MENG/MECT400 SUMMER PRACTICE REPORT

Submitted to the Summer Practice Committee in Partial Fulfilment of the Requirements for the Summer Practice Course MENG/MECT400

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ACKNOWLEDGEMENT

The internship opportunity I had with [redacted]

I would like to [redacted]

Lastly, I take this opportunity to [redacted]

CHAPTER 1 INTRODUCTION

1.1 Background

Kuwait Integrated Petroleum Industries Company (KIPIC) was established by the State of Kuwait in 2016 and is a new subsidiary of Kuwait Petroleum Corporation (KPC). Kuwait Integrated Petroleum Industries Company (KIPIC) is entering a new era for the oil industry, a unique organization that's inspired by integration and built on the best minds and expertise across the sector, head office, and subsidiary companies [1].

KIPIC's vision is to be a leader in integrated refining & petrochemicals operations and LNG supply that maximizes shareholder value, achieves operational excellence, unlocks the potential of Kuwaiti's people and cares for the community [1].

KIPIC's mission is to manufacture refined petroleum and petrochemicals products and supply LNG in a reliable, efficient, safe and environmentally responsible manner to meet Kuwait's energy demand, maximize profit through integration, develop a professional and competent workforce and enable the development of the local economy [1].

I was [redacted]. Where my job was to learn about different Maintenance group divisions responsibilities and key activities. The duration of the industrial training (40 working days) was distributed by [redacted] into different Maintenance divisions. During the training period my daily work was to meet an engineer from the scheduled division and discuss their duties and what machines or units they are dealing with and what procedures or standards they follow. Also, I had a limited site visit to the refinery processing units and utilities, since [redacted]. The nature of interaction I had with my co-workers was great and respectful. After completing the training period successfully, I was able to achieve the following:

1. Learned [redacted]
2. Gained [redacted]
3. Enhanced [redacted]
4. Developed [redacted]

1.2 Company Information

Kuwait Integrated Petroleum Industries Company (KIPIC) was launched on May 1st, 2017 and is responsible for operating and managing refining, liquefied natural gas, and petrochemicals activities of Al-Zour complex. This consists of the following three facilities, currently under construction and anticipated to be operational progressively from 2019 to 2024 [2].

1. Al-Zour refinery facility processes 615,000 Barrels-per-Day (BPD) of Kuwait crudes to produce high value products and fuel oil. This refinery is in the engineering, procurement and construction phase, with target date of completion by June 2019, and commencement of operations in phased manner thereafter. Figure 1-1[3] shows [redacted]

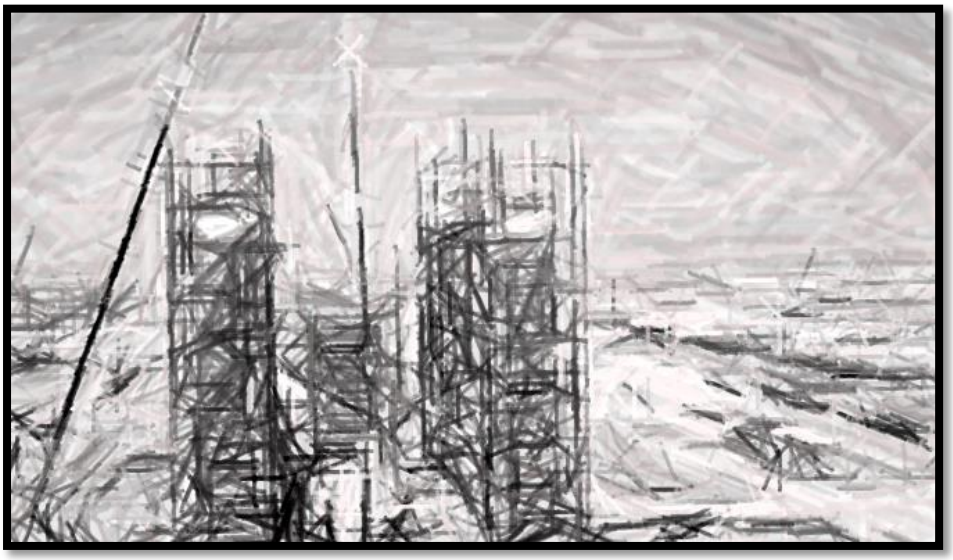

Figure 1-1: [redacted]

2. Liquified Natural Gas (LNG) import facility will be responsible for, importing, vaporizing and distributing high quality gas up to 3,000 Billion-British-Thermal-Units (BBTU) of liquefied natural gas per day. The engineering, procurement and construction started in May 2016, and the terminal is expected to be commissioned by September 2020. Figure 1-2[4] shows [redacted]

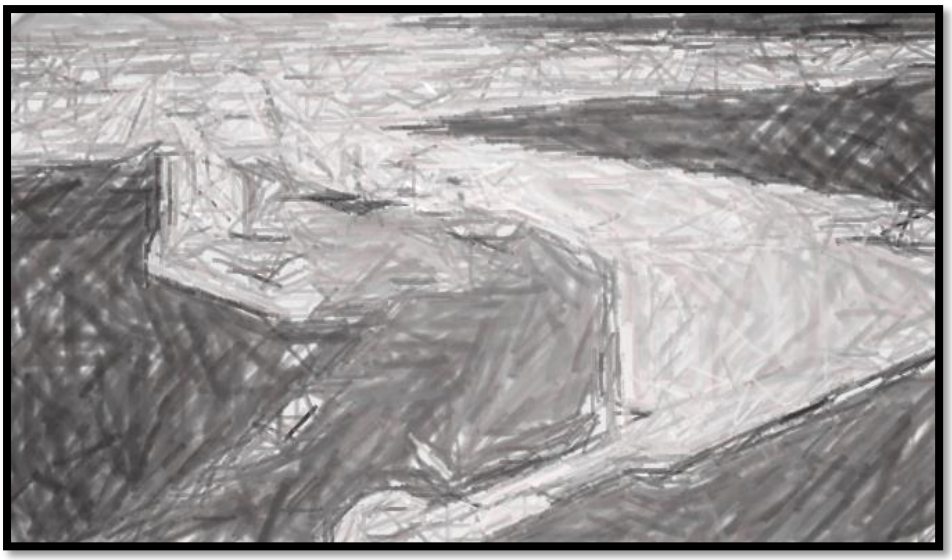

Figure 1-2: [redacted]

3. Petrochemical facility is where base petrochemical products are manufactured, with an annual capacity of 2,761 Kilo-Tonnes-per-Annum (KTPA) of aromatics and polypropylene. The facility is in the front-end engineering design phase with an expected completion date of January 2019. The engineering, procurement and construction phase is planned to be completed in July 2023, with an operations start date in February 2024 [5].

1.3 Structure of the Report

This industrial training report detailing all the activities that were carried out by the trainee Hashem Alharthi during the training period. This report consists of five chapters. First, CHAPTER 1 introduces the company's profiles such as an introduction to the company's background, business activities, facilities, history, mission, and vision. Also, describes the trainee duties. After this, CHAPTER 2 gives information about products of the company. Also, gives information about the processes of production. In CHAPTER 3 daily activities and performed work of the trainee is presented. In CHAPTER 4 the relation between engineering education and practices in the workplace is presented. Finally, CHAPTER 5 illustrates the acquired skills and capabilities during the training period and mentions contemporary issues.

CHAPTER 2 PRODUCT INFORMATION

2.1 Products of the Company

Al-Zour refinery has a total refining capacity of 615,000 (BPD), based on Kuwait Export Crude (KEC). Main outputs from the refinery will be as follows:

- Low Sulfur Fuel Oil (LSFO) [redacted]
- Ultra-Low Sulfur (ULS) [redacted]

Table 2-1 shows Al-Zour refinery products and their destination.

Table 2-1: Al-Zour refinery products and their destination.

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Maintenance and inspection functions in a refinery are the backbone for safe and reliable plant operations and play a pivotal role in efficiently achieving the desired production target and profitability for the company. Maintenance functions in the refinery include mechanical, electrical, instrumentation, and civil functions, which are responsible for monitoring, repair, and maintenance of equipment in the respective defined areas. On the basis of the process condition, on-stream monitoring of all critical equipment is decided by an individual group and monitored religiously. Preventive maintenance, predictive maintenance, a structured repair system, and full-fledged plant shut-down management must be reliable [7].

Maintenance group works in conjunction with the department of operations and other departments where planning and support division makes the overall coordination. Inspection and corrosion division inspects the units and parts and sends a report to the planning and support division, then they schedule the job for the responsible division based on the type of machinery and works in conjunction with the department of operations. Figure 2-1[8] shows [redacted]

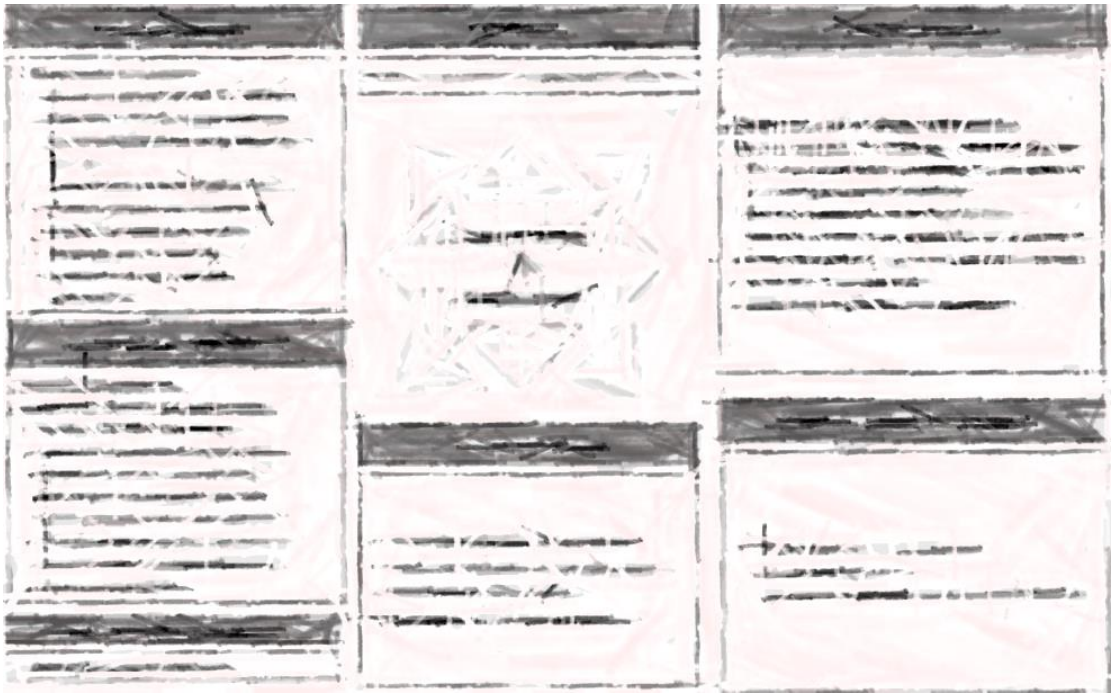

Figure 2-1: [redacted]

Table 2-2 shows [redacted]

Table 2-2: Equipment count for all EPCs.

[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

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CHAPTER 3 PERFORMED WORK

3.1 Daily Activities and Performed Work at the Workplace

The duration of the industrial training (40 working days) was distributed into different Maintenance divisions as follows:

- Week 1 & 2 from 01-07-2018 to 12-07-2018: Workshop & General works division.
- Week 3 & 4 from 15-07-2018 to 26-07-2018: Mechanical maintenance division.
- Week 5 from 29-07-2018 to 02-08-2018: Planning & Support division.
- Week 6 from 05-08-2018 to 09-08-2018: Inspection & Corrosion division.
- Week 7 from 12-08-2018 to 16-08-2018: Electrical & Instrumentation division.
- Week 8 from 26-08-2018 to 30-08-2018: Rotating equipment division.

3.1.1 Workshop and General Works Division

Day (1):

Workshop division is responsible mainly for welding and material removal processes while General works division is responsible for buildings construction. Workshop division can be categorized into two sections: (1) machine shop, and (2) welding. Therefore, workshop division engineers must be experts in the machine shop and welding. Machine shop engineers are responsible for cutting and material removal processes for example when a heat exchanger requires maintenance it is delivered to the machine shop then the machine shop engineer clean it and disassemble it. Welding engineers are responsible for welding in the field and in the machine shop, depends on the type of welded part. Most common tasks of welding engineers in a refinery are to weld piping systems, storage tanks, and vessels.

Day (2):

Workshop division requires knowledge of materials science since the welding and cutting processes depends on the type of materials. Equipment in a refinery categorized into two types: (1) stationary equipment including heat exchangers, columns, fired heaters, storage tanks, vessels, and piping systems. (2) rotating equipment including pumps, compressors, fans, and blowers. Other types of materials in the refinery are stainless steel, copper alloys, and Monel

Day (3):

Machine shop consists mainly of drilling machine, grinding machine, and lathe machine, and sizes of these machines vary depending on the size of the work parts. I discussed with engineer [redacted] the components and working principle of drilling machine, grinding machine, and lathe machine.

Lathe or turning machine working principle is that a single point cutting tool removes material from a rotating workpiece to generate a cylindrical shape. Figure 3-1[9] shows the principal components of an engine lathe.

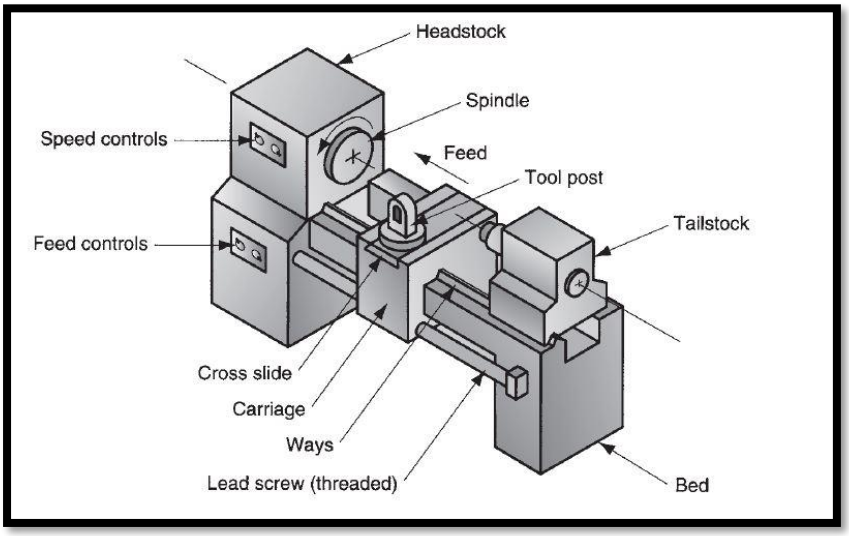

Figure 3-1: Diagram of an engine lathe, indicating its principal components [9].

Methods of holding a workpiece in a lathe are:

a) Holding the work between centers.
b) Chuck.
c) Collet.
d) Face plate.

Figure 3-2[10] shows four work-holding methods used in lathes.

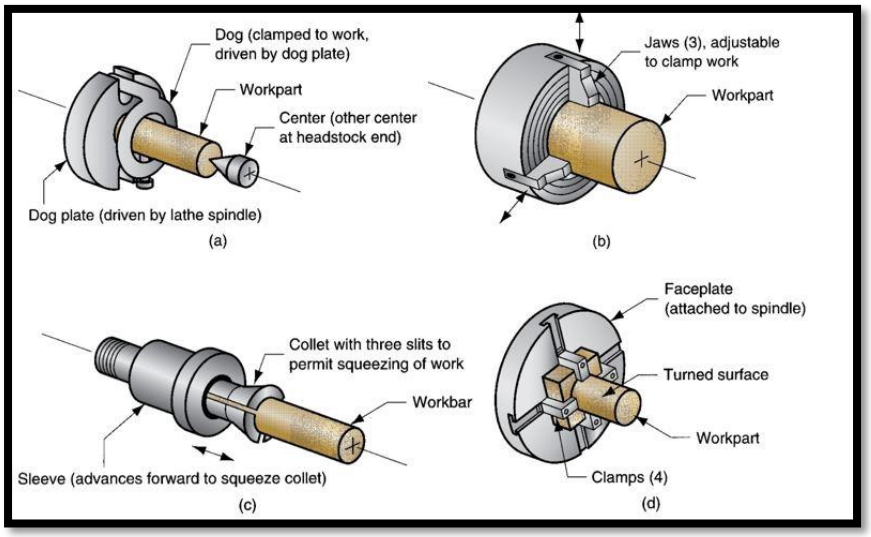

Figure 3-2: Four work-holding methods used in lathes: (a) mounting the work between centers using a dog, (b) three-jaw chuck, (c) collet, and (d) faceplate for non-cylindrical work-parts [10].

Holding the work between centers refers to the use of two centers, one in the headstock and the other in the tailstock, as in Figure 3-2(a). This method is appropriate for parts with large length-to-diameter ratios. At the headstock center, a device called a dog is attached to the outside of the work and is used to drive the rotation from the spindle. The tailstock center has a cone-shaped point which is inserted into a tapered hole in the end of the work [10].

The chuck, Figure 3-2(b), is available in several designs, with three or four jaws to grasp the cylindrical work-part on its outside diameter. The jaws are often designed so they can also grasp the inside diameter of a tubular part. A self-centering chuck has a mechanism to move the jaws in or out simultaneously, thus centering the work at the spindle axis. Other chucks allow independent operation of each jaw. Chucks can be used with or without a tailstock center. For parts with low length-to-diameter ratios, holding the part in the chuck in a cantilever fashion is usually sufficient to withstand the cutting forces. For long work-bars, the tailstock center is needed for support [10].

A collet consists of a tubular bushing with longitudinal slits running over half its length and equally spaced around its circumference, as in Figure 3-2(c). The inside diameter of the collet is used to hold cylindrical work such as bar-stock [10].

A face plate, Figure 3-2(d), is a work-holding device that fastens to the lathe spindle and is used to grasp parts with irregular shapes [10].

Drilling is a machining operation used to create a round hole in a work-part and its usually performed with a rotating cylindrical tool that has two cutting edges on its working end. Figure 3-3[11] shows upright drill press components.

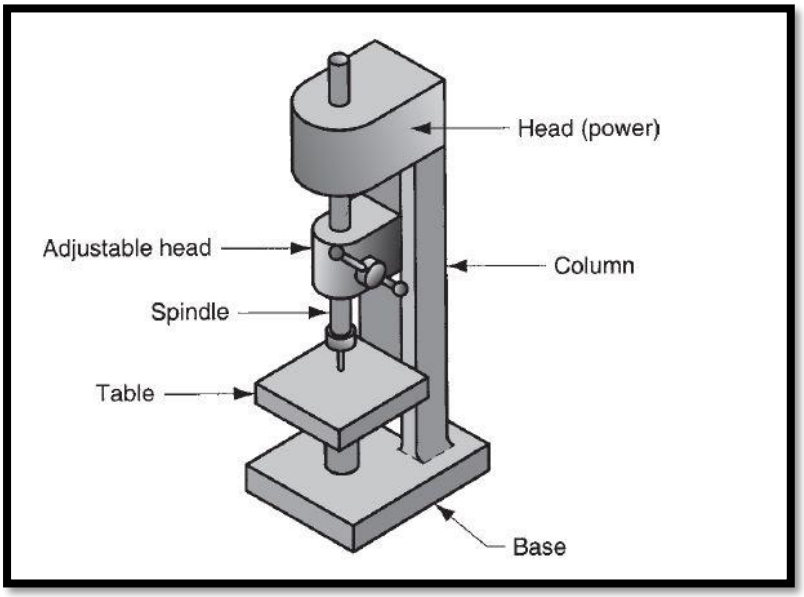

Figure 3-3: Upright drilling press [11].

Grinding is a material removal process accomplished by abrasive particles that are contained in a bonded grinding wheel rotating at very high surface speeds. The grinding wheel is usually disk-shaped and is precisely balanced for high rotational speeds. Grinding is traditionally used to finish parts whose geometries have already been created by other operations. Accordingly, grinding machines have been developed to grind plain flat surfaces, external and internal cylinders, and contour shapes such as threads. Figure 3-4[12] shows four types of surface grinding processes.

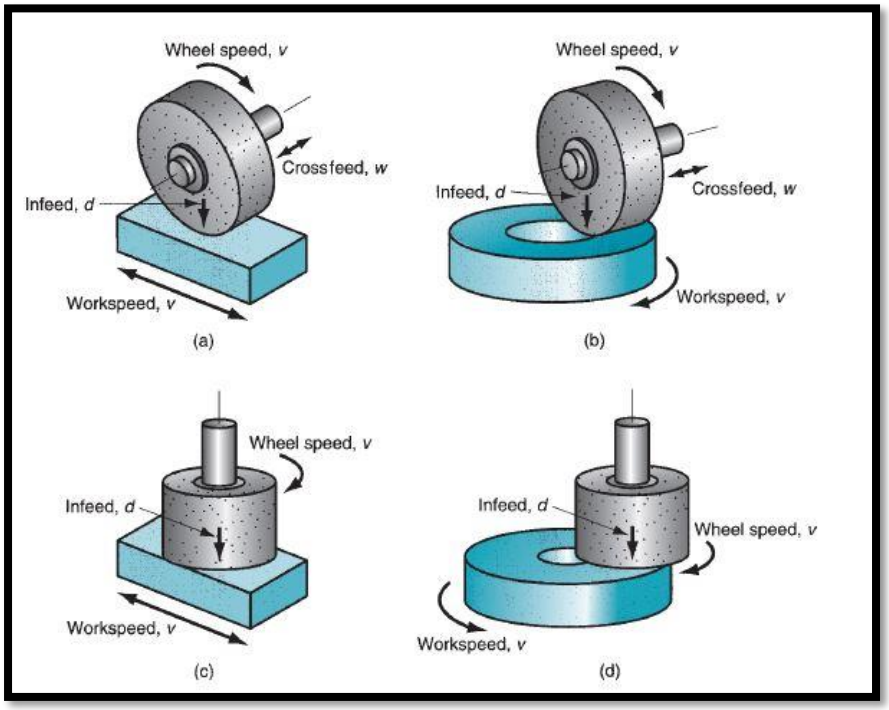

Figure 3-4: Four types of surface grinding: (a) horizontal spindle with reciprocating worktable, (b) horizontal spindle with rotating worktable, (c) vertical spindle with reciprocating worktable, (d) vertical spindle with rotating worktable [12].

Day (4):

There are many types of metal, and each requires different metal cutting techniques. I discussed with engineer [redacted] thermal and manual cutting methods of metals used in the refinery workshops.

Thermal cutting processes differ from mechanical cutting in that the cutting action is conducted either by oxidation or melting. All cutting processes result in the severing or removal of metals. Two major types of thermal cutting processes are (1) Oxy-fuel cutting, and (2) plasma cutting.

Day (5):

A refinery is a complex array of pressure vessels, piping, structural carbon steel, and other components that depends on welding for its structural integrity. A minor problem can have enormous cost and safety implications [14]. I discussed with engineer [redacted] Gas Metal Arc Welding (GMAW) process. Also, discussed types of welding joints.

Gas metal arc welding (GMAW) is an Arc-Welding (AW) process in which the electrode is a consumable bare metal wire, and shielding is accomplished by flooding the arc with a gas. The bare wire is fed continuously and automatically from a spool through the welding gun. Wire diameters ranging from 0.8 to 6.5 mm (1/32–1/4 in) are used in GMAW, the size depending on the thickness of the parts being joined and the desired deposition rate. Gases used for shielding include inert gases such as argon and helium and active gases such as carbon dioxide. Selection of gases (and mixtures of gases) depends on the metal being welded, as well as other factors [15].

Welding produces a solid connection between two pieces, called a weld joint. A weld joint is the junction of the edges or surfaces of parts that have been joined by welding.

There are five basic types of joints as shown in Figure 3-5[16].

a) Butt joint: in this joint type, the parts lie in the same plane and are joined at their edges.
b) Corner joint: the parts in a corner joint form a right angle and are joined at the corner of the angle.
c) Lap joint: this joint consists of two overlapping parts.
d) Tee joint: in a tee joint, one part is perpendicular to the other in the approximate shape of the letter ‘‘T.’’
e) Edge joint: the parts in an edge joint are parallel with at least one of their edges in common, and the joint is made at the common edge(s).

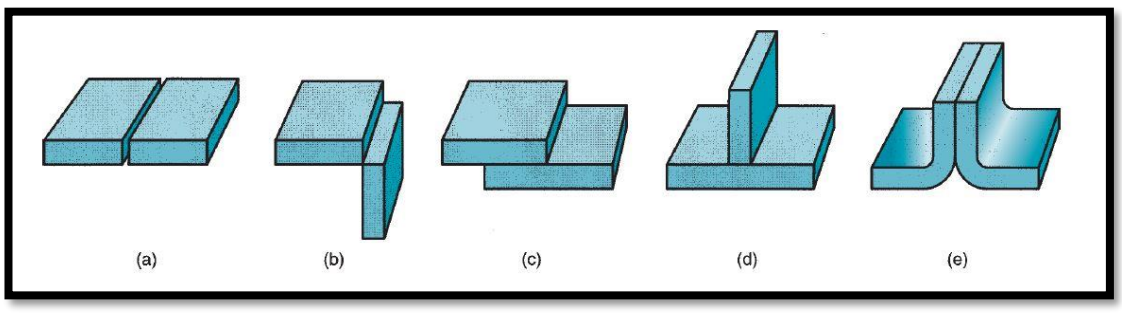

Figure 3-5: Five basic types of joints: (a) butt, (b) corner, (c) lap, (d) tee, and (e) edge [16].

Day (6):

I discussed with engineer [redacted] types of fillet welds. A fillet weld is used to fill in the edges of plates created by corner, lap, and tee joints. Figure 3-6[17] shows various forms of fillet welds.

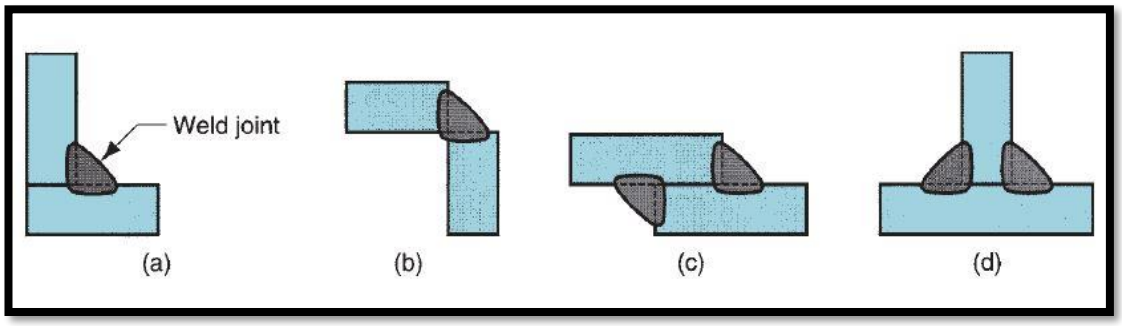

Figure 3-6: Various forms of fillet welds: (a) inside single fillet corner joint; (b) outside single fillet corner joint; (c) double fillet lap joint; and (d) double fillet tee joint. Dashed lines show the original part edges [17].

Day (7):

I attended a lecture about Welding Procedure Specifications (WPS) and Welding Procedure Qualification Record (WPQR).

Welding Procedure Specifications (WPS) are needed in order to provide a well-defined basis for planning of the welding operations and for quality control during welding. The preparation of a Welding Procedure Specification (WPS) provides the necessary basis for fulfilling the applicable requirements, but it does not in itself ensure that the welds fulfill the requirements [18].

The Welding Procedure Specification (WPS) is a required document for all code welding. WPS outlines all of the parameters required to perform a welding operation. It describes the welding process or processes used, the base materials used, the joint design and geometry, gases and flow rates, welding position and includes all of the process conditions and variables [19].

Day (8):

I attended a meeting regarding WPQ which is a test certificate that shows whether a welder have the necessary experience and knowledge to perform the specifications of a weld procedure.

Day (9):

I discussed with engineer [redacted] common weld faults such as incomplete penetration, lack of fusion, porosity, slag inclusions, and undercutting.

Day (10):

I discussed with engineer [redacted] two most common methods of non-destructive testing (NDT) of weld quality: (1) Radiographic Testing (RT), and (2) Ultrasonic Testing (UT).

Radiographic Testing (RT) – This method of weld testing makes use of X-rays, produced by an X-ray tube, or gamma rays, produced by a radioactive isotope. The amount of energy absorbed by the object depends on its thickness and density. Energy not absorbed by the object will cause exposure of the radiographic film. All discontinuities are detected by viewing shape and variation in density of the processed film [20].

Radiographic testing can provide a permanent film record of weld quality that is relatively easy to interpret by trained personnel. This testing method is usually suited to having access to both sides of the welded joint. Although this is a slow and expensive method of non-destructive testing, it is a positive method for detecting porosity, inclusions, cracks, and voids in the interior of welds. There are obvious safety considerations when conducting radiographic testing. X-ray and gamma radiation are invisible to the naked eye and can have serious health and safety implications. Only suitably trained and qualified personnel should practice this type of testing [20].

3.1.2 Mechanical Maintenance Division

Day (11):

Mechanical maintenance division concerned with static equipment in Al-Zour refinery, like heat exchangers, columns, fired heaters, storage tanks, vessels, and piping systems. Mechanical maintenance division key activities are …, etc.

Day (12):

I discussed with Engineer [redacted] five different types of maintenance as follows …, etc.

Day (13):

I discussed with Engineer [redacted] three types of shell-and-tube heat exchangers available in Al-Zour refinery.

A shell-and-tube heat exchanger consists of number of parallel tubes enclosed in a cylindrical shell. One fluid flows inside the tubes and is called the tube side fluid. The other fluid flows outside the tubes and is called the shell side fluid. All shell-and-tube heat exchangers consists of basically the same prats.

Day (14):

I discussed with Engineer [redacted] shell-and-tube heat exchangers maintenance, operating problems, and tubes design.

Tubes design: different types of materials are used for the construction of tubes. The basis for the selection depends on several factors such as …, etc.

Day (15):

I discussed with Engineer [redacted] BLC exchangers are the shell-and-tube type operating at high pressures and high temperatures with Hydrogen-rich streams.

In general, there are two types of BLC exchangers…, etc.

Day (16):

I went to Al-Zour refinery process units with a mechanical engineer and saw Al-Zour refinery Crude Distillation Unit (CDU), Atmospheric Residue Desulfurization Unit (ARD), columns, heat exchangers, boilers, fired heaters (furnaces), and reactors.

Figure 3-7 shows [redacted]

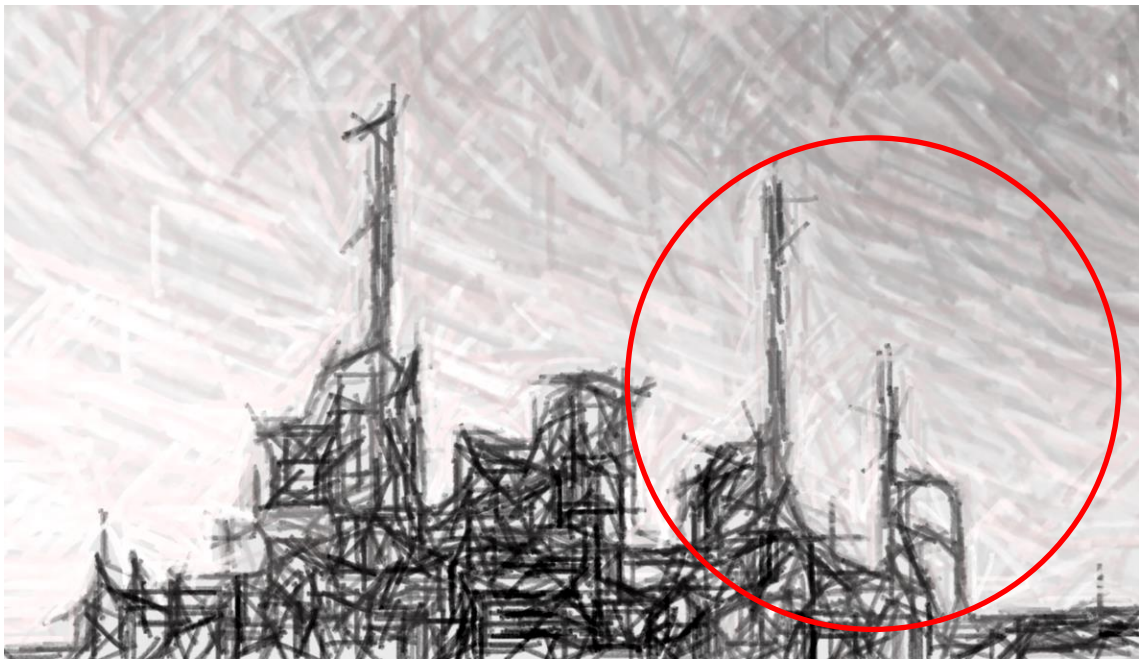

Figure 3-7: [redacted]

Figure 3-8 shows [redacted]

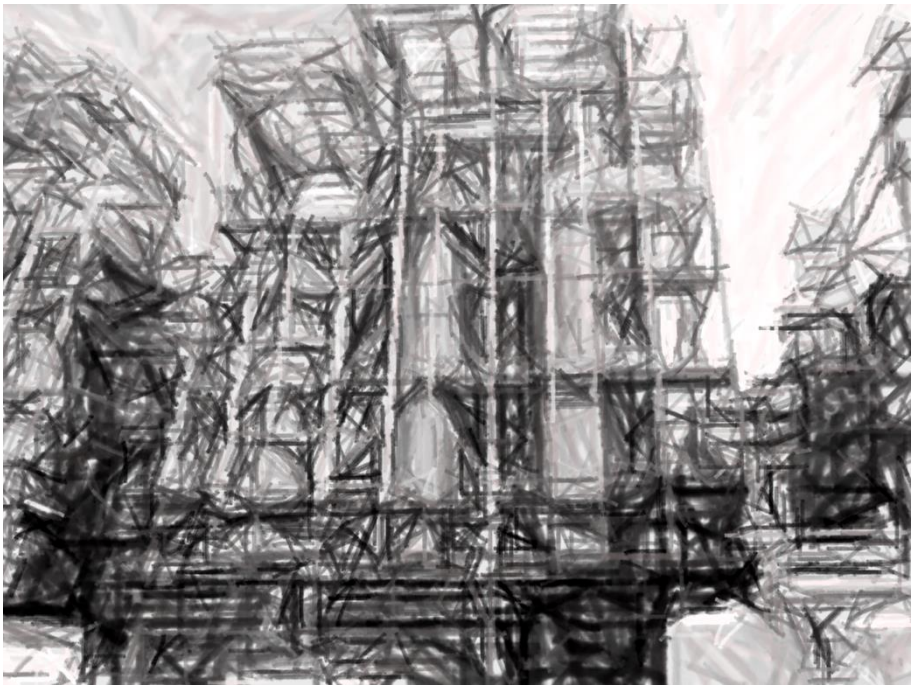

Figure 3-8: [redacted]

Figure 3-9 shows [redacted]

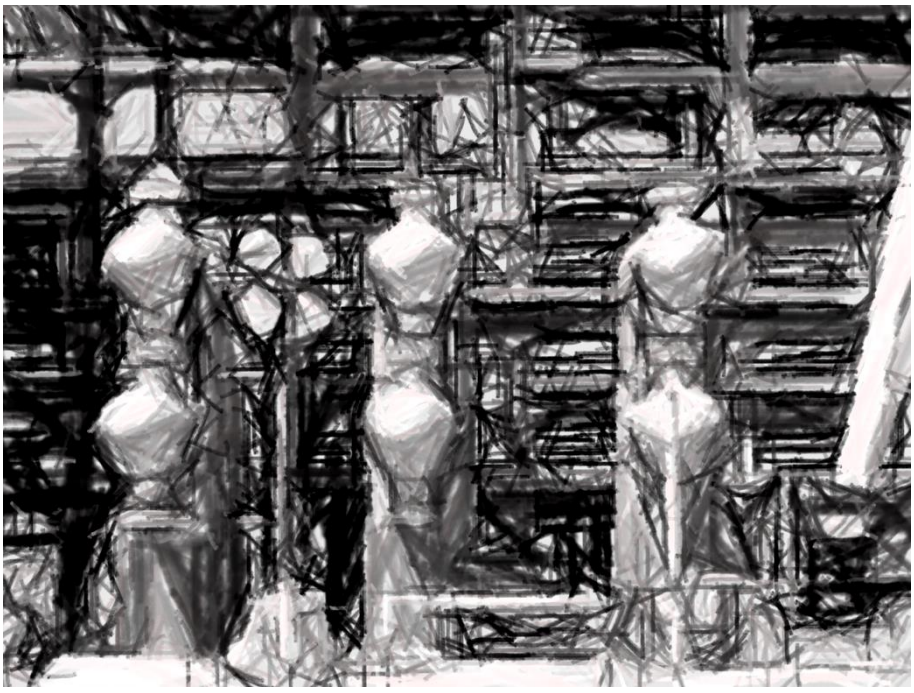

Figure 3-9: [redacted]

Figure 3-10 shows [redacted]

Figure 3-10: [redacted]

Figure 3-11 shows [redacted]

Figure 3-11: [redacted]

Figure 3-12 shows [redacted]

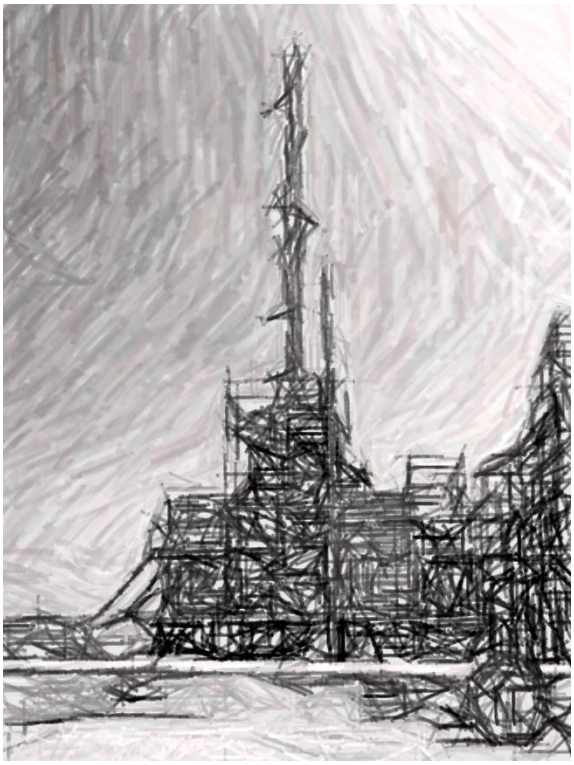

Figure 3-12: [redacted]

Day (17):

I discussed with Engineer [redacted] the main two types of storage tanks in Al-Zour refinery.

Day (18):

I went to Al-Zour refinery site area with a mechanical engineer and saw Al-Zour refinery storage tanks under construction.

Figure 3-13 [redacted]

Figure 3-13: [redacted]

Day (19):

I discussed with Engineer [redacted] fired heaters (furnaces) which are used to pre-heat crude oil and other feedstocks form many refinery processes.

Day (20):

I discussed with Engineer [redacted] fractionating tower (or column) which is an essential item in the Crude Distillation Unit (CDU) to separate the crude oil into fraction.

3.1.3 Planning and Support Division

Day (21):

Planning and Support division makes the overall coordination, relates all the maintenance group divisions together and works in conjunction with the other departments like the department of operations.

Day (22):

Al-Zour refinery specifics illustrated in CHAPTER 1.

Principal standards applied to Al-Zour refinery project are:

1. Shell Design and Engineering Practices (DEPs): Shell is an international energy company that aims to meet the world's growing need for more and cleaner energy solutions in ways that are economically, environmentally and socially responsible [26]. Shell Global Solutions provides an extensive refining technology portfolio to introduce new hardware into refineries, helping refiners improve refineries margins, by optimising process and equipment performance [27].
2. The American Petroleum Institute (API) and other international standards.

Day (23):

IBM Maximo asset management is a consolidated enterprise platform …., etc.

Day (24):

I discussed with engineer [redacted] refinery process units, utilities, and capacities.

Day (25):

I discussed with Engineer [redacted] Al-Zour refinery project objectives, products, and salient features. Al-Zour refinery products illustrated in CHAPTER 2.

Al-Zour refinery project objectives are: [redacted]

Al-Zour refinery salient features are: [redacted]

3.1.4 Inspection and Corrosion Division

Day (26):

Inspection and Corrosion division is committed to ensuring the mechanical integrity and reliability of static equipment and piping.

Inspection and Corrosion division goals are as follows: [redacted]

Inspection and Corrosion division key activities are as follows: [redacted]

Day (27):

I discussed with Engineer [redacted] sections of inspection and corrosion division: inspection section, corrosion section, and Non-destructive Testing (NDT) section.

Inspection section responsibilities: [redacted]

Corrosion section responsibilities: [redacted]

NDT section responsibilities: [redacted]

Day (28):

I went to Al-Zour refinery process units with an inspection engineer and witnessed pressure testing of piping.

Figure 3-14 shows [redacted]

Figure 3-14: [redacted]

Day (29):

I discussed with Engineer [redacted] guidelines to conduct pressure testing of metallic piping systems.

Safety considerations: [redacted]

Test media: [redacted]

Test preparations: [redacted]

Day (30):

I discussed with Engineer [redacted] Risk Based Inspection (RBI) and Integrity Operating Windows (IOW).

Risk-Based Inspection (RBI) is an analysis methodology and process that, as opposed to condition-based inspection, requires qualitative or quantitative assessment of the probability of failure (POF) and the consequence of failure (COF) associated with each equipment item, piping circuits included, in a particular process unit. A properly-implemented RBI program categorizes individual pieces of equipment by their risks and prioritizes inspection efforts based on this categorization [29].

Integrity Operating Windows (IOWs) are sets of limits used to determine the different variables that could affect the integrity and reliability of a process unit. Put simply, IOWs are the limits under which a machine can operate safely. Working outside of IOWs may cause otherwise preventable damage or failure. For this reason, it's incredibly important to be aware of the IOWs for each machine that is in operation [30].

3.1.5 Electrical and Instrumentation Division

Day (31):

In oil and gas industries, instrumentation is used to monitor and control the operating conditions of the facility, which helps to meet safety, environmental regulations, quality and productivity, profitable operation and stable plant operation objectives. It can be categorized under two main functions [31]:

1. Input devices, which are measuring instruments that mainly look at the different process variables [31].
2. Output devices of the control system, which are called the final control elements. These acts relative to the measured parameters to institute the required control action [31].

Day (32):

I discussed with Engineer [redacted] the main instruments in Al-Zour refinery which are: flow meters, pressure transmitters, level sensors, and temperature sensors.

Day (33):

I discussed with Engineer [redacted] orifice plate flow meter which relies on Bernoulli's principle.

Orifice plates are one of the most popular devices for the measurement and control of fluid flow. The shape and manufacturing tolerances of plates used in measurement applications are defined in the international standardization publications of ISO, AGA, ASME, and others. From the formulas and data within these publications, the relationships and values of flow, differential pressure, and plate bore are determined [36].

Day (34):

I discussed with Engineer [redacted] the main two methods used for level measurement in refineries.

1. Wet leg calibration: [redacted]
2. Displacer level sensors: [redacted]

Day (35):

I discussed with Engineer [redacted] main methods to measure pressure and temperature in refineries also, discussed one of the risk assessment methods Layer of Protection Analysis (LOPA).

Pressure measuring devices:

a) Pressure gauge.
b) Pressure transmitters.

Temperature measuring devices:

a) Thermocouples.
b) Thermistors.
c) Resistance temperature detector (RTD).

3.1.6 Rotating Equipment Division

Day (36):

Rotating equipment division concerned with rotating equipment in Al-Zour refinery, like pumps, compressors, steam turbines, fans, blowers, and gearboxes.

Day (37):

I discussed with Engineer [redacted] four types of maintenance which are followed by rotating equipment division.

Day (38):

I discussed with Engineer [redacted] Root Cause Analysis (RCA) method which is used to solve repeated failures.

Day (39):

I went to Al-Zour refinery process units with a site engineer and saw compressors and pumps. Figure 3-15 shows [redacted]

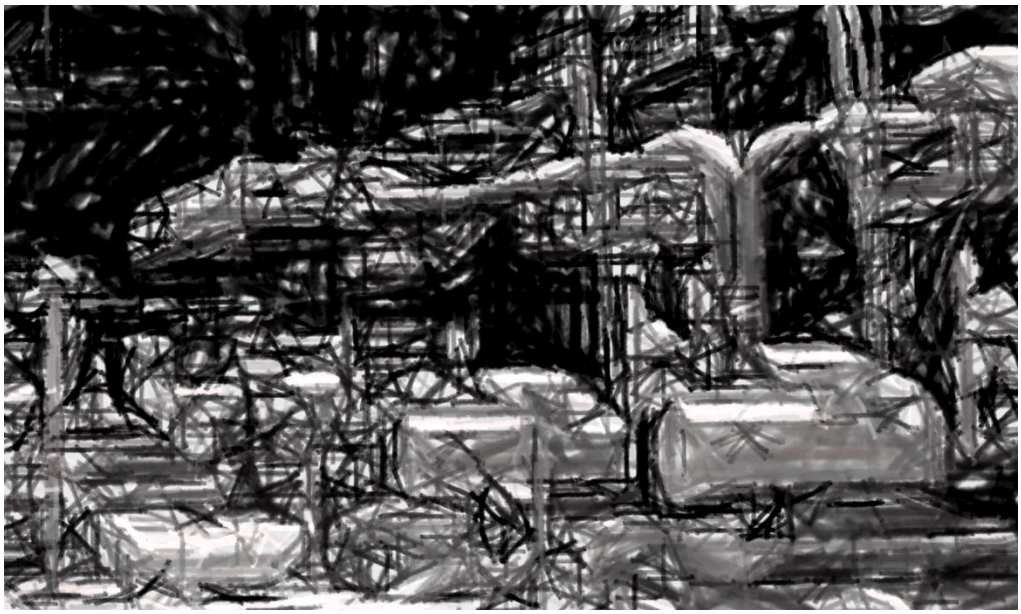

Figure 3-15: [redacted]

Day (40):

I discussed with Engineer [redacted] some of the rotary equipment in Al-Zour refinery.

CHAPTER 4 REQUIREMENT OF EDUCATION FOR THE ENGINEERING, GLOBAL, ECONOMIC AND ENVIRONMENTAL DEVELOPMENTS

4.1 Relation between the Engineering Education and Practices in the Global Workplace

The knowledge, capabilities, and skills acquired during my study at Mechanical engineering program [redacted]

The knowledge I gained from some courses like heat transfer, thermodynamics, manufacturing technology, mechanical workshop practice, materials science, and fluid mechanics, prepared me to involve in discussions related to those topics.

For example, [redacted]

Another example, [redacted]

Also, [redacted]

Finally, [redacted]

CHAPTER 5 PERSONAL DEVELOPMENT AND AWARENESS ABOUT CONTEMPORARY ISSUES

5.1 Acquired Skills and Recognition of Contemporary Issues

The industrial training opportunity I had with …, etc.

After the training period completed successfully, I was able to achieve the following:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

Contemporary issues that I experienced during my internship was:

1. [redacted]
2. [redacted]
3. [redacted]

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