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IMPROVING POWER QUALITY AND FAST ENERGY SAVING METHODS IN POWER DISTRIBUTION NETWORKS USING UPQC

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ABSTRACT

In this paper for taking care of the voltage issues in power distribution network with the high penetration of Conveyed Generation (DG)s, an original Bound together Power Quality Conditioner (UPQC) based on quick energy stockpiling is presented. The dispersed generation technology as the supporting technology of shrewd grid changes. In power distribution network system with DGs, the variance of power outputted by DGs would bring about voltage quality issues, such as voltage droop, voltage vacillation and voltage interruption, and so on. To expand the pay capacity of Brought together Power Quality Conditioner (UPQC) and suppress the grid current vacillation at the hour of power guideline, a sort of superior UPQC topological construction is proposed. With benefits of high power thickness, enormous electrostatic limit and long cycle life, super capacitors are joined with bidirectional DC/DC converter to form the energy stockpiling system in lined up with DC-connection to keep DC voltage consistent and to be utilized likewise as an extra UPS.

Low recurrence mathematical model of the conditioner under d-q organizes based on state-space method is constructed and non-PLL remuneration identifying method is applied. Moreover, both the control technique of voltage and current remuneration and energy the executives schemes of super capacitors are given. The quick energy stockpiling system that is immature, low-inductance rail switches and low-inductance capacitors. These parts are designed in a low-inductance stage and afterward stacked in series to frame a unit for the necessary voltage and various units in lined up for the expected system inductance and put away energy.

This new technology will give the ability to take out the requirement for putting away the energy in a huge water move capacitor. The design standard and the control methodology is improved by utilizing MAT LAB/SIMULINK.

INTRODUCTION

Electrical energy is the most productive and well known type of energy and the modern culture is heavily reliant upon the electric supply. The life can't be envisioned without the supply of power. Simultaneously the quality of the electric power supplied is additionally vital for the productive working of the end client equipment.

The term power quality turned out to be most conspicuous in the power area and both the electric power supply organization and the end clients are worried about it. The quality of power conveyed to the customers relies upon the voltage and recurrence scopes of the power. Assuming there is any deviation in the voltage and recurrence of the electric power conveyed from that of the standard qualities then the quality of power conveyed is impacted.

Presently a-days with the headway in technology there is an exceptional improvement in the semi-guide devices. With this turn of events and benefits, the semi-guide devices got a super durable spot in the power area helping to facilitate the control of generally speaking system. In addition, the greater part of the loads are likewise semi-guide based. In any case, the semi-guide devices are non-straight in nature and draws non-direct current from the source. And furthermore the semi-guide devices are associated with power change, which is either AC to DC or from DC to AC. This power transformation contains parcel of switching operations which might present brokenness in the current. Because of this irregularity and non-linearity, harmonics are available which influence the quality of power conveyed to the end client. To keep up with the quality of power conveyed, the harmonics should be filtered out.

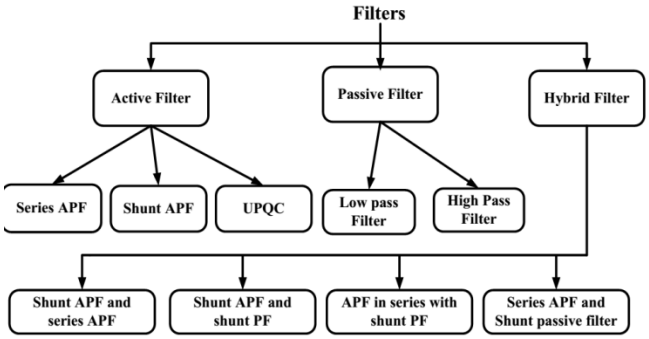
In this thesis, the idea of DG system, presentation, applications, significance, issue definition and its answers are talked about.

POWER QUALITY:

Power quality is unquestionably a central issue. Lately it became significant with the sophisticated devices, whose presentation is extremely delicate to the quality of power supply. Modern cycles are based on a lot of electronic devices such as programmable rationale controllers and flexible speed drives. Electronic devices are extremely delicate to unsettling influences and thus modern loads turned out to be less open minded to power quality issues.

Power Quality (PQ) chiefly manages issues like keeping a decent voltage at the Purpose in Common Coupling (PCC) for different distribution voltage levels regardless of voltage vacillations, keeping up with close to solidarity power factor power drawn from the supply, hindering of voltage and current unbalance from passing upwards

from different distribution levels, reduction of voltage and current harmonics in the system and suppression of unreasonable supply unbiased current. As of late, the significance of power quality issues has expanded because of different reasons. There, first of all, have been changes in the idea of electrical loads. On one hand, the characteristics of load have become more mind boggling because of the expanded utilization of power electronic equipment, which results in a deviation of voltage and current from its sinusoidal waveform. On another hand, equipments have become more delicate to power quality because of its electronic nature. Liberation of the electrical power market is a second variable that has expanded the significance of power quality. Liberation has isolated what was a single utility into three: supplier, transmitter and merchant. It is vital to assess power quality level and distinguish the source of shortcomings that beginning electrical aggravations in electrical power systems, which decides the obligation of a terrible quality of power. To assess and distinguish the aggravations and its starting point, power quality observing is the apparatus that utilities and clients use.



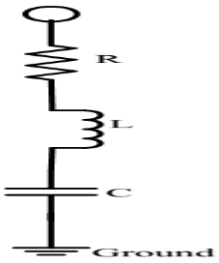
Classification of filters

Passive Power Filters:

These filters comprise of inactive components like capacitor, inductor and resistor. These are broadly utilized in light of their minimal expense and simplicity of control. The latent filters likewise give responsive power separated from filtering the harmonics. The exhibition of these filters is heavily reliant upon the system impedance. These are again characterized into two kinds of low pass and high pass.

A. Low Pass Filter:

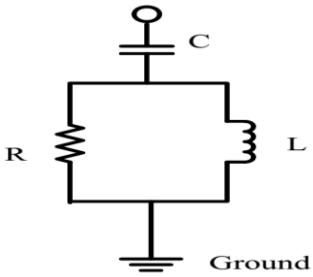
The Low Pass Filter (LPF) is a tuned LC circuit that is tuned to give low impedance to a specific harmonic current. Likewise these filters are additionally utilized for power factor rectification. In power system network these are for the most part used to filter 5th and 7th request harmonics. The line outline of the low pass filter is shown.



Low pass filter

B. High Pass Filter:

The High Pass Filters (HPF) are additionally made of uninvolved components like inductor and capacitor yet show low impedance for harmonic current over a specific corner recurrence. Every one of the harmonics present over that corner recurrence are filtered utilizing this filter. This filter is again of many kinds like single-request, two-request, and third-request and so on, based on the quantity of latent filters utilized in it. Among them the two-request filter is broadly utilized. belog fig shows the line outline of a high pass filter.



High pass filter

However, there are a few inconveniences with inactive filter, as

1. The filter characteristics has solid reliance on the system impedance
2. Possibility of over load in the uninvolved filter in light of harmonic current course creating from power electronic loads.
3. The change of the load impedance can detune the filter, so it isn't appropriate for variable loads.
4. The issue of series as well as equal resonances can be started which causes instable operation.
5. Limited operation that is utilized to dispense with either a specific request or less harmonics.

Due to the above inconveniences the inactive filters can't give a successful answer for enhance the quality of the

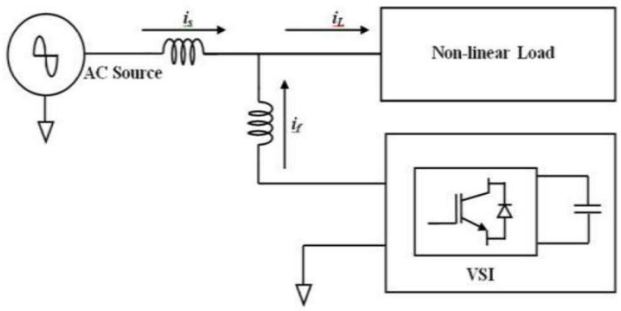
power system. Thus, the dynamic power filters are utilized to defeat the above downside.

Dynamic Power Filters (APF):

To conquer the downside of uninvolved filter, dynamic remuneration known as dynamic power filter is utilized as of late. The APF is a Voltage Source Inverter (VSI) which infuses the repaying current or voltage based on the organization configuration. It was proposed around 1970. Be that as it may, the new progression in power gadgets technology, alongside the theory of prompt dynamic and responsive power which was introduced in 1983, APF‟s are an up-to-date arrangement with quick switching devices, low power loss and quick advanced handling devices at a reasonable cost. Contingent upon the circuit configuration and capability, APF‟s are separated into three kinds and each one is made sense of exhaustively underneath.

A. Shunt Dynamic Power Filter:

The voltage sourced inverter based Shunt APF is like STATCOM. It is associated in shunt at the PCC. It infuses the current which is equivalent and inverse to the harmonic current. It goes about as a current source infusing harmonics and is reasonable for a load. It additionally helps in further developing the load power factor. The circuit outline of the power system with shunt associated APF is shown in fig 2.4. The expense of these filters is moderately higher thus not liked for enormous scope systems.



Circuit diagram of shunt active power filter

B. Series Active Power Filter:

Yet, there are a few drawbacks with inactive filter, as

1. The filter characteristics has solid reliance on the system impedance

2. Possibility of over load in the latent filter on account of harmonic current dissemination producing from power electronic loads.

3. The change of the load impedance can detune the filter, so it isn't appropriate for variable loads.

4. The issue of series and additionally equal resonances can be started which causes instable operation.

5. Limited operation that is utilized to wipe out either a specific request or less harmonics.

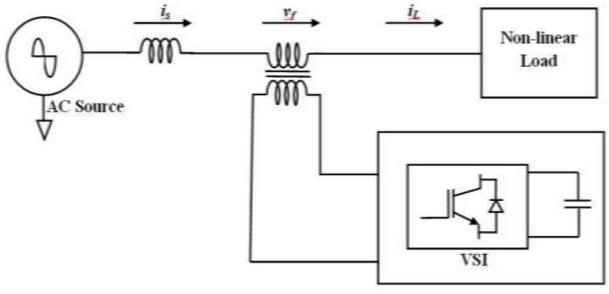
In view of the above hindrances the aloof filters can't give a compelling answer for enhance the quality of the power system. Thus, the dynamic power filters are utilized to defeat the above downside.

Dynamic Power Filters (APF):

To conquer the disadvantage of detached filter, dynamic remuneration known as dynamic power filter is utilized as of late. The APF is a Voltage Source Inverter (VSI) which infuses the repaying current or voltage based on the organization configuration. It was proposed around 1970. However, the new headway in power hardware technology, alongside the theory of quick dynamic and responsive power which was introduced in 1983, APF‟s are an up-to-date arrangement with quick switching devices, low power loss and quick computerized handling devices at a reasonable cost. Contingent upon the circuit configuration and capability, APF‟s are separated into three sorts and each one is made sense of exhaustively beneath.

A. Shunt Dynamic Power Filter:

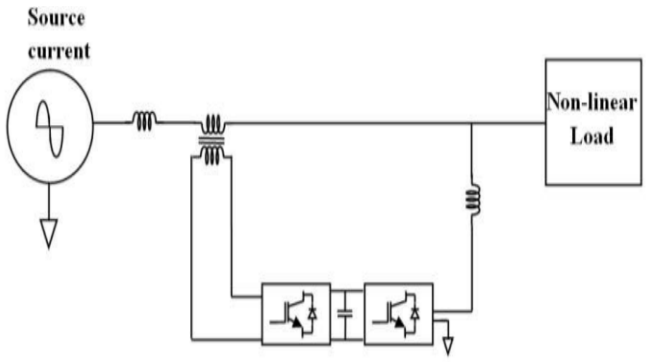
The voltage sourced inverter based Shunt APF is like STATCOM. It is associated in shunt at the PCC. It infuses the current which is equivalent and inverse to the harmonic current. It goes about as a current source infusing harmonics and is reasonable for a load. It likewise helps in further developing the load power factor. The circuit graph of the power system with shunt associated APF is shown in fig 2.4. The expense of these filters is generally higher thus not liked for enormous scope systems.



Circuit diagram of series active power filter

C. Unified Power Quality Conditioner (UPQC):

The UPQC is a blend of series and shunt dynamic power filters. It has the upside of both series APF and shunt APF. That implies, it repays both the voltage and current harmonics. Therefore, this filter can repay practically a wide range of power quality issues looked by a power system organization. The circuit outline of power system with UPQC is shown in underneath Fig.



Circuit Diagram with UPQC

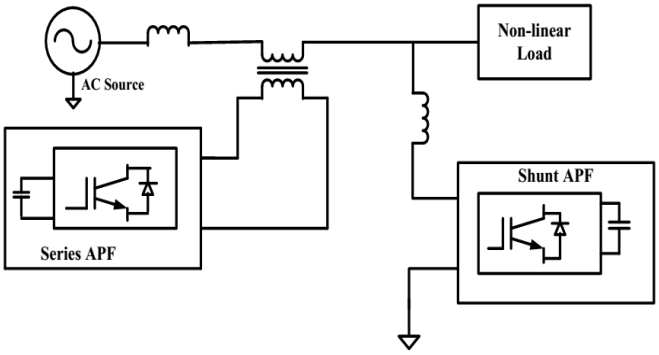
Hybrid Power Filters:

The dynamic power filters are improved answer for power quality improvement however they require high converter evaluations. So to defeat the above disadvantage, hybrid power filters are planned. The hybrid power filters are the blend of both dynamic and uninvolved power filters. They have the upside of both dynamic and uninvolved filters. There are different hybrid filters based on the circuit blend and course of action. They are-

1. Shunt Dynamic Power Filter and Series Dynamic Power Filter
2. Shunt Dynamic Power Filter and Shunt Latent Filter
3. Active Power Filter in series with Shunt Latent Filter
4. Series Dynamic Power Filter with Shunt Latent Filter

Each Filter configuration is made sense of beneath with their benefits and faults.

Shunt APF and Series APF:

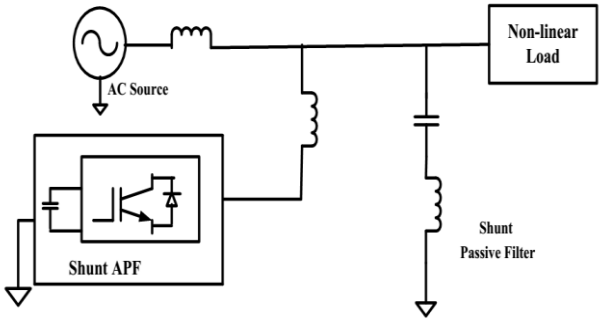


Shunt APF and series APF combination

This filter blend has the upside of both series associated APF i.e., disposal of voltage harmonics and that of shunt associated APF of killing current harmonics. The circuit chart is shown in fig 2.7. This mix tracks down its application in Adaptable AC Transmission Systems (Realities). Be that as it may, the control of APF is complicated and this blend includes two APF and hence the control of this filter configuration is considerably more intricate. Thus, this filter mix isn't utilized generally.

B. Shunt APF and Shunt Latent Filter:

The power rating of the APF rely upon the request for frequencies it is filtering out. Thus, an APF utilized for filtering out low request harmonics have low power rating with decreased size and cost. This rationale is utilized in planning this filter mix. The shunt associated APF filters out the low request current harmonics while the shunt associated latent filter is intended to filter out the higher request harmonics. The circuit configuration of this filter geography is shown in Fig below.



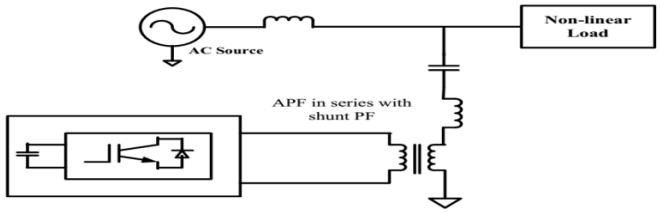
Shunt APF and Shunt Passive Filter Combination

However, the primary weakness of this filter configuration is it can't be appropriate for variable loading conditions. Since, the detached filter can be

tuned exclusively for a particular foreordained harmonic.

C. APF in Series with Shunt Uninvolved Filter:

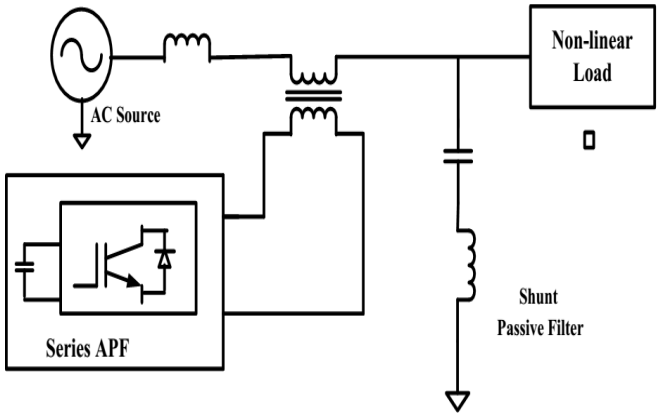
In this filter configuration, the dynamic power filter is associated in series with a Shunt associated uninvolved filter. The circuit outline of this filter configuration is shown in fig 2.9. The upside of this configuration is that the detached filter lessens the stress on the power electronic switches present in the APF. This filter has its application in medium to high voltage ranges.



APF in series with shunt connected passive filter

D. Series APF with Shunt Connected Passive Filter:

The Series APF and shunt APF combination seen in Fig 2.7 has the problem of complex control strategy. To overcome this drawback, the shunt APF is replaced by a shunt connected passive Filter. The passive power Filter does not require any additional control circuit and the cost is also less. This Filter combination is shown in Fig 2.10.



Series APF with shunt connected passive filter

Here the series associated APF gives low impedance (right around nothing) for low recurrence parts whereas the shunt associated APF gives less impedance to high recurrence parts and filters out all higher request harmonics. So this filter configuration is the most helpful of all others and has the upside of lessening both current and voltage harmonics. Thus, in this thesis this filter configuration is utilized to improve electric power quality.

PROPOSED Idea

In this chapter different issues with the Dispersed Generations are talked about, such as voltage hang, voltage variance and voltage interruption, and so on. To diminish this one of the Realities device named as EUPQC is proposed.

The dispersed generation technology as the supporting technology of brilliant grid changes rapidly as of late. In power distribution network system with DGs, the vacillation of power outputted by DGs would bring about voltage quality issues effectively, such as voltage hang, voltage change and voltage interruption, and so on. Together with voltage quality issues brought by power distribution network self-deformity, voltage quality is of an inexorably difficult issue.

Thusly, a more compelling estimation to further develop power quality is desperately required. The research on impact of voltage quality in the neighborhood power distribution network brought about by the high penetration of DGs, has become one of hotspot issues in the research of scholars both homegrown and abroad.

For voltage quality improvement of distributions network with the high penetration of DGs, Appropriated Adaptable AC Transmission Systems (DFACTS) center around the client side and the adaptability and power quality control of distribution network system. Simultaneously, the capability of UPQC is considered the most comprehensive and successful in the DFACTS devices.

Meanwhile, that steadiness of the DG system and power quality can be enhanced by designing energy stockpiling unit, has been a scholarly agreement. The job of the energy stockpiling in further developing voltage quality has been broke down in the reference. In more detail, the functioning rule of the soundness control based on energy capacity guideline has been portrayed, yet in addition its mathematical model is established in Reference.

Superconducting Attractive Energy Stockpiling (SMES) and Flywheel Energy Stockpiling (FES), the end that giving the power system suitable dynamic and receptive power pay enhances the dependability of AC transmission system really is checked.

As per the voltage quality issues brought about by enormous quantities of DGs which being entomb associated with in MV/LV distribution organization and self-imperfection of distribution organization, the thesis presents an original UPQC structure based on super capacitor quick energy stockpiling. The exactness and unwavering quality of the control methodology for this device are confirmed by both the experimental outcome

and the detail rule reenactment. Then through dissecting the commonsense use of such sort of UPQC in distribution organization, we actually understand the improvement of the voltage quality.

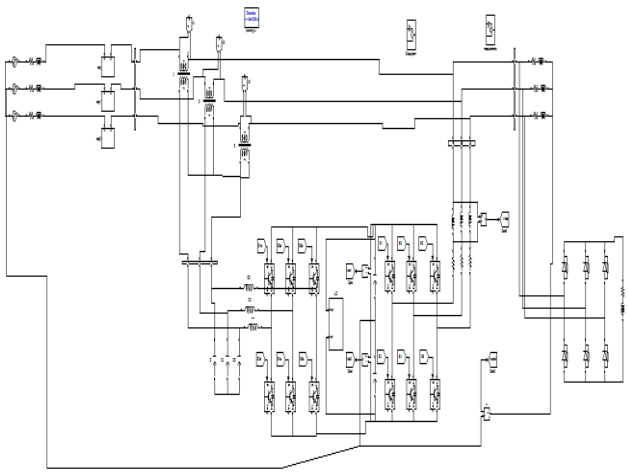
RESULTS AND Examination

In this Chapter, the recreation results are dissected by mimicking the proposed model in the climate of MATLAB/SIMULINK.

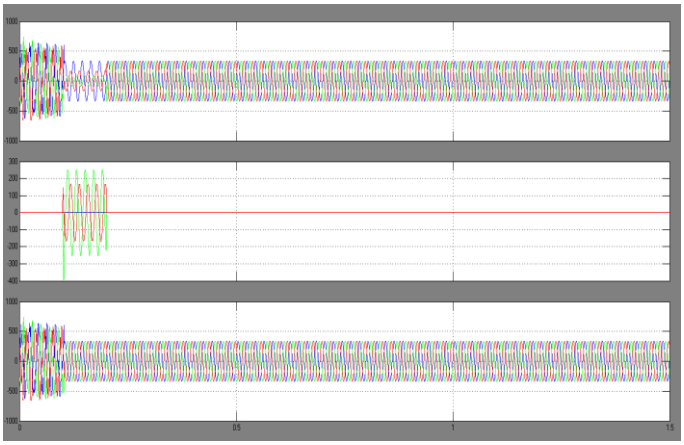
MATLAB is a high-execution language for technical processing. It coordinates calculation, perception, and programming in a simple to-utilize climate where issues and arrangements are communicated in natural mathematical documentation. Common purposes include:

1. Math and calculation
2. Algorithm turn of events
3. Data securing
4. Modeling, reproduction, and prototyping
5. Data investigation, exploration, and representation
6. Scientific and designing graphics

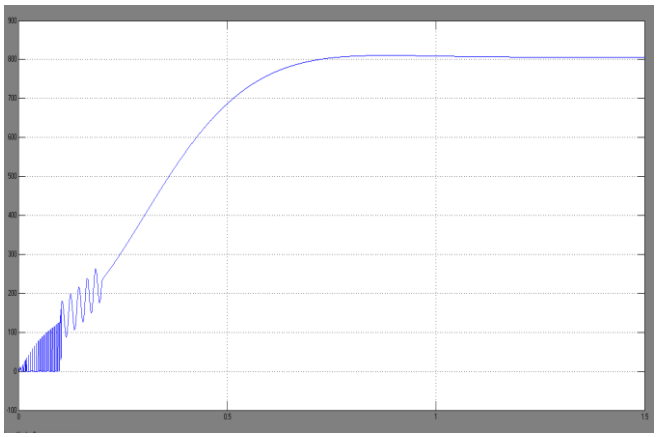
5.2 MATLAB/SIMULINK RESULTS:



Simulink diagram of distributed generation system with EUPQC

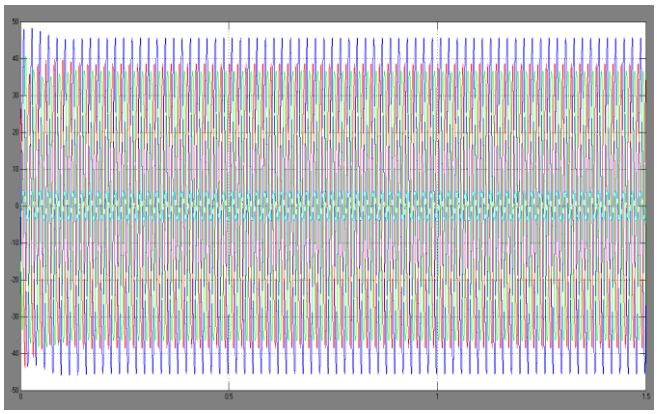


Simulation waveforms of distribution system with EUPQC

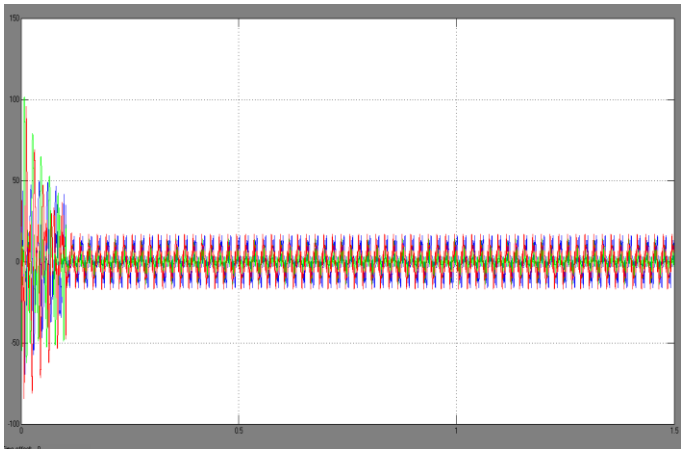


Simulation waveform of super capacitor DC bus voltage

Fig 5.2a Simulation waveforms of distribution system with EUPQC in three phase source voltage, load voltage and compensation voltage.fig 5.2b Simulation waveform Super capacitor DC bus voltage the sampling time is 0.8 to 1s change the voltages on sampling time.

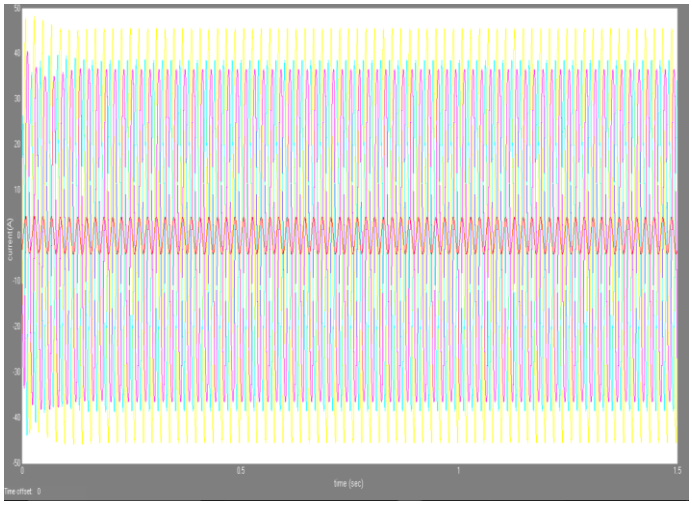


Three phase source current and neutral current distribution system with EUPQC



Three phase compensation current and neutral current distribution system with EUPQC

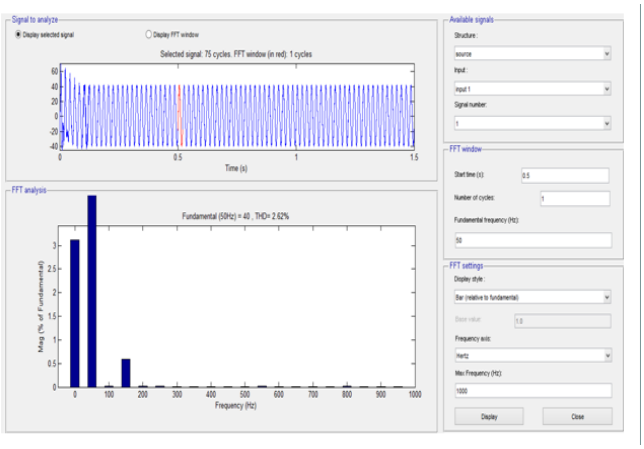
Fig 5.2c Three phase source current and neutral current distribution system with EUPQC in this fig source current and load current as same, fig 5.2d Three phase compensation current and neutral current distribution system with EUPQC.



Three phase load and neutral current distribution system with EUPQC

Three phase load and neutral current distribution system with EUPQC and source current is same as load current in the distribution system.

Three phase source voltage peaks normal are all 311V, but in sequence of 311V, 200V, 100V from 0.05s to 0.15s. Three phase balanced loads are in sequence of 6.28 Ω/20mH, 6.28 Ω/20mH, and 6.28 Ω/20mH. Three phase nonlinear load constitutes by three phase rectifier with 20 Ω /20mH. Series converter compensates voltage sags and parallel converter restrains harmonic and reactive current. The switching frequency fPWM=10 kHz and the sampling time Ts=0.8-1s.



THD calculation of distribution system with EUPQC

CONCLUSION:

This thesis researches structure guideline and the control technique of EUPQC and comes to the accompanying end results.

Super capacitor energy capacity and DC/DC converter cradle receptive power, exchange and give energy to voltage remuneration. Therefore, decoupling series converter and equal converter is executed. In addition, voltage quality issues of power interruption, which past the reach of conventional UPQC, can be settled effectively. With EUPQC, power quality issues in distribution network with high penetration of DGs could be gotten to the next level. The control systems of the three primary pieces of EUPQC are proposed based on criticism control. Recreation examination is done for source voltage droop and powering adjusted loads.

REFERENCES

1. Han Yingduo, Yan Gangui, Jiang Qirong, Huang Mincong. Electric Power in Information Society And FACTS & DFACTS [J] . Automation of Electric Power System, 2000, 24(19): 1-7.

2. Vinod Khadkikar, Ambrish Chandra. UPQC-S: A Novel Concept of Simultaneous Voltage Sag/Swell and Load Reactive Power Compensations Utilizing Series Inverter of UPQC [J]. IEEE Transactions on Power Electronics, 2011, 26(9):2414-2425.

3. J.A.Pecas Lopes, C.L.Moreira, A. G. Madureira. Defining control strategies for MicroGrids islanded operation [J]. IEEE Transactions on Power Systems, 2006, 21(2): 916-924.

4. Li Xun. Analysis and Control of Unified Power Quality Conditioner (UPQC) [D]. Wuhan:

Huazhong University of Science And Technology, 2006.

5. Fu Songping, Gao Qinxiang Yu Weiwei. Research on Series Convertor of Unified Power Quality Conditioner Based on Improved d-q-0 Transformation [J]. Power Electronic, 2009, 43(10): 31-33.

6. Xingtian Feng, Tongzhen Wei. Study on Voltage Quality of distribution Network with High Penetration of DG CHENG [C]. Power System Technology, Hangzhou, China, 2010

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