GUIDANCE FOR ELECTROMECHANICAL DESIGNS OF NEW PUMPING STATIONS IN NATIONAL WATER SUPPLY AND DRAINAGE BOARD

H D S Priyathilaka

(128782 E)

Degree of Master of Science in Electrical Installations

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

May 2017

GUIDANCE FOR ELECTROMECHANICAL DESIGNS OF NEW PUMPING STATIONS IN NATIONAL WATER SUPPLY AND DRAINAGE BOARD

H D S Priyathilaka

(128782 E)

Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

May 2017

DECLARATION OF THE CANDIDATE & SUPERVISORS

"I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

……

Signature Date

The above candidate has carried out research for the Masters thesis/Dissertation under my supervision.

…….. ……..

Signature of the Supervisor Date

(Prof. J P Karunadasa)

ABSTRACT

National Water Supply and Drainage Board is the largest individual customer of Ceylon Electricity Board. It has been observed that the cost of electricity and the capital cost of investment can be reduced appreciably by adapting better electromechanical design methodologies for new pumping stations. Current practice is that foreign contractors do the design and construction on secured funds with their own equipment and procedures without much of a concern of the operational cost in the long terms. This project is to identify drawbacks in the existing pumping stations and drafting design guidelines for the new pumping stations to achieve lower capital cost and operational cost. Some of the key areas considered in this thesis are given below.

Collect data such as power rating, pump type, pump operating point and the number of motors available to check whether they operate at the best efficient point and to compare whether the design requirements are fulfilled.

Main objective of the research is to develop a software guided systematic approach to electromechanical designs of new pumping stations in the NWSDB taking cost, performance, service, and maintenance factors in to consideration.

The total flow rate, static head of pumping system, number of duty pumps and standby pumps are the basic input to this software. Details of piping and accessories are to be provided additionally to calculate the total head and NPSH availability. Web base software provided by the pump manufacturers are used to select most efficient pumps for the particular application. Power transformers, standby generators, power cables and circuit breakers are selected with the use of this software. Additionally, operational cost calculation is also carried out in order to rank and select the optimum combination of pumps for cost optimization.

The web base software has been developed to analyze the existing pumping systems and to design new pumping stations while maintaining lower capital cost and operational cost.

Key words:
Pumping stations, Cost optimization, Design guidelines, NWSDB

ACKNOWLEDGEMENTS

My heartiest gratitude is granted to my supervisor Prof. J P Karunadasa who inspired me to start Masters level studies and guide me in every step to conclude the research successfully. He kept me on the track where conceptual directions were necessary to move forward and without his guiding, there wouldn't have been a research like this.

My sincere gratitude and thanks are also extended to all lectures of the Department of Electrical Engineering, University of Moratuwa for providing all the necessary facilities and guidance for all our academic activities including progress review presentations.

I specially would like to appreciate the National Water Supply and Drainage Board for technical and financial support during this work. In addition, I would like to extend my sincere thanks to all Engineers who helped me in numerous ways to collect data for this work.

My heartiest gratitude is granted to all batch mates of the Postgraduate Diploma who inspired me during the Master's program of studies and supported me in every step of the research.

I also would like to thank all personnel who gave ideas, support and encouragement to make this a success.

Finally, I owe my gratitude to my father, mother and my loving wife Achala Damayanthi De Silva for their endless support and encouragement and without which I would not have come this far.

H D S Priyathilaka

TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLE

LIST OF ABBREVIATIONS

Abbreviation	Description
CB	Circuit Breaker
CEB	Ceylon Electricity Board
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
kWh	kilo Watt hour
LKR	Lanka Rupees
LV	Low Voltage
MV	Medium Voltage
NPSH	Net Positive Suction Head
N RW	None Revenue Water
NWS&DB	National Water Supply and Drainage Board
OC	Over Current
O&M	Operation & maintenance
SCADA	Supervisory Control and Data Acquisition
VFD	Variable Frequency Drive

LIST OF APPENDICES