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A Technological Literature Survey on various Mitigation Techniques for Voltage Sag and Swell necessary for Power Quality Improvement.

Engineering

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ABSTRACT

Voltage sag and swell is very harmful for the power quality. It is very important to reduce voltage sag and swell for improving the power quality. The fast developments in power electronic technology have made it possible to mitigate voltage disturbances in power system. Among the voltage disturbances challenging the industry, the voltage sags are considered the most important problem to the sensitive loads. This paper presents the technological literature survey on various mitigation techniques for voltage sag and swell.

Francis, D. and Thomas, T. have presented Mitigation of voltage sag and swell using dynamic voltage restorer. The fast developments in power electronic technology have made it possible to mitigate voltage disturbances in power system. Among the voltage disturbances challenging the industry, the voltage sags are considered the most important problem to the sensitive loads. Dynamic voltage restorer (DVR) is a series connected power electronic based device that can quickly mitigate the voltage sags in the system and restore the load voltage to the pre fault value. DVR is recognized to be the best effective solution to overcome this problem. The primary advantage of the DVR is keeping the users always on-line with high quality constant voltage maintaining the continuity of production. In this paper, the usefulness of including DVR in distribution system for the purpose of voltage sag and swell mitigation is described. The DVR presented here is based on the concept of dqo. The proposed control method is found very efficient for detecting and clearing any power quality disturbance in distribution systems. Results of simulation using Matlab-Simulink are demonstrated to prove the usefulness of this scheme [1].

Mehranfar, H. ; Baghramian, A. ; Rafieinia, F. have presented Mitigation of voltage swell by switched autotransformer with random hysteresis voltage control. This paper presents a voltage swell compensator based on a switched autotransformer by random hysteresis voltage control. The advantage of this compensator is that it uses only one controlled switch per phase with no energy storages. Also the control scheme purposed here distributes the harmonic spectrum of the load voltage and reduces its total harmonic distortion (THD). Different voltage swell events have been simulated by MATLAB/SIMULINK software. The results of simulations verify the ability of proposed method to mitigate voltage swell event [2].

Rajasekaran, D. ; SekharDash, S. ; Vignesh, P. have presented Mitigation of voltage sags and voltage swells by Dynamic voltage restorer. Modern industrial processes are based on a large amount of electronic devices such as programmable logic controllers and adjustable speed drives. Unfortunately, electronic devices are sensitive to disturbances, and thus, industrial loads become less tolerant to power quality problems such as voltage sags, voltage swells, and harmonics. The dynamic voltage restorer (DVR) has become popular as a cost effective solution for the protection of sensitive loads from voltage sags and swells. This paper deals with modeling and simulation of a Dynamic Voltage Restore (DVR) for mitigation of voltage sags and voltage swells. The control of the compensation voltages in DVR based on d-q-0 algorithm is discussed. Effectiveness of technique is investigated through computer simulation by using MATLAB/SIMULNK software [3].

Ashourpouri, A. ; Dargahi, M. ; Nabavi Niaki, S.A., have presented Residential voltage dip and swell mitigation using Plug-in Hybrid Electric Vehicle in smart grid. Solutions to remedy the voltage disturbances have been mostly suggested only for industrial customers. Not much research has been done on the impact of the voltage problems on residential facilities. This paper proposes a new method to reduce the effect of voltage dip and swell in smart grids equipped by communication systems. A voltage source inverter and the corresponding control system are employed. The behavior of a power system during voltage dip and swell are analyzed. The results demonstrate reasonable improvement in terms of voltage dip and swell mitigation. All simulations are implemented in MATLAB/Simulink environment [4].

Eskander, M.N. ; Amer, S.I. have presented Mitigation of voltage dips and swells in grid-connected wind energy conversion systems. This paper investigates two methods for mitigation of voltage dips and voltage swells in a grid to which a wind energy conversion system (WECS) is connected. The two mitigation methods are the dynamic voltage regulator (DVR), and the static compensator (STATCOM). The wind energy system employs permanent magnet synchronous generator (PMSG). It is well known that the voltage dips affect the PMSG adversely, leading to unlimited increase in its speed. Hence, quick voltage dip mitigation is required. The responses of both DVR and STATCOM to voltage dips as well as voltage swells are investigated and compared. Also the active and reactive power behaviors in each system during and after fault recovery are investigated. The simulation results compared for voltage dips and voltage swells show less harmonic contents for the system employing the DVR. However, the response of the two systems to faults is comparable [5].

Basu, K.P. ; Hafidz, S.A. have presented Mitigation of single-phase voltage sag and swell with zigzag transformer. Voltage sag or swell in one phase of a 3-phase system due to LG fault, capacitor switching or any other reason is to be mitigated immediately for proper functioning of all the equipments. A 3-phase zigzag-winding transformer connected across a 3-phase star-connected load may mitigate the voltage sag or swell at any one phase of the load. The phase experiencing the voltage disturbance is disconnected from the source of supply first, while the other two phases remain connected to the source. The zigzag

transformer immediately rebuilds the voltage across the load of the open phase and allows the current to flow to the open phase load. Very low value of zero sequence impedance of the zigzag transformer produces very small voltage drop and the open phase voltage nearly equals the normal voltage. After the disturbance disappears, the open phase of the transformer and load is reconnected to the supply [6].

Awad, H. ; Blaabjerg, F. have presented Mitigation of voltage swells by static series compensator. Swells and overvoltages can cause overheating, tripping or even destruction of industrial equipment such as motor drives and control relays. This paper investigates the possibility of employing the static series compensator (SSC) to mitigate voltage swells/overvoltages. In the case of voltage swells, active power may be drawn from the grid into the energy-storage capacitor (ESC) of the SSC, depending on the load current and the SSC impedance. This active power may overcharge the ESC. Two possibilities to overcome this situation are explored in this paper: 1) if the DC-voltage of the ESC is lower than a predetermined voltage level, the active power is employed to charge the ESC to this voltage level; 2) otherwise, the overvoltage protection of the SSC must operate. This paper also applies an overvoltage protection scheme based on a combination of a DC resistor with a chopper and the valves of the SSC [7].

Pathan, A.I. ; Vanamane, S.S. ; Chile, R.H. have presented Different control techniques of Dynamic Voltage Restorer for power quality problems. Nowadays power quality is the biggest issue in power sector. Everyone demands for reliable and good power quality. There are different problems in power quality like harmonic distortion, flicker, notching, transient, etc. Voltage sag and swell are the major problems in power quality. Dynamic voltage Restorer (DVR) is a custom power device used for mitigation of voltage sag and swell. DVR is connected in series by using the injection transformer to inject the appropriate voltage to mitigate voltage sag/swell and maintain the load voltage constant. For the generation of this compensating voltage there are two steps which are reference voltage generation and gate pulse generation for IGBT's of VSC. These methods detect the voltage sag/swell condition and give the reference voltage. Hysteresis controller is used for gate pulse generation in both methods [8].

Venkatesh, C. ; Reddy, V.P. ; Siva Sarma, D.V.S.S. have presented Mitigation of voltage sags/swells using PWM switched autotransformer. Dynamic voltage restorer and STATCOM are normally employed as a solution for mitigation of voltage sag and swell. This paper presents modelling and analysis of PWM switched autotransformer as a mitigating device for voltage sag and swell disturbances. The proposed system has less number of switching devices and has good compensating capability in comparison to commonly used compensators. Simulation analysis of three-phase compensator is performed in PSCAD/EMTDC and performance analysis of the system is presented for various levels of sag and swell. The THD of the load voltage when the compensator is functioning during disturbance condition are within the limits. Also the compensator can maintain the load real and reactive powers constant [9].

Jayalakshmi, V. ; Gunasekar, N.O. have presented Implementation of discrete PWM control scheme on Dynamic Voltage Restorer for the mitigation of voltage sag /swell. A Dynamic Voltage Restorer (DVR) is one of the most common custom power devices to compensate for the voltage sag and swell. The main functions of the DVR are the injection of voltage to the power line and maintain the pre-sag voltage condition in the load side. Different control strategies are available depending upon the compensation technique. In this paper, a simple method for the generation of reference voltage for a DVR is presented. This control scheme provides superior performance compared to conventional control methods because it directly measurers the rms voltage at the load point without involving any transformation process. The simulation was carried using MATLAB/ SIMULINK and the results of the simulation show that this proposed method is able to provide the desirable power quality in the presence of a wide range of disturbances [10].

CONCLUSION: - This literature survey is dedicated to a comprehensive study of various mitigation techniques for voltage sag and swells. Dynamic voltage restorer (DVR) is a series connected power electronic based device that can quickly mitigate the voltage sags in the system and restore the load voltage to the pre fault value. DVR is recognized to be the best effective solution to overcome this problem.

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