iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** III **Month of publication:** March 2023

DOI: https://doi.org/10.22214/ijraset.2023.49527

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue III Mar 2023- Available at www.ijraset.com

A Hydroelectric Plant's Performance Evolution

Sushrut Patki[1], Ramesh Mote[2], Mangesh Mahajan[3], Rohit Jadhav[4], Rushikesh Pawar[5], Tushar Mohite[6]
Department of Electrical Engg. Sanjay Bhokare group of Institutes, Miraj

Abstract: ***Water's potential energy is used to generate electricity in hydroelectric power plants. It generates clean energy. Water may be utilised for agriculture and other purposes after it has been used to generate power. In 1882, a waterwheel on Wisconsin's Fox River was used to generate electricity for the first time.***

Early in the twentieth century, hydropower continued to play an important role in the global expansion of electrical service. Hydroelectric power plants range in size from a few hundred kW to thousands of MW. For generating capacities less than 100 KW, they are classified as micro hydro power plants. As a renewable and clean source, hydroelectric power plants are far more reliable and efficient than fossil fuel power plants. As a result, small to medium-sized hydroelectric generating stations were upgraded wherever there was a sufficient supply of moving water and a demand for electricity. Small hydro plants fell out of favour as electricity demand increased in the middle of the century and the efficiency of coal and oil-fired power plants improved. Hydropower plant megaprojects have been created. The bulk of these power plants used enormous dams to flood large amounts of land in order to provide water storage and hence a continual supply of energy. The environmental implications of such huge hydro projects have recently been noted as a source of concern. Developers are finding it increasingly difficult to build additional dams due to objections from environmentalists and residents in the flooded areas. As a result, the necessity for small-scale hydroelectric power plants in the form of mini and micro hydro power plants has developed. Malaysia has no micro hydro power plants, and the smallest category of hydro power plants in Malaysia is mini hydro, with capacities ranging from 500 kW to 100 kW. The purpose of this work is to explore the conceptual design and development of a micro hydro power plant.

Hydroelectric power generating is one of several methods for producing energy. Coal, natural gas, and oil were the three most commonly utilized energy sources in 2009. These sources not only emit hazardous pollutants to the environment, but they also deplete scarce resources. As a result, other energy sources must be investigated. The inherent energy of moving water is harvested by guiding the water through a turbine, which converts the energy of moving water into mechanical energy. In the generator, mechanical energy is turned into electricity.

The flow rate and pressure head of the water supply must be determined in order to select the right generator for a certain application. Small-scale hydropower is one of the most cost-effective energy options to be explored for rural electrification in developing nations. It is also the key hope for future hydro projects in Europe, where large-scale prospects have either been exhausted or are now deemed environmentally undesirable. Little hydro technology is incredibly durable and one of the most ecologically friendly energy sources accessible.

The growth of hydroelectricity in the twentieth century was commonly connected with the construction of big dams. Hundreds of large concrete, rock, and earth barriers were built across river valleys across the world to construct massive artificial lakes. Although providing a substantial, steady power source as well as irrigation and flood control benefits, the dams inevitably inundated significant areas of arable land and displaced thousands of local residents. In many situations, the dam's output and longevity have been diminished as a result of fast silting up. There are also other environmental issues that might arise as a result of such significant influence with river flows.

Keywords: Hydropower Plant, Dam, Canal, Hydro Energy

I. INTRODUCTION

Renewable energy is defined as energy produced from natural sources that are replenished at a faster rate than it is consumed. Sunshine and wind are two examples of such continually replenishing sources. Renewable energy sources abound and are all around us. Coal, oil, and gas, on the other hand, are non-renewable resources that develop over hundreds of millions of years. When fossil fuels are used to generate energy, they emit dangerous greenhouse gases such as carbon dioxide. Renewable energy produces much less emissions than burning fossil fuels.

Transitioning away from fossil fuels, which now account for the majority of emissions, and towards renewable energy is critical for tackling the climate catastrophe. Renewables are now less expensive in most nations and provide three times as many employments as fossil fuels.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue III Mar 2023- Available at www.ijraset.com

Hydropower captures the energy of transporting water from higher to lower heights. It can be produced by reservoirs and rivers. Reservoir hydropower facilities use stored water in a reservoir, whereas run-of-river hydropower plants use energy from the river's available flow. Hydropower reservoirs frequently provide numerous functions, including drinking water, irrigation water, flood and drought management, navigation services, and electricity delivery.

II. SCOPE AND RELEVANCE

Hydropower is now the most important renewable energy source in the electrical industry. It is dependent on relatively steady rainfall patterns and can be harmed by climate-induced droughts or changes in ecosystems that affect rainfall patterns. The infrastructure required to generate hydropower can potentially have a negative influence on ecosystems. As a result, many people believe that small-scale hydro is a more ecologically benign alternative, especially for isolated populations. In particular, the use of drones does allow the opportunity to get an overall survey of the area and make a better use of farmer time. For this purpose, our work aims at developing a system capable of analyzing the soil condition with a rapid flight. The idea is to approach a correlation between radar or satellite acquired parameters and soil roughness values obtained from RGB-D cameras or laser scanners.

III.LITERATURE REVIEW

1) O. P. Rahi, National Institute of Technology, Hamirpur Ashwani Kumar, National Institute of Technology, Hamirpur

Refurbishment and uprating of hydro power plants has become an important issue for power generation experts and the utilities because of perennial shortage of power and slow pace in new hydro power addition programs. As a result, in the recent years there has been great deal of interest in refurbishment and uprating of hydro power plants (HPP) for effective utilization of water potential. The concern about the issue has resulted from the large number of power houses in India which have outlived their useful life or are not operating optimally due to inadequacies in design. Hence, refurbishment and uprating of hydro power plants is the need of the day. To accomplish such a task various aspect of refurbishment and uprating of hydro power plants need to be reviewed. The present paper focuses on the research activities and practical experience in the area of refurbishment and uprating of hydro power plants. This exhaustive review consisting of about 214 research papers, reports, guidelines and standards will be of great help to the researchers, hydro power utilities and energy policy planners.

2) *International Conference on Research in Sciences, Engineering & Technology*

Hydroelectricity is electricity produced by the generators that are pushed by the water movement. This is one of the widely used sustainable power. One of the major advantages of the hydro power after constructing the plant is wastage is not created.22% of the word power is generated by hydroelectricity, which constitutes around about 78% of power from inexhaustible natural resources. The yearly hydroelectric creation of India is 115.6 TWh with an introduced limit is 33.6 GW. Miniature hydro is a word utilized for hydroelectric force establishments that commonly produce a power up to 300 KW of intensity. These establishments can give capacity to a disconnected home or little network of sloping territories, or are here and there associated with electric force organizations.

There are a considerable lot of these establishments around the globe, especially in agricultural countries as they can give a prudent wellspring of energy without acquisition of fuel. In the current paper an endeavor is made to portray the different parts of miniature hydro for creation of power in uneven regions like site evaluation, development and attributes, job of miniature hydro in supportable improvement and so forth.

3) Taalaibek Mederov, Kyrgyz State Technical University

In this article, the subject of research is hydro turbine systems for micro hydroelectric power plants, and much attention is paid to the hydropower potential and the possibility of their development. Electricity is important in the socioeconomic sphere. Hydropower is one of the most suitable and efficient renewable energy sources with over a century of experience in generating electricity. Capacity and construction are the two main criteria by which hydropower plants are classified. On the scale of power: large, small and micro hydropower.

By design: dam structures with a reservoir, run of river, pumped storage, in stream. The purpose of the study was to review and analyze the potential of hydropower, as well as various designs of hydro turbines. Various types of hydraulic turbines have been studied. The classification of hydraulic turbines for small and micro hydroelectric power plants is given. General descriptions of hydraulic turbines, their elements and characteristics are presented. Recommendations are made for a suitable hydro turbine for various small hydro power plants.

4) Gaurang Chaudhari, C.K. Pithawalla College of Engineering & Technology

Renewable energy is one of the best options for challenging situation to supply and demand of electricity. Out of all renewable energy sources, hydro gives effective results at different phase. The hydro power plant helps us to generate the electricity from the potential energy of water. Site selection and huge investment are major drawbacks for huge hydro power plant. Instead of creating one large source of energy, we can install the same amount of source by using small or micro hydropower plant on the local river. River being rich source of water and location for installation of small hydro power plant are in favor of India. The design and components of small hydro power plant to be discuss in this paper apart from that, there is a wide range of possibility to improve the performance efficiency of small hydro power plant.

IV. OBJECTIVES OF PROPOSED WORK

The objective is to design a hydroelectric plant utilizing optimal energy in the water, with minimum submergence and economic costs, considering seasonal variation in power generation to meet the region's demand during all seasons.

V. METHODOLOGY

The potential energy of water held in a dam erected across the river is used in a hydroelectric power plant (Hydel plant). The stored water's potential energy is transformed to kinetic energy by first sending it via the penstock pipe. With a water turbine, the kinetic energy of the water is turned into mechanical energy. The turbine is connected to the generator. The generator converts the mechanical energy available at the turbine's shaft into electrical energy.

Because gravity is the driving force behind the cascade, the energy contained in the water is known as gravitational potential energy.

A. Schematic and Layout Diagram of Hydropower Plant

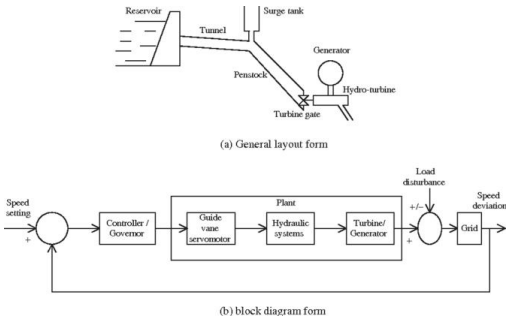


Figure A: Schematic of Hydropower Plant.

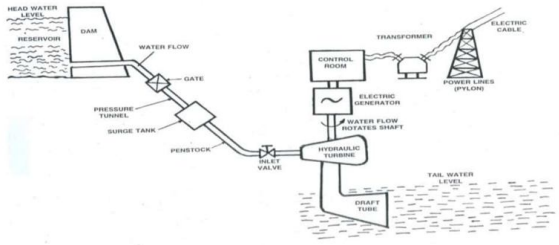


Figure B: Layout of Hydropower Plant.

B. Layout of Hydroelectric Power Plant

The schematic depiction of a hydroelectric power plant is shown in Figure B.

The primary elements are

- Water Reservoir
- Dam
- Spillway
- Gate
- Pressure Tunnel
- Powerhouse
- Penstock
- Surge Tank
- Water Turbine
- Draft Tube
- Tail Race Level

1) *Water Reservoir:* Water collected from the catchment area during the rainy season is kept behind a dam in a reservoir. Rain and streams provide water to the catchment region. Water must be available at all times for a hydroelectric power plant to function. The level of the reservoir's water surface is referred to as the Headwater level. The available water head for power generation is determined by the reservoir height.
2) *Dam:* The dam's aim is to store water and manage the outgoing flow of water. The dam aids in the storage of all incoming water. It also aids in increasing the water's head. A sufficient head must be available in order to create the needed amount of electricity.

3) *Spillway:* Excessive water build-up compromises the stability of dam construction. Spillways are also created to prevent water from overflowing from the dam, particularly during rainy seasons. This keeps the dam's water level from rising. Spillways are passageways that enable surplus water to move out from the dam to a separate storage place.
4) *Gate:* A gate regulates or controls the flow of water from a dam.
5) *Pressure Tunnel:* It's a channel that transports water from the reservoir to the surge tank.
6) *Surge Tank:* A surge tank is a small reservoir or tank in which the water level rises or lowers as a result of abrupt pressure fluctuations. As the load on the turbine is lessened, there may be a rapid increase in pressure in the penstock pipe owing to abrupt backflow of water. Water hammer refers to the abrupt increase in pressure in the penstock pipe.
7) *Penstock:* The penstock pipe transports water from the dam to the hydraulic turbine. Steel or reinforced concrete penstock pipes are used. The turbine is located on a lower level than the dam. Penstock has a gate valve at the input to totally shut off the water flow. It contains a control valve that regulates the flow rate of water into the turbine. Primary mover (water turbine or hydraulic turbine): Water energy is converted into mechanical energy by the hydraulic turbine. The mechanical energy (rotation) available on the turbine shaft is linked to the shaft of an electric generator, resulting in the generation of electricity. After working on the turbine blade, the water is expelled through the draught tube. The most popular prime movers are the Pelton wheel, the Kaplan turbine, and the Francis turbine
8) *Draft Tube:* The draught tube is linked to the turbine's output. In the diverging part, it turns the kinetic energy in the water into pressure energy. As a result, it maintains a pressure just above atmospheric at the end of the draught tube in order to transport water into a tailrace. The tailrace water is discharged for irrigation reasons.
9) *Tailrace Level:* A tailrace is a water route that transports water released from a turbine to a river or canal. The water level in the tailrace is referred to as the Tailrace water level.
10) *Power House:* The water turbine, generator, transformer, and control room are all housed in the powerhouse. As water flows through the turbine, it rotates the turbine shaft, which is connected to the generator. The generator consists of a revolving electromagnet known as a rotor and a stationary component known as a stator. The rotor generates a magnetic field, which causes an electric charge to be generated in the stator. Electricity is used to convey the charge. The voltage of the current originating from the stator is increased by the step-up transformer. Power lines are used to distribute electricity.

VI. ADVANTAGES

1) Hydropower is a renewable energy source. Hydropower energy is renewable since it is based on the water cycle, which is powered by the sun.
2) Hydropower is a clean form of energy since it is powered by water.
3) Hydroelectric power is a home source of energy, allowing each state to generate its own energy without relying on imported fuel.
4) Impoundment hydropower provides reservoirs that may be used for leisure activities like fishing, swimming, and boating. To allow the public to take use of these opportunities, most hydropower plants are mandated to give some public access to the reservoir.

VII. APPLICATIONS

1) Hydroelectric energy is adaptable. Certain hydropower plants can swiftly transition from zero to full production. Since hydropower facilities can instantly create power for the system, they provide critical backup power during large power outages or interruptions.
2) Beyond electricity generation, hydropower offers flood control, agriculture support, and safe drinking water.
3) Hydropower is inexpensive. In comparison to other energy sources, hydropower delivers low-cost electricity and long-term durability. Building costs can be reduced even further by reusing existing infrastructure such as bridges, tunnels, and dams.
4) Hydropower works in tandem with other renewable energy sources. When demand is high, technologies such as pumped storage hydropower (PSH) store energy to be used in conjunction with renewables such as wind and solar power.

VIII. RESULTS

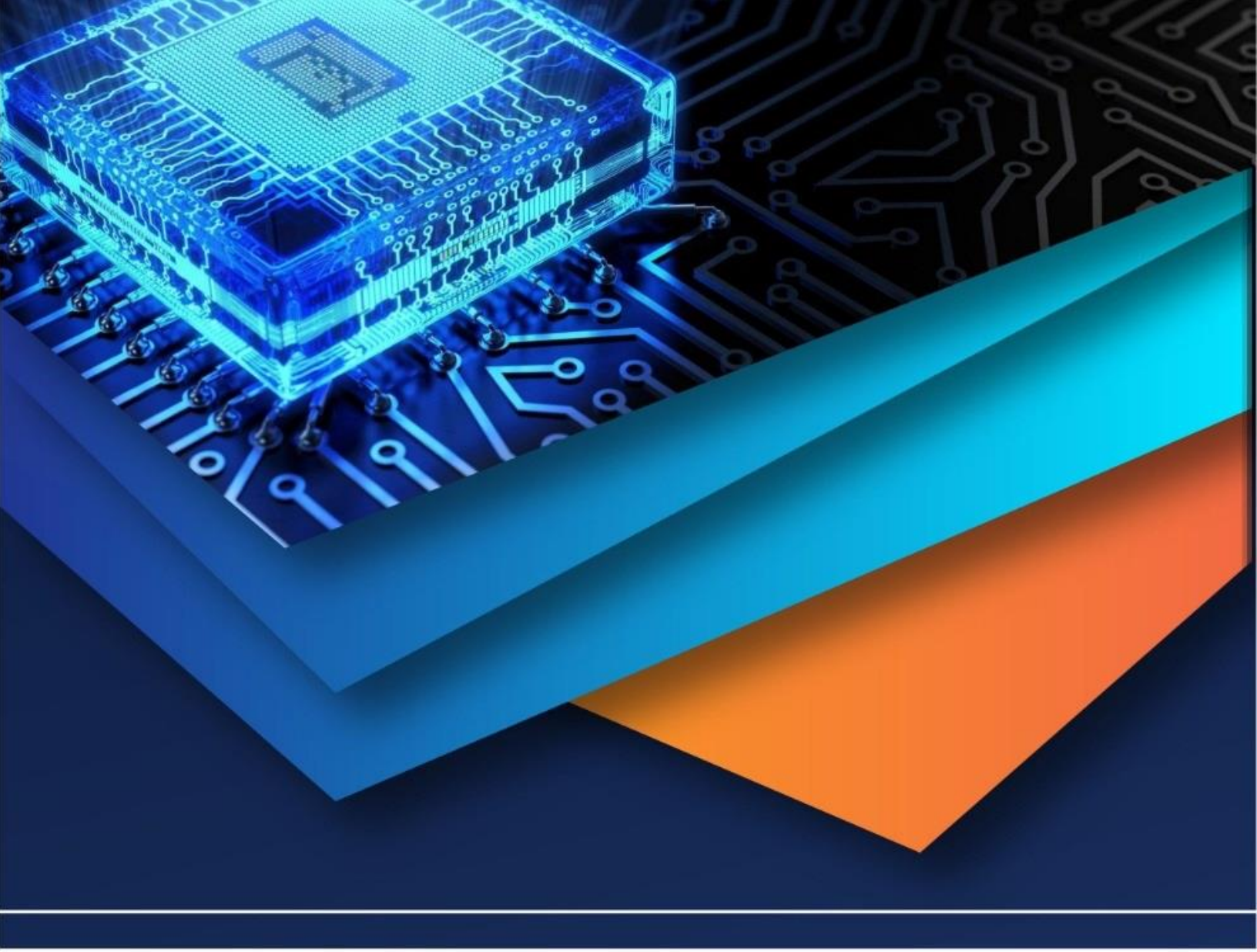
We should promote the usage of hydropower since it does not pollute the environment or emit greenhouse gases. Hydropower is one of the cleanest, most dependable, and least expensive energy sources. There are several reasons why more hydroelectric power or hydroelectricity is beneficial, such as the fact that hydroelectric power is a clean, renewable form of energy that does not contribute to global warming or climate change, as fossil fuels such as oil do.

IX. CONCLUSION

Hydroelectric power plants guarantee stable electricity delivery by permitting consistent and consistent electricity generation, which is not the case with other renewable energy sources such as solar and wind energy. Hydroelectric power plants have a long history of usage and create the world's greatest percentage of renewable energy, far exceeding that of solar, wind, and geothermal energy. The lake formed as a consequence of the construction of a hydroelectric power plant may be utilized for irrigation as well as recreational tourism in the form of water sports, fishing, swimming, and boating. Utilizing hydropower offers several advantages. It might help us produce more power more quickly, consistently, and sustainably in the future.

REFERENCES

[1] Y. R. Pasalli and A. B. Rehiara, “Design Planning of Micro-hydro Power Plant in Hink River,” Procedia Environ. Sci., 2014, doi: 10.1016/j.proenv.2014.03.009.
[2] Anon, “HYDRO POWER.,” Civ. Eng. New York, N.Y., 1984, doi: 10.4324/9780203168738_chapter_20.
[3] G. Ardizzon, G. Cavazzini, and G. Pavesi, “A new generation of small hydro and pumped-hydro power plants: Advances and future challenges,” Renewable and Sustainable Energy Reviews. 2014, doi: 10.1016/j.rser.2013.12.043.
[4] V. K. Singh and S. K. Singal, “Operation of hydro power plants-a review,” Renewable and Sustainable Energy Reviews. 2017, doi: 10.1016/j.rser.2016.11.169.
[5] J. P. Deane, B. P. Ó Gallachóir, and E. J. McKeogh, “Techno-economic review of existing and new pumped hydro energy storage plant,” Renewable and Sustainable Energy Reviews. 2010, doi:10.1016/j.rser.2009.11.015.
[6] R. Raja Singh, T. Raj Chelliah, and P. Agarwal, “Power electronics in hydro electric energy systems - A review,” Renewable and Sustainable Energy Reviews. 2014, doi: 10.1016/j.rser.2014.01.041.
[7] C. P. Jawahar and P. A. Michael, “A review on turbines for micro hydro power plant,” Renewable and Sustainable Energy Reviews. 2017, doi: 10.1016/j.rser.2017.01.133. B. A. Nasir, “Design considerations of micro-hydro-electric power plant,” 2014, doi: 10.1016/j.egypro.2014.06.003.
[8] Priyono S and Ibrahim K.A.. “Design. Simulation and Experiment of the Very Low Head Turbine with Minimum Pressure and Free Vortex Criterions”, International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS Vol: 11 No: 01. 2011.
[9] Abdul Muis, Priyono S, Ariyadi S and Firman H., “Design and Simulation of Very Low Head Axial Hydraulic Turbine with Variation of Swirl Velocity Criterion", The 12th Asian International Conference on Fluid Machinery (AICFM12). 2013.
[10] Julian R., “Optimization and Design of Two Micro-Hydro Turbines for Medium and Low Head Applications”, Thesis of Master of Science. University of Natal. 2000.
[11] S.R. Sheikh , Z.U. Koreshi , U. Rauf , S. Khalil and U. Aziz, “A Novel Blade-Pitching Mechanism Design and Testing for Micro Vertical-Axis Water



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY