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Mohd Ruddin Ab Ghani
Professor of Electrical Engineering, Universiti Teknikal Malaysia Melaka
System Engineering and Control- Energy and Distribution Automation System-Optimization - Operational Research
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Title

OPTIMAL CABLE SELECTION IN RADIAL DISTRIBUTION NETWORKS CONSIDERING PLANNER'S DEFINED VOLTAGE DROP LIMIT

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Shah Jahirul Islam, Musse Mahamud Ahmed, Mohd Ruddin Abd Ghani, Ismail Bin Hassan, Wazir Bin Mustafa, Kolej Universiti Teknical Kebengsan Malaysia

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OPTIMAL CABLE SELECTION IN RADIAL DISTRIBUTION NETWORKS CONSIDERING PLANNER'S DEFINED VOLTAGE DROP LIMIT

Shah Jahirul Islam* Musse Mahamud Ahmed** Mohd. Ruddin Abd. Ghani***,
Ismail Bin Hassan*, Wazir Bin Mustafa*

*Faculty of Electrical Engineering
Universiti Teknologi Malaysia
L.B – 791, 80990 JB, Malaysia
Email: sjahir_I@hotmail.com
** Faculty of Electrical Engineering
***Kolej Universiti Teknical Kebengsan Malaysia
Karun berkuni 1200, Ayer Keroh-75450,
Malaka, Malaysia

Abstract

New computer algorithms are provided to determine the optimal cable size selection considering radial distribution networks and planner of power distribution defined allowable voltage drop all over the networks. The planner should properly populate the location of all load substations and the joint node location in the input data source. Distance calculation of the demand node to demand node and joint node to joint node etc. depends on the geo-graphical location of the defined node. Cable size and type of all feeder segment determination depends on the total cost of the networks, cost of feeder losses etc. An acceptable voltage profile will be maintained all point of the entire networks. The resource of the cable inventory is also responsible for optimal selection of the cable. By using this proposed computer algorithm and program an example is solved successfully that is presented in the results.

1. INTRODUCTION

In distribution network design a large amount of data is required, e.g. information of present networks, design objectives, etc. Complicated calculations are necessary in some cases to optimize network configurations. The use of computers makes it possible to carry out sophisticated network-design calculations. Common tasks for computer-aided network design are to obtain quantitative information on the status of networks. Computer programs can also act as an efficient tool for long planning and the study of more complex aspects [2]. But in this case the main aim of using of computer program is to draw distribution network by using the geographical co-ordinates and to calculate the length of each segment of complete feeder route of distribution networks according to planning procedure. The high investment cost of electricity distribution systems and the increasing cost of energy, equipment and labor has caused design engineers to look for more efficient planning methods and techniques to reduce these costs [1]. The main contributions of this paper are i) selection the optimal cable size and type ii) measurement of cable length and node to node distance considering practical scenario ii) mapping of power distribution networks including precious direction change iii) to include zoom facilities in mapping iv) power losses and voltage drop determination v) required KVA rating for the demand node vi) Node current for each branch.

The factors of systems costs, voltage quality and losses are directly related to the network configuration The financial justification of the solution in each selection of cable I related and therefore these factors are considered.

2. MAPPING OF FEEDER ROUTES

The methods of mapping of feeder routes will be more transparent if we consider all necessary things to explain it properly and preciously. Main program will handle the mapping after retrieving data from the data bank and getting the information about the initialization of graphics interfaces. Output of this program will be the mapping of entire networks. This output depends on the proper handling of related data structures.

2.1.1 Connection Sequence Selection Method

In practical situation to determine actual route flow from the practical design route it is very complex to ensure all direction is considered properly and implement it in the calculation module accurately.

Connection sequence selection method is a systematic numbering selection method for calculation of distance of towers. Systematic numbering of nodes and branches is not an essential criterion for calculation of distance of towers of distribution network but it will be better for node sequence selection.

Four types of nodes are considered in the distribution network. They are:

- nodes which will be used for getting more accurate distance
- load substation nodes
- joint nodes
- source substation node

Load substation nodes are to be numbered at first. On completion of the numbering of all the load substation nodes joint nodes have to be numbered. There are three types of joint nodes. Joint node of

- two or more than two load substation nodes
- load substation feeders
- load substation node and load substation feeder

The last number will be source substation node. It is not essential to follow this procedure of numbering. But if this procedure is followed it will be easy to find out the node number of the demand load substations, joint nodes and source substation. Extra nodes of each route will be numbered after finishing of numbering of source substation node. Any extra node number will be bigger than substation number and it will be start after the number of source substation.

On completion of the numbering of all nodes it is needed to arrange the node sequence selection. Figure 3.2 shows the typical distribution network.

For each feeder branch it is needed to mention the connecting node numbers. The node-to-node connection sequence will be

18→ 1   18 → 2   18 → 3   19 → 17   19→ 18
20→ 5   20→ 6   21→ 4   21 → 20   22→ 7
22 → 8   22→ 21   23 → 9   23 → 10   23 → 11
24→ 23   24 → 22   25→14   25→ 15   26→ 12
26→ 13   26 → 25   27 →16   27→ 26   28→ 19
28→ 24   28 → 27

Total number of load substations is 17. Joint nodes number is 18 to 27. 28 is the source substation node in fig. 2.1. Radial distribution network is shown in the 2.1 figure. There are a lot of hidden nodes between two adjacent nodes those make the mapping accurate and practical based.
The mapping of the node connection is shown as below:

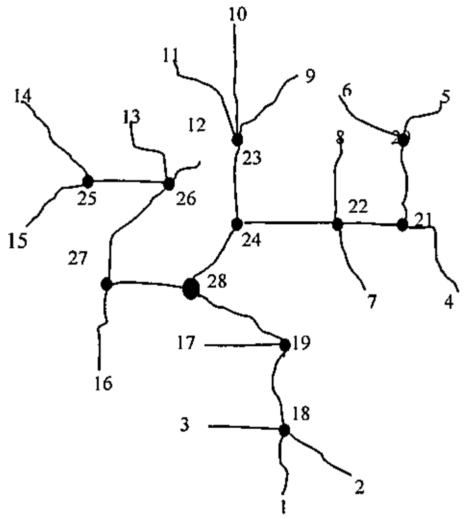

Figure 2.1: Typical distribution network

3. PROBLEM FORMULATION

To determine the distance between two nodes, at first it is needed to select the location of the nodes. The location of nodes are stated by geographical co-ordinates then the distances are determined as follows:

The required distance between two nodes [2]is

$$D_{ijk} = \sqrt{[(x_j - x_k)^2 + (y_j - y_k)^2]}$$

Total distance of a single route of n number of nodes is

$$D_n = \sum_{i=1}^{n} D_{ijk}$$

Total length of cable of complete route of network is

$$D^T_n = \sum_{i=1}^{n} D_i$$

Calculated node number

$$C^{NN} = AC^{NN} + 1$$

Calculated demand node number

$$CD^{NN} = ACD^{NN} + 1$$

Total joint node number

$$TJ^{NN} = C^{NN} - CD^{NN}$$

Allowable voltage drop of the considered network

$$VD^A = VD^{LI} * VL$$

The present worth factor for proposed network life

$$PWF = (1 + IR/100.0)^{PNL}$$

Node selection sequence is needed for optimal cable selection module. The memory location for this node selection is maintained as below:

$[P_{2*(1-1)+1} \rightarrow N_{11},\ P_{2*(1-1)+2} \rightarrow N_{12}]$,
$[P_{2*(2-1)+1} \rightarrow N_{21}, P_{2*(2-1)+2} \rightarrow N_{22}]$,
$[P_{2*(3-1)+1} \rightarrow N_{31}\ \ P_{2*(3-1)+2} \rightarrow N_{32}]$,

:

:

$[P_{2*(n-2)+1} \rightarrow N_{(n-1)1},\ \ P_{2*(n-2)+2} \rightarrow N_{(n-1)2}]$

$[P_{2*(n-1)+1} \rightarrow N_{n1},\ \ P_{2*(n-1)+2} \rightarrow N_{n2}]$

Approximate transformer rating for the demand load

$$ATRR_i = DL_i / AEF$$

Actual efficiency of the transformer

$$e^{acef}_i = 1 - (P^{acil}_i + P^{accu}_i) / (T^{actr}_i * 1000)$$

Required transformer rating of demand node

$$RT^{dn}_i = DL^{ac}_i / e^{acef}_i$$

The required rating of source substation

$$RT^{ss} = \sum_{i=1}^{n} RT^{dn}_i$$

Required transformer rating may not be standard transformer rating. It is needed to get associated standard transformer rating from the input data bank.

Actual efficiency of the source substation transformer

$$e^{acef}_{ss} = 1 - (P^{acil}_{ss} + P^{accu}_{ss}) / (AT^{ss} * 1000)$$

Required transformer rating by using efficiency

$$RT^{sse} = RT^{ss} / e^{acef}_{ss}$$

Required transformer rating , RT^{sse} may not be standard transformer rating. It is needed to get associated standard transformer rating from the input data bank. If RST^{SS} indicates the standard value and $RST^{SS} > AT^{ss}$ RST^{SS} will be actual source substation transformer rating.

The position of transformer and the position of rating of transformer is as below:

$[\ P^t_1 \rightarrow P^{it}_1,\ P^{il}_1 \rightarrow P^{iit}_1,\ P^{cul}_1 \rightarrow P^{icul}_1\ ]$,

$[\ P^t_2 \rightarrow P^{it}_2,\ P^{il}_2 \rightarrow P^{iit}_2,\ P^{cul}_2 \rightarrow P^{icul}_2\ ]$,

$[\ P^t_3 \rightarrow P^{it}_3,\ P^{il}_3 \rightarrow P^{iit}_3,\ P^{cul}_3 \rightarrow P^{icul}_3\ ]$,

:

:

$[\ P^t_{(n-1)} \rightarrow P^{it}_{(n-1)},\ P^{il}_{(n-1)} \rightarrow P^{iit}_{(n-1)},\ P^{cul}_{(n-1)} \rightarrow P^{icul}_{(n-1)}\ ]$,

$[\ P^t_n \rightarrow P^{it}_n,\ P^{il}_n \rightarrow P^{iit}_n,\ P^{cul}_n \rightarrow P^{icul}_n\ ]$

If source substation is associated with ith transformer of the internal data bank the associated parameter of that transformer will be used to find out the efficiency for that particular rating of the transformer and this efficiency will be used for the source substation.

The node current will be

$$I^n_i = T^r_i * 1000 / (\sqrt{3.0} * VL)$$

This current rating will be indicated for all nodes. But associated required transformer is essential input for the determination of particular node current.

To determine the feeder route selection it is needed to separate the demand load of the end point of the networks and the joint nodes. The sequence is the most important to generate the appropriate route determination.

The sequence of node number

$S^N_1 \rightarrow S_1\ \{\ S^n_{11},\ S^n_{12},\ S^n_{13},\ S^n_{14} \ldots\ldots S^n_{1(n-1)},\ S^n_{1n}\}$

$S^N_2 \rightarrow S_2\ \{\ S^n_{21},\ S^n_{22},\ S^n_{23},\ S^n_{24} \ldots\ldots S^n_{2(n-1)},\ S^n_{2n}\}$

$S^N_3 \rightarrow S_3\ \{\ S^n_{31},\ S^n_{32},\ S^n_{33},\ S^n_{34} \ldots\ldots S^n_{3(n-1)},\ S^n_{3n}\}$

:

:

$S^N_{(m-1)} \rightarrow S_{(m-1)}\ \{\ S^n_{(m-1)1},\ S^n_{(m-1)2},\ S^n_{(m-1)3},\ S^n_{(m-1)4} \ldots\ldots S^n_{(m-1)(n-1)},\ S^n_{(m-1)n}\}$

$S^N_m \rightarrow S_m\ \{\ S^n_{m1},\ S^n_{m2},\ S^n_{m3},\ S^n_{m4} \ldots\ldots S^n_{m(n-1)},\ S^n_{mn}\}$

Connection sequence of joint node

$JS^N_m \rightarrow JS_m\ \{\ JS^n_{m1},\ JS^n_{m2},\ JS^n_{m3},\ JS^n_{m4} \ldots\ldots JS^n_{m(n-1)},\ JS^n_{mn},\ DS^n_{m1},\ DS^n_{m2},\ DS^n_{m3},\ DS^n_{m4} \ldots\ldots DS^n_{m(n-1)},\ DS^n_{mn}\ \}$

The nth joint node of the sequence joint node set for mth joint node

$JS^n_{mn} = DS^n_{mn}\ \ \{\ DS^n_{m1},\ DS^n_{m2},\ DS^n_{m3},\ DS^n_{m4} \ldots\ldots DS^n_{m(n-1)},\ DS^n_{mn}\ \}$

The current flow of joint node

$$I^{JSN}_m = \sum (I^{JSn}_{m1} + I^{JSn}_{m2} + I^{JSn}_{m3} + I^{JSn}_{m4} + \ldots\ldots + I^{JSn}_{m(n-1)} + I^{JSn}_{mn} + I^{DSn}_{m1} + I^{DSn}_{m2} + I^{DSn}_{m3} + I^{DSn}_{m4} + \ldots\ldots + I^{DSn}_{m(n-1)} + I^{DSn}_{mn})$$

The current flow of nth joint node of the sequence joint node set for mth joint node if all connecting node are demand nodes

$$I^{JSn}_{mn} = \sum (I^{DSn}_{m1} + I^{DSn}_{m2} + I^{DSn}_{m3} + I^{DSn}_{m4} + \ldots\ldots + I^{DSn}_{m(n-1)} + I^{DSn}_{mn})$$

All current flow of demand node will be calculated according to I^n_i.

The voltage drop of the particular is

$$VS^N_m = \sum \{ VS^n_{m1} + VS^n_{m2} + VS^n_{m3} + VS^n_{m4} \ldots\ldots + VS^n_{m(n-1)} + VS^n_{mn}$$

The individual node voltage drop of the sequence node set

$$VS^n_{mn} = \sqrt{3} I^{Sn}_{mn} \left(\sum_{i=1}^{n} D^T_i \ (R^n_i \cos Q + X^n_i \sin Q) \right)$$

The power loss of joint node feeder and all associated sequence node feeder

$$P^{JSN}_{m} = \sum (P^{JSn}_{m1} + P^{JSn}_{m2} + P^{JSn}_{m3} + P^{JSn}_{m4} + \ldots\ldots + P^{JSn}_{m(n-1)} + P^{JSn}_{mn} + P^{DSn}_{m1} + P^{DSn}_{m2} + P^{DSn}_{m3} + P^{DSn}_{m4} + \ldots\ldots + P^{DSn}_{m(n-1)} + P^{DSn}_{mn})$$

The power flow of nth joint node of the sequence joint node set for mth joint node if all connecting nodes are demand nodes

$$P^{JSn}_{mn} = \sum (P^{DSn}_{m1} + P^{DSn}_{m2} + P^{DSn}_{m3} + P^{DSn}_{m4} + .+ P^{DSn}_{m(n-1)} + P^{DSn}_{mn})$$

The power loss of the nth node of the sequence node set for mth node

$$P^{Sn}_{mn} = 3(I^{Sn}_{mn})^2 R^n_i D^T_i$$

Total power losses is

$$P_{tpl} = (\sum_{i=1}^{n} P^{acil}_{i}) + P^{acil}_{ss} + F_{loss}\{\sum_{i=1}^{n} P^{accu}_{i} + P^{accu}_{ss} + P^{JSN}_{m})\}$$

In this case demand loss is same for all possible complete routes of the feeders. For this reason demand loss is ignored. All fixed cost are also ignored.

Cable cost of jth feeder segment of the feeder branch of ith load substation route is

$$C^{cb}_{ij} = D_i C^{cpk}_{ij} (1 + IR/100.0)^{PNL}$$

Total cable cost of the network is

$$C_{tcc} = \sum_{i=1}^{m}\sum_{j=1}^{bn} C^{cb}_{ij}$$

Cable installation cost of jth feeder segment of the feeder branch of ith load substation is

$$C^{int}_{ij} = D_i C^{ipk}_{ij} (1 + IR/100.0)^{PNL}$$

Total cable cost of the network is

$$C_{tic} = \sum_{i=1}^{m}\sum_{j=1}^{bn} C^{int}_{ij}$$

Total power loss cost is

$$C_{tpl} = 8760 L_{nfl} P_{tpl} C_{kwh} I_{rf}$$

Total variable cost of the network is

$$T_{vcn} = C_{tcc} + C_{tic} + C_{tpl}$$

The type and size of cable depend on voltage level and required current flow and current density in the feeder. The type and size of cable are selected from table of standard cable according to the input voltage level of the feeder and current flow of the feeder.

Current flow of ith feeder is I_i and I_{rated} is current of standard cable, C_i. I_{rated} is also equal or nearly greater than I_i compare to other rated current of standard cable.

The cable size and type of ith feeder will be C_i as primary selection.

Economical cable size and type are selected after primary selection of cable size of all feeder routes. Total number of feeder type and size are considered in the following way:

If N_{cs} is the total number of standard cable size and type of data bank and N^{ps}_{ij} is the number of primary selection of jth feeder of the feeder branch of ith load substation then the difference between N_{cs} and N^{ps}_{ij} will be

$$D^t_{ij} = N_{cs} - N^{ps}_{ij}$$

The final selection of cable size and type will be selected between N^{ps}_{ij} and N_{cs}. Maximum voltage drop of the feeder route of load substations have to be determined after primary selection of cable size and types of all feeder branches. According to descending order of voltage drop of feeder route of load substations the cable size and type of each feeder segment of feeder route of load substations are determined.

Cable size and type of all feeder segments are selected which are economic after justification of all feeder type and size of feeder segment of all branches.

3.1 Notations

- D_{ijk} is the distance from jth node to kth node that is the distance of ith branch of feeders
- x_j ,x_k are geographical horizontal co-ordinates of jth node and kth node respectively
- y_j ,y_k are geographical vertical co-ordinates of jth node and kth node respectively.
- C^{NN} indicates calculated node number of the calculation module
- AC^{NN} indicates actual node number that is designed by the planners
- CD^{NN} indicates calculated demand node number of the calculation modules
- ACD_{NN} indicates actual demand node number that is designed by the planners
- VD^A indicates the allowable voltage drop that will be maintained each segment
- VD^{LI} indicates the limitation indication of voltage drop that is assigned by planners of the proposed network
- VL Voltage level of the network
- IR indicates the interest rate of total investment
- PNL Planner's proposed network life
- $P_{2*(n-1)+1}$ indicates the position of 1st node of nth sequence of node selection

$P_{2*(n-1)+2}$ indicates the position of 2^{st} node of nth sequence of node selection

N_{n1} 1^{st} node of nth sequence of node selection

N_{n2} 2^{nd} node of nth seq. of node selection

$ATRR_i$ indicates the approximate transformer rating for ith node point of demand node

DL_i indicates demand load of ith node

AEF is approx. efficiency of the transformer

e^{acef}_i is actual efficiency of ith load node transformer

P^{acil}_i is actual iron loss of ith load node transformer

P^{accu}_i is actual cu loss of ith load node transformer

T^{actr}_i is the transformer rating of ith demand node

RT^{dn}_i is required transformer rating of ith load node

DL^{ac}_i is the demand load of ith demand node

RT^{ss} is the required transformer rating of source substation

P^{acil}_{ss} is the actual iron loss of the source substation transformer

P^{accu}_{ss} is the actual cupper loss of the source substation transformer

AT^{ss} is the actual transformer rating of the source substation

$P^{t}_{n,}$ is the position of internal database of nth transformer rating

P^{il}_{n} id the position of internal database of iron loss of nth transformer rating

P^{cul}_{n} is the position of internal database of cupper loss of nth transformer rating

$P^{it}_{n,}$ is the position of input source of nth transformer rating

P^{iil}_{n} id the position of internal database of iron loss of nth transformer rating

P^{icul}_{n} id the position of internal database of cupper loss of nth transformer rating

I^{r}_i is the current rating of ith demand node

T^{r}_i is the required transformer of ith demand node

VL Voltage level of the networ

S^{N}_m is the node sequence indicator for mth node

S_m is the sequence node set for mth node

$S^{n}_{m(n-1)}$ is the (n-1)th node of the seq. node set for mth node

S^{n}_{mn} is nth node of the seq. node set for mth node

JS^{N}_m is joint node seq. indicator for mth jont node

JS_m is the sequence jojnt node set for mth joint node

$JS^{n}_{m(n-1)}$ is the (n-1)th node of the sequence joint node set for mth joint node

JS^{n}_{mn} is the nth demand node of the sequence joint node set for mth demand node

$DS^{n}_{m(n-1)}$ is the (n-1)th node of the sequence demand node set for mth demand node

DS^{n}_{mn} is the nth joint node of the sequence joint node set for mth demand node

DS_m is the seq. demand node set for mth load node

$DS^{n}_{m(n-1)}$ is the (n-1)th node of the sequence demand node set for mth demand node

DS^{n}_{mn} is the nth joint node of the sequence joint node set for mth demand node

I^{JSN}_m is the current flow of the sequence indicator for mth jont node

$I^{JSn}_{m(n-1)}$ is current flow of the (n-1)th node of the sequence joint node set for mth joint node

I^{JSn}_{mn} is current flow of the nth demand node of the sequence joint node set for mth demand node

$I^{DSn}_{m(n-1)}$ is the current flow of the (n-1)th node of the seq. demand node set for mth demand node

I^{DSn}_{mn} is the current flow of nth joint node of the sequence joint node set for mth demand node

$I^{DSn}_{m(n-1)}$ is the (n-1)th node of the sequence demand node set for mth demand node

I^{DSn}_{mn} is the nth joint node of the sequence joint node set for mth demand node

VS^{N}_m is voltage drop of the node sequence indicator for mth node

$VS^{n}_{m(n-1)}$ is voltage drop of the (n-1)th node of the sequence node set for mth node

VS^{n}_{mn} is voltage drop of the nth node of the sequence node set for mth node

I^{Sn}_{mn} is current flow of the nth node of the sequence node set for mth node

D^{T}_i is the total distance of ith hidden node of the nth node of the sequence node set for mth node

R^{n}_i is resistance of i number of hidden node of ith node of the nth node of the sequence node set for mth node in ohm/km

X^{n}_i is reactance of i number of hidden node of ith node of the nth node of the sequence node set for mth node in ohm/km

P^{JSN}_{m}, Q is the power loss of the sequence indicator for mth joint node, power factor of the feeder.

$P^{JSn}_{m(n-1)}$ is power loss of the (n-1)th node of the sequence joint node set for mth joint node

P^{JSn}_{mn} is power loss of the nth demand node of the sequence joint node set for mth demand node

$P^{DSn}_{m(n-1)}$ is power loss of the (n-1)th node of the seq. demand node set for mth demand node

P^{DSn}_{mn} is power loss of nth joint node of the sequence joint node set for mth demand node

$P^{DSn}_{m(n-1)}$ is the (n-1)th node of the sequence demand node set for mth demand node

P^{DSn}_{mn} is the nth joint node of the sequence joint node set for mth demand node

I^{Sn}_{mn} is current flow of the nth node of the sequence node set for mth node

D^{T}_i is the total distance of i number of hidden nodes of the nth node of the sequence node set for mth node

R^{n}_{i} is resistance i no. of hidden node of nth node of the seq. node set for mth node in ohm/km

$F_{loss,\,n}$ is loss factor & total no. of load substation

C^{cpk}_{ij} is cable cost per km of jth feeder segment of ith demand load substation route.

C^{ipk}_{ij} is cable installation cost per km of jth feeder segment of ith load substation route.

C_{kwh}, L_{nf}, I_{rf} is cost per kWh, the desired life of networks and load factor of the network

4. PROGRAMMING STRUCTURE AND RESULTS

The programming structure of the optimal network planning is as bellow:

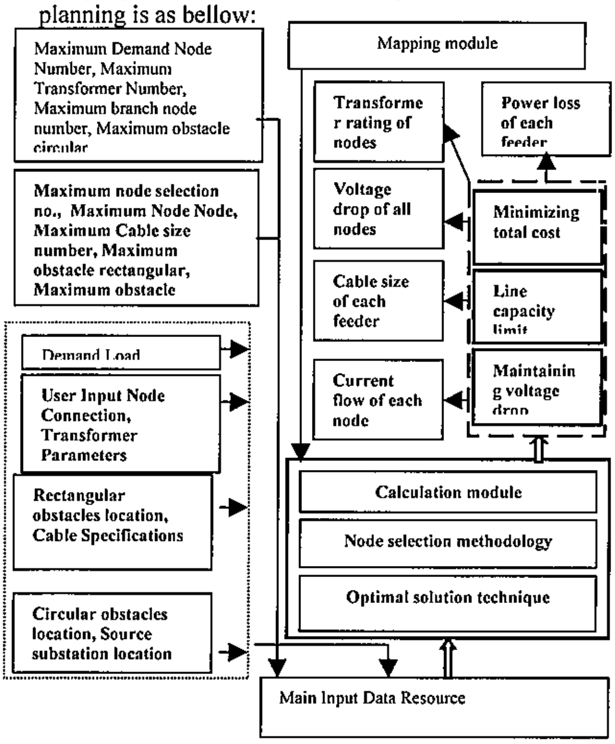

Figure 4.1: Programming Structure of Optimal Planning Solution of Distribution Networks

An example of distribution network is considered. In this case 57 nodes are used in which 35 nodes are load substation nodes and 21 nodes are joint nodes and one is source substation node. The output screen is generated 24X32. The maximum area is considered 23.333X30 square km. The ratio factor is considered 15. The source substation rating is 17.5MVA. The limitation of voltage drop is considered 4%. The mapping of the network is the output of the solution programming which is shown as below:

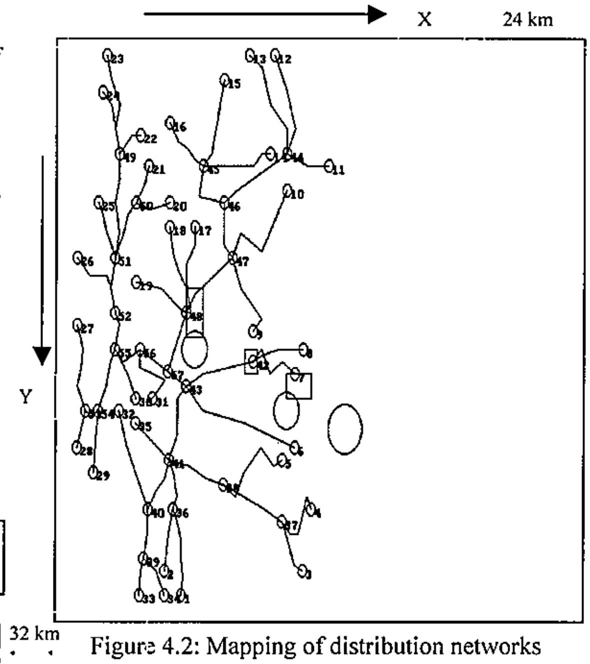

Figure 4.2: Mapping of distribution networks

The optimal the cable size is as below:

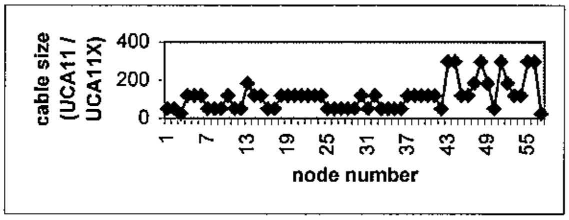

Figure 4.3 : Cable Size of Design

The KVA rating of transformers are 250,300,200,500, 500,1500,500,630,500,630,300,200,250,500,250,200,1500,2000,2000,500,300,500,200,250,630,630,500,630,630,2000,1500,500,630,250,630 sequentially.

5. CONCLUSION

All feeder voltage must be maintained used defined voltage drop to select optimal cable size and type in the entire networks by considering proper calculation of user defined load. Minimal capital investment was the key role to select optimal cable selection.

6. REFERENCES

[1] Lo K.L and Nashid, I. "Interactive expert system for optimal design of electricity distribution systems", IEE Proceedings on Generation, Transmission & Distribution, vol.143, no. 2, March 1996,pp.143-156.

[2] Lakervi, E. & Holmes, E. J. (1989).Electricaty Distribution Network Design, Peter Peregrinus Ltd.