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Report On Harmonics Generation and Mitigation in Power System

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Abstract : In India, Industrial based sections it's very essential to fulfill power demand with low losses, improvements in electrical loading pattern and productions with high speed.For such high speed production, using of microprocessor and / or electronic base automated machineries are been used. By using such type of electronic based equipment's, it's increasing the nonlinear load in system so its leads to lagging power factor. In nonlinear load with low power factor draws more currents from source and increases the losses in system. So because of losses and high current draws in system it's affected on life of electrical switchgears, equipment's and cable. So due to this waste energy the Utility power department penalized for the constant lagging power factor.

Keywords: Harmonics Distortion, Current harmonics, Voltage harmonics, Variable Speed, Motors, Active and Passive filter, Hybrid filter, Sinusoidal and non-sinusoidal, Power Factor, Linear and Non-Linear, De-rating, Losses etc.

I. INTRODUCTION

In Ideal situation, the utility board shows the ideal sinusoidal voltage waveform at every consumer point. But the consumer may not be able to maintain the ideal conditions. The differences of ideal waveform of voltage and current goes distorted waveform, this distortion waveform knows as harmonic distortion. It is important to maintain the ideal situation, but when the consumer fails to maintain unity power, the utility board may not bear the wastage of electricity. The main concern of electricity board is to maintain sinusoidal waveform of voltage whereas the consumer has to maintain the quality of current. Harmonics may generate in plant or it may enter in plant from utility board. Generation of Harmonics can causes many problems like power loss, malfunctioning of equipment's; reduce life of switchgear and many more. Ultimately it's impacted on power factor and utility board impose penalty for correcting the power factor. Because of this industries start to use of capacitor bank, but it draw harmonic current to the system too. Then consumers have to proceed with another option like filter.

Additionally most of the electronics based equipment's those are converts the circuits from AC to DC like rectifiers, silicon controlled rectifier (SCR's), transistors, and converters change over the sinusoidal AC supply to DC. Since the switching current waveform is non-sinusoidal the consequent load current is said to contain Harmonics.

Non-sinusoidal composite waveforms are industrialized by "including" composed an evolution of sine wave frequencies known as "Harmonics".

i. Harmonic Distortion Level:

For better quality of power, the voltage and current waveform must be sinusoidal however it observed waveform because of proper distribution of electrical loads. That why it is called harmonic distortion. There are always the occurrence of current and voltage harmonic in supply of power from electricity board/utility. The current harmonic distortion which is injected by nonlinear load to the supply of electricity board and destroy it.

ii. Non Linear Load

In a linear circuit it is been understood with the sinusoidal waveform has a special property which is been supplied by sinusoidal supply the voltage must be sinusoidal. But if in practices the phase distribution is not properly ended then current passes over the circuit is drawn non sinusoidal waveform that load is must be called nonlinear load.

There are some samples which may be of nonlinear loads are:-

i. Saturation in transformer and de rating
ii. All equipment controlled by devices belonging to thyrister
iii. AC / DC converter's and reactors.

HARMONIC EFFECT IN SYSTEM

The harmonics effects in electrical power system are as follows –

i. The series and parallel resonance draws the high voltage and high current in the system. The Voltage and Current harmonics can be improved in the system because of the resonance available between capacitive and inductive elements system.
ii. Losses and heating issue affected to the system of transformer and rotating machine. At higher order harmonics increases the frequency and the skin effect loss.
iii. Overloading and excessive current can be leads fuse blowing because of shunt capacitor draws more current I the system while correcting power factor.
iv. Electrical equipment insulation may get weakens because of overheating and it decreases the efficiency of power generation, transmission and consumption.
v. Due to harmonics meter calibration also get decrease which result in amplify of error in the loading energy meter.

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vi. Voltage and current harmonics produces in the system because of unproven functioning of circuit breakers and relays.
vii. Machine may get trip at normal load.
viii. It may be a possibility for Fire risk.

II. METHODOLOGY

iii. Reducing Harmonic Current

Passive Filters – This filter can be installed at individual load side. The filter size shall be calculated at the base of connected load and as per reactive power requirements.

Harmonic frequency can be tuned as per compose LC circuit,

Advantages:

It reduces harmonic voltages THD (U)

At full load conditions improves Power Factor

Minimized harmonic currents

Disadvantages:

It is more expensive and need to proper design on connected and running load.

Characteristics may get change at overloading the system.

0.5 to 1.5% range of is the losses of passive filter in system.

In a 6-pulse rectifier the losses has driven 2%, the total system loss is the sum of the losses

Active Filters – This filter can be used for in nonlinear load to present the current components.

This filter can be connected in series as well as parallel at AC network for reducing Harmonic current at nonlinear load and voltage alteration in the grid.

As per standards practices the voltage distortion range is 5-9%, and the values are recommended in some areas but it is not mandatory everywhere.

Industrial areas and utility boards follow the standard guideline mentioned in IEEE 519. By using this way for them to able to provide guarantee free disturbances at the end point. By using this Active filter schedule it decreased the energy usage and cuts the energy cost. It is simply decreases the harmonic near and meets all necessities. Active filter can identify the order of harmonics and reimburse the condition of power. This filter is the perfect solution for harmonics generated in system. The filters are available in different series.

Earlier, it has defined that the Active Harmonic Filter is the best for variable speed drives.

It is very normal practice to installed the 3% or 5% choke on the drive, the fitting of chokes can be reduced the harmonics 80 to 85% in to the system.

Hybrid – This filter can be connected series or in parallel, this is the combination of active and passive filter. The passive filter conveys the basic filtering in the system and the active filter mitigates the other harmonics present in the system.

High pass filter - High pass filter can be minimized the 5th and 7th harmonics level produced in the system

According to EN-61000-3-4 and IEEE-519

CONCEPT	Active Filters	High Pass Filters	Passive and Protection Filter
Harmonics compensation	<5 %	5 to 10 %	Depends of network and load
Harmonic Regulation	Automatic	Automatic	Partial
Adaptation to load	Automatic	NO	Partial
Cost for reactive compensation	High	Medium	Low
Cost for Harmonics Compensation	High	Low	Medium
Cost for 3rd harmonics balance	Medium	-----	Low

Following factors need to considered while designing of the filter panel,

i. Odd type of harmonics is generally observed in the system. Above 50th and more harmonics are difficult to mitigate, some PQ meters are available to switch it prominently and minimized the harmonics. Harmonics compensation at different frequency level is difficult but Active filter is suitable solution to compensate the different level Harmonics. The important factor for the filter capacity decides is de-rating, so it can compensate certain harmonics orders.
ii. The filter capacity shall be design and calculated as per requirements, it may get affected while fast flickering and transient spike in process. Sometimes in the power quality phenomena occurs harmonics and it should be extremely fast requirements to mitigation of harmonics. So the response time is very important.
iii. Interharmonics is also the major problems so load synchronization should be done properly. If in any systems occurs interharmonics sources then need to change the type of active filter.
iv. The active harmonics filter rating is completely defines on the nominal load at end point, it mean 50 / 60Hz. Means the filter works as their nominal start and derated. The derating curve can be documented. The filter can be design robustly that the matter of De-rating.

III. CONCLUSION

At t+he consumer level, it is very important and looks at lagging power factor, and by using capacitor bank it is easy to maintained power factor close to unity and current sinusoidal waveform. Generally need to understand the quality and saving of power.

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Today in industry each and every equipment having power supplies and power controlling systems. So it is difficult to maintain current sinusoidal waveform and indirectly difficult to maintain power factor. In this case Active filter is the best solution comparing with passive filter as per industrial loading patterns and using electronics based equipment's. Capital cost is also very similar as well as good choice of power consumption.

Active Harmonics Filter is required for some industrial based applications like variable frequency drive (VFD), Heaters, Furnaces, wind and solar plant, CFL lighting, UPS system, Welding etc. are widely used in industry. All these are highly source to generate harmonics in the power network. Active filter is guaranteed filter solution to mitigate all odd harmonics present in the system and meets all the requirements as well as saves the energy. Following are some advantages of Active Harmonics Filter Panel,

i. Increased the productivity and efficiency of equipment's.
ii. Reduced the losses in the system.
iii. Resolve the power quality issues.
iv. Energy can be save 10 to 20%.
v. Reduced total energy cost.
vi. Maintenance cost will be low and increase the life of switchgears, cables and other electrical equipment's.
vii. Power factor can be maintained above 0.95.
viii. Can be avoiding penalty from utility board.
ix. Payback period is very less.

IV. REFERENCE

i. HI-Tech Electrical Systems , "Effects of Harmonic Currents",
ii. IEEE Std 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, New York, NY: IEEE.
iii. J. C. Balda, et al., "Comments on the Derating of Distribution Transformers Serving Nonlinear Loads," Proc. of the Second Int'l Conf. on Power Quality: End-Use Applications and Perspectives, Atlanta, Georgia, Sept. 28-30, 1992, paper D-23.
iv. 'Electric Utility Power System". A text book by John Smith& McGraw-Hill.
v. J.Arillaga,et al,"Power System Harmonics"
vi. R.C. Dugan, D.T. Rizy, "Harmonic Considerations for Electrical Distribution Feeders"
vii. Holt, M., "Harmonics, What You Should Know", http://www.electrical-contractor.net/Need_To_Know/Harmonics.htm, 1998
viii. W. Mack Grady and Robert J. Gilleskie, " http://studylib.net/doc/7951074/harmonics-and-how-they-relate-to-power-factor"
ix. " Harmonics Made Simple" by R.Fehr , P.E
x. AEMC 605 User Manual "THDf: Total harmonic distortion with respect to the fundamental. THDr: Total harmonic distortion with respect to the true RMS value of the signal."