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A REVIEW ON TRANSMISSION LOSS AND COST ALLOCATION IN RESTRUCTURED MARKET SCENARIO

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ABSTRACT

The power system analysis and design is generally done by using power flow analysis. .This analysis is carried out at the state of planning, operation, control and economic scheduling .They are useful in determining the magnitude and phase angle of load buses, and active and reactive power flows over transmission lines, and active and reactive powers that are injected at the buses.Power transmission losses minimization is basic research work done in power flow analysis. In this paper analysis is done on how research work is going on for transmission loss minimization.

Keywords: Postage Stamp (PS), Proportional Sharing Principle (PSP), Load Frequency Control(LFC), Automatic generation control (AGC)

I. INTRODUCTION

In the Indian Constitution electricity is a concurrent subject, where both State and Central governments are involved in the decision-making and implementation. By the Indian Electricity Act 1910 and Electricity Supply Act 1948,the power sector was governed in India. A public monopoly was evolving the power sector till 1990. Affiliated authority of the development of the power sector was given to the Ministry of Power (MOP). The MOP activities include formulating plans and policies, for decisions of investments in power processing projects, developments and research, power supply and generation pertained in legislating formulation, and the required linkage is provided between other departments and ministries in the planning commission, Central and State governments.

Throughout the world, for providing quality service and for better resources utilization and choice to the consumer at competitive prices the Electricity Supply Industry (ESI) has undergone restructuring. Since 1991 in India, a competition has been introduced by allowing the Independent Power Producers (IPPs) participationwhich areintroduced already at generation level.

In several states, the three organs separation of electric power business that is distribution, transmission and generation has been done which has been followed by distribution privatization. At central level and also in most states independent regulatory bodies have been formed forthe transparent policies formulation regarding promotion and subsidies of benign policies that are efficient and environmentally, rationalization of electricity tariff these regulatory bodies. After the Electricity (Laws) Amendments Act, 1998 enactment at the national level and at the state level, State Transmission Utilities (STUs), the Central Transmission Utility (CTU) also

have been made effective. In addition, in all three electricity facets that is, distribution, transmission, and generation the private sector has entered. The Electricity Act, 2003, clearly calls and focuses on this.A central utility transmission has notified the PGCIL at national level function. As state utility transmission, the main transmission companies or SEBs are functioned in the states restructured at state level.

II. ELECTRICITY ACT 2003 SALIENT FEATURES ARE:

No licensing for state and techno-economic clearance for generations of stations, Non-discriminatory and transmission system open access, regulators , licensing for tariff, SERCs and CERCs, access rules and grid, Provided for a spot market eventual creation and trading power and subsidies .For access and promotion in rural areas having special provisions to electricity and for the person who is weaker economically, transition provision available from monopoly that is State owned to a competitive and liberalized industry. Transmission grid nationally has been created for electricity dispatch and optimum scheduling among the transmission grids that are regional. In the electricity market, the competition is assured by the Electricity Act 2003 at the wholesale level, i.e., the distribution companies and the consumers in bulk now are given permission for buying power directly from any companies generating power. In wholesale trading after sufficient experience is gained, at the retail level with the creation of the supplier the competition can also be introduced, in which retail consumersare provided with power supply by the utility the open access to network that the distribution and transmission companies offer. According to their requirement, buyers can buy power from any ofthese suppliers from any generating companies/ power exchange/power pool, etc., and any other commodity trading the electricity [18].

In the power industry, a competition is introduced due to the power system deregulation and restructuringbased on price and reliability allowing the customers the suppliers' selection.

The result of the deregulation and restructuring in the integrated vertical utility with functional segregation,consists of transmission, distribution and generation into distinct utilities each performing a single function. The conventional mechanism of system operation and planning changed due to economic segregation and service unbundling from cost-based operation to price-based operation and planning. The back-up supply provision in the event that its energy obligations cannot be met by a generating company (Genco) is not the responsibility of the other power producers unless there are reserve agreements with others. In power system having transmission facilities are usually maintained and owned by different transmission companies (Transcos).

All power producers, with no discrimination should be able to access the transmission. Although the market players contracts in a financial power market are settled, implementing physically the energy transactions through the same network of transmission. Therefore, the problems of the reliability and stability such as load shedding, voltage constraints, and congestion can be coordinated and controlled through the independent system operator (ISO) or transmission administrator. Some fundamental problems are created by these changes [1–5] which is regarding reliability management system. The reliability assessment techniques having wide range, which is developed for the conventional systems that is vertically integrated,for the extent of its need and its use in restructured power systems is reconsidered.

The transmission activities separation starts the restricting process from the activities of the electricity generation. In generation activities the competition is introduced by the subsequent step, either through the power pools creation, bilateral direct transactions provision or spot markets command. For the whole system appointing the system operator and commended with the responsibility of the maintenanceNaturally, an independent authority is required with no involvement in market competition [1].

The struggle of the generators is to supply for the distribution companies and large users in the restructured power system. Thus, the market uses a reasonable economic indicator as transmission pricing for decision making on system expansion, resource allocation, and strengthening. However, an efficient transmission pricing scheme is difficult to achieve which the market structures are fit in different locations. [9].

III. LITERATURE REVIEW

With and without real power transmission losses this paper [1] focuses on the cost allocation transmission procedures and providesanalternative comparison oftwo methodologies; Flat Rate based method i.e., Power Flow based method and Postage Stamp (PS) Method i.e., Proportional Sharing Principle (PSP) Method. Based on these two methods the algorithms have been implemented and developed for cost allocation. On the IEEE-24 bus system and sample 3-bus system these two methodologies are illustrated. The MATLAB program is used to analyze and the simulation results are obtained. In a restructured environment the Load Frequency Control (LFC) of the two-area multiple-unit interconnected thermal reheat power system is proposed in this paper [4]. With fast power consumption and large capacity the various kinds of apparatus may cause frequency oscillations series problem in the restructured scenario. If no adequate damping is available the system frequency oscillation may grow and sustain causing a problem of series frequency stability.. So to stabilize the system in order, at the terminal of area 1 with tie-line and Redox Flow Batteries (RFB) impact of Interline Power Flow Controller (IPFC) have been investigated. In the competitive electricity market, for optimizing under different transactions of the Load-frequency Controller integral gains using the Bacterial Foraging Optimization (BFO) algorithm. In this work for Load Frequency Control, compliance with North American Electric Reliability Council (NERC) standards has also been established. With IPFC units the RFB have been coordinated for LFC loop having great potential to improve the dynamic performance of the systemwhich is revealed by the simulation studies.

In [5], To maintain system parameters within feasible operational margin the system operator's one of the major aims. A day-load changes very rapidly during certain period of time, especially when it tends, for reactive power sources, a generalized stressed condition and voltage decrement occurs. Under unpredictable load scenario, maintains voltage profile is maintainedunder load varying conditions. While the reactive power support that is necessary is provided under perturbations to improvethe power system voltage profile, this highlights the expediency of STATCOM by the embedded work. Using software tool PSAT based on MATLAB under different loading conditions the simulation results supporting the performance evaluation on WSCC 3-generator 9-bus system have been obtained.

In [6],for two-area restructured power system having an automatic generation control (AGC) an optimal controller has been designed. For two cases the controller performance has been studied: (a) the parallel EHVAC and HVDC lines are consisted when the two areas are in the tie line and (b) interconnection acting only

as ac tie line. In each area, damping out frequency oscillations while doing the comparisons for two cases in terms of the time taken is done, when there is change in load by each generator the tie-line power exchanges in between the generated power and the two areas. With EHVAC in parallel tie line, improving the control performance when in parallel connecting the HVDC link that is indicated by the simulation results and for the optimal controller as additional state considering the dc block output. By DISCOs for bilateral contract violation condition and for contracted condition the simulation studies are carried out in detail. As compared to conventional PI controller better dynamic response is given by the optimal controller. By using optimal fuzzy controller combined with the dynamic response is further improved. For tuning the fuzzy controller, the Particle swarm optimization (PSO) technique is used. In terms of settling time and peak overshoot, the two area thermal–thermal system results indicate better control performance. In the secure and economic operationof the competitive energy market of the restructured power system the price and load prediction are components that have been described important [7]. To half hourly ahead price prediction, applications and to half hourly ahead load prediction, the use of the artificial neural network is presented in this paper. For the half hour ahead prediction, with Back propagation (BP) algorithm a multi-layer feed forward (FF) neural network has been developed by using the price and calendar data, load consumption and historical weather. With Australian market data for half hourly prediction the developed algorithm has been tested. The conventional Multiple Regression (MR) prediction model and the ANN prediction model resulthave been compared.

In power markets an In power markets an iterative generator maintenance scheduling (GMS) scheme is proposed [8],an unexpected unit failures influence is consider. Within the entire scheduling horizon, GMS problems with the individual producers by their payoffs optimization, the ISO determines the outage periods as the coordinated benchmark. Between the scheduling of the producers and the benchmark based on the difference of the system costs, the generating units in corrective signals are synthesized by the ISO, in which outage planning is rescheduled by direct producers and ISO resubmitting them. For the balancing of the benefits of producers and an appropriate schedule by the system operating costs through the iterations among power producers is obtained. To demonstrate the proposed GMS issue utilizing a 21-unit system equivalent energy function (EEF) method is used. With high wind power penetration in restructured power systems, to evaluate operational reliabilities a new technique is proposed for this [9]. The proposed technique is the reliability network equivalent and time-sequential simulation approaches in combination.. For real time operation which is considered to its day-ahead coupling with contingency management scheme is proposed. To model the chronological characteristics of corresponding reliability network equivalents with the use of time-sequential Monte Carlo simulation are used. For improving the computational efficiency a simplified method is developed. In the deregulated environment for customers' reliabilities evaluation considering high wind power penetration the proposed technique is used during the operation of power system. In the System Operator (SO) in paper [10] theTransmission congestion management is one of the important and critical tasks. With the rescheduling, cost minimization objective comparing withthe congestion relief procedure is discussed in this paper. Transmission Congestion Distribution Factors (TCDFs) on the zone/cluster bases.The Congestion Management is carried out by the real power generation rescheduling using the proposed idea has been based on a 6 bus system and IEEE 30 bus system. Based on the EBE principle a new LA scheme has been developed and tested in this [11]. For the transmission allocation use costs this principle has been applied, and for an LA scheme there are also several

desirable properties: 1) for its implementation it is based on flow,only load flow is required; 2) Onslack bus choice it is not dependent; 3) for application it is straightforward; 4) does not produce the undesirable negative loss allocation; For loss allocation the application of this principle required several steps: 1) all bus generations and demands identification; 2) all equivalent line loss loads identification; 3) EBE definition; 4) to each EBE the line loss component definition and calculation are defined according to the use of its line by the factors of line flow distribution; and 5) EBE all line loss allocations is among all loads and generators.Based on the bilateral AGC scheme and changing environment of power system operation under deregulation and to adapt the classical automatic generation control (AGC) system that is well tested, a new decentralized robust strategy is addressed in this [12]. In a modified traditional dynamical model the effect of bilateral contracts has been taken as a set of new input signals. The multi-objective control problem is formulated by the AGC problem, and in a multi-area power system forsynthesizing the desired robust controllers using the mixed H_2/H_∞ control technique for AGC design.

In an electric energy environment that is competitive,a generation maintenance scheduling is addressed in this [13]. While minimizing and imposing it to all producers, a maintenance scheduling plan driven by the system operatorin which the desired reliability is attained in a centralized setting. This is not possible in a competitive environment because for the maintenanceof reliability,operation having adequate level is still in charge, but the each producer target is the maximization of profile of its own, with the reliability operator which conflicts in general. Based on the operator and incentives/disincentives among producers a technically sound coordinating mechanism is proposed in this paper, while an appropriate reliability level is ensured by operator which allowed producers their respective profiles maximization.

In restructured power system for automatic generation control (AGC) simulation, the control loop of the traditional automatic generation is incorporated with modifications in this [14]. For price based operation the Federal energy regulatory commission (FERC), an open market system is encountered. For proposed rulemaking of various ancillary services the FERC has issued a notice. For optimal transient performance to obtain optimal gain parameters the Hybrid particle swarm optimization is used.Fundamentally,Bialek's "Tracing forthe flow of electricity" method is proposed in [15]. Using the loss weight factors (LWFs) to market participants the losses are allocated which are obtained from the Z-bus matrix and square current magnitude. When network topology is considered on current magnitude the LWF method is solved are load flow based and is emphasized strongly.

For the cost allocationto its users of a transmission network, a novel methodology is presented in [16] based on the equivalent bilateral exchanges principle After the governing of all the physical laws like meeting the power flow, each generation fraction assigning each demand and in uniform manner, each demand fraction assigned by each generator. Transmission cost allocation on the bases of this principle hasseveral advantages, such as, the slack bus choice independence, counter-flows recognition, and charges used by transmission that are positive and stable.The four alternative algorithms comparison in detail is provided in [17] which focuses on transmission loss allocation procedures: 1) marginal allocation, 2) proportional sharing, 3)*pro rata*, and 4) unsubsidized marginal allocation. In this paper, a case study is provided which is based on IEEE RTS. A scenarios analyzing load condition for whole year has been considered.

TABLE1 Review Table

Author Name	Title and Publishing year	Technology used	Description
P. Srinivasa Varma et al.	"Transmission cost allocation with and without losses in restructured power system."(2011)	MATLAB, Postage Stamp (PS) Method and Power Flow based method	With and without real power transmission losses focusing on the cost allocation transmission procedures and provided an alternative two methodologies comparison; Flat Rate based method i.e., Power Flow based method and Postage Stamp (PS) Method i.e., Proportional Sharing Principle (PSP) Method.
I.A. Chidambaram et al.	"Optimized load-frequency simulation in restructured power system with Redox Flow Batteries and Interline Power Flow Controller." (2013)	Load Frequency Control (LFC), Bacterial Foraging Optimization (BFO)	In the competitive electricity market, for optimizing under different transactions of the Load-frequency Controller integral gains using the Bacterial Foraging Optimization (BFO) algorithm. In this work for Load Frequency Control compliance with North American Electric Reliability Council (NERC) standards has also been established. With IPFC units the RFB coordinated for LFC loop having great potential is applied to improve the dynamic performance of the system which is revealed by the simulation studies.
HitarthBuch et al.	"Voltage profile management in restructured power system using STATCOM." (2011)	MATLAB based software tool PSAT	Using software tool PSAT based on MATLAB under different loading conditions the simulation results supporting the performance evaluation on WSCC 3-generator 9-bus system. While the reactive

			power support that is necessary is provided under perturbations to improve the power system voltage profile, loss highlights the expediency of STATCOM by the embedded work.
Sanjay Sinah et al.	"Application of AI supported optimal controller for automatic generation control of a restructured power system with parallel AC–DC tie lines." (2012)	Automatic generation control (AGC), Particle swarm optimization (PSO) technique	With EHVAC in parallel tie line, improving the control performance when in parallel connecting the HVDC link that is indicated by the simulation results and for the optimal controller as additional state considering the dc block output. For tuning the fuzzy controller using the Particle swarm optimization (PSO) technique. In terms of settling time and peak overshoot, the two area thermal–thermal system results indicate better control performance.
Mohan Akole et al.	"Predictive model of load and price for restructured power system using neural network."(2011)	ANN prediction model	To half hourly ahead price prediction applications and to half hourly ahead load prediction the use of the artificial neural network is presented in this paper. For the half hour ahead prediction, with Back propagation (BP) algorithm a multi-layer feed forward (FF) neural network is developed by using the price and calendar data, load consumption and historical weather.
Changyou Feng et al.	"Iterative approach to generator maintenance schedule considering unexpected unit failures in restructured power	Generator maintenance scheduling (GMS) scheme, energy function (EEF)	In power markets an iterative generator maintenance scheduling (GMS) scheme is proposed, unexpected unit failures influence is considered. Within the entire

	systems." (2011)	method	scheduling horizon GMS problems with the individual producers are considered by their payoffs optimization, whilst by the cost of system operating minimization. The ISO determines the outage periods as the coordinated benchmark.
Yi Ding et al.	"Operational reliability evaluation of restructured power systems with wind power penetration utilizing reliability network equivalent and time-sequential simulation approaches." (2014)		With high wind power penetration to evaluate restructured power systems operational reliabilities a new technique is proposed. The proposed technique is the combination of reliability network equivalent and time-sequential simulation approaches. In restructured power systems the representation of reliability models of reserve provides and conventional generation, transmission network and fast reserve providers and wind farms are developed using the operational reliability network equivalents.
S. Charles Raja et al.	"Transmission congestion management in restructured power systems." (2011)	Congestion Management (CM), Transmission Congestion Distribution Factors (TCDFs), Particle Swarm Optimization (PSO)	In the System Operator (SO) paper [10] the Transmission congestion management is one of the important and critical tasks. With the rescheduling, cost minimization objective comparing the congestion relief procedure is discussed in this paper. Transmission Congestion Distribution Factors (TCDFs) are utilized on the zone/cluster based. The Congestion Management is

			carried out by the real power generation rescheduling.

IV. CONCLUSION

Power loss minimization is necessary for any power system. This can be done using various optimization methods like Bacterial Foraging Optimization (BFO), Particle swarm optimization (PSO). With power loss minimization one can optimally allocate the cost of power to different users as power losses varies with distance from generating units along the lines and other factors too.

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