

# A Review Paper on Single Area and Two Area Interconnected Power System using Pid Controller in Load Frequency Control

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**Abstract:-** The main frequency control objective is that to regulate the load of receiving, generating and distributing end within generator via interconnected system. It is stimulated through MATLAB. In this we use time domain simulations to prove the scalability in 3 area interconnected Also to control the performance of two and three area network with or without deregulated power system. The main idea to minimize the oscillations throughout the load.[1] To compensate this power imbalance, an external Battery system is incorporated. Oscillations due to large frequency can be damped by devices such as Battery systems and load disturbances also. The sudden changes in power devices calm down by battery . This review paper presents the qualitative and quantitative comparison of controllers in a conventional way and Battery system in LFC to a typical interconnected power system. The versatility of the performance of BES over conventional controllers is highlighted.[2]

**Keywords:-** Battery energy storage (BES), Load Frequency Control (LFC), Proportional Integrator Derivative (PID), SINGLE/TWO AREA NETWORK.

## I. INTRODUCTION

Every power system needs to transport the electricity to houses and factories in efficient manner, but probably due to certain circumstances it is not possible to transfer the ideal power. The two major [3] frequency : as we know in the system depends on active and reactive power both . voltage and frequency are two independent quantities one react to active another react to reactive . so, we have to manage them independently . To figure the problems in frequency we used to call it Load Frequency Control(LFC). And to figure out the problem in voltage we used to call it Automatic Regulation Power(AVR)[3].

Due to the fast growing industry power grids highlights their role in power grid for future . Battery system can provide better response than any other . The power system load frequency control (LFC) problems are caused by small load perturbations which continuously disturb the normal operation of power system. Small perturbations by load caused by LFC which disturbs the normal operations of power system. BES also used for control error [4]. Therefore, the

generation rate must be changed until their acceptable limits which maintained the frequency and tie line . Mechanical input of generator controls the output power. Load distribution problem is a major problem in any area disturbs if it disturbs the frequency . Fluctuations in the real output and input occurs through the variation of load and demand . On a generating unit rotating parts stores high difference in energy. Frequency deviations occurs when the kinetic energy decreases tend to manipulate the speed . This whole process runs by governor tends to nullified the change in frequency. Different controller were there in the market for LFC . Redox flow batteries, SMES unit is one of the best examples . RFB units in operation has been on the increase demand because of its advantages . The whole process is performed in MATLAB SIMULINK, graph reading and understanding the core need of interconnected single and two area network for power system. Complex problems solved by this swarm intelligence algorithm in an optimization system which applied in two and single area network.[5]

## II. BATTERY ENERGY STORAGE

Due to sudden changes in power system energy units are used as damping of oscillations .It also improves the dynamic behavior of the two / three area network . Battery system are rechargeable used to provide energy to homes and business are generated by power grids or solar arrays. In two area and single area there secondary control with load frequency control is an important control function which regulates the frequency and tie line in different areas. [6] Real and output power momentarily occurred the unbalance in variation demand of the load in the generating unit .[6] Reducing peak values of tie line and frequency can be done by BES . Steady state time error value in the control system accumulates the advert interchanges . Active power can be compensate by BES , improves the performance of LFC . Reliability of supply in peak . Also the BES maintains leveling factor , with black start capability . [7] BES system provides load operation in discharging mode and off peak hours during charging mode . By this discharging mode technique only 1% step load disturbance in different areas which maintains Area Control Error . BES system reduces considerable amount of peak deviations . Energy storage can be used in the conversion of electrical energy into a form in which it is converted back when required in electrical energy.

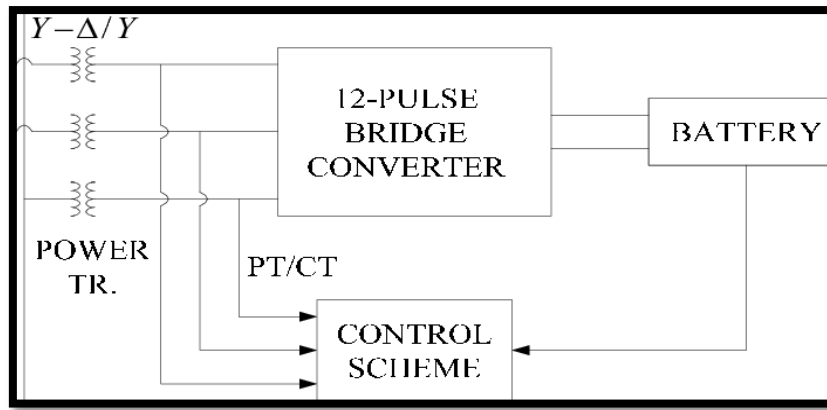


Fig. 1: USING BATTERY CONTROL

$E_{do} = E_{do1} - E_{do2}$  To get the desired instantaneous power variation demand controllers should be capable of responding rates of generators takes much time to respond. Therefore, BES supply the power within less possible time ,it can compensate the dynamic nature of the system . BES provides benefits like peak control, reserve of spinning , regulation of area and most importantly power quality with black start capability.[8]

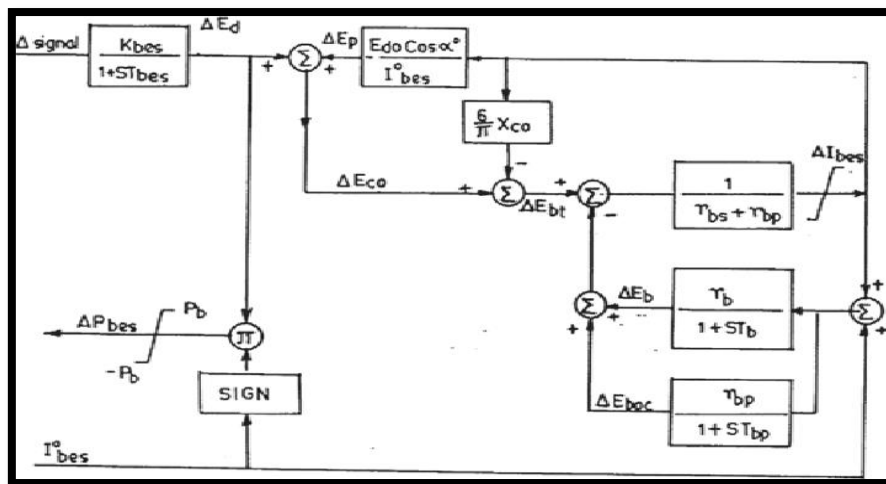


Fig. 2: BES SYSTEM

$E_{bt}$  represents the terminal voltage.

$E_{do} = E_{bt} \cos \alpha - R_c I_{(bes)}$  battery over voltage is  $E_b$ ;  $r_{bt}$  is connected to resistance;  $r_{bs}$  denotes to internal resistance; we can say  $\alpha$  is firing angle;  $I_{bes}$  is the current travelling into battery;  $X_{co}$  is depicted as reactance;  $r_b$  denotes overvoltage resistance;  $c_b$  denotes highvoltage and capacitance;  $r_{bp}$  is an selfdischarge ;  $c_{bp}$  is capacitance to battery; Without overlap voltage we use  $D_{co}$  as  $D_p$ . [9]

### III. PID CONTROLLER

In industrial control system PID controller is used. It includes three separate constant parameters sometimes which are called three term control the proportional , the integral and derivative values denoted by PI and D.

PID Controller is used to measure temperature level pressure regulate. Flow and many other Industrial variable. In today time the use of PID Controller in Industrial Automation increased a lot. The PID Controller combines three controller to form a single controller. [10]

- 1)Proportion :-Improve to rise time .2)Integral :-Reduce the steady state.3)Derivative :-Reduce the overshoot.

PID controller works on closed loop control system, we also call feedback loop control system. [11]

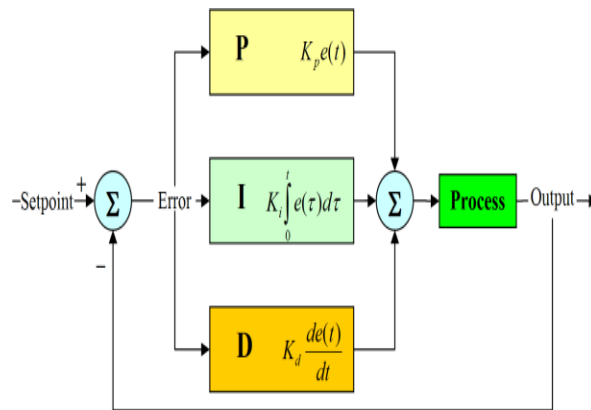


Fig. 3: Pid Controller

**IV. SINGLE AREA NETWORK**

LFC (Single Area)-: Single area power system is mainly made up of a governor, generator, turbine. It also has a step load change input to the generator. It is the same as the controller unit of a single area power system. [12]

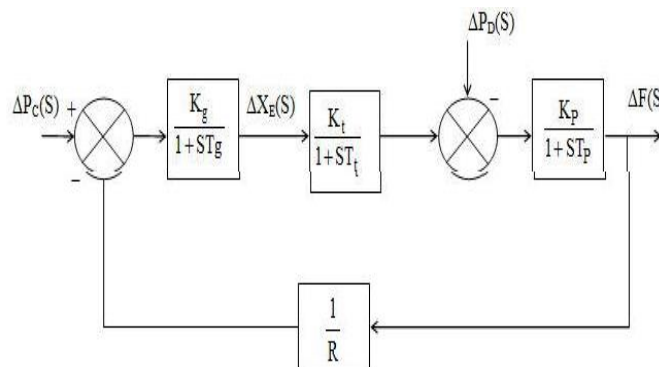


Fig. 4: Single Area Network

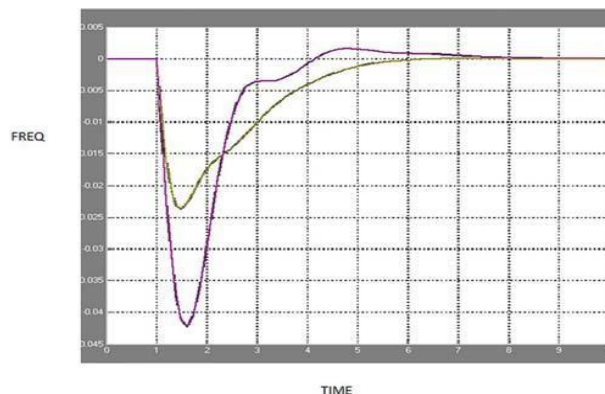


Fig. 5: Single Area Network Graph

**V. TWO AREA NETWORK**

Interconnected by means of tie lines now within loss of generating considered to be the two area system connected by a single line. The zero state error is acquired by frequency and proportional integral. Equivalent generator, governor and turbine system combined form control area of power

system.  $(\Delta P_G - \Delta P_D)$  this is the incremental power by the rise of  $K > E >$  stored. Controllers provides a better performance. [13] BES used load frequency for single area with the help of these controllers. Power balance equation helped in reducing battery system. Each area frequency regulation stimulate the tie line power which contracts accordingly. [14]

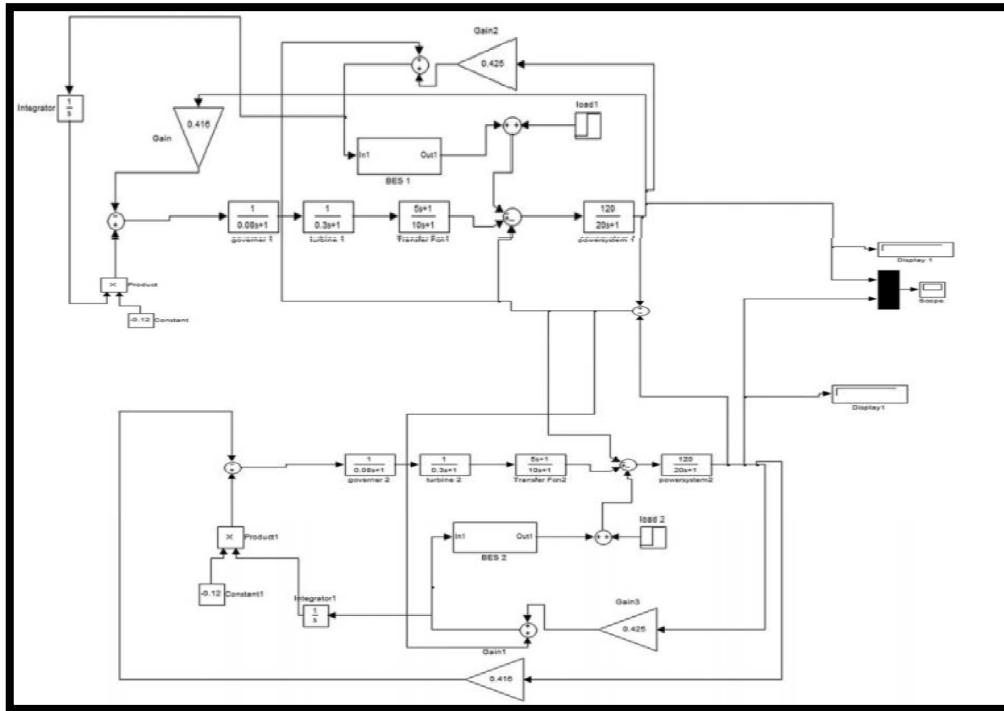


Fig. 6: Two Area Network[1]

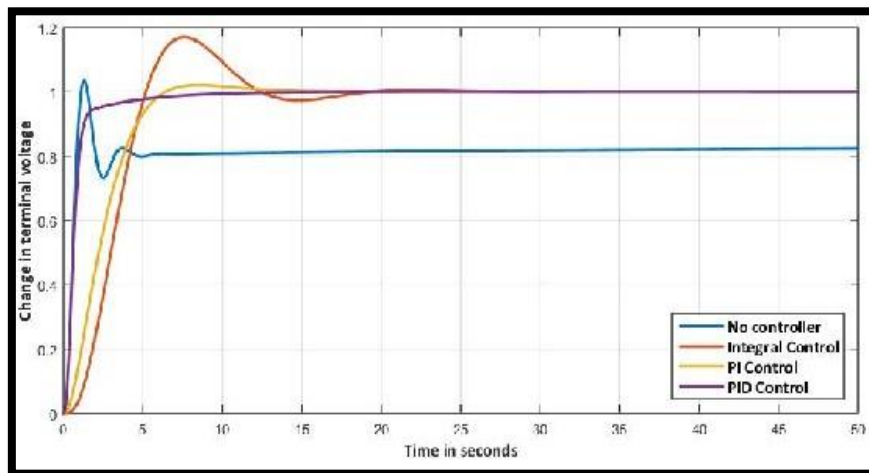


Fig. 7: TWO AREA GRAPH

**VI. AREA CONTROL ERROR (ACE)**

Area Integrator and frequency sensor composed of integral controller. The error in the frequency measures by frequency sensor and after testing fed to integrator. The value which passed on to the integrator called as area control error . [15] The actuating signal uses reference power to change active signals and let steady state reached to zero . Area control error forces zero state error by changing the frequency of each area . On reaching the net area error to zero then only frequency bias factor supposed to come in favour . It

measures load change of an area given out a better control result. We have to decrease the good control of generation.  $ACE = 0$  , the required system is in steady state and will be stable.[16]

**VII. THREE AREA NETWORK**

A tie line power deviation and frequency can be presented by three area system . The simulated model created by MATLAB can be generated with or without PID controller .[17]

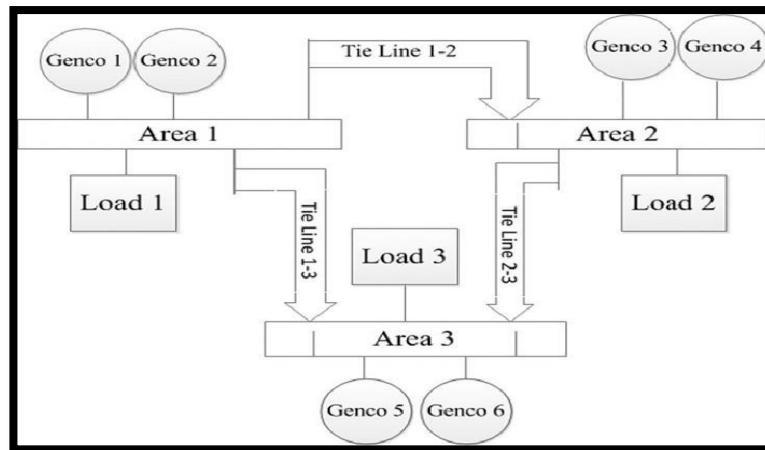


Fig. 8: Three Area Network Pictorial

## VIII. RESULT

It improves the performance of power system frequency controllers. It has the stability with mutual assistance under normal condition each control area unit contains own load. It has a problem with parameter variations, we need to go through the advanced control technology are expected to applied. Overall it is qualitative and quantitative analysis.[18]. frequency deviations resulting from sudden demand variations[19].The settling time reduces by the use of BATTERY SYSTEM which also controls the ACE.

## IX. CONCLUSION

In this paper we has evaluated that how a single area network behave under the presence of governor, turbine and tie line . we have evaluated inpresence of with and without controller . The common graph of single area and second area saysit all. In future there must be some kind of hybrid technology involved which reduces the effective load and frequency disturbance , mainly the BES and ANN model for better functioning of the system. [20]

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