

الآية

(وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ

وَالْمُؤْمِنُونَ وَسْتَرَّوْنَ إِلَى عَالِمِ الْغَيْبِ وَالشَّهَادَةِ

فَيُنَبَّئُكُمْ بِمَا كُنْتُمْ تَعْمَلُونَ)

صدق الله العظيم

التوبة(105)

DEDICATION

This work is dedicated to my beloved parents, who have always loved me unconditionally and whose good examples have taught me to work hard for the things that I aspire to achieve. Also I dedicated to all the people in my life who touch my heart.

ACKNOWLEDGMENT

In the Name of Allah, the Beneficent, the Merciful first praise is to Allah, the Almighty, on whom ultimately we depend for sustenance and guidance. Second my sincere gratitude goes to my supervisor:**Ustaz. Abdalla Salih Ali**, whose encouragement, guidance and support were really valuable during every stage of this research.

I offer my regards to the faculty of engineering, Omdurman Islamic University, its leadership and the staff for providing me with an academic base, which has enabled me to take up this study. I also offer my regards to the School of Electrical and Nuclear Engineering, Sudan University of Science and Technology.

Finally, I would like to express the profound gratitude to my beloved family and friends who supported me in any respect during the completion of the research.

ABSTRACT

A simulation study of the main steam (steam inlet to the turbine) temperature control system shows that this control strategy is effective. Using microcontroller which is programmed using the PROTUS.

Simulation program to control temperature of the main steam, the microcontroller compare the actual temperature value with set point temperature value, if the temperature is high microcontroller send command to the control valve which will open with certain percentage according to the difference between two temperature and the spray water starting blowdown through the nozzle to cool down the temperature of the steam .

المستخلص

التحكم في درجة حرارة بخار التوربينه من الأمورالمهمة التي يجب أخذها في الإعتبار عند تشغيل وحدات الغلايه، درجة حرارة التوربينه يجب أن تكون مستقرة لتحقيق أعلى كفاءة تشغيل للتوربينه وتجنب حدوث الضرر على ريش التوربينه وتدميرها. ضبط كمية معينه من ماء التبريد والتي تقوم بتبريد البخار الرئيسي قبل دخوله للتوربينه وذلك عن طريق إختلاط ماء التبريد مع البخار الرئيسي عن طريق الفوهات الموجودة على الأنابيب الحامل للبخار.

إستخدمت دراسة المحاكاة لنظام التحكم في درجة حرارة البخار الرئيسي (البخار الداخل للتوربينه) في هذه الأطروحة، وتمت المحاكاة عن طريق استخدام الحاكمة الدقيقة المبرمجة والمتضمنة في برنامج البروتوس للمحاكاة.

برنامج المحاكاة مستخدم للتحكم في درجة حرارة البخار الرئيسي، والمتحكم يقوم بمقارنة قيمة درجة الحرارة الفعلية مع قيمة درجة الحرارة المرجعية، إذا كانت درجة الحرارة عالية يقوم المتحكم بإرسال أمر إلى صمام التحكم والذي يقوم بفتح الصمام بنسبة معينة وفقا للإختلاف بين درجة الحرارة. بعد ذلك يبدأ الماء المستخدم لرش البخار بغرض التبريد بالإنسياپ من خلال فوهه الأنابيب لخفض درجة حرارة البخار.

TABLE of CONTENTS

Contents	page
الأية	i
Dedication	ii
Acknowledgement	iii
Abstract	iv
المستخلص	v
Table of Contents	vi
List of Figures	ix
List of Tables	x
CHAPTER ONE - INTRODUCTION	
1.1 General	1
1.2 Problem Statement	1
1.3 Objective	2
1.4 Methodology	2
1.5 Thesis Outline	2
CHAPTER TWO-TURBINE AND CONTROL SYSTEM	
2.1 Previous Study	3
2.2 A Steam Turbine	4
2.3 Classification Of Steam Turbines	5
2.3.1 The impulse type steam turbine	5
2.3.2 The reaction type steam turbine	6
2.4 Steam turbine parts	6
2.4.1 Thrust bearings and squealer rings	6
2.4.2 Shaft couplings	6
2.4.3 Turbine bleeder	7
2.4.4 The governer	7
2.4.5 Gland seal	8

2.4.6 The steam strainer	8
2.4.7 Main stop valve	8
2.5 Control System	10
2.5.1 Open loop and closed loop System	10
2.5.2 Classical and modern control system	12
2.6 Microcontroller	13
2.6.1 Higher integration	14
2.6.2 Atmel® 16 Microcontrollers	16
2.6.3 Applications for atmel microcontrollers	17
CHAPTER THREE-THERMAL SYSTEM	
3.1 Introduction	19
3.2 Steam Superheat Temperature Control	20
3.3 Process Description	20
3.3.1 Open-loop control	21
3.3.2 Closed-loop control	21
3.4 Desuperheating System	21
3.5 Desuperheater type	22
3.5.1 Indirect type	22
3.5.2 Direct type	24
3.6 Factor Affected On The Water Spray Desuperheaters	25
3.6.1 Particle size	25
3.6.2 pipeline size	26
3.6.3 Turbulence	26
3.6.4 Pressure drop across the nozzle	26
3.6.5 Spray water temperature	27
3.6.6 Velocity	27
3.6.7 Cooling water flow rate	28
CHAPTER FOUR-System Simulation and Results	
4.1 Simulation Modeling	32
4.2. System Identification	32
4.3 System Analysis	35
4.3.1 Stage one	37

4.3.2 stage two	37
4.3.3 Stage three	38
4.3.4 Stage four	38
4.4 Discussion	39
CHAPTER FIVE-CONCULSION AND ECOMMENDATIONS	
5.1 Conclusion	40
5.2 Recommendations	40
References	41
Appendix-A	A

LIST of FIGURES

Figure	Title	Page
2.1	The main parts of steam turbine cutaway	9
2.2	Open loop Control System	11
2.3	Closed-loop Feedback System with External Disturbances and Measurement Noise	12
2.4	Microcontroller	17
2.5	Microcontroller pin configuration	18
3.1	Steam superheat temperature control process Description	23
3.2	A typically indirect shell and tube desuperheating type	24
3.3	A typical direct contact desuperheating type	25
3.4	Variable area orifice	30
3.5	A thermal sleeve inserted in an in line spray desuperheater	30
4.1	PROTUS simulink model for control temperature	34
4.2	The flow chart of control process discription	36

LIST of TABLES

Table	Title	Page
4.1	stage one desuperheating result	37
4.2	stage two desuperheating result	37
4.3	Stage three desuperheating result	38
4.4	stage four desuperheating result	38

LIST of ABBREVIATION

Abbreviation	Description	Page
CPU	Central Processing Unit	14
DSP	Digital Signal Processor	14
EEPROM	Electrically Erasable Programmable Read-Only Memory	14
EPROM	Erasable Programmable Read-Only Memory	14
MFT	Main Fuel Trip	21
μ C, uC or MCU	Microcontroller	13
ODE	Ordinary Differential Equation	13
PID	Proportional-Integral-Derivative	4
RAM	RandomAccess Memory	13
ROM	read only memory	13
RH	Reheat	4
RC	Resistor-Capacitor Circuit	15
UARTs	Universal Asynchronous Receiver/Transmitter	15