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Optimizing Power Output of Floating Solar Plant

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Abstract - Fossil fuels are burning out at a rapid rate. An alternative source of energy is required and various resource needs to be found for use for humans as soon as possible. There is no other better alternative than solar energy. it is the one of the main alternative sources for cope up the gap energy crisis. a near-term alternative option for cost-effective solar electric power generation based on a sunlight concentrating technology: integrated high-concentration of photovoltaic cells. The advantages of using Fresnel lens is been well analyzed, but development was resisted by the fact that the solar panels cant withstand the high temperature caused due to focus of Fresnel lens. In this project photovoltaic cells are used by placing Fresnel lens over them, and for heat reduction a cooling equipment should be attached to maximize the generation of electricity. By using Fresnel lens, the efficiency of photovoltaic cell can brought to maximum and the cost can be reduced to minimum. The use Fresnel lens for solar power generation through solar panels in hot areas such as those with equatorial or tropical climate is generally avoided.

Key Words: photovoltaic cells, Fresnel lens, parabolic solar collectors, cooling equipment, sunlight concentrating technology

1. INTRODUCTION

Floating Solar Plant- PV systems known as floating solar arrays float on the water's surface of remediation and tailing ponds, quarry lakes, irrigation canals, or drinking water reservoirs. There are only a few of these systems in France, India, Japan, South Korea, the UK, Singapore, and the US.] It is claimed that the systems have advantages over photovoltaic on land. For construction on bodies of water not used for recreation, there are fewer laws and regulations and higher land costs. Unlike the majority of terrestrial solar farms, floating arrays can be unobtrusive because they are out of sight.. Due to the fact that water cools the panels, they operate at better efficiency than PV panels on land. The panels have a special coating to prevent rust or corrosion. Installing solar panels above a pond allows for natural cooling of the panels, which enhances power output. The system's lifespan is increased by the cooler environment's reduced load on it. Floating solar uses the same readily accessible solar panels as roof- and ground-based single-axis tracking solar systems and is as affordable. The floating installations are eligible for federal, state, and local grant and incentive programmes, just like land-based solar. The systems not only provide power but also improve the environment in other ways. As an illustration, the solar power generating system can reduce evaporation by up to 70% by shading the water. The systems can also raise the standard of the water. As sunlight reaches aquatic bodies, photosynthesis encourages the formation of organic materials, including algae. Algae growth is decreased by darkening the water.

Fig -1: floating solar plant of 25MW on omkareshwar reservoir in Madhya Pradesh.

Fresnel lens-Fresnel lenses are flat on one side and have numerous concentric grooves that function as small prisms on the opposite side to bend parallel light rays into a single focal length. There are several Fresnel lens types, each of which is appropriate for a particular application. Large, durable acrylic sheets for concentration photovoltaic (CPV) applications. Reverse arrangement To focus the light, Fresnel lenses are made with the flat side facing the sun and the grooved side towards the photovoltaic cell. Several applications have been developed and successfully tested over the last 20 years to demonstrate the viability of Fresnel lens solar concentration systems. Although current applications are minor, research and development projects indicate that non-imaging Fresnel lens solar concentrators will soon lead to a breakthrough in commercial solar energy concentration application technology.

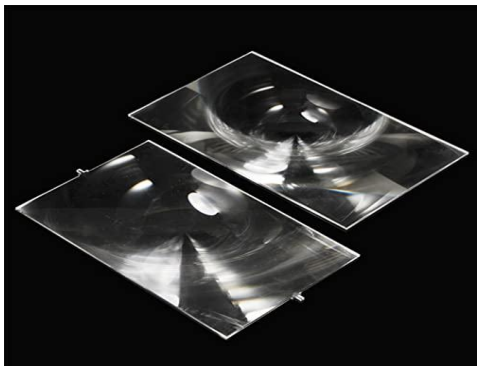

Fig -2: Fresnel lens to be used on solar panels.

1.1 Problem Statement of Study:-

There are some major problems which are interlinked to each other caused due to fitting Fresnel lens panels on floating solar plant/other solar plants:

As the temperature increases on surface of solar panels the amount of electricity production also increases. But after a specific point the energy production starts to decrease due to excessive heating caused due to Fresnel lens focus.

The cost of building a floating solar plant is very high

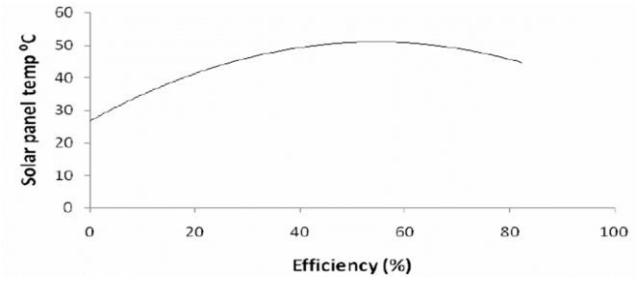

Fig -3: graph showing temperature vs efficiency effect on solar panel

1.2 Objective of the study:-

To find solution to keep the solar panels cool to increase energy production to its maximum capacity

To try to optimize cost and energy output of floating solar plant

To find perfect type of Fresnel lens to be used in the model

2. LITERATURE REVIEW

There are many researches done in the field of floating solar plant some of major researches are listed below.

Table -1: literature Review

Literature review		
Title of Paper	**Author**	**findings**
A Study on Power Generation Analysis of Floating PV System Considering Environmental Impact	Young-Kwan Choi	The superiority of floating PV systems is demonstrated in the paper through a comparison analysis of the generation amounts produced by floating PV systems installed by K-water, 2.4kW, 100kW, and 500kW. The paper also examines the factors that contributed to this superiority. In order to assess the impact of the environment on the generation efficiency of floating PV systems, the effect of wind speed and waves on the construction of the systems was also measured.
Feasibility analysis of Floating Solar Photovoltaic Plant at Srisailam in Andhra Pradesh: India	P S Kulkarni G Mamatha	In this study, MATLAB is used to examine the performance and properties of the FSPV module with actual meteorological data from the year 2020. The technical performance of the proposed 5MWp FSPV plant at the Srisailam reservoir in A.P., India, was also assessed using PVSyst and compared to GSPV of the same rating. The findings indicate that compared to GSPV Plant, FSPV generates 4.8% more capacity and reduces 5.45% more carbon emissions annually. Due to the cooling effect, the suggested floating solar PV offers higher performance characteristics in real-

		time application than GSPV and prevents the evaporation of 111.09 million litres of water yearly.
Investigation of Fresnel Lens Effect on Solar Panel Power Generation	Abdul Hadi Mohaimin Md Rakib Uddin Hasnul Hashim	There are indeed many ways to increase the power output of solar panels. This research examines how the proximity of the Fresnel lens to the solar panel affects the amount of energy generated by the panel. Fresnel lenses are used to amplify the sun's light intensity in order to boost the solar panel's solar collectability and perhaps increase power output.
A review of photovoltaic cells cooling techniques	Swar A. Zubeer H.A. Mohammed Mustafa Ilkan	In order to increase the efficiency of small household PV systems, this paper focuses on maintaining a uniformly low cell temperature. The effects of the operating temperature of the cells on the electrical and thermal performance of the PV systems have been examined experimentally and numerically using various cooling strategies.
Comprehensive review on Advanced Cooling Techniques for Photovoltaic Panel	Sampurna Panda Manoj Gupta Cs Malvi	Despite their low yield, photovoltaic systems are frequently used. The productivity of the PV module decreases when it heats up, which in turn affects the panel's output, energy efficiency, operation, and lifespan. Therefore, cooling strategies are crucial to lowering the PV panel's temperature and maintaining it. This research focuses on cutting-edge cooling methods for PV panels as well as upcoming scientific advances.
Techno-economic Analysis of 1 MWp Floating Solar PV Plant	Swati S Gurfude Deshetty Tanusha Dhayapule Mounika	A new solar energy method for producing electricity is the floating photovoltaic system. To boost their generation efficiency, the solar panels in the FPV system are placed on water rather than the ground. Due to the water cooling effect, the temperature of the PV panels will be lower. Their power temperature coefficient is negative. As a result, power production rises as panel temperature falls. For the chosen site, the energy production and cost of electricity are determined to be roughly 1614 MWh per year and 3 INR/kWh. The FPV plant will be in charge of closing the supply-demand energy gap for electrical energy. Compared to solar PV facilities that are ground-mounted, it offers more environmental advantages.

Need For Cooling:- External climate factors including concentrated dust, concentrated sunlight, wind speed, moisture content, and air temperature affect changes in surface temperature. As it is more difficult to change other relevant factors, efficiency can be increased by lowering the operating temperature. Solar radiation is an unpredictable factor, for instance, when constructing photovoltaic panels on the facades of buildings, which are vertical and non-directional surfaces. A range of cooling strategies have been tested and evaluated in a number of papers to increase the efficiency of photovoltaics by preventing the problem of temperature rise.

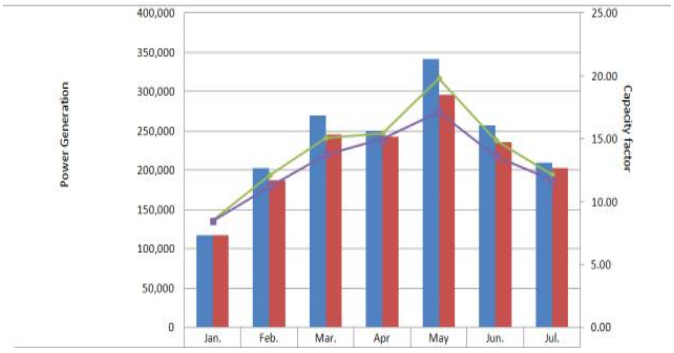

Chart -1: Graph showing greater efficiency of floating solar plant over conventional solar plant due to natural cooling effect conducted in south Korea

3. METHODOLOGY

Classification of cooling techniques:-

Active and passive cooling methods, which are being developed by scientists, are intended to lower solar cell operating temperatures. the P.V. being cooled properly array has a tendency to lower output loss and boost the PV's dependability. module. In order to increase P.V. performance, passive cooling and active cooling techniques are used. Modules.

The three main passive cooling categories are conductive cooling, passive cooling of the water, and passive cooling of the air. Additional components for passive cooling may include a heat pipe, sink, or exchanger to support natural convection cooling. The material used for the heat sinks was actually highly thermally conductive. To maintain the total flow of heat from the solar panel to the local environment, they are positioned at the bottom of the solar panel. Therefore, it is believed that passive cooling solutions are effective at lowering PV temperature. cells, as their production is very simple and affordable.

Heat sinks, microchannels, heat exchangers, phase-change materials (PCMs), nanofluids, thermoelectric generators (TEGs), or combinations with other systems are some examples of the increasingly complicated techniques that cooling technologies have moved toward. The cutting-edge, innovative field is focused on beam splitting (or spectrum filter) technology, which separates the P.V. wavelengths. cells different from those utilized for the PVT system's thermal conversion.

Technique used in cooling- Forced water circulation:

liquid is utilized as the cooling medium to cool the cells, heat pipes can be adopted on the back side of module panels to reduce the temperature. The excess radiation absorption heat for P.V. modules can therefore be transferred to the circulating coolant and even employed for other purposes. Studies have shown that the capacity of the pipe material for heat transfer has a significant impact on the system's overall efficiency. However, using such a technique incurs substantial installation and material expenses, and as a result we will implement the cooling system composed of radiators and other major parts form scrap vehicles which will play major part in cost cutting.

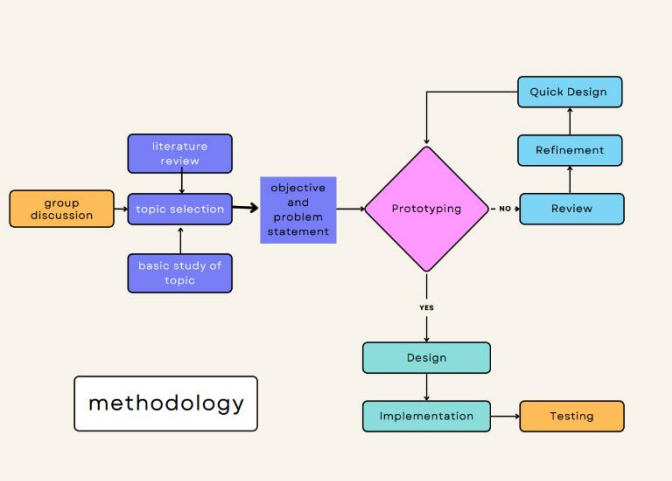

Fig 4:- flowchart of methodology to be followed

Other techniques used for cooling solar panel:

Water spraying:- The sprinklers on the front of the P.V. squirt water. this system's modules, including the pump and related pipelines (Fig.4). Interesting findings from earlier studies on water spraying demonstrate an up to 15% boost in electricity efficiency in adverse weather conditions. While this water-wasting device, which was put on the overland P.V. In terms of cost and suitability, it can be a good option for floating solar systems.

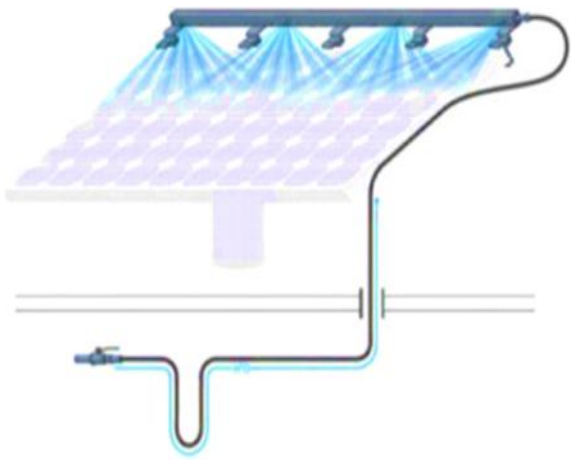

Fig 5:- Reducing temperature of solar panel by water spraying

Heat pipe:- A passive cooling system known as a "Heat Pipe" uses the evaporation and condensation of a fluid in a

sealed system to move energy from the source to the sink. A typical heat pipe has a sealed pipe made of a high thermal conductivity material, such copper or aluminum, at the condenser and the evaporator. Here is a diagram and model of a heat pipe with a solar panel. The heat pipe can transfer heat from the solar panel to air or water, lower the temperature, and increase the solar panel's effectiveness.

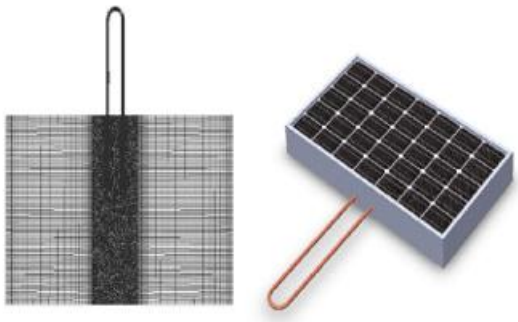

Fig 6:- Image of Heat Pipes

4. CONCLUSIONS

The power output of a floating solar plant shall be efficiently optimized by use of Fresnel lens to concentrate the light rays form the sun to achieve higher efficiency of of solar panel which may increase the production of electricity. but development was resisted by the fact that the solar panels cant withstand the high temperature caused due to focus of Fresnel lens. Heat pipes can be installed on the rear of module panels to lower the temperature. Liquid is used as the cooling medium to cool the cells. However, utilizing this method results in high installation and material costs. As a result, we will use a cooling system made of radiators and other significant pieces from junk vehicles, which will significantly reduce costs.

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