Pre-Feasibility Report

For

Offshore & Onshore Oil and Gas Exploration and Appraisal in CY-OSHP-2017/1 Block offshore of Bay of Bengal, Vilupuram (Tamilnadu) & Puducherry

VEDANTA LTD. (CAIRN OIL & GAS)

March 2019

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1. Executive Summary

Vedanta (erstwhile Cairn India Limited merged with Vedanta Limited w.e.f. April 11, 2017, pursuant to NCLT order dated March 23, 2017) is a globally diversified natural resources company with interest in Zinc, Iron Ore, Aluminium, Copper, Power and Oil & Gas. Vedanta Ltd. (Cairn Oil & Gas) is the operator of the CY-OSHP-2017/01 block. The block covers an area of 1794 Sq. Km consisting of 139 sq km of Viluppuram (Tamilnadu), 2 Sq. km of Puducherry &1654 Sq. Km of sea portion of Bay of Bengal. Vedanta Ltd. (Cairn Oil & Gas) has been allocated the CY-OSHP-2017-1 hydrocarbon block, MoP&NG, for exploration & exploitation of hydrocarbon. A Revenue Sharing Contract (RSC) was signed between the Government of India (GoI) and Vedanta Ltd on 1st October 2018

1.1 Project Details

1.1.1 Introduction

Vedanta Limited (Cairn Oil & Gas) proposes to carryout seismic survey/ data acquisition in the block and exploration (including appraisal) drilling of 116 nos. of wells for hydrocarbon.

1.1.2 Nature of the Project

The proposed project is green field in nature. At this stage the project is purely an oil and gas exploration (including appraisal) project.

1.1.3 Proposed facilities

Vedanta Ltd. (Cairn Oil & Gas) proposes to carryout exploration including seismic data acquisition survey and exploratory & appraisal drilling.

1.1.4 Justification of the project

The demand for petroleum has recorded a considerable increase over the last few years. There is a considerable increase in consumption of petroleum products due to the development activities in the country in the last few years. During the year 2016-17, the consumption of petroleum products in India was 194.60 MMT with a growth of 5.37% as compared to consumption of 184.67 MMT during 2015-16. The consumption of petroleum products during April-November, 2017 was at 134.60 MMT i.e. an increase of 3.40% over 130.17 MMT in April-November, 2016. The crude oil production for the year 2016-17 is at 36.01 Million Metric Tonnes (MMT) as against production of 36.94 MMT in 2015-16, showing a decrease of about 2.53%. Whereas Natural Gas production during the year 2016-17 is at 31.90 Billion Cubic Meters (BCM) which is 1.09% lower than production of 32.25 BCM in 2015-16. Import of crude oil during 2016-17 was 213.93 MMT valued at 470159 crore as against import of 202.85 MMT valued at 416579 crore in 2015-16 which marked an increase of 5.46% in quantity terms and 12.86% in value terms as compared to the import of crude oil during 2015-16.

Import of Crude Oil during April-November, 2017 was 144.72 MMT valued at 3,42,673 crore which marked an increase of 9.31% in quantity terms and 15.32% in value terms as against the imports of 143.81 MMT valued at 2,97,161 crore for the same period of last year. Therefore, India is largely dependent on import of petroleum goods to meet its requirements. Facing an environment of increasing consumption, static reserves, increasing imports and increasing costs of crude as well as decreasing value of the Indian Rupee vis-à-vis the US Dollar, it follows that any accretion of hydrocarbon reserves in the country, is welcome.

Vedanta's proposed exploratory drilling, development and production project could possibly result in the discovery of hydrocarbon and in that case, would help in reducing India's dependence on imports.

1.2 Site analysis

The Block area covers 1654 Sq Km of the offshore in Bay of Bengal, 139 sq. km of Viluppuram (Tamilnadu) and 2 Sq. km of Puducherry.

1.2.1 Climate

The Villupuram district falls under tropical climate with temperature in the summer months of March to May. The average temperature varies from 26 to 41^0 C. The humidity is also high in the order of 80%. The wind speed is high during the months of July and August. The wind speed ranges from 7.4 to 12.6 km/hr, which increases from 100 to 120 km/hr during cyclone period.

The Puducherry region enjoys a hot and tropical climate characterized by little variation of temperature and humid weather. The summer season, which is very oppressive, is from March to May. January to the end of February is comparatively cool. The relative humidity is generally high, being about 80% during October to April. It is at its minimum of 70 to 73% in June and July. Winds are moderately strong throughout the year, except during the months July to October. During May to September winds are mainly southwesterly in the mornings.

1.3 Water and power requirements

1.3.1 Water Requirement

A. During Seismic Survey

The water required during seismic operation 20-30 m3/day will be mostly for domestic use, which will be sourced locally through approved authorities for onshore & from the nearest port authority for offshore.

B. During Exploratory and Appraisal well drilling

Water is required at the drilling location for drinking, domestic use and preparation of drilling mud. An estimated 20 -30 m^3 per day of water during drilling campaign will be used for domestic consumption. Water used for the preparation of drilling mud is generally known as drill water. The quantity of drill water required for preparation of Water Based Mud (WBM) will be approximately 600 m^3 -1000 m3 per well, while for Synthetic Based Mud (SBM), approximate drill water requirement will be 150 m^3 -300 m3 per well. Water requirements for miscellaneous use like engine cooling, washing, firefighting storage etc. will be approximately 25-30 m3/day/well. Water for drilling purposes will be sourced partially from sea. Other remaining water requirements will be met by water supplied through supply vessels from the nearest port and will be stored in water storage tanks.

1.3.2 Power Requirement

A. Power requirement during seismic Survey

The required power supply estimated to be 2*350KVA will be generated from diesel generators at the seismic vessel for offshore and from diesel generators/ State Grid for onshore.

B. Power requirement during Exploratory well drilling

The power requirement of offshore drill rig will be met by four (04) DG sets (4*2000 KVA) and one (01) standby DG set (1*500 KVA) with a diesel consumption of about 4 KL/day.

The power requirement of onshore drill rig will be 3*1000 KVA, 2*350 KVA for drilling campsite & 2*100KVA for radio room.

1.4 Pollution control measures

1.4.1 During Seismic Operations

1.4.1.1. Offshore

A. Air Emissions and Control Measure

Air emissions from on-board DG set of seismic vessels.

B. Noise Emissions and Control Measure

Noise emission envisaged from DG sets and on-board vessels.

C. Wastes treatment and disposal

The food wastes will be mercerised and disposed offshore. Non-biodegradable and other waste like metal garbage, plastics, and paper will be collected and brought to onshore for appropriate disposal.

The hazardous wastes would include: waste oils, used oil, small quantities of chemicals (e.g. paint, thinners etc.) will be disposed through recyclers.

D. Discharges

The discharge from vessels like bilge water, sewage shall be complied with the requirements of MARPOL for disposal into sea.

1.4.1.2. Onshore

A. Air Emissions and Control Measure

Emissions to air include transient airborne dust raised by construction activities (e.g. preparation of seismic cut lines and moving vehicles and equipment) and emissions from vehicles and machinery. These emissions are transient and very short duration in nature.

B. Noise Emissions and Control Measure

Noise emissions that could be released during the seismic operations will include those generated by blasting of charges in shot holes, field machinery (Bulldozer and support vehicles) and generators and work yard at the camp site. Adequate noise control measures will be taken to minimize the noise level.

C. Wastes treatment and disposal

The non-hazardous wastes like domestic wastes and effluents, plastics, and paper and disposal options include, compaction and removal from site and burying (especially for biodegradable material), or a combination of these activities.

D. Waste water Generations

Domestic waste water of 15-25 m3/day is envisaged & will be treated suitably.

1.4.2. During Drilling Operations

A. Air Emissions and Control Measure

The emissions to the atmosphere from the drilling operations shall be from the diesel generators associated with the drilling rigs and temporary from flaring activity during testing/extended testify of wells. Appropriate control measures will be taken.

B. Noise Emissions and Control Measure

The source of noise generation during this phase of operations would be the operation of rig and diesel generator sets. The expected noise generation at source is due to operation of rig. Besides, certain pumps are expected to be in operation during this phase, for mud circulation. The noise generation work however is transient and limited to the drilling period only. Appropriate control measures will be taken to minimise exposure to noise.

C. Waste treatment and disposal

The food wastes will be mercerised and disposed offshore. Non-biodegradable and other wastes like metals, plastics, and paper will be collected and brought to onshore for appropriate disposal.

The hazardous wastes would include: waste oils, used oil, small quantities of chemicals (e.g. paint, thinners etc.) will be disposed through recyclers.

Drill cuttings of 250-750 tons per well associated with Water Based Mud (WBM) and 500-1500 tons/well associated with Synthetic Based Mud (SBM) is envisaged for offshore & onshore drilling operation. 250-500 Tons per well of spent/ residual drilling mud shall be generated at site during drilling operations.

Used oil /waste Oil – During the drilling approx. 1-2 tons per well shall be generated. Sludge containing oil & other drilling waste generation will be approximately 250-500 tons per well. This oil shall be sent to authorized recyclers.

Domestic waste of 25-30 kg/day per well shall be generated on-board drilling rigs.

D. Waste water treatment

Drilling rigs and drilling logistics will comply with the MARPOL requirements for disposal of the bilge water, sewage into the sea for offshore and will be treated suitably & disposed suitably for onshore.

1.5 Project schedule and cost estimate

Vedanta Ltd. (Cairn Oil and Gas) has planned to carry out seismic data acquisition, exploration and appraisal well drilling and well testing in the CY-OSHP-2017/1 Block over a period of 10-12 years.
The cost of the project is estimated is given below:

1) Physical Surveys Cost estimated to be approximately INR 6.93 Crore.
2) Average Cost per well for exploratory & appraisal well is estimated to be INR 49 Crore.

1.6. Employment Generations:

The seismic survey is expected to take about 6 to 8 months and will require a crew of approximately 60 to 80 persons. Most of the workforce will be from local/nearby areas. During the site preparation for drilling, approximately 30-35 workmen will be employed per drill site. It is anticipated that, at any given time, there will be about 80-100 personnel working on site including technical staff, drilling crew, security staff etc.

1.7. Rehabilitation and Resettlement

For exploration and appraisal activities, the project does not envisage any Rehabilitation and Resettlement of the project, since the land requirement would be very less and temporary on short term lease and away from the settlements. If the identified lands are of private landowners then land lease mode will be applied and in case of govt. land, land allotment from Govt. to be applied. Initially lease will be taken for 3 - 5 years for exploration purpose and in case of commercially viable discovery of hydrocarbon resources; the land lease would be converted into long term lease up to life of the project.

For sites selected having settlements if any, Resettlement & rehabilitation (R&R) plan will be developed and implemented as per the applicable State/ Central Govt. policy. Compensation to affected landowners for any loss of land, Cairn will ensure the livelihood of local community, if any affected by the proposed land take, are identified and compensated through adequate compensation and other livelihood restoration activities directly or indirectly through CSR activities.

2. Introduction of the Project

2.1 Identification of the project

Vedanta Ltd (Cairn Oil & Gas) has been allocated the CY-OSHP-2017/01 hydrocarbon block under the OALP (Open Acreage Licensing Policy) by MoP&NG, Govt. of India. RSC (Revenue Sharing Contract) has been signed between Vedanta Ltd and MoP&NG on 1st October, 2018 for the exploration and exploitation of hydrocarbons. Vedanta Ltd (Cairn Oil & Gas) proposes to carry out exploration (including seismic surveys, exploratory and appraisal well drilling) of oil and gas in the block. The

wells will be tested by flowing hydrocarbons to assess the quality and commercial viability to ascertain reservoir oil parameters as a part of exploration and appraisal.

The Operator has planned to acquire seismic data covering the full block area and subsequently drill 116 exploratory wells. Exploratory and Appraisal drilling needs to be undertaken in the identified sub-surface structures to find out if there is any presence of hydrocarbons in commercially exploitable quantities.

2.2 Brief description of nature of the project

The proposed project is green field in nature. The proposed project involves oil and gas exploratory (including appraisal) drilling and well testing.

2.3 Need for the project and its importance to country/region

India is largely dependent on import of petroleum goods to meet its requirements. Facing an environment of increasing consumption, static reserves, increasing imports and increasing costs of crude as well as decreasing value of the Indian Rupee vis-à-vis the US Dollar, it follows that any accretion of hydrocarbon reserves in the country, is welcome.

Vedanta's proposed exploratory drilling project could possibly result in the discovery of hydrocarbon and subsequent development and production would help in reducing India's dependence on imports. Consequently, the need for the project is evident. The proposed project would also contribute to the state Governments in terms of royalty through the mining lease. Additionally the proposed project would generate direct and indirect employment in the region. To date four exploratory well has been drilled in the contract area.

2.4 Demand-supply Gap

As on 1.4.2017, In-place hydrocarbon volume of 10454 million tonnes of oil and oil equivalent gas could be established through exploration by ONGC, OIL and Private/JV companies. So, about 75% of resources are under "yet to find" category. Out of 10454 MMT of oil and oil equivalent gas of In-place volumes, the ultimate reserves which can be produced are about 4017 MMT of oil and oil equivalent gas since inception. The balance recoverable reserves are of the order of 1787 MMT of oil and oil equivalent gas.

2.4.1 Production and Consumption

The crude oil production for the year 2016-17 is at 36.01 Million Metric Tonnes (MMT) as against production of 36.94 MMT in 2015-16, showing a decrease of about 2.53%. Whereas Natural Gas production during the year 2016-17 is at 31.90 Billion Cubic Meters (BCM) which is 1.09% lower than production of 32.25 BCM in 2015-16. The demand for petroleum has recorded a considerable increase over the last few years due to the development activities in the country in the last few years.

During the year 2016-17, the consumption of petroleum products in India was 194.60 MMT with a growth of 5.37% as compared to consumption of 184.67 MMT during 2015-16. The consumption of petroleum products during April-November, 2017 was at 134.60 MMT i.e. an increase of 3.40% over 130.17 MMT in April-November, 2016

Therefore, India is largely dependent on import of petroleum goods to meet its requirements. Vedanta's proposed exploratory drilling project could possibly result in the discovery of hydrocarbon and in that case, would help in reducing India's dependence on imports.

2.4.2 Imports

Import of crude oil during 2016-17 was 213.93 MMT valued at 470159 crore as against import of 202.85 MMT valued at 416579 crore in 2015-16 which marked an increase of 5.46% in quantity terms and 12.86% in value terms as compared to the import of crude oil during 2015-16. Import of Crude Oil during April-November, 2017 was 144.72 MMT valued at 3,42,673 crore which marked an increase of 9.31% in quantity terms and 15.32% in value terms as against the imports of 143.81 MMT valued at 2,97,161 crore for the same period of last year.

2.5 Import versus indigenous production and export

India imports more than 80% of the petroleum products of its daily requirement.

2.6 Domestic Markets

The Oil & Gas, if there is commercially viable discovery and subsequent development, will be utilized for domestic purpose only. There is enough demand in domestic market.

2.7 Employment generation

The seismic survey is expected to take about 6 to 8 months and will require a crew of approximately 60 to 80 persons. Most of the workforce will be from local/nearby areas. During the site preparation for drilling, approximately 30-35 workmen will be employed per drill site. It is anticipated that, at any given time, there will be about 80-100 personnel working on site including technical staff, drilling crew, security staff etc.

3 Project Description

3.1 Type of project

The proposed project is a green field project. There is no interlinked and inter-dependent project.

3.2 Location with co-ordinates

The block CY-OSHP-2017/1 covers an area of 1794 Sq. Km consisting of 139 sq. km of Viluppuram (Tamilnadu), 2 Sq. km of Puducherry & 1654 Sq. Km of sea portion of Bay of Bengal.

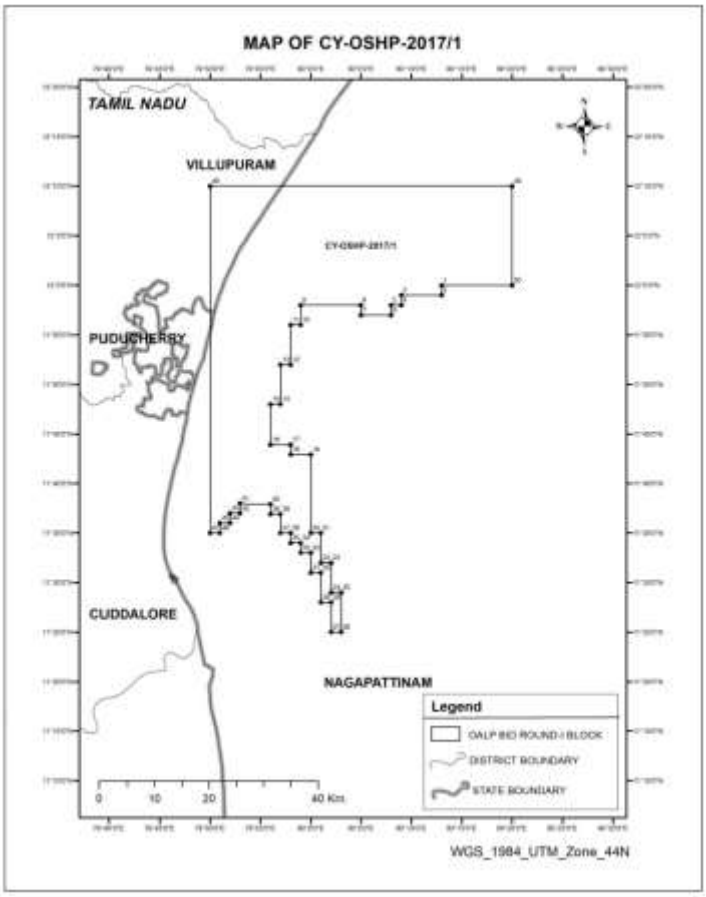


Figure 1 - Location map of block CY-OSHP-2017/1 with state and district boundary

Points	Longitude	Latitude		Points	Longitude	Latitude
1	80° 13'	12° 0'		26	80° 3'	11° 25'
2	80° 13'	11° 59'		27	80° 2'	11° 25'
3	80° 9'	11° 59'		28	80° 2'	11° 28'
4	80° 9'	11° 58'		29	80° 1'	11° 28'
5	80° 8'	11° 58'		30	80° 1'	11° 31'
6	80° 8'	11° 57'		31	80° 0'	11° 31'
7	80° 5'	11° 57'		32	80° 0'	11° 33'
8	80° 5'	11° 58'		33	79° 59'	11° 33'
9	79° 59'	11° 58'		34	79° 59'	11° 34'
10	79° 59'	11° 56'		35	79° 58'	11° 34'
11	79° 58'	11° 56'		36	79° 58'	11° 35'
12	79° 58'	11° 52'		37	79° 57'	11° 35'
13	79° 57'	11° 52'		38	79° 57'	11° 37'
14	79° 57'	11° 48'		39	79° 56'	11° 37'
15	79° 56'	11° 48'		40	79° 56'	11° 38'
16	79° 56'	11° 44'		41	79° 53'	11° 38'
17	79° 58'	11° 44'		42	79° 53'	11° 37'
18	79° 58'	11° 43'		43	79° 52'	11° 37'
19	80° 0'	11° 43'		44	79° 52'	11° 36'
20	80° 0'	11° 35'		45	79° 51'	11° 36'
21	80° 1'	11° 35'		46	79° 51'	11° 35'
22	80° 1'	11° 32'		47	79° 50'	11° 35'
23	80° 2'	11° 32'		48	79° 50'	12° 10'
24	80° 2'	11° 29'		49	80° 20'	12° 10'
25	80° 3'	11° 29'		50	80° 20'	12° 0'

Table 1: Co-ordinates of block CY-OSHP-2017/1

For the supply of equipment, consumable, food, water and fuel may be sourced from Karaikal Port.

Physical and Geographical Features near to the CY-OSHP-2017/1 Block

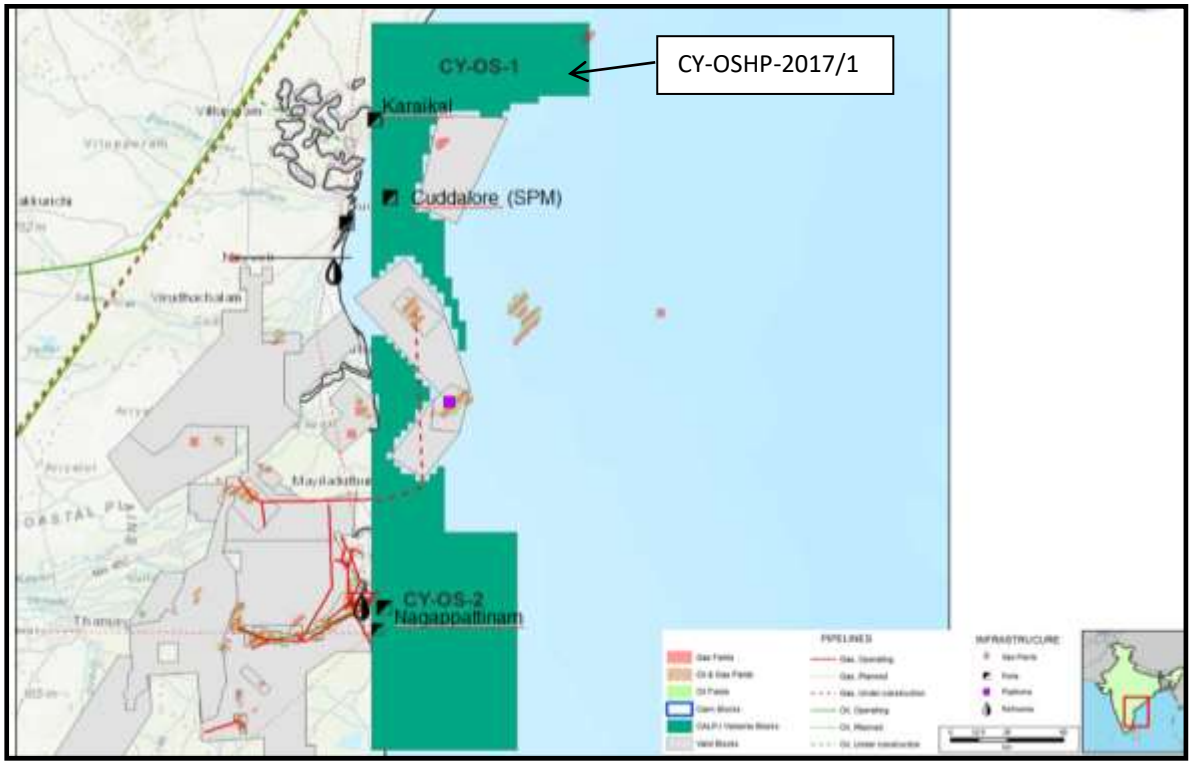


Figure 1: Location of the Block CY-OSHP-2017/1

3.3 Details of alternate site considered and the basis of selecting the proposed site

The block is allocated by the Government of India under the Revenue Sharing Contract (RSC). Vedanta Ltd. (Cairn Oil & Gas) is the Operator for this block. Drilling locations are proposed based on geo-scientific information and alternate sites cannot be considered for the proposed project facilities due to the following reasons:

The location is within the existing RSC boundary of the block. The locations of wells are selected considering the drilling configuration (reach to reservoirs), potential source of hydrocarbon as general environmental & social factors.

3.4 Size/ magnitude of operation

The proposed offshore oil and gas exploration (including Appraisal) is expected to carry out

- Seismic data acquisition
- Drilling of 116 exploratory (including appraisal) wells and testing
- The well depth may vary from 2000-5000m depth.

3.5 Project description with process details

3.5.1 2D & 3D Seismic survey:

Seismic surveys are a primary tool utilized during the exploration of hydrocarbons over land and water. A seismic survey is conducted by creating an energy wave commonly referred to as a 'seismic wave' on the surface of the ground/ over water along a predetermined line, using an energy source. The seismic method employed an acoustic source and acoustic receivers connected to a recording system. During the seismic data, acquisition the source and receivers were advanced along the identified seismic line and the reflected data recorded from the receiver for every shot point (SP). By considering the travel times to the various receivers from each source along with the sound wave velocity in the rocks, the paths of the seismic sound waves had been reconstructed. The travel times

normally is depended on the physical properties of the rocks and the attitudes of the beds. Thus, the recorded data on processing had provided images of the subsurface geology because of the way different rocks reflect sound differently. Seismic surveys are a primary tool utilized during the exploration of hydrocarbons over land and water.

Generally offshore seismic surveys are conducted by trawling arrays behind a ship which explodes every 10-15 seconds. By analyzing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface formations can be mapped and potential oil or gas deposits identified. Seismic surveys are acquired by laying out energy source points and receiver points (geophones in onshore or hydrophone in offshore in conventional seismic) in a grid over the area to be surveyed. The receiver points - to record the reflected vibrations from the source points - are laid down in parallel lines (receiver lines), and the source points are laid out in parallel lines that are approximately perpendicular to the receiver lines. The spacing of the source and receiver points is determined by the design and objectives of the survey.

In the transition zone area, Depending on the nature of the environment where the survey had been conducted, the source and receiver types had been chosen, viz., on a TZ seismic project more than one source and receiver types were employed to account for differing environment encountered. The receivers utilized in the survey included dual sensor groups in the shallow marine and deeper intertidal area, flush drilled hydrophones in the shallow intertidal area and marshy phone and geophone arrays in the exposed intertidal and land area. The above combination of receivers employed also aided to preserve frequency content through optimal signal/noise recordings. The results of infield data processing confirmed that all the above objectives have been met by the survey and that the selection of parameters was ideal.TZ seismic operations in marine environment used airguns and hydrophones. The airgun array is towed on a separate source boat and the hydrophones either sits on the seafloor on cables deployed by small boats or are flushed into the mud in inundated intertidal areas. The marine cables are connected to a recorder housed on a small vessel, which stays anchored just off the line.TZ and land operations required the use of small dynamite charges as a source and geophones as receivers. The dynamite charges are drilled into the ground and the geophones are “planted” into the ground before connection to land cables and the land recorder, which stays just off the line during recording.

The land and marine recorders are in radio contact with the source boat and land shooting crews and the taking of land and marine shots are synchronized at the recorders.

The objective of seismic exploration is to deduce information about the rocks from the observed arrival times together with variations in amplitude and frequency. It is the interpretation of the resultant imagery that allows oil and gas companies, to make decisions on further exploration and development drilling in an area.

3.5.2 Drilling activity

3.5.2.1 Location & description of drilling of exploration & appraisal wells

The locations for the drilling of wells will be fixed once the detailed interpretation of the acquired seismic survey is over. However, the wells will be strictly confined within the acquired block itself. Since the exact drilling locations are yet to be determined, the details of the block location are provided herewith. The acquired exploratory block CY-OSHP-2017/1 is situated in Bay of Bengal, Puducherry & Villupuram District of Tamil Nadu. The tentative drilling locations are presented on Survey of India topo sheet and satellite image **(Figure-2 & 3).** The tentative co-ordinates of the wells are given in the **Table 2.**

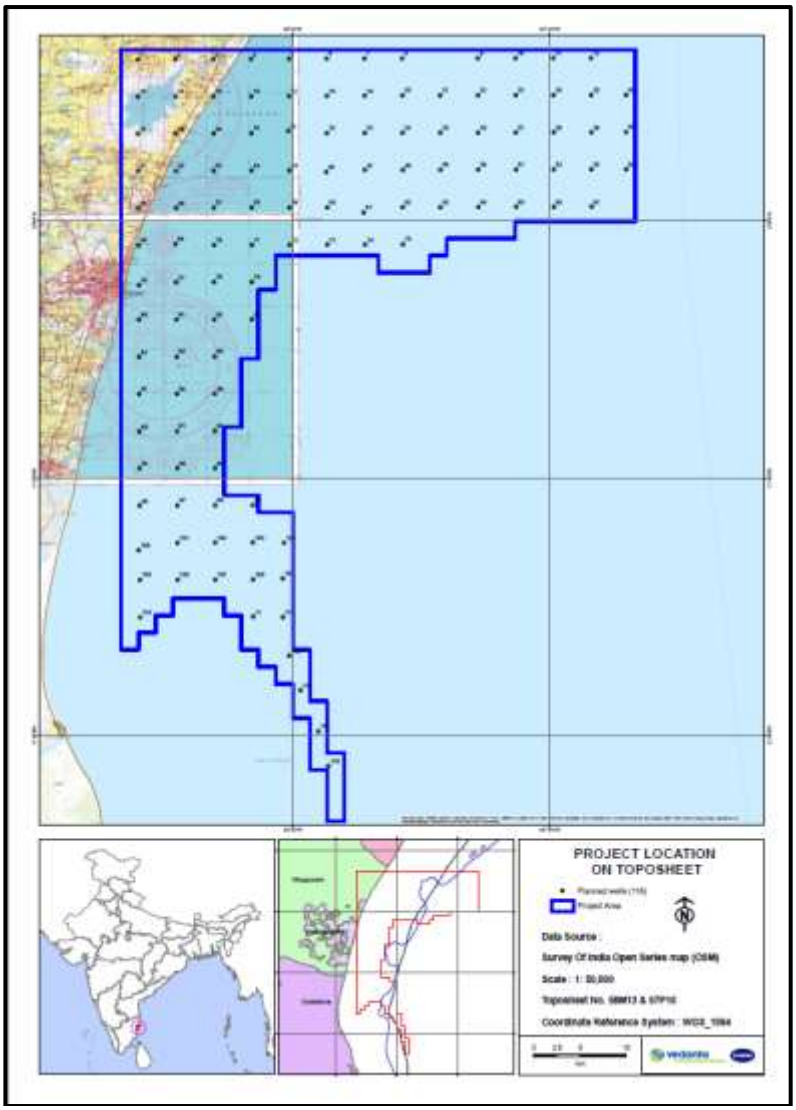


Figure-3: The drilling locations in Survey of India Toposheet

Figure 4: Tentative Location of proposed well location on satellite map

Table 2: Tentative co-ordinate of the wells in CY-OSHP-2017/1

Well ID	Longitude	Latitude
1	79° 50' 57.368" E	12° 9' 26.564" N
2	79° 53' 9.700" E	12° 9' 27.106" N
3	79° 55' 22.035" E	12° 9' 27.630" N
4	79° 57' 34.370" E	12° 9' 28.137" N
5	79° 59' 46.708" E	12° 9' 28.626" N
6	80° 1' 59.047" E	12° 9' 29.098" N
7	80° 4' 11.387" E	12° 9' 29.552" N
8	80° 6' 23.729" E	12° 9' 29.988" N
9	80° 10' 48.417" E	12° 9' 30.808" N
10	80° 13' 0.763" E	12° 9' 31.192" N
11	80° 15' 13.110" E	12° 9' 31.558" N
12	80° 17' 25.459" E	12° 9' 31.906" N
13	79° 50' 57.927" E	12° 7' 16.367" N
14	79° 53' 10.242" E	12° 7' 16.907" N
15	79° 55' 22.558" E	12° 7' 17.430" N
16	79° 57' 34.876" E	12° 7' 17.935" N
17	79° 59' 47.195" E	12° 7' 18.423" N
18	80° 1' 59.517" E	12° 7' 18.893" N
19	80° 4' 11.839" E	12° 7' 19.346" N
20	80° 6' 24.163" E	12° 7' 19.781" N
21	80° 8' 36.489" E	12° 7' 20.198" N

Table 2: Tentative co-ordinate of the wells in CY-OSHP-2017/1

Well ID	Longitude	Latitude
22	80° 10' 48.816" E	12° 7' 20.598" N
23	80° 13' 1.144" E	12° 7' 20.981" N
24	80° 15' 13.473" E	12° 7' 21.346" N
25	80° 17' 25.804" E	12° 7' 21.693" N
26	80° 19' 27.027" E	12° 7' 22.023" N
27	79° 50' 58.484" E	12° 5' 6.169" N
28	79° 53' 10.781" E	12° 5' 6.708" N
29	79° 55' 23.079" E	12° 5' 7.229" N
30	79° 57' 35.380" E	12° 5' 7.733" N
31	79° 59' 45.143" E	12° 5' 16.230" N
32	80° 1' 59.985" E	12° 5' 8.688" N
33	80° 4' 12.290" E	12° 5' 9.139" N
34	80° 6' 24.596" E	12° 5' 9.573" N
35	80° 8' 36.904" E	12° 5' 9.989" N
36	80° 10' 49.213" E	12° 5' 10.388" N
37	80° 13' 1.523" E	12° 5' 10.769" N
38	80° 15' 13.834" E	12° 5' 11.133" N
39	80° 17' 26.147" E	12° 5' 11.479" N
40	80° 19' 27.353" E	12° 5' 11.808" N
41	79° 50' 59.039" E	12° 2' 55.972" N
42	79° 53' 11.318" E	12° 2' 56.509" N
43	79° 55' 23.599" E	12° 2' 57.028" N
44	79° 57' 35.882" E	12° 2' 57.530" N
45	79° 59' 48.166" E	12° 2' 58.015" N
46	80° 1' 57.728" E	12° 2' 52.362" N
47	80° 4' 12.738" E	12° 2' 58.932" N
48	80° 6' 25.027" E	12° 2' 59.365" N
49	80° 8' 37.317" E	12° 2' 59.780" N
50	80° 10' 49.608" E	12° 3' 0.177" N
51	80° 13' 1.901" E	12° 3' 0.557" N
52	80° 15' 14.195" E	12° 3' 0.920" N
53	80° 17' 26.490" E	12° 3' 1.265" N
54	80° 19' 27.678" E	12° 3' 1.593" N
55	79° 50' 59.593" E	12° 0' 45.773" N
56	79° 53' 11.854" E	12° 0' 46.309" N
57	79° 55' 24.117" E	12° 0' 46.827" N
58	79° 57' 36.382" E	12° 0' 47.327" N
59	79° 59' 48.649" E	12° 0' 47.811" N
60	80° 2' 0.917" E	12° 0' 48.276" N
61	80° 4' 9.021" E	12° 0' 30.675" N
62	80° 6' 25.457" E	12° 0' 49.156" N
63	80° 8' 37.729" E	12° 0' 49.570" N

Table 2: Tentative co-ordinate of the wells in CY-OSHP-2017/1

Well ID	Longitude	Latitude
64	80° 10' 50.003" E	12° 0' 49.966" N
65	80° 13' 2.278" E	12° 0' 50.345" N
66	80° 15' 14.554" E	12° 0' 50.707" N
67	80° 17' 26.831" E	12° 0' 51.051" N
68	79° 51' 0.145" E	11° 58' 35.575" N
69	79° 53' 9.804" E	11° 58' 40.336" N
70	79° 55' 24.634" E	11° 58' 36.625" N
71	79° 57' 36.881" E	11° 58' 37.124" N
72	79° 59' 49.130" E	11° 58' 37.606" N
73	80° 2' 1.380" E	11° 58' 38.070" N
74	80° 4' 13.632" E	11° 58' 38.517" N
75	80° 6' 25.885" E	11° 58' 38.947" N
76	79° 51' 0.856" E	11° 56' 16.984" N
77	79° 53' 12.921" E	11° 56' 25.908" N
78	79° 55' 25.149" E	11° 56' 26.423" N
79	79° 57' 37.378" E	11° 56' 26.921" N
80	79° 51' 1.243" E	11° 54' 15.177" N
81	79° 53' 13.452" E	11° 54' 15.707" N
82	79° 55' 25.662" E	11° 54' 16.221" N
83	79° 57' 37.874" E	11° 54' 16.717" N
84	79° 51' 1.789" E	11° 52' 4.978" N
85	79° 53' 13.980" E	11° 52' 5.506" N
86	79° 55' 26.173" E	11° 52' 6.018" N
87	79° 51' 2.334" E	11° 49' 54.778" N
88	79° 53' 14.508" E	11° 49' 55.305" N
89	79° 55' 26.683" E	11° 49' 55.815" N
90	79° 51' 2.877" E	11° 47' 44.578" N
91	79° 53' 15.033" E	11° 47' 45.103" N
92	79° 55' 27.191" E	11° 47' 45.611" N
93	79° 51' 3.418" E	11° 45' 34.377" N
94	79° 53' 15.557" E	11° 45' 34.901" N
95	79° 55' 27.698" E	11° 45' 35.408" N
96	79° 51' 3.957" E	11° 43' 24.176" N
97	79° 53' 16.079" E	11° 43' 24.699" N
98	79° 55' 28.203" E	11° 43' 25.204" N
99	79° 57' 40.328" E	11° 43' 25.692" N
100	79° 51' 0.329" E	11° 40' 47.594" N
101	79° 53' 16.599" E	11° 41' 14.496" N
102	79° 55' 28.706" E	11° 41' 14.999" N
103	79° 57' 40.814" E	11° 41' 15.486" N
104	79° 59' 30.037" E	11° 41' 14.266" N
105	79° 51' 5.030" E	11° 39' 3.774" N

Table 2: Tentative co-ordinate of the wells in CY-OSHP-2017/1		
Well ID	**Longitude**	**Latitude**
106	79° 53' 17.118" E	11° 39' 4.293" N
107	79° 55' 29.207" E	11° 39' 4.795" N
108	79° 57' 41.299" E	11° 39' 5.280" N
109	79° 59' 25.483" E	11° 39' 8.686" N
110	79° 51' 5.564" E	11° 36' 53.572" N
111	79° 57' 41.781" E	11° 36' 55.073" N
112	79° 59' 25.949" E	11° 36' 54.071" N
113	79° 59' 47.663" E	11° 34' 38.110" N
114	80° 0' 27.405" E	11° 32' 37.869" N
115	80° 1' 29.524" E	11° 30' 14.125" N
116	80° 2' 4.810" E	11° 28' 12.953" N

Note: Actual geographical surface co-ordinates of the exploratory and appraisal well location will be within 4000m radius of the proposed location.

3.5.2.2. Exploratory and Appraisal well Drilling Process

a) Site Selection

The exploration history of the area exhibits the potential presence of the oil and gas in the region. The exact location of the wells has not been finalized, and the seismic data interpretation of the seismic survey would decide the exact locations of the drilling well.

b) Land requirement

For Onshore drilling activities, an area of about 300m X 300m would be taken on temporary lease basis for the construction of well pad, drill site, etc.For the preparation of suitable access roads connecting to well pads, laying of infield interconnecting pipelines, OHL and laying pipelines for utilities in future, a width of 30m RoU (approx.) will be required. Wherever needed, infield interconnecting pipeline will be laid.

c) Site & Access road preparation

The site is already well connected with the state highways. The internal village roads will be strengthened for transportation of machineries, equipment's and drilling crew members. Additionally strengthening of the existing approach road to the site can be done if required for transportation of drilling rig & associated equipment. In general, movement of drilling rig and ancillary equipment would involve around 20-25 truck load for approximately one and half years. A provision will be kept for parking of these cars within the developed site or its nearby area.

d) Drilling Activities

Initial Well Construction

Wells will be drilled in sections, with the diameter of each section decreasing with increasing depth. Before commencing the actual drilling, large diameter pipe (Conductor) will be lowered into a hole and cemented/grouted. Conductor pipes provide a conduit for the return fluid during drilling next section and also prevent whole unconsolidated material falling into hole and potential washout problems. Typical depths of such pipes are 6m. The lengths and diameters of each section of the well will be determined prior to the starting of the drilling activities and are dependent on the geological conditions through which the well is to be drilled. Once each section of the well is completed, the

drill string is lifted and protective steel pipe or casing lowered into the well and cemented into place. The casing helps to maintain the stability of the hole and reduce fluid losses from the well bore into surrounding rock formations.

The Drilling Process

The exploitation of hydrocarbons requires the construction of a conduit between the surface and the reservoir, which is achieved by the drilling process. All the exploration wells within the block will be drilled using an Electric Land Rig of around 1200-1500 HP capacity, equipped with a Rotary/Top Drive System. The typical configuration of a Drilling Rig along with the layout plan is shown in the Figure 4.

To support the drilling operation, the following systems and services will be included at the rig package:

- Portable Living Quarters – to house essential personnel on site on a 24 hr basis. These units are provided with Bath/Washroom.
- Crane-age - cranes for loading/off loading equipment and supplies.
- Emergency Systems - it includes fire detection and protection equipment.
- Environmental Protection – Blow out Prevention (BOP) system, wastewater treatment unit, cuttings handling equipment.

Additionally, there will be other ancillary facilities like Drilling mud system, ETP,Cuttings disposal, Drill Cementing equipment etc. and utilities to supply Power (DGsets), water, fuel (HSD) to the drilling process and will be set up as a part of the project.

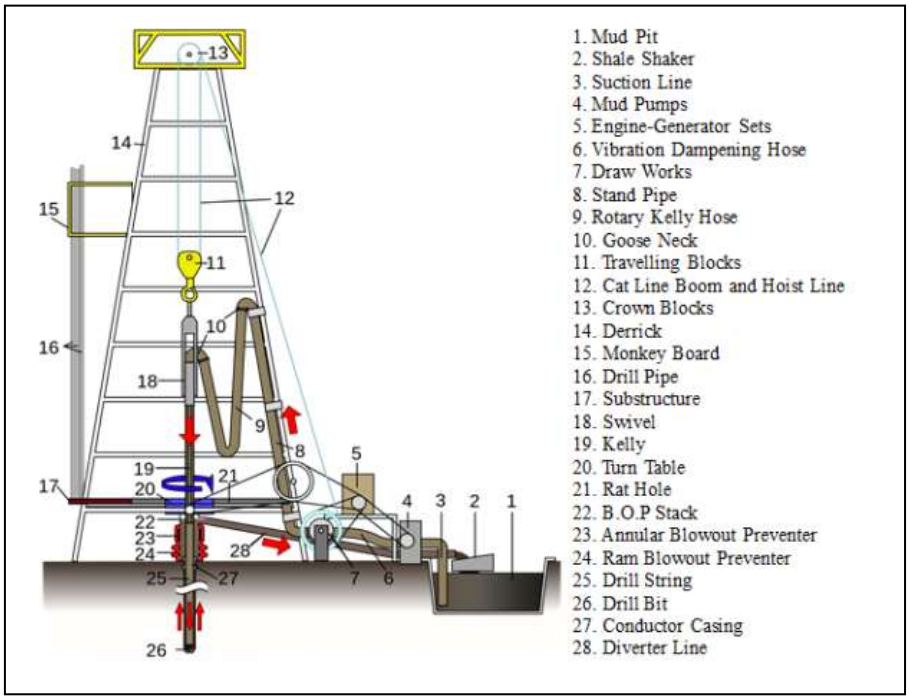


Figure 5: Typical configuration of a Drilling Rig

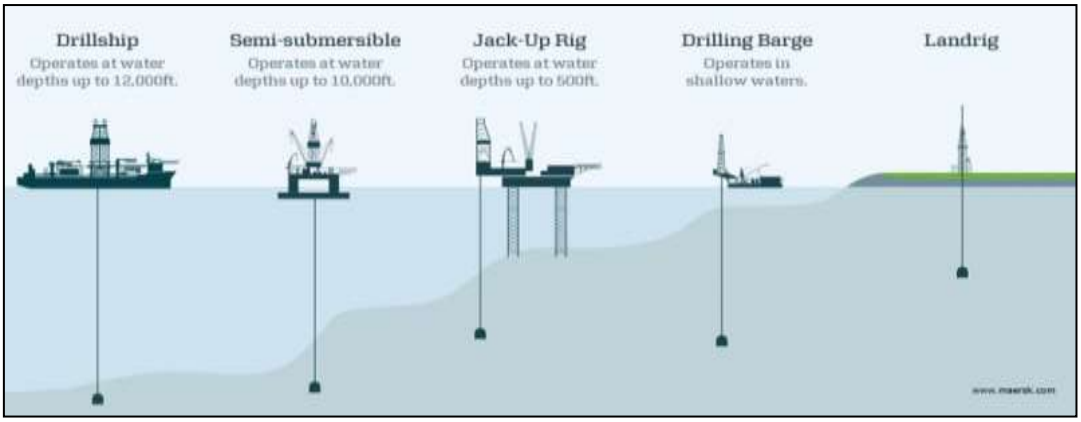


Figure 6: Type of drilling rigs used, based on water depth

Jack up Rig

A drilling process for development (infill production) and exploration and appraisal wells is similar. Jack up rig will be used in both cases - mat supported jack up or independent leg jack-up may be deployed where water depth is lesser than 100m. Rig suitability study findings will confirm on the type of rig to be utilized for drilling offshore wells.

Figure 7: A Typical View of Jack-up Rig

A Jack up rig is an offshore structure composed of a hull, legs and a lifting system that allows it to be towed to a site, lower its legs into the seabed and elevate its hull to provide a stable work deck. The hull of a jack up rig is a watertight structure that supports or houses the equipment, systems, and personnel, thus enabling the jack up rig to perform its tasks. When the jack up rig is afloat, the hull provides buoyancy and supports the weight of the legs and footings (spud cans), equipment, and variable load. The legs and footings of a jack up rig are steel structures that support the hull when the rig is in the elevated mode and provide stability to resist lateral loads. Footings are needed to increase the soil bearing area thereby reducing required soil strength. The legs and footings have certain characteristics which affect how the Unit reacts in the elevated and afloat modes, while going on location and in non-design events. When in the elevated mode, the legs of a jack up rig are subjected to wind, wave, and current loadings.

There are three main groups of equipment on a jack-up rig, the marine equipment, mission equipment, and elevating equipment. Marine equipment are not directly involved in drilling however are used for movement, positioning and communications. Marine equipment include items such as main diesel engines, fuel oil piping, electrical power distribution switchboards, lifeboats, radar, communication equipment, galley equipment, etc. Mission equipment refers to aboard a jack up rig, which are necessary for the jack up to complete the drilling process. Mission Equipment includes derricks, mud pumps, mud piping, drilling control systems, production equipment, cranes,

combustible gas detection and alarms systems, etc. Elevating equipment refers to the equipment and systems aboard a jack up rig which are necessary for the jack up to raise, lower, and lock-off the legs and hull of the jack up.

Semi-Submersible Rig

A semisubmersible is a MODU designed with a platform-type deck that contains drilling equipment and other machinery supported by pontoon-type columns that are submerged into the water. Another type of drilling rig that can drill in ultra-deep waters, drill ships are capable of holding more equipment; but semisubmersibles are chosen for their stability. The design concept of partially submerging the rig lessens both rolling and pitching on semisubs. Offshore drilling in water depth greater than around 100 meters requires that operations be carried out from a floating vessel, since fixed structures are not practical. With its hull structure submerged at a deep draft, the semi-submersible is less affected by wave loadings than a normal ship. The semi-submersible vessel was developed because of the need for vessels that could stay afloat and carry out their required functions in the high seas amidst the constant movement of the waves. Semi-submersible rigs make stable platforms for drilling for offshore oil and gas. They can be towed into position by atugboat and anchored, or moved by and kept in position by their own azimuth thrusters with dynamic positioning. In simple terms, the semi-submersible vessel is supported by way of pontoons which are located under the water surface. Semisubmersibles do not rest on the sea floor like jack-up rigs. Instead, the working deck sits atop giant pontoons and hollow columns. These float high in the water when the rig is moved. At the drill site, the crew pumps seawater into the pontoons and columns to partially submerge the rig, hence the name semisubmersible. With much of its bulk below the water's surface, the semisubmersible becomes a stable platform for drilling, moving only slightly with wind and currents (this is termed wave transparency). Like jack-ups, most semisubmersibles are towed to the drill site.

Because of their exceptional stability, "semis" are well suited for drilling in rough waters. Semisubmersibles can drill in water as deep as 10,000 feet. Because semis lack the legs of a jack-up, they must have a means of maintaining their position over the well during drilling. This is accomplished using either an eight or 12 point anchoring (mooring) systems. In deeper waters, some semis employ dynamic positioning (DP) systems to replace or supplement the mooring system. DP systems employ computer-controlled motor-driven propellers, called "thrusters," to adjust for the action of winds and waves. They respond automatically to satellite GPS signals coordinated with acoustic beacons placed on the sea floor.

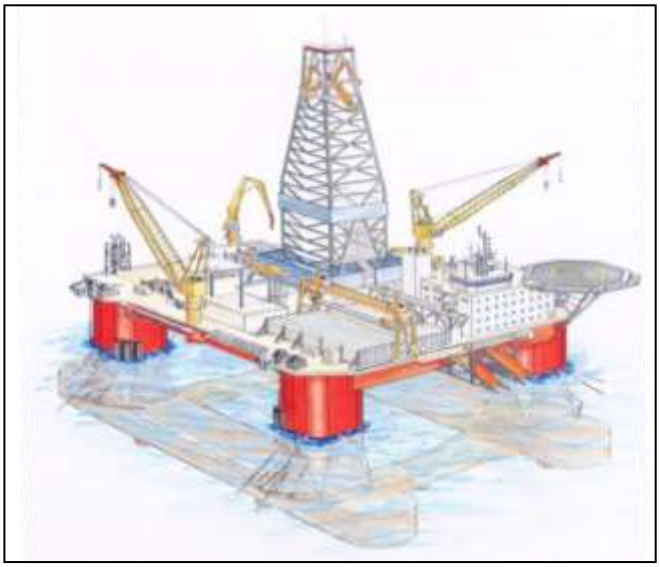


Figure 8: A Typical View of Semi-Submersible Rig

Mud System and Cuttings

During drilling operations a fluid known as drilling fluid (or 'mud') is pumped through the drill string down to the drilling bit and returns between the drill pipe – casing annulus up to surface back into the circulation system after separation of drill cuttings /solids through solids control equipment. Drilling fluid is important to the operation of drilling rig, as it performs the following functions:

Control the down hole pressure;

- Lift soil/rock cuttings from the bottom of the borehole and carry them to a settling pit;
- Allow cuttings to drop out in the mud pit so that they are not re-circulated (influenced by mud thickness, flow rate in the settling pits and shape/size of the pits);
- Prevent cuttings from rapidly settling while another length of drill pipe is being added (if cuttings drop too fast, they can build up on top of the bit and seize it in the hole);
- Create a film of small particles on the borehole wall to prevent caving and to ensure that the upward flowing stream of drilling fluid does not erode the adjacent formation;
- Seal the borehole wall to reduce fluid loss (minimizing volumes of drilling fluid is especially important in dry areas where water must be carried from far away);
- Cool and clean the drill bit; and
- Lubricate the bit, bearings, mud pump and drill pipe.

It has been decided that a uniform environment-friendly water-based mud system will be used for all the four exploratory wells. Unlike an oil-based mud system, the use of water based mud will not pose higher risk of contamination to subsurface formations, but the disposal of the fluid and the cuttings will be less problematic. Because of the anticipated borehole instability problems it may be necessary to introduce a base salt, such as Potassium Sulphate (K2SO4) into the system. Base salt additions will only be considered after all commonly accessed freshwater aquifers have been securely cased and cemented off. The mud used during the operation will flush out formation cuttings from the well hole. These cuttings will be separated from the drilling mud using a solids-control and waste management package. This will comprise a stepped system of processes consisting of linear motion vibrating screens called shakers and centrifuges to mechanically separate cuttings from the mud fluid. The mud from the hole is first screened in the shakers through a mud flow line which separates 100 micron size of cuttings. The solids up to 2micron are separated in a centrifuge. The mud is then collected in mud tanks I & II (Refer Figure 3-9).Both the cuttings from the shale shakers and centrifuge are collected in a solid discharge pit and then removed to a specially designed pit lined with HDPE of 20m x25m x1.5m dimension. This cuttings pit has a certain slope to drain off water in the adjacent waste pit. This pit after being filled up shall be covered with an impervious liner over which a thick layer of native top-soil with proper top slope will be provided. The total amount of mud cuttings produce during the entire drilling period is projected to be about 800 MT per well. Once the cuttings have been separated, the drilling fluid will be reused or processed after further treatment in a chemically enhanced dewatering (CED) system designed to remove suspended solids that are too fine for mechanical separation in the solids control package. The CED system comprises a chemical mixing and dosing unit and decanting centrifuges. The unusable portion of the drilling mud after dewatering shall be disposed on-site in a lined pit (HDPE 1-1.5mm thickness) conforming to the regulatory requirements. The drilling and wash waste water will be confined to a similar HDPE lined waste pit and then disposed into nearby natural drain after adequate treatment complying with the notified standards for disposal. Dilution in case of marginal excess of standards can be ensured prior to disposal conforming to regulatory requirements. The whole process by which the drilling fluid will be reused during the drilling operation is commonly known as a "closed loop system." This system is ideal for drilling operations in those areas, where

water availability is comparatively less as it cuts down the total water consumption for the formulation of drilling mud and also saves the consumption of chemicals. The drilling fluid circulation system is likely to be considered to enable the drilling fluid to be recycled and maintained in good condition throughout the operation. Figure 3-14 shows the schematic layout of drilling mud & solids discharge involved as a part of the drilling system for exploratory wells.

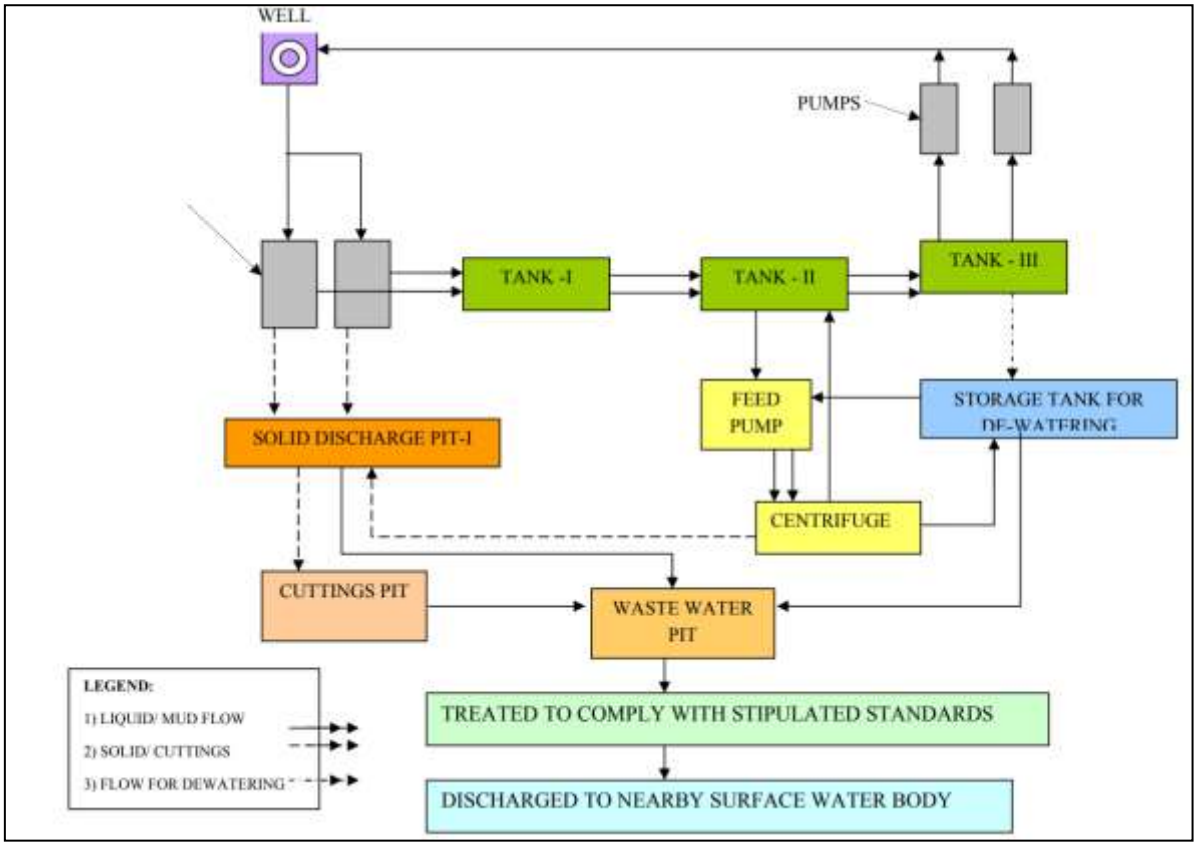


Figure 9: Flow Chart for Drilling Mud & Solid Discharge

Well Evaluation

During the drilling operations for different zones, logging operations will be undertaken to get information on the potential type and quantities of hydrocarbons present in the target formations. Technicians employed by a specialist logging Service Company do well logging by different well logging techniques including electric, sonic and radioactive techniques. Logging instruments (sensors) are attached to the bottom of a wire line and lowered to the bottom of the well and they are then slowly brought back. The devices read different data as they pass each formation and record it on graphs, which will be interpreted by the geologist, geophysicist and drilling engineer. No emissions to the environment or any environmental harm is associated with wire line logging operations. The radioactive source required for well logging operations will be kept in specially designed container. In this drilling procedure, once the drilling is over, the well evaluation will be done by using electric wire line logs to assess the potential of the reservoir. This typically involves sampling the reservoir formation and pressure points during logging operations and reduces the requirement to flow hydrocarbons to the surface, significantly reducing the atmospheric emissions associated with the testing operation. Normally, in the event that hydrocarbons are encountered in sufficient quantities, as determined by electric wire line logs, a temporary drill stem test string may be run and the well fluids flowed to surface and processed using a surface well testing package, involving the oil being stored and trucked off the site and associated gas being flared to atmosphere.

Hydraulic Fracturing – for Tight Rock Reservoirs of Hydrocarbons

Hydraulic fracturing is used in tight rock reservoirs with low permeability, such as shale (i.e., the conductivity or ability of hydrocarbons to flow in the formation is low because of the small pore size in the rock). The goal of hydraulic fracturing in tight reservoir (shale) formations is to enable a well to produce the resource or to increase the rate at which a well is able to produce the resource. Hydraulic fracturing may be conducted in wells with low permeability formation and low pressure. Wells requiring hydraulic fracturing and numbers of stages of hydraulic fracturing per well will depend on seismic data acquired & interpreted and data acquired during the drilling phase of the project.

Hydraulic fracturing is a common technique used to stimulate the production of oil and natural gas by creating fractures or cracks that extend from the well hole into the rock formations. This is accomplished by injecting fluid, which is usually a mixture of water and high viscosity fluid additives, under extremely high pressure. The pressure of the water will then exceed the strength of the rock, causing fractures to enlarge. After the fractures take place, a "propping agent" known as proppant (which is usually sand) is injected into the fractures to keep them from closing. This allows the hydrocarbon to move more efficiently from the rock to the well. A single well may require up to 15,000 m^3 of water which may vary depending on the fracking requirements. For the hydraulic fracturing in a well, proppant mass of 150,000 – 200,000 lbs per stage and fluid volume of 2500 bbls – 4000 bbls per stage will be required.

Fracturing effluent generated will be discharged in the HDPE lined pits at the drilling well sites. Additional land will be procured wherever required. For effective recycling and reuse of the frac fluid, effluent treatment plant (ETP) will be installed, thus raw water required for fracturing will be minimized.

Appraisal

When, exploratory drilling is successful, more wells (termed as Appraisal wells) will be drilled to determine the size and the extent of the field. Wells drilled to quantify the hydrocarbon reserves found are called as 'appraisal' wells. The appraisal activity will be carried out with an aim to evaluate the size and nature of the reservoir, to determine the number of confirming or appraisal wells required, and whether any further seismic survey is necessary. The technical procedures and activities in appraisal drilling will be the same as those employed for exploration wells. A number of wells may be drilled from a single well pad/ drill site. Deviated or directional drilling at an angle from a site adjacent to the original discovery well may be used to appraise other parts of the reservoir, in order to reduce the land requirement.

Well Testing & Flaring

During the exploration and appraisal drilling, where a hydrocarbon formation is found, initial well tests (generally about one month of duration) will be carried out to establish flow rates, formation pressure and other parameters. However, depending on the need, based on nature of the reservoirs, the exploratory and appraisal wells will be tested for longer/extended durations to ascertain the reservoir parameters. During the well testing, crude oil, natural gas and produced water could be generated and will be treated/ disposed appropriately. Hydrocarbons will be flared. Efficient test flare burner will be used to minimize incomplete combustion. As an alternative option, if feasible, crude oil/ slop oil will be transferred to nearby refinery (terminals/depots) for processing or will be sent to a SPCB authorized recyclers.

Completion of Drilling

On completion of activities, the well will be either plugged and suspended (if the well evaluations indicate commercial quantities of hydrocarbons) or will be killed and permanently abandoned. In the event of a decision to suspend the well, it will be filled with a brine solution containing very small

quantities of inhibitors to protect the well. The well will be sealed with cement plugs and some of the wellhead equipment (Blind Flange) will be left on the surface (Cellar). If the well is abandoned it will be sealed with a series of cement plugs, all the wellhead equipment will be removed, by leaving the surface clear of any debris and the site will be restored.

Decommissioning & closure of wells

After the completion of the drilling activity, partial de-mobilization of the drilling rig and associated infrastructure will be initiated. As discussed earlier, well testing may be carried out immediately after the drilling is completed. The complete de-mobilization of the facilities at site will happen once well-testing completed successfully. This will involve the dismantling of the rig, all associated equipments and the residential camp, and transporting it out of the project area. It is expected that demobilization will take approximately 20-25 days and will involve the trucking away of materials, equipments and other materials from the site to bring it back to its original condition. It is estimated that about 50 truckloads will be transported out of site during this period. If no indication of any commercially viable amount of oil or gas is encountered either before or after testing, the well will be declared dry and accordingly will be plugged of and abandoned, and the site will be restored in line with regulations and good industry practice. The following steps will be typically involved to restore and rehabilitate the area:

- The wellhead and all ca/sing string will be cut off to a minimum depth of 3 m (10 ft) below ground level.
- All concrete structures will be broken up, and the debris disposed off as per the regulatory requirements.
- All other waste products, solid and liquid, will be disposed of in accordance with the requirements of the EIA and will be treated to render them harmless.
- All fencing and access gates will be removed.
- All pits whose contents will show regulatory compliance for on-site disposal, at the time of site closure, will be backfilled and closed out as per the legal requirements.
- Restoration of unusable portion of the access track, removal of pilings and landscaping.

3.6 Raw materials required and source

Multiple vessels will be used for seismic data acquisition for offshore. No raw materials are required during the seismic acquisitions.

Drilling related material like HSD, Steel (in the form of casings & tubulars) and chemicals like barite, oil well cement and bentonite will be required. Other production equipment like tubular (Casing and tubing), wellhead assembly, packer etc., and chemicals for mud and cementing required for the drilling operations and shall be procured by the company from within the country and from abroad before the commencement of operations.

Water based mud will be used for initial, shallower sections where massive shales are not encountered. The deeper and difficult to drill formations will be drilled using synthetic base mud (SBM). Synthetic base mud can be re-used. WBM typically consists of water, bentonite, polymers and barite. Other chemical additives viz. glycols and salts may be used in conjunction to mitigate potential problems related to hydrate formation.

3.7 Resource optimization / recycling and reuse envisaged in the project

Maximum care will be taken for resource optimization, wherever possible with an aim of

- Resource Conservation
- Elimination of Waste Streams

- Minimizing Waste
- Reuse /Recycle of Wastes
- The drill cuttings from the drilling operations associated with water based mud will be used for filling low lying areas as a sub grade construction material in construction of well pads and surface facilities.
- Synthetic base mud will be re-used in further drilling activities.

3.8 Water and power requirement

Water requirement

Water is required at the drilling location for drinking, domestic use and preparation of drilling mud. An estimated 20 -30 m^3 per day of water will be used for domestic consumption depending on the type of MODU used. Water used for the preparation of drilling mud is generally known as drill water. The quantity of drill water required for preparation of Water Based Mud (WBM) will be approximately 600 m^3 -1000 m3 per well, while for Synthetic Based Mud (SBM), approximate drill water requirement will be 150 m^3 -300 m3 per well. Water requirements for miscellaneous use like engine cooling, washing, firefighting storage etc. will be approximately 25-30 m3/day/well. For Onshore in case of extraction fo ground water permission (NOC) will be obtained from CGWA/CGWB (Central Ground Water Authority/Board).Installation of raw water treatment plant will be done depending on the need for process water and domestic water consumption. For offshore, Water for drilling purposes will be sourced partially from sea. Other remaining water requirements will be met by water supplied through supply vessels from the nearest port and will be stored in water storage tanks.

Power requirement

The required power supply will be generated from diesel generators at the seismic vessels.

B. Power requirement during Exploratory well drilling

The power requirement of offshore drill rig will be met by four (04) DG sets (including one as standby) (4*2000 KVA) with a diesel consumption of about 4 KL/day.

The power requirement of onshore drill rig will be 3*1000 KVA, 2*350 KVA for drilling campsite& 2*100KVA for radio room.

3.9 Quantity of waste water to be generated and its disposal

3.9.1 During Seismic Operation:

Insignificant amount of waste water will be generated from domestic use and the same shall be disposed through septic tanks/soak pits. The air emissions and generated noise will be also very insignificant and will be temporary in nature.

3.9.2 During Drilling Operations:

3.9.2.1 Waste water generation

The drilling operation would generate wastewater in the form of wash water due to washing of equipment, string and cuttings etc. The only other source of wastewater generated from drilling operation is sewage from sanitation facilities, around 15-25 m3/day/well, which shall be disposed through septic tanks/soak pits. It is expected that wastewater in the form of Drill cutting washing + Rig washing + cooling etc. shall be generated at an average rate of around 30 - 40 m3/day/well during the drilling operations from a single well. Waste water will be discharged in HDPE lined evaporation pit for disposal, size of the pit is generally 50m x 20m x 1.5m. The wash water would contain variable quantities of mineral salts, solids, suspended and dissolved hydrocarbons, and other organic and inorganic components in very minor quantities.

3.9.2.2 Solid Waste Management

The drill cuttings and spent drilling mud will be generated at site per well during drilling operations. This will be stored in well-designed HDPE line pit. It will be tested for its hazardous constituents (Oil and Grease), If found to be hazardous, It will be handed over to authorized TSDF. In case of Nonhazardous, it will be disposed insitu in HDPE lined pit.

Used /waste Oil – During the drilling approx. 1-2 tons/well of spent oil will be generated per well. This oil will be sent to authorized recyclers.

Domestic waste of 25-30 kg/day per well will be generated at site, which will be segregated at source (Organic / Inorganic) and disposed accordingly.

The expected waste generation from well drilling will be as per Table 1.8.

S.No	Nature of Waste	Quantity during Drilling Activities
A	**Hazardous Waste**	
1	Drill cuttings associated with WBM Drill cuttings associated with SBM	250-750 tons/well m3 per well 500-1500 tons/well
2	Spent /Residual drilling mud	250-500 tons/well
3	Used Lubricating oil, Sludge containing oil and other drilling work	1-2 tons/well 250-500 tons/well
B	**Non Hazardous Waste**	
4	Food waste	25-30 Kg per well
5	Non-combustible waste containing metallic residues, glass	1000-1200 Kg/well
6	Packaging wastes including drums, wooden pallets, plastic containers, plastic foils.	1000 kg/well
7	Left over chemicals and materials, scrap metal, sludges, scales, batteries, spent acids, spent lubricants, filters etc.	250-300 kg/well
8	Cement, grit, blasting and painting wastes.	500 kg per well

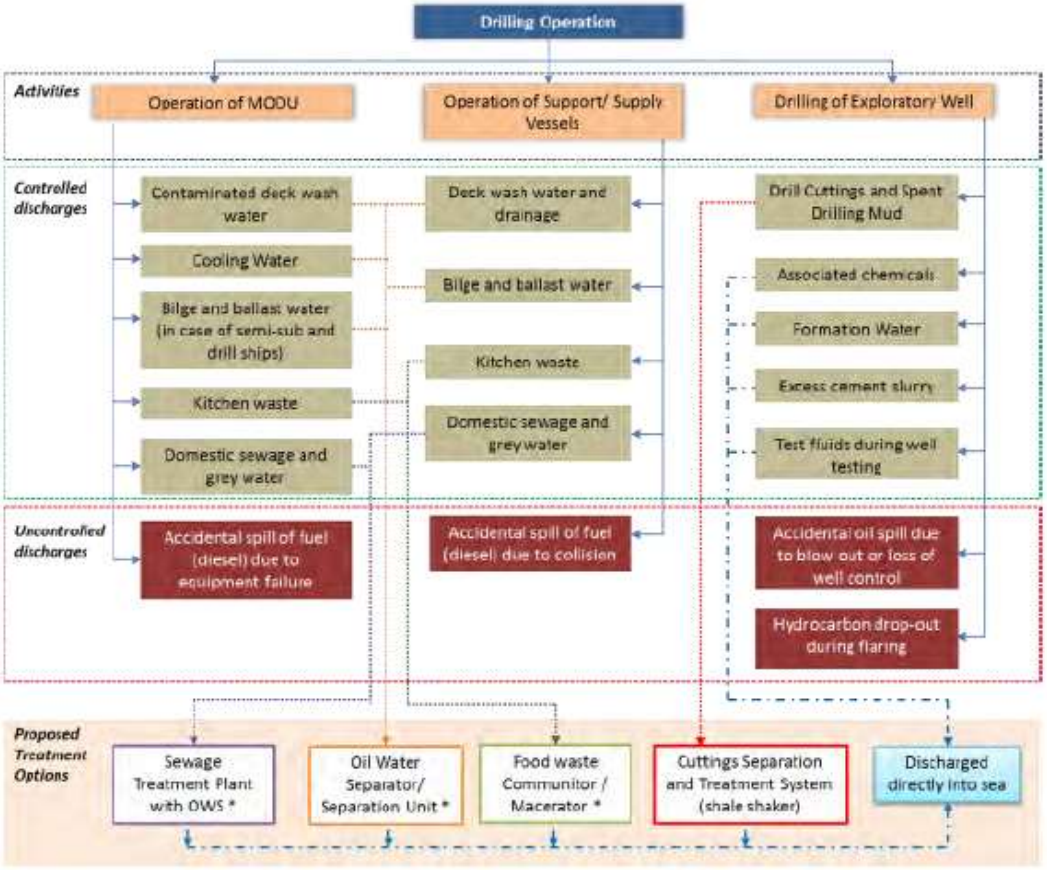
Disposal of wastes will be as per prior approval of State Pollution Control Board (SPCB).

Domestic wastewater from kitchen, shower, toilets and laundry area on board drilling rig will be approximately 15-25 m3/day. Domestic wastewater will be treated in on board Sewage treatment plant (STP). Bilge water consisting of rainwater/seawater containing diesel and oil will be 10m3/well. Bilge water will be collected into a sludge tank and then to a water/oil separator on board drilling rig before offshore disposal with less than 15 mg/l of oil and grease content.

The drilling of an offshore exploratory well and associated activities are likely to result in discharges into the sea water. Drilling activity generates drill cuttings and spent mud as the main discharges into sea. Other discharges to sea from the MODU and support vessels will comprise of food waste, bilge water, cooling water, deck drainage, sewage and grey water. While such discharges will be controlled, there may also be uncontrolled releases from drilling activities such as accidental oil spills and flare drop-out.

All discharges will be handled, treated and disposed as per the requirements of applicable Indian regulations/ standards and requirements of MARPOL Convention.

Various controlled and uncontrolled discharges to sea water and their proposed treatment options are listed below:



* *On board the respective MODU or support/supply vessel*

Figure 10: The figure denotes the various controlled and uncontrolled discharges to sea water and their proposed treatment options

3.10 Schematic of Feasibility Drawing

The typical layout of an onshore well pad/drill site for exploratory and appraisal well is as below:

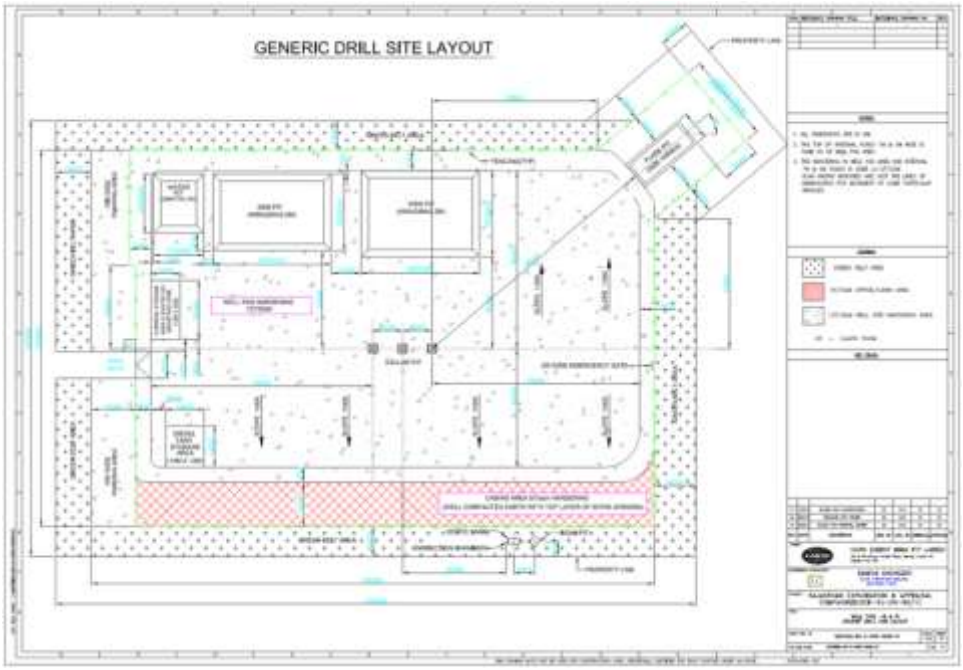


Figure 11: Schematic for a typical Well Pad

Each exploratory & appraisal well drill site will require the following:

- Potable office cabins / rest rooms (container type cubicles);
- Drilling rig foundation and cellar;
- Foundation / Pits for equipment;
- Space for drill rig equipment, working area and materials lay down area;
- Waste storage pits;
- Cutting disposal (impervious lined) pits;
- Solar evaporation pits (waste drilling fluid disposal);
- Water storage pit;
- Septic tank with soak pits;
- Paved and contained chemical storage area;
- Above ground Diesel storage tanks with paved and bunded area;
- Below ground level flare pit (well testing);
- Provisional space for definitive fracking program.
- Radio room;
- Storm water drainage system;
- Internal roads and fencing.

The drill site is restricted access area and is fenced all round with round the clock watch. Entry of vehicles into the drilling site area is prohibited except for material movement. Adequate parking are provided outside the drilling location.

4. Site Analysis

4.1 Connectivity

The project location is well connected by road, rail and by Air. Puducheery Railway Station is located at 0.6Km, West from the block, Cuddalore Port Railway Station is 7.33Km from the block boundary and Puducheery Airport is 3.61 Km, West from the block.

4.2 Land form, land use and land ownership

Most of the block area is in sea portion of Villupuram, Puducheery region and the land portion in the block is covered by natural lake/tank. Kaliveli Lake falls within block and Odusu Lake is 8.4 km from the block.

4.3 Topography

The most of the block area lies in offshore region and the balance is covered by water bodies. The topography map of nearby coastal areas has been shown in figure 3.4 of Chapter-3 in previous section.

4.4 Existing land use pattern and relative location of protected areas

The Project site falls within CRZ II & III, therefore requires CRZ Clearance under the CRZ Notification, 2019. No, Eco-sensitive area/national port/wildlife sanctuary falls within the block.

4.5 Existing infrastructure / industries

The land portion of block area is located in Villupuram and Puducherry districts and well equipped with existing infrastructure like roads, rail lines, water supply, power supply, sewerage facility, telecommunication facilities, hospitals, schools etc

4.6 Soil classification

The soils in the Villupuram district are mostly forest soils and red soil. Alluvial soils are found in eastern side bordering coast. Black soils are confined to low ground in select pockets in Vanur taluk.

Soils in the Puducherry district have been classified into i) Red soil, ii) Black soil, iii) Alluvial soil and iv) Colluvial soil. The major part is covered by Red soil of red sandy/clay loam type. Ferruginous red

soils are also seen at places. Alluvial soils occur along the river courses and eastern part of the coastal areas. Sandy coastal alluvium (arenaceous soil) are seen all along the sea coast as a narrow belt.

4.6 Climatedata from secondary sources

The climatological summary details of parameters like temperature, relative humidity, rainfall, cloud cover, wind speed and wind direction monitored at IMD Cuddalore & Puducherry is given below.

Climate Data of Ponducherry

Month	Daily mean Temp. (^{0}C)		Relative Humidity (%)		Rainfall (mm)		Cloud cover (in Okta)		Mean Wind Speed (km/h)
	Max	Min	8:30	17:30	Monthly Total	No. of Rainy days	8:30	17:30	
January	29.0	21.9	82	78	12.3	0.9	4.6	3.9	13.2
February	30.0	22.5	80	78	22.2	0.9	4.6	3.8	13.3
March	31.2	23.8	78	76	19.3	0.8	4.5	3.7	13.3
April	32.8	25.9	76	76	7.8	0.4	4.9	3.9	14.9
May	34.6	26.8	72	75	48.6	1.9	4.8	4.2	13.9
June	35.8	26.5	70	70	48.0	2.8	5.0	4.4	11.7
July	34.5	25.7	74	73	89.5	5.3	5.2	4.5	10.4
August	33.9	25.2	76	73	132.3	6.7	5.1	4.6	10.6
September	33.1	24.9	77	76	132.8	6.5	5.1	4.5	11.0
October	31.5	24.5	80	77	273.9	10.3	5.3	4.6	10.3
November	29.8	23.6	82	79	350.0	11.8	5.5	4.9	11.9
December	29.0	22.6	83	79	217.3	6.8	5.2	4.5	13.7
Annual or Mean	32.1	24.5	77	76	1354.0	55.0	5.0	4.3	12.4

Source: India Meteorological Department (IMD)

Climate Data of Cuddalore

Month	Daily mean Temp. (^{0}C)		Relative Humidity (%)		Rainfall (mm)		Cloud cover (in Okta)		Mean Wind Speed (km/h)
	Max	Min	8:30	17:30	Monthly Total	No. of Rainy days	8:30	17:30	
January	28.8	20.3	85	70	31.4	1.6	3.4	3.1	7.9
February	30.1	21.1	84	69	6.7	1.0	2.8	2.3	6.8
March	31.9	22.8	81	70	15.1	0.8	2.4	1.8	7.4
April	33.9	25.7	75	73	8.1	0.4	3.8	3.4	9.1
May	36.5	26.9	68	72	29.6	1.6	4.0	4.3	9.8
June	37.0	26.6	65	62	39.3	3.1	5.2	6.1	9.7
July	35.4	25.7	70	64	87.0	5.2	5.9	6.3	8.4
August	34.7	25.2	73	66	115.1	6.1	5.7	6.1	8.0
September	33.7	24.7	77	74	142.9	7.1	5.2	5.5	7.2
October	31.8	24.2	83	77	250.9	9.6	5.4	5.6	6.0
November	29.7	22.7	86	78	335.4	11.0	5.1	5.3	7.4
December	28.6	21.3	86	75	219.7	7.0	4.5	4.5	9.5
Annual or Mean	32.7	23.9	78	71	1281.2	54.5	4.5	4.5	8.1

Source: India Meteorological Department (IMD)

4.7.1 Wind

The monthly mean wind speed of Cuddalore is varied from 6.8 to 9.8km/hr occurring in February and May months respectively. The predominant wind during winter season was recorded from SE and NW direction.

4.7.2 Storms and Cyclones

Cyclone hazard in Tamil Nadu is moderate. Considering the size and density of population, the vulnerability of Puducherry (UT) to cyclone hazard is very high. Puducherry UT has 4 enclaves Puducherry, Karaikal and Yenam situated in the east coast and Mahe in the west coast. Among the enclaves, cyclone frequency is low in Puducherry where only three severe cyclones and Mahe where severe cyclone have made their landfall. Cyclones making landfall in Puducherry can have significant impact on Tamil Nadu. The number of cyclone landfall is highest in Kancheepuram followed by Nagapattinam and Karaikal. Cuddalore is next in terms of frequency followed by Thiruvallur, Villupuram and Puducherry. Most of the precipitation occurs in the form of cyclonic storms caused due to the depressions in Bay of Bengal chiefly during Northeast monsoon period.

4.7.3 Rainfall

Rainfall occurred in Cuddalore, maximum in November (335.4mm) followed by August (250.9mm). The Annual mean rainfall received in the year is about 1281.2mm with total number of rainy days of about 54.5 days.

Rainfall occurred in Puducherry, maximum in November (350.0mm) followed by October (273.9mm). The Annual mean rainfall received in the year is about 1354.0mm with total number of rainy days of about 55 days.

4.7.4 Temperature and Humidity

The Villupuram area falls under tropical climate with temperature in the summer months of March to May. The average temperature varies from 26◦ to 41^0 C. The humidity is also high in the order of 80%. The Puducherry region enjoys a hot and tropical climate characterised by little variation of temperature and humid weather. The summer season, which is very oppressive, is from March to May. January to the end of February is comparatively cool. The relative humidity is generally high, being about 80% during October to April. It is at its minimum of 70 to 73% in June and July. Winds are moderately strong throughout the year, except during the months July to October. During May to September winds are mainly southwesterly in the mornings.

5 Planning Brief

5.1 Planning concept

The project is a green field offshore and onshore oil and gas exploration spread over CY-OSHP-2017/01 Block of area of 1794 Sq.Km consisting of 139 sq km of Viluppuram (Tamilnadu), 2 Sq km of Puducherry & 1654 Sq Km of sea portion of Bay of Bengal.

Well sites and roads will be built or upgraded for transportation of rig and its equipment for seismic acquisition and drilling. The drilling will be carried out following the safety standards. Upon successful exploration the well will be completed and suspended for further activities and the wells devoid of hydrocarbon will be plugged and abandoned. The land will be restored back to its original form.

5.2 Population Projection

Direct and indirect employment will be created due to project. Temporary influx of people will be there as the managerial and supervisory staff will generally be outsider.

5.3 Land use planning (break up along with green belt, etc)

The well within the block will not be taken completely for drilling of the wells. An area of about 300m X 300m would be taken on temporary short-term lease basis for the construction of well pad, drill site etc.

5.4 Assessment of Infrastructure demand

No major infrastructure (physical and social) is envisaged. Access road will be taken up by Vedanta (Cairn Oil & Gas) for the drilling well site for the movement of heavy equipment.

5.5 Amenities and facilities

The amenities/ facilities

- Potable drinking water
- Firefighting/ alarm system and ambulance is available in case of emergency
- Drinking water, canteen and electricity facilities is provided
- Separate sanitation facilities will be provided for men and women.

6. Proposed Infrastructure

No measure physical and social infrastructure is envisaged. Only drill site / well pad and temporary camp site (Porta cabin) for the drilling of exploratory (including) appraisal wells are envisaged, which will be dismantled after drilling of the wells.

7. Rehabilitation and Resettlement (R&R) Plan

For exploration and appraisal activities, the project does not envisage any R & R of the project, since the land requirement would be very less and on short term lease and away from the settlements. If the identified lands are of private landowners then land lease mode will be applied and in case of govt. land, land allotment from Govt. to be applied. Initially lease will be taken for 3 - 5 years for exploration purpose and in case of commercially viable discovery of hydrocarbon resources; the land lease would be converted into long term lease up to life of the project.

For sites selected having settlements if any, Resettlement & rehabilitation (R&R) plan will be developed and implemented as per the applicable State/ Central Govt. policy. Compensation to affected landowners for any loss of land, Cairn will ensure the livelihood of local community, if any affected by the proposed land take, are identified and compensated through adequate compensation and other livelihood restoration activities directly or indirectly through CSR activities.

8. Project schedule and cost estimate

8.1 Project schedule

Vedanta Ltd (Cairn Oil and gas) has planned to carryout 3D seismic data acquisition, exploration and appraisal in the CY-OSHP-2017/1 Block in next 10-12 years.
The cost of the project is estimated is given below:

1) Physical Surveys Cost estimated to be approximately INR 6.93 Crore.
2) Average Cost per well for exploratory & appraisal well is estimated to be INR 49 Crore.

9. Analysis of Proposals (Final Recommendations)

The implementation of this project will not have any adverse effect on the environment as appropriate pollution control measures will be taken from the initial stage itself.

Proposed drilling activities will result in growth of the surrounding areas by increasing direct and indirect employment opportunities in the region.