Automatic Voltage Regulator

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Abstract- **A power system is important for today's infrastructure which is controlled by various methods and to handle a system smartly it is necessary to know about its various parameters and role played by them. The objective of this project is to improve the stability by using power system stabilizer, automatic voltage regulator and Governor. In power system it is necessary to achieve effective stability and good regulation of various devices and hence AVR are extensively used. But AVR should be coupled with any appropriate controller to overcome slow response due to disturbance which will provide efficient stability. In power generating system, AVR controller with PID is very necessary for controlling the voltage of power generation system due to change in load. Voltage fluctuation is mainly due to the variation in the load and if there is a variation in the voltage then it can damage the equipment so it is necessary to stabilize the voltage, so AVR is used in the system. The systems modeled consist of the amplifier, exciter, sensor & stabilizer or PID controller. Simulation results of the AVR system using MATLAB are presented.**

Keyword- Automatic Voltage Rregulator (AVR), transient stability, PID Controller

I.INTRODUCTION

Modern power systems to operate at a standard voltages. Power systems, this device has been designed to work with predetermined values of the voltage and frequency of operation of the system is required to operate the steady state condition. The voltage profile during the operation of the upcoming elections, it is desirable to limit the need to allow all times. The load on the system, not all the time it is always different and it is constantly changing load conditions, hence the automatic excitation system can be applied to stabilize the voltage in the power system as the automatic voltage regulator that can get through the automatic excitation system sense.

The generation of electricity as the system voltage changes in a system interconnected electric network, as well as customer premises only results. Quality is the result of the transfer of power to the consumers. Generally, according to a consistent standard voltage and frequency is irregular and no fluctuation in the frequency where the power quality of the power. In the case of a power pole system, but the system affects the speed of alternators and results as well as the overall power system frequency variation of real power and reactive fault not only because of the weight and effect on the voltage. In order to restore the balance of the system, the voltage regulator is used with the reactive power compensator. Generator excitation system is constantly required to meet the demand for reactive power regulation; which will minimize the system buses of different voltages fluctuating beyond the prescribed limits. Customer area Production units and the system voltage and frequency fluctuates greatly such as three-phase consumers are affected. Whatever the difference between the input voltage at the end of the customer even though most electrical and electronic equipment, which are run by the voltage stabilizers produce voltage keeps constant. Although some electronic devices have inbuilt voltage stabilizer for voltage fluctuation restrictions. Power Center, voltage regulators are used to keep the voltage generator produces the limits allowed.

A contemporary generator or alternator automatic voltage regulator (AVR) is equipped. The general operating conditions of different load levels is responsible for keeping a constant voltage output power. Large interconnected power system oscillations may continue for an extended period of progress in the design as well as the growing complexity. AVRs fast acting and even instability may occur due to the loss of some system. More AVR performance of PID controller can be improved in various forms. Objective of this paper is to suggest AVR system to obtain optimal performance with the help of controller which is derived from the integral controller proportional- (PID). So, AVR is used to develop the dynamic response as well as to decrease the steady state error of the loop, to study the response of controller linear PID controller is used in this paper. Degree controller overshoots the set point of the system and the degree of movement. So they will be required to research and analyze changes in the acute fluctuation load. Bus voltage fluctuations in the system, resulting in a change of power rotation. The study of the existing limit voltages in the system can be personalized to manage a stable condition, will analyze a model to regulate the rotation speed of the generator. Degree controller overshoots the set point of the system and the degree of movement. So they will be required to research and analyze changes in the acute fluctuation load. Bus voltage fluctuations in the system, resulting in a change of power rotation. The study and the existing limit voltage in the system can be tailored to manage a stable condition, will analyze a model to regulate the rotation speed of the generator. Degree controller exceeds the set point

of the system and the degree of movement. So they will be required to research and analyze changes in the critical fluctuation load. Bus voltage fluctuations in the system, resulting in a change of power rotation.

II. THE CURRENT SYSTEM

Power control system engineers, their almost constant while varying the nature of the high complexity and nonlinearity of power system faces challenges together. Contemporary generator controller has been established in a number of researches, in order to obtain high quality and have been published in numerous papers. Traditional excitation controllers are designed primarily using linear control theory. The main conventional excitation controller is AVR. Power AVR system in a variety of models have been developed to represent the different types of used. Automatic voltage regulators are not traditional (AVRs) is used on a large scale using contemporary design and a linear transfer machine functions. However, an Contemporary generator and its components, such as the governor and exciter systems, are actually all nonlinear. Therefore, a control system are valid only for a set of selected terms linearized model-based design, Benefits and positive results of the AVR system is unable to respond satisfactorily over the entire range of working conditions. linearized AVR model may also introduce negative Damping causes some problems with the stability of the situation. So many studies faster and more accurate response to the work conditions that can lead to uncertainties have been developed and adaptive self-tuning of AVRs to be a controller. linearized AVR model may also introduce negative Damping causes some problems with the stability of the situation. So many studies faster and more accurate response to the work conditions that can lead to uncertainties have been developed and adaptive self-tuning of AVRs to be a controller. linearized AVR model may also introduce negative Damping causes some problems with the stability of the situation. So in order to have a fast controller offers many study and respond to the work conditions can lead to more accurate and adaptive uncertainties own.

I. AUTOMATIC VOLTAGE REGULATOR

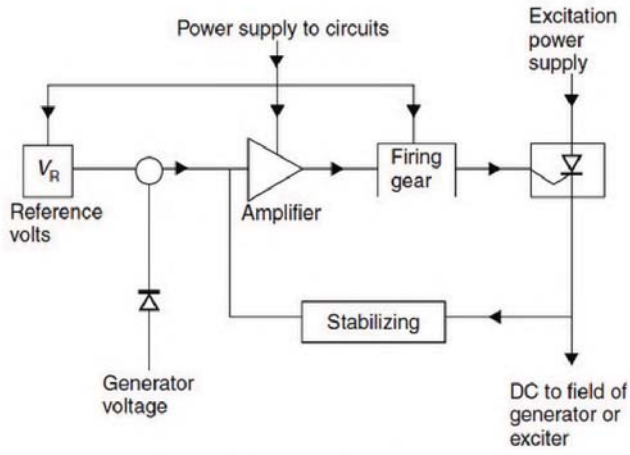

Figure A Automatic voltage regulator

The main role of the AVR, the distribution system is adequate reactive power during the voltage constant monitoring and improvement of stability of parallel work machine. Upanna speed excitation system of a machine that helps in maintaining the voltage control reactive power flow and the rate of the terminal. Increases the speed of a machine terminal voltage reactive power demand to the contrary, and as R upanna. Terminal voltage change is sensed through a sensor that potential transformer (PT). Fix using a fixed voltage AC output from the sensor and the correct product separator is a DC reference signal strength. An excitation control device to the main course in a upanna to restore the voltage signal and the absence of a nominal terminal is the exciter.

IV. MATHEMATICAL MODELING OF AVR SYSTEM

There are two ways a model is mathematically described, a component of the transfer function method and the other is the state variable method. State variable methodology is desirable for both linear and non-linear system. Transfer function approach, if the system is linear and easy to apply. Linearize the transfer function is taken as a non-linear model assumptions and approximations approach to deal with. The time difference depends on the difference between the system time generator transient reactance magnitude is constant voltage synchronous machines in the decision. Since a static device, AVR provides a minimum time delay and quickly brings irregular system of its nominal value. The terminal voltage is sensed by the AVR and is maintained at its rated value by regulating the excitation.

i) Amplifier model

An amplifier and a gain by the transfer function of the time constant is tailored to:

$$TFA = \frac{Ka}{1 + sTa}$$

Where and represent the voice message or a continuous device to gain and time. Usually taken in the range of values 40 and 10 are taken in the classroom $0.02'Ka''Ta''Ka''Ta'$ is 0.1 seconds.

ii) Exciter model

An exciter gain and a transfer function given by the time constant is tailored to:

$$TFE = \frac{Ke}{1 + sTe}$$

Where and constantly develop and represent the exciter time. The typical values taken from the range of 10 to 1 and 1.0 to 0.4 range are taken in seconds $'Ke''Te''Ke''Te'$

iii) Generator Model

A generator and a gain on the transfer of the work by the time constant is tailored to:

$$TFg = \frac{Kg}{1 + sTg}$$

Where have the time and energy to grow and represent a constant load and depending on. Typical values of the range from 1.0 to 0.7 is taken and no load full load range of 1.0 to 2.0 are met. $'Kg''Tg''Kg''Tg'$

iv) Sensor model

A gain and time constant is given by a sensor can be represented by a simple first order transfer function:$'Ks'\ 'Ts'$

$$TFs = \frac{Ks}{1 + sTs}$$

Where and constantly develop and represent the exciter time. It is generally thought of about 1.0 is taken and is taking a range of 0.001 to 0.06 seconds too short.$'Ks''Ts''Ks''Ts'$

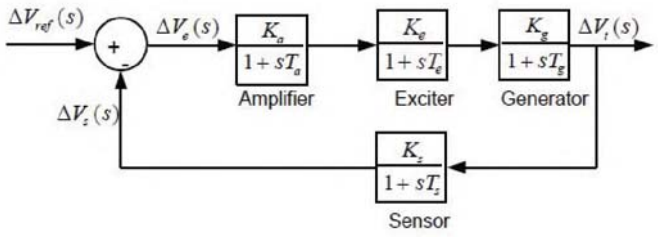

Figure B:AVR system with Transfer function model.

After a start of the disturbance action figure AVR system shown in B can not be sufficient enough to nominal voltage terminal. So in addition to the AVR, an extra controller is also required to restore the system quickly nominal voltage. Due to the AVR system is working to enhance the dynamics, PID control system to its simplicity and robustness.PID parameters to develop the right design is a challenge to design engineers a day now. The early days of PID parameters or by using hit-and-test approach was receivedCohen Coon approach, Ziegler- the last few decades, the PID controller design using some classical techniques using a variety of soft computing techniques, etc. Nichols approach have been used on a large scale. AVR system PID controller gains of many optimization Liaisons (mol), locally Unimodal Sampling (call), the gravitational search algorithm (Gsa) based Learning and Teaching Optimization (TLBO) are friendly by using some recently developed optimization techniques.

V.PID controller

PID controller is a combination of proportional action, integral action and derivative actions. In industrial control systems, feedback loop system is widely used where AVR is used to stabilize the voltage.

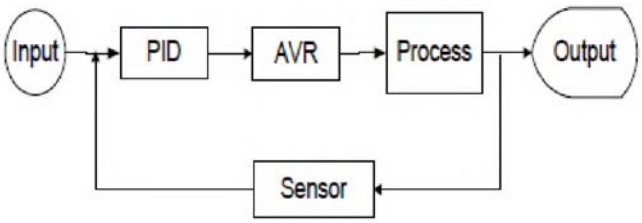

Figure C: AVR with PID Controller

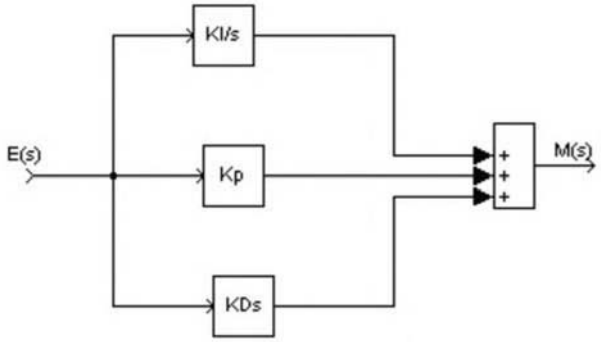

Figure D: PID controller

PID controller can be described in mathematical form:

$$M(t) = E(t) + KI\int_0^t e(t).dtK + \frac{de(t)}{dt}$$

M (t) = Compensator input
E (t) = Compensator production
Follows the PID controller is not the product transfer function:

$$\mathbf{M\ (s) = (K + E\ (S)}\frac{\boldsymbol{KI}}{\boldsymbol{S}} + \boldsymbol{KDs})$$

or

$$\mathbf{G\ (S) = (K +)}\frac{\boldsymbol{M(S)}}{\boldsymbol{E(S)}}\frac{\boldsymbol{KI}}{\boldsymbol{S}} + \boldsymbol{KDs}$$

Kp = Proportional gain. It defines the value of the reaction to the present errors.
Ki = Integral time constant. It defines the value of the reaction based on the sum of the recent errors.
Kd = Derivative time constant. It is used to decide the rate at which the error has been changed.
The sum of these three actions is used to adjust the process by the use of control elements. These controllers are used to correct the error between the measured variables and the preferred set value or the reference value. And hence it helps to minimize the error.

VI.PID simulation model

As mentioned earlier, for system stability, an AVR system is used to normalize the voltage and reactive power which will minimize the magnitude of the error. To eliminate the error response, the PID controller has been added to the path forward AVR system to reduce errors and improve dynamic response.

fig FShow the PID controller of the form Simulink to model and demonstrate the system to respond to an AVR. Enhancers, Exciter, and AVR system that is integrated generator units are the basic units of Contemporary generator model. A Hall effect sensor is used to measure the voltage and external interferences controller offers exceptional linearity and accuracy .It back to a way of thinking, improved thermal conduct and carry a high tolerance.

VII.SIMULATION RESULTS

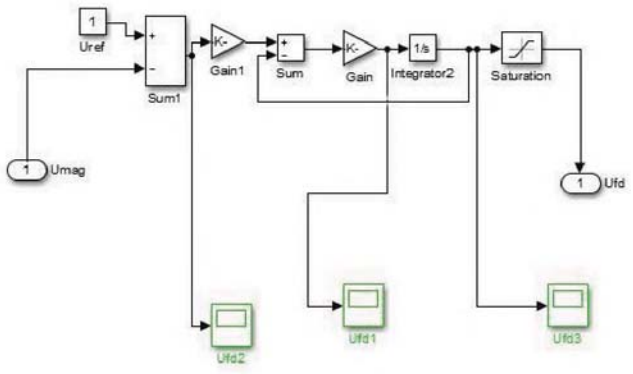

Figure E:Designed Simulink model of AVR without PID controller

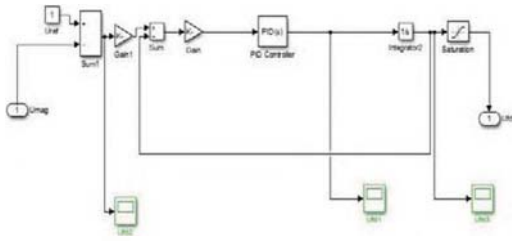

Figure F:Designed Simulink model of AVR with PID controller

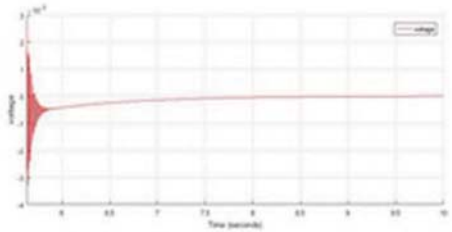

Figure G: Voltage step response of AVR with PID .

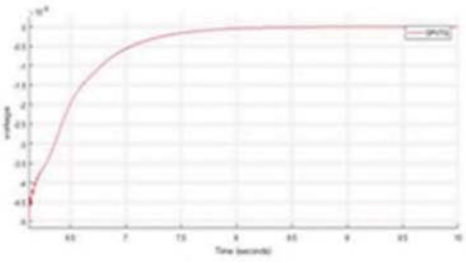

Figure H: Voltage step response of AVR without PID .

VIII.CONCLUSION

Power system transient stability and impact of AVR is briefly studied, making simulation and taking response for generator with PID controller and without PID.AVR increases exciting current so that generator output voltage is gradually restored to given value and finally system reached at a new steady value. Parameters of PID controller take time to improve terminal voltage. As it is shown from the study, using of AVR plays important role in power system transient stability.

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