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TRANSMISSION PRICING USING POWER FLOW TRACING METHOD

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ABSTRACT
Electricity is a unifying force in attaining Economic, Social and Environmental goals of sustainable human development. Generation, Transmission and Distribution are three prevailing features of Electrical Power System. The Transmission system is a vital component in competitive electricity markets. In a Restructured power system, generators offer to serve large consumers and distribution companies in the transmission network. The goal of this project is to propose a simple transmission pricing scheme based on a power flow tracing method. This paper presents a methodology for transparent and efficient transmission pricing using power flow tracing techniques. The project involves applying a Newton Raphson load flow analysis on the IEEE 30 bus system in MATLAB, and then tracing the contribution of each generator to loads and line flows . Employing the MW-mile concept, we compute the cost of transmission usage proportionally to the actual transmission infrastructure usage. The method allows users causing larger overload of the transmission network to pay more, with higher transparency and economic efficiency. Results validate that power flow tracing offers a transparent transmission usage allocation, hence appropriate for modern deregulated power systems.

Keywords- Power system, Power flow tracing, Newton Raphson Method, load flow, tracing methods, MW-mile concept, IEEE 30 Bus system.

I. INTRODUCTION

Electricity transmission pricing refers to the system and technologies used to determine the cost of electricity transmission across a power grid are distributed among various participants, including generators, consumers, and other stakeholders. The objective of transmission pricing is to ensure that the price of building, maintenance, and operating the transmission facilities are fairly evenly spread across consumers who benefit and enjoy the system of electricity flow.
Transmission Company plays an important role into ascertain the wheeling transaction charge. The imbedded cost or capital investment is huge in relation to operating expenses. In allocation pricing methods (APMs) all the costs of the current transmission system and the cost of system operation are also added to the total transmission cost. The entire sum is distributed among all the new and existing users based on the use of transmission system. The APTs can be categorized into Postage Stamp, Distance-Based MW-mile (or MW-Km) and Power Flow Based MW-mile approaches. Power flow tracing is a recent technique that distributes transmission costs to participants according to the actual routes traveled by electricity from generators to loads. The subject of this paper is to apply power flow tracing methods on a typical test system and with the MW-mile cost allocation method using IEEE 30 bus system data.

II. WHAT IS TRANSMISSION PRICING

Transmission pricing refers to the method of calculating the price of transferring electricity from one transmission system to another and levying it on consumers consisting of distributors, power producers, and consumers. Transmission pricing is an essential element of the operation of an electricity market since it provides equal access, cost recovery, and efficient use of the grid infrastructure. The transmission network, through which consumption centers are linked with generation sources, entails initial heavy investment and recurrent maintenance. An efficient pricing mechanism is therefore of utmost priority for cost recovery in a reasonable way.There are a number of transmission price schemes such as postage stamp price (flat rate), distance charging, and nodal pricing based on real network congestion and losses. Sophisticated markets use more dynamic and locational price schemes such as Locational Marginal Pricing (LMP), which promotes efficient electricity use and infrastructure investment.The importance of transmission pricing is to allow transparency, promote competition, and ensure grid reliability. Proper pricing sends signals to producers and consumers about the actual cost of electricity supply, avoiding overconsumption and encouraging investment in efficient generation or alternatives at the consumption points. Lastly, good transmission pricing enables the creation of a secure, safe, and economically efficient power system.

III POWER FLOW TRACING METHOD

Power flow tracing is an application of electrical power systems to compute how electricity generated by different sources travels through the transmission system
to different consumers. It determines the contribution of a generator to the power flow on a specific transmission line and at different points of load. Power flow tracing is especially useful in deregulated electricity markets where accurate cost allocation as well as system utilization monitoring is essential.Power flow tracing works through the analysis of the result of load flow studies, typically using proportional sharing, marginal participation, or extended incidence matrix methods. In proportional sharing method, for instance, the power flowing into a node is presumed to be proportionally distributed to the outgoing lines. This allows backward (sources to loads) Downstream algorithm or forward (loads to sources) Upstream algorithm tracing of the paths of power.The significance of power flow tracing is that it can reasonably allocate transmission usage and charges to various market players. It helps with congestion management, tariff determination, and loss allocation. It also improves transparency and accountability of grid operation by indicating who utilizes which portion of the grid and to what level. Overall, power flow tracing helps with effective and equitable operation of competitive electricity markets.

IV POWER FLOW TRACING USING DOWNSTREAM AND UPSTREAM TRACING ALGORITHM

The MW-Km method is an embedded cost method that is also referred to as a line-by-line strategy. The MW-Km technique is employed in designing transmission channels of a power transaction. It is a dc-power flow calculation. The MW-Km method is the first cost-determining method to be presented for the compensation of transmission fixed costs for real consumption of transmission network. The approach ensures the recovery completeness of the fixed transmission cost and fairly represents the true usage of transmission systems.Tracing of power flow within IEEE 30 bus system is accomplished by the process of upstream tracing algorithm and downstream tracing algorithm. where downstream tracing algorithm refers to the determination of how much power from every generator reaches every load and upstream tracing algorithm refers to Trace how every unit of load is served by various generators.

DOWNSTREAM TRACING ALGORITHM

The Downstream Tracing algorithm governs how power flow from each of generators is allocated to each of the loads in the network. It starts by building the contribution matrix
The Contribution Matrix:-
C is a downstream distribution matrix built from the direction and magnitude of the power flow in the network. It is a description of how power from each bus is distributed to the downstream buses.

$$C(i,j) = \frac{P_{ij}}{\sum_k P_{ik}} \quad \text{if } \sum_k P_{ik} \neq 0 \qquad (1)$$

P_{ij} = Power flow from bus i to bus j

$\sum_k P_{ik}$ = Total power outflow from bus i

This matrix essentially tells us: "What fraction of power flowing out of bus iii is going to bus j.For any bus i , the contribution from i to j is defined as

$$C(i,j) = \frac{P_{ij}}{\sum_k P_{ik}} = \frac{P_{ij}}{P_i^{out}} \quad (2)$$

Derivative with respect to $P_{ij:}$

Lets define total outflow from bus i as:

$$P_i^{out} = \sum_k P_{ik} \quad (3)$$

Then:

$$\frac{\partial C(i,j)}{\partial P_{ij}} = \frac{P_i^{out} - P_{ij}}{(P_i^{out})^2} \quad (4)$$

The Downstream Tracing Algorithm traces how each generator output is propagated to all loads within the system.

Using matrix

$$D=(I-C)^{-1} \quad (5)$$

D=Downstream Algorithm I= identity
Matrix
C= Contribution matrix

C distributes the flows forward (from one bus to others), (I−C) represents the retention at each node. Inverting it gives the total downstream influence how generator output propagates through the system.

$$D=(I-C)^{-1}$$

This gives the total downstream dependency from a bus

If $D=(I-C)^{-1}$, then:

$$\frac{\partial D}{\partial C} = (I-C)^{-1}.\frac{\partial D}{\partial C}(I-C)^{-1} \quad (6)$$

In general for a matrix inverse A^{-1},the derivative is:

$$\frac{\partial D}{\partial C(i,j)} = D.(\frac{\partial C(i,j)}{\partial C(i,j)}).D \quad (7)$$

This reflects how sensitive the downstream path is to changes in the contribution matrix.This matrix traces the path of power from every generator to the network to feed all loads. It effectively allocates the generator output to each load based on physical flow paths. The algorithm provides transmission cost planning and allocation via determination of the exact influence of the generator output on the network loads.

UPSTREAM TRACING ALGORITHM:

The Upstream Tracing Algorithm computes how every load in the network is supplied by the contribution of power from the generators upstream. It begins by employing the transpose of the contribution matrix C^T , which indicates the opposite direction of flow, i.e., from sources to loads.

$$T=(I-C^T)^{-1} \quad (8)$$

C^T= Transpose of contribution matrix

It is used to trace how loads are supported by upstream generators. Here:

C^T tracks reverse influence, i.e., how loads "pull" power from upstream buses. Inverting I-C^T gives total upstream contributions to each load.

In this case, the power at any bus can be traced back upstream to the initial generators. It is merely the transpose form of downstream tracing.

Derivative:

$$\frac{\partial T}{\partial C} = \frac{\partial}{\partial C}(I-C^T)^{-1} = T.(\frac{\partial C^T}{\partial C}).T \quad (9)$$

Load Attribution Formula:-

$$\text{Loadtogen}_{b,g} = \left(\frac{T(g,b)}{\sum_{\varepsilon \in G(:)} T(\varepsilon,b)}\right). L_b \qquad (10)$$

$\text{Loadtogen}_{b,g}$= Portion of load L_b attributed to generator g,
T(g,b) = Upstream contribution of generator g to bus b,
$\sum_{\varepsilon \in G(:)} T(\varepsilon, b)$= Sum of contributions from all generators to bus b, L_b= load to bus b.
By making these values standard, the algorithm calculates the contribution of each load to each generator. This method is important in equitable cost recovery in deregulated power systems because it assigns transmission use responsibility based on actual paths of demand.

V TRANSMISSION PRICING USING MW-MILE METHOD:-

The MW-mile method is perhaps the most prevalent transmission pricing method charging transmission costs as a function of the amount of power (in megawatts, MW) transmitted over a transmission line and the physical distance (in miles or kilometers) power travels. It is premised on the idea that consumers using more of the transmission system or hauling power longer distances should pay the higher portion of the cost.

Practically, the method approximates costs to each generator or customer from the formula:

$$\text{Cost} = \text{MW Flow} \times \text{Line Length} \times \text{Cost per MW-Km} \qquad (11)$$

In power flow tracing, the process is utilized to find each generator's contribution to power flow on every line and to allocate the cost proportionally. It provides a transparent and equitable cost allocation process in deregulated power systems. It generates optimal utilization of the network and conveys signals to site generation close to center of demand in order to minimize transmission load.
This is used to assign transmission cost based on how much power from each generator uses each line and its length.
For each line k:

$$\text{Cost}_{g,k} = \left(\frac{T(g,i)}{\sum T(:,i)}\right).P_{ij}.L.\text{cost per MW Km} \qquad (12)$$

Where:
T(g, i)= Generator g’s contribution to bus i,
$\sum T(:,i)$ = Total Contribution to bus i, P_{ij}= Power flow on the line from i to j, L = Length of the line.
This pricing approach fairly attributes transmission usage costs to generators based on how much of their power uses each line and its length.
For a line l with Power flow P_l and length L_l the MW-mile contribution is:

$$MWM_l = P_l.L_l \qquad (13)$$

Derivative in terms of power flow:

$$\frac{\partial MWN_l}{\partial P_l} = L_l \qquad (14)$$

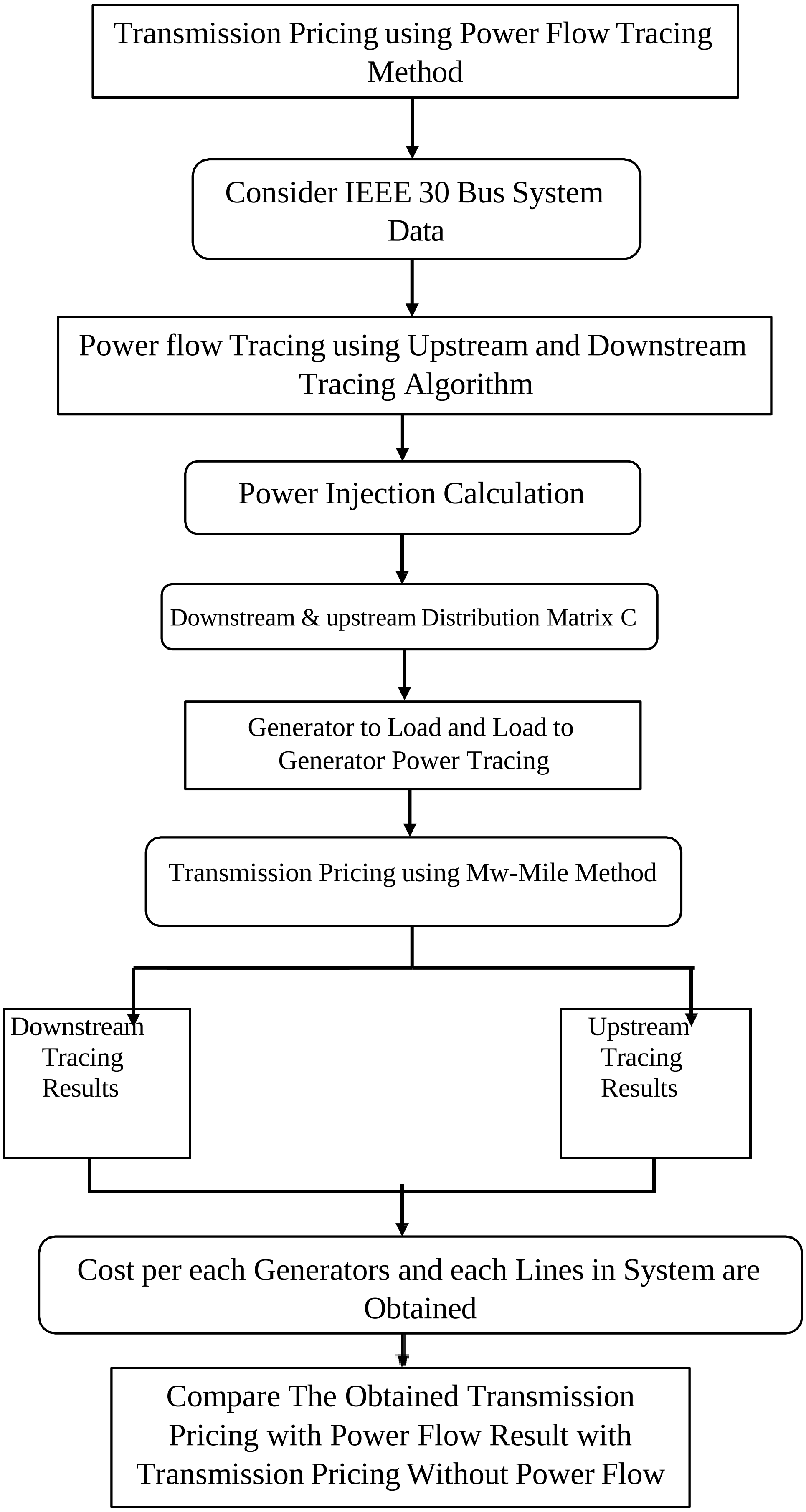
Derivative with respect to line length:

$$\frac{\partial MWN_l}{\partial L_l} = P_l \qquad (15)$$

VI IMPLEMENTATION

For the implementation of Transmission Pricing with Power Flow Tracing method in Matlab IEEE 30 bus system bus data and line data are taken from Matlab workshop. For the implementation two case studies are taken those are
Case Study 1. Transmission Pricing using Power Flow Tracing Method.
Case Study 2. Transmission Pricing without Power Flow Tracing Method.
For transmission price calculation line distance taken as 50km and price taken as 10 Rs per MW-KM.

Flow Chart for Transmission Pricing using Power Flow Tracing Method:-



RESULTS AND DISCUSSION:-

The proposed approach is tested on IEEE 30bus system. The IEEE 30 bus system data:- Generated Power P_{g}:-

Bus 1: 260 MW
Bus 2: 40 MW
Bus 5: 30 MW
Bus 8: 35 MW
Bus 11: 16 MW
Bus 13: 10 MW

Type 1:- Slack Type 2:- PV Type 3:-PQ

Table 1:IEEE 30 Bus System Data

Bus	Type	P_g (MW)	P_l (MW)
1	1	260	0
2	2	40	21.7
3	3	0	94.2
4	3	0	47.8
5	2	30	7.6
6	3	0	11.2
7	3	0	0
8	2	35	0
9	3	0	29.5
10	3	0	9
11	2	16	3.5
12	3	0	6.1
13	2	10	13.5
14	3	0	14.9
15	3	0	18
16	3	0	16.3
17	3	0	9.5
18	3	0	3.2
19	3	0	9.5
20	3	0	2.2
21	3	0	17.5

22	3	0	0
23	3	0	3.2
24	3	0	8.7
25	3	0	0
26	3	0	3.5
27	3	0	0
28	3	0	0
29	3	0	2.4
30	3	0	10.6

Table 2:IEEE 30 Line data:-

From	To	P_{ij}	P_{ji}
1	2	0.0192	0.0572
1	3	0.0452	0.1652
2	4	0.057	0.1737
3	4	0.0132	0.0379
2	5	0.0472	0.1983
2	6	0.0581	0.1763
4	6	0.0119	0.0414
5	7	0.046	0.116
6	7	0.0267	0.082
6	8	0.012	0.042
6	9	0	0.208
6	10	0	0.556
9	11	0	0.208
9	10	0	0.11
4	12	0	0.256
12	13	0	0.14
12	14	0.1231	0.2559
12	15	0.0662	0.1304
12	16	0.0945	0.1987
14	15	0.221	0.1997
16	17	0.0524	0.1923
15	18	0.1073	0.2185
18	19	0.0639	0.1292

19	20	0.034	0.068
10	20	0.0936	0.209
10	17	0.0324	0.0845
10	21	0.0348	0.0749
10	22	0.0727	0.1499
21	22	0.0116	0.0236
15	23	0.1	0.202
22	24	0.115	0.179
23	24	0.132	0.27
24	25	0.1885	0.3292
25	26	0.2544	0.38
25	27	0.1093	0.2087
28	27	0	0.396
27	29	0.2198	0.4153
27	30	0.3202	0.6027
29	30	0.2399	0.4533
8	30	0.636	0.2
6	28	0.0169	0.0599

CASE STUDY 1:-

The Transmission pricing using Power flow tracing on IEEE 30 bus system.
By tracing the IEEE 30 bus system using power flow tracing algorithms we get results as Genrator to load and generator to each line allocation and Upstream tracing algorithm and downstream tracing algorithms the results obtained are:-

Table 3 : Generator to Load Allocation Matrix:

	Generator 1	Generator 2	Generator 5	Generator 8	Generator 11	Generator 13
Load 2	0	21.7	7.23	2.17	1.085	0.904
Load 3	0	0	0	9.42	4.71	11.775
Load 4	0	0	0	4.78	2.39	5.97
Load 5	0	0	7.6	0	0	0
Load 6	0	0	0	2.24	1.12	0
Load 9	0	0	0	0	14.75	0
Load10	0	0	0	0	0	0
Load11	0	0	0	0	3.5	0
Load 12	0	0	0	0	0	1.525
Load 13	0	0	0	0	0	13.5
Load 14	0	0	0	0	0	0
Load 15	0	0	0	0	0	0

Load 16	0	0	0	0	0	0
Load 17	0	0	0	0	0	0
Load 18	0	0	0	0	0	0
Load 19	0	0	0	0	0	0
Load 20	0	0	0	0	0	0
Load 21	0	0	0	0	0	0
Load 23	0	0	0	0	0	0
Load 24	0	0	0	0	0	0
Load 26	0	0	0	0	0	0
Load 29	0	0	0	0	0	0
Load 30	0	0	0	0	0	0

Table 4:Detailed Generator Contribution to Each Line:-

	Generator 1	Generator 2	Generator 5	Generator 8	Generator 11	Generator 13
Line 1	3587.7	1793..9	597.96	358.77	179.39	298.98
Line 2	10308	5153.9	1718	1030.8	515.39	858.98
Line 3	0	14679	4893.1	1467.9	733.96	611.64
Line 4	0	0	0	246.12	123.06	307.65
Line 5	0	16758	5585.1	1675.8	837.91	698.26
Line 6	0	14899	4966.3	1489.9	744.95	620.79
Line 7	0	0	0	318.75	159.38	398.44
Line 8	0	0	24058	0	0	0
Line 9	0	0	0	1568.4	784.18	0
Line 10	0	0	0	803.3	401.65	0
Line 11	0	0	0	3978.3	1989.1	0
Line 12	0	0	0	10634	5317.1	0
Line 13	0	0	0	0	12109	0
Line 14	0	0	0	0	6403.9	0
Line 15	0	0	0	1971	985.51	2463.8
Line 16	0	0	0	0	0	3271.7
Line 17	0	0	0	0	0	5980.1
Line 18	0	0	0	0	0	3047.3
Line 19	0	0	0	0	0	4643.4
Line 20	0	0	0	0	0	0
Line 21	0	0	0	0	0	0
Line 22	0	0	0	0	0	0
Line 23	0	0	0	0	0	0
Line 24	0	0	0	0	0	0

Line 25	0	0	0	0	0	0
Line 26	0	0	0	0	0	0
Line 27	0	0	0	0	0	0
Line 28	0	0	0	0	0	0
Line 29	0	0	0	0	0	0
Line 30	0	0	0	0	0	0
Line 31	0	0	0	0	0	0
Line 32	0	0	0	0	0	0
Line 33	0	0	0	0	0	0
Line 34	0	0	0	0	0	0
Line 35	0	0	0	0	0	0
Line 36	0	0	0	0	0	0
Line 37	0	0	0	0	0	0
Line 38	0	0	0	0	0	0
Line 39	0	0	0	0	0	0
Line 40	0	0	0	18436	0	0
Line 41	0	0	0	1145.7	572.83	0

Table 5:Upstream Tracing: Load to Generator:-

	Generator 1	Generator 2	Generator 5	Generator 8	Generator 11	Generator 13
Load 2	0	14.23	4.74	1.423	0.71	0.59
Load 3	0	0	0	34.25	17.12	42.81
Load 4	0	0	0	17.38	8.69	21.72
Load 5	0	0	7.6	0	0	0
Load 6	0	0	0	7.466	3.73	0
Load 9	0	0	0	0	29.5	0
Load 10	0	0	0	0	0	0
Load 11	0	0	0	0	3.5	0
Load 13	0	0	0	0	0	6.1
Load 14	0	0	0	0	0	13.5
Load 15	0	0	0	0	0	0
Load 16	0	0	0	0	0	0
Load 17	0	0	0	0	0	0
Load 18	0	0	0	0	0	0
Load 19	0	0	0	0	0	0
Load 20	0	0	0	0	0	0
Load 21	0	0	0	0	0	0
Load 23	0	0	0	0	0	0

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Load 24	0	0	0	0	0	0
Load 26	0	0	0	0	0	0
Load 29	0	0	0	0	0	0
Load 30	0	0	0	0	0	0

Table 6:Downstream Tracing: Generator to Load :-

	Generator 1	Generator 2	Generator 5	Generator 8	Generator 11	Generator 13
Load 2	0	21.7	7.23	2.17	1.08	0.904
Load 3	0	0	0	9.42	4.71	11.77
Load 4	0	0	0	4.78	2.39	5.97
Load 5	0	0	7.6	0	0	0
Load 6	0	0	0	2.24	1.12	0
Load 9	0	0	0	0	14.75	0
Load 10	0	0	0	0	0	0
Load 11	0	0	0	0	3.5	0
Load 12	0	0	0	0	0	1.52
Load 13	0	0	0	0	0	13.5
Load 14	0	0	0	0	0	0
Load 15	0	0	0	0	0	0
Load 16	0	0	0	0	0	0
Load 17	0	0	0	0	0	0
Load 18	0	0	0	0	0	0
Load 19	0	0	0	0	0	0
Load 20	0	0	0	0	0	0
Load 21	0	0	0	0	0	0
Load 23	0	0	0	0	0	0
Load 24	0	0	0	0	0	0
Load 26	0	0	0	0	0	0
Load 29	0	0	0	0	0	0
Load 30	0	0	0	0	0	0

Table 7:Upstream Transmission Cost per Generator in Rs (MW-km pricing):

Generator	Cost(Rs)
Generator 1	1389.5
Generator 2	5328.4
Generator 5	4182
Generator 8	4512.4
Generator 11	3185.8
Generator 13	2320.1

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Table 8:Downstream Transmission Cost per Generator in Rs (MW-km pricing):-

Generator	Cost(Rs)
Generator 1	19929
Generator 2	16139
Generator 5	8078
Generator 8	13612
Generator 11	4900
Generator 13	3628.7

Table 9:Transmission Cost per Line in Rs (MW-km pricing):

Line	Cost(Rs)
Line 1	6816.7
Line 2	19585
Line 3	22386
Line 4	676.83
Line 5	25556
Line 6	22721
Line 7	876.57
Line 8	24058
Line 9	2352.5
Line 10	1205
Line 11	5967.8
Line 12	15951
Line 13	12109
Line 14	6403.9
Line 15	5420.3
Line 16	3217.7
Line 17	5980.1
Line 18	3047.3
Line 19	4643.4
Line 20	0
Line 21	0
Line 22	0
Line 23	0
Line 24	0
Line 25	0
Line 26	0
Line 27	0

Line 28	0
Line 29	0
Line 30	0
Line 31	0
Line 32	0
Line 33	0
Line 34	0
Line 35	0
Line 36	0
Line 37	0
Line 38	0
Line 39	0
Line 40	18436
Line 41	1718.5

Table10:Transmission Cost per Generator in Rs (MW-km pricing):

Generator	Cost(Rs)
Generator 1	13895
Generator 2	53284
Generator 5	41820
Generator 8	45124
Generator 11	31858
Generator 13	23201

Total Transmission Cost for the IEEE 30-Bus System using Power Flow Tracing Method in Rs: 209182.55 MW-km Units

CASE STUDY II:-

Transmission Pricing without Power Flow tracing method for IEEE 30 bus system Generated Power Pg:

Bus 1: 260 MW
Bus 2: 40 MW
Bus 5: 30 MW
Bus 8: 35 MW
Bus 11: 16 MW
Bus 13: 10 MW

Table 11:Transmission Cost per Line in Rs:-

Line	Cost
Line 1	2385.1
Line 2	6852.5
Line 3	7205.1
Line 4	1572.1

Line 5	8225.5
Line 6	7312.9
Line 7	1717.3
Line 8	4811.7
Line 9	3401.4
Line 10	1742.2
Line 11	8627.8
Line 12	23063
Line 13	8627.8
Line 14	4562.7
Line 15	10619
Line 16	5807.2
Line 17	10615
Line 18	5409
Line 19	8242.1
Line 20	8283.6
Line 21	7976.6
Line 22	9063.4
Line 23	5359.2
Line 24	2820.6
Line 25	8669.3
Line 26	3505.1
Line 27	3106.9
Line 28	6217.9
Line 29	978.93
Line 30	8379
Line 31	7424.9
Line 32	11200
Line 33	13655
Line 34	15762
Line 35	8656.9
Line 36	16426
Line 37	17227
Line 38	25000
Line 39	18803
Line 40	8296
Line 41	2484.7

Table 12:Transmission Cost per Generator in Rs:-

Generator	Cost(Rs)
Generator 1	16590
Generator 2	24885
Generator 5	8295
Generator 8	8295
Generator 11	0
Generator 13	0

Table 13:Transmission Cost per Load in Rs:-

Load	Cost(Rs)
Load 2	8020.3
Load 3	8244
Load 4	16942
Load 5	8324.3
Load 6	16680
Load 9	8230.1
Load 10	16485
Load 11	8374
Load 12	8152
Load 13	8520.9
Load 14	16510
Load 15	8122.6
Load 16	8480.4
Load 17	16271
Load 18	8327.4
Load19	8291.2
Load 20	16271
Load 21	8327.4
Load 23	8291.2
Load 24	16444
Load 26	8217.5
Load 29	8264.6
Load 30	16603

Total Transmission Cost for the IEEE 30-Bus System without Power Flow Tracing Method in Rs: 340094.57 MW-km Units

After comparing both the case studies transmission cost with power flow tracing gives low cost compared to without tracing and also can trace how much power is allocated to each load and

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line from generator in Power flow Tracing method.

Total Transmission cost with Power Flow Tracing	Rs 209182.55 MW-km Units
Total Transmission cost without Power Flow Tracing	Rs 340094.57 MW-km Units

CONCLUSION:-

MATLAB implementation of power flow tracing method-based transmission pricing is a transparent and fair model of transmission cost allocation in the IEEE 30-bus system. By utilizing upstream and downstream tracing algorithms, it efficiently calculates the contribution of each generator to loads and calculates cost according to the MW-mile method. This approach is a reflection of actual network use, promoting economic efficiency and accountability. The model is scalable, and the model can be adapted to actual networks. It also facilitates further integration with advanced power system tools. Overall, it is a strong platform for modern transmission cost allocation in deregulated power markets.

FUTURE SCOPE :-

The potential for the future of this transmission price model based on MATLAB is integration with Optimal Power Flow (OPF) for real-time pricing, extension to reactive power and voltage profile, and scaling up to larger networks like IEEE 118 or 300-bus networks. It can be made more advanced by integrating dynamic load profiles, congestion-based pricing, and AI/ML for predictive optimization. Integration with renewable energy sources, storage systems, and peer-to-peer energy trading models can make it more applicable to smart grids. Making it more user-friendly with a Graphical User Interface (GUI) and comparing it to other pricing schemes would make it more usable and of interest to academics, making it applicable to real-world regulatory and operational purposes.

REFERENCES

B. Naresh, M. Sailaja Kumari and M. Sydulu, "Transmission cost allocation using power flow tracing and Genetic Algorithm," *2010 5th IEEE International Conference Intelligent Systems*, London, UK, 2010.

Abhyankar, A. & Khaparde, S.A. & Soman, Shreevardhan & Polagani, Pentayya. (2005). A Transmission Pricing Mechanism Based on Power Tracing for Central Transmission Utility in India. International Journal of Emerging Electric Power Systems. 2. 10.2202/1553-779X.1033.

Bialek, J. W., July 1996. Tracing the flow of electricity. IEE Proc.-Gener. Transm. Distrib. 143, 313–320.

P. Rathore, G. Agnihotri, B. Khan and G. Gupta, "Transmission pricing using power flow tracing methodology with consideration N-1 security criterion," 2014 Students Conference on Engineering and Systems, Allahabad, India, 2014, pp. 1-6, doi: 10.1109/SCES.2014.6880071.