Department: Electrical Engineering

3.4.6 Books and Chapters published in edited volumes

Sl. No.	Documents Attached
1.	E-copy of the Cover page, content page and first page of the publications

3.4.6 Number of books and chapters in edited volumes published per teacher during the last five years (15)

3.4.6.1: Total number of books and chapters in edited volumes / books published, and papers in national/international conf proceedings year wise during the last five year

Sl. No.	Name of the teacher	Title of the book/chapters published	Title of the paper	Title of the proceedings of the conference	Name of the conference	National / International	Year of publication	ISBN/ISSN number of the proceeding	Affiliating Institute at the time of publication	Name of the publisher
1	Y S Brar	8th International Conference on Smart Grid and Clean Energy Technologies, 978-1-7281-5736-8/20, IEEE, Kuching, Malaysia	Solar-Thermal Power Scheduling by Inserting -Constrained Method to Nonlinear Simplex Method with Mutations	8th International Conference on Smart Grid and Clean Energy Technologies, 978-1-7281-5736-8/20, IEEE, Kuching, Malaysia	IEEE					
2	Y S Brar	th International Conference on Smart Grid and Clean Energy Technologies,	Multi-Objective Power Scheduling of Wind –Thermal Integrated System by Using -Constrained Simplex Method	8th International Conference on Smart Grid and Clean Energy Technologies, 978-1-7281-5736-8/20, IEEE Kuching, Malaysia, 4-7 Oct. 2020	DOI: 10.1109/ICSGCE49177.2020.9275653 IEEE	International	2020			
3	Y S Brar	7th Internationa confrences on power electronics	Active and reactive power dispatch using predator prey optimization approach	2016 7th India International Conference on Power Electronics (IICPE), Thapar University Patiala,	IEEE	International	2020			
4	Naveen Kumar Sharma	Internationa confrences on power energy envirment and Intelligent Control	Strategic Utilization of Resources in a Microgrid in an Uncertain Electricity Market	IEEE International Conference on Power Energy, Environment and Intelligent Control (PEEIC-2018)	IEEE International Conference on Power Energy, Environment and Intelligent Control (PEEIC-2018)	International	2018	978-1-5386-2341-3	IKG Punjab Technical University	IEEE
5	Naveen Kumar Sharma	Internationa confrences on power energy envirment and Intelligent Control	Economic Profit Maximization by Optimal Allocation and Sizing of WPG in Double Auction Competitive Electricity Market	IEEE International Conference on Power Energy, Environment and Intelligent Control (PEEIC-2018)	IEEE International Conference on Power Energy, Environment and Intelligent Control (PEEIC-2018)	International	2018	978-1-5386-2341-2	IKG Punjab Technical University	IEEE
6	Naveen Kumar Sharma	Internationa confrences on power energy envirment and Intelligent Control	Sequential Procurement of Energy and Operating Reserve under Competitive Electricity Market	IEEE International Conference on Power Energy, Environment and Intelligent Control (PEEIC-2018)	IEEE International Conference on Power Energy, Environment and Intelligent Control (PEEIC-2018)	International	2018	978-1-5386-2341-1	IKG Punjab Technical University	IEEE
7	Gupta A., Verma K. and Thakur B., ,	"A review on switching function of multi level inverter and applications"	In: Proc. Of IEEE 7th India International Conference on Power Electronics (IICPE-2016),	In: Proc. Of IEEE 7th India International Conference on Power Electronics (IICPE-2016),		Interntional	2016	978-1-5090-4530-3	CU mohali	IEEE
8	Gupta A., Verma K. and Thakur B.,	"A modeling and control functions of grid-connected converter for photovoltaic system-a review",	In: Proc. Of IEEE 7th India International Conference on Power Electronics (IICPE-2016),	In: Proc. Of IEEE 7th India International Conference on Power Electronics (IICPE-2016),		Interntional	2016	978-1-5090-4530-3	CU mohali	IEEE
9	Gupta A. and Singh N., "	A study on mitigation of blackout risks in smart grid"	, In: Proc. Of IEEE 7th India International Conference on Power Electronics (IICPE-2016),	, In: Proc. Of IEEE 7th India International Conference on Power Electronics (IICPE-2016),		Interntional	2016	978-1-5090-4530-3	CU mohali	IEEE
10	Singh S. and Gupta A., "	Power Quality Analysis of Multilevel grid-interactive converter system with varying DC source and switching angle",	In: Proc. Of 1st IEEE India International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES)	In: Proc. Of 1st IEEE India International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES)	..	Interntional	2016	978-1467-385886	CU mohali	IEEE
11	Naveen Kumar Sharma	Latest Trends in Renewable Energy Technologies,	Fuzzy Based modeling of PV power loss due to soiling based on ecological parameters	Lecture Notes in Electrical Engineering book series (LNEE, volume 760)	Lecture Notes in Electrical Engineering book series (LNEE, volume 760)	international	2020	ISBN 978-981-16-1185-8, ISBN 978-981-16-1186-5 (eBook)	iKG Punjab Technical University	Springer, Singapore
12	Deepika Bhalla	Latest Trends in Renewable Energy Technologies,	Current Scenario of Solar Power and Various Schemes for Stimulation and Expansion of Solar Energy Sector in India	Lecture Notes in Electrical Engineering book series (LNEE, volume 760)	Lecture Notes in Electrical Engineering book series (LNEE, volume 760)	international	2020	ISBN 978-981-16-1185-8, ISBN 978-981-16-1186-5 (eBook)	iKG Punjab Technical University	Springer, Singapore
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14	Akhil Gupta, Kamal Sharma, Sunny Vig, Gagandeep Kaur, and Ashish Sharma	Green information and communication systems for a sustainable future (GICSSF 2020), 1st edition, 2020	Power quality analysis of a wind energy conversion systems using UPFC			International	2020	9.78E+12	IKGPTU	CRC press, Taylor & Francis	
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Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

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Power and Energy Engineering

Modern Power System and Operation

Solar-Thermal Power Scheduling by Inserting α-Constrained Method to Nonlinear Simplex Method with Mutations

Publisher: IEEE Cite This PDF

Sunimerjit Kaur ; Y. S. Brar ; J. S. Dhillon **All Authors**

Abstract: Sun is the biggest source of renewable energy, which is sustainable, inexhaustible, readily available, free of cost, non-polluting and most abundant. Earth and its atmosp... **View more**

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Abstract:
Sun is the biggest source of renewable energy, which is sustainable, inexhaustible, readily available, free of cost, non-polluting and most abundant. Earth and its atmosphere are continuously accepting about 1.7 X 10^{17} W solar radiations. If only one percent of these radiations can be transformed into electrical energy with 10 percent efficiency, then all the energy needs of the whole world can be fulfilled. A few years ago, it wasn't used more frequently as an electrical power source because of its unreliability. Now modern technology has changed the picture to a great extent. Solar PV has become the most competitive choice for power generation in increasing number of sites for residential and commercial purposes. Many countries have inducted ample solar power into their electrical grids to reduce their dependence on fossil fuels. In this paper, economic- environmental, solar-thermal power scheduling problem of an integrated system is recommended and it is optimized by using α - constrained simplex method, which is composed after inserting α -constrained method to nonlinear simplex method along with mutations. Justifiability of the presented method has been tested on five test systems.

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Multi-Objective Power Scheduling of Wind–Thermal Integrated System by Using α-Constrained Simplex Method

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Sunimerjit Kaur ; Y. S. Brar ; J. S. Dhillon All Authors

Abstract: While meeting the growing power needs of the world, use of fossil fuels has increased so much that the crises of their looming has raised now. Along with that, global war... **View more**

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Abstract:
While meeting the growing power needs of the world, use of fossil fuels has increased so much that the crises of their looming has raised now. Along with that, global warming and air pollution are also the matters of great worries for humans. All these problems can be reduced by enhancement of utilization of renewable energy resources in power generation. In many parts of the world, wind energy is present in sufficient quantity. Just one percent of wind power in the world is equivalent to 2 X 10 ^{11} W, which is about three percent of total world energy consumption rate. Role of wind energy in power generation field is increasing day by day because evolved technologies and power management techniques have started suppressing its shortcomings. In this paper, multi-objective wind- thermal power scheduling problem has been proposed and it is optimized by using α-constrained simplex method to satisfy economic and emission (NO_x,) SO_2 &CO_2) constraints. The credibility of presented method has been corroborated on five test systems.

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Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Active and Reactive Power Dispatch using Predator Prey Optimization Approach

Harinder Pal Singh
Assistant Professor,
Electrical Engg.Deptt.
SBSSTC, Ferozepur,
152004, Punjab, India
Email-harinderpal011@yahoo.com

Yadwinder Singh Brar
Professor,
Electrical Engg. Deptt,
GNDEC Ludhiana,
141006, Punjab, India
Email-braryadwinder@yahoo.co.in

D. P. Kothari
Director Research,
Gaikwad Patil Group of
Insitutions, Nagpur
Maharashtra, India
Email- dpk0710@yahoo.com

Abstract
The economic load dispatch in thermal power plant is done for minimizing the fuel generation cost by assigning optimum power generation of each unit while maintaining the equality constraints and inequality constraints. Mostly the fuel cost is calculated only based on real power cost, but it is also very important to consider reactive power for secure procedure of power systems, therefore the cost considering reactive power has to be comprised in main cost function. Furthermore, the production of reactive power will decrease the ability of generator to produce active power. Hence, reactive power production by generator will results in decrease in its production of active power. Therefore the reactive power pricing is equally important as the pricing of real power, so a true cost function considering combined cost considering both active and reactive power has to be formulated. The main objective considered in this paper is to minimize combined cost considering both active and reactive power subject to constraints. Predator prey Optimization (PPO) algorithm has been applied to minimize combined cost considering active and reactive power. The proposed approach has tested on Standard IEEE 9-bus network in order to show the effectiveness. Numerical results obtained are compared with research works carried out by other researcher which confirms its validation and efficiency.

***Keywords*-Active power pricing, Reactive power pricing, Predator prey Optimization.**

I. INTRODUCTION

In the economic load dispatch (ELD) problem the main objective is to minimize the total operating cost of generation by assigning the optimal power generation of each unit in order to meet the total load demand. Under ELD problem the both active and reactive power is varied within min-max limits to meet the total demand and losses [1]. Reactive power is very essential for the secure operation of power systems. Each generated load has reactive power requirements therefore the reactive power dispatch is likewise important with real power dispatch. Generally the cost for reactive power output is not considered in the objective function but only the cost for active power output is considered in the objective function of ELD, which is not an accurate cost function. Therefore the cost considering reactive power has to be comprised in objective function ELD. The cost for reactive power generation is dependent on real power generation, it is mainly restricted to local consumption. In order to maintain the secure operation, a fair cost allocation method is required [2]. To solve ELD problem the optimization techniques such as, neural networks, simulated annealing, ant colony and evolutionary algorithms have been applied by many researchers because they are find a global best solution [3]-[5]. In order to solve the Multi objective load dispatch problem [8] has applied an another heuristic optimization technique Particle swarm optimization (PSO)[6]-[7], which gives better results for their problem.

To calculate the reactive power pricing, different techniques have been suggested in past researches [9]-[14]. Some of these utilize combination of ant colony and genetic algorithms for pricing reactive power [13]. [15] has presented the survey on reactive pricing algorithms. [16] has demonstrated the pricing considering active and reactive using interior point nonlinear optimization method. Cost-based reactive power pricing method in which minimization of the cost of reactive power production by generators and capacitors are minimized has been done is presented by [17]. [18] has applied a PSO algorithm to solve combined active-reactive power dispatch problem.

Predator prey optimization (PPO) algorithm has been applied in this paper to get the best optimal solution. PPO associates the concept of PSO with predator's effect, which helps to keep diversity in the flock and avoid premature convergence [19]-[20]. To show the effectiveness of proposed approach the results as obtained by the developed algorithm are compared with technique used in [2] and [18] and are found better..

II. PROBLEM FORMULATION

A. Problem Objectives

1) Minimization of fuel cost considering real power.

The cost function of fuel for thermal power generators is given by a quadratic expression. The total cost of fuel considering active power generation can be written as:

$$F(P_{gi}) = \sum_{i=1}^{NG}\left(a_i P_{gi}^2 + b_i P_{gi} + c_i\right) \quad (1)$$

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Sequential Procurement of Energy and Operating Reserve under Competitive Electricity Market

*Anuj Banshwar[*1], Naveen Kumar Sharma[2], Jasmine Kaur Saini[3], Yog Raj Sood[4], Rajnish Shrivastava[5]*
*[*1]Noida Institute of Engineering & Technology, Greater Noida, India*
[2] IKG Punjab Technical University Batala Campus, Punjab, India
[3,4]National Institute of Technology, Hamirpur, India
[5]Director, Mahindra Ecole Centrale, College of Engineering, Telangana, India
E-mail:[1] anujbanshwar@gmail.com,[2]naveen31.sharma@gmail.com,[3]jasminekaur.nith@gmail.com,*
[4]yrsood.nith@gmail.com, [5]rajnishshri@gmail.com

***Abstract*— In a competitive electricity market, Ancillary Services (AS) plays an important role, as these services are essential for required reliability and safe functioning of the electrical scheme. Procurement of reserve based AS, that is, Operating Reserve (OR) is considered in the present work. OR is defined as an ability of a generating resource to prevent any unanticipated discrepancies initiated from outages. The present work considers sequential procurement of energy and OR, which can hold up the growth of an effective reserve distribution and pricing mechanism. With the consideration of cost minimization, this mechanism clears Energy Market (EM) and Reserve Market (RM) sequentially. The formulated problem is optimized through Optimal Power Flow (OPF) approach while considering constraints like generation and line limits. The discussed market scenario has been validated on a modified 5 unit PJM system.**

Index Terms*— Electrical restructuring, energy market, market mechanism, operating reserve, reserve market, sequential dispatch.

I. INTRODUCTION

An electrical scheme over the past ages has been under the control of large Vertical Integrated Utilities (VIUs) that acts like a principal authority behind the activities like generation, transmission and distribution of electrical supply. These VIUs are obliged to supply electricity in their domain of operation. In mid-1990s,VIUsof several developed markets undergone an electrical restructuring process to introduce competition [1]. Fig. 1 shows the disaggregation of VIUs into several independent entities like GENCOs, DISCOs, and TRANSCOs.

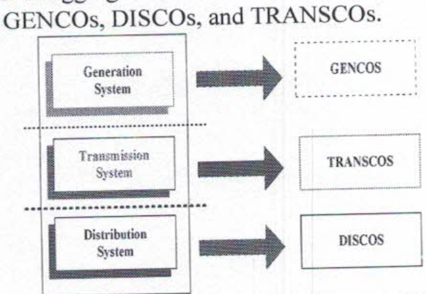

Fig. 1. Disaggregation of Traditional Vertical Integrated Utility

Restructuring of electrical industry brought significant changes in its operation. Generation and distribution activities began to be performed as an independent entities that trades their capacity in a competitive electricity market while the transmission system, however, continued to be a monopolistic entity. These reforms principally focuses system efficiency, and cost minimization by providing options to the utilities by creating competition in the market [2].

II. MARKET MECHANISM FOR E & AS DISPATCH

The market mechanism approaches reflects different techniques while considering optimality, practicability and complexity of efficient market operation. There are two distinct market structure designs that are existed worldwide for obtaining several type of services. These markets differ from each other on the basis of operationalized timeline, objective and the role of SO in operating these markets [3].The characteristics of these markets are discussed in Table I.

TABLE I: CHARACTERISTICS OF MARKET STRUCTURE DESIGN

Description	Forward Markets (FM)	Real-Time Market (RTM)
Timeline	Day-ahead or hour-ahead real time delivery	10-15 minutes ahead
Objective	To fulfill energy requirements at day-ahead schedule	To meet the reliability of the system

The sequential clearing of EM and RM clears the reality that both energy and reserve consumes the same resource [4]. Electricity markets of California (in its early phase of restructuring), and Nordic countries involves such type of dispatch for the clearing of their AS markets[5]. Evolution of different auction mechanism for energy and AS markets worldwide is illustrated in Fig. 2.

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Economic Profit Maximization by Optimal Allocation and Sizing of WPG in Double Auction Competitive Electricity Market

Naveen Kumar Sharma[*1], AnujBanshwar[2], Jasmine Kaur Saini[3], Yog Raj Sood[4], Rajnish Shrivastava[5]
[*1] *IKG Punjab Technical University Batala Campus, Punjab, India*
[2] *Noida Institute of Engineering & Technology, Greater Noida, India*
[3,4] *National Institute of Technology, Hamirpur, India*
[5] *Director, Mahindra Ecole Centrale, College of Engineering, Telangana, India*
E-mail:[1]*naveen31.sharma@gmail.com,*[2]*anujbanshwar@gmail.com,*[3]*jasminekaur.nith@gmail.com,*
[4]*yrsood.nith@gmail.com,* [5]*rajnishshri@gmail.com*

Abstract—**Liberalization of the electricity market systems have resulted in the introduction of Competitive Electricity Market (CEM). The recognition of CEM provides special consideration tothe development of Renewable Energy (RE)projects throughout the world. Only wind-based generation capacity accounted for around 75% of the total installed RE capacity all over the world. Wind energy is an indigenous and virtually unlimited source of electricity generation. The present work proposes an efficient model for determination of the optimal location and size of Wind Power Generation (WPG) under the competitive environment. The optimization algorithm has been formulated with an objective of social welfare maximization by minimizing the generation cost. The objective can be achieved by optimally placing WPGof optimal size in the system. To test the validity, the approach has been successfully applied on modified IEEE 14-bus modified test system.**

Index Terms-- competitive electricity market, marginal pricing, social welfare, wind power generation.

INTRODUCTION

With the rapid increase in the energy demands, more energy resources are required to follow the energy generation that results in an increased ecological pollutions if it is fulfilled from conventional plants. The liberalization of an electricity sector primarily focuses the improvement of power quality standards, improving system efficiency, and developing CEM. [1]. The main reason behind the development of CEM was to encourage competition among utilities and market participants to reduce electricity price. In present electricity market scenario, the earlier un-deregulated system which was the sole authority that takes care of all the roles associated to electricity is now unbundled into GENCOs, TRANSCOs and DISCOs.

With oil prices reaching to its peak levels, non-availability of good quality of conventional fuels and desire to reduce CO_2 emissions leads to develop a vast recognition of Renewable Energy Sources (RES)as an important source of energy provider as well as a new participant in ancillary services markets [2]. These resources are best suited in electricity production and also to achieve goals likeCO_2 emissions reduction, energy liberation and to enhance infrastructure reliability in CEM.

Muis*et al.* [3] uses MILP algorithm for optimal allocation of REin multi-unit generation system to reduce CO_2emission. Banshwar*et al.* [4] formulated and presented a multi-unit optimization problem with an objective to maximize the profitability of a WPG. Rezaei et al. [5] investigated a case study on determination of optimal construction site for hybrid wind-PV system in Iran on the basis of economic, social, and geological along with disaster conditions. A novel technique based on wind characteristics and electrical grid constraints has been proposed by Cetinay et al. [6] to determine the best suited location of WPG in Turkey. Bjørnebye et al. [7] employed numerical energy system model to investigate potential welfare cost and WP capacity in Norwegian electricity system. Even by considering load growth, optimal sizing and siting of RE based DG units can be achieved in distribution systems [8].

Merrouni et al. [9] determines sites selection for large scale PV using hybrid GIS-AHP. Similarly, site selection of offshore WP farms in South Korea has been investigated by Kim et al. [10]. Ramli et al. [11] employed MOSaDE algorithm for optimal sizing of multi-sources with battery storage system in microgrid. These multi-sources includes PV/wind/diesel hybrid system. Hatata et al. [12] similarly proposed a novel technique to determine optimal rating of hybrid a solar/wind/battery system.

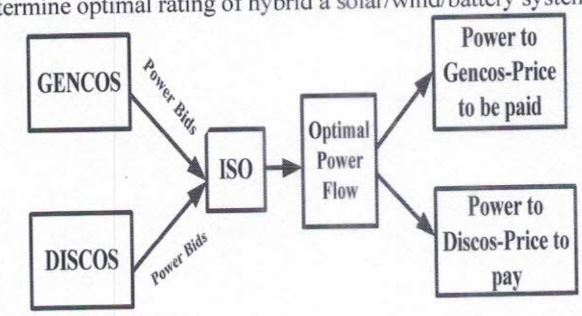

Fig. 1. Double auction power market operation

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006
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Strategic Utilization of Resources in a Microgrid in an Uncertain Electricity Market

Jasmine Kaur[1], Anuj Banshwar[2], Naveen Kumar Sharma[3], Yog Raj Sood[4] and Rajnish Shrivastava[5]
[1]*Department of Electrical Engineering, NIT Hamirpur, H.P.-177005, India*
[2]*Noida Institute of Engineering and Technology, Greater Noida, U.P.-201306, India*
[3]*Department of Electrical Engineering,IKG Punjab Technical University Batala Campus,Punjab, India*
[4]*Department of Electrical Engineering, NIT Hamirpur, H.P.-177005, India*
[5]*Director, Mahindra Ecole Centrale, College of Engineering, Telangana, India*
E-mail: [1]jasminekaur.nith@gmail.com,[2]anujbanshwar@gmail.com, [3]naveen31.sharma@gmail.com,
[4]yrsood.nith@gmail.com, [5]rajnishshri@gmail.com

***Abstract* -Microgrids integrated with renewable energy sources are a promising step towards the accomplishment of goal of power to all. It is essential to ensure that the available renewable sources are utilized in the best possible manner. This paperreviews the work done in this field and lays emphasis on optimally utilizing renewable energy sources (RES) in renewable microgrid i.e. the available power from RES is either utilized within the microgrid or shared with the main grid. The concept of renewable microgrid is presented as a microgrid consisting of renewable energy sources like wind, solar etc. in addition to conventional thermal generation. In order to maintain uninterrupted power supply, a pump hydro storage unit is proposed to manage intermittencies associated with renewable energy sources.**

Index Terms - optimal utilization; pump hydro storage; renewable microgrid; renewable energy sources; social benefit.

I. INTRODUCTION

The microgrid (μg) concept refers to a single controllable system designed to meet special requirements such as enhancing local reliability, supporting local voltages and reducing feeder losses [1]. The accomplishment of the mission to provide power to one and all makes microgrid an inevitable option. Microgrids consist of micro generating sources, controllable loads coupled with energy storage systems [2]. The mode of operation of a μg can broadly be categorized as grid connected and island mode.The former mode allows μg to either cater to its entire load all by itself or export/import power to/from the main grid, whereas the latter supports the isolated grid operation without any power sharing with the main grid. In Ref. [3] a scenario where customers control their consumption in accordance with the guidelines issued by them is discussed, whereas [4]presents a methodology to assess the introduction of renewable energy technologies in rural communities. The approaches in [3-4] are limited to uncompetitive market environment. Quick depletion of conventional fossil fuels is brought to focus in [5] and the consequent need to make renewable energy sources (RES) work in conjunction with fossil fuel plants is highlighted.

As per Ministry of New and Renewable Energy (MNRE), India has huge potential of electricity generation through renewable [6].It is thus realized in this work that RES integration in μg could be a promising solution to tackle ever increasing energy demand. The nineties decade saw many power network companies changing their way of operation from vertically integrated units to open market systems [7]. The major driving force behind deregulation was to encourage competition among utilities and marketers to reduce energy prices. Out of the many energy pricing methods available, spot pricing or locational marginal pricing (LMP) is one of the most popular ones [8]. In [9], LMP determination at different buses with optimization of social benefit has been carried out where social benefit refers to the difference between the benefit of energy to society i.e. society's willingness to pay for its demand and the cost of energy. Ref. [10] details a renewable energy based μg which is aimed at minimizing lifecycle cost and [11] highlights the uncertainties involved in storage devices in μg.The concept of a self sustainable green microgrid, the use of a pump storage reservoir is well presented in [12]. Using the same concept, a novel two layer optimization approach, aimed at renewable energy management of the microgrid while maximizing social benefit of both the main grid and the microgrid, is well established in [13]. Energy storage plays a vital role in maintaining continuous power supply in renewable μgs. Storage devices facilitate a robust energy balance within the μg [14]. Ref. [15] reviewsadvancements of energy storage systems (ESS) and microgrid basedapplications and details the features and benefits of various existing ESS. Energy storage with newer battery technologies are descriptively outlined in [16] with several types of storage technologies described. Despite all the merits, the battery storage suffers an obvious drawback of being bulky. Therefore in this work, pump hydro storage has been proposed which is not only robust, but also cost effective as compared to battery storage. Optimal pumped storage unit bidding strategies for a competitive electricity market are developed in [17] with an objective to maximize profit of pump storage unit.

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Gagandeep
Head
Department of Electrical Engineer
I.K. Gujral Punjab Technical Univer
Kapurthala-144006

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Head
Department of Electrical Engineer
I.K. Gujral Punjab Technical Unive
Kapurthala-144006

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A Modeling and Control Functions of Grid Connected Converter for Solar Photovoltaic System- A Review

Kapil Verma
ME-EE Scholar
Chandigarh University, Mohali
Punjab, India

Bharti
ME-EE Scholar
Chandigarh University, Mohali
Punjab, India

Akhil Gupta
Associate Professor-Electrical Engineering
Chandigarh University, Mohali
Punjab, India

***Abstract*-This review paper represents the modeling design and controlling function of solar Photovoltaic (PV) grid-connected systems from various sources available through literature. The converter system is composed of an isolated DC-DC converter and a three phase DC to AC Voltage Source Inverter (VSI). This type of converters is designed to obtain small signal transfer function which is used to design of three closed loop controllers-For the output voltage of solar PV array, The DC line voltage, the output currents. To point up the effectiveness of solar PV Grid connected system, Matlab simulations are used.**

Keywords—Solar photovoltaic; simulation; grid-connected; converter.

I. Introduction

Due to global warming increases day by day, Renewable Energy Source (RES) turn into a more important source of energy due to their flexibility, reliability and eco friendly nature. Among these RES, solar PV generation is attracting political as well as commercial interest in growing amount. A model of solar PV generators with control functions of grid-connected converters simulating results is the main subject of this review paper. These experimental results shows the response behavior of experimental set-up solar PV system to various disturbances and proposed RES based DG function which contains numerous states and non linear blocks like power electronic based switches with converter behaviors. To maximize the efficiency of the solar PV cell, Maximum Power Point Tracking (MPPT) controllers are used which is connected starting end of the model. Simulation of a batter performance of a 3 phase grid linked solar PV model and its control design is described in this section [1-2].

Solar PV devices are element that converts sunlight which is coming from the sun and directly into electrical power. A set of connected cells form a panel that is usually connected in series to get large output voltages from solar PV cell. Panel with more output side current can be achieved by raising the surface region of the PV cells and by linking solar cells in parallel. Large PV systems can be formed by connecting PV arrays in series or parallel. The converter is linked with solar PV arrays to control the output current by their functions. [4-6].

II. Grid Connected Solar PV System with MPPT Control

As shown in Figure 1, In this model, two controllers are used. DC to DC and DC to AC. DC to DC converter controls the input voltage of the PV array and DC to AC controller controls the voltage which is coming from the DC to DC converter. Power storage structure is planned in work by MPPT controller, to provide the continuous hybrid loads. The blocks representation of the solar PV model is shown in figure 1. MPPT controller is used to get the more output power during the time when sun rays are present. The storage battery is charge throughout the day and provides the power to the loads at night the awful climate situations. MPPT controller is used to increase the effectiveness of the solar PV cell.

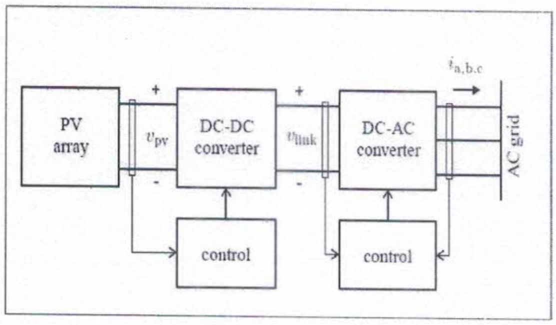

Figure 1: Block figure of the solar PV system.

Figure 1 represents the purposeful blocks grid linked solar PV system. Solar PV array is consists with many individual PV cells that are arranged in a series or parallel to get suitable energy from sun. DC output current I_{dc} of a solar PV array is converted into AC current I_{ac} by inverter and delivers to the grid end. Figure 2 shows the *I-V* and *P-V* characteristics of a PV array represents the relation between voltage and current which are highly non linear. The mixture of voltage and current on solar PV system maximize the output of the inverter which depends on the solar radiations and temperature of the PV cells. A MPPT

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A Review on Switching Function of Multi Level Inverter and Applications

Bharti
ME-EE Scholar
Chandigarh University, Mohali
Punjab, India

Kapil Verma
ME-EE Scholar
Chandigarh University, Mohali
Punjab, India

Akhil Gupta
Associate Professor-Electrical Engineering
Chandigarh University, Mohali
Punjab, India

***Abstract*—Multi Level Inverters (MLI) are widely used in the field of industrial applications. By using MLI harmonic contents and Electro Magnetic Interference (EMI) in different power electronics applications can be reduced. Switching function and reduced switching components of MLI are discussed in this paper. Output voltage levels of MLI can be increased by adding up switching components and DC input voltage source. It can synthesize more sinusoidal waveform and it can also improve the output voltage Total Harmonic Distortion (THD) requirement. If we compare MLI with the conventional two level inverters it has advantages such as higher dc link voltages, low EMI and reduced harmonic distortion. But it also has some disadvantages such as required to use more switches, voltage balancing problem, and complex Pulse Width Modulation (PWM) control. To overcome these disadvantages new MLI topologies can be invented to improve the performance with reduced number of switches. In case of MLIs, they are extremely capable of achieving high power quality output voltage waveform and higher power ratings with the help of structures of MLIs.. Mathematical analysis and Matlab simulation results are used.**

Keywords—Multi Level Inverter, Switching function, Harmonic contents, Total Harmonic Distortion.

I. INTRODUCTION

Multi Level Inverter (MLI) has many advantages such as better power quality, low harmonics, less switching losses, better Electro Magnetic Interference (EMI) and better performance. So MLIs are highly used in various different applications [1-4]. There are three kinds of basic Multi Level Topologies (MLT). They are Neutral Point Clamped MLI (NPC), Flying Capacitor (FC) and Cascaded H-bridge (CHB) MLI. Among the different inverter topologies, the CHB have attracted more attention due to its simple structure, easily extendable to higher voltage levels, minimum number of components, reliability and modularity [5-6]. It also can be easily interfaced with Renewable Energy Resources (RER) with various high power applications. The input side DC voltage sources can be obtained from batteries, capacitors and various RER [7-9].

MLI now a days have become useful solution for reducing switching loss in high power application. There have been appropriate developments, advancement on multilevel converters and making them a capable technology for high power drives. Many topologies have been proposed with different characteristics [10-15]. In addition, a combined arrangement also call hybrid of the MLI have been developed in [16] to obtain improved quality of the output voltage waveform and to reduce the device-account. Hence, manufacturing cost and complexity of this system reduced to some extent.

There are few disadvantages of using large number of switching devices in MLI. These switching devices enlarge the size of circuit, increase power losses in conducting switches and reduce the output voltage due to the drop in voltage across each switching circuits. This paper shows the switching function and reduced number of switching components of MLI. Output performance of MLI can be improved with reduced number of switches. Cascaded Multi Level Converter using reduced number of switches and gate drive circuits are discussed in [17-20]. These meant to increase the number of output voltage levels, reduce the number of power switches drive circuits and overall cost of MLI. So in this paper switching function and reduced number of switches during operation are brought out so that overall efficiency of MLI can be enhanced.

II. CASCADED BRIDGE MULTI LEVEL INVERTER

A. General Cascaded H-Bridge MLI

Figure 1 shows circuit configuration of a general cascaded H-bridge circuit configuration. Every module used in H-bridge circuit has independent source of DC voltage which are represented by E in Figure 1. All H-bridge cells output terminals are series connected, therefore, Equation 1 is used to get output voltage and Equation 2 is used to obtain the number of levels in output voltage. In Equation 2, k represents the number of H-bridge cells.

$$V_{out} = \sum_{n-1}^{k} V_n + V_1 + V_2 + V_3 + V_4 \qquad (1)$$

$$N = 2k+1 \qquad (2)$$

In Equation (1), V_n can be positive, zero or negative i.e. E, 0, -E. Therefore, output of same equation can vary according to the value of V_n. It means V_{out} can produce values from -4E to +4E i.e. -4E, -3E, -2E, -E, 0, E, 2E, 3E, 4E. Circuit configuration shown in Figure 1 is used to synthesize 9 levels output voltage [8].

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Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

A study on mitigation of blackout risks in smart grid

Navpreet Singh
Electrical Engineering
Chandigarh University
Mohali, India
navpreetsingh909@gmail.com

Akhil Gupta
Electrical Engineering
Chandigarh University
Mohali, India
akhilgupta1977@gmail.com

Abstract—**The unnecessary action of critical distance relays leads to cascading failure in power system. The cascading is initial event is recognized as the main mechanism for power system blackout. Load shedding is provided for mitigate the cascading failure during the activation of critical distance relays which helps to reduce the blackout risk. The load shedding magnitude should in proper order which cannot leads to overload the transmission line. In IEEE 39 bus test system used is used for optimization of proposed algorithm which provides the continuous power transfer from generator to load without cascading failure.**

Keywords—smart grid; power grid; blackouts;

I. Introduction

The liberalization of electrical energy market is not only serving an affordable cost of electrical energy by agreement between two or more countries but also use the off seasonal energy with full loaded transits [1]. For the possibility of liberalization, the interconnected system has to be constructed between two or more grids through transmission lines i.e. cascading system. The cascading system is complex and its failure leads to blackout over the wide area. The recovery of blackout had been noted down for flawless operation of power system in smart grid. The erratic loss of power in wide area due to cascading failure is called blackout. These cascading failures happen because of weather assault (hurricanes & storms) which limits power transfer capability. The line sagging of transmission and distribution in power systems get also affected. During heavy storms, the overhead transmission lines are collapsed whereas in winter season, the snow gathers at surface of insulator to construct a conducting path [2]. The synchronism between load and generator plays a vital role for power flow. This synchronism is disturbed by power swing which occurs due to adverse events (line switching, sudden load change, overstressed transmission line) [3]. Due to failure of one line, the overstressed transmission line causes thermal instability due to which load is transmitted to other line [4]. Thus, blackout becomes evident which leads to loss of synchronism and tripping of line. This effect causes oscillations in power [3]. The distance relays are provided for blocking the power swing. However, not all power swings are unstable, sometimes; there are temporary events which are automatically resolved that time unnecessary action of distance relays causes trip line. Due to tripping, the generator experiences a electromechanical oscillation which also leads to loss of synchronism. The unstable events like power oscillation, voltage drop, frequency deviation of transmission line mainly causes for activation of protective distance relays, hence cascading failure occurs.

II. System Description

The proposed approach which is combination of deterministic and statistical method which is explained for 39 bus system in New England as shown in Figure 1 [5].

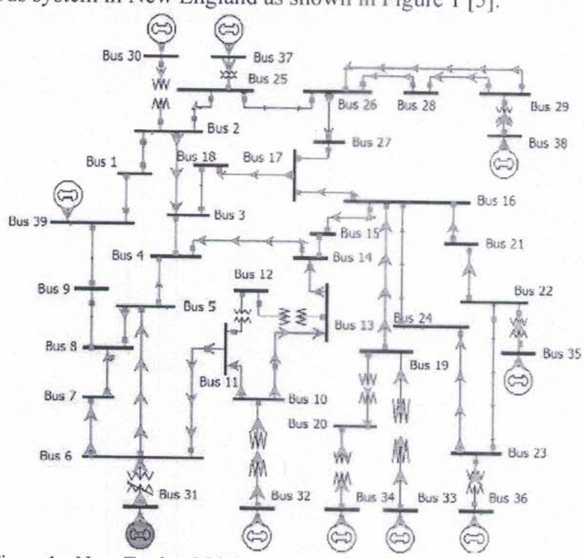

Figure1: New England 39-bus test system [6]

Basically New England 39-bus test systems used for different simulation and is also known as 10 machines New- England power system. The Figure 1 shows supply of 34 KV in transmission system of New England which has 10 generators, 39 load buses and 46 transmission lines. The first generator shows aggregation of a large number of generators. The complexity of 39 bus power system provides the continuums of power flow without any tripping of line as shown in Figure 1 if any generator is not responding the power is flow without any interruption.

Power factory software is used for blackout simulation and loads are connected to power system through load transformer. The active and reactive powers of loads are depend on voltage and frequency as shown in Figure 1.

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Power Quality Analysis of Multilevel Grid-interactive Converter System with Varying DC Source and Switching Angle

Satwinder Singh[1] and Akhil Gupta[2]
[1,2]Electrical Engineering, University Institute of Engineering, Chandigarh University, Mohali, India
E-mail: [1]satwindersingh416@yahoo.com, [2]akhilgupta1977@gmail.com

***Abstract*—This paper aims to present the power quality analysis of Multilevel Inverter (MLI) phase controlled systems. The analysis is achieved by developing models for five-level MLI systems in continuous conduction mode. In this mode, the switching angle of the thyristor is varied in order that it can be operated in inversion mode. As compared to conventional line commutated DC-AC inverters which have higher order harmonics, the proposed MLI system has output with reduced higher order harmonics. In addition, the performance of proposed system has been tested at Resistance Inductance DC source (RLE) load, with changing DC voltage levels. Furthermore, the operation of proposed topology has been demonstrated under changing switching modes. It has been analyzed that the level of Total Harmonic Distortion (THD) is reduced whereas, the real output power is injected to utility-grid. Output waveforms with low harmonic content are desirable in MLI systems. The simulation models developed are well suited for practicing engineers, who are keen to their pursue studies in power quality, especially while integrating any renewable energy technology into the higher level MLI systems.**

***Keywords:** Power Quality, Harmonic Distortion, Multilevel, Inverter, Grid*

I. Introduction

A Multilevel Inverters (MLI) is a power electronic system that synthesizes a sinusoidal AC output voltage from several DC sources. The basic aim of using MLI is to generate a staircase type sinusoidal voltage and current at the output by using thyristor or inverter switches in series [1]. The concept of MLIs does not depend on just two levels of voltage to create an AC signal. Instead, several voltage levels are added with each other in order to create a smooth stepped waveform at the output. The commonly used converter systems can be classified into various categories: flying capacitors, diode-clamped, and isolated H-bridge cell. Among them, an isolated H-bridge converter has various H-bridge modules at low voltage which are connected in series. Each converter module has its own independent source. Therefore, in [2], it is mentioned that to remove the shortcomings of an isolated H-bridge type converter, an isolated transformer is proposed which can be operated on single DC voltage source. Few high power applications are reported in [3] in which these converter systems have found its use are large motor drives, flexible AC transmission systems, and renewable energy sources. Additionally, this technology has been widely used for power quality improvements and reactive power compensation.

An important application of solar photovoltaic based power generation in reported in [4] in which it feeds the generated DC power into utility grid, after its conversion into AC power. To achieve this, the Pulse Width Modulation (PWM) inverters have been implemented for gate commutated devices. However, apart from higher switching losses, the power handling capability and reliability of these semiconductor devices are quite low in comparison to thyristors, as mentioned in [5]. Furthermore, the switching angles play an important role in order that the output voltage and current has low harmonic distortion. Various renewable energy sources such as batteries, solar cells, and wind turbines can be connected through these MLI systems to feed a load. However, the solar photovoltaic arrays are restricted because its output mainly depends upon changing environmental conditions. Therefore, in this paper, the impact of the presence of a single DC voltage source on output power and harmonic distortion is studied. As described in [6], with an increase in the number of voltage levels on the DC side, the synthesized output voltage and current waveforms adds more steps, thus, producing a staircase waveform with minimum harmonic distortion. It has been found in [7] that multilevel converter topologies are integrated easily with photovoltaic applications because of their modular structure. Also, the different levels of DC voltage can easily be provided. The ability to operate MLI at very high input voltage is described in [8] in which the discussion on HVDC transmission with low distortion is presented. Also, the generation of voltages with low distortion reduces the *dv/dt* stresses. Due to their attractive features, multilevel converters are an interesting alternative for medium voltage and high power applications [9]. Multilevel converters are also employed for controlling the speed of single-phase and three-phase induction motors. For achieving low harmonic distortion at the output, the various types of multilevel topologies and multicarrier PWM have been mentioned in [10]. Multilevel inverter topology is implemented with reduced number of PWM controlled switches, which makes a reduction of the overall system cost and its size [11-12].

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Fuzzy-Based Modeling of Photovoltaic Power Loss Due to Soiling Based on Ecological Parameters

Sujit Kumar, Neel Kamal, Kumar Shri Nivas, Anuj Banshwar, and Naveen Kumar Sharma

1 Introduction

Nowadays, people are mainly focusing on renewable energy resources rather than non-renewable resources for energy consumption due to its scarcity in the coming future. Of all the major renewable resources, solar power is drawing a lot of attention. The solar panel made up of semiconductors restrict its maximum efficiency to 15%–16% only under optimum conditions [1]. Furthermore, the efficiency of solar panels is drastically affected due to environmental factors such as temperature, irradiance, wind speed, and soiling. A report from CSIR-CSIO Chennai suggests that there may be a loss of up to 49.42% in the power if the solar panel is not cleaned for two months [2]. Due to this, soiling on the surface of the panel becomes a major concern. The traditional method of cleaning the panel through automation processes are a bit costly. The soiling problem on the surface of the panel is quite severe which

S. Kumar (✉)
Department of Electrical and Electronics Engineering, Jain (Deemed-to-be University), Bangalore, Karnataka, India
e-mail: sujitvj.kumar@gmail.com

N. Kamal · K. S. Nivas
Department of Electrical and Electronics Engineering, Noida Institute of Engineering and Technology, Greater Noida, India
e-mail: drsaini25aug@gmail.com

K. S. Nivas
e-mail: shrinivas2108@gmail.com

A. Banshwar
Government Polytechnic Tada Gulabrai, U.P, Madhotanda Road, Puranpur (Pilibhit), India
e-mail: anujbanshwar@gmail.com

N. K. Sharma
IKG Punjab Technical University, Main Campus, Jalandhar, Punjab, India
e-mail: naveen31.sharma@gmail.com

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Current Scenario of Solar Power and Various Schemes for Stimulation and Expansion of Solar Energy Sector in India

Sunny Vaish, Ravneet Kaur, Deepika Bhalla, and Naveen Kumar Sharma

1 Introduction

Power and energy are among the key factors that have a significant contribution towards the economy of a nation. Research projects that are linked to the utilities for defining, formulating, implementing and then redefining for improvement finally result in the national development along with the benefit of it reaching the consumer [1]. During the last decade of the previous millennium, most of the utilities were forces to their operations, structure and the ways the business was done. Earlier the functioning of the utilities was vertical and closely held and the demand changes it to an open system. The fast depletion of reserves of fossil resources for meeting the energy demand of high-energy intense industries and the resulting visible change, the use of these reserves caused to the environment caught the much-needed attention for decelerating the dependence on fossil fuel. The industrial activity and demand for development result in dumping carbon into the atmosphere; of the total 8 billion tonnes of carbon emissions, 81.25% comes from fossil fuels and the remaining from deforestation [2]. Renewable Energy Sources (RESs) such as pico and micro hydro, solar, wind, biomass, fuel-cell, etc. are non-polluting, clean and can easily substitute fossil fuels provided technology and economics are achieved.

The power sector in India is extremely diversified, and it also has a considerable growth rate. For both capacity addition and energy security, the power sector of India

S. Vaish · R. Kaur (✉) · D. Bhalla · N. K. Sharma
Department of Electrical Engineering, IKGPTU Jalandhar, Punjab 144 603, India
e-mail: ravneetasr2506@gmail.com

S. Vaish
e-mail: sunnyvaish3@gmail.com

D. Bhalla
e-mail: deepika.bhalla89@gmail.com

N. K. Sharma
e-mail: naveen31.sharma@gmail.com

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An Evaluation of Different Health Assessment Methods on 50 MVA Power Transformer: A Case Study

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Alok Patel ; Naveen Kumar Sharma ; Anuj Banshwar ; Bharat Bhushan Sharma ; Mohit Pathak **All Authors**

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Abstract:
Transformers are considered to be important and expensive apparatus used in electrical systems. Therefore, it is important to determine their operational conditions, and thus it is required to employ quality control tests for testing of an insulation design of oil filled transformers. The effect of aging on insulating oil in transformer in terms of physical, chemical and electrical properties has been studied in this paper. As a critical asset, transformer failures can cause equipment damage, customer outages, and safety concerns. In this paper, the three important methods of Dissolved Gas Analysis (DGA) have been discussed to assess transformer health and experiments are performed on 50MVA power transformer.

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GREEN INFORMATION AND COMMUNICATION SYSTEMS FOR A SUSTAINABLE FUTURE

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Green Information and Communication Systems for a Sustainable Future

Gagandeep

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

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Brujo Kishore Mishra
GIET University, India
Raghvendra Kumar
LNCT College, India

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Gagandeep
Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

Green Information and Communication Systems for a Sustainable Future

Edited by
Rajshree Srivastava
Sandeep Kautish
Rajeev Tiwari

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Akhil Gupta, Kamal Kant Sharma, Sunny Vig, Gagandeep Kaur, and Ashish Sharma

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8.1 INTRODUCTION

From the previous century, people have started using wind as a major resource for generating electric energy [1]. Altogether, along with hydro-power and photovoltaic power, electric power generated from wind power technology has become one of the most-utilized sources of electric energy. At the end of the 19thcentury, the first laboratory experiment was successfully carried out to use windmills for the generation of electric power. Since then, wind power has become a reliable and cheap source of electric power. This is due to the fact that the several different types of generators can be used for wind electric power generation (WEPG), namely asynchronous generators and induction generators [2–4]. However, stability of electricity supply is the critical issue related to power quality (PQ), due to the fact that wind direction

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14 Microbial Fuel Cell
A Source of Bioelectricity Production

Gagandeep Kaur, Akhil Gupta, and Jaspreet Kaur

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14.1 INTRODUCTION

In addition to the considerable (and increasing) demand for energy in rural and urban Indian communities, the trend is gradually shifting from non-renewable energy sources to renewable ones, the latter being acknowledged as effective alternatives for generating energy for distribution to consumers. Agriculture-, forest-, and livestock-based biowastes or by-products are called biomass or bioresidues, and are available in large quantities in India [1, 2]. Biomass-based energy generation is popular in rural areas due to infrastructural constraints to delivery *via* conventional sources. Bioenergy has merit as it is renewable and extractable from organic matter by utilizing simple and economical techniques, and processes of anaerobic digestion (AD), yielding high levels of practically usable biogas [3–5]. Biogas is a recognized eco-friendly energy source, with the main components being methane (60–70%) and carbon dioxide (30–40%) [6–8].

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5 Renewable Energy Sources

Kamal Kant Sharma, Akhil Gupta, and Akhil Nigam

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5.1 INTRODUCTION

Frequently, renewable energy (RE) is referred to as clean energy or green energy, making use of natural resources like solar orientation or rotation, or wind flow at a particular speed [1, 2]. Renewable energy is a freely available energy which is extracted from all natural resources which are present in abundance like solar orientation (which normally people frequently misinterpret as sunlight), rotation of wind (clockwise or anticlockwise direction), and using the gravitational effect of the moon towards the earth in bringing heavy tides every 15 days [3–5]. Renewable energy also involves differences in the earth's crust temperature in the uppermost layer in the form of geothermal energy, which can be connected to meet local and global loads. These sources, cited as renewable energy sources, are replicable, consistent, and readily available. Another advantage of renewable energy is its use as a dispersed resource for a connected power system.

In the past century, there was less knowledge about renewable energy sources (RES), but, as time passed, people began to understand about the generation of electricity through various RESs. With the usage of fossil fuels, like gas, coal, and oil, there are problems like hazardous gas emissions, high noise, poor reliability, and low efficiency. These non-RESs can endanger human and other life, and cause serious problems. All the RESs should be introduced by bearing many considerations in mind, because every source performs well under certain climatic conditions. Properly selecting the appropriate RESs at a particular location can provide efficient and sustainable energy. Following depletion of the ozone layer with the release of

7 Hybrid Energy Systems

Akhil Gupta, Kamal Kant Sharma, and Akhil Nigam

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7.1 INTRODUCTION

In today's times, renewable energy systems (RESs) can replace the use of fossil fuel with the installation of the latest renewable sources. There are many RESs available, each type performing best under particular climatic conditions, but, due to the unpredictability of the availability of any of the energy sources, the performance of the overall system may be disturbed [2–4]. A single RES may not be able to fulfill all the demands of the end-user,

A hybrid energy system is a combination of two or more systems, connected together in order to provide maximum deliverables in terms of energy and power, to provide sufficient cooling, heating, and hot water for domestic buildings and industrial applications [1], as depicted in Figure 7.1. By employing a hybrid RES, combining two (or more) RESs, if one energy source is unavailable or unable to perform as per requirements under certain climatic conditions, the second source fulfills the requirement and provides an appropriate response [2–4]. A combination of RESs, connected together, would provide a better and more reliable output than a single RES, so these hybrid systems have been preferred for many years [3]. Various sources have been used, with different configurations and approaches, to develop new arrangements to achieve faster energy supply, with better deliverables in terms of efficiency. With a hybrid RES, various sources, which are similar in their operation or which have similar properties, can share the same cluster requirements and overcome the necessity for additional manpower and for sophisticated equipment for energy storage.

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9 Electric Energy Systems

Kamal Kant Sharma, Akhil Gupta, and Akhil Nigam

CONTENTS

9.1 INTRODUCTION

The needs of society and the dependence of gross domestic product (GDP) on reliable performance parameters for the production of electrical energy have increased exponentially. The main reason for this increase is the enormous use of electrically enabled devices and the "rat race" between developing and developed countries for a share of the profits from industry. The energy system is also making progress in the production of electricity by employing advanced technologies with a focused effort to make the system more reliable and sustainable. For more than a century, the electric power industry has developed across the whole world, with the introduction of different energy production sources [1]. There are basically two types of sources, namely conventional and non-conventional energy sources.

Conventional fossil fuel-based technologies, which have dominated electricity generation for decades have many drawbacks and various limitations, such as greenhouse gas emissions, pollution and the destruction of aquatic life, and the global

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

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10 Power Quality Analysis Using Various Computational Techniques for Induction Machines

Akhil Gupta and Sunny Vig

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10.1 INTRODUCTION

The current deregulated industry is mainly responsible for the introduction of Power Quality (PQ) issues in the electric power system; these issues, which are quite challenging in the long run, have been major concerns in recent times. Therefore, the impact of these issues needs immediate consideration on account of the sudden increase in harmonic-producing loads. However, the existence of harmonics is inevitable at the user end [1–3]. Critical sources of harmonics are rotating machines, inverter drives, non-linearity of a transformer, phase controllers, and AC regulators. In particularly, the presence of any level of harmonic in the system depends upon the switching pattern employed. That is why a novel hybrid phase shift Pulse Width Modulation (PWM)-modified synchronous optimal hybrid techniques has been proposed [4] for a 27-level multi-level inverter, which was aimed at improving the harmonic voltage profile of a 4 kW solar photovoltaic grid-connected system.

14 Microbial Fuel Cell

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Gagandeep

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006