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THREE PHASE FAULT TRANSIENT CONTROL USING SSSC BASED DAMPING CONTROLLER

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ABSTRACT

The main aim of this paper is to control power oscillation which is major concern related to power system operation. In this research work is on SSSC-based power oscillation damping controller, which can damp the power oscillations occurring due to the any change in the transmission line like sudden change in load of line, occurrence of fault, transmission line switching and short circuit. In this work Simulation model of the two machine infinite bus system using SSSC & power oscillation damping controller has been done in MATLAB/SIMULIINK and power system toolbox is used for simulation purpose. These simulation models have been setup into MATLAB based Power System Toolbox (PST) for their transient stability analysis. It is observed that with the proper change of phase of the injection of voltages through SSSC, capacitive & inductive compensation can be provided by which increased and decreased in the active power respectively of transmission line can be done according to the mentioned power demand, but when only the SSSC is used in the line the settling time and amplitude of power oscillations are more as compared when SSSC is used with power oscillation damping controller. When in two machine infinite bus systems 3-phase fault analysis is done then it is observed that that the clearance time is less when the system is provided with SSSC and power oscillation damping controller together.

KEYWORDS: - Statics Synchronous Series Compensator (SSSC),(Power System Toolbox (PST), Power Oscillation Damping Controller(PODC).

I. INTRODUCTION

Now a days the most important requirement of power system is to improve the parameters like reliability, transmission capability, security with utilization of power. Power transfer capability of transmission lines is reduced by stability consideration. Oscillation of generator angle or line angle are generally associated with the transmission system disturbances and can occur due to step changes in load, sudden change of generator output, transmission line switching and short circuit. The low frequency is important factor in power plant because it causes power quality problems. The electromechanical oscillations are causes of total system outage. So these are removed by different techniques of oscillation control such as sssc based damping controller.

In early age this signal instability problem was solved by amortisseurs implemented in generator rotors, later with the application of fast excitation system this was solved by development & utilization of Power System Stabilizer (PSS) and however in modern power system due to the connection of power grids in vast area, for inter area oscillation damping due to the ability of controlling line impedance, power flow and bus voltage, Flexible AC transmission Systems (FACTS) devices implementation offers an alternative solution.

II. MATERIALS AND METHODS

1. Symmetrical 3-Phase Fault at Bus-2

1.1 Simulation Model of Two Machine System with 3-Phase Fault at Bus-2

On the two machine system model of Fig. 1.1 a 3-phase fault happened at bus B2 as shown in fig. 1.2.

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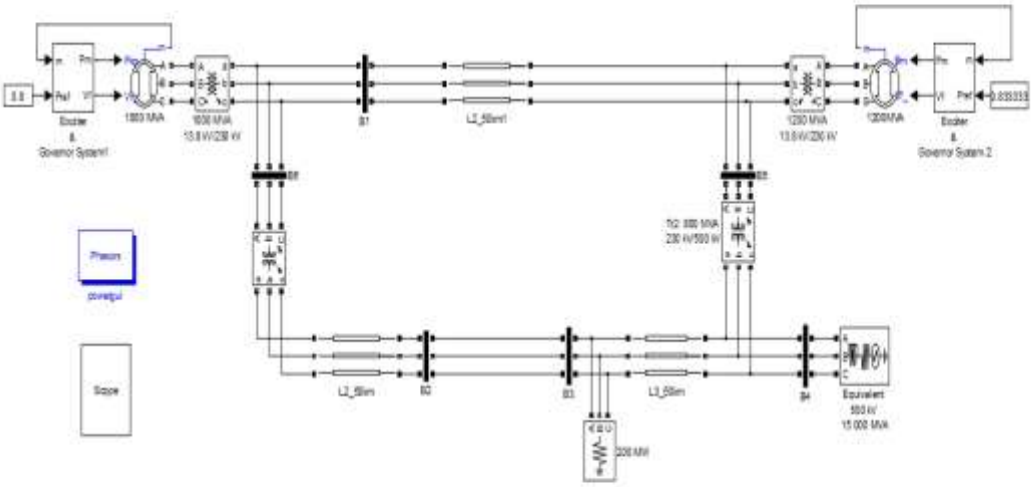

Fig1.1 Simulation model of two machine infinite bus system

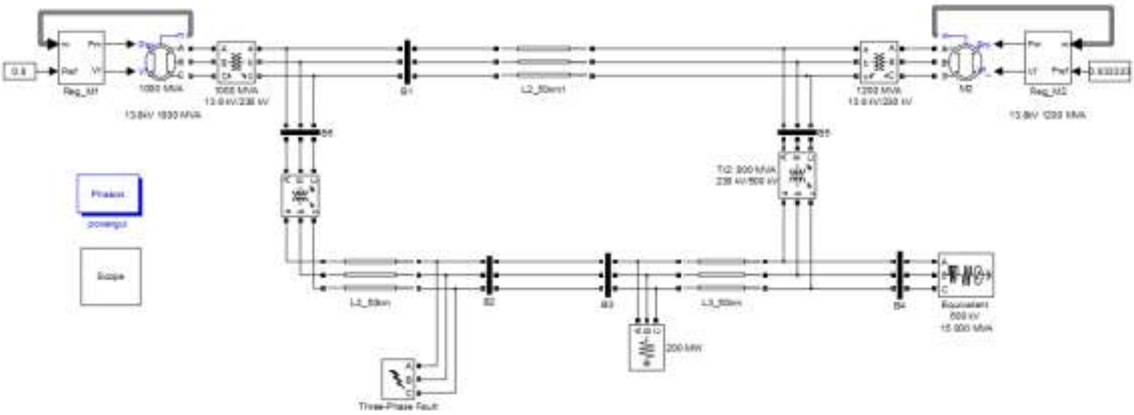

Fig. 1.2 Simulation model of two machine infinite bus system with 3-phase fault at bus 2

In two machine infinite bus system with 3-phase fault, results of the variation of magnitude of active power at bus-2, magnitude of voltages, active power at bus1-4 versus time are shown in fig. 1.3 to 1.5 respectively.

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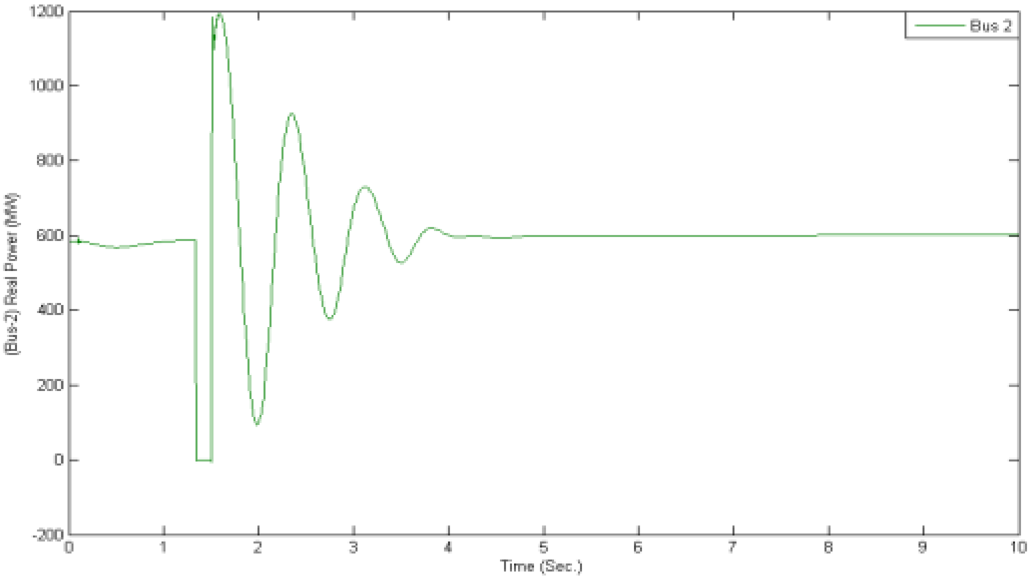

Fig. 1.3 Active power (at bus 2) with 3-ϕ fault at bus 2

After clearance of fault at 1.5 sec., from fig. 1.3 it is seen that active power at bus 2 changes abruptly for about 4 sec.The effect of 3-phase fault on voltages, active power at remaining buses are shown in fig. 1.4.

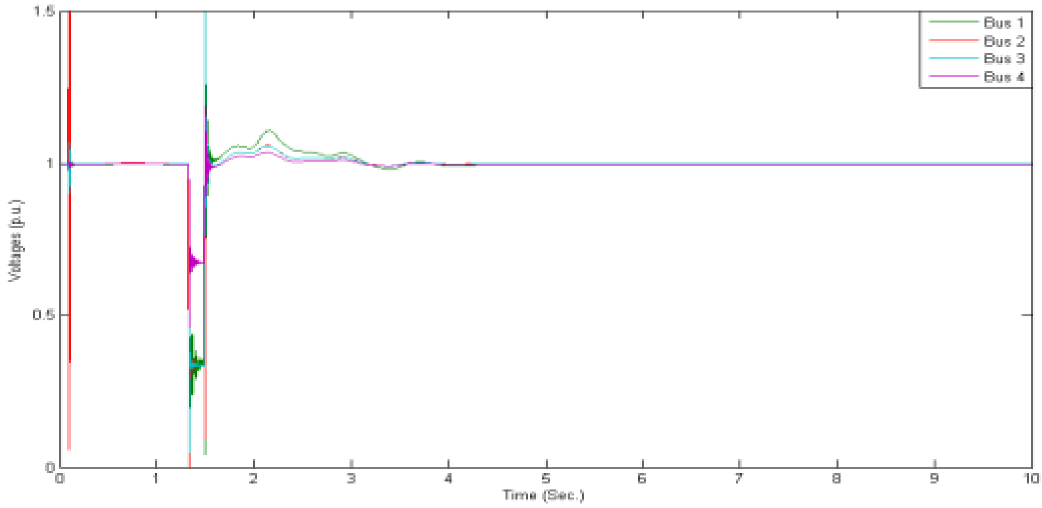

Fig. 1.4 Voltages (at bus 1-4) with 3-ϕ fault at bus 2

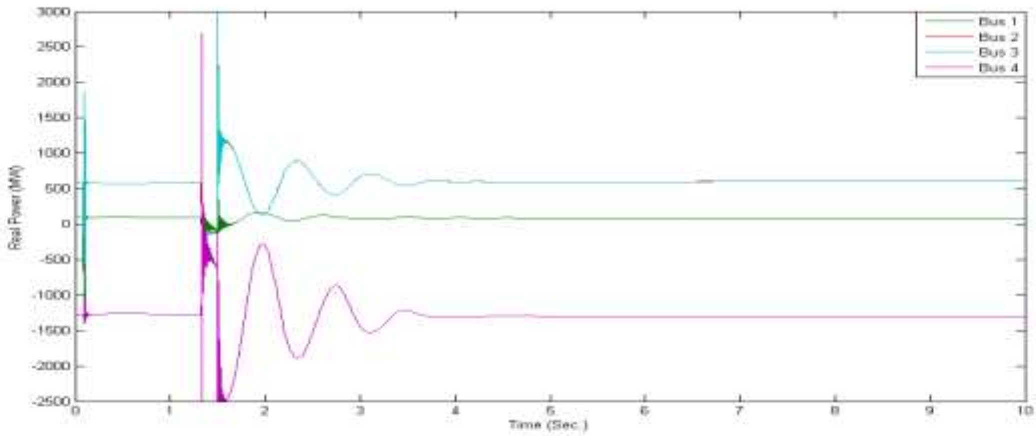

Fig. 1.5 Active power (at bus 1-4) with 3-ϕ fault at bus 2

1.2 Simulation Model of Two Machine System with 3-Phase Fault & SSSC-based Damping Controller

In this case a SSSC-based power oscillation damping controller is connected between bus B1 and bus B2 of the two machine infinite bus system model with 3-phase fault of fig. 1.2

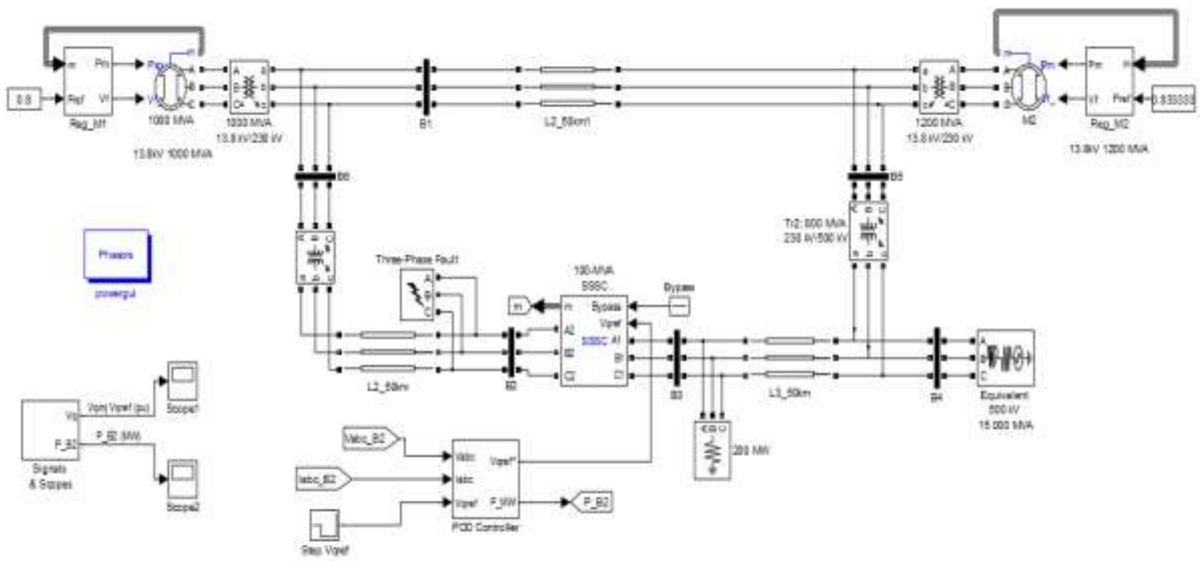

Fig. 1.6 Simulation model of two machine infinite bus with 3-phase fault & SSSC-based damping controller

With the control of effect of 3-phase fault on two machine system by SSSC-based power oscillation damping controller, results of the variation of magnitude of injected voltage, magnitude of active powe at bus-2, magnitude of voltages, active power across bus1-4 versus time are shown in fig. 1.7 to 1.10.

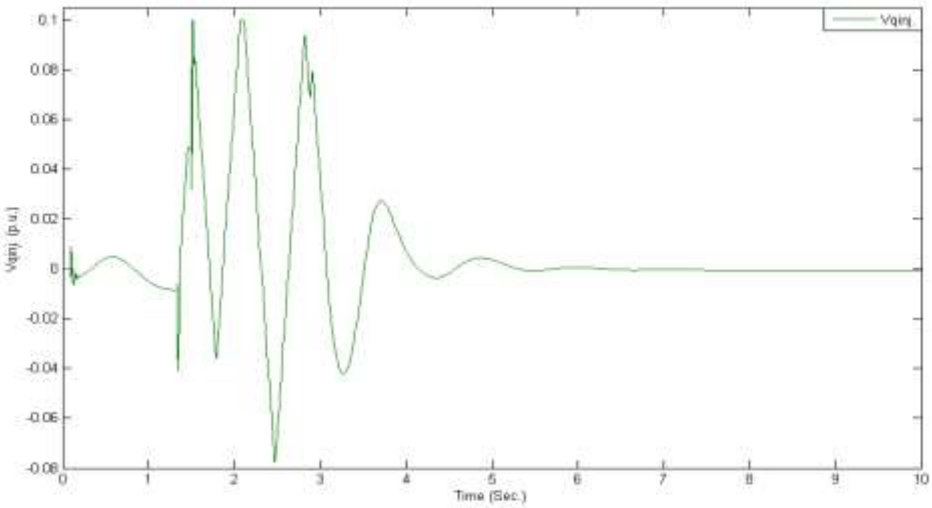

Fig. 1.7 Vqinj. by SSSC-based POD with 3-ϕ fault at bus 2

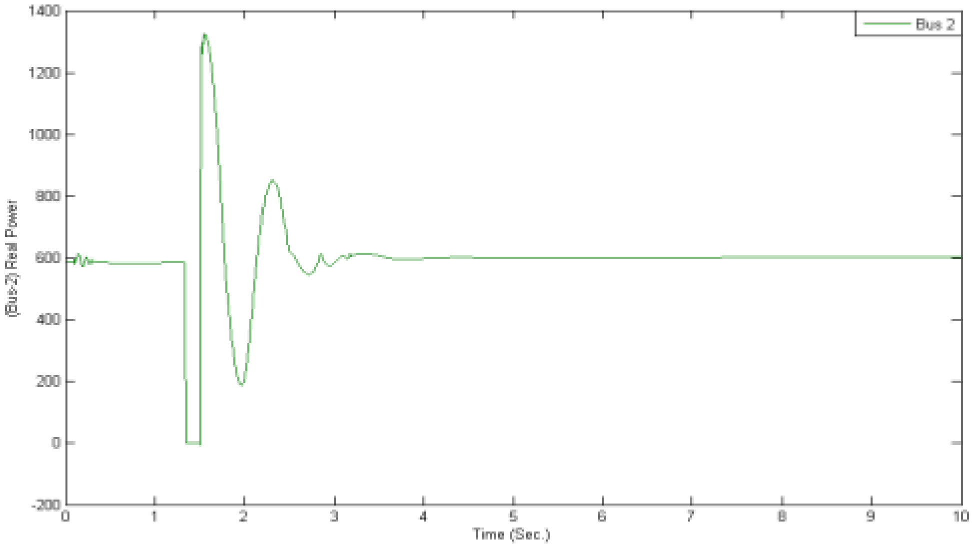

Fig.1.8 Active power (at bus 2) using SSSC-based POD with 3-ϕ fault at bus 2

it is seen that by the use of SSSC-based damping controller, there is a injection of voltage which varies abruptly across zero value so as to compensate the effect of power oscillations which genarates due to the occurance of 3-phase fault at bus 2. This compensation of oscillations of active power at bus 2 is shown in fig. 4.8, where period of oscillation remains for about 1.5 sec.The effect of 3-phase fault and SSSC-based damping controller simultaneously on voltages, active power of remaining buses are shown in fig. 1.9 to 1.10 respectively

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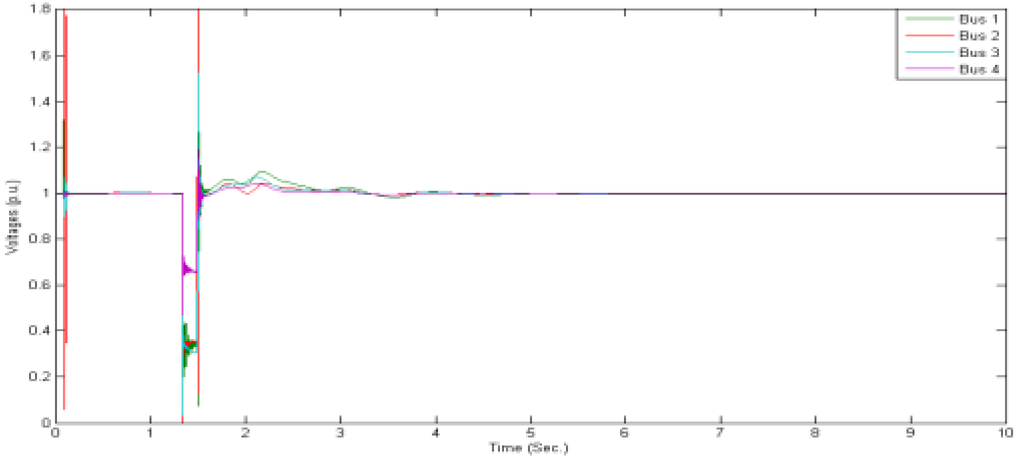

Fig. 1.9 Voltages (at bus 1-4) using SSSC-based POD with 3-ϕ fault at bus 2

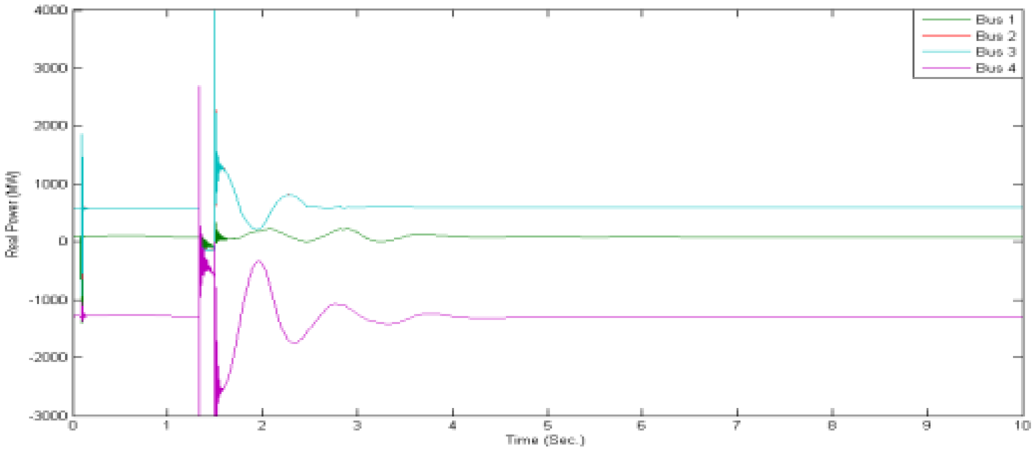

Fig. 1.10 Active power (at bus 1-4) using SSSC-based POD with 3-ϕ fault at bus 2

III. RESULTS AND DISCUSSION

1.3 Comparison of Two Machine System with 3-Phase Fault and SSSC-based Damping Controller

Fig.1.11and 1.12 shows the comparison of results of variation of injected voltage , magnitude of bus-2 active power versus time with 3-phase fault & SSSC-based damping controller

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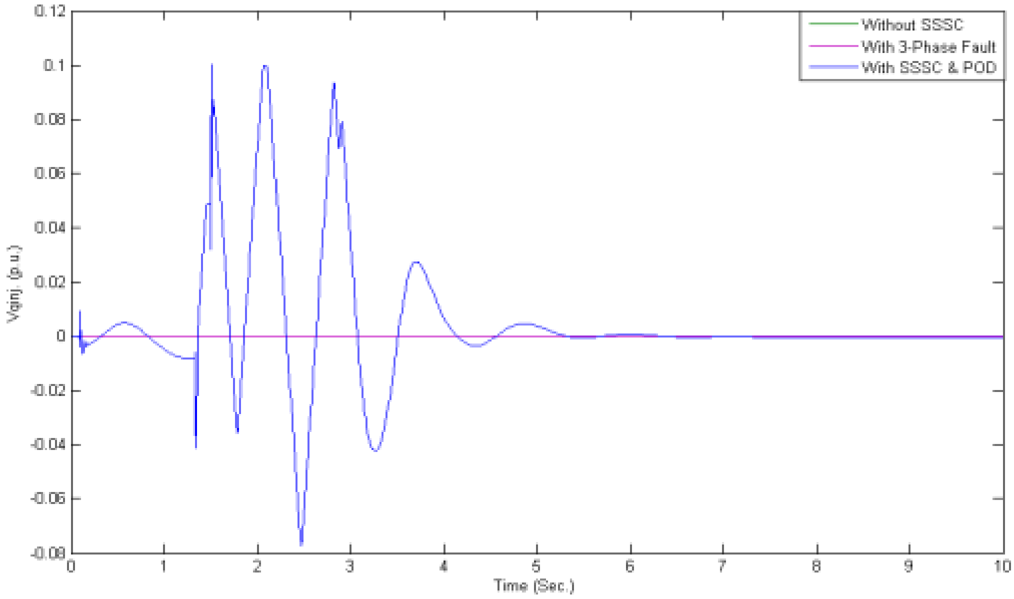

Fig. ***1.11 Vqinj. by SSSC-based POD with 3-ϕ fault at bus 2***

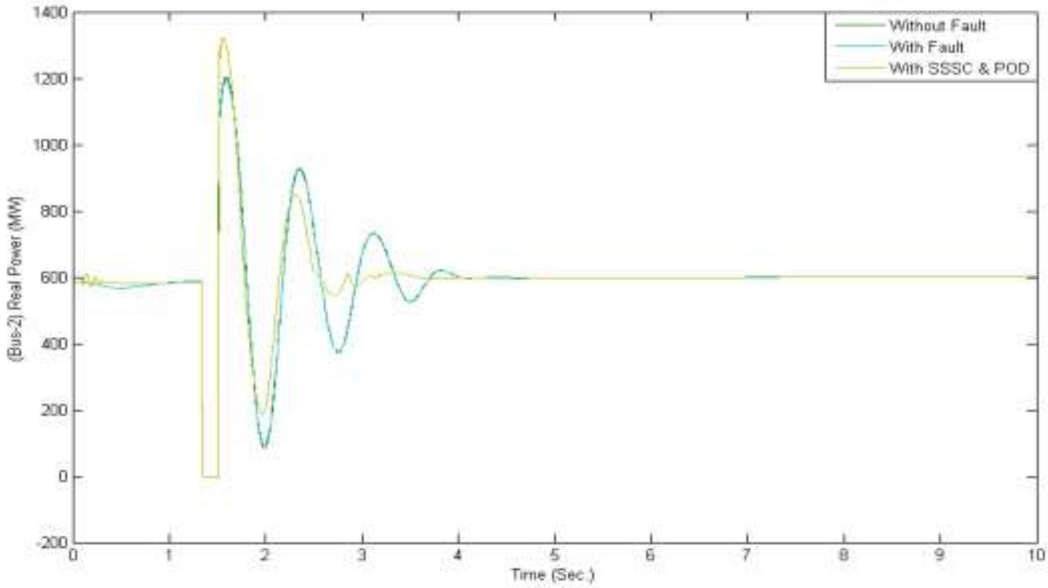

Fig. 1.12 Active power (at bus 2) using SSSC-based POD with 3-ϕ fault at bus 2

Fig. 1.11 shows the injected voltage by SSSC-based damping controller to compensate active power oscillations at bus 2. As shown in fig. 1.12, without the use of SSSC-based damping controller, after clearance of 3-phase fault active power at bus 2 changes abruptly from 1.5 sec. to 5 sec. But with the use of SSSC-based damping controller, after clearance of fault at 1.5 sec. oscillations in active power at bus 2 remain up to 3 sec. i.e for a time of about 1.5 sec.

IV. CONCLUSION

Simulation model of the two machine infinite bus system using SSSC & power oscillation damping controller has been done in MATLAB/SIMULIINK and power system toolbox is used for simulation purpose. In this two machine infinite bus system increase and decrease in active power demand has been shown in one step of each. It is observed that with the proper change of phase of the injection of voltages through SSSC, capacitive & inductive compensation can be provided by which increased and decreased in the active power respectively of transmission line can be done according to the mentioned power demand, but when only the SSSC is used in the line the settling time and amplitude of power oscillations are more as compared when SSSC is used with power oscillation damping controller. It also enhances the power carrying capability of other buses connected to the system. In this two machine infinite bus system 3-phase fault analysis at bus 2 is also done. It is observed that the clearance time is less when the system is provided with SSSC and power oscillation damping controller together.

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