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Power Quality Improvement by D-STATCOM in Distribution under Various Fault Conditions

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ABSTRACT-We know during fault condition power quality problem occur in system so for improvement of power quality we use different type of FACT device , but generally we used D-STATCOM . in this paper addresses the modelling and analysis of custom power controllers, power electronic-based equipment aimed at enhancing the reliability and quality of power flows in low voltage distribution networks using DSTATCOM. A new PWM- based control scheme has been proposed that only requires voltage measurements the operation of the proposed control method is presented for D-STATCOM. Simulations and analysis are carried out in MATLAB/SIMULINK with this control method for two proposed systems.

Keywords: D-STATCOM, VSC, FACTS Controller, PCC, VSC.

I. INTRODUCTION

1.1 Power quality

The quality of electric power delivered is characterized by two factors namely-"continuity" of supply and the "quality" of voltage. As indicated by IEEE standard , Power Quality is characterized as- "The idea of controlling and establishing the touchy supplies in a manner that is suitable for the operation of the gear." .

Power quality Problems:

1. Interruptions: It is the failure in the continuity of supply for a period of time.

A. Short Interruption:

- **Causes:** The causes of these interruptions are-
- Opening of an Automatic Re-closure
- Lightening stroke or Insulation Flash over
- **Consequence**s:
- The data storage system gets affected
- There may be malfunction of sensitive devices like- PLC's, ASD's

B. Long Interruptions: If the duration for which the interruption occur is large ranging from few milliseconds to several seconds then it is noticed as long interruption.

- **Causes**:

The causes of these interruptions are-
Faults in power system network
Human error
Improper functioning of protective equipment

- **Consequences:**

This type of interruption leads to the stoppage of power completely for a period of time until the fault is cleared.

2.Waveform Distortion : The power system network tries to generate and transmit sinusoidal voltage and current signals. But the sinusoidal nature is not maintained and distortions occur in the signal.

- The cause of waveform distortions are
  - Harmonics
  - Inter harmonics
  - Noise
  - DC offset

3.Transients:

- **Causes:**
- Arcing between the contacts of the switches
- Sudden switching of loads
- Poor or loose connections
- Lightening strokes
- **Consequences:**
- Electronics devices are affected and show wrong results
- Motors run with higher temperature
- Failure of ballasts in the fluorescent lights
- Reduce the efficiency and lifetime of equipment

4.Voltage Sag:

The voltage sag is defined as the dip in the voltage level by 10% to 90% for a period of half cycle or more.

- **Causes:**

The causes of voltage sag are-

- Starting of an electric motor, which draws more current
- Faults in the power system
- Sudden increase in the load connected to the system
- **Consequences:**
- Failure of contactors and switchgear
- Malfunction of Adjustable Speed Drives (ASD's)

5.Voltage Fluctuation:

These are a series of a random voltage changes that exist within the specified voltage ranges.

- **Causes:**
- Frequency start/ stop of electric ballasts
- Oscillating loads
- Electric arc furnaces
- **Consequences:**
- Flickering of lights
- Unsteadiness in the visuals

Disadvantages due to poor power quality :

- Increased energy consumption
- Fees for reactive power consumption
- Stalled production
- Damaged or malfunctioning equipment
- Decreased equipment lifetime
- Loss of data

1.2 Fault.

The most common type of fault on a three phase system by far is the single line-to-ground (SLG), followed by the line-to-line faults (LL), double line-to-ground (DLG) faults, and balanced three phase faults .

1.3 D-STATCOM

- VOLTAGE SOURCE CONVERTER
- CONTROLLER
- ENERGY STORAGE CIRCUIT
- LCL PASSSIVE FILTER

II. Objective of the research paper :

- The main objective of this research is to improve the power quality by using D-STATCOM in distribution network under different fault conditions.
- To achieve the above objective, the following were the specific objectives.
  - Make simulation model of distribution network .
  - Then make simulation model of D-STATCOM.
  - Then compare power quality with and without using of D-STATCOM during different type of fault.

III. METHODOLOGY OF RESEARCH

- We design the system consists of two parallel feeder with similar load of same ratings.
- We simulate a model of d-statcom.
- One feeder is connected with d-statcom and other is alone.
- Create a different type of faults in both the feeders.
- Observe the result with different types of fault on feeder with d-statcom and without d-statcom .

IV. SIMULINK MODEL OF THE TEST SYSTEM WITH STATIC LINEAR LOAD.

Simulation model of test system are shown in figure .here to identical non linear load connected with identical parallel feeder. One of the feeder connected with D-STATCOM and other feeder are not connected with D-STATCOM.

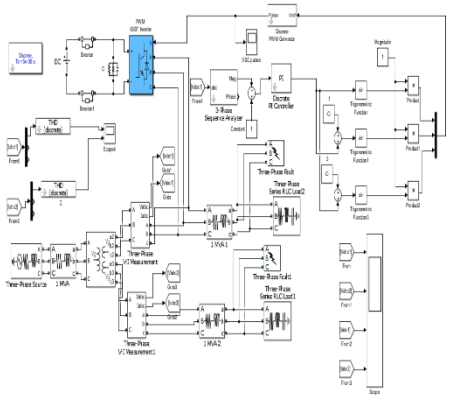

Fig 1. Simulation model of test system

On this test system different type of fault create like single line to ground fault , double line to ground fault, thriple line to ground fault . result of each fault are given below.

V. RESULT

CASE 1. Single Line to Ground Fault Condition

In first case a single line to ground fault is considered for both the feeders. Here the fault resistance is 0.001 ohm and the ground resistance is 0.001 ohm. The fault is created for the duration of 0.1s to 0.3s. The output wave for the line voltage and load current without compensation is shown in Figure-2, Figure-3 respectively.

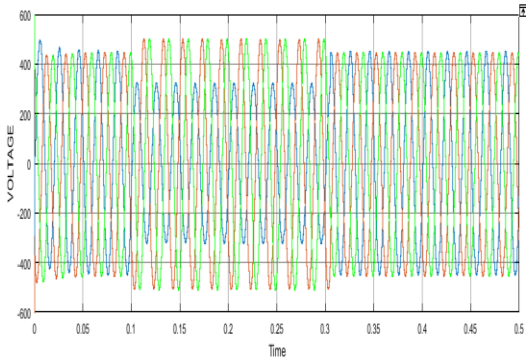

Fig 2. Voltage waveform (without compensation)

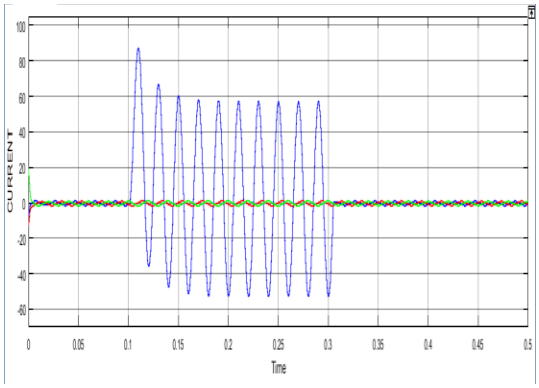

Fig 3. Current waveform (without compensation)

B. CASE 2. Double Line to Ground Fault Condition

In second case considered fault for both the feeders is double line to ground fault. For this fault resistance and ground resistance is 0.001ohm and 0.001ohm respectively. And the time duration for this fault is 0.1seconds to 0.3seconds. The output wave for the line voltage and load current without compensation is shown in figure-4 and Figure-5 respectively.

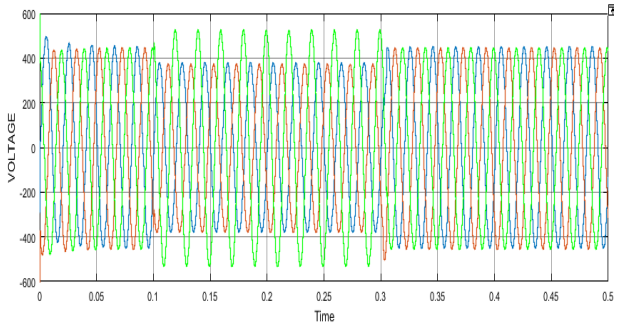

Fig 4. Voltage waveform (without compensation)

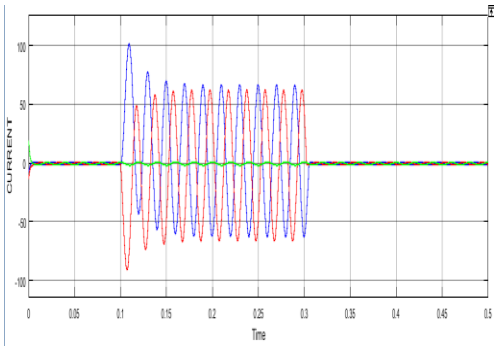

Fig 5. Current waveform (without compensation)

C. CASE 3. Three Phase Line to Ground Fault Condition

In third case a considered fault for both the feeders is three phase to line fault. The fault is created for the duration of 0.1s to 0.3s. And fault resistance and ground resistance is 0.001ohm and 0.001ohm respectively. The output wave for the line voltage and load current without compensation is shown in Figure-6 and Figure-7 respectively.

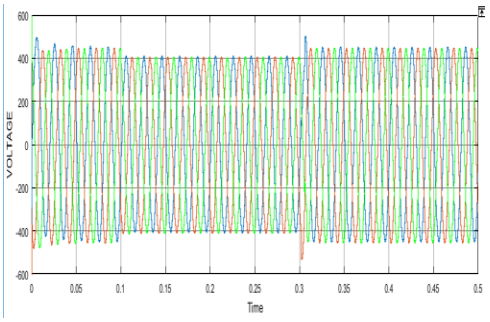

Fig 6. Voltage waveform (without compensation)

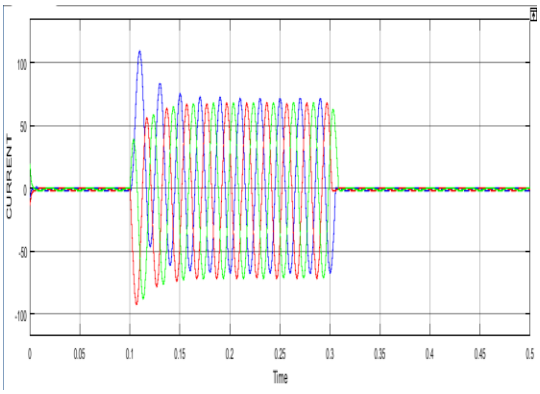

Fig 7. Current waveform (without compensation)

So during fault condition voltage dip and over current flow so power quality of system is poor so we use D-STATCOM compensator for improvement of power quality . after using compensation we get balanced three phase voltage and balanced three phase current in system .

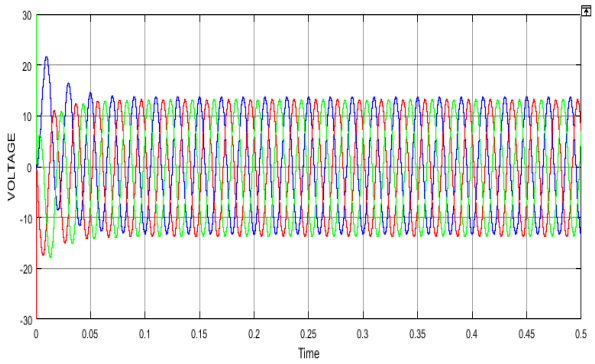

Fig 8. Voltage waveform (with compensation)

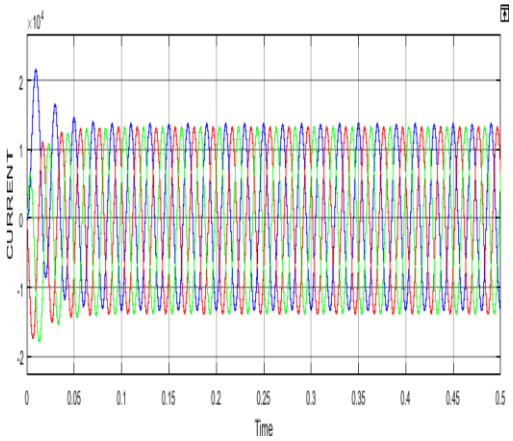

Fig 9. Current waveform (with compensation)

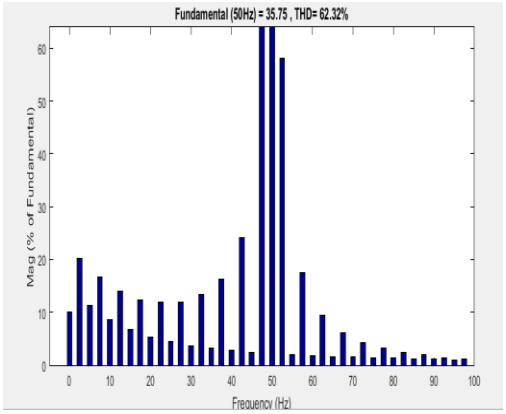

Fig 10. THD waveform (without compensation)

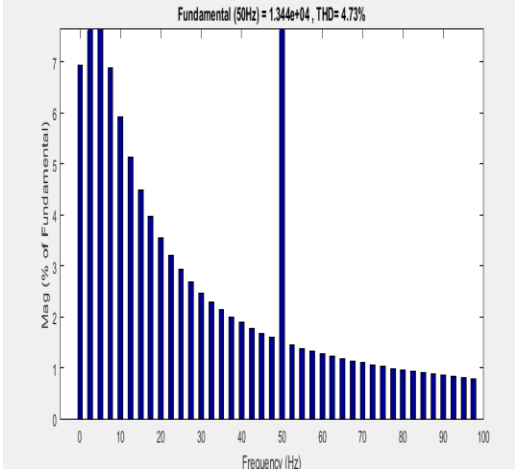

Fig 11. THD waveform (with compensation)

CONCLUSION

So power quality of distribution system in linear and non-linear load can be improved by using D-STATCOM.

So we can say that D-STATCOM has a huge scope in improving power quality in distribution network .

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