EFFECT OF EMBEDDED GENERATORS ON SRI LANKA POWER SYSTEM FREQUENCY FLUCTUATIONS

MASTER OF SCIENCE

L.N.W. ARACHCHIGE

DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITY OF MORATUWA
SRI LANKA

JULY 2004

Executive Summary

The purpose of this research was to review the current utility operating methods and associated technical issues, basically on frequency stability in Sri Lanka when considering embedded generation connected to distribution network, and to examine the prospects for future active operation and control of the network.

A comprehensive software based study was done which allowed identifying some prospective modifications for a more active approach to the operation of the power system to accommodate the expected amount of embedded generation that is likely to be connected in the coming decade in order to meet the government targets.

Different loading conditions based on the load curve was assed and technical issues on protection, basically Rate of Change of Frequency (ROCOF) protection and load shedding were covered in detail, and a new load shedding scheme was proposed.

Guidelines were suggested to the future modifications and control of the network. These will allow the embedded generation developers and the Ceylon Electricity Board (CEB) to maximize the potential of embedded generation and improve the utilization of their network.

DECLARATION

The work submitted in this thesis is the results of my own investigation, except where otherwise stated.

The work included in the thesis in part or whole has not been submitted for any other academic qualification at any institution.

Miss L.N.W. Arachchige — Signature — 10/08/2004

(Author) — Signature — Date

UOM Verified Signature

Dr. D.P.N. Nanayakkara — Signature — 10/08/04

(Supervisor) — Signature — Date

Executive Summary

The purpose of this research was to review the current utility operating methods and associated technical issues, basically on frequency stability in Sri Lanka when considering embedded generation connected to distribution network, and to examine the prospects for future active operation and control of the network.

A comprehensive software based study was done which allowed identifying some prospective modifications for a more active approach to the operation of the power system to accommodate the expected amount of embedded generation that is likely to be connected in the coming decade in order to meet the government targets.

Different loading conditions based on the load curve was assed and technical issues on protection, basically Rate of Change of Frequency (ROCOF) protection and load shedding were covered in detail, and a new load shedding scheme was proposed.

Guidelines were suggested to the future modifications and control of the network. These will allow the embedded generation developers and the Ceylon Electricity Board (CEB) to maximize the potential of embedded generation and improve the utilization of their network.

Acknowledgement

It is a great pleasure to thank those who were behind me in completing the research successfully.

First of all I must thank ADB, Post Graduate Division and all who decided to award me with the scholarship.

I would like to express my gratitude to Dr. D.P.N. Nanayakkara (Senior Lecturer, Dept. of Elect. Engineering, University of Moratuwa): my research supervisor for proposing such an interesting topic and for guiding me through out the research.

My special thanks go to Prof. J.R.Lucas, (Prof. of Elect. Engineering, University of Moratuwa), Dr.Jahan Peiris (Consultant, Hydro-Thusmania), Dr.Thrishantha Nanayakkara (Senior Lecturer, Dept. of Elect. Engineering, University of Moratuwa), Dr.Sarath Perera (Senior Lecturer, School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, Australia), and Dr.Ranjith Perera (Head/ Dept. of Elect. Engineering, University of Moratuwa). I would like to thank Ms Kamala Gamage for guiding me specially in using the simulation tools.

I would also like to thank Prof. P.D.C. Wijayathunga (Dean, Faculty of IT, University of Moratuwa),and all the Electrical Engineers at the CEB, who helped me in collecting the information. Thank you very much for your kind support.

Last but not least I would also like to thank all my friends Vajira, Kanchana, Lalin, Chandana, Rangika, Bandula and all the others who helped me in various ways and specially my mother and sister for encouraging me all the way through.

Miss Lidula Nilakshi Widanagama Arachchige
Department of Electrical Engineering
University of Moratuwa.

Figures & Tables

Contents