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DESIGN PARAMETERS OF 10KW FLOATING SOLAR POWER PLANT

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Abstract: The high energy demand and the constant depletion of the fossil fuels lead us to shift our focus to renewable energy sources which are not only the future unlimited source of energy, it is also eco-friendly and viable for the environment. Hydro and Wind though are renewable sources but are area specific. Solar energy on the other hand can be installed in any place. The major issue with the solar energy is the requirement of land which is scarcely available in the world and even costly to get. But floating solar plants can be installed in any water bodies which will not only reduce the cost of the land but will increase the amount of generation with the cooling effect of water. This paper concentrates upon the design parameters of the floating platform but will also focus upon the effect of panel shade on the ecosystem.

Keywords: Floating Solar, Design parameters, Floating Platform, ecosystem, renewable

INTRODUCTION

Solar energy is energy produced by sun created through a thermonuclear process and this process crates heat and electromagnetic radiations. These electromagnetic radiations have the energy that reaches the earth.

As solar energy is an indirect source of energy so we need two components: one the collector and other the storage device initially. The collector will collect the radiations coming from the sun and convert it in the form of electrical energy. One the other hand we require storage unit since the radiations keeps varying throughout the day and during night hours there will be no radiations.

Now let us discuss the types of collectors. These are of three types-

1) flat-plate collectors,
2) Focusing collectors,
3) Passive collectors.

Most of the time we use flat- plate panel which is a combination of array of solar

cells arranged in a simple plane. The output of these panels depends upon the size of panel, intensity of radiations and the cleanness of the panel.

Now with the concept of floating solar we are enchasing the availabilities of water bodies in different regions. Since with this idea we do not have to utilize a large area, so the problem of land for the solar plant can be easily solved. Also, keeping in mind the fact that land acquisition in India is not an easy task, this sort of an idea keep itself away from disputes.

A solar cell or PV cell converts solar energy into electrical energy by the photo voltaic effect. When the sunlight is incident upon a material surface, the electrons present in the valence band absorb energy and, being excited, jump to the conduction band and become free. These highly excited, non-thermal electrons diffuse, and some reach a junction where they are accelerated into a different material by a built-in potential (Galvani potential). This generates an electromotive force, and thus the light energy is converted into electric energy.

An Array of solar panels are used to generate electricity. The output of solar panel is of DC (Direct current) nature. The output of each solar panel is combined through the combiner who has two input ports and two output ports and has connected with the lightening arresters and store in the storage device. Output of the combiner is attached to inverter which converts DC into 3-phase AC. The 3 phase AC power is then given to meet the load demand or fed to grid.

Now introducing the concept of floating to the above previous theory is what we aim to do. With this, the basic idea is that, we float the solar panels over the water bodies. With this not only we can solve the problem of land as we have discussed earlier but there are many other environmental benefits that we can accomplish.

We all know, that during summers canals face the threat of drying up due to which irrigation problems arise. With floating solar, around 70% of the evaporation could be prevented which would in turn help in the retaining sufficient amount of waters in the canals and small river bodies. Also, algae formation in the water bodies can be reduced as the amount of sunlight entering into the water would decrease which in turn reduce the photosynthesis process to produce less algae in water. This makes water less contaminated and helps the aquatic life in sustaining.

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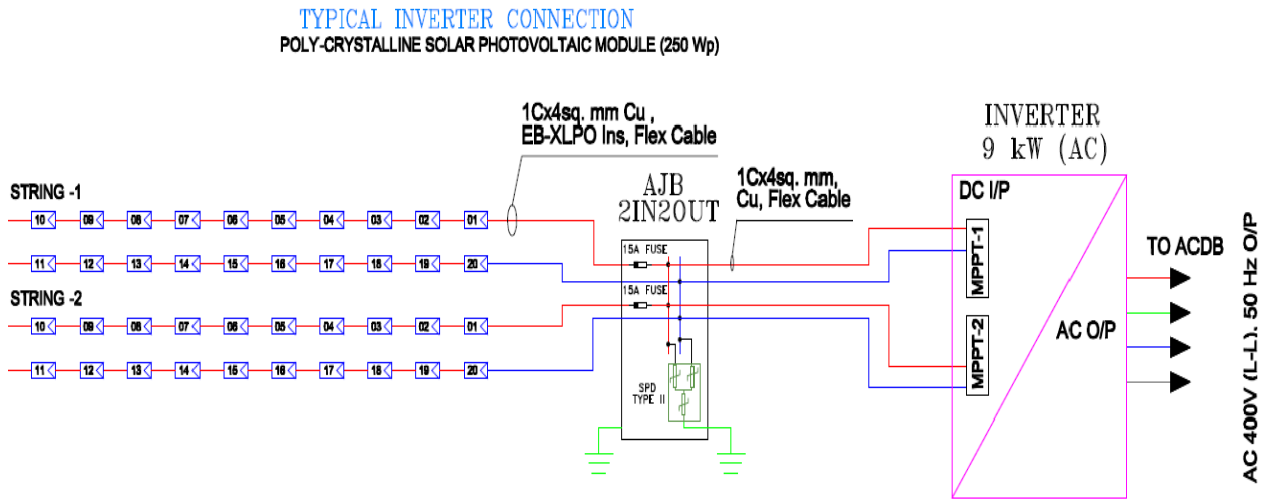
PUPOSE OF THE PROJECT

PV Generating Stations require disproportionately large land area compared to other generating modes. In view of the demand of land in the country in general, setting up large PV Stations faces the problem of land acquisition in most part of the country. On the other hand, innumerable water bodies, large and small, are available throughout the country. If small Panels of PV Stations can be developed, which would require a small depth of water for floatation, they may be put up in ponds wherever needed. The cumulative generating capacity could be substantial.

CONSTRUCTIONAL DETAILS



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 sheetto provide maximum protection from the severestenvironmental conditions. High torsion and corrosion resistantanodized aluminum frame provides structural strength and ease of installation. The junction box of module is located back side. In each module junction box there are two terminal both –ve & +ve terminal. To minimize the loss in output when shading occurs a Bypass diodes which is connected to out terminal of the module. The aluminum frame of Module contains holes in suitable positions for mounting. A photovoltaic module is a packaged interconnected assembly of photovoltaic cells, which converts sunlight into energy. The modules are PID protected.

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. Inmost 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. The Grid connected inverter range is state of the art equipment with robust control platform, high efficiency, high availability, low maintenance features built with quality components. Grid connected inverter is single / three phase output inverter system. 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. The inverters (3-phase) will be

designed with innovative, cutting-edge technology. 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) MODULE MOUNTING STRUCTURE-

The module mounting structure is designed for holding suitable number of modules in series over rooftop. The frames and supporting structures are made of galvanized steel post, hot dip galvanized material of suitable sections

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of angle, channel, tubes or any other sections conforming to meet the design criteria. All fasteners considered for fastening modules with this structure are of very good quality of stainless steel. The array structure is designed in such a way that it will occupy minimum space without sacrificing the output from SPV panels at the same time.

4) 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.

5) 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 beno 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.

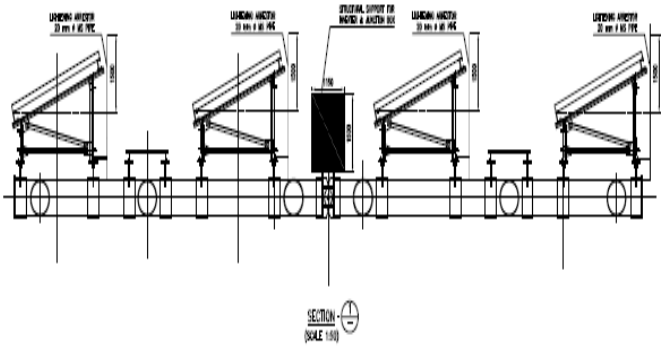
6) MOORING ARRANGEMENT

The assembled Platform has to be held in a position allowing for slight movement due to change 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.

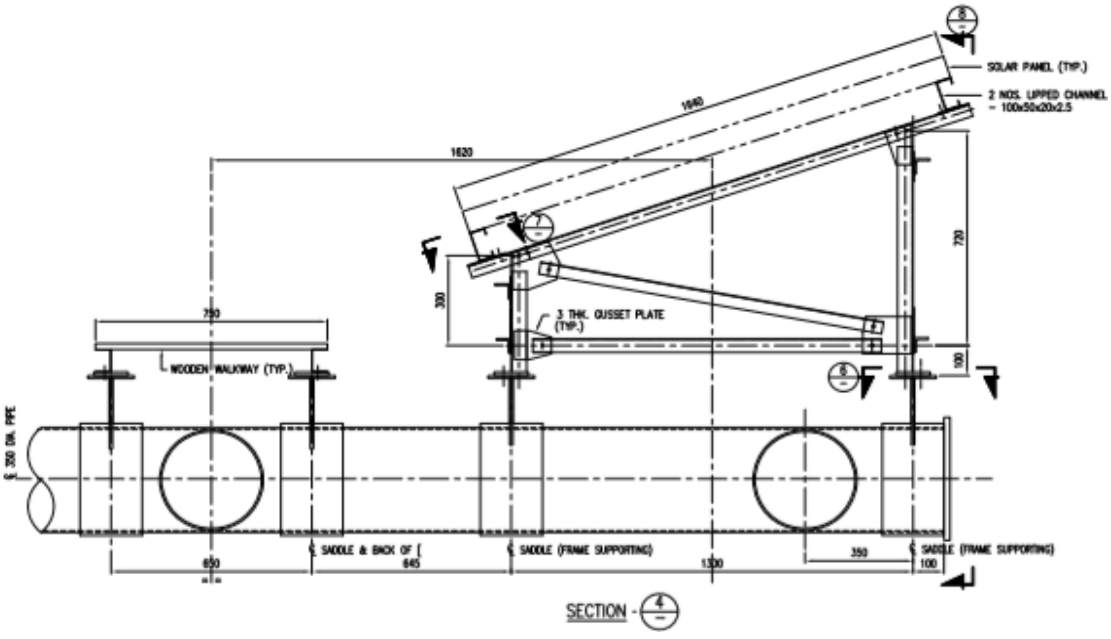
7) ACCESS GANGWAY FROM THE BANK

A permanent approach gangway from the bank may be dispensed with for cost saving and a small boat may be used for occasional purpose of cleaning the panels and maintenance. By placing the platform close to the bank, no boat will even be required.

8) ELECTRICAL INSTALLATIONS ON THE BANK



DESIGN PARAMETERS



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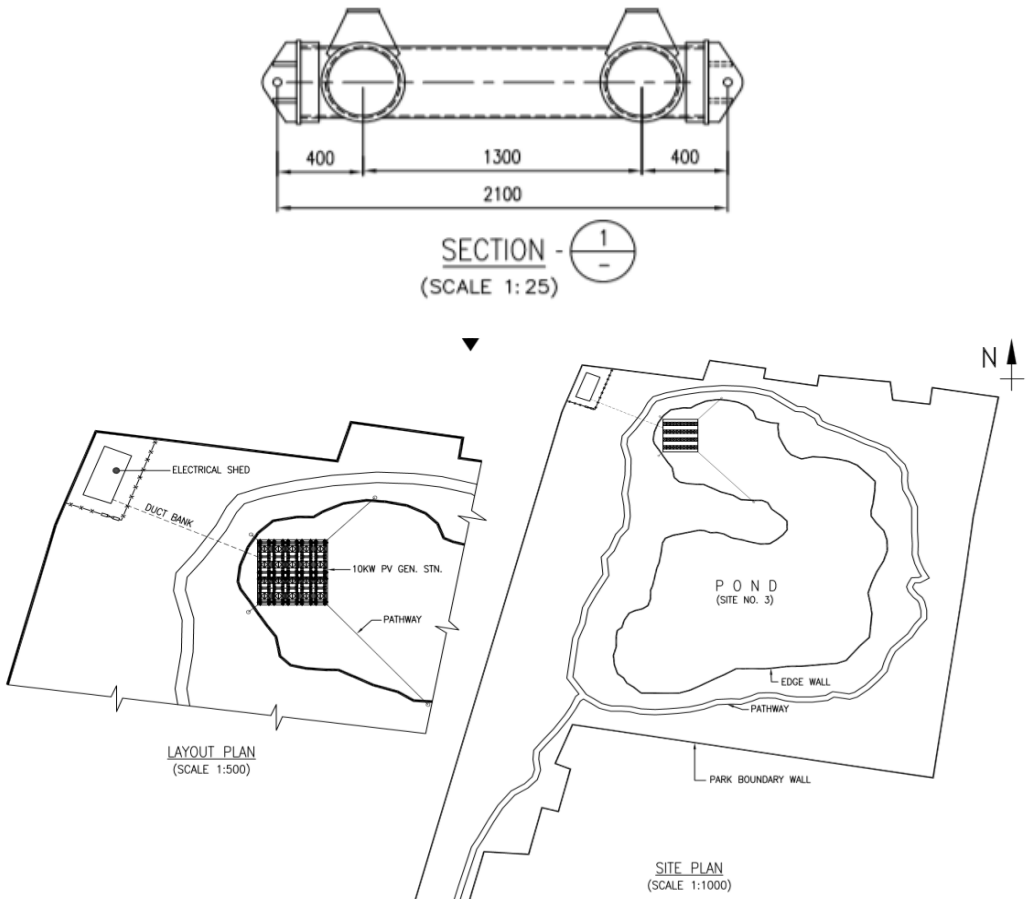

Each module will carry four PV Panels having a generating capacity of 1kW. The module will be complete with maintenance walkways. Ten such modules will be required to produce 10kW of power. The modules will be arranged in two rows of five modules each. The inter-connection will be through pins so that slight rotational movements caused by wind or ripples in water surface are permitted which will relieve stresses in the Platform members.

Walkways are placed between two rows of panels and also on surrounding periphery for easy access at all locations. To match the layout two types of Platform Module will be required as detailed in drawings.

In view of protection against corrosion, GRP tubes will be used in the construction of the platform Panels which will always be partly immersed in water. The supporting saddles will also be in GRP integrally connected with the tubes. The walkway supporting structures will be cold rolled channels and galvanized for corrosion protection. The walkway Panels will be of 20mm thick timber planks for low self weight and painted for protection. The panel supporting structures will also be of cold rolled channels and angles, all galvanized and bolted together.

Since weight to be carried is small, small thickness cold rolled sections are selected to reduce total load on the Platforms to the practicable minimum.

The modular Platform Panels are about 5.61m by 2.10m in size and weigh only about 140kg each. Therefore, a number of modular Platform Panels can be stacked up on a truck for transportation from factory to installation site. The other components to complete the set up will be separately delivered to site.

A suitable timber slipway will be erected at site for launching the modules. A Platform module will be placed on the slipway and the walkways and PV Panel supporting structures erected there on. A completed module formed thus will be launched followed by other modules. The floating modules will connected with each other to form the total configuration.

CHALLENGES

1) The maximum Wind speed that the plant can bear is up to 210 km/h. This is the reason Cyclonic and Typhoon area covered with special design to prevent any damage.

2) The water Current could be maximum max speed 2 m/s .

3) Though the project is initially tested in still water but it also has a scope to have height up to 1 meter.

4) Temperature limits under which the solar panel can operate is between -5°C to50°C.

5) Solar panel can bear Snow load of 70DaN/m². Beyond this limit its efficiency get affected.

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6) As solar panel structure is surrounded by the water and the moisture due to which there occurs corrosion phenomenon which will affect the strength of the floating solar structure.

CONCLUSION

(a) Panels are naturally cooled as the air just above the water bodies has high content of moisture and hence it automatically solves the issue of heating losses that occur during its operation.

(b) Reduce evaporation by up to 70%.

(c) Cement structures like boilers and chimneys that are used in power plants like thermal have no scope in such a plant. Also electro-mechanical machines like generators are not required which reduce the amount of steel structures in the plant. Therefore, such plants are comparatively more eco-friendly.

(d) It can also improve water quality. As water bodies are exposed to the sun, photosynthesis promotes growth of organic matter, including algae.

By shading the water, algae growth is reduced, minimizing the associated treatment and labor costs.

Moreover the concept of more generation due to cooling of the panel surface can be experimented in due course as the investment is nearly 1.2 times the conventional land solar plants.

REFERENCES

[1] M. Abdolzadeh and M. Ameri, "Improving the effectiveness of a photovoltaic water pumping system by spraying water over the front of photovoltaic cells", Proceedings of ISES World Congress, **(2007)**.
[2] J. J. Wysocki and P. Rappaport, "Effect of Temperature on Photovoltaic Solar Energy Conversion", The American Institute of Physics, AIP, **(1960)**.
[3] E. Radziemska, "The effect of temperature on the power drop in crystalline silicon solar cells", Renewable Energy, vol. 28, no. 1, **(2003)**.
[4] C. Hark sun, "A Study on Development of Syntactic Foam(I)", The Korean Society of Ocean Engineers, **(1992)**.
[5] H. Haeberlin and J. D. Graf, "Gradual Reduction of PV Generator Yield due to Pollution", 2nd World conference on Photovoltaic Solar Energy Conversion, **(1998)**.
[6] Haman Photovoltaic Power Plant, http://haman-solar.iptime.org/.
[7] K-water, Groundwork research for Commercialization of Floated Photovoltaic System, **(2011)**.
[8] Y. K. Choi, N. H. Lee and K. J. Kim, "Empirical Research on the efficiency of Floating PV systems compared with Overland PV Systems", CES-CUBE 2013, Guam, USA, **(2013)** July 19.
[9] S Bergermann,(1997), The solar chimney transferability of results from Themanzanarus solar chimney plant to large scale plants', report, s bergermann and partner, Civil Engineers, Stuttgart , Germany
[10] Solar turbine power stations with floating solar chimney of Prof. Christos D. Papageorgiou School of Electrical & Computer Engineering N.T.U.A. Electrical Machines Laboratory [2004] and [2005]
[11] Mr. K.V. Avinash, Software Engineer Infosys Tech. Ltd.
[12] www.math.purdue.edu.com