sikkim.

Maharashtra is one of the states where most of the villages have power supply. However, there are about 88 villages which have still not been electrified as they are very remote. Most of these villages are located in Gadchiroli and Nandurbar districts.

In Nandurbar District out of total 930 nos Villages & 2991 Wadipada/Habitations, 869 nos of Villages & 2256 Nos of Wadipadas are electrified, balance 61 Nos of Villages & 735 Nos Wadipada are partially electrified. In DPDC TSP 2017-18 scheme 8 Nos of villages proposed for electrification, balance 9 Nos villages proposed in DPDC 2018-19 by conventional method, remaining 44 villages and 735 wadipada electrification proposed in MEDA (Maharashtra Energy Devlopment Agency) Nashik by non conventional method (Solar Electrification). These villages and wadipadas are scattered hamlets with meager (less) population in hilly and difficult terrain. The transport/ road facility for heavy Pole & other Material is not available and under partial submergence of back water of Sardar Sarovar Dam project and uneconomical as cost concern to electrify by conventional method. Hence these villages proposed electrification is being done by non conventional method.

We have particularly picked a village called Goradi from the district Nandurbar. And found its following information which has helped us understanding the present situation of that area and it made us easy to find various ways to electrify the area using solar thermal power generation plant.

2.1) LOCATION

Nandurbar Maharashtra 425412

Location and Geographical Units:

The newly formed Nandurbar district is located in the Northern part of Maharashtra state, lies between 21.00 to 22.03 degree North latitude and 73.31 to 74.32 degree Eastern longitude. The district comprises of 6 tehsils namely Nandurbar, Navapur,Akkalkuva, Shahada, Taloda and Akrani. Under the NandurbarZillaParishad jurisdiction, 956 villages are covered through 6 panchayat Samities and 501 Gram Panchayats. The variation in relief ranges from the pinnacles and high plateaus of main Satpuda range having height over 3000 feet above mean sea level to the subdued basin of the Nira river in Phaltantahasils with the average height of about 1000 feet above mean sea level. The climate of the district is hot and dry having average annual rainfall of 872 mm.

2.2) AREA

Land utilization in Nandurbar District as compared to Maharashtra state.

1) Geographical Area 3075800 cm^2
2) Area Under Forests 52100 cm^2
3) 3) Land not available for cultivation
   a) Barren &Uncultivation 172800 cm^2
   b) Land put to non-agric. Use 145000 cm^2
4) Other Uncultivated land
   a) Cultivable waste land
   b) Permanent pastures and grazing lands 241300 cm^2
5) Current fallows 137800 cm^2
6) Other fallows 119200 cm^2
7) Net area sown 1738600 cm^2
8) Area sown more than once 572000 cm^2
9) Gross cropped area 2310600 cm^2
10) Cropping Intensity 127 cm^2

Source - Economic survey of Maharashtra (As per latest records), GOM.P.T 20

2.3) CULTIVATION:

- Main Crops Jawar, Wheat, Rice, Toor, Groundnuts, Chilly.
- Annual Crops Sugarcane, Cotton
- Area Under Cultivation: 2,53,413
- Crop Pattern Kharif (approx. 800 villages), Rabi (approx. 130 villages)
- Fruits: Mango, Sitaphal, Banana, Papaya, etc.

Farm of Sugarcane in Nandurbar

Kharifjawar, cotton, Bajara, kharif paddy are the main crops. Whereas tur, green gram, black gram, sunflower and groundnut are second important crops. Maize and Soyabean is fastemerging crop of the district. In rabbi season rabbi Jawar, wheat and gram are predominant crops. Groundnut, Bajara and sunflower are taken in summer season.

2.4) DEMOGRAPHIC PROFILE: As per the Census 2011, the total population of the Nandurbar district was 16.48 lakh with a population density of 327 per square kilometer. Out of the total population, 13.72 lakh reside in rural areas while 2.75 lakh are in urban areas. This indicates that 84 percent of Nandurbar's population is rural. The ratio of female population per thousand of male was 978. Out of the total population, 2.91 percent belong to SC and 69.28 percent to ST communities. The district has low literacy level of 64.38 percent, 59.75 percent in rural areas and 86.60 percent in urban areas.

2.5) EMPLOYMENT GENERATION: Because of inadequate developmental activities in the district and greater scope for employment in the industrialized Surat town of bordering Gujarat state a trend of migration of labours for work is of typical nature found in the district. They are not permanent migrants.

2.6) SOCIAL AND ECONOMICAL STATUS :- The total population of Nandurbar District is 16,48,295 of which nearly 69 percent population belongs to tribal community .The major occupation of tribal community is Agriculture. The land holding of this community is very small and C-DAP Nandurbar: the economic condition of most of the rural triable community is said to be poor.One of the pecularity of this community is that they have strong social beliefs for their customs and traditions.Most of the population of Nandurbar District is illiterate and living in the remote areas. So the agricultural extension worker faces the problem in disseminating Agriculture technology know how.

CHAPTER NO: 03

PROTOTYPE

The Concentrated solar thermal Power plant produces electricity from the heat from sun's rays. It's an effective source of large-scale energy production.

Firstly a solar farm is made up of heliostats. These are computer controlled mirrors which follow the movement of the sun in order to best reflect its rays towards a central point throughout the day. A solar farm can include from several hundred to several thousand heliostats which communicate with each other over Wifi in order to optimize their yield.

These heliostats reflect and concentrate sunlight onto a large heat exchanger called receiver that sits on top of a tower which located in the center of the solar farm. Within the receiver, fluid flows through the piping that forms the external walls. This fluid absorbs the heat from the concentrated sunlight.

There are many types of solar thermal power plants as given below

1) PARABOLIC TROUGH COLLECTOR

A parabolic trough is a type of solar thermal collector that is straight in one dimension and curved as a parabola in the other two, lined with a polished metal mirror. The energy of 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. For example, food may be placed at the focal line of a trough, which causes the food to be cooked when the trough is aimed so the Sun is in its plane of symmetry. Further information on the use of parabolic troughs for cooking can be found in the article about solar cookers.

2) LINER FRENSEL COLLECTOR

A compact linear Fresnel reflector (CLFR) – also referred to as a concentrating linear Fresnel reflector – is a specific type of linear Fresnel reflector (LFR) technology. Linear Fresnel reflectors use long, thin segments of mirrors to focus sunlight onto a fixed absorber located at a common focal point of the reflectors. These mirrors are capable of concentrating the sun's energy to approximately 30 times its normal intensity. This concentrated energy is transferred through the absorber into some thermal fluid (this is typically oil capable of maintaining liquid state at very high temperatures). The fluid then goes through a heat exchanger to power a steam generator. As opposed to traditional LFR's, the CLFR utilizes multiple absorbers within the vicinity of the mirrors.

3) SOLAR TOWER COLLECTOR

The solar power tower, also known as 'central tower' power plants or 'heliostat' power plants or power towers, is a type of solar furnace using a tower to receive the focused sunlight. It uses an array of flat, movable mirrors (called heliostats) to focus the sun's rays upon a collector tower (the target). Concentrated solar thermal is seen as one viable solution for renewable, pollution-free energy

4) STIRLING DISH COLLECTOR

CSP-Stir-ling is known to have the highest efficiency of all solar technologies (around 30%, compared to solar photo-voltaic' s approximately 15%), and is predicted to be able to produce the cheapest energy among all renewable energy sources in high-scale production and hot areas, semi-deserts, etc

All this collectors work on same principle and they are used according to desired conditions and applications.

We decided to make a mini solar power tower because of

1) Greater efficiency

2) Power generated is huge

3) As we wanted explain electrification of an village this plant is better than other as we have a large area to setup the plant and we get a maximum output to feed the village

4) Maintenance of this plant is low

5) As this plant is using solar radiations , it is eco-friendly and does not require fuel.

Consumption Model

For our concentrated solar thermal mini power plant. We make consumption model.

- **Transmission line tower:** They are used in high-voltage AC and DC systems, and come in a wide variety of shapes and sizes. Typical height ranges from 15 to 55 m (49 to 180 ft.), though the tallest are the 370 m (1,214 ft.) towers of a

  2,700 m (8,858 ft.) In addition to steel, other materials may be used, including concrete and wood. We are make small model of Tower showing in picture. The Area of the tower are 9.5cm$^{2.}$
- **Insulators:** An **electrical insulator** is a material whose internal electric charges do not flow freely; very little electric current will flow through it under the influence of an electric field. This contrasts with other materials, semiconductors and conductors, which conduct electric current more easily. The property that distinguishes an insulator is its resistivity; insulators have higher resistivity than semiconductors or conductors .The term insulator is also used more specifically to refer to insulating supports used to attach electric power distribution or transmission lines to utility poles and transmission towers. They support the weight of the suspended wires without allowing the current to flow through the tower to ground.

- **Transformer box**: A **distribution transformer** or **service transformer** is a transformer that provides the final voltage transformation in the electric power distribution system, stepping down the voltage used in the distribution lines to the level used by the customer.

  Distribution transformers normally have ratings less than 200 kVA, although some national standards can allow for units up to 5000 kVA to be described as distribution transformers. Since distribution transformers are energized for 24 hours a day (even when they don't carry any load), reducing iron losses has an important role in their design. As they usually don't operate at full load, they are designed to have maximum efficiency at lower loads. To have a better efficiency, voltage regulation in these transformers should be kept to a minimum. Hence they are designed to have small leakage reactance.

- **Poles:** A **utility pole** is a column or post used to support overhead power lines and various other public utilities, such as electrical cable, fiber optic cable, and related equipment such as transformers and street lights. Electrical wires and cables are routed overhead on utility poles as an inexpensive way to keep them insulated from the ground and out of the way of people and vehicles. Utility poles can be made of

  wood, metal, concrete, or composites like fiberglass. They are used for two different types of power lines; sub-transmission lines which carry higher voltage power between substations, and distribution lines which distribute lower voltage power to customers. Utility poles are commonly used to carry two types of electric power lines: distribution lines (or "feeders") and Sub-transmission lines. Distribution lines carry power from local substations to customers. They generally carry voltages from 4.6 to 33 kilovolts (kV) for distances up to 30 miles, and include transformers to step the voltage down from the primary voltage to the lower secondary voltage used by the customer. A service drop carries this lower voltage to the customer's premises.

WORKING

Solar thermal power generating plant is a very simple power plant. In this power plant we use solar radiation to produce electrical energy.

First sun rays fall on the reflectors which are placed on heliostats and the heliostats can be moved according to incident angle and focusing required. This radiations are then made to incident on collector/solar power tower where the heating medium like molten salt and therminol oil are passed through some ducts which are heated by the solar radiations due to the passing of this heating elements through the ducts the heating medium gets heated and temperature of it rises.

The heated element is then stored in thermal insulated storage where the heated element remains at a high temperature for a long time this storage provide us the flexibility to produce electricity whenever we require.

Then the heating element is passed to boiler where due to the high temperature of the heating elements water is converted to steam this steam is than pressurized and allowed to pass through a steam turbine where the steam turbine is placed on a shaft.

The shaft which is rotated due steam turbines momentum is coupled to an alternator which gives us electrical output.

Which is then step up and transmitted to fulfill the load demand.

CHAPTER NO: 04

ACTUAL SETUP

A 2.75 MW of Solar tower power plant has been installed by **ACME** in **Bikaner, Rajasthan.** The turbine pressure and temperature are 60 bar at 440°**C**. World largest heliostat with an area of 150 m^2 has been installed at Gurgaon with an aim to set up 1 MW^{th} CSP Central Tower Pilot Facility in India.

- The main objective of this power plant is to

(i) Development of optimized design of the heliostat field, volumetric air receiver and thermal storage, the three major components of a Concentrated Solar Power (CSP) Central Receiver plant and

(ii) Development of local sources for all the key components of the plant with a focus on lowering costs, which will make the technology competitive with other forms of energy.

(iii) Solar thermal electric energy generation concentrates the light from the sun to create heat, and that heat is used to run a heat engine, which turns a generator to make electricity. The working fluid that is heated by the concentrated sunlight can be a liquid or a gas. A heat-transfer fluid is heated and circulated in the receiver and used to produce steam. The steam is converted into mechanical energy in a turbine, which powers a generator to produce electricity.

A concentrating solar power (CSP) project, with data organized by background, participants, and power plant configuration.

4.1) Background:

Technology:	Power tower
Status:	Operational
Country:	India
City:	Bikaner

Region:	Rajasthan
Lat/Long Location:	28°11′ 2.0″ North, 73°14′ 26.0″ East
Land Area:	12 acres
Contact(s):	Solar PACES
Start Production:	April 2011

4.2) Plant Configuration

Solar Field

Heliostat Solar-Field Aperture Area:	16,222 m²
# of Heliostats:	14,280
Heliostat Aperture Area:	1.136 m²
Heliostat Manufacturer:	eSolar
Tower Height:	46 m
Receiver Manufacturer:	Victory Energy
Heat-Transfer Fluid Type:	Water/Steam
Receiver Inlet Temp:	218C

4.3) Power Block

Turbine Capacity (Gross):	2.5 MW
Turbine Capacity (Net):	2.5 MW
Turbine Manufacturer:	Max Watt
Output Type:	Steam Rankine
Power Cycle Pressure:	60.0 bar
Cooling Method:	Wet cooling
Cooling Method Description:	Cooling Towers

4.4)Thermal Storage

Storage Type: None

"Project developers want Rajasthan to rationalize its transmission charges which is as high as Rs.159.48/kW per month and losses of 4.2% even as solar plants use the transmission system only for part of the day resulting in total impact of about Rs1.5 - 2 per unit," said developer preferring anonymity. This utility was constructed using 87000 Canadian Solar CS6X-P modules.

ACME'S first 2.5 MW Solar Thermal Power Plant with eSolar, USA, has been commissioned which will be scaled up to 10MW at Bikaner, Rajasthan.

CHAPTER NO: 05

CALCULATIONS

1) Calculation of consumed power with proportion to generated power

We here are taking an example of a solar power tower CSP plant which is in INDIA .

Name: acme solar thermal tower

Location: Bikaner, Rajasthan .

Generating capacity: 2.5 MW.

If we want to electrify a village where there are mainly domestic consumers and some commercial consumers then a small power plant of less than 1MW is sufficient to provide the electricity.

If we consider a normal house hold consumption then it may be as follows

1) Tubelight : 60 watts
2) Incandescent lamp : 40 watts
3) Ceeling fan : 60 watts
4) Agricultural use : 200 watts (approx.)
5) Other house hold use : 70 watts

So if we consider that we wnt to electrify a village having consumers from 80 to 100 so ;

1) Total consumption of each house : 430 watts
2) Total consumption of houses in village : 43 KW
3) Total electricity consumed (including schools , hospitals , street lights , grampanchayat, etc) : 60 kW

The remaining electricity can be transmitted to some other villages nearby .

2) Actual vapor power cycle differs from the ideal Rankine cycle because of irreveresibilities.

$\dot{q}$ = Heat flow rate per unit time

$\dot{m}$ = Mass flow rate per unit time

$\dot{w}$ = Mechanical energy consumed per unit time

ηthermo = Thermodynamic efficiency of a power plant

h1, h2, h3, h4 = Specific enthalpies at indicated point on the T-S Diagram

p1, p2 = The pressure before and after the compression process

Efficiency of the CSP Plant

- At Turbine (3–4)

 $\dot{w}t=h3-h4$

- At Condenser (1–4)

 $\dot{q}out=h1-h4$

- At Pump (1–2)

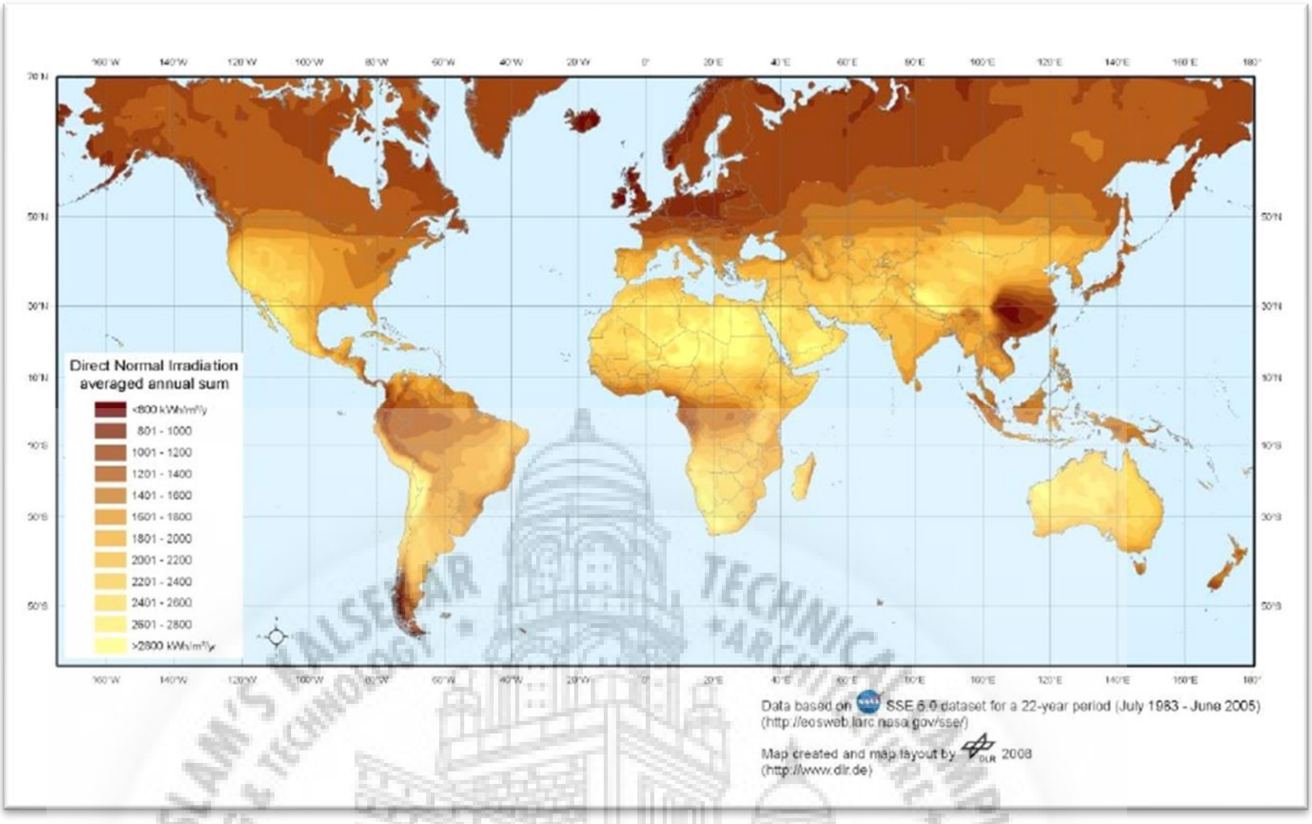
$\dot{w}p=h2-h1$

- At Boiler (2–3)

$\dot{q}in=h3-h2$

$\eta thermo=\dot{w}net\dot{q}in=wt-wp\dot{q}in=(h1-h2)-(h4-h3)h1-h4$

2.2. HTF (heat transfer fluid)



3) Calculations of Effective Load Carrying Capability:

One of the most robust and widely accepted techniques for estimating capacity value is determining the effective load carrying capability (ELCC) of a generator

1. For a given set of conventional generators, the LOLE of the system without the CSP plant is calculated using the following formula: are as following

$$\mathbf{LOLE = \Sigma\ P\ (\mathit{Gi<Li}\ )}$$

Here: T = No of hours of study

Gi = Available conventional capacity in hour i

Li = Amount of load

P (*Gi<Li*) = *Indicates the probability of available generating capacity being less than demand.*

1. The CSP plant is added to the system and the LOLE is recalculated. This is shown as *LOLECSP*. Since the CSP plant has been added to the system, *LOLECSP* will be lower than LOLE (indicating a more reliable system with lower LOLPs).

$$\text{LOLE CSP} = \sum P\,(G_i + C_i < L_i)$$

HERE;*Ci = Out-put of CSP plant in hour*

2. The CSP plant is "removed" from the system and a conventional generator is added. The LOLE of the new system, which is denoted as *LOLE Gen* is computed as:

$$\text{LOLE } Gen = \sum P\,(G_i + X_i < L_i)$$

Where *Xi* is the available generating capacity in hour *I* from the added conventional generator

. This added conventional generator is assumed to have a fixed EFOR, but the nameplate capacity of the plant is adjusted until the LOLE of the system with the CSP plant and the conventional generator are equal.

4) Highest-Load Hours Approximation Method

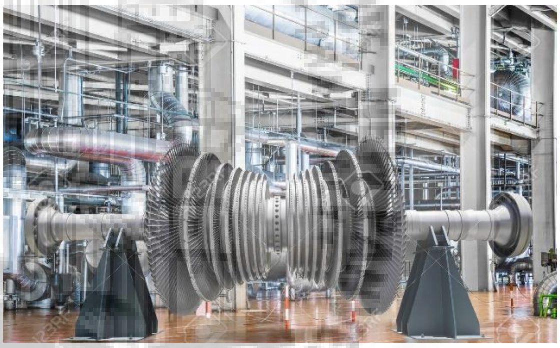
The highest-load hours. approximation method is the simplest approach that can be used to obtain an estimate of a generator's capacity value. This approach uses the average capacity factor of the CSP plant during the highest-load hours as an approximation for the capacity value. The number of hours considered is important since the capacity factor can be highly sensitive to this parameter. This study compares three cases in which the top 10, top 100, and top 10% (or top 876) of load hours are used.

CHAPTER NO: 06

EQUIPMENT

Brushed DC Motors: Brushed DC motors are probably the most common type of motors . this motors can be found in everything from hand-held fans and cordless drills to cell phone buzzers . Which has a rating of 12volts DC, which has 4850 No load rpm.

Steam Turbine: A steam turbine is a device the extracts thermal energy from pressurized steam and produces it to do mechanical work on a rotating output shaft. It has (6-8) blades .This turbine is further connected to alternator due to which we generate electric energy from mechanical energy.



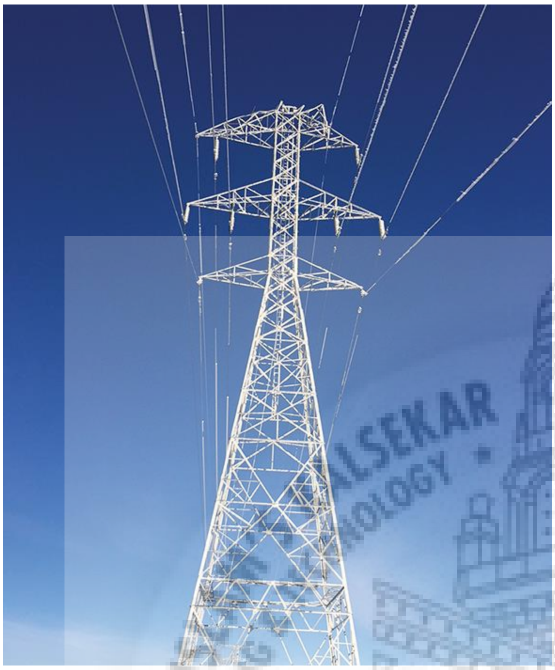
Heliostats: It is a device that includes a mirror to reflect sunrays on specific target. They are the main part of solar thermal power generation the height of heliostats we used are 4.5 cm , and the size of reflectors we used is 3 cm – 3 cm .and are placed at specific distance from one another.

Central receiver / Collector: In this part the solar radiations are concreted and water is converted into steam. It is in black colour because black colour absorbs more heat and due to this heating process is boosted. The height receiver is4.75 Inches .diameter is 2.6 inches and volume is 25.219 inches.

Reflectors: They are to be placed on heilostats. Their function is to reflect and focus the sunrays on a point on collector .reflectors are of size 3 – 3 cm each and has a width of 0.3 cm.

Push switch: It is a switch in which electricity flows through a circuit when it's pushed in , and if we push it again it disconnects the circuit . It's specifications are IP65/66 , Type 1/1*/4 . AND it shall be placed in series with the supply.

Electric Tower prototype: It is made up of metal rods . They are used to replicate the actual transmission towers. It's height is 25.5 cm and it's area is 9.5 cm/square .they are placed to show transmission of 132 KV.



House model: These models are used to replicate domestic consumers of electricity of an area. We are placing some of them together to replicate a locality. They are made up of wood The house is of [h-15,l-12.5,b-10 cm each]

LEDS: It is a special type of diode which emits light when we pass current across it . we are using this lights to replicate electricity consumed by household in an area like bulb , tube light , fans , etc. it has a rating of 10 volts DC supply.

Transformer: We used a step-up and step-down transformer according to it's requirement , they are used to increase and decrease the voltage level . We used 2 step-down transformer and 1 step-up transformer.

Pressure valve: It is an instrument used to pressure the steam and release it out at a very low focus point. It is placed above then receiving tower to pressure the steam.

CHAPTER NO: 07

PROS AND CONS

PROS

- No fuel cost is there as this power plant runs on solar energy.
- No pollution and gases are emitted as no fuel is burn to produce heat and serves to be less harm full for people living around the plant.
- As the plant has storage to store not molten salt in storage tanks so electricity can be generated whenever there is a demand of load.
- As we know due to pollution global warming is taking place s using sources we can reduce global warming.
- Solar thermal energy uses equipment like solar thermal mirrors and turbines which is made in large scale at low cost by existing industrial base.
- Using this plants we can give an area stand alone capacity. Which is better than laying long transmission lines from the other plants to this loads.
- As INDIA is located near to the equator we get abundant amount of solar radiations which we can utilise for generation in solar thermal power plant.

CONS

- It is unreliable due to the factor of sun rays.
- Storage required for this power plant is costly and requires much space.
- The area around the solar power tower should be kept isolated as the rays reflected from the reflectors are very concentrated and can harm humans if they come in front of that reflected rays.
- The power plant has to be placed on a flat area and that should be open i.e. no trees should be there to block the sun radiations.
- Solar thermal power generation is eco-friendly but the installation cost is very high.
- Water should be there around the power plant, cause the steam generation is done by heating water, So available of water is also a factor to be seen.
- It take around 5to7 years to develop a solar thermal power generation plant to setup, whereas a small wind mill can be setup in 6 months and small PV plant requires 3 months to develop.
- Financing is the biggest problem in developing projects particularly for small solar thermal developers.

CHAPTER NO: 08

FUTURE SCOPE

FUTURE SCOPE:

India can have a great deal of control over how rapidly solar power becomes cost-competitive. And, by getting in on the ground floor of this new technology, India can also create millions of jobs in renewable energy.

The annual global radiation varies from 1600 to 2200 kWh/m 2. Which is comparable with radiation received in the tropical and sub-tropical regions. The equivalent energy potential is about 6,000 million GWh of energy per year. It can be observed that although the highest annual global radiation is received in Rajasthan, northern Gujarat and parts of Ladakh region, the parts of Andhra Pradesh, Maharashtra, and Madhya Pradesh also receive fairly large amount of radiation as compared to many parts of the world

1) Opportunities for Solar Thermal Power Generation in India:

Solar thermal power generation can play a significant important role in meeting the demand supply gap for electricity. associated power-house infrastructure thus reducing the cost of generation of solar electricity. BHEL limited, an Indian company in power equipment, manufacturing, had built a solar dish based power plant in 1990's as a part of research and development program of then the Ministry of Nonconventional Energy Sources. The project was partly funded by the US Government. Six dishes were used in this plant.

Three types of applications are possible

1. Rural electrification using solar dish collector technology.

2. Typically these dishes care of 10 to 25 kW capacity each and use striling engine for power generation. These can be developed for village level distributed generation by hybridizing them with biomass gasifier for hot air generation.

2) Limitations of Solar Energy:

In a country like INDIA we have to see factors like Land , Cost ,Durablity and Protection .As the technology is in an evolving stage, the efficiency levels of conversion from light to electricity is in the range of 10 to 17%, depending on the technology used. The initial investment cost of this technology is high. At present the technology is basically surviving because of subsidy schemes available by the government. Solar energy is available only during daytime. Most load profiles indicate peak load in the evening/night time. This necessitates expensive storage devices like battery, which need to be replaced every 3 to 5 years

CHAPTER NO: 09

BIBLIOGRAPHY

WEBSITE LINKS:

1) https://www.iea.org/publications/freepublications/publication/CSP_Essentials.pdf

2) https://www.azocleantech.com/article.aspx?ArticleID=24#

3) http://www.greenworldinvestor.com/2011/07/07/advantages-and-disadvantages-of-solar-thermal-energy-power-towersparabolic-troughs/

4) http://solareis.anl.gov/guide/solar/csp/

5) https://www.eia.gov/energyexplained/index.cfm

6) http://www.ijetae.com/files/ICADET14/IJETAE_ICADET_14_73.pdf

7) https://www.nexteraenergyresources.com/what/solar_works.shtml

8) https://www.eia.gov/energyexplained/?page=solar_thermal_power_plants

9) http://www.triplepundit.com/2011/04/4-things-to-consider-before-going-solar-thermal/

10) https://www.hackster.io/Newphysicist/make-mini-solar-power-plant-concentrated-sun-light-d9d765

11) http://Saubhagya.gov.in/

REFERENCE BOOKS:

1) Non-Conventional Energy Sources

- G. D. Rai.