Enhancement of Voltage and Transient Stability of Photovoltaic Inverters

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Abstract. This workoffer fuzzy logic controller based PV system fed with grid. Generally large rating PV system is associated to the already existing power system it may affect the grid operations due to inconstancy in nature. In this proposed system we design our system in stable even faulty condition and voltage support for LVRT. Solar fed inverters are playing crucial role for operating our system at stable and increasing reliability and stability. This work provides a controlling strategy for PV system that get better the transient stability of a synchronous generator linked the utility. According to the study, the suggested control strategy results in some of the kinetic energy held in the SG during a temporary halt being absorbed by the dc link capacitors of the PV inverter. In addition, the proposed technology can improve voltage stability by adding reactive power to the system. The results are accessible to show how successful the planned control method.

Keywords— PV Inverters, Voltage stability, Fuzzy controller

1. Introduction

As of overdue, energy frameworks have encountered a massive growth in the entrance of RE resources, which might be usually related to the energy network thru energy converters. The increment of PV age shows some new specialized difficulties, for instance, temporary steadiness [1], which makes the interest of force frameworks below severe unsettling affects a significant issue. The preferred framework dormancy and lead consultant reaction are reduced for this new framework layout, which may additionally adversely have an impact on the temporary reaction of the rotor point of SGs. In any case, the inverters applied in PV age deliver novel open doorways, like subordinate administrations to SGs. PV converters might assist with retaining up with soundness after a framework unsettling have an impact on, for example, a brief out delivered approximately [2]. The GCs of the history twenty years did not count on the big adjustments in the electricity framework setup concerning the activity of pressure inverters. Indeed, still today, it's far difficult to appreciate and verify future conditions. Hence, over the past 10 years, GCs have anticipated the RE assets to be separated while an unsettling have an impact on is recognized [3]. This necessity is fine the period of the RE infiltration level isn't huge, which is completed to forestall the deficiency of synchronism. In any case, the GCs have modified to need FRT restriction from RE gadgets in the course of aggravations [4], and that means that the age unit must live associated with the power framework as well as, additionally, should give guide in maintaining up with synchronism and voltage solidness. A few nations have laid out ideas that require greater capacities of PV inverters utilized in disseminated age devices and from PV flora related to the intermediate voltage transmission matrix. A portion of those principles take into consideration a MC running mode or in short end transferring dynamic potential to the matrix whilst giving need to the responsive electricity backing to in addition develop voltage dependability [5][7]. A few GCs lay out APRRR for publish shortcoming interest, as need to be seen in [5-6] and [8]. In the writing, the FRT limit of PV frameworks in consistence with the GCs have been to a awesome volume researched. For instance, [9] proposes a FRT plan to help the community via infusing responsive electricity, as anticipated in the German GC [6], and that empowers the electricity first-rate to change in view of a trade off among power wave and present day sounds. In [10-11], the impact of the accompanying PV frameworks' running modes is tested: detachment from the lattice; FRT in impeding mode; and FRT with dynamic voltage help on temporary voltage dependability, on submit-shortcoming restoration and, in the long run, on brief

soundness. One more important exploration is added in which replica the LVRT restrict in PV plants in light of field take a look at outcomes completed with the aid of producers in consistence with the Chinese GC [7]. The NERC/WECC joint crew [13], prescribes acting dynamic recreations to recognize the effect of MC and put up-issue APRRR on safety. These examinations are have to be utilized, and assuming that is the case, what type of pressure have to be conveyed (dynamic or responsive) and, additionally, the association of the infused current (advantageous, poor, or 0). As of overdue, some exam endeavours have been needed to survey the effect of the MC mode on brief dependability [14]. Given the significance of creating the PV plant decidedly have an effect on the framework solidness whilst running inside the MC mode, this paper proposes a FRT manage plot in view of the retention of the dynamic strength put away within the SM's pivoting mass to assure brief soundness. The proposed manage conspire likewise in addition develops voltage solidness and its put up trouble restoration thru the conveyance of responsive electricity into the framework. While making use of the proposed plot, the SG dynamic strength yield is extended near its pre-shortcoming esteem, getting better the harmony stuck between the SG electric strength and automatic electricity, what decelerate the rotor rakish speed that, thusly, lessens the rotor factor outings and ensures temporary steadiness in the fundamental styles of the aggravation.

2. Test system Case study implementation

The proposed test system shown in figure.1 is considered for transient analysis of integrated system. The synchronous machine and PV system both are connected in parallel and they are integrated with grid by means of transmission lines.

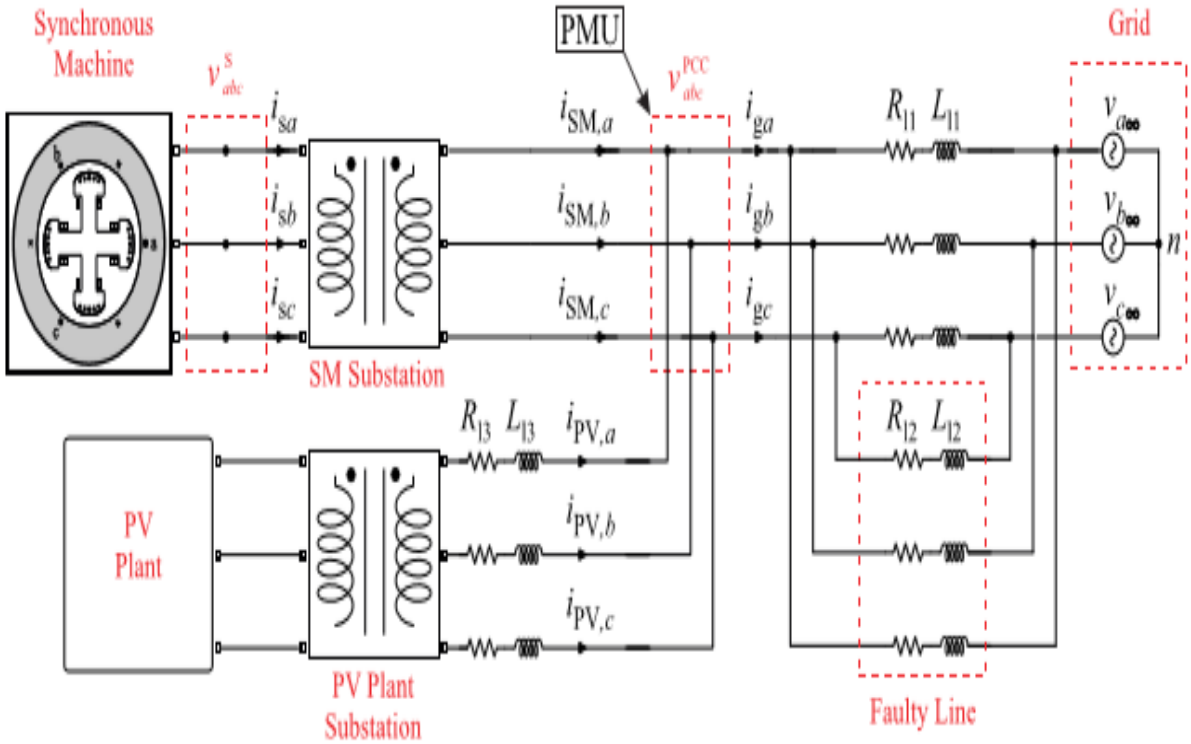

Fig.1 Proposed 3-phase power network for implementation

The PV systems have n PV system as depicted in figure.2, and are restricted by using MPPT strategy. It is known fact that the harmonics injected by the nonlinear loads are controlled by using active power filters. The synchronous machines current components control the torque and flux in the

machine by injecting and controlling the PV system. As it is known that this approach depends on the prepared limits during the fault the excess energy will not be absorbed by the grid and it was sent to PV inverters dc link for storage purpose.

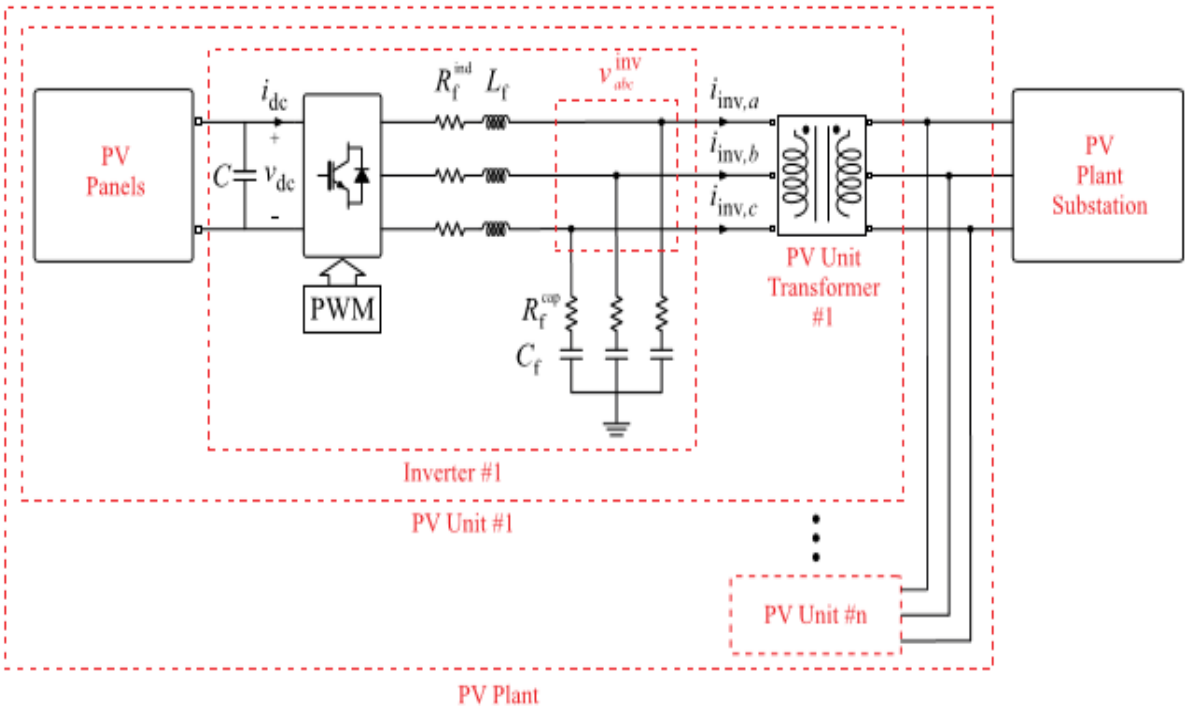

Fig.2 Model Training control

3. Proposed controller for implementation

The overall control scheme for controlling the proposed system is presented in figure.3. Under steady state operating conditions, power comes beginning the PV of is fed to the utility. The dc link controllers receive the active from dc link and regulate dc link error voltage. When the dc link error control building block is disabling, the move of power is made from grid to MC mode. In this situation, dc link receives the power and absorb the kinetic energy so by reducing the effect on synchronous machines transient stability.

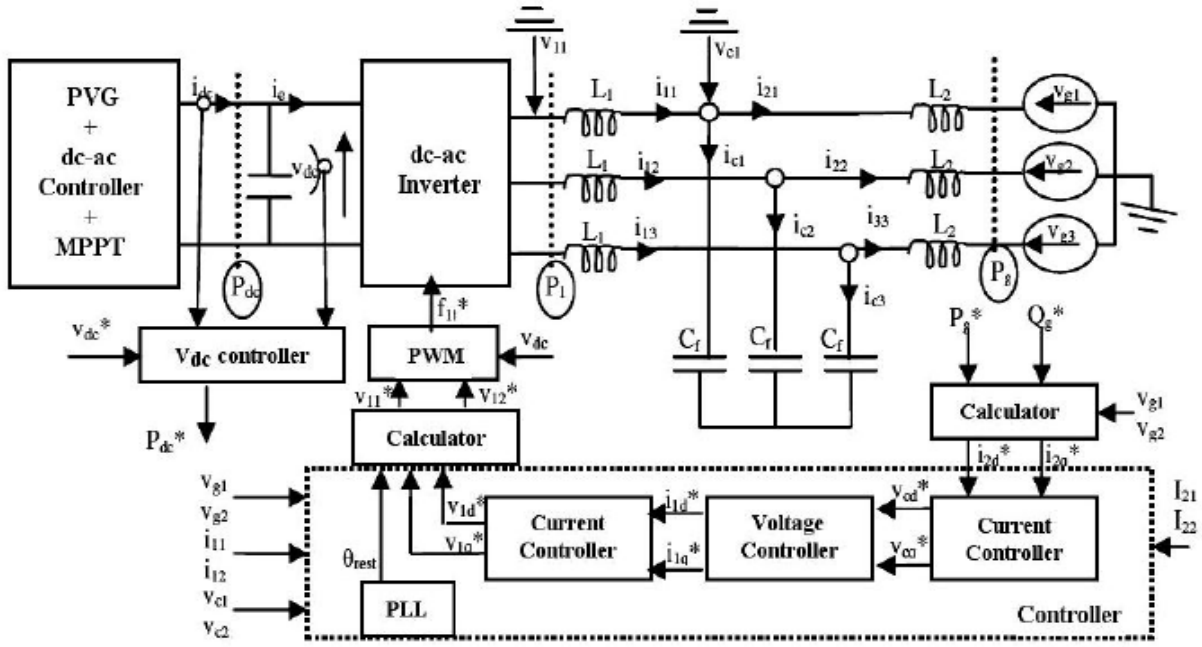

Fig.3. Proposed controller implementation

4. Simulation results

Hybrid system response synchronous machines active and reactive power are exposed in figure.4, and figure.5 shows the hybrid system response PV systems active and reactive power, figure.6, Hybrid system response PCC voltage and dc link voltage and lastly in figure.7, the hybrid system response inverters currents and synchronous machines rotor angle.

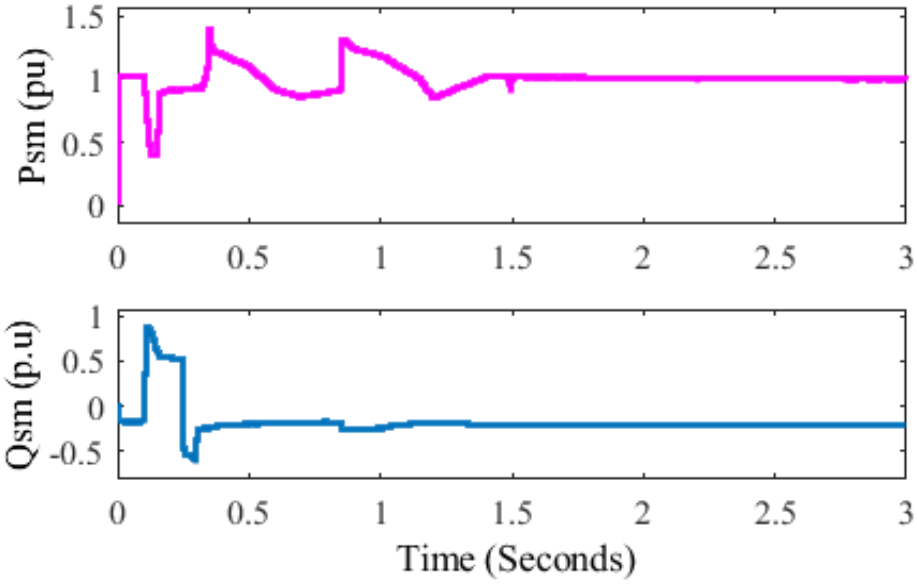

Fig.4.Hybrid system response synchronous machines active &reactive powers

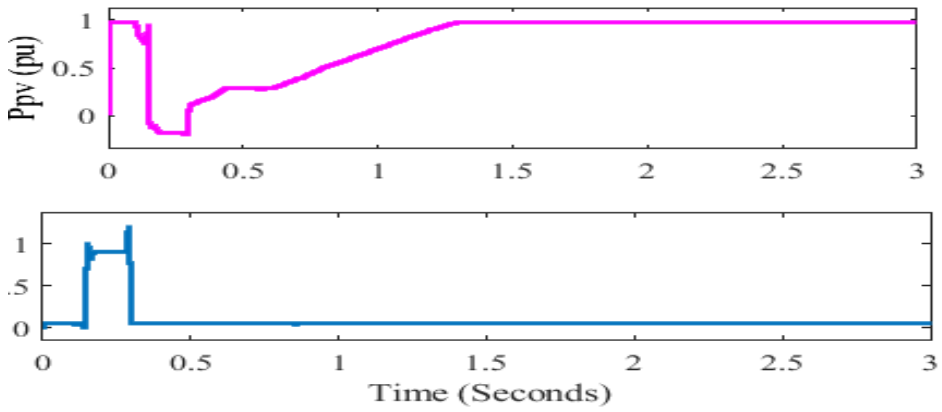

Fig.5. Hybrid system response PV systems active &reactive powers

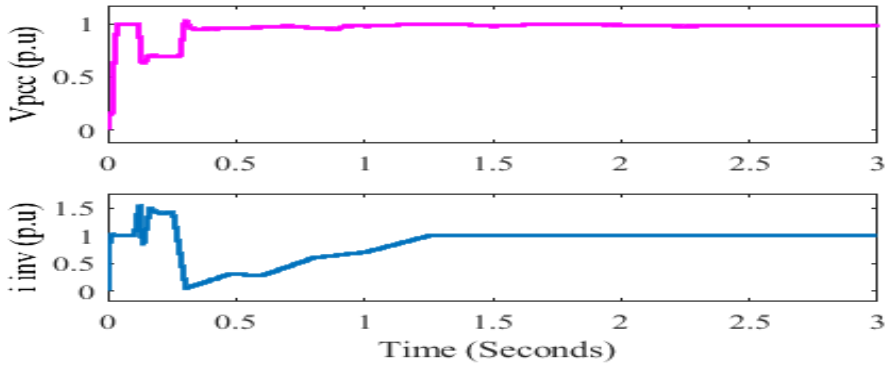

Fig.6. Hybrid system response PCC voltage and dc link voltage

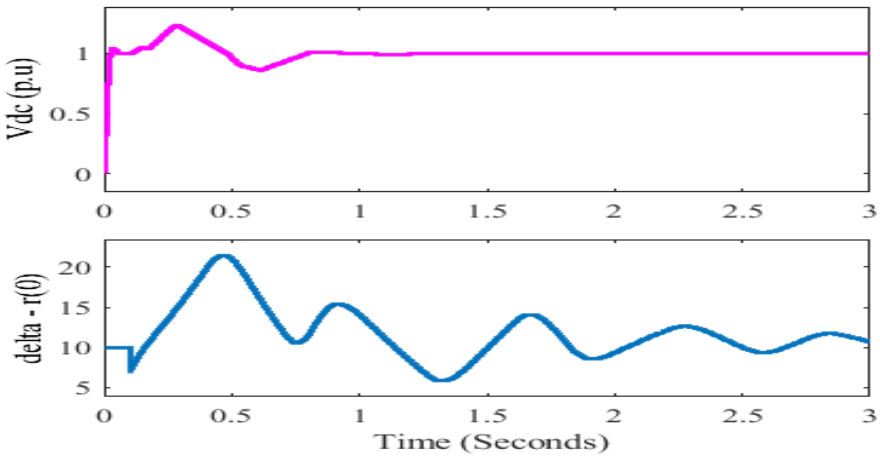

Fig.7. Hybrid system response inverters currents and synchronous machines rotor angle

Conclusion

In this project we propose fuzzy logic controller based solar power system fed with grid. Generally large rating PV system is associated to the already existing system it may affect the grid operations due to inconstancy in nature. In this proposed system we design our system in stable even faulty condition and voltage support for LVRT. Solar fed inverters are playing crucial role for operating our system at stable and increasing reliability and stability. The dc link capacitors engage the SG kinetic energy as part of the suggested control mechanism to achieve transient stability. Additionally, it enables the addition of reactive electricity to the grid, assisting in the maintenance of voltage stability. Results reveal that by decreasing rotor angle oscillations during the first few cycles of the failure, the recommended control technique effectively ensures the SM's transient stability.

References

[1]. Neves. F. A. S and Santos, V. S. "Unbalanced grid fault ride-through control for single stage photovoltaic inverters," IEEE Transaction of. Power Electronics., vol. 31, pp. 3338-3347, April. 2016.

[2]. Lammert. L. D. P. and Premm. Ospina "Control of photovoltaic systems for enhanced short-term voltage stability and recovery," IEEE Trans. Energy Convers., vol. 34, no. 1, pp. 243254, Mar. 2019.

[3]. Raja Reddy. Duvvuru , A.V. Sudhakara Reddy "Power Quality Improvement in Integrated System using Inductive UPQC", International Journal of Renewable Energy Research, 2021,Vol-11(2), pp. 566–576.

[4]. Mirhosseini.V. G. and Agelidis. M, "Single and two stage inverter-based grid-connected photovoltaic power plants with ride-through capability under grid faults," IEEE Trans. Sustain. Energy, vol. 6, no. 3, pp. 11501159, Jul. 2015.

[5]. Raja Reddy. Duvvuru, Ch. Rami Reddy " Harmonic Compensation in Integrated System using Inductive UPQC" Recent Advances in Power Systems, LNEE, 2022, pp.365-380.

[6]. Raja Reddy. Duvvuru, A.V. Sudhakara Reddy, N.Rajeswaran, "Application of modified ALO to economic load dispatch for coal fired stations" International journal of innovative technology and engineering (IJRTE), Volume-8,Issue-2,pp:2147-2152,July-2019.

[7]. Raja Reddy. Duvvuru and Rajesh Reddy. Duvvuru "DESIGN OF TRANSFORMER LESS UPFC BASED ON MULTI LEVEL INVERTER" International Journal of Electrical Engineering and Technology (IJEET), Volume 11, Issue 4, June 2020, pp. 122-134.

[8]. Lee. B.N "Determining capacity limit of inverter based on distributed generators in high-generation areas considering transient and frequency stability," IEEE Access, vol. 8, pp. 3407134079, Feb. 2020.

[9]. Raja Reddy. Duvvuru, N.Rajeswaran, T.Sanjeeva Rao"Performance of distributed power flow controller in transmission system based on fuzzy logic controller" International journal of innovative technology and engineering (IJRTE), Volume-8, Issue-3, pp:2039-2043.