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A Review on Congestion Management in Power System Reforms

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Abstract - In the recent decades the evolution of power system reformation has engaged in over loading transmission line or congestion. Over loading of transmission network become most important effects on power systems reforms. Congestion occurs when transmission networks fail to transfer power based on the load demand. These congestion constraints are mitigated by employing various congestion management schemes that mitigates the various congestion issues in the deregulated power system. This paper discusses about various congestion management techniques, such as congestion management based on power market, conventional optimal approaches, artificial intelligence methods. In this paper involves overall review of all the publications in congestion relieving management techniques.

Key Words: Power system Reforms, Congestion management, optimization; methods

1.INTRODUCTION

In many nations, the electrical power industry is currently undergoing deregulation and reformation, with replacement of monopoly power systems industry.[1] In order to meet the rapid increase in the power demand globally at reasonable prices. congestion in the transmission lines become the major issue in the reformed power system [2]. Congestion management must be exercised immediately in order to relieve congestion in the transmission network. Congestion in the electricity system can be caused by a variety of factors, according to literature Survey. Congestion arises in a competitive market when transmission networks are unable to handle all intended transactions owing to system operational limitations [3]. Overloading of the transmission lines involves when the thermal limit boundaries and line capacity are broken, congestion occurs, overloading transmission lines [4]. Congestion occurs when power flows in the transmission line exceed the actual flow on the transmission line [5]. When the physical constraints in the transmission network become active then the system is said to be in the state of congestion. One of key factors of congestion on transmission lines includes physical and technical constraints of the transmission network [6]. Physical limitations such as thermal limits may involve on short transmission line networks. Transient stability, dynamic stability, reliability limitations involve in long transmission line networks. Sudden issues like power outages, unexpected increases in load demand, and equipment failure all contribute to congestion [7]. In order to obtain transmission system security, the congestion management techniques are exercised instantly. The appearance of congestion in the system may lead to damage to interconnected systems and also damages the power system components, power quality [8]. The congestion should be prevented as early as possible the significance of the congestion management is mentioned in [6]. A fast relief of congestion may be possible by removing congested lines to prevent severe damages to the system. Many case studies have been conducted to find the most effective congestion management strategies for managing transmission line congestion despite growing power demand. Some of the congestion management techniques, such as congestion management based on power market, conventional optimal approaches, artificial intelligence methods.

II. CONGESTION MANAGEMENT TECHNIQUES

The Technical and non-technical Congestion management methods were discussed in reference [9], [10]. The implementations of phase shifters, tap transformers and FACT devices are comes under technical methods. Technical methods are also called as free cost methods. Non-technical methods involve in network security congestion pricing and competitive market-based schemes. This method is also called as non-free cost method. Generators Rescheduling (GR), load shedding, Distributed Generations (DG), Demand Response (DR), and nodal pricing schemes are some of the approaches which are discussed in reference [11]. In this paper Congestion management methods are discussed on power market, conventional optimal approaches, and also on artificial intelligence control methods.

III. CONGESTION MANAGEMENT BASED ON POWER MARKET

To manage crowded systems, many power market models have been created across the world. Most familiar methods for congestion management are technical and non-technical methods where technical methods is classified in to three such as a outaging of lines, transformer tap changers, operation of FACTS devices. Whereas non- technical methods are classified into two namely market based and non-market based. Market based methods are auctioning, market splitting, counter trading, dispatching, load curtailment, nodal pricing zonal pricing. Non-market based consists of first come first serve, pro rata. GR method plays an important role in the selection of generators to reschedule the load. The reference papers [12][13] proposed the GR methods to mitigate the congestion in the deregulated power system. GR method is the most inefficient method [14].

The implementation of AI algorithms with an optimal methods gives the good and efficient results [15-17].

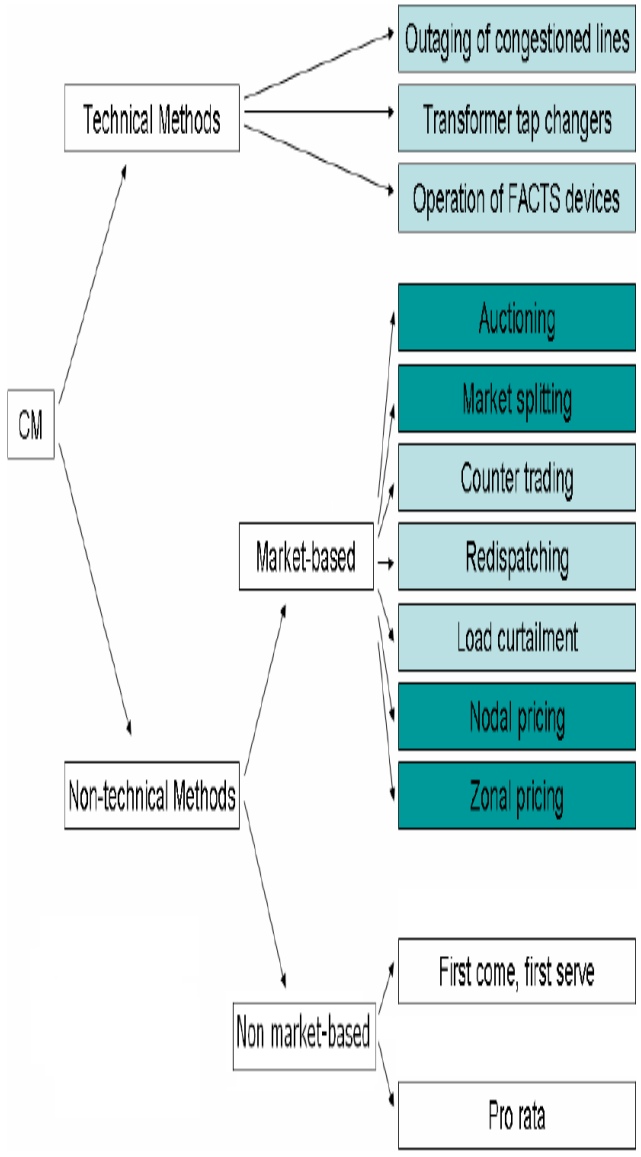

Figure 1. Congestion management methods [36]

IV. CONVETIONAL OPTIMMAL METHODS

The Conventional optimization methods are employed to mitigate the congestion problems in deregulated power systems. In order to improve the power transfer capability FACTS devices, play an important role. It also helps to improve the power flow capability and system stability. So that the system can attain optimal performance [18]. Some Optimal techniques such as MINLP- The Mixed Integer Nonlinear Programming, UPFC - Unified Power Flow Controllers [18]. Reference Papers [19][20][21] postulated an improved techniques for congestion management using the TCSC - Optimal placement of Thyristor Controlled Series Compensators in transmission networks. The optimal techniques are proposed to reduce the cost of reactive power procurement [20]. With the TCSC congestion can be eradicated with the minimum cost by installing the optimization approach in locating the devices [22]. FACTS devices have an ability to control the power flow quickly. Hence in order to enhance the power transfer capability limit of the line the FACTS devices are well suited to control the power flow. The advantage of the employing the FACTS devices are listed in the reference paper [23]. The most effective controller device for the congestion management is unified power flow controller (UPFC) [24]. The optimization of the UPFC reduces generation costs while also relieving congestion in the system. In order to promote the use of Renewable Energy Sources (RES) in the power system network, an ideal model for controlling the congestion was introduced in the literature [24]. In order to promote the use of Renewable Energy Sources (RES) in the power system network, an ideal model for controlling congestion was presented. the literature survey in the reference [19] states that system with the combination of the wind power systems with FACTS devices can improve the transfer capabilities and also reduces the congestion in the system. A stochastic self-scheduling of RES considering Compressed Air Energy Storage (CAES) is introduced with the presence of DR program [25]. From the Renewable Energy Sources wind energy and photovoltaic energy systems are included in this paper. In the model, Mixed Integer Linear Programming (MILP) is defined and solved optimally by utilizing a GAMS-based optimization algorithm. The impacts of the DR program and CAES on the self-scheduling problem are evaluated using four case studies, which show that the suggested stochastic program is legitimate based on the impressive results obtained.

V. ARTIFICIAL INTELLIGENCE APPROACHES

To solve congestion in power system networks, artificial intelligence techniques are employed for developing numerical algorithms. In this paper many of the techniques are being discussed such as PSO, FLCS-Fuzzy-Logic controlled systems, SA- simulated annealing, GAMS-General Algebraic Modelling Systems, FSO- Fish School Optimization, FLA- Flower Pollination Algorithm, SPEA- Strength Pareto Evolutionary Algorithm, MOEA-Multi objective Evolutionary Algorithm. In power markets PSO technique is use to relieve the congestion by minimizing generator rescheduling cost [26][27][28]. The literature [16], [17], [28] introduces GA method to solve the congestion for numerical formulated problem. The proposed techniques are effective optimization tools for alleviating congestion and lowering system expenses [29]. The Nondominated Sorting Genetic Algorithm II (NSGA-II) is employed to handle the optimization problem in a GR congestion technique [30]. The paper developed a congestion management strategy with two goals: 1. Optimizing transmission line overload 2. System congestion costs, it is employed the NSGA-II optimization method to achieve these goals. In the literature [31] controlling active power flow for congestion management utilizing FACTS devices. A Fuzzy Based Technique for Determining the Optimal Location of TCSC to Control the Active Power Flow and Reduce Congestion in a Transmission Line has been proposed in the

literature [32]. In general FACTS devices reduces the power flows in the lines in order to enhance the stability [31], [33]. Power losses are also be reduced by employing the FACTS devices. In the literature [32], [34, [45] Fuzzy control techniques are used to determine the best placements for FACTS devices to control active power flows. It reduces transmission line congestion. In [34] the optimal techniques employed for the optimal choice and location and size of Static Var Compensators (SVC) which decreases the congestion in the power line and also increases the line voltage stability, by the help of Differential Evolution (DE).

VI. CONCLUSION

As the increase of Congestion in the deregulated power markets congestion management became an important and Serious approach for mitigating the congestion issues. The employment of emerging technologies to build effective techniques that improve power system performance in the shortest period of time to relieve congestion is one of the new challenges and considerations. A survey of congestion management approaches and techniques from the literature is offered in this work. A thorough endeavour was made to demonstrate the necessity of using a congestion management strategy to alleviate traffic congestion, which is a growing trend in many studies.

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