



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 12, December 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)

# Enhancement in Control System by using Dynamic Response of Wind in Offshore Site

Aatifa Fatima<sup>1</sup>, Shashank Nayak<sup>2</sup>, R. Girish Kumar<sup>3</sup>, Dr. Shailendra Verma<sup>4</sup>

M.Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India<sup>1</sup>

M.Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India<sup>2</sup>

M.Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India<sup>3</sup>

Head of Department, Department of EE, CCET, CSVTU BHILAI, C.G, India<sup>4</sup>

**ABSTRACT:** This paper described a control system using Fuzzy logic in which specific location of a site in Offshore is selected. Characteristics of wind has been studied and its dynamic response for a specific period of time in which the wind potential can be easily captured for every season. Mainly wind potential density and wind speed has to be taken as a considerable parameters and this information can also be used for the design of fuzzy control logic and rule tables for the wind energy conversion system to obtain desired output. Weather data taken from the climate consultant software and other weather forecasting website. The fuzzy control system designed in the Matlab in which the rules can be modified as per the wind speed available in the site and can have the outputs analysis.

**KEYWORDS:** Wind speed, Wind potential density, Fuzzy Control System, WECS wind energy conversion system, Renewable Energy Services RES.

## I.INTRODUCTION

The country has become the world's third largest energy consumer; energy use has almost doubled since 2000, with 80% of demand still fulfilled by conventional sources of energy (IEA 2021). The global economy, which is built on fossil fuels and growing greenhouse gas emissions, is causing major changes in the climate system [1]. As per the commitments under the UN Paris climate agreement in 2015 announced its renewable energy targets for 175 GW from renewable energy generations by 2022 and this target includes 60 GW from wind energy. [2] India has a good record in the on shore wind capacity of 33 GW installation completed till September 2017 and this makes India fourth largest market in installation of wind energy.

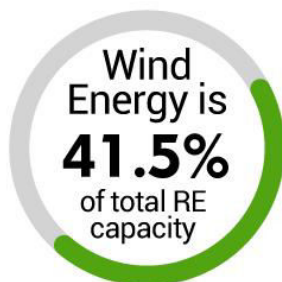
In September 2015 India's cabinet approved the National Offshore Wind energy policy and ministry of new and renewable energy authorized as the nodal agency for use of offshore area in exclusive economic zone of the country. In November 2017 MNRE announced its road map for the target of 175 GW from RES. The projections drawn from the global experience of offshore wind development and builds in constraints of the local power sector development in India.

The pathways for reaching 500 MW to 5 GW in Gujarat and Tamil Nadu will be achieved by a better action plan in the upcoming years. As the installation cost are so high so a prefeasibility report and a detailed climatic analysis based on wind is the essential part of the project.

**Wind energy in India:**

Total installed capacity

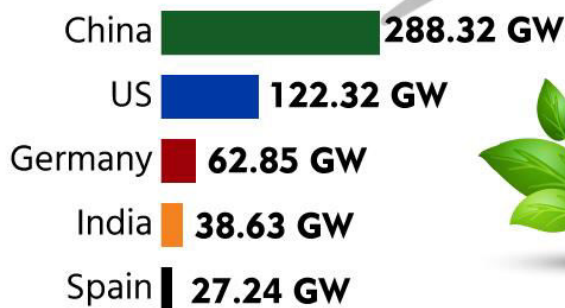
**39.25 GW** Mar 2021



2022 **05 GW**

2030 **30 GW**

**Top five countries with the highest wind energy capacity in 2020:**



**Top states in wind energy capacity in 2020-21**

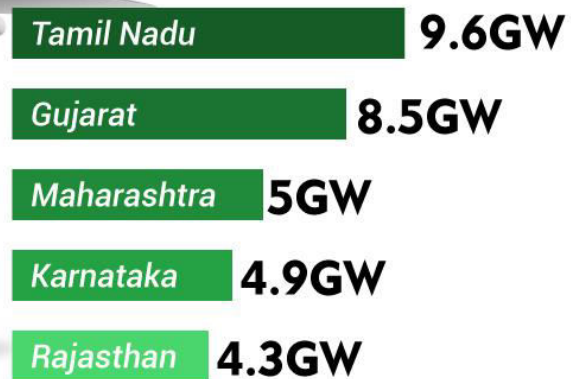


Fig. 1 Wind Energy Scenario till 2021

As the expansion in the wind energy projects in India and worldwide it is the responsibility of scholars and researcher to make the system as accurate as possible. The system should be in the format of wind potential of that particular location. Various industries always try to install the plant where the wind speed is slightly very high and within a constant range. The control system used conventionally use that logic in which the constant wind speed will give much better results and the system non linearity will reduce and therefore the injection of reactive power in the system will reduce.

By the use of weather forecasting websites and other software's the wind capacity for the specific period of time can be retrieved so that the wind potential behaviour can be analysed for every season and will be helpful in modelling of whole system with the best output from the system and reduction in other losses.

## II. SITE SELECTION

Location Selected for the Prototype – Jafrabad Offshore location in the coastal areas of Gujarat

Latitude - 20°51'4" Longitude - 71°22'9"

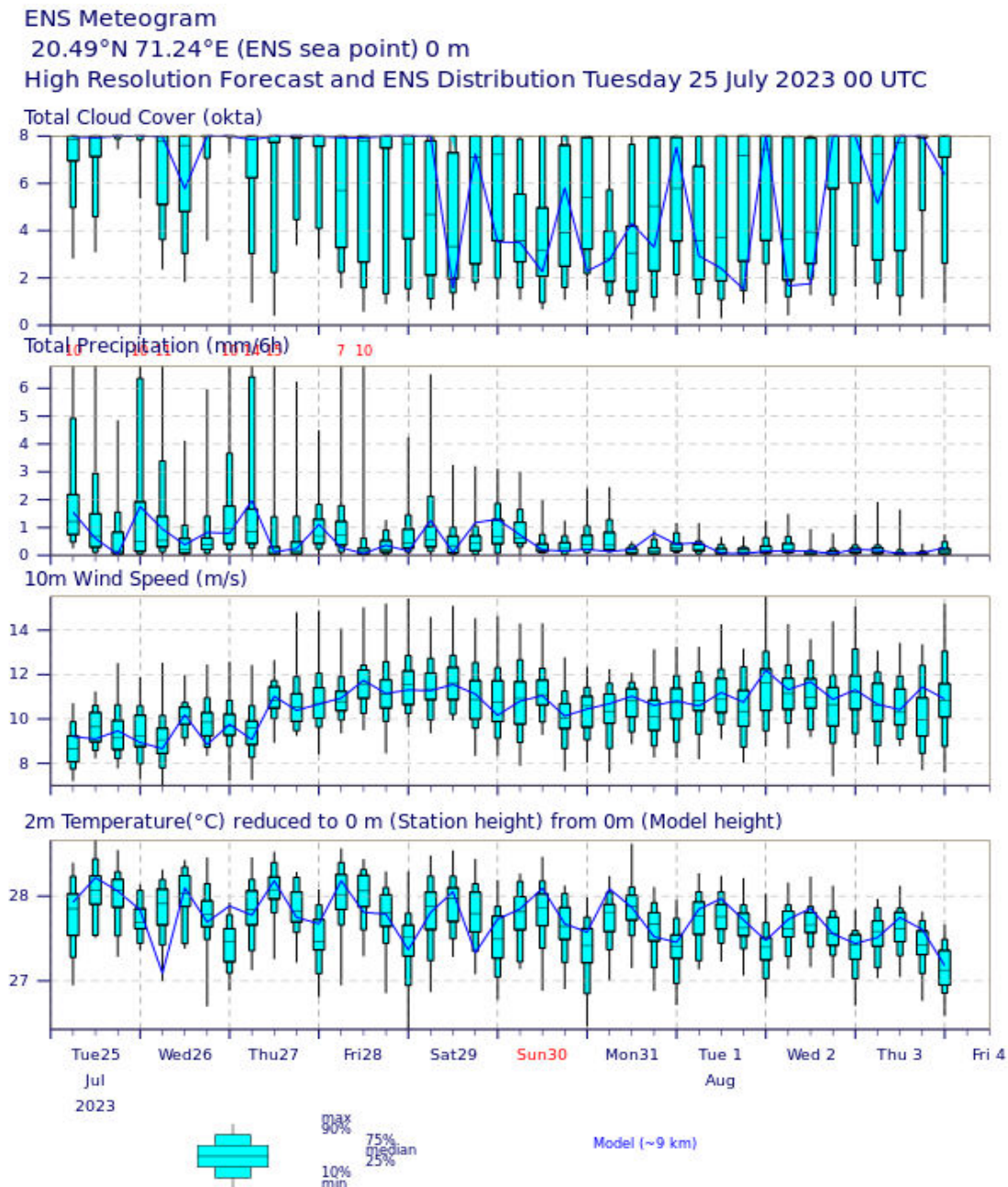


Fig. 2: ENS 10 days meteogram of Jafrabad

### III. CONTROL SYSTEM ALGORITHM

A model of wind energy conversion system connected with a grid has been designed in Matlab. A fuzzy control system also been developed for a particular site selected for the installation. As many industries needs the pre-feasibility study of a selected location before the installation of the plant. Most European countries will go for the wind speed above 15 m/s location for the installation. So according to this scenario many vendors will not be interested in sites of India. The main challenge is to find out the locations having a good wind speed and wind power density for the installation of the plant. This paper will focus on the site weather data of the past years and design a control system using a fuzzy rule table in which the predefined rule set has been arranged for a specific selected output. The steps followed in this work for a better output in the offshore location of Gujarat.

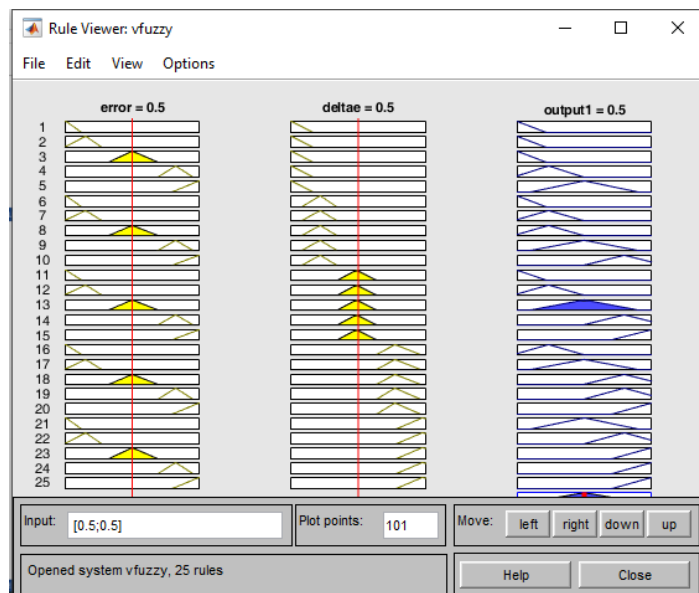


Fig. 3 Rule Table designed for the system

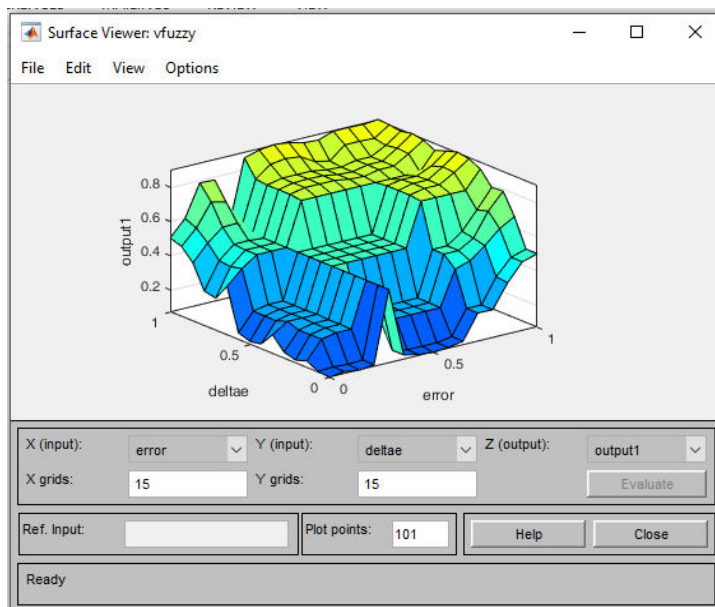


Fig. 4 Surface View of Rules in Fuzzy System

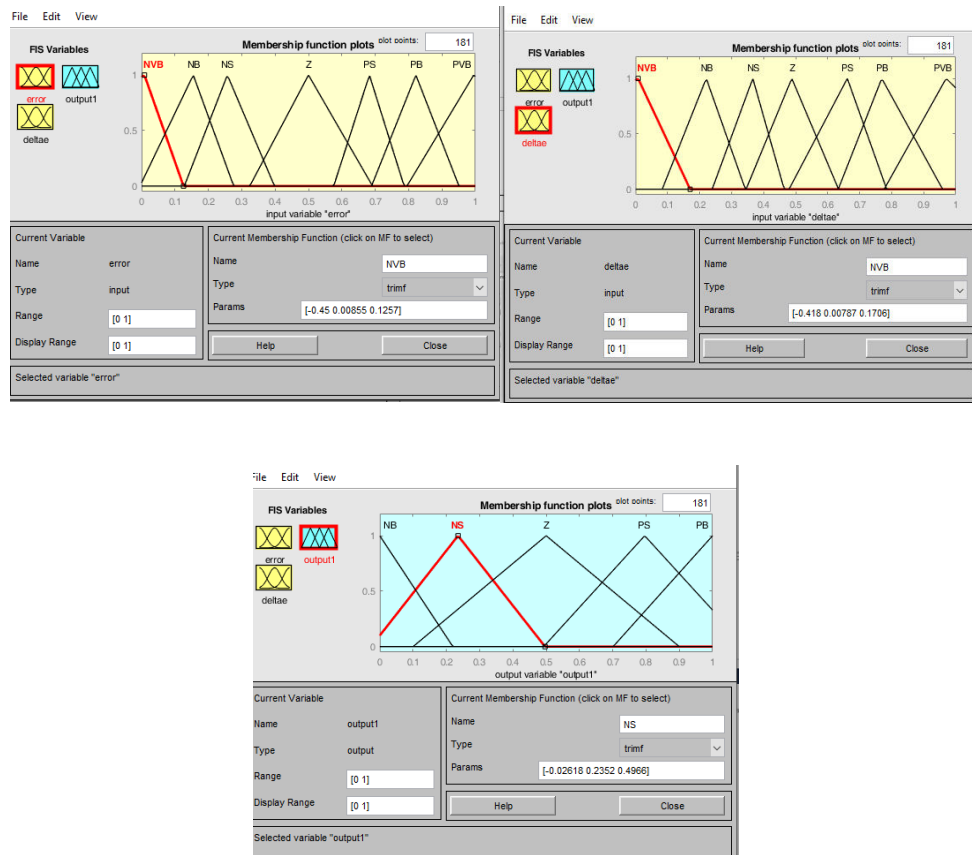


Fig. 5 Input and output Variables of designed fuzzy system

The aerodynamic power of the wind turbine can be expressed as

$$P_t = 1/2 \rho \pi R^2 C_p (\lambda) v^3 \dots (1)$$

When the rotor is adjusted to maintain its optimum value the maximum power can be gained as

$$P_{rmax} = k_{opt} \omega^3 \dots (2)$$

Where  $K_{opt}$  is decided by

$$K_{opt} = \rho \pi R^5 C_{pmax} 2 \lambda_{3opt} \dots (3)$$

$$T_{mopt} = K_{opt} (\omega_{opt})^2 \dots (4)$$

It is observed that there is always matching rotor speed which produces optimum power for any wind. The function of controller is to keep turbine operating on this curve as the wind velocity varies. If the controller can properly follow the optimum curve, the wind turbine will produce maximum power at any speed with in allowable range. It can be seen from the above equation that the power dependency on wind speed is so high so prediction of wind speed variation and its range should be known in a better manner before set up of a plant along with the height. The control system should also be designed as per the location wind speed for its better output.

#### IV. RESULT AND DISCUSSION

The output waveform of the designed model has been recorded for voltages, currents and other parameters in the output ports of the System. The Total harmonic distortion also measured in the voltage and current side so as to calculate the nonlinear loads impacts on the system.

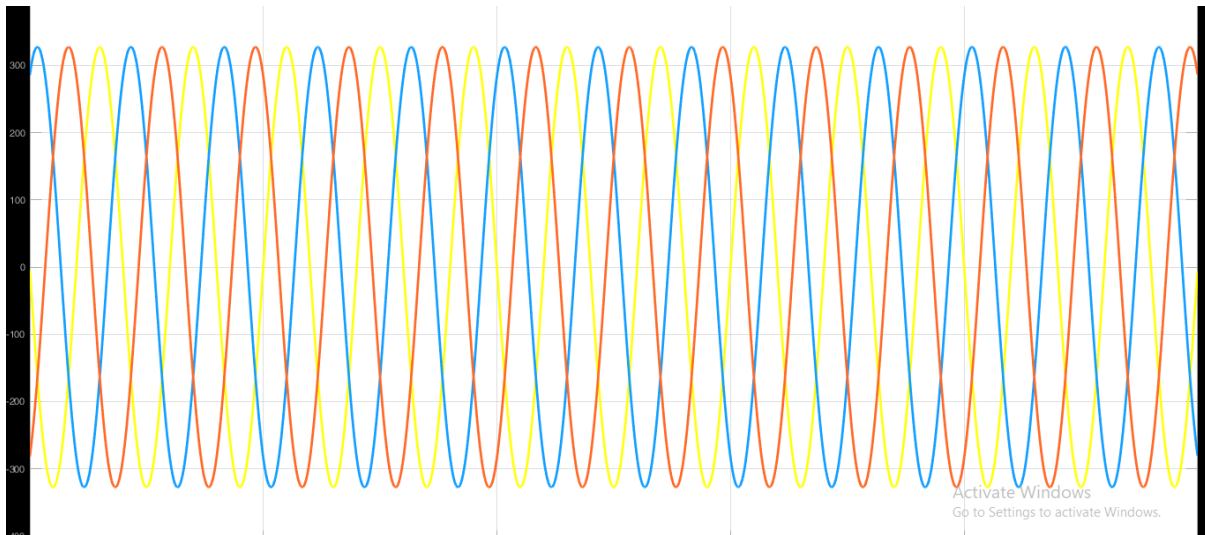


Fig. 6 Three Phase Voltage at output

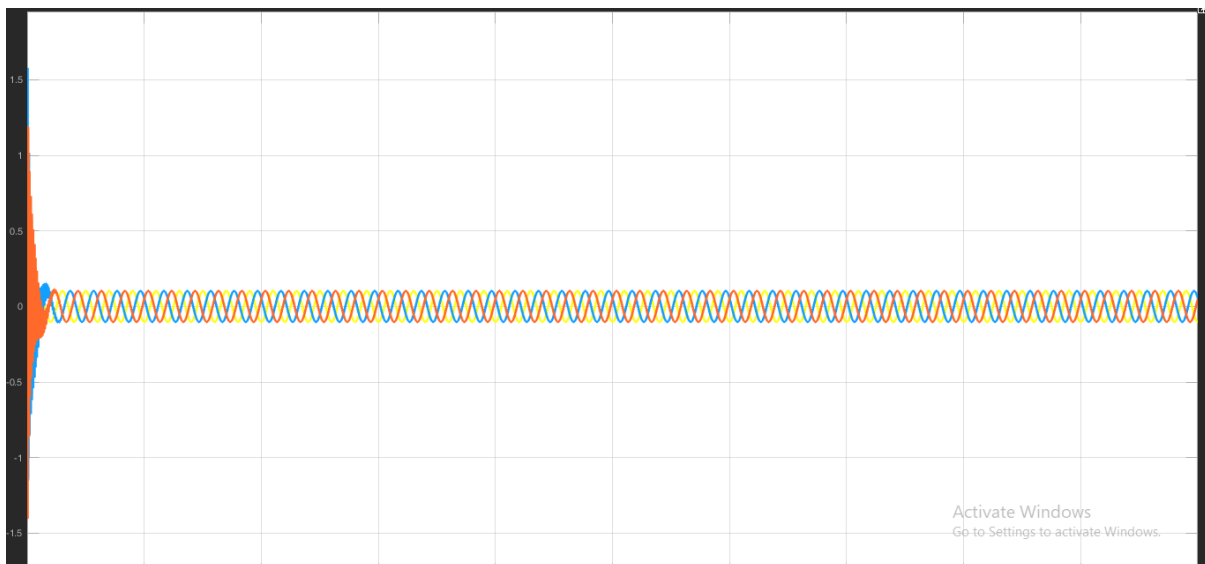


Fig. 7 Three Phase Current at output

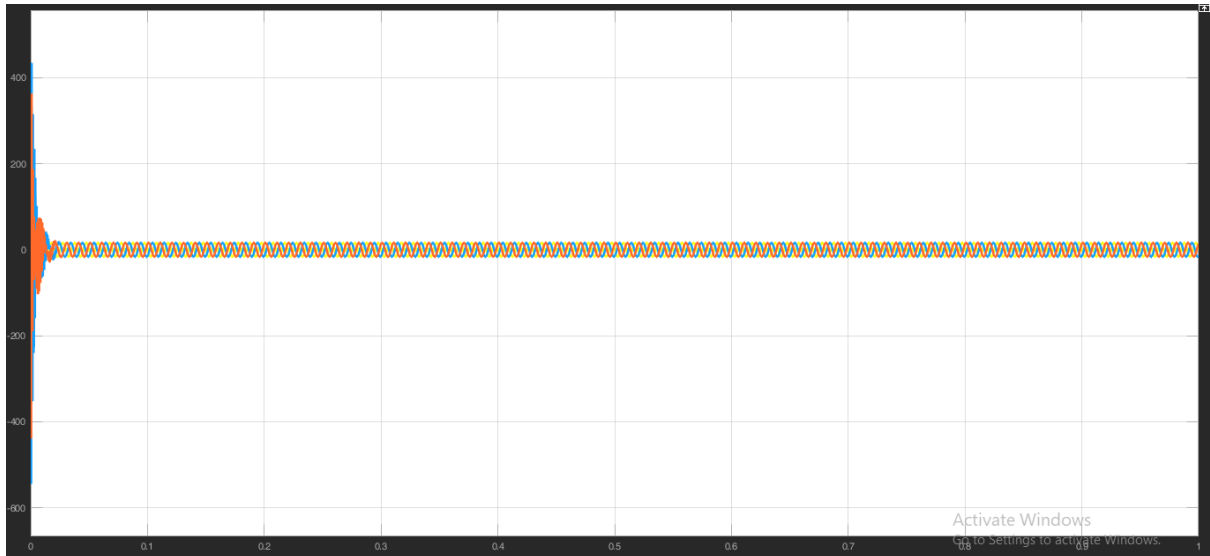


Fig. 8 Three Phase Power at output

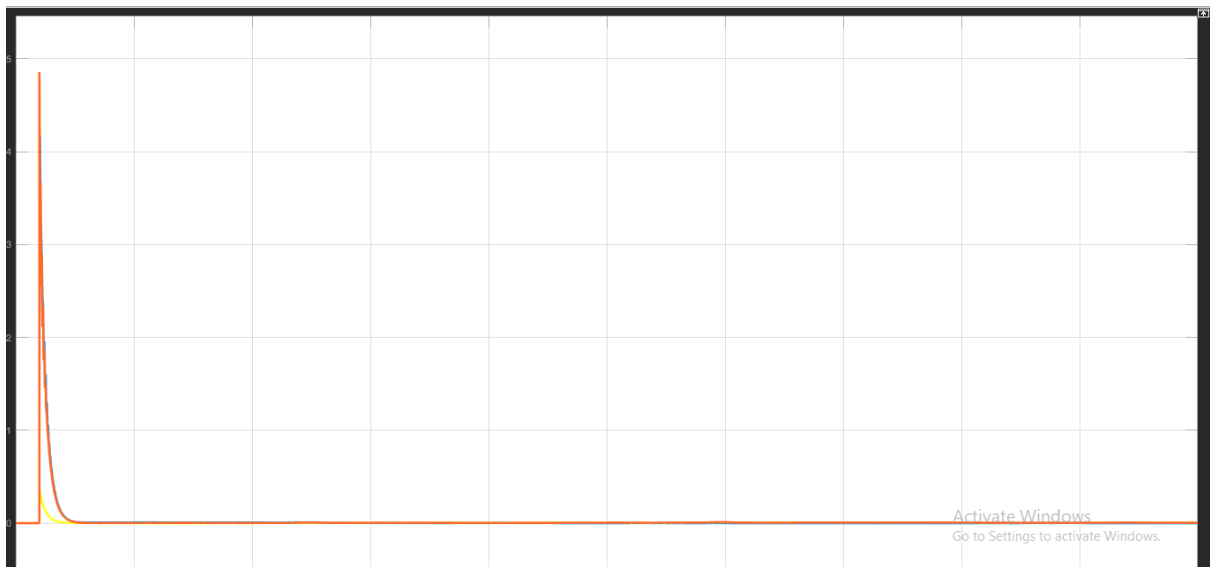


Fig. 9 Total Harmonic Distortion



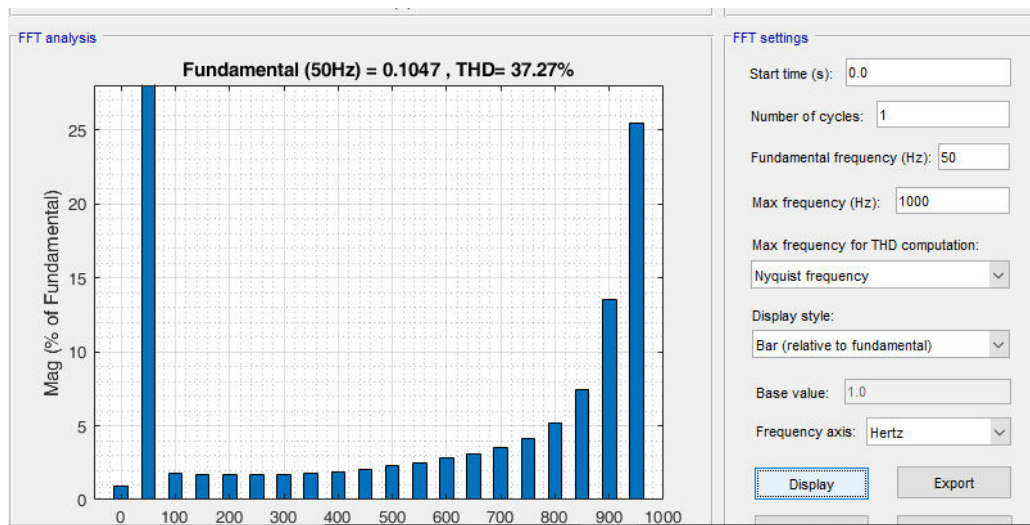


Fig. 10 Voltage THD

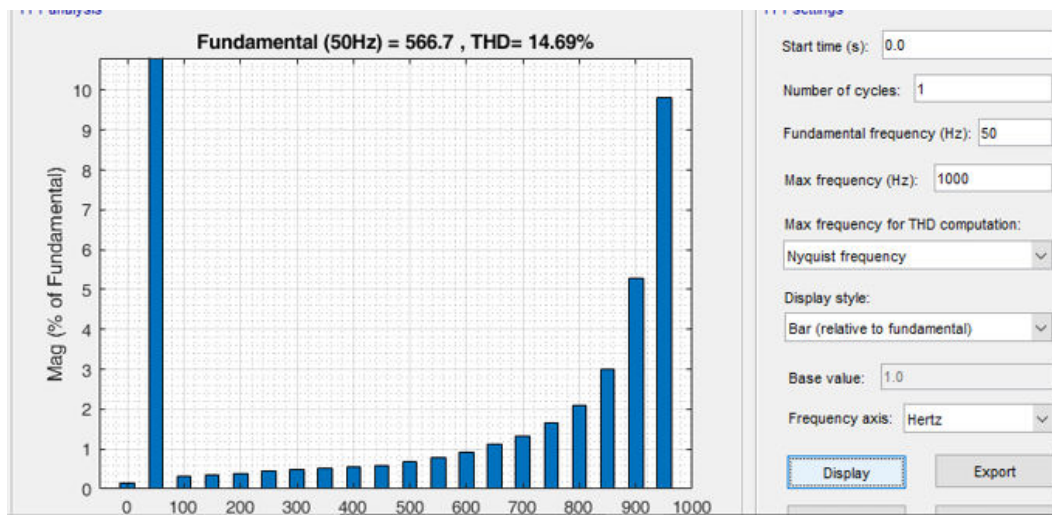


Fig. 11 Current THD

## V.CONCLUSION

In this work a site in the offshore region of Gujarat has been selected for the analysis. European climate weather forecasting details available for that site in very useful as ENS meteogram is useful for the parameters of a specified time selected. Here we have taken 10 days ENS meteogram in which the site named Jafrabaad has a wind speed which is in a range of installation of wind turbine. A prefeasibility technical study is required before the installation is required. A model has been designed in the Matlab with the standard wind energy conversion system parameters and other system considered in the whole model. Conventionally the PID based control system is used for the pitch control strategy. Now a days fuzzy control system used so frequently for the control system. In this work a control system designed with a simple rule table in which the output also derived for the system. The outputs can be seen as voltage, current and power has a smooth waveform and THD values are little bit high. The filter for the reactive power compensation is required as THD values are high as compared to permissible limit.

#### REFERENCES

- [1] Chaturvedi KR, Sharma T (2020) Enhanced carbon capture and storage in depleted sandstone reservoirs using silica nanofluids.
- [2] Global Wind Energy Council, “Global Wind Energy Statistics 2016”, Feb 2017.
- [3] Serban A, Lizica SP, Spiru P. Assessment of wind energy potential based on Weibull and Rayleigh distribution models. 2020; 6(6):250–67.
- [4] National Air Quality Monitoring Network (RNMCA).
- [5] Ashrafi Zabihollah Najafian, Ghasemian Masoud, Shahrestani Misagh Irandoost, Khodabandeh Erfan, Sedaghat Ahmad. Evaluation of hydrogen production from harvesting wind energy at high altitudes in Iran by three extrapolating Weibull methods. *Int J Hydrogen Energy* 2018; 43:3110–32.
- [6] Ilhan U, Ibrahim A, Ismail Y, Yeliz MK. A new estimation approach based on moments for estimating Weibull parameters in wind power applications. *Energy Convers Manage* 2018; 164:570–8.
- [7] Jianzhou W, Xiaojia H, Li Qiwei, and Xuejiao M. Comparison of seven methods for determining the optimal statistical distribution parameters: A case study of wind energy assessment in the large-scale wind farms of China. *Energy* 2018; 164:432–48.
- [8] Chen, D., Xie, S.: Review of the control strategies applied to active power filters. In: *IEEE International Conference on Electric Utility Deregulation, Restructuring and Power Technologies (DRPT2004)*, pp. 666-670 (2004).
- [9] G.W.Chang and T.C.Shee, “A comparative study of active power filter reference compensation approaches”, *Proc. IEEE Power Eng. Soc. Summer Meeting, Vol.2, July 2002*, pp. 1017-1021.
- [10] Liu,W.Y. A review on wind turbine noise mechanism and de-noising techniques. *Renew. Energy* 2017, 108, 311–320.
- [11] Zagubie´ n, A. Analysis of acoustic pressure fluctuation around wind farms. *Pol. J. Environ. Stud.* 2018, 27, 2843–2849.
- [12] Celik, A. Energy output estimation for small scale wind power generators using Weibull representative wind data. *J. Wind Eng. Ind. Aerodyn.* 2003, 91, 693–707
- [13] Wais, P. Two and three-parameter Weibull distribution in available wind power analysis. *Renew. Energy* 2017, 103, 15–29.
- [14] World-Wind-Atlas: 60+ Years Wind Data. Available online: <https://sander-partner.com/en/products/wwa.html> (accessed on 20 May 2021).



**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.423**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details