Reduction of Sags and Swells in a Distributed Generation System based on Environmental Characteristics

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Abstract-- The renewable energy resources based distributed system in the power system suffers due to power quality problems which resulting in degradation of system reliability. The renewable resources when subjected to transmission will induce sags and swell due to certain environmental characteristics. The wind is the resource that has an issue of variation of wind speed and solar suffers due to various insolation levels that are caused due to continuous variation in solar radiation throughout the day. This paper discusses the results that are produced in distribution system. The static compensator (STATCOM) is employed to overcome the power quality problems. The installment of STATCOM in the system interconnection will reduce the sags and swells produced in the power system thus it allows the power system to maintain the constant and rated power flow in the grid.

Keywords- DG-Distributed Generation, PCC-point of common coupling, PV-photovoltaics, FACTS-Flexible AC Transmission System, STATCOM-Static Compensator.

I. INTRODUCTION

The wind and solar are popular in renewable energy power generation. These resources operated in isolated and grid connected mode. The purpose of having operating modes is that they induce many power quality problems. These problems are improved by having ultra capacitors and flywheel arrangement. The wind resource lacks in power quality due to change in algorithm, continuous change in wind speed and tower shadow effect[1],[2]. Also, the solar has problem of cloud shading effect, solar intensity and cell temperature. These problems associated with PV system cause distortions in the generated voltage. These resources wind and solar majorly induce power quality problems of sags and swells in the power system.

It is seen that power quality affecting factors can be occurred in both generation and distribution side. Hence this will give rise to system malfunctioning and failure of equipment. But in this paper, a steady state analysis is performed to overcome the issues in power flow and hence power flow regulation is done to reduce the occurrence of faults. The analysis done between the inverter and load where the sags and swell often occur. The continuous monitoring in interconnection is done by STATCOM.

The device is connected between the inverter and load. This arrangement helps to reduce power quality problems in a distributed generation system.

In a solar system, The PWM and bridge converters are employed for rectification and also maximum power point algorithm is used to track the magnitude of voltage and current. This will make the system complex and filter design complicated.

Block Diagram

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Block Diagram

Fig.1. DG-system employing STATCOM

II. INTERCONNECTION OF HYBRID DG SYSTEM

In a distributed generation system the resources are connected to grid. The “power quality” is the term that refers to proper sine wave with no harmonics and less signal distortions. Influencing growth in solar system that are connected to grid vary the levels of quality in power. This gives the way to increased grid faults and power quality levels are considerably low. Also, it influences the violation of system integrated codes[1]. The violation results in malfunction of inverters and hence ends in poor operation. In case of wind power generation, the turbine causes large fluctuation.
This will produce heavy distortions in voltage. Large fluctuations are due to tower shadow effect and variation in wind turbulence[2].

A. Wind System:

In this paper doubly fed induction generator is used to generate electricity. The wind farm employing DFIG has an advantage of independent control over magnitude of voltage and current. DFIG system generates potential irrespective of rotor disturbances. This makes the system to have high efficient operation[3].

![Fig2. Doubly Fed Induction Generator](image)

B. PV System:

The solar system is integrated to form the distribution generation system. The PV system is one of the emerging method of power generation. The continuous variation in solar radiation makes the difference in voltage levels. The output suffers a greater extent by this power quality issues[2]. This difference in solar radiation makes the way to arise sags and swells. The STATCOM is installed to overcome this power quality problem in the hybrid interconnected system[5].

C. Installation Of Statcom To DG System:

STATCOM is one of the emerging FACTS controller. This controller is employed to reduce power quality problem. This also helps to have good power factor management. The purpose this controller is to mitigate sags and swells. This is connected in between inverter and the grid arrangement. Reactive power management is the main objective of STATCOM[5]. This helps the load to have constant voltage and current irrespective of power quality issues.

III. HYBRID DG SYSTEM

A. DFIG (Doubly fed Induction Generator)

The DFIG is the emerging and promising technique applied in wind farms to generate electric power. DFIG systems are closed loop systems. They employ converters in both stator and rotor[3]. The converters are made available at both the ends to excite the stator and rotor. Controllers are designed to control the gating sequence of converter. When the fault induces sags and swells in the distribution side the STATCOM in the grid side converter will provide excess voltage and hence it makes the load to get rated voltage and current.

![Fig3. Simulation block for Stator Controller](image)

![Fig4. Simulation result for stator controller.](image)
Fig 5. Simulation block for Rotor Controller

Fig 6. Simulation output for rotor controller

B. PV System To Interconnection:

The PV array system comprises of chopper and inverter arrangement. The DC output is chopped to meet the requirements of grid. The boost chopper is employed here to have steady increase in voltage levels. The DC produced is fed as input to the inverter circuitry. The inverter arrangement will produce different levels of voltage depending on the solar insolation.

C. Occurrence Of Swells In The DG System:

D. Design Of Statcom

The design of STATCOM consists of voltage source converter. The main objective of STATCOM is to transfer active power between power system and the VSC[5]. The STATCOM comes into existence only when power system voltage levels goes beyond the limit. It supplies real power when power system voltage is low and it consumes reactive power when the system voltage is high.

E. Regulated Voltage After The Installation Of Statcom

IV. CONCLUSION

The involvement of power electronics based controller STATCOM gives the way to reduce power quality issues. It is effective tool which helps in regulation of voltage in DG system. This helps the grid to have constant voltage and current magnitude. The power quality terms sags and swells are reduced considerably in limits. This analysis makes the DG system to operate in grid connected mode thus regulating power flow. The involvement of STATCOM improves the power transfer capability and the reactive power consumption.
REFERENCES


AUTHOR’S PROFILE

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