A REVIEW PAPER ON EFFICIENT APPROACH FOR HARMONIC MITIGATION IN GRID-CONNECTED POWER SYSTEMS

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Abstract: Harmonic problems in power systems have become an significant concern for both industrial users and for power suppliers, leading to their negative impacts in both consumer and service equipment. Consumers will try to mitigate harmonic leakage, irrespective of the voltage or current distortion currently occurring in the network.This paper discusses the topic of harmonic mitigation with the power grid and the contrast here between various harmonic approaches with their strengths and weaknesses, which lead to more researching new concepts for electricity.

Keywords: Harmonic Mitigation, Power system, Power Quality, Load,Voltage

I.INTRODUCTION

In recent years, there have been major concerns about the impact of available energy in electrical grids, making this topic a major subject of research interest for both producers and consumers. Power system harmonics are regarded to be one of the most critical topics due to their reduced power quality in power systems [1]. This is due to prevalent non-linear loads exhibited along all electronic devices (such as variable frequency drives and switching mode power supplies) which may result in distortion currents with a frequency greater than the basic frequency. Such harmonics may have adverse effects on other parts of the power system in all electrical industries. There are some of these consequences [2] immediate (i.e., noise, interference, and control circuits, etc.) While some are long-term (i.e. heating due to extra power losses, damages). In addition, they lead to a decrease in the load power factor and greater transmission line failures and thus lead to reductions in the productivity of the transmission network. It is also clear that the harmonic rates should be reduced by all parties in the electrical grid[3–4]. There are various methods to minimize the effects of harmonic issues, like load balancing, which means that electrical equipment has become less prone to power disturbances. Other strategies used include the addition of filters to the line power system, or in series or shunt connections.Harmonic mitigation approaches such as[5] the K-factor transformer and shifting transformer are also applied in order to limit the power quality problem.Two types of Harmonic filters are[6]:

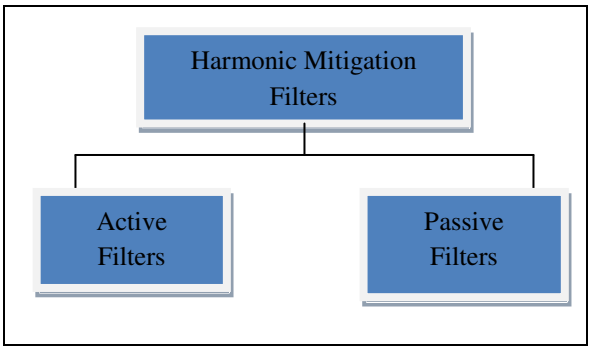

Figure 1:Types of Harmonic Filters

As power electronics device develops, there is a massive rise in non-linear loads, like cyclo converters, adjustable speed drives, diode bridge rectifiers, etc. This has elevated the effectiveness of the harmonics involved in the framework, which calls for a good method to the issue[7]. Power quality is essentially characterized as the study,enhancement of the voltage to ensure that the voltage is sinusoidal with the stated magnitude and frequency as needed[8].There are some problems of consistency of power[11] Voltage spikes, Micro interruptions, Harmonic Distoration ,Voltage swells,Voltage unbalance ,long Interruptions etc.So,study shows due to harmonic distortion-related problems, reducing the quality of electrical power and the

performance of the power system. Here,focused on Harmonic related issues to achieve good quality power voltage.

Table 1:Comparative analysis of Passive and active Harmonic filters[8-10]

	Passive Filters	**Active Filters**
Harmonic Analysis Studies Required	Yes	No
Target Harmonics	Only Single harmonic Order(typically 5^{th})	From 2^{nd} to 50^{th}
Available Voltages	Low voltage and Medium Voltage passive filters are available	No.AHF Current is limited to maximum RMS current rating of the filter
Installation Options	Indoor or outdoor	Indoor
Field expandable	Sometimes	Yes. Addition Parallel units is Possible.
Maintenance	Easy	Difficult
Cost	Cheap	Most expensive solution
Probability of Series	Yes	No
Meet IEEE 519 Limits	Sometimes ,if properly sized	Yes

II.LITERATURE SURVEY

Dash et al.,[12]This paper will explain the idea of an active power filter to mitigate the harmonic generated at the point of common coupling. The experimental analysis of the idea is carried out by means of the MATLAB / SIMULINK model as generally recognised. The efficiency of the device is realized on the basis of the total harmonic distortion, the degree of change of the power factor and the cost wise reduction corresponding to the annual savings on the part of the user and on the generation side.

Farrag et al.,[13]This paper discusses air conditioners (ACs) load, which is a especially rapidly escalating load, with nonlinearity, in sunny regions, resulting in harmonic pollution. This paper thus replicates a method of harmonic distortion of air conditioners using ETAP model to create a low-voltage network in Pakistan as an instance of a warm territory. The findings of this investigation indicate the disturbing extent of harmonic distortions in Pakistani distribution systems. In addition , the study incorporates and introduces a harmonics reduction strategy to substantially mitigate harmonic emissions via air conditioners.

Silva et al.,[14]The object of this article is to explore a wind power system with a PMSG under speed variation operating in the conventional power generation mode (case 1) and a system working with harmonic power mitigation and generator power control (case 2). In both cases, the power supplied to the grid and the DC-link voltage are retained the same. Comparing the harmonic content of the grid prior to the harmonic compensation and the active filtering method was reduced from 14.63 per cent to 3.51 per cent for 170 rad / s and from 14.60 per cent to 3.50 per cent for 180 rad / s. It is therefore necessary to gauge that THD has been decreased to reasonable standards in accordance with international standards.Thus, the harmonic compensation technique integrated into the PMSG wind generator increases the efficiency of the power.

Smadi et al.,[15]This paper presents the design of a photovoltaic converter with optimized HAPF (Hybrid Active Power Filter) functionality to enhance power quality across three phase distribution networks. The grid-connected PV network with three-phase optimized HAPF voltage feed features is evaluated and the results of hysteresis current control for loss minimization and power factor correction. The harmonic profile and current features of the inverter current are evaluated in day and night mode of operation. The numerical simulations of the MATLAB R2018b / SIMULINK program indicate the efficacy of the proposed control systems in both types.The simulation also demonstrated that the developed management framework has improved results in terms of harmonic suppression, power factor correction and energy generation. Total harmonic distortion (THD) is achieved within the rules defined by IEEE-519.

Lakshmi et al.,[16]This work provides load flow, short circuit and harmonic analysis performed using the adaptive Newton Raphson method, impedance technique and the harmonic load flow approach , respectively. IEEE 13 bus system with linear and non-linear charges. The approach is also suggested towards the end for the conservation of harmonics within permissible limits using ETAP tools. ETAP only uses passive filters and the single-tone filter is very effective in removing harmonic current, in particular the harmonic order.

Liang et al., [17]focuses on harmonic mitigation strategies via advanced control techniques for grid-interfacing inverters. First, the harmonics produced by the solar photovoltaic (PV) system are evaluated; potential resonance due to the LCL filter is addressed. Numerous control methods for harmonic reduction are then checked and summarized. This systematic analysis will promote a better understanding of the harmonics and establish more sophisticated control strategies to minimize the harmonics of the renewable energy resources.

Aswal et al.,[18]This paper presents a comparison of the passive and active filters for the mitigation of harmonics present in the system when an uncontrolled three-phase rectifier with an RL load is linked to it. Two kinds of sensors are intended in the paper one is a passive filter in which single tuned and double tuned filters are aimed to minimize the harmonics of the scheme from 20.41 per cent to 4.25 per cent, another filter is an active filter intended using p-q theory and capable of reducing the THD of the same scheme to 2.88 per cent.Trying to compare the simulation data achieved for passive and active filters, it is found that active filters, when introduce in the system, are more effective in reducing the THD of the scheme compared to passive filters.

Kulkarni et al. [19] A simple single-phase grid connected photovoltaic (PV) inverter topology composed of a boost segment, a low-voltage single-phase inverter with an inductive filter and a grid-interfacing step-up transformer is regarded. Ideally, due to high-frequency PWM operation, this configuration will not incorporate any lower order harmonics into the grid. Nevertheless, the non-ideal variables in the network, including the core saturation caused distorted magnetizing present of the transformer and the dead time of the inverter, etc., lead to a large number of lower order harmonics in the grid current. In their studies, a new architecture of inverter control scheme that mitigates lower order harmonics is described.

Monem et al. [20] Operated on the Passive filter chosen to reduce recorded harmonics. Two types of filters have been developed. The first is three single tuned passive filters designed to suppress the 5th, 7th and 11th harmonics. The second category is a 2nd order high-pass filter designed to minimize harmonics equivalent to and greater than 13th harmonics. The simulation of MATLAB is done to verify the suggested methodology. The current total harmonic distortion can be decreased from 29.6 per cent to 1.5 per cent and the total harmonic distortion of the supply voltage is also enhanced from 3.25 per cent to 0.62 per cent, which

fulfills the international standard and enhances the power quality of the voltage at the point of connection.

III.CONCLUSION

The use of power electronics is very significant at current, as most of the house hold & industrial loads need a variable supply from a few volts to kv. Such non-linear power electronic devices draws only the non-linear currents & thereby injects harmonics at the PCC. These harmonic currents have a set of inputs on the power system network, including the saturation point transformer core, which affects the chances of the transformer. Once, this harmonic current often generates a large amount of heat in the spinning unit. Review the harmonic mitigation with the power system in this paper, so that this study will help further investigations.

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