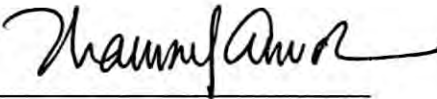


"I declare that I have read this thesis and in my opinion, it is sufficient in term of scope and quality for the award of the Bachelor Degree of Mechanical Engineering (Design And Innovation)

Signature : 
Supervisor : Mr. Shamsul Anuar Bin Shamsudin
Date : 5 MEI 2007

**THE IMPROVEMENT AND FABRICATION OF NEW BREATHER VALVE
IN OIL AND GAS INDUSTRY**


AZRIN BIN MOHAMAD EFFANDY

A project report is submitted to the Faculty of Mechanical Engineering in partial
fulfillment of the requirements for the award of the Bachelor Degree
of Mechanical Engineering (Design And Innovation)

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

Date : 5 MEI 2007

I hereby declare that this thesis entitled
**“THE IMPROVEMENT AND FABRICATION OF NEW BREATHER VALVE
FOR OIL AND GAS INDUSTRY”**
is the result of my own research except as cited in the references.

Signature : 
Name : AZRIN BIN MOHAMAD EFFANDY
Date : 5 MEI 2007

To my beloved Bapak and Emak, Mohamad Effandy and Zaridah Zaini,

Thank you for your support..

Acknowledgement

Alhamdulillahilahirabilalamin...The Projek Sarjana Muda would not have been successful without the support and cooperation to me by the people that surround me .Therefore, I would like to take this opportunity to express my sincere gratitude to those who are willing to help me without failing to motivate me and give me many encouragements to complete my Projek Sarjana Muda on the period given.

Primarily, my Supervisor, Mr Shamsul Anuar B Shamsudin, the Head of Design and Innovation Department, who has been giving so much support in providing me with his invaluable advice and guidance and for sparing his time to me for consultation and discussion in the tasks undertaken during my PSM period. My deepest thanks to him for being very patient especially during answering my questions and helpful throughout the period in 4Sem1.

Thank you once again to Mr. Shamsul Anuar B Shamsudin for providing me with many positive remarks, which has boosted my spirit and has increased my enthusiasm in making my choice for my future career path.

I would like to express my appreciation to the Mechanical Engineers and Technicians whom I had worked for throughout my project in PSM 1.

Also I would like to extend my appreciation to Mr Saiful the Operation Engineer and Mr Rashid Hj Monek The Senior Operation Engineer in Miri Crude Oil Terminal in

Sarawak for their support and fruitful information regarding the Breather Valve Project, Mr. Isa for his help regarding the format of PSM. I had a wonderful experience working with them in completing the tasks.

My sincere thanks are due to all the Mechanical & Process Unit staffs who continuously gave me support and provided me with a lot of valuable information to enhance my skills and to survive in this tasks. Without their valuable input, it would have been tough for me to find the tune and the rhythm to be successful in completing my project regarding the Breather Valve.

A deepest thank to all of them for giving me moral support and providing me with many advices to be successful in life as a whole.

Finally, to the Almighty God, Allah Hu Akhbar, the source of my life, wisdom, and hope for giving me the strength and patience to pursue this training.

ABSTRACT

The paper works or report of Breather Valve covers all on-the-job needed in order to reach the objectives and purpose of the study.

During the period of developing the report, the purpose of this study is reached such as:

1. To investigate the weaknesses of current Breather Valve
2. To add and redesign the Breather Valve with fire protection equipment which can help to reduce the probabilities of fire in the tank
3. The purpose of this study is also to develop and enhance a safety environment to the workers and save the oil production in the oil and gas terminal
4. Develop improvement systems in term of design and pattern in order to solve the weakness using computer aided design (CAD).

Maintenance guidelines recommendations are proposed based on the experimental results and (therefore) this report conforms to Universiti Teknikal Malaysia Melaka Faculty's standard guidelines in preparing Projek Sarjana Muda's report.

ABSTRAK

Kertas kerja atau laporan tentang Injap Pernafasan Pelepasan Tekanan merangkumi maklumat dan cara-cara tugas dijalankan untuk mencapai objektif dan tujuan penyelidikan.

Semasa tempoh mempersiapkan laporan, tujuan penyelidikan ini untuk :

1. Untuk menyiasat kelemahan yang ada pada Injap Pernafasan Pelepasan Tekanan pada masa ini
2. Untuk menambah dan mereka bentuk semula Injap Pernafasan Pelepasan Tekanan dengan alat keselamatan pemadam api di mana alat ini boleh membantu mengurangkan kebarangkalian kebakaran dalam tangki penyimpanan minyak.
3. Tujuan penyelidikan ini juga untuk memperbaiki and meningkatkan ciri-ciri keselamatan di tempat kerja kepada pekerja-pekerja dan juga menyelamatkan pengeluaran minyak dan gas di terminal.
4. Meningkatkan dan membaiki sistem dari segi rekabentuk dan hak cipta rekabentuk untuk menyelesaikan masalah kelemahan Injap Pernafasan Pelepasan Tekanan dengan menggunakan Computer Aided Design (CAD)

Cadangan panduan penyelenggaraan akan dicadangkan mengenai keputusan kajian dan laporan ini akan mengikut standard panduan yang dikehendaki oleh Universiti Teknikal Malaysia Melaka dalam menyediakan laporan Projek Sarjana Muda

CONTENT OF TABLE

CHAPTER	PAGES
CHAPTER 1	
INTRODUCTION	
1.1 Definition	1
1.2 PSM Mission	2
1.3 PSM Objectives	2
1.4 Purpose of the study	4
1.4.1 Research goals	4
1.4.2 Limitations of the study	4
1.5 Definition of terms	5
1.5.1 Behavior questions	5
1.5.2 Mistake	5
1.5.3 Breather Valve	6
1.5.4 The functions of Breather Valve	7
1.5.5 Currently Breather Valve	8
1.5.6 The component parts of Breather Valve	8
1.5.7 Breather Valve Configuration	9
1.6 Concept	10
1.6.1 Valve Operation	10
1.6.2 Storage Tank	12
1.7 Literature Review	13
1.7.1 History of Valve	13
1.7.2 Background	14
1.7.3 Types of Breather Valve	16
1.8 Problem Definition	17
1.8.1 Scenario	18

1.9	Objective of the project	19
1.9.1	Objective Tree of new Breather Valve	20
1.10	Solution of the problem	21
1.11	Significant of the research	22

CHAPTER 2

RESEARCH

2.1	Characteristic of Crude Oil	23
2.2	Factor of Ignition	24
2.2.1	Flame	24
2.2.2	Heated Surface	24
2.2.3	Electric Sparks	25
2.2.4	Water	25
2.2.5	Lightning	26
2.3	Minimum Spark Ignition Energy For Various Fuels	26
2.4	Protection Equipment For New Breather Valve	27
2.4.1	Flammable-Gas Detection	27
2.4.2	Sprinkler Systems	28
2.4.3	Foam Systems	29
2.5	Standards And Guidance Cod	31
2.5.1	Breather Valve Seat Tightness Standards	31
2.5.2	Sprinkler-system	33
2.5.3	Foam System Standard	33
2.6	Theory of the Breather Valve	34
2.7	Free Body Diagram	35
2.8	Formula for the Equilibrium Force Balance	36
2.9	Formula for the Equilibrium Moment Balance	38
2.10	Formula for the Equilibrium Moment Balance Equation	40
2.11	Material Analysis	42
2.11.1	Chemical Analysis	42
2.11.2	Tensile Test	42

2.11.3	Hardness Test	43
2.12	Chemical Composition	43
2.13	Mechanical Properties	44

CHAPTER 3

METHODOLOGY

3.1	Project Plan	46
3.2	Design	47
3.2.1	Design Presentation	47
3.2.2	Sketch	47
3.2.3	Design Methodology and Concept Development	48
3.2.4	Flow Chart of Design and Fabricate Breather Valve	49
3.2.5	Selection for new design of Breather Valve	51
3.2.6	Selection of Fire-arrester (Sprinkler)	51
3.2.7	Specifying Sprinklers Procedure	52
3.3	Developing Concept From Function	52
3.4	Morphological Chart	55
3.5	Conclusion	58
3.6	Future Work	58

CHAPTER 4

ANALYSIS

4.1	Data Analysis of Breather Valve, Spring, Ball Melted and Spring	59
4.2	Analysis of Breather Valve Body	60
4.3	Analysis of Foam Sprinkler	64
4.3.1	Problem	65
4.3.2	Calculation	65
4.3.3	CATIA ANALYSIS	66
4.4	Analysis Of Melted Ball	69
4.4.1	CATIA Data Analysis	70

4.4.2	ANSYS CAE Data Analysis	71
4.4.3	Summary of Melt Ball Analysis	72
4.5	Analysis of Spring	73
4.5.1	Expansion of Air from atmosphere against a Spring Calculation	73
4.5.2	Problem	75
4.5.3	Summary of the Spring Analysis	77
CHAPTER 5		
DISCUSSION		
5.1	Mechanism of the New Product	78
5.2	Detail Design	79
5.3	Breather Valve Dimension in mm	82
5.4	Sprinkler Dimension in mm	83
5.5	Function of Each Part	84
5.6	Bill of Material for New Breather Valve	85
5.7	Model of Breather Valve	86
5.8	Fabrication of Sprinkler	87
5.9	Design Concept Selection for Improve Design	88
5.9.1	Introduction	88
5.9.2	Selection criteria	88
5.9.3	The Process and Material Selection Procedure	88
5.9.4	General Design Guidelines for New Breather Valve	89
5.10	Suggested material for new Breather Valve component	90
5.11	Picture of Breather valve installation on the tank	91
5.12	Picture of Chemical Foam Released	92
5.13	Conclusion	93
5.13.1	Report	93
5.13.2	Fabrication Process	93
Appendix		95

CONTENT OF FIGURE

NO.	TITLE	PAGE
Figure 1.1	Industrial Internship Training	4
Figure 1.2	Breather Valve	6
Figure 1.3	Breather Valve System	7
Figure 1.4	The component parts of Breather Valve	8
Figure 1.5	Pressure Relief to Atmosphere Vacuum Relief from Atmosphere	9
Figure 1.6	Pressure Relief to Atmosphere	9
Figure 1.7	Vacuum Relief from Atmosphere	9
Figure 1.8	Factor of uninstalation of breather valve	11
Figure 1.9	Example of Breather Valve Normally Use In the Oil & Gas Terminal (Model of Breather Valve)	16
Figure 1.10	The current Breather Valve without fire-Arrester	17
Figure 1.11	Fire occurred after lightning striking the breather Valve	18
Figure 1.12	Fire released	18
Figure 1.13	The breather separated from the pipe	18
Figure 1.14	The contained oil fire	18
Figure 1.15	New Breather Valve will act as a fire-arrester	21
Figure 2.1	New Breather Valve also acted as a fire-arrester or sprinkle	34
Figure 2.2	Free Body Diagram	36
Figure 2.3	Pressure Distribution On Incremental	

	Area Element of Disc	38
Figure 4.1	Breather Valve	60
Figure 4.2	Temperature field symbol	61
Figure 4.3	Temperature field fringe	62
Figure 4.4	Deformed Mesh	63
Figure 4.5	Von Mises Stress (nodal values)	63
Figure 4.6	Chemical Foam Flow	64
Figure 4.7	Deformed Mesh	67
Figure 4.8	Von Mises Stress (nodal values)	68
Figure 4.9	Nodes and Elements	70
Figure 4.10	Strain principal tensor component (nodal values)	70
Figure 4.11	Local strain energy	71
Figure 4.12	Temperature	71
Figure 4.13:	Melt Ball melting point color	72
Figure 5.1	Transparent View	79
Figure 5.2	New Breather Valve	79
Figure 5.2	Explode Design	80
Figure 5.3	Combination part of sprinkler	81
Figure 5.4	Model of Breather Valve	86
Figure 5.5	Upper View	86
Figure 5.6	Prototype of sprinkler	87
Figure 5.7	Wrapping process	87
Figure 5.8	Fiber-glass drying process	87
Figure 5.9	Before installation of sprinkler for fire protector	91
Figure 5.10	After installation of sprinkler and foam pipeline connection	91
Figure 5.11	Chemical Foam Flow	92

CONTENT OF TABLE

NO.	TITLE	PAGE
Table 1.1	Planning of PSM	3
Table 2.1	Spark Ignition Value	26
Table 2.2	Actual chemical composition of the shaft sample	42
Table 2.3	Tension test analysis	42
Table 2.4	Hardness test analysis	43
Table 2.5	Chemical compositions for AISI 41XX steels	44
Table 2.6	Mechanical properties of AISI 41XX steels	45
Table 3.1	Function	52
Table 3.2	Subfunction Part	53
Table 3.3	Subfunction of Material	54
Table 3.4	Concept design of Breather Valve	55
Table 3.5	Concept design of Breather Valve	56
Table 3.6	Concept design of Breather	57
Table 4.1	Physical Properties	59
Table 4.2	Material Properties for melting point	60
Table 4.3	Materials.1 : Make description	61
Table 4.4	Equilibrium Result	62
Table 4.4	Result Analysis of Energy	63
Table 4.5	Result Analysis of Mesh	65
Table 4.6	Result Analysis of element	66
Table 4.7	physical properties of brass material's result	66

Table 4.8	Result Analysis for equilibrium	67
Table 4.9	Physical properties of Lead	69
Table 4.10	Table of Lead physical properties from the result	70
Table 4.11	Result data from ANSYS	72
Table 5.1	Function for every part of breather valve	84
Table 5.2	bill of material	85
Table 5.3	Final Selection of Material and Process	90

NOMENCLATURE

h	distance from the seal to applied the load	L	length
F	force applied load	D	Diameter
P	system pressure	Q	volume flow rate
r	radius of sealing area (disc insert)	Ep	pump energy
c	distance from the center axis to applied load	A	area
F_f	Frictional force	P	Power
$F\sin\theta$	Vertical Force	V	velocity or volume
$F\cos\theta$	Horizontal Force		
P_m	maximum pressure along seal		
r	Disc radius		
Δ_r	radial length of sealing surface		
θ	angular location on		
$d\theta$	incremental angle		
D	Diameter of the disc.		
Π	pai (3.142)		
v	Volume flow rate		
γ	gamma specific unit		
h_L	total head loss		

CHAPTER 1

INTRODUCTION

1.1 Definition

Definition of Projek Sarjana Muda focuses on research and scientific which involving the studies in Faculty which must be prepared by student as a requirement to get the Bachelor's degree.

Projek Sarjana Muda or PSM are required to fulfill the condition in order to get the Bachelor Degree, every students have to complete one of the project like research and investigation which involving one of the important title in every subjects. This project is compulsory for all final year student in Mechanical Engineering Faculty to be awarded a Bachelor Degree.

In the process of studying, student are already taught with the basic of mathematics and engineering knowledge. Students are also exposed to the application of knowledge and practical from the lab studies and also during the 20 weeks internship training .This program also helping the student to develop skills in work ethics, writing, and management towards attaining Universiti Teknikal Malaysia Melaka (UTeM) mission in producing well-rounded graduates who possess technical competence, communication and behavioral skills, lifetime learning capacity, critical thinking, business acumen, practical aptitude and solution synthesis ability.

After getting the basic of education, students are required to complete the project or thesis in order to increase more knowledge and their skill in domains especially with the problem occurred and find out the solution of the problem.

1.2 PSM Mission

The mission of PSM is to develop the knowledge and skill for every student in overcoming the problem occurred by researching and scientific in order to produce quality, competence and very professional student.

1.3 PSM Objectives

Students have the ability to relate theoretical knowledge learned in university and practical during 20 weeks internship training with application in the project.

Develops skills in work ethics, communication, writing, and management towards attaining Universiti Teknikal Malaysia Melaka (UTeM) mission in producing well-rounded graduates who possess technical competence, communication and behavioral skills, lifetime learning capacity, critical thinking, business acumen, practical aptitude and solution synthesis ability.

Students need to have an opportunity to get a better understanding on the theoretical learned by having hands on experience on practical application in the industry since the university is providing students with theoretical knowledge.

Students are required to interface the theoretical knowledge gained in Universiti Teknikal Malaysia Melaka (UTeM) with practical application in project. During the Projek Sarjana Muda, students are able to consult with supervisor or lecturer. The student can develop the level of confidence or improve the communication skills when they interact or communicate with supervisor.

TITLE: Breather Valve

TASK	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	WK13	WK14	WK15
1. Literature Review on Breather Valve	[Shaded]												
1. Find out the problem definition of Breather Valve		[Shaded]											
3. Problem Solution				[Shaded]									
4. Selection on part of new Breather Valve						[Shaded]							
2. Sketch & Design the part using the CATIA(CAD)								[Shaded]					
6. Report Writing												[Shaded]	
~ Introduction												[Shaded]	
~ Literature Review												[Shaded]	
~ Problem Definition and Solution												[Shaded]	
~ Methodology												[Shaded]	
~ Discussions												[Shaded]	
~ Conclusion												[Shaded]	
7. Preparation for Seminar I													[Shaded]

Remarks:

[Shaded]	Planning
[Shaded]	Actual (In Planning)
[Shaded]	Actual (Out of Planning)

1.4 Purpose of the study

This study identifies and to improve the weakness of current breather valve possible that can cause fires or explosions during tankers' cargo loading and unloading operations at the petroleum terminal or by other ignition resources. Risk control solutions are developed to minimize the fire hazard.

1.4.1 Research goals

1. Identify possible types of feebleness of current breather valve that can cause fires or explosions during tankers' cargo loading and unloading operations.
2. Provide risk control solutions to the identified problems.
3. Enhance the safety environment in the petroleum terminal

1.4.2 Limitations of the study

1. This study is based on the experiences during 20 weeks internship training in Miri Crude Oil Terminal (MCOT), Miri, Sarawak as shown in **Figure 1.1**
2. Interviews and questionnaire with the staff of MCOT and the MCOT Fire And Rescue Team (MFRT) (PETRONAS Fireman).



Figure 1.1: Industrial Internship Training

1.5 Definition of terms

1.5.1 Behavior questions:

Questions that ask about the way the MCOT Fire And Rescue Team (MFRT) to stop the fire which can occur anytime inside the breather valve.

1.5.2 Mistake

There are no fire protection installed in order to stop the fire on the top of storage tank and the MCOT Fire And Rescue Team has to come out by spraying the chemical foam by using a hose nozzle from the bottom of the storage tank. Sometime the staffs of the MCOT including the MCOT Fire & Rescue team can not expect the fire can occur anytime especially during heavy rain storm and heat weather because of the area of the terminal is very big and wide to take care and there is no electronic detector equipment because these equipment are not allow to be installed on the oil storage tank.

1.5.3 Breather Valve

Breather valve is a protection tool mounted which installed on the nozzle opening on the top of a fixed roof of storage tank. The purpose of the breather valve is to protect the tank from fully loaded of pressure or rupturing. If there are no breather valve installed, it can cause the tank rupture under increasing pressure which caused by pumping crude oil into the tank which is pumped from the offshore or as a result of vapor pressure changes caused by thermal changes. Imploding or the collapsing of a tank occurs during the pumping out procedure or thermal changes. As the liquid level lowers, the vapor space pressure is reduced to below atmosphere pressure. This vacuum condition will be controlled by allowing atmosphere air to flow into the tank. So the tanks need to breathe in order to eliminate the possibility of rupturing or imploding. Because of its function, this component also known as Pressure Relief Valve. There are many types and brands of Breather Valve in the market where it is used widely in the oil and gas terminal in the whole world now as shown in **Figure 1.2**.

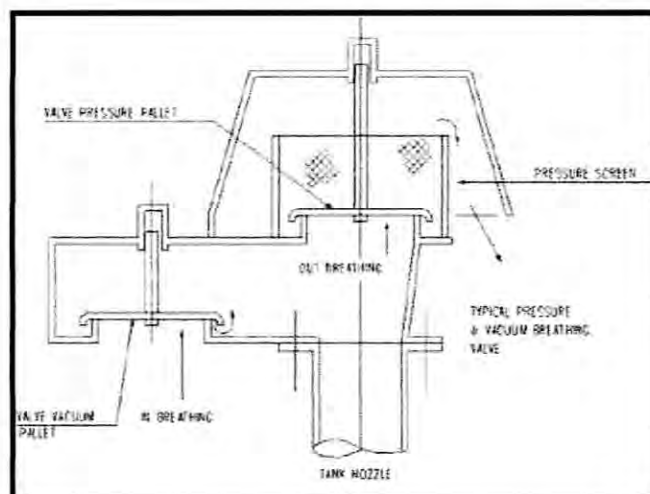


Figure 1.2: Breather Valve

1.5.4 The functions of Breather Valve

- a) Relieves excessive pressure & vacuum created by thermal expansion & reduction
- b) Minimizes costly product evaporation losses during product movement, while protecting tanks against deformation caused by explosion or implosion
- c) Relieves vapor safely before reaching tank limited of pressure 's level.
- d) Tank is always maintained within design parameters
- e) Reduces EPA regulated productions
- f) Complies with corporate productions standards

Design considerations for Breather Valve include:

- a) The pressure drop before the safety valve always low to avoid instability;
- b) The design must take into consideration differences between gas and liquid duties as shown in **Figure 1.3**.
- c) Back pressure can affect opening / closing pressures, stability and capacity;
- d) The relief valve usually only determines relief capacity if proper piping is used.

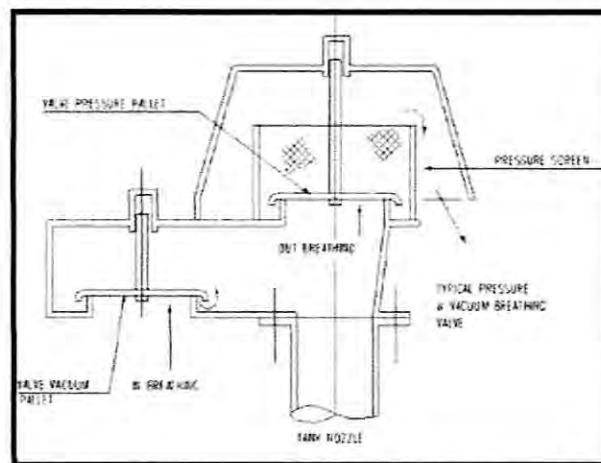


Figure 1.3: Breather Valve System