DEDICATION

TO MY MOTHER

TO MY FATHER

TO MY BELOVED, WHO

CONSTANT PRAYER, SACRIFICE

AND INSPIRATION LED TO THIS

WONDERFUL ACCOMPLISHMENT

ACKNOWLEDGMENT

All praises and thanks are due to **ALLAH (Subhanaho WA taala)** for bestowing me with health, knowledge and patience to complete this work.

Thereafter, acknowledgements are to **GARRI combined cycle power plant.**

Thanks to my supervisor:

Dr. Ali Mohammed Hamdan

For his assistance, guidance and endless help throughout the step of this research work.

May sincere thanks to:

Mr. Yousif Khalfalla Dafalla Abderahman

Mr. Yousif Ahmed Abdalkarium

Thanks for any one help me to make this work.

Abstract

The cooling lubrication oil of the turbine gas in GARI Thermal Station (1and 2) depends on the passage of the lubricating oil outside the tubes of the heat exchanger, and the cooling water from the cooling towers go to the inside of the pipes in the heat exchanger.

It is an open system which makes the control of the treatment of the cooling water difficult. This system suffers from the effectiveness of the cooling because of the layer of lime salts building around the membrane tube, this layers is growing with time, and become as an insulator for heat exchange and cause the increment of the temperature of the lubricating oil, which affects the stability of the production of gas turbine.

This research attempted to solve this cooling problem. It was done by examining the user's cooling system, and then changes the system to a new system.

The new system is based on a closed system with treated cooling water to cool the lubricating oil. Then the treated water is cooled by the water coming from the cooling towers.

This done by adding a flat heat exchanger, which was designed, and then was chosen from among a large number of thermal flat exchangers The lubricating oil entering at 70 ºC and leaves at 49 ºC and cooled by the treated water that enters at 33 ºC and leaves at 43 ºC. While the cooling water from the cooling towers at 31 ºC cooled the treated water and leaves at 32.5 ºC. The effectiveness of the new system was confirmed by using computational fluid dynamics program.

The results show the consequences effective heat exchange between the lubricating oil and cooling water and matching the temperature degrees of the design heat exchanger. It was then worked out a model illustrates the new cooling system with full accessories.

The cost of the production of the new system is found to be equivalent to the cast of loss of production due to gas turbine cooling system for a period of 9 days and 3 hours.

الملخص

يعتمد تبريد زيت التزييت للتوربينة الغازية في محطة قري (1و2) الحرارية علي مرور زيت التزييت خارج أنابيب المبادل الحراري، وتمر مياه التبريد القادمة من ابراج التبريد الي داخل الانابيب في المبادل الحراري، وهو نظام مفتوح يصعب معه التحكم في معالجة مياه التبريد.

يعاني هذا النظام من عدم فعالية التبريد لتكون طبقة من الاملاح الجيرية حول غشاء الانبوب، وتتزايد هذه الطبقة بمرور الزمن، مما يكون عازل للتبادل الحراري يعمل الي ارتفاع درجة حرارة زيت التزييت الذي يؤثر علي استقرار انتاج التوربينة الغازية.

عمل هذا البحث علي حل مشكلة التبريد هذه. تم ذلك عن طريق دراسة نظام التبريد المستخدم، ومن ثم تغيير هذا النظام بنظام جديد مغلق.

يعتمد النظام الجديد علي نظام مغلق لمياه التبريد المعالجة والتي تعمل علي تبريد زيت التزييت، ومن ثم يتم تبريد هذه المياه عن طريق المياه القادمة من ابراج التبريد وذلك باضافة مبادل حراري مسطح، تم تصميمه، ومن ثم تم اختياره من بين عدد ضخمة من المبادلات الحرارية المسطحة.

تم تصميم مبادل تبريد زيت التزييت على دخول الزيت عند 70 درجة سيلزيوس وخروجه عند 49 درجة سيلزيوس، ويبرد بمياه التبريد المعالجة التي تدخل عند 33 درجة سيلزيوس وتخرج عند 43 درجة سيلزيوس. بينما يتم تبريد مياه التبريد المعالجة عن طريق مياه التبريد القادمة من ابراج التبريد التي تدخل عند 31 درجة سيلزيوس وتخرج عند 32.5 درجة سلزيوس.

تم التأكد من فعالية النظام الجديد عن طريق برنامج حوسبة ديناميكا الموائع، والذي اوضح من نتائجه فعالية التبادل الحراري، وذلك من خلال نتائجه لمخطط درجة الحرارة التدريجي، الذي اوضح التبادل الحراري بين زيت التزييت ومياه التبريد ومطابقة الحالة لدرجات الحرارة التصميمية.

ومن ثم تم عمل نموذج يوضح نظام التبريد الجديد بكامل ملحقاته. وتم حساب تكلفة الانتاج بالنسبة للنظام الجديد. ،وجد ان خسارة انتاج التوربينة الغازية بسب نظام التبريد لمدة 9 ايام و3 ساعات يعادل تكلفة انشاء النظام الجديد.

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List of Symbols

Symbols	Means	Unit
K p	Specific Heat at Constant Pressure	J/kg. K
T	Temperature	°C ‘ K
μ	Thermal Efficiency	-
P	Pressure	Pa
U	Overall Heat Transfer Coefficient	W/m^2. K
F_t	log Mean Correction Factor	-
$\dot{m}_h$	Mass Flow of Hot Fluid	kg/sec
$\dot{m}_c$	Mass Flow of Cold Fluid	kg/sec
C_{ph}	Specific Heat at Constant Pressure of Hot Fluid	J/kg. K
C_{pc}	Specific Heat at Constant Pressure of Cold Fluid	J/kg. K
T_{hi}	Inlet Temperature for hot fluid	°C ‘ K
T_{ho}	Outlet Temperature for Hot Fluid	°C ‘ K
T_{ci}	Inlet Temperature for Cold Fluid	°C ‘ K
T_{co}	Outlet Temperature for Cold Fluid	°C ‘ K
Q	Heat Transfer Rate	W
Q_c	Heat Transfer Rate for Cold Fluid	W
Q_h	Heat Transfer Rate for Hot Fluid	W
dT	Change of Temperature Range	°C ‘ K
N_t	Total Number of Tube	M
D_o	Out Diameter	M
L	Length of Tube	M
LMTD	Logarithmic Mean Temperature Difference	°C ‘ K
T_f	Average Temperature	°C ‘ K
H	High of Plate	M
W	Width of Plate	M
D_e	Equivalent Diameter	M
Re	Reynolds Number	-
M_f	Dynamic Viscosity	Pa.s
Nu	Nusslat Number	-
Pr	Brintal Number	-
h	Heat Transfer Coefficient	W/m^2. K
k	Thermal Conductivity	W/m. K
P	Power	W

W	Specific Volume	N/m^3
$\dot{V}$	Flow Rate	m^3/s
g	Gravity	m/s^2
ΔP	Pressure Drop	Pa
v	Velocity	m/s
A	Total area of Tube Side Heat Exchanger	m^2
x	Thickness of Plate	M
b	Distance between two Plates	M

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Abbreviations

HPT	High Pressure Turbine
LPT	Low Pressure Turbine
STPS	Super Thermal Power Stations
71QH-1	Alarm when lube oil tank level high
71QL-1	Alarm when lube oil tank level low
88QE	Main lube oil pump
23QT-1	Connect heater circuit
23QT-2	Heat lube oil temp increase
26QL-1	Open circuit of heater
26QN-1	Lube oil tank temp normal
26QT	Lube oil header temp high trip
26QA	lube oil header high temp alarm
63QA	Low lube oil pressure alarm
63QT	Low lube oil header pressure trip
63QL	Low lube oil pressure emergency pump start
TDS	Total Dissolved Solids
PHEs	Gasket plate heat exchangers
PHE	plate heat exchanger
LMTD	Logarithmic Mean Temperature Difference
NTU	Number of Transfer Unit
VPR1	Hydraulic trip pressure regulator valve
VPR 2	Lube oil header pressure regulator
TSI	Texas Success Initiative
LVDT	linear variable differential transformer