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Optimal Siting and Sizing of Solar Power Sources in Interconnection Grid System

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ABSTRACT

Growing concerns electrical power demand in need and necessity of daily livelihood of life. Impacted over addition power demanded there is climate impacts, environmental conditions due to conventional power generation resulted in improvement of cheaper solar power generation in the whole distribution system network, and programs offered by governments have contributed to an increment in the number of distributed energy resources (DERs) system in commercial and domestic electrical power output. It is well known that fact the non-optimal size and non-optimal siting system may lead to high power losses, bad voltage profiles and high losses of profit margins of DISCOM's end. Therefore, this paper to determine the location best siting and filler of multiple DERs generators supported power loss, generation units, and cheaper power transfer demonstrated through IEEE 30 bus standard test system with help of Power World Simulator Package and single line drawing of 2MW solar PV power plant added to APDISCOM.

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1. INTRODUCTION

Distributed energy resources are decentralized power generation by small generating units to distribution system. Nowadays DERs technology is gaining wide spread interest Because of new constraints placed in India like economical, political, voltage level rating ,power loss, growing demand and environmental factors modern trends in electrical power system planning and operation have to push existing power system to capable to fulfill maximum demand will lead to power loss, trapping , and power cut. Centralized Electrical congenital generation (coal, thermal, hydro, and nuclear) fails to meet maximum demand and power loss.

Due to low voltage level LV and high voltage level HV in distribution network system largest power loss is occurred in three stage of power system i.e. power generation , power transmission and power distribution network power losses in line a distribution end will constitute in range of 6%- 15% of the compared with power generation system .

Distributed energy resources to an electrical power grid is very complex integration of plug and play problem due to added exiting electrical system consideration of power loss, power quality, protection, stability, reliability etc. It very important to determine the optimal siting and sizing solar power generation before interconnect with exiting electrical power grid.

Present power system integration of solar power system to electrical grid has been rapidly increasing over the past few decade as a result of growing load most demand. To develop efficient expansion optimal power flow algorithms in computational optimizing network and generation. Power losses could be minimized by placing DER in proper place.

This paper is approaches analytical method and numerical method to setting up solar power plant in India. Paper organized as follows. Problem description minimizes the power loss in the network section II. Next the Optimal distributed energy resources sizing and location solar in IEEE 30 bus system section III. Proposed method is verified the simulation results and practical implemented system in 33 kV Nagaladinne feeder, Andhra Pradesh, India. Result are obtained clearly explains minimization the power losses in electrical grid section IV. Finally, the conclusion is given in section V.

2. PROBLEM FORMULATION

In Electrical power system load forecasting is done based on demand at distribution network here is a brief description of reduction Method in Network as follows

- Initial outline rating of station in kilovolt all the buses that within that have similar properties.
- Ignore all lines connecting buses that belong to same space buses.
- Lines interconnecting buses that belong to same space can aggregative.
- Power flow is computed in reduced network.
- Placement of solar power generation based on constraints.

Power loss is reduced network with speed up computational time. OPF studies significant importance in economical factor and also finding feasible generation that will impact by considering constraints. Power injected from sending end in the buses is equal to the receiving end bus is balanced system.

If power unbalanced occurred in receiving end will generate power loss in network. Power injection with help of solar power at receiving end will reduce the power loss in network. Buses are connected with generation units is Generation Area. Buses are connected with load is Load Area as shown in Table.1 planned to interconnect solar energy generator IEEE 30-bus system.

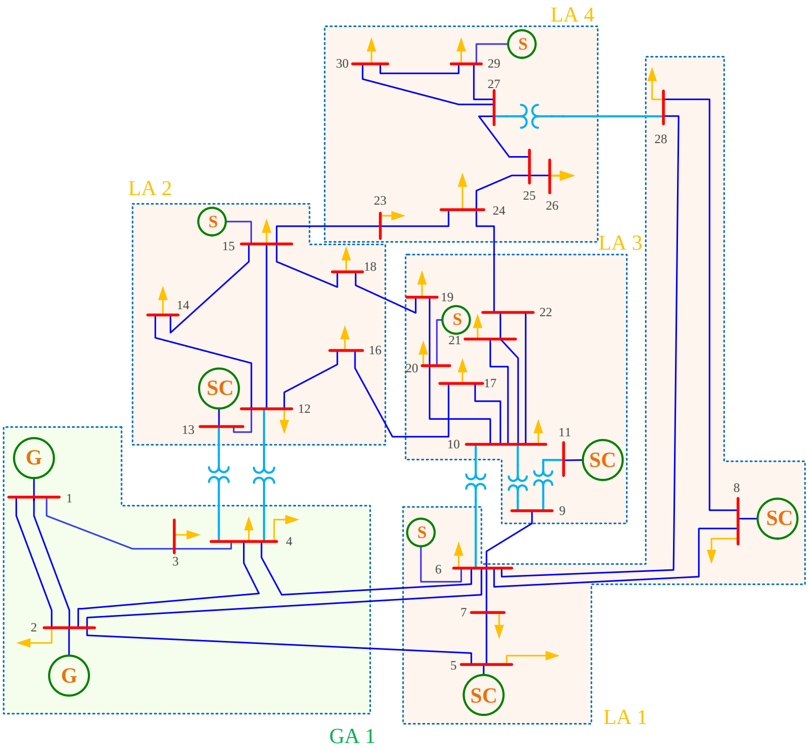

Figure 1. Planned to interconnection of solar energy generator IEEE 30-bus system.

Objective function feature proposed version is to decrease the power strength loss within the network by means of standard optimal siting and sizing of solar power electricity assets in grid network. The primary goal function is mathematically formulated as shown in Equation below (1)

Minimize $f(x) = \sum_{i=1}^{n} P_{loss}$ (1)

Where,
P_{loss} power loss in network;
n number of nodes.

Power loss in network is given by

$$P_{loss} = \min \sum_{i=1}^{n} \sum_{j=1}^{n} I_{ij}^{2} Z_{ij} \quad (2)$$

Impedance between the sending end node bus node and receiving end node bus is given by

$$Z_{ij} = R_{ij} + jX_{ij} \quad (3)$$

Where,
I_{ij} line current magnitude at node bus i th to j th;
Z_{ij} line impedance at node bus i th to j th in ohms;
R_{ij} line resistance at node bus i th to j th in ohms;
X_{ij} line reactance at node bus i th to j th in ohms.

Branch current magnitude between two buses nodes given by

$$I_{ij} = \frac{V_i - V_j}{Z_{ij}} \quad (4)$$

Where,
I_{ij} Branch current magnitude ij th ampere;
V_i Voltage magnitude at node bus i th in volt;
V_j Voltage magnitude at node bus j th in volt;
Z_{ij} Branch impedance at node bus ij th in ohms.

The real power loss in a system is given by Equation. This is popularly referred to as the "exact loss" formula. Power loss is given by

$$P_{loss} = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij}(P_i P_j + Q_i Q_j) + b_{ij}(Q_i P_j - P_i Q_j) \quad (5)$$

Where,

$$a_{ij} = \frac{Z_{ij}}{V_i V_j} * \cos(\delta_i - \delta_j) \quad (6)$$

$$b_{ij} = \frac{Z_{ij}}{V_i V_j} * \sin(\delta_i - \delta_j) \quad (7)$$

Where

a_{ij} , b_{ij} function loss coefficient in network at node bus ij th;

P_i Active power flow kW at node bus i th;

Q_i Reactive power flow kVAR at node bus i th;

P_j Active power flow kW at node bus j th;

Q_j Reactive power flow kVAR at node bus i th;

$V_i V_j$ Voltage magnitude sending and receiving end at bus in Per Unit.

The sensitivity factor of power loss with respect to a power injection from solar generator is given by

$$a_{inj} = \frac{\partial P_{loss}}{\partial P_i} = 2\sum_{i=1}^{n}\sum_{j=1}^{n}\left(a_{ij}P_j - b_{ij}Q_j\right) \tag{8}$$

Objective function is to satisfy constraints. The constraints are mathematically formulated as follows in Equation below:

2.1. Equality constraints

Power flow constraints related to the non-liner equation to balancing constraints

$$P_i = P_{solar} - P_{load} \tag{9}$$

Where,

P_{solar} Power generated from solar;

P_{load} Power Load demand;

P_i Real power flow injection at node bus kW.

Table 1. Generator, Load Buses Included In Each Area in Figure 1.

Area	Buses	Total Power consumption at load side	Rating of Transmission line
Generating area 1	1,2,3,4	111.42	132 kV
Load area 1	5,6,7,8,28	146.14	132 kV
Load area 2	12,13,14,15,16,18	39.42	33 kV
Load area 3	9,10,11,17,19,20,21,22	49.92	33 kV
Load area 4	23,24,25,26,27,29,30	34.10	33 V

2.2. Inequality constraints

Bus voltage limitation profile is maintained within acceptable operating limits the in voltage in bus limit is given by

$$V_{tr\_\min} \le V_{tr} \le V_{tr\_\max} \tag{10}$$

Where,

$V_{tr\_\min}$ And $V_{tr\_\max}$ acceptable bounder voltage limits in Per Unit.

DEGs capacities Interconnection of different nominal value of solar power generations be maintained in rated limits

$$P_{solar\_\min} \le P_{solar} \le P_{solar\_\max} \quad (11)$$

Where,

$P_{solar\_\min}$ And P_{solar_max} minimum and maximum reactive power generated in solar power kW.

Table 2. Transmission Voltage Levels In India

Nominal	Voltage (kV rms)	
	Max	Min
765	800	728
400	420	380
220	245	198
132	145	122
110	121	99
66	72	60
33	36	30

3. MODELING OF OPF PROBLEM

In practical electrical power system generating plants are located far away from the consumer distribution network as result in large transmission network is estimated to transfer that power to load side end hence lead to Power loss in the network. Connection of solar electricity power can slight power losses if their right sittings are region. To determine the optimal sitting of solar power generator in IEEE 30-bus system used.

In sensible electric energy device producing plants are positioned a long way far away from the client distribution community as bring about massive transmission network is predicted to switch that energy to load side stop consequently lead to power loss in the community. Connection of sun electricity flowers can slight power losses if their right sittings are region. To decide the highest useful solar electricity generator in IEEE 30-bus system running power flow.

As show in figure 1 planned interconnection of IEEE 30-bus test system using optimal siting and sizing generator. Now examine two power flow models with respect to generator or load. These two cases are shown in figure 2 power flow go with the power generator to various power loads and figure 3 power go with the flow from various power generators to single power load, respectively. The associated constraints are described as follows:

- P_{gen}: Electricity provided with the aid of the P_{gen} in electrical power network.
- P_{load}: Power fed on via the P_{load} in electrical power network.
- P_{gen_n}: Electricity strength flowing from power generator to power load.
- P_{load_n}: Electricity consumed by numerous power loads.

In a mixture of above two instances defined for figure 1 can be conveyed with the aid of figure 4 single line simplified power flow model only power generators and loads. In figure 4 Node buses i and j can be symbolized with the single line diagram of each buses as show in figure 5. Then total power losses in overall power system can be calculated by way of summing the losses of all the nodes every time the solar power generator is interconnected to buses.

As a figure 5 is that specialize in the connection among solar generator and load. In same manner, the whole power electrical network figure 1 can also be resolute by means of making an allowance for about network electrical power losses. In figure 5 is used as an equivalent arrangement in figure 1 from the point of view of solar power generator. P_{load} equivalent load consumed from j th node bus.

In figure 5, the electricity flow depends on the quantity of power furnished from electrical substation and solar power generator. Then power loss among each bus calculated with the aid of eq.2.

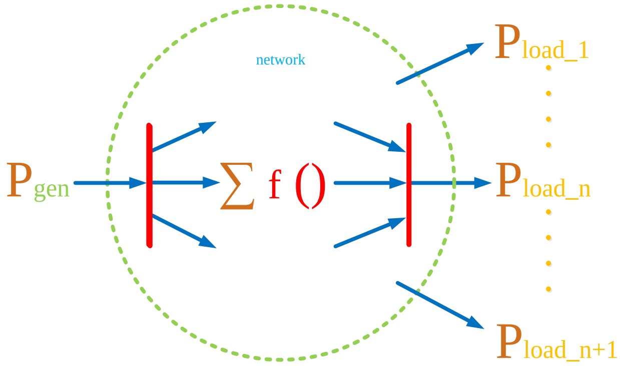

Figure 2. Power goes with the flow from generators to the numerous power loads.

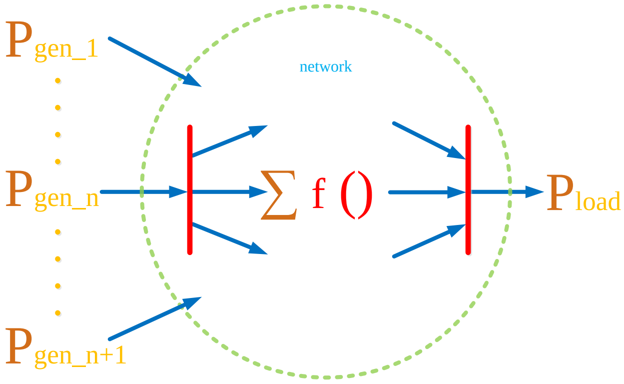

Figure 3. Electricity float from numerous power generators to power load.

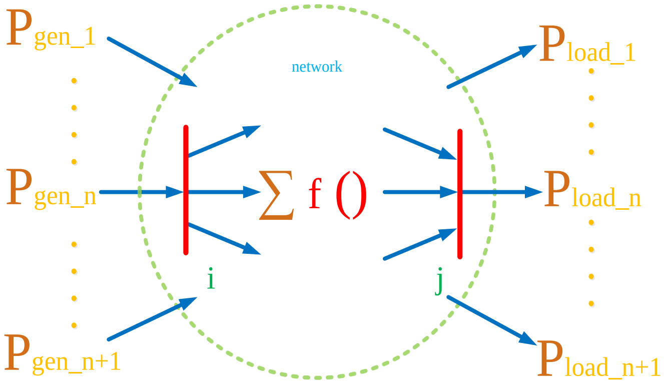

Figure 4. Simplified power flow only power generators and loads.

3.1. Selection of optimal location

Assuming no change in node voltage magnitude at j th bus solar power generated can be written as in below equation

$$P_{solar=}I_{solar} * \left(\pm V_j\right) \tag{12}$$

I_{solar} Current magnitude at jth bus node.

The whole electricity power loss against injected strength is a function and, at minimum losses, the charge of exchange of loss with recognize to the injected electricity turns into zero.

$$\frac{\partial P_{loss}}{\partial P_i} = 2\sum_{i=1}^{n}\sum_{j=1}^{n}\left(a_{ij}P_j - b_{ij}Q_j\right) = 0 \quad (13)$$

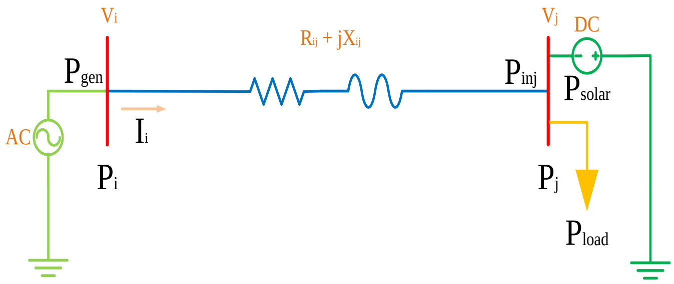

Figure 5. Single line diagram of between two buses.

3.2. Optimal distributed energy resource's sizing and location

The fact the non-optimal size and non-optimal siting system may lead to high power losses, bad voltage profiles and high losses of profit margins of DISCOM's end.

DEG's will generating power will be identified by optimal sizing constraints in eq (9)

$$P_{inj} = P_{solar} - P_{load} \quad (14)$$

P_{inj} Power flow injection at node bus kW;

P_{loss} Can write as with constraints.

$$P_{loss} = -\frac{1}{\left[a_{ij}\right]}\sum_{i\neq j}^{n}\sum_{j=1}^{n}\left[a_{ij}P_j - b_{ij}Q_j\right] \quad (15)$$

The above equation is solved as

$$P_{solar} = P_{load} + \frac{1}{\left[a_{ij}\right]}\sum_{i\neq j}^{n}\sum_{j=1}^{n}\left[a_{ij}P_j - b_{ij}Q_j\right] \quad (16)$$

The DEG's units at non-optimal size and non-optimal siting system may lead to high power losses. Thus power loss is a function of loss coefficients. After installation of solar power system to network loss coefficients will change depending injection of power. Load flow calculation is required for updating Ploss. Finally the optimal size is calculated from the basic case IEEE 30 Bus system.

4. PROPOSED ALGORITHM FLOW CHART

This paper, IEEE 30 bus test system N=30, and number of DEG's interconnected is 5 by dividing into Areas. In this case, the maximum losses in node bus number are selected for DEG's installation. Each time power flow is evaluated to find Power loss and voltage is updated. Both cases are compares with voltage difference at each node bus graph is plotted in figure 6.

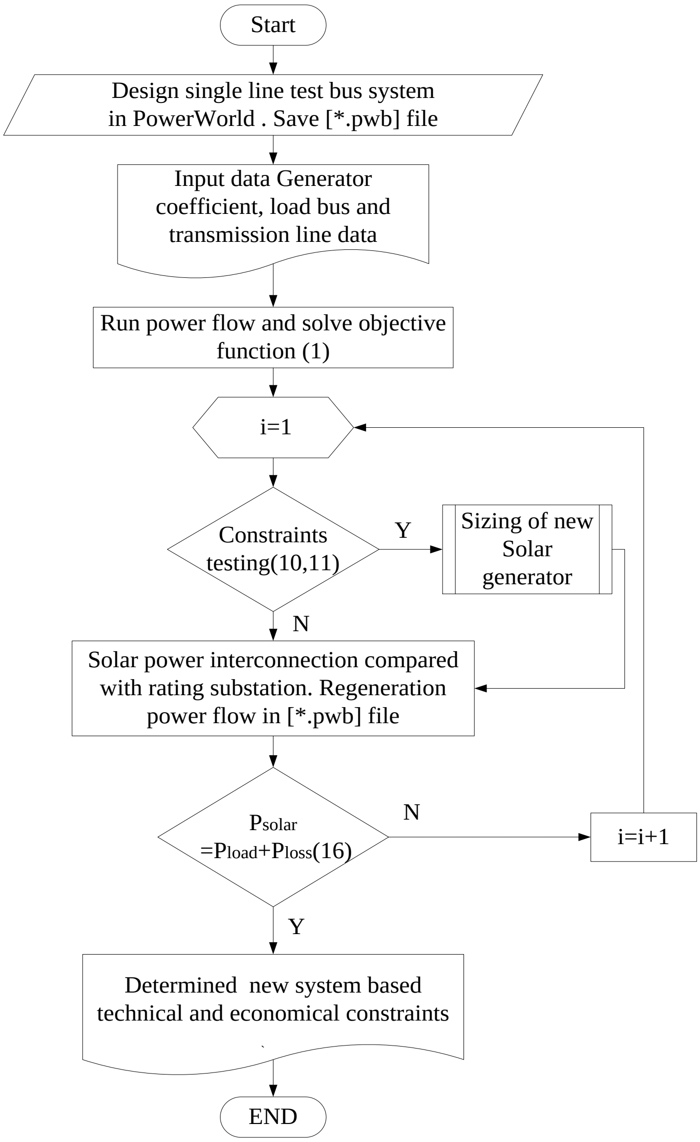

Figure 6. Proposed algorithm flow chart

5. SPECIFICATION OF TEST SYSTEM AND TABLES

In our paper calculation the optimal size and optimal siting system is resolute based on reducing power losses simply. Uncertainty DEG's is in electrical power marketplace, optimal size and optimal siting system is determined based on Power losses in network, Voltage level rating and available solar power feasible ratings. Based on algorithm show in figure 6 optimal size DEG's are calculated at various load areas as shown in figures 7, 8, 9 and 10 at various node buses for IEEE 30 bus system.

As far as sitting is concerned, test system each load areas, corresponding highest value would deliver ranging of the DEG's rating to probable to least power losses.

Any government supervisory organization can give there restricting the sizes of solar power based on rating of existing power system in operation.

In the 30-bus IEEE system, is ranging from 2MW-150MW as shown in table 3. Solar power system will interconnected to electrical grid .For the IEEE 30 bus system 33/11 kV and 132/33 kV rating is selected. The range of DEG's system is sited at various locations of node buses as show in figure 1. If the proposed DEG's is inserted it will reduce 87 MW losses. Solar power step of MW to each DEG's, the initial power loss is obtained by a power flow computation.

Table 3. Solar interconnection grid India

Interfacing grid substation	Injection voltage level	Injection capacity at substation
33/11 kV	33 kV	2 to 8
132/33 kV	33 kV	6 to 15
132/33 kV	132 kV	11 to 50
220/132 kV	132 kV	11 to 50
220/132 kV	220 kV	41 to 100
400/220 kV	220 kV	51 o 150

5.2. Per Unit voltage selection

Figure 11. Optimal sizing and sitting of DEG's show before and after installations of solar at various node buses. The results are in agreement with the result with previous work. Notice at Load area 1 will installation of 50 MW is best location to reduction of power losses. Similarly load area 2, load area 3 and load 4 installation of 8MW respectively as show in table 4.

Table 4. Highest, lowest load, highest and lowest loss

Area	Highest load bus	Lowest load bus	Highest loss	Lowest loss
Load area 1	5	28	6	8
Load area 2	12	13	15	13
Load area 3	21	9	20	9
Load area 4	29	27	29	27

Though in realty the sizes will be fixed and power factor can be allowed to vary to observe the impact of DEG's on power loss. It is interesting to see in table 7. Per unit are system is improved. Comparison of voltage level in PU at each bus before and after installation of solar power plotted in graph.

Table 5. Loss comparison of generation, load and losses before and after installation of solar power in figure 1.

	Generators MW	Load MW	Loss MW
Before solar	477.16	381.01	96.15
After solar	493.76	485.6	8.16

Figure 11. Optimal sizing and placement of DEG's show before and after installations of solar at various node buses. Notice at zone 1 will installation of 150 kW node buses 12 is best location to reduction of power losses. Similarly Zone 2, Zone 3 and Zone 4 will install 150 kW respectively as show in table 4.

Though in realty the sizes will be fixed and power factor can be allowed to vary to observe the impact of DEG's on power loss. It is interesting to see in table 7. Per unit are system is improved. Comparison of voltage level in PU at each bus before and after installation of solar power plotted in graph.

6. PRATICAL TEST SYSTEM

Technical feasibility for new and renewable energy (NRE) generation unit Bhavsvat solar energy Pvt ltd approved by central power distribution company of AP limited to connecting to power transformer capacity 5MVA with voltage rating 33/11 kV. Substation is anticipated maximum demand 2.25MVA. As show in figure 11 single line diagram EHT SS 33/11 kV with solar power plant will generation capacity of 2MW. Difference between load and generation capacity is 4.25 MW. In 33kV line is feasible to transmit the power with load and generation capacity 4.25MW with power transformer rated capacity 5MVA. Power transformer will able to load and generation capacity 0.75MW after installation of solar to existing 33 kV feeders. 33 kV feeder percentage of Regulation before installation of solar power plant %5.25 and after installation of solar power plant %5.55 show in table 6.

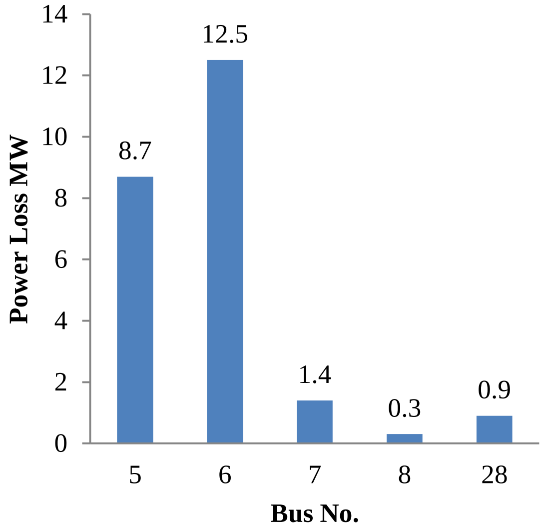

Figure 7. MW loss load area 1

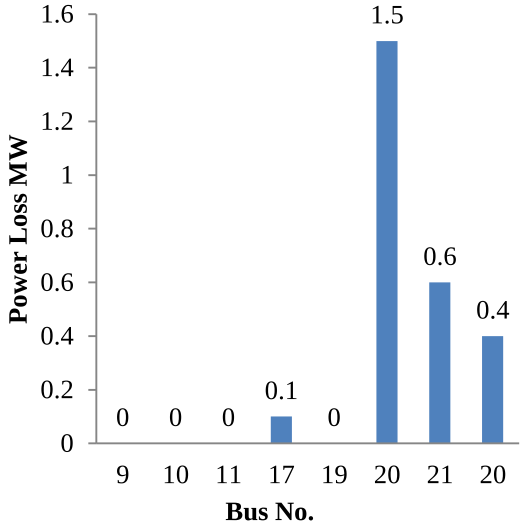

Figure 9. MW loss load area 3

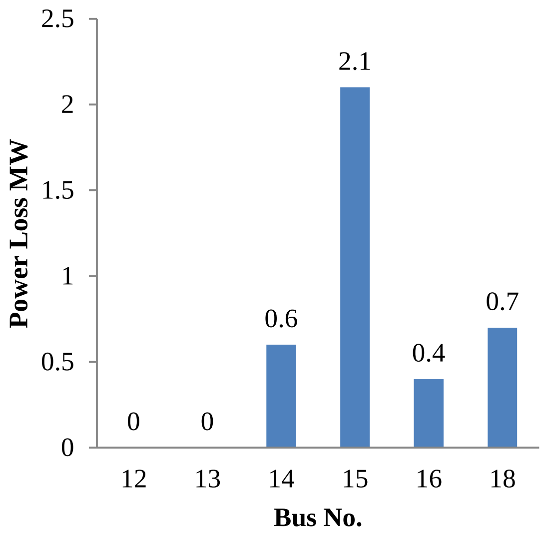

Figure 8 MW loss load area 2

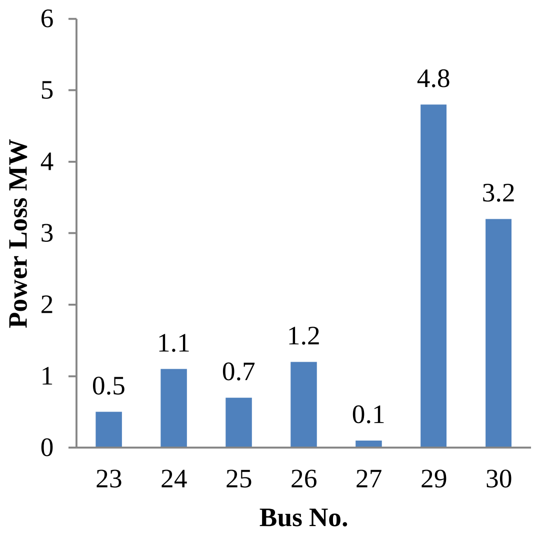

Figure 10. MW loss load area 4

Table 6. Comparison of generation, load and losses before and after installation of solar power in figure 13.

	Before	After
% Regulation	5.25	5.55

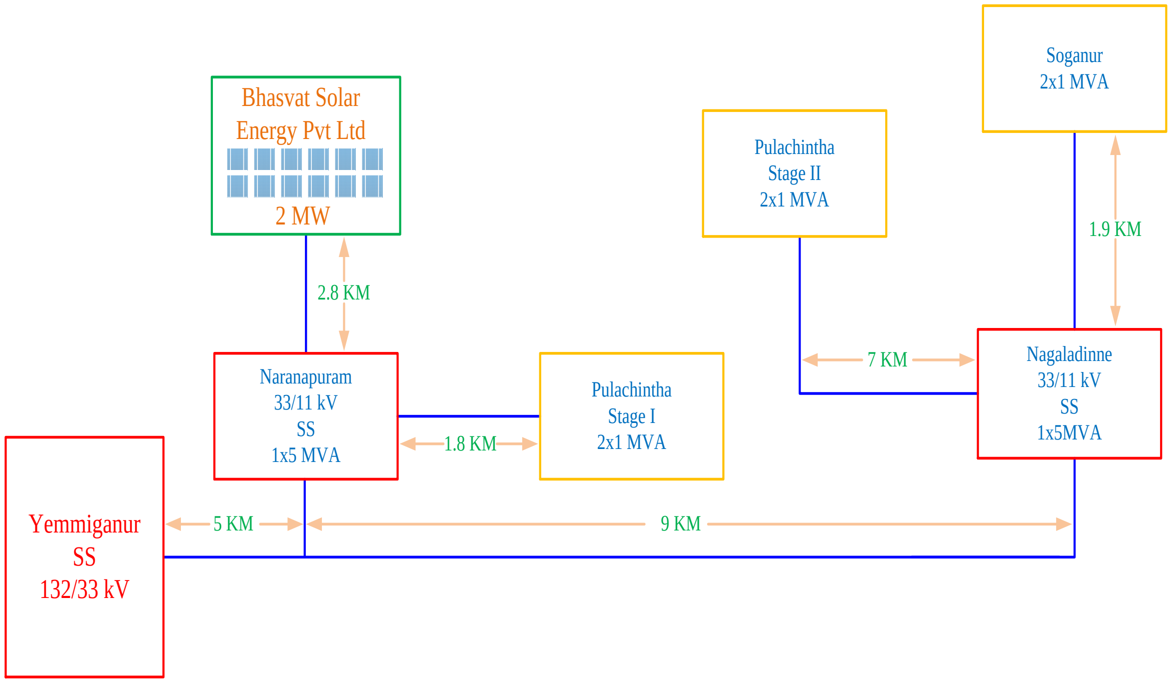

Figure11. Single line diagram EHT SS 33/11 kV with solar power plant.

Table 7. Comparison of voltage level in per unit at each bus before and after installation of solar power.

BUS No.	Per Unit Volt before solar	Per Unit Volt after solar	BUS No.	Per Unit Volt before solar	Per Unit Volt after solar
1	1	1	16	0.54378	0.96417
2	0.83857	0.98899	17	0.53353	0.94363
3	0.70691	0.96736	18	0.46756	0.93325
4	0.66299	0.94912	19	0.46309	0.92724
5	0.70736	0.98899	20	0.47276	0.93005
6	0.64045	0.94129	21	0.51254	0.91427
7	0.65471	0.95290	22	0.51058	0.91050
8	0.63523	0.94961	23	0.47092	0.89506
9	0.59912	0.97643	24	0.45178	0.83503
10	0.54247	0.94198	25	0.38238	0.79281
11	0.67326	0.96899	26	0.30945	0.76983
12	0.58732	0.99689	27	0.37776	0.77815
13	0.63983	0.98899	28	0.60157	0.95348
14	0.53833	0.96926	29	0.18268	0.94405
15	0.51818	0.94928	30	0.19125	0.92968

7. CONCLUSION

This paper has proposed optimal sitting and sizing of multiple solar power system gird interconnection in distribution system network by using nonlinear constrains equations. OPF based on power loss and power margin was developed to pick up point optimal sitting location.

After connecting multiple solar powers system to an electrical network system, this paper will be used to making decision in minimizing power losses and maximizing profit margin to increasing regulation and performance of the system.

Simulation results show economical dispatch of final siting solar power system in IEEE 30 bus system within limits of operating section of voltages and currents ratings

Practical result is verified the implemented system in 33 KV Nagaladinne feeder show the improvement in power regulation and minimizing losses.

REFERENCES

[1] HyungSeon Oh, "Aggregation of Buses for a Network Reduction," in Power Systems, *IEEE* Transactions on , vol.27, no.2, pp.705-712, May 2012.

[2] Di Shi; Tylavsky, D.J., "A Novel Bus-Aggregation-Based Structure-Preserving Power System Equivalent," in Power Systems, *IEEE* Transactions on , vol.30, no.4, pp.1977-1986, July 2015.

[3] Le, Thanh Luong; Tran, Quoc Tuan; Devaux, O.; Chilard, O.; Caire, R., *"Reduction and aggregation for critical and emergency operation of distribution network in presence of distributed generators,"* in Electricity Distribution - Part 1, 2009. CIRED 2009. 20th International Conference and Exhibition on, vol., no., pp.1-4, 8-11 June 2009.

[4] Tautiva, C.; Cadena, A.; Rodriguez, F., *"Optimal placement of distributed generation on distribution networks,"* in Universities Power Engineering Conference (UPEC), 2009 Proceedings of the 44th International , vol., no., pp.1-5, 1-4 Sept. 2009.

[5] Duong Quoc Hung; Mithulananthan, N.; Bansal, R.C., "Analytical Expressions for DG Allocation in Primary Distribution Networks," in Energy Conversion, *IEEE* Transactions on , vol.25, no.3, pp.814-820, Sept. 2010.

[6] A. Elmitwally,"A new algorithm for allocating multiple distributed generation units based on load centroid concept", Alexandria Engineering Journal, Volume 52, Issue 4, December 2013, Pages 655-663, ISSN 1110-0168.

[7] Anwar, A.; Pota, H.R., "Loss reduction of power distribution network using optimum size and location of distributed generation," in Universities Power Engineering Conference (AUPEC), 2011 21st Australasian , vol., no., pp.1-6, 25-28 Sept. 2011.

[8] Parizad, A.; Khazali, A.; Kalantar, M., "Optimal placement of distributed generation with sensitivity factors considering voltage stability and losses indices," in Electrical Engineering (ICEE), 2010 18th Iranian Conference on , vol., no., pp.848-855, 11-13 May 2010.

[9] Talaat, H.E.A.; Al-Ammar, E., *"Optimal allocation and sizing of Distributed Generation in distribution networks using Genetic Algorithms,"* in Electrical Power Quality and Utilisation (EPQU), 2011 11th International Conference on , vol., no., pp.1-6, 17-19 Oct. 2011.

[10] Duong Quoc Hung; Mithulananthan, N., "Multiple Distributed Generator Placement in Primary Distribution Networks for Loss Reduction," in Industrial Electronics, *IEEE* Transactions on , vol.60, no.4, pp.1700-1708, April 2013.

[11] Ziari, I.; Ledwich, G.; Ghosh, A.; Cornforth, D.; Wishart, M., "Optimal allocation and sizing of DGs in distribution networks," in Power and Energy Society General Meeting, 2010 *IEEE* , vol., no., pp.1-8, 25-29 July 2010.

[12] Soo Hyoung Lee; Jung-Wook Park, "Optimal placement and sizing of multiple DGs in a practical distribution system," in Industry Applications Society Annual Meeting (IAS), 2012 *IEEE*, vol., no., pp.1-8, 7-11 Oct. 2012.

[13] Xiangjing Su; Masoum, M.A.S.; Wolfs, P.J., "Optimal PV Inverter Reactive Power Control and Real Power Curtailment to Improve Performance of Unbalanced Four-Wire LV Distribution Networks," in Sustainable Energy, *IEEE* Transactions on , vol.5, no.3, pp.967-977, July 2014.

[14] Tautiva, C.; Cadena, A., *"Optimal placement of distributed generation on distribution networks,"* in Transmission and Distribution Conference and Exposition: Latin America, 2008 IEEE/PES, vol., no., pp.1-5, 13-15 Aug. 2008.

[15] Lei Liu; Hai Bao; Hong Liu, *"Siting and sizing of distributed generation based on the minimum transmission losses cost,"* in Power Engineering and Automation Conference (PEAM), 2011 IEEE , vol.3, no., pp.22-25, 8-9 Sept. 2011.

[16] Paliwal, P.; Patidar, N.P.; Nema, R.K., "A comprehensive survey of optimization techniques used for Distributed Generator siting and sizing," in Southeastcon, 2012 Proceedings of *IEEE* , vol., no., pp.1-7, 15-18 March 2012.

[17] Babu, P.R.; Rakesh, C.P.; Kumar, M.N.; Srikanth, G.; Reddy, D.P., *"A Novel Approach for Solving Distribution Networks,"* in India Conference (INDICON), 2009 Annual IEEE , vol., no., pp.1-5, 18-20 Dec. 2009.

[18] Alinejad-Beromi, Y.; Sedighizadeh, M.; Bayat, M.R.; Khodayar, M.E., *"Using genetic alghoritm for distributed generation allocation to reduce losses and improve voltage profile,"* in Universities Power Engineering Conference, 2007. UPEC 2007. 42nd International, vol., no., pp.954-959, 4-6 Sept. 2007.

[19] Wogrin, S.; Gayme, D.F., "Optimizing Storage Siting, Sizing, and Technology Portfolios in Transmission-Constrained Networks," in Power Systems, *IEEE* Transactions on, vol.30, no.6, pp.3304-3313, Nov. 2015.

[20] Totonchi, I.; Al Akash, H.; Al Akash, A.; Faza, A., "*Sensitivity analysis for the IEEE 30 bus system using load-flow studies,"* in Electric Power and Energy Conversion Systems (EPECS), 2013 3rd International Conference on , vol., no., pp.1-6, 2-4 Oct. 2013.

[21] Kian, A.R.; Thomas, R.J.; Zimmerman, R.; Lesieutre, B.C.; Mount, T.D., *"Identifying the potential for market power in electric power systems in real-time,"* in System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on, vol., no., pp.7 pp.-, 5-8 Jan. 2004.

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