UTM

UNIVERSITI TEKNOLOGI MALAYSIA

SKMM 3915

INDUSTRIAL TRAINING

FINAL REPORT

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OCTOBER 2020

ACKNOWLEDGEMENT

First of all, I would like to express my utmost gratitude to Allah, the Almighty for giving me the opportunity to attend the industrial training program successfully in UTM Centre for Low Carbon Transport in Cooperation with Imperial College London (LoCARtic).

Next is, I would like to truly and gratefully thank the administration from UTM for assisting me with this internship opportunity which I have been offered. They have been a great help both throughout the entire duration of my internship as well as the aftermath. They have also provided a great deal of information and advice that has helped me in many ways to ensure my success and comfortable internship

A special thank you I bid to Prof Dr Srithar Rajoo, Director of LoCARtic and also my supervisor, for accepting and giving me opportunity to join LoCARtic team for my internship. It is an honour to have my industrial training under his patience and advice.

I would also like to express my gratitude to my co-supervisor, Dr Nur Izwanne Binti Mahyon and Mr Muhd Fadhirul Bin Saminan, for tremendous and continuous guidance during my internship period. I would like to thank her for always bear with my questions and given me prompt replies for my uncertainties in all aspects including the industrial, managerial, and educational aspect. All the guidance and advices had helped me a lot throughout my entire time of industrial training and it will the guidance for my future career opportunity.

Next is i also would like to thanks all staff and lecturers in Innovation Centre in Agritechnology for Advanced Bioprocessing (ICA) for always helping me in finishing my industrial training from day one until the last day. Thank you for managing all the intern student in ICA throughout our industrial training period. Thank you for your great hospitality and kindness for giving us a comfortable room and facilities, always helping us getting the resources that we want and welcome us with open arms.

A special thanks to my fellow intern friends, Nurul Iwani, Syazwani Najwa, Amirul Syah, Naqib Al Haddad, Wahyu Setiawan and Alif Armizie. It was fantastic for me to have the opportunity to work with all of you.

I also want to convey my earnest appreciation to my faculty supervisor, Prof Ir Dr Syahrullail Samion who supervise and evaluate me for this industrial training program.

ABSTRACT

This report contains the work done during the period of 12 weeks of internship in UTM Centre for Low Carbon Transport in Cooperation with Imperial College London (LoCARtic). The report shows an overview of the tasks in detail that I had done during the period of internship. The purposes of this industrial training report is to explain the knowledge, skill and experience that I had learnt and gained during the period of my internship in UTM Centre for Low Carbon Transport in Cooperation with Imperial College London (LoCARtic) from 20th of July until 8th of October 2020.

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Chapter 1: Introduction, objective, scope, and summary of industrial training.

Chapter 2: Background of LoCARtic where included the company profile, organizational chart, and research facilities.

Chapter 3: Description of the project or training that undergone during the internship.

Chapter 4: Overall of the Project or training in detail, and also skills that gained during the period of internship.

Chapter 5: Conclusion of this report.

ABSTRAK

Laporan ini mengandungi kerja-kerja yang telah dilakukan dalam tempoh selama 12 minggu di UTM Centre for Low Carbon Transport in Cooperation with Imperial College London (LoCARtic). Laporan ini menerangkan tugas-tugas secara terperinci yang telah saya lakukan sepanjang tempoh latihan industri ini. Tujuan laporan latihan industri ini adalah untuk menjelaskan kemahiran dan pengalaman yang saya pelajari dan perolehi sepanjang tempoh magang saya di UTM Centre for Low Carbon Transport in Cooperation with Imperial College London (LoCARtic) dari 20 Julai hingga 8 Oktober 2020.

Laporan ini terdiri daripada lima bab iaitu:

Bab 1: Pengenalan, objektif, skop dan ringkasan tentang latihan industri.

Bab 2: Latar belakang LoCARtic, termasuk profil syarikat, carta organisasi, dan kemudahan fasiliti

Bab 3: Penerangan mengenai projek atau latihan yang dilalui semasa latihan industri.

Bab 4: Kesuluruhan projek atau latihan secara terperinci dan juga kemahiran yang diperolehi selama tempoh latihan industri

Bab 5: Kesimpulan laporan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction to the Industrial Training

In Universiti Teknologi Malaysia, all undergraduate students are required to undergo an industrial training. As for the Faculty of Mechanical Engineering, the students must attend a 12-weeks Industrial Training in companies that is related to the Mechanical field. The training will be attended during the period of studies before graduating as an engineer. It is compulsory that the students to undergo this industrial training course during their Year Three of studies as a short semester course. The purpose of the training is to expose the students to the real-world working scenario where all the theories and knowledge gained during the three years of study can be applied in the working area.

Furthermore, the industrial training aims to let the students to enhance their knowledge and skills that will comply with the standard of the industrial level. The difference between studying and working can help the students to understand the better way to work properly in the near future when they graduate later. The industrial training helps the students to familiarize themselves with the professional working environment that is so competitive.

In my point of view, I believed that the industrial training that is provided by the Faculty of Mechanical Engineering is a great platform for the students to seek knowledge and experiences before they get into real-working scenario. This is due to the purpose of the industrial training which intends to help the students to get more understanding on the Mechanical field in the industries based on the hands-on skills and the experiences with the working environment. The experiences and knowledge gained

will be enhance the students' learning process. Furthermore, the students can now know the important things to be consider when they work as an engineer later. Therefore, we can say that the program is really helpful in terms of ensuring good career opportunity for the students as well as beneficial to the students later generally.

1.2 Objective of Industrial Training

The objectives of this industrial training are:

i. to expose students to the environment and working conditions in their respective fields
ii. to gain working experiences in the organization/industry related field of study
iii. to use the knowledge of the Industrial Training, which was followed at university
iv. to train students to interact and communicate effectively at all levels in the workplace
v. to train students to prepare technical reports related to the Industrial Training which conducted
vi. to inspire a spirit or working as a team
vii. to appreciate the ethical values of their profession

1.3 Scope of Industrial Training

The job scope given during industrial training is defined by the experiences and knowledge gained throughout the internship. During my training period with LoCARtic, many personalized training opportunities are conducted. It includes various aspects such as:

i. To understand the companies/organizations in term of operations.

ii. To perform the task by making use of the various kind of machineries and equipment.
iii. To work on fabrication of the machines.
iv. To perform inspection and testing on the products.
v. To understand the basic mechanisms of the products.
vi. To work on maintenance and repairing of the machines.
vii. To be involved in management and administration related tasks.

1.4 Summary of Industrial Training

In summary, the industrial training course that is provided by the Faculty of Engineering is a great platform for the students to enhance their knowledge and skills in order to prepare themselves for the working environment in the near future. The industrial training is not only let the students to gain new knowledge, but it also helps in developing technical skills due to hands-on training conducted during internship. Students therefore can learn how to work in a proper manner when they enter real-working scenario. Hence, the students that had undergo the industrial training process should be able to develop team working spirits, self-confidence and good soft skills in order for them to commit to their career after graduating. It also helps the students to identify their interests in the related field, so that it can guide them to their respective career opportunity.

CHAPTER 2

BACKGROUND OF THE ORGANISATIONS

2.1 Company Introduction

Figure 2.1 : LoCARtic's logo.

The UTM Centre for Low Carbon Transport was founded in 2014 as a collaborative research venture between UTM and Imperial College London with the aim of being at the forefront of research on low carbon technologies. LoCARtic is a spin-off company of Universiti Teknologi Malaysia (UTM) founded by Assoc. Prof. Dr Srithar Rajoo. The idea behind the establishment of LoCARtic stems from underlying principle to contribute towards Human Capital Development, especially in training Masters and PhDs student. LoCARtic are interested in all areas of Low Carbon Technology for application in transport. Their current research focuses on internal combustion engine efficiency, specifically related to engine downsizing and waste heat recovery systems.

In March 2018, LoCARtic was awarded funding from the Malaysia Electricity Supply Industries Trust Account (MESITA) for a three-year project

worth £1,358,695 for Imperial and 21M Ringgit (around £4M) in total. UTM, Imperial and Universiti Tenaga Nasional (UNITEN) are partners in the project, which aims to develop a framework for renewable centric microgrids capable of local energy recovery in Malaysia.

The Centre received another significant grant in November 2018 from the Malaysia-Thailand Joint Authority (MTJA). UTM and King Mongkut's University of Technology Thonburi, Thailand KMUTT will collaborate to complete the research project 'Energy Recovery in Petroleum Processing Via Integrated High Performance Technologies'. This project is also in collaboration with Imperial College London. The project was awarded to the consortium UTM-KMUTT-Imperial College with the total value of USD4.89m for 5 years from January 2018 – December 2022. KMUTT, UTM and Imperial College will develop advanced energy recovery solutions for oil platform applications, and to produce skilled graduates in this field.

Figure 2.2 : Sustainable Development Goals

LoCARtic is committed to Sustainable Development Goal (SGD) adopted by United Nations. They realized that apart from looking at the productivity of an organization, people's well-being, environmental health as well as global relationship are equally important in balancing social, economic and environmental needs. Therefore, LoCARtic selects four key agendas in SDG that serve as a guide and direction to their organization.

2.2 Company Information

Company Name	:	UTM Centre for Low Carbon Transport (LoCARtic) in cooperation with Imperial College London
Address	:	Blok P21, Automotive Laboratory Universiti Teknologi Malaysia 81310 Skudai, Johor
Contact (Hq)	:	Office: +607-5535821
Email	:	srithar@utm.my

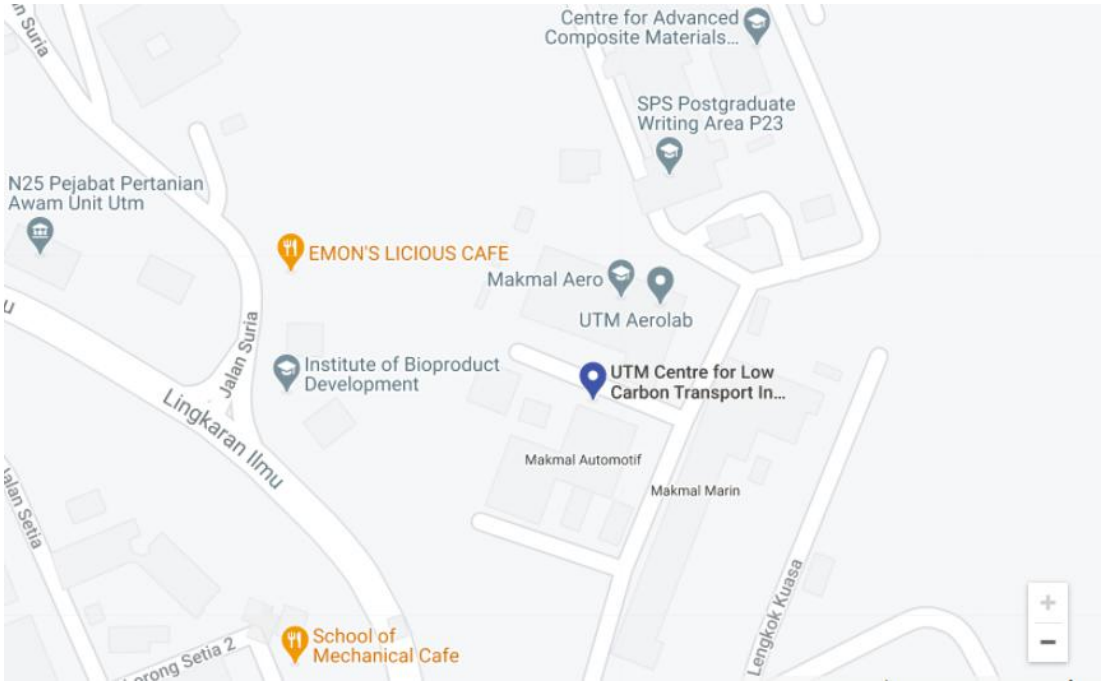


Figure 2.3 : Location of LoCARtic

2.3 Organizational Structure

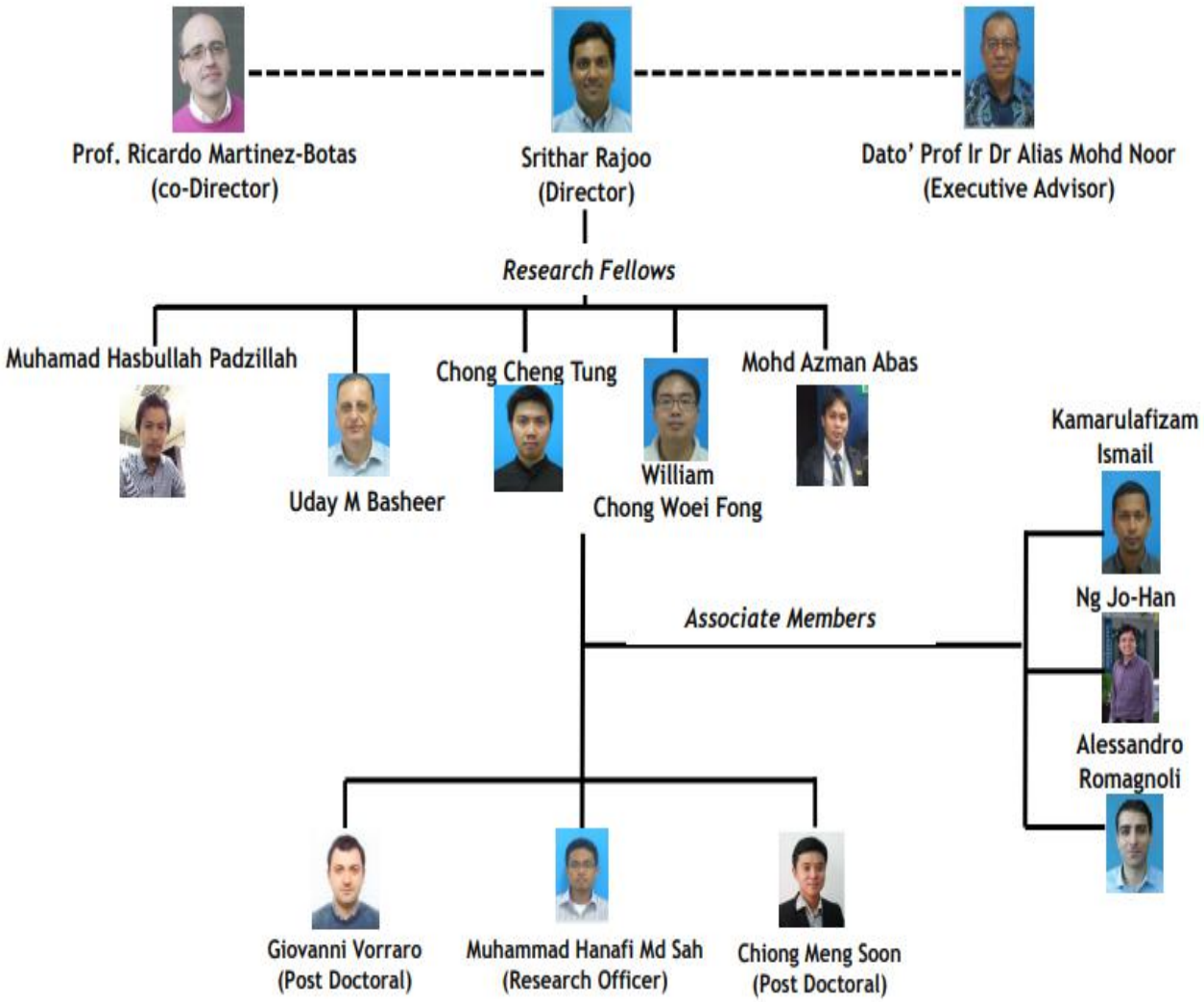


Figure 2.4 : LoCARtic Organizational Structure

2.4 Research Facilities

1) 400 kW Turbocharger Hot Gas Stand

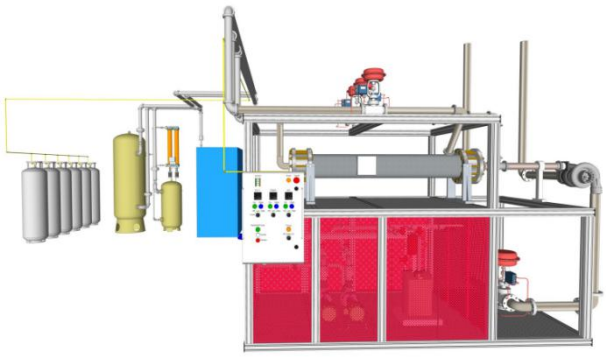


Figure 2.5 : 400 kW Turbocharger Hot Gas Stand

- Performance measurement of turbocharger turbine and compressor
- Heat transfer measurement and analyses
- Lubrication and bearing performance measurements
- Durability analysis under hot gas conditions

2) Cold - Flow Steady-State Turbocharger Test Facility

Figure 2.6 : Cold - Flow Steady-State Turbocharger Test Facility

- Steady state turbine and compressor aerodynamic performance mapping
- Max $5.4 m^3 / hr$ flow rate @ 7 bar pressure

- Equipped with electric heaters capable of heating gas flow to 120 degree celcius
- Max 180,000 rpm turbocharger speed
- Suitable for single scroll turbine & compressor

3) 250 kW Engine Ac Dynamometer

Figure 2.7 : 250 kW Engine Ac Dynamometer

- Capable of steady state, transient & drive-cycle engine performance testing
- Turbocharged & naturally aspirated diesel and gasoline engine characterization
- Max 6000rpm speed & 700Nm torque measurement
- Modular high speed DAQ system configurable for different testing measurement

4) Small-scale Full Anechoic Chamber

Figure 2.8 : Small-scale Full Anechoic Chamber

- Full anechoic chamber for acoustic performance measurement & characterization
- Acoustic measurement range of 5-20000Hz / max 118dB
- 270 Hz cut off frequency
- Working volume: 1m x 1m x 1m

CHAPTER 3

COMPREHENSIVE TRAINING INFORMATION

3.1 Training Introduction

In general, within 12 weeks in, I have gain a lot of knowledge and experience in LoCARtic. I have work with a lot of people from engineers, technician, researcher and more in order to complete the task given. They have exposed me how to make a decision and push my limit to finish all the task in a limited time. Eveything that i have done will be my responsibilites so I cannot be careless during finishing the task.

In LoCARtic Pagoh, I was assisted by the assistant engineer named Mr. Muhd Fadhirul Bin Saminan and research fellow, Dr Nur Izwanne Binti Mahyon. They are the responsible people who guide and give me task and project during the whole internship programmes. Besides them, the others staff and lecturers in Innovation Centre in Agritechnology for Advanced Bioprocessing (ICA) also always helping me in finishing my industrial training from day one until the last day.

For the first month, we intern student in LoCARtic were assigned by Prof Dr Srithar to make lab manual for lab in Pagoh. Since UTM & Imperial research collaboration expands its test facility to Pagoh Multi-Varsity Hub under the aspiration of Malaysian Ministry of Higher Education, all the facility and the equipment in Pagoh still have no any lab user manual for future reference. So this

project concern is about lab user manual for LPG system and compressor system at LoCARtic lab in Pagoh. This includes general layout, design and specification, safety and precautions, dimension and service installation, and maintenance and troubleshooting.

We are divided into two group, one group are doing for liquefied petroleum gas (LPG) system and the other group are doing for air compressor system. Before we start making the lab manual, Mr Fadhirul asked us to study first about liquefied petroleum gas (LPG) and compressor system for turbocharger hot gas stand charger 400kW system. I also learning flow of project from the contractor/ engineer (Teras Berkat Sdn bhd) about the installation, testing, and commissioning the turbocharger hot gas stand 400kW. Engineer from Teras Berkat also explaining to us about construction drawing; overall layout and compressor piping details

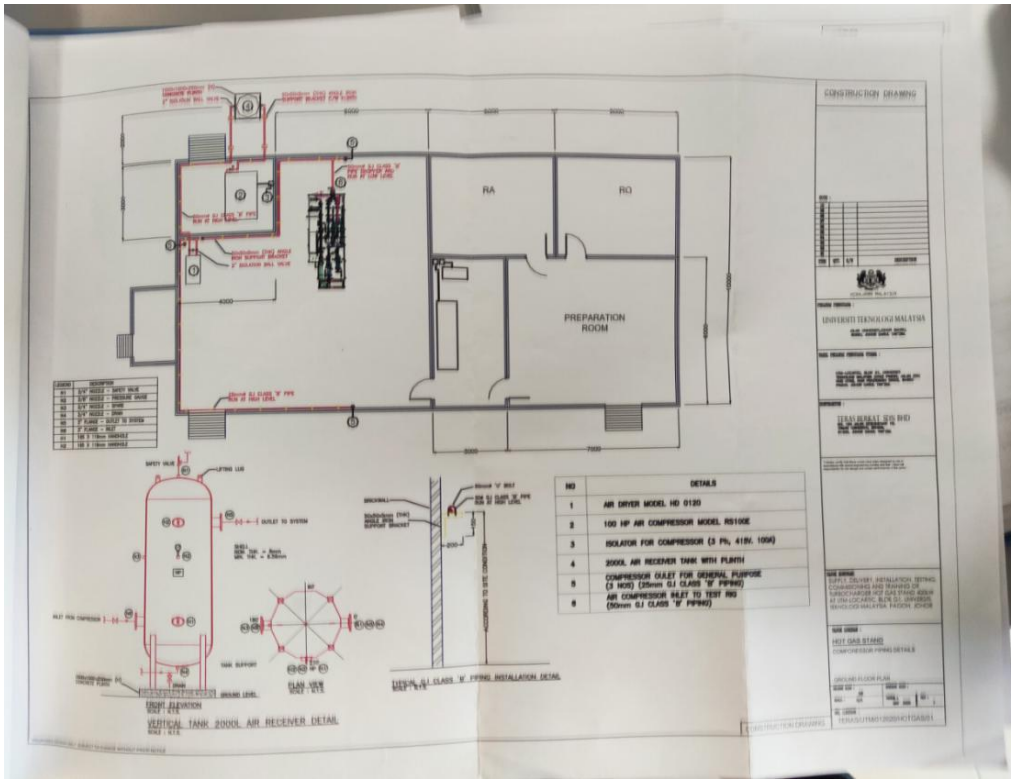


Figure 3.1: Drawing for compressor piping details

Apart from that I also assisted the project engineer to measure pumping time from compressor to receiver tank until it achieve 8bar and compare the measurement result with the measurement specification on the tender and state the reason if it have any different. The engineer also teach me about the ideal compressed air installation layout in order to ensure low maintenance cost and minimize the downtime with Intelligent Controller that has multifunctional protection to monitor the dryer system.

Before started to make the lab manual, we measure the dimensions for all component in the air compressor; compressed air dryer, compressed air filter and air receiver tank to be include in the lab manual. We also using our Solid Mechanic knowledge for making component analysis for air compressed system; stress and strain, buckling and welding. I also do research about safety requirement for compressor pipe system. By using SolidWork amd AutoCad, I draw all the component in air compressor system; compressed air dryer, vertical air receiver tank and compressed air filter

Mr Fadhirul also assigned us to draw floor plan for air compressor system with the detail measurement for applying the approval from Department of Occupational System and Health Malaysia (DOSH).

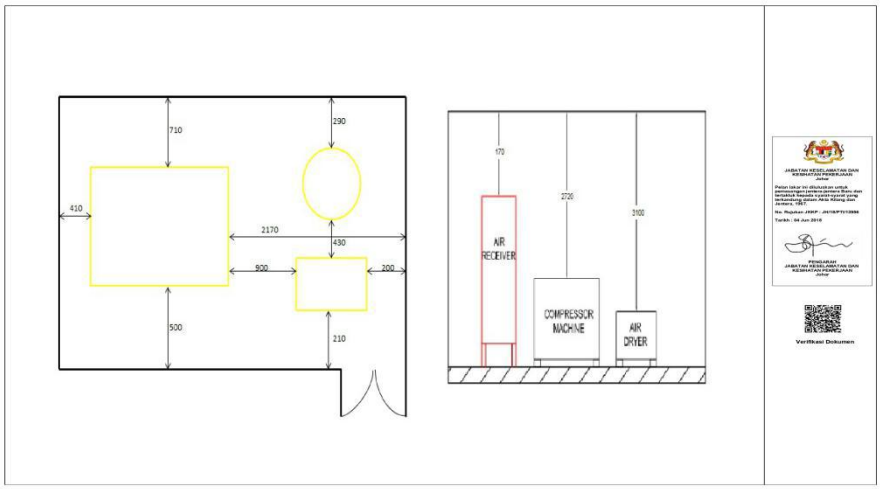


Figure 3.2 : Drawing for DOSH

I also had joined several activites held by Innovation Centre In Agritechnology For Advanced Bioprocessing (ICA) such as Fun Run & Walk 3km and talk session with Dr Umi Aisah binti Ali; Academic Manager ICA on “Research Methodology for Beginner”. Apart from that I also got a chance to see the process for making Freeze Dried Fruit or its commercial name are known as BNUTRA. This product is the signature product from ICA. The freeze dried fruit are come with three flavour which are dragonfruit, jackfruit and pineapple. This is one of ICA initiative in promoting our local fruit and helping the farmer around Pagoh.

Figure 3.3 : Freeze dried fruit

Figure 3.4 : Freeze dryer machine

Apart from that I also involved with a research under Dr Izwanne related to waste heat recovery and production of liquid air. I had been assigned to design a few system model to utilize the waste heat energy from Organic Rankine Cycle (ORC) and cycle it back into the system and also to use power generated from ORC to power up any mechanical component in the liquid air process. I must make use the heat from pilot plant that produce 20.6kW work to produce liquid air. This project involve many searching and finding work as I need to find many information from previous research. I need to go through a few article and thesis from previous researcher to fully understand the task so that the process of designing the system model will be more easily.

Last but not least, I also need to present my work to my supervisor and co supervisor; Prof Srithar and Dr Izwanne. Before the final presentation, every week I will having a discussion session with Dr Izwanne about my project progress and she will check the progress. I also learn on how to create a technical report which are based on the standard report. In LoCARtic I also learn how to be flexible in difference types of work or activities and also had been taught how to present every report that I submitted which is help me in improving my soft skills

3.2 Experience Gained

Based on 12 week which is about 3 months of given of time, I have gained a lot of knowledge that related to engineering and mechanical component at the same time. The first thing that I learned at LoCARtic is how to test various type of engine performance. I had been taught how to assist the project engineer during the instrument testing .It is very important to communicate with each other not only with engineer but also to all of the people working with LoCARtic team. A great knowledge that i got from there is when working and discuss with the engineer and also contractor in order to complete the task. I had learned how process set up the air compressor system and also liquefied petroleum gas (LPG) piping system.

My knowledge in understanding drawing had been improved as I need to study and understand the floor plan made by the contractor. By following the drawing the process to finish up making the lab manual became more easily. By doing my daily task also I learn many things in part of solving problems such as a .

Last but not least, I also learn on how to create a technical report which are based on the standard report submitted. In LoCARtic I also learn how to be flexible in difference types of work or activities. I also had been taught how to present every report that I submitted which is help me in improving my soft skills.

3.3 Safety Regulations

Normally, experimental laboratory is a safe place to work. However, the presence of rotating machinery, heavy equipment and materials, hot materials and pipes, and hazardous materials requires that us to take extra precautions to protect ourselves. So in order to reduce the risk of the more common hazards, we must wear:

1) Safety glasses with side shields or goggles to cover prescription glasses shall be worn in the lab at all times to avoid from any flying debris.
2) Loosely fitting clothing may become entangled in rotating machinery; do not wear it in the shop or labs.
3) Safety shoes with steel toe caps are required when working in the lab
4) No one is permitted to work in the shop or lab areas alone. This is to provide protection and assistance in case personal injury should occur.
5) Keep the working area neat and well organized; keep the floor clean of oil spills and metal chips. Clean off the machine when finished and return all tooling to the storage bins, trays, etc. The area must be swept clean before leaving the lab
6) Wear earplugs to protect an our hearing in areas where the equipment or machinery is very loud.
7) In the event of any problems arising while operating a piece of equipment, shut down the equipment and report the problem to the instructor
8) Machine or instrument that using liquids or gases under high pressures shall only be handled by a qualified person, i.e. technical staff, or under the supervision of a competent person.
9) Wear facemask when enter the lab to prevent the spread of infection and prevent the individual from contracting any airborne infectious germs.

Figure 3.5 : Personal protective equipment in lab

CHAPTER 4

PROJECT INFORMATION

4.1 Design Model for Liquid Air Production

4.1.1 Project Introduction

This project concerns is about production of liquid air ; Liquid Air Energy Storage (LAES) by using waste heat from pilot plant that produce 20.6kW work and is often termed as Cryogenic Energy Storage (CES) in some literature articles. LAES uses intermittent renewable sources or off-peak electricity to produce liquid air in an air liquefaction (charging) process; the stored liquid air is pumped to a high pressure, heated by a heat source to expand in air turbines to generate electricity in a power recovery (discharging) process.

Increased worldwide electricity demand and environmental issues have motivated the development of alternative technologies for using renewable resources. However, the increased utilization of renewable energy faces significant challenges. First, the renewable generation is less predictable due to its nature of intermittence. Solar PV panels or solar collectors require suitable solar radiation which is only possible on daytime and sunny days. Wind turbines need wind to rotate the blades; hydro generation relies on water to fill up and maintain the reservoir. Second, there is significant mismatch between the time-dependent demand of the endusers and the intermittent supply of the renewable energy. Third, the fluctuating renewable energy supply can impact on the state of frequency equilibrium of electricity networks without an extra reserve capacity, particularly when the renewable penetrations

exceeds ~10-20% of the total load. The above challenges can be partially addressed by energy storage technologies, for example, Liquid Air Energy Storage (LAES).

Energy storage technologies provide an avenue to meet the energy supply and demand through the chain of generation, transmission, distribution and end use. Such technologies store the energy in a form that can be either directly used later on or converted into a form that is needed . Note that the definition of energy storage is specifically for electrical energy storage, i.e. electrical energy in, electrical energy out. The use of energy storage gives more flexibility on top of other function such as peak shaving, intermittency smoothing and backup generation for electrical networks.

It is mainly for large scale operation, and has attracted significant attention in recent years due to high energy density, a highly competitive capital cost, low maintenance and operational costs, a long life span, no geographical constraints and environmental friendliness. The estimated round trip efficiency of the LAES is ~60% using the current configuration. There is therefore a great drive to enhance the round trip efficiency.

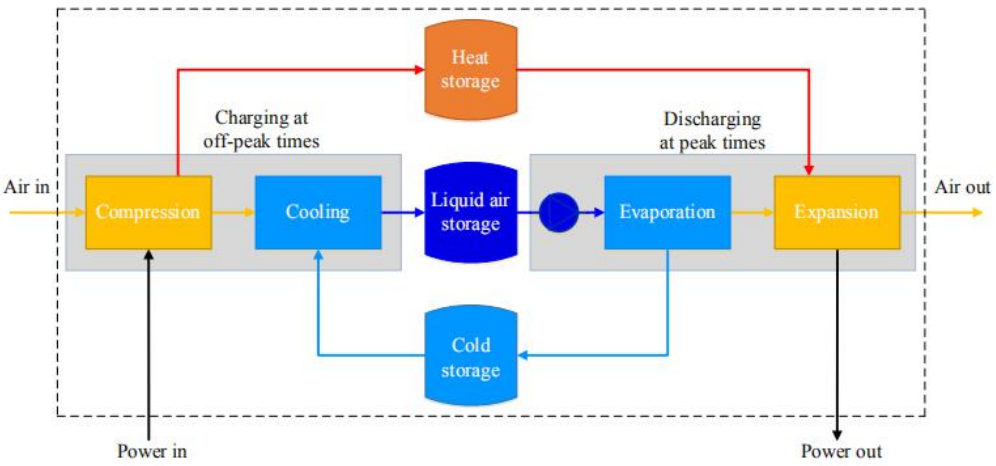


Figure 4.1 : Schematic diagram of the basic principle of the LAES

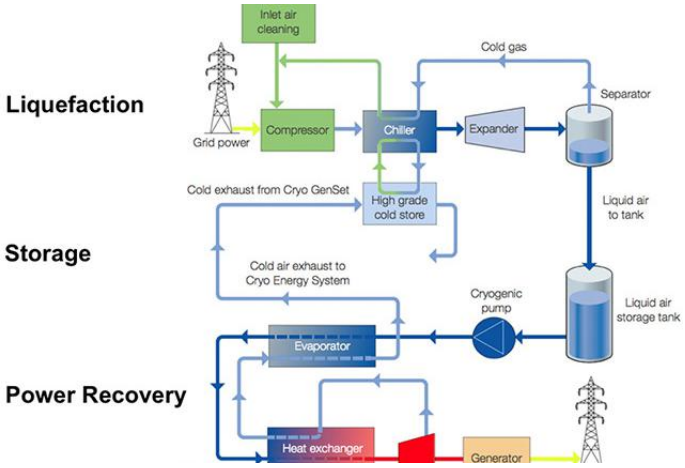


Figure 4.2 : Production of liquid air

4.1.2 Project Objective

The aim of this project/study is to increase the round trip efficiency of the LAES technology, particularly through developing novel thermodynamic cycles for an increased use of the thermal energy and system optimization strategies.

The specific objectives of this study include:

1) To utilize the waste heat energy from Organic Rankine Cycle (ORC) and cycle it back into the system
2) To use power generated from ORC to power up any mechanical component in the liquid air process.
3) To perform experiments on the LAES pilot plant and compare the results with the model

4.1.3 Project Details

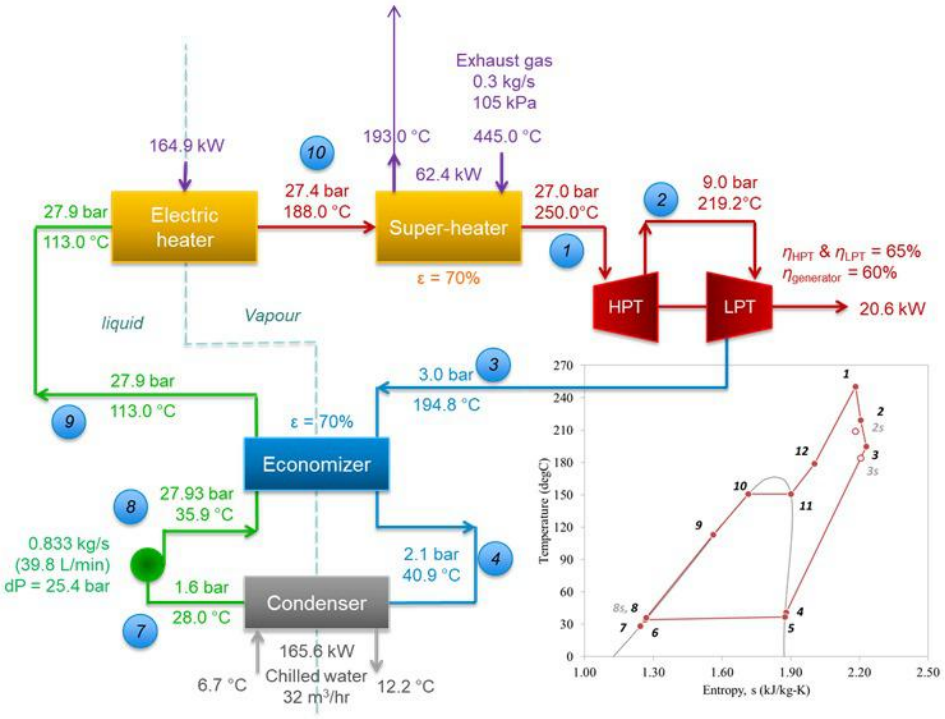
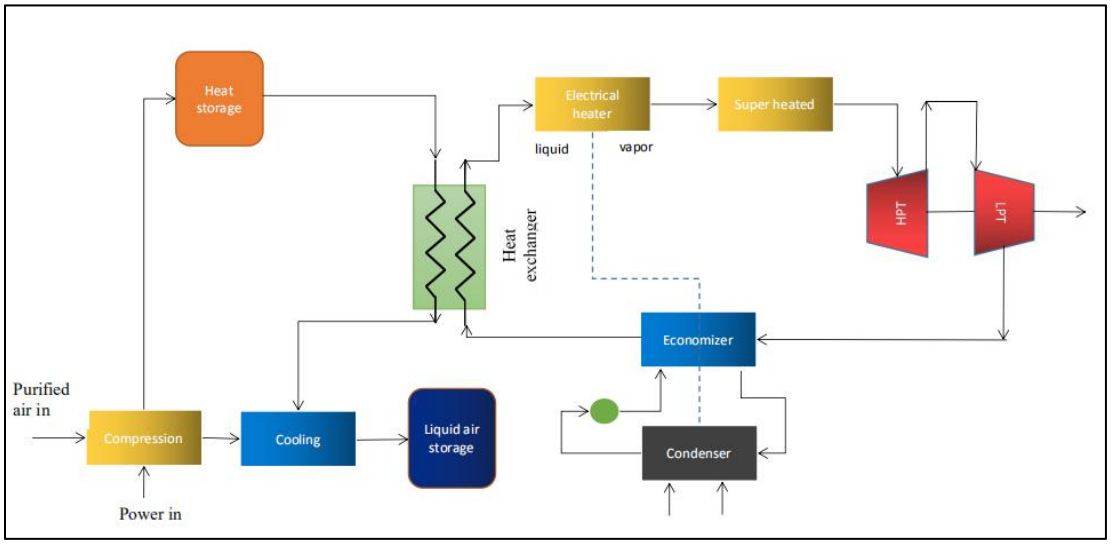


Figure 4.3 : Energy Recovery System Configuration

Based on the given pilot plant working conditions, we are required to design a few system model at suitable location that allow the utilization of waste heat energy from Organic Rankine Cycle (ORC) and cycle it back into the system or make use use power generated from ORC to power up any mechanical component in the liquid air process. Besides that, we also need to compared the advantages for each design thru calculation.

For the ORC, R134a is chosen as the working medium, which has been shown to have a better performance even when the turbine inlet pressure is low. Thermodynamically, for a given heat source, a lower temperature cold source will give to a higher specific output power. Ambient water can be used as a free cold source for the ORC.

4.1.4 Project System Model



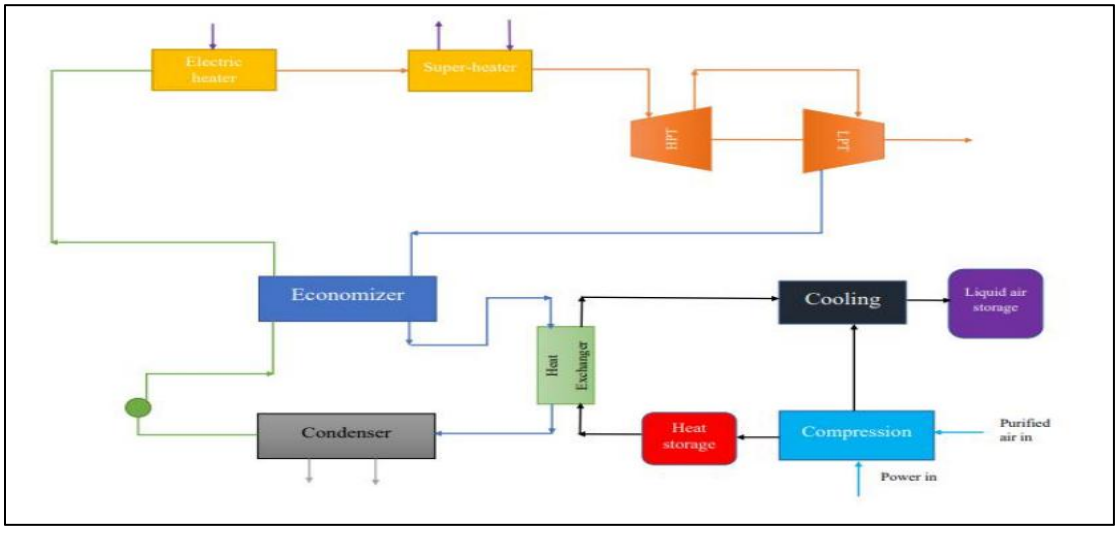


Figure 4.4 : System model

System model and validation:

The entire system is complex. To simplify the system analysis, several assumptions are made:

1) The system is in a steady state, and neither dynamic nor transient analyses are considered;
2) There is no heat loss from the system components unless otherwise specified;
3) In the ORC, R134a is condensed to a saturated state in the evaporator-condenser.

Both the system model configuration are developed based on a standalone Liquid Air Energy Storage (LAES) system, so the round trip efficiency and energy efficiency are calculated in the same ways.

The round trip efficiency of the LAES-ORC can then be calculated by:

$$\eta_{RTE,orc} = \frac{W_{air,out} + W_{orc,out}}{W_{air,in}}$$

The enhancement of the round trip efficiency for the LAES-ORC , with respect to the LAES, can then be respectively given by:

$$\eta_{RTE,imp,orc} = \frac{\eta_{RTE,orc} - \eta_{RTE}}{\eta_{RTE}}$$

4.2 Lab Manual for LoCARtic Lab in Pagoh

4.2.1 Project Introduction

Since UTM & Imperial research collaboration expands its test facility to Pagoh Multi-Varsity Hub under the aspiration of Malaysian Ministry of Higher Education, all the facility and the equipment in Pagoh still have no any lab user manual for future reference. So this project concern is about lab user manual for LPG system and compressor system at LoCARtic lab in Pagoh. This includes general layout, design and specification, safety and precautions, dimension and service installation, and maintenance and troubleshooting

4.2.2 PROJECT OBJECTIVE

A key component of teaching and learning in the laboratory is the laboratory manual. The laboratory manual plays a major role for most teaching and learning session in defining goals and procedures for laboratory activities/work. It is also supposed to help focus observations and the development of inferences, explanations, and other activities/ work in laboratory investigation. In addition the lab manual is also important for future reference and works

4.2.3 PROJECT DETAILS

The first step of the project is i have been assigned to sketch the general layout. In the laboratory manual, there are general layout for the laboratory and also for

Department of Occupational Safety and Health (DOSH). All the important parameter are stated in the sketch. The general layout for DOSH are very important in order to make sure the safety and health of the worker at the workplace. Before the sketching process begin, I have to measure and record the important parameter all the instrument and equipment in the lab. And listing all the technical specification data for air compressed system; working pressure, free air delivery rate, weight, noise level and etc . I also refer to the lab contractor from Teras Berkat Sdn Bhd about the installation, testing and commissioning the turbocharger hot gas stand 400kW.

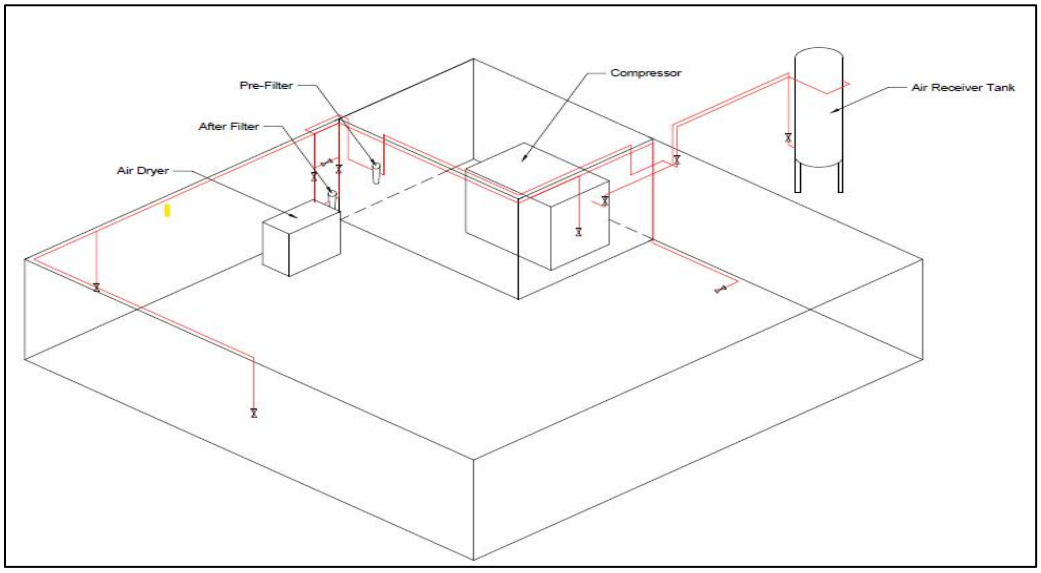


Figure 4.5: Floor plan for compressor system

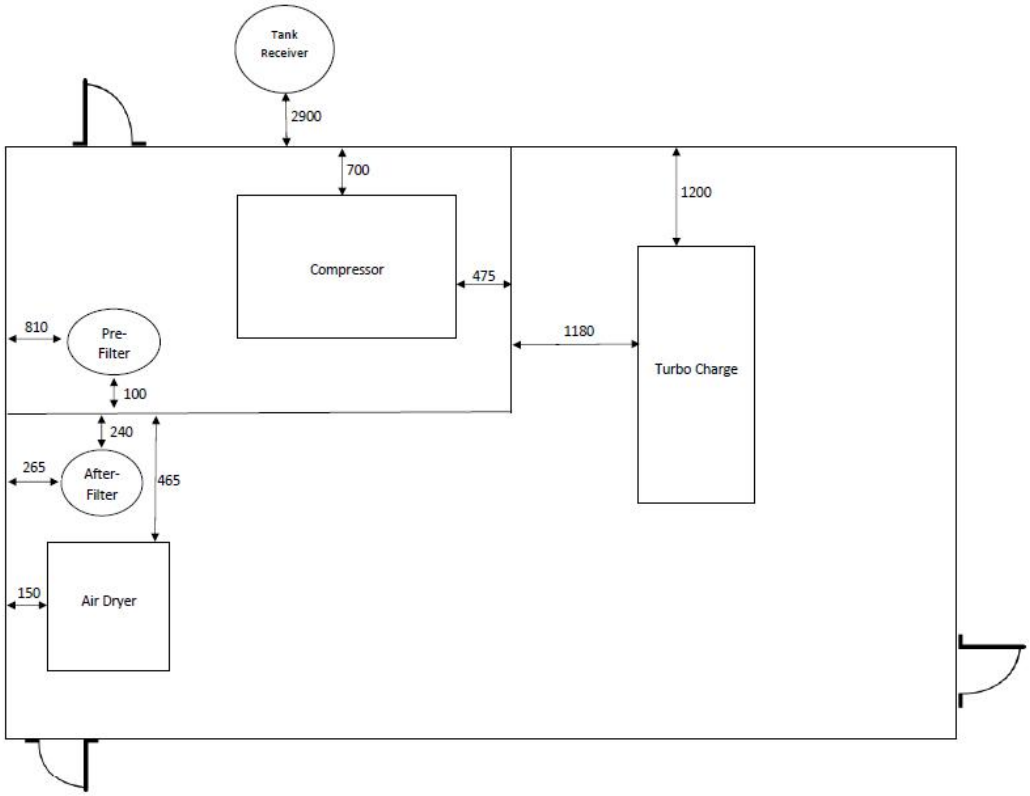


Figure 4.6 : General layout for DOSH

Figure 4.7 show the example of how we listing all the technical specification data in the laboratory manual. All the important details and data such as model, dimensions, weight are stated in table form so that easy for future references. The technical specification are important for maintenance and problem troubleshooting of the instrument in the future.

2. Vertical Air Receiver Tank

Figure 7

Technical Specification

Model	2000-V
Capacity (Litres)	2000
Maximum Pressure (BAR)	10
Dimension (mm)	OD (930) x Shell length (2440) x Overall Height (3190)
Inspection opening	2.0" Socket x 2 Nos.
Connection	3.0" Flanges
Weight (Kgs)	715
Internal & External surface finish	Grey colour shop primer
Standard accessories	• Safety valve with lever • Pressure gauge 4" x 3/8" connection • Drain ball valve • GI fitting

10

Figure 4.7 : Lab manual example

The component that include in the air compressor system are compressor, vertical air receiver tank, air dryer, and also air filter. All the technical specification for the instruments can be get from the company website and also from tender given by constructor. The instrument and machines are all occupied with various safety precautions. For example for vertical air receiver tank, it come with automatic drain system that located at the bottom of the receiver. Receivers need frequently drained to prevent the accumulation of liquid inside the unit.

Figure 4.8 Component in air compressor system

The installation of all component for air compressor system must follow certain specification. The first specification is the base for vertical air receiver tank. An air receiver tank require a concrete slab foundation, which is anchored to the bedrock or on a solid soil base. This is to ensure base of the air receiver tank is strong and sturdy to fit in with air receiver tank that weight 715 kg

Figure 4.9 : Concrete slab for air receiver

The compressor room need to have ventilation system to get rid off all the heat from compressor. The heat must be remove in order to make sure the temperature inside the room at normal temperature and to avoid the compressor from overheating. The ventilation fan should be placed high up on one of the compressor room's end walls, and the air intake placed on the opposite wall. This is to avoid the dust and explosive or corrosive substances might potentially enter the compressor room. The air velocity at the ventilation inlet opening should not exceed 4 m/s. Thermostat-controlled fans are the most appropriate in this case. These fans must be design to handle the pressure drop in the ducting, outer wall louver, etc.

The quantity of ventilation air flow into the compressor room can be calculated by using this formula:

$$q_v = \frac{P_v}{1.21 \times \Delta T}$$

q_v = quantity of ventilation air (m^3 / s)

P_v = heat flow (kW)

ΔT = permitted temperature rise (°C)

Figure 4.10 : Ventilation system in the compressor room

4.3 Skill That Gained And Increased During Training

4.3.1 Generic Skills

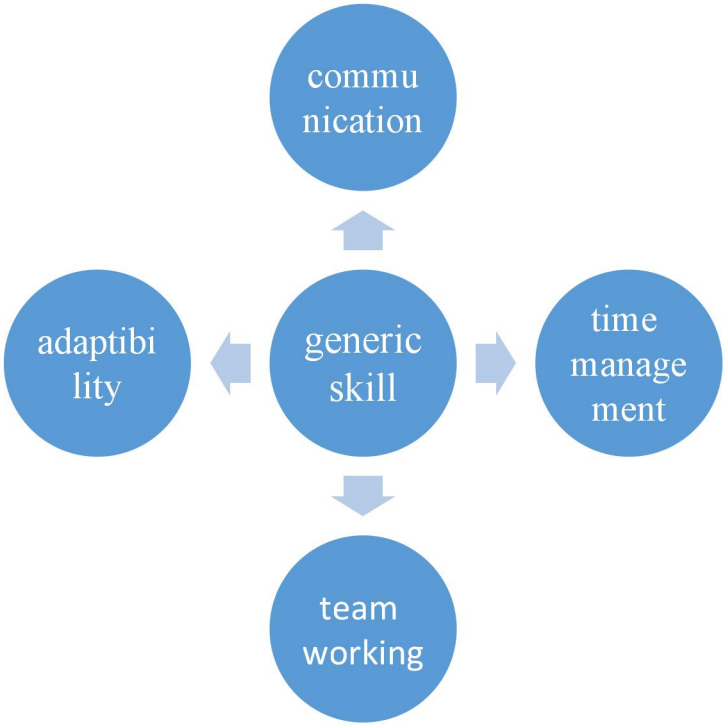


Figure 4.11 : Mind map on generic skills that increased during internship

During my internship period, beside gained knowledge and experience, I also had increased some of my generic skills were included team working, adaptability, time management, and communication skills, as shown in Figure 14 above. I got chances to communicate with project engineer from Malaysia and also Japan throughout the process to set up the test rig for 400 kW Turbocharger Hot Gas Stand in control room. This experience taught me how to communicate to people with higher up position and also how to overcome the language barrier as the engineer from Japan cannot speak english so well . Being able to successful communicate with people helps us better understand people and situations. It helps us overcome diversities, build trust and respect, and create conditions for sharing creative ideas and solving problems.

Joining a new company/team and working with new colleagues can be daunting, so I manage to quickly adapt with the new environment and know my colleagues very well. This make my internship journey goes smoothly as I need to do project assigned by supervisor with my new colleagues

Therefore, the course of industrial training not only give me new experience and expose me to the real working environment, it also can increase my generic skills that is the important skill in the working world.

2.3.2 Technical Skills

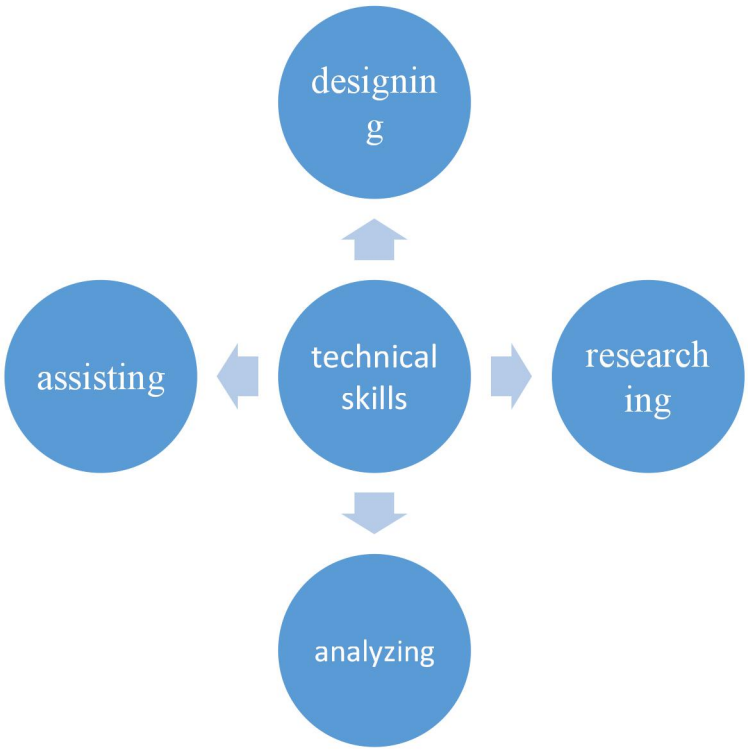


Figure 4.12 : Mind map on technical skills that gained during internship

Besides generic skills that mentioned above, I also gained and improved some of my technical skills during my internship, such as designing skill using SolidWorks and AutoCad software, assisting skill in assist project engineer from Teras Berkat Sdn Bhd in the installation, testing, and commissioning the turbocharger hot gas stand

400kW, and also my research and analyse skill when doing the project given by my supervisor.

In conclusion, besides gaining new experiences and knowledge during my industrial training, I also learned and improved many skill that will be useful in my future career.

CHAPTER 5

CONCLUSION

5.1 Conclusions

Summing up my industrial training for 12 weeks, being part of LoCARtic company/team is one of a kind experiences ever for me. This has assisted me in getting a big picture of how research work look like specifically in the area of Low Carbon Technology for application in transport. As a result, I am very proud of what I had learnt and I am grateful for ending the practice of this industry with very meaningful and useful experience for the future. This experience was not only ntroduced me some new knowledge, but it also as a preparation for me before stepping into the real work environment in the future.

The engineer and staff of the company/team were very friendly and helpful. They gave me a lot of advise and help related to my work and task. Working in LoCARtic Pagoh supervised by Prof Srithar and Dr Izwanne indeed have been great experience that I will never forget. There has been never ending to learning here. You get express your ideas and techniques while gaining hands-on experience in what is done.

To me, as a Mechanical Engineering student, I can see on how Thermodynamics, Heat Transfer, Vibration, Solid Mechanics, and Engineering Material are applied in the instrument or application use in the industry. Even though sometime the theory that we learn in class is not exactly the same as those carried out during the time of industrial training, but we as a student should always thinking out of the box and be creative person.

5.2 Future Recommendations

As for recommendations to improve the subjects on those who will be taking, it is important for the objectives, and course outcomes to be achieved, especially for engineering students. Thus, university and companies must have clear understandings and committed to generate graduates who will leading the course of the nation. Internship in a company must be related to the course taken. This industrial training has proved the theories I have learned.

Being an engineering student, this subject is the only opportunity to learn the application of knowledge I have learned in class and outside class. So in order to make sure the student get the best understandings of what they have learned in the class, UTM need to ensure the student to get the best placement for their industrial training by giving the student list of the company that good to work with. UTM can issued the companies which students doing their internship to compensate amount of days or weeks to physically involved with their operations. LoCARtic also can organize a complete well-versed programme for their interns to make sure they make use of it. This will increase the productivity of skilful graduates and the employability rate

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Locartic. (2018, December 13). LoCARtic. Retrieved , from https://www.utm.my/locartic/

APPENDICES

Appendix A Letter of Appointment

UTM LOCARTIC
UNIVERSITI TEKNOLOGI MALAYSIA

UTM Centre for Low Carbon Transport
in cooperation with Imperial College London (LOCARTIC)
Ground Floor, Block P21
Universiti Teknologi Malaysia
81310 Johor Bahru
Johor, Malaysia

Tel: +(6)07-5535889 Fax: +(6)07-5535887 http://www.utm.my/locartic/

OUR REF. :

UTM.J.09.07.04/14.15/1/ (4)

14 Julai 2020

Farah Umaira Binti Hairul Anuar (980328016708)
No 302, Batu 16 Ayer Hitam
84060, Muar
Johor Darul Ta'zim

Tuan/Puan,

KELULUSAN MENJALANI LATIHAN INDUSTRI DI UTM Centre for Low Carbon Transport (LoCARtic), EDU HUB PAGOH

Dengan segala hormatnya merujuk perkara di atas.

2. Sukacita dimaklumkan bahawa Jabatan ini bersetuju menerima tuan/puan untuk menjalani latihan industri mulai **19/07/2020 hingga 09/10/2020**. Pelatih akan ditempatkan di **UTM LoCARtic Edu Hub Pagoh.**

3. Semasa dalam latihan industri, pelatih adalah tertakluk kepada syarat-syarat yang telah ditetapkan seperti berikut :

a. **Waktu bekerja** : 8.00 pagi hingga 5.00 petang
(Ahad hingga Rabu)

8.00 pagi hingga 3.30 petang
(Khamis)
Cuti Am : Jumaat & Sabtu

b. **Waktu Rehat** : **1.00 tengahari hingga 2.00 petang**

c. **Elaun** : **RM 500/sebulan**

d. Elaun adalah bergantung kepada pencapaian bulanan. Pelajar yang tidak hadir tanpa sebab munasabah dan yang tidak menjalankan tugas dengan memuaskan tidak akan dibayar elaun.
e. Pelatih hendaklah mengikuti dan tertakluk kepada semua peraturan Universiti.
f. Pelatih tidak dibenarkan membocorkan segala maklumat rasmi yang tuan/puan perolehi semasa menjalani latihan industri kepada mana-mana pihak yang tidak berkenaan.
g. Pelatih tidak layak mendapat apa-apa kemudahan seperti mana yang dinikmati oleh staf dalam perkhidmatan awam seperti perubatan, cuti rehat dan pinjaman.
h. Sekiranya pelatih memerlukan cuti, sila berhubung kepada ketua atau penyelia masing-masing.

i. Universiti tidak terikat dalam menawarkan apa-apa jawatan di dalam perkhidmatan Universiti setelah tamat latihan industri.

4. Pelatih adalah dimohon agar dapat memulangkan surat penerimaan tawaran latihan industri yang disertakan bersama surat ini kepada pejabat ini melalui email **m.hanafi@utm.my**. Jika sekiranya Universiti tidak menerima jawapan dalam tempoh **tiga (3) hari** dari tarikh surat ini, maka tawaran ini dianggap terbatal dengan sendirinya.

5. Pihak Universiti mengucapkan selamat menjalani latihan industri dengan jayanya dan dapat memenuhi syarat kursus/majikan.

Sekian, terima kasih.

"Berkhidmat untuk Negara kerana Allah"

Saya yang menjalankan amanah,

PROF. MADYA DR SRITHAR RAJOO
Pengarah
UTM Centre for Low Carbon Transport (LoCARtic)
Universiti Teknologi Malaysia
81310 UTM Johor Bahru, Johor
✉ : srithar@utm.my

s.k **Prof Madya Dr Tuty Asma Abu Bakar**
Pengerusi Jawatankuasa Latihan Industri
Sekolah Kejuruteraan Mekanikal
Fakulti Kejuruteraan
Universiti Teknologi Malaysia

Dr Umi Aisah Asli
Penolong Pengarah
Pusat Inovasi Agriteknologi dan Biopemprosesan Termaju (ICA)
Pusat Penyelidikan Universiti Teknologi Malaysia (UTM)-Pagoh
84600 Pagoh, Johor Darul Takzim.

Appendix B Industrial Training Reply Form

UTM LoCARtic
Blok P21, Sekolah Kejuruteraan Mekanikal
Universiti Teknologi Malaysia
81310 Johor Bahru, Johor
MALAYSIA

Email : **m.hanafi@utm.my**

Saudara,

BORANG PENERIMAAN TAWARAN PELAJAR LATIHAN INDUSTRI DI UTM LoCARtic

Saya FARAH UMAIRA BINTI HAIRUL ANUAR bernombor kad pengenalan 980328016708 dan nombor matrik A17KM0080 yang beralamat di NO 302, BATU 16, AYER HITAM 84060, MUAR JOHOR dengan ini menerima tawaran tersebut mulai 19/07/2020 hingga 9/10/2020

2. Saya juga bersetuju dengan syarat-syarat perkhidmatan yang ditetapkan seperti dijelaskan di dalam Surat Tawaran.

Sekian, terima kasih

Yang benar

Nama : FARAH UMAIRA BINTI HAIRUL ANUAR

Tarikh :15 JULAI 2020

Appendix C Health Declaration Letter

UTM-Pagoh Research Centres
UNIVERSITI TEKNOLOGI MALAYSIA

Universiti Teknologi Malaysia - Pagoh
Research Centres
Jalan Edu Hub UTM 2
Pagoh Higher Education Hub
84600 Pagoh
Johor, Malaysia

Tel: +(6)06-9742888 Fax: +(6)06-9742996/98 http://www.utm.my/ica

Ruj. Kami : UTM.P.09/14.15/1 Jld. 2 (40)
Tarikh : 22 Julai 2020

Farah Umaira Binti Hairul Anuar
No 302, Batu 16, Ayer Hitam,
84060 Muar,
Johor

Saudara,

KELULUSAN TAHAP KESIHATAN BERDASARKAN DEKLARASI KESIHATAN COVID19 OLEH PELAJAR LATIHAN INDUSTRI DI UNIVERSITI TEKNOLOGI MALAYSIA

Dengan segala hormatnya saya merujuk kepada perkara di atas.

Sukacita dimaklumkan bahawa berdasarkan deklarasi kesihatan yang dibuat oleh saudara pada **20 Julai 2020** menunjukkan bahawa saudara tidak mempunyai sebarang gelaja COVID19.

KEPUTUSAN : LULUS

Sehubungan dengan itu, saudara dibenarkan hadir untuk bertugas mengikut arahan yang dikeluarkan oleh PTJ dan mematuhi SOP PKPP yang dikeluarkan oleh Universiti dari semasa ke semasa.

Sekian, terima kasih.

"Berkhidmat untuk Negara kerana Allah"

Saya yang menjalankan amanah,

MOHD FARID BIN RAHMAT
Timbalan Pendaftar
Pusat Penyelidikan UTM Pagoh
b/p Pengarah
☎ 06-974 2803
✉ mfrahmat@utm.my

MFR/nar