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Further Development of Offshore Floating Solar and Its Design Requirements

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Abstract : Floating solar was not very well-known in the renewable energy field a decade ago; however, there has been tremendous growth internationally with a Compound Annual Growth Rate (CAGR) of nearly 30% in recent years. To reach the goal of global net-zero emission by 2050, all renewable energy sources including solar should be used. Considering that 40% of the world's population lives within 100 kilometres of the coasts, floating solar in coastal waters is an obvious energy solution. However, this requires more robust floating solar solutions. This paper tries to enlighten the fundamental requirements in the design of floating solar for offshore installations from the hydrodynamic and offshore engineering points of view. In this regard, a closer look at dynamic characteristics, stochastic behaviour and nonlinear phenomena appearing in this kind of structure is a major focus of the current article. Floating solar structures are alternative and very attractive green energy installations with (a) Less strain on land usage for densely populated areas; (b) Natural cooling effect with efficiency gain; and (c) Increased irradiance from the reflectivity of water. Also, floating solar in conjunction with the hydroelectric plants can optimise energy efficiency and improve system reliability. The co-locating of floating solar units with other types such as offshore wind, wave energy, tidal turbines as well as aquaculture (fish farming) can result in better ocean space usage and increase the synergies. Floating solar technology has seen considerable developments in installed capacities in the past decade. Development of design standards and codes of practice for floating solar technologies deployed on both inland water-bodies and offshore is required to ensure robust and reliable systems that do not have detrimental impacts on the hosting water body. Floating solar will account for 17% of all PV energy produced worldwide by 2030. To enhance the development, further research in this area is needed. This paper aims to discuss the main critical design aspects in light of the load and load effects that the floating solar platforms are subjected to. The key considerations in hydrodynamics, aerodynamics and simultaneous effects from the wind and wave load actions will be discussed. The link of dynamic nonlinear loading, limit states and design space considering the environmental conditions is set to enable a better understanding of the design requirements of fast-evolving floating solar technology.

Keywords : floating solar, offshore renewable energy, wind and wave loading, design space
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