Journal of Research in Electrical Circuits and Systems
Volume 2 Issue 3, September-December 2017

Analysis of Kayathar Wind Farm with and Without Battery Energy Storage System

R. Priyanka[1], S. Archana[2]
Assistant Professor[1, 2]
S. A. Engineering College, Chennai
Corresponding Author's email: *priyasasi1410@gmail.com[1]*

Abstract

In this paper deals with the battery energy storage system used in kayathar wind farm which analyse the variation in voltage using battery in wind farm which leads to implement in plant. Using Digsilent power factory software analysed the voltage variation in wind farm which has only a minimum variation in voltage therefore it can be implemented in kayathar wind farm which helps to store the power and that can be used in peak demand.

Keywords: *Kayathar, Wind farm, Battery, Energy storage system*

INTRODUCTION

In order to meet the increasing in power demand, we need to move on to non-renewable energy to renewable energy sources because renewable energy sources like Wind , solar etc which is non polluting and does not create any harm to living organisms. Among those renewable sources wind place a important role which is directly generating from wind and that generating power is AC source so it does not required any power electronics devices to convert the power. This project mainly concentrate on the energy storage because when the wind is more the generating power will be more which will be more than the demand so in order to save the power we need energy storage devices should be included in the distributing side so that we can store and that can be used later when the power demand is too high.

Battery energy storage technique in kayathar wind farm is new and that can analysed only with DIgsilent software if the voltage levels are equal between the battery storage and the grid then it can be implemented also to the plant. Here the battery energy storage is used therefore we need to required the rated capacity of the battery and how much the power is to be stored in the storage system and inverter is used to convert the battery dc power to ac source to the grid.

LAYOUT OF NEPC:

NEPC layout is the part of kayathar wind farm which consist of 23 wind generator with different rating, there are (1*600kw), (9*200kw), (12*250kw).These 23 generators are connected with 11kv feeder and then it stepped up into 110kv to the grid and this lines have the reactance value that should matches with the overall grid therefore the values find out from the voltage value of each line. This NEPC layout has different generators from different sectors but CWET has 6 wind generators.

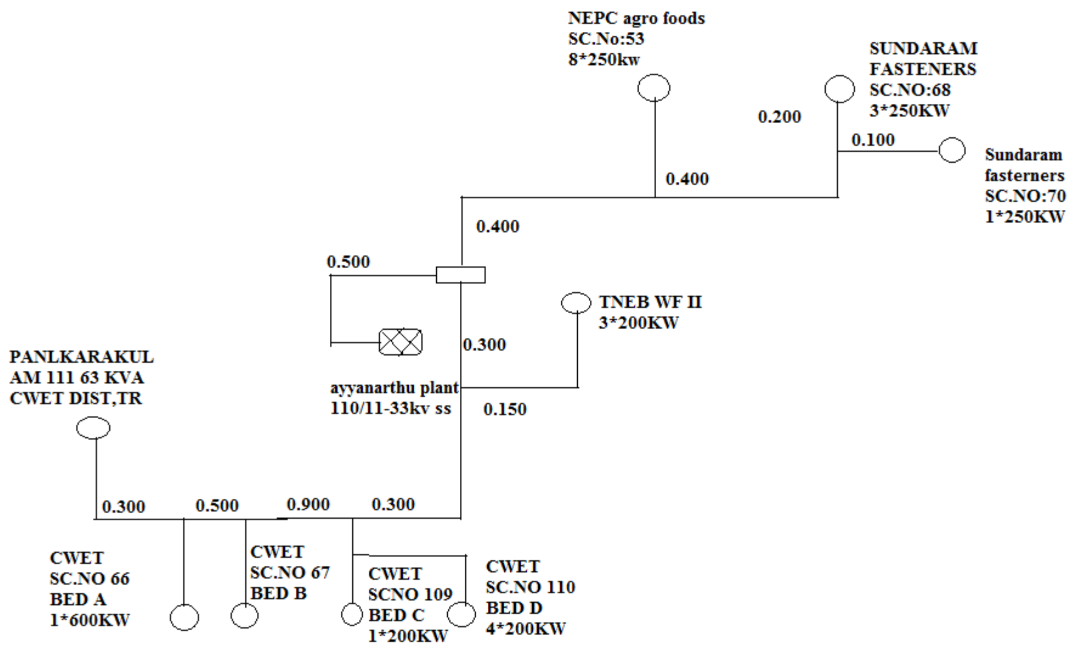

Fig 1 layout of NEPC

SINGLE LINE DIAGRAM OF NEPC LAYOUT:

The single line diagram consist of overall 23 wind turbines along with the transformers are connected with each turbine and the lines are connected between the each bus which has the value of 11kv and the main grid consist the voltage value of 110kv.here there are 85 bus are included with lines and the transformers. totally it consist of 23 wind turbines,23 transformers and 85 buses and those are connected through the transmission line which has the rated capacity of 11kv, it should be stepped up to the grid with the voltage of 110kv.

LOAD FLOW ANALYSIS OF NEPC LAYOUT:

Load flow analysis of NEPC layout which mainly done for analysing the voltage which is equals to the bus value. The voltage at each terminal should be equal to voltage at the bus or otherwise we should include the compensation technique to compensate the voltage level. This fig 3 shows the load flow analysis of wind turbine which has the voltage of 0.4kv and it stepped up to the 11kv through the transformers and the 11kv flows throughout the line which rated capacity is 11kv and the overall transformer is connected to the grid which is 110/11kv.

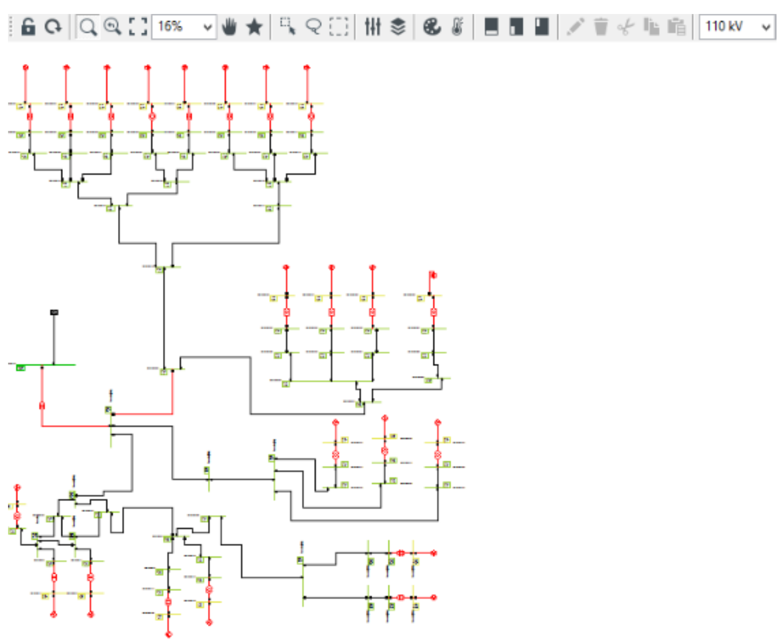

Fig 2: single line diagram of NEPC layout

Journal of Research in Electrical Circuits and Systems
Volume 2 Issue 3, September-December 2017

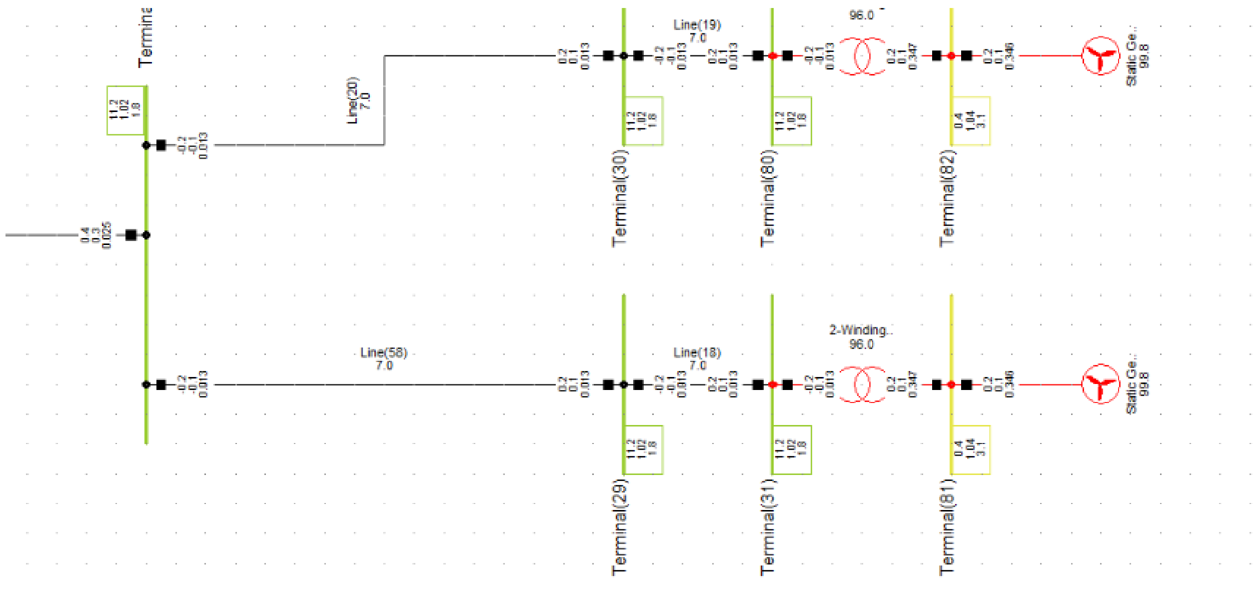

Fig 3: load flow analysis of NEPC layout

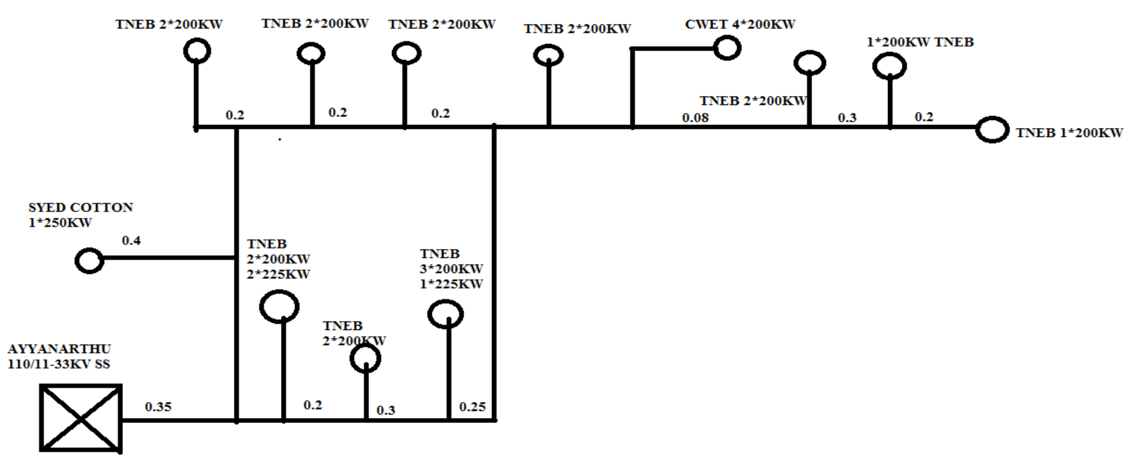

Fig 4: Ayyanarthu layout

Layout Of Ayyanarthu Plant

Ayyanarthu layout consist of 27 wind turbines which is rated as (1*250KW) , (23*200KW) , (3*225KW) then the total output will be 5.525MW.the wind turbines are connected in feeder which rated capacity is 11kv and it stepped up into 110kv at the distribution side. This layout consists of various department wind turbines, here CWET has 4 wind turbines and rating is 200kw then the output power will be 0.8Mw.This layout transmission lines have the impedance inorder to choose the rated capacity of the line.

SINGLE LINE DIAGRAM OF AYYANARUTHU LAYOUT

The single line diagram consist of overall 23 wind turbines along with the transformers are connected with each turbine and the lines are connected between the each bus which has the value of 11kv and the main grid consist the voltage value of 110kv.here there are 108 bus are included with lines and the transformers. totally it consist of 27 wind turbines,28 transformers and 108 buses and those are connected through the transmission line which has the rated capacity of 11kv, it should be stepped up to the grid with the voltage of 110kv.

Analysisng the Power

Kayathar wind farm layout has simulated with the help of single line diagram in Digsilent software. Here we analysed the load flow analysis of both NEPC and AYYANARTHU layout from this we can know the power level at each terminal therefore if there is any power sag or swell easily rectified through the power electronics devices. The power electronics devices can easily allowed the error terminal, it will not allow any changes in other terminal and the devices will the compensate the power which will match with other terminal.

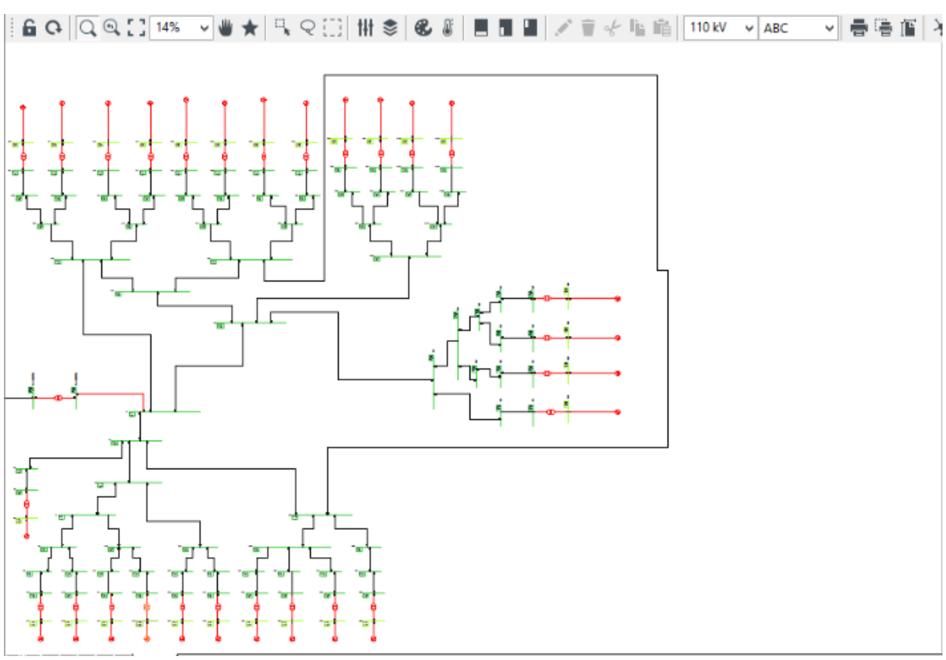

Fig 5: single line diagram of ayyanaruthu layout

NEPC Power Rating:

A	B	C	D	E	F	G	H	I
	WIND TURBINE GENERATOR					TWO WINDING TRANSFORMER		
SL.NO	P(MW)	Q(MVAR)	S(MVA)		SL.NO	S(MVA)	HV(KV)	LV(KV)
G1	0.2	0.149	0.25		T1	0.25	11	0.4
G2	0.6	0.449	0.75		T2	0.75	11	0.4
G3	0.2	0.149	0.25		T3	0.25	11	0.4
G4	0.2	0.149	0.25		T4	0.25	11	0.4
G5	0.2	0.149	0.25		T5	0.25	11	0.4
G6	0.2	0.149	0.25		T6	0.25	11	0.4
G7	0.2	0.149	0.25		T7	0.25	11	0.4
G8	0.2	0.149	0.25		T8	0.25	11	0.4
G9	0.2	0.149	0.25		T9	0.25	11	0.4
G10	0.2	0.149	0.25		T10	0.25	11	0.4
G11	0.25	0.187	0.312		T11	0.312	11	0.4
G12	0.25	0.187	0.312		T12	0.312	11	0.4
G13	0.25	0.187	0.312		T13	0.312	11	0.4
G14	0.25	0.187	0.312		T14	0.312	11	0.4
G15	0.25	0.187	0.312		T15	0.312	11	0.4
G16	0.25	0.187	0.312		T16	0.312	11	0.4
G17	0.25	0.187	0.312		T17	0.312	11	0.4
G18	0.25	0.187	0.312		T18	0.312	11	0.4
G19	0.25	0.187	0.312		T19	0.312	11	0.4
G20	0.25	0.187	0.312		T20	0.312	11	0.4
G21	0.25	0.187	0.312		T21	0.312	11	0.4
G22	0.25	0.187	0.312		T22	0.312	11	0.4
					T23	5	110	11

Fig 6: NEPC power value

The above tabular column clearly explains the power rating at wind turbine and transformer. NEPC layout has 22 wind turbine generator and 23 transformers therefore the power rating of each generator and transformer is evaluated ,this values are analysed through the load flow analysis here gauss seidal method is used and it has done three iterations therefore the output values will be accurate.

AYYANARTHU POWER RATING:

In Ayyarathu power plant consist of more number of wind turbines compared to NEPC plant therefore it has more analysis to get the accurate power rating. Here there are 27 wind turbine generators are used and has different rating (1*250Kw), (3*225Kw), (23*200Kw) then the total output power 6.906Mw.This layout consist only the step up transformer, there are 28 transformer are used which are stepped up to 11/0.4 Kv and one transformer are used in grid side i.e 110/11-33Kv.

WIND TURBINE GENERATOR				WIND TURBINE GENERATOR				TRASNFORMER				TRASNFORMER			
SL.NO	P(MW)	Q(MVAR)	S(MVA)	SL.NO	P(MW)	Q(MVAR)	S(MVA)	SL.NO	S(MVA)	HV(KV)	LV)KV)	SL.NO	S(MVA)	HV(KV)	LV)KV)
G1	0.25	0.187	0.312	G24	0.2	0.149	0.25	T1	0.312	11	0.4	T24	0.25	11	0.4
G2	0.2	0.149	0.25	G25	0.2	0.149	0.25	T2	0.312	11	0.4	T25	0.25	11	0.4
G3	0.2	0.149	0.25	G26	0.2	0.149	0.25	T3	0.312	11	0.4	T26	0.25	11	0.4
G4	0.225	0.168	0.281	G27	0.2	0.149	0.25	T4	0.312	11	0.4	T27	0.25	11	0.4
G5	0.225	0.168	0.281					T5	0.312	11	0.4	T28	6.906	110	11
G6	0.2	0.149	0.25					T6	0.25	11	0.4				
G7	0.2	0.149	0.25					T7	0.25	11	0.4				
G8	0.2	0.149	0.25					T8	0.25	11	0.4				
G9	0.2	0.149	0.25					T9	0.25	11	0.4				
G10	0.2	0.149	0.25					T10	0.25	11	0.4				
G11	0.225	0.168	0.281					T11	0.281	11	0.4				
G12	0.2	0.149	0.25					T12	0.25	11	0.4				
G13	0.2	0.149	0.25					T13	0.25	11	0.4				
G14	0.2	0.149	0.25					T14	0.25	11	0.4				
G15	0.2	0.149	0.25					T15	0.25	11	0.4				
G16	0.2	0.149	0.25					T16	0.25	11	0.4				
G17	0.2	0.149	0.25					T17	0.25	11	0.4				
G18	0.2	0.149	0.25					T18	0.25	11	0.4				
G19	0.2	0.149	0.25					T19	0.25	11	0.4				
G20	0.2	0.149	0.25					T20	0.25	11	0.4				
G21	0.2	0.149	0.25					T21	0.25	11	0.4				
G22	0.2	0.149	0.25					T22	0.25	11	0.4				
G23	0.2	0.149	0.25					T23	0.25	11	0.4				

Fig 7: power tabular column of ayyarathu

ANALYSING OF VOLATGE WITHOUT BATTERY:

In NEPC layout we have analysing the voltage at the different terminal which means that bus voltage .All the other devices are connected through the bus bar.All the bus bar rating is 11kv until it connected to the grid once it connected to grid the voltage is stepped up to 110KV therefore only one bus bar alone with the rating of 110kv.This layout used 85 bus bar therefore it required the voltage values, reactive power and real power.

If there is any problem in simulation we need to check all the voltages that we have applied in bus bar therefore while the values are applying to the bus bar need more concentration and the execution will take place, the simulation is carried out through the guass seidal method it will take atleast three iterations to get the accurate voltage values.

MANTECH Publications

Journal of Research in Electrical Circuits and Systems

Volume 2 Issue 3, September-December 2017

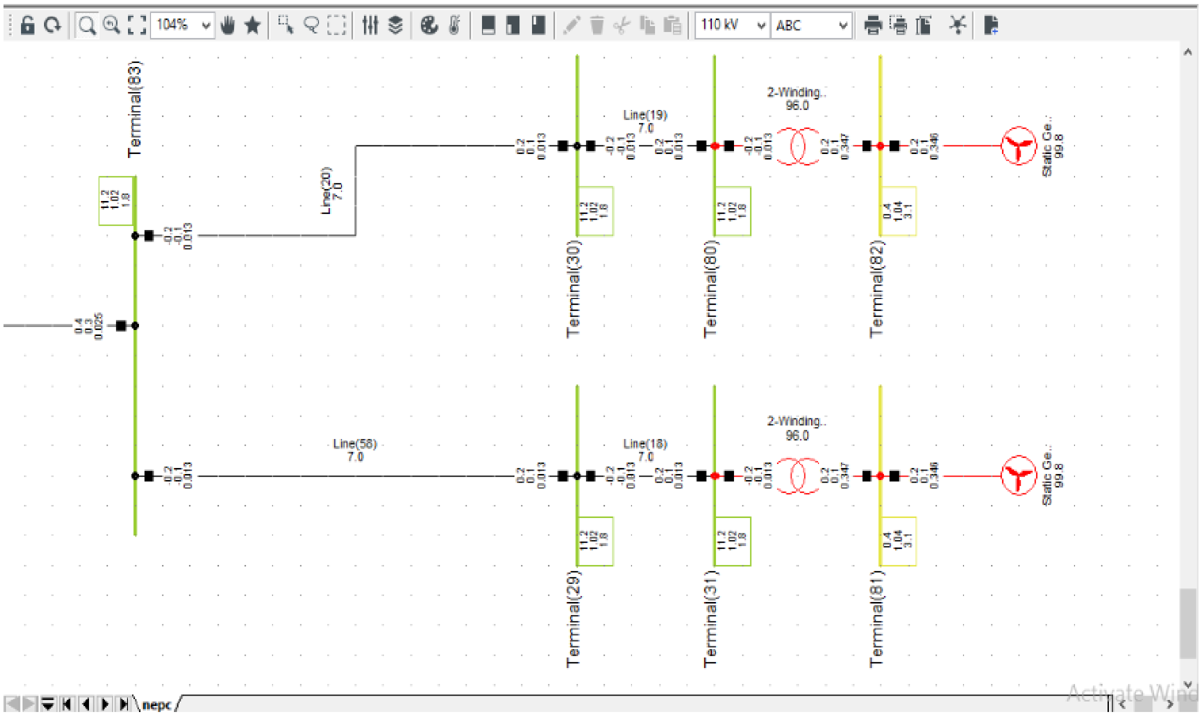

Fig 8: Load flow voltage values

Terminal voltage of NEPC layout without using battery:

TERMINAL VOLTAGE WITHOUT BATTERY

SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)
T1	0.4	1.04	3.1	T23	0.4	1.04	3.1	T45	11.2	1.02	1.8	T67	11.2	1.02	1.8
T2	11.2	1.02	1.8	T24	11.2	1.02	1.8	T46	11.2	1.02	1.8	T68	11.2	1.02	1.8
T3	1.2	1.02	1.8	T25	11.2	1.02	1.8	T47	0.4	1.04	3.1	T69	11.2	1.02	1.8
T4	11.2	1.02	1.8	T26	0.4	1.04	3.1	T48	11.2	1.02	1.8	T70	0.4	1.04	3.1
T5	0.4	1.04	3.1	T27	11.2	1.02	1.8	T49	11.2	1.02	1.8	T71	11.2	1.02	1.8
T6	11.2	1.02	1.8	T28	11.2	1.02	1.8	T50	0.4	1.04	3.1	T72	11.2	1.02	1.8
T7	0.4	1.04	3.1	T29	11.2	1.02	1.8	T51	11.2	1.02	1.8	T73	0.4	1.04	3.1
T8	11.2	1.02	1.8	T30	11.2	1.02	1.8	T52	11.2	1.02	1.8	T74	11.2	1.02	1.8
T9	11.2	1.02	1.8	T31	0.4	1.04	3.1	T53	11.2	1.02	1.8	T75	11.2	1.02	1.8
T10	11.2	1.02	1.8	T32	11.2	1.02	1.8	T54	0.4	1.04	3.1	T76	11.2	1.02	1.8
T11	11.2	1.02	1.8	T33	11.2	1.02	1.8	T55	11.2	1.02	1.8	T77	11.2	1.02	1.8
T12	11.2	1.02	1.8	T34	0.4	1.04	3.1	T56	11.2	1.02	1.8	T78	0.4	1.04	3.1
T13	11.2	1.02	1.8	T35	11.2	1.02	1.8	T57	11.2	1.02	1.8	T79	11.2	1.02	1.8
T14	11.2	1.02	1.8	T36	11.2	1.02	1.8	T58	11.2	1.02	1.8	T80	11.2	1.02	1.8
T15	11.2	1.02	1.8	T37	0.4	1.04	3.1	T59	11.2	1.02	1.8	T81	0.4	1.04	3.1
T16	0.4	1.04	3.1	T38	11.2	1.02	1.8	T60	0.4	1.04	3.1	T82	11.2	1.02	1.8
T17	11.2	1.02	1.8	T39	11.2	1.02	1.8	T61	11.2	1.02	1.8	T83	11.2	1.02	1.8
T18	11.2	1.02	1.8	T40	11.2	1.02	1.8	T62	11.2	1.02	1.8	T84	0.4	1.04	3.1
T19	0.4	1.04	3.1	T41	11.2	1.02	1.8	T63	0.4	1.04	3.1	T85	110	1	0
T20	11.2	1.02	1.8	T42	11.2	1.02	1.8	T64	11.2	1.02	1.8				
T21	11.2	1.02	1.8	T43	11.2	1.02	1.8	T65	11.2	1.02	1.8				
T22	11.2	1.02	1.8	T44	0.4	1.04	3.1	T66	0.4	1.04	3.1				

Fig 9: NEPC terminal voltage without battery

NEPC consist of 85 terminal voltage which has the same voltage and the phase angle difference will be differ according to the step up and step down voltage levels and the per unit will be 0.02 and 0.04 great than 1.This voltage level should be compare with the terminal voltage once the battery is applied to the grid.

Analysing Of Voltage with Battery in NEPC Layout:

TERMINAL VOLTAGE WITH BATTERY															
SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)
T1	0.4	1.04	3.1	T23	0.4	1.04	3.1	T45	11.2	1.02	1.7	T67	11.2	1.02	1.7
T2	11.2	1.02	1.7	T24	11.2	1.02	1.7	T46	11.2	1.02	1.7	T68	11.2	1.02	1.7
T3	1.2	1.02	1.7	T25	11.2	1.02	1.7	T47	0.4	1.04	3.1	T69	11.2	1.02	1.7
T4	11.2	1.02	1.7	T26	0.4	1.04	3.1	T48	11.2	1.02	1.7	T70	0.4	1.04	3.1
T5	0.4	1.04	3.1	T27	11.2	1.02	1.7	T49	11.2	1.02	1.7	T71	11.2	1.02	1.7
T6	11.2	1.02	1.7	T28	11.2	1.02	1.7	T50	0.4	1.04	3.1	T72	11.2	1.02	1.7
T7	0.4	1.04	3.1	T29	11.2	1.02	1.7	T51	11.2	1.02	1.7	T73	0.4	1.04	3.1
T8	11.2	1.02	1.7	T30	11.2	1.02	1.7	T52	11.2	1.02	1.7	T74	11.2	1.02	1.7
T9	11.2	1.02	1.7	T31	0.4	1.04	3.1	T53	11.2	1.02	1.7	T75	11.2	1.02	1.7
T10	11.2	1.02	1.7	T32	11.2	1.02	1.7	T54	0.4	1.04	3.1	T76	11.2	1.02	1.7
T11	11.2	1.02	1.7	T33	11.2	1.02	1.7	T55	11.2	1.02	1.7	T77	11.2	1.02	1.7
T12	11.2	1.02	1.7	T34	0.4	1.04	3.1	T56	11.2	1.02	1.7	T78	0.4	1.04	3.1
T13	11.2	1.02	1.7	T35	11.2	1.02	1.7	T57	11.2	1.02	1.7	T79	11.2	1.02	1.7
T14	11.2	1.02	1.7	T36	11.2	1.02	1.7	T58	11.2	1.02	1.7	T80	11.2	1.02	1.7
T15	11.2	1.02	1.7	T37	0.4	1.04	3.1	T59	11.2	1.02	1.7	T81	0.4	1.04	3.1
T16	0.4	1.04	3.1	T38	11.2	1.02	1.7	T60	0.4	1.04	3.1	T82	11.2	1.02	1.7
T17	11.2	1.02	1.7	T39	11.2	1.02	1.7	T61	11.2	1.02	1.7	T83	11.2	1.02	1.7
T18	11.2	1.02	1.7	T40	11.2	1.02	1.7	T62	11.2	1.02	1.7	T84	0.4	1.04	3.1
T19	0.4	1.04	3.1	T41	11.2	1.02	1.7	T63	0.4	1.04	3.1	T85	110	1	0
T20	11.2	1.02	1.7	T42	11.2	1.02	1.7	T64	11.2	1.02	1.7				
T21	11.2	1.02	1.7	T43	11.2	1.02	1.7	T65	11.2	1.02	1.7				
T22	11.2	1.02	1.7	T44	0.4	1.04	3.1	T66	0.4	1.04	3.1				

Fig 10: NEPC battery voltage

Journal of Research in Electrical Circuits and Systems
Volume 2 Issue 3, September-December 2017

The battery is inserted as energy storage device in grid, therefore we need to compare the battery voltage with the terminal voltage. If both the terminal without battery and terminal voltage with battery is same then we can implement the energy storage techniques in real plant. The simulation results will be almost equal and there is somewhat very minute variation and that will not be affecting anyways to the system and the voltage at distribution side will be accurate.

Ayyanarathu layout which has 108 terminals i.e. busbar voltage, it consist of both step up and step down voltage levels therefore all the terminal voltage will be same. The phase angle will be differ according to the voltage levels and per unit level will be slightly greater than the 1 but that will not be affect the system even the terminal voltage also has the value that is slightly greater than the voltage as the input. Here given input voltage is 0.4Kv and the busbar value has 11Kv therefore step up transformer is used again the grid voltage is 110Kv that will be distributed to the consumers and the industries so again need to step up the voltage.

Ayyanaruthu layout terminal voltage without battery:

1	TERMINAL VOLTAGE WITHOUT BATTERY				TERMINAL VOLTAGE WITHOUT BATTERY				TERMINAL VOLTAGE WITHOUT BATTERY				TERMINAL VOLTAGE WITHOUT BATTERY				TERMINAL VOLTAGE WITHOUT BATTERY			
2	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)	SL.NO	Ul (KV)	u (p.u)	phiu(deg)
3	T1	11.2	1.02	1.4	T24	11.2	1.02	1.4	T47	11.2	1.02	1.4	T70	11.2	1.02	1.4	T93	11.2	1.02	1.4
4	T2	11.2	1.02	1.4	T25	0.4	1.03	2.7	T48	11.2	1.02	1.4	T71	0.4	1.03	2.7	T94	11.2	1.02	1.4
5	T3	11.2	1.02	1.4	T26	11.2	1.02	1.4	T49	11.2	1.02	1.4	T72	11.2	1.02	1.4	T95	11.2	1.02	1.4
6	T4	11.2	1.02	1.4	T27	11.2	1.02	1.4	T50	11.2	1.02	1.4	T73	11.2	1.02	1.4	T96	0.4	1.03	2.7
7	T5	0.4	1.03	2.7	T28	0.4	1.03	2.7	T51	11.2	1.02	1.4	T74	11.2	1.02	1.4	T97	11.2	1.02	1.4
8	T6	11.2	1.02	1.4	T29	0.4	1.03	2.7	T52	0.4	1.03	2.7	T75	0.4	1.03	2.7	T98	11.2	1.02	1.4
9	T7	11.2	1.02	1.4	T30	11.2	1.02	1.4	T53	11.2	1.02	1.4	T76	11.2	1.02	1.4	T99	0.4	1.03	2.7
10	T8	11.2	1.02	1.4	T31	11.2	1.02	1.4	T54	11.2	1.02	1.4	T77	11.2	1.02	1.4	T100	11.2	1.02	1.4
11	T9	11.2	1.02	1.4	T32	11.2	1.02	1.4	T55	11.2	1.02	1.4	T78	0.4	1.03	2.7	T101	11.2	1.02	1.4
12	T10	11.2	1.02	1.4	T33	0.4	1.03	2.7	T56	0.4	1.03	2.7	T79	11.2	1.02	1.4	T102	11.2	1.02	1.4
13	T11	0.4	1.03	2.7	T34	11.2	1.02	1.4	T57	11.2	1.02	1.4	T80	11.2	1.02	1.4	T103	0.4	1.03	2.7
14	T12	11.2	1.02	1.4	T35	11.2	1.02	1.4	T58	11.2	1.02	1.4	T81	11.2	1.02	1.4	T104	11.2	1.02	1.4
15	T13	11.2	1.02	1.4	T36	0.4	1.03	2.7	T59	0.4	1.03	2.7	T82	0.4	1.03	2.7	T105	11.2	1.02	1.4
16	T14	0.4	1.03	2.7	T37	11.2	1.02	1.4	T60	11.2	1.02	1.4	T83	11.2	1.02	1.4	T106	0.4	1.03	2.7
17	T15	11.2	1.02	1.4	T38	11.2	1.02	1.4	T61	11.2	1.02	1.4	T84	11.2	1.02	1.4	T107	110	1	0
18	T16	11.2	1.02	1.4	T39	0.4	1.03	2.8	T62	11.2	1.02	1.4	T85	0.4	1.03	2.7	T108	11.2	1.02	1.4
19	T17	11.2	1.02	1.4	T40	11.2	1.02	1.4	T63	11.2	1.02	1.4	T86	11.2	1.02	1.4				
20	T18	0.4	1.03	2.7	T41	11.2	1.02	1.4	T64	11.2	1.02	1.4	T87	11.2	1.02	1.4				
21	T19	11.2	1.02	1.4	T42	11.2	1.02	1.4	T65	11.2	1.02	1.4	T88	11.2	1.02	1.4				
22	T20	11.2	1.02	1.4	T43	0.4	1.03	2.7	T66	11.2	1.02	1.4	T89	0.4	1.03	2.7				
23	T21	0.4	1.03	2.7	T44	11.2	1.02	1.4	T67	11.2	1.02	1.4	T90	11.2	1.02	1.4				
24	T22	11.2	1.02	1.4	T45	11.2	1.02	1.4	T68	0.4	1.03	2.7	T91	11.2	1.02	1.4				
25	T23	11.2	1.02	1.4	T46	11.2	1.02	1.4	T69	11.2	1.02	1.4	T92	0.4	1.03	2.7				

Fig 11: Ayyanarathu terminal voltage without battery

ANALYSING OF VOLTAGE WITH BATTERY IN AYYANARUTHU PLANT:

The battery is inserted as energy storage device in grid, therefore we need to compare the battery voltage with the terminal voltage. If both the terminal without battery and terminal voltage with battery is same then we can implement the energy storage techniques in real plant. The simulation results will be almost equal and there is somewhat very minute variation and that will not be affecting anyways to the system and the voltage at distribution side will be accurate.

1	TERMINAL VOLTAGE WITH BATTERY				TERMINAL VOLTAGE WITH BATTERY				TERMINAL VOLTAGE WITH BATTERY				TERMINAL VOLTAGE WITH BATTERY				TERMINAL VOLTAGE WITH BATTERY			
2	SL.NO	UI (KV)	u (p.u)	phiu(deg)	SL.NO	UI (KV)	u (p.u)	phiu(deg)	SL.NO	UI (KV)	u (p.u)	phiu(deg)	SL.NO	UI (KV)	u (p.u)	phiu(deg)	SL.NO	UI (KV)	u (p.u)	phiu(deg)
3	T1	11.2	1.02	1.5	T24	11.2	1.02	1.5	T47	11.2	1.02	1.5	T70	11.2	1.02	1.5	T93	11.2	1.02	1.5
4	T2	11.2	1.02	1.5	T25	0.4	1.03	2.7	T48	11.2	1.02	1.5	T71	0.4	1.03	2.7	T94	11.2	1.02	1.5
5	T3	11.2	1.02	1.5	T26	11.2	1.02	1.5	T49	11.2	1.02	1.5	T72	11.2	1.02	1.5	T95	11.2	1.02	1.5
6	T4	11.2	1.02	1.5	T27	11.2	1.02	1.5	T50	11.2	1.02	1.5	T73	11.2	1.02	1.5	T96	0.4	1.03	2.7
7	T5	0.4	1.03	2.7	T28	0.4	1.03	2.7	T51	11.2	1.02	1.5	T74	11.2	1.02	1.5	T97	11.2	1.02	1.5
8	T6	11.2	1.02	1.5	T29	0.4	1.03	2.7	T52	0.4	1.03	2.7	T75	0.4	1.03	2.7	T98	11.2	1.02	1.5
9	T7	11.2	1.02	1.5	T30	11.2	1.02	1.5	T53	11.2	1.02	1.5	T76	11.2	1.02	1.5	T99	0.4	1.03	2.7
10	T8	11.2	1.02	1.5	T31	11.2	1.02	1.5	T54	11.2	1.02	1.5	T77	11.2	1.02	1.5	T100	11.2	1.02	1.5
11	T9	11.2	1.02	1.5	T32	11.2	1.02	1.5	T55	11.2	1.02	1.5	T78	0.4	1.03	2.7	T101	11.2	1.02	1.5
12	T10	11.2	1.02	1.5	T33	0.4	1.03	2.7	T56	0.4	1.03	2.7	T79	11.2	1.02	1.5	T102	11.2	1.02	1.5
13	T11	0.4	1.03	2.7	T34	11.2	1.02	1.5	T57	11.2	1.02	1.5	T80	11.2	1.02	1.5	T103	0.4	1.03	2.7
14	T12	11.2	1.02	1.5	T35	11.2	1.02	1.5	T58	11.2	1.02	1.5	T81	11.2	1.02	1.5	T104	11.2	1.02	1.5
15	T13	11.2	1.02	1.5	T36	0.4	1.03	2.7	T59	0.4	1.03	2.7	T82	0.4	1.03	2.7	T105	11.2	1.02	1.5
16	T14	0.4	1.03	2.7	T37	11.2	1.02	1.5	T60	11.2	1.02	1.5	T83	11.2	1.02	1.5	T106	0.4	1.03	1.5
17	T15	11.2	1.02	1.5	T38	11.2	1.02	0.5	T61	11.2	1.02	1.5	T84	11.2	1.02	1.5	T107	110	1	0
18	T16	11.2	1.02	1.5	T39	0.4	1.03	2.8	T62	11.2	1.02	1.5	T85	0.4	1.03	2.7	T108	11.2	1.02	1.5
19	T17	11.2	1.02	1.5	T40	11.2	1.02	1.5	T63	11.2	1.02	1.5	T86	11.2	1.02	1.5				
20	T18	0.4	1.03	2.7	T41	11.2	1.02	1.5	T64	11.2	1.02	1.5	T87	11.2	1.02	1.5				
21	T19	11.2	1.02	1.5	T42	11.2	1.02	1.5	T65	11.2	1.02	1.5	T88	11.2	1.02	1.5				
22	T20	11.2	1.02	1.5	T43	0.4	1.03	2.7	T66	11.2	1.02	1.5	T89	0.4	1.03	2.7				
23	T21	0.4	1.03	2.7	T44	11.2	1.02	1.5	T67	11.2	1.02	1.5	T90	11.2	1.02	1.5				
24	T22	11.2	1.02	1.5	T45	11.2	1.02	1.5	T68	0.4	1.03	2.7	T91	11.2	1.02	1.5				
25	T23	11.2	1.02	1.5	T46	11.2	1.02	1.5	T69	11.2	1.02	1.5	T92	0.4	1.03	2.7				

Fig 12: Ayyanarathu Battery Voltage

CONCLUSION

From this paper we analysed that if battery is placed in the wind farm the voltage should not get increased or decreased, the voltage will be same as the voltage given as input. This paper describes that wind farm with and without battery the voltage almost same and there is slightly the voltage value greater than the voltage without battery through the Digsilent software and the variation in voltage will not be affect the system, therefore it can be implemented in wind farm and we can save the excess power and it can be used for peak demand.

REFERENCES

[1] Cong-Long Nguyen, Student Member, IEEE, Hong-Hee Lee, Senior Member, IEEE “A Novel Dual-Battery Energy Storage System for Wind Power Applications “IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS 2016

[2] Fengji Luo, Member, IEEE, Ke Meng, Member, IEEE, Zhao Yang Dong, Senior Member, IEEE, Yu Zheng, Student Member, IEEE, Yingying Chen, Student Member, IEEE, and Kit Po Wong, Fellow, IEEE “Coordinated Operational Planning for Wind Farm With Battery Energy Storage System” IEEE TRANSACTIONS ON SUSTAINABLE ENERGY, VOL. 6, NO. 1, JANUARY 2015

[3] Nilesh G. Kumbhare, W. Z. Gandhare “Energy Storage Equipped STATCOM for Power Quality Improvement in Grid Integrated Wind System” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 6, June 2015

[4] Md Abu Abdullah, Student Member, IEEE, K. M. Muttaqi, Senior Member, IEEE, Danny Sutanto, Senior Member, IEEE, and A. P. Agalgaonkar, Senior Member, IEEE IEEE “An Effective Power Dispatch Control Strategy to Improve Generation Schedulability and Supply Reliability of a Wind Farm Using a Battery Energy Storage System” TRANSACTIONS ON SUSTAINABLE ENERGY, VOL. 6, NO. 3, JULY 2015

[5] B. Neelamegan, A.Ezhil Mathy, M.Shanmugam, B.Thulasibrindha "Power Fluctuation of the Large Scale Wind Farm is controlled Using Energy Storage Application" International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 4, April 2014.

[6] Harish S. Krishnamurthy, Student Member, IEEE, Dibyendu Rana, Student Member, IEEE, Pawan Garg, Student Member, IEEE, Prasad N. Enjeti, Fellow, IEEE, and Ira J. Pitel, Fellow, IEEE "Wind Turbine Generator–Battery Energy Storage Utility Interface Converter Topology With Medium-Frequency Transformer Link" IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 29, NO. 8, AUGUST 2014

[7] Ted K. A. Brekken, Member, IEEE, Alex Yokochi, Annette von Jouanne, Fellow, IEEE, Zuan Z. Yen, Hannes Max Hapke, Member, IEEE, and Douglas A. Halamay, Student Member, IEEE" Optimal Energy Storage Sizing and Control for Wind Power Applications" IEEE TRANSACTIONS ON SUSTAINABLE ENERGY, VOL. 2, NO. 1, JANUARY 2011

[8] S. M. Muyeen, Member, IEEE, Rion Takahashi, Member, IEEE, Toshiaki Murata, and Junji Tamura, Senior Member, IEEE "Integration of an Energy Capacitor System With a Variable-Speed Wind Generator" IEEE TRANSACTIONS ON ENERGY CONVERSION, VOL. 24, NO. 3, SEPTEMBER 2009

[9] Derk J. Swider, Member, IEEE "Compressed Air Energy Storage in Electricity System with Significant Wind Power Generation" IEEE TRANSACTIONS ON ENERGY CONVERSION, VOL. 22, NO. 1, MARCH 2007.

[10] Alfred Rufer, Senior Member, IEEE, and Philippe Barrade, Member, "A Supercapacitor-Based Energy-Storage System for Elevators with Soft Commutated Interface" IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 38, NO. 5, SEPTEMBER/OCTOBER 2002.

