# Congestion Management in Hybrid Electric Businesses Using Different Technologies

[1]Vikas, [2]Dr.Kuldeep

[1]M.Tech. Scholar, [2]Associate Professor

Department of ECE
BRCM College of Engineering and Technology, Bahal (Bhiwani) India

**Abstract:- The restructuring of the power sector offers a number of advantages to energy sellers and buyers. Power sector reform is creating competition in the electricity industry. It improves the efficiency of the electricity industry and gives consumers the opportunity to receive quality and economical electricity from different suppliers. Therefore, a competitive electricity market brings about energy security and efficient system operation, of which system congestion is one of the major problems**

**Keywords: Energy BSES, wake effect, WTC**

## INTRODUCTION

The power sector has undergone rapid and irreversible change since the 1980s. Traditionally, large utility companies have had full control in a vertically integrated system. These utilities control production, transmission, and distribution within an area. Under the law of monopolistic markets, only one power company can produce, transmit and distribute electricity in an area. Utilities must operate according to government plans, rules, and regulations. At the same time, they must be assured of a reasonable profit. In most parts of the world, this has led to inefficiencies and stagnant attitudes in the industry. They focus more on profitability than technological innovation and customer satisfaction. These proprietary strategies are necessary for the expansion, standardization and development of the energy industry. The electricity sector has been restructured in many countries to operate under state and federal control with the primary objective of increasing electricity production and distribution. Some countries such as Chile, UK, Spain, Argentina, New Zealand, Norway, Sweden and the United States have carried out restructuring to encourage privatization of the electricity sector, increasing choice for consumers. and competition among manufacturers. Initially, there was no competition in production, transmission and distribution as all three were considered a single entity, but in the deregulation system all activities were different. The contract of the manufacturing and distribution company defines the schedule for power supply and load distribution. Therefore, the energy flow in the deregulation system is different from the existing traditional environment. All companies will strive to maximize profits and consumers will strive for cheaper energy, even at the expense of transmission limits. This can overload the transmission line and lead to system congestion. This can exceed voltage, temperature and stability limits, which can reduce the security of the system.

### Concept of ATCDF for ATC Enhancement

It is difficult to find the optimal location of WF and BESS for different emergency situations to improve ATC. The ATCDF approach is used to find the optimal positions of WF and BESS. The ATCDF value is determined using the method described in Chapter 3. Buses with the same TCDF sign (positive or negative) for different line constellations are considered for wind power penetration. Buses with opposite signs (some positive and some negative) of the TCDF are ignored in case of emergency. This is because in one of the emergency cases, the effect of wind descent on that bus has a significant impact on traffic congestion. For optimal placement of WF and BESS, the bus with the highest ATCDF value is selected for integration.

### WF Power Output Due to Wake Effects Considering Wind Direction

$$Avg.TCDF\ (ATCDF) = \frac{(|TCDF| + |TCDF|)}{2}$$

The WF power is calculated using the formula as discussed previously. The WTsare placed in row and column layout so that impact of wake effect and wind direction can be analysed. The mathematical expression is given in Equation

$$P_{WF} = \begin{cases} \sum_{i'=1}^{l} \frac{m * P_r}{1 + e^{4s\left(v_{ip} - \tilde{V}_{wake}(x)_{i'}\right)/P_r}} & 0° < \theta < 20° \\ \sum_{i'=1}^{l} \frac{(m + n + 1 - 2i') * P_r}{1 + e^{4s\left(v_{ip} - \tilde{V}_{wake}(x)_{i'}\right)/P_r}} & 20° < \theta < 70° \\ \sum_{i'=1}^{l} \frac{n * P_r}{1 + e^{4s\left(v_{ip} - \tilde{V}_{wake}(x)_{i'}\right)/P_r}} & 70° < \theta < 90° \end{cases}$$

The most prominent parameter considered here in this work is the overall wattage and lumens/ watt possessed by the installed luminaries and overall wattage of fans installed. Second parameter considered here is the cost of replacement of high-wattage equipment by some low-wattage equipment vailable and the time-of-return of the invested cost.

## Aggregation Approach for WF Power Calculation

The whole model is used to calculate (wind power)eque

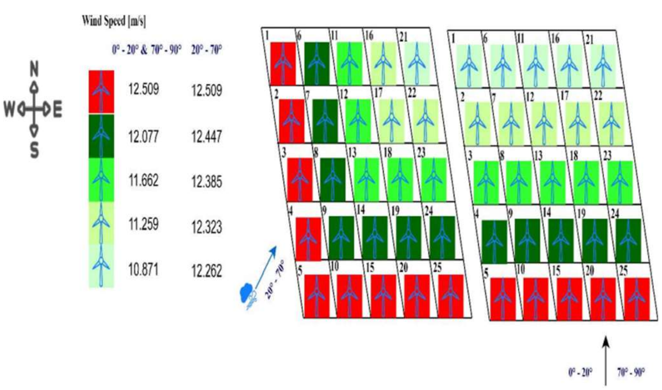



Fig-1.2 WF shadowing pattern due to change in wind direction

The red group shows the first turbine group for normal wind speeds. The second group is represented in green and similarly slows down due to the wake effect of the neighboring red WT. Similarly, bright green group 3 also experiences similar inflow wind speed reductions due to wake effects such as the green WTG group. The final WTG experiences lower inflow wind speeds, depending on wind direction. This is indicated by a bright color. The notion of orientation was taken from Ref. [243] and the number of WTs in the group was chosen based on the coherence matrix.

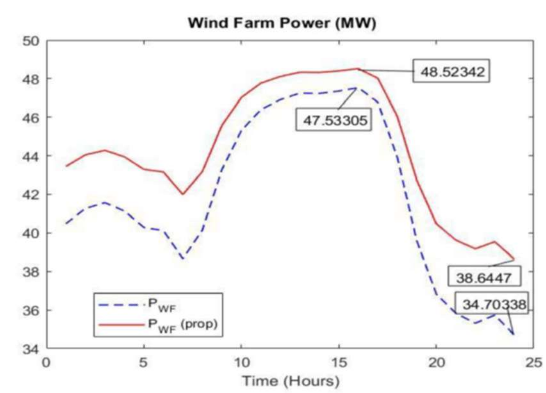
, the direction of wind and shadows is obtained from equation (5.13). WTs that experience
The power is given by the following equation

$$P_{WF} = \begin{cases} \sum_{i'=1}^{l} \frac{m * P_r}{1 + e^{4s\left(v_{ip} - \tilde{V}_{wake}(x)_{i'}\right)/P_r}} & 0° < \theta < 20° \\ \sum_{i'=1}^{l} \frac{(m + n + 1 - 2i') * P_r}{1 + e^{4s\left(v_{ip} - \tilde{V}_{wake}(x)_{i'}\right)/P_r}} & 20° < \theta < 70° \\ \sum_{i'=1}^{l} \frac{n * P_r}{1 + e^{4s\left(v_{ip} - \tilde{V}_{wake}(x)_{i'}\right)/P_r}} & 70° < \theta < 90° \end{cases}$$

in $l$ case of unequal number of row and column; $V_{wake}(x)_{i'}$ = speed of wake velocity for WT in shadow group; $P_{WF}$ = total power of WF considers wind direction and wake effect.

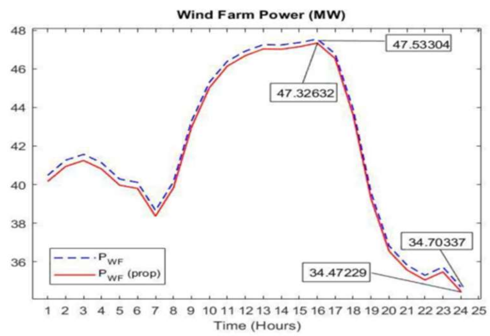
| PWF [242] (MW) | PWF_(MW)_prop | Difference (MW) |
|---|---|---|
| 40.4825 | 43.44319 | 2.960690 |
| 41.26438 | 44.05083 | 2.786449 |
| 41.56839 | 44.28432 | 2.715937 |
| 41.12842 | 43.94590 | 2.817481 |
| 40.28689 | 43.28958 | 3.002695 |
| 40.11614 | 43.15499 | 3.038845 |
| 38.66379 | 41.99087 | 3.327077 |
| 40.14398 | 43.17697 | 3.032984 |
| 43.27578 | 45.56630 | 2.290515 |
| 45.30134 | 47.01922 | 1.717875 |
| 46.39100 | 47.76755 | 1.376558 |
| 46.90992 | 48.11487 | 1.204950 |
| 47.24485 | 48.33568 | 1.090823 |

| | | |
|---|---|---|
| 47.22956 | 48.32566 | 1.096093 |
| 47.35408 | 48.40708 | 1.053004 |
| 47.53305 | 48.52342 | 0.990374 |
| 46.77478 | 48.02502 | 1.250238 |
| 43.92577 | 46.04084 | 2.115066 |
| 39.58555 | 42.73368 | 3.148128 |
| 36.83524 | 40.47686 | 3.641627 |
| 35.83508 | 39.62624 | 3.791162 |
| 35.30597 | 39.16984 | 3.863876 |
| 35.73376 | 39.53919 | 3.805427 |
| 34.70338 | 38.64470 | 3.941318 |




WF power comparison when wind direction between ( $0 < \Theta < 70$)

| Date | Time | PWF (kW) [242] | PWF (kW)_prop | Difference in kW |
|---|---|---|---|---|
| 19-07-2019 | 00:30 | 40482.50 | 40166.02 | 316.48 |
| 19-07-2019 | 01:30 | 41264.38 | 40944.37 | 320.01 |
| 19-07-2019 | 02:30 | 41568.39 | 41247.74 | 320.65 |
| 19-07-2019 | 03:30 | 41128.42 | 40808.83 | 319.59 |
| 19-07-2019 | 04:30 | 40286.89 | 39971.69 | 315.20 |
| 19-07-2019 | 05:30 | 40116.14 | 39802.18 | 313.96 |
| 19-07-2019 | 06:30 | 38663.79 | 38364.54 | 299.25 |
| 19-07-2019 | 07:30 | 40143.98 | 39829.81 | 314.17 |
| 19-07-2019 | 08:30 | 43275.78 | 42960.37 | 315.41 |
| 19-07-2019 | 09:30 | 45301.34 | 45016.49 | 284.85 |
| 19-07-2019 | 10:30 | 46391.00 | 46137.11 | 253.89 |
| 19-07-2019 | 11:30 | 46909.92 | 46675.34 | 234.58 |
| 19-07-2019 | 12:30 | 47244.85 | 47024.56 | 220.29 |
| 19-07-2019 | 13:30 | 47229.56 | 47008.59 | 220.98 |
| 19-07-2019 | 14:30 | 47354.08 | 47138.79 | 215.29 |
| 19-07-2019 | 15:30 | 47533.05 | 47326.33 | 206.72 |
| 19-07-2019 | 16:30 | 46774.78 | 46534.85 | 239.93 |
| 19-07-2019 | 17:30 | 43925.77 | 43616.90 | 308.87 |
| 19-07-2019 | 18:30 | 39585.55 | 39276.13 | 309.42 |
| 19-07-2019 | 19:30 | 36835.24 or | 36563.33 | 271.91 |
| 19-07-2019 | 20:30 | 35835.08 | 35581.34 | 253.74 |
| 19-07-2019 | 21:30 | 35305.97 | 35062.58 | 243.39 |
| 19-07-2019 | 22:30 | 35733.76 | 35481.97 | 251.79 |
| 19-07-2019 | 23:30 | 34703.38 | 34472.30 | 231.08 |




WF power comparison when wind direction between

Table 1.1 shows how the WF 24-hour output power is calculated. The total capacity of the WTs is added taking into account wind direction and speed. In the case of partial shading, the output power is higher than in the first case (full shading) because in the case of full shading, the wind speed decreases more due to the wake-up effect of the upstream WT.

## CONCLUSION

In this paper the changes in transactions create areas of congestion to control the CM. When planning WT construction, it is important to consider the optimal area due to land savings. However, area minimization reduces the distance between WTs. As the distance decreases, the BT shadow effect appears. Upstream winds extract energy and reduce wind speed, while downwinds create turbulence.

The effectiveness of the proposed method can be seen by comparing the WF power calculation with the existing equation and equation model. Mathematical instructions accurately calculate the VT power and reduce the possibility of overestimating the VT power number. From a business perspective, it calculates and displays more accurate results.

**REFERENCES**

[1] Y.R. Sood ,N.P. Padhy and H.O. Gupta "Deregulation of power sector a bibliographical survey." Int. J.Glob. Energy Issues, vol.11,no 1-4.pp.195-202-2019

[2] H.L.Wills and Philipson Understanding electric utilities and de-regulation,vol 27 CRC Press 2018

[3] X.Zhang , Y.H.Song, Q.Lu and S.Mci "Dynamic available transfer capability (ATC) evaluation by dynamic constrained optimization on ." IEEE Power Eng. REV ,Vol-19 no-2 pp.1240-1242,2004

[4] M.Eidiani and M.H.M.Shancchi, "FAD-ATC: A new method for. computing dynamic ATC ," Int. J. Electic power Energy Syst., vol 28 no 2 pp.109 118 ,2006ATC

[5] M.I.AlomoushandS.M.Shahidehpour,*Restructuredelectricalpowersystems:Operation:Trading,andvolatility*.vol.1,CRCPress,2017.

[6] M.Shahidehpour,H. Yamin,andZ. Li,*Marketoperations inelectricpowersystems:forecasting,scheduling,andriskmanagement*.2003.