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Localisation of Production Placement and Reduction of Energy Transfer

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Abstract: The first step in the planning of the electrical supply networks consists in defining the optimum placement of one or more power stations; this can be done by the centre of gravity method, or by the minimal reduced costs. The first method take in account only the optimisation of investments, tended that the second in addition to the investments holds operating statement "production cost, cooling and transport." In this study, we show also the strategy and the criteria of delimitation of the zones to electrify by the same departure and to reduce the transfer of power between zones, which has as a consequence a better plan of voltage.

Key words: Localisation of production, placement and reduction, energy transfer, investment

INTRODUCTION

The realisation of an electrical supply network to feed from the consumers given lately installed is subjected to two principal conditions:

- Determination of optimal place of installation of one or more voltage sources.
- Determination of the optimal structure of the distribution architecture (Mahadev and Christie, 1996).

The treatment of these two questions is carried out under technico-economic considerations, whose fundamental criterion is the research of the minimum of the reduced expenditure (Dr.).

In this research work the authors develop a method of analysis based on the substitution of the electric efforts with those mechanical by way of similarity.

Type of model: We chose a standard area to electrify, with a diversified geology and whose distribution of the concentrations of the points of consumption is dictated by socio economical considerations "proximity with a water source a fertile ground, etc….", (Fig. 1).

The research of the installation of the electric energy source placement must thus obey to technico-economical criteria in addition to the cost of the power station itself it is added other expenses such as the electrical network which ensure the connexion between this source and the customers, the losses of energy, the cooling of the power station, etc…. in this study we dealt with all the quoted expenses.

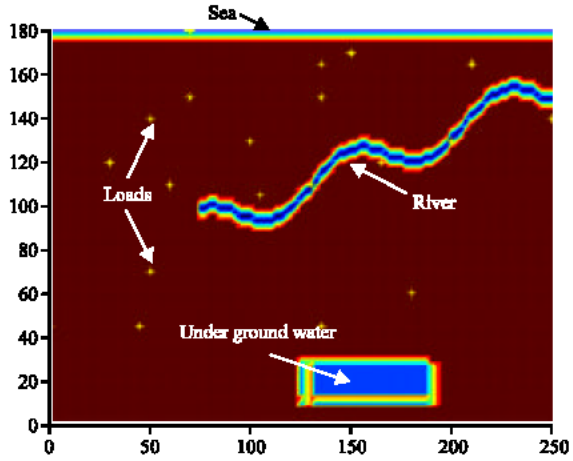

Fig. 1: Topology and geology of quotes to electrify

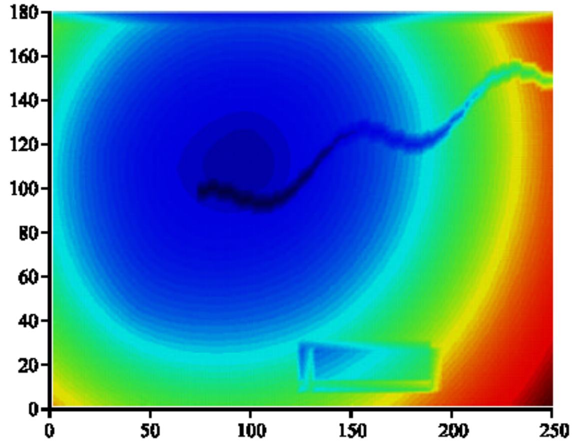

Fig. 2: Variation of the expenditure according to the source site

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On Fig. 2 we represent the effect of the voltage source site on the cost of realisation of the project. The difference in colours thus reflects the total cost this cost increases blue towards the red. It means that the minimal expenditure is in the restricted blue zone (D'Amour and Block, 1994).

MATHEMATICAL DEVELOPMENT

Centre of gravity: The first approach which can define the place of the source is the research of the centre of revolves whose co-ordinates can be thus defined

$$\begin{aligned} Xo\ (K) &= \Sigma\ [X\ (I)\ .Pch\ (K, I)]/\Sigma Pch\ (K, I) \\ Yo\ (K) &= \Sigma\ [Y\ (I)\ .Pch\ (K, I)]/\Sigma Pch\ (K, I) \end{aligned} \tag{1}$$

Spend: The second method that we propose is the reduced expenditure

$$Dr. = Dref+Dres+D_{\Delta P}+Ds \tag{2}$$

With:

$$Ds = ks.\Sigma P$$

Ds- Cost of the power station,
ks- Cost of MWH

$$Dref = kref.Ds$$

Dref- Cooling fee proportional to the cost of the power station
kref- Coefficient of cooling depends on geology

$$Dres = kl.\ \Sigma l$$

Dres- Price of the network
kl- Cost of the kilometre of line

$$D\Delta P = kw.\ \Sigma\Delta P$$

DΔP- Losses costs in the lines

The computation in accordance with the expressions (1 and 2) gives us 12 co-ordinates relating to each month for each method (Christie, 1994).

View that we took the load variables per month (Fig. 3) . Being given that the source must take only one place the optimum placement chooses will make according to the expenditure minimal during the year (Fig. 4) (Ghoshal and Doughlas, 1994).

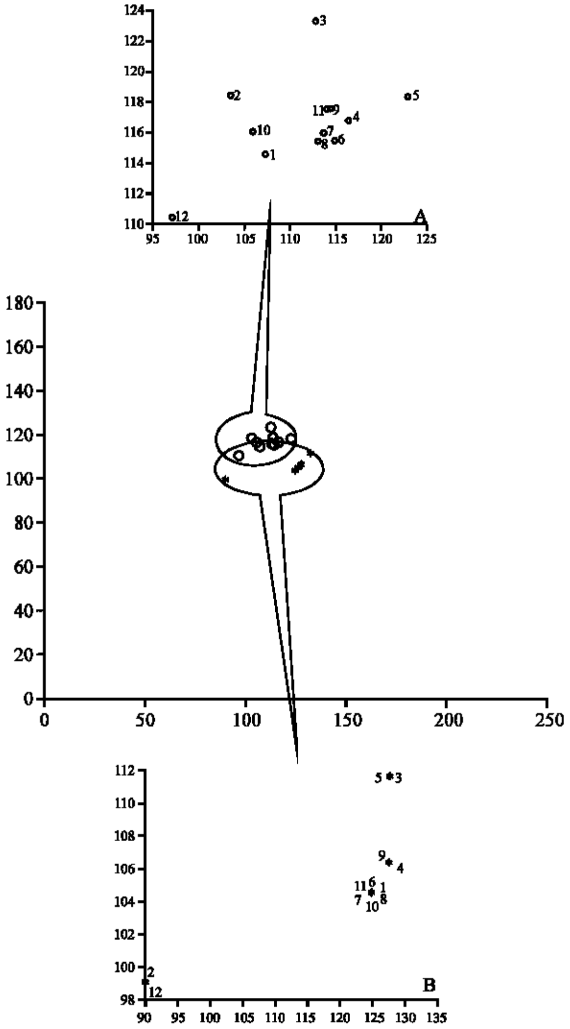

Fig. 3: Localisation of the source according to the centre of gravity and of the reduced expenditure

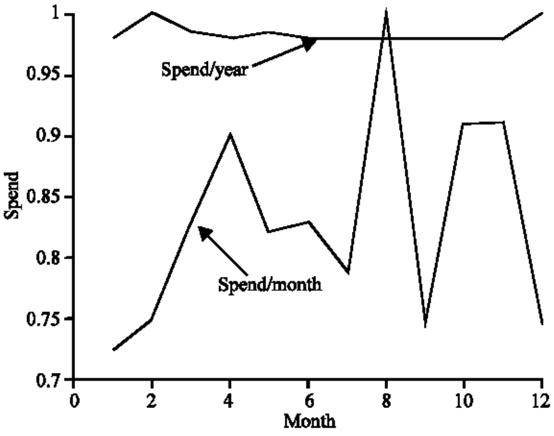

Fig. 4: Expenditure reduced per month and year

The optimal co-ordinate of the source was fixed according to the minimal expenditure reached during the year which is different with that from the month (De Azevedo *et al*., 1996).

ELECTRIC NETWORK ARCHITECTURE

Once the power station is established we must bind it to the loads a good plan of voltage with an optimum power flow strongly depends on the network architecture (Thiyagarajah *et al*., 1993) for these reasons we propose to make a configuration with two departures distinct and that thanks to the principle from the means axes, which consists in seeking the angle, which enables us to reduce the transfer of energy between zone (Mahadev and Christies, 1993)

$$T_{EX} = \Sigma Y\,(I)^{2}\,Pch\,(I)$$

T_{EX}- Transfer of energy along axis X

$$T_{EY} = \Sigma X\,(I)^{2}\,Pch\,(I)$$

T_{EY}- Transfer of energy along the axis y

$$T_{EXY} = \Sigma X\,(I)\,Y\,(I)\,Pch\,(I)$$

T_{EXY}- Transfer of energy according to the xoy plan

$$Tg\,(2\,\alpha) = -\,2\,T_{EXY}/[\,TEX - TEY]$$

α- Angle of transfer of energy

Thus the optimum zone division in accordance with the T_{EXY} min (Mahadev and Christie, 1994) is represented on the figure by a subdivision of surface along the axis given by the optimum angle α (Fig. 5 and 6).

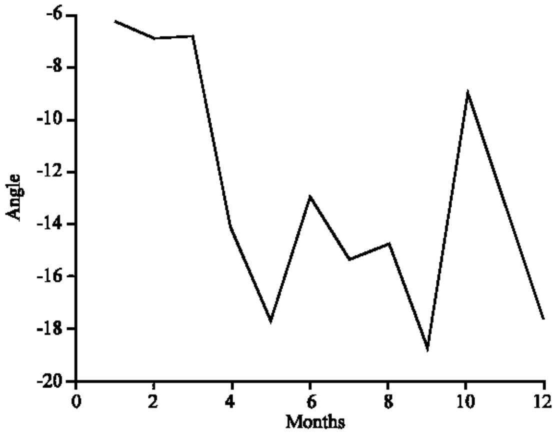

Fig. 5: Swing angle of the mean axes per month

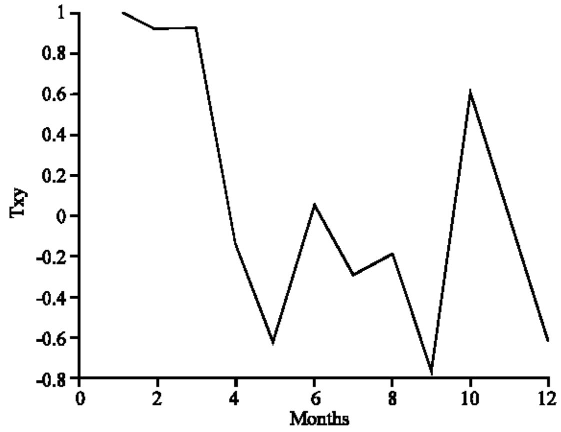

Fig. 6: Quantity of energy transferred from one zone to the other

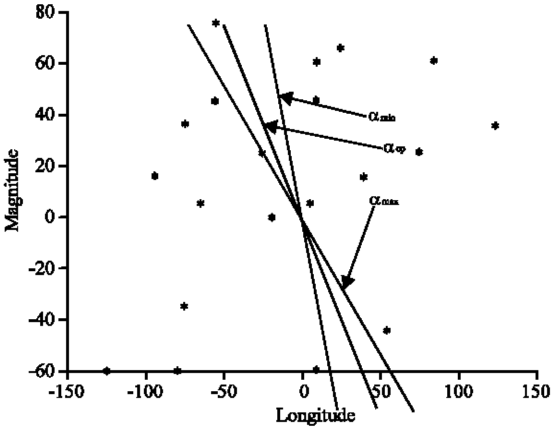

Fig. 7: Surface division to be electrified in two distinct zones

Cutting following the axis α_{op} allows delimiting the zones (Huang and Galiava, 1991) to be electrified by the same network in addition to the localisation of the points of interconnections in the case of the connexion of wide-area networks for strategic reasons, economic or stability of exploitation (Fig. 7) (Overbye *et al*., 1997; Weber, 1997).

CONCLUSION

Following this study, we can say that the method of the reduced expenditure is more rigorous in the determination of the rational placement of one or more sources. At the end of this research the authors show the importance of the mean axes theory which they propose in the reduction of forwards of flows of distinct powers between zones. This same proposal can be useful in the questions of the interconnections of wide-area networks.

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