INVESTIGATION OF HARMONICS & OPTIMAL POWER FLOW IN IEEE 14 BUS SYSTEM USING ETAP SOFTWARE

A.Subramaniya Siva , S.Sathieshkumar, T.Santhosh Kumar

Abstract— Power system Analysis is the important part of power system engineering .The main intension of any electrical utility company is to deliver power with best quality. By expanding the utililiztion of power electronics gadgets (non linear load),sinusoidal waveform of current and voltage get deformed and deviated which leads to deterioration in power system quality. One of the important causes of improper power quality is power system harmonics and harmonics analysis need to investigate in filter to reduce this harmonics current and voltage. This Paper will discusses about the ,optimal power flow analysis and harmonics analysis on IEEE 14 bus systems in Renewable energy Source with and without PV and Wind interaction .Also the solution is recommended toward the end for the maintained of economic harmonics and losses with permissible limits using ETAP software

Index Terms - PV, Wind, Harmonics Analysis, IEEE 14 Bus systems, ETAP software, power quality, optimal power flow analysis.

I. INTRODUCTION

The continuous growth of renewable energy sources especially in the recent year in India has been encouraging on their influence and impact in the power quality. Power electronics devices used to connect the distribution generation to the electrical power systems generate electromagnetic disturbance thus their effect must be investigated. The use of power electronics devices and equipement generate the significant such as harmonics, inter harmonics recently named super harmonics

Therefore the correct analysis of electrical signal harmonics content is extremely important to mitigate the problem caused in electrical power systems.[1]While contrasting with other inexhaustible source wind and sunlight based sources are create high MW power. In traditional vitality sources are produced the power in extremely long separation so it have high transmission misfortunes to reach at customers however in sustainable power sources are created the influence in short separation. Sustainable power sources like breeze and sun powered power structure an Appropriated Generation The primary issue today in control segment is misfortunes in dissemination network[2] .In old occasions, wind was utilized to move the sails of the boats. In this section, we will perceive how wind vitality is utilized to create electricity .A turbine changes over the active vitality of the breeze to valuable mechanical vitality [3]. This vitality could be utilized in mechanical structure or turn generator turbines and give power. Much the same as in the hydropower frameworks, wind vitality is tackled through transformation of the breeze dynamic vitality to mechanical vitality ingests progressively responsive power from the age source. In this way voltage drop happens in the appropriation systems and furthermore in conveyance organize have a few branches to isolate the power for buyers, it additionally make a reason for voltage drop. The effect of PV entrance at an enormous scale into the power dispersion systems, at extreme system conditions and area of flaw event stays dubious. This prompts the significance of analyzing the short out level to guarantee the legitimacy of interfacing such DG to guarantee smooth system activity and unwavering quality. There may be bothers of interfacing appropriated age, for instance, extending the voltage profile and outperforming the framework cut off, and therefore, this may oblige the relationship of the dispersed age to the framework [10].This paper will look at the effect of Doubly Fed Induction Generator wind turbines and sun powered exhibit on load stream examination, transient soundness and short out level in conveyance test framework utilizing ETAP programming this is done by ETAP software .

II.SIMULATION OF IEEE 14 BUS SYSTEM

In this single procession outline of an IEEE 14 transport framework is given about alter mode utilizing ETAP programming. The line chart comprises of 14 transports of power system analysis [. Transport 2 is taken as loose bus, & Generator 2 as taken as swing generator Bus 4 is a PV transport and transports 5,7,8,9 are PQ Busses .The transports are associated in communication line .Reproduction of IEEE 14 Bus system is perform utilizing ETAP Software & power stream in transmission line break down.

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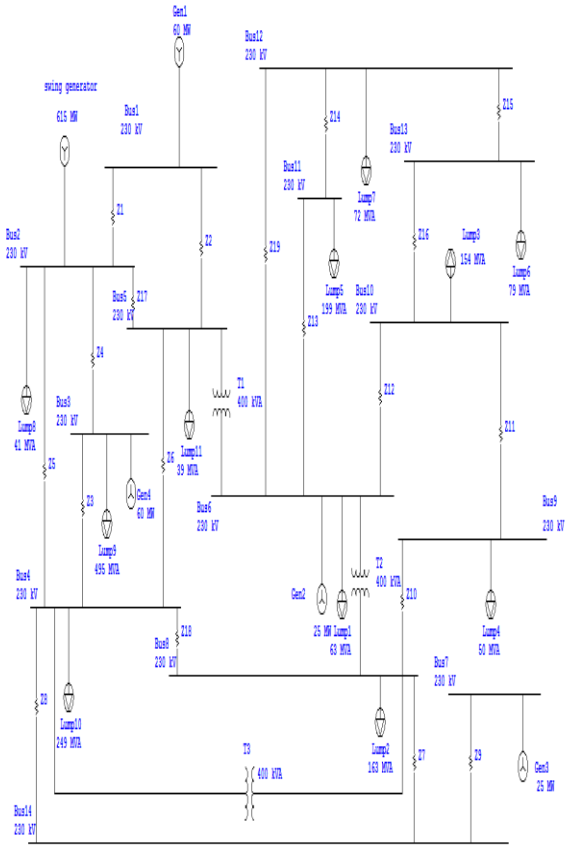

Fig 1: IEEE 14 Bus System

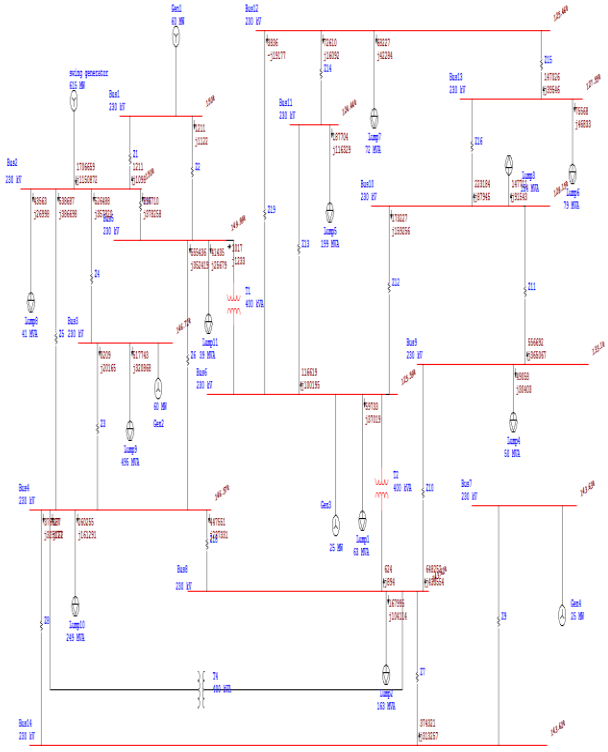

Figure 2: Optimal Flow Analysis of IEEE 14 Bus Systems without PV &Wind

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Line impedance	N-Rap son Methods		Optimal Power Flow Method	
	Real power (Mva)	Reactive power (Mvar)	Real power (Mva)	Reactive Power Mvar)
2	27.88	17.27	44.454	20.542
3	336.6	208.61	50.057	35.127
4	169.3	104.935	80.199	60.127
5	42.84	26.55	245.4	185..54

Table 1: Optimal Power Flow in IEEE 14 Bus Systems without PV & Wind Integration

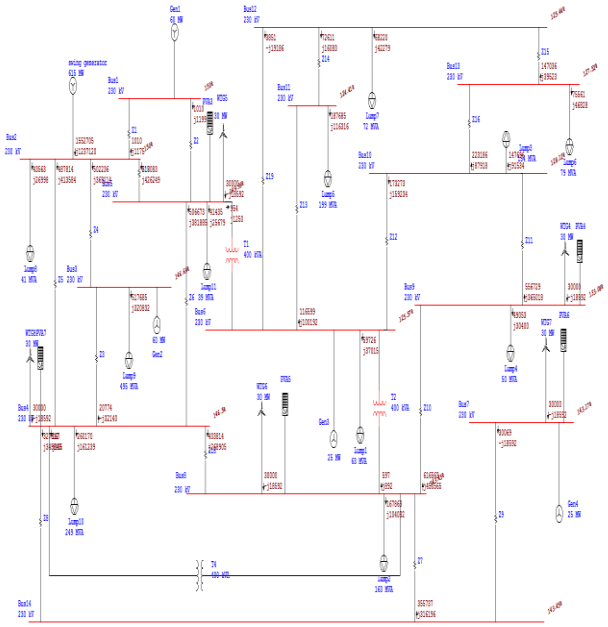

Fig.3.Optimal Flow Analysis of IEEE 14 system with PV & Wind

Table 2: Reproduction Grade of IEEE 14 Bus Systems with PV and Wind

Line	N-Raphson Method		Optimal Power Flow method	
	Real power (Mva)	Reactive power (Mvar)	Real power (Mva)	Reactive Power (Mvar
2	2.257	0.209	207.28	128.553
3	1.037	0.228	33.127	20.548
4	0.636	0.217	30.68	18.592
5	0.697	0.211	133.306	82.615

III HARMONICS ANALYSIS

The harmonic analysis in ETAP module provides an excellent tool for modelling diverse power system components to incorporate their qualities under the harmonic. sources presence. It fully complies with the IEEE standard 519, ANSI/IEEE standard 399, IEEE standard 141, IEEE standard 519-2014, IEC standard 61000-3-14 and IEC standard 61000-3-6. Origin of harmonics can be detected and mitigation methods can be verified by this two analytical methods i.e., harmonic load flow method &harmonic frequency scanning technique[4]. After designing distribution network single line diagram in edit mode and carrying out load flow analysis and short circuit analysis on it, current presentation is switched to harmonic analysis mode in ETAP Software. To describe the effect of harmonic current, & harmonic load analysis was performed. The harmonic load flow study first conducts a load flow analysis in the 50 Hz frequency which acts as the base for the bus voltage and branch currents. Then, for each harmonics frequency from the second to the two fifth order, an immediate burden stream arrangement is controlled by utilizing the present infusion approach.[5] From the figuring of symphonious burden stream, the consonant fragments for transport voltages and branch ebbs and flows are resolved, and in like manner all symphonious lists are figured. The symphonious burden stream study results showing the framework input data, key burden stream data, framework consonant data, and classification of transport voltages and branch ebbs and flows with every consonant substance can be viewed in direct manner from the one-line chart as appeared

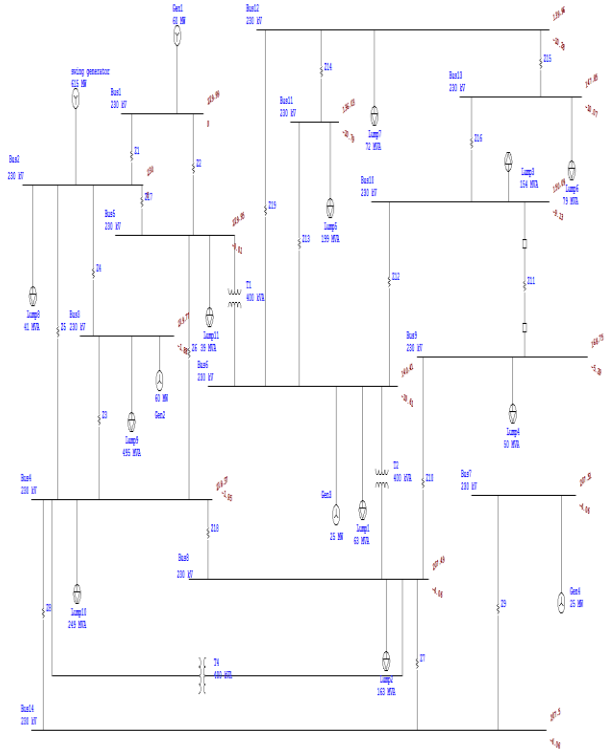

Fig.4 Harmonics Analysis without PV and Wind

Bus voltage and branch current plots are also accessible by pressing the button of the harmonics analysis plots situated in the harmonic toolbar to point out both voltage and current waveforms in time domain graph and the harmonic spectrums in a bar graph.

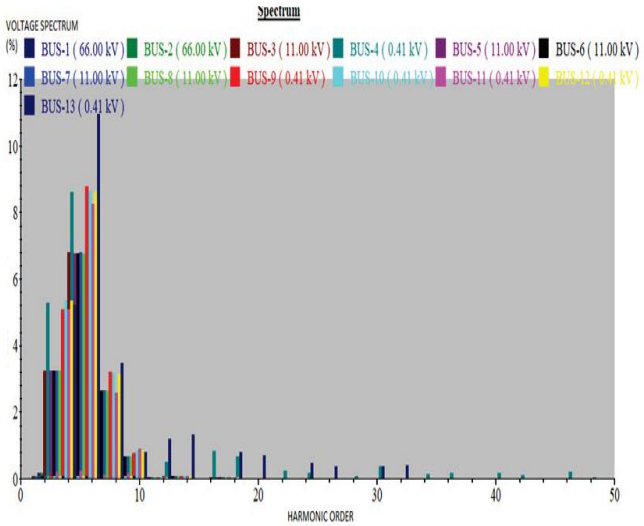

Fig 5 Harmonics Analysis Voltage Spectrum without PV and Wind

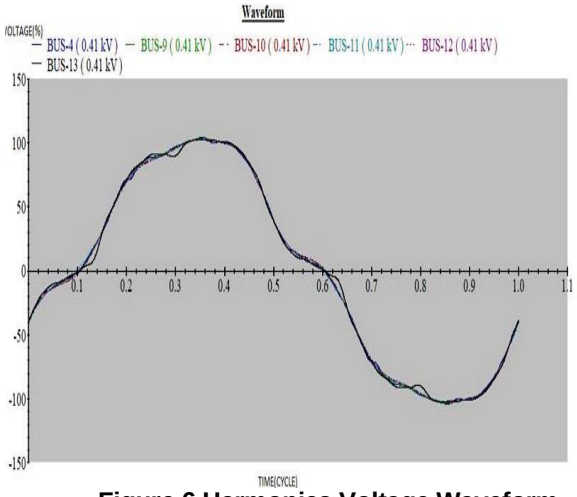

Figure 6 Harmonics Voltage Waveform

Harmonic filters are widely employed to solve harmonic issues. Properly structured consonant channel has the potential prevent the symphonious current from bringing into the system, or it can disestablish an equal reverberation.[6] Before channel situation, it is seen from the voltage range diagram that the complete symphonious mutilation limit is surpassing 5% which isn't the allowable incentive agreeing IEEE 519 standard. The voltage waveform at a few burden transports is likewise observed mutilated because of symphonious sources like diverse force electronic gadgets, transformers, and so on. The most predominant consonant saw is of fifth and third request and for its alleviation single tuned uninvolved symphonious channel, which is an arrangement RLC circuit tuned to a solitary symphonious recurrence and gives a low symphonious impedance

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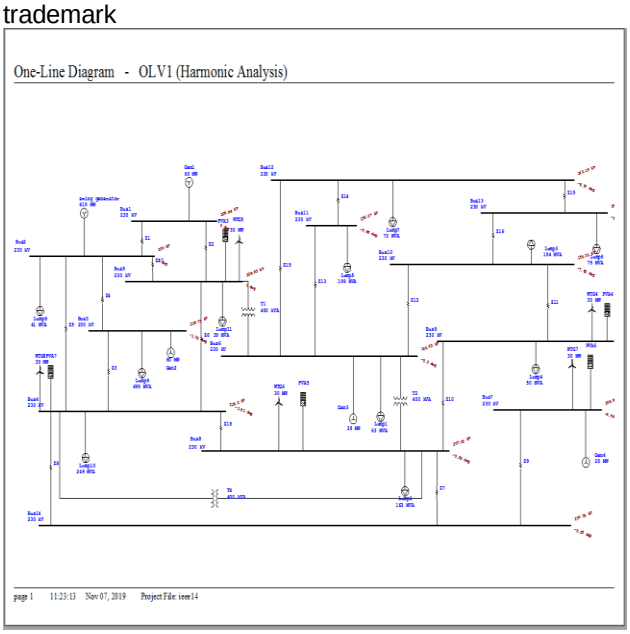

Figure 7 Harmonics analysis with PV and Wind

generally, is most suitable. All the famous filter structures which can be applied to real situation are supplied by harmonic filter editor. [7]This editor also contains a filter sizing with which the filter parameters can be optimized based on various installation or operation standard.

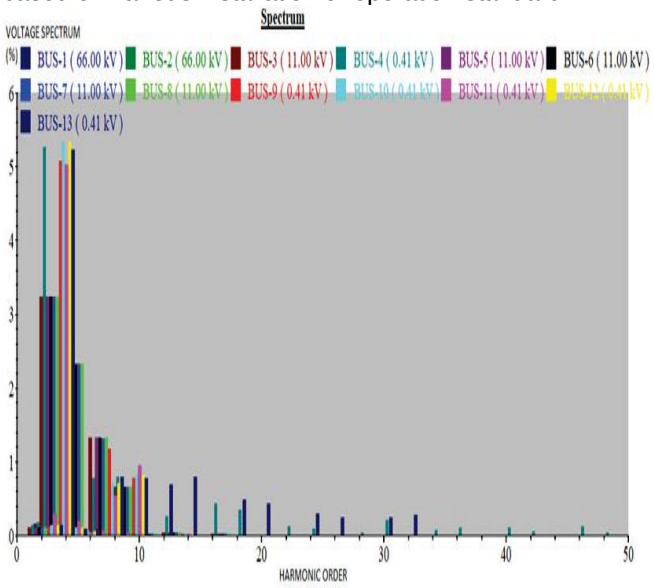

Fig 8 Harmonics Analysis Voltage Spectrum with PV and Wind placement of Filter

Harmonic filter necessary information are harmonic filter ID, bus connection, status, filter type, rated voltage and single phase power for capacitors, reactance and quality factor for reactors, resistance, if applicable and grounding connection. [8]Harmonic filter in the harmonic editor, parameter page is commonly important in practical application. Some of the calculation formulae used for designing single tuned filter are as follow

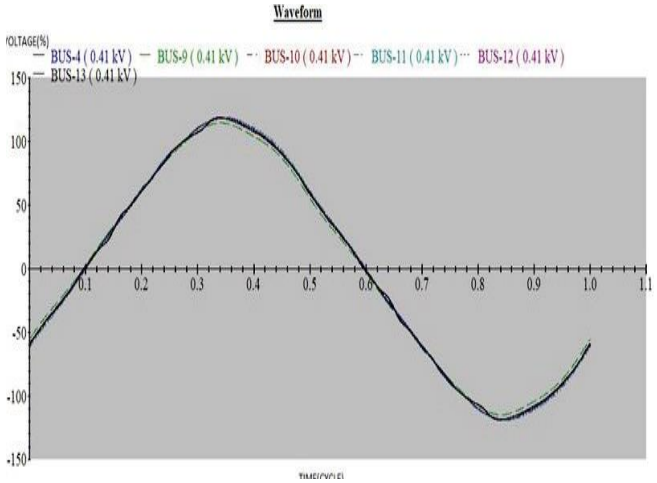

Figure 6 Harmonics Voltage Waveform with Filter

IV CONCLUSION

Standalone function of an IEEE 14 bus with hybrid PV and Wind power Generation coordination has been monitor and analyze using ETAP. The random nature of this energy source has its huge impact on the power system operation and scheduling. The scope of this particular work is to calculate the effect of the integration of solar power and wind power generator with main grid which are having opposite characteristics to each other. This plan was achieved by increasing the design of hybrid PV and wind system to be implementing in this grid connected System. In order to make sure of the design authority, different model using ETAP program have been build and carried out. Actual load and PV data were used in the simulation to get more practical results that can help for future analysis and development process. The grid connected hybrid renewable energy resources have caused the addition of some voltage harmonics that started to increase over the system. However, the quantity of generate harmonics was within the global limits declared by different standards Even though the consumption of the Grid Connected Hybrid Photovoltaic and Wind power Generation System is limited by the particular site condition, high initial investment, and long payback period, as the PV and wind energy technology improvement and financial incentive from the government, the building-integratedHPWS may be applied in a future.

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