

การควบคุมการจ่ายกำลังไฟฟ้าของโรงจักรพระนครใต้
โดยใช้เชื้อเพลิงน้อยที่สุด



นาย วิชระ บุญหนัก

004540

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต

แผนกวิชา วิศวกรรมไฟฟ้า

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

พ.ศ. 2521

MINIMUM - FUEL CONTROL
OF THE SOUTH BANGKOK THERMAL PLANT

Mr Vatchara Noomahan

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering
Department of Electrical Engineering
Graduate School
Chulalongkorn University

1978

Thesis Title Minimum-Fuel Control of the
 South Bangkok Thermal Plant

By Mr Vatchara Noomahan

Department Electrical Engineering

Thesis Advisor Assistant Professor Tienchai Pradisthayon Ph.D.

Accepted by the Graduate School, Chulalongkorn University
 in partial fulfillment of the requirements for the Master's degree.

Visid Prachuabmoh
 Dean of Graduate School

(Professor Visid Prachuabmoh Ph.D.)

Thesis Committee

B. Yangthara
 Chairman
 (Doctor Boonmee Yangthara Ph.D.)

S. Sangkasaad
 Member
 (Ass. Professor Samruay Sangkasaad Dr.sc.techn.)

Tatchai Sumitra
 Member
 (Ass. Professor Tatchai Sumitra Dr.Ing.)

T. Pradisthayon
 Member
 (Ass. Professor Tienchai Pradisthayon Ph.D.)

Thesis Title	Minimum-Fuel Control of the South Bangkok Thermal Plant
Name	Mr. Vatchara Noomahan
Thesis Advisor	Dr. Tienchai Pradisthayon
Department	Electrical Engineering
Academic Year	1977

ABSTRACT

In an attempt to minimize the total fuel consumption as a common problem of load distribution of a plant consisting of n generating units, a new direct search algorithm of nonlinear programming for seeking an optimum solution is developed. It is an application of the Sequential Unconstrained Minimization Technique (SUMT) which uses the Lootsma's penalty function. The method for seeking an optimum solution used in this study is the combination of Brooks' and Rosenbrock's search methods, which has been applied to solve a real economic load dispatching problem. As a numerical example, the economic dispatching at the South Bangkok Thermal Plant is solved; and the results appear to be satisfactory.



ACKNOWLEDGEMENT

The author wishes to express his sincere gratitude to Dr. Tienchai Pradisthayon for his constant encouragements, advices and criticisms, without which this study would not have been successful. Appreciations are due to Dr. Boonmee Yangthara, Dr. Samruay Sangkasaad and Dr. Tatchai Sumitra for serving as committee members, taking interests in and offering helpful criticisms of the research. Acknowledgement is also extended to Mrs Isabel Thongsawasdi for her kind help.

Appreciations are also due to the Electricity Generating Authority of Thailand (EGAT) for permitting and supplying the necessary data for the author's Master of Engineering studies and research. Lastly, the author gladly acknowledges the computing facilities offered at the Computer Centre of EGAT installation at Bang-Gruay, Nonthaburee.

CONTENTS

	Page
TITLE PAGE IN THAI	i
TITLE PAGE IN ENGLISH	ii
THESIS APPROVAL	iii
ABSTRACT IN THAI	iv
ABSTRACT IN ENGLISH	v
ACKNOWLEDGEMENT	vi
TABLE OF CONTENTS	vii
TABLE OF ILLUSTRATIONS	x



Chapter

I INTRODUCTION	1
--------------------------	---

- Introduction
- Statement of the Problem
- Purposes and Objectives
- Scope and Limitations
- Plan of the Study

II LITERATURE SURVEY	7
--------------------------------	---

- Introduction
- Background of Economic Operation Problems
- The Survey of Methodologies

Chapter

Page

III MODEL FORMULATION 16

Introduction

Load division with Minimum Fuel Consumption

Mathematical Formulation

Solution Procedure

Nonlinear Programming Model

The Sequential Unconstrained Minimization Technique (SUMT)

New Direct Search Method to Solve Unconstrained Minimization Problem

The Decision Rule and Minimization Algorithm

Consideration of Emergency Conditions of Power Plant

IV CASE STUDY 37

The South Bangkok Thermal Plant

Data for Formulation

Formulation of the Problem

Results

The Unit Shutdown Case

V COMPARATIVE STUDIES 50

Comparison of Optimum and Non-optimum Operation

The Number of Iterations on Various Loads

Convergence Rate of the Algorithm

Chapter	Page
VI CONCLUSION AND RECOMMENDATION	54
REFERENCES	56
APPENDICES	59
A. Performance Data of the South Bangkok Thermal Plant	
B. Least Square Curve Fitting	
C. Computer Program	
D. Economic Operation on the Normal Condition	
E. Economic Operation on the Shutdown Unit Condition	
VITA	136



TABLE OF ILLUSTRATIONS

	Page
Figure 1-1. The thermal power plant.	3
Figure 3-1. Input-output curve of component station equipment and derivation of the overall station input-output curve, and the corresponding heat-rate curve.	17
Figure 3-2. Simplificated one-line diagram for each unit of power plant.	17
Figure 3-3. New direct search method.	27
Figure 3-4. The flow chart diagram of n-unit plant load distribution problem.	34
Figure 4-1. The output of each unit versus total output of the plant for economic operation.	41
Figure 4-2. The output of each unit versus total output of the plant in case of one unit shutdown.	43
Figure 4-3. The output of each unit versus total output in case of two units shutdown.	47
Figure 5-1. Optimum and non-optimum solution versus the total load demand.	51

Figure 5-2. The optimum and non-optimum energy input.	52
Figure 5-3. The iteration versus the total load demand.	52
Figure 5-4. The convergence rate of the algorithm.	53
Figure A-1. Station net heat rate performance data curve of each unit of the South Bangkok Thermal Plant.	61
Figure A-2. Station auxiliary power performance data curve of each unit of the South Bangkok Thermal Plant.	65