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COMPARISON OF POWER SYSTEM PERFORMANCE WITHOUT AND WITH STATCOM

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Abstract —*Transmission networks of modern power systems have grown to be extremely pressured due to increasing demand and limitations of building new lines. One of the outcomes of this kind of pressured system is the risk of sacrificing stability following a disturbance. FACTS devices are discovered to be particularly valuable in stressing a transmission network to improve utilization of its current features without losing the required stability margin. Flexible ac transmission system controllers, like utilize the most recent technology of power electronic STATCOM and SVC, switching devices in power transmission systems to manage voltage and power flow, and perform significant role as a stability aid for and transient interruptions in an tied power systems.*

Keywords-*STATCOM, Power system performance*

I. INTRODUCTION

The power system is a highly nonlinear system that operates in a constantly changing environment; loads, generator outputs, topology, and key operating parameters change continually. Increase in load demand make these types of problems more imminent in modern power systems. Demand of electrical power is continuously rising at a very high rate due to rapid industrial development. To meet this demand, it is essential to raise the transmitted power along with the existing transmission facilities. The need for the power flow control in electrical power systems is thus evident. With the increased loading of transmission lines, the problem of transient stability after a major fault can become a transmission power limiting factor. The power system should adapt to momentary system conditions, in other words, power system should be flexible [1].

II. Introduction to Facts

Alternating current transmission systems incorporating power electronic based and other static controllers to enhance controllability and increase power transfer capability are known as FACTS.

2.1 Static Synchronous Compensator (STATCOM)

STATCOM is a shunt-connected static var compensator whose capacitive and inductive output current may be regulated unbiased of the ac system voltage. The STATCOM is a static part of synchronous condenser which doesn't have rotating part, so reactive power generates and absorb at faster rate. STATCOM works identical from the point of view of features like voltage regulation rather than SVC at principle point of view. Its functionality is not aggravated by the presence of low voltage. The STATCOM has excellent performance throughout small voltage condition as the reactive current may be maintained constant. If the devices are rated for the transient overload one might raise the reactive current in a STATCOM under transient conditions[1].

2.2 STATCOM- working principle

STATCOM constitute of components like VSC, energy storage device (dc), and coupling-transformer. STATCOM has energy storage device so that it can exchange reactive power with the transmission line, if battery is replaced by energy storage device. The controller exchanges real and reactive power in transmission line, and its operation region extends in four quadrants. The construction of STATCOM is as shown in Fig.2.1Converter ac output voltage and voltage across dc capacitor will relates each other as follows, $Vout = kVdc$ Where k=coefficient,
Depending upon the relative change between output of converter voltage and AC system Bus voltage, reactive power will flowing in the system either from coupling transformer to system or from system to coupling transformer. Losses occurred due to switching are provided by the true power flowing into VSC and charges a dc capacitor to a sufficient dc voltage level. In steady state operation capacitor voltage remains fixed and capacitor will charge and discharge through switching wave. In stable level, power from ac system will balance losses because of switching. The STATCOM's capability to take and deliver true power relies on the size of dc capacitor along with the true power losses because of switching. Every time the dc capacitor and also the losses are comparatively small, the quantity of true power transfer is also comparatively small. This means that the STATCOM's outline ac current Iac, needs to be around + 90º with regards

to ac system voltage at its line terminals. Varying the amplitude of the converter three-phase output voltage Vout controls the reactive power production as well as delivered to the STATCOM. AC current will flow from transformer reactance to the ac system if the amplitude of output voltage is raised above ac system bus voltage. so ac system extracts capacitive current that leads by an angle of 90º by ac system voltage, assume the losses occurs in the converter are equal to zero. If the amplitude of converter output voltage is less than ac system voltage then converter absorbs reactive power. For an inductive operation the current lags the ac voltage by an angle of 90°.Assuming that the converter losses are ignored. If the amplitudes of the ac system and converter output voltages are equal, it seems to be in floating state [1].

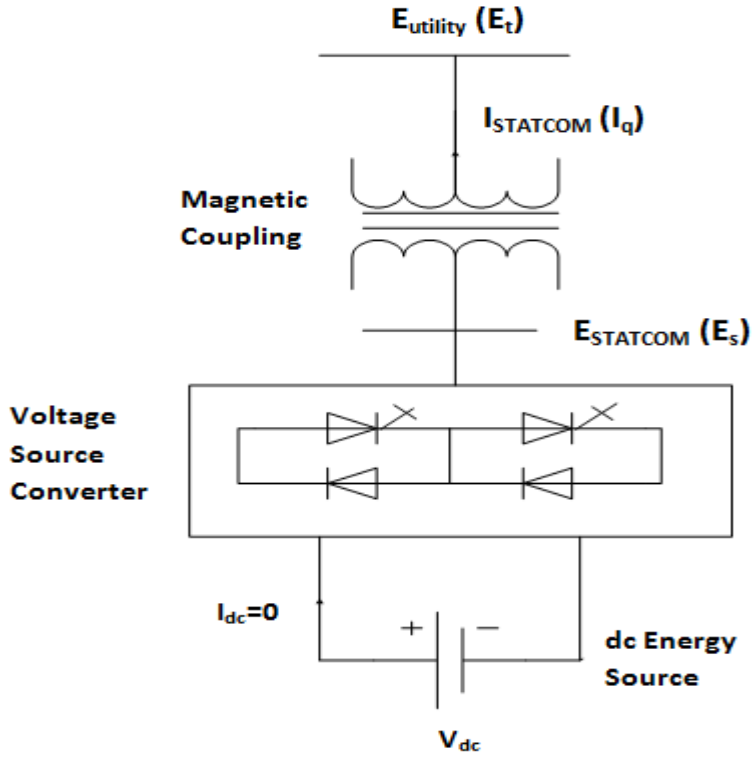

Fig.2.1 Construction of STATCOM [1]

III. Simulation and results of two machine system at different conditions

3.1 Without STATCOM

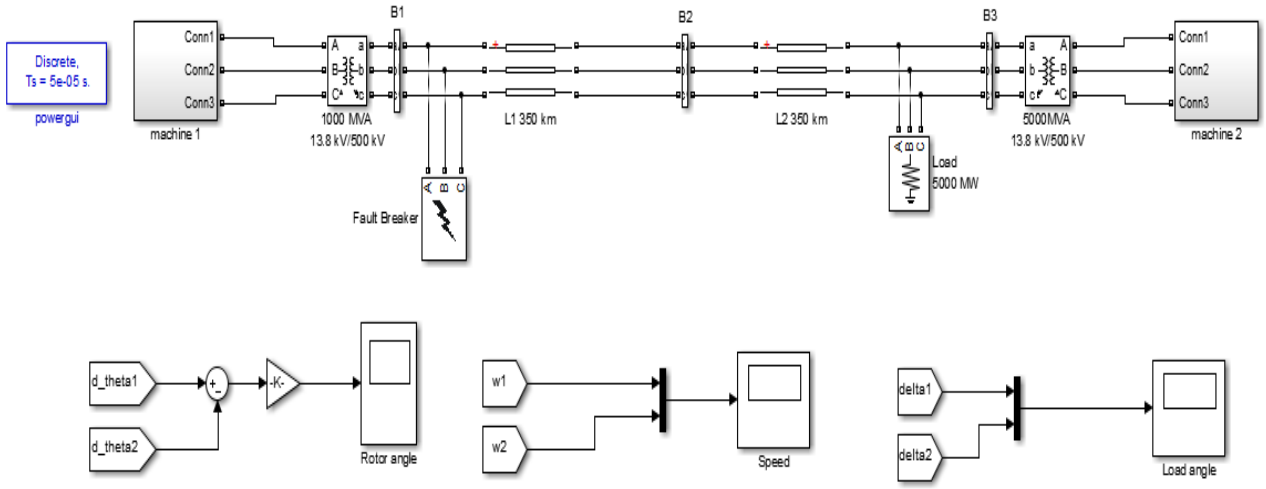

Figure: 3.1 MATLAB/Simulink model of two area system without STATCOM.

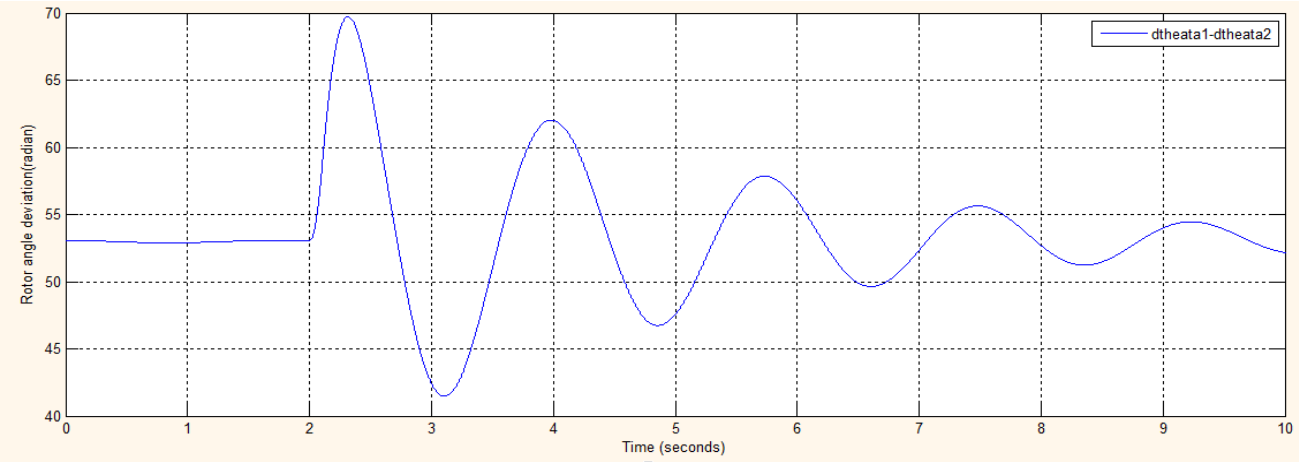

Figure: 3.2 Waveform of Rotor angle deviation

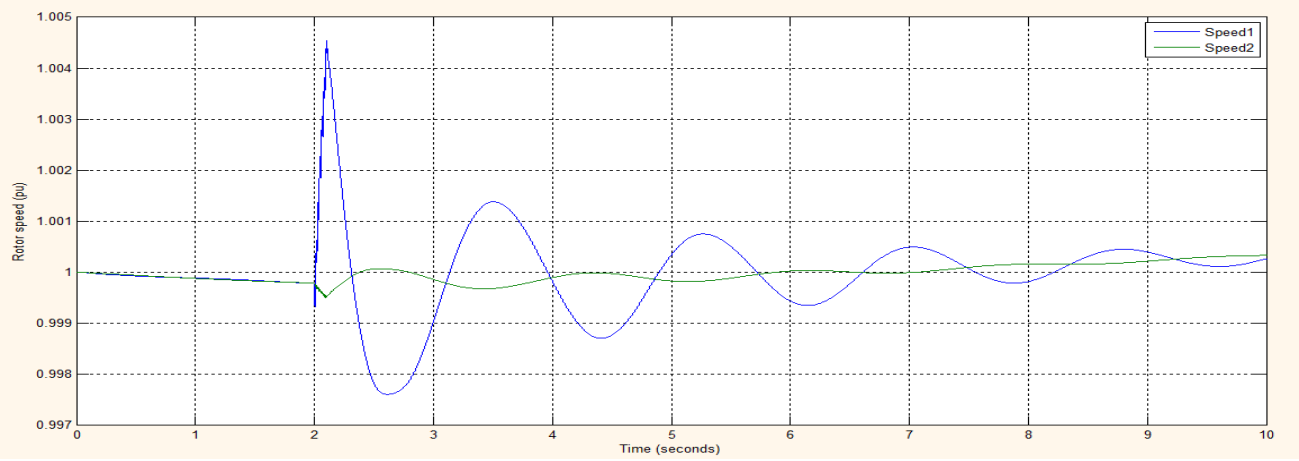

Figure: 3.3 Waveform of Rotor speed

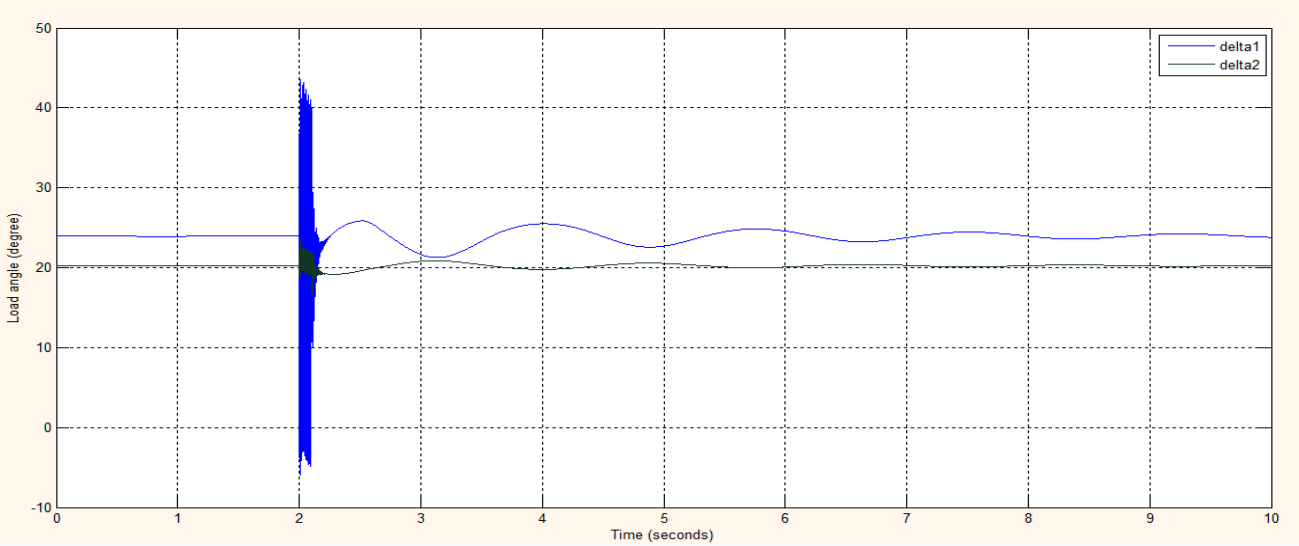

Figure: 3.4 Waveform of load angle

In this simulation STATCOM is not connected and fault of 0.1 sec duration is created at 2sec, different kind of results are obtained like rotor angle deviation, rotor speed and load angle. By observing this waveforms we can come to know that they are stable at 10sec, 10sec, and 9sec respectively.

3.2 With STATCOM

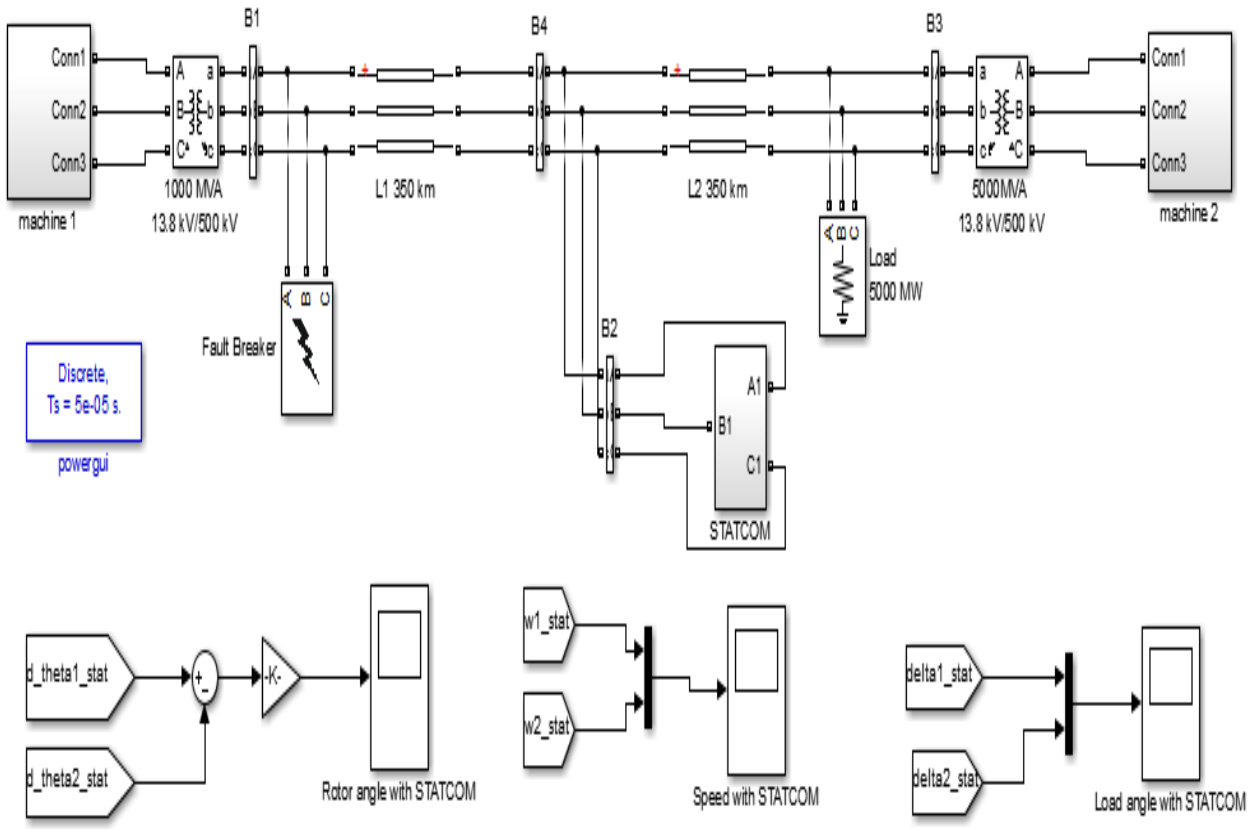

Figure: 3.5 MATLAB/Simulink model of Two area system with STATCOM.

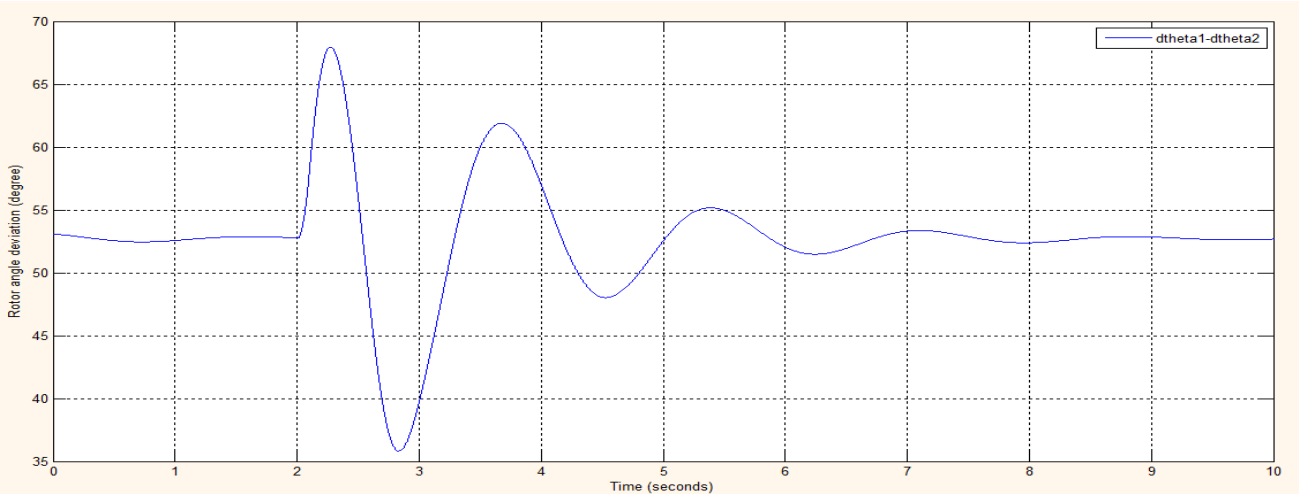

Figure: 3.6 Waveform of Rotor angle deviation

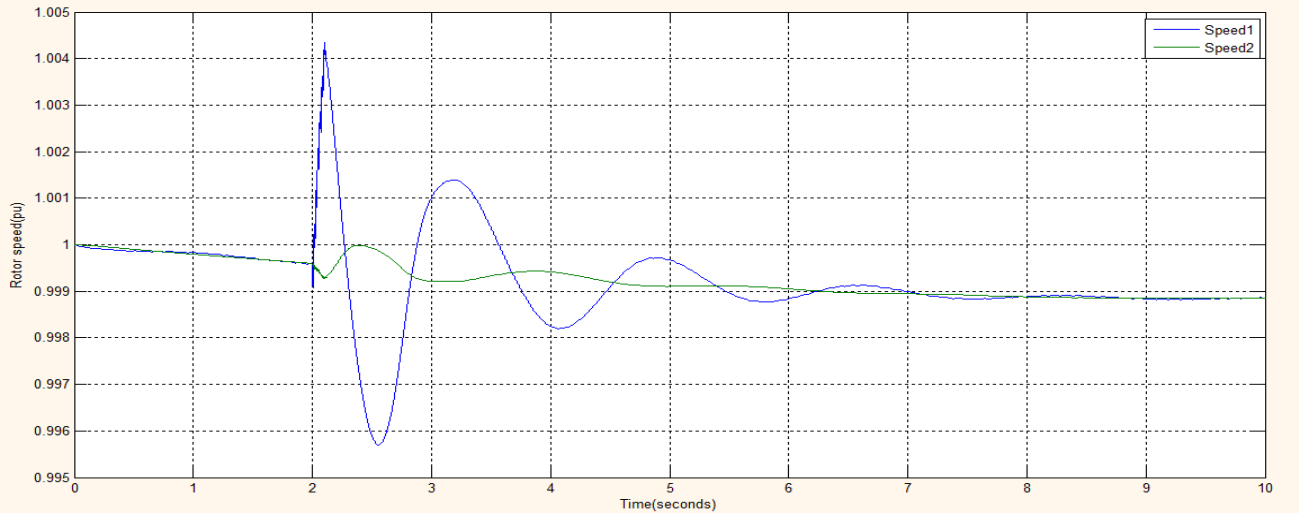

Figure: 3.7 Waveform of Rotor speed

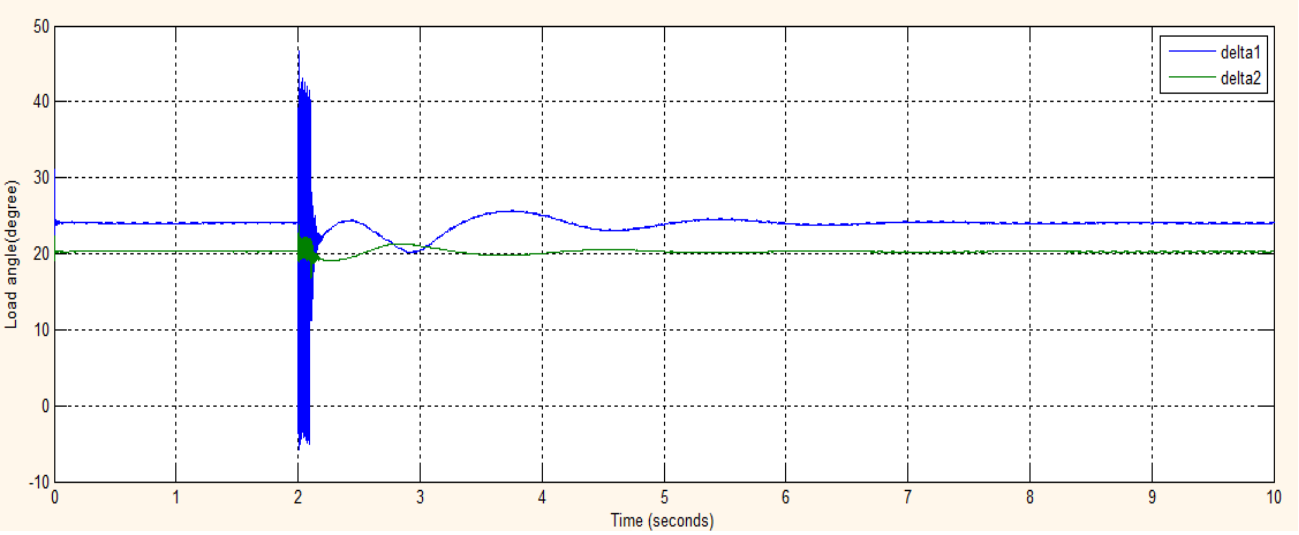

Figure: 3.8 Waveform of load angle

In this simulation STATCOM (using PI controller) is connected and fault of 0.1 sec duration is created at 2sec, different kind of results are obtained like rotor angle deviation, rotor speed and load angle. By observing this waveforms we can come to know that they are stable at 9sec, 8sec, and 7sec respectively.

IV. RESULT

Parameters	Rotor Angle Deviation(sec)	Rotor Speed (sec)	Load Angle(sec)
Without STATCOM	10	10	9
With STATCOM using PI controller	9	8	7

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