American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN: 2320-0936
Volume-7, Issue-6, pp-357-366
www.ajer.org
Research Paper Open Access

Effect of Large-scale Wind Integration in Coastal Territories of Bangladesh

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ABSTRACT: *Wind vitality is one of the effective sustainable power sources in our advanced world. Wind control plants help to produce a critical vitality. A wind turbine is by and large associated with the network transport with the converter. It soothes the mechanical pressure and vitality limit increment. The effect of huge scale twist combination in beachfront regions of Bangladesh which are mimicked by power world simulator system 18.0 programming. We watched the effect of transport voltage. We mimicked some beach front regions like Kaptai, Feni, Cox`s Bazar, Halisahar and so on we watched static operation when the wind is associated with the bus and wind are not associated with the Bus. We got time area mimicked graph.*

KEYWORDS -*Wind integration in Bangladesh, Wind turbines, Wind integration challenges, Wind potential.*

Date of Submission: 14-06-2018 Date of acceptance: 29-06-2018

I. INTRODUCTION

The wind turbine is a standout amongst the most central sustainable power source for the worldwide nation. Wind control is produced by moving air. Oil and Gas are not boundless for the worldwide nation. The regular fills are diminishing step by step. The legislature bolstered the development of advancement of new vitality nations like joined states, China, Germany, Italy. It supports for over 20% power request in a few nations like Denmark, Nicaragua, Portugal, and Spain. The United States is the main nation where wind control is the minimum cost alternative for new power creating. In 2014 the normal yearly development rates of sustainable power source limit of wind control were ninth percent. In 2013, the figured of sustainable power source partition of worldwide power creation of wind control was 1.3 percent. In 2014, the aggregate limit of sustainable power was 380 GW, EU-28 was 125 GW and BRICS was 150 GW. Notwithstanding, in 2014 the most elevated sustainable power limit was China than USA, Germany, Spain, India, Italy, Japan. In 2014, the inexhaustible power limit of China was roughly 115 GW, USA was 65 GW and Germany was 40 GW. The position of twist at inland, the turbine estimate was 1.5mw to 3.5mw and limit factor 20% to half. The position of twist at seaward, the turbine estimate was 1.5mw to 7.5mw and limit factor 35% to 45% [1].

In 2013, the aggregate worldwide energy of wind limit was 319 GW. In 2014, the worldwide breeze control limit included by 51 GW and the aggregate worldwide breeze control limit was 370 GW in 2014 and 23.2 GW wind control limit included China and 4.9 GW wind control limit included the USA, 5.3 GW wind control limit included Germany in 2014 [2]. The test of wind joining is to make the best utilization of the variable and questionable powersource while keeping up the consistent harmony amongst utilization and age and abnormal state of unwavering quality in the power framework and the primary effects of wind mix are interests in network foundation and productivity misfortunes in influence plants when following the expanded varieties and vulnerability in the influence framework [3]. challenges of incorporating wind control emerge from its high between fleeting variety and constrained consistency and the effect of wind control coordination are shown in, yet not restricted to, planning, recurrence directions, and framework adjustment prerequisites[4].The principle specialized difficulties that are related with the joining of twist control into control frameworks and these difficulties incorporate impacts of twist control on the power framework, the power framework working cost, control quality, control awkward nature, control framework progression, and effects on transmission arranging [5].

The real issues related to extensive scale wind control joining in China are stressed, in particular, adjusting ability, framework interconnection, transmission expenses and innovation pattern and gauging innovation feature the adjusting capacity of the framework and the transmission costs caused by China's breeze control advancement mode are probably going to a standout amongst the most requesting issues that it needs to confront and fathom [6].While sustainable power source frameworks are equipped for fueling houses and private companies with no association with the power network, many individuals lean toward the preferences that lattice association offers and any abundance power you deliver is nourished once again into the matrix and when inexhaustible assets are inaccessible, power from the lattice supplies your requirements, disposing of the cost of power stockpiling gadgets like batteries and power suppliers most states permit net metering, a plan where the overabundance power created by matrix associated sustainable power source framework [7].

II. PROSPECT OF WIND IN BANGLADESH

2.1 WIND IN COASTAL AREAS

The prospect of wind energy in Bangladesh being a torrid country does have a lot of wind flow at different seasons of the year and some windy locations where wind energy projects would be enforceable [8]. Wind moves over the surface of Bangladesh from March to September and the average speed of 3m/s to 6m/s. The maximum wind speed is achieved during June to July and wind speed remains relatively lower during October to February [9]. In 2005, the first project was Muhuri Dam wind power project. From2007 to 2008, the second project was kutubdia island wind power. In 2005, the Muhuri Dam project was included 900 kW Vestas' turbine which diameter had 27m. It was the first grid-connected wind power in Bangladesh. This project calculated annual production was 2 GWh. The second project was kutubdia Island. This project was the wind battery hybrid plant. It had 1000 kW turbines on the soft tower. Its WTG was China. The WTGS charged 1000,12v,200AH batteries. It also used 11kv transmission line. The coastal sites of Bangladesh have 11 small wind turbines which are installed by BRAC. The WTGS charged 1000,12v,200AH batteries. It also used 11kv transmission line. The coastal sites of Bangladesh have 11 small wind turbines which are installed by BRAC.BCAS(Bangladesh center for advanced studies) installed a wind pump in patenga (Chittagong). It has 40 feet high tower with 12 blades rotor. The average water output between November and January. It approximately 8000 liters per day [10].

2.2 THE POTENTIAL OF WIND ENERGY IN BANGLADESH

Wind energy has the potential to give mechanical energy or electricity without producing pollutants. Although wind energy used many countries, as a source of mechanical energy, e.g. grinding corn or pumping water. However, in Bangladesh wind energy has also been used to take steps some intention force to boats with sails of many designs. Unluckily, not much research has been conveyed in these areas, although renewed interest has recently been generated in utilizing the energy of wind for wind pumps and sailing boats [11]. The potential users of wind turbine guided for drinking water and irrigation and industries along the Bay of Bengal coastline, many industries areas without the electrical grid and presently used diesel generators [10].

2.3 WIND VELOCITY IN BANGLADESH

Fig. 1. The mean monthly wind speed over the year in Chittagong, Bangladesh (meters per second).

From figure 1, In 2015, the average most wind speed is observed in March and the least wind speed is observed in July in Chittagong [18].

Table 1: In 2003, the average wind speed in m/s at different locations.

Locations	Months						
	March	April	May	June	July	August	Sep.
Teknaf	2.85	2.56	2.39	4.71	2.83	4.14	3.11
Kutubdia	3.78	12.02	2.37	4.71	5.73	4.78	2.92
Sandwip	NA	8.34	2.28	3.93	5.44	4.44	5.18
Kuakata	3.07	5.26	3.10	3.69	4.28	3.37	2.03
Mongla	3.07	2.41	2.94	4.23	4.34	4.44	2.92

From the table 1, we observed that the maximum average wind speed was 12.02 m/s in April at Kutubdia and the least average wind speed was 2.03 m/s in September at Kukata in 2003[19].

Table 2: In 2003, the theoretical available power of different locations in coastal region in Bangladesh.

Locations	Months	Avg. Wind Speed(m/s)	Theoretical Available Power (W/M^2)
Teknaf	March to September	3.23	22.11
Kutubdia	March to September	5.19	86.65
Sandwip	May to September	4.93	72.66
Kuakata	March to September	3.55	27.35
Mongla	March to September	3.48	25.52

From the table 2, shows that the maximum average wind speed was 5.19 m/s in Kutubdia from March to September. Moreover, the least average wind speed in Mongla which was 3.48 m/s from March to September. However, the maximum theoretical available power was 86.65 W/m2 from March to September in Kutubdia. Consequently, the minimum theoretical available power which was 22.11 W/m2 in Teknaf from March toSeptember [19].

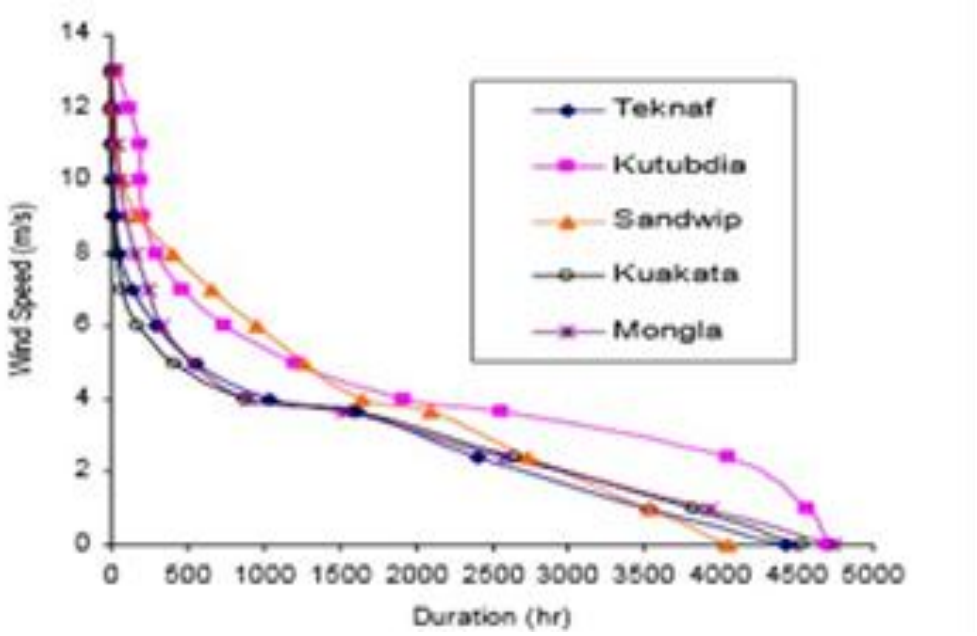

Fig. 2. In 2003, the difference of speed duration curves among difference locations of coastal region.

From figure 2, shows that the average wind speed in kutubdia and Sandip about 2.57 m/s for 2500 hrs. The average wind speed of reminder of the location is below 2.57 m/s for 2500 hrs. [19].

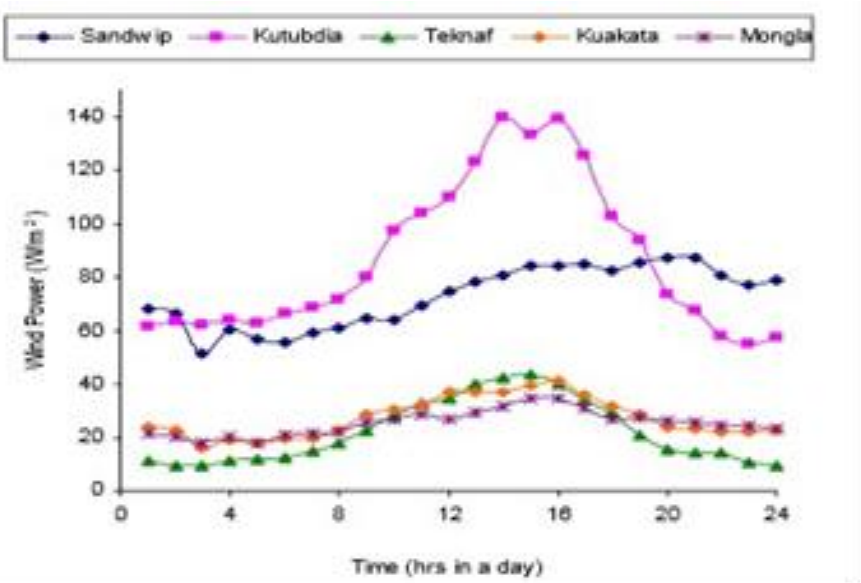

Fig. 3. In 2003, from March to September, the wind power in the different location in the coastal region.

From figure 3, indicates that the maximum wind power was in Sandip which was approximately 68 W/m2 in a day. In addition, with, the least wind power was in Teknaf which was approximately 10 W/m2 [19].

III. WIND GENERATORS IN USE

An assortment of complete wind turbine advancements is utilized as a part of the worldwide nation. On the other hand, wind turbine advances are extremely costly. Numerous nations have not shouldered this cost. Additionally, this innovation is so much multifaceted nature, effectiveness and gear which are generally utilized as a part of the wind turbine. A breeze turbine is a machine which changed over the motor vitality in the twist into mechanical vitality. Wind generator changed over mechanical vitality to power. A significant breeze turbine benefits a sharp edge and center point rotor get together to embodiment control from the breeze. Also,

acceptance generator is a well-known for electro-mechanical vitality transformation gadget. subsequently, acceptance generator has nonconcurrent nature [12]. Wind turbine proves us to create power. A breeze turbine works inverse of a fan. The breeze turns the cutting edges which turn a pole and it likewise associates with a generator and delivers power. Wind stream examples and paces differ boundlessly a crossed the United States. By and large, twist likewise utilized for creating mechanical power and power. mechanical power can be utilized for delegated errands like pounding grain, pumping water [13]. In [14,15], There are four sorts of fundamental breeze turbines.

Type 1: Fixed Speed Wind Turbines
Type 2: Variable-Slip Wind Turbines
Type 3: Doubly fed induction generator (DFIG) Wind turbines
Type 4: Full convert Wind Turbines

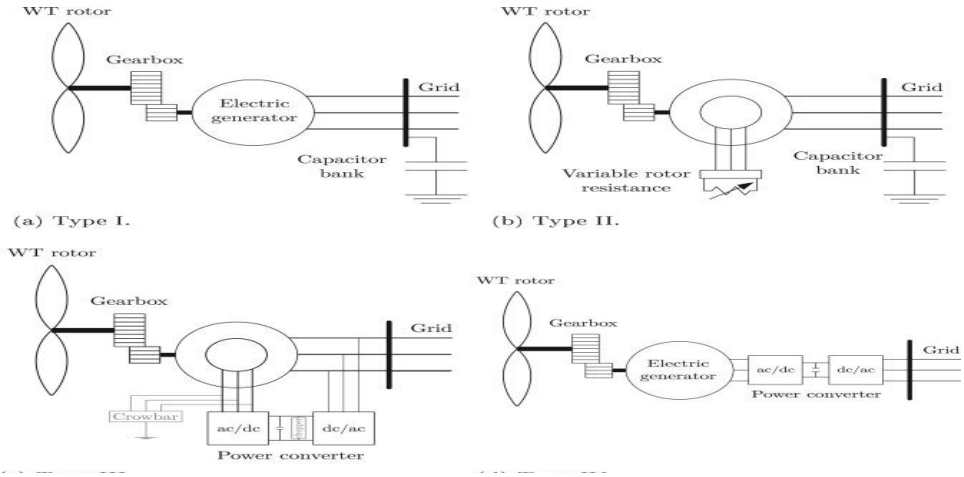

Fig. 4. Four types of basic wind turbines.

3.1 TYPE 1: FIXED SPEED WINDTURBINES

The fixed speed wind turbine can be worked the variety in rotor speed which is short of what one percent squirrel confine acceptance machines are straight to the power framework. For the most part, they adjusted pitch control to control removed from the breeze. Center point can be turned a couple of degrees into the breeze. Also, slow down controlled turbines, the rotor edges are solidly changed in accordance with the center point which is arranged so the wind current over the sharp edges qualified from the streamlined stream to turbulent stream at most extreme breeze speeds. The points of confinement energy of mechanical which are diverted out from the breeze at high speeds. Settled speed offbeat breeze generator, capacitor bank likewise associated with the low voltage side. Besides, asynchronous acceptance generator additionally associated with the apparatus box [16]. There are many focal points of settled speed wind speed turbines which are easy, simple to keep up, powerful, dependable and it likewise demonstrated in the field [17].

3.2 TYPE 2: VARIABLE-SLIP WIND TURBINES

Variable speed wind turbines can work at an extensive variety of rotor speed. This turbine, as a rule, underpins sharp edges pitching. An extensive variety of working slip variety can be accomplished by a controlled protection in the rotor circuit of the variable slip turbines. The rotor protection may deplete control due to warm [16].

3.3 TYPE 3: DOUBLY FED INDUCTION GENERATOR (DFIG) WIND TURBINES

A DFIG dynamic model can help to enhance decouple control of dynamic and responsive power. An injury rotor acceptance machine which is like an injury rotor enlistment machine. DFIG recuperates the slip control. It brings down the machine pressure and expanded breeze control extraction [20].

3.4 TYPE 4: FILLED CONVERT WIND TURBINES

The main power stream far from the breeze turbine to the lattice is a consecutive AC/DC/AC converter. It has no immediate matrix association. It might support acceptance generator. A full converter is recreated by lasting magnet alternator (PMA) machine [16].

IV. RESULTS AND ANALYSIS

A. MODELING OF CHITTAGONG ZONE POWER STATION IN THE POWER WORLD'

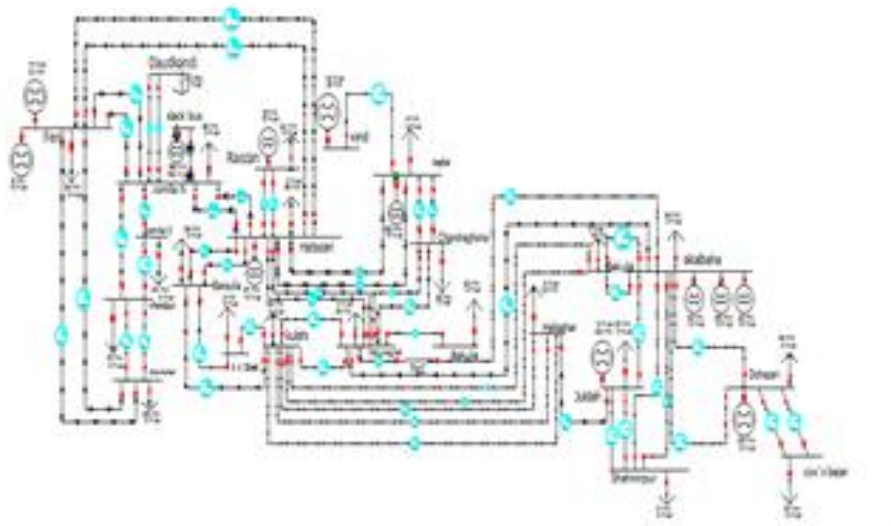

Fig. 5. Modeling of Chittagong Zone Power Station in the Power World.

From figure 5, the demonstrating of Chittagong zone control station in the power world which is mimicked by Power World Software 18.0. we additionally mimicked the impact of transport voltage in numerous regions in the Chittagong zone control station like kaptai, cox's Bazar, Hatazari, Feni, Sikalbaha and so on, when wind generator associated with the framework transport or don't associated with the network bus. We have one slack transport in this model which has high megawatt generator associated with this model. Initially, we figured the impact of transport voltage when winds are associated or disengaged to the lattice transport.

B. TESTING SYSTEM

The testing system of large-scale wind integration in coastal areas of Bangladesh is simulated by power world simulator 18.0 software. It is a very update model of power world simulator. Moreover, in the power world simulator, we used the type of active machine model is Gensal and generator MVA base is 100MVA. Therefore, we also used Gensal model because this model helps to get the flexibility to get a proper and accurate bus voltage. When the wind is connected to the Bus, then we connected WT1G in the wind generation which is one type of machine model. The load's megawatt (MW) is calculated from the daily report of fifteenth April 2015 and the generation (MW) are calculated from the daily report of twenty-sixth January 2016[21]. When the wind is connected to the bus like Kaptai, Feni, Shahmirpur, Cox`s Bazar, Halisahar then we observed the difference of Bus voltage.

C. STATIC OPERATION

In the investigation of static operation, for the most part, we watched that the distinction of per unit voltage when winds are associated with the network transport and winds are not associated with the lattice transport. In addition, we watched that the time is specifically converse corresponding to the transport voltage of per unit when the wind is or not associated with the lattice transport.

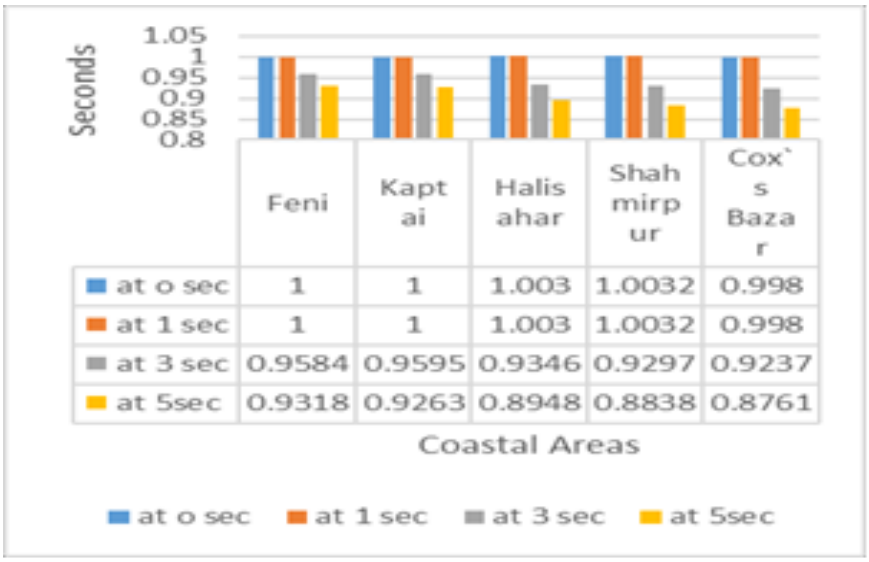

Fig. 6. When winds are not connected to the Bus.

From figure 6, when winds are not associated with the framework transport then we watched that the transport voltage of Feni and Kaptai are 1 for each unit at 0 seconds to 1 second separately. In addition, the transport voltage of Halisahar, Shahmirpur and Cox`s Bazar is thusly 1.003 for every unit, 1.0032 for each unit, 0.998 for every unit separately. At 3 seconds, the transport voltage of Feni is .9584pu and at 5 seconds, the transport voltage of Feni is 9318pu. Be that as it may, the Bus voltage of Cox's Bazar is 0.998 for every unit and .998 for each unit at 0 seconds and 1 second individually.

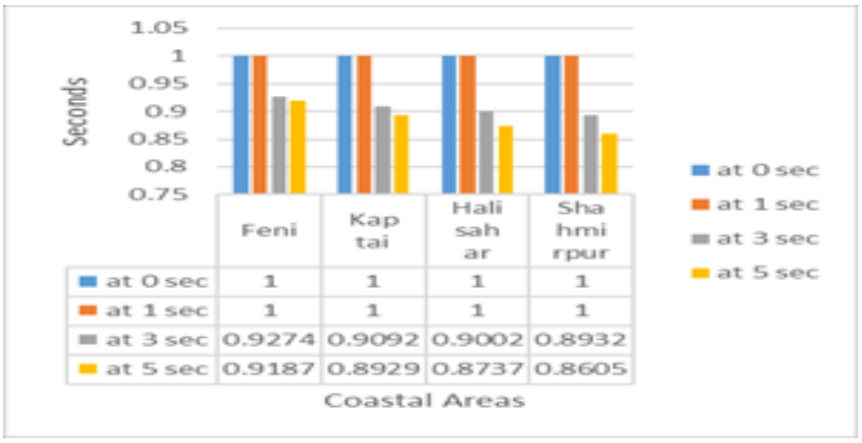

Fig. 7. When winds(WT1G) are connected to the Bus with 10MW.

From figure 7, When winds are associated with the lattice transport then we watched that the transport voltage of Halisahar is superbly 1 for every unit and the transport voltage of Shahmirpur is totally 1 for each unit at 0 seconds to 1 second individually. We likewise associated the machine dynamic model of wind turbine (WT1G) with 10MW. We additionally utilized Wind Turbine (WT1G) in light of the fact that it gets precise per unit voltage.

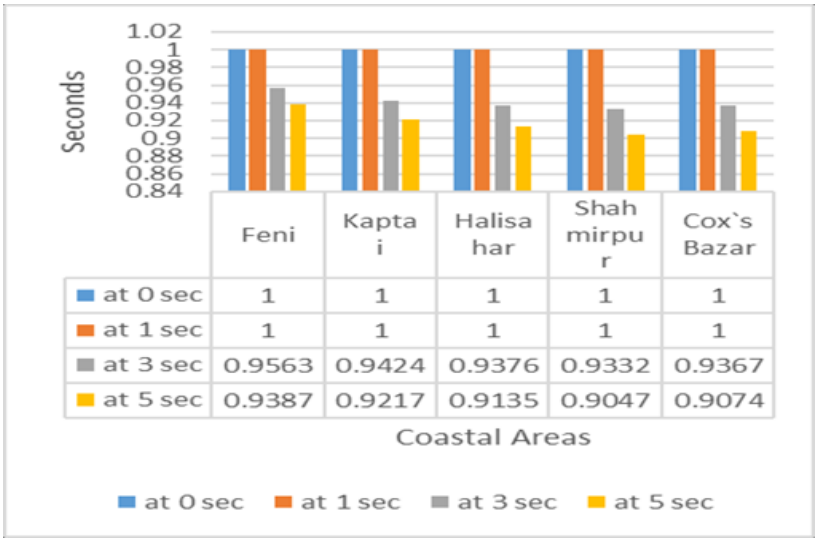

Fig. 8. When winds(WT3G) are connected to the Bus with 10MW.

From figure 8, when winds are associated with the matrix transport with 10mw and the machine demonstrate is wind turbine 3G (WT3G). we watched that the most noteworthy voltage of feni is 0.9563pu at 3 secs and the least voltage of Shahmirpur is 0.9332pu at 3 secs. In addition, at 5 secs, the voltage is diminished which is 0.9387pu.

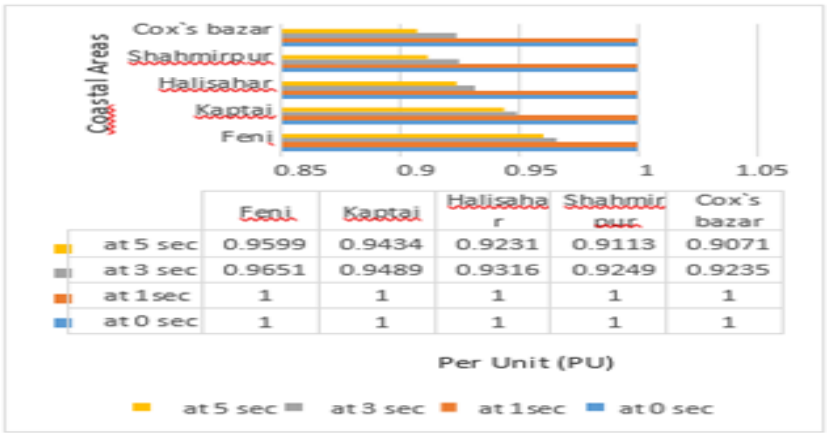

Fig. 9. When winds(WT4G) are connected to the Bus with 100MW.

From figure 9, when winds (wind turbine 4G) with 100mw are associated with the network transport (Feni, Kaptai, Halishar, Shahmirpur, Cox's Bazar) and reproduced by Power World Software then we watched that each framework transport accomplished 1 for every unit voltage at 0 seconds and 1 second individually. In any case, on the off chance that we watched that at 3 seconds and 5 seconds the transport voltage of each lattice transport associated with the twist is beneath the estimation of 1 for every unit like the transport voltage of Feni 0.9651pu and 0.9599 for each unit individually.

Table 3. When winds are connected with different machine models with 100MW.

	WT1G		WT2G		WT3G	
	At1sec	At5secs	At 1 sec 1 sec	At5secs	At1 sec	At5secs
1.Feni	1pu	0.9566 Pu	1pu	0.9592pu	1pu	0.973pu
2.Kaptai	1pu	0.9415Pu	1pu	0.945pu	1pu	0.969pu
3. Halisahar	1pu	0.9199 Pu	1pu	0.9246pu	1pu	0.959pu
4. Shahmirpur	1pu	0.9073 Pu	1pu	0.913pu	1pu	0.9508pu
5.Cox's Bazar	1pu	0.902 Pu	1pu	0.908pu	1pu	0.95pu

From table 3, when wind turbines are associated with the distinctive network transport with various machine models like WT1G, WT2G, and WT3G with 100MW, at that point we obtained the diverse sorts of transport voltage. Be that as it may, when times are expanded, at that point the breezes associated transport voltage per unit is diminished.

D. TIME DOMAIN SIMULATION

Time domain simulation originally focused on the graph of bus voltage per unit when the wind is connected or not connected.

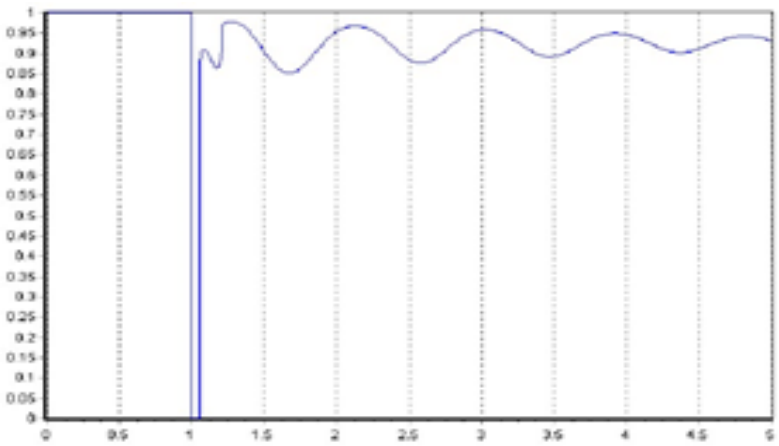

Fig. 10. The bus voltage of Feni without wind generator.

From Figure 10, the transport voltage of Feni without wind generator has been vacillated around between at 1.075 seconds and 5 seconds which are about roughly 0.9 for each unit and 0.95 for each unit individually. At 1 second the transport voltage of Feni without wind has straightforwardly come to the peak at roughly 1 for every unit and at 1.075 seconds the transport voltage has vacillated and on the double-time, it will be steady.

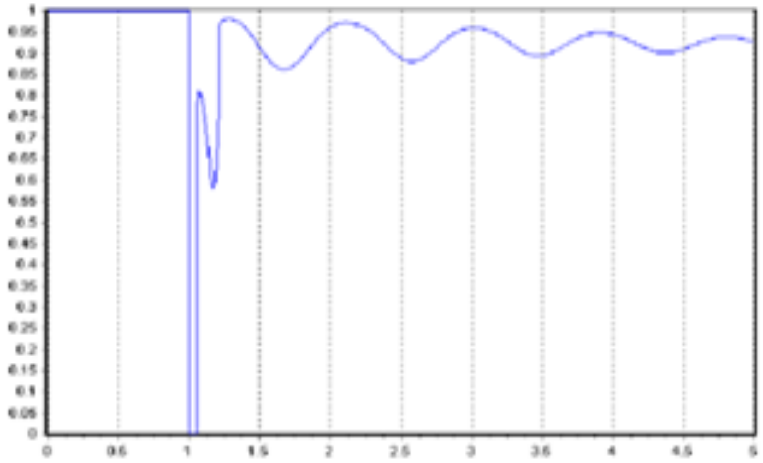

Fig. 11. The bus voltage of Kaptai without wind generator.

From figure 11, the transport voltage of kaptai without wind generator has been changed between at 1.2 seconds and 5 seconds which is around 0.97 voltage and 0.94 voltage individually. In any case, between at 1.1 seconds and 1.2 seconds, the transport voltage of Kaptai is specifically falling down which is around 0.8 voltage to 0.6 voltage roughly while the greatest transport voltage of Kaptai at 1 second is 1 voltage. Moreover, at 1.25 seconds, the bus voltage of Kaptai is dramatically increased which is close to the maximum voltage.

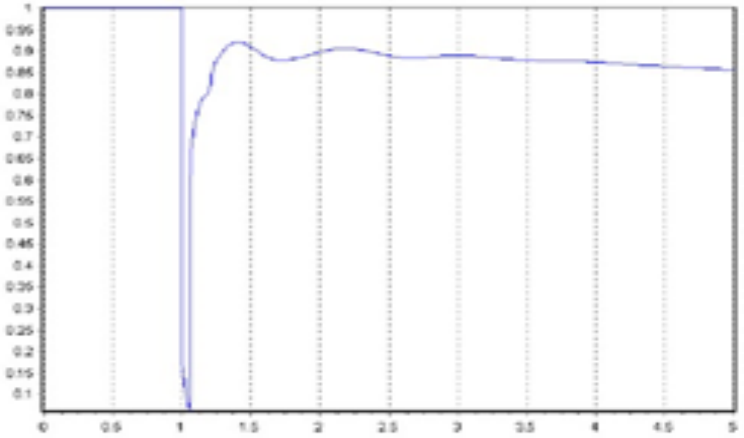

Fig. 12. The bus voltage of Cox`s bazar with wind Generator.

From Figure 12, when wind generator is associated with the lattice transport of Cox's Bazar, we watched that at 1.05 seconds, the greatest transport voltage is 1 for every unit. Nonetheless, without twist at 1 second, the greatest transport voltage is 1 for each unit. We examined that the time delay between with twist and without wind is .05 second. Also, the chart is the minimum vacillated between 1.1 second and 5 seconds. Thus, without varied at 2.75 seconds to 5 seconds, the transport voltage of Cox's Bazar with wind is gradually decreased.

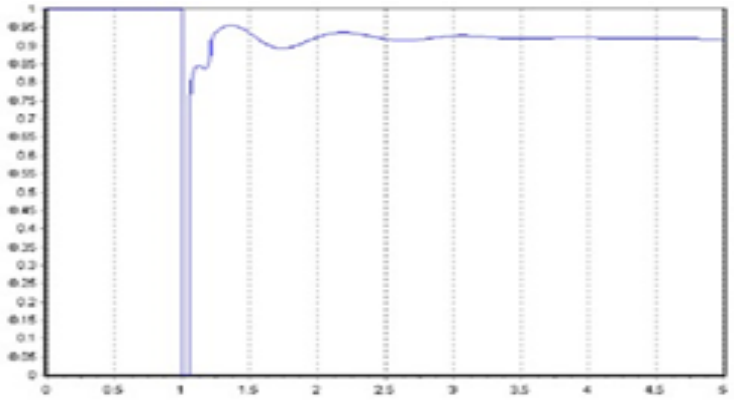

Fig 13. The bus voltage of Feni with wind generator.

From figure 10 and 13, in the event that we contrasted with the charts, we broke down that the variance is diminished when wind generator is associated with the Feni transport matrix. At once, the transport voltage took after steady transport voltage at around between 3 seconds and 5 seconds when wind generator is associated with the Feni Bus lattice.

V. CONCLUSION

From this paper, we likewise associated a few winds to the matrix transport with the converter in the beachfront zones. This paper features the effect of transport voltage. In this paper, wind turbines mollified the mechanical pressure andvitality limit increment. We mimicked some beach front regions like skipper, Feni, Cox`s Bazar, Shahmirpur and Halisahar by control world programming 18.0. we utilized the dynamic machine model of WT1G with 10 MW when we reproduced by control world programming. In Bangladesh control framework, wind vitality isn't produced consummately. There are many lacking for creating wind vitality. The absence of impeccable place is the primary impediment to creating wind vitality in Bangladesh.

VI. ACKNOWLEDGEMENTS

This examination was upheld by Dr. Tareq Aziz. We thank our instructor from Ahsanullah University of Science and Technology. who gave knowledge and aptitude that incredibly helped the exploration, despite the fact that he may not concur with the greater part of the finishes of this paper.

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