INTELLIGENT CONTROLLER APPLIED TO MULTI AREA LOAD FREQUENCY INTERCONNECTION POWER SYSTEM

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Abstract—The paper describes about the concept of Multi area load frequency control, Intelligent and conventional controller is included. If the system load frequency control mechanism is working perfectly, the frequency is quickly returned to the normal operating point. Many types of controllers have been employed for the LFC but due to non linearity of power system components and generators, the response are not usually fast and efficient. The performances of the controllers are simulated using MATLAB/SIMULINK package. The investigated Load Frequency Control using proportional integral Controller and proposed Ziegler-Nicholas Controller for Single area system and multi area. Works are being done to optimize the controllers to get faster and better results; the main proposed objective of Load Frequency Control is to minimize transient deviations.

Keywords—Automatic Voltage Regulator, PI controller, PID controller and Fuzzy-PID controller

I. INTRODUCTION

In recent years electricity has been used to power more sophisticated and technically complex manufacturing processes, and a variety of high-technology consumer goods. These products and process are sensitive not only to the continuity of power supply but also on the quality of power supply such as voltage and frequency. In power system, both active and reactive power demands are never steady they continuously change with the rising or falling trend. The changes in real power affect the system frequency, while reactive power is less sensitive to changes in frequency and is mainly dependent on Changes in voltage magnitude [1]. The main objective of power system operation and control is to maintain continuous supply of power with an acceptable quality, to all the consumers in the system. The system will be in equilibrium, when there is a balance between the power demand and the power generated. As the power in AC form has real and reactive components: the real power balance; as well as the reactive power balance is to be achieved. There are two basic control mechanisms used to achieve reactive power balance (acceptable voltage profile) and real power balance (acceptable frequency values) [2]. In an interconnected power system a sudden load change in any area causes the deviation of frequency of all the areas and also of the tie-line powers which has to be corrected to ensure generation and distribution of electric power with good quality and is achieved by load frequency control (LFC). The main objective of LFC is to maintain the steady frequency, control the tie-line flows, to control the frequency deviation by maintaining the real power balance in the system and distribute the load among the participating generating units [3-4]. In this paper, an Automatic Generation Control scheme for two area power system using proposed frequency Ziegler Nichols controller and conventional controller is presented. The simulation result shows improved system performance when the Ziegler Nichols controller is employed even outside the operating range.

II. LITERATURE REVIEW

In 2012 V. Ganesh, K.Vasu and P.Bhavana [5] has presented a LQR Based Load Frequency Controller for Two Area Power System. Recently, LQR controllers have received extensive attention and research. Accordingly, there is an increasing interest in LQR controller. The widely used classical integer order proportional integral controller and proportional integral derivative controller are usually adopted in the load frequency control (LFC) and automatic
generation control (AGC) to improve the dynamic response and to eliminate or reduce steady state errors. In this paper LQR controllers are used to improve dynamic stability and response of LFC and AGC system. This paper investigates LFC and AGC for interconnected power systems and shows that LQR controllers perform better than classical integer order controllers in these systems.

In 2013 Afshan Ilyas et al [6] presented a tuning of Conventional PID and Fuzzy Logic Controller Using Different Defuzzification Techniques. The tuning of conventional PID controller. Simplicity, robustness, wide range of applicability and near-optimal performance are some of the reasons that have made PID control so popular in the academic and industry sectors. Recently, it has been noticed that PID controllers are often poorly tuned and some efforts have been made to systematically resolve this matter. Thus Fuzzy logic can be used in context to vary the parameters values during the transient response, in order to improve the step response performances. Simulation analysis has been carried out for the different processes by conventional and different defuzzification techniques and the results indicate that the values of percentage overshoot are reduced by using fuzzy logic mechanism.

In 2014 K. Vijaya Kumar1, V. Lakshma Naik2 [7] This paper presents A novel method to improve the load frequency control in single area and two area power system. This means the load variation on a power system which gives the frequency drift from its nominal value. This gives the quality of electric power, reliable and good, because for minimizing the fluctuations of frequency. This paper is mainly focused on technical issues associated with load frequency control (LFC) in single area and two area power system.

In 2015 K. Swetha et al [8] has worked on Load Frequency Control of a Single Area Power System Using Type-1 Fuzzy Controller, Load frequency control problem is considered as one of the most important issues in the design and operation of power systems. Due to lack of good efficiency in parameters variation conditions, working conditions of system and non-linear factors, a simple PI controller is not suitable in industrial applications. Instead, fuzzy controllers can be used in order to enhance the performances of the systems. In this paper, the use of the optimized type-1 fuzzy logic controller is proposed to solve the load frequency control problem.

### III. MODELING OF AGC

Figure 1 Automatic Generation Control

In an associated power system, maintenance of power inter change is not an issue. With the primary LFC loop, a change in the power system load will result in a steady state frequency deviation, depending on the governor speed regulation. To make the frequency deviation zero, we must provide a reset action. This is done by introducing an integral controller which acts on the load reference setting and changes the speed set point. The integral controller increases the system type by 1 which makes the final frequency deviation to zero. The integral controller gain must be adjusted for a satisfactory transient response. The schematic diagram of AGC is shown below. It consists of valve control mechanism, turbine, generator and governor. The change in frequency is compared with a reference speed. A valve controller is used to regulate the steam valve thereby increasing the power
output from the generators which results in matching of generation and demand. As a result the frequency is restored to the original value [7-8]

3.1 Multi Area LFC zone

The block diagram of a simple AGC for a two-area system is shown in figure 4. ACEs are used as actuating signals to active changes in the reference power set points, and when steady state is reached, \( \Delta P_{12} \) and \( \Delta \omega \) will be zero. Conventional LFC is based up on the tie-line bias control, where each area tends to reduce the area control error (ACE) to zero. Even if some generating units in one area fail, the generating units in the other area can compensate to meet the load demand. A two area model is adapted in the work is shown in Figure 2.

![Figure 2 complete block diagram of multi area system](image1)

3.2 Multi area methodology With Ziegler Nichols controller

In 1942, Ziegler and Nichols proposed two experimental approaches to quickly adjust the controller parameters without knowing the precise dynamic model of the system to adjust. Both methods are empirical and based on tests. In this paper we use the second method of Ziegler-Nichols, it is a simple technique to tuning P, I, D controller parameters. Ziegler and Nichols presented two methods, a step response method and a frequency response method [10]. An isolated electric area, where one generating unit or bunch of generating units, is placed in close vicinity to distribute the electricity in the same area is called single area system. More than one control area power systems with a single control zone is actually a combination of power systems and the problems of each region, combining a control structure. Figure 3 is MATLAB Simulink model design PID controller auto tune ZN controller for load frequency control of single area.

![Figure 3 single area matlab model](image2)
IV. MATLAB SIMULINK RESULTS AND DISCUSSIONS

In this paper, Power system multi area Model using Ziegler-Nicholas used of two area system and frequency parameter of load frequency control [7]. Hear two test case study in paper.

Test System 1 multi-area interconnected with integral Controller

In this case integral Controller used of multi-area system MATLAB simulink model given below figure 4. The output response of multi-area is shown in Fig.5. Its clear settling is both areas good.

![Figure 4 multi-area interconnected with integral control system](image)

Test System 2 multi-area interconnected with integral Controller

In this case MATLAB simulink model given below figure 7 and parameter of PID area-1. The output response of multi-area is shown in Fig.8. The output response of multi-area is shown in Fig.7. Its clear settling is both areas good.
Test case 3 compare with integral controller and frequency Ziegler Nichols controller

Proposed frequency Ziegler Nichols controller is better dynamic responses; we can optimize settling time and oscillation of system. The proposed Ziegler Nichols controller gives better dynamic responses comparing to conventional other controller is given in table 2 and figure 8.

Table 1 multi-area interconnected with integral and Ziegler Nichols controller

| Used techniques | integral controller | frequency Ziegler Nichols controller |
|-----------------|---------------------|--------------------------------------|
| Area name       | Area -1             | Area -2                              |
| Settling Time sec | 17.9 sec           | 32.2 sec                            | 2.89 sec | 14.2 sec |

Figure 8 results of multi-area interconnected with integral and Ziegler Nichols controller
V. CONCLUSION

In this paper, multi-area interconnected load frequency control integral and Ziegler Nichols controller have been presented. Simulation was carried out using MATLAB version 2012a to get the output response of the system. The amount of settling time for the output response was successfully decreased using integral and Ziegler Nichols controller. Simulation results show Ziegler Nichols controller provides suitable dynamic frequency response.

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