

DOUBLE CONTROL SMART GRID SYSTEM USING POWER FLOW CONTROL SYSTEM OF UPFC & PST

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Abstract: Before we can start to modernize the present matrix, we initially require a reasonable vision of the power framework required for what's to come. Understanding that vision, we can make the arrangement important to motivate energy, speculation, and advance toward the Smart Grid for the 21st century. The Smart Grid is an important empowering influence for a prosperous society later on. Vitality supply has turned out to be a standout amongst the most difficult issues confronting the world in the 21st Century. Developing populace, more homes and organizations and a bunch of new machines have caused vitality request to soar in all aspects of the nation. Utilities over the globe are attempting to make sense of how to bring their systems into the 21st century and the advanced age. This push to make the power framework more astute is for the most part alluded to as making a "brilliant network". The business sees this change to a shrewd framework enhancing the strategies for conveyance and also utilization. In This Paper 'Best in class' of Smart Grid alongside the vision, application and control are presented. In this paper basically we present a two model which can improve the power flow control and try to reduce the loss issue from power grid and smart grid system.

Index Terms— Smart Grid, Power, Power Flow, Power Loss.

1. Introduction

1.1 SMART GRID

Keen Grid supports capable and trustworthy end-to-end clever two-way transport structure from source to sink through coordination of reasonable power sources, splendid transmission and scattering. Thusly Smart Grid advancement may get viability and reasonability dealing with the creating power request with immovable quality and best of the quality. Splendid Grid moreover enables consistent checking and control of vitality structure and furthermore helps in reduction of AT&C adversities, ask for response and demand side organization, impact quality organization, power outage organization, Smart home imperativeness system et cetera. Keen Grid will go about as a spine establishment to engage new plans of activity like splendid city, electric vehicles, sagacious gatherings isolated from more grounded and profitable essentialness system and exact structures.

POWERGRID has made leading steps in passing on Smart Grid advancement to all highlights of vitality supply regard chain and made splendid system pilot stretch out at Pondicherry through open joint exertion covering all characteristics of sharp lattice in circulation. Indian goliath control system is going up against the diverse issues. As a result of these issues, the advancement of energy publicize is direct.

The present system structure in this country is unfit to manage these abberations. To manage these mistakes and other average gets in charge system, there is a need to complete robotization. Overview these issue sharp Grid headways is to be available/embedded in charge game plan of our country. In these days Smart Grid is the panacea of most of the issues in the power structure. The sharp structure will check and slaughter the distinctive bottlenecks and inconsistencies in the present power cross section framework. The Indian power networks are not secure, strong and up to the stamp. To reduce these does not have, the advancement of "Astute Grid" is required. The Smart Grid can be made by move advancement, instruments and Smart organization system .Smart Grid is a crucial response to the natural, social, and political solicitations, set on essentialness supply.

The Smart power framework ends up being altogether more perplexing than a standard power grid as time-fluctuating wellsprings of essentialness and new one of a kind weights are facilitated into it. The splendid cross section's versatile quality will progress after some time and require new developments for beneficial, strong and secure operation and control as the enthusiasm for control increases. The inspiration driving Smart Grid is to recognize and overhaul supply ask for imbalance rapidly and perceive faults through a self-recovering" process that upgrades organizations quality, viability, enhances immovable quality and declines costs. With the propelled innovations, the savvy electric power matrix will be secure, dependable and bi-directional.

1.2 DEFINITIONS OF SMART GRID

While there is no formal definition of the smart grid, but according to the features of it based on literature, "the Smart Grid is a modern grid which consist the advanced technologies of electrical engineering, communication engineering and software engineering with the present power grid".

To full-fill the objective of electrical power sector, the Smart Grid has the great characteristics.

1. Safe and Reliable: The electricity is still on the power supply capacity for the user, rather than a large area power outage in large electricity failures, malfunctions, natural disasters and extreme weather, or man-made damage done to maintain.

2. Efficient and Economical: power grid, will be able to improve the economic benefits through related policy innovation, management and energy efficient, and market competition orderly.

3. Clean and Green: With the large-scale of renewable energy sources, Smart Grid can reduce the potential impact on the environment e.g., carbon emission reduction, more green energy.

4. Optimization: The most appropriate price of the electrical energy provide to the society. Smart grid to optimize resource utilization; reduce investment costs and operation and maintenance costs. Quality of power meets industry standards and consumer needs.

5. Interactive: With the interaction and real-time response to the power market and users, the services are increased. Mature wholesale market operations in place, well integrated nationwide and integrated with reliability coordinators.

6. Self-healing: The new power grid has a features Self-healing. It is a process that improves services quality, enhances reliability and reduces costs. It identify and correct supply demand imbalance instantaneously and detect faults.

7. Flexible and Compatible: The new power grid can support correct, reasonable integration of renewable energy resources and it is suitable for integration of distributed generation and micro power grid. Moreover, it can improve and enhance the function of demand side management to achieve the efficient interaction capability with consumers. It is compatible with the present grid also.

8. Integrated: A unified platform and model are employed on a grid. It can obtain good quality of integration and information sharing of power grid and to achieve standard, normative and refined management that integrates the infrastructure, processes, devices, information and structure of market so that electricity can be generated, distributed, and used more efficiently and cost effectively.

2. Unified Power Flow Controller

A Combination of static synchronous compensator STATCOM and a static series compensator SSSC which are coupled via a common dc link, to allow bidirectional flow of real power between the series output terminals of the SSSC and the shunt output terminals of the STATCOM , and are controlled to provide concurrent real and reactive series line compensation without an external electric energy source. The UPFC, by means of angularly unconstrained series voltage injection, is able to control, concurrently or selectively, the transmission line voltage, impedance, and angle or, alternatively, the real and reactive power flow in the line.

The UPFC may also provide independently controllable shunt reactive compensation.

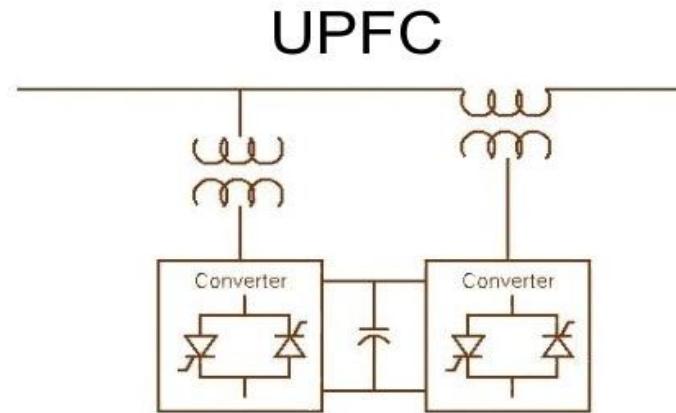


FIG. 1 Block Diagram of UPFC

- MAY CONTROL VOLTAGE, IMPEDANCE, AND ANGLE.
- IMPACTS ACTIVE AND REACTIVE POWER FLOW IN LINE.

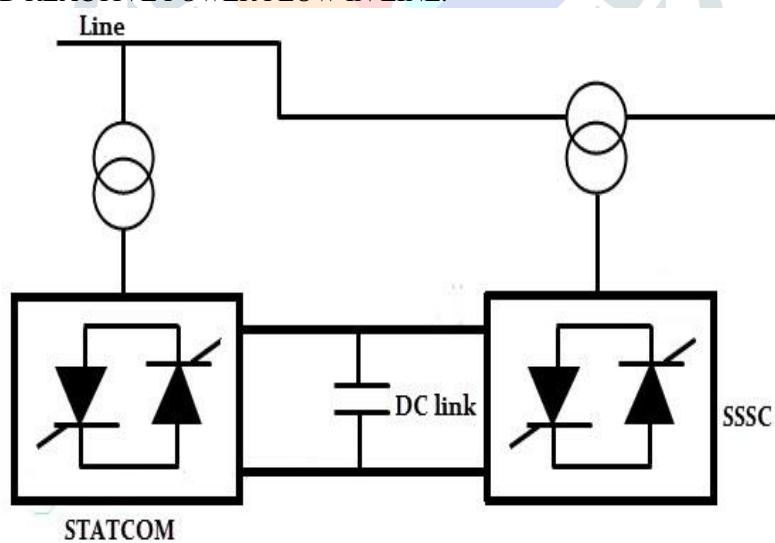


FIG. 2 Schematic Diagram of UPFC

The UPFC was devised for the real- time control and dynamic compensation of ac transmission systems, providing multifunctional flexibility required to solve many of the problems facing the power delivery industry.

Within the framework of traditional power transmission concepts, the upfc is able to control, simultaneously or selectively, all the parameters affecting power flow in the transmission line i.e., voltage, impedance, and phase angle, and this unique capability is signified by the adjective “unified” in its name.

Alternatively, it can independently control both the real and reactive power flow in the line. The control of real power is associated with similar change in reactive power, i.e., increased real power flow also resulted in increased reactive line power.

The flexible AC transmission system (FACTS) controllers such as Unified power flow controller (UPFC) can strongly improve the different parameters in a power system.

3. Literature Review

Here we demonstrate the past work which is done by some investigation in the region of smart grid. M. R. Aghaeibrahimi, "power consumption management and control for peak load reduction in smart grids using upfc" in this paper, a power usage organization show is familiar with control the zenith stack decreasing in a smart grid using the unified power flow controller (upfc). [12]

P.ramesh, dr. M .damodara reddy "adversity reducing through perfect course of action of unified power-flow controller" the purpose of this paper is to lessen impact setback and improve the voltage profiles in an electrical structure in perfect way. The versatile ac transmission structure (facts) controllers, for instance, unified power stream controller (upfc) can vehemently improve the differing parameters in a power system. Upfc can be used to improve voltage profiles, decrease line hardships and augmentation line transmission limits. The enhanced task of facts devices is a fundamental issue, so the voltage relentlessness list (l-record) has been used as a piece of demand to place upfc in control system. The advantage of the l-list is to animate the progression process.[13]

T.nireekshana, dr.g.kesavarao, dr.s.siva naga raju "joining of unified power flow controller model for optimal placement using particle swam optimization technique, in this work another numerical model of upfc is delivered which can be easily intertwined in newton-raphson stack stream computation. Perfect region of upfc is settled in perspective of voltage stability index. Particle swarm optimization (pso) system is used to set the parameters upfc. The objective work characterized contains two terms: cost for imperativeness setback and cost related to upfc, which must be extended for net saving.[2]

M. R. Aghaeibrahimi, m. Tourani and m. Amiri, "influence usage organization and control for top load decreasing in smart grids using upfc," this paper proposes an organization exhibit for improved use diminishment which reduces setbacks, time costs and over-trouble in transmission lines in the midst of the apex time. Disregarding the way that the apex period cost is lessened, the cost of costumer's movements must be paid too, thusly these movements are associated with the end goal that the points of interest for the two social affairs will be maximal.[12]

This paper depicts the establishment of splendid information structure and the prerequisites for keen system information security. It familiarizes the figured examination with the procedure with the utilization of hermeneutic circle and information security utilitarian need unmistakable verification. Information security for the grid publicize cover matters fuses computerization and trades industry that impacts the operation of electric power systems and the working of the utilities that administer them and its regard for this information establishment has ended up being essential to the steady nature of the power structure. Gathering benefits by of cost speculation assets, flexibility and sending nearby the establishment of remote correspondences. In any case, concern pivots around the security confirmations for successfully accessible devices, for instance, the shrewd meter and the related correspondences hardware. On the other hand, the changing concentrations between regular versus splendid cross section arranging design and the information security centrality on the correspondence field reflects the criticality of system information security utilitarian need conspicuous verification. The goal of this paper is to recognize the helpful essential and relate its significance conveys to the purchaser need of an information security of a smartnetwork. Vulnerabilities may convey believability for an attacker to enter a framework, gain ground admission to control programming, change it to stack conditions that destabilize the grid in sporadic ways. Focusing on the structure information security utilitarian essential is wandering ahead in making client trust and satisfaction toward smart system completeness.[14]

4. Research Gap & Objective

As we can all existing approach are tacking about the power loss control but all those previous research are not enough to control it there is need of some more system which can intrigate with UPFC system and will help to reduce the power loss of smart grid system. So in this area there is lots of future objective will be there which further research are resolve and give a novel approach which is able to reduce to reduce the power loss on the smart grid system. So in this paper basically we present double control system model.

5. Proposed Methodology

In this section basically we present our proposed technique which is able to reduce the power loss and improve the power quality with small fluctuation in output power. So here basically we present two approaches and both approaches are far batter than previous existing approaches like UPFS, PST based power control model. As we know UPFA is able to improve both power active and reactive and PST is able to improve active power. But power boost is more on PST as compare to UPFA. Similar UPFC has less power fluctuations as compare to PST. That's we involve both technique and propose a new model which is combination of PST and UPFC model. So here we are discuss our first model which is:

5. 1. PST WITH UPFC MODEL

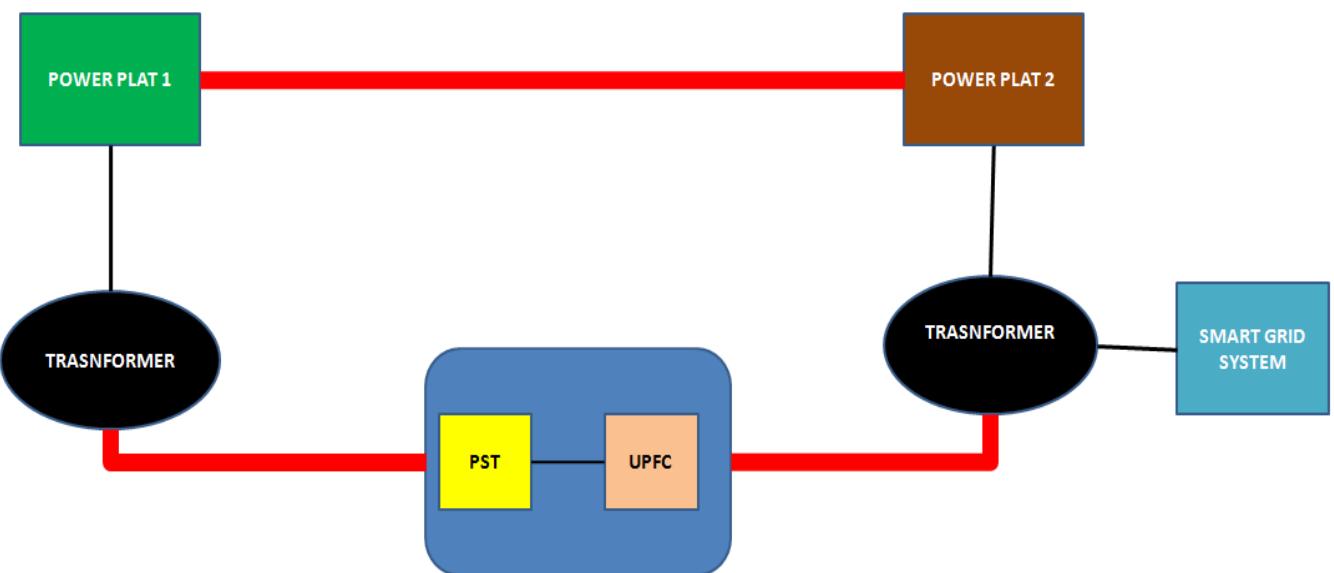


FIG. 3 Block Diagram of PST WITH UPFC

5. 2 UPFC WITH PST MODEL

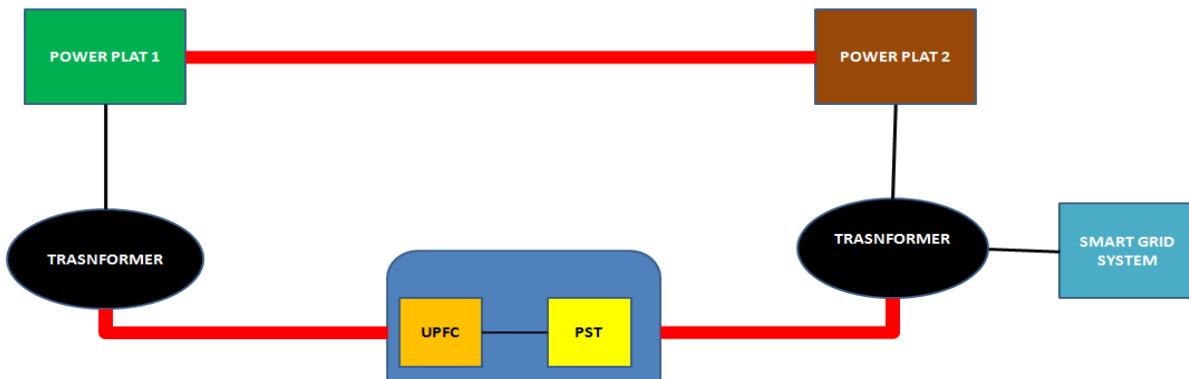


FIG. 4 Block Diagram of UPFC WITH PST

So these both proposed model are working in very good way they both are able to improve the power quality.

6. Result & Analysis

As we already discuss about our proposed model and as per our propose model we are able to improve both parameters which are:

1. Power Quality

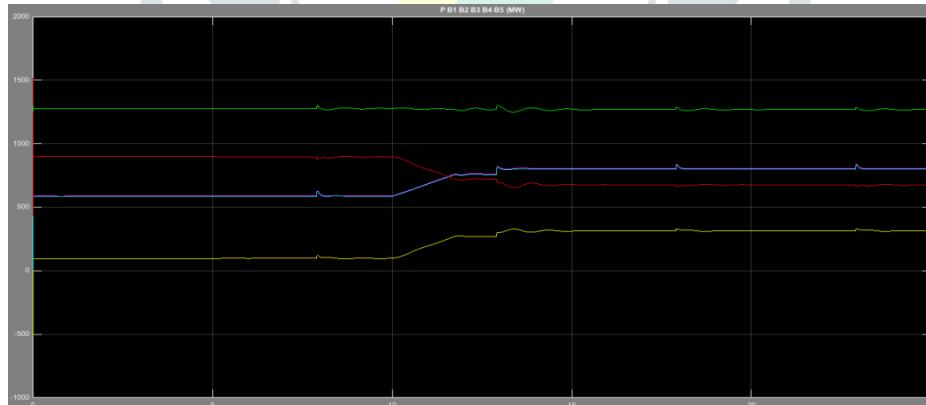
2. Reduction In Fluctuation

As per our proposed approach here we present our two model which are PST with UPFC and UPFC with PST. So as per the quality level analysis our both model are far batter than previous existing approach like PST, UPFC etc. But when we compare our both proposed approach so our UPFS with PST will give better result as compare to PST with UPFC.

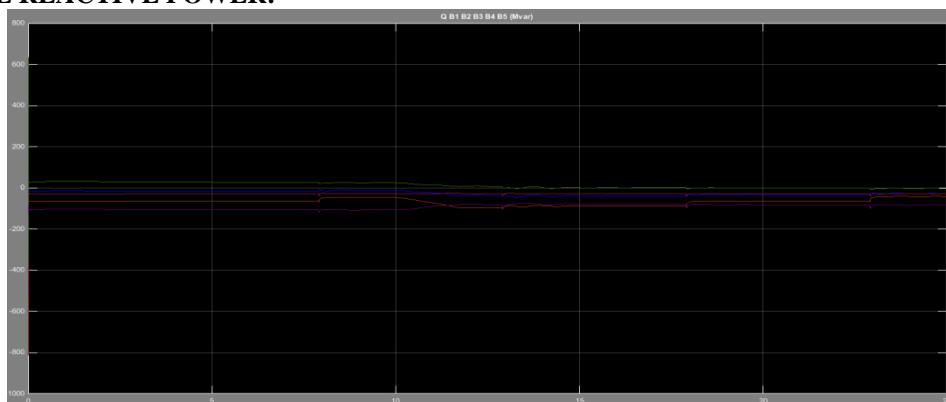
Table. 1 Parameter Analysis

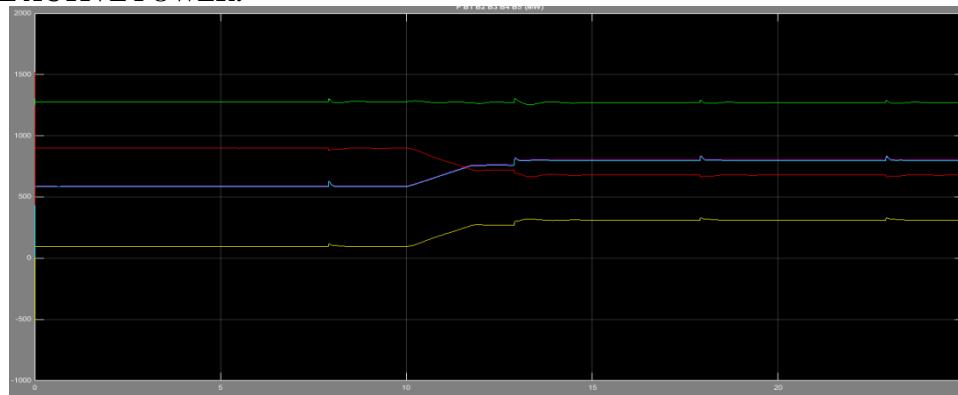
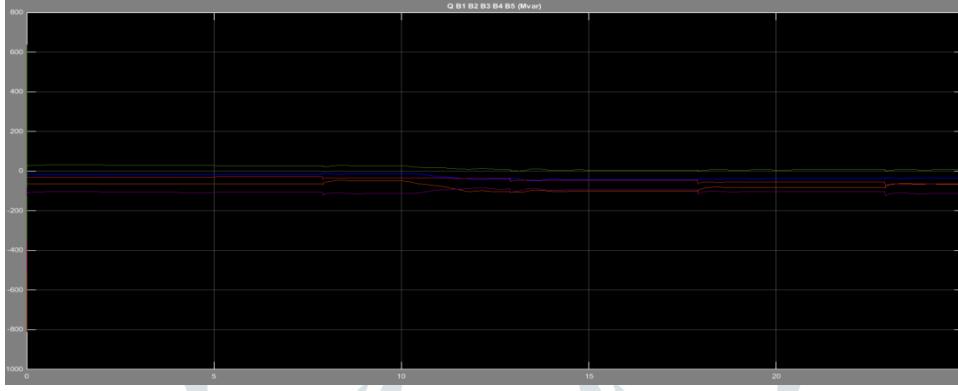
Parameter	Without	PST	UPFC	PST With UPFC	UPFC With PST
Voltage	<1	>1	=1	>1.05	>1.05
Active Power(MW)	1220	1450	1280	1450	1450
Reactive Power(MW)	35	40	40	50	50
Fluctuation	No	High	Avg.	Low	Very Low
Power Loss	Yes	Low	Avg.	Very Low	Very Low

PST WITH UPFC BASE ACTIVE POWER:



PST WITH UPFC BASE REACTIVE POWER:



UPFC WITH PST BASE ACTIVE POWER:**UPFC WITH PST BASE REACTIVE POWER:**

So as you can see there is lots of profit with our proposed model. Our proposed model is far better than as compare to UPFA and PST model. Overall our proposed model did improvement of approach 10-20%. Also our proposed model UPFC with PST performs well in terms of all parameters.

6. Conclusion

The lessening of energy utilization at crest hours not just diminishes the utility's cost of age and operation, yet in addition can achieve extensive advantages for the clients who co – work with the utility towards understanding the savvy lattice. In this paper we show the entire investigation about the current proposed which is attempt to decrease the power misfortune. In this paper basically we work on improvement of power quality and also did reduction in power loss with less fluctuation. We did improvement of approx 10-20% as compare to PST and UPFC approach.

REFERENCES

- [1]. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", New York: IEEE Press, (2000).
- [2]. T.Nireekshana, Dr.G.KesavaRao, Dr.S.Siva Naga Raju "Incorporation of Unified Power Flow Controller Model for Optimal Placement using Particle Swarm Optimization Technique", 978-1-4244-8679-3/11 IEEE, 2011.
- [3]. C.R.Fuerte-Esquivel, E.Acha, "Unified power flow controller: a critical comparison of Newton-Raphson UPFC algorithms in power flow studies", IEE Proceedings on Generation, Transmission, Distribution, Vol. 144, No. 5, pp. 437–443, Sept 1997.
- [4]. 1k. Venkateswarlu, 2ch. Saibabu," A New Evolutionary Algorithms Used For Optimal Location Of Upfc On Power System ",Jatit&Lls. All Rights Reserved,2005 – 2010.
- [5]. Jigar S.Sarda1, Manish J. Chauhan2, Viren B. Pandya3, Dhaval G. Patel4, "Optimal Location Of Multi-Types Of Facts Devices Using Genetic Algorithm", International Journal Of Research In Computer Science Eissn 2249-8265 Volume 2 Issue 3,Pp. 11-15,2012.
- [6]. Sreekanth Reddy Donapati and M.K.Verma , "An Approach for Optimal Placement of UPFC to Enhance Voltage Stability Margin under Contingencies", Fifteenth National Power Systems Conference (NPSC), IIT Bombay, December 2008.
- [7]. Kiran Kumar Kuthadi and 2 M. Suresh Babu , "A Modified Particle Swarm Optimization Technique For Solving Improvement Of Voltage Stability And Reduce Power Losses Using Upfc", Issn: 2248-9622, Vol. 2, Issue 3, Pp. 1516-1521 May-Jun 2012.
- [8]. M.BehshadA.Lashkarara A. H. Rahmani "Optimal Location of UPFC Device Considering System Loadability, Total Fuel cost, Power losses and Cost of Installation", 2nd International Conference on Power Electronics and Intelligent Transportation System, 2009.
- [9]. R.JahaniH.A.ShayanfarN.M.Tabatabaei J. Olamaei, "Optimal placement of UPFC power system by a New advanced Heuristic method", International Journal on —Technical and Physical Problems of Engineering, ISSN 2077-3528, December 2010.
- [10]. Bindeshwar Singh, N. K. Sharma and A. N. Tiwari, and S.P.Singh "Incorporation of FACTS Controllers in Newton Raphson Load Flow for Power Flow Operation" Bindeshwar Singh et. al. / (IJCSE) International Journal on Computer Science and Engineering Vol. 02, No. 06, 2117- 2124, 2010.
- [11]. Xin-She Yang," Firefly Algorithms for Multimodal Optimization", Xiv: 1003.1466v1 [math.OC] 7 Mar 2010. [13] K..Sudhakara Reddy, Dr. M. DamodarReddy,"Economic Load Dispatch Using Firefly Algorithm", International Journal of Engineering Research and Applications ISSN: 2248-9622 Vol. 2, Issue4, pp.2325-2330, , July-August 2012.

- [12]. M. R. Aghaeibrahimi, M. Tourani and M. Amiri, "Power consumption management and control for peak load reduction in Smart Grids using UPFC," *2011 IEEE Electrical Power and Energy Conference*, Winnipeg, MB, 2011, pp. 327-333.
- [13]. Ramesh, P., and M. Damodara Reddy. "Loss reduction through optimal placement of unified power-flow controller using firefly algorithm." *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering* 2.10 (2013): 4657-4667.
- [14]. Ling, Amy Poh Ai, and Mukaidono Masao. "Grid Information Security Functional Requirement-Fulfilling Information Security of a Smart Grid System." *arXiv preprint arXiv:1108.0267* (2011).

