DETERMINATION OF MAXIMUM POSSIBLE LOADING CAPACITY OF A SINGLE GENERATOR UNIT: A CASE STUDY FOR THE PRESENT SRI LANKAN POWER SYSTEM

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Electrical Installations

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Declaration

I declare that this is my own work and this thesis 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.

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Signature of the supervisor: Date:
(Dr. W.D.A.S. Rodrigo)

Abstract

Present Sri Lankan power system consists of a rich energy mix and a vast diversity within all over the island, out of which hydro power generation is predominant. Even though hydro power generation is predominant and has least operational cost, the emerging consumer demand growth cannot be catered by hydro power generation only. In addition to hydro power, nearly 50% of country's energy demand is fulfilled by three number of coal power plants which are considered as largest capacity low cost thermal power plants in the country and are operated in base load basis.

Even though these large scale coal power plants are very much cost effective and have large net output power capacity, considering the system reliability, they cannot be dispatched in full load manner during certain demand conditions and different dispatch conditions which are currently practiced by Ceylon Electricity Board, which is the country's main power utility which has the authority to large scale electricity generation, transmission and distribution. The reason is when such a large generator gets tripped, the frequency stability and voltage stability would be highly vulnerable for resulting the system collapsing due to such large generation rejection from the system.

Recently the national power network has experienced several failures due to tripping of such large generators during certain demand condition under different dispatch conditions. Hence, it has become a challenging decision to determine the loading capacity of the large generators when it comes to system operations.

A model has been implemented with PSS/E software and has been validated with actual system incidents considering latest power system parameters. This validated model has been used for simulating generation rejections according to the appropriate generation percentages during all the dispatch scenarios considering worst case demand conditions. This study evaluates the capacity percentage range of the maximum loading capacity of single generator unit considering both frequency stability and voltage stability, compromising both power system operational cost and power system reliability as a case study which is carried out considering the parameters of operational guide lines of present Sri Lankan national power system.

Dedication

I dedicate this thesis to my beloved parents, who have guided and motivated me unconditionally to reach my best.

To all supporters who have encouraged me in various ways for achieving this life milestone.

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LIST OF ABBREVIATIONS

Abbreviation	Description
CEB	Ceylon Electricity Board
LECO	Lanka Electricity Company
GSS	Grid Sub Station
NCRE	Non Conventional Renewable Energy
LVPS	Lakvijaya Power Station
PSS/E	Power System Simulator for Engineers
KCCP	Kelanitissa Combined Cycle Plant
WCP	West Coast Plant
GT	Gas Turbine
Gen	Generator
T/F	Transformer
SCC	System Control Centre
PS	Power Station
UFLS	Under Frequency Load Shedding
SCADA	Supervisory Control And Data Acquisition
DFR	Digital Fault Recorder
IPP	Independent Power Producers

LIST OF APPENDICES