

A Paper on Floating Solar Power Plants: A Review

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Abstract - Combining marine and renewable energy technology is an eco-friendly technique to produce electricity. Solar panels are made to float on the surface of water, like in a dam or reservoir. Underwater lines deliver electricity to a transmission tower. A floating solar power plant comprises essential elements: the solar module, buoyancy system, and corrosion-resistant components. These anti-corrosion elements encompass vertical and horizontal frames, an inspection footrest, and a module mounting assembly. In addition to passing the drinking water test, the solar module should be lead-free, dust-proof, humidity-resistant, and resistant to the impacts of transient water jets. Polyethylene, used to build the buoyancy body, has a 2.5 times weight capacity. K-water's floating structure is created using magnesium alloy coating product. In comparison to ground mounted PV (GPV), FPV has a number of benefits that are addressed in this review. The influence of FSPP on water quality and aquatic life is where there is a significant study void. This review paper looks at the most recent FSPP research and analyzes its advantages, disadvantages, and prospects. In terms of different water bodies that can be employed, system effectiveness, worldwide potential, and possibility for integrating FSPP with other technologies, the evaluation sheds further light on FSPP.

Key Words: Renewable energy, floating solar power Plant, floating Solar System, floating solar PV installations in the world. Conventional solar power plant (CSPP).

I. INTRODUCTION

In locations where no other power plants have gone, floating solar farms, often known as floating photo voltaics or "floato voltaics," are capturing electricity. The only difference between a solar farm on land and one that is floating is the location. As with any novel approach, there are unknowable hazards. For instance, how well will the panels function over time? How might they possibly affect wildlife? However, floating solar has generated a lot of excitement for converting bodies of water into clean energy producers in its brief history. Floating solar systems are now being deployed across various water bodies like irrigation canals, water reservoirs, quarry lakes, and tailing ponds, utilizing anchored rafts to provide support. These lightweight PV concentrators are strategically positioned on the water's surface, with several countries including France, India, Japan, Korea, the United Kingdom, and the United States adopting this approach. By leveraging these floating solar systems, the demand for costly land space is alleviated. Additionally, evaporation of precious drinking water is curbed, and the proliferation of algae is reduced.

The floating nature of these solar systems contributes to their operational efficiency, maintaining lower temperatures for the panels compared to land-based installations. Crafted from high-density polyethylene, these floating platforms are both corrosion-resistant and UV-tolerant, while also being fully recyclable. An array

of names is used to refer to this technology.

Solar energy has earned recognition as a clean and potent electricity source, playing a pivotal role in the global battle against greenhouse gas emissions. Nonetheless, the industry encounters several obstacles impeding its growth. Industry participants are actively seeking innovative approaches to enhance the feasibility and attractiveness of solar energy from a business perspective. Water utilities, with access to diverse water sources, stand to benefit from floating solar panels across open channel aqueducts, storage reservoirs, and irrigation setups.

However, the introduction of floating solar systems demands careful consideration. Potential alterations to local microclimates and potential harm to native flora and fauna due to altered water evaporation patterns in natural lakes must be meticulously examined. Notably, the cooling impact generated by water vapor interacting with the back of PV panels in reservoirs or lakes leads to higher electricity production compared to conventional PV installations—an added benefit highlighted in the literature.

II.LITERATURE SURVEY

Nonetheless, batteries and other forms of alternative energy storage continue to hold significant importance. A key limitation of hybrid FPV-hydropower configurations is the constrained availability of "virtual battery" functionality, which is contingent upon specific geographical areas and susceptible to seasonal and meteorological influences, as well as reservoir capacity. Moreover, the spatial distribution of population centers (demand) may not align with resource availability. By incorporating hybrid FPV-hydropower plants, these locations have the potential to contribute substantially to the renewable energy generation. For example, there are regions with sparse populations that could greatly benefit. However, due to its stationary nature, diverse electricity storage technologies would still be essential to mitigate the shortfall.

FPV initiatives that concentrate on tropical-climate nations. A FPV installation in artificial lakes and reservoirs that serve many uses, including agricultural, water storage, and hydro dams, has shown excellent outcomes according to the analysis of environmental implications. The effects of project allocation are expected to have a more pronounced impact on the implementation of conventional PV installations. These effects encompass concerns like deforestation (linked to project setup and site entry), avian fatalities, soil erosion, runoff, and alterations in the local microclimate. As a result, FPV is better for the environment since it minimizes these issues with traditional terrestrial utility-scale solar projects. Although further research is needed in this area and needs to be evaluated, the FPV may reduce water evaporation from the lake and limit algae formation.

The performance assessment of the photovoltaic (PV) techniques ELKEM and POLY Silicate is the primary goal of this essay. A comprehensive comparative study of the output powers of these PV cells is conducted, factoring in variables such as irradiance, panel temperatures, and weather patterns spanning May to August. The performance assessment involves plotting graphs for the four arrays: These visual representations aid in determining the respective efficiencies of each configuration. The generated power is fed into the grid, where continuous monitoring ensures its stability and reliability.

The development of solar photovoltaic systems has made the role of floating solar power plants increasingly important. The floating method has the advantage of reducing evaporation, which helps maintain water levels during extremely hot summers. The heating issue with solar panels on land is greatly resolved when panels are put on floating platforms. This floating technology requires less time for installation, is durable, affordable, and versatile. This document discusses the benefits and specific technical information of floating solar power plants. With this development, a nation like India can eventually meet its energy needs.

To facilitate FSPV operations and assess the feasibility of such systems, it's possible to examine the design and optimization of FSPV components through a floating approach. Implementing the following strategies can lead to reduced energy costs and consumption when integrating surface-floating photovoltaic power plants with conventional hydropower grid networks, aligning with sustainable development principles: Aligning power plant energy and water consumption management with established models. The overall load on the distribution network is correlated with network balance, impacted by the weight of the input. Leveraging solar power plants enhances the utilization of local renewable energy, consequently minimizing environmental repercussions. Beyond the aforementioned benefits, Iran's geographical positioning offers a strategic advantage for floating solar power plants. Given land scarcity, countries like China and the United Kingdom have successfully adopted floating solar solutions to produce clean energy. This approach holds potential to address water scarcity concerns in our nation. Notably, the deployment of float-builders and solar panels significantly reduces evaporation rates – approximately 80% in small-scale solar facilities in Japan and over 90% in industrial-scale solar installations in the UK and China. Globally available irradiation data aids in estimating the potential of usable water reservoirs. As solar technology advances and becomes more affordable, floating solar power plants are poised to play a significant role in future power generation and hybridization efforts.

III. WHY FLOATING SOLAR?

Why not just keep developing solar farms where they are successful: on land? Solar farms are significantly advancing clean energy access. Land has historically made the most logistical sense. However, there is a counterargument: why limit solar's potential by enclosing it on land?

For a certain solar farm, water might be a superior option for a number of reasons. To begin with, it's not always possible to acquire land for a project. In regions where land is limited and needs to be set aside for homes and other structures, floating photo voltaic can offer a solution.

A novel variant of photovoltaic (PV) systems emerges as floating solar PV installations, designed to rest stop reservoirs for drinking water, lakes in quarries, canals for irrigation, and wetlands for reclamation or waste. These floating PV platforms exhibit a robust framework that supports the solar panels, often referred to as an "aprontoon."

IV. OVERVIEW AND BASICS OF FLOATING SOLAR POWER PLANTS

In order to power our future, renewable sources are crucial. The establishment of solar energy power facilities, which harness the power of the sun, requires enough space. It is common knowledge that only about 29% of the 510 million km² of the earth's surface is covered by land. Additionally, it might not be possible to designate some space for a solar energy power plant in some regions due to the value of the land. Installing solar power plants, which need vast tracts of land, could not be practical in a nation with many densely populated cities and little agricultural land. Floating PV power plants can save the day in this situation. The term "floating PV power plant" refers to solar panels that are suspended in air.

The following figure shows the layout of the floating solar power plant.

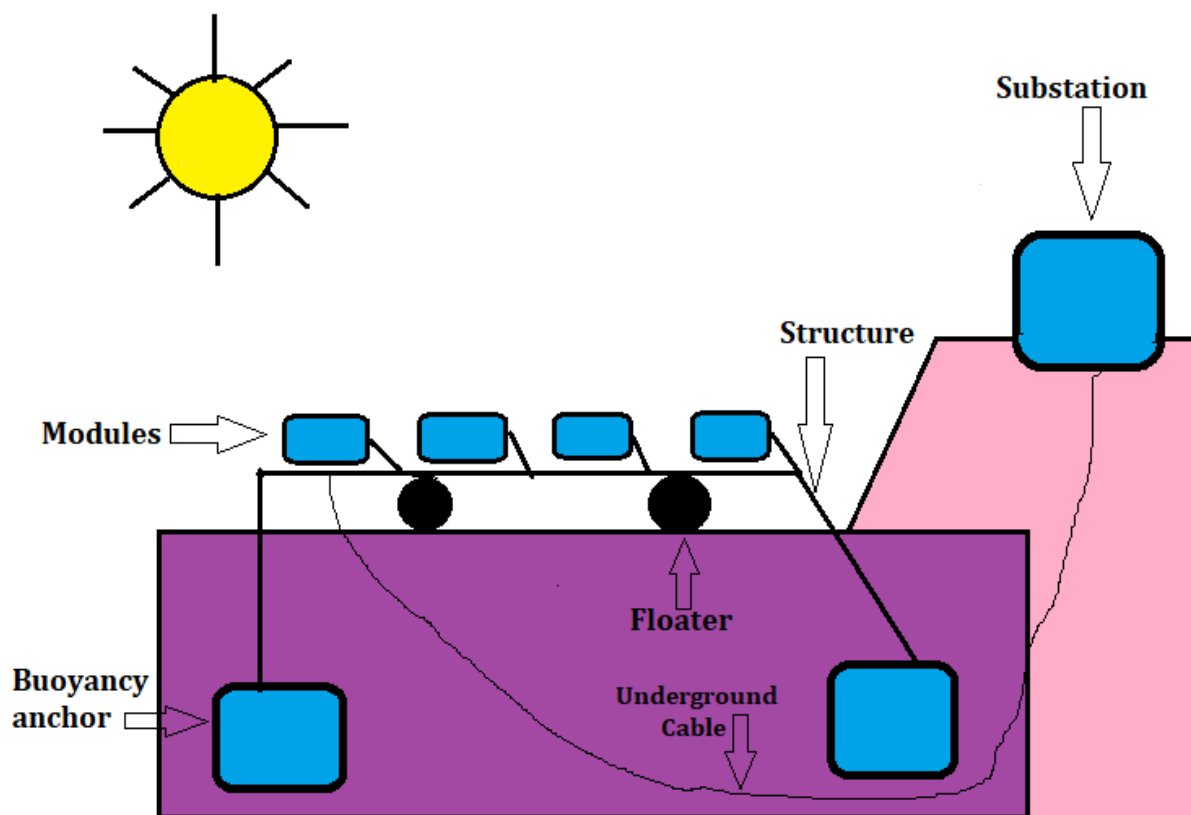


Fig -1: Layout of floating solar power plant.

Currently, the majority of floating solar farms are situated on man-made bodies of water such ponds used for agricultural irrigation, wastewater storage, and reservoirs. Despite the potential for Photo voltaic growth in natural bodies of water, man-made reservoirs have advantages. Because they were produced by humans, man-made bodies of water are more likely to be governed and to have already-existing infrastructure and roads. This results in more practical and economical installation and maintenance.

V.VARIOUS COMPONENTS OF FLOATING SOLAR OPERATED PLANT

The various components Floating Solar Operated plant is as follows

1. Floating system,
2. Mooring system,
3. PV system and
4. Underwater cables.

Floating System - The FSPP floating platform is its most vital and significant component. It supports all of the significant electricity-generating elements, including PV panels, inverters, combination boxes, etc. As a result, the system needs to be developed with the proper materials. Most FSPP factories use High Density Polyethylene

(HDPE), which is a common material. In addition, medium density polyethylene (MDPE), Ferro cement, and fiber reinforced plastic (FRP) are used in the design of floating platforms.

Mooring Structure - A lasting fixture secures the buoyant framework's position, while the mooring system curtails the unrestricted movement of these floating structures over water. Employing an anchor mooring technique, the floating structure is affixed in position relative to a point on the canal bed, obviating the need for attachment to the shoreline.

Solar Module - Photovoltaic generation units, termed solar modules, are affixed atop the floating structure and bear resemblance to electrical junction enclosures. Given the relatively modest power output of an individual solar module, installations commonly incorporate numerous modules. An assembly of rooftop solar cells, an inverter for the sunlight, a battery, and sometimes a tracker for the sun make up a typical solar energy (PV) setup. all interconnected through cables. Floating solar systems frequently employ crystalline solar PV modules.

Cabling - Electricity harnessed from aquatic sources is transmitted to the substation using specialized cabling. These solar cables are engineered to withstand outdoor conditions, boasting exceptional resistance to UV exposure and extreme temperature fluctuations.

V. COMPARISON OF FSPP AND CONVENTIONAL SOLAR POWER PLANT

Sr. No.	FLOATING SOLAR POWER PLANT	Sr.No.	CONVENTIONAL SOLAR POWER PLANT
01	The floating solar power plant produces a greater electricity output compared to the conventional solar power plant.	01	The Less energy is generates in Conventional solar power plant as compared with FSPP.
02	Land is not required to Build a FSPP.	02	Large Land is required to Build a CSPP.
03	The Efficiency Of FSPP is higher than the CSPP.	03	The Efficiency Of CSPP is comparatively less than the FSPP.
04	Maintenance is easy.	04	Maintenance is difficult than FSPP.
05	FSPP reduce the dust pollution.	05	Dust pollution is occurs in CSPP.
06	FSPP is convenient for some villages and cities that is closed to water.	06	CSPP is not convenient where villages and cities that is closed to water.
07	Evaporation is reduce in FSPP.	07	Evaporation is occurs in larger means as compared with FSPP.
08	On water bodies like sewage treatment facilities, drinking water reservoirs, or hydropower dam reservoirs, floating solar power plant can be employed.	08	Conventional solar power plant does not required water reservoirs.

09	Because of the cooling influence of water, floating solar panels have the capability to generate a higher amount of power in contrast to traditional solar power plants.	09	There is no cooling effects occurs on this power plant, hence it produce less power than the FSPP.
10	The initial cost of a floating solar Power Plant is fairly high.	10	The initial cost of a Conventional solar Power Plant is less as compared with FSPP.

VI.ADVANTAGES OF FLOATING SOLAR POWER PLANT OVER CONVENTIONAL SOLAR POWER PLANT

Installing solar panels on floating platforms offers several advantages over conventional land-based installations. Here are some key benefits:

Heat Dissipation: Solar panels exhibit enhanced electrical efficiency under cooler conditions. Water offers a natural cooling mechanism, addressing the heat-related challenges frequently encountered by land-based solar panels exposed directly to sunlight.

Increased Efficiency: Optimal panel temperature contributes to superior performance, potentially yielding increased energy generation. Consequently, the overall efficacy of the floating solar power setup may surpass that of installations on land

Conservation of Land: Land holds inherent value, and the implementation of floating solar panels facilitates the exploitation of water surfaces such as lakes, reservoirs, and ponds. This approach avoids the consumption of land that could otherwise be allocated for alternative functions like agriculture or development.

Reduced Evaporation: The floating panels provide shade to the water surface, reducing evaporation rates in the covered area. This can be particularly beneficial in regions facing water scarcity.

Flexibility and Scalability: Floating solar solutions exhibit remarkable adaptability, suitable for installation across diverse water body configurations and dimensions. Their scalability is a prominent feature, enabling gradual panel expansions aligned with energy requirements.

Environmental Benefits: By using water bodies for solar installations, floating platforms can contribute to the preservation of terrestrial habitats and protect ecosystems that might have otherwise been disturbed by land-based solar farms.

Cost-Effectiveness: While the initial investment might be higher due to the construction of floating platforms, the cooling effect of water can lead to increased efficiency and lower maintenance costs in the long run, making it a cost-effective solution.

Fast Installation: Setting up floating solar panels can be relatively quick compared to ground-mounted systems, as there is no need for extensive land preparation or civil engineering work.

Long-Lasting: Floating solar platforms are designed to withstand water exposure and environmental factors, making them durable and able to provide electricity over an extended period.

CONCLUSIONS

It's essential to acknowledge that while floating solar holds numerous advantages, it also presents distinctive challenges, including engineering complexities, anchoring methodologies, and potential ecological impacts. Nevertheless, ongoing technological advancements and accumulated experience are actively mitigating these challenges, bolstering the appeal of floating solar for renewable energy generation.

Comparatively, despite the floating solar plant exhibiting 11% efficiency boost and reducing water evaporation by 70%, its initial investment surpasses that of traditional solar power plants by 1.2%. Regions in eastern, southern, and south-eastern India, including the various states boast significant expanses of water bodies. This innovation holds potential for implementation in these areas, thereby directing considerable resources towards onshore costs while concurrently curbing power generation expenses. This process contributes to bridging the gap between warm and solar-based electricity production.