



Monitoring Report for the Exploration Drilling in Block M11



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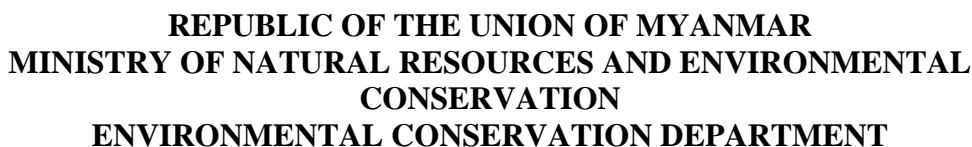
PTTEP

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This is the official submission form of Monitoring Report under *Environmental Impact Assessment Procedure Notification No.616/2015*. This form shall be completed in its entirety and submitted to the Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation, along with all required Monitoring Report according to the issued Environmental Compliance Certificate (ECC).

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Project Title	Offshore Block M11 Exploration Drilling
Project Location (Address)	Offshore Block M11, Gulf of Martaban, Andaman Sea
ECC number	

This provides an overview of the project's compliance with the conditions set in the ECC. It shall be summarized in the following table;

Compliance to the Environmental Management Plan (EMP)

This provides an overview of the compliance to the EMP committed by the proponent during the review of the ECC application. It shall be summarized as in the following Table;

Proposed mitigation measures	Cost	Institutional Plan	Schedule	Guarantees	Remarks

Validation of Project scale and predicted impact

In case of any change of the project scale or parameters of the predicted impacts, the proponent shall provide the status of the changes as in the following table. If the changes are significant, the Ministry may request additional survey to the proponent as to update the issued ECC.

Items (scale, predicted impact)	Scale / Parameters at the survey phase	Actual scale / parameters	Remark

Signature (Representative of the project proponent)

I, the undersigned Proponent (or representative, there of), hereby state that the information provided in/with the application and the report ensure that the Monitoring Report are undertaken in a professional manner and in accordance with EIA Procedure Notification No. 616/2015 and any applicable legislations issued or adopted by the Ministry.

Signature:



Date of
submission:
(dd/mm/yyyy)

Print
name:

Hsu Myat Maw

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Date received:

Project Identification Number:

The proponent submitted the reports
with the forms of;

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Recorded by:

Additional comments, notes or recommendations (attached if necessary):

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Executive Summary

REM-UAE Laboratory and Consultant Company Limited conducted compliance audit of implementation of environmental mitigation measures and monitoring program for Exploration Drilling in Block M11 Project.

The objective of the review is to evaluate the effectiveness of implementation of the Environmental Management Plan, including both mitigation and monitoring measures, defined in the EIA report. Reporting of observed problems, obstacles and recommendations for issued identified during the review were provided in order to improve the effectiveness of the existing environmental mitigation and monitoring measures.

The evaluation process includes (1) meeting with PTTEPI personnel, (2) site observation and interview with PTTEPI' representatives, and (3) document review.

1. Project Description

PTTEP International Limited (PTTEPI) was granted the petroleum Production Sharing Contract (PSC) for offshore Block M11, owned by Myanma Oil & Gas Enterprise (MOGE). PTTEPI is an Operator of Production Sharing Contract (PSC) of Block M11. The area of Block M11 is located in the Gulf of Martaban and encompasses 7,278 km². It is approximately 188 km south of the Deltaic Coastal Zone and 265 km west of Dawei. The water depth in the block ranges from approximately 600 to 1,500 m.

2. Facilities and Utilities

1) Accommodation

During drilling activities, accommodation for drilling workers will be provided on the drilling rig. Workers working on support vessels will be accommodated in the allocated accommodation on the vessels.

2) Water supply and usage

The water supply system on the drilling unit typically comprises an on-board water maker unit with a capacity equal to 200% of the daily consumption. The volume generated is in the range of 43.6 m³/day. Water is pumped from the sea, filtered, desalinized and sterilized. The water-based drilling fluids will be prepared with seawater.

3) Power supply

Power to the rig for supporting drilling activities will be supplied by 6 generators driven by diesel engines. One spare generator will be used in case of an emergency situation or during service or repair of one of the main generators. Estimated fuel consumption, based on previous projects using rigs with similar power requirements, is 35 m³/day.

4) Transportation

Transportation of materials and equipment, chemicals and waste from drilling rig to the Onshore Support Base will be conducted mainly by material support vessels. A helicopter will be used to transfer staff, with capacity of 12 staff per flight. Staff transfer to the Project area by helicopter takes 1 hour 10 minutes.

5) Well control and safety equipment

The typical facilities for well control and safety equipment on-board the drilling rig include the following:

- Gas detection system with sensors for hydrogen sulphide and combustible gas, a general warning system including navigational lights and horns;
- Continuous monitoring of the well-bore pressures and fluids by the drilling and mud logging crews;
- Regular monitoring of the specific gravity of the mud;
- Alarms to warn the drilling and mud logging crews of any fluid level changes in the pits, indicating well kick;
- Use of blow-out preventers to protect against excess pressures imposed by the formation that may damage drilling equipment and cause unrestrained flow of crude oil from the reservoir.;
- Flotation devices such as lifeboats, life rafts, buoys and life vests.

5.1) Pollution Prevention Equipment

A typical drilling unit comprises the following pollution prevention equipment:

- Sewage treatment systems;
- One air operated garbage compaction system;
- Garbage grinders;
- One skimmer tank typically of 25 bbls;
- One oily water separator typically of 5 m³/h.

Apart from the above equipment, several devices will be available on the rig or on its support vessels for emergency interventions (e.g. oil spill, blowout, etc.). The following means of intervention are anticipated:

- Fire hydrant and water cannon;
- IMO/SOPEP spill kits

An "On-board Oil Pollution Emergency Plan" and an Emergency Response Plan will be applied during the appraisal/exploration drilling campaign.

5.2) Hazardous Materials

Hazardous materials comprise the mud and cementing chemicals, which are typically stored in tote tanks in a dedicated closed area. Hazardous materials will not be discharged into the environment.

5.3) Ballast System

The drilling unit shall be equipped with fully segregated ballast tanks that will be filled and emptied with seawater as necessary to maintain trim. This system avoids hydrocarbons pollution of ballast water.

The Andaman Sea is an important biodiversity area, contamination risk with ballast waters is significant. Therefore, ballasts waters are usually treated before being released. Treatment options are: UV radiation or adding chlorine.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted on 13 February 2004. It seeks to prevent the spread of harmful aquatic organisms from one region to another by establishing Standards and procedures for the control and management of ships' ballast water and sediments. All ships engaged on international voyages are required to manage their ballast water and sediment according to certain rules, in accordance with their own ballast water management plan. All vessels must also carry a ballast water register and an international ballast water certificate.

3. Inventory of wastes discharge and emissions

An offshore appraisal/exploration drilling campaign may generate emissions to air, wastewater and liquid discharges, and production of hazardous and non-hazardous wastes. Abnormal discharges such as spills of oil or chemicals are also possible.

A brief description of the types of emissions and discharges that are expected to be generated from the drilling campaign is presented below:

- **Atmospheric emissions** are mainly associated with multiplying diesel consumption and emission factors for relevant atmospheric components. Estimations of the diesel consumption for supply boat and the drilling unit.
- **Cuttings** may contain hydrocarbons from the reservoir. They are generally treated on-board to meet the specification expected by relevant Myanmar regulation and MARPOL 73/78 requirements. If the specification is reached, the cuttings will be discharged into the sea. A total of 957 m³ for cuttings are expected to be generated from the exploration drilling program.
- The majority of the **Cement and cement additives** used for securing the casing remains in the well. Spacer and excess lead slurry from the cementing of the first casing string (36") will be discharged close to the seabed. This cement does not settle but slowly dissolves into seawater.
- **Wastewater** is generally associated with domestic and sanitary wastewater (black and grey water) and oil contaminated wastewater (bilge and deck water). These water streams will be managed by the water storage and treatment devices on-board:
 - Domestic and sanitary wastewater will be generated as a result of the human presence on the rig and support vessels. The maximum amount of black and grey water generated per day during the Project in each phase can be estimated from the number of operational staff, and the rate of produced black water at 0.08 m³/person/day and grey water at 0.16 m³/person/day (calculated from 80% of water for use at 200 l/person/day). The estimated total generation for one well is of -1.14 m³/day of black water and 2.27 m³ of grey water.
 - Bilge water means accumulated water in the ship holds and containing infiltration water, oil residues or any other product that would have been stored. Based on 0.23 m³/d typical output (0.15 m³/d typical values for the rig and 0.08 m³/d typical values for each vessel), total volume of bilge water for the entire campaign is estimated around 22.01 m³.
 - Deck water comprises rainwater and deck washing water of the vessel. The run-off water is collected by an open drain system. Considering a typical drilling rig and typical vessels' deck dimensions (Rig 50x100 and vessel 2x10x30, sum: 5,600 m²) as well as the typical annual rainfall values during the rainy season (from May to October) in Myanmar (100 mm/month in average), a rough estimation of the total deck water to be produced during the entire campaign is 44,020 m³.
 - Ballast water is stored in specially designated ballast tanks and cannot be mixed with any other contaminants. No discharge of ballast water is expected to occur during the project, the rig will normally arrive on-site and leave the site de-ballasted and ballast supply vessels will perform rotations within the same marine eco-zone.
 - BOP Fluid Average usage of BOP fluid (Erifon HD 603HP; the water based hydraulic fluid) was 1,000 Liters per month.

- Drilling operations produce non-hazardous waste (glass, paper, plastic and wood) and very low amounts of hazardous waste (medical waste, chemical waste). Both wastes will be managed in accordance with the provisions of the waste management procedures of PTTEPI. In particular, the waste streams will be categorized on-board at source for the purpose of segregation and temporary storage prior to shipping to shore by the supply vessels for treatment or disposal in an authorized facility.
- The quantities of each waste generated during the Exploration Drilling in Block M11 Project are the following:
 - Non-hazardous waste: 72,920 kg
 - Hazardous waste: 20,060 kg

That is, an estimated total quantity of 29,966 kg of waste for one well will be produced during the drilling campaign.

- The potential for venting and fugitive releases exists; however, volumes will be small and unlikely to raise an odour problem. Ambient noise impacts may occur during drilling activities, however, these will be short term and at a small scale. A key factor for noise impact is the remote location of the project, which is located 260 km offshore away from people and any environmentally sensitive areas. Added to this, potential impact from extraneous light is expected to be minor, with the main sources arising from lighting and the flare (which will be performed in case of success and during limited time only).
- Accidental releases such as fuel leaks are possible but with low probability of occurrence. An Oil Spill Contingency Plan will be implemented if oil is accidentally discharged into the sea.

4. Project's Environmental, Social and Health Policies

PTTEPI management is fully committed to providing a safe, secured and healthy workplace and conducting its operations in a manner that protects the environment. These commitments are in accordance with PTTEP's Corporate Vision, Mission, and Values and PTTEPI's SSHE Policy. Proactive individual involvement, responsibility and accountability are expected of all employees, contractors and third party personnel. PTTEPI SSHE Management System (SSHE MS) is designed to align all stakeholders' efforts to enable attainment of these principles.

All levels of line management at PTTEPI are responsible for implementing and maintaining its SSHE policy and SSHE MS. Both documents are reviewed and revised at regular intervals.

5. Compliance Status

5.1 Environmental Mitigation Measures Compliance Result in Drilling Phase

The results determined that the project completely complied on the environmental mitigation measures implementation compliance in Drilling Phase with 100%.

- **Air Quality / GHG emissions** - Routine inspection and preventive maintenance for all machinery were conducted as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project. Helicopter transportation of the project was used for only crew changed and emergency case as follow Zawtika Medical Emergency Response Plan.
- **Seawater & Sediment Quality** - Seawater and Water-base mud (WBM) were the priority as drilling fluid. The mud circulation system was provided to circulate mud for recycling. Synthetic-base mud (SBM) which is categorized as environmental friendly and biodegradable was used by technical reason. Chemical used and discharge of cutting were recorded by the project. Cutting would be discharged at 15 m below sea surface. The quantities of cement and the dosing of chemicals used were optimized by project staffs to minimize waste for discharge. SDS which identified the toxicity of chemical was provided at all chemical storage area of NCB Rig. Low toxicity of chemical was used in this project. Waste containers were provided at NCB Rig and supply vessel. All waste was collected in garbage bag before drop in waste containers. Waste containers were covered to protect from the environment. The waste from NCB Rig and vessel was transferred to dispose

onshore by authorized contractor. PTTEPI and contractors followed the requirements of MARPOL 73/78 and PTTEPI's Waste Management Procedure. The vessel deck was regularly cleaned to minimize the impact from oil and chemical contamination into the sea during period of rain. Crew was prohibited to drop waste into the sea. Food grinder was provided to grind the food waste to 25 mm prior to discharge to sea.

- **Seabed characteristics and Marine life and marine ecology** - PTTEPI strictly implement and follow mitigation measures for impacts to seawater & sediment quality.
- **Fishing communities and fisheries and Shipping and navigation** - The project information and drilling plan were informed to all related organizations by PTTEPI before starting of drilling activity. An exclusion zone (radius of 500 m) was already established surrounding the drilling rig. Project has 2 support vessels for warning off traffic. Appropriate lights and warning signals were already provided around the NCB Rig and support vessels.
- **Socio-economy** - Local goods and services such as local workers from contractor were added to work on rig during drilling period.
- **Occupational Health and Safety** - PTTEPI's Occupational Health Management Standard was already prepared and enforced to the worker and contractor to implement those standards throughout the operation. All related staffs were already trained about safe handling of the chemicals and instructed to follow PTTEPI Chemical handling. Personnel protective equipment were already provided to all project's staffs.

Safety training was provided for all project's staffs according to PTTEPI SSHE Training and Competency Standard. The PTTEPI's MERP was already provided. In case of emergency, the patients will transfer to the hospital in Yangon by helicopter.

Chemical storage area was provided adequately. SDS was attached at all chemical storage area. The condition of storage area was regularly inspected by project's staff. Spill kits and first aid kits were already provided at NCB Rig. The sanitary systems and others facilities such as drinking water, canteen, coffee corner, toilet, smoking area and rest area were properly provided at NBC Rig.

At high noise level area, the noise protection equipment and high noise area sign were provided on site.

From Starting of the project on 7th April 2019 (Anchor Operation) and finished on 26th July 2019 (Anchor Handling Operation), project had already 4 cases of incident which were separated as 2 property damage cases, lost of primary containment (LOPC) and Near miss as shown in Appendix I.

- **Public health and Health service** - PTTEPI's Occupational Health Management Standard was already prepared and enforced the worker and contractor to implement. The PTTEPI's MERP was already provided. In case of emergency, the patients will transfer to the hospital in Yangon by helicopter.

5.2 Environmental Mitigation Measures Compliance Result in Unplanned Events

The results determined that the project completely complied on the environmental mitigation measures implementation compliance in unplanned event with 100%.

- **Vessel collision** - The emergency response plan for vessel collision was already provided at NCB Rig as follow the PTTEPI Zawtika Offshore Field Emergency Response Plan.
- **Accidental Spills** - The emergency response plan for accidental spills was already provided at NCB Rig as follow the PTTEPI Spill Contingency Plan. Oil spill case will be monitoring and recording by project's staff. Currently, there is no oil spill case from project operation. The BOP equipment was provided for blowout prevention during drilling activity. Moreover, the PTTEPI Blowout Contingency Plan was already provided.
- **Well blowout** - The Spill kits, PTTEPI Spill Contingency Plan and PTTEPI Blowout Contingency Plan were already provided at NCB Rig according to MARPOL 73/78.

- **Tropical cyclone** - The emergency response plan for tropical cyclone was already provided at NCB Rig as follow the PTTEPI Tropical Cyclone Procedure. The emergency drill for tropical cyclone escape was already trained to all staff.
- **Fire or Explosion** - The firefighting equipments were already provided around the operation and living area. The fire plan was attached on both of operation and living area. Emergency plan for fire or explosion was already provided. Moreover, emergency drill was performed regularly.

5.3 Environmental Monitoring Result

The results of Environmental Monitoring determined that the project completely complied with 100%.

1) Cutting and Stock Barite Monitoring

- **Oil on Cuttings (for SBM)**

Mud and Cutting were collected by project staff during April to June 2019 in drilling phase. Well was drilled by SBM. So oil on cutting was analyzed on mud and cutting. The results of oil on cutting are in range of 1.46 – 2.82% OOC (dry weight) which meet the control limit of 6.9%, refer to IFC EHS Offshore Oil and Gas Guideline) for Existing Facilities.

- **Total Mercury and Total Cadmium in Stock Barite**

Stock Barite was collected by project staff in April 2019. Total mercury and total cadmium (in stock barite) was analysed, The results found that total Mercury (in stock barite) was 0.452 mg/kg (dry weight) and total Cadmium (in stock Barite) was ND. When compared the results with National Environmental Quality (Emission) Guidelines found that total mercury and total cadmium (in stock barite) at PWC-1, 12-1/4" x 19" Section TD was complied with the standard.

2) Sewage Monitoring

Sewage monitoring was conducted by REM-UAE Laboratory and Consultant Company Limited on May 15, 2019 from sewage water treatment system discharge point at NCB Rig. The result found that BOD complied with MEPC.159 (55), except pH, COD and Total Coliform Bacteria.

The performance of sewage treatment system has to be considered and improved to ensure that all parameters will meet the control limit as per their Sewage Pollution Prevention Certificate.

Chapter 1

Introduction

Chapter 1

Introduction

1.1 Introduction

PTTEP International Limited (PTTEPI) was granted the petroleum Production Sharing Contract (PSC) for offshore Block M11, owned by Myanmar Oil & Gas Enterprise (MOGE). PTTEPI is an Operator of Production Sharing Contract (PSC) of Block M11. The area of Block M11 is located in the Gulf of Martaban and encompasses 7,278 km². It is approximately 188 km south of the Deltaic Coastal Zone and 265 km west of Dawei. The water depth in the block ranges from approximately 600 to 1,500 m. The project location is indicated on the figure 1-1. One well was previously drilled in Block M11 in 2013 by PTTEPI.

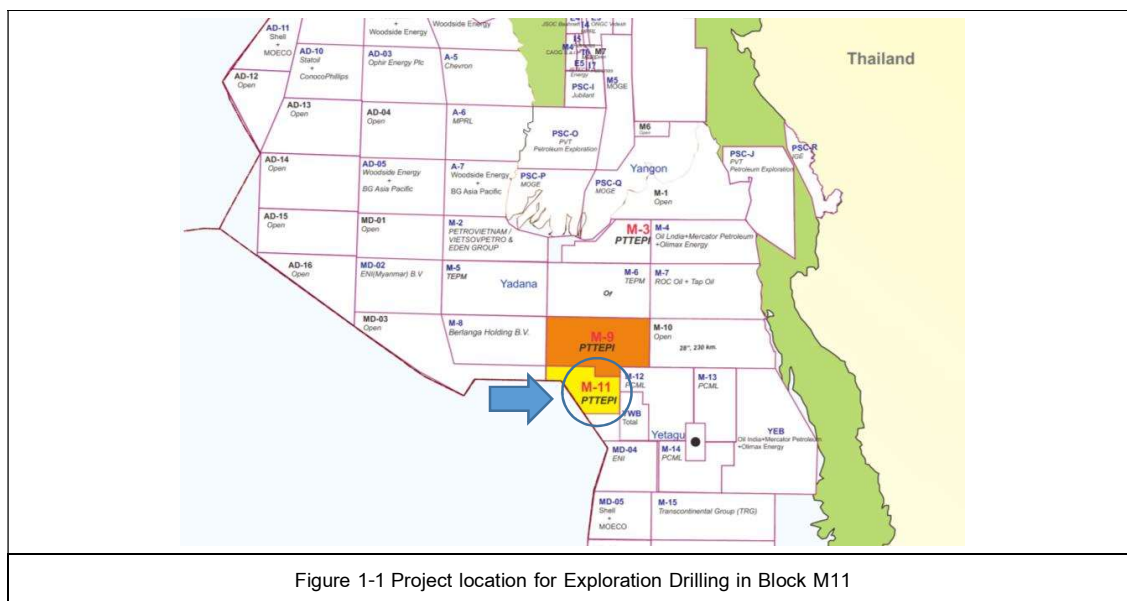


Figure 1-1 Project location for Exploration Drilling in Block M11

According to the Environmental Impact Assessment Procedure (EIA) issued by MOECAP (now MONREC) - Notification No. 616/2015, the project is classified as an EIA type economic activity (classified at line 16 of the table present in appendix I of the EIA procedure). The first screening stage of the project was the submission of the project proposal to MOGE and onward submission to MONREC. Regarding to this, the Environmental Conservative Department (ECD) responded to the project proposal with the instruction to perform an EIA for the proposed project.. Therefore, PTTEPI had contracted Artelia Myanmar/Artelia Eau & Environnement RSE International Department to complete Offshore Exploration Drilling in Block M11 in Mobilization and installation phase, Drilling phase, and P&A phase (Plug and Abandon) and Demobilization. The Environmental Impact Assessment (EIA) Report of the Project was submitted to Myanmar Oil and Gas Enterprise (MOGE) and Environmental Conservation Department (ECD) on 3rd December 2018, according to the submission letter no. PTTEPI. 13253/01-3699/2018 (Appendix A-1.1). After that ECD called reviewed team meeting on 27th June 2019 and requested PTTEPI to revise the EIA report. Then PTTEPI submitted the revised EIA report on 18th September 2019 (Appendix A-1.2). EIA report was approved on 28th May 2020 by MOGE and 25th May 2020 by ECD according to the approval letter number MD – (100) 3/6 (1132) 2020 and EIA-2/ Petroleum (1123/2020) respectively (Appendix A-1.3).

As per commitment in EIA Report, PTTEPI has the responsibility to follow the environmental mitigation and monitoring measures and has to submit the monitoring report together with Hazardous waste Management Plan based on information from EIA report to MOGE and ECD. Therefore, PTTEPI, as the project owner, has assigned a qualified third party, REM-UAE Laboratory and

Consultant Company Limited to perform compliance audit of the mitigation measures and perform the monitoring at frequency specified in the EIA's environmental management plan and report the results to MOGE and ECD as prescribing in EIA.

1.2 Objective

The main objectives of this report are:

- To evaluate the effectiveness of implementation of the Environmental Management Plan, including both mitigation and monitoring measures, defined in the EIA report; and
- To report any potential problems or obstacles and propose recommendation for improvement in order to ensure the effectiveness of the prevention and mitigation measures.

1.3 Project Location

The area of Block M11 is located in the Gulf of Martaban and encompasses 7,278 km². It is approximately 188 km south of the Deltaic Coastal Zone and 265 km west of Dawei. The water depth in the block ranges from approximately 600 to 1,500 m. The project location is indicated on the figure 1-1.

1.4 Status of Current Operations

The current plan is to drill one exploration well targeting multiple reservoirs. Well design is planned with multiple casing strings. Directional plan is to drill vertical hole with corrections wherever required to remain within the target tolerances. Depending upon the reservoir potential, future wells may be drilled in M11 block. A vertical well is a type of well, which will drill vertically to the reservoir section. A 17-1/2" hole will be spud and a 13-3/8" surface casing will be set up to prevent bore hole collapse. Then a 12-1/4" hole will be drilled with well control equipment (e.g. diverter, BOP) and a 9-5/8" casing will be set up and cemented to isolate non-productive (for that particular well) gas sand. The main reservoirs section will be vertically penetrated with a 8-1/2" hole size.

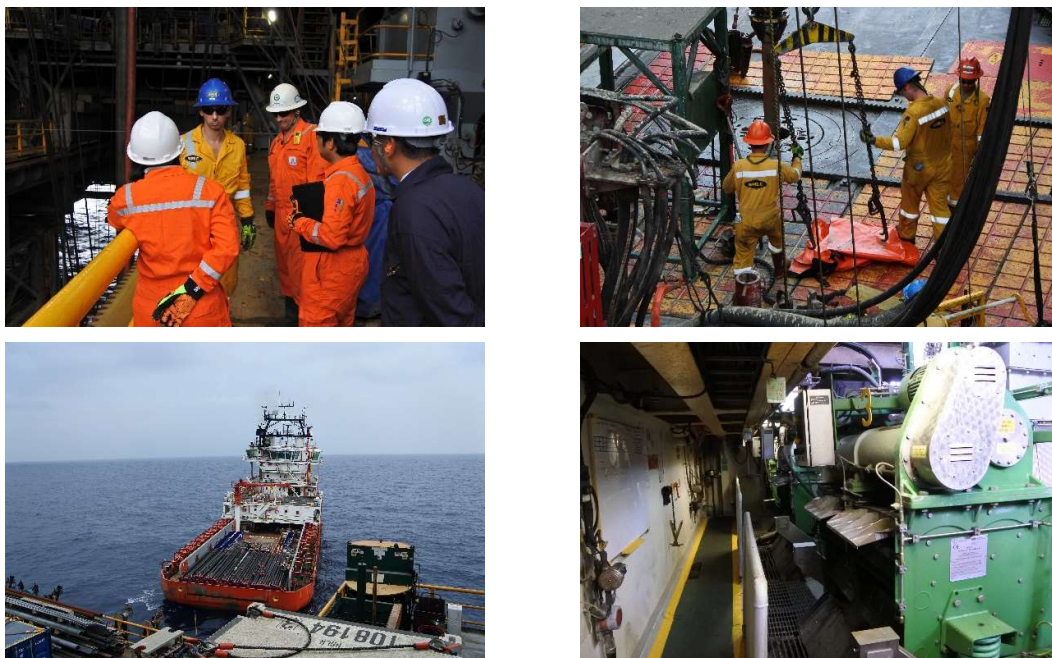


Figure 1-2 Current condition of Offshore Exploration Drilling in Block M11 in Drilling Phase

1.5 Components of Project's Facilities

Before beginning of drilling operations, PTTEPI will coordinate with relevant government authorities and stakeholders via a "Notice to Mariners", sent to the Myanmar Oil and Gas Enterprise (MOGE), at least four weeks prior to the campaign. This is to inform stakeholders of the schedule of the Project in order to allow time for them to remove their fishing gears (if any) from the drilling area as well as to avoid fishing in these locations.

Descriptions for each component of project's facilities in drilling phase are summarised in below subsections.

1.5.1 Facilities and Utilities

1) Accommodation

During drilling activities, accommodation for drilling workers will be provided on the drilling rig. Workers working on support vessels will be accommodated in the allocated accommodation on the vessels.

2) Water supply and usage

The project's activities in each phase utilize water for various purposes as summarized in the Table 1-1.

Table 1-1 Type of water and volume of water use in the project activities.

Project Activities	Type of Potable Water	Water Source	Quantity of Potable Water/Day (m ³)
Production well drilling, well logging and production well preparation	Potable water for staff on drilling rig	Bottled water/ water producing unit on drilling rig	31.2
	Daily use water for staff on vessels	Water storage tanks in operational vessels	12.4

The water supply system on the drilling unit typically comprises an on-board water maker unit with a capacity equal to 200% of the daily consumption. The volume generated is in the range of 43.6 m³/day. Water is pumped from the sea, filtered, desalinized and sterilized. The water based drilling fluids will be prepared with seawater.

3) Power supply

Power to the rig for supporting drilling activities will be supplied by 6 generators driven by diesel engines. One spare generator will be used in case of an emergency situation or during service or repair of one of the main generators. Estimated fuel consumption, based on previous projects using rigs with similar power requirements, is 35 m³/day.

4) Transportation

Transportation of materials and equipment, chemicals and waste from drilling rig to the Onshore Support Base will be conducted mainly by material support vessels. A helicopter will be used to transfer staff, with capacity of 12 staff per flight. Staff transfer to the Project area by helicopter takes 1 hour 10 minutes.

5) Well control and safety equipment

The typical facilities for well control and safety equipment on-board the drilling rig include the following:

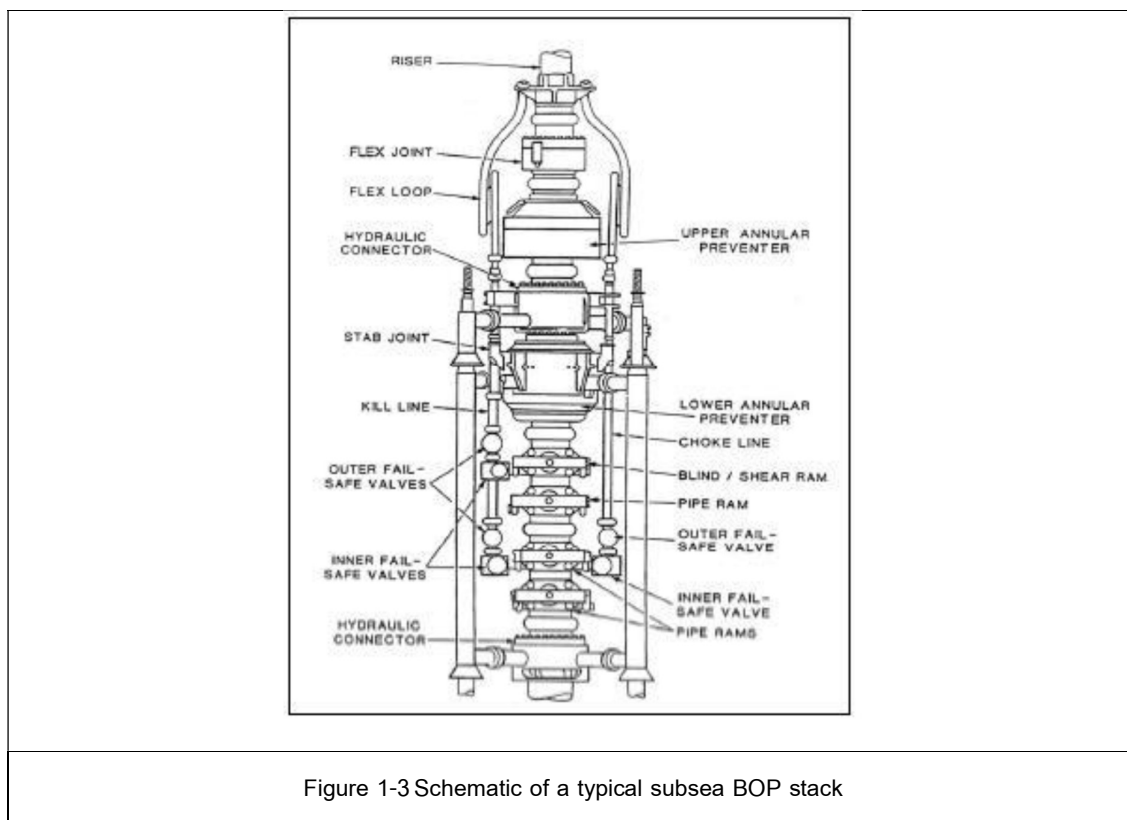
- Gas detection system with sensors for hydrogen sulphide and combustible gas, a general warning system including navigational lights and horns;
- Continuous monitoring of the well-bore pressures and fluids by the drilling and mud logging crews;
- Regular monitoring of the specific gravity of the mud;

- Alarms to warn the drilling and mud logging crews of any fluid level changes in the pits, indicating well kick;
- Use of blow-out preventers to protect against excess pressures imposed by the formation that may damage drilling equipment and cause unrestrained flow of crude oil from the reservoir.;
- Flotation devices such as lifeboats, life rafts, buoys and life vests.

The drilling rig is equipped with the necessary equipment to allow emergency disconnection for example during extreme weather conditions or in the case of mechanical/electrical problems on the rig resulting in drift off.

Although the probability of a well blow-out is extremely low, it nonetheless provides the greatest environmental concern during drilling operations. The primary safeguard to prevent a blow-out is to control the pore pressure by hydrostatic means, thereby maintaining a column of fluid to overbalance the formation pressure. This would include ensuring that the correct fluid density is used, operating in a prudent manner to avoid under balancing the well and designing the well to take all the risk (both mechanical and operational) into consideration. This approach is supported by correctly monitoring the well by such means as pit level indicators, return mud-flow indicators, pump pressures, shaker returns and gas detection. Geologically the well would also be monitored for signs of abnormal (high or low) pressure to correctly identify any variations from the projected pressures and hole conditions.

The likelihood of a blow-out is further minimized by employing a blow-out preventer, which is a secondary control system. A typical BOP stack is shown in Figure 1-3. When installed on top of the wellbore, a BOP is designed to close inside the well if flow from the wellbore is detected. The BOP allows the influx to be safely circulated out of the well in order to regain primary well control.



5.1) Pollution Prevention Equipment

A typical drilling unit comprises the following pollution prevention equipment:

- Sewage treatment systems;
- One air operated garbage compaction system;
- Garbage grinders;
- One skimmer tank typically of 25 bbls;
- One oily water separator typically of 5 m³/h.

Apart from the above equipment, several devices will be available on the rig or on its support vessels for emergency interventions (e.g. oil spill, blowout, etc.). The following means of intervention are anticipated:

- Fire hydrant and water cannon;
- IMO/SOPEP spill kits;

An “On-board Oil Pollution Emergency Plan” and an Emergency Response Plan will be applied during the appraisal/exploration drilling campaign.

5.2) Hazardous Materials

Hazardous materials comprise the mud and cementing chemicals, which are typically stored in tote tanks in a dedicated closed area. Hazardous materials will not be discharged into the environment.

5.3) Ballast System

The drilling unit shall be equipped with fully segregated ballast tanks that will be filled and emptied with seawater as necessary to maintain trim. This system avoids hydrocarbons pollution of ballast water.

In the context of offshore oil & gas operations, ballast water is of great importance for the safety of both crew and ship. However, there are globally environmental issues related to ballast water. This is because in shipping, ballast water primarily consists of water collected from the point of take-off which contains thousands of living species (and to a lesser extent sediment). The species carried in ballast water may be invasive and are particularly responsible for a number of very destructive incidents towards marine biodiversity.

These invasive species are not indigenous and so could be described as alien, exotic species which implies that they are members of a population that enters an ecosystem other than their historic or native range. Such species have the potential to cause direct environmental consequences to the biota of the recipient environment with its concomitant socio-economic consequences. Most of them are opportunistic species.

Because the Andaman Sea is an important biodiversity area, contamination risk with ballast waters is significant. Therefore, ballast waters are usually treated before being released. Treatment options are: UV radiation or adding chlorine.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted on 13 February 2004. It seeks to prevent the spread of harmful aquatic organisms from one region to another by establishing Standards and procedures for the control and management of ships' ballast water and sediments. All ships engaged on international voyages are required to manage their ballast water and sediment according to certain rules, in accordance with their own ballast water management plan. All vessels must also carry a ballast water register and an international ballast water certificate.

The provisions for each support vessel include the following:

- Vessels must have on-board and implement an approved ballast water management plan.
- Vessels must have a Ballast Water Register

- Where the ship is unable to renew the ballast water in the manner described in the convention, such ballast renewal should be carried out as far as possible from the nearest land and, in any event, at a distance of at least 50 nautical miles from the nearest land and at least 200 meters from the bottom.

1.5.2 Inventory of Waste Discharges and Emissions

The following section is a brief description of the types of emissions and discharges that normally result from a typical well drilling operation.

- Normal emissions and discharges from the drilling unit are emissions to air, discharges to sea and wastes returning to shore;
- Abnormal discharges such as spills or losses of oil and/or chemicals are possible, but unlikely. In the event of an abnormal discharge, PTTEP's Myanmar Asset Spill Contingency Plan would be implemented.

1) Atmospheric emissions

Atmospheric emissions from a drilling campaign are primarily due to routine operations of the drilling program.

Estimations of atmospheric emissions were undertaken by multiplying diesel consumption and emission factors for relevant atmospheric components. Estimations of the diesel consumption for supply boat and the drilling unit are based on the following:

- 15 m³/day/material supply vessel (2 supply boats for 71 days of total duration of the all campaign);
- Drillship's consumption: 40 m³/d;

The emission factors (EM) are specified by the International Organization of Oil & Gas Producer (OGP) to express the emissions for each gas in tonnes of equivalent CO₂. The greenhouse gas production was then calculated as the sum of CO₂ and NO₂. A summary table of emissions calculations for each gas is presented in the Table 1-2.

Table 1-2 Air emission evaluation estimated for Block M11 exploration drilling campaign

Gas produced	OGP Emission Factor (t/t)	Estimated emissions (tonnes of equivalent CO ₂)
		Main vessel
Diesel engine combustion (drilling rig, vessels and helicopter)		
CO ₂	3.2	13,518
CO	0.0021	8.9
NO _x	0.0094	40
N ₂ O	0.00022	0.9
SO ₂	0.008	34
CH ₄	0.00008	0.3
VOC	0.0019	8.0
Total Emission		13,610

Additional air emissions will be generated by positioning and operating the supply boats and during refuelling operations. Levels of pollution from these sources are expected to be insignificant.

2) Drilling discharges to the sea

2.1) Drilling Waste

2.1.1) Drilling Cuttings

A total of 957 m³ for cuttings are expected to be generated from the exploration drilling program, which will be eventually discharged at sea after being treated overboard if IFC standards are met (see 3.2.2 Myanmar legislation relevant to the project Whilst environmental legislation in Myanmar is under active development, some legislation has been passed; the table below summarizes the national environmental legislation that is relevant to the project. Main Myanmar environmental legislation applicable to the Project).

2.1.2) Drilling Mud

Mud will be removed from the cuttings to the extent possible. As the bottom section of the drilling system that utilizes SBM / WBM is within a closed-loop system, SBM/WBM mud loss would be limited to only two factors: 1) lost into formation and 2) lost on cuttings. The amount of mud lost into formation cannot be determined until it actually occurs, because it is an operational uncertainty. As soon as mud loss into formation occurs, engineers will pump the pre-mixed Loss Circulation Materials (LCM) into the well to seal the cracks and continue the drilling operation. Response to loss into formation is usually very quick. Immediately pump rates are reduced and drilling of new formation is completely stopped until major losses are cured. Minor seepage losses are sometimes tolerated and controlled drilling is exercised. Mud that is lost into formation will not cause harm to the environment and will not be returned. Oil on cutting would be controlled to below 6.9% using Cutting dryer.

2.2) Cement and Cement Additives

Although small volumes of spacer and of excess cement slurry are pumped to allow for overgauge hole volumes, the majority of the cement used for securing the casing remains in the well. Spacer and excess lead slurry from the cementing of the first casing string (36") will be discharged close to the seabed. This cement does not settle but slowly dissolves into seawater.

3) Wastewater

Wastewaters are generally associated with domestic and sanitary wastewater (black and grey water) and oil contaminated wastewater (bilge and deck water). These water streams will be managed by the water storage devices on-board.

- Domestic and sanitary wastewater will be generated as a result of the human presence on the rig and support vessels. The maximum amount of black and grey water generated per day during the Project in each phase can be estimated from the number of operational staff, and the rate of produced black water at 0.08 m³/person/day and grey water at 0.16 m³/person/day (calculated from 80% of water for use at 200 l/person/day). The estimated total generation for one well is of -1.14 m³/day of black water and 2.27 m³ of grey water.
- The bilge water means accumulated water in the ship holds and containing infiltration water, oil residues or any other product that would have been stored. Based on 0.23 m³/d typical output (0.15 m³/d typical values for the rig and 0.08 m³/d typical values for each vessel), total volume of bilge water for the entire campaign is estimated around 22.01 m³.
- The deck water comprises rainwater and deck washing water of the vessel. The run-off water is collected by an open drain system. Considering a typical drilling rig and typical vessels' deck dimensions (Rig 50x100 and vessel 2x10x30,

sum: 5,600 m²) as well as the typical annual rainfall values during the rainy season (from May to October) in Myanmar (—100 mm/month in average), a rough estimation of the total deck water to be produced during the entire campaign is 44,020 m³.

- Ballast water is stored in specially designated ballast tanks and cannot be mixed with any other contaminants. No discharge of ballast water is expected to occur during the project, the rig will normally arrive on-site and leave the site de-ballasted and ballast supply vessels will perform rotations within the same marine eco-zone.

In order to minimize the waste associated with oil in bilge and deck water, no water will be discharged without prior on-board treatment. These wastewater releases comply with MARPOL. Moreover, the sewage treatment unit on NCB Rig has been certified by American Bureau of Shipping which was shown in Appendix C-10.

4) Solid Waste

Ship activities produce waste which can be different:

- A variety of non-hazardous solid waste will be generated such as glass, paper, plastic and wood. Much of this is associated with galley and food services operations and with operational supplies such as shipping pallets, containers and protective coverings. No solid waste is intentionally disposed of into the marine environment as per MARPOL specification.
- Food wastes will be milled (<25 mm diameter) and discharged into the sea more than 12 miles offshore as per practices of MARPOL Convention. All non-food wastes will be collected for compaction and transport to the Thaketa Support Base and delivered to either MOGE or Yangon City Development Committee for final disposal. No incinerator is forecasted on-board 100% of garbage collection recovery will be treated onshore.

Typical hazardous wastes include drilling muds and cuttings, cementing wastes, well completion, excess drilling chemicals and containers, empty chemical drums, used lubricants, filters, paints, solvents, contaminated soil, batteries, medical waste, oily sludge, absorbents from spill clean-up. Moreover, average usage of BOP fluid (Erifon HD 603HP; the water based hydraulic fluid) was 1,000 Liters per month. The estimated quantities of non-hazardous and hazardous wastes generated during the Block M11 exploration activities are presented in the Table 1-3.

Table 1-3 Waste production from projected activities

Waste Type	Quantity of generated waste (kg)
2. Non-hazardous waste	72,920
5. Hazardous waste	20,060
Total	92,980

Solid and liquid wastes will be managed in accordance with the provisions of the waste management systems and procedures outlines in the Environmental Management Plan (EMP) of the rig operator. In particular, the waste streams will be categorized on-board at source for the purpose of segregation and temporary storage prior to shipping to shore by the supply vessels for treatment or disposal in an approved facility.

5) Odour, noise and light

The potential for venting and fugitive releases exists; however, volumes will be small and unlikely to raise an odour problem. Ambient noise impacts may occur during drilling activities, however, these will be short term and at a small scale. A key factor for noise impact is the remote location of the project, which is located 260 km offshore away from people and any environmentally sensitive areas. Added to this, potential impact from extraneous light is expected to be minor, with the main sources arising from lighting and the flare (which will be performed in case of success and during limited time only).

6) Accidental releases

Accidental releases such as fuel leaks are possible but with low probability of occurrence. An Oil Spill Contingency Plan will be implemented if oil is accidentally discharged into the sea.

1.5.3 PTTEPI's SSHE Policy

PTTEPI management is fully committed to providing a safe, secured and healthy workplace and conducting its operations in a manner that protects the environment. These commitments are in accordance with PTTEP's Corporate Vision, Mission, and Values and PTTEPI's SSHE Policy. Proactive individual involvement, responsibility and accountability are expected of all employees, contractors and third party personnel. PTTEPI SSHE Management System (SSHE MS) is designed to align all stakeholders' efforts to enable attainment of these principles.

All levels of line management at PTTEPI are responsible for implementing and maintaining its SSHE policy and SSHE MS. Both documents are reviewed and revised at regular intervals.

PTTEPI'S SSHE Policy

PTTEP Myanmar Asset is committed to safe Exploration and Production (E&P) Operations in Myanmar with an ultimate goal of "Target Zero - Nobody Gets Hurts in Our Operations" which covers (1) Zero Injury, (2) Zero Major Accident (e.g. zero major hydrocarbon leak, vehicle accident, ship collision), and (3) Zero Spill or External Complaint (e.g. zero complaint by authorities/ communities/ sea users).

To accomplish this, PTTEP Myanmar Asset Implements Safety, Security, Health and Environmental Management System (SSHE-MS) that outlines the main principles and accountabilities to drive for continuous improvement. We are committed to:

- Comply with Myanmar SSHE laws, other applicable requirements and PTTEP Standards.
- Perform hazard identification and SSHE risk assessments so that risks are As Low As Reasonably Practicable (ALARP).
- Hold employees accountable for SSHE performance by setting and monitoring SSHE Plans and KPIs.
- Prevent operational and process incidents by implementing asset integrity programs and monitoring of Safety Critical Elements addressed in Safety Cases and complying with Management of Change (MOC) Standard.
- Work with contractors and suppliers to achieve PTTEP's SSHE requirement.
- Ensure all employees and contractors are assessed and maintain the required level of job and SSHE competency.
- Apply "Stop Work Authority Policy" for unsafe work by implementing Behavior-Based Safety (BBS) programs to improve positive SSHE culture.
- Implement security management for potential threats to safeguard personnel, assets, information and reputation.
- Promote occupational health and hygiene in the workplace by conducting health risk assessments, medical surveillances, education and regular industrial hygiene monitoring.
- Prevent environmental impacts by strictly following the mitigation measures stated in Environmental Impact Assessment.

- Promote sustainable development by implementing waste management, greenhouse gas reduction and energy efficiency programs.
- Report, investigate and analyse SSHE incidents to prevent recurrence and close out corrective actions with evidence.
- Ensure that emergency and crisis management plans are proactive and effective.
- Ensure policy and SSHE Management System compliance through regular SSHE audits and Senior Management visits with corrective actions follow up for continuous improvement.

PTTEP requires its contractors to comply with its “SSHE Contractor Management Standard”. The contractors are also required to carry out an SSHE Risk Assessment of their work and present a specific SSHE work plan. Workers must be formally trained in the general and specific SSHE issues at the site.

1.5.4 Environmental Management in PTTEPI

PTTEPI is committed in operating the business conscientiously and responsibly towards society and environment through adhering to the Safety, Security, Health, and Environmental (SSHE) Policy, which includes the commitment to environmental protection. Company personnel, business partners as well as contractors working for or on behalf of the company must implement this SSHE Policy. Implementation of the Environmental Management System (EMS) is integrated in the SSHE Management System and is aligned with the ISO 14001 international standard. To reinforce the implementation of the EMS, the company concentrates on the management of the environmental aspects and impacts for all the activities including product transportation, waste management, other logistics activities and supply chain management. For an effective management of environmental impact, PTTEPI has continued the certification and implementation of ISO 14001 for all his domestic operating assets. PTTEPI has developed an environmental information database, and has continuously reviewed and updated the data collection method and database itself. The data reported since 2010 has continuously been assured by an independent external party as well as publicly disclosed in PTTEPI Sustainability Report. In addition, PTTEPI also benchmark its performance against peers in the International Association of Oil and Gas Producer (IOGP).

The manual covers details on the areas specified in Table 1-4. The document is designed to serve as a comprehensive guide for all Operational Assets to develop its own SSHE management system and related documents. This document also provides an overview of the SSHE management system approach. Additional SSHE documents are available from PTTEPI upon request as needed.

Table 1-4 PTTEPI SSHE Management System Standards

Item	Document	Document Number
1	Myanmar Asset SSHE Management System	11027-PDR-SSHE-340-007-R01
2	SSHE Training and Competency Procedure	11027-PDR-SSHE-340-003-R01
3	Myanmar Asset Alcohol and Drugs Testing Procedure	11027-PDR-SSHE-564-002-R00
4	PTTEPI SSHE Requirements for Contractors	Myanmar 13036-PDR-078
5	SSHE Regulatory Compliance Standard	Myanmar-0550-STD-014
6	Fitness to Work Procedure	Myanmar-SSHE-11027-PDR-508
7	Myanmar Asset Waste Management Procedure	11027-PDR-SSHE_503/01-R02
8	Myanmar Asset Emergency Management Plan	11027-PDR-SSHE-502-006-R01
9	Myanmar Asset Crisis Management Plan	11027-PDR-SSHE-501-005-R00
10	Myanmar Asset Security Management Procedure	11027-PDR-SSHE-530-004-R00
11	Myanmar Asset Blowout Contingency Plan	11027-PDR-SSHE-501/03-R02
12	Myanmar Asset Spill Contingency Plan	11027-PDR-SSHE-501/03-R02
13	Working in Adverse Weather Procedure (offshore)	11027-PDR-401-R02
14	PTTEP Crisis Communication Plan	Myanmar-0550-PDR-008
15	Offshore Medical Emergency Response Plan (MERP)	Myanmar-SSHE-11027-PDR-506
16	Myanmar Asset Tropical Cyclone Procedure	11027-PDR-SSHE-507-R05
17	Offshore Helicopter Emergency Landing Procedure	Myanmar-SSHE-11027-PDR-516

1.5.5 Environmental Monitoring and Mitigation Measure Implementation Compliance

According to EIA, the environmental mitigation measures implementation audit which considered environmental issues and essential impacts that may occur were conducted in the drilling phase of the project on May 13-15, 2019 by REM-UAE, as the environmental consultant of the project together with the representation from PTTEPI. The results were described in Chapter 2. The environmental monitoring measures were implemented on May 15, 2019 and the results were presented in Chapter 3 and the conclusion was summarized in Chapter 4.

Chapter 2

Environmental Mitigation Measures Implementation Compliance Audit

Chapter 2

Environmental Mitigation Measures Implementation Compliance Audit

Environmental Mitigation Measures Implementation Compliance audit was carried out by REM-UAE Laboratory and Consultant Company Limited together with representatives from PTTEPI. The audit conducted against the mitigation measures specified in EIA as detailed in Appendix B.

Audit was performed at Block M11, Drilling Rig Noble Clyde Boudreaux (NCB) on May 13-15, 2019 and document checking by setting 4 levels of evaluation as follows;

- Completely complied on the Mitigation Measures (✓) refers the project can complete comply with the measure without any barriers.
- Mostly complied on the Mitigation Measures (✓) refers the project can mostly comply with the measure without any barriers.
- Do not complied on the Mitigation Measures (✗) refers the project cannot comply with the measure because of some barriers.
- Do not have situation follows the Mitigation Measures (NA) refers during the project operations do not have any of situation follow the Mitigation Measures.

Although the project does not comply with the mitigation measures, REM- UAE Laboratory and Consultant Company Limited will identify the cause of problems, barriers and solutions ways.

From the audit, it was found that PTTEPI have a hundred percent (100%) comply with the mitigation measures. The details are shown in Table 2-1 to Table 2-2 as followed;

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
Environmental Mitigation Measures								
1. Air Quality/ GHG Emissions	1.1 Air emissions from combustion due to operation of machines and engines.	1.1.1 Maintaining generators and compressors in good working order.	All project vessels Drilling rig	Drilling phase	✓	Routine inspection and preventive maintenance for all machinery were conducted as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project.	-	Figure 2-1, Figure 2-2, and Appendix C-1
	1.2 Exhaust gases from helicopter jet fuel combustion.	1.2.1 Use the helicopter only for crew transportation and emergency case	Onshore bases Drilling rig	Drilling phase	✓	Helicopter transportation of the project was used for only crew changed and emergency case as follow Medical Emergency Response Plan.	-	-
2. Seawater & Sediment Quality	2.1 Discharge of mud and cuttings into the sea could impact seawater and sediment quality.	2.1.1 Use of WBM with high biodegradability and low toxicity additives as main drilling fluid for all well sections.	Drilling rig	Drilling phase	✓	Seawater and WBM were the priority as drilling fluid at all wells. The mud circulation system was provided to circulate mud for recycling.	-	Figure 2-3 and Appendix D
	2.2 Discharge of cement could impact seawater quality.	2.2.1 For contingency and technical reason, SBM will be used with low toxicity biodegradable and non-persistent.	Drilling rig	Drilling phase	✓	SBM was used by technical reason. However, the mud circulation system was provided to circulate mud for recycling.	-	Figure 2-3 and Appendix D
		2.2.2 The discharge of cuttings shall be complied with Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (IFC, 2015).	Drilling rig	Drilling phase	✓	Chemical used and discharge of cutting were recorded by the project. This operation was complied with Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (IFC, 2015).	-	Figure 2-4

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		2.2.3 Discharge of cuttings will be 15 m below sea surface.	Drilling rig	Drilling phase	✓	Cutting was discharged at 15 m below sea surface as specify in the measure.	-	Figure 2-3
		2.2.4 Use of centrifuges, shale shakers and mud cleaners to separate out the cuttings from the mud.	Drilling rig	Drilling phase	✓	The mud circulation system was provided for separate cutting from mud which consist of centrifuges, shale shakers and mud cleaners.	-	Figure 2-3
		2.2.5 Drilling mud will be treated and then send back to the cycle in a continual circulation through the rig' s mud handling system: recycling of mud to minimize the quantity discharge to sea.	Drilling rig	Drilling phase	✓	The mud circulation system was provided to circulate mud for recycling.	-	Figure 2-3
		2.2.6 Optimization of the quantities of cement and the dosing of chemicals used.	Drilling rig	Drilling phase	✓	The quantities of cement and the dosing of chemicals used were optimized by project staffs to minimize waste for discharge.	-	Figure 2-4
		2.2.7 SDS available on the drilling rig	Drilling rig	Drilling phase	✓	SDS was provided at all chemical storage area of NCB Rig.	-	Figure 2-5, Figure 2-6 and Appendix D
	2.3 Chemical additives in the drilling fluid may impact seawater and sediment quality.	2.3.1 Chemicals shall be selected according to their low toxicity.	All project vessels	Drilling phase	✓	Low toxicity of chemical was used in this project. And SDS was provided to identify the toxic of chemical.	-	Figure 2-6 and Appendix D

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
	2.4 The Project will generate various types of hazardous and non-hazardous wastes. Inappropriate management (including transportation, storage and disposal) of waste will impact seawater quality.	2.4.1 Manage waste at offshore facilities in compliance with the requirements under MARPOL 73/ 78 and PTTEPI' s Waste Management Plan.						
		<ul style="list-style-type: none"> ● Hazardous Waste <ul style="list-style-type: none"> ○ Waste storage areas shall be clearly defined. 	Drilling rig	Drilling phase	✓	Waste containers were provided at NCB Rig. PTTEPI followed the requirements of MARPOL 73/ 78 and PTTEPI' s Waste Management Procedure.	-	Figure 2-7, Appendix E-1
		<ul style="list-style-type: none"> ○ Collected and stored in suitable containers that are protected from the environment (rain, wind, etc.). 	Drilling rig	Drilling phase	✓	Waste container was prepared at NCB Rig and supply vessel. All waste was collected in garbage bag before dispose in waste containers. Waste containers were covered to protect from the environment.	-	Figure 2-7, Figure 2-8 and Appendix E-2
		<ul style="list-style-type: none"> ○ The vessel deck shall be cleaned to minimize the impact from oil and chemical contamination into the sea during period of rain. 	Drilling rig	Drilling phase	✓	The vessel deck was regularly cleaned to minimize the impact from oil and chemical contamination into the sea during period of rain.	-	Figure 2-9
		<ul style="list-style-type: none"> ○ Containers equipped with means to contain any spills or leaks. 	Drilling rig	Drilling phase	✓	Waste container was prepared at NCB Rig and supply vessel. All waste was collected in garbage bag before dispose in waste containers. Waste containers were covered to protect from the environment.	-	Figure 2-7, Figure 2-8 and Appendix E-2

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		○ Transferred to an authorized disposal facility onshore by a certified transporter.	Drilling rig	Drilling phase	✓	The waste from NCB Rig and vessel was transferred to dispose onshore by authorized contractor.	-	Appendix E-4
		○ Prohibit any discharge of hazardous waste into the sea.	Drilling rig	Drilling phase	✓	Crew was prohibited to drop waste into the sea. Waste from NCB Rig and vessel were transferred to dispose at onshore by authorized contractor.	-	Figure 2-10 Appendix E-3
		<ul style="list-style-type: none"> ● Non-Hazardous Waste <ul style="list-style-type: none"> ○ Segregate non- hazardous waste, including food waste, paper, aluminum can, glass, rag and other wastes in separate containers or proper areas. 	Drilling rig	Drilling phase	✓	Non-hazardous waste was segregated to food waste, plastic, paper, can and glass as specify in PTTEPI' s Waste Management Procedure. Waste bin should separate properly with the type of waste.	-	Figure 2-7, Figure 2-8, Appendix E-1
		○ Waste storage areas shall be clearly defined.	Drilling rig	Drilling phase	✓	Waste container was already prepared at NCB Rig and supply vessel. All waste was collected in garbage bag before dispose in waste containers which were covered to protect from the environment.	-	Figure 2-7, Figure 2-8 and Appendix E-2
		○ Food wastes will be ground to 25 mm prior to discharge to sea. All non-food wastes will be collected for compaction and transport to shore for landfill or acceptable disposal.	Drilling rig	Drilling phase	✓	Food grinder was provided to grind the food waste to 25 mm prior to discharge to sea. Non- food waste was compacted before collected in waste container and transferred to dispose at onshore by authorized contractor.	-	Figure 2-11 and Figure 2-12

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		○ Dispose non-hazardous waste at onshore treatment facilities in accordance with the law of Myanmar and PTTEPI's Waste Management Plan.	Drilling rig	Drilling phase	✓	Non-hazardous waste was collected in the waste container and transferred to dispose at onshore by authorized contractor.	-	Figure 2-7, Figure 2-8 and Appendix E-3
		○ Transported to the onshore bases for collection and recycling by an authorized waste management contractor.	Drilling rig	Drilling phase	✓	Non-hazardous waste was collected in the waste container and transferred to dispose at onshore by authorized contractor.	-	Figure 2-7, Figure 2-8 and Appendix E-3
		○ Keep the record of waste inventories, including type and quantities updated.	Drilling rig	Drilling phase	✓	All waste inventories were recorded by project's staffs.	-	Figure 2-13 and Figure 2-14
3. Seabed characteristics	3.1 The pattern of seafloor sediment topography could be affected by discharge of drilling mud and cuttings.	3.1.1 Implement all mitigation measures in Item 2.	All project vessels Drilling rig	Drilling phase	✓	PTTEPI strictly implement and follow mitigation measures for impacts to seawater & sediment quality as shown in content 2.	-	-
4. Marine life and marine ecology	4.1 Offshore activities may disturb marine species.	4.1.1 Implement all mitigation measures in Item 2.	All project vessels Drilling rig	Drilling phase	✓	PTTEPI strictly implement and follow mitigation measures for impacts to seawater & sediment quality as shown in content 2.	-	-
	4.2 Drilling discharge may cause an impact on seawater and sediments, which may indirectly affect	4.1.2 Implement all mitigation measures in Item 2.	All project vessels Drilling rig	Drilling phase	✓	PTTEPI strictly implement and follow mitigation measures for impacts to seawater & sediment quality as shown in content 2.	-	-

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
	the community of marine biota at the surface level and the seabed.							
Social Mitigation Measures								
5. Fishing communities and fisheries	5.1 Reduced fishing area due to the presence of drilling rig and vessels, and 500 m exclusion zones.	5.1.1 Before drilling starts, PTTEPI will coordinate with MOGE, who will then issue "Notice to Mariner" regarding project activities to concerned parties (i.e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, Myanmar Navy, and Myanmar Fisheries Federation).	All project vessels Drilling rig	Drilling phase	✓	The project information and drilling plan were informed to all related organizations by PTTEPI before starting of drilling activity.	-	Appendix A-2
		5.1.2 An exclusion zone (radius of 500 m) will be established surrounding the drilling rig.	All project vessels Drilling rig	Drilling phase	✓	An exclusion zone (radius of 500 m) was already established surrounding the drilling rig.	-	Appendix C-6
		5.1.3 Use support vessels to warn off traffic.	All project vessels Drilling rig	Drilling phase	✓	Project has 2 support vessels for warning off traffic.	-	Figure 2-15
		5.1.4 Provide appropriate lights and warning signals at offshore facilities to prevent accidental collision.	All project vessels Drilling rig	Drilling phase	✓	Appropriate lights and warning signals were already provided around the NCB Rig and support vessels.	-	Figure 2-16 and Appendix C-4

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/Reference
	5.2 The quantity and quality of aquatic biota may decrease due to waste contamination in the sea. Contaminants may consist of non-hazardous and hazardous waste and mud and cuttings from drilling activities.	5.2.1 Implement all mitigation measures for Item 2 and 3 above.	All project vessels Drilling rig	Drilling phase	✓	PTTEPI strictly implement and follow mitigation measures for impacts to seawater & sediment quality and seabed characteristics as shown in content 2 and 3.	-	-
6. Shipping and navigation	6.1 Marine vessels may obstruct marine navigation during transporting the rig and equipment from onshore.	6.1.1 Before drilling starts, PTTEPI will coordinate with MOGE, who will then issue "Notice to Mariner" regarding project activities to concerned parties (i. e. Department of Fisheries, Ministry of Livestock, Fisheries and Rural Development, Myanmar Navy, and Myanmar Fisheries Federation).	All project vessels Drilling rig	Drilling phase	✓	The project information and drilling plan were informed to all related organizations by PTTEPI before starting of drilling activity. MOGE issued Notice to Mariner to concerned parties over 30 days in advance.	-	Appendix A-2
	6.2 The presence of the offshore facilities may obstruct navigation.	6.2.1 Use support vessels to warn off traffic.	All project vessels Drilling rig	Drilling phase	✓	Project has 2 support vessels for warning off traffic.	-	Figure 2-15
		6.2.2 Provide appropriate lights and warning signals at offshore facilities to prevent accidental collision.	All project vessels Drilling rig	Drilling phase	✓	Appropriate lights and warning signals were already provided around the NCB Rig and support vessels.	-	Figure 2-16 and Appendix C-4

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		6.2.3 An exclusion zone (radius of 500 m) will be established surrounding the drilling rig.	All project vessels Drilling rig	Drilling phase	✓	An exclusion zone (radius of 500 m) was already established surrounding the drilling rig.	-	Appendix C-6
7. Socio-economy	7.1 Increase in industrial expenditure and income (positive impact)	7.1.1 Enhance utilization of local goods and services as much as possible.	Onshore bases	Drilling phase	✓	Local goods and services such as local workers from contractor were added to work on rig during drilling period.	-	Figure 2-17
Health mitigation measures								
8. Occupational health and safety	8.1 Injuries or illness due to exposure to harmful substances or accident	8.1.1 Implement relevant components of PTTEPI's SSHE Management System, including the following:						
		<ul style="list-style-type: none"> Implement PTTEPI's Occupational Health Management Standard. 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	PTTEPI's Occupational Health Management Standard was already prepared and enforced the worker and contractor to implement.	-	-
		<ul style="list-style-type: none"> Personnel will be trained with the safe handling of the chemicals 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	All related staffs were already trained about safe handling of the chemicals according to PTTEPI Chemical handling.	-	-
		<ul style="list-style-type: none"> Personnel will be provided with the necessary personnel protective safety equipment. 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	Personnel protective equipments were already provided to all project's staffs.	-	Figure 2-18

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		<ul style="list-style-type: none"> Personnel will be provided with safety training to ensure that all workers practice under safety operation and regulation of work, as per PTTEPI' s SSHE Training & Competency Standard. 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	Safety training was provided for all project' staffs as follow PTTEP's SSHE Training and Competency Standard and Noble Global Training Matrix also.	-	Figure 2-19 and Appendix C-2
		<ul style="list-style-type: none"> Cooperate with the nearest health center/ hospital in order to immediately support response to emergency events, as per PTTEPI' s MERP. Duty Manager and Emergency Management Team for Medevac response or Medical Referral in case of emergency events. 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	The PTTEPI' s MERP was already provided. In case of emergency, the patients will transfer to the hospital in Yangon by helicopter.	-	-
		8.1.2 Implement following operational measures for prevention and control of accidents:						
		<ul style="list-style-type: none"> Safety Data Sheets must be provided with every chemical product for safety and the environment. 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	SDS was already provided at all chemical storage area.	-	Figure 2-6 and Appendix D

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		<ul style="list-style-type: none"> Adequate storage will be provided for each chemical in accordance with safety instruction (storage conditions, etc.). 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	Chemical storage area was provided adequately. SDS was attached at all chemical storage area. The condition of storage area was regularly inspected by project's staff.	-	Figure 2-5, Figure 2-6 and Appendix D
		<ul style="list-style-type: none"> Provide spill kits on-site. 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	Spill kits were already provided at NCB Rig.	-	Figure 2-20 and Appendix E-2
		<ul style="list-style-type: none"> Provide first aid kits on-site 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	First aid kits were already provided at NCB Rig	-	Figure 2-21
		<ul style="list-style-type: none"> Provide proper sanitary systems, including drinking water, potable water, toilet and waste management 	All project vessels Drilling rig Onshore bases	Drilling phase	✓	The sanitary systems such as drinking water, canteen, coffee corner, toilet and rest area were properly provided at NBC Rig.	-	Figure 2-22
	8.2 Injuries due to working in noisy areas.	<ul style="list-style-type: none"> Maintaining generators and compressors in good working order. 	All project vessels Drilling rig	Preparation and installation phase	✓	Routine inspection and preventive maintenance for all machinery were conducted as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project.	-	Figure 2-1, Figure 2-2 and Appendix C-1
		<ul style="list-style-type: none"> Provide personal protection equipment (ear plug for 	All project vessels Drilling rig	Preparation and	✓	At high noise level area, the noise protection equipment was already provided on site.	-	Appendix C-7

Table 2-1 Environmental Mitigation Measure Implementation Compliance Result Summary for Exporation Drilling in Block M11

Aspects	Potential Impacts	Mitigation Measures	Location	Duration	Status	Details	Recommendation	Remarks/ Reference
		instance) to workers working on high noise level activities.		installation phase				
9. Public health and Health service	9.1 Project activities could involve general public around shore bases that will be used for staff, materials and waste transportation.	9.1.1 Implement PTTEPI' s Occupational Health Management Standard.	Shore bases	Preparation and installation phase	✓	PTTEPI' s Occupational Health Management Standard was already prepared and enforced the worker and contractor to implement.	-	-
	9.2 In case of accident or illness during project activities, it may be required to use healthcare services around the shore bases.	9.2.1 Cooperate with the nearest health center/ hospital in order to immediately support response to emergency events, as per PTTEPI' s MERP. Duty Manager and Emergency Management Team for Medevac response or Medical Referral in case of emergency events.	Shore bases	Preparation and installation phase	✓	The PTTEPI' s MERP was already provided. In case of emergency, the patients will transfer to the hospital in Yangon by helicopter.	-	-

Table 2-2 Environmental Mitigation Measure Implementation Compliance Result Summary in Unplanned Events

Aspect	Potential Impact	Mitigation Measures	Location	Period/ Frequency	Status	Details	Recommendation	Remarks/ Reference
1. Vessel Collision	1.1 Collision could potentially occur during transport of material and rig tow-out.	1.1.1 Emergency Response Plan	All project vessels	Entire appraisal/ exploration activities	✓	The emergency response plan for vessel collision was already provided at NCB Rig as follow the PTTEPI Offshore Field Emergency Response Plan.	-	-
2. Accidental Spills	2.1 Accidental spills of drilling fluids, chemicals, or diesel fuel could occur throughout all project phases, and may directly affect surface water quality and indirectly affect sediment quality and marine ecology.	2.1.1 Emergency Response Plan	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The emergency response plan for accidental spills was already provided at NCB Rig as follow the PTTEPI Spill Contingency Plan.	-	-
		2.1.2 Oil Spill Contingency Plan shall be implemented and updated.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The Oil Spill Contingency Plan of NCB Rig was updated as follow PTTEPI Spill Contingency Plan.	-	-
		2.1.3 Perform current monitoring and incorporate data into oil spill contingency plan	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	Oil spill case will be monitoring and recording by project's staff. Currently, oil spill case was not found from project operation.	-	-
		2.1.4 Blowout preventer	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The BOP equipment was provided for blowout prevention during drilling activity. Moreover, the PTTEPI Blowout Contingency Plan was already provided.	-	-

Table 2-2 Environmental Mitigation Measure Implementation Compliance Result Summary in Unplanned Events

Aspect	Potential Impact	Mitigation Measures	Location	Period/ Frequency	Status	Details	Recommendation	Remarks/ Reference
3. Well Blowout	3.1 A blowout can result in the release of hydrocarbons into the sea and surrounding environment at high pressure, potentially impacting seawater/sediment quality, marine life and marine ecology, occupational health and safety and public health.	3.1.1 Requirements to have a Shipboard Oil Pollution Plan (SOPEP) in compliance with MARPOL 73/78.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The Spill kits and PTTEPI Spill Contingency Plan were already provided at NCB Rig according to MARPOL 73/78.	-	Figure 2-20, Appendix E-2
		3.1.2 On-board anti-pollution equipment.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The Spill kits, PTTEPI Spill Contingency Plan and PTTEPI Blowout Contingency Plan were already provided at NCB Rig according to MARPOL 73/78.	-	Figure 2-20, Appendix E-2
		3.1.3 On-going maintenance program to ensure equipment is in good working order.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	Routine inspection and preventive maintenance for all machinery were conducted as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project.	-	Figure 2-1, Figure 2-2 and Appendix C-1
		3.1.4 Risk assessment prior to maintenance works or lifting operations.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The lifting activity was performed as follow NCB Rigging and Lifting Operations. The lifting equipment was inspected as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project.	-	Figure 2-2, Appendix C-1 and C-5
		3.1.5 Training of personnel.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	Safety training was provided for all project' staffs as follow PTTEP's SSHE Training and Competency Standard and Noble Global Training Matrix also.	-	Appendix C-2

Table 2-2 Environmental Mitigation Measure Implementation Compliance Result Summary in Unplanned Events

Aspect	Potential Impact	Mitigation Measures	Location	Period/ Frequency	Status	Details	Recommendation	Remarks/ Reference
4. Tropical Cyclone	4.1 Potential threat to the safety of offshore personnel and could result in multiple facilities and damage to assets.	4.1.1 Training of personnel.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The emergency response plan for tropical cyclone was already provided at NCB Rig as follow the PTTEPI Tropical Cyclone Procedure. The emergency drill for tropical cyclone response was already trained to all staff.	-	Figure 2-23
5. Fire or Explosion	5.1 Fire or explosion could potentially impact air quality, health and safety concerns to PTTEPI' s employees and contractors, and damages structures.	5.1.1 High integrity design safety system	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The fire fighting equipments were already provided around the operation and living area. The fire plan was attached on both of operation and living area Emergency plan for fire or explosion was already provided. Moreover, emergency drill was performed regularly.	-	Figure 2-23, Figure 2-24 Appendix C-3
		5.1.2 Conduct regular inspections and drills for fire protection equipment	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	Routine inspection and preventive maintenance for all machinery were conducted as follow yearly PM and Inspection Plan. Emergency plan for fire or explosion was already provided. Moreover, emergency drill was performed regularly.	-	Figure 2-1, Figure 2-23, Figure 2-24
		5.1.3 Provide fire protection equipment, including fire extinguishers and alarms, on all offshore facilities.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	The fire fighting equipments were already provided around the operation and living area The fire plan was attached on both of operation and living area.	-	Figure 2-24 and Appendix C-3
		5.1.4 Emergency Response Plan and Crisis Management Plan.	All project vessels Drilling rig	Entire appraisal/ exploration activities	✓	Emergency plan for fire or explosion and crisis management plan were already provided. Moreover, emergency drill was performed regularly.	-	-



Figure 2-1 Inspection tag on equipment

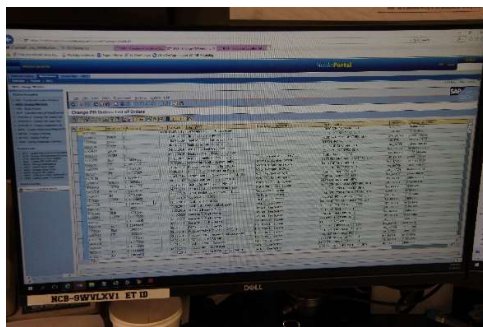
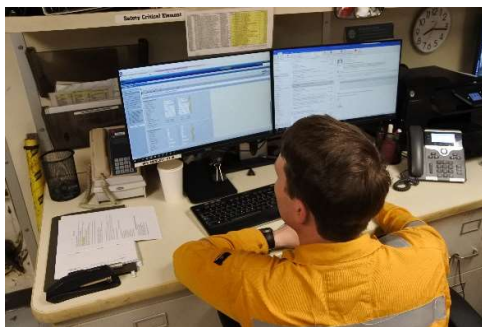


Figure 2-2 Display of SAP System (PM Planning System)

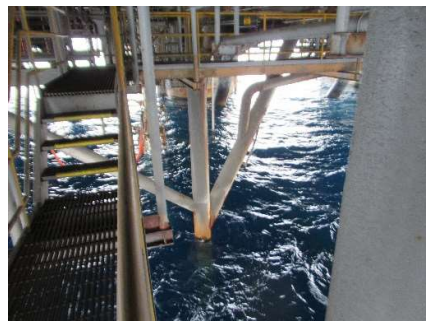


Figure 2-3 Mud Circulation System

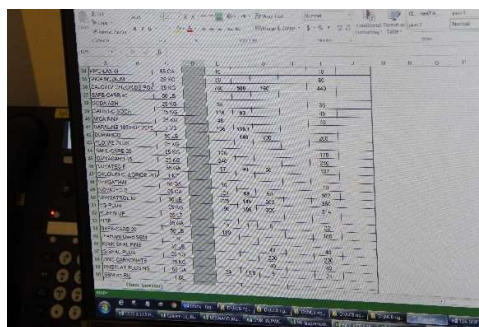


Figure 2-4 Display to show the record of chemical used



Figure 2-5 Chemical Storage Area at NCB Rig

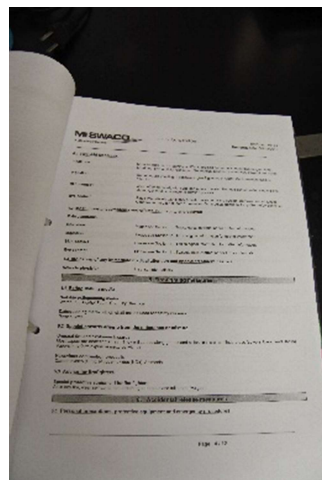
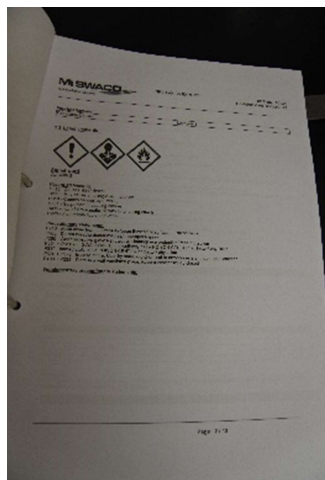


Figure 2-6 Provided SDS at Chemical Storage Area



Figure 2-7 Waste Containers around NCB Rig



Figure 2-7 Waste Containers around NCB Rig (Cont.)



Figure 2-8 Hazardous waste identify sticker on containers

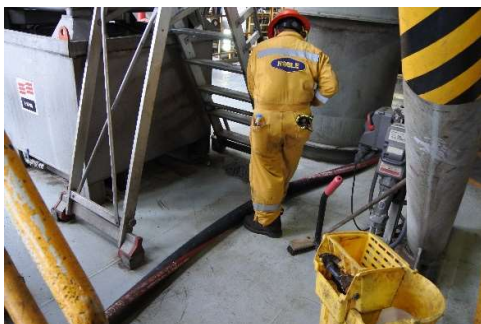


Figure 2-9 Vessel Deck Cleaning by Staffs



Figure 2-10 Warning sign to stop dropped objects




Figure 2-11 Food Grinder



Figure 2-12 Waste Compactor Machine

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Figure 2-13 Garbage Record Book

<div style="text-align: center;">  Maternity, Women Transport Voucher </div>				<div style="text-align: right;">Page No. _____ of _____</div>	
Instructions: Maternity, Women Transport Voucher is to be submitted to the District Magistrate (D.M.)					
1. The Voucher is to be filled up by the <u>Wife</u>					
2. The Voucher is to be filled up by the <u>Wife</u>					
3. The Voucher is to be filled up by the <u>Wife</u>					
Receipt of Medical Facilities					
1. Name of the Hospital/Clinic _____					
2. Date of Admission _____					
3. Name of the Doctor _____					
4. Name of the Patient _____					
Particulars					
1. Name _____		2. Date of Admission _____		3. Date of Discharge _____	
4. Name of the Doctor _____		5. Name of the Patient _____		6. Name of the Hospital/Clinic _____	
Type and Amount of Medical Transport					
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Figure 2-14 Disposal Waste Record



Figure 2-15 Support Vessel of the project



Figure 2-16 Lighting System around NCB Rig



Figure 2-17 Local Goods supply were used by project

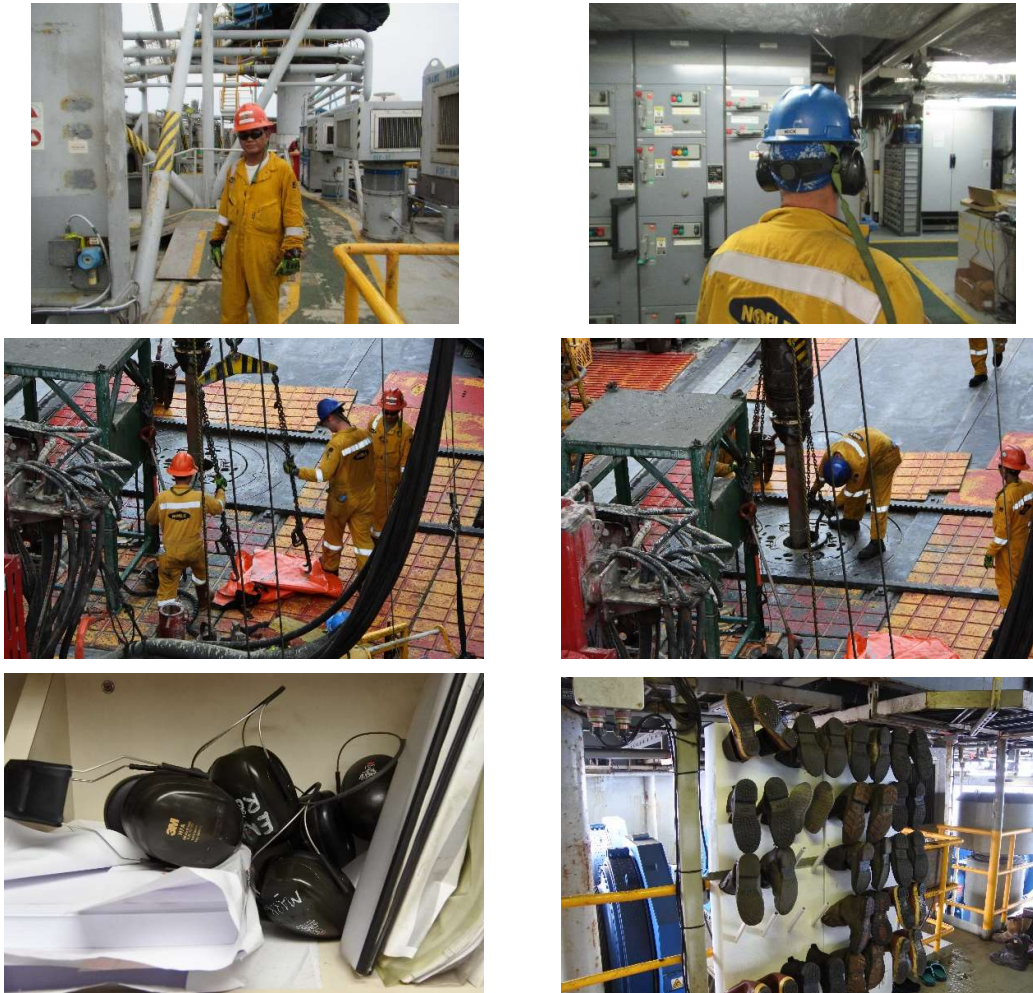


Figure 2-18 Project Staffs wear provided properly PPE

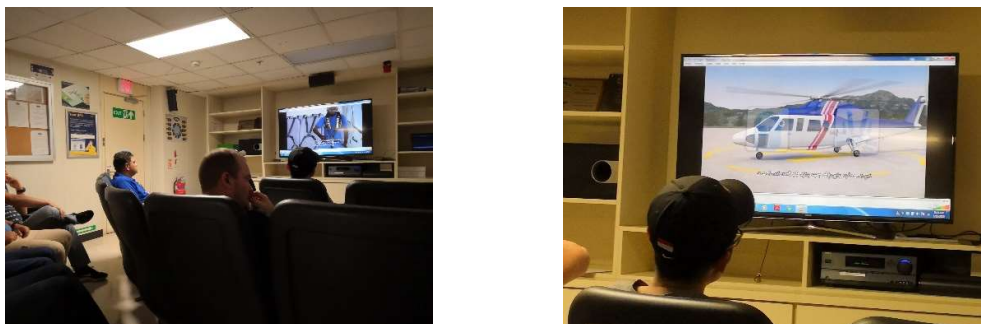


Figure 2-19 Safety Induction Programme for arrival person at NCB Rig



Figure 2-20 Spill kits on NCB Rig



Figure 2-21 First Aid kits on NCB Rig



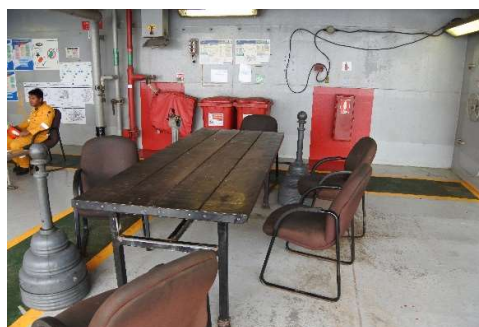
Rest Room



Toilet



Changing Room & Locker



Smoking Area



Conference Room

Figure 2-22 Provided facilities on NCB Rig



Laundries Service

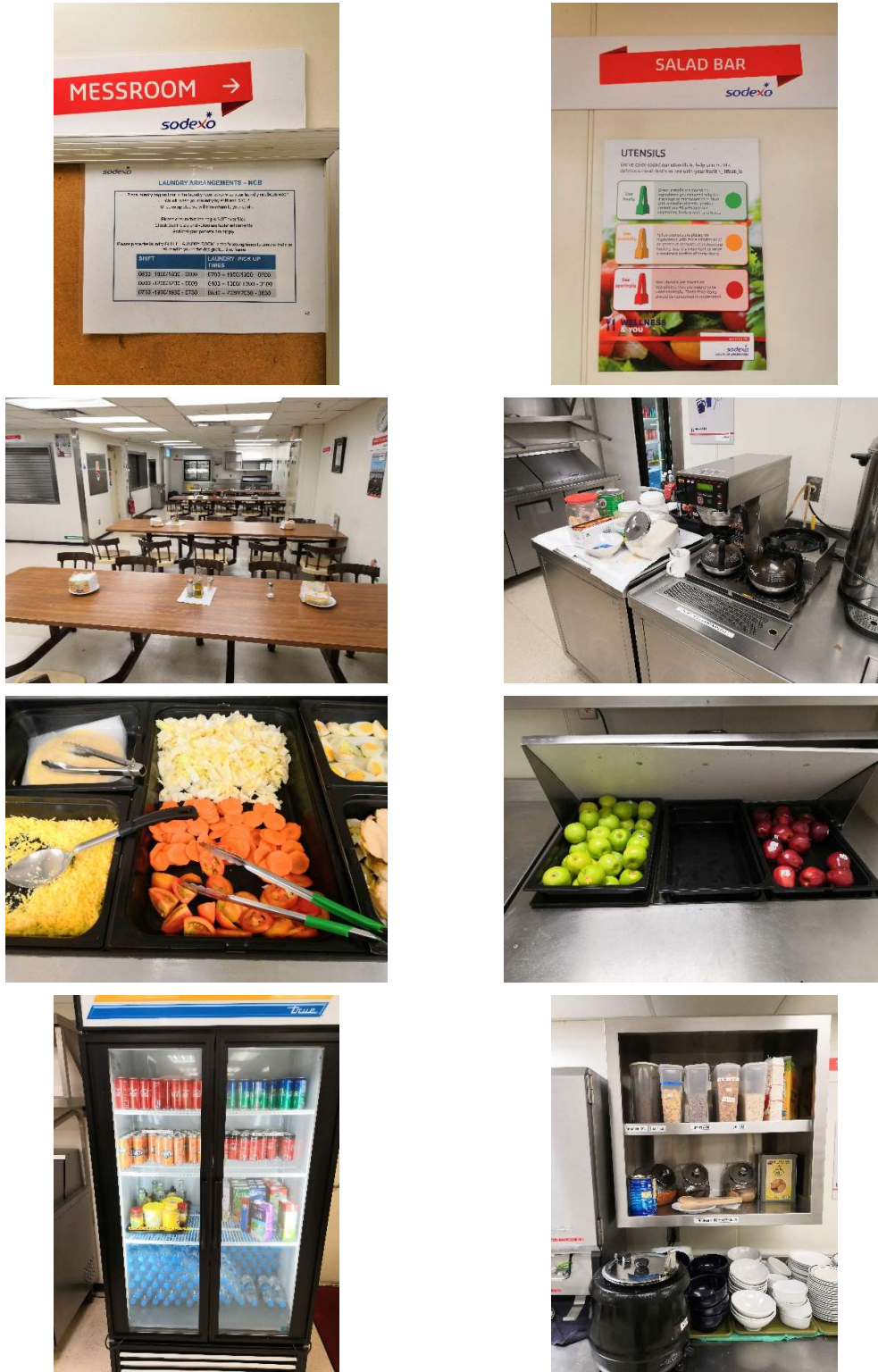


Gym Room



Video Room

Figure 2-22 (Cont.) Provided facilities on NCB Rig



Mess Room

Figure 2-22 (Cont.) Provided facilities on NCB Rig

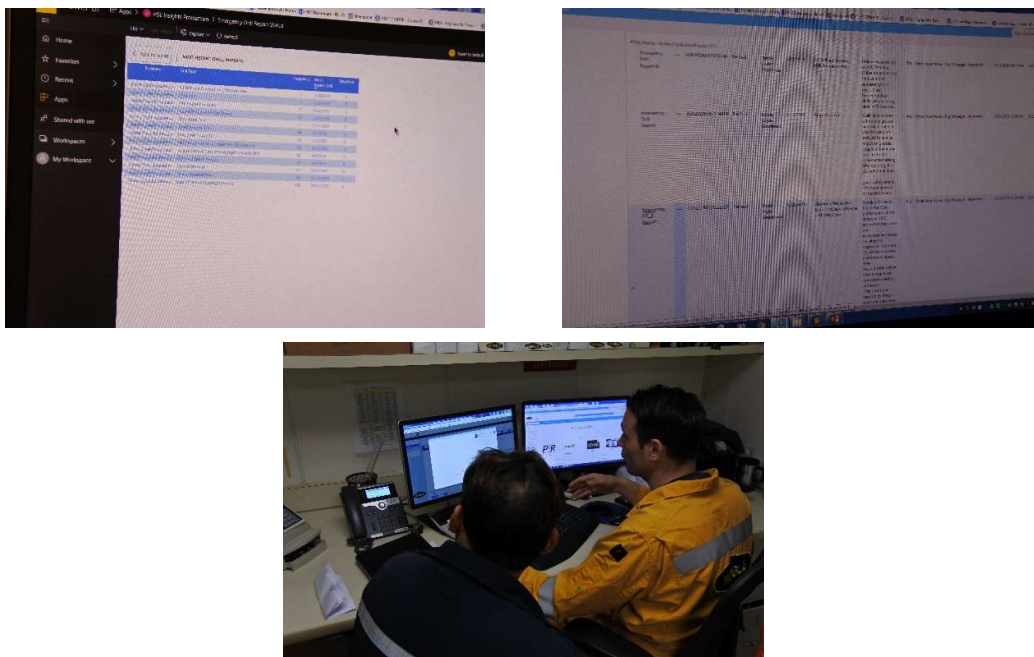


Figure 2-23 Display to show emergency drill record



Fire Fighting Equipment

Figure 2-24 Emergency equipment on NCB RIG



Fire Fighting Equipment

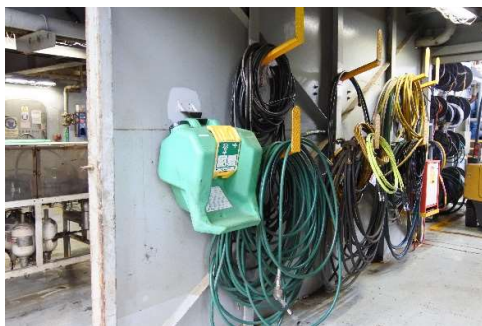


Alarm and Detector

Figure 2-24 (Cont.) Emergency equipment on NCB RIG



Alarm and Detector

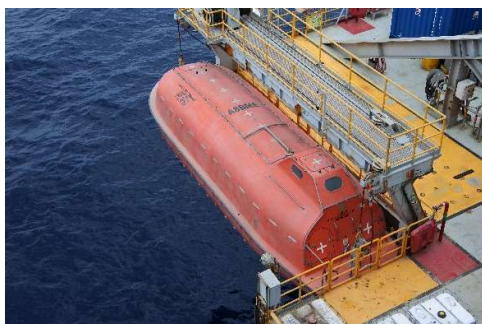


Emergency Equipment

Figure 2-24 (Cont.) Emergency equipment on NCB RIG

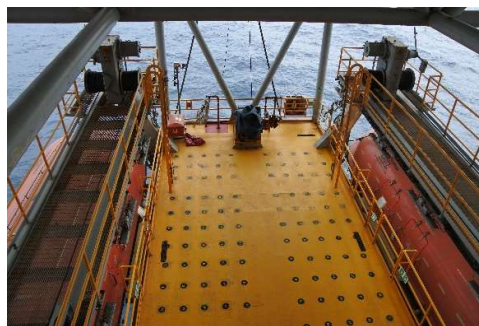


Emergency Equipment



Life Saving Equipment

Figure 2-24 (Cont.) Emergency equipment on NCB RIG



Life Saving Equipment

Figure 2-24 (Cont.) Emergency equipment on NCB RIG

Chapter 3

Environmental Monitoring Results

Chapter 3

Environmental Monitoring Results

Environmental monitoring was conducted as specify in EIA which the project has assigned REM-UAE Laboratory and Consultant Company Limited to performed the environmental monitoring. This chapter presents the environmental monitoring results of Exploration Drilling in Block M11, the detail is presented as follow;

3.1 Environmental Monitoring Plan

Environmental monitoring plan for Exploration Drilling in Block M11 has been implemented with 100% compliance as shown in Table 3-1.

Table 3-1 Environmental Monitoring Plan for Exploration Drilling in Block M11

Environmental Quality	Parameter	Period/Frequency	Location	Implemented	
				Complied	Not complied
1. Mud and cuttings (WBM)	Parameters required by NEQG to be analysed: <ul style="list-style-type: none"> Chloride (for WBM) 	Once during drilling at each well	At each potential well location ; <ul style="list-style-type: none"> Sampling from Chemical Storage Area at NCB Rig. 	WBM was not used in this Section	-
2. Cuttings (SBM)	Parameters required by NEQG to be analysed: <ul style="list-style-type: none"> Oil on Cuttings (for SBM) 	Once during drilling at each well	At each potential well location ; <ul style="list-style-type: none"> Sampling from NCB Rig. 	<ul style="list-style-type: none"> Monitored by REM-UAE Laboratory and Consultant Co.,Ltd. The result as shown in Content 3.2.4. 	-
			<ul style="list-style-type: none"> PWC-1, 12-1/4" x 19" Section TD (Cutting) 	<ul style="list-style-type: none"> April 25, 2019 	-
			<ul style="list-style-type: none"> PWC-1, 14-3/4" x 17-1/2" Section TD (Cutting) 	<ul style="list-style-type: none"> May 4, 2019 	-
			<ul style="list-style-type: none"> 12-1/4" PWC-1 (Cutting) 	<ul style="list-style-type: none"> May 22, 2019 	-
			<ul style="list-style-type: none"> 8-1/2" PWC-1 (Cutting) 	<ul style="list-style-type: none"> June 4, 2019 	-
3. Stock Barite	Parameters required by NEQG to be analysed: <ul style="list-style-type: none"> Mercury (in stock Barite) Cadmium (in stock Barite) 	Once during drilling at each well	At each potential well location ; <ul style="list-style-type: none"> Sampling from Chemical Storage Area at NCB Rig : PWC-1, 12-1/4" x 19" Section TD 	<ul style="list-style-type: none"> Monitored by REM-UAE Laboratory and Consultant Co.,Ltd on April 25, 2019. The result as shown in Content 3.2.4. 	-
4. Sewage	Parameters required by NEQG to be analysed (as per MARPOL 73/78): <ul style="list-style-type: none"> Total Coliform Bacteria BOD COD pH 	Once every 6 months	At NCB Rig ; <ul style="list-style-type: none"> Sampling from sewage water treatment system discharge point. 	<ul style="list-style-type: none"> Monitored by REM-UAE Laboratory and Consultant Co.,Ltd on May 15, 2019. The result as shown in Content 3.3.4. 	-

3.2 Cutting and Stock Barite Monitoring

Cutting and Stock Barite monitoring at NCB Rig as specified in EMP was conducted by REM-UAE Laboratory and Consultant Company Limited for Exploration Drilling in Block M11. The detail as shown in Table 3-2.

Table 3-2 Cutting and Stock Barite Monitoring Plan

Environmental Quality	Parameter	Location	Period
Cutting and Stock Barite	1. Oil on Cuttings (for SBM)	Sampling from NCB Rig.	
		- PWC-1, 12-1/4" x 19" Section TD (Cutting)	April 25, 2019
		- PWC-1, 14-3/4" x 17-1/2" Section TD (Cutting)	May 4, 2019
		- 12-1/4" PWC-1 (Cutting)	May 22, 2019
		- 8-1/2" PWC-1 (Cutting)	June 4, 2019
	2. Mercury (in stock Barite) 3. Cadmium (in stock Barite)	Sampling from Chemical Storage Area at NCB Rig : PWC-1, 12-1/4" x 19" Section TD (Stock barite)	April 25, 2019

3.2.1 Cutting and Stock Barite Monitoring Method

Details of Cutting and Stock Barite monitoring including parameters and analysis methods are shown in Table 3-3.

Table 3-3 Parameters and Analysis Methods for Cutting and Stock Barite Monitoring

Parameter	Analysis Method ^{1/}
1. Oil on Cuttings (for SBM)	Soxhlet Extraction Method
2. Mercury (in stock Barite)	Acid Digestion and Cold Vapour AAS Method
3. Cadmium (in stock Barite)	Acid Digestion and Direct Air-Acetylene Flame Method

Remark: ^{1/}U.S.EPA = Test Methods Evaluating Solid Waste, Physical/Chemical Methods (SW 846),
United States Environmental Protection Agency
BS = British Standard Method

3.2.2 Preservation Methods

All samples were preserved with specific procedure and storage as shown in Table 3-4.

Table 3-4 Monitoring parameter, container and preservation method for Cutting and Stock Barite

Parameter	Container	Preservation Method ^{1/}
1. Oil on Cuttings (for SBM)	Polyethylene Bottle 500 mL	Refrigerate $\leq 6^{\circ}\text{C}$
2. Mercury (in stock Barite)	Polyethylene Bottle 500 mL	Refrigerate $\leq 6^{\circ}\text{C}$
3. Cadmium (in stock Barite)	Polyethylene Bottle 500 mL	Refrigerate $\leq 6^{\circ}\text{C}$

Remark: ^{1/}U.S.EPA = Test Methods Evaluating Solid Waste, Physical/Chemical Methods (SW 846),
United States Environmental Protection Agency
BS = British Standard Method

3.2.3 Cutting and Stock Barite Monitoring Results

- Oil on Cuttings (for SBM)

Drilled cutting samples were collected by project staff and concentration of oil on cutting (OOC) was analyzed. The results of oil on cutting are in range of 1.46 – 2.82% OOC (dry weight) which meet the control limit of 6.9%, refer to IFC EHS Offshore Oil and Gas Guideline) for Existing Facilities. The monitoring result was shown in Table 3-5.

Table 3-5 The Results of Oil on Cutting Monitoring

Station	Date	Oil on Cuttings (for SBM) %OOC (dry weight)	Sample Condition
1. PWC-1, 12-1/4" x 19" Section TD (Cutting)	April 25, 2019	2.82	Brown Cutting
2. PWC-1, 14-3/4" x 17-1/2" Section TD (Cutting)	May 4, 2019	2.23	Brown Cutting
3. 12-1/4" PWC-1 (Cutting)	May 22, 2019	1.46	Brown Cutting
4. 8-1/2" PWC-1 (Cutting)	June 4, 2019	1.54	Brown Cutting
Guideline ^{1/}		6.9	-

Remark: ^{1/} Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (IFC, 2015).

- Total Mercury and Total Cadmium in stock barite

Stock Barite was collected by project staff. Total mercury and total cadmium (in stock barite) was analysed, The results found that total Mercury (in stock barite) was 0.452 mg/kg (dry weight) and total Cadmium (in stock Barite) was ND. When compared the results with National Environmental Quality (Emission) Guidelines found that total mercury and total cadmium (in stock barite) at PWC-1, 12-1/4" x 19" Section TD was complied with the standard. The monitoring results as shown in Table 3-6.

The analysis results, certificate for laboratory instrument and approval registration certificate of laboratory are shown in Appendix F, G and H.

Table 3-6 The Results of Total Mercury and Total Cadmium in Stock Barite Monitoring

Station	Date	Total Mercury (in stock Barite) mg/kg (dry weight)	Total Cadmium (in stock Barite) mg/kg (dry weight)	Sample Condition
1. PWC-1, 12-1/4" x 19" Section TD (Stock Barite)	April 25, 2019	0.452	ND	Gray Powder
Guideline^{2/}		1	3	-

Remark: ^{1/} National Environmental Quality (Emission) Guidelines.

3.3 Sewage Monitoring

Sewage monitoring was conducted by REM-UAE Laboratory and Consultant Company Limited on May 15, 2019 from sewage water treatment system discharge point at NCB Rig. The detail as shown in Table 3-7.

Table 3-7 Sewage Monitoring Plan

Environmental Quality	Parameter	Location	Period
Sewage	<ul style="list-style-type: none"> Total Coliform Bacteria BOD COD pH 	Sewage water treatment system discharge point at NCB Rig.	May 15, 2019

3.3.1 Sewage Analysis Method

Details of sewage monitoring including parameters and analysis methods are shown in Table 3-8.

Table 3-8 Parameters and Analyses Methods for Sewage water Quality Monitoring

Parameter	Analysis Method ^{1/}
1. Total Coliform Bacteria	Multiple Tube Fermentation Technique (SM : 9221 B)
2. BOD	Membrane Electrode Method (SM : 5210 B and 4500-O G)
3. COD	Closed Reflux, Titrimetric Method (SM : 5220 C)
4. pH	Electrometric Method at Site (SM : 4500-H+ B)

Remark: ^{1/} Based on Standard Methods for the examination of water and wastewater, APHA, AWWA, WEF, 23rd edition, 2017

3.3.2 Preservation Methods

All samples were preserved with specific procedure and storage as shown in Table 3-9.

Table 3-9 Container and Preservation Methods of Sewage water Monitoring

Parameter	Container	Preservation Methods*
1. Total Coliform Bacteria	Sterile, Brown Glass Bottle 150 mL	Add 10% Na ₂ S ₂ O ₃ 0.1 mL/100 mL and Refrigerate at < 10 °C (above freezing point of water)
2. BOD	Polyethylene Bottle 1 L	Refrigerate at >0°C, ≤6 °C
3. COD	Glass Bottle 250 mL	Add H ₂ SO ₄ to pH<2 and Refrigerate at >0 °C, ≤6 °C
4. pH	-	Measuring at Site

Remark: * Based on Standard Methods for the examination of water and wastewater, APHA, AWWA, WEF, 23rd edition, 2017

3.3.3 Sewage Water Monitoring Result

Sewage sample was conducted at NCB rig on May 15, 2019 for Exploration Drilling in Block M11. The result found that BOD complied with MEPC.159 (55), except pH, COD and Total Coliform Bacteria.

However, the sewage treatment unit has been inspected periodically, the performance of sewage treatment system have to be considered and improved to ensure that all parameters will meet the control limit as per Sewage Pollution Prevention Certificate (Appendix C-10). The sewage water monitoring results are shown in Table 3-10.

The analysis results, certificate for laboratory instrument and approval registration certificate of laboratory are shown in Appendix F, G and H.

Table 3-10 Results of Sewage Monitoring at NCB Rig

Parameter	Unit	The Results of Sewage Quality	Guideline ^{1/}	Detection Limit
		SEWAGE WATER at NCB Rig (May 15, 2019)		
Total Coliform Bacteria	MPN/100 ml	>160,000	100	1.8
BOD	mg/L	11.2	25	2.0
COD	mg/L	256	125	25.0
pH	S.U. ^a	8.6 (25°C)	6-8.5	-
Sample condition				
Water's Colour/Turbid	-	Yellow/Turbid	-	-
Sediment	-	Yellow	-	-

Remark: ^{1/} Resolution of the Marine Environment Protection Committee MEPC.159 (55)

Chapter 4

Environmental Mitigation Measures

Compliance Audit and

Environmental Monitoring Conclusion

Chapter 4

Environmental Mitigation Measures Compliance Audit and Environmental Monitoring Conclusion

From the implementation of Environmental Mitigation Measures Compliance Audit and Environmental Monitoring of Exploration Drilling in Block M11, it was found that the project has implemented the measures as specified in EIA.

Audit and document checking by setting 4 levels of evaluation as follows;

- Completely complied on the Mitigation Measures (✓) refers the project can complete comply with the measure without any barriers.
- Mostly complied on the Mitigation Measures (✓) refers the project can mostly comply with the measure without any barriers.
- Do not complied on the Mitigation Measures (✗) refers the project cannot comply with the measure because of some barriers.
- Do not have situation follows the Mitigation Measures (NA) refers during the project operations do not have any of situation follow the Mitigation Measures

Although the project does not comply with the mitigation measures, REM-UAE Laboratory and Consultant Company Limited will identify the cause of problems, barriers and solutions ways. And the results can be summarized as follows.

4.1 Environmental Mitigation Measures Compliance Audit Conclusion

4.1.1 Environmental Mitigation Measures Compliance Result in Drilling Phase

- **Air Quality / GHG emissions** - Routine inspection and preventive maintenance for all machinery were conducted as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project. Helicopter transportation of the project was used for only crew changed and emergency case as follow Zawtika Medical Emergency Response Plan.
- **Seawater & Sediment Quality** - Seawater and WBM were the priority as drilling fluid at all wells. The mud circulation system was provided to circulate mud for recycling. SBM was used by technical reason. Chemical used and discharge of cutting were recorded by the project. Cutting would be discharged at 15 m below sea surface. The quantities of cement and the dosing of chemicals used were optimized by project staffs to minimize waste for discharge. SDS was provided at all chemical storage area of NCB Rig. Low toxicity of chemical was used in this project. And SDS was provided to identify the toxic of chemical.

Waste containers were provided at NCB Rig and supply vessel. All waste was collected in garbage bag before drop in waste containers. Waste containers were covered to protect from the environment. The waste from NCB Rig and vessel was transferred to dispose onshore by authorized contractor. PTTEPI followed the requirements of MARPOL 73/78 and PTTEPI's Waste Management Procedure. The vessel deck was regularly cleaned to minimize the impact from oil and chemical contamination into the sea during period of rain. Crew was prohibited to drop waste into the sea. Food grinder was provided to grind the food waste to 25 mm prior to discharge to sea.
- **Seabed characteristics and Marine life and marine ecology** - PTTEPI strictly implement and follow mitigation measures for impacts to seawater & sediment quality.

- **Fishing communities and fisheries and Shipping and navigation** - The project information and drilling plan were informed to all related organizations by PTTEPI before starting of drilling activity. An exclusion zone (radius of 500 m) was already established surrounding the drilling rig. Project has 2 support vessels for warning off traffic. Appropriate lights and warning signals were already provided around the NCB Rig and support vessels.
- **Socio-economy** - Local goods and services such as local workers from contractor were added to work on rig during drilling period.
- **Occupational Health and Safety** - PTTEPI's Occupational Health Management Standard was already prepared and enforced the worker and contractor to implement. All related staffs were already trained about safe handling of the chemicals as follow PTTEPI Chemical handling. Personnel protective equipment were already provided to all project's staffs.

Safety training was provided for all project's staffs as follow the PTTEPI SSHE Training and Competency Standard and Noble Global Training Matrix. The PTTEPI's MERP was already provided. In case of emergency, the patients will transfer to the hospital in Yangon by helicopter.

Chemical storage area was provided adequately. SDS was attached at all chemical storage area. The condition of storage area was regularly inspected by project's staff. Spill kits and first aid kits were already provided at NCB Rig. The sanitary systems such as drinking water, canteen, coffee corner, toilet and rest area were properly provided at NBC Rig.

At high noise level area, the noise protection equipment was already provided on site.

- **Public health and Health service** - PTTEPI's Occupational Health Management Standard was already prepared and enforced the worker and contractor to implement. The PTTEPI's MERP was already provided. In case of emergency, the patients will transfer to the hospital in Yangon by helicopter.

The results determined that the project completely complied on the environmental mitigation measures implementation compliance in Drilling Phase with 100%. The results are shown in Figure 4-1.

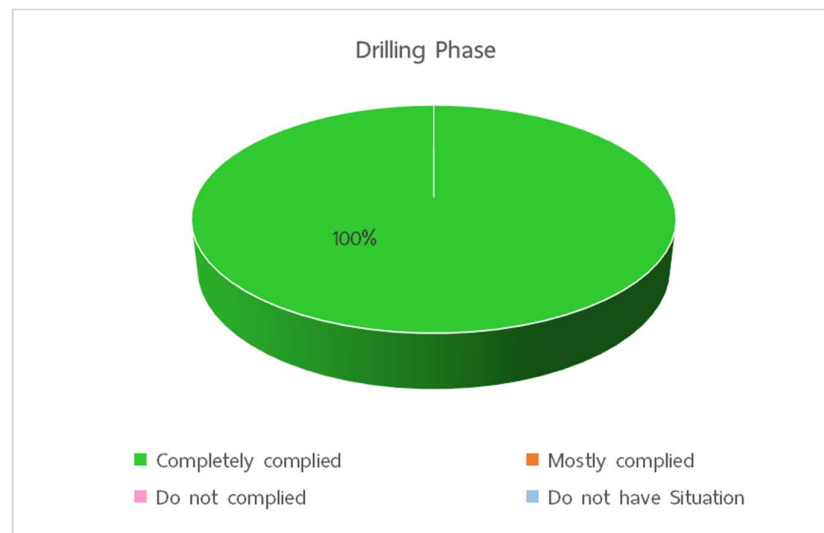


Figure 4-1 The Results of Environmental Mitigation Measures Compliance during Drilling Phase

4.1.2 Environmental Mitigation Measures Compliance Result in Unplanned Events

- **Vessel collision** - The emergency response plan for vessel collision was already provided at NCB Rig as follow the PTTEPI Zawtika Offshore Field Emergency Response Plan.
- **Accidental Spills** - The emergency response plan for accidental spills was already provided at NCB Rig as follow the PTTEPI Spill Contingency Plan. Oil spill case will be monitoring and recording by project's staff. Currently, oil spill case was not found from project operation. The BOP equipment was provided for blowout prevention during drilling activity. Moreover, the PTTEPI Blowout Contingency Plan was already provided.
- **Well blowout** - The Spill kits, PTTEPI Spill Contingency Plan and PTTEPI Blowout Contingency Plan were already provided at NCB Rig as follow MARPOL 73/78. The lifting activity was performed as follow NCB Rigging and Lifting Operations. The lifting equipment was inspected as follow yearly PM and Inspection Plan. SAP system was used to support for the PM plan of this project. Safety training was provided for all project's staffs as follow the PTTEPI SSHE Training and Competency Standard.
- **Tropical cyclone** - The emergency response plan for tropical cyclone was already provided at NCB Rig as follow the PTTEPI Tropical Cyclone Procedure. The emergency drill for tropical cyclone escape was already trained to all staff.
- **Fire or Explosion** - The firefighting equipments were already provided around the operation and living area. The fire plan was attached on both of operation and living area. Emergency plan for fire or explosion was already provided. Moreover, emergency drill was performed regularly.

The results determined that the project completely complied on the environmental mitigation measures implementation compliance in unplanned event with 100%. The results are shown in Figure 4-2.



Figure 4-2 The Results of Environmental Mitigation Measures Compliance in Unplanned Events

4.2 Environmental Monitoring Conclusion

4.2.1 Cutting and Stock Barite Monitoring

- **Oil on Cuttings (for SBM)**

Drilled cutting samples were collected by project staff and concentration of oil on cutting (OOC) was analyzed. The results of oil on cutting are in range of 1.46 – 2.82% OOC (dry weight) which meet the control limit of 6.9%, refer to IFC EHS Offshore Oil and Gas Guideline) for Existing Facilities. In addition, the sample of mud were collected and analyzed just for further reference by company.

- **Total Mercury and Total Cadmium in Stock Barite**

Stock Barite was collected by project staff in April 2019. Total mercury and total cadmium (in stock barite) was analysed, The results found that total Mercury (in stock barite) was 0.452 mg/kg (dry weight) and total Cadmium (in stock Barite) was ND. When compared the results with National Environmental Quality (Emission) Guidelines found that total mercury and total cadmium (in stock barite) at PWC-1, 12-1/4" x 19" Section TD was complied with the standard.

4.2.2 Sewage Monitoring

Sewage monitoring was conducted by REM-UAE Laboratory and Consultant Company Limited on May 15, 2019 from sewage water treatment system discharge point at NCB Rig. The result found that BOD complied with MEPC.159 (55), except pH, COD and Total Coliform Bacteria.

The performance of sewage treatment system have to be considered and improved to ensure that all parameters will meet the control limit as per Sewage Pollution Prevention Certificate.

The results of Environmental Monitoring determined that the project completely complied with 100% as shown in Figure 4-3.

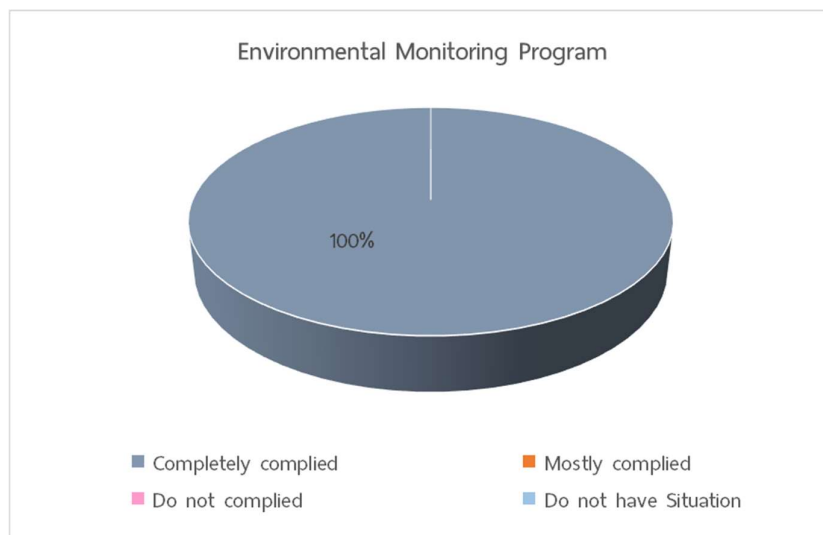


Figure 4-3 The Results of Environmental Monitoring