Multilevel Inverter Based UPQC for Power Quality Improvement

Chinta Narendra Kumar
Associate Professor, EEE Department, Malla Reddy Engineering College (Autonomous), Secunderabad 500100

Ulli Mounika
PG Scholar, EEE Department, Malla Reddy Engineering College (Autonomous), Secunderabad 500100

Golla Venkata Shiva Kumar
Assistant Professor, EEE Department, Malla Reddy Engineering College (Autonomous), Secunderabad 500100

Abstract: The main aim of this project is to implement a multilevel inverter associated UPQC for power quality enhancement. UPQC having 2 controllers namely series controller & another one is shunt controller. These controllers are associated with the DC link capacitor. DC voltage is produced by PV source. In this project multilevel inverters are used in series & shunt controller for producing accurate sinusoidal wave shape. The series controller is connected at grid side for grid power quality improvement. In this project grid side voltage sag/swell reduced by series controller. The shunt controller regulates the reactive power compensation as well as reduced the load current harmonics. These controllers are regulated by using synchronous reference frame theory (SRF). The advantages of proposed system is high efficiency & enrichment of quality power. The simulated results of proposed system is verified by MATLAB/Simulink environment.

Key word: PV, UPQC, Power quality, harmonics, Synchronous reference frame theory,

I. INTRODUCTION

In recent days usage of renewable energy sources are very popular & there is also enhancing emphasis on unpolluted energy generation via connection of rooftop-PV structures in small scale apartments as well as profitable buildings [1]. Due to discontinuous nature of PV, an improved penetration of such frameworks, mostly in weak-circulation networks leads to power quality issues i.e., voltage swell & voltage sag, which ultimately insecurity in grid [2]. These issues also lead to frequent false tripping of power electronic frameworks, damaging & false triggering of electronic structures & increases heating of capacitor banks etc [3]. In the Power quality issue on together load side & grid side is main problem are faced between in modern distribution systems. The three stage multi-functional solar energy transformation network, which compensates into load side power-quality issue was proposed in [4]. The single-phase solar PV inverter along with active power filtering ability as well-known proposed as [5]. The main researched works are done into integrate at cleaned energy generations among the shunt active filters. While shunt active filters is capable as together load voltage-regulation, has been coming into the cause of injects into reactive powers. In shunt-active filter are not regulates in PCC voltages as known in maintained in grid current unit power factor into equal time, as well as the stringent-voltage quality-requirements form electronic load, in the used in series-active filter have propose form used into little apartment & profitable building[6]. The solar photovoltaic systems are integrate into the dynamic voltages at restorer are proposed in [7]. Comparing at shunt & series-active power filters, at unify power quality-conditioner (UPQC), when it is have been together series or shunt compensator may be performed into load voltage regulations on maintaining at grid current sinusoidal at unity power factor into same time. Integrating PV array as well as UPQC, giving to the two benefit in the cleaned energy generations into universals active. This integration on PV array within unify power quality-conditioner have been reported in [8]. Compared between conventional grid connected inverters, in the PV integrated unify power quality-conditioner was many benefit into such improves in power quality in the grid, protecting critical loads for gridside conflict separately in increases in the faults rides among the capability to converter throughout transients. With the increase stress on distribution generations & micro grids, here on renewable interested into unify power quality-conditioner systems [9]. Mention signal-generations are main tasks into control of the PV-UPQC. References signal generation technique may broad dividing astime domains at frequencies as domain technique. Time-domain method is common uses in between in the lower computational requirement into real time implementation. Which are common using methods includes inductive power theories, synchronous-reference frames theory (DQ theory). The major issue in use in the synchronous referenced with frames theory base on technique as due to loads disturbed conditions, at double harmonic component are presented in the D-axis currents. Because of this, lowpass filter at low cut off frequency is uses into filter out double harmonic component. In the project is, a moves average filter (MAF) at uses in filter at the D axis.
current to obtaining fundamental loads active currents. And giving as optimal-attenuation inwithin reduces the bandwidth in the controls [10]. Later, MAF is apply into improving performance of DC-link controls are known into grid synchronization used to phase locked loop. In the project, is the design & performance analysis of a three phase PV-UPQC are presented. Here the single phase inverter is replaced by cascaded multilevel inverter (CMLI-UPQC) for reducing the harmonics&improve the wave shape of inverter. These major benefits of the proposing system as following,

• Integrated into the clean energy generation&power quality improvements.

• Simulated into voltages or currents quality improves.

• The performing into load current compensate because of uses into MAF as DQ controls in CMLI-UPQC.

These improvements are the proposed systems are analyzing extensively below at two dynamic & stable state condition using into Matlab/Simulink softwares.

II. EXISTING SYSTEM

Fig.1 indicates the existing system configuration with 2 level inverters. The framework PV-UPQC has series controller&shunt controller& DC link capacitor it is connected with PV source. The shunt controller associated with load side for reduction of load current harmonics & reactive power compensation & here filters are used for smoothing the ac wave. The series controller associated with grid side for improvement of grid power quality i.e., voltage sag/swell. The main drawback of this system is high harmonics are produced because of 2 level inverters.

In the proposed system the 2 level inverter is replaced by multilevel inverter namely CMLI-UPQC. The main benefit of cascaded multilevel inverter is to generate the accurate sinusoidal shape of the ac wave. In this framework series&shunt controllers are replaced by multilevel inverter via dc associated capacitor. The function series CMLI-1 is to compensate power quality problems at grid side i.e. voltage sag/swell. This controller is operated by synchronous reference theory by taking feedback as grid side voltages as discussed in control strategy. The function of shunt CMLI-2 is to compensate the load current harmonics produced by nonlinear or unbalanced load. It is regulated by synchronous referenced frame theory as discussed in below segment.

![Fig 2 ProjectedSystem of CMLI –UPQC](image)

Cascaded Multilevel Inverter

The below figure.3 indicates the cascaded multilevel inverter. This inverter consists of dc link capacitors & each dc link capacitor associated with on full bridge inverter connected in cascaded with h shape.

![Fig 3 Three phase H Bridge cascaded Multilevel Inverter](image)

Every single inverter employed a dc-interface voltage to sortan altered voltage at yield terminals. The entire yield voltage is acquired by total of every individual yield voltage is picked up by the cumulative of the separate yield voltage.

III. PROPOSED SYSTEM

Because of 2 level inverter getting higher THD. So this is the major drawback of existing framework.
IV. PROPOSED CONTROL STRATEGY

A. Control of Shunt Compensator

The control block diagram of shunt compensator is indicated in fig.4. As per synchronous reference frame theory the load side currents taken as feedback signals i_{La}, i_{Lb}, i_{Lc} are transformation in to dqo. Assumed that active component is taken as reference signal this signal known as i_{d} is passes through the moving average filter for harmonic elimination. The final signal i_{dq} is addition with i_{loss} & subtracted with i_{pv}. Here i_{cos} is getting form PV source by employing P&O MPPT algorithm. The final signal is i_{d}. The dq0 is transformation in to Currents as reference signals these reference singles pass through the hysteresis current controller. In this controller reference currents are compared with measured load currents for producing pulses. These pulses are given to the shunt controller for operating. Here to take out DC portion without dividing the dynamic execution, a MAF is applied to separate DC divider.

The exchange furthest reaches of moving commonplace filters are assumed at,

\[ MAF(s) = 1 - e^{-\frac{\omega}{T_w}} \ldots 1 \]

Where T\(_w\) are the window lengths in the moved into typical filters. T\(_w\) is timespan.

In equivalent current part owing to PV group is known as,

\[ I_{peg} = \frac{2 P_{pv}}{3 V_s} \ldots \ldots 2 \]

Where P\(_{pv}\) is the PV exhibit power & Vs is size of the PCC voltages. The references framework current set as

\[ I^{*}_{ad} = I_{d} + I_{cos} - I_{peg} \ldots \ldots 3 \]

I\(_{ad}^{*}\) changed over to abc territory reference structure streams.

B. Control of Series Compensator

The control block diagram of series controller is indicated in fig.5

V. SIMULATION RESULT

In figure.6 indicates the MATLAB/SIMULINK diagram of projected CMLI-UPQC framework. Fig.7 indicate cascaded multilevel inverter subsystem

![Fig. 4 Control Structure of Shunt Compensator](image)

![Fig. 5 Control Structure of Series Compensator](image)

![Fig.6 MATLAB/SIMULINK diagram of projected CMLI-UPQC system](image)
RESULTS(THD):

<table>
<thead>
<tr>
<th>THD VALUES</th>
<th>WITHOUT UPQC</th>
<th>WITH UPQC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAG</td>
<td>20.62%</td>
<td>14.51%</td>
</tr>
<tr>
<td>SWELL</td>
<td>14.51%</td>
<td>8.71%</td>
</tr>
<tr>
<td>LINE TO LINE</td>
<td>8.71%</td>
<td>1.36%</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>1.36%</td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION

In the proposed PV-UPQC framework multilevel inverters are used in series&shunt controllers. The series controller is connected at grid side for grid power quality i.e., voltage sag/swell. The shunt controller reduced the load current harmonics. This may located the PV unify power quality conditioner arehigh-quality resolution meant in recent circulation structure among incorporating circulated generation for enhancement of powerquality. The series&shunt controllers are regulated by synchronous reference frame theory. The simulated results are studied&verified by MATLAB/Simulink environment.

REFERENCES


