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Congestion Management in Deregulated Electricity Market with Facts Devices using Firefly Algorithm

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***Abstract* - The job of an self-governing system operator in a aggressive market atmosphere would be to make easy the total send off of the power that gets constricted among the market. With the development of an growing quantity of bilateral contracts being assigned for bazaar trades, the opportunity of inadequate property primary to group congestion may be inevitable. Real-time congestion in transmission line can be defined as the working situation in which present is not sufficient transmission potential to apply all the traded communication concurrently due to a number of unpredicted contingencies. Firefly algorithms is assigned to locate best solutions of piercing non-linear uninterrupted mathematical designs. Firefly Algorithm is solitary of the current elapsing designs which is encouraged by fireflies actions in environment. A sequence of elapsing experiments by every algorithm were studied. The outcome of this testing were understand and compared to the optimal solutions set up consequently far-off on the origin of signify of completing moment to join to the most favorable. The Firefly algorithm seems to execute superior for advanced mode of noise.**

***Index Terms*—Flexible AC Transmission system(FACTS), unified power flow controller(UPFC),30 bus system, firefly algorithm.**

I. INTRODUCTION

With the continuing expansion and enlargement of the electric convenience engineering, counting deregulation in several countries, frequent changes are constantly being designed to a one time conventional business[1]. Now, supplementary than ever, modern technologies are aim for the sensible and safe operation of [3] power systems. Enhanced operation of the presented power system is obtained through the submission of[6] superior organize technologies. The prospective profit of FACTS tools are now broadly acknowledged by the[9] power systems manufacturing and T&D networks.

In stable [13]state, the shunt converter of the UPFC provisions the real power requirement of the series converter. To avoid unsteadiness/loss of DC[14] link capacitor voltage during transitory conditions, a fresh real power coordination controller has been planned. The desire for reactive[15] power harmonization controller for UPFC request from the piece of matter that tremendous bus voltage (the bus to which the shunt converter is modeled) excursions occur for the period of reactive power transmission.

II. SCOPE OF THE PRESENT EXPLORATION

UPFC which contains series and a shunt converter associated by a general dc link capacitor can concurrently perform the job of transmission line real/reactive power flow control in totaling to UPFC bus voltage/shunt reactive power control. The shunt converter of the UPFC reins the UPFC bus voltage/shunt reactive power and the dc link capacitor voltage. The series converter of the UPFC reins the transmission line real/reactive power flows by controlling a series voltage of adaptable amount and phase position. The communication among the series injected voltage and the transmission line current superier to real and reactive power switch over among the series converter and the power system. Under set state conditions, the real power requirement of the series converter is complete by the shunt converter. But at some stage in transient conditions, the series converter real power requirement is abounding by the dc link capacitor. If the matter regarding the series converter real requirement is not communicated to the shunt converter control system, it might pilot to fail of the dc link capacitor voltage and following elimination of UPFC from operation. Extraordinarily little or no notice has been given to the significant feature of coordination control among the series and the shunt converter control systems.

The real power coordination said in this project is dependent on the acknowledged fact that the shunt converter ought to give the real power requirement of the series converter. In this crate, the series converter gives the shunt converter control system an corresponding shunt converter real power mention that having the error due to vary in dc link capacitor voltage and the series converter real power requirement.

The control system modeled for the shunt converter in cause's expensive stoppage in relaying the series converter real power demand in sequence to the shunt converter.This might superier to scandalous organization of the overall UPFC control system and successive collapse of dc link capacitor voltage below transient.

The key to the reactive power management controller is the transmission line reactive power position. The shunt converter Q-axis power system with the reactive power coordination controller shown. The failure circuit mention the reactive power coordination controller. The grow of the failure circuit has been selected to be 1.0.

This is for the reason that, a few increase/decrease in the transmission line reactive power flow owing to modify in its location is supplied by the shunt converter. The failure time constant is modeled based on the comeback of the power system to stair modification in transmission line reactive power flow not including the reactive power coordination controller. conditions. In this development, a novel real power coordination controller has been residential to stay away from volatility/excessive loss of dc link capacitor voltage through transient conditions.

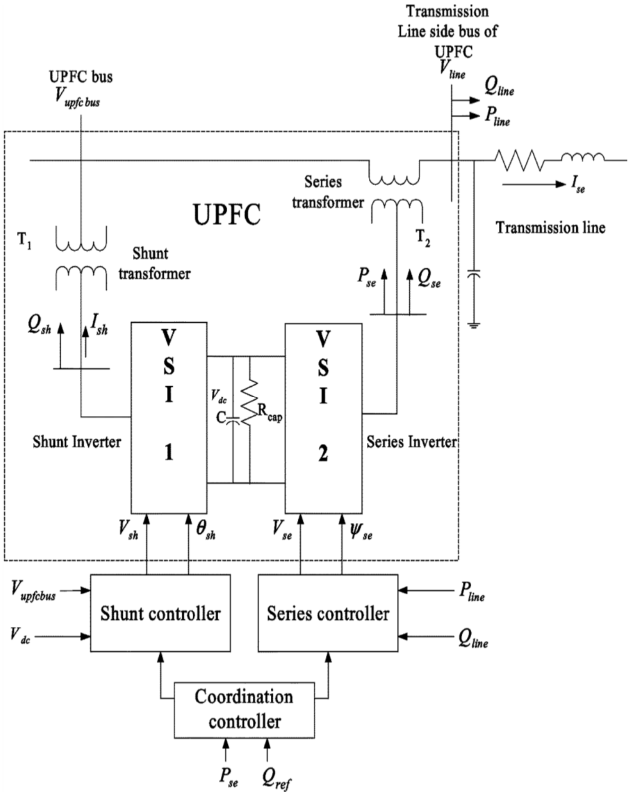
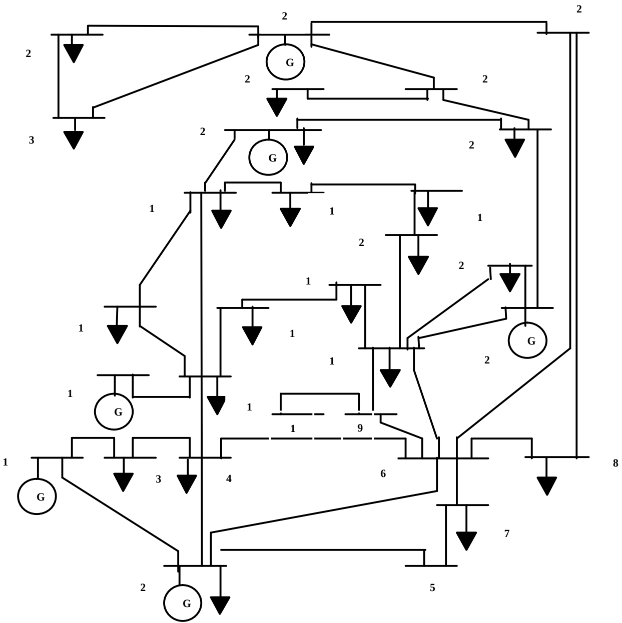


Fig. 1. UPFC connected to a transmission line.

In difference to real power coordination among the series and shunt converter control system, the organize of transmission line reactive power flow superier to extreme voltage excursions of the UPFC bus voltage through reactive power transactions. This is owing to the reality that a few modify in transmission line reactive power flow aimed by compensating the magnitude/phase angle of the sequence injected voltage of the UPFC is really supplied by the shunt converter. The extreme voltage excursions of the UPFC bus voltage is owing to lack of reactive power coordination between the series and the shunt converter control system. This feature of UPFC organize has too not been observed earlier. A modern reactive power coordination controller among the series and the shunt converter control network has been modeled to limit UPFC bus voltage excursions through reactive power transfers.

III. 30 BUS SYSTEM

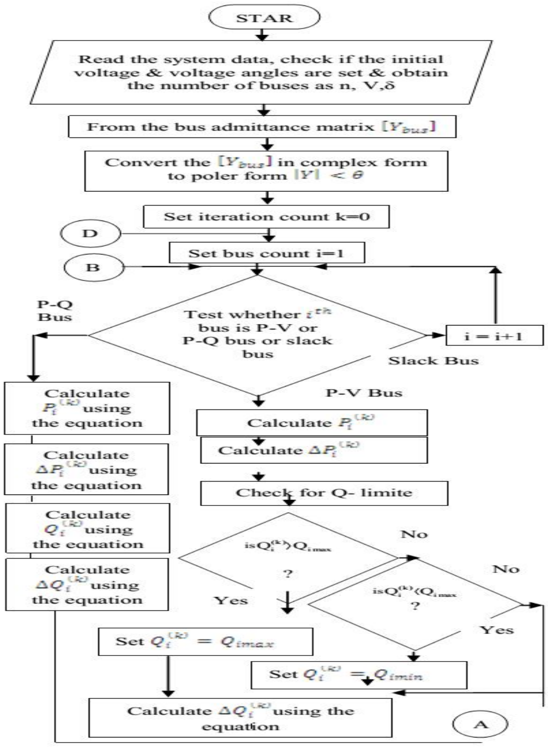


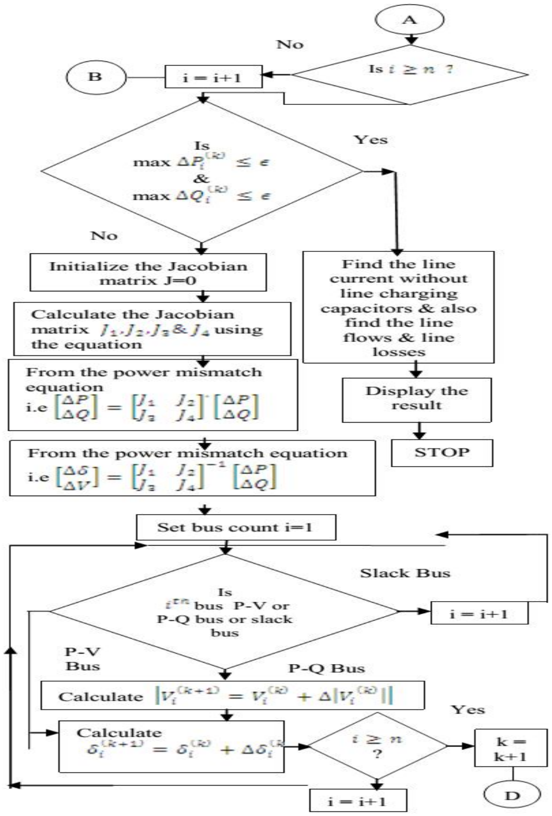
To realize the model of a real power coordination controller used for a UPFC, consider a UPFC coupled to a transmission line as shown in Fig. 3. The interface between the series injected voltage (Vse) and the transmission line current (Ise) superier to replace of real power between the series converter and the transmission line. The real power (Pse) requirement of the series converter (Pse) induces the dc link capacitor voltage (Vdc) to moreover increase or decrease based on the route of the real power flow from the series converter. This reduce/boost in dc link capacitor voltage (Vdc) is measured by the shunt converter controller that compensate the dc link capacitor voltage (Vdc) with acts to reduce/boost the shunt converter real power flow to give the dc link capacitor voltage (Vdc) reverse to its planned value. Otherwise, the real power requirement of the series converter is acknowledged by the shunt converter controller just by the reduce/boost of the dc link capacitor voltage (Vdc). Thus, the force and the series converter process are in a mode splitted from each other. To give for good organization between the shunt and the series converter control system, a reaction from the series converter is given to the shunt converter control system. The comment signal is the real power requirement of the series converter (Pse). The real power requirement of the series converter (Pse) is transformed into an identical D-axis current for the shunt converter (iDse).

iDse = Pse / l Vupfc bus l (1)

The real power requirement of the series converter (Pse) is the real part of invention of the series converter injected voltage (Vse) and the transmission line current (Ise). Vupfc bus, iDse signify the voltage of the bus to which the shunt converter is linked and the same extra D-axis current that ought to flow during the shunt converter to provide the real power demand of the series converter. The same D-axis extra current signal (iDse) is given to the inner control system, in that way rising the usefulness of the coordination controller. Additional, the interior control system loops are quick performing PI controllers and make sure quick supply of the series converter real power requirement (Pse) by the shunt converter.

IV. NR METHOD





V SIMULATION RESULTS

POWER FLOW RESULTS FOR 30 BUS SYSTEM		POWER FLOW RESULTS FOR 30 BUS SYSTEM(AFTER CONGESTION)	
Total Generation in P (MW)	191.64	Total Generation in P (MW)	192.01
Total Generation in Q(MVAR)	100.41	Total Generation in Q(MVAR)	95.84
Total Load in P (MW)	189.20	Total Load in P (MW)	189.20
Total Load in Q(MVAR)	107.20	Total Load in Q(MVAR)	107.20

Fig.1.Power flow calculation

POWER FLOW RESULTS FOR 30 BUS SYSTEM		POWER FLOW RESULTS FOR 30 BUSSYSTEM(AFTER CONGESTION)	
Total Loss in P (MW)	2.444	Total Loss in P (MW)	2.813
Total Loss in Q(MVAR)	8.99	Total Loss in Q(MVAR)	4.59

Fig.2.Total loss calculation

LINE LIMIT CALCULATION FOR 30 BUS SYSTEM							
LINE	RA	RB	RC	**LINE**	RA	RB	RC
1-2	130	130	130	**6-8**	32	32	32
1-3	130	130	130	**6-9**	65	65	65
2-4	65	65	65	**6-10**	32	32	32
3-4	130	130	130	**9-11**	65	65	65
2-5	130	130	130	**9-10**	65	65	65
2-6	65	65	65	**4-12**	65	65	65
4-6	90	90	90	**12-13**	65	65	65
5-7	70	70	70	**12-14**	32	32	32
6-7	130	130	130	**12-15**	32	32	32

Fig.3.Line limit calculation

LINE LIMIT CALCULATION FOR 30 BUS SYSTEM							
LINE	RA	RB	RC	**LINE**	RA	RB	RC
LINE	RA	RB	RC	**LINE**	RA	RB	RC
12-16	32	32	32	**10-22**	32	32	32
14-15	16	16	16	**21-22**	32	32	32
16-17	16	16	16	**15-23**	16	16	16
15-18	16	16	16	**22-24**	16	16	16
18-19	16	16	16	**23-24**	16	16	16
19-20	32	32	32	**24-25**	16	16	16
10-20	32	32	32	**25-26**	16	16	16
10-17	32	32	32	**29-30**	16	16	16

Fig.4. Line limit calculation

LINE LIMIT CALCULATION FOR 30 BUS SYSTEM(AFTER CONGESTION)							
LINE	RA	RB	RC	**LINE**	RA	RB	RC
1-2	138	138	138	**6-8**	32	32	32
1-3	137	137	137	**6-9**	68	68	68
2-4	71	71	71	**6-10**	34	34	34
3-4	134	134	134	**9-11**	71	71	71
2-5	140	140	140	**9-10**	66	66	66
2-6	70	70	70	**4-12**	69	69	69
4-6	93	93	93	**12-13**	68	68	68
5-7	74	74	74	**12-14**	32	32	32
6-7	131	131	131	**12-15**	33	33	33

Fig.5. Line limit calculation during congestion

LINE LIMIT CALCULATION FOR 30 BUS SYSTEM(AFTER CONGESTION)							
LINE	RA	RB	RC	**LINE**	RA	RB	RC
12-16	33	33	33	**10-22**	34	34	34
14-15	17	17	17	**21-22**	33	33	33
16-17	16	16	16	**15-23**	16	16	16
15-18	17	17	17	**22-24**	16	16	16
18-19	16	16	16	**23-24**	17	17	17
19-20	34	34	34	**24-25**	16	16	16
10-20	33	33	33	**25-26**	17	17	17
10-17	34	34	34	**29-30**	16	16	16
10-21	34	34	34	**6-28**	32	32	32

Fig.6. Line limit calculation during congestion

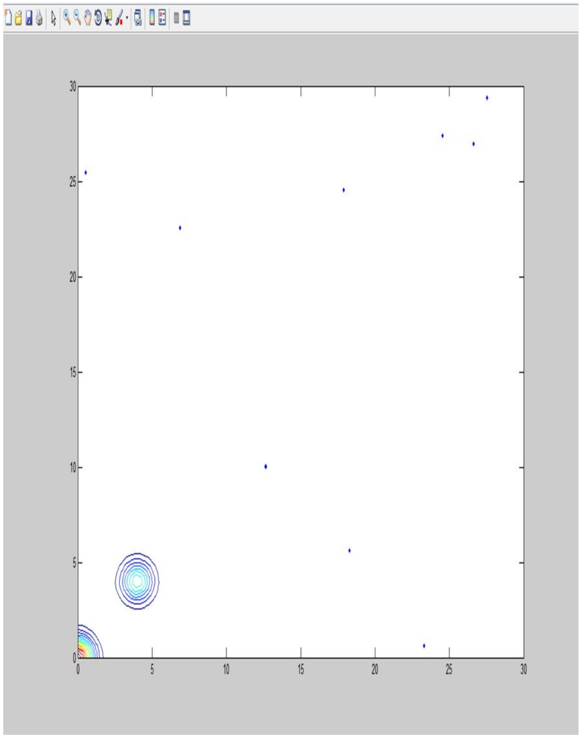


Fig.7. Firefly algorithm

POWER FLOW RESULTS FOR 30 BUS SYSTEM(SOLVED BY FIREFLY ALGORITHM)	
Total Generation in P (MW)	191.64
Total Generation in Q(MVAR)	100.41
Total Load in P (MW)	189.20
Total Load in Q(MVAR)	107.20
Total Loss in P (MW)	2.444
Total Loss in Q(MVAR)	8.99

Fig.8. Power flow results solved by Firefly algorithm

LINE LIMIT CALCULATION FOR 30 BUS SYSTEM(SOLVED BY FIREFLY ALGORITHM)							
LINE	RA	RB	RC	**LINE**	RA	RB	RC
1-2	130	130	130	**6-8**	32	32	32
1-3	130	130	130	**6-9**	65	65	65
2-4	65	65	65	**6-10**	32	32	32
3-4	130	130	130	**9-11**	65	65	65
2-5	130	130	130	**9-10**	65	65	65
2-6	65	65	65	**4-12**	65	65	65
4-6	90	90	90	**12-13**	65	65	65
5-7	70	70	70	**12-14**	32	32	32
6-7	130	130	130	**12-15**	32	32	32

Fig.9. Line limit calculation during Firefly algorithm

LINE LIMIT CALCULATION FOR 30 BUS SYSTEM(SOLVED BY FIREFLY ALGORITHM)							
LINE	RA	RB	RC	**LINE**	RA	RB	RC
LINE	RA	RB	RC	**LINE**	RA	RB	RC
12-16	32	32	32	**10-22**	32	32	32
14-15	16	16	16	**21-22**	32	32	32
16-17	16	16	16	**15-23**	16	16	16
15-18	16	16	16	**22-24**	16	16	16
18-19	16	16	16	**23-24**	16	16	16
19-20	32	32	32	**24-25**	16	16	16
10-20	32	32	32	**25-26**	16	16	16
10-17	32	32	32	**29-30**	16	16	16

Fig.10. Line limit calculation during Firefly algorithm

VI.CONCLUSION

In this discussion, the presentation of UPFC coupled to a transmission line has been modeled and computed. This development also says, the control plan for real and reactive power of the transmission line modeled with UPFC. For the revision of FACTS technique, simulation with MATLAB performed. The performance of UPFC was computed together in open loop and closed loop control conditions. The outcome of the simulation visibly shows that Unified Power Flow Controllers are efficient to provide the safety, ability and elasticity of power transmission systems.

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