International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-2 Issue-4, March 2013

Potentials and Capabilities of FACTS Controllers for Quality and Performance Enhancement of Power System

J. Sandeep Soni, H. P. Agrawal, R. Gupta and H.O. Bansal

Abstract-At present the demand of electrical power is growing day by day with a very fast rate, so we require much capable transmission and distribution system with the most excellent quality of supply. That's why power quality is a major issue in the distribution system and this is the area which attracts all electrical engineers. The major impact of poor quality of supply is on the highly loaded distribution system, on which the maximum load is connected. In this paper authors focus on the FACTS technology, classification schemes, applications, potentials and control attributes in terms of the performance and quality issues of power supply. Power quality means the non-standard supply voltage, supply current and supply frequency, that results malfunctioning or failure of operation of various equipments and accessories.

Key Words-FACTS devices, Transmission and distribution system, power quality and Power flow control.

I. INTRODUCTION

Power flow in alternating current (AC) systems is not similar with other kind of signal flow, like telecommunications system, in which packets of information can be routed such that they travel along a shortest path between a sender and a receiver by any suitable method or technique of communication. But power flow is not routable and cannot be directly controlled. In other systems of distributing goods and services, products can be stored in a warehouse until they need to be sent to the end user. If the desired supply is not available, the end user can wait until it arrives later. In power systems, customers are in control of how much power they use and always expect that amount of power to be available because electrical power can't store in huge amount so electricity is produced exactly when it is needed. The power distribution should be optimistic. [1] The reason for demanding high quality of power without interruption during production process is mainly because of the modern manufacturing and process equipments controlled with latest techniques, that operate at high efficiency requires stable and defect free power supply for the successful operation of their equipments and machines.

Manuscript published on 30 March 2013.
*Correspondence Author(s)
J. Sandeep Soni (M. Tech Scholar), EE Department, SEC, Dundload, Rajasthan, INDIA,
H. P. Agrawal, Vice Principal & HOD, EE Department, SEC, Dundload, Rajasthan, INDIA
Dr. R. Gupta, HOD & professor, Engg. College, Kota, Rajasthan, INDIA
Dr. H.O. Bansal, Associate Professor, EEE Department, BITS, Pilani, Rajasthan, INDIA

Modern technologies based machines are very much sensitive to power supply variations, so the power system should be designed more accurate and can be controlled with highly precise control devices.

For instance, some instruments like adjustable speed control drives, automation devices, power electronic based equipments etc. fall into the above category [2].

Flexible AC transmission system offers many potential benefits to power systems. Specific applications of FACTS devices for line flow control, active & reactive power flow control, loss minimization, Voltage control, ability of flexibility in operation & control and distributed reactive support to locations in the system where support is needed. To overcome the power quality problem of distribution system, we have number of power quality solution techniques by using FACTS controllers, which uses newly available power electronics devices.

The quality of supply should be as per standards otherwise, degraded output from utility may sometimes cause complete shutdown of the industries, which will make a significant financial loss to the industry. It has been observed that in industries, most of the conditions that can disturb the process are generated within the load area itself. For example, most of the non-linear loads cause transients, which can affect the stability, quality and reliability of the power supply. Following are the few abnormal electrical conditions that can disturb the healthy operation of transmission and distribution (T&D) system [3]:

- Voltage Sag (Dip).
- Very short time disturbance/interruption
- Long time disturbance/interruption
- Voltage spikes and swell
- Voltage fluctuation and unbalance
- Harmonics distortion and Noise

The power flow control problem is also complicated due to highly interconnected structure of transmission and distribution networks. Interconnection of smaller systems allows faulted areas to be quickly isolated, which causes less service interruption to customers. This will help supply reliability and improve load scheduling, load diversity, co-generation of different power generation stations. However, a utility cannot exactly & effectively knows how much power flows through the network due to the interconnections with other systems. When a transfer between two small or large areas occurs, it impacts the flows on the other part of the system also, even though that part may be far away.

The ability to flexibility and effectively control on power flow in a distribution network would allow better utilization of the existing network by routing power flow away from overloaded facilities by using load diversion. Furthermore, wide-ranging power flow control with flexibility can change the traditional power flow problem into a simple solvable problem, more like which have wide range of available transfer capability (ATC); means can be more routed with large control facilities and flexibilities. Approximately three decades ago, flexible AC transmission systems (FACTS) were introduced. A FACTS incorporates power electronics and controllers to enhance power system controllability, increase transfer capability, stability and reliability [4, 5].

FACTS or "flexible AC transmission systems" is a term that has been suggested for the use of solid state devices to control bulk power flow in T&D network. The Electric Power Research Institute supported this idea, and many researchers have invested efforts on the importance and potentials of FACTS. At this time, it appears that the main value of FACTS lies in improving transmission capability, increasing the flexibility of power flow control (e.g. for economic dispatch), for controlling Voltage (and VAR flow) and possibly additional advantages in lower Voltage distribution systems [6].

The power flow through a route is limited by the operating limits of the T&D line. The good quality of supply with secure operation can be done in satisfactory operating conditions only. Thus, T&D systems are being pushed closer to their stability and thermal limits, while the focus on the quality of power delivered is greater than ever. Dielectric limitation is relevant to insulation or Voltage rating of the line .The FACT technology could be used to ensure acceptable over Voltage and power flow condition [7, 8]. It is very critical that the system be able to maintain secure operation, even as any or all elements are put in and taken out of service or any kind of abnormal operating conditions. Number of benefits associated with the use of FACTS devices have been established in some successful applications by implementing various technologies in various applications in power system [1].

Even though FACTS devices are very important and much capable for enhance quality of supply, control and flexibility of operation in terms of technical, but they have not experienced the very big deployment that their theory may demand. Now a day's fortunately, technology in many areas of power system has become faster, less expensive, smaller in size, and ultimately better over the past number of decades. Recent development in computing solutions, wireless communications, microprocessors & microcontroller based electronic devices, and other electrical engineering technology affected all aspects of life. Fast improvement in available power system technologies with newly electronic devices will allow us to modify and enhance the properties of existing flexible AC transmission systems from a fresh perceptional area. One decade before introduced distributed flexible AC transmission system (D-FACTS) devices are very much capable to control the quality of supply [9, 10]. If we compare conventional FACTS devices to D-FACTS, devices, these devices are particularly small, light-weight and fast in response. D-FACTS devices can clamp onto T&D lines rather than in a separate building on the ground .D-FACTS devices are much capable to control the power flow through the transmission line.

FACTS devices are used to control power flow in the transmission grid to relieve congestion and control the quality of supply. High cost, quality and reliability concerns have limited the common deployment of FACTS solutions. The D-FACTS is an alternative approach which is having operation flexibility and control of power systems by providing active & reactive power flow control, loss reduction, Voltage and current control and also cost-effective. The fulfillments of the demand of various industrial, commercial, domestic and more loads were possible only because of the modern and innovative technologies of the utilities. D-FACTS devices are an improved and enhanced version of conventional FACTS devices, because they have a unique ability to provide flexibility in operation, wide range of control and distributed reactive support to locations in the system where support is needed [11, 12]. Furthermore, By using distribution automation in power system T&D systems, the D-FACTS devices can be made to communicate with other devices or with a central controller by wire or wirelessly. Communication allows coordination among the controllers or it can be controlled from a control room if SCADA system is implemented.

A. Review on FACTS Definitions

FACTS is a group of static equipments and devices used for the AC T&D of electrical energy. A power electronic-based system and other static equipment that provide control of one or more AC T&D system parameters. It is meant to enhance quality, controllability, flexibility and increase power transfer capability of T&D systems [14].

FACTS is defined by the IEEE as "a power electronic based system and other static equipment that provide control of one or more AC transmission system and increase the capacity of power transfer." FACTS can also be defined as: Alternating current transmission system incorporating power electronic based and other static controllers to enhance flexibility of control enhance quality of supply and increase power transfer capability [15].

B. Overview About FACTS

Flexible AC Transmission Systems (FACTS) controllers have been used in power systems since the 70s with the objective of improving system performance and quality of supply. FACTS is a term that has been suggested for the use of solid state electronic devices to control bulk power flow in T&D network. According to present scenario, it appears that the main worth of FACTS lies in improving power transmission and distribution quality, capacity & capability by increasing the flexibility of power flow control by controlling VAR flow and possibly few additional advantages in T&D systems[13].

Due to the environmental conditions, right-of-way, and cost problems in both power T&D lines have been forced to operate at almost their full capacities worldwide. FACTS controllers enhance the static performance by increased loading, congestion management, reduced system loss, economic operation etc., and dynamic performance by increased stability limits, damping of power system oscillation, etc.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

The need for more efficient electricity systems, management has put efforts to introduce innovative technologies in power generation, transmission and distribution. The combined cycle power station is a good example of a new development in power generation and FACTS as they are generally known are new devices that improve overall performance of power systems. Worldwide transmission systems are undergoing continuous changes and restructuring, they are becoming more heavily loaded and are being operated in ways not originally forecasted. T&D systems must be flexible to react to more diverse generation and loading patterns. In developing countries, the optimized use of T&D systems investments is also important to support industry, create employment and utilize efficiently inadequate economic resources. FACTS is a technology that responds to these needs.

C. FACTS Technology and Potentials

The FACTS technology has a collection of controllers that can be used individually or coordinated with other controls installed in the network, thus permitting to profit better of the network's characteristics of control. The potential of FACTS technology is based on the possibility of control the route of the power flow and the ability of connecting networks, those are not satisfactorily interconnected. FACTS also provide the possibility of trading energy between distant agents.

The following features resume the main advantages of the FACTS technologies:

- They allow a greater control over the power flow, routing it through a predetermined route.
- It is possible to operate at safe load levels (without overload) near to the thermal limits of the transmission lines.
- Bigger capacity of power transmission between controlled areas, thus reducing considerable reserve margin.
- They increase the system security by enhancement of stability limits.
- They damp the system oscillations that harm the equipment and limit the available capacity of device.
- They provide the flexibility to the transmission and distribution network to install new generating plants.
- Great flexibility in the three operative status of the system: pre-fault, fault, post-fault and capacity to control transitory status and to impact phase in post fault status.

II. FACTS CLASSIFICATION

A. Depending on the technology the network FACTS devices can be categorized in following four categories:

- Serial controllers
- Derivation controllers
- Serial to serial controllers
- Serial-derivation controllers

B. Depending on the type of connection to the network FACTS controllers can be classified as:

- Shunt connected controllers connected in shunt with the power system (shunt compensation) [16]
- Series connected controllers connected in series with power system (series compensation) [17]
- Combined series-series controllers connected in series of power system [18]
- Combined shunt-series controllers connected both in series and shunt with power system [19]

C. FACTS controllers can also be classified as [3,11]

- **First generation of FACTS:** In First generation of FACTS devices, use thyristors with ignition controlled by gate (SCR). Common type of first generation FACTS devices are:
  - **Static VAR System (SVS):** A combination of different static and mechanically switched VAR compensators whose outputs are coordinated.
  - **Thyristor Controlled Braking Resistor (TCBR):** A shunt-connected, thyristors switched resistor, which is controlled to give support to stabilization of a power system or to minimize power acceleration of a generating unit during a disturbance or fault.
  - **Thyristor Controlled Reactor (TCR):** A shunt-connected, thyristor controlled inductor whose effective reactance is varied in a continuous manner by partial conduction control of the thyristor valve. It will compensate the inductive reactance of the network.
  - **Thyristor Switched Capacitor (TSC):** A shunt-connected, thyristor-switched capacitor whose effective reactance is varied in a stepwise manner by full- or zero conduction operation of the thyristor valve. It will compensate the capacitive reactance of the network.
  - **Thyristor Switched Reactor (TSR):** A shunt-connected, thyristor-switched inductor whose effective reactance is varied in a stepwise manner by full- or zero conduction operation of the thyristor valve.
  - **VAR Compensating System (VCS):** A combination of different static and rotating VAR compensators whose outputs are coordinated so that it will compensate VAR of the system.
- **Second Generation of FACTS:** In second generation of FACTS devices Semiconductors with ignition and extinction controlled by gate (GTO´s, MCTS, IGBTS, IGCTS, etc) are used. Common types of second generation FACTS devices are:
  - **Thyristor Controlled Series Compensation (TCSC):** An impedance compensator which is applied in series on an ac transmission system to provide smooth control of series reactance.
  - **Thyristor Controlled Series Reactor (TCSR):** An inductive reactance compensator which consists of a series reactor shunted by a thyristor controlled reactor in order to provide a smoothly variable series inductive reactance.
  - **Thyristor Switched Series Capacitor (TSSC):** A capacitive reactance compensator which consists of a series capacitor bank shunted by a thyristor switched reactor to provide a stepwise control of series capacitive reactance.
  - **Thyristor Switched Series Compensator (TSSC):** An impedance compensator which is applied in series on an ac transmission system to provide a step-wise control of series reactance.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

- ❖ **Thyristor Switched Series Reactor (TSSR):** An inductive reactance compensator which consists of series reactor shunted by thyristor.
- ➢ **Third Generation of FACTS:** In third generation of FACTS controller number of controllers or static controller devices used in series or parallel to control the desired property of the transmission and distribution network of the power system, like: Unified Power Flow Controller (UPFC).
- ➢ **Forth Generation of FACTS:** In fourth generation of FACTS controllers we use the number of controllers or static controllers devices used in series or parallel to control the desired property of a part of the network having relation with another part of the network. Then the desired property of transmission and distribution network of the power system is controlled. For example: Interline Power Flow Controller (ILPFC) Inter-phase Power Controller (IPC) and Thyristor Controlled Phase Shifting Transformer (TCPST).

III. FACTS TO POWER FLOW CONTROLS

Now a day's generally grids are used to interconnect the various parts of transmission system for economic reasons to reduce the cost of electricity and to improve system stability and reliability. As the interconnections increased the system complexity is also increased. Then challenges to meet the high quality power supply are also increased. In the present environment of competition between various utilities satisfaction of customer is necessary and very important.

These are few factors considered for the smooth functionality of power system operation and control:

- ➢ The Voltage level in a power system should maintain within limits.
- ➢ For interconnected power system operating in a synchronous mode must maintain the power quality.
- ➢ Transmission lines of power systems should operate with stability limits with minimum losses.
- ➢ In practical system, it is not possible to have fault less system, so our system should be totally protected against the various kinds of faults. When faults occur protective relaying systems are used to detect the faults and restore the system operation.
- ➢ If there is any kind of fault/disturbance the power system because of system failure, in such cases, the major control objective of power system is to manage the overloads that may results from disturbances to the normal operation of the power system.

If present market of energy is evolutes in terms environment impacts, financial and dependence on electrical power then it is difficult to operate the power system in more optimal and profitable operation with desired stability and flexibility in operation. So to obtain operational reliability and financial profitability we require more efficient utilization and control of the existing transmission and distribution system infrastructure.

For these kinds of power flow problems generally FACTS controllers can be used. Mainly the concept of FACTS was developed for transmission network, now since last two decades by improving the control and characteristics of FACTS can be used for PQ control and enhancement in distribution systems operating at low or medium Voltages. In early days, the power quality referred to the continuity of power supply at acceptable Voltage and frequency but now a day its meaning is very wide in which transient disturbances in current and Voltage magnitude, waveform and frequency, ripples, sags & swells, harmonics, noise as well as active & reactive power components also. Or we can say in the modern context, PQ problem is defined as "Any problem manifested in Voltage, current or frequency deviations from standard value, that result in failure or malfunctioning of power system equipments or customer equipment". [20]

Capabilities of FACTS Controllers:

In 1995 the great innovator of FACTS Mr. N.G. Hingorani developed the concept of custom power in distribution system. The major objective of the custom power is to improve the power quality (PQ) and also enhance the reliability & stability of supply. The custom power means the value-added power from the electric utilities offer to their customers. The value-added power involves the application of high quality & high switching power electronic controllers (similar to FACTS) to distribution systems, at end of distribution system for industrial, commercial customers and industrial parks.

In the present scenario the PQ of supply is focused on regular availability of power without any kind of disturbance and fluctuations in current, Voltage & frequency. One of the important facts about the reliability of supply is, "the Average Service Availability Index (ASAI) is the ratio of hours of available service in a year to the hours in a year." So the power quality has serious economic considerations and effects for customers, utilities and electrical equipment manufacturers. Now due to modernization and automation of end users by increasing the use of high sensitive equipments like, computers, microprocessors and power electronic devices etc. The power electronic device also contributes to power quality problems (by generating harmonics).

As the power transmission and distribution networks are being pushed closer to their stability and thermal limits, while concentration is on power quality, stability and enhancement in flexibility. That can be obtained by using various methods; FACTS controllers are one amongst them. The application of FACTS controllers in power system depends on case-by-case basis. By using FACTS controllers in transmission and distribution system following characteristics can be improved [21]

- ➢ Steady-State Power Transfer Limit
- ➢ Voltage Stability Limit
- ➢ Post contingency Voltage control
- ➢ Dynamic Voltage Limit
- ➢ Transient Stability Limit
- ➢ Power System Oscillation Damping Limit
- ➢ Inadvertent Loop Flow Limit
- ➢ Thermal Limit
- ➢ Short-Circuit Current Limit

By using FACTS controllers, as the capabilities and characteristics of FACTS controller, various technical benefits can be obtained in power system, these are as follows:

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

- Control of power flow
- Increase the loading capability of lines(Loading margin improved)
- Improve transient stability limit during contingencies
- Reduce the short-circuit power level
- Compensate reactive power
- Improve dynamic Voltage stability
- Control loop power flow
- Damp power oscillation
- Mitigate Voltage unbalance due to single-phase loads

Some of examples those can be use for improving power system control, quality, reliability and flexibility of operation.

- Static Synchronous Compensator (STATCOM)
- Static VAR Compensator (SVC)
- Distributed Power Flow Controllers (DFACTS)
- Unified Power Flow Controller (UPFC)
- Distributed Static Synchronous Compensator (DSTATCOM)
- Inter-phase Power Flow Controller (IPFC)
- Inter Line Power Flow Controllers (ILPFC)
- Static Synchronous Series Controller (SSSC)

IV. CONTROL ATTRIBUTES OF VARIOUS FACT CONTROLLER[21]

FACT controller	Controller Attributes
STATCOM	Voltage control VAR compensation Damping oscillation Voltage stability Dynamic stability Transient stability
Static VAR Compensator (SVC, TCR ,TSC ,TRS)	Voltage control VAR compensation Damping oscillation Voltage stability Dynamic stability Transient stability
Static Synchronous Current Control	Damping oscillation Voltage stability Dynamic stability Transient stability Fault current limiting
Thyristor Controlled Current Control Series Capacitor(TCSC)	Damping oscillation Voltage stability Dynamic stability Transient stability Fault current limiting
Thyristor Control Phase Shifting Transformer (TCPT)	Active power control Damping Oscillation Transient, Dynamics & Voltage stability
Unified power Flow Controller(UPFC)	Active & Reactive Power control Voltage control Transient, Dynamic & Voltage stability Fault Current limiting VAR Compensation Damping Oscillations

V. CONCLUSION

The above discussion reflects that various works and technologies are covered in the area of FACTS controllers. FACTS controllers are low cost, compacts power electronics based devices used to provide various control attributes, which helps to improve reliability, stability and flexibility of the operation of power system. The FACTS controllers are having various compensation like Voltage, current and phase angle control, line flow control, active & reactive power flow control, loss minimization and flexibility in operation & control and distributed reactive support in favor of improving power system quality and performance.

VI. ACKNOWLEDGEMENT

The author is indebted to Sh. Dinesh Ranwa, Managing Director, Shekhawati Engineering College, Dundload, Rajasthan, India, Dr. P.S. Bhatnagar, Director and Sh. L. Solanki, Dean EE & ECE of B K Birla Institute of Engineering & Technology, Pilani, Rajasthan, India, Mr. R. K. Vyas, HOD, ECE Department and Sh. Dilip Porwal, HOD, Physics both from Shekhawati Engineering College, Dundload, Rajasthan, India for his most valuable advice. We are also thankful to Asst. Prof. Smita Pareek, Asst. Prof. Gaurav Sahu, Asst. Prof. R.K. Alaria, Asst. Prof. A. K. Malik and Sh. Mahesh Sharma Technical Officer (ECE) all from B.K. Birla Institute of Engineering & Technology, Pilani, and Rajasthan and for their encouragement and whole hearted co-operation.

REFERENCES

1. NAERC (North American Electric Reliability Corporation), “Reliability standards for the bulk power system of North America”, July 2008,Online available: http://www.nerc.com/docs/standards/rs/Reliability_Standards_Complete_Set.pdf
2. N.G. Hingorani, “Introducing custom Power”, IEEE spectrum, Vol.32.PP:41-48,1995
3. K.R. Padiyar, “Facts controllers in power transmission and distribution”, New Age international Publishers, 2007
4. B. Singh, “Application of FACTS Controllers in power systems for enhance the power system stability: A state-of-the-Art”, International Journal of Review in Computing , 15th July 2011, Vol.6, PP 40-68
5. F.D.Galiana, K, Almeida, M.Torissaint, J.Griffin, D.Atanackovic, B.T.Ooin and D.Mcgills, “Assessment and Control of the Impact of FACT Devices on Power System Performance”, IEEE transactions on Power Systems, Vol.11, No.4, 1996,
6. J.J. Paserba, “How FACTS controllers Benefits AC Transmission System”, Fellow IEEE
7. D.J. Gotham, G.T.Heydt, “Power Flow Control and Power Flow Studies for System with FACT Devices” IEEE Transactions on Power Systems, Vol .13, No. 1, pp.60-65, 1998.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

8. B.Gao,and P. Kundur , " Voltage Stability Evaluation Using Model Analysis",IEEE Transactions on Power Systems, Vol.7, No.4, pp.1529-1542, 1992.
9. H. Johal and D. Divan, " Design considerations for series –connected distributed FACTS converters", IEEE Transactions on industry applications, Vol.43,PP: 1609-1618, Nov/Dec. 2007
10. D .M Divan, W. E. Brumsickle, R. S. Schneider, B. Kranz, R. W. Gascoigne, D.T. Bradshaw, M.R. Ingram and I.S. Grant, " A distributed static series compensator system for realizing active power flow control on existing power lines", IEEE transactions on power Delivery, Vol.22, No.1, PP:642-649, Jan 2007
11. K. M. Rogers, "Applications of Distributed Flexible AC Transmission System(D-FACTS) Devices in Power System ", Fellow , IEEE978-1-4244-4283-6©2008.
12. M. A. Adibo, "Power System Stability Enhancement Using FACTS Controllers: A Review" The Arabian Journal for Science and Engineering, Vol. 34, No. 1B , April 2009, PP-153-172.
13. G. Glanzmann, G. Anderson, "Using FACTS devices to resolve congestions in Transmission Grids" ETH Zentrum, ETL G24-1,8042 Zurich.
14. A. Edris and Task Force Members, "Proposed Terms and Definitions For Flexible AC Tramsission System (FACTS)," IEEE Transactions on Power Delivery, Vol-12, No. 4, Oct.-1997 PP-1848-1853.
15. L. E. V, Sanchez–Gasca JJ, Chow J H, "Concept for Design for FACT controller to Damp Power Swings", IEEE Transactions on Power Systems,Vol.10, No.3, pp. 948-956,1995.
16. M.R, Zunko P, Povhd, "Improvement of Transient Stability using Unified Power Flow Controller", IEEE Transactions on Power delivery, Vol.11, pp.485-491, 1996
17. K R Padiyar, Uma Rao K, "Discrete Control of Series Compensation for Stability Improvement of Power System", International Journal of Electrical Power Energy System, Vol 19, pp.311-319, 1997
18. S. Sutha and N. Kamaraj, "Optimal location of Multi type FACTS Devices for Multiple Contingencies Using Particle Swarm Optimisation", International Journal of Electrical System Sciences and Engineering, Vol.1, No.1, 2008, ISSN 1307-8917
19. L.Gyugyi, T.R. Rictman, A.Edris, "The Unified Power Flow Controller: A new Approach to Power Transmission Control" IEEE Transactions on Power Delivery Vol. 10, No. 2, 1995.
20. D. Murali And Dr. M. Rajaram, "Active and Reactive Power Flow Control Using FACTS Devices," International Journal of Computer Applications, Vol. 9, No. 8, Nov-2010, PP U5-50.
21. H. P. Agrawal, H O Bansal, Laxmi Srivastava "Flexible AC Transmission Systems: an Extended Overview".

AUTHOR PROFILE

J. Sandeep Soni has obtained Diploma (Electrical Engg.) form Govt. Polytechnic, Jodhpur in 2001 and B.E. (Hons.) in Electrical Engineering from University of Rajasthan in 2004. He worked for more than four years in corporate industries and more than four years in Engineering Education. Presently he is M. Tech scholar (Power Systems) in Shekhawati Engineering College, Dundload, and Rajasthan, India. He is an enterprising youth with the research bent of mind. His research interests are in power system quality monitoring and stabilization, Flexible AC transmission Systems, Electrical drives & control and renewable energy & applications.

Hanuman P. Agrawal has obtained his Bachelor's degree in Electrical Engineering from Govt. Engineering College Kota Affiliated to University of Rajasthan in 1999. He received his Post-graduate from Malviya Regional Engineering College (now MNIT), Jaipur in 2001. Presently he is working as an Associate Professor in Department of Electrical Engineering in Shekhawati Engineering College, Dundlod (Raj.). he is having number of publications in national and international journals and conferences. His fields of interest include Power systems, Control Systems, smart grid, renewable energy and applications.

Dr. Rajeev Gupta (ISTE-LM11248) has obtained B.E. (Electrical. Engg.) from University of Rajasthan in 1986. He obtained M. Tech (Control and Instrumentation Engg.) from Indian Institute of Technology Bombay, Mumbai 1995 and Ph. D. from same institute in 2004. He is working as Professor and Head in Electronics Engg. at University College of Engineering, Rajasthan Technical University, Kota. His research interests are in power system stabilizer, periodic output feedback, multirate output feedback techniques, artificial neural networks, fuzzy logic control and model reduction methods

Dr. H O Bansal obtained his Bachelor's degree in Electrical Engineering from University of Rajasthan in 1998. He received his Post-graduate from Malviya Regional Engineering College (now MNIT), Jaipur and completed his PhD in Electrical Engineering from BITS, Pilani in 2000 & 2005 respectively. Presently, he is an Assistant Professor in the Electrical Engineering Department, BITS, Pilani. His fields of interest include Power systems, Control Systems, renewable energy and application of artificial intelligence in these areas.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)