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ANALYSIS OF DVR IN DISTRIBUTION DURING VOLTAGE SAGS & VOLTAGE SWELLS

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Abstract - Now days Power quality is a premier fact by which the high-tech devices are getting affected. Power quality problem is quite natural and is often occurs, such as non-sinusoidal voltage, frequency of current which in turn results in the failure of end use equipment's. Main problem is voltage perturbation during voltage sags & voltage swells. To figure out these difficulties, custom power devices can be used. These problems can be solved up to a greater extent. Power Distribution systems ideally should provide their customers with an incessant flow of energy at smooth sinusoidal voltage at the slender magnitude level and frequency. The DVR has a higher energy capacity compared to the SMES and UPS devices. Moreover, the DVR is smaller in size and economical as compared to the DSTATCOM and other custom power devices. The DVR is fast, flexible and efficient .In addition to voltage sags and swells compensation, DVR having one more quality of harmonic s correction. DVR eliminates or mitigates the voltage sag/ swell and power quality problem when unnatural condition occur in distribution system.

This article focuses on the performance of DVR for voltage compensation which is done by using MATLAB Software to explain PI Controller & discrete PWM Pulse Generator Module have been used.

Keywords - Voltage sag, Voltage swell, Sinusoidal Pulse Width Modulation Technique and Dynamic Voltage Restorer.

I. Introduction

Electrical energy is the most Efficient and enormous of energy and all of us are desperately dependent on the electric supply. We cannot imagine the life without supply of electricity. At the same time the quality and persistence of electric power supplied is also very important for the efficient functioning of the end user equipment. Most of the commercial and industrial loads demand high quality uninterrupted power. Thus maintaining the qualitative power is of important.

Power quality is one of the leading concerns in the era of power system. Power quality measures the fitness of electric power transmitted from utilities. The high quality sinusoidal waveform produced at power stations. The well-known applications of power electronics based non linear devices and faults cause deviation from uncontaminated sinusoidal waveform. These situations facing electricity customers and suppliers have increased the popularity and development of power quality studies.

Power quality is becoming an increasingly important topic in the performance of many industrial applications such as information technology devices related to communication, advanced control, automation, precise manufacturing technique and online service.

II. LITERATURE REVIEW

The quality of power delivered to the end user is most important as performance of the Consumer's equipment is heavily dependent on it. Dynamic Voltage restorer's first unit installed in 1996 so many configurations compensating unit and

controller have been presented. In these papers we presented the most important contribution.

[1] O. Anaya Lara Et Presents The Simulation of Dynamic Voltage Restorer & Suggests four different methods to inject the voltage using DVR which are In Phase Compensation Phase Advance Compensation Voltage Tolerance method And In Phase Voltage Compensation.

[2] S.F Torebi presents Modeling & Simulation Technique of DVR which protects from voltage sags and swells to sensitive load. This can be used to protect a group of medium voltage or low voltage consumers by using improved d-q-0 controller technique.

[3] Frede Blaabjerg deals with four different topologies to provide DC supply and compare all these which can be realized with minimum amount of energy storage. Firstly DVR performed without energy storage and Passive convertor is used. In other case DVR performed with energy storage system as DC link capacitor.

[4] Jose M Lozano represents the use of matrix convertor which contains nine bidirectional switches arranged in three groups associated with an output line Matrix Convertor used in DVR to mitigate voltage fluctuation. DSVPWM Direct Space Vector Pulse Width Modulation technique is used for Unbalanced & distorted Voltage supply. In this method various different types of switching power converters have been employed.

[5] John Godask Nielsen deals with the Power Quality issues i.e. Voltage Dip By inserting the DVR in either the medium voltage distribution system or in low voltage distribution system. Michael john Newman presented that the series connected inverter of a DVR could also be used to compensate for steady state load voltage harmonics which increases the Power Quality value. Compensation is done by using Narrow bend resonant based controllers for each harmonics.

[6] D MhindaVilathgamuwa gives new concept of two or more DVR connection to common DC link. In which One DVR is used to compensate Voltage Sag & another DVR replenish the DC link energy storage which depends on load power factor.

[8] Shazl A. Mohammed says Voltage sag is a common method and desirable power quality phenomenon in the distribution system which put sensitive loads under danger. In this DVR can provide the solution to mitigate voltage sag by injection voltage as well as power into the system. This thesis presents and gives overview of DVR its function configuration components compensating strategies and control method.

[9] Meera Annie Varghese presents one of the modern devices which are used to guard consumers against sudden changes in voltage amplitude known as Dynamic Voltage Restorer. It is used in distribution system network to protect consumers from sudden change in voltage magnitude. DVR is a custom power device. In this paper Resonant Controller and Charged regulator is proposed in order to eliminate the steady state error in DVR response and stabilize the system. The current limitation protects the DVR and restores the point of common coupling (PCC) voltage. Here the DVR with the 15 level inverter systems protects the PCC voltage without any real power injection into the DVR during voltage sag condition. And the simulation results show how the DVR controls the emergency conditions of distribution systems.

[10] S.Masoud Barakati deals with a DVR as a solution to compensate the fault and protects sensitive load. DVR is connected across distribution system with voltage in range of kilovolts; series converter is a component of DVR which should be implemented based on the multilevel converter. Multilevel converter has a capability to handle voltage in range of kilo volts and power of several megawatts

III. PROPOSED METHODLOGY

Power quality means the fitness of electrical power system. And if any disturbances generated in system then it causes damage. To solve this problem the concept of custom power device is introduced.

One of them device is dynamic voltage restorer. Which is the most efficient & effective device. It is series connected solid state device that injects voltage into the system in order to modulate the load side voltage.

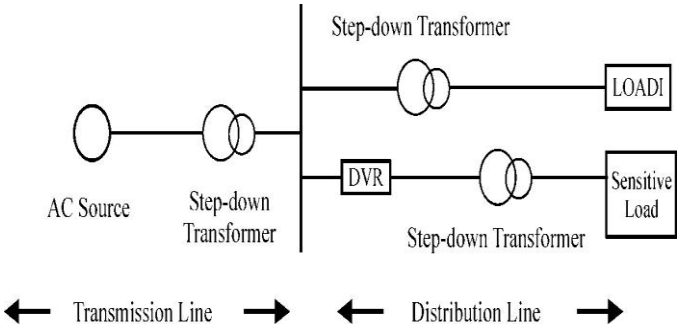

Fig. 1 Flow Chart of DVR Distribution

IV. MODES OF OPRATION

The role of DVR is to inject an energetically controlled missing voltage in series generated by a voltage source convertor which is connected in series to the bus/ line voltage by using injection transformer. The phase angle & magnitude of voltage are variable during sag. The DVR has three modes of operation i.e. Protection mode, Standby mode (during steady state) & Injection Mode (during sag).

- **Protection Mode**

If the system parameters exceeds from its reference or preset value on load side so system will be isolated. When the system observes any disturbance or detects any fault or abnormal condition bypass switch removes the DVR from the system to protect from damages and it protects from over current also and provide different path to current.

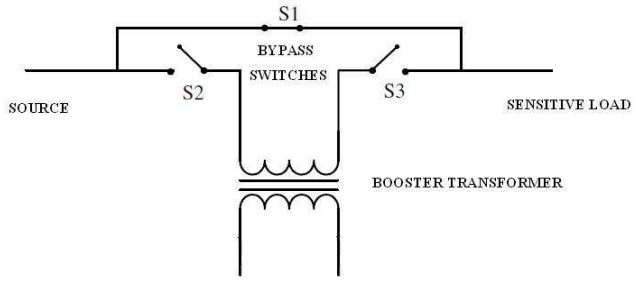

Fig 2 Protection mode

- **Standby Mode**

In Standby mode the DVR may either go into short circuit operation or inject small voltage to compensate voltage sag. The injection transformer's low voltage winding is shorted through the voltage source converter. There is no switching of semiconductor occurs full load current pass through the primary winding. Solid state bypass switches are used to perform short circuit operation.

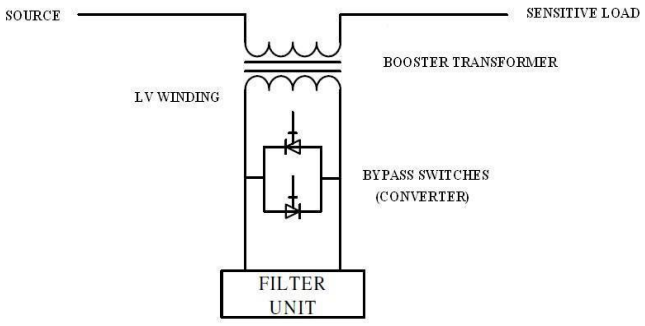

Fig 3 Standby mode

- **Injection Mode**

In injection mode DVR injects a compensating voltage through injection / booster transformer after disturbance of required phase and magnitude. The primary function of DVR is compensating voltage disturbances on distribution system. To attain compensation, three phase ac voltages are injected in series with required magnitude, phase angle and wave shape. The types of voltage sags, load conditions and power rating of DVR will determines the possibility of compensating voltage sag.

V. CONCLUSION

This paper has presented the power quality problems of voltage sags and swells. Compensation technique of DVR is presented to solve the problem of distortion. The design & simulation of DVR was presented. The aim of this paper is to compensate the voltage sag and swell problem. Modeling & Simulation was done by using MATLAB. This simulation shows DVR provides better regulation. In this PI controller is used to composite the error.

This report had presented the power quality problems such as voltage sag with the compensation techniques of custom power electronics device DVR. This research work presents comprehensive results for the design and application of DVR for voltage sag. A controller utilizes the error signal which is actually the difference between the reference signal and the actual signal. Voltage source convertor (VSC) was implemented with the help of pulse width modulation. Modeling and Simulation of DVR is done through MATLAB/SIMULINK computer software. The simulation carried out here shows that DVR provide better voltage regulation capabilities. Based on analysis of test system, it is suggested that percentage sag and operating voltage are major factors in estimating the requirement of DC storage capacity. The effectiveness of a DVR system mainly depends upon the amount and stiffness of DC energy storage device.

Investigations were carried out for various cases of voltage sags at different transmission voltage levels. Result show that any increase in transmission voltage and voltage sag demands sufficient increase in DC storage capacity. An expression is developed to estimate the required DC storage voltage for specified transmission voltage and percentage sag. In the test system, it is observed that after a particular amount of increases in the load on feeders, the voltage levels at the load terminal decreases.

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