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Future of Coordinated Transmission Expansion & Planning Interconnected Indian Power System

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Abstract

Restructuring and deregulation has exposed transmission planner to new objectives and uncertainties. Therefore, new criteria and approaches are needed for transmission planning in deregulated environments. In this paper we introduced a new method for computing the Location Marginal Prices and new market-based criteria for transmission expansion planning in deregulated environments. Using two probabilistic tool Cost of congestion and Standard deviation. Comparing these two find best plan.

Keywords: Competitive electric market, Transmission expansion planning, Uncertainty, Scenario techniques, power transmission planning, price profile, uncertainty, LMP, Cost of congestion, Standard Deviation.

1. Introduction

Restructuring and deregulation of the power industry have changed the aims of transmission expansion planning and increased the uncertainties. Due to these changes, new approaches and criteria are needed for transmission expansion planning in deregulated power systems.

Transmission expansion planning approaches can be classified into:

- Non-deterministic approaches, and
- Deterministic.

Non-deterministic Transmission Expansion Planning Approach

Non-deterministic approaches which have been used for transmission expansion Planning is:

1.Probabilistic load flow,
2.Probabilistic based reliability criteria,
3.Scenario technique,
4.Decision analysis, and
5.Fuzzy decision making

Objectives of transmission expansion planning in deregulated Power systems:
1. Investment cost will be decreased.
2. The network charges will be decreased.
3. The risk of investments against all uncertainties will be reduced.
4. Encouraging and facilitating competition among electric market participants.

Uncertainties in deregulated power systems:
Sources of random uncertainties in deregulated power systems are:
1. Power and bids of independent power producers (IPPs).
2. Wheeling transactions and power transactions with other areas, and
3. Load.

2. Location Marginal Prices (Nodal Price):

LMP=System Energy price +System congestion cost+Cost of marginal loss.

1. System Energy price:

- Same price for every bus.
- Calculated both in day ahead and real time

2. Congestion Price:

- Represents price of congestion for binding constraints.
- Calculated using cost of marginal units controlling constraints and sensitivity factors on each bus will be zero if no constraints (Unconstrained System).
- Will vary by location if system is constrained.
- Load pays Congestion Price.
- Generation is paid Congestion Price.

3. Loss Price:

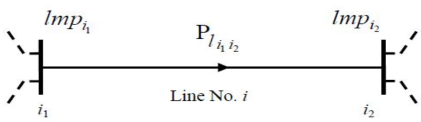
1. Calculated using penalty factors,
2. Vary by location,
3. Used to price losses,
4. Load pays the Loss Price.

3. Market based Criterion

Objective of transmission expansion planning in deregulated power systems is to provide a non-discriminatory competitive environment for all stakeholders, while maintaining power system reliability

To achieve this objective, it is needed to define some criteria to measure how competitive an electric market is and how much a specific expansion plan improves the competition.

In these section two probabilistic criteria, average congestion cost and standard deviation of mean of LMP, are proposed to measure how much a specific plan facilitates competition among customers.



Line No. *i* of a network

Transmission Congestion

A line is congested if its power has reached to its limit. Transmitting more power through this Line is not allowed.

Total congestion cost of the network or the opportunity cost of transmitting power though the network is equal to:

$$tcc = \sum_{i=1}^{N_l} (lmp_{i_2} - lmp_{i_1}) P_{l_{i_1 i_2}}$$

Standard Deviation of Mean of Location Marginal Price:

LMP of each bus is specified with a bar over it. Standard deviation of mean of LMP in the presence of plan *k*, where mean is taken over *Nr* samples and standard deviation is taken over *Nb* buses, is given by:

$$\sigma^k_{\mu_{lmp}} = \sqrt{\frac{1}{N_b - 1} \sum_{i=1}^{N_b} (\mu^k_{lmp_i} - \mu^k_{lmp})^2}$$

Where

$\sigma^k_{\mu_{lmp}}$ =standard deviation of mean of LMP in the presence of plan *k* in $/MWhr.

$\mu^k_{lmp_i}$ =mean of LMP of bus *i* over *Nr* samples in the presence of plan *k* in $/MWhr

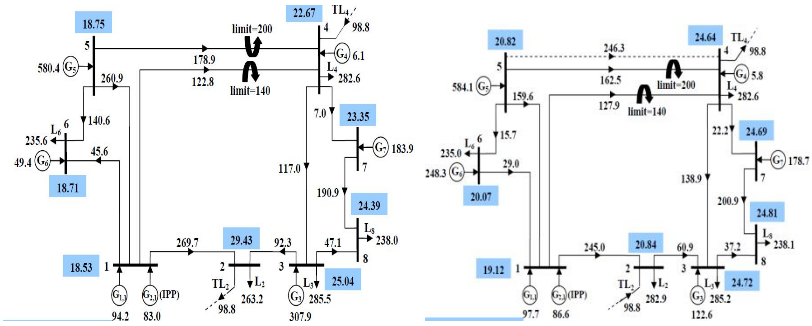
μ^k_{lmp} =mean of $\mu^k_{lmp_i}$ over *Nb* buses in $/MWhr (average LMP of the network)

4. Case Study (IEEE 8bus)

Network engineers suggest the following plans for transmission expansion

Plan 1: installing a line between buses 1 and 4
Plan 2: installing a line between buses 2 and 4
Plan 3: installing a line between buses 5 and 4
Plan 4: installing a line between buses 2 and 3
Plan 5: installing a line between buses 5 and 3

Dotted Line shows insertion of line for Specific Plan.()



IEEE 8 Bus System (Data)

Generator Data

Gen	Name	Bus no	Type	Min	Max(MW)	Bid($/MWhr)	Unavailability
1	G1,1	1	IPP	0	110	N~(14,2.5)	.02
2	G2,1	1	GEN	0	100	N~(15,1.8)	.02
3	G3	3	GEN	0	520	N~(25,1.5)	.02
4	G4	4	GEN	0	250	N~(30,2)	.02
5	G6	5	GEN	0	600	N~(10,3)	.02
6	G6	6	GEN	0	400	N~(20,2.1)	.02
7	G7	7	GEN	0	200	N~(20,1.5)	.02

Load Data of 8 bus Network System:

Load no	Name	Bus No	Load (MW)	Bid($/MWhr)	Unavailability
1	L2	2	N~(300,10)	30	.05
2	L3	3	N~(300,12)	32	.05
3	L4	4	N~(300,15)	35	.05
4	L6	6	N~(250,25)	28	.05
5	L8	8	N~(250,25)	35	.05

Result

S. No.	Probabilistic tool	Plan1 Line (1-4)	Plan2 Line (2-4)	Plan3 Line (5-4)	Plan4 Line (2-3)	Plan5 Line (5-3)	Existing plan
1	Cost of congestion	4520	4345	3777	4505	3519	4510
2	Standard Deviations	2.7802	5.0996	2.4849	4.5475	3.5199	4.5381

So this is comparisons of different plan using two parameter:

1. Cost of congestion
2. Standard deviation

A Transmission and expansion plan should optimum if

Cost of congestion and Standard Deviation would be minimum.

As we see in comparisons **Plan 3** both cost of congestion and Standard Deviation is minimum.

So plan 3 will consider for future purpose.

By help of these two parameter we are able to calculate other important parameter.

References

[1] S. Dekrajangpetch et al "Application of auction results to power system expansion," in *Proc. IEEE Int. Conf. Electric Utility Deregulation and Restructuring*, 2000, pp. 142–146.

[2] C. Ray *et al.*. Transmission capacity planning in a deregulated energy market. presented at Proc. CEPSI.

[3] T. De la Torre *et al.*, "Deregulation, privatization, and competition: Transmission planning under uncertainty," *IEEE Trans. Power Syst.*, vol. 14, pp. 460–465, May 1999.,[4] M. J. Beshir, "Probabilistic based transmission planning and operation criteria development for the western systems coordinating council," in *Proc. IEEE Power Engineering Soc. Summer Meeting*, vol. 1, 1999, pp. 134–139.

[4] Electra, "Sequential probabilistic methods for power system operation and planning," CIGRE AG 38.03.13, Aug. 1998.

[5] W. Li, Y. Mansour, J. K. Korczynski, and B. J. Mills, "Application of transmission reliability assessment in probabilistic planning of BChydro vancouver south metro system," *IEEE Trans. Power SystEM*, Technical Brochure, "Techniques for Power System Planning Under Uncertainties,", Ref. 154, Apr. 2000.

[6] V. Miranda and L. M. Proenca, "Probabilistic choice vs. risk analysis - conflicts and synthesis in power system ..

[7] M. Oloomi Buygi, M. Shahidehpour, H. Modir Shanechi, and, G. Balzer "Market based transmission planning under uncertainties," *in Proc. 2004 IEEE PES PMAPS Conf., IOWA, USA.*