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An Overview on Floating Solar PV Plant

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Abstract: The Photovoltaic (PV) energy is one of the most promising renewable energies in the world due to its ubiquity and sustainability. However, installation of solar panels on ground can cause some problems especially in countries where there is not enough space for installation. As an alternative floating PV with advantages in terms of efficiency and environment has attracted attention, particularly with regard to installing large scale floating PV for dam, lake and reservoirs in countries like India. Additionally, the water is also conserved due to reduction in evaporation of water from the water body. This paper focuses on the floating PV technology and its classification along with its future scope in India.

Keywords: floating PV system, solar photovoltaic, solar power plant

I. Introduction

Solar energy can be utilized for power generation in numerous ways. One of the barriers in harnessing solar energy is large land requirement. This problem can be addressed by using Floating Photovoltaic (FPV) system. Floating PV system is an innovative and new approach of installing PV modules on water bodies. By installing FPV system, evaporation of water from water bodies can be reduced to 70% and power gain is increased by 5.93% due to back water cooling of PV modules. India proposes the generation of solar power from renewable energy sources up to 1.75 GW and 1 GW of solar PV power in next 10 years. The country is forwarding as per the policies declared. As on date around 5000 MW has been commissioned in different parts of country, as per the Jawaharlal Nehru National Solar Mission. To match the targets declared, the progress noted so far is not sufficient and requires hard effort by each state and state departments to achieve the desired targetsand make the country consuming green power in the world.[1]

Fig.1 Floating PV Plant, Japan

II. Floating Photovoltaic System

Floating solar arrays are PV systems that float on the surface of drinking water reservoirs, quarry lakes, irrigation canals or remediation and tailing ponds. A

small number of such systems exist in France, India, Japan, South Korea, the United Kingdom, Singapore and the United States. The systems are said to have advantages over photovoltaic on land. The cost of land is more expensive, and there are fewer rules and regulations for structures built on bodies of water not used for recreation. Unlike most land-based solar plants, floating arrays can be unobtrusive because they are hidden from public view. They achieve higher efficiencies than PV panels on land, because water cools the panels. The panels have a special coating to prevent rust or corrosion.[4]

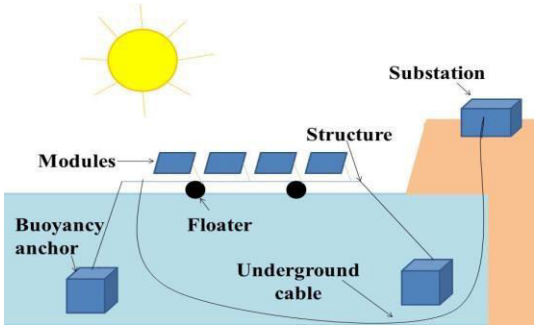

Fig 2. Floating PV Plant Outline

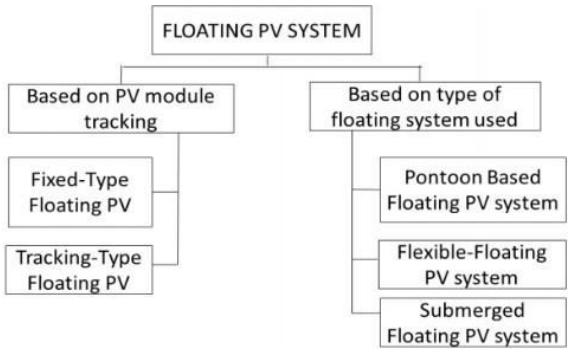

Fig 3. Classification of Floating PV System

III. Constructional Details of Floating PV System

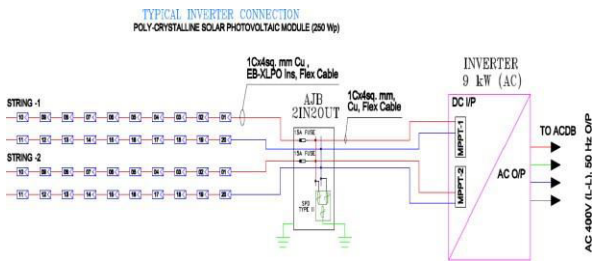

Fig 4. Connection Diagram of Floating PV System

Floating solar is a concept which extends the theory of Solar Power Generation only and through some structural modifications we aim to obtain higher efficiency of the plant. So, it's very important or understands the various components that will be used in addition to the already used panels and mounting structures. The constructional details of the various components are as follows-

1. SOLAR PV MODULE

Solar cells are the building blocks of a solar panel. Solar cells are joined together to make one solar panel at peak power production. Front side of module is covered by Tempered &textured clear glass with low iron content resulting in efficient sunlight absorption. Back side is covered by EVA potent sheet to provide maximum protection from the severest environmental conditions. High torsion and corrosion resistant anodized aluminum frame provides structural strength and ease of installation.[3]

2. STRING INVERTER

There are various types of inverter which are used in Photovoltaic systems. Inverters are distinguished according to the inverter operation, voltage and current control scheme. In most cases due to some advantages in grid-connected inverters, current control scheme is applied. Advantages are higher power factor, better transient current suppression; short circuit current is limited to rated AC current. Solar photovoltaic panels convert solar energy into electrical energy as AC power. This AC power is used for the load through inverter. The inverter position is considered over the floating platform. Optimized efficiency factor, higher availability (by proven long life components), the latest control procedure are key features. Some key features are:

1. Light & compact
2. Highest efficiency (97.9%)
3. Easy installation
4. Outdoor type (IP65)
5. Maintenance free

3. CABLE AND CONNECTORS

Cables will be extremely robust and resist high mechanical load and abrasion. High temperature resistance and excellent weatherproofing characteristics provide a long service life to the cables used. The connectors with high current capacity and easy mode of assembly are to be used for the connections of the power plant cables.[3]

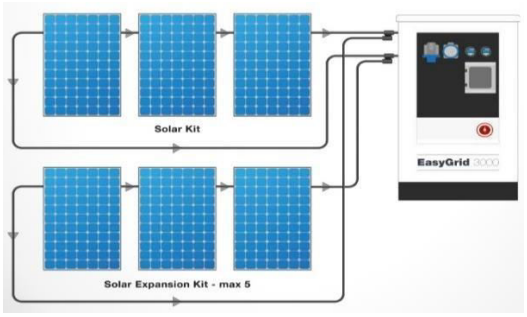

Fig 5. Connection of Floating PV System

4. FRP FLOATING PLATFORM

A floating platform would characteristically be made of hollow sections for effective buoyancy to self-weight ratio. The most advantageous is a circular section in this regard. An added advantage will be if the material itself is of lower density. The material will be fabricated to any desired shape and can be joined together by chemical bonding. The platform will be practically maintenance free as there will be no corrosion another material that may be looked into is Glass Fiber Reinforced Plastic (GRP).This material is comparable to steel in strength properties. It is about 4 times lighter than steel. Pipes made of GRP can be used in construction of the floating Platform. GRP Pipes will be manufactured using Isophthalic Polyester Resin. The GRP Pipes will be fabricated by Filament Winding Process. All outside surfaces of the pipes will be pigmented for protection against U.V. Ray of Sunlight. Mooring system of floating platform is with Wire Rope Sling.[3]

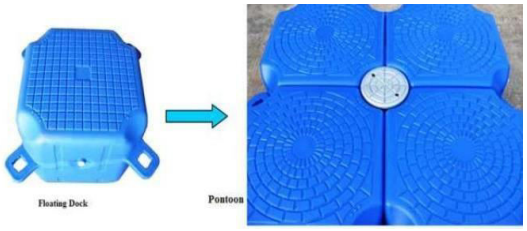

Fig 6. Floats

5. MOORING ARRANGEMENT

The assembled Platform has to be held in a position allowing for slight movement due changing in water level and wind blowing on it. This can be easily done with nylon ropes lashed at each corner and tied to bollards on the bank.[3]

Fig 7. Mooring

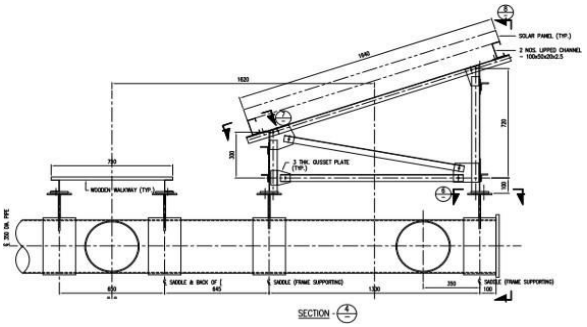

Fig 8. Installation Structure of Floating PV System (Single)

IV. Advantages of Floating PV System over Overland PV System

The benefits of floating PV system are: a) Increase in efficiency due to cooling effect of water; b) Evaporation is reduced due to shading of water surface; c) Algae growth on water is reduced; d) Since the system is installed on water, therefore the effect of dust on PV module is less prominent; e) Installing PV system on

water will conserve land; f) Floating solar PV can be installed in water intensive industries such as wineries, dairy farms etc. and thus providing electric energy and reducing the evaporation of water; g) Floating PV requires almost no evacuation and are affordable as well as simple to construct; h) Floating PV installed in industries or factories can help reduce carbon footprints; and i) Floating PV construction does not require any foundation work and deployment itself is quite straight forward.[2]

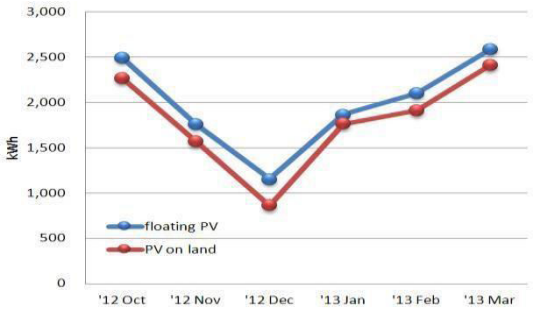

Fig 9. Comparison graph of Overland and Floating PV System [2]

V. Scope of Floating PV System in India

The Government of India recently announced an ambitious plan to develop 10 GW of floating solar capacity in the country over the next two years till 2020-21. Soon after, the Solar Energy Corporation of India (SECI), India's central public sector undertaking responsible for implementing renewable energy schemes in the country floated an expression of interest (EOI) from project developers to develop 10 GW of floating solar capacity. The objective of this EOI was to understand the feasibility of developing large scale floating solar PV capacities across the country. While the industry has praised the intent of the government and been forth coming with its suggestions, the common view is that a target is highly ambitious and multiple challenges need to be addressed considering current technology and costs.[5]

Fig 10. 10KW Floating Power Plant, West Bengal

VI. Conclusion

The concept of floating solar PV plant is recent and can increase the grid interactive solar power without additional land requirement. The design and performance of floating PV system requires more detailed research. Use of tracking system or concentrators can further increase the efficiency of the system. India being a peninsular country has large water bodies surrounding itself, showing a huge potential for floating PV plants as an offshore energy generation technology. The floating solar plants installed in India till now are on small scale and merely on trial basis. However India is slowly realizing the merits of the system and planning to install large number of floating plants to increase its share of renewable energy.

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