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DYNAMIC ANALYSIS OF INTERCONNECTED HYDRO-THERMAL SYSTEM CONSIDERING DOUBLE REHEAT TURBINE AND MECHANICAL GOVERNOR

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ABSTRACT

AGC problem can be solved by Simulation of a realistic power system using MATLAB Simulink tool and MATLAB coding for solving the controller design problem. Also Improvement of the dynamic response of LFC system in a realistic two area interconnected power system considering parallel AC-DC tie lines may be studied. Comparison of the dynamic responses of the LFC of the power system considering AC tie lines and parallel AC-DC tie lines. Examining the effect of Load disturbance by varying the Step load perturbation from 1% to 4%.

Keywords: Controller, AGC, Double Reheat Turbine, Mechanical Governor, MATLAB.

I. INTRODUCTION

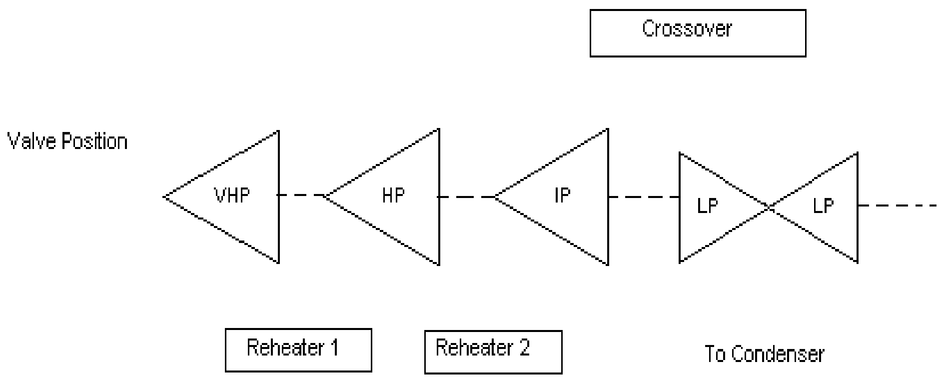
Global analysis of the power system markets shows that the Automatic Generation Control (AGC) is one of the most profitable ancillary services at these systems. This Scheme is related to the short duration balance of energy and frequency of the power systems. AGC acquires a principal role to enable power exchange and to provide better condition for electricity trading. The main goal of AGC problem is to maintain zero steady state errors for frequency deviation and good tracking load demands in a multi-area power system. Electric power systems are interconnected to make the systems more reliable. In a multi-area system, generations and loads are coordinated with each other through the tie lines among the areas. An electrical power system consists of many generating units and many loads while its total power demand varies continuously throughout the day. Smaller, but faster, load changes are dealt with LFC so as to maintain frequency at the scheduled value (frequency control) and maintain the net power interchanges with neighbouring control areas at their scheduled values.

II. HYDROTHERMAL SYSTEM

In an two-area interconnected system consists of hydro and thermal area are combined together to meet the power demand is known as hydrothermal system. Both the hydro system and thermal system are combined in order to meet the power balance in the power system i.e power generation is equal to the power demand. Both this area are capable of meeting the small signal disturbances by means of either increasing or decreasing the generation range in order to avoid the unstable mode of operation of the interconnected system. This interconnected system is arranged in such a manner, so they must maintain the frequency deviation and tie-line power deviation due to the small signal disturbances in an stable state.

III. TRANSFER FUNCTION MODEL FOR TWO-STAGE REHEAT TURBINE

The transfer function model for a two stage reheat turbine is shown in the fig.1. This two stage reheat turbine has four cylinders very high pressure VHP, high pressure HP, intermediate pressure IP and low pressure LP having the p.u. Mw ratings of $\alpha, \beta, \gamma, \mu$, respectively. It may be noted that $\alpha + \beta + \gamma + \mu = 1.0$. For a change in control valve position ΔP_V , the VHP turbine shall contribute the power component.



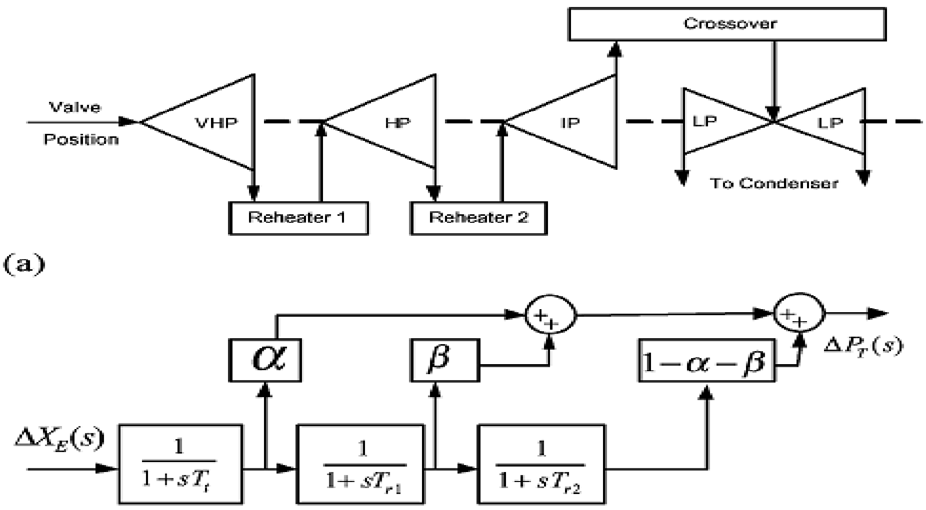


Fig .1 . Tandem-Compound Double Reheat Turbine. (a) Schematic Diagram.

IV. SYSTEM INVESTIGATED

For analyzing the system performance, the mathematical model is required. Moreover, the control system can be designed only if the complete mathematical model of the system exits. The mathematical model of thermal, hydro and gas turbine power plants have been considered in this paper. The thermal and hydro power plants are

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modelled for small signal analysis From the block diagram of thermal hydro interconnected power systems it is clear that the thermal power system consists of transfer functions of speed governor, Generator and steam turbine, similarly hydropower system consists of transfer functions of electric generator, Hydro turbine and Generator system. Now derive the equations of two areas to decide the stability of frequencies at the output. The value of stabled frequency is taken as 50 Hz.

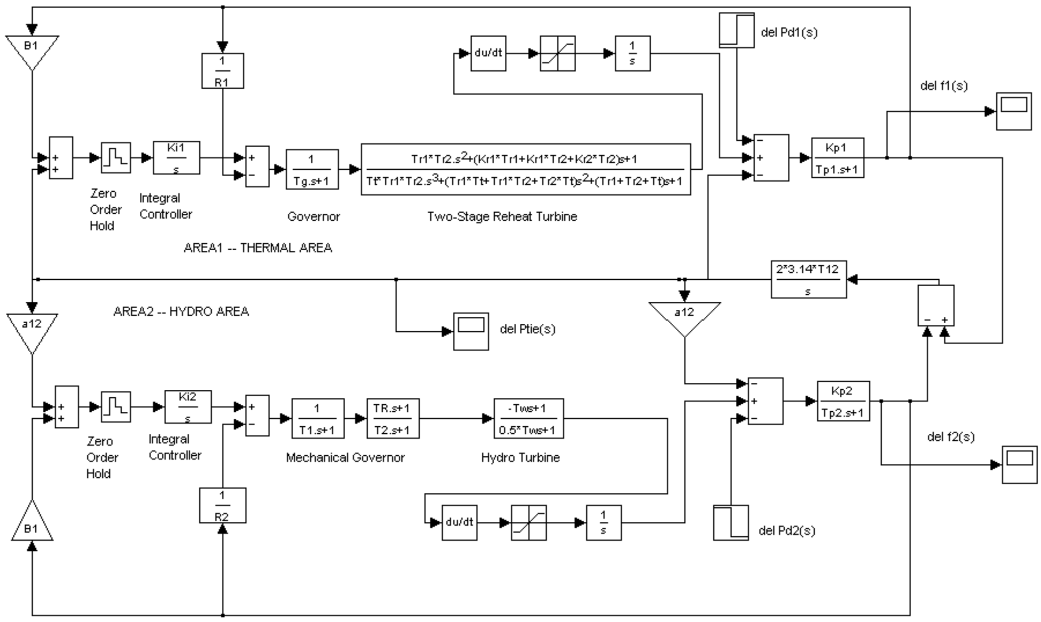

Fig .2 : Transfer function model considering two-stage reheat turbine in thermal area and mechanical governor in hydro area.

IV. RESULT AND ANALYSIS

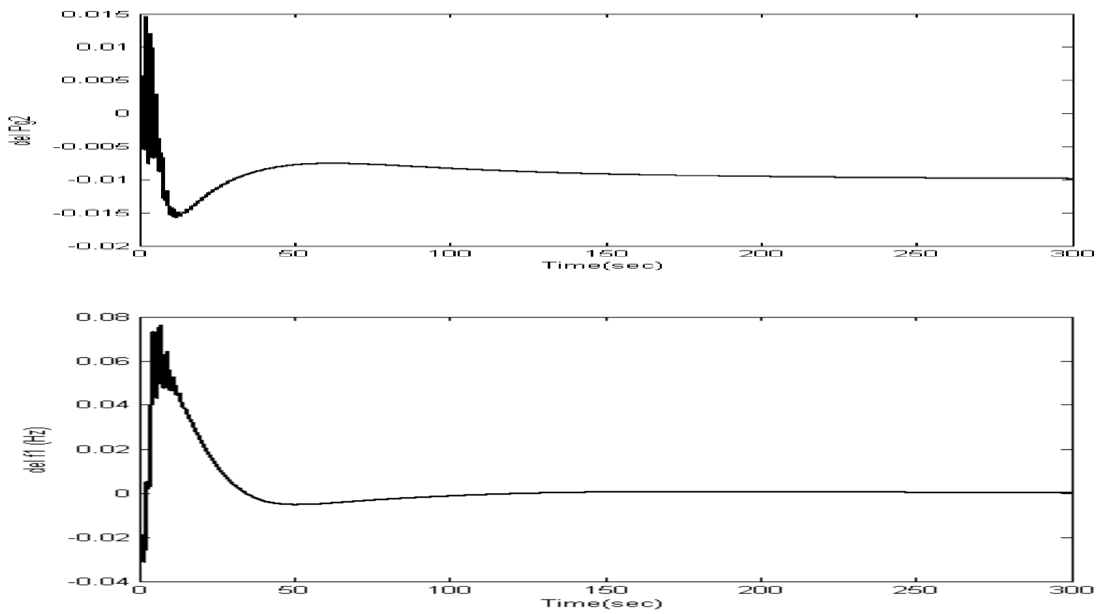

Fig 2.1: Dynamic response with 1% perturbation in thermal area.

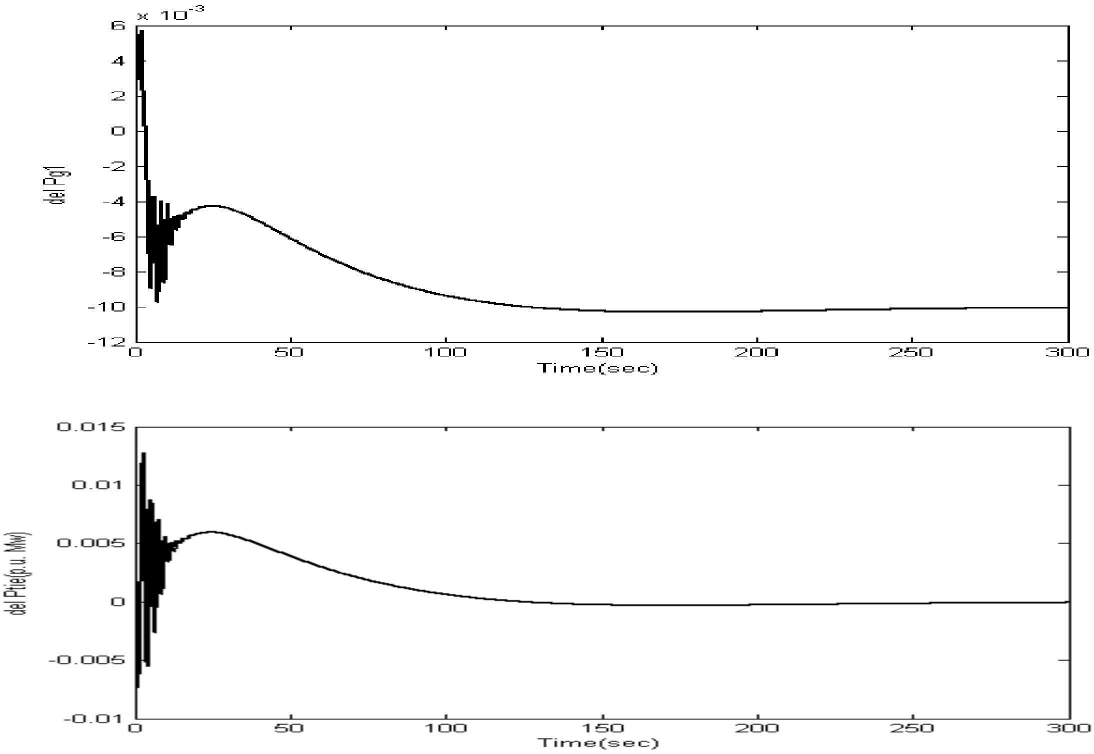

Fig .2.2: Dynamic response with 1% perturbation in hydro area.

V. CONCLUSION

Investigations shows that in a hydrothermal system, irrespective of small perturbation in either area, it is advisable to chose a much higher sampling period than used in practice that provides better system performances. In continuous-discrete mode method for a hydrothermal system, considering electric governor in hydro area, reheat turbine in thermal area and suitable GRC in both areas, the dynamic responses with integral and proportional-integral controller are more or less the same from the view point of peak deviation and settling time. The optimum value of temporary droop for a mechanical governor in hydro area evaluated in the uncontrolled mode works well in the controlled mode. The performance of mechanical governor is found to be quite superior to a electrical governor, although both take more or less same settling time. Mechanical governor provides very fast oscillations which are absent in electric governor. The dynamic responses for double reheat & single reheat turbines are close to each other. Thus for all practical purposes, a double reheat turbine can be modelled as a single reheat one.

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