ENHANCING THE THERMAL PERFORMANCE OF THE GAS TURBINE UNIT IN KELANITISSA COMBINED CYCLE POWER PLANT USING INLET AIR EVAPORATIVE COOLERS

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Degree of Master of Engineering

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Thesis/ Dissertation submitted in partial fulfilment of the requirements for the degree of Master of Engineering in Mechanical Engineering

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DECLARATION

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.

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

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Signature of the supervisor: ………………… Date: ……………….

ACKNOLEGEMENT

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ABSTRACT

This project report presents a study on the potential benefits of using an evaporative cooling system to reduce the temperature of the air entering the gas turbine at the Kelanitissa Combined Cycle Power Plant in Sri Lanka. The study was motivated by the fact that the plant's capacity is reduced during periods of high ambient temperature due to the decrease in air density and mass flow rate to the gas turbine.

The study began with a literature survey on gas turbine inlet air cooling methods, advantages and disadvantages, theoretical background, and gas turbine operation. Next, field measurements and historical data were obtained to develop a relationship between ambient temperature and turbine performance. Energy calculations were then performed to determine the required level of inlet air temperature and to select a suitable evaporative cooler. Finally, a technical and economic feasibility study of the system was conducted.

The study found that an evaporative cooling system has the potential to significantly improve the thermal performance of the Kelanitissa Combined Cycle Power Plant. By reducing the temperature of the air entering the gas turbine, the system can increase power output, improve thermal efficiency, and reduce fuel consumption. Additionally, the system is cost-effective and has a relatively short payback period.

Based on the findings of the study, it is recommended that an evaporative cooling system be installed at the Kelanitissa Combined Cycle Power Plant. The system would provide significant benefits to the plant and the country as a whole, including increased power generation capacity, improved efficiency, reduced fuel consumption, and lower emissions.

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Abbreviation	Description
GT	Gas Turbine
ST	Steam Turbine
HRSG	Heat Recovery Steam Generator
NG	Natural Gas
HFO	Heavy Fuel Oil
KCCPS	Kelanitissa Combined Cycle Power Station
GE	General Electrical
RH	Relative humidity
WBT	Wet Bulb Temperature
DBT	Dry Bulb Temperature
CPD	Compressor Discharge Pressure
BTU	British Thermal Unit
MR	Mechanical Refrigeration
hr	Hour
cfm	Cubic Feet Per Minutes
Lkr	Sri Lankan Rupees
USD	United State Dollers