

2.0 PROJECT DESCRIPTION

2.1 Introduction

This chapter presents the project information including technical details of the proposed drilling operations, utilities and services, infrastructure facilities and sources of pollution. The expected quantum of the waste generation and treatment and safe disposal of the waste are also discussed in the chapter.

2.2 Type of the Project

The exploratory drilling operation involves drilling of holes through various sub-surface layers (geological formations) to predetermined depth of potential hydrocarbon reserves that are identified through interpretation of seismic data.

The typical flow of events in planning and executing an exploratory well drilling activity comprises of the following steps:

- Site selection & acquisition;
- Site preparation;
- Pre-drilling activities like mobilising and commissioning rig;
- Drilling activities;
- Well testing;
- Well site abandonment and suspension phase; and
- Well site restoration in case of non-discovery of hydrocarbons.

Exploratory drilling is a temporary activity which lasts for about 4-5 months days for each well in the block.

2.3 Need for Exploratory Drilling

ONGC proposes to drill 3 nos of exploratory wells at selected area through seismic survey to identify and establish hydrocarbon potential. As exploration within the basin is still in its early stages, each new penetration aids in determining the basins stratigraphic architecture. The objective of exploratory drilling is to more definitively ascertain the oil reserves in the block, which then can be progressed to the development phase. The locations will vary, depending on the progressive exploration drilling results.

ONGC has identified three well locations HOAC, HOAD and BRBAA are included in present EIA study.

2.4 Project Location and Layout Details

It is proposed to drill 3 nos of exploratory wells in the NELP Block of Mizoram district. The proposed exploratory well sites has been identified based on the study and interpretation of the stratigraphy and seismic data. Within the identified location, the actual well drilling sites will be located based on the following consideration:

- Located at a safe distance from the nearest village habitat;
- Located at least the height of the well mast away from public road;
- Safe distances from any radio transmitters so that the use of explosives, if required and detonators may proceed without the danger of external activation;
- Located at least 300 – 500 m away from rivers and natural water bodies;
- Ensure natural drainage channels are avoided or drainage channels rerouted to ensure unhindered flow of rain / flood water. Where necessary adequate erosion control measures will be provided; and
- Located in a manner to avoid mature jungles and reserve forests.

The tentative well locations falling in the NELP on-shore block in Kolasib and Mamit district, Mizoram are given in **Table-2.1**.

**TABLE-2.1
TENTATIVE WELL LOCATIONS**

Sr. No	Proposed Location	Block Coordinates (WGS-84)	
		Latitude	Longitude
1	HOAC	24 ^o 12' 14.24"	92 ^o 35' 53.32"
2	HOAD	24 ^o 09' 41.42"	92 ^o 36' 13.31"
3	BRBAA	24 ^o 07' 10.08"	92 ^o 31' 06.77"

All practicable means shall be taken to minimize or avoid detrimental effects on the surrounding environment by virtue of the construction of the location or the operation of the drilling rig.

The above locations have been fixed by ONGC so that least possible effect may be felt by the surrounding environment and habitation due to the proposed exploratory drilling activities.

The exploratory well drilling is a short duration activity and after the well testing is completed, the drill site is restored to near original conditions.

2.4.1 Typical Well Site Details

The site will be sized to contain all equipment and buildings, storage, workshops, etc. using distances between various rig components in line with existing rules and regulations for the area of operation and the approved standard operating procedures of the drilling contractor. Within the above constraints, the site shall be sized to minimize environmental impact. The approximate area of well site is dependent on the type of drilling equipment deployed which in turn is dictated by the planned depth of drilling. Minimum land required at each well site during drilling will be 125 m x 125 m, i.e., 1.56 ha. On an average, the land requirement at each well site, including site facilities and camp site is considered as 1.5-2.25 ha.

About 2.5 hectare land for each well will be acquired on lease. The typical layout of the well site with ancillary structures is provided in **Figure-2.1**.

Each exploratory well drill site will require the following facilities:

- Portable office cabins / rest rooms (container type cubicles);
- Drilling rig foundation and celler;
- Foundation / Pits for ancillary equipments;
- Space for drill rig equipment, working area and materials lay down area;
- Waste storage pits;
- Cutting disposal (impervious lined) pits;
- Waste storage pit;
- Septic tank with soak away pits;
- Paved and contained chemical storage area;
- Above ground Diesel storage tanks with paved and bunded area;
- Radio room;
- Storm water drainage system;
- Internal roads and fencing.

The proposed drilling sites will be restricted access area and fenced all round with round the clock watch and ward facility. Entry of vehicles into the drilling site area will be prohibited except for material movement. Adequate parking facilities will be provided outside the drilling location.

2.5 Size or Magnitude of Operation

The proposed exploratory drilling project is subject to drilling of 3 wells in an area of 2660 km² to establish the presence of hydrocarbon reserves. The estimated cost of the proposed exploration well drilling Rs. 200 Crores. The salient features of the project and magnitude of various resources required for the project is given in **Table-2.2**.

TABLE-2.2
SALIENT FEATURES OF THE PROPOSED EXPLORATORY DRILLING IN NELP BLOCK OF MIZORAM

Sr. No	Features	Details
1	Total block area in the district	NELP block of 2660 km ² area in Kolasib and Mamit district
2	Project Operator	Oil and Natural Gas Corporation Limited (ONGC)
3	Proposed number of wells	3 exploratory drilling wells
4	Depth of wells	4400 m (approximately)
5	Estimated project cost	Total of Rs. 200 crores
6	Duration of exploratory drilling at each well site	4-5 months
7	Land requirement at each well site including site facilities and camp site	The 2.5 hectare land for each well. Total Average 1.5-2.25 ha At each well site: about 1.56 ha Base Camp: 0.5 ha
8	Hole size and casing	17 1/2" and 13 3/8"
9	Water requirement at each drill site during drilling	25 m ³ /day, for a short period of 4-5 months Source : Local water sources through tankers/



Sr. No	Features	Details
	phase and water source	Contactors
10	Drill mud requirement	About 700 m ³ of water based drill mud for each well
11	Drill cuttings generation	About 500 m ³ /well
12	Drilling Wastewater generation	About 15 m ³ /day (will be treated before sending for solar evaporation in lined pit at drilling site)
13	Domestic wastewater generation	8 m ³ /day (treated in septic tank, followed by soak pit)
14	Power requirement	2250 KVA (Drill site: 750 KVA X 3 Nos)
15	Manpower requirement at each well site	25 persons/shift of 12 hrs. in two shifts

Source: Project Report

2.5.1 Resource Requirement for the Project

2.5.1.1 Land Requirement

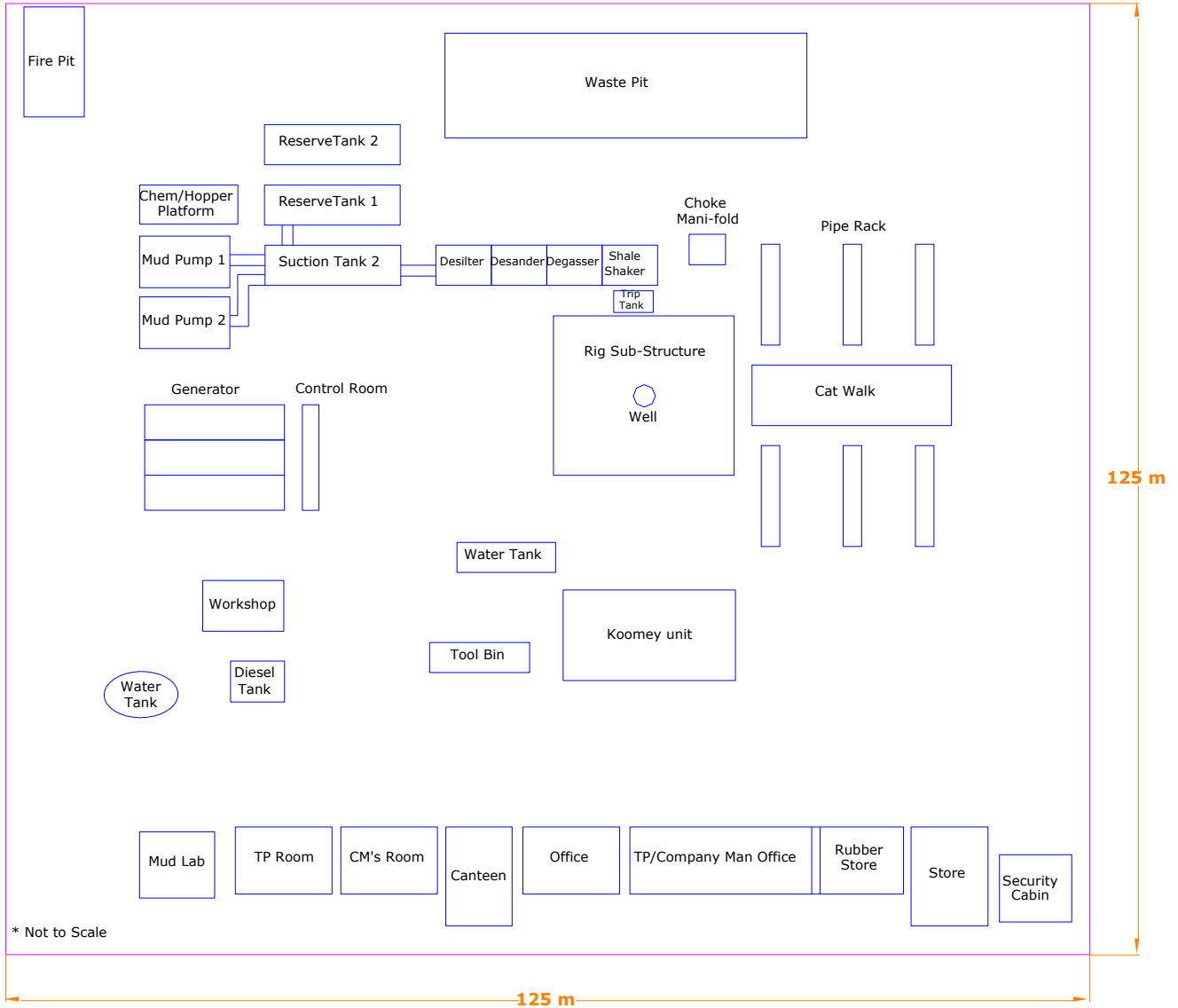
Three exploratory locations have been identified and tentative well location details are presented in **Table 2.1**. Minimum land required at each well site during drilling will be 125 m x 125 m, i.e., 1.5-2.0 ha. Land requirement for the base camp will be about 0.5 ha. The land will be acquired on a temporary basis and if commercial quantity of oil or gas is found, the land will be taken on long lease and if oil and gas is not found in commercial quantities, the land will be returned to the owner by bringing back to its original status and adequate compensation as per the guidelines of local administration will be provided.

2.5.1.2 Water Requirement

Water is basically required for preparing drilling mud, direct washing of drill cuttings, cooling of gas engines and for meeting domestic needs of the campsite. Typically, the water consumption for each well will be 25 m³/day. However, the drilling and domestic water requirement would depend on the time required to drill the well, which is primarily dependent on the proposed depth. **Table-2.3** gives the water consumption for a typical drill site.

**TABLE-2.3
WATER REQUIREMENTS PER WELL SITE**

Particulars	Water Requirement
Drilling water requirement at drilling site	20 m ³ /day
Domestic water requirement	5 m ³ /day
Total Water Consumption (KLD)	25 m³/day



**FIGURE-2.1
TYPICAL LAYOUT OF WELL SITE**



The water requirement will be met from the local sources through water tankers. Suitable water transport arrangement will be made to transfer water for both drilling and domestic purposes.

2.5.1.3 Power Requirement

The total power requirement at the drilling site and camp site will be 2250 KVA. The power requirement in the drilling site and the campsites will be catered through Diesel Generator (DG) sets. The power requirement will be met by 3 Nos of 750 KVA DG sets. Stand by DG set arrangement of 1 No of 750 KVA at drilling site will be made. The DG set details and fuel requirements is given in **Table-2.4**.

**TABLE-2.4
DETAILS OF DG SETS**

Location	DG Capacity	Operational	Stand by	Fuel Requirement
Drilling site	750 KVA	3	1	HSD – 6 KL /day

2.5.1.4 Manpower Requirement

The drill site construction would be done largely employing local labour. At each drill site construction, local employment will be generated for about 25/shift of 12 hrs in two shifts.

2.5.1.5 Drilling Mud

Only water-based drilling mud will be used for the drilling of all wells. Estimation of quantity of drilling mud is nearly 700 m³ for each well.

Drilling of wells requires specially formulated muds which basically comprise inert earth materials like bentonite, barite in water with several additives to give mud weight, fluidity and filter cake characteristics while drilling. The drilling muds have several functions like lubrication and cooling of the drill bit, balancing subsurface formation, bringing out the drill cuttings from the well bore, thixotropic property to hold cuttings during non-operations, formation of thin cake to prevent liquid loss along well bore etc. Several additives are mixed into the mud system to give the required properties. Water based mud will be used in exploratory drilling.

The constituents of water based mud (WBM) are given in **Table-2.5**. The special additives and their functions in WBM are shown in **Table-2.6**.

**TABLE-2.5
CONSTITUENTS OF WATER BASED MUD (WBM)**

Sr. No	Chemicals
1	Barite
2	Bentonite
3	Carboxy Methyl Cellulose
4	Mud Thinner / Conditioner
5	Resinated Lignite
6	Non-Weighted Spotting Fluid
7	Weighted Spotting Fluid
8	EP Lube



Sr. No	Chemicals
9	Drilling Detergent
10	Caustic Soda
11	Potassium Chloride
12	Soda Ash

**TABLE-2.6
SPECIAL ADDITIVES AND THEIR FUNCTIONS IN WATER BASED MUD**

Sr. No.	Discharge Category	Exploration
1	Sodium bicarbonate	Eliminate excess calcium ions due to cement contamination
2	Sodium chloride	Minimize borehole washout in salt zone
3	Groundnut shells, mica of cellophane	Minimise loss of drilling mud to formation
4	Cellulose polymers or starch	Counter thick, sticky filter cake, decrease filter loss to formation
5	Aluminium stearate	Minimize foaming
6	Vegetable oil lubricant	Reduce torque and drag on drill string
7	Pill of oil based mud spotting fluid	Counter differential pressure sticking of string. Placed down hole opposite contact zone to free pipe.

The main components of drilling mud are slurry of inert solids suspended in a liquid phase. The main constituents of the water-based mud are Bentonite and Barites and Calcium carbonate, all of which are natural minerals. The role of the mud in pressure control is especially important. The density of the mud can be increased by the addition of barite weighting material. Bentonite and Calcium carbonate are employed to improve the rheological properties and enable the drill cuttings to be transported from the hole while drilling and also be suspended in the fluid while the drill bit is being changed. The barite used in the drilling mud would be as per American Petroleum Institute (API) standard specifications.

The composition and other mud parameters for different hole sections are given in **Table-2.7**.

**TABLE-2.7
COMPOSITION AND PARAMETERS OF WATER BASED DRILLING MUD**

Mud Parameters	Details for Different Hole Sections			
	Hole Section	17 ½"	12 ¼"	8 ½"
Depth		350 m to 500 m	900 m to 1500 m	1500 m to 3700 m
Mud Type		Spud Mud	PHPA – Polymer	PHPA – Polymer
Density (ppg)		8.6+/-	9.5 – 10.5 ppg	10.0 – 11.5 ppg
Viscosity (sec /qt)		>60	50-60	40-45
PV (cps)		Alap	Alap	Alap
YP (lbs / 100ft ²)		30-40	20-25	15-20
6 rpm dial reading		20-25	10-15	5-10
pH		8.8+/-	8.5 – 9.2	8.5-9.2
Ca ⁺⁺ (mg/l)		<400	<400	<400
MBT (ppb)		30-35	20-25	<10
Drilled Solids (%)		<7	<7	<5
API Fluid Loss (cc)		n/c	<20	<2
Lower Fluid Loss (cc)		<15cc @ casing point	<10cc @ casing point	<5cc @ casing point
HPHT (cc)		n/c	<5cc @ 250°F	2cc @ 250°F
Cl ⁻ (mg/l)			400-1000	400-1000

If Synthetic Based Drilling mud (SBM) need to be used after certain depth, synthetic mud will be recycled completely and at the end of the drilling activities, drilling mud is collected and reused in subsequent drilling operations.

2.6 Proposed Schedule for the Project Approval and Implementation

The proposed exploratory drilling activity of 3 wells in the NELP block area will be accomplished in phases. To accomplish the exploration, the operator will drill 3 numbers of exploratory wells to a depth of about 4400 m each well.

The duration of various stages of the drilling project is given as under:

- The duration of construction works including site excavation, preparation and well pad construction is expected to last approximately 90-100 days for each well site.
- The duration of drilling will range from 4-5 months, depending on the target well depth.
- Well testing operation will be done over a period of 2-3 days.
- Abandonment and restoration of the well site is expected to take about one month.

Thus, on an average, site preparation and drilling of one well is likely to take approximately 4-5 months under normal conditions. Working hours during the drilling operation will be 24 hours per day, seven days per week with 12 hours per shift.

2.7 Technology and Drilling Process Description

The activity involves drilling of the hole across various ground layers to a predetermined depth. ONGC proposes to charter a land drilling rig to achieve the desired above objective. Rig essentially comprises of a mast, a draw work, rotatory table, Kelly or top drive, mud pump engines and generators. The drilling rig is presented in **Figure-2.2**.

2.7.1 Proposed Drilling Sequence

The drilling operation involves simultaneous data logging of the stratigraphy. If sufficient evidence is found of well location having trapped hydrocarbons, a well test will be performed to establish the oil & gas flow potential of the various zones of interest. In case the well test yields encouraging results, further exploratory wells will be drilled at identified locations within the prospect to delineate the extent and quantum of the reserve.

The drilling rig will be a "land rig or Mobile Land Rig" of a smaller capacity with a standard water or synthetic based drilling fluid treatment system. The choice of the rig would depend on the depth and the geological formations likely to be encountered. The well site once drilled will be temporarily suspended and the rig will be moved to next location. The drilling campaign shall continue till adequate results of the reservoir are collected for estimating the developmental activities.

The details of the exploratory drilling operation are given in the following sections.

2.7.2 Drilling Phase

Having completed the drill site preparation, drilling rig and associated equipment will be moved on to the location. This will be followed by a rig building process. This process involves assembling of various rig parts and equipment to drill a well. Once the drilling rig is assembled, thorough rig inspection will be carried out to check equipment working capability and quality standards including compliance to HSE requirements.

2.7.3 Drilling a Well

Well spudding is the start of drilling activity. Top-hole section will be drilled to a desired depth based on well design. After drilling top-hole section, it will be cased with a pipe called "Casing". "Casing" provides support to hole wall and secures hole section. Other than that it isolates problematic hole sections such as loss zones, shale sections, over pressurized formations etc. After running casing, space between hole wall and "Casing" (annulus) will be cemented. This process of drilling and casing the hole section continues until the final well depth (target) is achieved.

Drilling process may encounter various hazards such as well active situation (kicks), blowouts, H₂S situation etc. They are discussed in brief as follows.

- **Well Kick Situation**

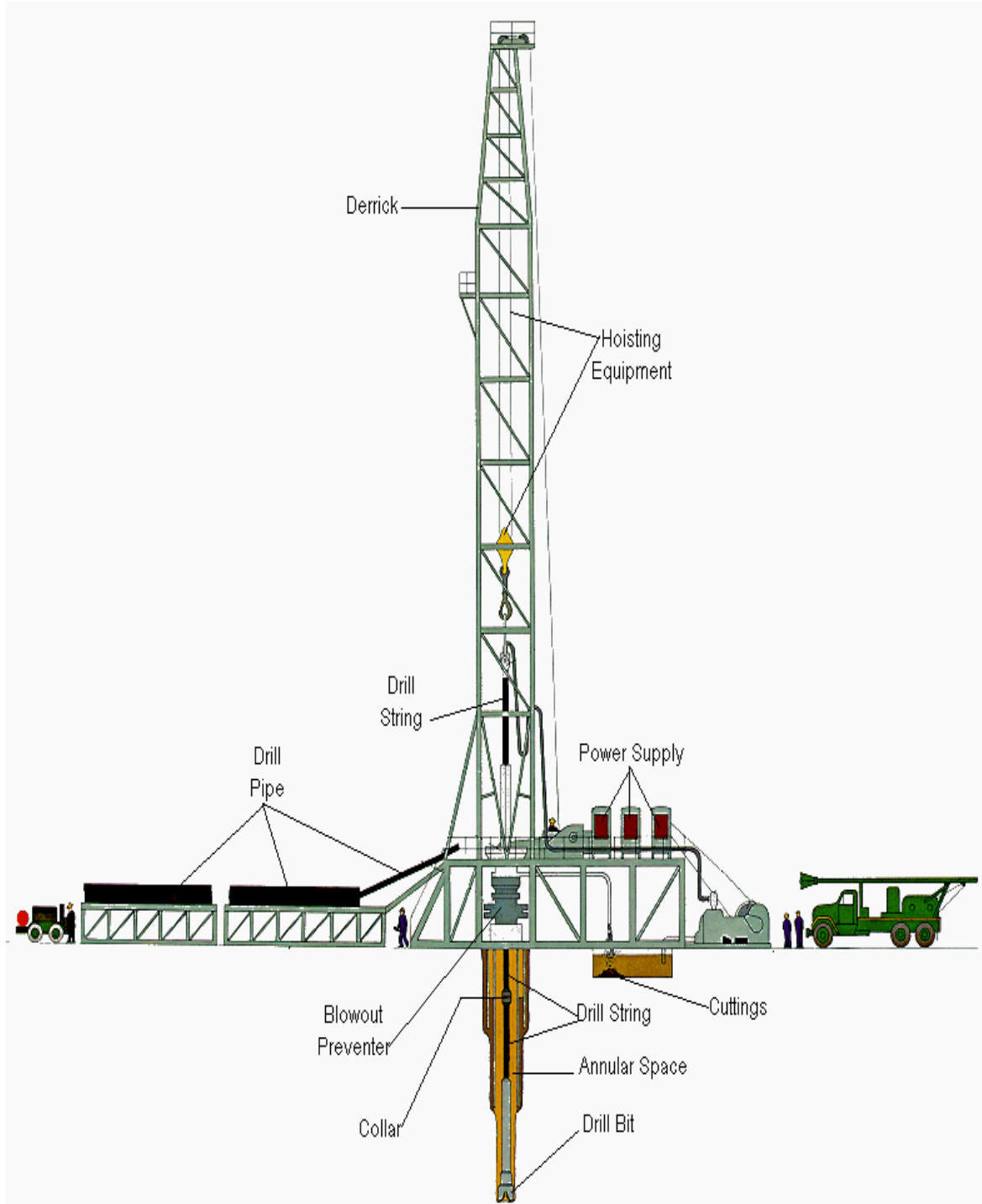
While drilling, if the formation pressure exceeds the hydrostatic pressure exerted by the drilling fluid, formation fluids break out in to the well bore. This is called kick. Primary means of well control is to have sufficient over-balance, over formation pressure. For some reason if an unexpected over-pressurized formation is encountered while drilling and if the well control situation arises, rig is equipped with equipment to control this situation.

2.7.4 Proposed Hole Size / Casing Programme

The exploratory wells will be of "Slim Hole Design". The wells will be drilled vertically to different depths based on the "target" depth. Details of typical hole size and casing are given in **Table-2.8**. It is to be noted that the figures given in the table below are approximate and subject to change as the drilling proceeds.

TABLE-2.8
HOLE SIZE AND CASING DETAILS

Hole Size	Casing Size	Note
Installed during civil work 24 to 26"	20"	Conductor
17 1/2"	13 3/8"	Casing
12 1/4 "	9 5/8 "	Casing
8 1/2"	7"	Casing
6"	5"	Liner (Contingency)



**FIGURE-2.2
DRILLING RIG**

2.7.5 Surface Testing & Flaring

ONGC will conduct vertical flaring at all the sites, in case the presence of hydrocarbon is encountered. A flaring stack with burner and adequate stack height will be provided. Approximately, the duration of the test is around 2-3 days. Temporary test separators with all control facilities for flow metering will be provided.

2.8 Details of Project Utilities

2.8.1 Site Preparation

On identification of the proposed drilling site, reconnaissance survey will be done to locate suitable land on temporary lease basis. Land clearance for site construction at each drilling site will be kept to a minimum practicable in order to safely accommodate the facilities.

Earth moving equipment typically a bull dozer armed with a grader blade / ripper teeth and scoop bucket will be used for the leveling / grading and excavating work. Where possible topsoil will be cleared and stored for later reinstatement purposes by piling it along the boundary of the site. The natural contours will be worked on to minimise off-site disposal of excavated earth. The site area (except the pit areas) will be provided with hard-standing by providing a layered base of coarse aggregate covered with moorum. This is done to provide sufficient load-bearing capacity to enable all construction and drilling operations to be executed safely.

2.8.2 Approach Roads

The approach road to drill sites will need to be constructed/ upgraded to provide access for the drilling equipment and construction machinery and material, supply vehicles, passenger vehicles etc. In general, it is intended to make maximum use of the existing infrastructure by strengthening the roads with the consent of the local administration and the concerned regulatory authorities. This would result in an added advantage to the local community. In case new roads are to be made, compensation for right of way will be provided. The choice to leave these newly constructed roads or to restore them back to original land use condition will depend on the requirements of the local authorities.

2.8.2.1 *Installation of Facilities*

Site construction would include the impermeable layer lined drilling fluid, drill cuttings, waste and water storage pits, foundations for the drilling rig and accessories, inter-connecting drains, secure storage provision for chemical, oil and waste oil, portable-cabins and a sewage treatment system (septic tank and soak away pits and piping). A ground level flare pit arrangement will be made for flaring purpose.

The mobilization of the drill site involves transportation of drilling rig in modules and erected by means of mobile cranes. The drill site equipment's are designed

as modular / skid mounted type, which facilitates quick demobilization and re-mobilisation. The installation of the drill site equipment / facilities involves about 50 trailer loads spread over 10 days. Once the site is prepared, drilling equipment, supplies and drilling personnel will be mobilized and the drilling rig will be erected.

The salient features of the drill site facilities are detailed below.

- **Earthwork**

The exploratory drill site area will be fenced by high barbed wire. The drilling rig will be positioned almost in the middle of this area. Typically, a depth of 1.0 or 1.5 m is excavated around the prospecting drilling location. Excavation work shall be carried out under the permit-to-work system and in such a manner that the collapse of sidewalls is precluded. The foundations for the drilling rig and accessories, inter-connecting drains, secure storage provision for chemical, oil and waste oil, porta-cabins and a sewage treatment system (septic tank and soak away pits and piping) waste and water storage pits will also be set up. Appropriate fencing and sign boards will be provided to prevent persons and livestock from accidentally falling into an excavation pit.

- **Surface Drainage**

Drilling sites and camps will have an adequate drainage and wastewater conveyance system so that all wastewater are contained and can be disposed as per the Mizoram Pollution Control Board (MPCB) discharge norms.

The drilling rig location will be connected with paved drains to the lined drilling fluid collection pits. Surface drains will be adequately graded and maintained and kept debris free to ensure quick disposal of their contents. Bunds will be sized so that they can contain surface runoffs for limited period.

- **Fuel & Chemical Storage Area**

The fuel (Diesel) will be received in bulk quantity through road tankers and stored in above ground steel diesel tanks. The tanks will be constructed, operated and maintained as per the requirements of the Explosive Rules and all the statutory licenses will be obtained. The tank farm area will be provided with secondary containment of adequate capacity to impound any accidental leaks.

Chemicals will be stored on a paved platform with kerb walls and protected against weather through an impervious covering. Separate storages are earmarked for liquid and solid chemicals. All the storages are identified with tags and sign boards. All required safety precautions such as display of the MSDS, provision of fire extinguishers are followed.

- **Waste Oil collection, Storage & Disposal System**

Waste oil of about 150-200 liters/day from pumps or other machinery will be trapped and manually collected and stored in a paved dedicated waste oil storage area. The storage area will be provided with paved flooring, containment bunding

and covered roofing. The storage facility shall be designed based on the CPCB guidelines for Hazardous waste Storage. The waste oil will be collected and handed over to MPCB and MoEF&CC authorized waste oil recyclers at the end of the exploratory drilling campaign.

- **Spill Containment System**

Containment systems and oil traps will be provided to trap any escape of oil before it can leave the drilling site. All potential sources of spillage will be equipped with drainage facilities / drip pans / spill collection kits in order to contain spills. Drains and bunds will be sized to contain surface runoffs for limited period and any oil detected in the drains will be manually soaked using sorbent materials.

- **Water & Drilling Fluid Storage Pit**

The water storage pit contains the water used for preparing drilling fluid. The drilling fluid storage pit will collect all the wastewater, which come from the drilling operations. The wastewater present in the waste pits will be recycled and reused during drilling phase. Whereas, the residual wastewater from the drilling operation will be collected in waste pits for solar drying. The pit will be lined with polyethylene propylene sheet and the overlaps welded together with the edges bought over the rim and tucked into the soil. At the end of the drilling phase, the liquid fraction of the waste drilling fluid will be allowed to evaporate and the pit is filled with soil and capped with compacted moorum layer.

- **Drill Cuttings Disposal Pit**

Cuttings will be collected and disposed off in an environmentally safe manner. The cuttings disposal pit will be similar in construction to the wastewater pit. Typically the pit would be about 30' x 33' x 5' – 2 Nos, 38' x 33' x 5' – 1 Nos, 23' x 20' x 5' – 1 Nos, and oil pit 3' x 3' x 4' – 1 Nos will be lined with polypropylene liner. The cuttings disposal pit will be placed within the drilling lease area to prevent the transport of waste mud and cuttings from the drilling site to another area to prevent any spillage on the other areas.

- **Domestic Sewage Treatment & Disposal System**

The domestic sewage generated from the drill site operations will be disposed off in a septic tank – soak pit system. The septic tank will conform to the IS design specification. The overflow from the septic tank will be led into series of soak pits for sub-surface disposal.

- **Drilling Fluid Circulation**

The drilling fluids circulation system consists of several items of equipment. The mud pump takes in mud from the mud tanks and sends it out a discharge line to a standpipe. The standpipe is a steel pipe mounted vertically on one leg of the derrick. The mud is pumped up the standpipe into a flexible reinforced rubber hose called the Kelly hose. The Kelly hose is connected to the swivel; goes down the Kelly, drill pipe and drill collars and exits at the bit. The mud then does a sharp U-turn and heads back up the hole in the annulus. The annulus is the space between outside of the drill string and the wall of the hole. Finally, the mud leaves the hole through a steel pipe called the mud return pipe and falls over a

vibrating screen like device called the shale shaker. The mud containing cuttings is screened out of the shaker. The mud drains back into the mud tanks and is recycled back into the well via the mud pump, while the drill cuttings which are inert materials of shale, sand, and clay fall into the lined waste pits. Once the mud is cleaned, it is pumped down the drill string again. The drilling fluids left over at the end of the particular well, which can't be further reused, will be discharged into the lined waste pits and dried. The pits will be provided with HDPE liners to maintain integrity and prevent any leakage. The drill cuttings cut by the drill bit are removed from the mud by the shale shakers and other solids removal equipment and transferred to the waste pits. The drilling fluid circulating system at rig is essentially a self contained, closed system, shown in **Figure-2.3**.

• **Role of Drilling Fluids**

Drilling fluid serves the following essential functions:

- The removal of drilled solids (i.e. cuttings) from the bottom of the hole and their transport to the surface for separation from the mud;
- Lubrication and cooling of the drill bit and string;
- Deposition of an impermeable cake on the well bore wall to seal the formation being drilled;
- Suspension of drilling cuttings in the fluid during the interruption of drilling; and
- Countering the natural formation pressures and preventing uncontrolled flow of fluid from the formations.

The role of the drilling fluids in pressure control is especially important. If the drill bit penetrates a formation containing oil, gas or water under pressure these fluids are prevented from flowing into the borehole by ensuring that the drilling mud is of sufficient density to counter the natural formation pressures. The density of the mud can be increased by the addition of barite weighting material. Bentonite is employed to improve the rheological properties and enable the drill cuttings to be transported from the hole while drilling and also be suspended in the fluid while the drill bit is being changed. The barite used in the drilling mud would be as per API standard specifications.

Water based drilling fluids, which are of an environmentally acceptable nature with regards to current Indian legislation, will be used. The water based drilling fluid will be non-hazardous in nature.

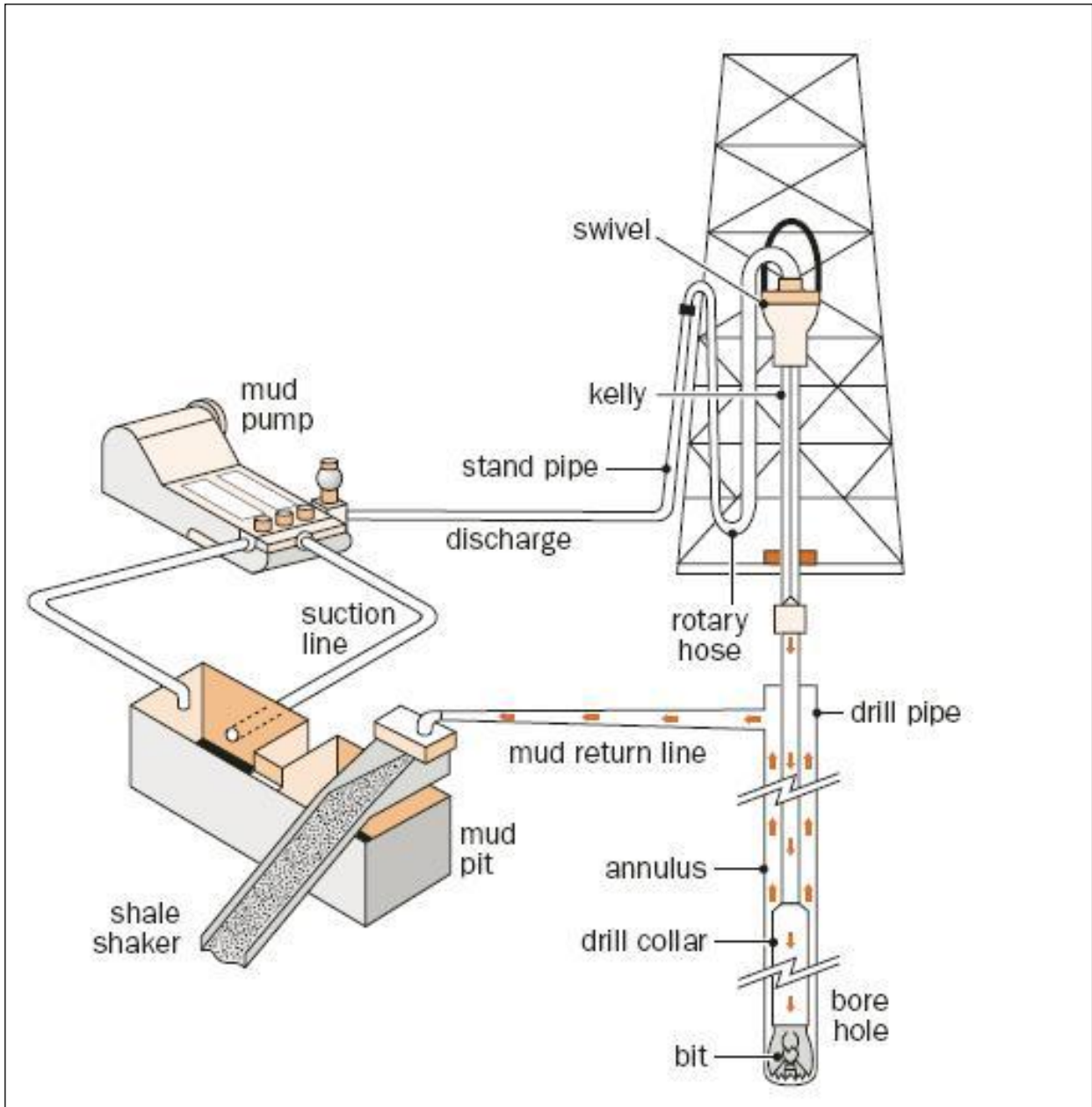


FIGURE-2.3
DRILLING FLUID CIRCULATION SYSTEM AT TYPICAL RIG

2.9 Post Drilling Operations - Abandonment and Restoration

2.9.1 Demobilization & Decommissioning

- **Well Capping - Removal of Equipment and Materials**

In the event that economic quantities of hydrocarbons are found, the well will be suspended with a wellhead / X-mass tree in place, but all other equipment and materials will be removed from the site.

All empty drums, wastes, used and unused drilling fluids, fuel and lubricants will be removed from the drilling site. Water supply and effluent discharge hoses and associated equipment will be removed. The access road(s) would be either left behind or reinstated based on the needs of the local authorities.

- **Restoration of Cutting Containment Area**

At the conclusion of well testing at each drilling site, the spent drilling fluids will be dewatered by flocculating the contents and allowing the water phase to evaporate away. All solids & liner will be buried in a secured lined pit and covered with soil and left onsite. The cutting mud is inert and with appropriate lining of the pit in place it does not pose any potential for soil or groundwater contamination. ONGC will follow a well laid site restoration plan. Tree plantation will be done on the closed pits to restore the original soil conditions. At all the sites the pits are filled with the black cotton soils or red soils which is available at shortest distance. Filling and plantations are handed over to the contractors with close watch of ONGC officials.

2.9.2 Restoration of Well Sites

- **Decommissioning upon Abandonment**

In the event that economic quantities of hydrocarbons are found, the well site will be closed as detailed above. In the event that no economic quantities of hydrocarbons are found, a full abandonment plan will be implemented for the drilling sites.

The actions outlined above would apply to decommissioning upon abandonment as well, but abandonment would be more permanent. All concrete or steel installations would be removed to at least 1 m below ground level so as to ensure that there are no protruding surface structures. In the unlikely event that soil is found contaminated, measures would be taken to remove or treat appropriately all contaminated topsoil to promote its remediation.

The overriding principle being that the environment should, with time, be reinstated to broadly its original condition. Until such time as this is achieved, ONGC would actively manage the reinstatement process.

2.9.3 Traffic Volumes

During the civil operations earth moving equipment will be working on the access road and the well location. It is anticipated that there will be an average of 5

truck movements a day to cater the site preparation for an average period of about 20 days.

Prior to and after the drilling operation, when building the rig or rig move, up to 80 heavy truckloads over a period of 4-5 days are envisaged.

During the drilling operation, supply truck movements are estimated on an average of Eight to five per day. Small vehicles movements are used mainly for transport of personnel, visitors etc. which might be as much as 10 per day.

ONGC will engage in constructing compacted approach roads without black topping to all well locations and camp sites. Though this will not cause any changes in topography, the dust generation will be less than any other village roads. The same roads can be used by the villagers after completion of the drilling activities.

2.10 Sources of Pollution

2.10.1 General

The various types of pollution from the proposed exploratory drilling operations are:

- *Wastewater Generation and Disposal;*
- *Air Emissions;*
- *Solid Waste Generation; and*
- *Noise Generation.*

Exhaust gases from DG sets, wastewater, drilling wastes and noise from the drilling operations are the major sources of the pollutants generated during the proposed drilling operations which is temporary activity lasting for maximum of 4-5 months at each of the well locations.

2.10.2 Wastewater Generation and Disposal

Water will be required during the exploratory drilling phase for drilling fluid preparation and for domestic purposes. Thus, wastewater during this phase will comprise of drilling wastewater and domestic wastewater.

Drilling sites and camps site will have an adequate drainage system so that all wastewater are contained and disposed as per the PCB Standards. Means will be provided to trap any escape of oil before it can leave the site. Surface drains will be adequately graded and kept debris free to ensure quick disposal of their contents. Minor quantity of wastewater would be generated from cleaning operations carried out at the rig. About 15 to 20 m³ /day of wastewater is expected.

All wastewater streams except sewage will be directed to a 1 mm HDPE lined pit. Wastewater collected in the pit will be clarified and treated in solar evaporation pond or packaged wastewater treatment plant for removal of oil and suspended solids to meet the regulatory discharge standards.



Solids generated from the treatment plant will be collected, tested for hazardous contents and disposed to land once it is ensured that there are no hazardous contents.

Produced water generation is not envisaged during the exploratory drilling phase.

Domestic Wastewater

Sewage generated from the camps would be discharged and treated in septic tanks. The supernatant from the septic tanks will be passed through soak pits into the ground. The quantity of sewage generated at each drill site is expected to be around 4 m³/day.

2.10.3 Air Emissions

During routine drilling operation, air pollutants are emitted by the diesel engines that power the drilling equipment. These engines release particulate matter that can contain heavy metals, volatile organic compounds and polycyclic organic matter. They also emit Sulphur dioxide, oxides of Nitrogen which contributes to smog formation. The vehicular movement associated with the drilling activities is also an important cause for the dust pollution.

The predominant air emissions from the proposed drilling operations are gaseous emissions, viz., Sulphur dioxide, Oxides of Nitrogen and Hydrocarbons. Each power generator will have the adequate stack height for easy dispersion of gaseous emissions. The height of the D.G exhaust stack will be about 7.5 m (including the height of the trailer from the ground).

Natural gas and traces of crude oil in gas will be flared during the well testing phase for short period. The test flaring will result in temporary emissions of CO₂, water vapours, NO_x and other trace gases in case of natural gas flaring and additionally particulates in case crude oil is flared. It is assumed that the occurrence SO₂ in the flare gas would be in traces or negligible.

2.10.4 Solid Waste

The drilling operations generate drill cuttings. The minor wastes include sanitary waste, domestic waste and waste oil from lubricating system.

2.10.4.1 Drilling Mud

The drilling mud will be re-circulated and reused to maximum possible extent through its mud recycling system. Maximum amount of drilling mud attached to the drill cutting is separated by Solid control System such as Shale Shaker, clay shaker and will be recycled during the drilling process. However, only a portion of the non usable mud at the end of the drilling would be discharged. The drilling mud will be collected in lined pit and solar evaporated.

2.10.4.2 Drill Cuttings

Drilling cuttings are worn out rocks from subsurface formations that are generated during drilling operations. The drill cuttings are conveyed to the surface, suspended in the drilling fluid (drilling mud). The drill cuttings are separated in the shale shaker from the drilling mud and are stored in an impervious 1.5 mm HDPE lined pit. The particle size varies from coarse particles of less than 1mm diameter to few centimeters. Drill cuttings are encapsulated by a thin layer of adhering mud.

The drill cuttings will be washed thoroughly and the wastewater generated will be treated. The clarified drill cuttings would then be dumped in a HDPE lined pit. Once the drill cuttings are dried it will be further treated and disposed through land farming by applying oil degrading bacteria, native soil and nutrients. Bioremediation and land farming are considered as a good treatment options which are recognised by MoEF as per MoEF guidelines for disposal of Drill Cutting/ Drilling Mud for onshore drilling activities (G.S.R. 546/E) dated 30-8-05.

2.10.4.3 Waste Pit Details

Typical sectional view of the drill cutting and drilling mud collection pit is presented in **Figure-2.4**.

- The storage pit will be constructed as per the method and specification of CPCB/MPCB. The pit shall consist of following layers commencing from the bottom;
- Compacted sub-base and side slopes comprising of clay or amended soil layer of 300 mm compacted thickness;
- Synthetic liner (HDPE / geo-membrane) of a minimum of 1.5 mm thick; and
- The drill cuttings are dewatered to reduce the amount of liquid fraction carry over. The liquid fraction of the drilling mud is recycled and excess fluid stored in the lined pits. The cuttings and mud waste are stored in lined pits and solar evaporated and covered with layer of local soil. The liner is tucked into the natural ground to form a continuous layer. All joints are seam welded to ensure the cover is continuous over the surface of the pit material. The pit is filled back with natural soil and locally available clay layer is placed at the upper most layer (top surface). The top surface is cambered with 2–3% slope to drain away the rain water from the pit location.

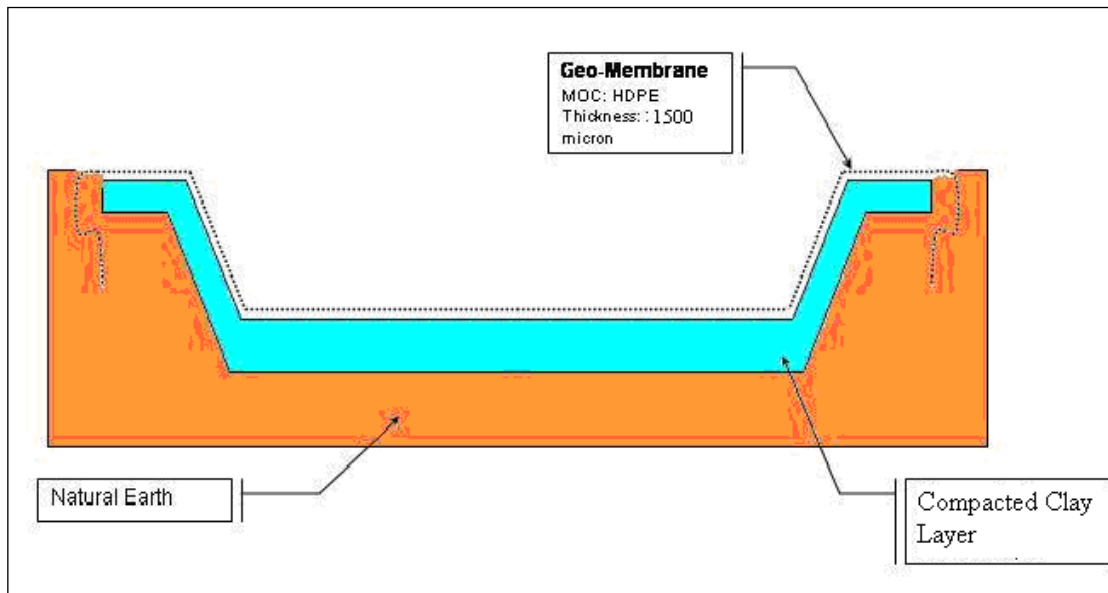


FIGURE-2.4
TYPICAL SECTION VIEW OF DRILLING CUT AND DRILL MUD COLLECTION PIT

2.10.4.4 Used / Spent Oil

Used / spent lubricating oil from pumps or other machinery would be trapped and manually collected and stored in a paved dedicated waste oil storage area. Approximately 150-200 liters/month of used / spent oil would be generated from a drilling operation. Stored waste oil would be disposed off to Mizoram State PCB & MoEF registered used / spent oil recyclers.

2.10.4.5 Summary of Waste Generation Quantities and Treatment and disposal Method

The quantum of wastes that would be generated from each well depends upon its target depth and duration of testing.

2.10.4.6 Drilling mud and drill Cuttings Analysis

The drill cuttings & the drilling mud at each location will be tested to ensure it meets the requirement of MoEF&CC guidelines for disposal of drill cuttings and drilling fluids for onshore operations. The analysis carried out on spent drilling mud / cuttings during the previous drilling campaigns by ONGC in other parts of the country have reported LC₅₀ in excess of 30,000 mg/l.

The potential source of heavy metal concentration in the drilling mud is primarily from the barite used in the mud formulation. Presence of heavy metal in drill cuttings is attributed to lithological characteristics of subsurface layers. Drill cuttings and mud would thus also be analyzed for heavy metal concentrations before disposal.

2.10.5 Noise Levels

The major noise generating sources are DG sets, pumps at drilling rig and other equipment of drilling rig would contribute to continuous noise. Typically, the noise generating sources for the drilling activity are provided below (in the immediate vicinity):

- Diesel Generator : 90 to 95 dB(A)
- Pumps at the Rig : 85 to 90 dB(A)
- Miscellaneous : 80 to 85 dB(A)
- Control Room & Quarters : 50 to 60 dB(A)

Noise is not considered to be a potential threat since the drilling sites will be selected keeping in view that there are no settlements in close proximity to the drilling site.

2.11 Qualifications, Skills and Training Practice

a) Qualification

Jobs requiring specific qualifications and certificates e.g. welding, driving of vehicles, electrical work, crane operation, fork lift & bulldozers operation should be carried out only by persons having the required qualifications and certificates.

The certificates should be properly checked for adequacy and a copy of the same should be available for verification by ONGC personnel.

b) Skills

Certain jobs e.g. operation of cranes and other mechanical equipment, erection of scaffolding need required skills and persons deployed should be checked for possession of adequate skills and experience in carrying out such work.

c) Training

All required HSE related training e.g. safe evacuation during emergencies, permit to work requirements, proper use of personal protective equipment, should be provided by the contractor HSE supervisor. The training contents should be discussed with the ONGC HSE personnel.

d) Personal Protective Equipment (PPE)

No personnel will be allowed into the drill site if the required PPE is not used. Adequate stock of required PPE will be available and distributed whenever needed. The PPE requirements are hard hat and safety shoe and those working in the drilling rig, overalls, gloves, safety glasses, nose masks when needed) and ear-muffs. Personnel working at height (during maintenance / erection) will need to use safety belts securely anchored.

e) General HSE Requirements

The general HSE requirements of ONGC which is strictly complied with by all ONGC and contract employees are enumerated below.

f) Vehicle Movement

The speed limit for vehicles is 10 kms/hr in village area and near to schools and in construction area. On tar road maximum speed is restricted to 35 km/hr and on highway speed should not be more than 60 km/hr for heavy vehicles and 80 km/hr for light vehicle.

g) No Smoking Regulations

Smoking is strictly prohibited in all the areas in the site.

h) First Aid Center

A first aid center shall be located at the construction site. The service of a doctor shall also be available all the time in the first aid center.

i) Permits

Type of permits agreed should be obtained wherever required. Conditions and precautions mentioned in the permit should be strictly followed.



j) Fire Extinguishers

Temporary fire extinguishers shall be readily available at convenient locations for use during any fire emergencies.

All persons working in the contract should be above 18 years of age and no child labour will be engaged in any job at any time.

k) Safety Seat Belts

All the vehicles used for construction purpose should be provided with safety seat belts. No vehicles are allowed inside the site without safety seat belts.