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Stability Enhancement of Power System By FACTS Devices with Different Controllers

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Abstract—This paper explores an improvement in maintaining the potential of the power system by utilizing FACTS devices like SSSC, SVC, STATCOM and UPFC. The continuous demand for electric power has made the network extremely loaded, leading to voltage insecurity. Under over whelming stacked regulations there might be an uncomfortable opposition energy leads to loss of potential. This decrement in potential leads to less potential in various parts in the system. The contextual investigation for dual-space electricity network has been considered in this paper. A distinctive blame examination gives idea about FACTS devices have development in motional constant. Out of all the FACTS devices, UPFC is best in providing the shortest fault clearing time in dual-pivot model of the network. For analyzing the controller, MATLAB 2016(a) is used. The analysis is carried out using PI controller and fuzzy logic controllers.

IndexTerms— FACTS, SSSC, STATCOM, SVC, UPFC, MATLAB.

I. INTRODUCTION

Reliable and efficient operation of a power system requires an instantaneous matching between generation and the consumer side. The instantaneous changes in the load side is regular and generally considered as normal as these changes are in tiny variations with finite time period. Electricity framework balance is typically a challenge. Electricity framework dependability may be characterized as its capacity to react to andisturbance from its typical activity by coming back in original regulation when working remains ordinary. At the point on adequate period passed over an disturbance, initial variation may respond to increment as well as to decrement. The typically happening is around one or one-and half seconds. Motional time maintains continuous inertia maybe 5 to 10 second sporadically reaches to 30 second based upon an inactivity of network attributes. At last thesystem settles to new optimum position.

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II. METHODOLOGY

In electricity network it is necessary to maintain continuous reliable power. Due to some obstacles, it is difficult to maintain settling time without any controller. Hence, we are using different controller equipped FACTS devices to reduce the settling time. Let's take a two-region framework (space -1 and space-2) with series and shunt FACTS devices, associated on long solitary transmission cable as demonstrated fig 3.1 and fig.3.2. In this arrangement, sequence FACTS devices like UPFC, SSSC, as well as TCSC connected between tranport-2 and transport-3 and the shunt FACTS device such as SVC are connected at transport-2.True power steams from space-1 to space-2.On two-zone electricity framework, the space-1 consists of Alternator1 & Alternator2 .In the case of space-2 consists of Alternator3 & Alternator4

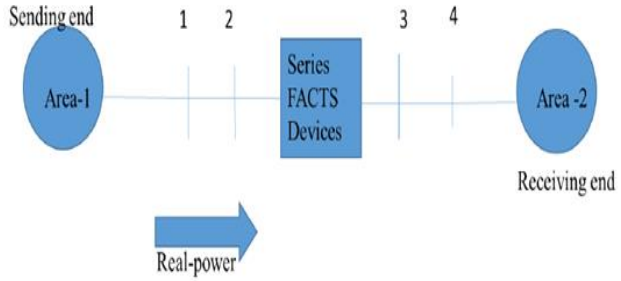

Fig 1:Dual-space electricity framework by using sequence FACTS Gadgets

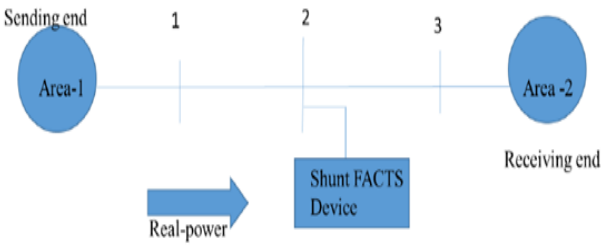

Fig 2: Dual-space electricity framework by using bypass FACTS gadgets.

A. CONTROL STRATEGIES

1. PI CONTROLLERS

It is abbreviated as proportional integral controller. It helps to reduce the steady state faults. When the speed variation of the

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controller is not important then this controller is used. It does not has the ability to find out the upcoming errors. It improves time and back and forth motions

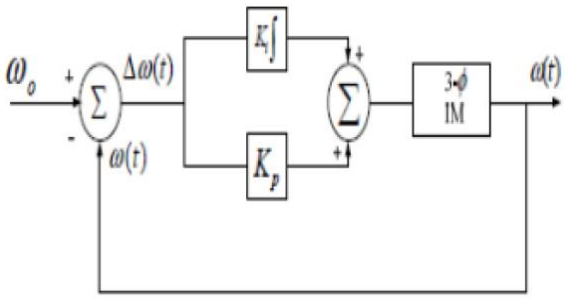

Fig 3:Block diagram of PI controller

2. PID CONTROLLERS

It is abbreviated as proportional integral derivative controller. It is a combination of parallel controller, serial controller, and mixed controller. It is algorithmically designed in industrial purpose.It has zero steady state error and quick/rapid response or short raise time and stability.

3. FUZZY LOGIC CONTROLLER

It is composed by linguistic rules. The numerical parameters are converted in to linguistic parameters fuzzy logic does not use mathematical calculations.

3.1 It has seven fuzzy sets.
3.2 Membership is calculated in triangular manner.

4. FUZZIFICATION

It has seven fuzzy subsets: NB (Negative Big), NM (Negative Medium), NS (Negative Small), ZE (Zero), PS (Positive Small), PM 5 (Positive Medium), and PB (Positive Big). The partition of fuzzy subsets and the shape of membership CE (k) E (k) function adapt the shape up to necessary system. The value of input error and change in error are normalized by an input method.

Change In Error	Error						
	NB	**NM**	**NS**	**Z**	**PS**	**PM**	**PB**
NB	PB	PB	PB	PM	PM	PS	Z
NM	PB	PB	PM	PM	PS	Z	Z
NS	PB	PM	PS	PS	Z	NM	NB
Z	PB	PM	PS	Z	NS	NM	NB
PS	PM	PS	Z	NS	NM	NB	NB
PM	PS	Z	NS	NM	NM	NB	NB
PB	Z	NS	NM	NM	NB	NB	NB

Table 1: Table of fuzzy logic controller

$$E(k) = \frac{P_{ph(k)} - P_{ph(k-1)}}{V_{ph(k)} - V_{ph(k-1)}}$$

$$CE(k) = E(k) - E(k-1)$$

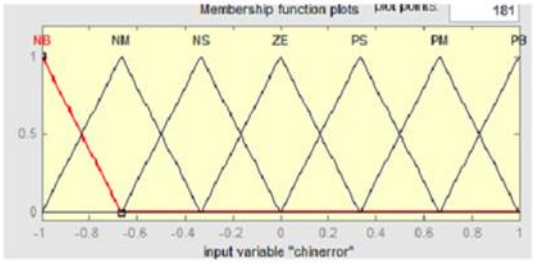

Fig **4: waveforms of fuzzy logic controller**

5. DEFUZZIFICATION:

It is the method of producing a quantifiable result in logic. This method charts a fuzzy set to a definite set governed by a set of rules

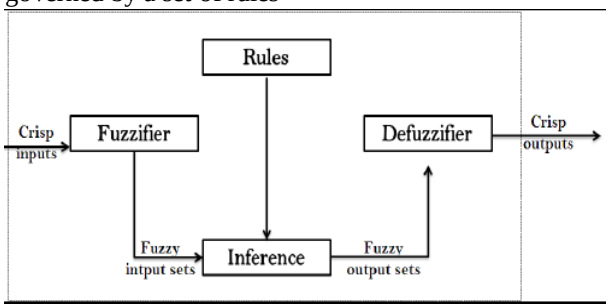

Fig 5: Defuzzification

III. MATLAB AND SIMULINK

MATLAB (matrix laboratory) it is one of the interpreted language itis very easy to solve the matrices, load functions, generating harmonics etc. It is very easy to learn and simple to use. By using the SIMULINK, only we can run the MATLAB functions. In Simulink with the help of display, we can see the data, with the help of scope we can see the waveform present in it. This software firstly modified by LINPACK, EISPACK. We can modified the present Simulink diagram after modifying the diagram. Itoperate on a system windows XP/8/10. The version of MATLAB used for this project is MATLAB2016 (a).

A. SIMULINK MODEL:

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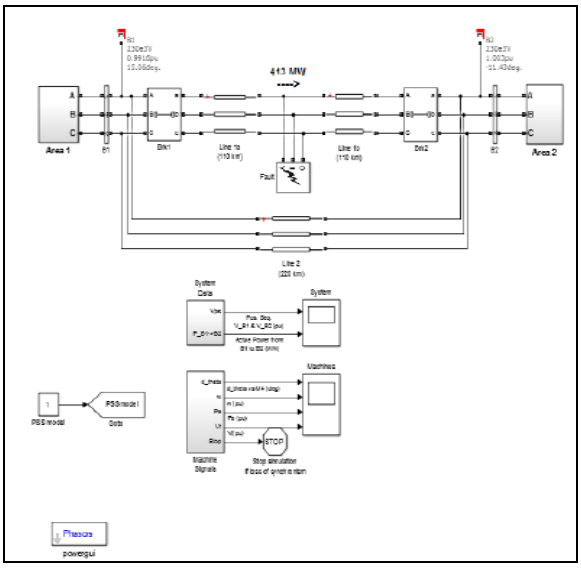

Fig 6: Model forsystem with no FACTS controller

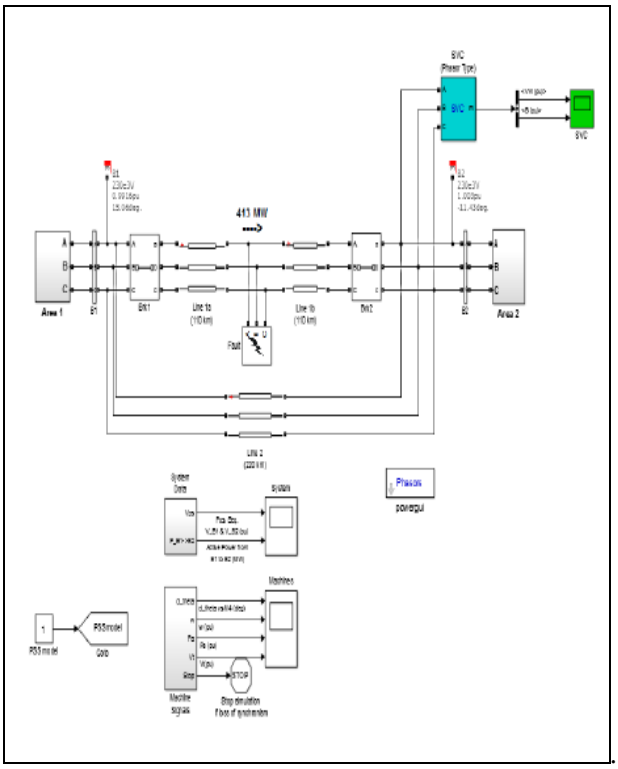

Fig 7:Model for system with SVC

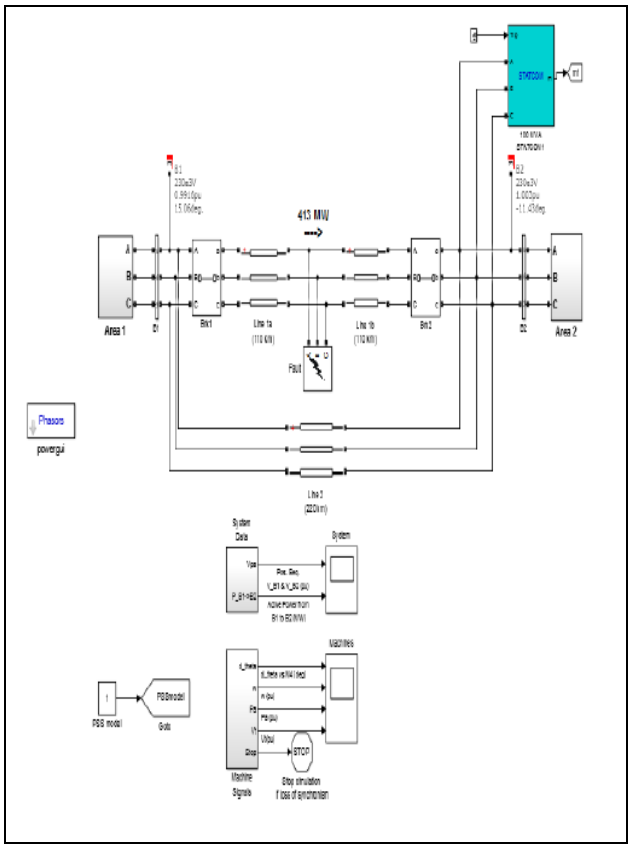

Fig 8: Model for system withSTATCOM

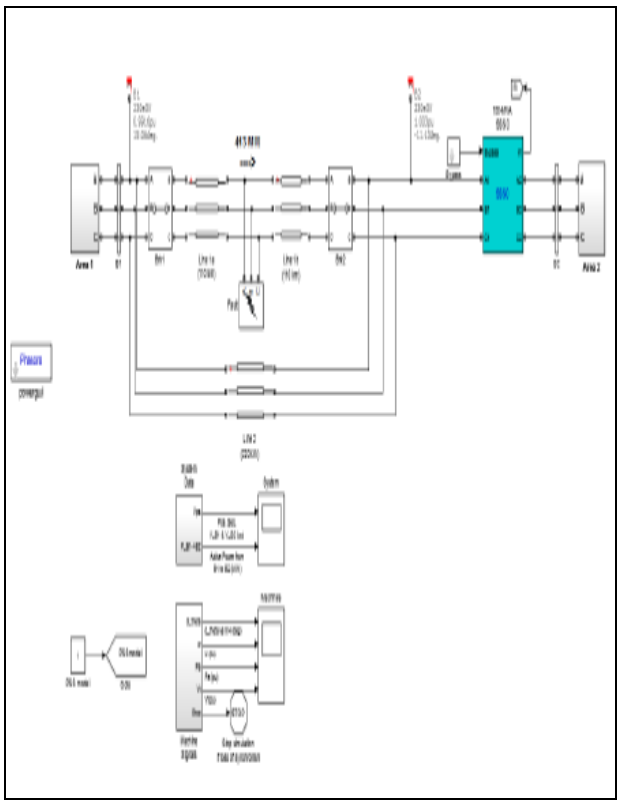

Fig 9: Model for system with SSSC

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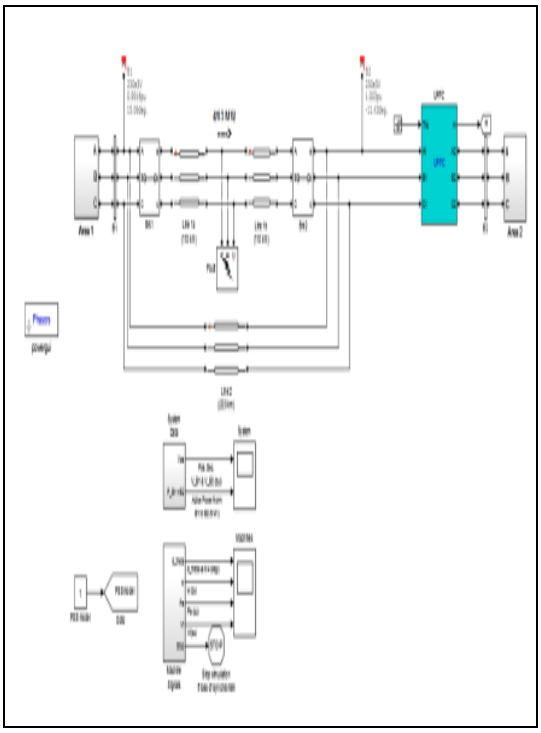

Fig 10:Model for system with UPFC

IV. RESULTS AND DISCUSSIONS

Representation of waveform with noFACTS device connected:

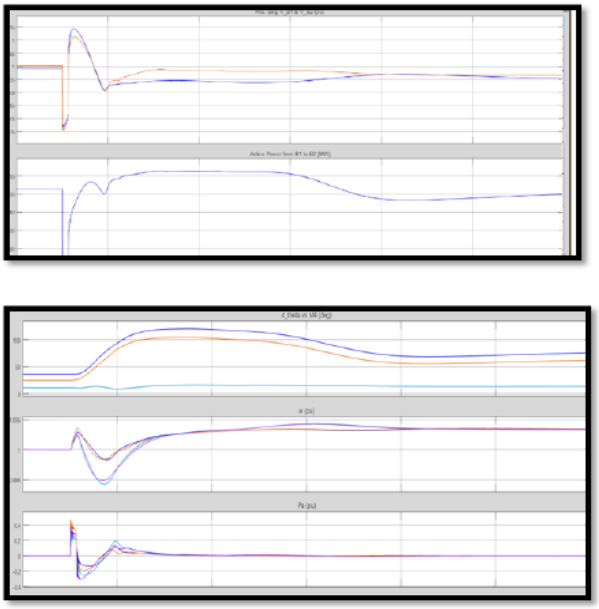

Fig 11: Graph of Rotor angle &energy Vs Time when FACTS device is not connected

From the waveform, it shows that x-axis is taken as time and y-axis is taken as energy in first waveform. In second waveform, y-axis is taken as rotor angle. The maximum point of the waveform is 105^0.After 12 sec fault reduces and we get a constant supply.

Representation of waveform when SVC is connected in dual region system:

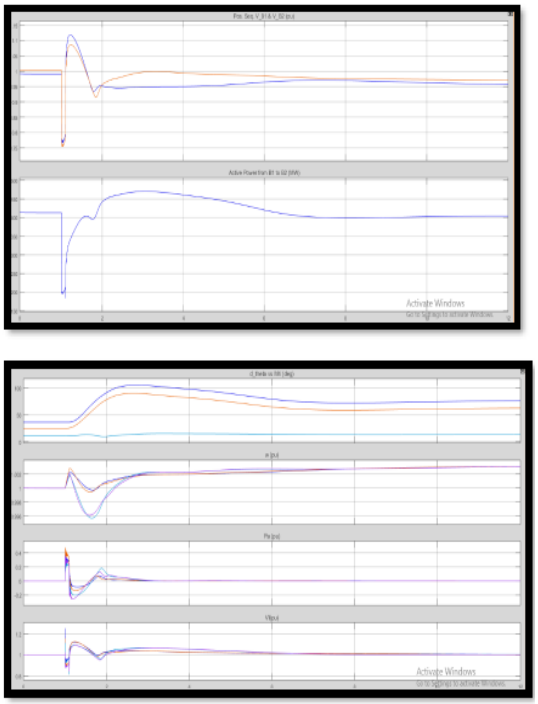

Fig 12: Graph of Rotor angle &energy Vs Time when SVC is connected in dual region system

From the waveform, it shows that x-axis is taken as time and y-axis is taken as energy in first waveform. In second waveform, y-axis is taken as rotor angle. The maximum point of the waveform is 105^0.After 6 sec fault reduces and we get a constant supply.

Representation of Waveform of when STATCOM is connected in the dual region system:

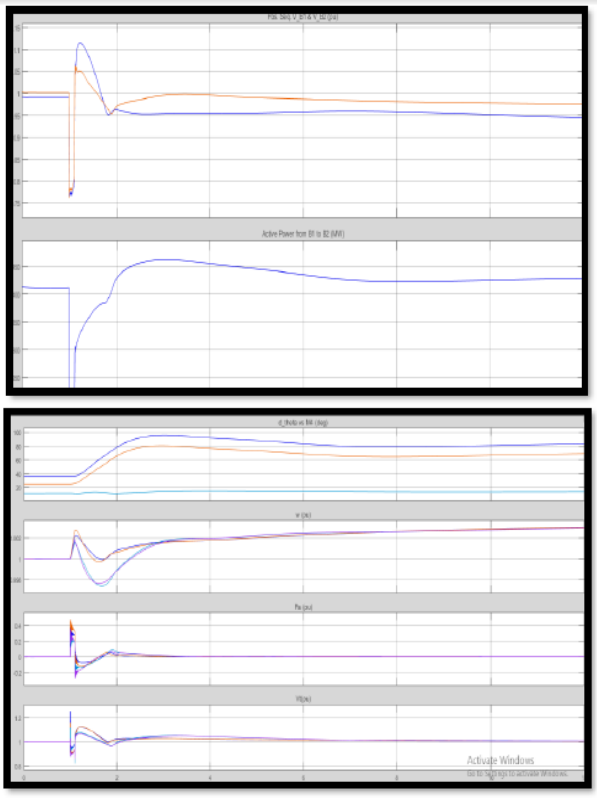

Fig 13: Graph of Rotor angle &energy Vs. Time with STATCOM connected in dual region system

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From the waveform, it shows that x-axis is taken as time and y-axis is taken as energy in first waveform. In second waveform, y-axis is taken as rotor angle. The maximum point of the waveform is 100^0.After 5.9 sec fault reduces and we get a constant supply.

Representation of Waveform when SSSCis connected in dual region system

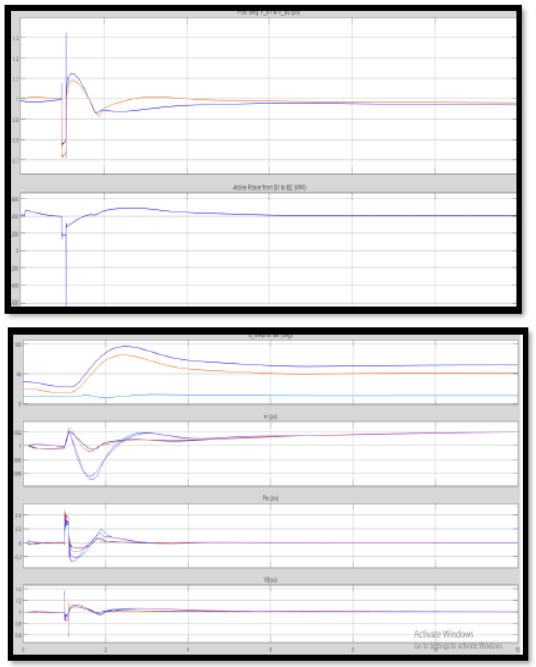

Fig14: Graph of Rotor angle &energy Vs Time with SSSC in dual area system

From the waveform, it shows that x-axis is taken as time and y-axis is taken as energy in first waveform. In second waveform, y-axis is taken as rotor angle. The maximum point of the waveform is80^0. After 6 sec fault reduces and we get a constant supply.

Representation of Waveform when UPFC is connected in dual region system:

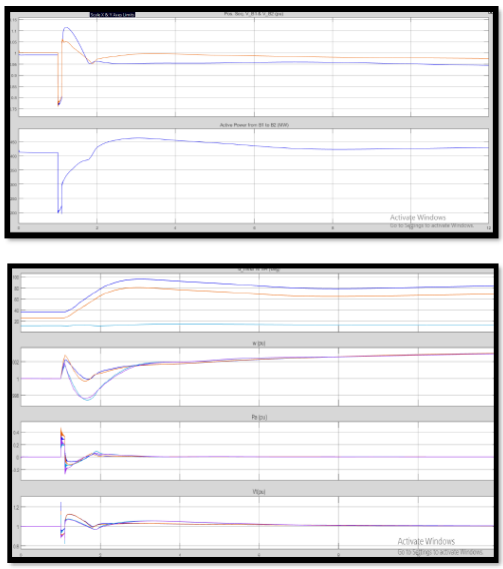

Fig 15: Graph of Rotor angle &power Vs. Time with UPFC indual area system

From the waveform, it shows that x-axis is taken as time and y-axis is taken as energy in first waveform. In second waveform, y-axis is taken as rotor angle. The maximum point of the waveform is95^0. After 5.5 sec fault reduces

Dual region system	**Stability improvement**	**Fault reducing time(sec) by PI and PID controller**	**By applying FUZZY LOGIC CONTROLLER time (in seconds)**
With UPFC	Improved	5.53	3.81
With STATCOM	Improved	5.91	3.93
With SVC	Improved	6.12	4.14
With SSSC	Improved	6.17	NA
No FACTS	Not improved	12.21	NA

Table 2: Comparison of different FACTS devices settling time.

Examination of theabove table clearlyshows that when FACTS devices areused the settling time isdecreased considerably.When UPFC is used, it takes less time as 5.5 sec to settle. Hence that UPFC is the best FACTS device from above result

V. CONCLUSION

In this paper, we are used different FACTS controller with the utilization of fault conditions and analyzing the performance of controllers. Initial dual –region system is taken and a three-phase fault is created as well as perceptions are set aside a few minutes. After the fault in the test system the outcomes of various gadgets are analyzed. The shunt associated FACTS devices, STATCOM in one of the most solid at constant perspective. Fault reducing period in STATCOM are little as contrast with SVC as shunt associated FACTS gadgets. UPFC is combination of shunt and series device associated FACTS balanced out, in general execution UPFC are substantially speeder as compared to different FACTS gadgets. Final execution investigations are finished in the assistance as MATLAB Simulation demonstration.

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REFERENCES

[1]. J.Gokula Krishnan, N.Senthil Kumar, M.Abdullah Khan, "On the optimal tuning of FACTS based stabilizers for dynamic stability enhancement in multimachine power systems", IEEE Conference, 2011.
[2]. N.K.Sharma, P.P.Jagtap, "Modelling and application of Unified Power Flow Controller (UPFC)" Third International Conference on Emerging Trends in Engineering and Technology, IEEE pp 350-355, 2010.
[3]. Arun Kumar and G. Priya, "Power system stability enhancement using FACTS controllers", IEEE press, 2012.
[4]. Kakkar, V., & Agarwal, N. K "Recent trends on FACTS and D FACTS".In modern electric power systems (MEPS), proceedings of the international symposium IEEE.pp. 1-8, 2010.
[5]. IEEE/CIGRE Joint Task Force on Stability Terms and Definitions, "Definition and classification of power system stability", IEEE Transaction.On Power System Stability. Vol. 19, No. 2, pp. 1387 1400, May 2004.
[6]. N.G. Hingorani, L. Gyugyi, "Understanding FACTS," New York: IEEE Press, pp. 2, 29, 135, 300 and 417.
[7]. P.M Anderson , A.A Fouad " power system control for stability enhancement"
[8]. control system book by A.V bhakshi and U.A bhakshi.
[9]. "fuzzy logic controller engineering applications" by Timothy j Ross
[10]. "Fuzzy set theory fuzzy logic and their applications " by Bhargava A.K

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