IMPLEMENTATION OF DISTRIBUTION SYSTEM DESIGN

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ABSTRACT

In these days load on the feeders is varying continuously and some electrical equipments like transformer motors and home equipment are working at low power factors. Power supply authorities have to generate much more current to face the problem. In this system the high current level requires to be reduced and efforts should be made to make the system more energy handling with minimum cost involved. The technique such as improving power factor, voltage level, conductor size and substituting covered cables with bare conductor should be included.

The main objective of this research is to provide guidelines for distribution authorities to show that by reducing the energy losses of distribution system, shifting of the load from overloaded feeder to lightly loaded feeder and decreasing the length of feeder. It helps in creating a new methodology. In the system, capacitor bank is proposing for improving the power factor. This helps in energy loss reduction by improving the voltage stability as well as reforming the energy handling capacity of the system at minimum cost.

Keywords— Design planning of distribution system, Reformation, Energy loss reduction.

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I. INTRODUCTION

Ganaur 132kv substation is heavily overloaded because the system has been expanded without proper planning and maintenance. This substation is 25.20 km from Fajilpur substation. Technical losses in this substation are about 9%. Due to the unplanned expansion in the system, feeders are overloaded which also affects the conductor and electrical equipments.

Electricity **losses** in India during transmission and distribution are extremely high and nearly 28.44 %(2008-09)**.** India needs to tide over a peak power shortfall of 13% between 5pm and 11pm by reducing losses due to theft and pilferage of energy. Due to shortage of electricity, power cuts are common throughout India and this has adversely effected the country's economic growth. Theft of electricity, common in most parts of urban India, amounts to 1.5% of India's GDP. [4]

Due to increasing demand of power all around, the distribution system of Ganaur substation are under pressure. They are affecting adversely the reliability of power supply and quality of service to the consumers. These conditions indicate timely planning of the strategy for reform of the overloaded feeder. Energy losses occur in the process of supplying electricity to consumers due to technical and commercial losses. The technical losses are due to energy dissipated in the conductors and equipment used for transmission transformation, sub-transmission and distribution of power. These technical losses are inherent in a system and can be reduced to an optimum level. The losses can be further sub grouped depending upon the stage of power transformation & transmission system as transmission losses (400kV/220kV/132kV/66kV), as Sub transmission losses (33kV /l l kV) and Distribution losses (l l KV/0.4kV). The commercial losses are caused by pilferage, defective meters, and errors in meter reading and in estimating unmetered supply of energy [4].

In this paper, distribution system has been proposed by taking consideration of the major issues faced by present distribution authorities in Indian electricity market. Some pieces of work have suggested some models to introduce the distribution system, but this paper focuses on design planning of distribution system arrangements, losses and present feeder structure of Ganaur substation and proposed structure. In section III, proposed feeder model is described and summary is presented in section IV.

II. CASE STUDY OF HARYANA DISTRIBUTION SYSTEM

Haryana is generating power approximate 8000mw. Haryana has been achieving the 100% electrification since 2010. Last 10 year load growth of Haryana is high due to industrial load. Faridabad, Gurgao, Panipat and Kundli, Rai and HSIDC are large industrial area of Haryana. Due to expansion of the industrial area loads are increasing in distribution lines. Haryana is generating the power through thermal power plant and non conventional resources.

The load demand has made the feeders overloaded. To decrease the load on feeder's bifurcation, trifurcation and augmentation are required.Earlier power sector structure and regulations have become time consuming, irrelevant and insufficient to meet the technical, commercial and legal requirements in the present scenario of rapid load growth, menace of power theft and obligation of providing reliable and quality power at competitive price to consumers.

The Haryana government owned Haryana Vidyut Prasaran Nigam (HVPN) is all set to increase the capacity of the transmission system up to 8,500 megawatt. The increase of transmission capacity is being aimed to meet the increased electricity demand in the state in summers. The authorities at HPVN are expecting a load growth of 500 mw this year. To meet the increased demand the generation capacity has already been enhanced to transmit additional 600 to 700 mw power. Till now the maximum power demand met by the state was of 5,678 megawatt during July 2009. Since then the Nigam has been working hard to meet the rising energy demand in the state. To meet the demands, the Haryana Power Utilities had commissioned 62 new sub-stations, augmented 82 existing substations and constructed 977 km of transmission lines with an investment of Rs 784 crore during 2010-11. From March 2005 to May 2011, total 260 new substations were commissioned, 468 existing substations augmented and 3584.151 Km transmission lines constructed by adding 13491.2 MVA transmission capacity with an investment of Rs. 2729.45 crore.

A. Study of LT Distribution Current structure

The objective of this research is to design an efficient and low cost power distribution system. 11 KV HSIDC, G.T.Road and Garhi kalan feeder of Ganaur substation are hereby proposed for the aforesaid purpose. Electrical energy is conveyed from generating stations or major substations over transmission line to the consumer end. Distribution system are high voltage and low voltage type. In the HV type system voltage is step down to 11 or 6.6 or 3.3 KV and power at this voltage is conveyed to different bulk supply consumer. In LV type system the voltage is step down to 400 volts. In distribution 16, 25, 63, 100, 200, 500 KVA transformers are installed. In Haryana 400KV, 200 KV, 132 KV substations are transmission substation and at Ganaur substation 132kv is stepped down to 11 KV and 33KV. At this substation 10/16 MVA and 16/20 MVA transformer are installed. 10/16 MVA transformer distributes the power to 10 feeders. And other 10/16 MVA distributes to 7 feeders. Some feeders of the distribution system are overloaded.

The length of HSIDC feeder is 21.55km with annual energy loss 3374532kWH and maximum percentage of energy loss is about 16%, which is beyond the specified limit of feeder and is not acceptable. The above mentioned energy losses and load flow in the feeders presses hard the feeder flow at 300 A. Single line diagram of the feeder is shown in fig (1).

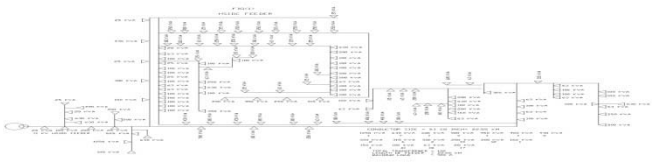

Fig (1) HSIDC FEEDER

The length of G.T. Road feeder is 25.02km with annual energy loss 3232416kWH and maximum percentage energy loss is about 21% which is beyond the specified limit of feeder i.e. 7.0% and it is not acceptable. The above written energy loss and load flow in the feeder presses hard the feeder flow at 270 A. Single line diagram of the feeder is shown in fig (2).

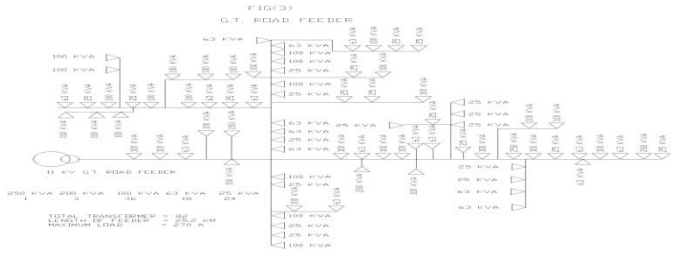

FIG (2) G.T. ROAD FEEDER

The length of feeder is 6.22km with annual energy loss 60492kWH and maximum percentage energy loss is about 24% which is beyond the specified limit of feeder i.e. 7.0% and such a position is not acceptable. The aforesaid energy loss and load flow in the feeder easily allows it for bifurcation or shifting of load as the load flow in the feeder is 40 A. Single line diagram of the feeder is shown in fig (3).

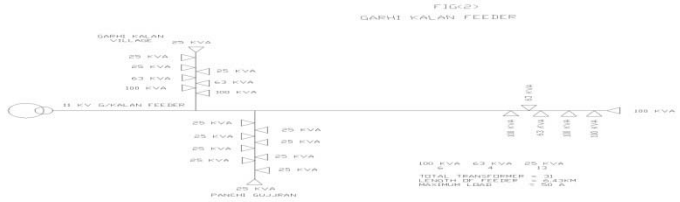

FIG (3) GARHI KALAN FEEDER

B. **Losses in distribution system**

Losses in the distribution system are approximate 38%. In Ganaur substation technical losses are nearly 9%. In the HSIDC feeder losses are about 25% while that feeder is overloaded with the consumption of 15 MW power. Due to overloading effect on the conductor AT&C losses are increasing. The length of feeder is 21.55 KM. Garhi kalan feeder is less overloaded as compared to the HSIDC feeder. The losses on the feeder are near about 34%. Overall losses on the distribution system are also 34%. To decrease the losses some reformation in distribution system is required.

III. PROPOSE STRUCTURE OF FEEDER

Reformation has been started all around in Haryana. Load on the feeder are increasing day by day so reformation is required to decrease the load level.

To design an efficient low cost power distribution system the 11 kV HSIDC, G.T. Road and Garhi Kalan feeders are selected for comprehensive study and research work. The results of existing 11kV HSIDC, G.T. Road and Garhi Kalan Feeders compared with modified 11kV HSIDC, G.T. Road and Garhi Kalan Feeders show that negligible investment is required

instead of installation of another new feeder. Hence HT reformation proposal is the most beneficial situation in the present position.

11kV, 3-Wire HSIDC feeder emanates from 132kV Ganaur Sub-Station which has four power transformers connected in parallel having a capacity of 10/16MVA, 132/11 KV and 16/20 MVA, 132/33KV. This feeder supplies power to industrial loads.

Physical Survey of proposed 11kV HSIDC is carried out. Single line diagram of proposed HSIDC is prepared and plotted and is shown in Fig.(4).

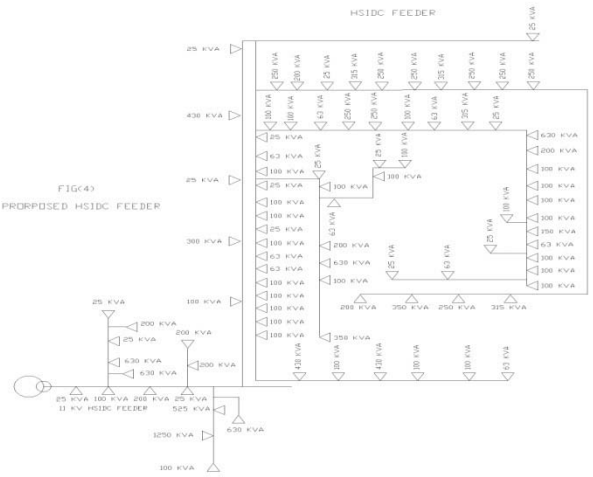

FIG (4) PROPOSED HSIDC FEEDER

Energy losses and voltage drop of proposed distribution system is calculated keeping in view the Ganaur substation. The length of proposed feeder is 15.62 km with annual energy loss 3374532kWH and maximum percentage voltage drop is 1.36%, which is as per specified limit of Ganaur and is acceptable.

11kV, 3-Wire G.T. Road Feeder emanates from 132kV ganaur sub Station. This feeder supplies power to mixed loads mostly residential and commercial with some industrial load. Some load of existing 11kV G.T. Road feeder can be shifted to Garhi Kalan feeder whih is lightly loaded feeder i.e. 40A .

Physical Survey of proposed 11kV G.T. Road Feeder is carried out. Single line diagram of proposed 11kV G.T. Road

is prepared and plotted and is shown in Fig.(5).

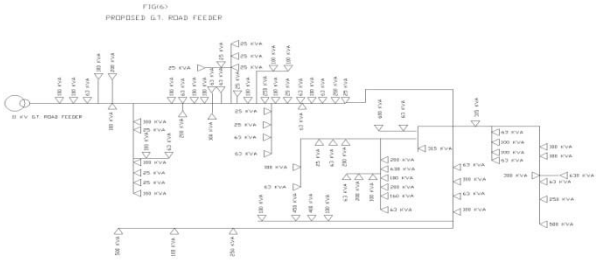

FIG (5) PROPOSED G.T. ROAD FEEDER

Energy losses and voltage drop of proposed distribution system is calculated keeping in view the Ganaur Substation. The length of proposed feeder is 14.963km with annual energy loss is 3232416 kWH and maximum percentage voltage drop is 1.4%, which is acceptable as per specified limit of Ganaur substation. Single line diagram of proposed GARHI KALAN FEEDER is prepared which is shown below in Fig (6).

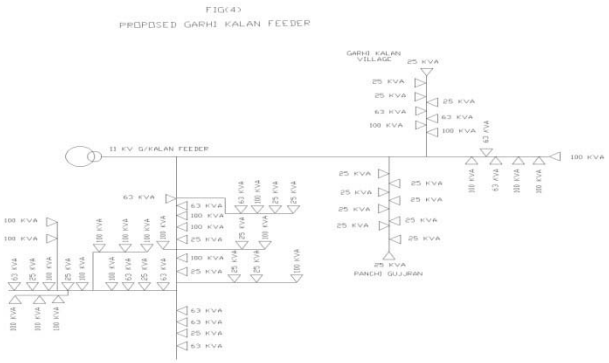

FIG (6) PROPOSED GARHI KALAN FEEDER

The detail of voltage drop, current flow, annual energy loss and power factor on substation is given below in table (1).

TABLE (1)

ENERGY LOSS AND VOLTAGE DROP

S.N.	Energy loss and voltage losses		
	HSIDC	Garhi Kalan	G.T. Road
Voltage drop	1.36%	.9%	1.4%
Current flowing	300 A	50A	270A
Annual Energy Loss	3374532KWH	60492kWH	3232416 kWH
Power Factor (Substation)	.89	.91	.90
Load Flowing	15 MW	1MW	6MW

C. Main Problem faced by distribution system

In these days the distribution system has to face the following main problems:

1. Old wires and heavily overloaded equipment.
2. Deputation of insufficient and less trained staff to large geographical area which includes rural area.
3. Long length of feeder.
4. Poor power factor.
5. Theft of Energy.
6. Improper metering and a non metering connection.
7. Poor Power Quality.
8. High T&D and AT&C Losses.
9. Low will power to work.
10. No installation of D.T. meter.
11. Misconception of privatization and deregulation.

D. Reformation of HT Distribution System

To minimize the aggregate losses the following steps or techniques must be taken by the distribution system authorities.

1. The distribution system authorities must minimize the length of the feeders through shifting of loads from heavy loaded to nearly light loaded feeders i.e. bifurcation and trifurcation of feeder.
2. The bare conductors must be replaced with the covered ones. Reconductoring of heavily loaded feeder i.e. replacement of existing conductor with higher capacity covered conductor.
3. Upgraded capacitor bank must be installed at the substation and different position on the feeders for improving the low power factor. Fixed and switch HT shunt capacitors can be installed at the substation.

4. D.T. meters must be installed on the distribution transformer for detection of accurate load and losses.
5. Time to time auditing of consumer loads must be made for healthy planning of the system.
6. The employees of the distribution system must have a strict eye view on the unbalancing phases of the distribution transformers.
7. Sometimes, area planning at grid station level is also required to provide relief to the over loaded grid stations. This is done by shifting the load of overloaded grid stations to nearby under-loaded or newly constructed grid stations. Area Planning may or may not involve new feeders.
8. The good moral character of the employees can minimize the effects of social and political turbulence.

E. Reformation of LT distribution system

Reformation of LT distribution system involves following techniques

1. Area planning without adding of new feeder.
2. Installation of LT shunts capacitors.
3. Replacement of conductor of LT line
4. Bifurcation or trifurcation of LT long line.
5. Replacing of LT cable

F. METHODOLOGY TO INCREASE THE CAPACITY

The methodology to increase the capacity of distribution system is given below:

1. Time to time auditing of given power distribution system.
2. Analysis of the power distribution system at different loads, power factor, current levels, conductor sizes, voltage levels.
3. Design Planning of power distribution network by auto-cad or simulation on computer and taking of different parameters of system such as power factor, voltage drops and power losses.
4. Proposing capacitor bank on substation to increase the power factor, decreasing the length of feeder, length of conductor to be replaced with covered conductor of required size.
5. Energy and cost saving through system improvement.
6. Time to time seminar or refresher course must be organised for the employees by the distribution system authority.

G. Objective

The main objective of this research is to develop methodology and guide lines for distribution engineers to show that by reducing the energy losses of distribution system, available capacity of the system may be conserved without putting up additional capacity. Load is shift from heavy loaded feeder to lightly loaded feeder without adding of new feeder. Capacitor bank is proposing on the substation for increasing the power factor and decreasing the feeder length for improving the voltage level. The main object of research work is:

1. Shifting of load is overloaded feeder to lightly loaded feeder

2. Improving the power factor
3. Reduction of losses
4. Decreasing the feeder length for improving the voltage level
5. Improvement of consumer service
6. Improving the power quality

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H. Recommendation

132 KV ganaur substation are low power factor. For improving the power factor proposing the capacitor bank on substation. 6Mvar capacitor is installed on substation. 9Mvar capactor bank is required on the substation. 11 KV HSIDC and G.T. Road feeder are heavy overloaded Garhi kalan feeder are lightly loaded feeder. The prime objective of this analysis is to shift some load of HSIDC feeder to G.T. Road feeder and G.T. Road to Garhi Kalan Feeder. Area planning of these feeders namely Hsidc, G.T. Road, and Garhi kalan has been considered.

IV. CONCLUSIONS

This analysis will provide detail and comprehensive information on the power factor improvement and power quality thereby saving energy and improving efficiency of electrical distribution system.. It will also indicate the benefits in terms of reduced current, energy losses and feeder length, which can be achieved by using the computer software. This study will be helpful in calculating the investment involved in distribution system. It is also concluded from the above results that after execution of HT proposals any existing power distribution system can be designed as an efficient low cost power distribution system by applying reformation techniques on it. It is therefore, recommended that Ganaur substation may reform its existing system to achieve fruitful results.

The main scope of the future work will be helpful in developing the software for design planning of distribution system. In this thesis, the design concept of distribution system will prove fruitful after taking consideration of major issues faced by present power distribution authorities in Haryana. This thesis focuses on design planning, high non technical losses in distribution system and effectiveness of proposed low cost feeder without adding of new feeder. Suitable program is developed for calculations of aggregate losses of a power distribution system. This thesis can be a guide line for the distribution policy makers and power systems designers.

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