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TECHNICAL REVIEW OF ENERGY HARVESTING THROUGH: FLOATING SOLAR STATIONS

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Abstract: Solar Power is a renewable energy source, a clean form of energy that converts the sun's radiation into usable energy. The use of solar power helps reduce greenhouse gases (CO_2, NO_2…) offering an alternative to fossil fuels. The Earth's surface receives more energy from the sun in a single hour than the world's population uses in a year. The constant usability of the fossil fuels and high energy demand of sources focuses us towards the use of renewable energy sources. The major problem in environment is the availability of these renewable energy sources and its cost. A new era in solar power, i.e., "Floating Solar Stations" will solve this issue. This floating solar station can be installed in any water bodies (like oceans, lakes, lagoons, reservoir, irrigation ponds, fish farms, dams and canals) which will not only decrease the cost of the amount of the generation with the cooling effect of water. This paper presents the technical details of the floating solar power plants, its benefits and the future in eco-friendly environment.

Keywords: Alternate energy sources, Eco system, Floating power plants, Photovoltaic system.

I. INTRODUCTION

We can't imagine a world without electricity and it has now become an integral part of our life. Rapid economic growth has created a growing need for ensuring reliable, round the clock supply of electricity. [2]

One of the largest challenges before India today is the Power Crisis. More than 300 million Indians have no access to electricity. India's power sector could supply just 124,000 MW for a country of more than 1.2 billon people. Even the supply is not regular for those who are accessing electricity. To meet the demand of India, our focus should be on the use of alternate energy sources. Renewable energy sources like hydro, wind and solar are area specific. With India being the 7th largest country in terms of area and gifted with fairly well sunshine nearly 300 days in a year. [3]

Solar power plays a dominant role in the world-wide effort to reduce greenhouse gases; it is considered a clean energy and an efficient source of electricity. Yet several obstacles have been un-determining for the expansion of this sector and many of its actions are looking
for new approaches that would make solar power more practical and commercially attractive. Water utilities often have suitable water sources such as storage reservoirs and open channel aqueducts where floating solar stations could be installed. [3]

The largest increase in energy demand in developing countries is expected to increase from 46% to 58% between 2004 and 2030. [4]

India has the world's 3rd largest electricity generation capacity and it is the 4th largest energy consumer accounting for 4.8% of global energy consumption. Due to the fast-paced growth of the Indian economy, the country's demand has grown at an average of 5.2% per annum over the past 30 years. [5]

II. SOLAR ENERGY

Solar energy is radiant light and heat from the sun that is harnesses using a range of ever-evolving technologies such as solar heating, photovoltaic's, solar thermal energy, solar architecture and artificial photosynthesis. [6]

Solar energy works on the simple principle, the sun's ray's fall on solar cells which converts sunlight into electricity. When sunlight hits the surface of the panel it excites electrons in the cells and they start to flow out as direct current. The direct current gets converted to alternating current using inverters and finally in most cases the charges gets exported through the grid on a large scale. [7]

Fig1: Fire lamp usage

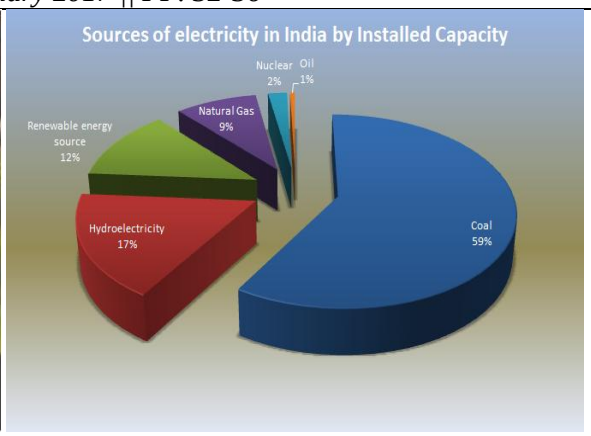

Fig2: Chart of sources of electricity in India

III. FLOATING SOLAR STATIONS

Unlike land-based solar plants, floating solar power plants are installed on water reservoirs like dams, lakes, rivers, oceans, etc. The solar panels will be mounted on floating platforms that are anchored tightly so that they do not get damaged even under the worse weather conditions. Moreover, research suggests that solar panels installed on land surfaces results in the reduction of yields, as the ground gets heated up and affects the rear surfaces of solar panel. Studies also suggests that if the rear surfaces of solar panels are placed on the top of the water, the solar panels will be able to cool themselves more efficiently which means they will last longer and they can shade the water they **float** on which reduces evaporation by up to 70%, also their ability to generate power goes up as high as to 16%. [8]

A photovoltaic (PV) floating power generation results from the combination of PV plant technology and floating technology. This fusion of new concept consists of floating system which is a floating body (structure + floater) that allows the installation of the PV module, PV system i.e. PV generation equipment, similar to electrical junction boxes, that are installed on top of the floating system and underwater cable which transfers the generated power to the PV system development. [9]

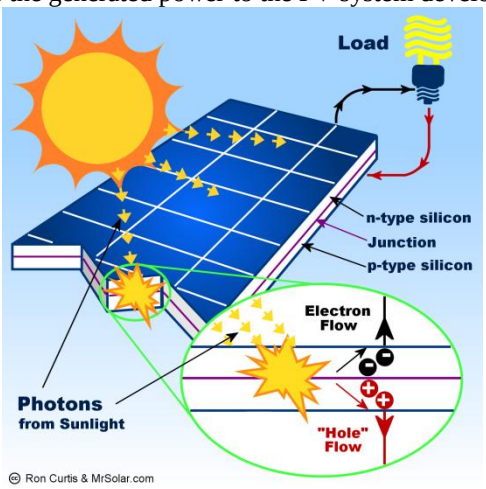

Fig3: Solar Panel Diagram

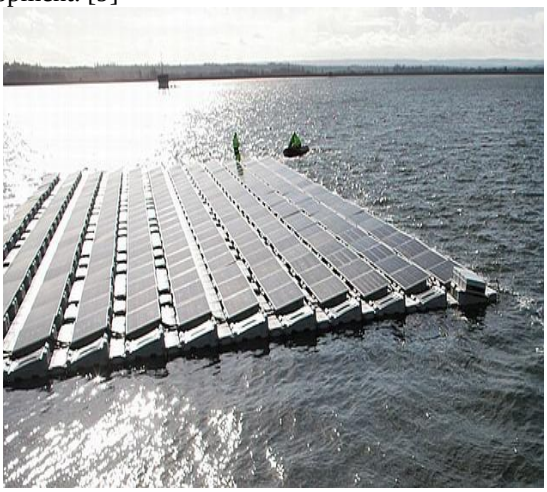

Fig4: Floating solar station in Japan

IV. MATERIAL CHARACTERISTICS

The material used for structure should be completely non-toxic, resistant to salt water and alkalis acids, UV rays resistant and completely recyclable. The structures should be able to withstand temperatures from -60°C to 80°C. Long life time that is 30 years withstand capability underwater. Main materials for the modules of structures are plastic float elements and stainless steel elements. The plastic structures are made by LUPOLEN 5261Z or PEAD materials which are used for construction of jetties both in marine and military fields. The other material suitable for floating solar stations is HDPE (High Density Poly Ethylene) materials. These HDPE structures are preferred due to their low cost and high reliability. The life time of HDPE structures of floating solar power systems is more than 20 years. [9]

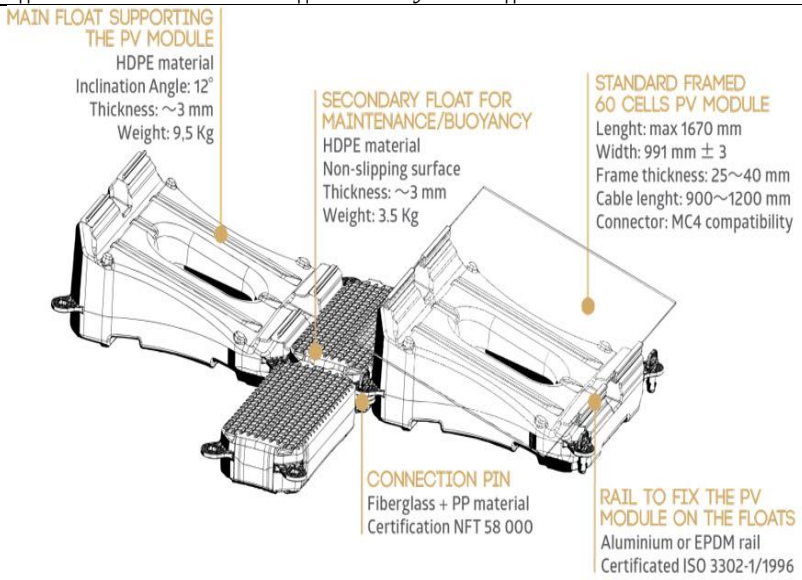

Fig5: Material structural representation

V. DRAW BACKS OF PRESENT SOLAR PROJECTS ON LAND

Most of the solar energy systems on the market today bare 2 major weaknesses, they require vast land areas in order to be built and the costs related to solar cells fabrication and also its maintenance is high and is less efficient than floating solar stations.

Example- Tamil Nadu is the state with highest installed solar power capacity in India as on 21st September 2016. Kamuthi solar power project with 648MW capacity at a single location was formally dedicated to the nation. Investment of Rs 4550 core, which consists of 3.80lakh foundations, 25lakh solar modules, 27000mtr of structure, 576 investors, 154 transformers along with 6000km cables.

Fig6: View of Kamuthi solar power plant

VI. Available dams in Karnataka

Bhadra dam, Harangi reservoir, Kadra dam-power, Kodasalli dam –power, Krishna raja sagara-drinking water and irrigation, Lakkavalli, Supa dam-power, Thippa gondanahalli reservoir-drinking water for Bangalore, Tungabhadra dam-power generation, Vani vilasa sagara-drinking water, Almatti dam.

Let us consider the Bhadra dam, it has a surface area of 11250.88hectares (27801.5acres). On this surface, solar panels can be installed for generation of solar power. If we can utilize 1% of the dam space (i.e. 120hectres approx.) using 339360 (270watt) modules we can produce 49MW of power which can be utilized to light up all the villages in shimoga district.

Fig7: View of Krishna raja sagara dam

VII. Major Problems Occurring in Floating Solar Stations

Wave and tides in oceans and seas, can be controlled using protection dip technique, which is reliable.

Thunderstorms, occurs on surfaces which are higher than the sea level, in rare cases when thunder strikes occur regularly then we can use some lightening protections like wire bundle shields, ground straps, aluminum flame spray coating etc., which are being used in aircraft industries.

Climatic or weather changes, we can place the weather forecast system with sensors at a place 1km away from the floating solar stations such that the position of the panels changes its directions and gets submerged into water to avoid strong winds and air turbulences.

Animals (aquatic animals), are not disturbed by the installation of floating solar station.

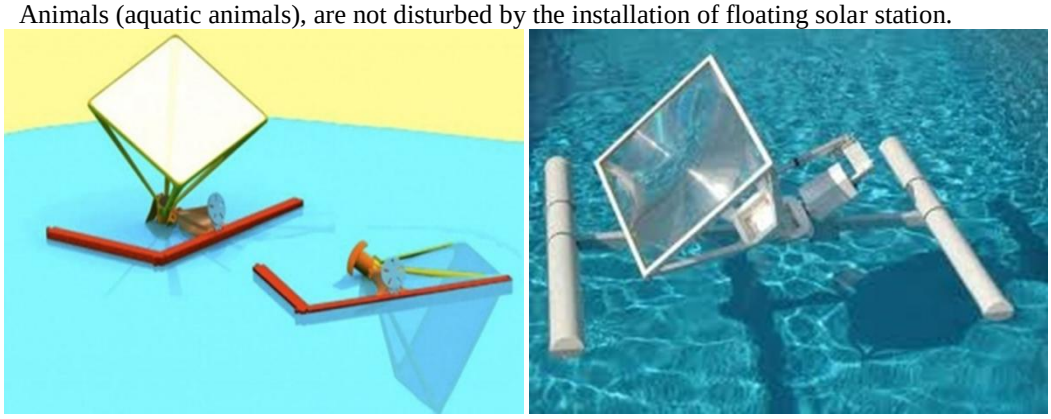

Fig8: Prototype view of Protection Dip Technique

VIII. Past History and Future Plans

Kyocera has been developing floating solar power plants since 2014 to take advantage of the abundant lakes and reservoirs in Japan. In March their first two plants went online—a 1.7 MW and a 1.2 MW plant. A third 2.3 MW plant was launched in March 2015. The Yamakura Dam solar plant represents a major increase in energy output for the floating solar panel design. The generated electricity is planned to be sold to the Tokyo Electric Power Company. Japanese electronics manufacturer Kyocera Corporation announced that construction has begun on the largest floating solar power plant in the world in terms of energy output, according to a press release from Kyocera. The 13.7 megawatt (MW) power plant will float on the waters of the Yamakura Dam reservoir in Japan. The plant is being constructed by Kyocera TCL Solar, a subsidiary of the Kyocera Corporation.

This is Kyocera's fourth floating solar power plant in Japan. The Yamakura Dam solar plant is scheduled for launch at the end of March 2018. Once it is complete, the 50,904 (270-watt) modules spread out over 180,000 square meters should pump out 16,170 megawatt hours (MWh) per year. This is equal to about 19,000 barrels of oil or enough to power almost 5,000 households. [10]FFFF

Floating solar projects are popping up in all corners of the world, from Japan, UK, Brazil, the US, and Australia. Also in India, the project is successfully implemented in West Bengal, the main objective was to explore unutilized water bodies and not consume the ever-decreasing land. An expert team is currently working on the prototype which is funded by the Indian ministry of new and renewable energy.

Fig9: View of Yamakura dam solar plant

Fig10: Switzerland floating solar station

IX. Conclusion

Floating solar stations is courting markets in developing countries that are plagued by electricity shortages but have abundant water resources and intense sunshine. We can out that unproductive land into productive use while reducing our electric costs. With the advancement in solar photovoltaic system, the floating solar station plays a vital role. Any solar power you generate on the dam allows you to feed the transmission line and save water in the dam for use on rainy days or at night. If you have a drought on a hydroelectric dam, your asset is dead. "If you have solar power on that dam, you can continue to generate electricity".

Compared to land installed solar power plants this floating solar plant has higher benefits, higher advantages and also eco-friendly where all the parts used are recyclable.

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