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FLOATING SOLAR PHOTOVOLTAIC POWER PLANTS:AN OVERVIEW

Ayush Agarwal*[1]

1.Undergraduate Student, Department of Civil Engineering, Malaviya National Institute of Technology, Malviya Nagar, Jaipur-302017,India

I. ABSTRACT:

Floating solar power plants represent a cutting-edge solution to the dual challenges of land scarcity and renewable energy demand. By utilizing water bodies such as reservoirs, lakes, and ponds, these innovative installations maximize energy production while minimizing land use. The floating platforms not only harness the abundant sunlight but also help in reducing water evaporation and algae growth, thereby enhancing the overall ecological balance of the aquatic environment. Moreover, their modular design allows for scalability and flexibility, making them suitable for a wide range of applications, from small-scale installations to large utility projects. With ongoing advancements in technology and growing environmental awareness, floating Solar PV power plants are poised to play a significant role in shaping the future of sustainable energy generation.

Key Words: Renewable Energy, Solar Photovoltaic, Solar Power Facilities, Floating Solar Systems, Floating Solar PV Installations Worldwide, Advantages of Floating Solar Power Facilities, Types of Floating Structures for Solar Power Plants

II. INTRODUCTION:

Floating solar power plants have garnered significant attention as a viable solution to the challenges associated with traditional land-based solar installations. By utilizing water bodies for solar panel placement, these innovative projects offer a multitude of advantages, including optimized land use, increased energy generation efficiency, and reduced environmental impact. The buoyant platforms not only facilitate the deployment of solar panels in areas with limited land availability but also provide opportunities for synergistic benefits, such as mitigating water evaporation and enhancing water quality through

shading.

Furthermore, floating solar power plants exhibit inherent flexibility and scalability, making them suitable for a diverse range of applications and environments. Whether deployed on reservoirs, lakes, or wastewater treatment ponds, these installations can be tailored to meet varying energy demands while adapting to local conditions and regulatory requirements. As technological advancements continue to improve the efficiency and cost-effectiveness of floating solar systems, they hold immense potential to contribute significantly to the global transition towards sustainable energy production and mitigate the impacts of climate change.

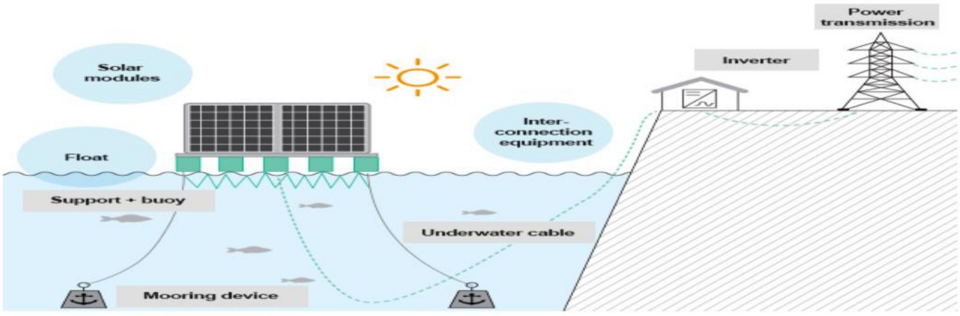

Fig. 1 Floating PV generation

III. Components of Floating Solar PV plant:

Here's a comprehensive breakdown of each component comprising a floating photovoltaic (PV) system:

1. **Pontoon/Floating Structure**: This is the main platform that floats on the water surface and supports the solar panels. It needs to have enough buoyancy to keep the solar panels a float while withstanding the weight of the PV modules and other associated equipment. These structures are often designed to be durable and resistant to corrosion.
2. **Mooring Structure:** The mooring structure serves to anchor the floating platform in place, preventing it from drifting or moving freely on the water. There are different types of mooring systems, such as anchor mooring, which fixes the floating structure's position relative to a point on the bottom of the water body. The mooring system ensures stability and proper positioning of the floating PV array.
3. **Solar Module:** The solar modules, also known as PV modules, are the key components responsible for converting sunlight into electricity. These modules are installed on top of the floating platform and typically consist of an array of individual solar cells. Crystalline silicon solar PV modules are commonly used in floating solar systems due to their efficiency and durability
4. **Cabling:** Cabling refers to the wiring and electrical connections used to transfer the electricity generated by the solar panels to the substation or grid. Specialized solar cables are required for outdoor use, as they need to withstand exposure to UV radiation and extreme temperature fluctuations. These cables ensure safe and efficient transmission of power from the floating PV system to the onshore infrastructure.

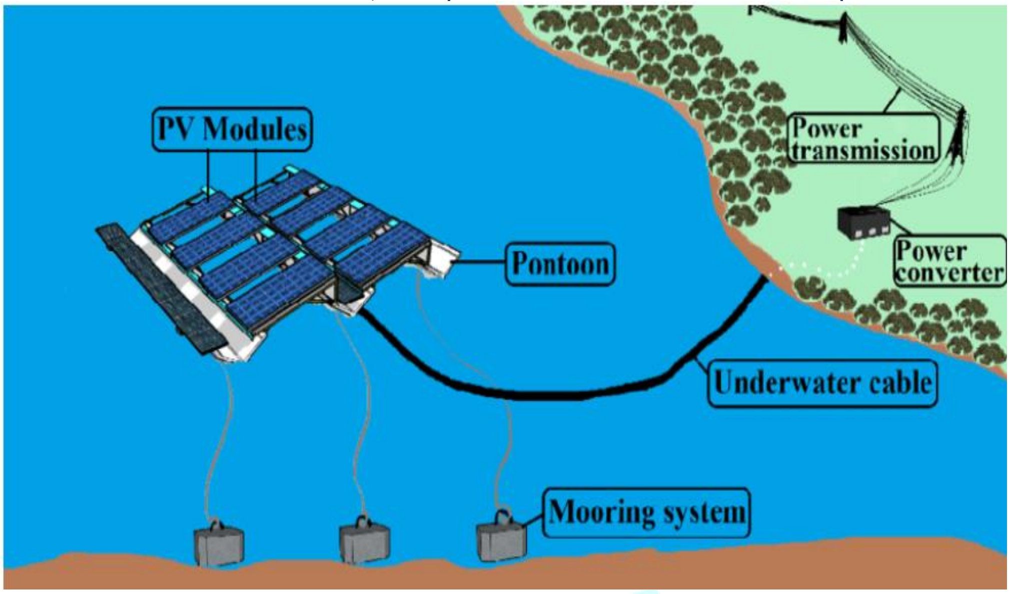

Fig. 2 Floating PV components

IV. Advantage of Floating Solar Plant:

Floating solar photovoltaic (PV) plants offer several advantages, including:

1. Space Efficiency: Floating solar panels epitomize innovative spatial utilization, particularly advantageous in regions characterized by constrained or prohibitively expensive land availability. By harnessing underutilized water bodies such as reservoirs, dams, and lakes, floating solar installations obviate the need to repurpose fertile agricultural land or disrupt natural landscapes for solar farm development. This strategy preserves invaluable land resources, facilitating a synergistic relationship with other land use priorities while facilitating the sustainable generation of solar energy.

2. Enhanced Efficiency: The symbiotic synergy between water and solar panels within floating PV systems yields notable enhancements in solar efficiency. Water's inherent cooling properties effectively regulate operational temperatures for the solar panels, thereby alleviating the prevalent overheating challenges encountered in terrestrial solar installations. This thermoregulatory advantage has the potential to significantly augment solar panel efficiency by up to 15%, consequently resulting in increased energy output and, consequently, improved return on investment.

3. Albedo Effect: Water bodies possess inherent reflective properties that contribute to the albedo effect, which in turn amplifies the efficiency of floating solar panels. The reflection of sunlight off the water's surface back onto the solar panels increases the amount of photons that can be converted into electricity. This mutually beneficial interaction augments the overall energy yield, making floating solar systems an attractive proposition for optimizing solar energy generation.

4. Water Conservation: Floating solar panels contribute to water conservation by reducing evaporation from the water bodies they occupy. Particularly in arid and semi-arid regions where water scarcity is a pressing concern, the shading effect of floating solar arrays can significantly curb water evaporation, preserving vital water resources. Moreover, by inhibiting sunlight penetration, these installations help control the growth of harmful algae, thus contributing to better water quality.

5. Reduced Algae Growth: The shading effect of floating solar panel on water bodies helps manage harmful algae growth. Algal blooms, often spurred by excessive sunlight and nutrient availability, pose threats to aquatic ecosystems and water quality. By limiting sunlight exposure, floating solar panels can play a role in algae control, thus contributing to maintaining the ecological balance and water quality of the hosting water bodies.

6. Reduced Installation Costs: The financial requisites of floating solar installations can be less demanding compared to their land-based counterparts. They bypass the need for land acquisition and extensive site preparation, which often entail significant expenses. Furthermore, the proximity to the existing electrical infrastructure of nearby hydroelectric plants or water treatment facilities can lead to cost savings in integration and transmission infrastructure.

7. Low Impact on Aquatic Life: Preliminary studies hint at the lower impact of floating solar installations on aquatic life compared to other over-water or in-water structures. The design and positioning of floating solar panels can be managed to ensure minimal interference with aquatic habitats, thereby fostering a benign coexistence with the aquatic ecosystem.

8. Enhanced Security and Durability: Floating solar array can boast of enhanced security and durability. Their location on water bodies renders them less accessible, thus reducing the risk of vandalism and theft. Additionally, the water-based setting may contribute to less wear and tear compared to land-based installations, ensuring a longer operational lifespan and lower maintenance needs.

V. Challenges for Floating Solar Plant:

1. Limited Applicability: The suitability of floating solar systems is confined to calm water bodies. Waves, tides, or high winds can significantly challenge the stability and functionality of floating solar installations. Furthermore, not all types of water bodies may be suitable due to either environmental considerations or other uses such as navigation, recreation, or fishing.

2. Maintenance and Cleaning: Maintaining solar panels on water bodies can pose enhanced challenges and higher costs, necessitating specialized equipment and skilled personnel. Ensuring regular cleaning is imperative to uphold optimal panel efficiency.

3. Limited Application: This technology isn't universally applicable. Many floating solar projects are large in scale and provide power to large commercial or utility companies. For individuals or entities desiring solar energy, opting for rooftop or ground-mounted solar systems is a more practical alternative.

VI. Comparison of FSP and GSP:

The Floating solar panel shows the increase in solar energy efficiency. At 1100 W/m2 of solar radiation, the power gain of the photovoltaic device increases to 5.93 percent. Design and manufacture of a PV system shows that it can increase PV efficiency by lowering the temperature of the solar cell. In relation to these circumstances, the FPV system is one solution to reduce the cost and space required for installing a solar panel, which increases the efficiency of the solar panel and offers ecological technology because it has less impact on the earth. It is proven that after two hours of testing in sunlight, the power gain of the floating solar panel increased by 15.5% compared to the conventional solar cell

COST ASPECTS	FLOATING SOLAR PLANT(100MW)	GROUND BASED SOLAR PLANT(100MW)
Land Acquisition	1 Crore (in rare cases)	2 Crore
Floating Structure	1.5Crore	N/A
Civil Works	15 Crore	45 Crore
Solar Panels	300 Crore	300 Crore

Mounting Structures	2 Crore	25 Crore
Electrical Component	50 Crore	50 Crore
Grid Connection	10 Crore	10 Crore
Installation and Labour	25 Crore	25 Crore
Maintenance and Operation	1-2 Crore	2-4 Crore
Security and Insurance	1 Crore	1 Crore
OVERALL COST	**405-407 Crore**	**460-462 Crore**

VII. CONCLUSION:

In conclusion, the exploration of floating solar photovoltaic (PV) plants reveals a transformative solution in the realm of renewable energy generation. By leveraging water bodies for solar panel installation, these innovative installations offer numerous advantages, including increased land use efficiency, reduced water evaporation, and potentially higher energy yields due to natural cooling effects. Despite challenges such as installation complexity and environmental considerations, the growing body of research and successful implementation projects worldwide underscore the viability and potential of floating solar PV technology. As the global demand for clean energy intensifies, embracing floating solar PV plants represents a pivotal step towards achieving sustainable energy goals, mitigating climate change, and fostering resilient energy systems for future generations.

VIII. REFERENCE:

1. Hyder Farhan, Sudhakar K, Rizalman Mamat. Solar PV tree design: A review. Renewable and Sustainable Energy Reviews.

2. Akash Kumar Shukla, Sudhakar K, Prashant Baredar, et al. BIPV in Southeast Asian countries –opportunities and challenges. Renewable Energy Focus.

3. Literature Review on the Solar Energy Potential for Botswana, Wilbert R. Mutoko, Phillis Mutoko. 2019 European Scientific Journal

4. P.V. Ramana, B. Sudheerprem kumar, Divya Nalla, T. Srilatha, JULY 2015 A COMPREHENSIVE STUDY ON SOLAR POWER PLANT AT EDUCATIONAL INSTITUTE LEVEL.

5. https://ijcrt.org/papers/IJCRT23A5021.pdf

6. https://energy.mit.edu/research/future-solar-energy/

7. https://www.mbt-energy.com/news/industry/2106181.html

8. https://www.pv-tech.org/plans-progress-for-600mw-floating-solar-project-in-india/

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