CHAPTER I

INTRODUCTION

Introduction

An economic operation of any power plant is always concerned with the cost of products and services. For a power system to return a profit on the capital invested, a proper operation is very important.

Recently, there has been a lot of success in increasing the efficiency of boilers, turbines, and generators. Thus, each new unit added to the steam generating plants of a system operates more efficiently than any older ones. In operating the system for any load conditions, the constribution from each unit within a plant must be determined so that the cost of delivering the power is at a minimum. Therefore, it can be stated that the load distribution problem is the problem of a proper division of the load among the units within a thermal plant in order to minimize the fuel consumption. How to solve this challenging problem is the subject of this study.

Statement of the Problem

The load distribution problem consists of the electrical energy output which is generated by a number of units within a plant.

Each unit has a station performance characteristic or the relation of fuel consumption and generated load (input-output curve) which is not the same for all the units. The total generated load for the plant during that time is also given. The objective is to distribute the load among the units within the plant in such a way that the operation is optimal (or the fuel used is minimum) with respect to the given total load.

In the load distribution problem considered here, the station performance characteristics (input-output curve) of each unit within the plant must be pre-calculated. Since the characteristic of the thermal plant is nonlinear; i.e., the input value is the function of the output value, so it is very difficult to calculate the output value directly from the input value with the constraint of keeping the total output of all units equals to the given total load demand. For example the given total load x_L requires a distribution of $x_1, x_2, \ldots, x_n$ for an n unit plant as illustrated in Fig. 1-1. Since y_i is the function of x_i which is a nonlinear characteristic, x_i cannot be calculated from y_i directly. This causes some troubles in solving the problem by the derivative method[13,15] which will be described in Chapter III. Fortunately, y_i can be calculated easily from x_i. This is the only way to solve this load distribution problem using the technique of SUMT which will be described in Chapter III also.

This study is an attempt to develop a nonlinear programming method for solving this interesting problem.

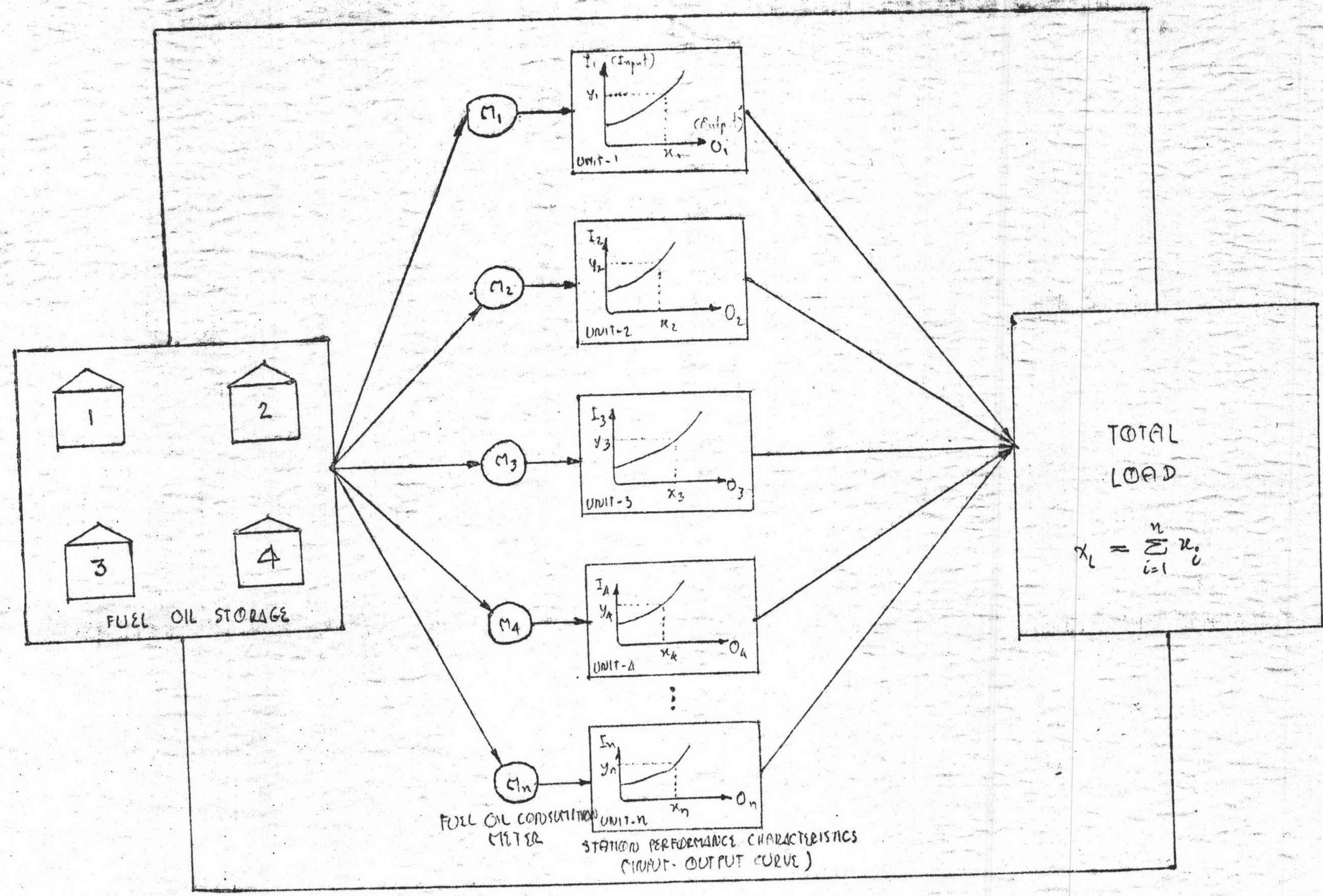

FIG. 1-1. The Thermal Power Plant.

Purposes and Objectives

This study aims at finding out a feasible load division among n units of a plant in such a way that the total fuel consumption is minimum.

The study emphasizes on the operation planning for every unit of a plant seeking to minimize the total fuel consumption of the plant while keeping its total generated load as a constant parameter equal to a given value.

In brief, the objectives of the study are listed as follows.

(a) To investigate a minimization method for the load distribution of a general thermal plant of n units;

(b) To study the existing methods and algorithms for solving the problems of this kind;

(c) To develop a SUMT method in solving a non-linear programming problem; and

(d) To apply the developed nonlinear programming model to a real economic load distribution problem.

Scope and Limitations

The present study seeks to develop a sequential unconstrained minimization technique(SUMT) for a load distribution problem and uses the practical application of this technique in the operation planning of a power plant. The study of the load distribution problem will be based on the following assumptions;

(a) No unit uses the reserved auxiliary power for the station service.

(b) The tie lines or the tie breakers among the units have negligible losses.

(c) The main step up transformers of all units have similar characteristics.

(d) The operation of each unit must follow a specific route, (e.g., no units cut off the feed-water heater system, etc.) since the efficiency of the units will be decreased and the input-output characteristic will be changed.

Plan of the Study

The load distribution problem is investigated to find out the best solution which can be used in the real world problem. The specific approach and steps of the research can be summarized as follows:

(a) In Chapter II, a brief review of the literature on load dispatching problem is given.

(b) A mathematical formulation, including the nonlinear programming and some of minimization techniques, are described in Chatper III.

(c) A new direct search method for this kind of problem is disscussed in Chapter III

(d) Practical applications of the new direct search method of nonlinear programming approach is given in Chapter IV. The South

Bangkok Thermal Plant is chosen for a case study. It includes the solution of load distribution when some of the units are shutdown.

(e) Comparative studies of the results are discussed in Chapter V.

(f) Conclusions and recommendations for future study are given in Chapter VI.