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# LOAD ANALYSIS AND LOAD FLOW ANALYSIS ON THE KATO PAPHOS AREA NETWORK. INVESTIGATION OF THE SYSTEM CONDITIONS AND OPTIMIZATION.

*BY*

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# LOAD ANALYSIS AND LOAD FLOW ANALYSIS ON THE KATO PAPHOS AREA NETWORK.

# INVESTIGATION OF THE SYSTEM CONDITIONS AND OPTIMIZATION .

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Maria Parouti, June 1999

# SUMMARY

## LOAD FLOW ANALYSIS ON THE KATO PAPHOS AREA NETWORK INVESTICATION OF THE SYSTEM AND OPTIMIZATION

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The objective of this project is the reinforcement of the power network which is use for the electricity supply Kato Paphos area. In order to do that, we will study the main factors on which the existing power network works on, its limitations and the problems arising when it is in full needs or overloaded. The system needs to be examined when in operational conditions.

At first we will take the historical observations in the behaviour of the system in the area. Then, we will observe what will happen, at ten years time, when there is an overload, with regression analysis and we will estimate what would be the behaviour in the future. Consequently we will examine the system under several loading conditions in order to determine the point in time at which the system shall be unable to preserve stability and sustainable economical losses are attained.

Having done that, we will derive the point in time when reinforcement of the system is necessary for more effective use by establishing a new transmission substation in the area. Then we will look at the reinforced system and examine alternative medium voltage reinforcements that would make the new transmission substation as operative as possible. For presentation purposes in describing the excising and future system conditions detailed statistics graphs, as well as single line diagrams and topographic maps are used. Furthermore, throughout the project the POWER SYSTEM ANALYSIS (PSA PC APPLICATION ) program is used in order to perform the above assignment without a lot of time waste.

# INTRODUCTION TO THE PROBLEM

In the old years, Electricity Authority of Cyprus performed calculations by hand and possible modification that needed to take place in a system were based on approximate estimations. This work, obviously was tedious, hard and mistakes were very likely to occur. Thus the need arose in simplifying these procedures.

Furthermore, as power engineering needs huge capital investment, generating, transmitting and distribution of power by Electricity Authority of Cyprus had to be done in the most economical manner. Thus, over the years, as technological breakthroughs evolved, Electricity Authority of Cyprus took advantage of the newly established procedures for the establishment of system load flow studies. In order to deliver electric energy to the Cyprus consumer in the most economical manner, Electricity authority of Cyprus employs Load flow studies in the procedures of studies over the various areas of the island.

Load flow analysis is defined as the specification of basic network parameters that indicate the behaviour of the system under several loading conditions. These parameters are the real (MW) and reactive (MVAr) power flows in the branches of the network, the voltage drops occurring at the nodes of the network, system losses, transformer tap settings etc. As a result, by investigating these parameters occurring under selected conditions, there may be clear specifications of possible modifications, that are essential to be made in the network in order to operate in a productive, and if possible, optimum manner. This is important, as by reducing the losses occurring in a network , automatically there is a reduction in the operating costs of the network.

The load flow analysis of a given network is one of the most important tasks to be performed, in order to specify the conditions occurring in the network during load variations, normal or abnormal situations and cases of fault.

In simulating the network parameters, at first, the network analyser was used in performing the necessary calculations and producing the wanted results. Although unreliable solutions and mistakes were reduced significantly the network analyser was not the most effective device, it was still found to be complicated and time-consuming. Thus, in solving the problem, a different approach was needed.

As a result, there was a dramatic change in digital equipment with the widespread use of computers in a vast range of applications. This evolution in digital equipment, enabled engineers to create programs which had the ability of analysing very large power systems and performing Load Flow studies effectively, accurately and most important, economically.

Nowadays Electricity Authority of Cyprus, utilises the Power System Analysis program (PSA package). It has the ability of performing Load Flow calculations and fault Level calculations as well. It may handle easily large power network, producing all necessary output data in no time. This establishes the PSA package as a powerful tool in the hands of every engineer.

As stated in the "Summary" section of this report, we use Load Flow module in the PSA package to simulate Kato Paphos area existing system. System conditions is studied, all system weak points are being identified and solutions are proposed in reinforcing the system.. Furthermore, the need in establishing a new transmission substation in the area is examined and the system conditions including the new substation is studied.