ISSN: 2455 - 1597

ijergs
Open Access

International Journal of Engineering Research and Generic Science (IJERGS)
Available Online at www.ijergs.in

Volume - 4, Issue - 6, November - December - 2018, Page No. 184 - 189

Theoretical Investigation of Floating Solar Photovoltaic : A Review

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Abstract

The requirement of energy for domestic, industrial and for various purposes is increasing day-by-day. On the other hand, the constant depletion of fossil fuels focuses us to move towards renewable energy sources. Renewable energy sources are ecological and sustainable if they are used optimally. The major problem faced by the government, scientist & researchers for setting up a solar power plant is—the availability of land. To overcome this problem a new technique is developed which is commonly known as Floating Solar Power Plants. These type of power plants can be set up on any surface of the water bodies. The Floating Solar Power Plants includes Solar Panels with other components, these components including solar panels are fitted onto a platform with a hollow plastic or tin drum that helps them to float on water. Also, these type of power plants helps in increasing the amount of generation of energy by the cooling effect of water. The benefits, classification of Floating Power Plants will be discussed in this paper.

Keywords: PV (Photovoltaic), efficiency, energy

Introduction

The total population of India is 1.35 billion (in 2018), and it is quite difficult to fulfill the demands of such a huge population on regular basis. The overall production of energy in the country is estimated to be 344.69 GW. In which 33.60 percentage is produced by the renewable energy power plants. According to a survey in 2017, About 240 million people in India do not have access to electricity. The supply isn't regular either for the people who have access to electricity. So, to fulfill the demands of the country the main focus should be on alternate energy resources. Different renewable energy resources like wind and hydro cannot be setup everywhere, they are area specific. On the other hand, solar energy power plants can be setup in any place. The solar power plays a vital role in reducing the greenhouse gases also they are considered as clean energy and efficient too. Water bodies like ponds, lakes, dams etc. can be used as an area to setup a Floating Solar Power Plants.

Floating Solar PV System

Floating Solar are the PV systems that float on the surface of water bodies (i.e. water reservoirs, lakes, rivers, ponds etc.). Also, the shortage of land as well as setup of solar power plant cost a fortune. So, the Floating Solar seems to be more beneficial than any other Solar power plant setup. Due to cooling effect of water the Floating solar achieves higher efficiency. The panels have a very special coating to prevent them from rust or corrosion. To setup solar panels on land there are few rules and regulations which need to be followed by the government.

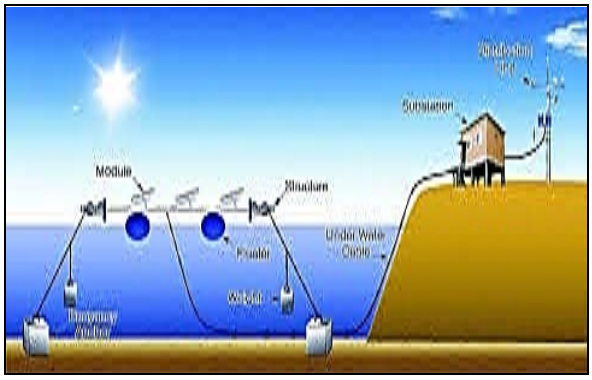

Fig. 1 Floating Photovoltaic Plant Outline

Advantages of Floating Solar System

When solar panels are setup on the surface of water bodies, the temperature of panels will be higher than the temperature of water so it helps in natural cooling of the panels resulting in performance of power production.Due to this cooler environment, the stress is reduced on the system which helps in extending the system's life. In hot summer days, the evaporation of the water bodies is reduced by 70% by the shadow of the floating solar panels.Algae formation is reduced due to shading of water results in lower maintenance cost in treatment of water bodies.

Components of Floating Solar System

A. Floating Structure

A floating structure has enough buoyancy so that it can float on water. Also it has a characteristic of carrying heavy load so that it can hold number of panels.

Fig. 2 Floating Structure

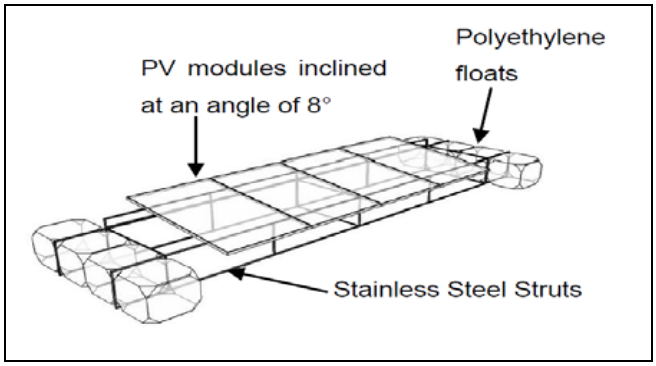

Fig. 3 Schematic of Floating Structure

B. Mooring System

Any permanent structure can secure its floating structure called docking. The dock ensures the floating structure to prevent free movement of the floating structure in the water bodies. Anchor anchors a floating structure with respect to a point at the bottom of the channel without connecting the floating structure to the beach.

C. Solar Module

One solar module can produce only a limited amount of energy; most installations contain multiple units. The PV system generally includes a panel or series of solar modules, an inventor of solar energy and sometimes a battery and / or solar tracking instrument and connected wires. Crystal photovoltaic solar modules are mainly used for floating solar systems.

D. Cabling

Due to their outdoor usage, the design of solar cables is designed in such a way that they resist UV radiations and extreme high temperature fluctuations. Also, they aren't affected by the weather conditions.

Types of Floating Solar Photovoltaic

***A.* Liquid Solar Array (by Sunengy)**

This type uses lightweight plastic concentrates that float in water and are also based on fixed rafts. To keep track of the sun daily and seasonally, the focus lens slowly concentrates slowly. There is a minimum of silicon photovoltaic cells in a photovoltaic container present in water. The lens is protected by turning it underwater to prevent damage in the high winds.

B. HDPE (by Ciel & Terre) –

This type offers a floating HDPE (High Density Polyethylene) platform for the installation of solar modules. It is easy to install, disassemble, no need tools or heavy equipment, it is easy to recycle and adapt easily to electrical configuration

Fig. 4 Liquid Solar array, by Sunengy Pvt. Ltd.

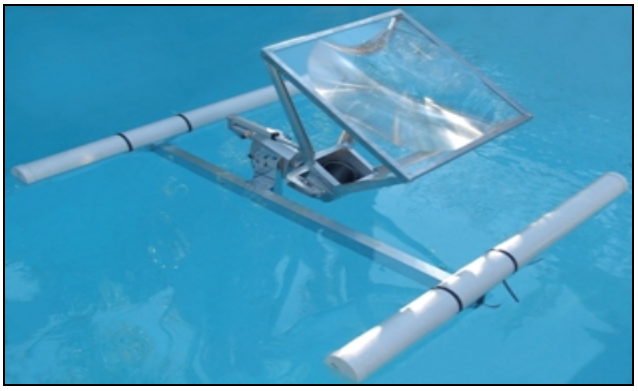

Fig. 5 Liquid Solar array, by Sunengy Pvt. Ltd.

Fig. 6 Part of Kagawa's 696 KW plant, installed by Ciel et Terre

C. Solaris Synergy

This type provides self-regulation of the angle of the plate under different wind loads, and allows the system to be configured in areas with very high wind speeds. The system is not affected by changes in water level. The open structure of the system ensures adequate water ventilation, as well as penetrating natural light and poses no risk to underwater life.

D. Solar Islands

Novation Solar Islands is a floating platform (approximately 12-100 m) designed to be compatible with both photovoltaic panels and solar thermal technologies (CSTs). The island consists of an external bull and a membrane, where solar receivers are placed with a longitudinal cable to keep them aligned.

E. Smart Floating Farm (by forward thinking Architecture) –

This type is polyculture based solution. It's highly productive floating ecosystem. It is flexible as well.

Fig. 7 Smart Floating Farm, by forward Thinking Architecture

F. Tracking Type

In this type, the sun's altitude and altitude are tracked to receive sunlight vertically on the surface of the unit. The photoelectric tracking type is a highly efficient generating system that produces a large amount of electricity by adding the solar tracking function in real time to the PV module. Taking into account the location of the sun each month of the year, the angle of negative tilt type is changed every month or season. As photovoltaic panels, in this type, receive orthogonal rays, which automatically rely on solar sensor information, this type of efficiency is greater.

Problems of Floating Solar Power Plants

The dirty phrase of the solar industry is solar shading. As the waves generated in the water bodies, sometimes the water comes on the surface of the solar panels. So, due to this the PV cells acts as a load and a reduction in efficiency is to be seen resulting in decrement of power. So to eliminate this bad effect, panels are tilted by some angle so, water can be easily removed.In rainy season, water come into the reservoir with more kinetic energy. So, system get displaced or damaged as more waves are created in the reservoir. That's why these type of systems is especially installed in man-made ponds, where there is no such causing.Robust and mechanically strong cables should be used. Also, high temperature resistance and all weather proof characteristics should be given to the cables.

Fig. 8 Trackers for Solar Power Panels

Conclusion

The floating solar panels save us from land issues which we face while setting up solar power plant. Also the depletion of fossil fuels focusses on renewable energy which are economical and eco – friendly. The maintenance of a floating solar power plant is more as compared to the solar power plant on land. More and more research is going on for better efficiency of this technique. So, there are lot of chances in future for this type of solar power plant.

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