# IMPROVING INDIGENOUS DISTRIBUTION POWER SYSTEM EFFICIENCY USING POWER LOSS REDUCTION


**BY**

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9) **DISSERTATION ENROLMENT SEMESTER: FALL-2017**
10) **SEMESTER IN WHICH SUPERVISOR ALLOTTED: FALL-2017**
11) **EXPECTED THESIS COMPLETE: FALL-2018**
12) **DATE OF SYNOPSIS SUBMISSION TO THE DEPARTMENT:**
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## 1. Description of the Research Work

Power losses in the distribution system of industrialized countries are mostly in the acceptable range (Agüero & Member, 2012) but even then there are some countries which are still unable the control the power losses in spite of having latest technologies in hand (Anumaka, 2012). Electric energy is the key element of every country and it directly effects the economical strength of the nation and lack of energy means the lack of economical strength (Jamil, 2013). The country like Pakistan is also facing shortage of electric energy by handsome amount and this shortfall of energy was almost 5000 MW as stated by PEPCO (Pakistan Electric Power Supply Company) in April 2011 and this amount was increased more in 2012 up to 6000 MW in 2012. (Kessides, 2013)

On the other hand losses in power distribution system of Pakistan is also effecting negatively to the overall power sector (Jamil, 2013). Therefore it is the best choice to improve the efficiency of power system by power loss reduction and to generate more power through renewable energy resources (Atwa, Member, Member, Salama, & Seethapathy, 2010). Technical and non technical losses are the major categories of losses in power distribution system (Nagi, Mohammad, Yap, Tiong, & Ahmed, 2008). Technical losses are normally in fixed range but the non technical losses are variable in range and the major reason of non technical losses is the electricity theft (Ramos & Chiachia, 2011). Power losses in any distribution system can't be removed completely but these can be minimized by effective and useful techniques.(Rao, Ravindra, Satish, & Narasimham, 2013)

## 2. Need and Significance of the Research

Significance of the research work can be explained with the help of problem statement and objectives, which are given below

### 2.1: Problem Statement

Now a day's our country is suffering from lack of electricity due to which every field of life is being disturbed and this disturbance becomes more irritating when available electric power is reduced due to having power losses in the distribution system therefore it is required enhance the power system efficiency by power loss reduction. Several mitigation techniques were employed in past but the problem of power loss is still dominant therefore, an effective and latest model is proposed which will provide the comprehensive solution to this problem and will improve the power system efficiency by following the international standards.

### 2.2: Objectives

Objective of the research work are as follows

1. Analysis of local and international standards to mitigate power losses
2. To investigate the constraints of power loss reduction
3. To suggest new effective techniques to overcome power losses

## 3. Review of Literature

Today the major challenge for the power sector is to minimize the distribution power loss which is either technical or non technical (Imran & Kowsalya, 2014) therefore efforts are being employed to make the power system more efficient by power loss reduction through effective techniques but professionals are still facing problems to mitigate this problem (Kayal & Chanda, 2013). Normally, the estimation of power loss is done by subtracting the total consumed power by consumers from the total power supplied to distribution substations and feeders. (César, Ramos, Sousa, Papa, & Falcão, 2011)

An international survey on Transmission and distribution (T&D) losses, performed in 2000 by world bank for over 100 countries and showed that T&D losses percentage. And the minimization of these losses were analyzed for 20 years in dominating regions of the world but losses were continue to increase which can be shown below (Agüero & Member, 2012).

24 countries of Eastern Europe had T&D losses 9.68% in 1980 and 18.18% in 2000 with 8.50% change, 11 countries of Middle East; North Africa had T&D losses 11.18% in 1980 and 19.63% in 2000 with 8.45% change, 11 countries of Africa had T&D losses 14.60% in 1980 and 19.95% in 2000 with 5.35% change, 09 countries of South America had T&D losses 13% in 1980 and 17.23% in 2000 with 4.23% change, 09 countries of Central America had T&D losses 15.50% in 1980 and 21.68% in 2000 with 6.18% change, 05 countries of South Asia had T&D losses 25.20% in 1980 and 27.55% in 2000 with 2.35% change, 07 countries of Southeast Asia had T&D losses 12.14% in 1980 and 13.32% in 2000 with 1.18% change (Agüero & Member, 2012)

On the other hand there exist such countries which showed tremendous performance in controlling the power losses and improved the reduction in power losses in receding years. For example 17 countries of Western Europe had T&D losses 7.71% in 1980 and 7.56% in 2000 with -0.15% change, 03 countries of Eastern Europe had T&D losses 9.67% in 1980 and 9.38% in 2000 with -0.29% change, 06 countries of East Asia, Australia had T&D losses 8.67% in 1980 and 7.65% in 2000 with -1.02% change, and hence overall 102 countries were analyzed and total observed losses in year 1980 were 11.69% in year

1980 and 16.22% in year 2000 with 4.54% change. After utilizing these results different effective techniques were employed to improve the performance of power system.(Agüero & Member, 2012)

For the sake of power loss analysis in Pakistan, A set al time data is collected from one of the substation situated in Gujrat. Data is based on daily losses which show the losses of each transformer used at substation. The table given below indicates the loss of units which are sent by the transformer on daily basis.

**Table-1: Real Time Date of 20 MVA Transformer**

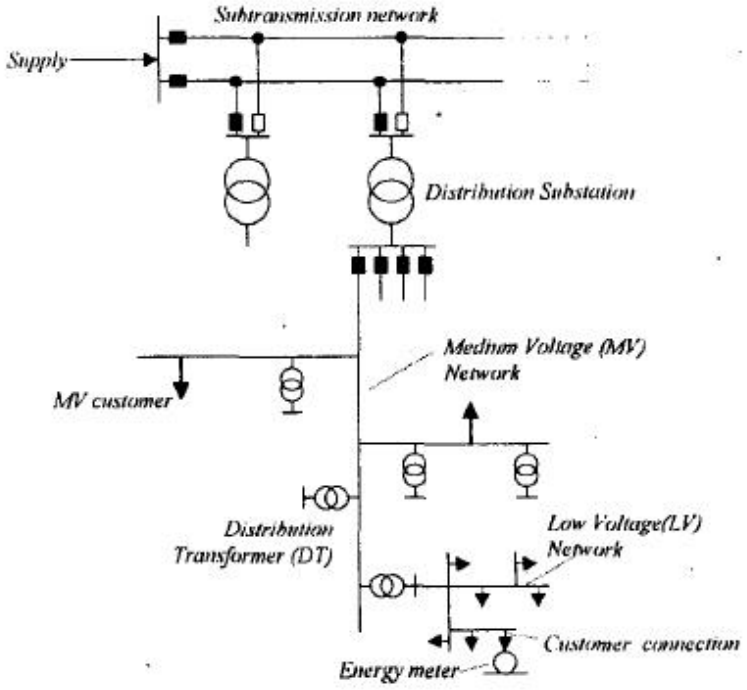
| Transformer (20MVA) | Units received | Units sent out | Difference | Losses |
|---|---|---|---|---|
| T1 | 86,541 | 86,290 | 251 | 0.29 % |
| T2 | 61103 | 60840 | 263 | 0.43 % |
| T3 | 81483 | 81130 | 353 | 0.44 % |

As the power losses cannot be removed completely therefore it is important to evaluate the technical losses in power distribution system (Rao et al., 2013). And for this purpose a computational tool was developed in Brazil and implemented at largest distribution company of Brazil named as "Eletropaulo". The main feature of methodology used for power loss computation was to divide the overall distribution network into eight different segments (Oliveira et al., 2001)

a) The sub transmission network
b) Distribution substations
c) Medium voltage networks
d) Distribution transformers
e) Low voltage networks
f) Customer connections
g) Energy meters
h) Other (Capacitors, voltage regulators, insulators etc)

The sub transmission system normally refers to the substation system that receives high voltage from HV transmission lines up to 132 KV then convert it to 11KV by using substation transformers and this 11KV voltage are referred to medium voltage which are then utilized by 11KV feeders (Bakana & Power, 2015). The distribution transformers are the ending transformer which covert the 11KV to 220 volts so that it can be used by the customers. (Oliveira et al., 2001)

**Figure-1: Segments of the Distribution System**




(Oliveira et al., 2001)

The estimated energy losses which were observed in Brazil were 2.0 – 3.0% in Sub transmission system, 0.5 – 2.0% in distribution substations, 0.5 – 2.5% in medium voltage networks, 1.0 – 2.0% in distribution transformers, 0.5 – 2.0% in low voltage networks, 0.05 – 0.15% in customers connections, 0.2 – 0.4% in Energy meters, Hence all these result were used to analyze the performance of the power system.(Oliveira et al., 2001)

A computational tool involves two steps for evaluation of losses, first step was to determine amount of losses in each segment based on daily load curves and second step was to ensure the global energy balance for the overall distribution system. While the global energy balance can be ensured by energy balance equation given below (Nagi et al., 2008)

$$E_{total} = E_{con} + E_{p.tec} + E_{p.com}$$

Where

$E_{total}$ = Total energy supplied to distribution company

$E_{con}$ = Total billed energy

$E_{p.tec}$ = Technical losses for the distribution system

$E_{p.com}$ = Commercial or non technical losses for distribution system

The name of the software that was used for evaluation of losses in overall distribution was PERTEC in which different models were presented for energy balance and losses in distribution transformer and feeders. (Oliveira et al., 2001)

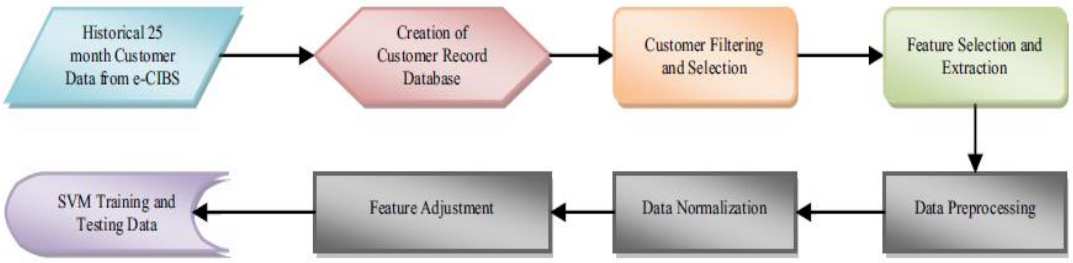
One of the best techniques for reduction of power losses was the placement of multiple distributed generator units at primary distributed networks which delivers both real and reactive power for minimizing losses (Hung, Member, Mithulananthan, & Member, 2013).

There are some major problems due to which non technical losses are difficult to control, for example the instruments used for measurements are not precise due to which incorrect results are produced, fraud of customers in case of electricity theft is also putting negative impact in data collection due which losses are difficult to analyzed, also poor data collection system can also created errors in results which should be taken into account to obtain correct results. (Alves, 2006)

For fraud customers and dishonestly use of electricity, an intelligence based technique was proposed in (Nagi et al., 2008), in which the main focus was to analyze non technical losses by support vector machine (SVM). The SVM filtered the suspected customers on the bases their load profiles and separates the entries by irregular and abnormal consumption of electricity (Nagi et al., 2008)

**Figure-2: Flowchart for reprocessing for raw e-CIBS data for SVM classification**

(Nagi et al., 2008)




Above figure shows the complete steps for SVM features in which electronic customer information billing system (CIBS) date was utilized for extracting the suspected customers.

There were a lot of other techniques for power loss mitigation were employed in past which would be useful for proposing the new approach for improving the distribution power system efficiency in Pakistan. For example one of the solutions to non-technical

losses (Alves, 2006; Chang, 2008; Deilami et al., 2011; Kumar & Jayabarathi, 2012; Nizar et al., 2008; Zhang, Member, Fu, & Zhang, 2008)

## 4. Methodology of Research

For successful completion of research work it is required to have scheduled visits to power grid stations and sub divisional offices of the distribution companies for collection of required data, Collaboration with staff of planning department of Distribution Company for software based evaluation, analyzing the performance of technical equipment with the standard figures to estimate the power loss factor and final comparison of outcome data with present data to check the expected results.

## 5. Implications of Research

After achievement of desired result the proposed model would be used by the Electrical distribution companies in the country to improve the efficiency of the power system by power loss reduction and to overcome the previous drawback due to which losses are being increased to maximum value.

## 6. Comprehensive Tentative Budget Required for Conducting Research

The financial aspects of the project include the site visits for date collection and the cost for purchasing registered software for feeder analysis, and the software for simulation of distribution systems.

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## APPENDIX-01

## *Turnitin* Originality Report

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