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LOSS CALCULATION IN DEREGULATED ELECTRICITY MARKET IN IEEE 33 BUS SYSTEM USING MATLAB

Pallavi Soni[1], Shoyab Ali[2]

[1]M.Tech Scholar, [2]Assistant Professor,Electrical and Electronics Engineering,
Vedant College of Engineering & Technology, Bundi, Rajasthan (India)

ABSTRACT

In modern era, deregulation has an important impact on power sector. Power system must be balanced at every second, which means that generation should be equals to loads plus losses at all times. Power dispatch does not take into consideration system losses and the system operator is the entity responsible for system security by providing the required real and reactive power. Since the power network is not lossless, entities providing the network losses must be compensated for their contribution, normally at the pool marginal price in a pool based market, or at their marginal cost in bilateral markets. The main goal of loss allocation is to assign each consumer of the network, whether a generator or a load, its share of the cost of transmission losses based on how much losses the user causes. Thus, this paper analysis focuses on calculating transmission losses in Deregulated Electricity Market (EM). These methods have been tested using radial bus network and the IEEE standard 33 test bus system.

Keywords: Electricity Market (EM), Deregulated Electricity Market (DEM), Losses, Power Market, and Price

I. INTRODUCTION

In current time, due to rise in power demand and supply, it is a difficult task to manage the generation and cost concurrently for one single party. To reduce monopoly of one organization and to provide quality and continue reliable power supply at reasonable cost, it is necessary to encourage competition in power market. This can be possible by introducing deregulation in electrical power sector. The importance of this matter is because the amount of loss consist significant part of total electrical energy. Loss in power system is a nonlinear function of power so using linear methods could not be efficient [1]. The purpose of this paper is to present an applicable solution for loss allocation of transmission lines in EM. This method has been tested on IEEE 33 bus System.

II. DEREGULATED ELECTRICITY MARKET

- In a DEM, market participants other than usefulness corporations own power plants and transmission lines. In some of the cases, generators companies that generate electricity and sell electricity into a wholesale market,

and retail energy suppliers purchase this electricity to sell it to customers. Transmission corporations or usefulness own and operate the transmission grid. This market universe is managed by an independent system operator (ISO) or regional transmission organization RTO. Your utility company is still around – It makes sure the power is distributed and everything is working correctly to keep your lights on [4].

- Deregulation is the process of removing or reducing state regulations. It is therefore opposite of regulation, which refers to the process of the government regulating certain activities.
- Energy charges are not regulated in these deregulated areas and customers are not forced to receive supply from their utility.
- Deregulation allows competitive energy market to enter the markets.
- Deregulation gives consumers choice.

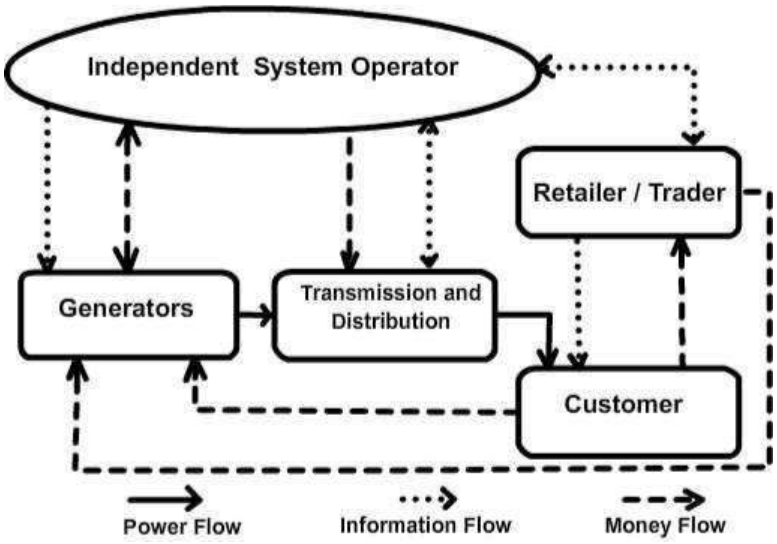

Fig.1. Deregulated Electricity Market Structure

2.1 DIFFERENCE BETWEEN REGULATED AND DEREGULATED EM

➢ In a regulated electricity market, vertically integrated monopoly utilities cover the entire value chain with oversight from a public regulator. The usefulness makes sure that power is generated, sent to the grid, and reaches to the consumers . Customers in regulated markets cannot choose who generates their power and are bound to the utility in that area [2].

 In a deregulated electricity market, market participants other than utility companies own power plants and transmission lines. In such instances, generators (companies that generate electricity) sell electricity into a wholesale market, and retail energy suppliers purchase this electricity to sell it to customers. This market universe is managed by an independent system operator (ISO) or regional transmission organization RTO. Your utility company is still around – It makes sure the power is distributed and everything is working correctly to keep your lights on.

2.2 ADVANTAGES OF DEREGULATED EM

- Electricity price will reduce

- Choice for consumers
- Customer-centric service
- Innovation

III PROPOSED METHODOLOGY

Usually, in real power systems, the total power generation is always greater than the total load demand because the total power generation is equal to the total load demand counting the losses

$P_G=P_D+L$---------- (1)

$$P_G = \sum_{i=1}^{NG} P_{Gi} \text{ ----------} \quad (2)$$

$$P_D = \sum_{i=1}^{ND} P_{Dj} \text{ ----------} \quad (3)$$

Where, P_G= total active power generated

P_{Gi}= power output of generators of bus i

P_D= total active power demand

P_{Dj}= active power demanded by consumers of bus j

L = transmission power losses

N_G= number of generating buses

N_D= number of demand buses

The principle is simple and easy to understand. The losses allocates to consumers proportionally with the level of energy consumption [5].

$$L_{Dj} = L \frac{P_{Dj}}{P_D}$$

This equation represents the Pro rata method allocation of losses to the load at bus j.

P_D= total real power consumed

P_{Dj}=real power consumed by the loads of bus j.

L_{Dj}= losses allocated at the demand j.

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The transmission loss is charged to the consumers through uniform pro rata charge. Uniform means that the same bid for each hour is being submitted.

The 33 bus system has following characteristics: -

- Total number of nodes or buses = 33
- Total number of branches or lines = 32
- Base voltage = 12.66kV
- Base MVA = 100
- Bus 1 is the slack bus
- The total active power loss of the system = 208.45kW
- The total reactive power loss of the system =111.68kVAr

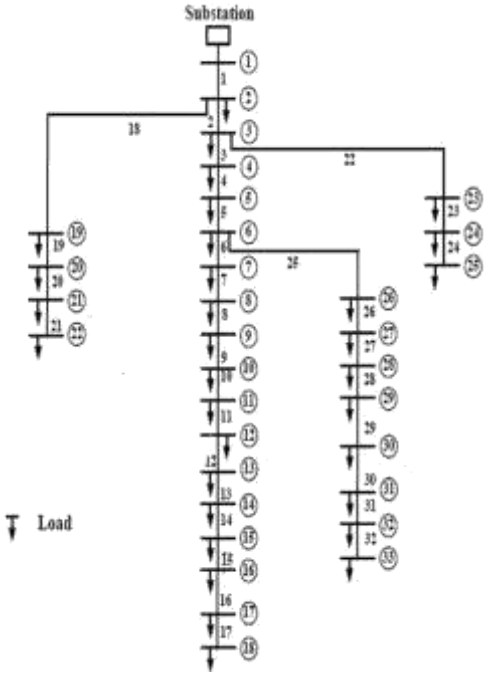

Fig. 1: IEEE 33-Bus Radial Distribution System

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Line	From Bus	To Bus	From bus injection P (MW)	From bus injection Q (MVAr)	To bus injection P (MW)	To bus injection Q (MVAr)	Loss P (MW)	Loss Q (MVAr)
1	1	2	3.92	2.41	-3.91	-2.41	0.012	0.01
2	2	3	3.45	2.18	-3.40	-2.16	0.052	0.03
3	3	4	2.37	1.66	-2.35	-1.65	0.020	0.01
4	4	5	2.23	1.57	-2.21	-1.56	0.019	0.01
5	5	6	2.15	1.53	-2.11	-1.53	0.038	0.00
6	6	7	1.10	0.53	-1.10	-0.53	0.002	0.01
7	7	8	0.90	0.43	-0.89	-0.42	0.012	0.01
8	8	9	0.69	0.32	-0.68	-0.32	0.004	0.00
9	9	10	0.62	0.30	-0.62	-0.29	0.004	0.00
10	10	11	0.56	0.27	-0.56	-0.27	0.001	0.00

11	11	12	0.52	0.24	-0.51	-0.24	0.001	0.00
12	12	13	0.45	0.21	-0.45	-0.21	0.003	0.00
13	13	14	0.39	0.17	-0.39	-0.17	0.001	0.00
14	14	15	0.27	0.09	-0.27	-0.09	0.000	0.00
15	15	16	0.21	0.08	-0.21	-0.08	0.000	0.00
16	16	17	0.15	0.06	-0.15	-0.06	0.000	0.00
17	17	18	0.09	0.04	-0.09	-0.04	0.000	0.00
18	2	19	0.36	0.16	-0.36	-0.16	0.000	0.00
19	19	20	0.27	0.12	-0.27	-0.12	0.001	0.00
20	20	21	0.18	0.08	-0.18	-0.08	0.000	0.00
21	21	22	0.09	0.04	-0.09	-0.04	0.000	0.00
22	3	23	0.94	0.46	-0.94	-0.46	0.003	0.00
23	23	24	0.85	0.41	-0.84	-0.40	0.005	0.00
24	24	25	0.42	0.20	-0.42	-0.20	0.001	0.00
25	6	26	0.95	0.97	-0.95	-0.97	0.003	0.00
26	26	27	0.89	0.95	-0.88	-0.95	0.003	0.00
27	27	28	0.82	0.92	-0.81	-0.91	0.011	0.01
28	28	29	0.75	0.89	-0.75	-0.88	0.008	0.01
29	29	30	0.63	0.81	-0.62	-0.81	0.004	0.00
30	30	31	0.42	0.21	-0.42	-0.21	0.002	0.00
31	31	32	0.27	0.14	-0.27	-0.14	0.000	0.00
32	32	33	0.06	0.04	-0.06	-0.04	0.000	0.00

Total: 0.208 0.11

IV. APPLICATION OF DEREGULATED EM

- Tariff Design
- Load Forecasting
- Various Power Distribution issues

V. CONCLUSIONS

The vital power to compensate losses should be assigned to all contributors fairly according to their actual use of the network. The actual use of the system mainly depends on two factors; the nature of the traded commodity in electricity markets, which is until now real power, and the relative locations of participants within the network [3]. This paper contributes towards the competitive electricity markets. In this paper, is to present an applicable solution for loss allocation of transmission lines in EM. The method is simple and transparent to implement. This method has been tested on IEEE 33 bus System.

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