Implementation of Loop Power Controllers Using Photovoltaic Based Balancing Distribution

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Abstract: For effective operation of distribution system , balanced loading on distribution feeders is very important. It mitigates power flow overloading and reduces power losses. In this paper, LOOP POWER CONTROLLER(LPC) is proposed to provide balanced loading on distribution feeders .To incorporate fuel cell power generation in feeder loading balance, a Tai power distribution feeder with large fuel cell is selected for computer simulation. Daily loading unbalance is determined by analyzing fuel cell power generation recorded by the SCADA system and by constructing daily power load profiles based on distribution automation system (DAS) data. The load transfer required to achieve loading balance and the line impedance of distribution feeders are used to derive the voltage ratio and phase shift of the LPC. Compute simulations indicated that loading balance can be achieved in distribution feeders with fuel cell system by using loop power controllers according to the variation of solar energy and power loading of study feeders.

Keywords: Distribution automation system, loop power controller, fuel cell

I. INTRODUCTION

The use of renewable vitality assets, for example, sunbased vitality, wind vitality and fuel vitality turn outto be more prevalent and are progressively coordinated in force framework operation in light of expanding interest for power, furthermore to diminish CO2 discharges from traditional force producing plants. Presently a days, sun based vitality based Photovoltaic force era assumes an essential part inforce era. Traditional force stations required toexchange control over long separations where as these PV frameworks are found near the heap they serve .So in future there will be a ton of appropriated generations (DG).But this discontinuous force era will impact framework operation. So it gets to be hard to keep up an appropriate voltage range[1]-[3].

Adjusted stacking on dissemination feeders is vital asit diminishes over-burdening issue further more misfortunes. In summer use of ventilation systems turns out to be all the more so over-burdening is such happens on a few feeders. so on the off chance that we give adjusted shifting so as to stack on feeders load from intensely stacked feeders to gently stacked feeder over-burdening issue will get decreased so misfortunes will likewise get lessened.

Photovoltaic is the innovation and examination the gadgets which have been specifically change over day light into power with semiconductors that demonstrate the photovoltaic impact. Photovoltaic impact that production of voltage in a material presentation to electromagnetic radiation. The sunlight based cell is the essential piece of the photovoltaic. Furthermore, it is made of semiconductor gadgets, for example, silicon. The property of semiconductors with has been helpful in conductivity it has been basically changed by embedding the precious stone grid. For time been, the creation of a photovoltaic sunlight based cell, silicon,which has the four valence electrons, it add to its conductivity. In favor of the cell, the polluting influence, which has the phosphorus particles with five valence electrons contribute feebly bound valence electrons to the silicon material, produceabundance negative charge. Particles with have been boron with three valence electrons produce a more note worthy partiality than silicon to draw electrons[6]. Since the p-sort silicon is in open contact with then-sort silicon a p-n association is perceived and adissemination of electrons happens from the locale ofsubstantial electron mindfulness into the area of low electron retention. At the point when the electrons diffuse over the p-n association, they recombine with openings on the p-sort. As, the dissemination of transporter not happen for an uncertain time, in light of the fact that the variety of charge immediately on either sides of the intersection begin an electric field.This electric field which has been structures a diode that permits the current to stream in single heading. l.In this way we produces electrical current is concentrate once the circuit is shut on an outerburden.

.BACKGROUND WORKS

Basic concept of LPC we propose is asfollows

(a)To open free access to the distributedpowersupply.

(b) To respond flexibly for imbalance load between feeders, and makes effective use of distribution systems.

(c) Loop distribution system is provided with out alteringexisting systems such as the protection system, except for loop points.

Lpc is able to take optimal control for distribution systems in the points of reducing voltage rise,voltage fluctuation and power flow control, and so

A.Circit Model Of LPC:

Fig.1shows circuit model of LPC by considering branch impedance of distribution feeders and phase shifter to derive voltage ratio and phase shift needs to be provided .

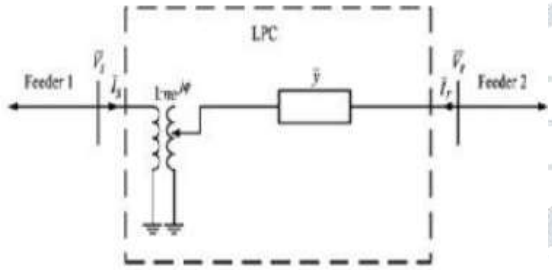


Fig 1:Circuit model of LPC

A modified equivalent circuit of LPC with dependent current source is shownin Fig.3 to simplify the process. Here, the dependent current sources are revised accordingto the adjustments of turn ratio and phase shift during the iteration process.To derive the injection currents due to the changeof voltage ratio and phase shift,those effects are taken individually .

(i)To consider effect of voltage ratio on injected current phase shift is taken as zero

(ii)To consider effect of phase shift on injected current ,volage ratio is taken as 1.

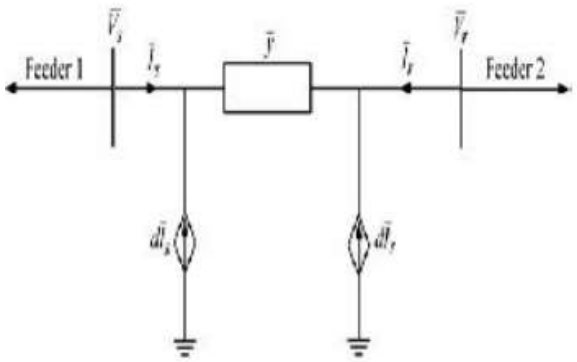


Fig. 2.Modified equivalent circuit of LPC.

Fig. 3 demonstrates the normal procedure to decide the Loop power controller to control calculation to enhance adjusting the heap of conveyance feeders. In this we have been study, the Loop power controller is consider as the gathering of tap changer and stage shifter with a circuit in Fig. 4. By change the voltage proportion and stage shift associating both sides of the Loop power controller to the branch impedance and stacking unbalance of circulation feeders, to accomplish the dynamic and responsive force change through the Loop power controller can be confined to accomplish the adjusting the heap [6]. The comparing circuit model can be speaking to as a model transformer with turn proportion of 1:nejø and an arrangement permission y. The scientific model of Loop force controller as show in mathematical statement in (1) to demonstrate the association between the hub including streams and voltages

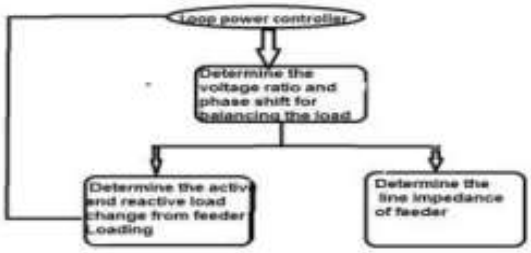


Fig. 3 Algorithm flow chart of loop power control

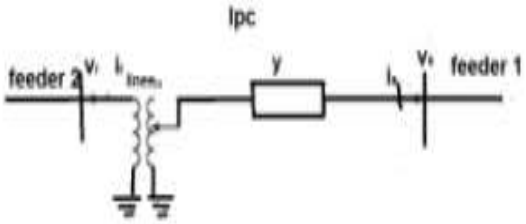


Fig. 4 loop power controller model

To changed the recipe to accomplish the voltage proportion and stage movement of Loop force controller [5]. Along these lines we have wanted to change comparing circuit with destitute on streams source and as appeared in Fig. 5. Here, the poor current sources are rehashed by change of turn proportion and stage shift amid the cycle technique.To decide the adding streams because of the changing of voltage proportion by Loop power controller the hub ebbs and flows are appeared by thinking of it aszero stage shifts as takes after.

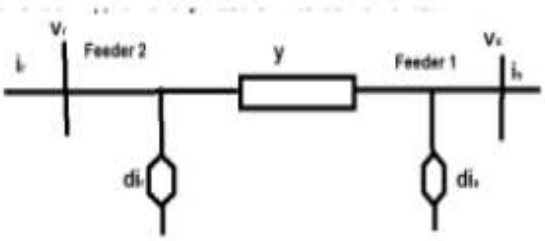


Fig. 5 Equivalent circuit model of loop powercontroller

By this way, the framework impedance lattice stays steady amid the emphasis technique to decide the voltage proportion and stage movement of Loop force controller. To exhibit the arranged control calculation for Loop power controller to achieve feeder adjustingthe heap, let as accept the two specimen out spread feeders connected with a Loop power controller.

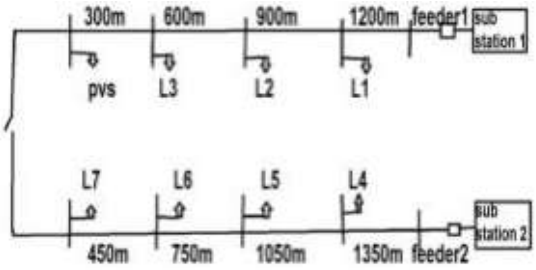


Fig. 6 distribution feeders of tai power is used inmat lab simulation

II. CASE STUDY OF TAI POWER DISTRIBUTION SYSTEM

A large fuel cell system with 8844 pieces has been installed with total capacity of 1027 kWP. Feeder MF65 is supplied by Bei-Ying substation to serve Kaohsiung Stadium and other low-voltage customers. The feeder is connected to Feeder MU67 with an open line switch so that the load transfer can be executed for service restoration during fault emergency. With such a fuel cell system being installed, it is expected that total annual fuel cell electricity energy of 1.37 GWH can be generated [17]. Fig. 7 shows the one-line diagram of the power system in the stadium. There are 179 units of DC/AC inverters which are used to convert the fuel cell generation to 380 Vac. Besides serving the local loads in the stadium, the surplus power generated by the fuel cell system is also sold to Taipower system.

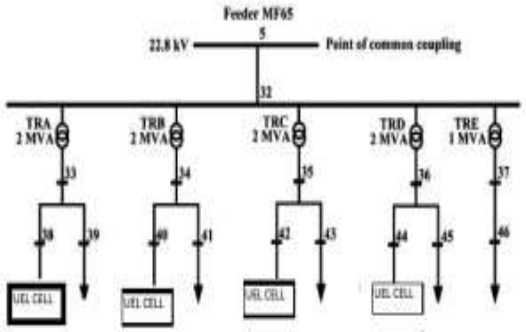
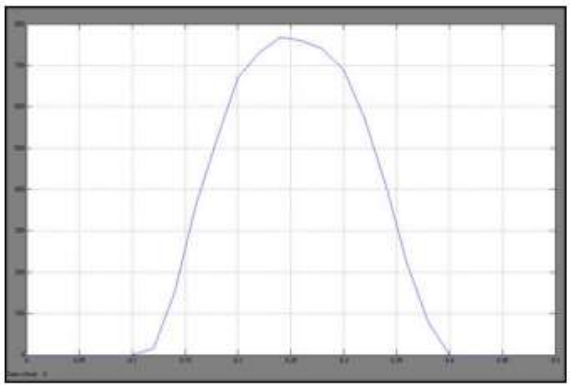


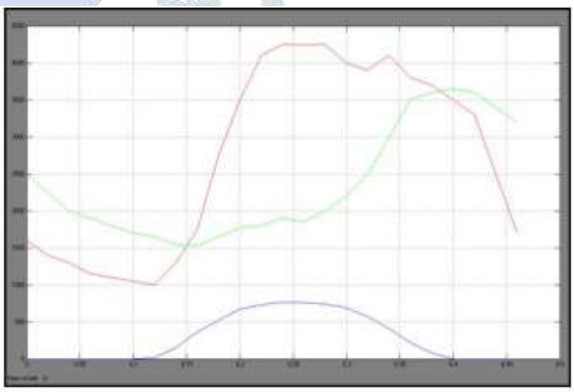
Fig. 7. One-line diagram of Kaohsiung MainStadium.

III. SIMULATION RESULTS



Fig·8· Actual fuel cell power generation of Kaohsiung Stadium (June 30, 2009)·

The daily power generation of the study fuel cell system has been recorded by the SCADA system as shown in Fig· 8· It is found that the fuel cell power generation is increased with solar irradiation· Themaximum power generation was 768 kWh at 12 PM,and the total harvesting energy of 6702 kWh has been obtained for June 30, 2009·



Fig· 9 shows the reduction of real power loading ofFeeder MF65 during daytime period after integrating fuel cell power generation in the distribution system·

A· Loading Balance of Distribution Feeder by aLoop Power Controller

With the variation of customer loading profiles and the intermittent generation of fuel cell systems, an adaptive LPC control algorithm is

derived to adjustthe voltage ratio and phase shift between both feeders
according to the feeder loading and fuel cell generation for each study hour. To illustrate the effectiveness of LPC for system loading balance, an LPC is assumed to be installed to replace the open-tie
switch between Feeders MF65 and MU67.

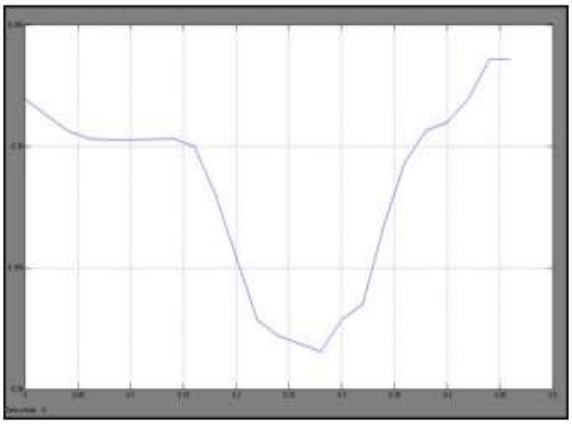


Fig. 10(a). Voltage ratio with the control of LPC (with fuel cell system).

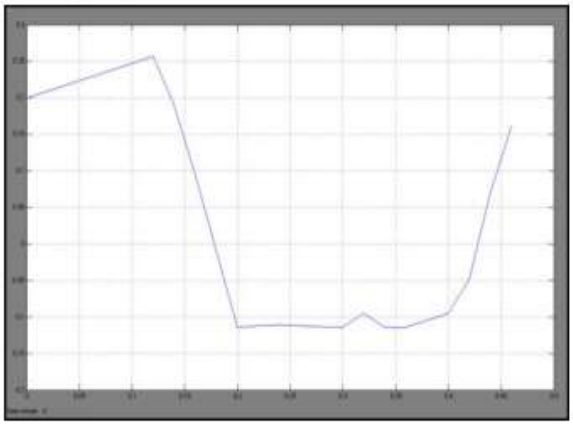


Fig. 10(b). Phase shift with the control of LPC (with
fuel cell system)

To achieve the loading balance, the voltage ratio and
phase shift by LPC have to be revised as shown in Fig.10 according to the variation of PV power generation.The fuel cell system does not generate reactive power. However, the phase shift of LPC required forreal power balancing is increased during the day time period when the real power generated by the fuel cell system is injected. For instance, a larger phase shift of is applied for real power transfer of 897 kWfrom MU67 to MF65 at 3 PM. With the control of LPC, the loading balance of test feeders by including the fuel cell power generation has been obtained as shown in Fig. 11. By comparing to Fig. 9, the mismatches of real power and reactive power loadings between Feeder MF 65 and Feeder MU 67at 3 PM are reduced from 2574kW/1727 kVAR to 191kW/79 kVAR after loading balance.

IV. CONCLUSION

The voltage ratio and phase shift adjusted by LPC are derived according to mismatches of real power and reactive power loadings between test feeders for each study hour. To demonstrate the effectiveness of LPC for the enhancement of loading balance, a Tai power distribution system consisting of two feeders with a fuel cell system has been selected for computer simulation. The power loadings of the study feeders and the fuel cell power generation have been recorded. By applying the control algorithm of LPC to adjust the voltage ratio and phase shift between both feeders, the proper amount of real power and reactive power can be transferred from the heavily loading feeder to the lightly loading feeder for each study hour. According to the computer simulation, itis concluded that the loading balance of distribution systems with intermittent fuel cell power generationcan be obtained effectively by the implementation of LPC to achieve adaptive control of load transfer between distribution feeders.

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