ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

Contrive Of Using High Voltage Distribution Technique in Tumbling Power Losses and Global Warming

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ABSTRACT: In this research paper, high voltage distribution system technique is proposed to reduce the losses and the focus is also laid on reducing the global warming. In India most of the electrical energy is generated by the thermal power plant which lead to the increase in emission of green house gases in the environment and thus contribute in increasing level of global warming. Thus by reducing the losses, need for the generation of electrical energy is reduced which ultimately reduces the emission of green house gases and hence global warming.

KEYWORDS: Carbon emission, Global warming, High-voltage techniques, Power distribution lines, Power demand

I.INTRODUCTION

Economic development of a country depends on the energy availability and its consumption. In nature energy exists in different form but the most important form is the electrical energy. If the supply of electrical energy halts even for few minutes, many necessary functions of present-day life stop. Electrical energy has played a great role in building up of present day civilization. Electrical energy has made our life easier, comfortable and saves our time. Now there is shorter working day and technology based on electricity resulted in a higher agricultural and industrial production, and better transportation facilities. Even the standard of living of a person is decided by its energy consumption. In fact, the greater the per capita consumption of energy in a country, the higher is the standard of living of its people. Today modern society is so much dependent upon the use of electrical energy that it has become an important part of our life. Earlier it was not so, electricity was used for the basic purpose of light and heat and thus there was little demand for electrical energy and it was easy for the power companies to meet their demand. But in today's modern world, energy demand is increasing day by day and to meet this ever increasing demand, power companies are making every effort to increase the energy availability. But in the developing country like India the efforts made by the power companies to bridge the gap between energy demand and energy availability are all in vain. Some says the reason behind the lack of availability of energy is fast depleting energy resources, but this is not true for the developing nation like India where there is treasure of nature. Many states in India still have large amount of unexplored and underutilized resources and this hidden potential is enough to meet the growing energy demand [24]. The root cause of the underutilized resources in India is the lack of commercial viability in power sector and thus less interest of the utilities to invest in the power sector as there is almost no or very low profits. Power companies are in loss because of losses in transmission and distribution system, illegal connection, theft and unwillingness to pay bills as some customers have attitude that our government is doing nothing for us, at least they can provide us free electricity and some customers are tired of poor quality of supply and thus don't pay their electricity bill. In fact, India's power sector today is characterized by financial insolvency and an inadequate power supply. Plant availability and efficiency are generally low and the system losses are untenably high specifically at the last mille secondary low tension network. In fact present power sector is like a leaking bucket and the efforts made by the government and power companies to generate more electrical power in this leaked sector are nothing but ways of pouring more water into the leaked bucket so that the consistency and quantity of leaks are assured. The logical thing to do would be to fix the bucket i.e. make the system leak proof rather than to persistently emphasize shortages of power and forever make exaggerated estimates of future demands for power and only then investing in generating more power will be of worth. Since once the utilities will get back more than what they are investing in the power project, then the problem of underutilized resources will be no more and then there will be light for every house. But efforts should be made on both sides i.e. at utility end as well as at the consumer end.

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Vol. 4, Issue 2, February 2015

Hence both commercial viability of power sector and consumer satisfaction will make a healthy system and then only the gap between energy demand and energy availability will be bridged.

II. LITERATURE SURVEY

Merlin et al. [1] proposed loss minimization by considering feeder reconfiguration. In this method all the network switches are closed to form a meshed system, and then the switches are opened successively to restore to the radial configuration by using a discrete branch and bound technique. However, this method involves approximations. In order to increase the efficiency of the distribution electrical networks, a reconfiguration process was applied to improve the reliability indices. Shirmohammadi et al. [2] proposed an algorithm to overcome these approximations. In this method, the switches are opened one by one, based on an optimal flow pattern. Peponis et al. [3] have developed a methodology for the optimal operation of distribution network. In this method loss minimization is obtained by installation of shunt capacitors and reconfiguration of the network. Schmidt et al. [4] have formulated the problem as a mixed integer nonlinear optimization problem. The integer variables represent the status of the switches, and continuous variables represent the current flowing through the branches. Broadwater et al. [5] have considered the time varying load demand, obtained through load estimation, to reduce the loss. Morton et al. [6] have proposed a method based on an exhaustive search algorithm for obtaining a minimum loss radial configuration of a distribution system. The algorithm uses the graph-theoretic techniques involving semi-sparse transformations of a current sensitivity matrix. M.W. Siti et al. [7] contribute such a technique at the low-voltage and medium-voltage levels of a distribution network simultaneously with reconfiguration at both levels. While the neural network is adopted for the network reconfiguration problem, this paper introduces a heuristic method for the phase balancing/loss minimization problem. A comparison of the heuristic algorithm with that of the neural network shows the former to be more robust. K. Viswanadha Raju et al. [8] describes a new, two stages, and heuristic method, for determining a minimum loss configuration of a distribution network, based on real power loss sensitivities with respect to the impedances of the candidate branches. S.K.Salam et al. discussed [9], the effects of distributed generation on voltage regulation and power losses in distribution systems. C.L.T. Borges et al. [10] have presented a technique to evaluate the impact of DG size and placement on losses, reliability and voltage profile of distribution networks. Davidson et al. [11] have presented an optimization model for loss minimization in a distribution network with DG. An algorithm has been proposed by T.Griffin et al. [12] to determine the near optimal placement of distributed generation with respect to system losses. Mutale et al. [13] have presented a methodology to evaluate the impact of DG on power loss minimization by examining loss allocation coefficients. M.A. Kashem et al. [14] represent techniques to minimize power losses in a distribution feeder by optimizing DG model in terms of size, location and operating point of DG. Sensitivity analysis for power losses in terms of DG size and DG operating point has been performed. X. P. Zhang et al. [15] paper discusses the issue of energy loss minimization of electricity networks with large renewable wind generation. The impact of the special operating arrangements of large wind generation on energy loss of electricity networks is investigated. An optimal power flow (OPF) approach is proposed to minimize the energy loss of electricity network with reactive power and FACTS control, while satisfying the network operating voltage and thermal limits. W.M. Lin et al. [16] propose to reduce power loss by means of load reconnection of the prime phase sequence of the open wye open delta transformers. The Genetic Algorithms (GAs) has been implemented for solving the optimal problem. Practical examples of Taiwan Power Company demonstrate that the proposed method is effective and available. M.S.Tsai et al. [17] compares several Genetic Algorithm reproduction methods for distribution system loss reduction and load balancing problems. Asexual reproduction method is proposed in this paper, which requires less generation to reach the optimal solution than gamogenesis. A.Augugliaro et al. [18] discussed the problem of voltage regulation and power losses minimization for automated distribution systems. The classical formulation of the problem of optimal control of shunt capacitor banks and Under Load Tap Changers located at HV/MV substations has been coupled with the optimal control of tie-switches and capacitor banks on the feeders of a large radially operated meshed distribution system with the aim of attaining minimum power losses and the flattening of the voltage profile. The considered formulation requires the optimization of two different objectives; therefore the use of adequate multi objective heuristic optimization methods is needed. The heuristic strategy used for the optimization is based on fuzzy sets theory. K.Amaresh et al. [19] introduced HVDS with small capacity distribution transformers. A simple load flow technique has been used for solving radial distribution networks before and after implementation of HVDS. An advantage of implementing HVDS over LVDS system for loss minimization is discussed. .M.Khalil et al. [20] presented a solution by using series capacitors connected to the nodes of distribution feeders. A proposed technique is introduced to calculate the desired size of series capacitors keeping the voltage at proper nominal operating limits and reducing the power losses. This technique is the Particle Swarm Optimization (PSO). A real case study is presented as an illustrative example showing the advantages of the proposed technique over other methods. L. Ramesh et al [21] proposes loss minimization in power distribution power flow by using various various methods. Arefi et al [22] had estimated the load growth thus an increase in losses until 2025 was made. He described the loss reduction planning in the distribution system based on the successful experiences in distribution utilities of IRAN and some developed countries. He suggested seven techniques for reducing the losses in the distribution system and the benefit per cost, payback period and the saving was also determined in both optimistic conditions and pessimistic conditions. A. Gupta et al. [23] presented the implementation of high voltage distribution system technique for agricultural load in Punjab and its advantages over conventional system. A. Gupta et al. [24] presented the comparison of existing low voltage distribution system with proposed high voltage distribution system. The study was based on a real low voltage feeder in J&K state. And to check the feasibility of the proposed work, the annual saving and payback period of the proposed method was also determined in this paper.

In their previous paper [23] [24], the authors addressed on loss minimization for power distribution system by using high voltage distribution system in agricultural sector as well as in commercial sector. In this paper apart from loss minimization, focus is also laid on the environmental aspects like global warming. The superiority of proposed system is validated by comparing the tested result with existing system and its feasibility is checked by the calculation of payback period.

III. ENVIRONMENTAL ASPECTS

This research work also takes environmental aspects into consideration as the global warming is one of the serious problems faced by the modern civilization. Table 2.1 shows the fossil fuels share in carbon emission and energy generation and it is seen that most of the electrical energy generated in India is by using coal and contribute 69.78% of carbon emission [26]. The proposed project in no way lead to any harm to the environment rather this shall lead to better environment due to reduction of green house gases emission and help in providing quality power supply [25]. Moreover due to the increasing energy prices, it is an alarming need to develop a way to save energy. It is also said that energy saved is energy produced. This statement can be justify by the fact that reduction in losses by the implementation of the proposed HVDS technique will save energy and this saved energy can supply for some of the energy demand. Thus there is decrease in need of energy generation which ultimately reduces the emission of carbon dioxide and hence global warming.

Table 2.1: Carbon emission and energy generation of fuel

Fuel	Share of energy generation in India (%)	Share of carbon emission in India (%)
Coal	55	69.78
Oil	30.5	26.31
Natural gas	7.0	3.9

IV. CALCULATION OF POWER LOSSES

There are two types of losses prevailing in the existing power distribution network: technical losses and non-technical losses. Technical losses are primarily due to heat dissipation resulting from current passing through conductors and magnetic losses in transformers. These include resistive losses of the primary feeders, the distribution transformer losses (resistive loses in windings and the core losses), resistive losses in secondary network, resistive losses in service drops and losses in KWh meter. These losses cannot be eliminated as they are inherent to the distribution of electricity but can be reduced. Non-Technical losses (NTL) include electricity theft and non-payment where customers refuse or are unable to pay for their electricity consumption. It is estimated that electricity theft costs in our country is in crores in a year. Both the technical and non-technical losses are together termed as T&D (transmission and distribution) losses. In addition to above two types of losses, there is also a loss in revenue due to non realization of revenue billed and the aggregate of all these losses is termed as aggregate technical and commercial (AT&C) losses. For this issue, Electricity Board is trying to draw attention to the need for reforms in electricity transmission and distribution sector, create mass awareness about transmission losses due to theft and misuse of electric energy. Also effective checks and balances in power distribution at various levels are imperative and to strictly implement timely revenue collection. As to reduce the losses, one should know the amount of power lost in the system. Formula to be used for the calculation of losses in terms of KW and units both for existing LT line and proposed HT line is given in (1), (2), (3) and (4) respectively.

FORMULAE FOR LT LINE LOSS

Line loss in KW= [{(cum load in KW/ (1.732 × voltage in kV × DF × Power factor)} ^2 × Length in Km × Resistance constant] /1000 (1)

Line loss in Units = [{(cum load in KW/ (1.732 × voltage in KV × DF × Power factor)} ^2 × Length in Km × Resistance constant × LLF × 8760]/1000 (2)

FORMULAE FOR HT LINE LOSS

Line loss in KW = [{(Cum load in KVA/ (1.732 × voltage in KV × DF)} ^2 × Length in Km × Resistance constant] /1000 (3)

Line loss in Units = [{(cum load in KVA/ (1.732 × voltage in KV × DF)} ^2 × Length in Km × Resistance constant × LLF × 8760] /1000 (4)

Where
Voltage = 11 KV for HT
= 0.4 kV for LT
Diversity factor (DF) = 1.5 for HT
= 1.1 for LT
Load Factor (LF) = Annual Energy consumption / (peak× 24 × 0.9 × 365 ×1000)
= 0.18 for HT
= 0.36 for LT
Line Loss Factor (LLF) = (0.2 × LF) + [0.8 × (LF^2)]
= 0.36 for HT
= 0.18 for LT

To determine the losses in the existing system (1) and (2) are used. In the proposed HVDS technique load is bifurcated i.e. large number of small size transformers are installed by replacing the one large size transformer and the losses in the proposed system is determined by (3) and (4). The bifurcation of load is proposed in the table 3.1:

Table: 3.1: Bifurcation of load

S.No	Transformer	Load in KVA	Sanction load in Kw	Length of LT line in km	No. Of Consumer	No. Of DT required for HVDS				Total
						63 KVA	10 KVA	15 KVA	23 KVA	
1	T1	400	148	0.05	136	8	8	10	5	21
2	T2	250	116.5	0.036	147	15	10	5		30
3	T3	630	319.15	0.027	233		5	15	15	35
4	T4	100	67.06	0.056	70	10	4			14
5	T5	400	180	0.2	231		15	10	5	30
6	T6	400	105	0.025	125		15		10	25
7	T7	500	242.8	0.177	307	20	15	10	5	50
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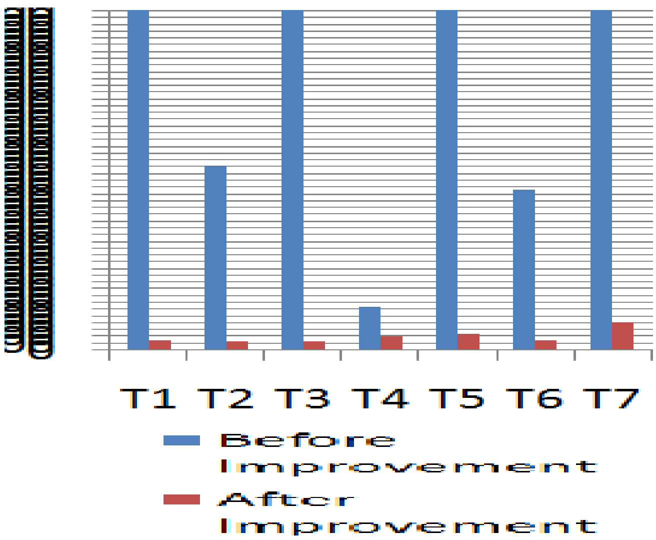
V. RESULTS

The losses so calculated using (1), (2) and (3), (4) in the existing system and the proposed system respectively is shown in table 4.1. and also depicted in graph 4.1.

Table: 4.1: Comparision of losses in existing system and the proposed system

S.No.	Transformer	Before improvement	After improvement	Reduction in losses in units
		Line losses in units	Line losses in units	
1	T1	59686.72	478.722	59207.998
2	T2	27214.77	209.379	27005.391
3	T3	291811.908	1227.089	290584.82
4	T4	6384.859	98.0578	6286.8012
5	T5	68104.488	2503.192	65601.296
6	T6	23602.933	156.766	23446.167
7	T7	298353.886	4056.499	294297.39
Total		775159.564	8729.7048	766429.86



Graph. 4.1: Comparison of the losses in existing system and the proposed system

In this graph 4.1, horizontal axis represents the number of transformer and vertical l axis represents the distribution losses in terms of units. Blue line represents the losses in the existing system i.e. before improvement and the red line represents the losses in the proposed system i.e. after improvement.

4.1 Calculation of payback period

In this scheme, total capital outlay includes the cost of thickening the conductor, cost of dismantling the large transformer and erection of small size transformers along with cost of labour charges, cost of transportation charges and cost of storage and handling.

Total capital outlay of the proposed project = 67 lakhs

Annual savings = Annual loss reduction in units × Unit price

= 7.66 × 2.50 = 19.15 lakhs

Payback period = Total capital outlay / Annual savings

= 67 lakhs / 19.15 lakhs

= 3.5 years

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From the above results, it is seen that the payback period of the scheme i.e. the rate of return is three years and five months which makes the scheme financially feasible.

VI. CONCLUSION

In this paper various aspects of loss minimization were discussed and from the experimental results it is concluded that the proposed scheme is financially viable and by adopting the HVDS technique for distribution system, technical losses as well non-technical losses are reduced to a great extent. Moreover, it is termed as eco-friendly scheme, as it saves energy and leads to reduction of CO_2 emission and hence global warming effect.

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