DETERMINATION OF OPTIMUM UNIT CAPACITIES OF FUTURE COAL POWER PLANTS IN SRI LANKA

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Abstract

In Sri Lanka, future generation plan includes number of coal power plants according to Long Term Generation Expansion Plan (LTGEP) prepared by Ceylon Electricity Board. Proportion of coal power generation is significant and hence their technology and unit size are important parameters when planning future coal power plants. Therefore, this study focuses on a methodology to determine optimum unit size of future coal power plants in accordance with LTGEP.

System stability constraint is identified as the limiting factor for larger units over conventional 300 MW size. In order to determine the constraint, off peak demand forecasting has been performed for next 20 years. Out of two forecasting methods, multiple regression analysis method is selected and based on off peak demand forecast, stability constraint is determined.

Technologies used for coal power generation are studies along with their advantages and limitations. High efficient supercritical technology is more focused and alternative options have been considered for proposed coal power units in LTGEP considering determined constraint. Accordingly, two cases are selected for financial analysis.

Discounted cash flow analysis is carried out for each case in order to compare supercritical single unit instead of two equal sized advanced subcritical units. Due to long project life time, constant cost basis is used to minimize error of financial forecast. NPV, IRR and LOCE figures were calculated and sensitivity is analysed against fuel price and selling price. Results show that high efficient supercritical unit is more economical than smaller units even under partial load operation condition at off peak period.

Therefore, high efficient supercritical plant is recommended considering other driving factors such as reduction in hazardous emissions, ash products and environmental factors. Furthermore, findings of this study can be used for other technologies as well.

Key words: unit size, regression analysis, supercritical, off peak demand forecasting

Dedication

I dedicate this thesis to my loving parents, who dedicate their life to raise me in higher level and to my ever loving wife.

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LIST OF ABBREVIATIONS

Abbreviation	Description
ASUB	Advanced Sub critical
BFBC	Bubbling Fluidizing Bed Combustion
CEB	Ceylon Electricity Board
CFB(C)	Circulating Fluidizing Bed (Combustion)
DCF	Discounted Cash Flow
GDP	Gross Domestic Production
GHG	Green House Gas
HHV	Higher Heating Value
HP	High Pressure
ID	Industrial Demand
IEA	International Energy Authority
IRR	Internal Rate of Return
LHV	Lower Heating Value
LNG	Liquid Natural Gas
LCOE	Levelised Cost of Electricity
LTGEP	Long Term Generation Expansion Plan
MAD	Mean Absolute Deviation
MAPE	Mean Absolute Percentage Error
MS	Microsoft
MSE	Mean Square Error
NPV	Net Present Value
O & M	Operation and Maintenance
PV	Present Value
SC	Supercritical
USD	United State Dollar
WASP	Wien Automatic System Planning Package