International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 8, Issue 3, pp: (37-41), Month: July - September 2020, Available at: www.researchpublish.com

Analysis of Congestion Cost in Modern Power Era of Restructured Power System Scenario

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Abstract: **In competitive electricity market, the power system is unbundled into Gencos, Transcos and Discos. In this environment, the market schedule will driven based on purely economic basis without security concern. The remedial actions for insecure schedule will leads to the market for economic inefficiency. The inability of the transmission system to dispatch market required schedule is known as congestion and the corresponding excessive generation cost with congestion relief action termed as congestion cost. This can be defined in a variety of ways. Each definition reflects the design objectives and cost-recovery policies of the particular market. In this paper, three major generic approaches are reviewed which already using by many electricity markets. The approaches are analyzed on IEEE-30 bus system and Indian utility 62 bus system.**

Keywords: **Congestion cost, Restructured power system, Gencos, Transcos, Discos.**

I. INTRODUCTION

Congestion is a consequence of network constraints and can result in an overall increase in the cost of power delivery. Presently, there are two pricing methods [1] that are being used in a competitive energy market to account for congestion: the uniform pricing method and the non-uniform pricing method. In the first method, all generators are paid the same price regardless of their individual bids based on the bid of the marginal generating unit that would be dispatched in the absence of congestion[1]. Such a bid is referred to as the market clearing price (MCP). Energy prices would not account for congestion and additional costs due to congestion will be passed on to all loads in proportion to their use (the U.K. pool is an example of this type).

The restructuring process in the electric power industry in the US over the last few years has led to several structural and regulatory issues regarding transmission grid operation and planning not fully anticipated at the design stage of the grid. The transmission system has not evolved at the rate needed to sustain increasing demand matched with negligible generation addition evidenced in the deregulated environment. This has caused somewhat unexpected congestion bottlenecks in the system. Moreover, the functional unbundling of generation and transmission operations is aggravated due to the lack of coordination between the generation resources and the transmission system operator[2]. As the transmission provider takes on a greater role of for-profit company in managing the transmission system, while facilitating the developing energy market, it is increasingly important to project and assess the magnitude of the transmission revenue collected from congestion rent (Presently, the ISOs allocate the congestion rent to the transmission right owners and the excess/shortfall is paid to/collected from the transmission owners.

In this paper we have to discuss about the congestion cost of IEEE-30 bus and Indian utility 62 bus system. With that we will able to make perfect prediction of congestion in deregulated Indian power market and also manage congestion in transmission system.

II. IMPACT OF TRANSMISSION CONGESTION

In the deregulated power industry, transmission congestion is a major problem for the electricity markets. The congestion has a wide range of impacts on the entire electricity market as well as the individual market players i.e. sellers and buyers. Without congestion lowest-priced resources are used to meet the demand but if the congestion is present in the transmission network then it prevents the demand to be met by the lowest-priced resources due to transmission constraints and some energy is purchased from alternative sources at higher prices. But if this price exceeded than the willingness to pay of the buyers, then some of the demand is not fulfilled in the particular market[3]. This condition occurs especially in area where demand exceeds the local generation. This demand can be met by the imports of electricity from other areas. The suppliers at the import side may raise their prices as high as they want and results in an increase in Locational Marginal Prices & creates market power. The LMP at a location is the marginal cost of supplying the next MW of load to the location using the lowest production cost of all available generation without violating any system security limit. Market power is defined as the conditions where a market participant can profitably maintain prices above a competitive level for a significant period of time[4]. Market power results a decrease in competition and exercising market power can raise price and lower market efficiency. There are two sources for the occurrence of market power i.e. market dominance and congestion. In the electricity market, a supplier can exercise market power by either physical withholding or economical withholding. International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN presence of congestion on the grid prevents the use of the lowest-priced resources to met the load, therefore change of the generation/demand schedule is required that will result in higher cost than that for the unconstrained market and hence a loss in the market efficiency occurs due to the change in the generation/demand schedule [5].

III. CONGESTION METHODOLOGY

Transmission congestion can occur in any power system and it prevents the systems operator to dispatch additional power from a specific generator, additional outages, creates market power and damages power system components. Therefore, congestion management becomes necessary and is done by system operator, who ensures that the transmission system is operating within operating limits. Because of impacts described above of congestion on electricity market, it is necessary to manage congestion, and this important task is performed by the independent system operator. Following are the various methods through which congestion can be managed:-

Generation rescheduling:- At first, sufficient¬ numbers of the least expensive generators are selected to meet system predicted demands and the market-clearing price is determined by the most expensive bid that has been accepted. Next, ISO will check whether there are constraint violations or not and if there are, it would execute a generation re-dispatch. System operator re-dispatches power generation in such a way that resulting power flows does not overload any line[6].

FACTS Devices:- They be used to improve system¬ performances in existing constrained system by controlling the power flows.

Demand Response:- DR can be defined as the¬ change in electricity usage by the end-user customers from the normal consumption patterns in response to change in the price of electricity over time. With the active participation of demand side, transmission congestion and locational marginal prices during peak period can be reduced[7].

IV. RESULTS AND DISCUSSIONS

Table -1

Bus No.	Congestion Cost
1	0
2	6.49E-17
3	1.72E-16
4	2.56E-16
5	2.45E-16
6	2.83E-16
7	2.88E-16
8	3.75E-16
9	2.78E-16

10	5.86E-16
11	1.44E-16
12	7.99E-16
13	8.98E-16
14	1.09E-15
15	1.21E-15
16	9.49E-16
17	8.42E-16
18	1.44E-15
19	1.38E-15
20	1.06E-15
21	1.08E-15
22	9.93E-16
23	1.61E-15
24	1.79E-15
25	1.51E-15
26	1.94E-15
27	7.72E-16
28	6.45E-16
29	1.52E-15
30	1.88E-15

Here we can classify our results with IEEE 30 bus and Indian utility 62 bus system [8]. The details of results are as under.

IEEE-30 bus system:

In the table we can see that congestion price across the IEEE 30 bus system. At slack bus value show zero because of reference.

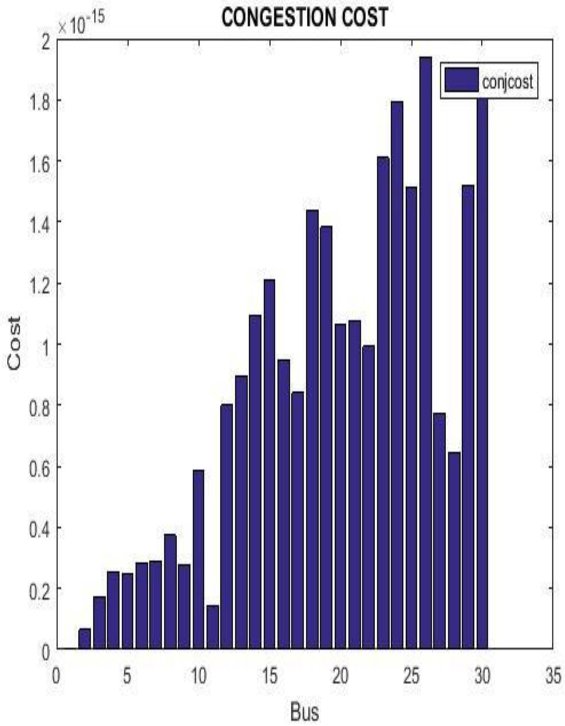

Fig 1: Congestion cost with various buses

Indian Utility 62 bus system: All parameters should place on Indian power scenario then we get the following results in form of table and figure form. Minus sign indicate additional profit of transmission owner.

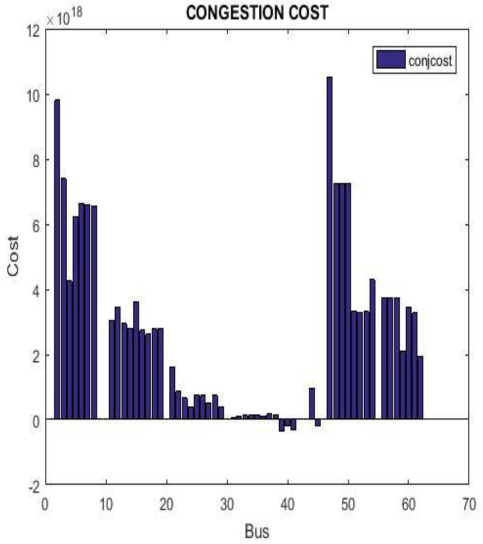

Fig 2: Congestion cost with various buses

Table 2 shows the results of 62 bus system with 62 lines.

Table 2

Bus No.	Congestion Cost
1	0
2	9.80E+18
3	7.40E+18
4	4.25E+18
5	6.21E+18
6	6.64E+18
7	6.60E+18
8	6.56E+18
9	0
10	261120
11	3.05E+18
12	3.46E+18
13	2.95E+18
14	2.79E+18
15	3.60E+18
16	2.74E+18
17	2.63E+18
18	2.79E+18
19	2.79E+18
20	314880
21	1.62E+18
22	8.71E+17
23	6.56E+17
24	3.81E+17
25	7.42E+17
26	7.42E+17
27	5.11E+17
28	7.42E+17
29	4.06E+17
30	-1568768
31	4.33E+16
32	1.21E+17
33	1.35E+17
34	1.50E+17

35	1.23E+17
36	1.04E+17
37	1.74E+17
38	1.62E+17
39	-3.38E+17
40	-1.72E+17
41	-3.19E+17
42	-73213952
43	-73211392
44	9.75E+17
45	-1.69E+17
46	-366080
47	1.05E+19
48	7.26E+18
49	7.26E+18
50	7.26E+18
51	3.33E+18
52	3.29E+18
53	3.31E+18
54	4.29E+18
55	-107008
56	3.74E+18
57	3.74E+18
58	3.74E+18
59	2.10E+18
60	3.44E+18
61	3.27E+18
62	1.95E+18

V. CONCLUSION

Transmission congestion is a phenomenon that occurs in electric power markets. It happens when scheduled market transactions (generation and load) result in power flow over a transmission element that exceeds the available capacity for that element. Since grid operators must ensure that physical overloads do not occur, they will dispatch generation so as to prevent them. The functions that provide this benefit provide lower cost energy, decrease loading on system elements, shift load to off-peak, or allow the grid operator to manage the flow of electricity around constrained interfaces (i.e. dynamic line capability or power flow control). These papers show the importance of all calculation in Indian power scenario and allow prediction in real power environment.

REFERENCES

[1] B. Porretta and D. Kiguel, “Bulk power system reliability evaluation, part 1: PROCOSE—A computer program for probabilistic composite system evaluation,” in Proc. 14th Inter-RAM Conf. Elect. Power Ind., Toronto, ON, Canada, May 26–29, 1987.

[2] IEEE Panel Session, “Congestion management practices,” in Proc. IEEE Winter Power Meeting, New York, Jan. 31–Feb. 4 1999.

[3] F. C. Schweppe, M. Caramanis, R. Taboras, and R. Bohn, Spot Pricing of Electricity. Norwell, MA: Kluwer, 1988.

[4] W. W. Hogan, “Contract networks for electric power transmission,” J. Regulatory Econ., vol. 4, pp. 211–242, 1992.

[5] W. W. Hogan, “Contract Networks for Electric Power Transmission”, Tech. Ref., Harvard Univ., Cambridge, MA, Feb. 1992.

[6] ABB Information System, The power source, in Energy Market IT Bulletin, no. 5, Mar. 5, 1998.

[7] J. D. Finney, H. A. Othman, and W. L. Rutz, “Evaluating transmission congestion in system planning,” IEEE Trans. Power Syst., vol. 12, pp. 1143–1150, Aug. 1997.

[8] IEEE Committee Rep., “IEEE Reliability Test System,”, vol. PAS-98, Nov./Dec. 1979. IEEE Trans. Power App. Syst..