

**METHODOLOGY TO DETERMINE THE MAXIMUM
DEMAND OF MULTI CATEGORY BULK
ELECTRICAL INSTALLATIONS**

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University of Moratuwa, Sri Lanka.
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Degree of Master of Science

Department of Electrical Engineering

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DECLARATION

“I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters Dissertation under my supervision.

Signature of the supervisor:

Date:

(Dr. Asanka Rodrigo)

ABSTRACT

Conventional method of maximum demand determination of a multi category bulk electrical installation at planning stage is done by using several rules of thumb, in which maximum demand and time at which maximum demand occurs cannot be estimated accurately. This incorrect maximum demand estimation caused for wrong transformer and backup power capacity estimation, wrong cable and switchgear selection, inefficient performance of transformer, incorrect statistics, etc.

In this research, a methodology is proposed to determine the maximum demand of multi category bulk electrical installation using its entire kVA profile. This entire kVA profile of multi category bulk electrical installation is generated through a database of kVA profiles in which averaged normalized kVA profile for each installation categories have been defined along with their electrical power loading characteristics.

Multi category bulk electrical installation can be considered as a combination of several single category bulk electrical installations. Hence, to determine the entire kVA profile of a multi category bulk electrical installation, averaged normalized common kVA profiles which represent each category will be added together with multiplying them by their individual calculated maximum demand.

To compile the database of averaged normalized common kVA profiles, kVA profiles (each contains kVA values of one month logging period with 15 minute intervals) of 500 numbers of single category bulk electrical installations have been considered as the sample. The sample is preprocessed, normalized and then clustered using Hierarchical Clustering Algorithm. By using square sum of error of each clusters and Knee point criterion, seventeen numbers of unique kVA pattern classes were identified. Then averaged normalized kVA profiles were derived for each pattern class and map them up with example single category bulk electrical installations and their characteristics to compile above said averaged normalized kVA profile database. Visual basic programming and Matlab software is used to execute above said research work.

This proposed methodology has been verified considering a multi category electrical installation and proposed methodology can be considered as an acceptable one to determine the maximum demand of multi category bulk electrical installations. This methodology can be further improved by compiling averaged normalized kVA profile database for each installation categories separately. Additionally, this research can be further improved as a required tool for load forecasting, demand-side management, system planning, distribution system loss estimation and better tariff design, etc.

Key words: kVA profile, Single category bulk electrical installations, multi category bulk electrical installations, Clustering, Hierarchical Clustering algorithm, Knee point criterion

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LIST OF ABBREVIATIONS

Abbreviation	Description
PUCSL	Public Utilities Commission of Sri Lanka
CEB	Ceylon Electricity Board
LECO	Lanka Electricity Private Limited
DR1	Distribution Region 1
DR2	Distribution Region 2
DR3	Distribution Region 3
DR4	Distribution Region 4
kVA	kilo-Volt-Ampere
kWh	kilo Watt Hour
kW	kilo Watt
PDF	Adobe Acrobat File Format
HC	Hierarchical Clustering
SSE	Square Sum of Error
BOC	Bank of Ceylon

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