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CONGESTION MANAGEMENT FOR COMPETITIVE ELECTRICITY MARKETS

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***ABSTRACT*:** *Congestion Management is one of the major tasks performed by system operators to ensure the operation of transmission system within operating limits. In the emerging electric power market the congestion management becomes extremely important and it can impose a barrier to the electricity trading. The method of congestion management based on Optimal Power flow are proposed to alleviate congestion in transmission lines and tested. This method requires re-dispatching on the basis of economic cost involved in making required changes to re-dispatching method. Alleviation of the emergency transmission line overload is a Critical problem in the present day power system operation; hence a control strategy is necessary to effectively reduce the line overloads to the security limits in the shortest time, by generation re-dispatching, not giving priority to the economic consideration. In the literature many methods have been reported for determining a secure operating point. Most of these methods use conventional optimization techniques, which are generally time consuming from computation point of view, especially for large systems. Further the conventional optimization techniques update all the controllers for most of the operating conditions. Under emergency conditions the operator has to make quick decisions, with little concern for the theoretical optimality of the operating point and also the operator cannot move all the controllers to different settings within less time. In this context a simplified expert system approach has been proposed in this paper for security and economy oriented power system operation. The proposed approach is used to remove the congestion in transmission line by generation re-dispatching. This paper presents a software tool for congestion management. The congestion management is based on a reformulated optimal power flow, whose main goal is to obtain a feasible solution for the re-dispatch minimizing the changes in the dispatch proposed by the market operator. The calculation is performed by MATPOWER fronted software with Graphic user interface facilities. Under emergency operating conditions the proposed approach helps the operator in load dispatch centre for improving the system security with the re-dispatching the few number of generators for overload relieving with less incremental fuel cost. The Paper includes a case study for IEEE 9 bus power system.*

Keywords: Congestion Management, Optimal Power flow

I. INTRODUCTION

Throughout the world electric power industries are moving toward competition through market based which is an objective for higher operational efficiency the competitive market are widely employed electric utility which are based on pool and bilateral models. The special characteristic network of electric power within the process of electricity trading. This model released on the action of pool operator for attaining the initial dispatch which is economical [4].In contrast, the bilateral model is motivated by the concept that free market trading is the best way to achieve the competition in the electricity wholesale [1], [2] However both model usually required a common transmission system to transmit the dispatched energy from supplier to customer.

In competitive environment, two market models widely use though out the world i.e. pool and bilateral markets can be jointly implemented in an electricity market [1], [2]. The implementation of these market modes depends on physical characteristics of system load and generation together the market structure policy.

In the pool model there are two main sides of entities participating in the market i.e. customer and supplier. The pool operator considers electricity transaction bids and offers from these two entities and dispatches this in an economic manner. In general the customer and supplier do not directly interact to each other, but only indirectly through the pool operator. After all the bids and offers have been received, and optimization tool will be use to solve the problems which includes congestion management [6].

This paper describe congestion management in the deregulated power system .transmission being the limited resource in any power system, the operation of transmission system and management of congestion is becoming very vital in the restructured environment[5].

The application of competitive market has been successful in the several sectors in the U.S. economy. The application of competition in the electric power market has not been completed .what makes the electric power market different in the presence of the transmission system where the flow of power cannot be easily controlled. In addition, the scarcity of transmission capacity leads to congestion or potential overloading. In spite the effort made to create and open, free market electric power company still has to cope with the transmission congestion problem.

Many different methods to structure and operate the electric power market have been proposed .This paper present new algorithm to solve congestion problem [6].

The purpose of this paper has been stated as the development of simulation tool for the congestion management scheme in a competitive electricity market.

In this paper with the help of software tool congestion management skill will be presented and evaluated were congestion management can in simple worlds ,be defined as: Managing the transmission grade in case of congestion ,with congestion being a situation here the plan demand for the transmission services exceed the capability of the network .

Congestion management is use to overcome temporary bottlenecks .Primarily the regional grids will also need the sufficient transmission capacity.

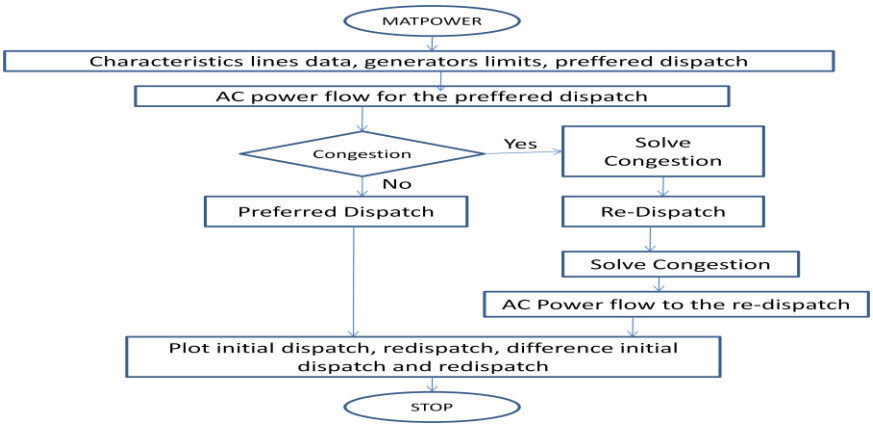
Congestion redispatch is a good alternative to have reliable transmission under competitive enviorement.It is employed when the market dispatch fails to provide feasible operation state i.e. a state with no constrains violations [3].

A congestion area is an area where insufficient electricity transmission capacity is available in relation with the installed production capacity.

Transmission redispatch is a means to resolve transmission congestion by changing generator output levels to reduce congestion.

This paper present a software tool using MATPOWER to assist decision making in competitive market environment .The initial dispatch is based on all the electricity transaction negotiated in the pool and in the bilateral contracts. It must be cheated if the proposed initial dispatch leads to congestion problem; if a congestion situation is detected, it must be solved [6].

FIGURE 1: ALGORITHM FOR REDISPATCH



MATPOWER FOR OPF :

Optimal power flow is a central decision making tool from 1962, OPF has had a long history of development. Now OPF has become a successful algorithm that could be applied on an everyday basis, in different kind of power market. The OPF is use for a wide range of task from calculating the minimum cost generation dispatch to setting generation voltage, transformer taps.MATPOWER is a package of MATLAB M-file for solving power flow and optimal power flow problems. It is used as a simulation tool for researchers and education that is easy to use and modify MATPOWER is designed to give the best performance possible while keeping the code simple to understand and modify .It was initially developed as part of the power Web Project..It also solves the congestion of initial dispatch and provides good offers to re-dispatch.

II. RESULTS OF IEEE 30 BUS CASE STUDY

The IEEE of bus test case represents a portion of the American Electric Power System. The data was kindly provided by Joe H.Chow's Book page No.70.

The one line diagram of an IEEE-9 bus system is as shown in the fig. The line data, bus data and load are as shown in table 1 and 2.

Single line diagram of IEEE 9 bus test system .The system consists of 3 synchronous generators and the system had 3 load points.

Associated flow results are given in the fig below. The data is on 100MVA base.

Figure 2: Single line diagram of IEEE 9 bus test system

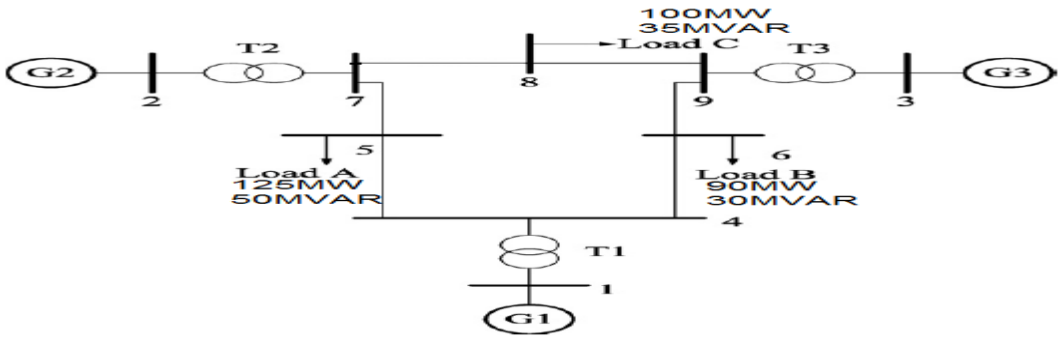


Table 1: Generator cost coefficient.

Unit	Bus No.	A ($/Mwh^2)	B ($/Mwh)	C ($)
G1	5	0.11	125	1
G2	8	0.085	100	1.2
G3	6	0.1225	90	1

Table 2: Flow Limits

Line No.	From	To	X(p.u.)	Flow Limit(MW)
1	1	4	0.0576	250
2	4	5	0.092	250
3	5	6	0.17	150
4	3	6	0.0586	300
5	6	7	0.1008	150
6	7	8	0.072	250
7	8	2	0.0625	250
8	8	9	0.161	250

9	9	4	0.085	250

Fig 3. Initial power flow at all buses in power system

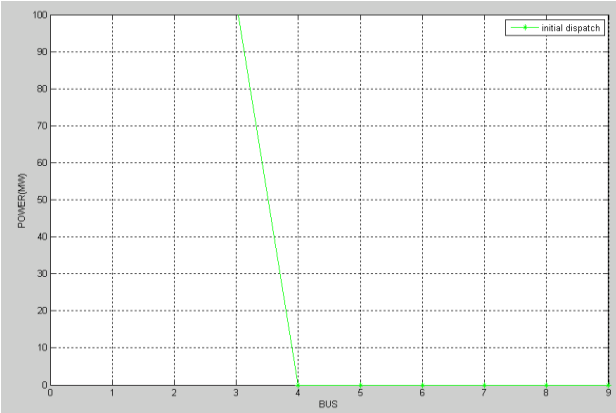


Fig 4. Redispatched power flow at all buses in power system

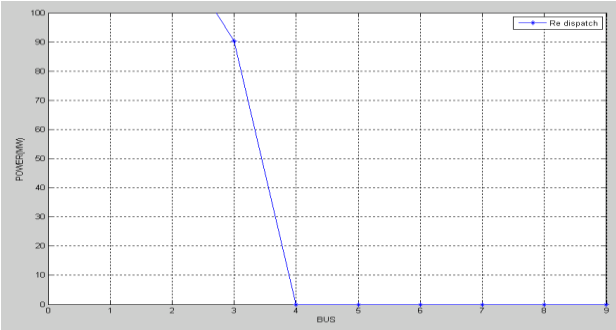
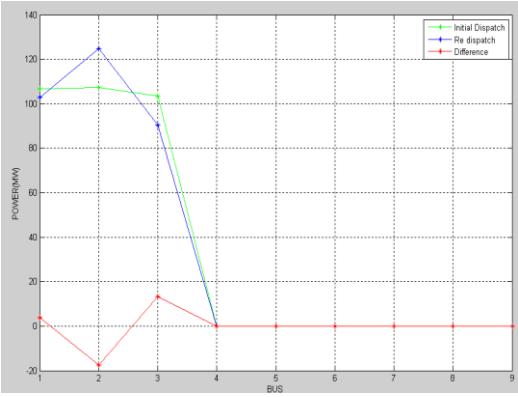


Fig 5. Difference in initial power flow and re-dispatched power at all buses in power system.



III. CONCLUSION

This paper represent a case study of standard IEEE of bus system for in depth analysis of congestion management skill and effect of re dispatch with optimal power flow constraint to relieve congestion. In this paper we presented a case study on IEEE 9bus test system .several congestion situation and transaction both in pool and bilateral contracts where analyzed and redispatch based relieved congestion proved to be effective as a solution with the software base programming tool with the use of MATPOWER.The initial dispatch resulting transaction negotiated both in the pool and bilateral contacts lead to several congestion situation in the transmission system. Our software based tool solved congestion situation and produced a redispatch.Hence this paper present a software tool which helps in decision making in competitive market environment.

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