WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Concept of Canal Top Solar Power Plant

Miss Asha Hanaji

Under Graduate Student, Department of Civil Engineering,KLS Gogte Institute of Technology, Belagavi
Email: ashashanaji@gmail.com

ABSTRACT-

Generating solar energy from barren territory or rooftops is a critical problem under the smart city program, a need that is difficult to meet in metropolitan and other large cities. In light of the country's extensive irrigation canal network, the idea of constructing a solar PV plant on the canal's top has been adopted. For the first ten years, the power output of ground-mounted PV panels typically drops by 1% on a flat basis. In contrast, a recent study conducted by Gujarat Energy Research and Management Institute (GERMI) found that consistent generation may be achieved even after three and a half years of continuous operation and solar exposure. This is a big achievement that will extend the life of the canal-mounted solar panels beyond 25 years. The canal top serves as the best administrative model for community-scale solar water pumping and village electrification. The canal-top solar PV project is critical to the smart city initiative and the national solar mission.

Key words: Solar PV panels, Renewable energy, Canal top, evaporation

Introduction

India, a country with a rapidly growing population (nearly 1.2 billion as of Census 2015) and a growing energy demand, faces a huge problem in producing energy while maximizing the use of existing resources. In this environment, the state of Gujarat devised an innovative and cost-effective approach for mounting and producing solar energy using existing irrigation canals. The average energy demand per capita in India is 1,010 kWh, according to the Central Electricity Authority of India. Despite the fact that India has the lowest per capita energy demand in the world, there is a significant need to improve energy generation as India emerges as one of the world's major manufacturing nations. India acknowledges the need of creating clean energy and has enacted a number of laws to that end. Over 70% of the country's electricity is now generated by fossil fuels, but the government has set a goal of 175 GW from renewable resources by 2022, according to the draft National Renewable Energy Act. To address difficulties of environmental protection and rehabilitation caused by renewable energy projects, the proposed act incorporates provisions from the Electricity Act of 2003, the Land Acquisition and Rehabilitation and Resettlement Act of 2013, and the Environment Protection Act of 1986.

It is for this reason that renewable energy, particularly solar energy, is being vigorously promoted in India. Land, on the other hand, is a valuable commodity in India. It's difficult to justify the use of land for solar plants when that space may be used for living, cultivation, or manufacturing. India has set a lofty goal of achieving 100 GW of solar PV plant installed capacity by 2022. If all of the plants were to be put in one location, the amount of land required would be 1.5 times that of the state of Delhi. Solar energy generation from barren territory or rooftops is a critical problem under the Smart City Programme, a condition that is difficult to meet in metropolitan and other large cities. In 2012, the Gujarat government proposed the construction of a solar PV plant on the canal top, based on the country's extensive irrigation canal network, and the first pilot demonstration project was established near Sanand, Gujarat (Figure 1).

Figure 1: World's first demonstration of canal top solar PV plant at Chandrasan, Gujarat

Engineering Marvel

Large structures had to be built without causing damage to the canal and its function, which was a difficult undertaking. The canal bed was around 4 meters broad, while the canal bank was over 6 meters wide. A structure of 16 m width was created to fit on any big canal to provide an exemplary structure design that may be easily copied in the future. A number of issues arose during the structure's construction. The construction of a structure in the canal's flow channel would have greatly hindered the flow of water. As a result, the structure was only designed with end supports. Despite the fact that this design raised the project's cost, it produced a concept that could be repeated in the future for canals with water flow issues. Galvanization of massive buildings was also a significant production concern. A zone of high air flow was produced beneath the mounting structure, akin to a wind tunnel. The concept of a wind breaker was developed to lessen the risk of structural damage caused by high wind speeds. This reduces wind speed greatly, preventing damage to the structure.

Superior Performance

When solar cells are heated, the voltage output of the cells decreases. Solar PV plants often lose 10–15 percent of their available energy on an annual basis as a result of this. These losses result in an annual loss of final power of up to 8%. The solar cells put on the canal top were found to be cooler than their land-based equivalents. As a result, the average temperature of the cells dropped by 10%. As a result, the plant generated much more electricity than a ground-mounted solar PV system. Since its start, the facility has offered a capacity utilization factor (CUF) of roughly 17.71 percent, which has remained nearly constant. In addition, when compared to a standard ground-mounted solar panel system, the canal-mounted solar plant experienced less panel degradation. For the first ten years, the power output of ground-mounted PV panels typically drops by 1% on a flat basis. In contrast, a recent study conducted by Gujarat Energy Research and Management Institute (GERMI) found that consistent generation may be achieved even after three and a half years of continuous operation and solar exposure. This is a big achievement that will extend the life of the canal-mounted solar panels beyond 25 years. As a result, it is clear that using a canal-mounted solar PV plant can result in long-term financial benefits. This, in turn, would allow greater resources to be allocated to similar projects.

Saving of Resources

As the world's population grows, so does the need to address the issue of water scarcity. It becomes a critical issue for a country that relies solely on the monsoon for its annual water supply. The solar panels on the canal's top block the sun's rays, allowing the water to remain in the shade. The evaporation of the water in the canal is reduced as a result. A 1 MW plant can save 9 million litres of water per year, according to conservative calculations. A huge amount of water is saved as the area covered by solar panels grows. The abundance of sunlight and moisture in the canals encourages algae growth. Algae choke and obstruct irrigation and water pumps, lowering water quality. As a result of the installation of solar PV panels and the lack of sunshine, algae development is substantially reduced. This cuts down on maintenance costs and increases the life of irrigation equipment. In addition, the irrigation pumps can be powered by the solar panels. Because the pumps are frequently placed in remote regions, this would help address the issue of electricity transmission while also strengthening the system. As a result, the canal top serves as the finest administrative model for a community-scale solar-powered water pumping/village electrification project. Because solar pumps are vulnerable to theft, mistreatment, and poor maintenance, they no longer need to be installed in isolation. Canal top provides a more efficient administration model. The authors anticipate that the canal top solar PV project will play a significant part in the Smart City Initiative, the National Solar Mission, and increased irrigation pump usage. Another benefit of the canal top solar power plant is that it generates energy closer to the point of consumption. As a result, electrical transmission and distribution losses are reduced, allowing urban and rural areas to generate their own power. The generation at remote consumption centers would also allow the grid to be strengthened, which would increase the power supply's reliability. In addition, the project's implementation could result in a slew of intangible benefits. Furthermore, the ecology and inhabitants of the area along the canal, as well as the flora and animals, have been unaffected. Workers from both rural and urban areas have been employed on the project, in both skilled and unskilled positions. Working on the plant's operation and upkeep would also assist to generate interest, which would lead to similar projects in the future.

Replication

The canal top power plant has tremendous replication potential. The project is simple to get started because only a few approvals and clearances are necessary. It also has a shorter implementation time because no land purchase or development is required. Because irrigation canals can be found all over India, it's a simple and cost-effective model to replicate. There is an 80,000-kilometer canal network in Gujarat alone, where the pilot project is being implemented successfully. Even if 30% of this canal network is utilised for solar PV plant installation, according to the Gujarat State Electricity Corporation Limited (GSECL), it can create up to 18,000 MW of power and save 90,000 acres of land. Similar vast canal networks may be found throughout the country, offering a cost-effective and efficient energy generation model. Many more canal top plants have been built in India: a 10 MW plant has been built in Vadodara, Gujarat (Figure 2), a 1 MW plant has been built in Karnataka, and a canal top plant has been built in Andhra Pradesh. It's worth noting at this point that similar canal networks can be found all over the planet. Furthermore, the possibilities for expanding on this concept are limitless. Recognizing its significance, the Indian government has created a policy to absorb 100 MW of additional capacity through canal top solar projects. For the year 2015, the GSECL's first pilot project won the coveted Prime Minister's Award for Best Project in Public Administration.

Figure 2: 10 MW canal top solar PV plant in Vadodara City, Gujarat

Conclusion

The canal top solar power plant is a novel concept that makes optimum use of land while conserving water. For smart village, smart city, and irrigation projects, it gives a better administrative approach. It can also be built through a public-private partnership (PPP). Canal top projects are projected to capture a larger share of national solar targets as costs decline. Solar power projects in India could be deployed faster and more cost-effectively if large-capacity canal top solar parks are built

References

[1] Ming-Tse Kuo, Wen-Yi Lo, "A combination of concentrator photovoltaics and water cooling system to improve solar energy utilization", IEEE Transactions on Industry Applications, vol. 50, no. 4, July/August 2014.

[2] Subhash Kumar, Tarlochan Kaur, "Solar PV performance-issues and challenges", International Journal Of Innovative Research In Electrical Electronics Instrumentation And Control Engineering, vol. 2, no. 11, pp. 2168-2172, November 2014.

[3] David L. King, William E. Boyson, A Jay, "Analysis of factors influencing the annual energy production of photovoltaic systems", IEEE Transactions On Photovoltaics, vol. 5, no. 3, July 2002.

[4] Deethumol Augustin, Rani Chacko, Joffie Jacob, "Canal top solar energy harvesting using reflector", Global Research and Development Journal for Engineering, vol. 1, no. 8, pp. 26-31, July 2016.

[5] Taylor Briglio, Jessica Galvan, Kelsey Ivan, "a feasibility analysis of installing solar photovoltaic panels over california water canals", UCLA Institute of the Environment and Sustainability, June 2014.

[6] Antonio Colmenar-Santos, Angel Buendia-Esparcia, Carlos de Palacio-Rodrguez, David Borge-Diez, "Water canal use for the implementation and efficiency optimization of photovoltaic facilities: Tajo-Segura transfer scenario", Journal on Solar Energy, pp. 168-194, January 2016.