# Assessment of Current Capacity of Local Service Providers in Offshore Decommissioning Waste Management in Malaysia

By

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Dissertation submitted in partial fulfillment of
the requirement for the
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(Civil Engineering)

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CERTIFICATION OF APPROVAL

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Civil Engineering Programme
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Approved by,

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UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
May 2013

# CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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NURIN ADLINA BINTI NOORDIN

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## ABSTRACT

This project in its present form is to assess the current capacities of local service provider in offshore decommissioning waste management. The initial idea of limited studies on offshore decommissioning in Malaysia so as the increasing number of platform to be decommissioned has led to the justification of the project relevancy. The project is given more attention on waste management of established local service provider. The element will be studied start from the service provider current capacities, level of awareness and their potential capabilities in handling waste management. A single case study approach is applied on three different parties that involve in decommissioning waste management namely *Fabrication Yard*, *Recycler* and *Hazardous Waste Disposal Service*. Their capabilities in handling waste produced and their level of awareness will be evaluated.

Hence, the controversial issued whether Malaysia have the availability and capacity of local service provider required for platform decommissioning waste management can be addressed.

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# CHAPTER 1

# INTRODUCTION

## 1.1. Background of Study

Malaysian Parliament has approved the Petroleum Development Act (1974) and this signifies the new era for the development of the oil & gas industry in the country. Since then, these industries have contributed significant impact to the Malaysia's economic. [1] By 2020, Oil and Gas sector is expected to generate RM131.4 billion for Gross National Income. [2] The progression of the Malaysian Oil & Gas industry has developed the whole Support industry, from services provider, products to operators. In order to do business with PETRONAS, local contractors and suppliers is required to register with its Licensing and Registration Department. As a result, Malaysian-owned businesses are now encouraged to opened up to new opportunities and expand their business internationally [1]. Under the Companies Act (1965), PETRONAS, the acronym for Petroliam Nasional Berhad, was incorporated on 17 August 1974. It is wholly owned Malaysian Government Company and according to Petroleum Development Act (1974), PETRONAS is vested with the entire ownership and control of the petroleum resources in Malaysia [2]. With Petroleum as a core business, Exploration and Production (E&P) is the important sector in PETRONAS.

Offshore jacket platforms have been commonly used for the offshore production in the shallow water depths of Malaysia [3]. Globally, following decades of resource exploitation, there are an increasing number of mines and hydrocarbon fields that are nearing depletion. Several studies show that, idle offshore structure that is left can cause damage and environment disaster. It is also proven that damaged platforms and wells cost

more to decommission than non-damaged wells. Therefore, there is a need to perform decommissioning activities to the platform. “Decommissioning” is the process by which options for the physical removal, disposal of structures at the end of their working life are assessed, dismantled and removed [4]. Many contractors involved throughout the decommissioning process. Operator will be awarded part of the process to a specific contractor base on the specialty. One of the important area covered in decommissioning project is waste management. The Decommissioned Platform pieces will be sent to the onshore Yard to be processed and treated accordingly. In recent discussions of Offshore Decommissioning Waste Management in Malaysia, a controversial issue has been whether Malaysia have the availability and capability of local service provider required for platform decommissioning waste management.

### 1.2. Problem Statement.

Off the coasts of Malaysia sit approximately 280 oil and gas jacket platforms. About 48% of these platforms have exceeded their 25-year design life [5]. These platforms would need to be decommissioned. However, there is the need after the decommissioning of the platforms to manage the wastes associated with the platforms. The processes involved in managing these wastes could be carried out offshore and some onshore i.e. at the dismantling /fabrication yard. Despite increasing interest in offshore decommissioning in Malaysia, it is surprising that so little empirical research has actually been conducted on the topic, especially from the perspective of waste management.

Therefore, for this waste management to be effective and efficient, there is the need to ascertain the main players in managing wastes from dismantled offshore platforms. However, there has been no published work on the establishment of the current capacity of local services providers in offshore decommissioning waste management in Malaysia. Also, the level of awareness of local services providers about offshore decommissioning potential activities has not been determined. Not that alone, there has been no previous published literature on the assessment of the current and future offshore decommissioning waste management capacity for local service providers in Malaysia. Thus, this research

aims at assessing the current capacity of local service providers in offshore decommissioning waste management in Malaysia.

### 1.3. Objective of Study

Objective of this study are as follows:

i) Establish the current capacity of local services providers in offshore decommissioning waste management in Malaysia.
ii) Determine the level of awareness of local services providers about offshore decommissioning potential activities.
iii) To assess the current and future offshore decommissioning waste management capacity for local service providers in Malaysia

### 1.4. Scope of Study

There are many options that can be used for decommissioning of offshore installation. Currently, conventional decommissioning alternatives fall into four general categories [6]; complete removal, partial removal, toppling (either as in-situ disposal of the structure or as artificial reefs), and reusing. In Malaysia, there is no governing legislation for decommissioning. The regulating 2008 PETRONAS Guidelines for Decommissioning of Upstream Installations, however, makes complete removal mandatory for all offshore installations [7]. Based on the guideline, the scope of study will cover on the current capacity of services providers for Offshore Structure decommissioning potential activities focusing on the waste management for onshore decommissioning.

Due to practical constraints, this paper cannot provide a comprehensive review of all decommissioning activities; and it is beyond the scope of this study to examine the all types of platform. The capacity assessed specific on Fixed Structure (Jacket) and Completely Removal Decommissioning Option. In complete removal option, the entire structure above the sea bed is remove. Study show it is not practical to completely remove the steel pile driven below the mudline. Therefore, the pile required to be removed is just

1.5m below seabed. This can be done using internal explosive charges or cutting tool [8]. The decommissioning capacity in this study refers to the offshore decommissioning waste management capacity. Basically, the process start after the structure is towed to the offloading site. Therefore, a full discussion of capacity of all offshore decommissioning activities lies beyond the scope of this study. Further, the reader should bear in mind that the study is based on a small sample of local service providers to represent each category of waste management.

### 1.5. Relevancy of the Study

A study of in offshore decommissioning waste management in Malaysia and its domain is important for many reasons. First, researchers have often studied offshore decommissioning but their findings may have been inadequate in onshore Decommissioning Process for Malaysia Platform. This illustration that, there are lack of study under decommissioning area in Malaysia especially in onshore waste management since Offshore Decommissioning is new area in Malaysia. The first and only official study on Malaysia's Platform conducted by PETRONAS on the decommissioning of offshore installation is done on 1997.With an uprising number of platforms that need to be decommissioning in future. It is necessary to conduct new study after 13 years to assess the awareness and the current capacity of the local service provider in Malaysia. This study may add knowledge to scholarly research and literature and provide a basic on the further study in the field.

Most of the paper outline the issue and process for the onshore decommissioning process for offshore structures only specified for Gulf of Mexico and North Sea region. As the decommissioning project in Malaysia will be increasing in further, there will be more opportunities open for the local services provider. They may want to be ready to provide service for the project in order to reduce the cost of the project. Study to assess local service provider is necessary to evaluate the current and future capacity of local service provider.

Current regulatory guidelines strongly recommend complete removal of the structures. For many of the offshore jacket structures in Malaysia, their design lives of 25-30 years are approaching the end, signifying the important for implementing the decommissioning efforts. [5]. According to [9], almost half of the country's existing platforms are in ageing conditions and there are less than ten handling facilities in Malaysia with the capacity dismantling jackets for recycling. Besides that, expert say that, there are lack of number of local service provider capable to perform the task especially in handling radioactive waste [9]. These operations and the associated infrastructure will require complex and costly decommissioning process.

The key challenges for decommissioning project in Malaysia are lack of in depth knowledge and expertise in the area besides, unavailability of dedicated decommissioning yards in Malaysia [3]. The waste from first decommissioning project in Malaysia is transport to China. This will increase cost of the project. Thus, in order to perform huge and complex project such decommissioning, capacity and capability of the service provider must be determine to ensure the efficiency during the project.

### 1.6. Feasibility of the Study

In order to complete this project, the project task has been divided into four stages within the time frame. Two stages are assigned for each FYP courses. The project activities is planned to fulfill every objective. The detail project activities are further explained in the methodology chapter. At the end of the last stage, all the objective of this project will be completed. The timeline of this project is presented in the appendix.

# CHAPTER 2

# LITERATURE REVIEW / THEORY

## 2.1. Decommissioning

Decommissioning offshore oil and gas structures represents the end of the production life cycle when wells are plugged and abandoned, infrastructure is removed, and the site is remediated and cleared of debris. [10] According to OGP's Environmental, Social, Health Risk and Impact Management Process, decommissioning is the termination of oil and gas production operations. [4]"Sustainable" in this decommissioning context, means that the legacy of the operation, during the project life cycle, from and environmental, social (including health and safety) and economic perspective, is balanced and at least neutral or positive. It is also being understood as the consideration and inclusion of the various components that are dealt with during decommissioning and closure (i.e., economic, social, environmental, technical, financial, health and safety) and the need to balance the outcomes of these components during the project's life-cycle [4]. Decommissioning capacity and techniques are limited to the technology currently available or that can be developed during the course of a project, however as decommissioning of the Mega Structures progress lessons will be learnt and new more efficient and safer techniques will be developed. [11]

## 2.2. Decommissioning in Malaysia

The decommissioning of oil and gas installations in Malaysia is primarily governed by the PETRONAS Decommissioning Guidelines which is based on recognized international guidelines such as the 1989 International Marine Organization Guidelines and Standards and the 1982 UN Convention on the Law od the Seas (UNCLOS) which is pro-complete removal of all structures in water depths less than 100 meters and substructures weighing

less than 4000 tonnes [12]. The first decommissioning project in was perform by Shell in KETAM field in Sabah water located in East Coast Malaysia. The cost throughout for the whole project is approximately RM 60 Million. Due to the shocking high price, it is decided that it is not economical to perform another decommissioning activity until a lower price mechanism decommissioning activities is proposed. Option available for offshore operator for platform exceed design life; Continue Production, Continue maintaining facilities which may be marginal at present in hope of technology providing more viable solution in the near future. Another option will be to reuse the platform for other purpose with less functionally to reduce load. Final option will be to decommission the platform. Since design life of the structures are typically 25 to 30 years. Study show that, based on the outcome of the analysis of structure and certification, structural strength, corrosion and gradual deterioration of the structure from the beginning of operation until decommissioning, beyond the design life, ongoing maintenance cost with increasing from year on year. [13]

**Timing of Abandonment Plan**

The proposal for field abandonment shall be submitted to the by the operator to the platform owner (PETRONAS) typically two to three years prior to the COP. The application will be review to consider available option. After the best option is selection and agreed by the PETRONAS, detailed program should be develop by the operator. COP define as the end of useful life of the field. The program will facilitate scheduling of the removal of the redundant platform in one mob/demob sequences in order to achieve cost optimization. [8]

## 2.3. Decommissioning Activities

There are two major phase of the decommissioning work; Offshore Decommissioning Activities and Onshore Decommissioning Activity which comprise of Decommissioning Waste Management.

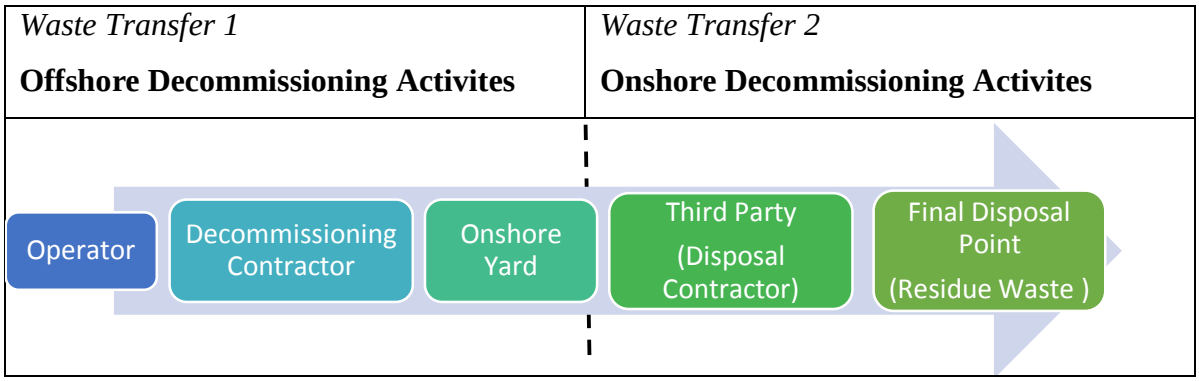


Figure 1: Phase in Decommissioning Project

There are basically two contractor involve in the decommissioning project, the Decommissioning Contractor (Main Contractor – offshore work) and the Onshore Dismantlement and Disposal Contractor (Sub-contractor –onshore work) [14] Final disposal point is where the material reached the end of the waste chain and was reused, recycled, recovered or disposed.

The shipment from offshore to the Final Disposal Point for each waste stream was split into two separate waste transfers: [14]

- Waste Transfer 1: Shipment from Offshore to Onshore Dismantling and Disposal Contractor's yard;
- Waste Transfer 2: Shipment from Onshore Dismantling and Disposal Contractor's yard to the Final Disposal Point.

### 2.3.1. Offshore Decommissioning Activities

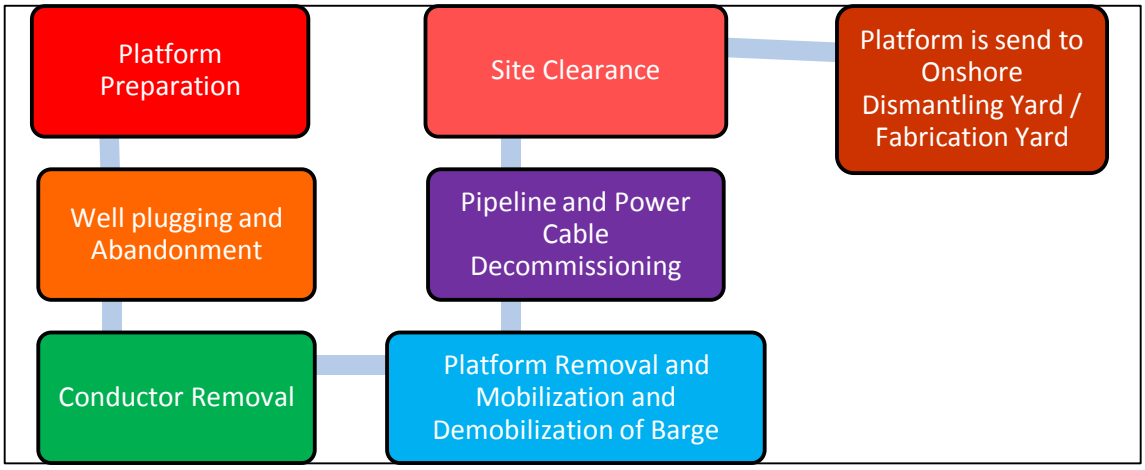


Figure 2: Offshore Decommissioning Process

Offshore Decommissioning Activities begin with the Planning and end after all the Platform material and waste is send to the onshore yard. Following initial, engineering planning, work begins with plug wells, clean and decontaminates the site and prepares the platform for removal. Any pipelines remaining in situ must be flushed, filled, plugged and buried. Heavy-lift vessels are engaged to eliminate the top-side and sub structures and move them to yards where waste materials will be managed and disposed accordingly. Final option will be disposing the material either remain in-situ or onshore. Finally, in order to avoid any future incidents, any debris that could interfere with other uses of the area is removed. The contractor must ensure that the site is clear and free from any potential obstruction. [15]

To ensure proper site clearance, operators need to follow a four-step site clearance procedure; Pre-decommissioning survey, Post decommissioning survey, ROVs and divers and Test trawling. [15] Finally, the site is trawled with a shrimp net to prove the site is clear of objects on the seafloor. To maintain the clearance, each piece had to be placed such that they would not overlap or lay at an angle so that one end would be high [16].

### 2.3.2. Onshore decommissioning Activities

There are certain equipment, facilities and services required to enable the onshore decommissioning of offshore structure once they return onshore. It cover the receipt of Structure, materials identification and waste management, method of dismantling of the structure. [13] The structure is bring onshore in order to increase the ability to control access in safety issues of the project. [13] Access to the sea and approaches for oncoming projects and ability to export steel by sea would be advantage. The facilities should be capable to handle all the substances which have been identified as existing offshore. Structure design as around 25-30 years and final decommissioning is dependent on the recoverable reserves, recovery rate and commercial issues at the time (Oil and Gas price) [13] Biological treatment will reduce the need to utilities landfill option. [13]

The whole sections or modules may be transported to shore, or the installation may be partially dismantled at sea and smaller units transported to shore in containers depending on the removal mode chosen [6]. Some of the non-steel waste must be handled and treat in specific procedures. Common methods of removing scale are high-pressure water jetting and mechanical scraping or scrubbing as the waste may contain pollutants (heavy metals, low specific activity (LSA) radioactive material, etc). In some circumstances, chemical cleaning methods such as Sandblasting may be used to clean large structures such as tanks [6]. Platform materials can be refurbished and reused, scrapped and recycled or disposed of in specified landfills [15]. The Hierarchy of Waste is typically in order of preference: reuse, recycle then disposal, though this is dependent on geographical constraints.

The Project Manager correlated with the major waste streams contractor, to establish a plan which products presented an opportunity to recycle and anticipated wastes suitable for recycling included concrete, masonry, timber, metals, plasterboard. Other waste not suitable for recycling and disposed of as general waste incurred normal disposal charges. Handling methods were considered important for the effective disposal of since the aim of maximizing recycling to benefit the environment and reducing disposal cost. From the lesson learnt of the North Sea decommissioning experience [14], a clear waste

management plan and strategy, developed together with the Decommissioning Contractor and Onshore Dismantlement and Disposal Contractor is important in decommissioning waste management.

Reuse of an installation in place without the need to expend energy, would be the most beneficial option. Where no practicable re-use opportunity is available elements of the structure will be re-cycled. For the largest structures up 97% by weight of the structure can be recycled, this weight is predominately [11] Three disposal methods were used during the Galveston 189 platform complex are onshore scrapping, reefing and refurbishment/reuse. The production deck was sold to the derrick barge contractor in exchange for services and sales price. The deck and production equipment were taken to shore for refurbishment and reuse. [16]

## 2.4. Waste Management of Offshore Decommissioning

In order to have a realistic view of the content of structures being receives from offshore decommissioning, offshore surveys will be required with backed up of more detailed surveys and sampling on reception process and during dismantling of the structures. The assessment of quantities can be made by comparison with the original construction information and offshore operation modifications. Production chemical and product residue may be more difficult to determine as the assessment requires access to the inner surfaces of pipework to determine the areas affected. [13]

Waste hierarchy principles are applied in waste management where “reduce, use, recycle and dispose” framework will be used as a core on the waste management strategy. [14] The project committed to ensuring that the Waste Management Hierarchy, shown in Figure 2 was at the core of its waste management strategy in order to:

- Maximize the amount of material from the platform which was reused or recovered / recycled;
- Minimize the environmental impact of its activities; and

- Achieve the publicly stated objectives of reusing or recovering / recycling 97% by weight of the recovered material.

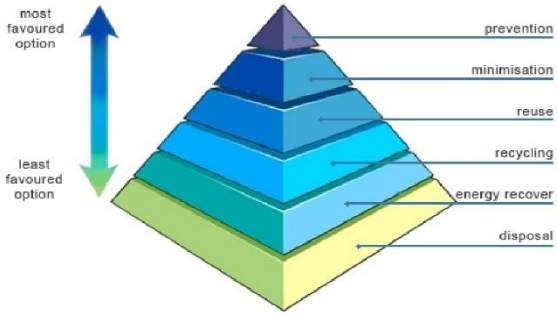


Figure 3: The Waste Management Hierarchy

Air discharge would be required in case of decommissioning be related mainly to asbestos, LSA and gasses such as H2S and noxious Marine growth odour's. [13]

Actual chemical name was required in order to provide the full hazard information for the waste consignment process. Analysis of records of chemicals present on the platform prior to cessation of production was not always conclusive. This meant that some additional survey work offshore, and research onshore, had to be carried out in order to provide the information necessary [14]. List of detailed waste identification for each region is presented in the appendix.

Routes for disposal are largely are largely determined by legislation, commercial waste management requirement, safety and the drive to recycle to maximum. Options for recycling and/or safe disposal are available. As market develops, new uses for materials will appear and drive to maximize the percentage of recycling. [13] Offshore Decommissioning waste management involved 3 Subcontractor; Onshore Dismantling Yard, Recycler, and Hazardous Management.

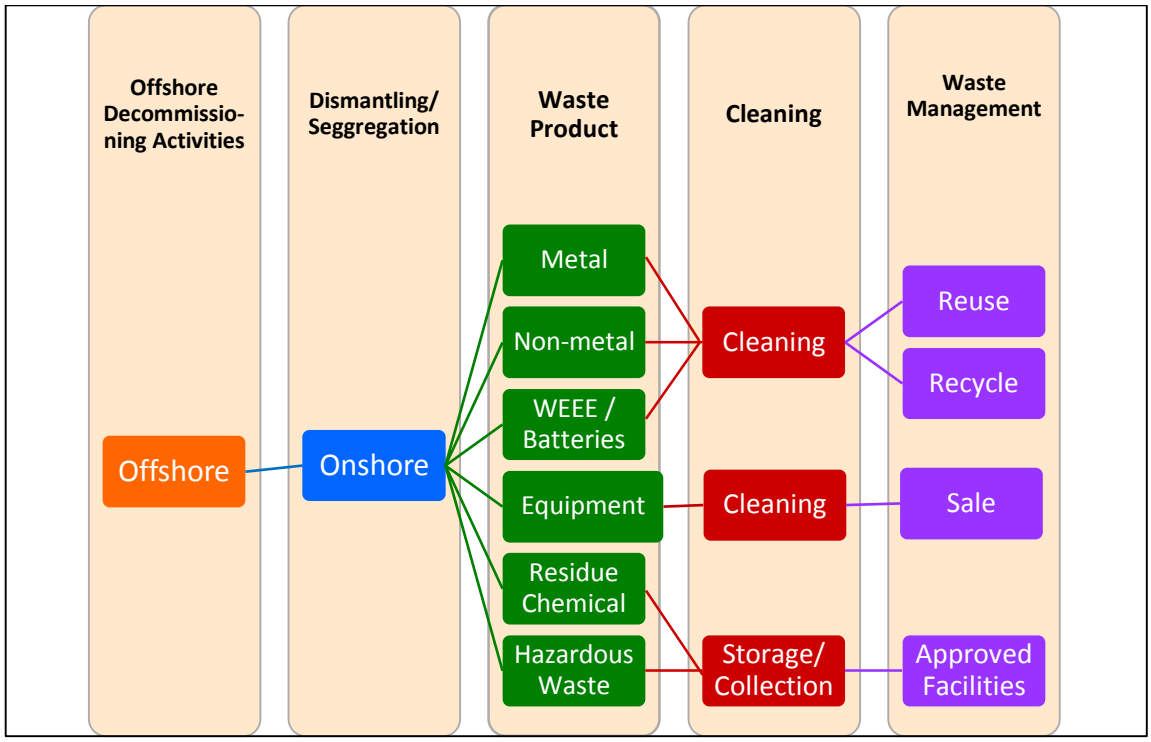


Figure 4: Onshore Decommissioning Potential Process

### 2.4.1. Reused

In the exploration and development phase of most projects worldwide, reuse of jack-ups and semi-sub rigs approach are already been applied to the waste management option considered. Based on the study done by [9], reuse of topsides and equipment especially is a practical and sustainable way forward in Malaysia as plenty of maturing platforms shall be decommissioned. There are huge business openings for contractors, service specialists, equipment providers, technology developers, consultants and professional service companies over the coming years in decommissioning area. [9] The reuse practice is gradually picking up in the North Sea. In fact, the industry is regularly exceeding 97% of reuse and recycle of all materials and components recovered from decommissioned structures. [9]

Some of the components (for example processing equipment, compressors) located on the topsides could have scrap value or possibly be of use in other operations. [17] Jackets shall be sent to the yards as acquired by the local fabricator and agreed by the owner for reuse purpose. Removed items will then be taken for scrap or refurbishment.

There are many examples where items of equipment or the complete topsides modules have been reused. Similarly jackets have been removed, cut to shape, equipped with additional foundation connections and relocated. In 1999, the infamous Brent Spar was cut into large sections and used to form the foundations a deep water quay near Stavanger, Norway. The reuse of complete jacket structures are understandably restricted and are more suited for usage outside of the oil and gas industry due to uncertainties surrounding their long term liability. Alternatively, if reusing a jacket or deck is deemed to be inefficient, the next rational step would be to recycle the steel [9].

However, in a majority cases in Malaysia, the field life appears to be longer than the original design intention. Most of the platform is considered under life extension program for continued use in the field. This program is triggered by the fact that new technology have improved the production process and the depleting field can still be exploited for the stack of reservoir. This also mean that, most of this platform have undergoes aging processing. It is unlikely that these platforms would be suitable for the reuse approach, but nevertheless the opportunistic option should be considered. [8]

## 2.5. Waste Identification

There is no available data for the decommissioning in Malaysia. Therefore, in order to predict the potential waste available, all the available Decommissioning waste generated for previous Decommissioning Project is 4 region being listed and compare to obtained general waste produce in Offshore Decommissioning and predicted the potential waste generated by the Malaysia Offshore Platform Decommissioning Project. The data tabulated for comparing between regions is attached in the appendix section on waste Identification.

The North West Hutton (NWH) platform was installed in 1983 and comprised an 18,000 tonne steel jacket support structure and 20,000 tonnes of topsides modules. There are also waste containing metals, glass reinforced plastic, hydrocarbon sludge, oils, production chemicals, drilling chemicals, asbestos, PCBs and radioactive materials etc [14].

**Schedule and Radioactive Waste**

For typical platform, liquids from oil reservoirs flow up to wellheads. The fluids contain sediment (formation sand and clay) and metal (including radium) compounds from the reservoir. The fluids are then passed through separators where they are separated into crude oil, associated gas and produced water.

Sludge accumulates inside the processing vessels and when there is a temperature or pressure drop, it deposited on the interior surface of the production components. The crude oil from the platform is pumped to an onshore crude oil terminal via pipelines. At the terminal, the crude oil is stored in storage tanks before being transported to refineries by ship. The gas is piped to the onshore gas facility while produced water is discharged into the sea after treatment. There are presence of $^{226}$Ra (limit of detection—10.4 Bq/l) and $^{228}$Ra (limit of detection—10 Bq/l) has been reported in produce water from Norwegian oil production facilities [18] .

Radium-containing waste is generated during maintenance activities of oil and gas facility components such as tubing, vessels and tanks. Sludge comprises hydrocarbon, heavy metals, natural radionuclides, sediments and, to a lesser extent, scales and corrosion products. Scales are sulphates or carbonates of barium, strontium, calcium, magnesium and radium. Some scale-contaminated components such as pumps and valves cannot be cleaned easily. The use of scale inhibitors reduces the formation of scale deposits. Thus, most radium will remain in the liquid streams in diluted form.

Management of oil and gas industry waste is not simple due to its content of hazardous and radioactive materials. In Malaysia, the waste is categorized as Scheduled Waste by the Department of Environment. Due to its potential radiological hazard and as a precautionary measure, the Atomic Energy Licensing of Malaysia (AELB) has also classified it as technologically enhanced naturally occurring radioactive material (TENORM) waste. Thus, the waste cannot be managed by the Scheduled Waste Treatment and Disposal Center until it is declassified from TENORM waste. Apparently, there is a need to characterize the radioactivity level of the waste prior to treatment and disposal. It is a common practice to store waste in metal drums at the crude oil terminals. Upon storage, the waste can harden due to the volatilization of some hydrocarbon

compounds. The quantity of stored drums is increasing. Being close to the seashore, metal drums can rust over time and require repacking. Up to May 2003, a few thousand drums of sludge have been accumulated while best management solutions are being investigated. [19]

To some extent, sludge farming (mixing sludge with soil) in concrete ponds is practiced as a method of treatment to remove hydrocarbons through biodegradation under the approval of the Department of Environment [19]. It is obvious that this method also dilutes the radioactivity in the treated sludge. Hydrocarbon extraction from sludge has been attempted as a treatment method for volume reduction purposes. The process leaves behind a solid sediment as the residue. Incineration is another option for treating the sludge. Sludge incineration [20] or combustion [21] enhances the radium concentration in the generated ash.

This paper presents a broad picture of the radium distribution in the various types of oil and gas industry waste generated in Malaysia. This is based on a compilation of 470 results from studies and analysis carried out by MINT in the past 10 years for different purposes using various gamma spectrometers. Overall, 75% of the waste, mostly sludge and extraction residue lies within the normal range of radium concentration in soils of Malaysia. However, some platform sludge can have radium concentration up to 560 Bq/kg. The highest mean $^{226}$Ra and $^{228}$Ra concentrations of 114,300 and 130,120 Bq/kg, respectively, were measured in scales. [22]

The types of materials involved in decommissioning include: [13]

Table 1: Types of Materials Involved In Decommissioning

| Waste categories | Material Type |
|---|---|
| Steel | High Grade, Various Structural Sections And Tubular |
| Other Metal | Copper, Cupro-Nickel, Aluminum, Zinc And Numerous Recyclable Materials. |
| Other Material | Equipment, Pipeline, Caisson |
| Hydrocarbon | Production hydrocarbon light to heavy sludge, sludge operational gearbox oils, greases, transformer oils (PCB), hydrocarbon gas |
| Oil | Diesal Oil, Hydraulic Oil, Spent Lubricating Oil |
| Deposits | Spent Acid And Alkaline, ,Spent Solvent, Hydrocarbon sludge, Scale, Sediment, Sand, calcium salt scales, |
| Production Chemical | Muds, Drilling Chemical, lubes, anti-freeze, biocides, drill additives/acids, corrosion inhibitors, gases, oxy scavengers, paints, solvents, Chemical mix with halogen, Metal mix chemical, etc |
| Hazardous Materials | Heavy metal, PFOs, PVC, Asbestos, mercury, pyrotechnics, biocides and many small quantities of materials contained in electrical system. |
| Radioactive Waste | LSA/NORMs Scale, TENORM, |
| Other | Marine Growth, batteries, Phthalates (plasticisers in flooring and cables), Light Bulb |

## 2.6. Categories Waste Management Service

### 2.6.1. Onshore Dismantling/Fabrication Yard

In order to operate, onshore facilities will required a level of capability suited to the multitude of possible forms in which the structures will arrive onshore. Most of the large launch barges requires min. 5m draft and quayside facilities allowing 200m length to be

docked. The smaller barges suitable for modules in the 1000 to 3500MT range require some 100m of space and min. 4m of draft. [13]

The general sequence of the operation will begin with the survey work as the requirement change from offshore to onshore section if HSE. As work on the project progresses, the job scopes will changes from survey work through stripping, removal of hazardous materials to structural dismantling. [13] Segregation of materials will take place at the point of removal as demolition proceeds – the purer the material the higher the prices paid. The quantity of wash down and cleaning required to bring material up to specification will require a treatment system for oily water generated in the process and recycling of used water. [13]

Platform fabrication experience is not necessary for receiving offshore platform scrap. Location, sufficient crane capacity and dock facilities are key elements for these yards. Once overcome, there is a region wide market for offshore facility reuse, recycle or resale for both within the oil and gas industry and in other sectors [9]. Access to the sea and approaches for oncoming projects and ability to export steel by sea would be advantage. The facilities should be capable to handle all the substances which have been identified as existing offshore.

The cost model for the decommissioning project assume that the transportation to the nearest yard will reduce the cost of the project and the nearest location will be more preferred choice for final disposal site. The logistics of the onshore transport to the recycling plant depends on the location of the scrapping yard. Sea or rail transport of steel scrap to the steel works would be desirable as a large steel would generate significant amount of road freight. [8]

### 2.6.2. Recycling

Based on cost benefit study done by PETRONAS, Platform in open waster at depth less than 75m and weightless than 4000 tonnes is not reusable. Thus, it is preferred that the

platform is sent to the nearest fabrication yard in the vicinity. The structure is then cut into manageable size before it being scuttle and recycle at the recycling facilities. [8]

Many of the materials on Offshore Structure will be recyclable, these include; metals, plastics and hydrocarbons. Recycling conductor is not practical due to the fact that conductors consists of several pipes (casing) grouted together [8]. The percentage of recovery of recovery of 90% and upwards will depend on the mix of materials and the age and condition of equipment aboard. Steel is almost recyclable while plastics vary according to type, Non-recyclable material such as hazardous will be treat as the designated facilities as laws compliance. [13]

The energy benefit from recycling steel compared to producing new steel (22GJ/t compared to 32 GJ/t according to the AURIS data) are substantially balanced by the energy needed to dismantle, transport the platform to shore and prepare it for recycling. Safety and other possible environmental would make this option unattractive. [8]

The steel from offshore decommissioning is contaminated by other waste such as marine growth and Mud from the Operation. Additionally, cleaning of any hydrocarbon residues and removal of hard marine growth may be required before the metal is sent for recycling. [8]

### 2.6.3. Hazardous Waste Management

The decommissioning project will lead to accumulation and production of toxic and hazardous wastes. The poor management and disposal of these wastes have cause to the environmental degradation and irreversible ecosystem damage all around the world. [23]. Therefore, to proper and safe disposal of these toxic and hazardous waste is the only solution to avoid the damage. Schedule wastes are required to be treated and disposed of at facilities approved by the authorities. Waste treatment plants of this kind are required to hold permit under Pollution Control Act. Strict requirement are intended to ensure environment and health option. [6]

Mechanical Cleaning and washing with detergent are employed to remove oil and gas residue. Removal of LSA radioactive scale may require further mechanical cleaning to bare metal. The waste from cleaning the structure has to be collected in tanks and sent to the approved facilities for safe disposal. Neutralizing the toxic sediment may require chemical treatment. It is clear that, cleaning operations generally will add to volume of waste and all associated problem and costs in comparison with those of the original content.

Appropriate safety and control procedures for handling and treating hazardous substances and their wastes from "cradle to grave" are integral elements in toxic and hazardous waste management in Malaysia. By means of the Law, has instituted administrative and legislative measures to control hazardous substances at every stage of production, storage, transfer, maintenance, use, and disposal. The applicant must provide details on the types and quantities of hazardous materials handled and the types and quantities of hazardous waste produced. The regulations will specifically relate to producer responsibility and will include a mechanism for enforcement and inspection of hazardous waste from cradle to grave as well as requirements and guidelines on hazardous waste treatment which are targeted at producers of hazardous waste, transporters, transfer stations and treatment, recycling and disposal facilities

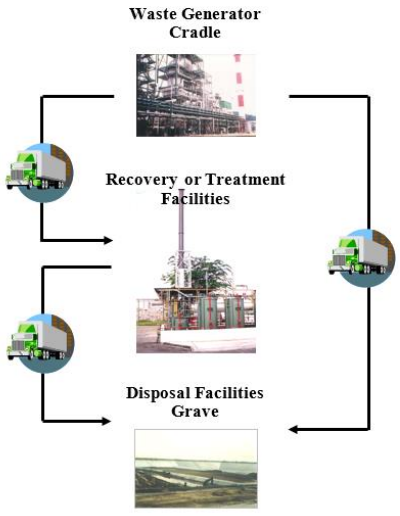


Figure 5: Principal of toxic and hazardous waste Management – ‘Cradle to Grave’

Management of oil and gas industry waste is not simple due to its content of hazardous and radioactive materials. In Malaysia, the hazardous waste is first categorized as Scheduled Waste by the Department of Environment.

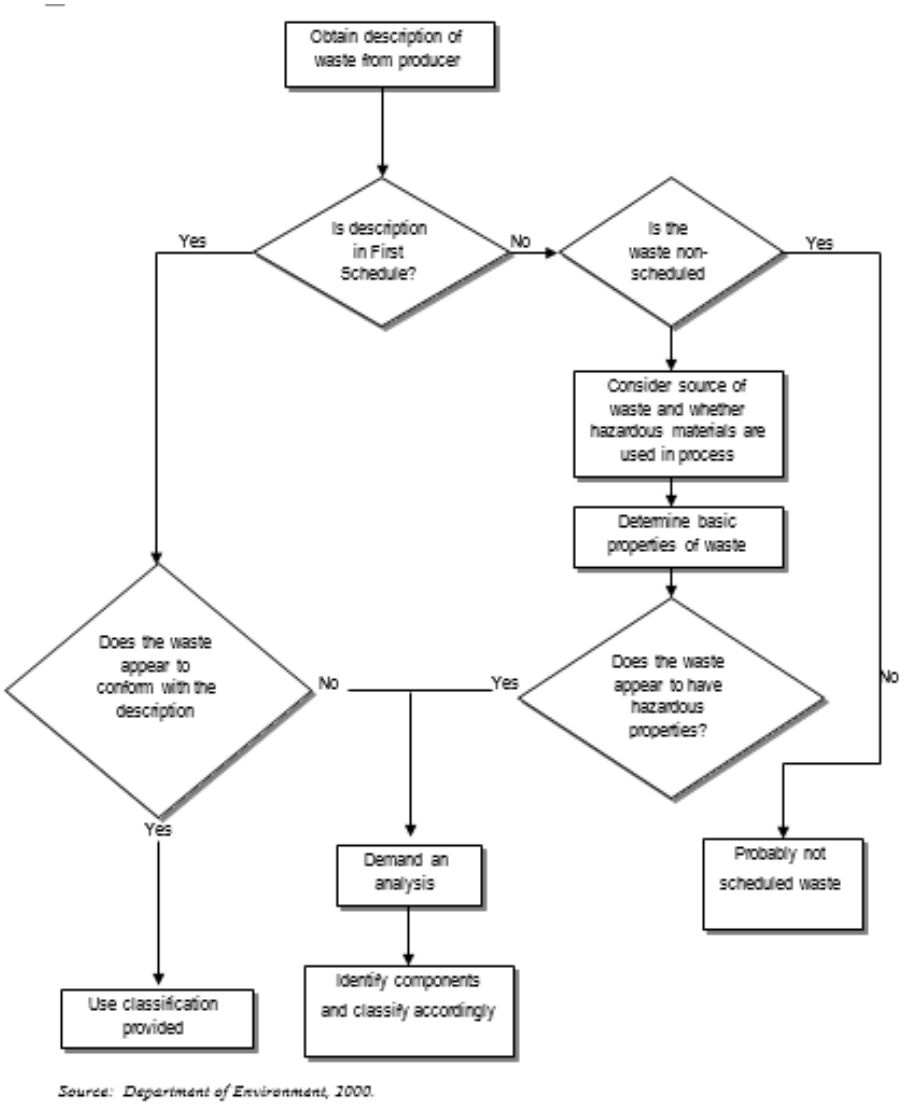


Figure 6: Procedure of Identifiying and Classifying Schedule Waste in Malaysia.

## 2.7. Previous Study

The first and only official study on Malaysia's Platform conducted by PETRONAS on the decommissioning of offshore installation is done on 1997.With an uprising number of platforms that need to be decommissioning in future. It is necessary to conduct new study

after 13 years to assess the awareness and the current capacity of the local service provider in Malaysia [8]. Paper from [22] discuss Radium concentrations in 470 samples of the various types of waste from oil and gas industries were analysed using gamma spectrometers. The results showed that the radium concentration varied within a wide range. However, it just focusing on radium relate waste from offshore oil and gas operation. This paper does not discussed on the decommissioning waste of oil and gas operation.

According to [14], based on the previous decommissioning of North West Hutton (NWH) Platform in North Sea, there are a few challenges in waste management;

- Identified and quantified the waste materials present in throughout the decommissioning process to the level of detail.
- Develop a clear strategy for the removal, transportation and waste management activities.
- Provide a clear strategy to hazardous offshore waste management in term of decision making for the level of cleanliness which must comply minimum requirement.
- Method of handling waste whether to be left in-situ or handled during onshore dismantlement.
- Quantified waste per separated section for removal and consignment onshore as required under regulation for onshore management planning.
- Managing the interfaces between a number of contractors to execute this effectively and in compliance with relevant regulatory requirement.

However, most of the study performed is from North Sea Platform, however lesson learnt and issue arise from their past decommissioning experience can be include in the study for Malaysian Offshore Decommissioning [14].

# CHAPTER 3

# METHODOLOGY/ PROJECT WORK

## 3.1. Case Study Approach

The use of case study as research methodology in engineering and technology management related researches are receiving growing recognition among groups of researchers [24]. Today, in many universities in Northern Europe, United States, Australia and other Asian countries; research related to engineering management are often based on case studies [25]

Dul and Hak define case study as a research strategy in which a single or small number of cases are in their real life context (without manipulation) chosen, and scores obtained from these cases are analyzed based on visual inspection of the scores of the case. [26] This research integrates a literature review and a case study. While the literature review provides an overview of industrial waste management practices, the case study provides qualitative and contextual data on the capacity of local services providers in offshore decommissioning waste management in Malaysia. The method to use for the research depends on the nature of the information required and other prevailing circumstances pertaining to the topic and the study area [27]. The case study approach is a very useful tool to collect detailed and contextual information. It gives an opportunity to delve into one aspect of a problem in more detail within a limited timeframe [28] . However, selecting cases must be done so as to maximize what can be learned in the period of time available for the study. The unit of analysis is a critical factor in the case study. It is typically a system of action rather than an individual or group of individuals. Through the case study approach, the corporate structures, and the information management of the organization under study, can be well understood [29].

Case studies can be either single or multiple-case designs. Levy [30] used a single-case design for the study at the University of Arizona. Single cases may be used to represent a unique or extreme case [31] .Single-case studies are also ideal for revelatory cases where an observer may have access to a phenomenon that was previously inaccessible. In order to represent assessment on unique case of the waste management in Offshore Decommissioning in Malaysia, single case design will be suitable for this study.

### 3.1.1. Validation for Adopting the Case Study Strategy

Yin [31] suggested using multiple sources of evidence as the way to ensure construct validity. The current study used multiple sources of evidence; survey instruments, interviews, and direct observation. Yin [31] listed six sources of evidence for data collection in the case study protocol: documentation, archival records, interviews, direct observation, participant observation, and physical artifacts. Not all need be used in every case study.

A frequent criticism of case study methodology is that its dependence on a single case renders it incapable of providing a generalizing conclusion. Yin, [32] presented Giddens' view that considered case methodology "microscopic" because it "lacked a sufficient number" of cases. Hamel [33] and Yin [32] [31] forcefully argued that the relative size of the sample whether 2, 10, or 100 cases are used, does not transform a multiple case into a macroscopic study. The goal of the study should establish the parameters, and then should be applied to all research. In this way, even a single case could be considered acceptable, provided it met the established objective.

### 3.1.2. Case Selection

In order to select the participant for this case study, purposive sampling approach is used. Patton [34], has proposed the following cases of purposive sampling. Purposive sampling is commonly used in qualitative research. A purposive sampling, also referred to as a judgmental or expert sampling, is a type of nonprobability sample. The main objective of a purposive sample is to produce a sample that can be rationally assumed to be illustrative of the current population. [35] The sample is selected based on the understanding of the

population and the research intention. They are selected because of some characteristic. [36] Sample elements are selected because they have been identified to represent the population of interest. Basically, it is a small sample in which the researcher used to represent all groups or segments from the population. [37]

Field researchers are often interested in studying different cases – that is, cases that don't fit into regular patterns of attitudes and behaviors. By studying the deviant cases, researchers can often gain a better understanding of the more regular patterns of behavior. This is where purposive sampling often takes place. For instance, if a researcher is interested in learning more about students at the top of their class, he or she is going to sample those students who fall into the "top of the class" category. They will be purposively selected because they meet a certain characteristic. [38]. Besides that, when the desired population for the study is rare or very difficult to locate and recruit for a study, purposive sampling may be the only option.

In this case, this project is interested on the most potential local service provider of offshore decommissioning. Three company is selected because they meet certain physical characteristic; different type of operation, location of the facilities to the yard, and year of experience. It is possible to defend purposive samples because the researcher uses clear criteria (e.g., experience and prior knowledge) to identify criteria for selecting the sample. The selection criteria is support by the theory that the cost model for the decommissioning project assume that the transportation to the nearest yard will reduce the cost of the project and the nearest location will be more preferred choice for final disposal site. [8]

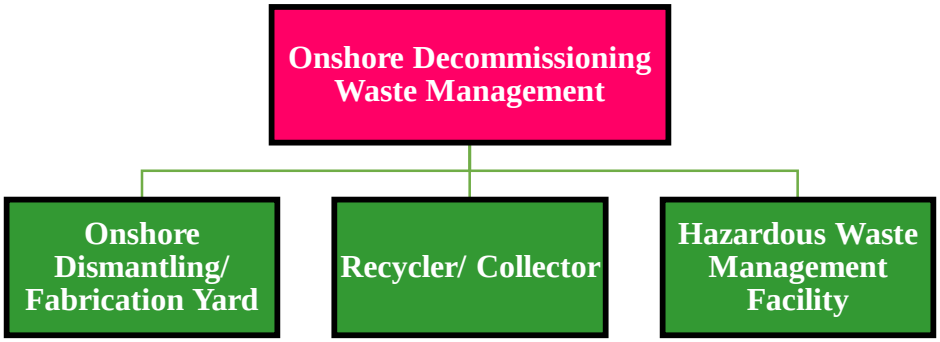


*Figure 7: Categories of Onshore Decommissioning Waste Management*

Purposive sampling can be very useful for situations where you need to reach a targeted sample quickly and where sampling for proportionality is not the main concern. [38] One of the first things the researcher will do in this situation is verify that the respondent does in fact meet the characteristics or criteria for being included in the sample. The validity of this samples type can be increased by trying to approximate random selection, and by eliminating as many sources of bias as possible. [36]

## 3.2. Data Collection

### 3.2.1. Triangulation Method

Triangulation is the process of strengthening the findings obtained from a qualitative inquiry by cross-checking information. [39] A researcher who argues that his or her findings are derived from many different kinds of people across many different situations will be more convincing than another researcher whose conclusions are based observations of one person in one setting [40]. This project have applied the triangulation method to increase the validity of the result obtained.

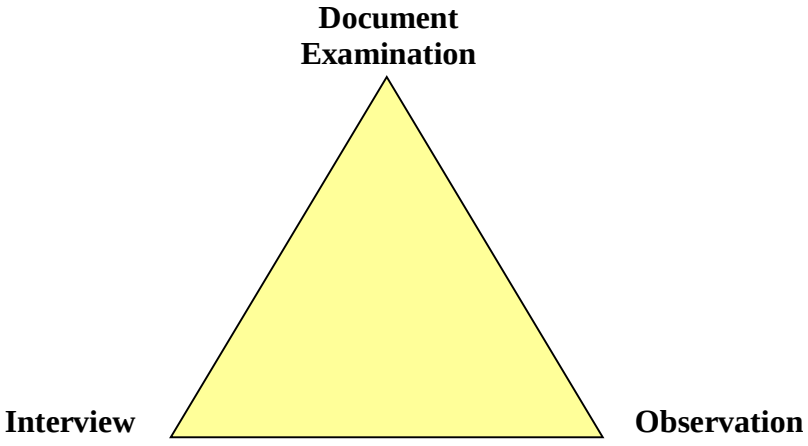


Figure 8 : Triangulation of Methods

### 3.2.2. Document Examinations

Document material may include letters, memos, notes, diaries, photographs, audiotapes, videotapes, films, articles, books, manuscripts, e-mails, online discussions and so forth. In general documents are any preserved recording of a person's thoughts, actions or creations [40] . Documents are also examined by researchers who are investigating subjects who are available. The examination of documents may also provide confirmatory evidence of the information obtained from interviews and observations. [39]

### 3.2.3. Interviews

Interviewing is a technique of gathering data from humans by asking questions in verbally manner. There are many different ways of conducting interviews. Structured interviews use an interview schedule that is similar to the survey questionnaire. You the question could be phrased the question in such a way that so the range of responses is limited. Structured interviews are widely used in surveying opinions, beliefs and perceptions of people. [39]

Face-to-face or personal interviews are labour intensive but can be the best way of collecting high quality data, especially when the subject matter is very sensitive, if the questions are very complex or if the interview is likely to be lengthy. [39]

For the purpose of this study, Structured Self-Administered Interview is used for the data collection where the respondent will receive the question set to be reviewed before begin the interview session. The question ask during the session is based on the questionnaire set with more detailed explanation.

### 3.2.4. Observations

Observation is the technique of obtaining data through direct contact with a persons or group of persons. Since, the main focus of qualitative research is naturalism, the researcher has to observe person or persons in their natural state as undisturbed as possible. Between being a passive observer and an active participant, the researcher could take a middle position of being an active observer. Here, participation is allowed but

limited. The researcher may intrude into the lives of subjects such as entering their homes or their communities but remains passive once inside the environment so as not to influence the natural occurring behaviours and conversations. The researcher tries as far as possible to be passive, saying as little as possible so as not to influence the behaviours and conversations of subjects. [39]

### 3.3. Project Methodology

Case study approach is applied to this study. A set of question shall be ask to the participant and the respond will be analysis based on the aim planned. In order to accomplish the desired objective, project activities is outlined based on the intended activities.

*Objective i)* *Establish the current capacity of local services providers in offshore decommissioning waste management in Malaysia.*

The potential decommissioning local service provider will be identified to collect the sampling data for respondent. The author must understand and familiar with the type and quantity of different waste material produced as well as the Decommissioning Waste Management procedure and disposal method available, in Malaysia. The assessment done will also include on their company profile and experience for the platform decommissioning, facilities available on site, their capability to handle each type of the waste identified and the readiness for the operation if needed. The respondent selected will be based 3 main categories based on the business operation; Onshore Dismantling/ Fabrication Yard, Recycler/ Collector and Hazardous Waste Management. The data are drawn from the results of surveys undertaken by the author will be analyst in order to assess the total capacity for each facility per year. Capacity is determined by calculating the total weight (tons) of the decommissioning activities per year and compare with the weight capacity of the respective facilities.

*Objective ii)* *To assess the current and future offshore decommissioning waste management capacity for local service providers in Malaysia*

**Fabrication Yard/ Recycler**

In order to accomplish this objective, projection of the capacity (volume) of offshore decommissioning in the years ahead was tabulated. The total capacities of the decommissioning 20 years later have to be projected and total weight of the waste is estimated. This is basically a comparison between the decommissioning capacity available today, and Malaysia's in the future, based on the timing of decommissioning on the Malaysia off coast and projections of the import of installations for decommissioning. Based on the result analyst from the current capacity of local service provide, evaluation on future capacity will be conducted in order to determine whether Malaysia will still capable to perform decommissioning project in the future. As a way forward, area of improvement for capability building among local service providers will be proposed. With the propose area, training and awareness creation on the decommissioning be addressed and implemented.

**Hazardous Waste Management**

There are no available data on the amount of waste generated from the Jacket Platform decommissioned project. But, general type of potential waste generated can be identified from the previous study done on the platform decommissioned all around the world. From that, the waste identified is tabulated and compare between different regions. Based on the similarities type of waste found, possible waste generated from Jacket Platform Decommissioned Project can be predicted. This will be supported by some of the study done on waste of Oil and gas Industry in Malaysia. The selected local service provider for the HWM category will be assessed on their capability to treat each type waste and what are the processing methods adopted by the company. The parameter used to assess the capacity for this service provider category will be in term of type of waste they can handle and capacity of the facilities instead of using volume as a parameter. The interpretation from this result will give answer on whether the service provider is able to handle all the hazardous waste generated from platform decommissioned work.

*Objective iii) Determine the level of awareness of local services providers about offshore decommissioning potential activities.*

A section of decommissioning awareness will be asked in the Questionnaire together with other section. The questionnaire is designed based on the potential decommissioning activities. The respondent will be assessed in the Likert Scale; (Very Low, Low, Moderate, High, and Very High.). The question asked will be on the decommissioning potential activities as general and specific to waste management. This will access on the level of respondent understanding on the decommissioning area. The respondent is asked on their awareness of the activities, facilities, and resources required for decommissioning.

## 4.1. Project Activities

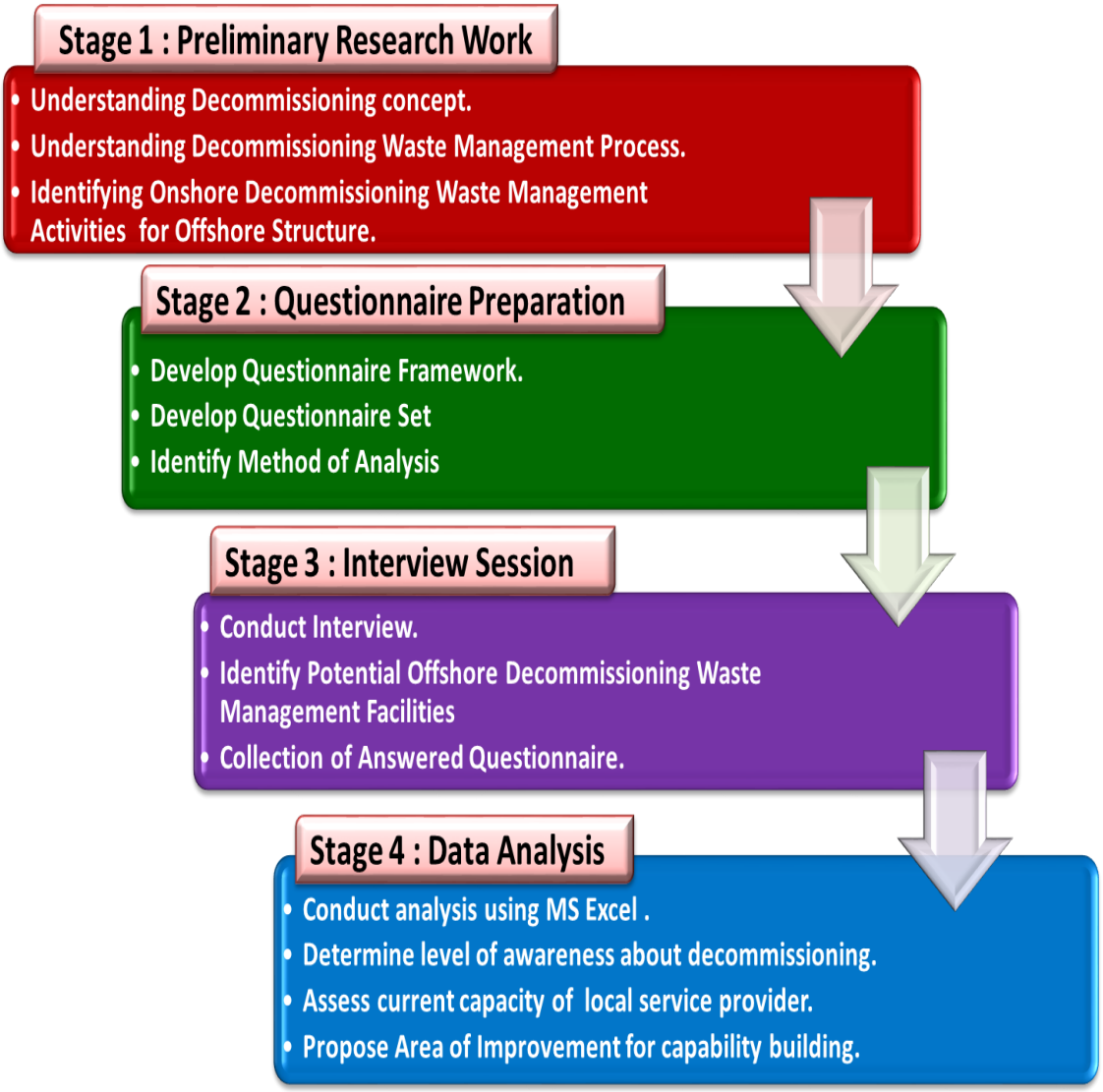


Figure 9: Project Activities

# CHAPTER 4

# RESULT AND DISCUSSION

## 4.1. Projection for Decommissioning of Offshore Installation

### 4.1.1. Timeframe and Weight Estimation

Cessation of Production (COP) is also known as end of useful life. COP defines as the termination of production from a well. It may be cause by mechanical breakdown, reworking operations, governmental orders, or depletion of oil or gas. The time for Cessation of Production COP different for each Offshore Structure depending on a few criteria; location of the field, oil prices, expected trends in production, operation, maintenance costs and technical condition of installation. There are also possibilities for the COP may deviate from the expected design life. The COP for each platform is based on field life estimation done by the operation to forecast the "last oil" of 100bbl/day. The field life estimation for each platform is conducted annually and the finding may be varies from time to time based on the current situation. Since the production is the major contribution to the business, most platform abandonment schedule begins after the platforms reach the COP instead of design life. Most of study shows that with proper integrity plan, the platforms in Malaysia are still able to operate and provide the sufficient strength even though the platforms have exceeded design life.

In this study, the weight estimation for decommissioning of offshore installation it Malaysia region has been estimated from the Malaysia Platform Report, 1997 on local oil and gas Industry. The weight estimates are mainly from the data directly provided from the report. However, there are certain degree of ambiguity in the data mainly due to a few aspect existed throughout the platform operation such as modification of the installation,

additional structure to the structure and possible re-use option for decommissioning option. From the report, the weight provided is only for Jacket, Pile and Conductor. For the sake of this study, the data can be used for the capacity assessment.

Data extracted from 1997 report on Malaysia Platform, Decommissioning Schedule of the platform is tabulated based on Cessation of Production, COP (Table 1) and Design Life (Table 2) which was 25 – 30 years. Below is the graph that forecast the cumulative weight of platform to be decommissioned based on COP (Fig.10) and Design Life (Fig.11) for respective Years of Abandonment.

Table 2: Abandonment Schedule Based on COP

| Year of Abandonment | No. of jacket Platform | Total Steel (MT) | Heaviest Jacket (MT) | Jacket + Pile+ Conductor Weight (MT) |
|---|---|---|---|---|
| 2015 | 82 | 72793 | 9990 | 148357 |
| 2020 | 74 | 51124 | 4086 | 113291 |
| 2025 | 32 | 22793 | 2896 | 48970 |
| 2026 | 2 | 1005 | 807 | 2850 |
| 2030 | 1 | 2548 | 2548 | 6082 |
| 2038 | 19 | 47153 | 4037 | 100523 |
| 2040 | 7 | 10291 | 2474 | 22819 |
| 2047 | 1 | 1869 | 1869 | 4035 |
| TOTAL | 218 | 209,576 | 9,990 | 446,927 |

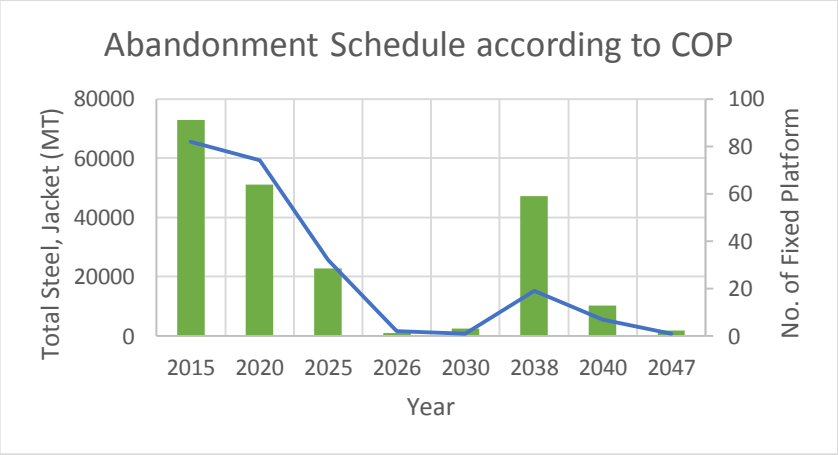


Figure 10: Graph of Abandonment Schedule according to COP

Table 3: Abandonment Schedule Based on Design

| Year of Abandonment | No. of jacket Platform | Total Steel (MT) | Heaviest Jacket (MT) |
|---|---|---|---|
| 2015 | 174 | 126712 | 9990 |
| 2020 | 35 | 46,800 | 4,086 |
| 2025 | 9 | 36,064 | 2,096 |
| TOTAL | 218 | 209,576 | |

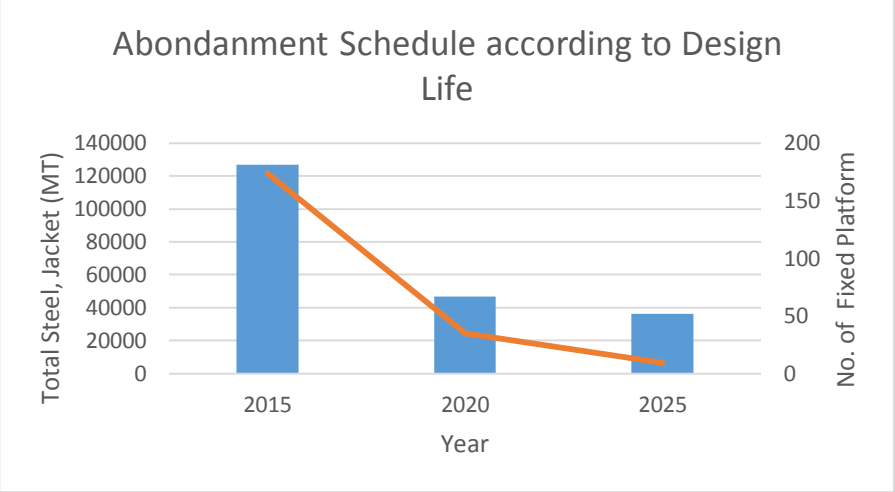


Figure 11: Graph of Abandonment Schedule according to Design Life

Based on the tabulate data from COP Schedule, the Decommissioned Platform in Malaysia is expected to large amount of waste in year ahead. The highest total weight of jacket need to decommission in 5 years is 72,793 MT give an average of 14,558 MT annually. Whereas, the highest total combination weight of Jacket, Pile and Conductor is 148,357 MT with an average of 29,671MT per year.

From both data population, it show that if the decommissioning is done in COP timeframe. The schedule shall be up until 2047 instead of 2025 based on design life. Below show the trending of Platform used exceed design life as the Production rate is acceptable. There are also platform that reach COP before exceed design life.

Table 4: Summary of Decommissioning Platform Timeframe in Malaysia

| | |
|---|---|
| **COP Exceed Design Life** | 171 |
| **Design Life Exceed COP** | 47 |
| **Total** | 218 |

From this data, it show that, with new advance technology develop for marginal oil exploration, the structure is still continue operation even though, the structure have exceed design life, However, the integrity of the structure must be assessed annually to ensure the strength of structure is acceptable.

### 4.1.2. Type of waste material

Most of the waste generated from the Platform Decommissioning is a steel or ferrous waste 98% which can be recycled. There is no documentation available on detail type of waste generated from Malaysia Platform. Therefore, waste generated from decommissioning platform from five different regions is compared in order to identify the potential type waste generated in Malaysia Platform to be used in the assessment. The detail comparison of the waste is tabulate in detail in **appendix section**. For this project purpose, the capacity of potential service provider is assessed based on their ability to treat, processed and disposed the identified type of waste for Platform Decommissioning in Malaysia.

## 4.2. Single Case Study

This finding is presented using single case study approach. The findings have been categorized into three based on each case (e.g.: Dismantling Yard, Recycler and Hazardous Waste Management.).To start with, the finding from the interview session and observation will be reported first, and then documentation findings follow next. The assessment results of the case study are presented into three main sections based on the objective of the project. The first section deals with establishment the current capacity of local services providers in offshore decommissioning waste management in Malaysia and determining the level of awareness of local services providers about offshore decommissioning potential activities which was carried out through interviews and documentation while the second section focuses on assessing the current and future offshore decommissioning waste management capacity for local service providers in Malaysia. Therefore, the response will be presented based on the question. From the current capacity of the facilities obtained from the finding, the current and future capacity

of local service provider in offshore decommissioning waste management can be assessed. This assessment is done to determine whether the selected local service providers have the ability and the capability to perform waste management service for local decommissioning project for offshore structure. This findings will offer a better understanding on the how the company operated and services provided by the selected company. Based on this understanding, an effective waste management system may be proposed in further for the waste management plan for Platform Decommissioning.

### 4.3. Question Set Used For the Interview.

The questionnaire prepared for the interview session is presented in questionnaire set to ease the interview process. However, there are other question asked besides the questionnaire set in order to understand detail process and structure of the selected company. Below is the outline of the questionnaire set and type of question used during the interview sessions.

**Part 1: Company and Respondent Profile**

a) Location of Company
b) Type and Year of Operation
c) Experience in Oil and Gas Offshore Decommissioning Platform
d) DOE License owned by company
e) Respondent Position and Year Of Experience

**Part 2: Capacity of Waste Processed and Managed by the facilities**

**Section 1: Fabrication Yard / Recycler**

a) Service available to process/treat waste generated from Dismantling Platform
b) Type of Waste Composition generated and received by the facilities
c) Available Secured Landfill
d) Waste Management Approach and Final Residue Disposal Option.
e) Type and capacity of waste storage available at the site.
f) Total capacity at the facilities to process the waste
g) Challenges of managing waste from Offshore Decommissioning in Malaysia

**Section 2: Schedule /Hazardous Waste Management Facilities**

a) Service available to process/treat waste generated from Dismantling Platform
b) Type of Schedule Waste Composition Received by the Facilities
c) Available Secured Landfill
d) Waste Processing Method and Final Residue Disposal Option.
e) Type and capacity of waste storage available at the site.
f) Total capacity at the facilities to process the waste
g) Challenges of managing waste from Offshore Decommissioning in Malaysia

**Part 3: Level of Awareness in Potential Decommissioning Activities and Opportunities.**

**Section 1: General Awareness of Oil and Gas Opportunities**

a) Local Oil and Gas Industry
b) Decommissioning of Offshore Oil and Gas Platforms in Malaysia
c) Approach used in processing steel waste from Platform Decommissioning
d) Type of waste generated from Offshore Decommissioned Platform
e) Waste Management process for Offshore Decommissioned Platform
f) Interest level in Offshore Decommissioned Platform Waste Management Business

**Section 2: Awareness in Schedule /Hazardous Waste Management Only**

- Processing and Residue Disposal method for each categories of Schedule Waste.

Other question asked during interview besides the questionnaire set is attached in the appendix. The question is developed specifically to the company. The purpose of this questionnaire is to understand in detail each aspect of the waste management of the service provider related to Offshore Platform Decommissioning.

## 4.4. Justification of the Question Used For the Interview.

**Part 1: Company and Respondent Profile**

This part of question is used to provide better understand the structure of the organization and type of business operation. The year of operation will indicated whether the company is new in business or it is well established. By knowing whether the service provide have experience in Platform decommissioning work, we can determine the appropriate question to ask the respondent on the service provide by the company. The License owned by the company can determine the capability of company to perform certain specific type of service. Respondent Position and Year of Experience will give an indication on the understanding and expertise of the respondent in the subject.

**Part 2: Capacity of Waste Processed and Managed by the facilities**

The first three questions are to understand the service provide by the company:

a) Service available to process/treat waste generated from Dismantling Platform
b) Type of Schedule Waste Composition Received by the Facilities
c) Waste Management Approach, Processing Method and Final Residue Disposal Option.

The last three questions to assess the total capacity of waste processed per year and capacity of each the facilities required to support the waste processed operation:

d) Available Secured Landfill
e) Type and capacity of waste storage available at the site.
f) Total capacity at the facilities to process the waste

By establish this three main components; (type of service provide, facilities available, and total capacity of the company), the general capacity of the service provider can be determined to completed *Objective i) To establish the current capacity of local services providers in offshore decommissioning waste management in Malaysia.* Besides that, question such as Challenges encounter to managing waste from Offshore Decommissioning in Malaysia may give an overview on the perspective and option of the personal to the waste management operation.

**Part 3: Level of Awareness in Potential Decommissioning Activities and Opportunities.**

Part 3 to achieved *Objective 2: Determine the level of awareness of local services providers about offshore decommissioning potential activities.* The questionnaire is designed based on the potential decommissioning activities. The respondent will be assessed in the Likert Scale; (Very Low, Low, Moderate, High, and Very High.). The same questions were asked to all three service provider. Since, the company selected is one of the most experience companies in the business. The responses received will indicate the highest level of awareness represent by each category. This is based on the assumption that new company will have less understanding in term of experience in the business.

## 4.5. Case Studies Findings.

Each of the Case Studies is selected based on type of operation:

*Objective i)* *To establish the current capacity of local services providers in offshore decommissioning waste management in Malaysia.*

### 4.6.1. Case Study 1: Onshore Dismantling / Fabrication Yard

Part 1: Company and Respondent Profile

The company selected for the Onshore Dismantling / Fabrication Yard is Kencana Fabrication Yard under SapuraKencana division, Kencana HL Sdn. Bhd (KHL). SapuraKencana Petroleum has become one of the world's top five EPCIC (Engineering, Procurement, Construction, Installation and Commissioning Service) players ranking alongside global giants. As a merged entity, SapuraKencana has proven and strong delivery capabilities across the oil and gas value chain, including expertise in deepwater

and marginal fields. SapuraKencana provides a full range of construction and engineering services required for the O&G industry, from detailed engineering design to construction. We are also focused on the fabrication, building and upgrading of rigs, vessels, jackets, topsides and other O&G facilities. The group also has a long track record in providing offshore installation and HUC activities in Malaysia and has since expanded into regional and global markets.

Kencana Fabrication Yard located in Lumut Port Industrial Park, Sitiawan, Perak. The facilities have been operated since 2000 (14 years). This will indicate the level of experience of the organization in the fabrication business Therefore, this company a suitable candidate for potential local service provider for this fabrication yard case study. The response received from the interview session show that, KHL have previously undertaken Offshore Decommissioning Project. However, the KHL does not provide the major decommissioning services and the record show that the project is more than 5 years ago before the respondent work at the company. Therefore, respondent was not able to explain further more on the project. However, the respondent was told that, the platform pieces from the decommissioning project are being reused for refurbishment purpose with a proper testing and process. In order to retrieve detail information from the previous project, another interview session needs to be conducted in the further with respondent who work longer than 10 years at the Kencana HL. The respondents representing Kencana HL is HSE Engineer with less than 5 years' experience. Besides that, record show that these facilities are not authorized to handle and store radioactive waste.

Figure 12: Kencana Yard, Lumut Perak

Part 2: Capacity of Waste Processing / Management

There is no service available to process/treat waste generated from Dismantling Platform. The waste management approach used at the facilities is reusing platform part for refurbishment as new unit. In order to process the waste, KHL have sent their waste to the third Party to support the operation. Below are the third party involve in the KHL waste management:

- Kualiti Alam Sdn Bhd (Schedule Waste Disposal)
- Alam Aliran Sdn Bhd (Contaiminated Drum and Rag Recycled)
- Aliran Segar Sdn Berhad (Waste Disposal Service)

**Yard Facilities**

Our workshops, storage areas, warehouse and fabrication areas are well organized to provide efficient work flow. The fabrication environment, workshop have been fitted with the most modern technology equipment.

| | Workshop 1 | Workshop 2 | Workshop 3 | Workshop 4 | Workshop 5 | Workshop 6 | Workshop 7 | Workshop 8 |
|---|---|---|---|---|---|---|---|---|
| Dimension | 25.5m (W) x 150m (L) x 12m (H) | 32m (W) x 150m (L) x 15m (H) | 32m (W) x 150m (L) x 15m (H) | 40m (W) x 145m (L) x 30m (H) | 37m (W) x 139m (L) x 15m (H) | 24.4m (W) x 137m (L) x 17m (H) | 15.2m (W) x 137m (L) x 9m (H) | Shipbuilding workshop 37.2M (W) x 110M (L) x 15M (H) |
| Area | 3,825 m² | 4,800 m² | 4,800 m² | 5,800 m² | 5,200 m² | 3,342 m² | 2,082 m² | 4,092 m² |
| Overhead Crane Capacity | 2 x 5T | 2 x 25T<br>1 x 5T | 2 x 25T<br>1 x 10T | 2 x 50T<br>1 x 10T | 2 x 25T | 3 x10T<br>2 x 5T | | 6.3T (1) & 10T (2) |
| Hook Height (meter) | 4m lift | 12m lift<br>4m lift | 12m lift<br>8m lift | 28m lift<br>8m lift | 12m lift | 8m lift<br>4m lift | | 8m lift |
| Major Equipment & Facilities | ■ Covered warehouse & Cold room<br>■ T&C and HUC Office Space<br>■ Calibration Lab Facilities | ■ Carbon steel & stainless steel piping fabrication shop fully equipped with TIG/ SMAW welding machines | Structure/ tubular fabrication/ assembly shop fully equipped with:<br>■ CNC Cutting Machine<br>■ 3-pinch Bending Roll Machine up to 100mm thick<br>■ Flame Planner Cutting Machine<br>■ TIG/MIG/ SAW/SMAW welding machines | ■ Heavy structures fabrication / assembly shop, fully equipped with TIG, MIG, SAW, FCAW, SMAW welding machines | ■ DSS, SS, Piping fabrication shop, fully equipped with TIG, Orbital and SMAW welding machines. | | | ■ Heavy steel fabrication and assembly shop fully equipped with TIG / SAW / SMAW / MIG / welding machine<br>■ 5 Torch Gas & Plasma CNC Machine (6.6m width x 24m length) |

Figure 13: Workshop Specification

The fabrication environment, electronically controlled and automated machinery ensures consistent quality and covers requirement for sophisticated auxiliary repair work. Equipped with a wide range of machines such as CNC gas and Plasma Cuting machine, Pre-Bending and Rolling Hydraulic press brakes, Plate Shearing machine, etc. KHL yard is equipped with all the necessary facilities, material handling and heavy lifting equipment to support fabrication and load-out of structures onto barge. One of the yard main features is the layout of the docks, jetties and workshop which allows smooth transportation of work.

Figure 14: Kencana Yard Workshop

**Manpower**

The Kencana fabrication yard is located in an industrial area where a large number of skilled personnel and experienced fabrication contractors are available to provide any trade and skilled workers as required. We also practice direct hiring of our workers to gain better control and increase productivity. The competitive labour rates, equal to international work productivity and performance standards. The workers also have be familiarized with international work standards.

Figure 15: Skilled Manpower

The last three questions to assess the total capacity of waste processed per year and capacity of each the facilities required to support the waste processed operation. It is appeared that, there is no available Secured Landfill. But, there are 100m$^2$ area storage facilities available at the KHL Yard. Total current capacity at the yard to process offshore structure are more than 80 000 MT per year.

Table 5: Kencana Yard Specification *[41]*

| Total Yard Space | Covered Fabrication Area | Open Fabrication Area | Open Storage Area |
|---|---|---|---|
| 192.3 Acres | 85,600m² | 546,200 m² | 128,800 m² |

| Total Office Space | Quay Water Depth | Bulkhead Jetty Length | Load Out Jetty Capacity | Yearly Capacity |
|---|---|---|---|---|
| 17,600 m² | -6m to -9m | 490 m | 30,000 mt, 20,000 mt, 10,000 mt, 3,000 mt & 1,500 mt | 64,000t |

Figure 16: Kencana Bonded Warehouse

**Challenging encounter during Managing waste from Offshore Platform Decommissioning in Malaysia**

Often Schedule waste produce by waste generator according to different operation and fabrication of varies Offshore Structure. Therefore, it is difficult to produce one type of waste management plan to handle all the waste received. Our workers involved in operations often find it challenging to identify the scheduled waste generated from source, and at times the practice of proper segregation of scheduled waste from domestic waste would still remain as one of the major challenges. Therefore in our progress to implement a proper scheduled waste management system. Moreover, the awareness of staffs and workers towards scheduled waste management are still considerably low.

### 4.6.2. Case Study 2: Recycler/Collector

Part 1: Company and Respondent Profile

The company selected for the recycler and collector is HengHiap Metal Sdn Bhd, today one of the largest ferrous metal scrap suppliers in Southern Malaysia. The company located at Johor Bahru close to the Pasir Gudang Yard in Johor. The facilities have been operated more than 30 years. This will indicate the level of experience of the organization in the recycling business Therefore, this company a suitable candidate for potential local service provider for this case study. However, the findings show that, the company has not performed any Oil and gas demolition work in the past. Besides that, these facilities are not authorized to handle and store radioactive waste. These conclude that, this company only focusing on the Metal recycling business. With experience of 5 -10 years, the manager who was the respondent for this questionnaire is considered experience worker to answer this type of question. Heng Hiap Metal Sdn Bhd is a subsidiaries company under Heng Hiap Group Industries. Heng Hiap is a fully integrated recycling company in Malaysia and we strategically located in Johor Bahru. Heng Hiap strongly believes in the value of scrap as a renewable resource. [42]


Figure 17: Machineries HengHiap Metal Sdn. Bhd

**Heng Hiap Previous Experience's Project** [42]

- SIME SEMBAWANG - Ex-contractor of Buying and disposing of scrap metal.
- PROMET FABRACATION - Main contractor for scrap metal and rubbish disposal.
- MAMUT COPPER MINING (SABAH, KOTA KINABALU) - Buying and handling scrap from KK to Johor Port and to steel mill.
- TENAGA NATIONAL BERHAD (STULANG LAUT) - Main contractor for dismantling and buying of scrap.
- MALAYSIA SHIPYARD AND ENGINEERING (MSE) - Ex-contractor of Buying and disposing of scrap metal

Part 2: Capacity of Waste Processing / Management

Type of waste composition process by the company is mainly Ferrous Metal. The waste management approach used at the yard is direct recycling the waste without preliminary process to remove any contamination. The final disposal from the plant is being reprocessed since there is no available secured Landfill at the site. The product from metal recycling is directly supplied to the steel mills such as Megasteel, Perwaja and Southern Steel. The waste received from the waste generator is gathered at the open area at the recycling yard for temporary storage before sent to recycling plant. From the response obtained, the total of current capacity to process the waste at the yard is between 50 000MT and 80 000MT per year.


Figure 18: Facilities of HengHiap Metal Sdn. Bhd

### 4.6.3. Case Study 3: Schedule /Hazardous Waste Management Facilities

This section will report the finding obtained from the interview session with the selection service provider. The finding is present based on the questionnaire set and the interview session.

Part 1: Company and Respondent Background

The company selected for the hazardous waste management is Kualiti Alam Sdn. Bhd. (KA) KA is known to be the most comprehensive hazardous waste management facilities in South East Asia. The company owned and operated Waste Management Center (WMC) located in Port Dickson, Negeri Sembilan and has been operated for 16 years. On top of that, they are Malaysia's First Integrated WMC that provides complete range of Waste Management Service. KA is entrusted by the government of Malaysia to provide an offsite facility for treatment and final disposal of Schedule Waste/ Hazardous waste in Peninsular Malaysia. KA has previous experience in Oil and gas Industry for Waste Disposal and Cleaning Service. KA also establishes that they have experience in Platform Decommissioning Project. However, the detail on the project is not clear since the person responsible on the project is not available during the interview session. Kualiti Alam WMC owned every required DOE license for Schedule Waste Collection, Treatment and Disposal operation. Nevertheless, KA do not have license from Atomic Energy Licensing Board (AESB) to dispose radioactive waste but, KA is entitled to the temporary license on TENORM Disposal.

There are two respondents representing Kualiti Alam WMC. They are Senior Document Control Safety and Health Department with 5 - 10 years' experience and Head of Waste Evaluation Section / Chemist with 14 years' experience.

Part 2: Capacity of Waste Processing / Management

The first three questions in the questionnaire set are to understand the service provide by the company. Generally, KA has the service to collect, process and disposed the Hazardous Waste generated from Dismantling Platform. The ability of KA to process the waste is based on the waste criteria acceptances provide by the Kualiti Alam Guideline. It is a standard to determine the type of schedule waste received and Treatment process that will be used to dispose the waste. The treatment process procedure in the guideline is not mandatory to all type of waste. It is depend on the waste type and waste criteria acceptance analysis result. The company has been fully operation since June 1998 and handle all 77 categories of schedule wastes listed in First Schedule by the of Environment Quality (Schedule Wastes) Regulations 2005. Nevertheless, KA does not treat radioactive waste and explosive. Even though KA does not treat radioactive waste such as NORMs but they have the capabilities of managing TENORM waste. KA has five certificates, namely MS ISO 9001:2008, ISO14001:2004, OHSAS 18001:2007, MS 1722: Part 1: 2011 and ISO/IEC 17025.

Type of Waste Composition Processed at the facilities are all 77 Schedule Waste (SW 1 – SW5) in First Schedule provide by DOE and Technological Enhanced Natural Occurring Radioactive Materials (TENORM). Below are the categories of the schedule waste handle by Kualiti Alam WMC:

- SW1: Metal and Metal-Bearing Waste
- SW2: Waste containing principally Inorganic Waste Constituents Which May Contain Metal and Organic Material
- SW3: Waste containing principally Organic Waste Constituents Which May Contain Metal and Inorganic Material
- SW4: Waste Which May Contain either Organic or Inorganic Constituents
- SW5: Waste Residue from treatment or Recovery of Scheduled Waste.

*Source by: Kualiti Alam Brochure* [23]

There are waste that could not be taken by Kualiti Alam such as Explosive Waste and Radioactive waste such as Natural Occurring Radioactive Materials (NORM) Scale which

can only be processed at Malaysian Institute for Nuclear Technology Research (MINT). The Radioactive Waste disposal required License from Atomic Energy Licensing Board (AESB).

The waste treatment available includes incineration, physical/chemical treatment, solidification and waste disposal in a secured landfill. With cradle to grave concept, these integrated WMC provide sufficient service for their schedule waste disposal and TENORM. It is an integrated facility because the entire residue from the plant is either treat by or other Plant or disposed directly to the Secured Landfill for final disposal. Besides, KA waste collection and transportation network service cover the entire country.

The complete range of service provide by KA is as follow:

- Waste Transportation
- Waste Analysis
- Waste Treatment (Incineration, PCT and Solidification)
- Waste Disposal (Secured Landfill)

The capacity of the processing plant will be used to assess the capacity of the service provider (waste management facilities) since the operation at the facilities is perform based on the capability of the processing plant. From the documentation record, the capacity of each processing Plant is as follow:

1) **Incineration Plant Capacity** ; INC 1 = 38 000MT / Year
   INC 4 (KAMI) = 10 000MT/year.
2) **Physical / Chemical Treatment (PCT) Plant Capcity** ; 15 000MT/ year
3) **Solification Plant Capacity** ; 60 000MT/ Year
4) **Secured Landfill Capacity** ; 1.6 Million tonnes (more than 15 year)

The final disposal for Kualiti Alam WMC is the residue will be send to the Secured Landfill.

**Waste Management Flow**

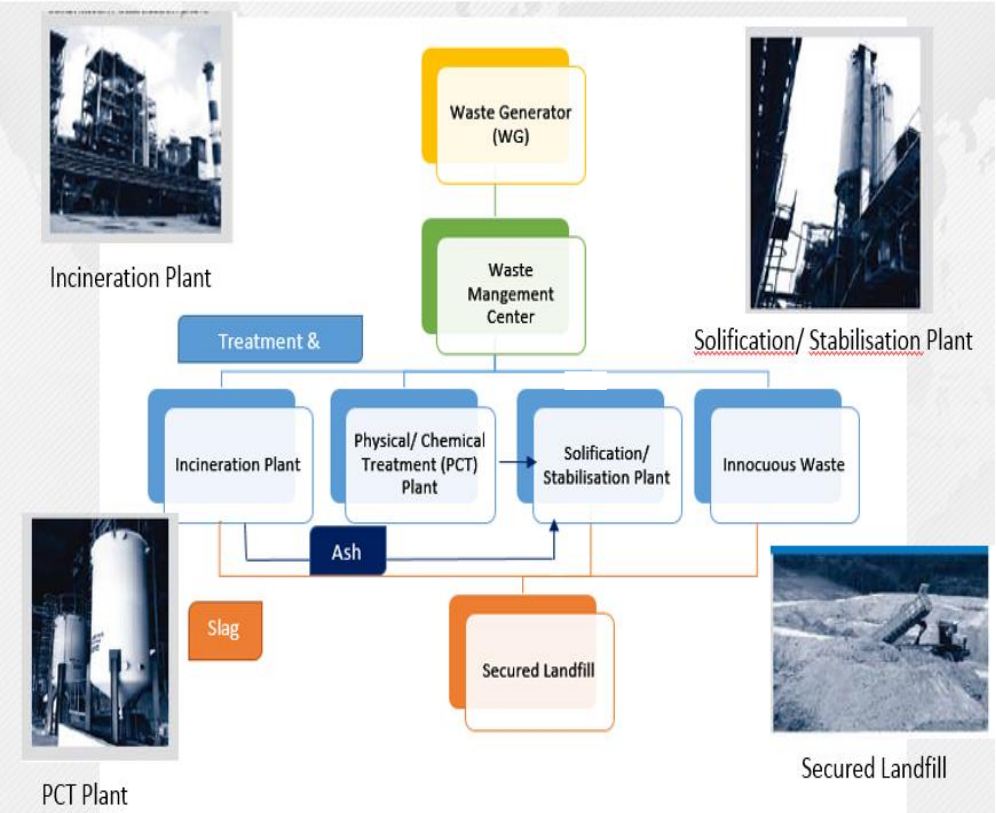


Figure 19: Kualiti Alam Waste Management Flow Chart

**Waste Generator (WG) –** Waste are advised to be prepared before deliver to the WMC. In order to activate waste collection, a Schedule Waste Transportation and Treatment Agreement (SWTTA) between customer and KA have to be signed. Marketing Agent then will coordinates the transportation vehicle deployment between WG and KA. This is because only qualified driver and vehicle are allowed to collect the waste from WG.

**Waste Management Center (WMC) –** Upon arrival at the WMC, the weight of the vehicle is together with its contents is taken at the weighbridge. A waste Inspection and sampling of waste from each waste consignment. The waste container will be bar-coded and locked into our Electronic Integrated Waste Information System (EIWIS) to ensure accurate and reliable retrieval of information. Upon analysis and evaluation by the laboratory, the waste consignment will be transferred to a temporary storage and is ready for treatment or disposal.

***Treatment or Disposal*** [23]

**Incineration Plant -** The Incinerator Plant operates a high temperature rotary kiln with an efficient flue gas-cleaning system. This plant ensures a thermal destruction efficiency of 99.9999% and meets Department of Environment (DOE) licensing conditions on incineration emissions including dioxin/furan at 0.1 ng/m3. The WMC's Incineration Plant treats organic waste such as mineral oil waste, waste solvents, pesticide waste and wastes containing halogens and sulphur. Inorganic waste such as metal hydroxide sludge which contains more than 10% Total Organic Carbon (TOC) is incinerated at this plant. Slag from the rotary kiln is disposed of in the Secured Landfill. Fly ash trapped in the fabric filter is further treated in the fabric filter is further treated at the solidification/Stabilisation Plant.

**Physical/Chemical Treatment (PCT) Plant** – Inorganic liquid such as spent acid and alkaline, chromate and cyanide wastes are treated at this plant. The residual filter cake from the detoxification process is treated at Solidification/Stabalisation Plant before it is finally disposed of in the Secured Landfill site.

**Solidification/ Stabilisation Plant:** This Plant continues the process of rendering the treated waste from PCT Plant and from other process by solidifying the waste via fixation before disposal to Secured Landfill site. Some inorganic solid wastes such as metal hydroxide sludge are also treated at this plant including lead arsenic, nickel, zinc and chromium.

**Secured Landfill-** The final destination of all waste sent to the WMC is the Secured Landfill. It has a system of containment for final disposal of treated waste. Each Landfill cell is protected by one meter-thick compacted clay and a 2 mm HDPE geo-membrane while leachate collection system ensures the cell is effectively monitored. Wastes meeting the Direct Landfill Acceptance Criteria which include the Toxicity Characteristic Leaching Procedures (TCLP) test can be disposed of at the Secured Landfill directly without treatment. The 13 leachable metals listed under TCLP test are arsenic, barium, boron, cadmium, chromium, copper lead, mercury, nickel, selenium, silver, tin and zinc. Types of waste being disposed of in the Secured Landfill include slag from the incineration Plant, solidified wastes from solidification Plant and external wastes that

fulfill the Direct Landfill Acceptance Criteria. Innocuous or Harmless waste also being sent directly to Secured Landfill Site.

**Packaging / Storage Medium**

The law requires that these waste to be properly packed, labeled, stored and inventoried [23]. Marketing Agent Representative adviced Waste Generator (WG) to prepare the waste for delivery for WMC. Proper Packaging is vital for the safe transportation and handling of hazardous waste. WG is responsible for the proper packaging, labeling, transportation and specification of the waste as stated in the Environmental Quality (Scheduled Wastes) Regulations 2005.

Standard Packaging and type of wastes:

- Bunghole drum (Steel / Plastic) – All liquid waste
- Plastic Pallet tank with cover or stopper - All liquid waste
- One-tonne Polypropylene (PP) Bags – Dry solid waste and contaminated rags.
- Open top drum (Steel or Plastic) – Solid, Laboratory, Pharmaceutical waste and empty contaminated container.

**Kualiti Alam WMC Storage Area**

There are four storage units available at the WMC. This is sufficient to cater all the waste received from the waste generator and should be capable to handle all the waste generated from the Malaysia jacket platform decommissioned project. Below is the detail of the storage unit and the purposes for each unit.

- 3 Temporary Storage Area (A,B,C) to receive the waste arrived at the facilities
- 1 Warehouse (D) to store the waste before send to the Processing Plant

Storage Capacity Limit in area A, B, C, and D at any one time are 21,142 pallet or 15,100MT.

**Processing Method for Hazardous Waste**

Waste Analysis need to be conducted in order to accurately determine the appropriate treatment process. General Processing method for each type of possible waste generated

from Platform decommissioning is tabulate below. Based on the Processing Method available, it shown that the KA WMC has the capabilities to handle and process the possible generated waste.

| | |
|---|---|
| INCI – Incineration Plant | PCT – Physical/ Chemical Treatment Plant |
| SL – Directly Secured Landfill | SOLI – Solidification/Stabalization Plant |

*Table 6: List of possible schedule waste generated from platform decommissioning.*

| Schedule Waste Code | Type of waste | General Processing Method |
|---|---|---|
| **SW1** | **Metal and Metal-Bearing Waste** | |
| SW102 | Waste of lead acid batteries in whole or crushed form | PCT →SOLI→DL<br>• Cementation Treatment |
| SW103 | Waste of batteries containing cadmium and nickel or mercury or lithium. | |
| SW104 | Dust, slag, dross or ash containing aluminium, arsenic, mercury, lead, cadmium, chromium, nickel, copper, vanadium, beryllium, antimony, tellurium, thallium or selenium excluding slag from iron and steel factory | PCT →SOLI→DL |
| SW109 | Waste containing mercury or its compound | PCT → SOLI→DL<br>• Bulb heater (solid) |
| SW110 | Waste from electrical and electronic assemblies containing components such as accumulators, mercury-switches, glass from cathode-ray tubes and other activated glass or polychlorinated biphenyl-capacitors, or contaminated with cadmium, mercury, lead, nickel, chromium, copper, lithium, silver, manganese or polychlorinated biphenyl | PCT →SOLI→DL<br>• Bulb heater (solid) |
| **SW2** | **Waste containing principally Inorganic Waste Constituents Which May Contain Metal and Organic Material** | |
| SW201 | Asbestos wastes in sludges, dust or fibre forms | LF |
| SW202 | Waste catalysts | INC → LF |
| SW203 | Immobilized scheduled wastes including chemically fixed, encapsulated, solidified or stabilized sludges. | All |
| SW204 | Sludges containing one or several metals including chromium, copper, nickel, zinc, lead, cadmium, aluminium, tin, vanadium and beryllium | All |
| SW206 | Spent inorganic acids | PCT |
| **SW3** | **Waste containing principally Organic Waste Constituents Which May Contain Metal and Inorganic Material** | |
| SW 301 | Spent organic acids with pH less or equal to 2 which are corrosive or hazardous | INCI |

| | | |
|---|---|---|
| SW 302 | Flux waste containing mixture of organic acids, solvents or compounds of ammonium chloride | INCI |
| SW 305 | Spent lubricating oil | INCI |
| SW 306 | Spent hydraulic oil | INCI |
| SW 307 | Spent mineral oil-water emulsion | INCI |
| SW 308 | Oil tanker sludges | INCI |
| SW 309 | Oil-water mixture such as ballast water | INCI |
| SW 310 | Sludge from mineral oil storage tank | INCI |
| SW 311 | Waste of oil or oily sludge | INCI |
| SW 312 | Oily residue from automotive workshop, service station oil or grease interceptor | INCI |
| SW 313 | Oil contaminated earth from re-refining of used lubricating oil | INCI |
| SW 314 | Oil or sludge from oil refinery plant maintenance operation | INCI |
| SW 315 | Tar or tarry residues from oil refinery or petrochemical plant | INCI |
| SW 316 | Acid sludge | INCI |
| SW 318 | Waste, substances and articles containing or contaminated with polychlorinated biphenyls (PCB) or polychlorinated triphenyls (PCT) | INCI |
| SW 319 | Waste of phenols or phenol compounds including chlorophenol in the form of liquids or sludges | INCI |
| SW 321 | Rubber or latex wastes or sludges containing organic solvents or heavy metals | INCI |
| SW 323 | Waste of halogenated organic solvents | INCI |
| SW 326 | Waste of organic phosphorus compound | INCI |
| **SW4** | **Waste Which May Contain either Organic or Inorganic Constituents** | |
| SW 401 | Spent alkalis containing heavy metals | INCI/PCT |
| SW 402 | Spent alkalis with pH more or equal to 11.5 which are corrosive or hazardous | INCI/PCT |
| SW 406 | Clinker, slag and ashes from scheduled wastes incinerator | INCI/SOLI |
| SW 408 | Contaminated soil, debris or matter resulting from cleaning-up of a spill of chemical, mineral oil or scheduled wastes | INCI |
| SW 409 | Disposed containers, bags or equipment contaminated with chemicals, pesticides, mineral oil or scheduled wastes | INCI |
| SW 410 | Rags, plastics, papers or filters contaminated with scheduled wastes | INCI |
| SW 416 | Sludges of inks, paints, pigments, lacquer, dye or varnish | INCI |

| | | |
|---|---|---|
| SW 417 | Waste of inks, paints, pigments, lacquer, dye or varnish | INCI |
| SW 421 | A mixture of scheduled wastes | INCI |
| SW 422 | A mixture of scheduled and non-scheduled wastes | INCI |
| SW 427 | Mineral sludges including calcium hydroxide sludges, phosphating sludges, calcium sulphite sludges and carbonates sludges | ALL |
| SW 429 | Chemicals that are discarded or off-specification | INCI |
| SW 432 | Waste containing, consisting of or contaminated with peroxides | INCI |
| **SW5** | **Waste Residue from treatment or Recovery of Scheduled Waste.** | |
| SW 501 | Any residues from treatment or recovery of scheduled wastes | INCI/PCT |
| **Other Waste** | | |
| | Asbestos | LF |
| TENORM | Technologically Enhanced Naturally Occurring Radioactive Materials | INCI |
| LSA | Low Specific Activity Scale | INCI / MINT |
| NORMs | Naturally Occurring Radioactive Materials | MINT |

**Challenges in managing hazardous waste in Malaysia**

The major challenge is to be able to meet every customer requirement without increasing the price. Nowadays, most of the waste sent by WG are problematic waste and thus have increase the operation cost to treat the waste since the process is more stringent. This is one of the important factors to the business. Hazardous Waste Management is a Competitive Business. Trienekens (Sarawak) Sdn. Bhd is the only company other than Kualiti Alam that provides the hazardous waste disposal service. There is also other Competitor beside Trienekens (Sarawak) Sdn. Bhd:

- Oil Recycler Services
- Cement Industries
- Cleaning and Desludging Service for Oil and Gas Operation

Oil recycler service has provided service to recycle the oil waste from the operation and extract the usable oil to be sent back to client. The process give and alternative solution to the client to reduce the amount of waste needed to be dispose beside, could generate oil from the waste produced. On the other hand, cement industries is exproring this new

business area because the ash from the incinerator residue waste can be used as a material in cement process. Most of the cement industries have the incinetor for their operation and they decided to extend the purpose of the incinerator on this new business area. In cleaning service, there are a lot of other service company provide the same service to the oil and gas industry. Even though, there are fewer competitors for hazardous waste disposal service but, the competition is high in other service for hazardous waste management service in Malaysia. Therefore, in order to solve this issue, Kualiti Alam have to come out with alternative to reduce their operation cost.

**Product and Technology Innovation**

KA has built a made-in Malaysia modular incinerator unit (KAMI). This design will operated and maintenance to meet the stringent environment standard. This will reduce the cost to maintain the system since it was built by the KA. One of the innovations by KA is developed a waste burner which uses waste oil or reconstituted oil to replace diesel as burning fuel. This has resulted in significant cost saving. On top of that, KA upgraded our incinerator with industrial shredder to be more robust and get a stable mix of waste for better combustion. KA also provide services in developing software for waste management systems with capabilities of providing real time reporting, tracking and enforcement through finger printing of waste to track the original sources of waste (Waste DNA). This system will help the WG to identify the type of scheduled was in order to prepare for the collection.

### 4.6.4. Level of Awareness in Potential Decommissioning Activities and Opportunities.

*Objective ii)* *Determine the level of awareness of local services providers about offshore decommissioning potential activities.*

**Section 1: General Awareness of Oil and Gas Opportunities**

The table above shows the response from the local service provider on the general awareness on Malaysia platform and decommissioning project.

Table 7: General Awareness Response from each Case Study

| Question | Yard | Recycler | HWM |
|---|---|---|---|
| **Local Oil and Gas Industry** | Moderate | Low | Moderate |
| **Decommissioning Offshore Structure in Malaysia** | Moderate | Very Low | Low |
| **Approach used in processing steel waste for Platform Decommissioning in Malaysia** | Low | Low | Low |
| **Type of waste generated in Platform Decommissioning in Malaysia** | Low | Very Low | Low |
| **Waste Management Process for Platform Decommissioning in Malaysia** | High | Very Low | Low |
| **Level of Interest in Platform Decommissioning Waste Management Business in Malaysia** | Moderate | Very Low | Very High |

*Yard* *: Kencana Fabrication Yard*

*Recycler* *: Heng Hiap Metal Sdn bhd*

*HWM* *: Kualiti Alam Sdn Bhd*

**Hazardous Waste Management*

The response show that the Yard and HWM aware on local oil and gas industry in Malaysia. But, only yard show awareness in the platform decommissioning and waste management process in Malaysia. In term of identifying type of waste generated, all the service providers show a low level of understanding in the matter. Most of the companies have less understanding on approach used in processing steel waste for Platform Decommissioning in Malaysia. There are different process involve to process the Steel

Waste from platform decommissioning. The residue must be scrapped from the structure and sent to the proper channel. There are also some residues that are difficult to separate the residue from the platform. Even though HWM has low understanding in process of waste management for platform decommissioning, the company shows a very high level of interest to involve in the Platform Decommissioning Project in Malaysia.

**Section 2: Awareness in Schedule /Hazardous Waste Management Only**

The next section establish the level of awareness on the Platform Decommissioning Hazardous waste management in Malaysia.

Table 8: Level of Awareness in Hazardous Waste Processing/ Disposing Method

| Question | Yard | Recycler | HWM |
|---|---|---|---|
| The processing and residue disposal method for Metal And Metal-Bearing Waste (SW1) | Low | Very Low | Very High |
| The processing and residue disposal method for Inorganic Waste Constituents Which May Contain Metal And Organic Material (SW2) | Low | Very Low | Very High |
| The processing and residue disposal method for Organic Waste Constituents Which May Contain Metal And Inorganic Material (SW3) | Low | Very Low | Very High |
| The processing and residue disposal method Waste Which May Contain Organic And Inorganic Material (SW4) | Low | Very Low | Very High |
| The processing and residue disposal method Other Waste from any Residues from treatment and recovery of scheduled waste (SW5) | Low | Very Low | Very High |
| The processing and residue disposal method for Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) Scale | Low | Very Low | Very High |

From the findings obtained, it shows that level of awareness and understand the Processing Method of the Schedule Waste other service provider besides Kualiti Alam Sdn Bhd (KA) is very low. Since the hazardous waste is one of the major issue in platform decommissioning in Malaysia, area of improved on this area need to be proposed.

## 4.6. Discussion

*Objective iii) To assess the current and future offshore decommissioning waste management capacity for local service providers in Malaysia*

### 4.6.1. Current and Future capacity Assessment for Local Service Provider in Case Study 1 (Fabrication Yard) and Case Study 2 (Recycler)

The data for the weight projection of platform that need to be decommissioned is presented in weight which is tabulated in 5 years interval. The highest total weight of jacket need to decommission in 5 years is 72,793 MT with average of 14,558 MT annually. Highest total combination weight of Jacket, Pile and Conductor 5 years is 148,357 MT with give an average of 29,671MT / year. The Largest Jacket Weight recorded is 9,990 MT.

**Case Study 1: Fabrication Yard.**

There are $100m^2$ storage facilities available at the KHL Yard. KHL Yard have total capacity of more than 80 000 MT per year to process Offshore Structure. The capability of the yard has exceeded the highest weight projection from the Platform decommissioning in Malaysia. These shows even though, KHL Yard does not provide major Decommissioning, the yard have the capacity to perform the decommissioning Project. However, the decision to provider Major Decommissioning Service in Malaysia must consider the current capacity of their core business in fabrication so that, the decommissioning project may not interferes with their current business operation. Beside, KHL have the $100m^2$ storage facilities which can be used to hold the queue project in the further. Proper Waste Management System on Platform Decommissioning must be introduce

**Case Study 2: Recycler**

In comparison with the capacity of recycling yard which are in a range of 50 000MT to 80 000MT per year. The existed facilities appear to have the capacity to recycle the waste from offshore platform for the next 30 year. However, the number of platform to be

decommissioned will increase in further, therefore improve need to planned to ensure the capacity of the recycling company still be able to cater the decommissioning demand. Nevertheless, since the facilities is not certified to process and dispose radioactive waste, there is a need to search alternative solution on processing and cleaning the radioactive waste from the structure before send to the recycling yard.

### 4.6.2. Current and Future capacity Assessment for Local Service Provider in Case Study 3 (Hazardous Waste Management)

Management of oil and gas industry waste is not simple due to its content of hazardous and radioactive materials. In Malaysia, the waste is categorized as Scheduled Waste by the Department of Environment.

*Table 9: Potential Waste Generated from Platform Decommissioning in Malaysia*

| Waste categories | Material Type | General Processing Method |
|---|---|---|
| Steel | High Grade, Various Structural Sections And Tubular | Reuse/ Recycle |
| Other Metal | Copper, Cupro-Nickel, Aluminum, Zinc And Numerous Recyclable Materials. | Reuse/ Recycle |
| Other Material | Equipment | Recycle |
| Hydrocarbon | Production hydrocarbon light to heavy sludge, sludge operational gearbox oils, greases, transformer oils (PCB), hydrocarbon gas | SW3 & SW4 |
| Oil | Diesal Oil, Hydraulic Oil, Spent Lubricating Oil | SW3 |
| Deposits | Spent Acid And Alkaline, ,Spent Solvent, Hydrocarbon sludge, Scale, Sediment, Sand, calcium salt scales, | SW3, SW4 |
| Production Chemical | Muds, Drilling Chemical, lubes, anti-freeze, biocides, drill additives/acids, corrosion inhibitors, gases, oxy scavengers, paints, solvents, Chemical mix with halogen, Metal mix chemical, etc | SW3, SW4 |

| | | |
|---|---|---|
| Hazardous Materials | Heavy metal, PFOs, PVC, Asbestos, mercury, pyrotechnics, biocides and many small quantities of materials contained in electrical system. | SW1, SW2 LF |
| Radioactive Waste | LSA/NORMs Scale, TENORM, | Incinerator / MINT |
| Other | Marine Growth, batteries, Phthalates (plasticisers in flooring and cables), Light Bulb | PCT → LF Bulb Heater |

Based on the discussion for each identified potential decommissioning waste, Kualiti Alam WMC are able to handle all the waste generated except NORMs which have higher concentration of radioactive. By understanding the processing method available for the identified possible waste generated from the Malaysia platform decommissioning. The current capacity of the facilities to handle and process the waste generated can be establish. Based on the data from the capacity of each processing plant, the future capacity of the facilities can be assessed. It is appeared that KA Waste Management Center have the capacity and all the facilities required to handle all the schedule waste and TENORM material generated. However, collaboration between the contractor and MINT need to be establish in order to process and dispose radioactive material that may contained in Low Specific Activity (LSA) Scale such as NORMs with high concentration of radioactive.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATION

This chapter has given an account of and the reasons for a further study on assessment of local service provider of platform decommissioning waste management in Malaysia. The chapter sets out to highlight major contributions to the study of platform decommissioning waste management in Malaysia. For many of the offshore jacket structures in Malaysia, their design life of 25-30 years is approaching the end, signifying the urgent implementation of decommissioning efforts. Therefore, it is importance for the local service provider to be aware and ready on the decommissioning of offshore installation. Assessment on the current and future capacity of the local service provider for the decommissioning will establish a benchmark on the Decommissioning trend in Malaysia. Improvement in the decommissioning activities for the local service provider will create a new trend for decommissioning operation in future. While current regulatory guidelines strongly recommend complete removal of the structures, in view of sustainability issues, other options of decommissioning should not be overlooked [5]. The strengths and weaknesses of the previous studies have been reasoned out and the findings and syntheses in this chapter suggest that, in general, previous studies have deeply rooted the foundation in Platform Decommissioning in Malaysia but have not entirely answered the question of whether the local service provider have the capacity to perform waste management in Malaysia Offshore Decommissioning Project. The Waste management service provider is categories by different type of operation; Fabrication Yard, recycler and Hazardous Waste Management. Each case study represent one type of operation.

Based on the assessment, all the selected company from all three categories is appear to have the capacity to perform Platform Decommissioning in Malaysia in years ahead. Level of awareness on decommissioning in Malaysia among local service provider for

this Case is below Moderate Level. Therefore, below is need to be improved the understanding and awareness since most of the service provider is not aware on the business opportunities available and lack of understanding in proper waste management process for Platform Decommissioning. Even though KA have low understanding in process of waste management for platform decommissioning, the company shows a very high level of interest to involve in the Platform Decommissioning Project in Malaysia. There also seem that the level of interest of yard and recycler is moderate and low due to very low understanding and awareness in the decommissioning activities in Malaysia. There is need to be improve the understanding and awareness since most of the service provider is not aware on the business opportunities available and lack of understanding in proper waste management process for Platform Decommissioning .By educating the local service provider, readiness among local service provider on the decommissioning activities will be improved.

Onshore Decommissioning facilities should serve the needs of the 'Client'. Market will require the confidence that the operations will be safe, contained and low on the public agenda. Facilities for decommissioning should present a clean, safe image consistent with customer image. Project management will require considerable skill and Specialist technical skills for receipt, managing waste, and specialized contractor will be required by all projects. [13] This study can provide a basic guideline on the current capacity of the local service providers for decommissioning waste management activities in Malaysia.

For further studies on this area, the assessment done can cover all the other possible category of waste management facilities such as oil recycling service and other potential local service provider in Malaysia. A complete survey assessment on all the population of onshore waste disposal for platform decommissioned would give more generalization on the assessment of the local service provider. New questionnaire set need to developed based on the new understanding on the service provided by the company. This new questionnaire will accommodate the organization structure practice by the industry in order to provide a better question that can complied with current practice used by the

service providers. Besides, a complete study to identify type of waste generated from the platform decommissioning need to be performed by Platform Operator. This study is crucial for planning process of decommissioning project in Malaysia in further.

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## APPENDICES

### Abbreviations

| | |
|---|---|
| **COP** | Cease of production |
| **LSA** | Low specific activity |
| **PCB** | Polychlorinated biphenyl |
| **PVC** | Polyvinyl chloride |
| **WEEE** | Waste electrical and electronic equipment |
| **PFOs** | Perfluorooctyl sulphonate |
| **NORMs** | Natural Occurring Radioactive Materials |
| **TENORM** | Technological Enhanced Natural Occurring Radioactive Materials |
| **KA** | Kualiti Alam Sdn Bhd |
| **HWM** | Hazardous Waste Management |
| **KHL** | Kencana HL Sdn Bhd. (Kencana Fabrication Yard) |
| **MINT** | Malaysian Institute for Nuclear Technology Research |
| **AESB** | Atomic Energy Licensing Board |
| **WMC** | Waste Management Center |
| **DOE** | Department of Environment |

## Waste Identification

X Waste Present at the region

# No exact references (Possible waste present)

| No | Waste Type | North Sea | GOM | Australia | Nigeria | Malaysia |
|---|---|---|---|---|---|---|
| | **Metallic (Support Structure)** | | | | | |
| 1 | Bulk Steel | x | x | x | x | x |
| 2 | Value Metal | | x | | | |
| | - Alloy Steel (Jacket) | x | | | | |
| | - Zinc (Anodes) [1] [2] | x | | | x | |
| | - Aluminum (Anode) | x | x | | x | |
| | - Carbon Steel | x | x | | | |
| | -Cement (Grout) | x | | | | |
| | -Iron | x | | | | |
| | -Titanium | x | | | | |
| | - Stainless Steel | x | | | x | |
| | - Cunifer | x | | | | |
| | - Monel | x | | | | |
| | - Copper (Cable) | x | x | | x | |
| | - High Grade Steel | | x | | | |
| | -Pipeline | x | x | x | | |
| | | | | | | |
| | **Non-Metallic** | | | Oil Waste | | |
| | Salable Component | | | | | |
| 1 | -Equipment | | | | | |
| | • Rotating Equipment<br>• Injection Pump<br>• Prime Movers<br>• Compressor<br>• Gas turbine<br>• Alternator<br>• MV/HV Transformers | x | x | x | x | x |
| 2 | WEEE (Electrical and Electronic Equipment) | | | | | |
| 3 | Topside Cleaning (Residue Material) | | | | | |
| | - Hydrocarbon Sludge (Oil & Gas) | x | x | x | x | x |
| | - Production Chemical / Chemical residue | x | x | x | x | x |
| | - Drilling Chemical | x | x | x | | |
| | - Diesel Oil | x | | | | |
| | - NORMs (Natural Occurring Radioactive Materials) Scale | x | x | x | x | x |
| | - Hydraulic Oil | x | | | | |
| | - Lube Oil | x | x | | | |
| | - Seal Oil | x | | | | |
| | - Mercury (present in fluorescent tubes) | x | x | | x | x |
| | - Asbestos [1] [2] | x | x | | x | |
| **No** | **Waste Type** | **North Sea** | **GOM** | **Australia** | **Nigeria** | **Malaysia** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | - Heating Medium | x | | | | |
| | - PCBs (polychlorinated biphenyls) | x | x | | | |
| | - Sediment (reservoir contaminants) | x | | | | |
| | - Sands | x | | x | | # |
| | - heavy Metal | | x | x | | |
| | | | | | | |
| 4 | Hazardous Confined Waste | x | | | | |
| | - Hydrocarbon gas | x | | | | # |
| | - hydrogen Sulphide (H2S) | x | | | | # |
| | - Benzene | x | | | | # |
| | - Oxygen | x | x | | | # |
| 5 | Other Hazardous Waste | x | | | | |
| | - Flame retardants | x | | | | |
| | – Phthalates (plasticizers in flooring and cables) | x | | | | |
| | – Hydraulic oil, grease and lubricants | x | | | | |
| | – Isocyanates from polyurethane paints | x | | | | |
| | – CFC and HCFC gases released from cooling agents | x | | | | |
| | – Chloroparaffins | x | | | | |
| | – Low specific activity (LSA) material | x | x | | | |
| | – PFOS (perfluorooctyl sulphonate) | x | | | | |
| | – PVC (polyvinyl chloride) | x | | | | |
| | - Organotin compounds | x | | | | |
| | - Paint | x | | | | |
| 6 | Batteries | x | | | x | |
| | - Nickel Cadmium | x | | | | |
| | - Lead Acid | x | | | | |
| 7 | Waste from Normallu Unmanned Installation (NUI) Node | x | | | | |
| | – Aerosols | x | | | | |
| | – Empty Chemical / Oil drum | x | | | | |
| | – Pyrotechnics | x | | | | |
| 8 | Other | | | | | |
| | Marine Growth | x | x | x | x | x |
| | Smoke Detector | x | | | | |
| | Plastic | | x | | | |

## Project Timeline

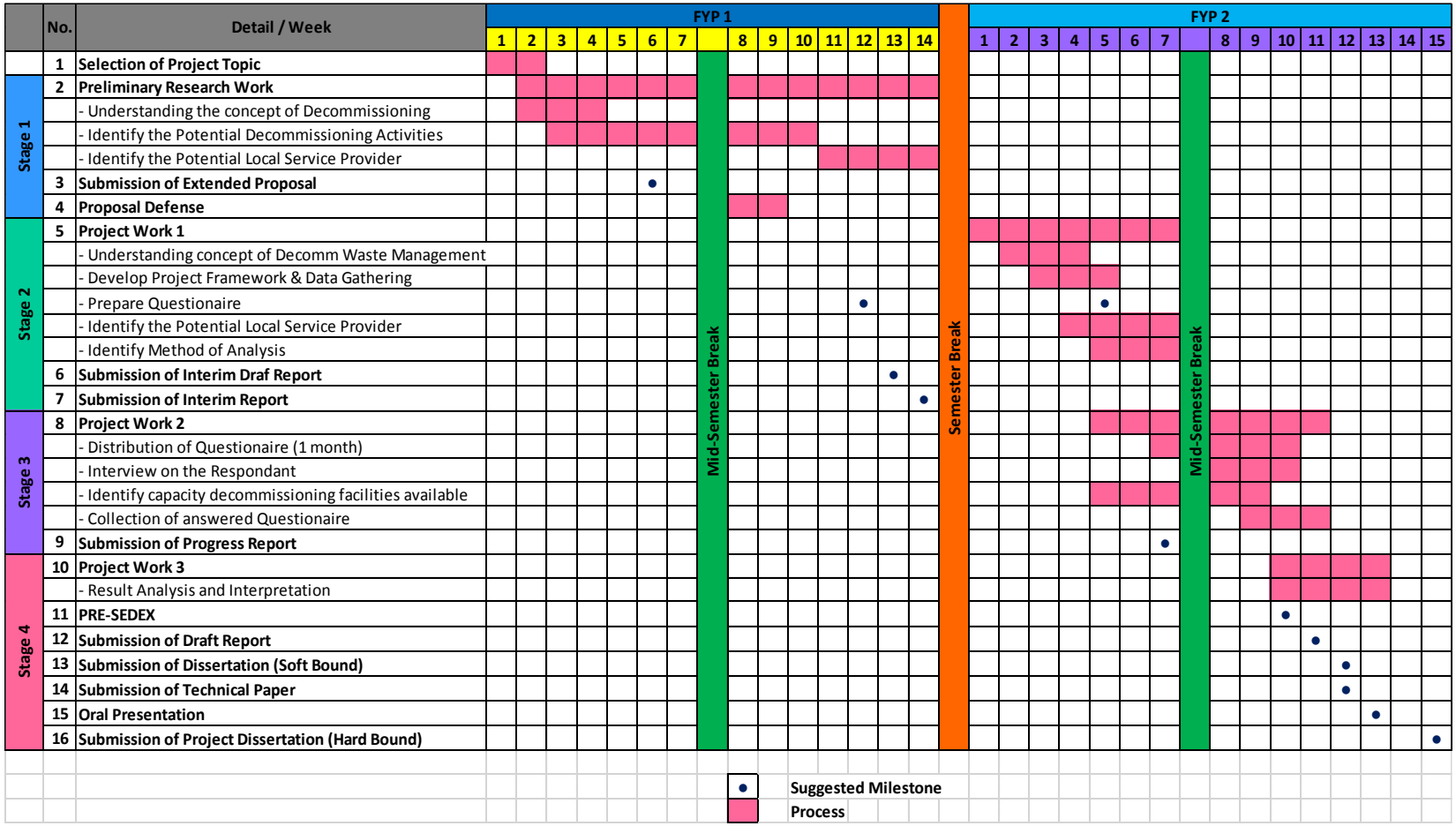


Figure 20: Project Timeline

**List of Selected Service Provider**

Table 10: Selected Service Provider List

| No. | Company | Location | Remark |
|---|---|---|---|
| 1 | Sapura Kencana Yard | Lumut, Perak | Onshore Dismantling / Fabrication Yard |
| 2 | Heng Hiap Metal Sdn Bhd | Johor Bharu | Recycler/ Collection |
| 3 | Kualiti Alam Sdn Bhd (WMC) | Port Dickson, N. Sembilan | Hazardous Waste Management |

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TEKNOLOGI
PETRONAS

13th August 2013

**To Whom It May Concern**

Dear Sir/Madam,

**Acknowledgement for Nurin Adlina binti Noordin to conduct Final Year Project II**

Kindly be informed that Nurin Adlina binti Noordin is a student of Universiti Teknologi PETRONAS. She will be conducting her FYP II interview session at your company for **the purpose of data collection on waste management capacity of your facilities.**

Details are as follow;

| | |
|---|---|
| Passport / IC No. | : 901223-07-5412 |
| Nationality | : Malaysian |
| Matric No. | : 12813 |
| Programme | : Civil Engineering |
| Academic Year | : Final Year, Final Semester |
| FYP Tittle | : Assessment of Current Capacity of Local Service Providers in Offshore Decommissioning Waste Management in Malaysia. |
| Date of Study | : August - September 2013 |

For further information, please do not hesitate to contact our office at +605- 3867283. Thank you in advance for your kind cooperation.

Thank You,

Sincerely,

Dr. Noor Amila Wan Abdullah Zawawi
Lecturer
Civil Engineering Department
Universiti Teknologi PETRONAS
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Fax : HRMA 605-3654075 Finance 605-3654087 IRC 605-3661672 Student Support Services 605-3667740 Registry 605-3654082 Website http://www.utp.edu.my

Nurin Adlina binti Noordin
Civil Engineering Department
Universiti Teknologi PETRONAS,
Bandar Seri Iskandar, 31750,
Perak

12 August 2013

**TO WHOM IT MAY CONCERN**

Dear Sir/Madams, on

**Assessment of Current Capacity of Local Service Providers in Offshore Decommissioning Waste Management in Malaysia**

Following our telecommunication with you, it is my pleasure to hereby explain to you in details on the above mentioned matter. I would like to first fully introduce myself, my name is Nurin Adlina binti Noordin and I am a graduate student in Universiti Teknologi PETRONAS. For my final year project, I am doing assessment of current capacity of local service provider for offshore platform decommissioning activities.

Offshore platform decommissioning are new area in Malaysia and there has been no published work on the establishment of the current capacity of local services providers in platform decommissioning waste management. Thus, this research aims at assessing the current capacity of local service providers and will hopefully improve the operation in platform decommissioning onshore waste management in Malaysia.

As the part of the preparatory work, we are currently conducting interview under case study on onshore waste management for offshore decommissioning in selected potential local service providers, which aims to determine the current capacity of onshore decommissioning waste management of local service provider, as well as to get an overview on awareness level of local services providers about offshore decommissioning potential activities

For your preparation purpose, we enclose a list of information that we hope to acquire from you during the discussion:

1. Company and Respondent Profile
   a) Type of operation
   b) Experience in Oil and Gas Industry
   c) DOE License of waste Disposal

2. Waste Processed
   a) Type and Capacity of waste processed per year.
   b) Waste Management Approach used by the company.
   c) Waste Processing Method.

3. Waste Storage
   a) Type of waste storage facility available and quantity.
   b) Capacity of waste storage facility.

4. Waste Disposal
   a) Waste disposal method used.
   b) Waste contractor name if any.

5. Any other comment or suggestion from the industry in relation to the current waste management for platform decommissioning in this country – e.g. what challenge your industry is facing, suggestion to improve the decommissioning waste management for offshore platform.

In addition to the discussion, we would like to also kindly request your cooperation to provide relevant documentation on waste generated and managed and allow us to tour and take some photo relevance for understanding the waste handling during our visit to your company, in order for us to have a better impression and documentation on the existing practice of the waste management within the industry premises. This information from this survey will be aggregated by facility type to prevent disclosure of commercial details.

Please do not hesitate to contact me at +6019-4302838 or nurinadlina@gmail.com if any clarification and further information is required. We are looking forward to meeting you soon for discussion. Your cooperation is highly appreciated.

Thank you.

Sincerely,

Nurin Adlina binti Noordin
Civil Engineering Department

Project Supervisor,
Dr. Noor Amila Bt Wan Abdullah Zawawi
Civil Engineering Department,
Tel: + 605 - 368 7292
E-mail: amilawa@petronas.com.my

## Questionnaire Set

If you require more information about the Study, please do not hesitate to contact either:
Nurin Adlina binti Noordin - Tel: 019-4302838 Dr. Noor Amila Bt Wan Abdullah Zawawi – Tel: 05 - 368 7292

**Assessment of Current Capacity of Local Service Provider for Decommissioning Activities: Questionnaire**

**PART 1: BACKGROUND**

*This part is to gather the information on the Company and the Respondent profile. Please complete all the field and tick (/) to indicate your answer.*

**SECTION 1: COMPANY PROFILE**

**Name of Company** | **Location**

**Type of Operation** | **Year of Operation**

☐ Onshore Dismantling / Fabrication Yard ☐ Recycler / Collector ☐ Hazardous Waste Management*
**If you choose Hazardous Waste Management, Please go to PART 2 (Section 2)*

**Has your company previously undertaken Offshore Oil and Gas Decommissioning/Demolition work?** ☐ Yes ☐ No

**Does your company have DOE License for disposal of Radioactive Waste?** ☐ Yes ☐ No

**SECTION 2: RESPONDENT'S PROFILE**

**Respondent's Name**

**Respondent's Position**

**Years of Experience** ☐ Less than 5 Years ☐ 5- 10 Years ☐ 11-15 Years ☐ Over 15 years

**PART 2 : CAPACITY OF WASTE PROCESSING/ MANAGEMENT**

*This Part of the questionnaire will assess the capacity of your company in decommissioning waste management activities.*
*This Part is divided into two Section based on type of operation of the company/organization;*
***Section 1: Onshore Dismantling Yard / Fabrication Yard / Recycler / Collector***
***Section 2: Hazardous Waste Management Facilities***
*Please answer the respective section based on your operation. You may answer both section. Please tick (/) to indicate your answer.*

**SECTION 1: ONSHORE DISMANTLING YARD / FABRICATION YARD / RECYCLER / COLLECTOR**

1. **Does your yard process/treat the wastes associated with the dismantling platform?** ☐ Yes ☐ No

**If yes, please tick (/) to indicate the Type of Waste Composition.** ***(You may tick more than 1)***

☐ Ferrous Metal Wastes (e.g. Steel) ☐ Non- Metallic Waste (e.g. : Plastic) ☐ EEE – Electric and Electronics
☐ Non Ferrous Metal (e.g. Batteries, Aluminum) ☐ Platform Equipment ☐ Hazardous wastes *
☐ Other :
* Please go to Section 2 : Hazardous Waste Management Facilities

2. **Is Secured Landfill available at the Yard?** ☐ Yes - Capacity, Area (m2): ☐ No

3. **What is Waste Management Approach do you used at the yard?**

☐ Treat/Process the Waste. * ☐ Send to Secured Landfill directly without treatment.
☐ Other : ☐ Sent to Third Party. State Name :
*Please answer the next Question

**After the waste is being treated, what is the Final Residue Disposal option used at the Yard?**

☐ Dispose with other municipal waste ☐ Send to Secured Landfill.
☐ Other: ☐ Sent to Third Party. State Name:

Page 1

4. **Is there any waste storage available at the Yard?** ☐ Yes ☐ No

5. **Type of waste storage available at the Yard?**

| | |
|---|---|
| ☐ Bin / Barrel - *Capacity, Volume($m^3$)* : | ☐ Waste Yard (Open Area) - *Capacity, Area($m^2$)* : |
| ☐ Storage Area - *Capacity, Area($m^2$)* : | ☐ Waste Yard (Roofed) - *Capacity, Area($m^2$)* : |
| ☐ Other : Capacity, Area($m^2$) : | |

6. **What is the total capacity at the yard to processed Offshore Structure (tonnes per year)?**

| | | |
|---|---|---|
| ☐ Less than 5 000MT | ☐ 5 000MT – 10 000MT | ☐ 10 000MT-30 000MT |
| ☐ 30 000MT – 50 000MT | ☐ 50 000MT-80 000MT | ☐ More than 80,000MT |

7. **What is the challenges of managing wastes from Offshore Platform Decommissioning in Malaysia?**

## SECTION 2: HAZARDOUS WASTE MANAGEMENT FACILITIES

1. **Does your facilities process/treat the wastes associated with the dismantling platform?** ☐ Yes ☐ No

**If yes, please tick (/) to indicate the Type of Hazardous Waste Composition.** ***(You may tick more than 1)***

| | |
|---|---|
| ☐ Metal and Metal-Bearing Waste | ☐ Organic Waste Constituents Which May Contain Metal and Inorganic Material |
| ☐ Inorganic Waste Constituents Which May Contain Metal and Organic Material | ☐ Waste Which May Contain Organic and Inorganic Material |
| ☐ Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) | ☐ Other: |

2. **Is Secured Landfill available at the facilities?** ☐ Yes - Capacity, Area (m2): ☐ No

3. **If the hazardous waste is being treated, what are the Processing and Final Residue Disposal method used at the facilities? Please tell us the amount of waste receive per month.**

| Waste Group | Type of Waste | Quantity (tons/Mon) | Processing Method | Way to Dispose Residue |
|---|---|---|---|---|
| SW1 | **METAL AND METAL-BEARING WASTE** *(Lead acid batteries, Leaches Residue contain zinc, waste contain mercury, Waste from electrical and electronic (WEEE), etc.)* | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other: |
| SW2 | **INORGANIC WASTE CONSTITUENTS WHICH MAY CONTAIN METAL AND ORGANIC MATERIAL** *(Asbestos wastes in sludge, Waste contain metal: zinc, cadmium, aluminum, etc.)* | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other: |
| SW3 | **ORGANIC WASTE CONSTITUENTS WHICH MAY CONTAIN METAL AND INORGANIC MATERIAL** | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process | ☐ Secured Landfill<br>☐ Send to Third Party State: |

| | | | | |
|---|---|---|---|---|
| | *(Lubricating and hydraulic oil, Oil tanker sludge, Sludge from mineral storage, oil waste or oily sludge, Acid Sludge, Waste substances contained PCB and PCT, etc.)* | | ☐ Send to Third Party – State:<br>☐ Other : | ☐ Other : |
| SW4 | **WASTE WHICH MAY CONTAIN ORGANIC AND INORGANIC MATERIAL**<br>*(Alkalis contain heavy metal, Mineral Sludge, Contaminated soil or debris, Disposed chemical container, waste of paints, mixture of waste, etc.)* | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other : |
| SW5 | **OTHER WASTE**<br>*(Any Residues from treatment and recovery of scheduled waste etc.)* | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other : |
| | **Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM)**<br>(Sludge, scale, sediment, Surface contamination, contaminated water) | | ☐ Sludge Farm<br>☐ Incineration Process<br>☐ Extraction Method<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Return the Processed waste to the Supplier<br>☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other : |
| | **OTHER:** | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other : |
| | **OTHER:** | | ☐ Incineration Process<br>☐ Physical/Chemical Treatment (PCT)<br>☐ Solidification/ Stabilization Process<br>☐ Send to Third Party – State:<br>☐ Other : | ☐ Secured Landfill<br>☐ Send to Third Party State:<br>☐ Other : |

***Schedule Waste Category based on Environment Quality Regulation 2005 (First Schedule)***

4. **Is there any waste storage available at the facilities?** ☐ Yes ☐ No

5. **Type of waste storage medium/area available at the facilities?**

☐ Bin / Barrel - *Capacity, Volume($m^3$)* :
☐ Store Room - *Capacity, Area($m^2$)* :
☐ Other: Capacity, Area($m^2$) :
☐ Temporary Storage / Warehouse - *Capacity, Area($m^2$)* :
☐ Waste Yard (Roofed) - *Capacity, Area($m^2$)* :

6. **Average total amount of hazardous waste processed (Tonnes per year)?**

☐ Less than 2000 t ☐ 2000 t - 5000 t ☐ 5000 t -10 000 t ☐ 10,000 t -15,000 t ☐ More than 15,000 t

**What is the challenges of managing hazardous wastes from Offshore Platform Decommissioning in Malaysia?**

**PART 3: AWARENESS IN POTENTIAL DECOMMISSIONING ACTIVITIES AND OPPURTUNITIES**

*This Part of the questionnaire will assess the level of the local service provider in Offshore Decommissioning waste management activities. This Part is divided into two Section based on type of awareness;*

***Section A: General Awareness of Oil and Gas Opportunities.***

***Section B: Hazardous Waste Management Only.***

**SECTION A : GENERAL AWARENESS OF OIL AND GAS OPPORTUNITIES**

**Please tick (/) your answer based on your level understanding and awareness.**

| Questions | Degree of Understanding/Awareness | | | | |
|---|---|---|---|---|---|
| | Very Low | Low | Moderate | High | Very High |
| To what extend are you aware of the local Oil and Gas industry? | | | | | |
| How would you rate your level of understanding about the decommissioning of offshore Oil and Gas Platforms in Malaysia? | | | | | |
| What is your level of awareness on the approach used in processing the steel waste from offshore decommissioning platforms? | | | | | |
| To what extend are you aware of the waste generated from decommissioning offshore Oil and Gas Platforms? | | | | | |
| To what extend do you know about the waste management process for offshore decommissioned platforms? | | | | | |
| How do you rate your level of interest in the Offshore Platform Decommissioning Waste Management Business? | | | | | |

**SECTION B : HAZARDOUS WASTE MANAGEMENT ONLY**

**Please tick (/) your answer based on your level of understanding.**

| Questions | Degree of Understanding/Awareness | | | | |
|---|---|---|---|---|---|
| | Very Low | Low | Moderate | High | Very High |
| To what extend do you know about the processing and residue disposal method for Metal And Metal-Bearing Waste (SW1)? | | | | | |
| To what extend do you know about the processing and residue disposal method for Inorganic Waste Constituents Which May Contain Metal And Organic Material (SW2)? | | | | | |
| To what extend do you know about the processing and residue disposal method for Organic Waste Constituents Which May Contain Metal And Inorganic Material (SW3)? | | | | | |
| To what extend do you know about the processing and residue disposal method for Waste Which May Contain Organic And Inorganic Material (SW4)? | | | | | |
| To what extend do you know about the processing and residue disposal method for Other Waste from any Residues from treatment and recovery of scheduled waste (SW5)? | | | | | |
| To what extend do you know about the processing and residue disposal method for Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) Scale? | | | | | |

*Thank you for taking the time to complete this questionnaire.*

**Kualiti Alam Interview questions**

Q1. Tell me more about services provided by Kualiti Alam.

Q2. If Kualiti Alam WMC have previously undertaken with Oil & Gas Work or Offshore Decommissioning Work, please explain briefly type of project involved?

Q3. What is the type of Schedule wastes that is being processed in Kualiti Alam WMC?

Q4. What is the type of Schedule wastes that is not being processed in Kualiti Alam WMC?

Q5. Could you explain type of treatment process used for each type of schedule waste?

Q6. Is there a third party involved in the process or the facilities cover all the process?

Q7. Does the facility has the capability to process TENORM and Mercury waste, Could you explain briefly the method used?

Q8. What are the challenges of managing hazardous wastes from Offshore Platform Decommissioning in Malaysia?

Q9. What are the challenges of managing hazardous wastes from Offshore Oil and Gas Industry in Malaysia?

Q10. Are there other local scheduled waste management / treatment plant involved in offshore operations? If not, where is the waste sent?

Q11. Are there other local NORM / mercury waste management / treatment plant involved in offshore operations? If not, where is the waste sent?

**Kencana HL Yard Interview Question**

Q1: Since, KHL does not provide major decommissioning, what type of service provide by KHL for decommissioning?

Q2: As you state earlier for decommissioning platform project, KHL approach is to either refurbish and reused the platform or to scrap the structure and recycle.

i) Can you explain briefly process for platform refurbishment and reused practice by KHL?

ii) Can you explain briefly, how is the scraping process perform by KHL to the decommissioning Structure

Q3: Have KHL encounter schedule waste such as Heavy metal SW401, Oil or sludge such as SW311. SW109 and how is the handling procedure for this type of waste.

Q4: Do KHL using Kualiti Alam Sdn Bhd as service provide to disposal the schedule waste?

Q5: Can you explain more on what is the service provided by Aliran Segar Sdn Bhd?

Q6: Can I confirm on the location of the third party company where the waste is send?

- Alam Aliran - Bukit Mertajam
- Aliran Segar - Ipoh

Q7: How is the packaging medium for hazardous waste? (Metal drum / Plastic drum)

Q8: The cleaning and packaging process done by the KHL or the service provider?

Q9: Is the total capacity of more than 80 000MT cover the fabrication capacity or the weight of structure that can be handle by the KHL?