ELECTRIC POWER DISTRIBUTION SYSTEM EXPANSION AND PLANNING TO MEET DEMAND

Dr. V.Raviprasad[1], Paradesi Neelandeswari[2], Marella Gnaneswar, Nuvvuru Dakshayani, Shaik Iliyaz

Abstract

Distribution network is an important part of power system, as well as a giant system of complex uncertainty, which is a line of transmitting power from the distribution transformer to the power point, so as to supply power for each distribution substation of cities and various power loads. The aim of this paper is to address Distribution Network Reconfiguration Issues, Day by day population is increased with the increase in population the power demand also increased gradually. To meet that increased power demand we have to provide a new distribution network or extend an existing distribution line to meet supply power to newly formed residential/agricultural areas . For providing new distribution network we have to know how much power demand increased, what are the materials required, length of the line, money required. i.e., Investment required for expansion. Estimates for expansion acquiring land required, materials required (like towers or poles, cross arms, insulators, transformers, conductors etc.), labor charges and transportation charges etc,. Mixed integer linear programming method was utilized to solve the optimal distribution expansion planning problem. Simulations were performed on an 18-node distribution network. Results revealed effectiveness of the proposed model and showed that consideration of cost elasticity of demand in expansion planning, changes optimal configuration of network and significantly influences total costs.

Keywords: *Distribution networks, power distribution planning, pricing, linear programming, demand side management, power distribution economics, investment, integer programming, power generation economics*

Introduction

Modern distribution networks have introduced new concepts and applications.
The modern Distribution Network Planning implements combination of traditional network planning options and so called non-network solutions. ... It also includes study of network demand management, smart grids, distributed energy resources (DER), embedded generation, energy storage equipment and grid support systems.

Distribution networks topology
A distribution system upgrade moving towards Smart Grid implementation is necessary to face the proliferation of distributed generators and electric vehicles, in order to satisfy the increasing demand for high quality, efficient, secure, reliable energy supply. This perspective requires taking into account system vulnerability to cyber - attacks. An effective attack could destroy stored information about network structure, historical data and so on. Countermeasures and network applications could be made impracticable since most of them are based on the

[1]Professor, EEE Dept., Narayana Engineering College, Gudur, Andhra Pradesh, India,
[2]neelandeswariparadeshi@gmail.com, Student, Narayana Engineering College, Gudur, AP, India.

Copyright @ 2020 Authors

knowledge of network topology. Usually, the location of each link between nodes in a network is known. Therefore, the methods used for topology identification determine if a link is open or closed. When no information on the location of the network links is available, these methods become totally unfeasible.

The main concept might be the possibility of demand-side participation in load management. Demand-side participation is often referred to as demand response (DR). DR can be a promising solution to solve power system challenges such as congestion. DR programs are market-based approaches.

The aim of this paper is to quantify the impact of cost to erect a new line to RV palem and compare it with reconfiguring a the existing network to meet the demand

The main contributions of this paper can be summarized as follows:
• present distribution network at nellatur to rv palem, it voltage regulation problem.
• planning a new line extension to serve new locality in rv palem, extension or bifurcation of existing line to RV palem
• Cost estimation of erecting new line to RV palem and
Cost estimation extension or bifurcation of line to rv palem.
• analytical method is used to solve planning problem to meet voltage regulation norms.

The distribution network already consists a power line having voltage levels 33/11 KV at SS Kothagunta in operation section, chittamuru of operation division, Gudur in operation circle, Nellore. In addition to that a new 11 KV line over 7.98 KM is introduced to meet the increase demand. This new 11 KV line consits of two 6.3 KVA transformers

Requirements of new 11 KV line
1. The new 11 KV line was introduced to decrease the distance between the supply line and the consumer premises.
2. To meet the increased power demand.

Advantages of new 11 KV line
1. voltage drop over the existing line was decreased.
2. Nearer to the consumer premises.
3. power factor of the line was also improved

By extending the 11 KV line over 7.98 KM the new agricultural and domestic customers are added, The agricultural customers uses the power over 9 hours per day due to this percentage usage of power on new line the investments are easily recovered over short period of time and revenue of the electricity department also improved.

Because of increase in demand and to reduce voltage drop over long distance new line is going to be constructed

At RV Palem village near Gudur in Nellore district the demand of power consumed by the consumers on 11KV line was increased to more than its supply limit. To meet that increased power demand a new 11KV line was introduced having an estimation cost of Rs.26,83,005/-. The proposed line involes:

 Copyright @ 2020 Authors

ISSN: 2278-4632
Vol-10 Issue-7 No. 7 July 2020

1. Erection of 7.98 KM 11KV line over 8Mts PSCC Poles.
2. Erection of 1No 11KV VCB along with Bay Extension

SL.NO	Proposal involves	Total in Rs
1	10 – ERECTION OF 7.98 KM 11KV LINE	1559780.55
2	20 – ERECTION OF 1NO 11KV FEEDER VCB	499944.55
3	30 – LABOUR	623280.00
	Estimate Cost (Gross) :	2683005.10
	Less Credits (-) :	0.00
	Estimate Cost (Net) :	2683005.10

The below three tables gives the brief description details of APSPDCL Nellatur

Table 1: Length of lines in KM under 33/11KV substation at Nellatur

S.No	Voltage level	Length
1	33KV	346.34KM
2	11KV	2148.179KM
3	6.3KV	357.364KM
4	LT	5334.681KM

Table2: Number of transformers and their capacities under 33/11KV substation at Nellatur

S.No	Type of phase	Transformer Rating	No. of transformers
1	Three Phase	400KVA	1
2	Three Phase	315KVA	22
3	Three Phase	250KVA	15
4	Three Phase	160KVA	74
5	Three Phase	100KVA	1489
6	Three Phase	75KVA	3
7	Three Phase	63KVA	1505
8	Three Phase	50KVA	19
9	Three Phase	40KVA	16

Copyright @ 2020 Authors

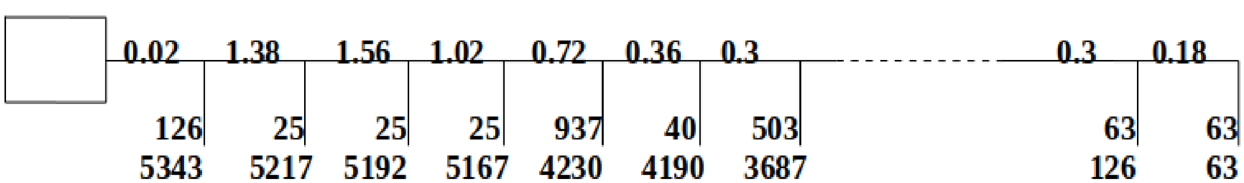
ISSN: 2278-4632
Vol-10 Issue-7 No. 7 July 2020

10	Three Phase	25KVA	3244
11	Three Phase	16KVA	3509
12	Three Phase	5KVA	-
13	Single Phase	15KVA	1911
14	Single Phase	10KVA	18
15	Single Phase	5KVA	100

Table 3: Total customers under 33/11KV substation at Nellatur

S.No	**Type of customer**	**Number**
1	CAT-I Domestic	153236
2	CAT-II Non-Domestic	12434
3	CAT-III Industrial III (A) Other than aqua III (B) Above 75HP UP To 150HP aqua services	21022
4	CAT-IV Cottage Industries	5645
5	CAT-V Agricultural	32568
6	CAT-VI (A) Street lighting VI (B) PWS and RWS Services	35163
7	CAT-VII General purpose	144
8	CAT-VIII Temporary supply	38
9	HT Services	9

Before HT Regulation of 11KV RV Palem feeder



Length (KM)	*	DTR Capacity (KVA)	=	Length * Capacity(KM-KVA)
0.02	*	5343	=	106.9
1.38	*	5217	=	7199

Copyright @ 2020 Authors

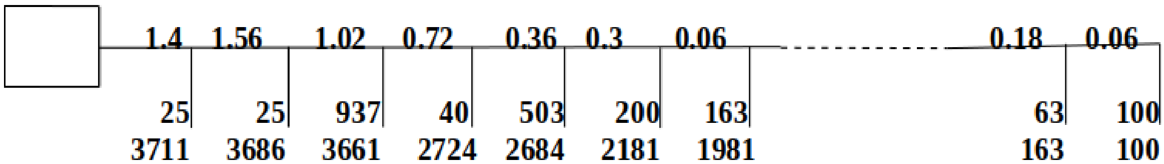
1.56	*	5192	=	8100
1.02	*	5167	=	5270
0.72	*	4230	=	3046
0.36	*	4190	=	1508
0.3	*	3687	=	1106
0.36	*	3487	=	1255
0.3	*	3324	=	997.2
0.06	*	3261	=	195.7
0.12	*	3110	=	373.2
0.18	*	3010	=	541.8
0.3	*	2910	=	873
0.06	*	2747	=	164.8
0.12	*	2584	=	310.1
0.06	*	2521	=	151.3
0.3	*	2458	=	737.4
0.06	*	2132	=	127.9
0.12	*	2032	=	243.8
0.3	*	1969	=	590.7
0.06	*	1869	=	112.1
0.48	*	1769	=	849.1
0.18	*	1669	=	300.4
0.06	*	100	=	6
0.12	*	1506	=	180.72
0.12	*	1406	=	168.72
0.18	*	1343	=	241.74
0.24	*	1143	=	274.32
0.3	*	1017	=	305.1
0.18	*	954	=	171.72
0.18	*	891	=	160.38
0.24	*	728	=	174.72
0.24	*	578	=	138.72
0.12	*	515	=	61.8
0.18	*	352	=	63.36
0.18	*	226	=	40.68
0.3	*	126	=	37.8
0.18	*	63	=	11.34
Total sum = 36197				

Power factor = 0.8
Regulation constant of the conductor used for the line = 1350

(36197 * 0.8)/1350 = 21.5

Copyright @ 2020 Authors

After Bifurcation HT Regulation 1



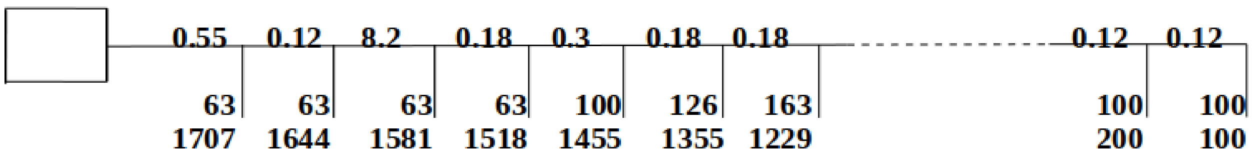
Length (KM)	*	DTR Capacity (KVA)	=	Length * Capacity(KM-KVA)
0	*	0	=	0
1.4	*	3711	=	5195.4
1.56	*	3686	=	5750.2
1.02	*	3661	=	3734.2
0.72	*	2724	=	1961.3
0.36	*	2684	=	966.24
0.3	*	2181	=	654.3
0.36	*	1981	=	713.16
0.3	*	1818	=	545.4
0.06	*	1755	=	105.3
0.12	*	1604	=	192.48
0.18	*	1504	=	270.72
0.3	*	1404	=	421.2
0.06	*	1241	=	74.46
0.12	*	1078	=	129.36
0.06	*	1015	=	60.9
0.3	*	952	=	285.6
0.06	*	626	=	37.56
0.12	*	526	=	63.12
0.3	*	463	=	138.9
0.06	*	363	=	21.78
0.48	*	263	=	126.24
0.18	*	163	=	29.34
0.06	*	100	=	6
Total sum = 21483				

Power factor = 0.8
Regulation constant of the conductor used for the line = 1350

(21483 * 0.8)/1350 = 12.7

Copyright @ 2020 Authors

After Bifurcation HT Regulation 2



Length (KM)	*	DTR Capacity (KVA)	=	Length * Capacity(KM-KVA)
0.55	*	1707	=	938.85
0.12	*	1644	=	197.28
8.2	*	1581	=	12964
0.18	*	1518	=	273.24
0.3	*	1455	=	436.5
0.18	*	1355	=	243.9
0.18	*	1229	=	221.22
0.12	*	1066	=	127.92
0.24	*	1003	=	240.72
0.24	*	878	=	210.72
0.18	*	715	=	128.7
0.18	*	652	=	117.36
0.3	*	589	=	176.7
0.24	*	463	=	111.12
0.18	*	263	=	47.34
0.12	*	200	=	24
0.12	*	100	=	12
Total sum = 16472				

Power factor = 0.8
Regulation constant of the conductor used for the line = 1350

(16472 * 0.8)/1350 = 9.76

Conclusion

In this paper, The Estimate was prepared for erection of 11 KV R. V. Palem feeder emanating from 33/11 KV SS Kothagunta in operation section, chittamuru of operation division, Gudur in operation circle, Nellore under T & D improvement works. The estimate proposal covered the extending of 9 hours supply during day time to agriculture feeders.

Acknowledgments

Copyright @ 2020 Authors

The authors wish to thank staff members of APSPDCL Nelatur for their helpful comments in developing and simulating the proposed model.

References

[1]Kirschen, D.S.: ‘Demand-side view of electricity markets’, IEEE Trans. Power Syst., 2003, 18, (2), pp. 520–527
[2]Siano, P.: ‘Demand response and smart grids – a survey’, Renew. Sustain. Energy Rev., 2014, 30, pp. 461–478
[3]Abessi, A., Zakariazadeh, A., Vahidinasab, V., et al.: ‘End-user participation in a collaborative distributed voltage control and demand response programme’, IET Gener. Transm. Distrib., 2018, 12, pp. 3079–3085
[4]Aalami, H.A., Moghaddam, M.P., Yousefi, G.R.: ‘Modeling and prioritizing demand response programs in power markets’, Electr. Power Syst. Res., 2010, 80, (4), pp. 426–435
[5]Nojavan, S., Zare, K., Mohammadi-Ivatloo, B.: ‘Optimal stochastic energy management of retailer based on selling price determination under smart grid environment in the presence of demand response program’, Appl. Energy, 2017, 187, pp. 449–464
[6]Qiu, J.: ‘How to build an electric power transmission network considering demand side management and a risk constraint?’, Int. J. Electr. Power Energy Syst., 2018, 94, pp. 311–320
[7]Feng, C., Liu, W., Wen, F., et al.: ‘Expansion planning for active distribution networks considering deployment of smart management technologies’, IET Gener. Transm. Distrib., 2018, 12, pp. 4605–4614
[8]Georgilakis, P.S., Hatziargyriou, N.D.: ‘A review of power distribution planning in the modern power systems era: models, methods and future research’, Electr. Power Syst. Res., 2015, 121, pp. 89–100
[9]Gitizadeh, M., Vahed, A.A., Aghaei, J.: ‘Multistage distribution system expansion planning considering distributed generation using hybrid evolutionary algorithms’, Appl. Energy, 2013, 101, pp. 655–666
[10]Ravadanegh, S.N., Roshanagh, R.G.: ‘On optimal multistage electric power distribution networks expansion planning’, Int. J. Electr. Power Energy Syst., 2014, 54, pp. 487–497
[11]Hemmati, R., Hooshmand, R.A., Taheri, N.: ‘Distribution network expansion planning and DG placement in the presence of uncertainties’, Int. J. Electr. Power Energy Syst., 2015, 73, pp. 665–673
[12]Haffner, S., Pereira, L.F.A., Pereira, L.A., et al.: ‘Multistage model for distribution expansion planning with distributed generation – part I: problem formulation’, IEEE Trans. Power Deliv., 2008, 23, (2), pp. 915–923
[13]Franco, J.F., Rider, M.J., Romero, R.: ‘A mixed-integer quadratically- constrained programming model for the distribution system expansion planning’, Int. J. Electr. Power Energy Syst., 2014, 62, pp. 265–272
[14]Haghighat, H., Zeng, B.: ‘Stochastic and chance-constrained conic distribution system expansion planning using bilinear benders decomposition’, IEEE Trans. Power Syst., 2018, 33, (3), pp. 2696–2705
[15]Haffner, S., Pereira, L.F.A., Pereira, L.A., et al.: ‘Multistage model for distribution expansion planning with distributed generation – part II: numerical results’, IEEE Trans. Power Deliv., 2008, 23, (2), pp. 924–929

Copyright @ 2020 Authors