Flexible Micro-Grid Operation in Distributed Generation Using PID Controller

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Abstract - This paper presents an distributed generation(DG) interface for flexible micro-grid operation using PID controller. In the smart distribution system .DG units included in the system operation and also improve the system reliability by providing backup generation provided in isolated mode ,also voltage support in the system and reactive power control in the grid connected mode. This method always meets the load demand and improves the reliability. The micro-grid has been proposed that one solution to the reliability issue. Smart distribution system is used to supervisory control system to control all the operation. PID controller is used to maintain the stability of the system. A general low voltage distribution system has different number of DG units and different number of load connected to the main feeder. The DG units always connected parallel to the utility grid, the isolated mode main breaker is open condition and connected mode main breaker is closed. The proposed operation control system it is flexible, in grid connected mode active and reactive power maintain constant. Micro-grid system the voltage maintain in autonomous mode method, reduce voltage distortion under heavily nonlinear condition. Evaluation results are presented to demonstrate the flexibility, high efficient and also effective of the proposed controller.

Index Terms-Distribution generation, micro-grids, smart distribution systems, PID.

I. INTRODUCTION

Distributed generation units are a major objective in the future smart power grid [1-4]. The DG units are interfaced to grid/load via power electronic converters, current controlled voltage sourced inverters are commonly used for grid connection [3]. The interactive generation system are used to meet the load demand, supervisory control are used to control all the operation within the system [4].During operating condition time the nonlinear load is applied the voltage occur and also voltage disturbance occurs, using the DG and reactive power to reduce the voltage disturbance. The DG always connected parallel to the utility grid. The main breaker is opened in the isolated mode and also gives the protection to the sensitive load. During the isolated mode robust control performance under islanding delays, also in the grid connected mode the active and reactive power maintain constant within the system. PID controller is used to control the real and reactive power within the limit and also improve the stability of the system. Interactive DG interface for flexible micro-grid operation in smart distribution system [5].Micro-grid applications become more attractive in modern power systems. Micro sources of electric energy in a micro-grid can include wind, photovoltaic, fuel Cells[6], combined heat power systems, and micro-turbines Energy demand in India as well as in many countries across the world is ever increasing and expected to grow in future. If the Indian power scenario is viewed, although India's power sector has shown impressive growth over the last few years, the power demand has increased more rapidly than the power availability. The proposed control scheme utilizes a fixed hierarchical power-voltage-current control structure used different modes of operation, only the magnitude of the reference voltage vector is taken to the variation , to minimise the internal disturbances. The overall cost of energy in the micro-grid can be minimized by designing a scheme with appropriate DG resources along with suitable control strategies. In fact, in a micro-grid, oscillating active power may appear due to variations in the load consumption or fluctuation in the renewable energy sources generation presents a long published report on the frequency variation range of the wind speed and that most micro-grids have tensional torque oscillation that should be damped to avoid frequency variation[7].A micro-grid is a controllable small-scale power system comprised of distributed generation sources (DGSs), storage devices, controllers, and loads. It can be applied to remote locations to supply electricity to customers, or implemented in utility power systems to increase their reliability [8]. These days, the concept of micro-grids is popular in utilities and with customers. The power grid is moving away from the current centralized power generation, the smart grid, consisting of control the complexity of the future power grid, needs to be able to deal with unpredictable, distributed power generation and consumption. Typical issues of the future power grid are voltage and frequency instabilities as a result of local power generation, power security issues resulting from bidirectional energy flows and less predictable demand supply matching given the nature of renewable energy sources and the flexibility of loads that are shifted in time. A control plane is required that ensures[9].

II. SYSTEM CONFIGURATION

System configuration as above the fig 1 shows the micro-grid system under study method as above, we used from the IEEE 1559 standard for low voltage applications, we adopted low voltage distribution system in above figure. The DG units always connected parallel to the utility grid, the capacitor bank 2.5 Kvar and inductive load 8 KVA 0.95 PF connected to the main feeder for the purpose of reduce the problem in the power system. The configuration as shown above figure, if any fault occurs in the power system the main breaker open.And serve the protection to the sensitive load, in the isolated mode robust control performance under islanding detection delay, under grid connected mode the main breaker closed and connected to the utility grid and maintain active and reactive power in the system. Supervisory control used to control all the operation process of the system, as above figure in micro-grid system we used two DG units, PID are used to control the active and reactive power in a system.

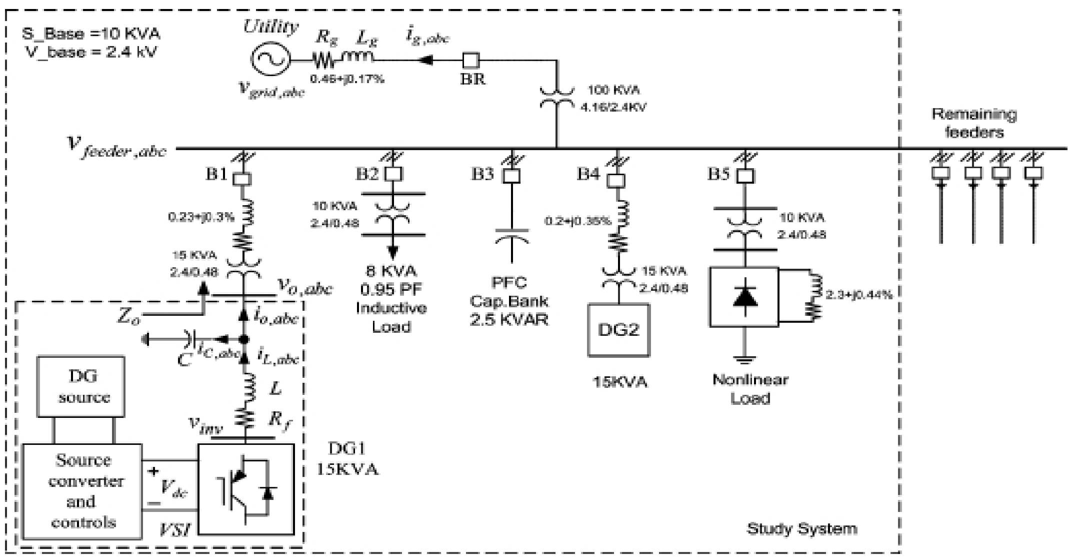

Fig.1 Single line diagram of the micro-grid system

III POWER FLOW PROPOSED CONTROL SCHEME

We used hierarchical approach design provides flexible operation of the DG unit in the grid connected mode, to minimise the control switching action between grid connected and isolated mode, a single active power control controller used in both the mode, in the grid connected mode the phase angle of the grid is generated via a three phase phase-locked loop. In fig availability, efficiency and low emissions[10].are shifted in time. A control plane is required that ensures availability, efficiency and low emissions[11].the power factor (PF) should be one; in stand-alone mode, the output voltage should be controlled to have a pure sine wave. Therefore, an LC filter should be used to obtain good waveform quality of the output voltage [12].Evaluation results the effectiveness of the proposed control scheme.

Fig. 2 the proposed control scheme as shown using PID controller to maintain constant real and reactive power, this controller system connect either grid connected or isolated mode. If any problem appear in the grid or in the power system the grid is blocked, that time keep in isolated mode and also normal condition connect grid connected mode and also maintain a constant active and reactive power in the system. Internal model based hierarchical voltage control, control the voltage within the limit, the proposed real power controller can be used both in grid connected and isolating modes, even if it is required to have different slope at different modes, in fig. 2. In the grid connected mode the phase angle of the grid w*t is generated via a dq three phase phase-locked loop, a resonant filter tuned at a fundamental grid frequency is used along the phase-locked loop to make it more robust in the presence of voltage harmonics or unbalances, in islanded operation the processor internal clock is used to generate the signal w* is assumed to be 120pie, as above fig. 2.

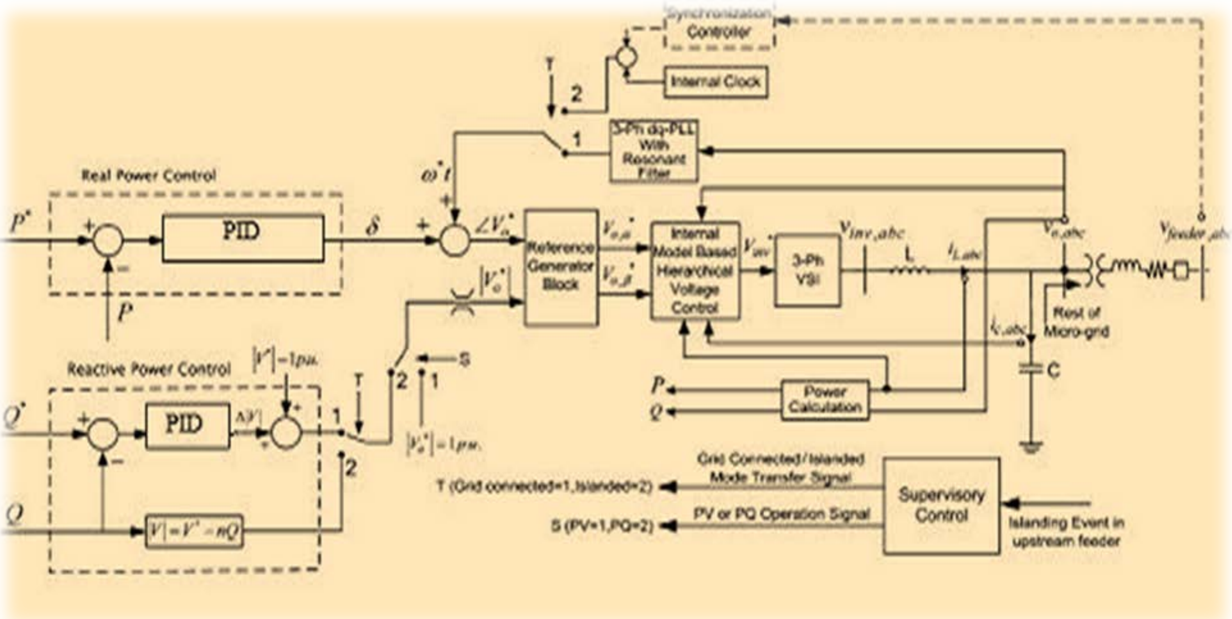

Fig 2. Proposed control scheme.

IV RESULTS AND DISCUSSION

To evaluate the performance of the proposed control scheme in fig.1 is implemented for time domain simulation under the simulink.We used two DG unit connected parallel to the utility grid or in isolated mode. The DG unit to support the grid in different mode, different mode tested, the results as follows.

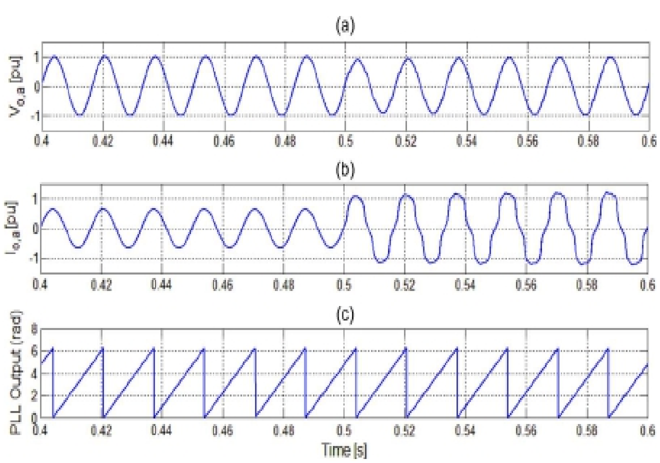

Fig. 3.Dynamic response of the system to an active power command step change in grid connected mode and PQ operation.(a)Converter active power.(b)Converter reactive power.(c)Output voltage phase-a output voltage.

a) GRID CONNECTED MODE:

Fig. 3 as shown above, the DG unit control PQ in the system, the capacitor bank and inductive load connected to the main feeder. As shown fig the real power is set to zero and active power step changes at the time t=1s. The fig (a),(b) the real and reactive power generated by the DG unit,the output voltage changes to maintain unity power factor to injection of the active power as shown in fig (d).The DG units contribute the voltage reliability of the common point. The voltage sag occur that time generate reactive power and maintain a constant voltage and also DG units used support the voltage continuously to the system

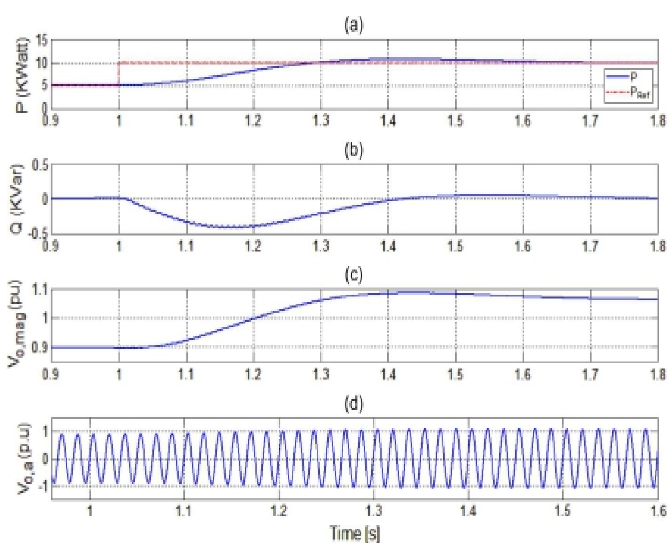

Fig.4.Dynamic response of the system when the nonlinear load in grid connected mode.(a)Phase-a output vpltage.(b)Phase-a load current.(c)PLL output

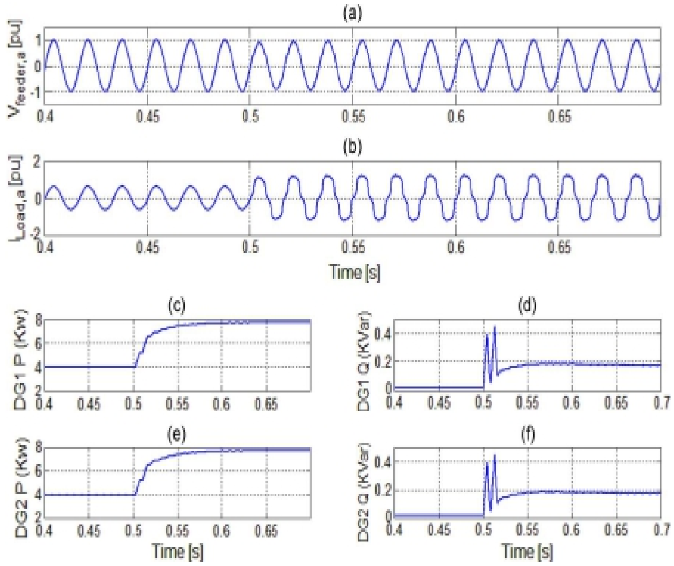

Fig. 5.Dynamic response of the system when the nonlinear load is added in islanded mode.(a)Instantaneous phase-a output voltage.(b)Phase-a load current instantaneous phase-a grid current.(c),(d)Active and reactive converter power for DG1.(e),(f)Active and reactive converter power for DG2.

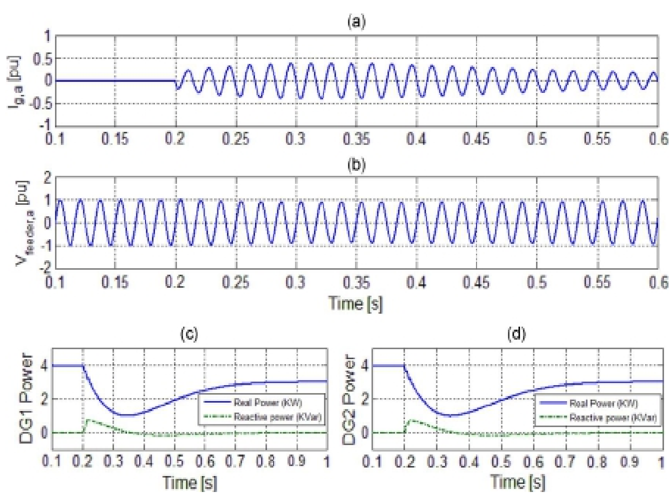

Fig. 6.Dynamic response of the two DG micro-grid system when reconnecting to the utility as PQ buses. (a) Instantaneous phase a grid current b) Instantaneous phase a output voltage (c), (d) Active and reactive converter power for each DG unit.

b) ISOLATED MODE:

The performance of the study system using a proposed control scheme change from grid connected mode to isolated mode by using breaker switch, the breaker switch opening in fig. 1.the micro grid connected to the grid system, both DG working in PV mode, The Smart distr-ibution system are used to communicate and detect the islanding mode. As shown in fig. 5. In the isolated mode the nonlinear load applied the distorted current going through the load. The total harmonic distortion of the load voltages is 2.7%.active and reactive power profiles of the both DG units as shown in fig.5(c-f). As shown Fig. 6.the restoration the utility grid the DG operate in the PQ mode, the proposed control used to control internal and external disturbance within the system

V. CONCLUSION

DG interface for flexible micro-grid operation in the smart distribution system using PID controller. We using proposed control system utilize power-voltage-current and also rejection of disturbance. Using smart grid to reduce amount of losses, disturbance and also improve the reliability of the system. Using the micro grid supply the power continuously in a remote area Using autonomous mode, under the isolated mode the DG operated PV mode and grid connected the DG operated PQ mode. We are using this method, because, it is simple, flexible operation DG system, especially in my project. I am using a PID controller, for this controller used to maintain the stability of whole system and also reduce the peak over voltage. My project has more advantages and future applications, we using this project improve the efficiency, reliability and maximum utilise the renewable energy sources

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