

Wheeling of Electric Power and Price Forecasting in Deregulated Power System- A Bibliographical Survey

Gagandeep Kaur ^a, Sobiya Mukhtar ^b, Akhil Gupta ^c

^a Academician, Maharaja Ranjit Singh Punjab Technical University, Bathinda, India,
Email Id: gaganpitk@gmail.com

^b Former research scholar, I. K. Gujral Punjab Technical University, Jalandhar, Punjab

^c Academician, I. K. Gujral Punjab Technical University, Jalandhar, Punjab

ABSTRACT: Power diligence is working quickly from regulated power system to a deregulated environment in power system. The emerging fields are taking place where there is a decisive need to keep a track on the continuously acting activities. In electricity market the deregulation environment has created a competition among power producers, transmitters, and distributors. For fair competition among the suppliers, and to shatter the monopoly of transmission system a transmission open access system and conventional wheeling has introduced the new approach of power transmission using third parties line. The forecasting of price in deregulated system is also a matter of great concern due to congestion on lines and price spikes. This manuscript gives, a concise bibliographical survey, developments in the field of wheeling of power and price forecasting and different approaches of universal background beneath deregulated background based on over 150 published articles. The combined text have been alienated into sections so that researcher do not face any problem in favor of attaining information in the field of wheeling of power and price forecasting in deregulated environment.

Index Terms:- deregulation, independent system operator, congestion ,privatization ,wheeling , transmission open access (TOA) ,price forecasting ,fuzzy logic , artificial neural network , load forecasting.

I. INTRODUCTION

The simple definition of “Wheeling” of electric power is the transmission of power from a seller party to a buyer party by using the network of transmission lines owned by another third party. In deregulated environment of power system, there are three independent activities namely; generation, transmission and distribution of power. For the benefit of other parties, wheeling make use of transmission system of a party or some parties having own transmission systems. The pricing of these transactions and sharing of benefits are the important issues related to wheeling. In fact the term wheeling is introduced to define transmission of power from one entity to another entities by the use of transmission or distribution facilities [1]. Wheeling is a hybrid conception, ensuing from pairing of two dissimilar profitable concepts: an ultimate deregulated competitive market place, and an ultimate world of regulated utilities.

With the beginning of competition in electricity segment and simultaneously restructuring, the price for fuel and electricity are getting renewed attentions for the price forecasting and their techniques. Due to several existence the market value calculation is relatively an anxious subject, interested in load forecasting for newly created competitors in electricity market. The crash of electricity price is the additional physical factor for price volatility. There are various forecast methods that

have been worn for the electricity cost forecasting. The impact of price volatility depends on some physical factors. The hourly load demand, is relatively alike and its variations are quite cyclical in contrast to the hourly market value. This paper review the

II. CONCEPT OF WHEELING OF POWER AND PRICE FORECASTING

Since 1980, the need for more power generation, higher efficiency and delivery of power has shown the way for restructuring of power sectors. Countries started to consider the restructuring of their power sector for sake of competition in power producers and more number of choices for customers. In order to consider and implement this, Electricity Supply Industry Restructuring has separated the functions of power generation, transmission and distribution and electricity supply to consumers. The creation of several power generation producers and the recognition of transmission system as monopoly and accordingly to make provisions. The inclusion of transmission into competition framework has raised an idea of transmission open access (TOA) which alters the conventional monopoly and aims for fair competition among supply producers. TOA is a regulatory body which examine the operational procedure, protects rights and obligations and check economic conditions for parties use transmission network for power transfer. This TOA approach combine with wheeling in this competitive market as later is prevalent for these types of unbundled services. In power market due to competition in transmission of power by power suppliers and over flow on lines by many users led to congestion of lines. Because of this the electricity price exhibits a major volatility, and market clearing price (MCP) representing the electricity pricing is higher in congested zones. The price differentials are represented by Locational Marginal Price (LMP) and would have to forecast for individual buses in the power system network. The accuracy of price forecasting is effected by spikes happens in prices due to worse situations of congestion.

III. METHODOLOGIES AND ANALYSIS

This portion involves those articles which are linked to methodologies, operational issues, technical analysis and costing etc.

A) WHEELING OF POWER

The bibliographical survey of wheeling of power presents that: In 1993 and 1994 the subsidiary wheeling charge with assessment difficulty and theory of wheeling is explained in [8,9]. The locational price modification on a network based proposal incorporates with the uniform auction [10]. The theory of existing transmission capability is illustrated in [11]. Reference [12, 13] introduced the theory of long – run subsidiary cost. The secondary wheeling cost evaluation and TOA is illustrated in [14]. Reference [15] describes the model of open access pricing with scheme approaches. The concept of Available Transfer Capability (ATC) and its estimation by disintegration is explained in [16]. The approach of wheeling costs allocation is explained in [17, 18]. The marginal cost based on setting wheeling rates are explained in [19]. The incremental loss approaches and incremental pricing approaches are used for wheeling loss evaluation and interchange costing [20]. For the evaluation of wheeling and nonutility generation (NUG) related options the applications of optimum power flow are described in [21]. In a multi utility background the optimization in federal and decentralized power system based on theoretical benefits [22, 23]. Reference [24] describes a method for calculating marginal cost of transmission capacity and embedded incremental . The

concept of optimal multi area wheeling is described in [25]. The finest pricing of distribution as well as transmission services in electricity markets are illustrated in [26]. The wheeling fees and pricing control sales depends on the utility – cogeneration game [27, 28]. Reference [29] illustrated short tenure and long tenure simulation of wheeling cost. The electrical energy exchange transaction modes are explained in [30]. The area energy interchange depends on the transmission loss penalty factor [31]. The concept of optimal pricing of transmission services are explained in [32]. In case of Energy Exchange for security constrained economic dispatch the fast algorithm is used [33]. The bulk power trading depends on the development of option markets [34]. The network constraints in deregulated system using optimal power transactions are explained in [35]. The investigation and supervision of power dealings beneath open access using numerical framework is described in [36]. The subsidiary cost-based pricing meant for wheeling transactions analyzed the consequence of neglecting volt / VAR optimization [37]. The perception of wheeling price assessment by means of Optimal Power Flow (OPFs) is explained in [38]. On behalf of allocating transmission expenditure along with users an analytical approach is used within transmission services [39]. The concept of independent power producers (IPPs) and secondary fee pricing of wheeling transactions are briefly discussed in [40]. The modified mile power method based on innovative model for pricing of fixed cost within wheeling charges [41]. The transmission pricing has an impact on flexible ac transmission system devices [42]. The concept of integrated mutual trades in support of stimulating control networks are described in [43]. In deregulated environment the bilateral transactions analyzed with probabilistic security [44]. The concept of transmission congestion management in electricity market is explained in [45]. Power industry reconfiguration applied to retail wheeling assessment and dispersed generation planning describes the incremental transmission capability evaluation [46]. Reference [47] describes the shortcomings and importance of an assortment of techniques to deal out the wheeling expenditure on behalf of several wheels in interrelated control systems. Reference [48] explained the practice of some analyzing strength and weakness in the approach, analytic background intended for all of the foremost techniques used for congestion management at present use world - wide, needs connected with this vital problem and exploring the future directions. In support of assessing the possibility of instantaneous mutual dealings the uncomplicated and convenient method is used [49, 50]. The network cost allocation method based on comparative analysis described in [51]. The power industry based on deregulated environment has realistic concepts for transfer limit analysis [52]. Within a competitive environment the approach intended for distribution of transmission losses to share the contracts designed for end to end transactions are presented in [53]. In deregulated energy markets a pricing of whirling preserve is explained in [54]. In a deregulated system the explanation of short term transmission line maintenance scheduling is defined [55,56]. The theory of an optimization come close to access where ATC is explained in [57]. A stochastic programming can be evaluated by using ATC evaluation [58]. By selecting the various wheeling options the evolutionary programming – based algorithm is used [59]. The concept of emerging energy market structure used for congestion management has been described in [60]. In deregulated environment the approach of reactive power as an auxiliary service is described [61]. Under deregulated environment short – term transmission planning based on network congestion evaluation [62]. The energy transaction factor calculations are illustrated in [63]. Under deregulated background of power region the supervision of wheeling contacts be analyzed [64]. In deregulated electricity market, the basic representation of involuntary generation manage for multi-area scheme is presented in [65].

B) GENERAL ISSUES WITH WHEELING OF POWER

To exploit the transmission through third-party have long term impact [66]. The approach based on the deregulation of electric utility is explained in [67]. The competitive electricity supplies and its importance are described in [68]. The composite system adequacy evaluation based on the impact of power wheeling [69]. The simulations help how to quantify wheeling flow due to short circuits [70]. The dealing in power transmission and wheeling is described in [71]. The various importance issues with transmission access are explained in [72]. To concern the optimizing wheeling parties the benefits has given various considerations on transmission services [73]. In an open market the visualizing power system operators are described [74]. In an electricity system the advanced pricing approaches are described in [75]. Reference [76] describes the electric utility industry transformation. The explanation intended for effectiveness of incorporated reserve preparation is explained in [77]. The overview of the deregulated concepts are explained in [78]. The privatization of power deliver production along with supply measures, such as, sound pricing principles, ending unmetered supply and transparency on subsidy regime are illustrated in [79,80]. The electrical utility can be explained with customer service enhancement [81]. A viable option is how private power could succeed [82]. To set up a superior transmission policy within power market the various critical issues to be pointed out [83]. In electricity generation the transmission access is considered as an global issue [84]. The production is treated like an open market in addition to transmission like an monopoly where several topics effect the transmission pricing on system cost in this new environment [85,86]. Reference [87] explained a research in relation to the optimal wheeling proposal. The restructuring electricity markets explained a market power – monitoring model [88]. In a deregulated power system the multiple – impact assessment of wheeling and IPPs are described [89].

C) PRICE FORECASTING

Within the whole power organization, LMP would cover to be forecasted meant for the individual buses. After making an allowance for the production of secondary price, losses and charge of transmission overcrowding, where as LMP be the expenditure of supplying MW of the load by the side of a explicit location. LMP is identical like MCP, where there is refusal of congestion. Optimal power flow (OPF) solution involves the transmission contour constraints. To organize stability in supply and demand by the side of every bus, when there is congestion. LMP defines the subsidiary charge of every bus [90-95]. The typical aspects of electrical energy which possibly will force the forecasting precision are prices spikes after the load intensity in the scheme approaches its generating capability restrictions it would be difficult to correct the price spikes. In dissimilar consignment levels, it is valuable to revise the possibility of price spikes and added, the possibility in distribution of costs under dissimilar consignment levels. In recent years, in assorted markets the power have been traded as a commodity. In additional to commodity markets like agriculture and stocks where price forecasting has extended at the core of concentrated studies. However, the divergent uniqueness from further commodities depend on the power. Thus, the purposes of forecasting methods prevail in additional service markets, can create a bigger mistake in forecasting the charge of electrical energy and a major volatility can exhibit within electricity price movements [96-105]. The forecasting electricity prices depend on two possible methods. The first method is the power system components depend on the imitation of

the accurate substantial model and by considering the substantial individuality of power networks, the resolution is originated by applying mathematical algorithms. The second method finds a mapping involving numerous input parameters along with hourly market prices based on artificial intelligence. In historical cases the mapping is adopted. In this paper, we review the various methods that have been used for price forecasting.

The Artificial Neural Network (ANN's) capability to gain knowledge of the estimated multifarious relationship through training is the foremost explanation of ANN purposes. The non linear association involving upcoming and chronological cost records and its impacting factors have uncomplicated achievement and good quality presentation for modeling using ANN. The conventional forecasting methods in certain circumstances could respond the most admired technique is ANN which have acknowledged the extensive approval in the utility diligence [106 - 116]. There are three parts in the architecture of the ANN i.e. input layer , hidden layer , output layer .The outside world is connected to the input layer. The layer which receives the information from the outside world is known as input layer . The layer which doesn't have connection with the outside world known as hidden layer. The layer which will provide the ANN output to the outside world subsequent to the external information is process by association known as output layer.

There are two methods used for the existing time series forecasting .Statistical and mathematical concepts are based on classical methods and algorithm from the field on intelligence based on the modern heuristic methods .The classical methods can be sub divided into following types: Regression models, Exponential smoothing models, Auto – regressive moving average (ARMA) models and Threshold models. The first three models are concerned as linear methods and the last model is concerned as non linear method . The business, economic, engineering and science are various fields of research that have become increasingly important in time series methodologies and its purposes. To estimate the values of variables from notorious or unspecified standards of other variable is the study of relationship among variables [117-125].

Fuzzy sets, cannot repeatedly obtain their regulations they employ to make individuals decisions but know how to communicate for the inexact information , are appropriate in favor of explaining their decisions. The decision -making systems are employed on the ANN to alter attachment function of fuzzy systems by means of FNN. The two techniques are united in a behavior to overcomes the limitation of individual techniques that have formed a fundamental dynamic power after the establishment of FNN [126-131].

Since mid 80's the an assortment of approaches that have been implemented and useful to forecast electricity price [131 -150]. Currently, a new perception in statistical learning theory the support vector machine (SVM) has been practical in power market price forecasting and achieved suitable consequences. Based on fuel cost ,customers' hourly consumption ,transmission and generation schedules, predicted and reserve behavior of market participants depend on price of electricity under stochastic analysis .The price and load forecasting has been used in stochastic analysis.

D) PRICE SPIKES IN PRICE FORECASTING

Price spikes can be influenced by many possible factors including fuel prices, weather conditions, plant operating costs, physical characteristics of the system and some other factors which impacts the price. Due to several volatile measures or accidents, price spikes are hard to predict and highly randomized. Based on numerical allocation of spikes, several approaches have been used for estimation of the probability of spikes. It can also be caused by the unexpected indecisions, and by market power. The highly randomized events in the electricity markets are price spikes. An irregular market clearance cost under price spikes at an instant of point t , are unusual from cost of others hours.

IV. CONCLUSION

This article gives a general idea of the theory of wheeling of power and price forecasting under deregulated background of power system, through an assessment of the chronological events, the relevant background, practical requirements and techniques. The precise evaluation of cost could result in economic rewards is essential to formulate the operational settlement in price forecasting. This paper is based on many research articles and the credentials listed within this survey provide a delegate samples in current engineering thoughts pertaining to wheeling of power and price forecasting problems underneath the deregulated background.

IX. REFERENCES

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