Pre-feasibility Report

For

Onshore Oil and Gas Exploration and Appraisal in RJ-ONHP-2017/1 Block, Barmer District, Rajasthan

Vedanta
Limited
(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. Through Cairn, its upstream Oil and Gas division, Vedanta is the operator of the Onshore RJ-ONHP-2017/01 block.

Vedanta Ltd. (Cairn Oil & Gas) has been granted with block in Barmer Basin, namely RJ-ONHP-2017/01 by Government of India under the Revenue Sharing Contract (RSC) for exploration and 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 Proposed project

Vedanta Limited (Cairn Oil & Gas) proposes to carryout seismic survey, exploratory including appraisal well drilling and setting up of Early Production Units (EPUs)/ Quick Production Units (QPUs) and early production in the block RJ-ONHP-2017/1.

1.1.2 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 (Cairn Oil & Gas) proposed exploratory and appraisal drilling 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

1.2.1 Climate

The Block experiences hot and arid climate typical of desert region. The predominant wind direction is from west and southwest during the months of April to August and from north and northeast during the months of September to March. The annual average wind speed was observed to be 7.4 kmph in Barmer District. As per long term trends, the total annual precipitation of Barmer District is 260mm/year.

1.3 Water and Power requirement

1.3.1 Water Requirement

A. Water Requirement during Seismic Survey

The water requirement 20-30 m3/day is for domestic needs of the temporary campsite will be sourced locally through approved authorities.

B. Water requirement during Exploratory and Appraisal well drilling

The most significant requirement of water for drilling activities is for mud preparation. The water requirement for WBM preparation will be 600-1000 m3/well. The water requirement for SBM preparation will be 150-300 m3/well. The other requirement approx. 25-50 m3/well/day would be for drilling activities like engine cooling, floor / equipment / string washing, fire-fighting storage / make-up. For domestic consumption, approx. 20 - 30 m3/day water will be required during drilling period. The water requirement will be sourced locally through approved authorities.

1.3.2 Power Requirement

A. Power requirement during seismic Survey

The required power supply will be provided from diesel generators of 2 X 350 KVA.

B. Power requirement during Exploratory and Appraisal well drilling

The power requirement of drill rig will be met by three (03) DG sets (including one as standby) (3*1000 KVA). The power requirement for drilling camp site will be met by (02) DG sets (including one as standby) (2*350 KVA). The power requirement for Radio room will be met by (02) DG sets (including one as standby) (2*100 KVA).

1.4 Pollution control measures

1.4.1 Seismic Operations

A. Air Emissions and Control Measure

Emissions to air include short term and transient airborne dust raised by temporary activities (such as preparation of seismic cut lines and moving vehicles and equipment) and emissions from vehicles, machinery, and DG sets. 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 are short term and transient which will include those generated by shot-hole technique, field machinery (Bulldozer and support vehicles) and generators and work yard at the camp site. Appropriate noise control measures will be taken.

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.

1.4.2 Drilling Operations

A. Air Emissions and Control Measure

The emissions to the atmosphere from the drilling operations shall be from the diesel engines, and power generator and temporary from flaring activity (during testing). Appropriate air emission 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 of noise to drill personnel.

C. Waste treatment and disposal

Spent WBM mud 250-500 tons/well will be generated at site during drilling operations. This will be stored in well-designed HDPE line pit.

Drill cutting associated with WBM will be 250-750 tons/well and drill cutting associated with SBM will be 500-1500 tons/well. Sludge containing oil & other drilling wastes will be 250-500 tons/well.

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

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

All kinds of waste will be disposed in accordance with the requirement of CPCB/RSPCB.

D. Waste water Treatment

The drilling waste water will be treated suitably.

1.5 Project Schedule and cost estimate

Vedanta Ltd. (Cairn Oil and Gas) has planned to carry out the proposed project activities in the RJ-ONHP-2017/1 Block over a period of 10-12 years.

The estimated cost of the project is given below:

1) Physical Surveys Cost estimated to be approximately INR 36 Crore.
2) Average Cost per well for exploratory & appraisal well drilling is estimated to be INR 14 Crore.
3) Average cost of each EPU (Early Production Unit)/ QPU (Quick Production Unit) is estimated to be INR 44 Crore.

1.6 Employment Generation

The seismic surveys and drilling operations are expected to take about 12 to 18 months to complete and will require a crew of approximately 300 to 500 persons. And most of the workforce will be from local area. During the site preparation for drilling, approximately 30-35 workmen will be employed per drill site. During the drilling phase, about 50 workmen per shift will be working on site. This will include technical experts, who will be responsible for various drilling related activities and some technical manpower engaged are either from Vedanta Limited (Cairn Oil & Gas) or contractor's crew as applicable. 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 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 temporary short term 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 INRODUCTION OF THE PROJECT

2.1 Identification of the Project

Vedanta Ltd (Cairn Oil & Gas) has been awarded the RJ-ONHP-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) and early production of oil and gas in the block. In case of a discovery (ies), the exploratory and appraisal well(s) will be tested for extended duration by flowing hydrocarbons to ascertain the reservoir parameters and assess the quality and commercial viability. Moreover, in case of commercially viable discovery (s) of hydrocarbons in the block and having established the size of the hydrocarbon field (s), field will be immediately brought into early production of crude oil and associated gas using some of the successful exploratory/ appraisal wells by setting up of temporary and mobile Early Production Units (EPUs)/ QPUs (Quick Production Units) for the processing of produced well fluids.

2.2 Brief description of nature of the Project

The proposed project is green field in nature. The project is an oil and gas exploration and early production project.

2.3 Need for the Project and its Importance to the Country and 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-s-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. The proposed project would also contribute to the State Government in Rajasthan in terms of Royalty through the mining lease. Additionally, the proposed project would generate direct and indirect employment in the region.

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.

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.

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 vs. Indigenous production

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

2.6 Export Possibility

The crude oil and natural gas, in case of commercially viable discovery and subsequent production, will be utilized within the country.

2.7 Domestic / Export Markets

The produced oil & gas, in case of commercially viable discoveries of hydrocarbons, will be utilized for domestic purpose to supply the increasing demand in domestic market.

2.8 Employment Generation

The seismic surveys and drilling operations are expected to take about 6 to 8 months to complete and will require a crew of approximately 300 to 500 persons. And most of the workforce will be from local area. During the site preparation for drilling, approximately 30-35 workmen will be employed per drill site. During the drilling phase, about 50 workmen per shift will be working on site. This will include technical experts, who will be responsible for various drilling related activities and some technical manpower engaged are either from Vedanta Limited (Cairn Oil & Gas) or contractor's crew as applicable. 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. In case of commercial discovery of oil and gas additional manpower will be employed for building of quick production facilities and associated activities.

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

A map of the area is shown in **Fig 3.1.** The block RJ-ONHP-2017/01 is located in Barmer district of Rajasthan. It encloses an area of 542 Sq. Km. and is bounded by the points having following coordinates (Table-1). The geographic co-ordinates are in **Table 3.1**

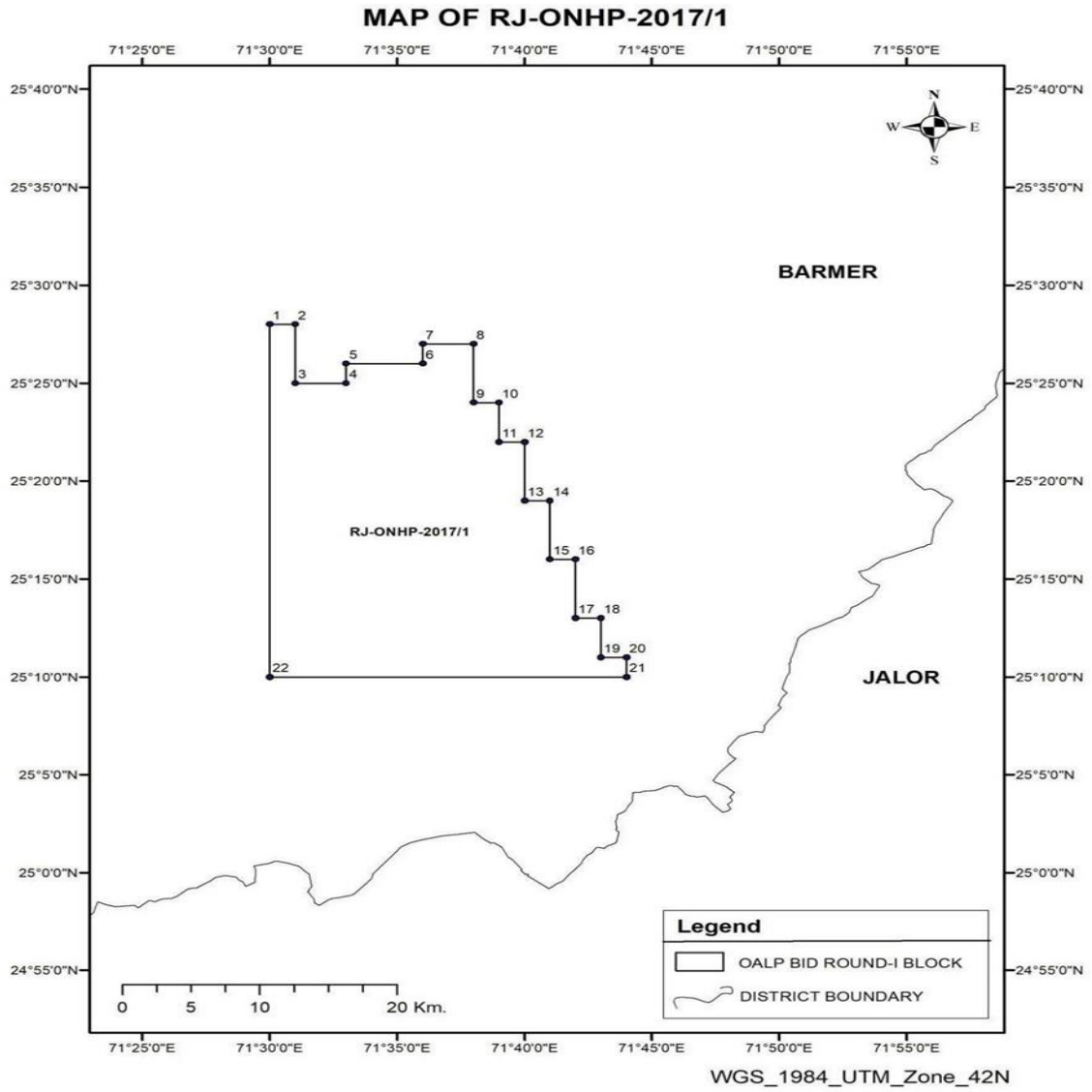

Fig 3.1 Map of the contract area- RJ-ONHP-2017/1

Table 3-1 Block boundary Co-Ordinates – RJ-ONHP-2017/01

Points	Longitude	Latitude
1	71° 30'	25° 28'
2	71° 31'	25° 28'
3	71° 31'	25° 25'
4	71° 33'	25° 25'
5	71° 33'	25° 26'
6	71° 36'	25° 26'
7	71° 36'	25° 27'
8	71° 38'	25° 27'
9	71° 38'	25° 24'
10	71° 39'	25° 24'
11	71° 39'	25° 22'
12	71° 40'	25° 22'
13	71° 40'	25° 19'
14	71° 41'	25° 19'
15	71° 41'	25° 16'
16	71° 42'	25° 16'
17	71° 42'	25° 13'
18	71° 43'	25° 13'
19	71° 43'	25° 11'
20	71° 44'	25° 11'
21	71° 44'	25° 10'
22	71° 30'	25° 10'

3.3 Details of alternate sites 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 reservoir).

3.4 Size and magnitude of operation

The proposed onshore oil and gas exploration and appraisal, and early production is expected to carry out:

1. Seismic data acquisition in the block
2. Drilling of 29 exploratory (including appraisal) wells and testing
3. Setting up of Early Production Units (UPUs)/ Quick Production Units (QPUs) for produced well fluid processing and production of up to 12000 BOPD crude oil and up to 1.8 MMSCFD associated natural gas.
4. The exploratory and appraisal wells will be drilled to explore the reservoirs up to depth of approx. 1750-5000 m.

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. Seismic surveys are acquired by laying out energy source points (vibroseis or dynamite charges) and receiver points (geophones) in a grid over the area to be surveyed.

The seismic data acquisition exercise (Recording) will take approximately 250 to 350 days. It should be noted that while there are pre-determined seismic line transects based on analysis of pre-existing data, the actual locations of the seismic transects may be varied prior to and/or during the seismic data acquisition exercise. The seismic survey operation will be constrained along the seismic survey lines and to the base and fly camps, as well as to the access roads to these areas.

Seismic 'upholes' are drill holes (20–50m in depth) placed at regular intervals (1–2km) along exploration seismic lines. Seismic upholes will be drilled at regular intervals along the seismic lines. The upholes will be drilled by a small truck-mounted rig usually using compressed air to lift soil cuttings, adding water occasionally to lift gravelly material. Uphole drilling will take place during the seismic survey. Uphole drilling is a relatively simple process and no drill casing is used. The drilling fluids used in Uphole drilling consist of soil, ground sandstone and locally sourced groundwater as a wet mix. Apart from soil, ground sandstone and groundwater, no chemicals will be added to the drilling fluid only small quantities of bentonite clay if required during backfilling to seal off any encountered groundwater. Once recordings have been made, the majority of the cuttings will be returned to the hole. The cuttings present no risk to the environment in toxicity terms. Excess cuttings at each Uphole, if any, are placed on top of the Uphole and will integrate into the soil over time.

3.5.2 Drilling of Exploration and Appraisal Wells

Vedanta Ltd. (Cairn Oil & Gas) proposes to drill 29 exploration & appraisal wells within the present block boundary of RJ-ONHP-2017/01.

The basic objectives of the exploratory drilling will be as follows:-

- To determine the presence of potential hydrocarbon
- To appraise discovered oil & gas

The lifecycle of drilling activities involve well site selection, site and access road preparation and its maintenance, construction of drilling well, drilling activities, well testing and decommissioning and closure of wells, if not proved economically viable for production of oil and gas.

If a discovery is made it is likely to need to be appraised. This is an intermediate step between exploration and development which is necessary to confirm the reserve size and field deliverability to an acceptable degree of accuracy. This may be in order to determine whether the discovery is commercial, or to establish the parameters necessary to define the optimal development scheme for the field. Appraisal may consist of additional seismic, further drilling or extended testing of an existing well. Any or all of these types of operations may be deemed desirable or necessary.

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 (DG sets), water, fuel (HSD) to the drilling process and will be set up as a part of the project. The following flow chart of **Fig 3.2** and **Fig 3.3** shows the various phases of the drilling activities and model of drilling process respectively:

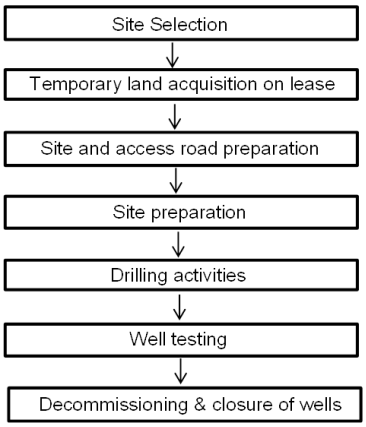

Fig 3.2 Various phases of the drilling activities

Fig 3.3 A typical model onshore drilling process

Location & Description of Drilling 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. The specific details of the wells are given in the following **Table 3.2.**

The proposed wells are located as shown in the **Fig 3.4** and **Fig 3.5** and tabulated in **Table 3.3**. There is a wide variation in the Target Depths of the planned wells as the well depths vary from 1750m to 5000m due to the subsurface structural configuration and the depth of occurrence of the primary reservoirs. Typically estimated drilling duration is 60-90 days/ well. In general, exploratory and appraisal well testing duration is about 30 days/well. 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. Water Base Mud (WBM) will be used as drilling fluid for initial, shallower sections where massive shale not encountered. The deeper and difficult to drill geological formations will be drilled using Synthetic Base Mud (SBM) as drilling fluid.

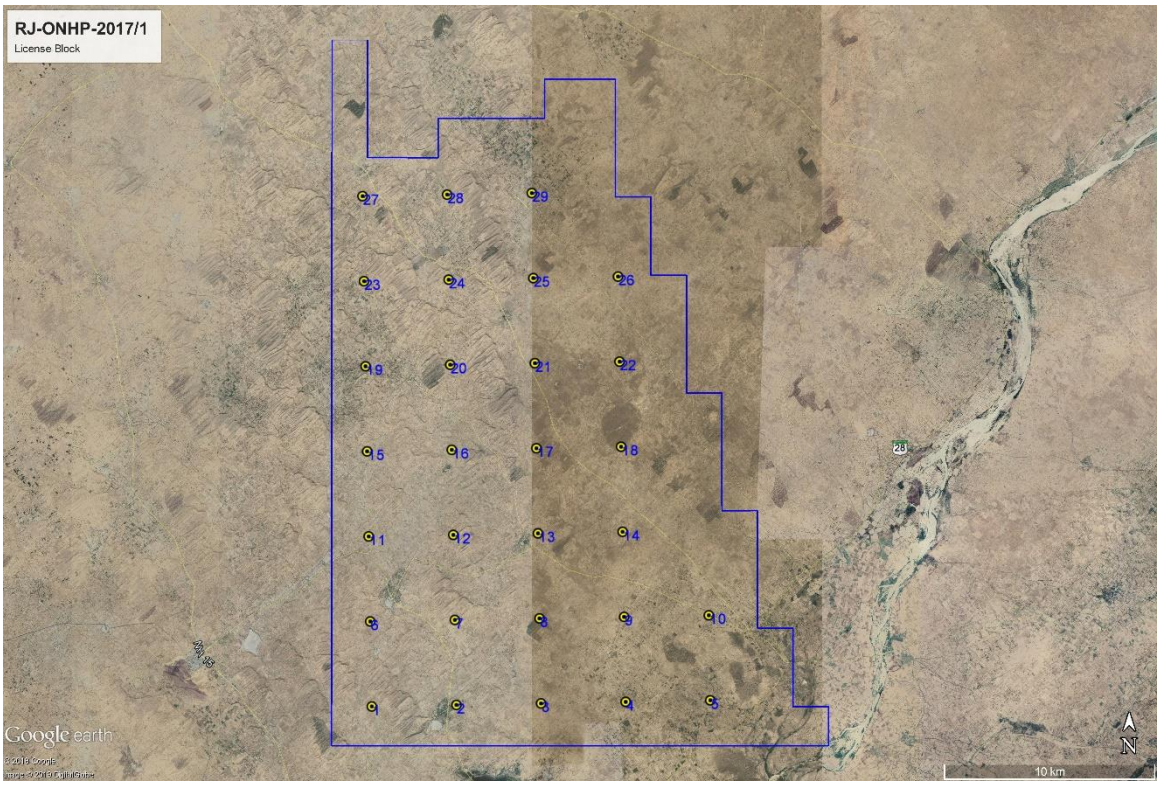

Fig 3.4 Proposed well locations for Block RJ-ONHP-2017/1

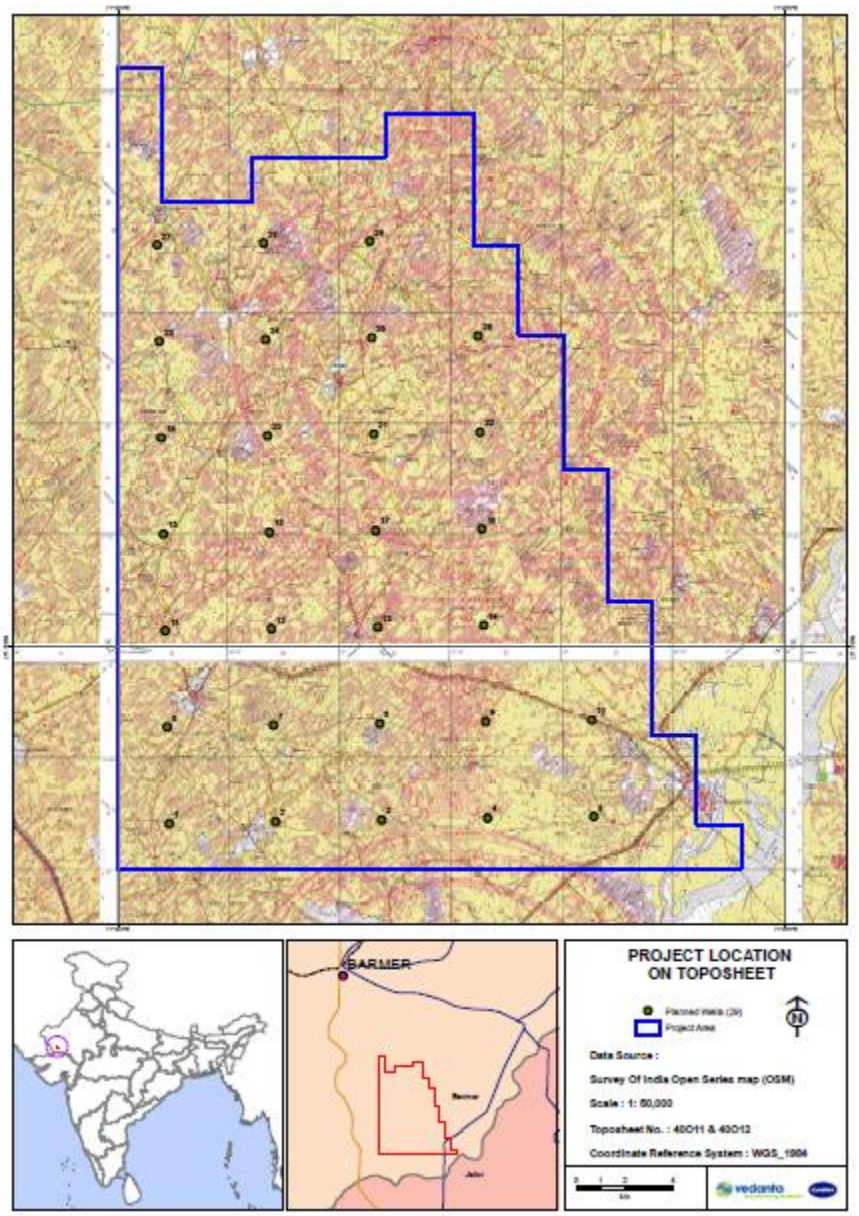

Fig 3.5 Proposed well locations on Survey of India Toposheet

Well_Id	Longitude	Latitude
1	71° 31' 9.297" E	25° 11' 1.268" N
2	71° 33' 32.304" E	25° 11' 3.715" N
3	71° 35' 55.312" E	25° 11' 6.122" N
4	71° 38' 18.323" E	25° 11' 8.490" N
5	71° 40' 41.334" E	25° 11' 10.818" N
6	71° 31' 6.585" E	25° 13' 11.382" N
7	71° 33' 29.636" E	25° 13' 13.830" N
8	71° 35' 52.687" E	25° 13' 16.238" N
9	71° 38' 15.741" E	25° 13' 18.606" N
10	71° 40' 38.796" E	25° 13' 20.936" N
11	71° 31' 3.872" E	25° 15' 21.497" N
12	71° 33' 26.965" E	25° 15' 23.945" N
13	71° 35' 50.061" E	25° 15' 26.354" N
14	71° 38' 13.158" E	25° 15' 28.723" N
15	71° 31' 1.156" E	25° 17' 31.612" N

Well_Id	Longitude	Latitude
16	71° 33' 24.294" E	25° 17' 34.061" N
17	71° 35' 47.433" E	25° 17' 36.471" N
18	71° 38' 10.573" E	25° 17' 38.841" N
19	71° 30' 58.440" E	25° 19' 41.727" N
20	71° 33' 21.620" E	25° 19' 44.177" N
21	71° 35' 44.803" E	25° 19' 46.587" N
22	71° 38' 7.987" E	25° 19' 48.958" N
23	71° 30' 55.721" E	25° 21' 51.843" N
24	71° 33' 18.945" E	25° 21' 54.293" N
25	71° 35' 42.171" E	25° 21' 56.705" N
26	71° 38' 5.399" E	25° 21' 59.076" N
27	71° 30' 53.001" E	25° 24' 1.959" N
28	71° 33' 16.269" E	25° 24' 4.410" N
29	71° 35' 39.538" E	25° 24' 6.822" N

Table 3-2 Proposed well co-ordinates to be drilled in block RJ-ONHP-2017/01

Note: Actual geographical surface coordinates of exploratory and appraisal well locations will be within 2000m radius of the proposed coordinates.

Site Selection

The exploration history of the area exhibits the potential presence of the oil and gas in the region. The seismic data interpretation of the seismic survey would decide the exact locations of the drilling well. The proposed exploratory well site will be identified based on the study and interpretation of the stratigraphy and seismic data. Within the identified location the actual well drilling site will be selected based on the following factors:

- Located at least 200 m away from the nearest habitat / sensitive receptors
- Located at a safe distance (at least the boom / mast length away) from public road
- Safe distances from any radio transmitters so that the use of explosives and detonators may proceed without the danger of external activation
- 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

Land Requirement

An area of approximately 300m X 300m would be taken on temporary short-term lease basis for the construction of well pad (drill site) for exploratory and appraisal wells. For the preparation of suitable access roads connecting to well pads, accommodating OHL and other utilities in future, a width of 30m (approx.) RoU will be required.

Site Preparation

Site preparation will involve all activities required to facilitate the operation of the drilling rig and associated equipment and machineries. At the initial stage, the drilling site will be elevated to about 2.0 m from the existing ground level with minimal clearance of existing ground vegetation. The loose top soil will be removed by using mechanical means like bulldozer and saved at a nearby place for later use during site restoration. Levelling and compaction will be done with the help of graders and mechanical rollers.

The land filling materials and rubbles will be required for the purpose of site preparation in sufficient amount. All such materials will be procured by Vedanta (Cairn Oil & Gas) through contractors and it will be ensured that they source the materials from government approved borrows and quarries. A backhoe will be used for all excavation and cutting activities (for construction of pits) on site. Subsequently, the proposed well site & campsite will be duly fenced using chain link and barbed wires.

Drilling Rig

The proposed drilling shall be carried out by using a standard land rig or a "Mobile Land Rig" with standard water based drilling fluid treatment system. This rig will be suitable for deep drilling up to the desired depth of 6000 meters (TVDSS) as planned for the project. The typical configuration of a Drilling Rig is shown in the **Fig 3.6** and given in **Table 3.4**. Additionally, there will be other ancillary facilities like Drilling mud system, ETP, Cuttings disposal, Drill Cementing equipment etc. and utilities to supply power (DG sets), water, fuel (HSD) to the drilling process and will be set up as a part of the Project.

Type of Rig	Electrical Rig
Drilling mud composition	Water based Drilling Fluid
Power generator type & nos.	AC - SCR Type. (03 Nos.)
Details of solids handling systems on rig	Shale Shakers - 1200 GPM Capacity Desander - 1200 GPM Capacity Desilter - 1200 GPM Capacity

Table 3-3 Details of the drilling rig

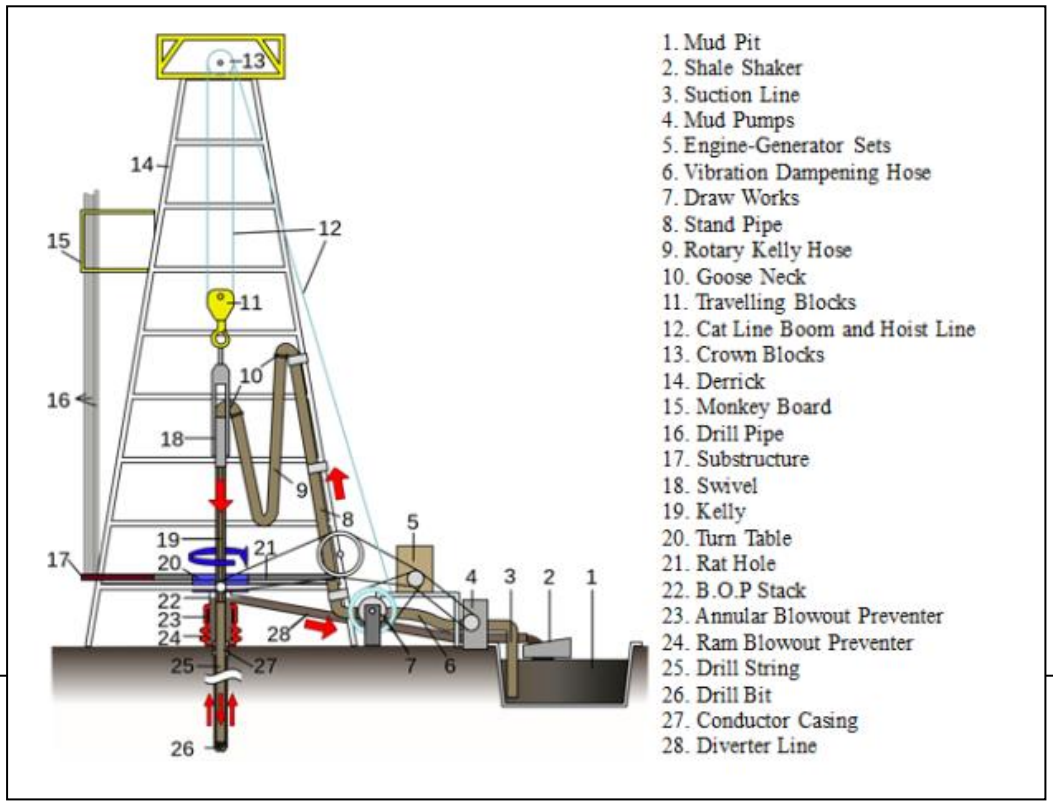

Fig 3.6 Typical configuration of a Drilling Rig

Drilling Activities

A rig will be installed at the potential site of drilling after thorough inspection for its working capability and quality standards. Well spudding shall be the start of drilling activity. 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. 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". 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 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. This process of drilling and casing the hole section continues until the final well depth (target) is achieved. Drilling process is associated with various hazards such as well active situation (kicks), blowouts, H2S situation etc.

Mud System and Cuttings

During drilling operations, the drilling fluid (or mud) is pumped through the drill string down to the drilling bit and returns at the drill pipe–casing annulus up to surface back into the circulation system after separation of drill cuttings /solids through solids control equipment. The primary function of drilling fluid is to ensure that the rock cuttings generated by the drill bit are continuously removed from the wellbore. The mud must be designed such that it can carry the cuttings to surface while circulating, suspend the cuttings while not circulating and drop the cuttings out of suspension at the surface. The drilled solids are removed at the surface by mechanical devices such as shale shakers, de-sanders and de-silters. The hydrostatic pressure exerted by the mud column prevents influx of formation fluids into the wellbore. The instability caused by the pressure differential between the borehole and the pore pressure can be overcome by increasing the mud weight. Hydration of the clays can be overcome by using non aqueous based muds, or partially addressed by treating the mud with chemicals which will reduce the ability of the water in the mud to hydrate the clays in the formation. 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 unlike oil based mud (OBM) is biodegradable but can be re-used. At the end of drilling a well almost the entire amount of the SBM is collected for re-use in next drilling operation. SBM systems promote good hole cleaning and cuttings suspension properties. They also suppress gas hydrate formation and exhibit improved conditions for well bore stability compared to most WBM. 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. The mud to be used will be continuously tested for its density, viscosity, yield point, water loss, pH value etc. The mud will be prepared onsite (drill location) using centrifugal pumps, hoppers and treatment tanks.

During drilling activity, cuttings will be generated due to crushing action of the drill bit. These cuttings will be removed by pumping drilling fluid into the well via triplex mud pumps. The mud used during such operation will flush out formation cuttings from the well hole. Cuttings will be then separated from drilling mud using solids-control equipment. This will comprise a stepped system of processes consisting of linear motion vibrating screens called shale shakers, hydro-cyclones (including de-sanders and de-silters), and centrifuges to mechanically separate cuttings from the mud.

Fig 3.7 shows the flow chart for drilling mud & solid discharge and Fig 3.8 indicates a typical view of drill cutting separation & Treatment system

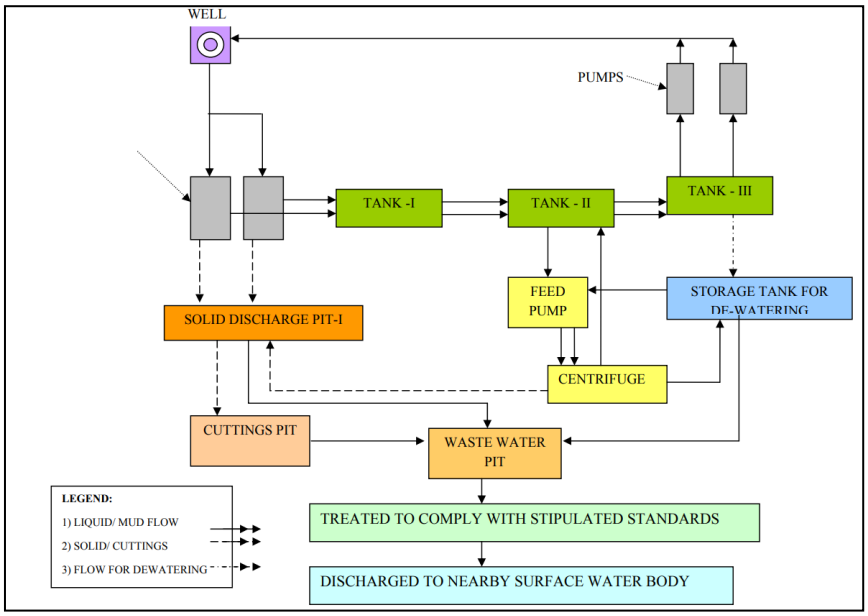

Fig 3.7 Flow chart for drilling mud & solid discharge

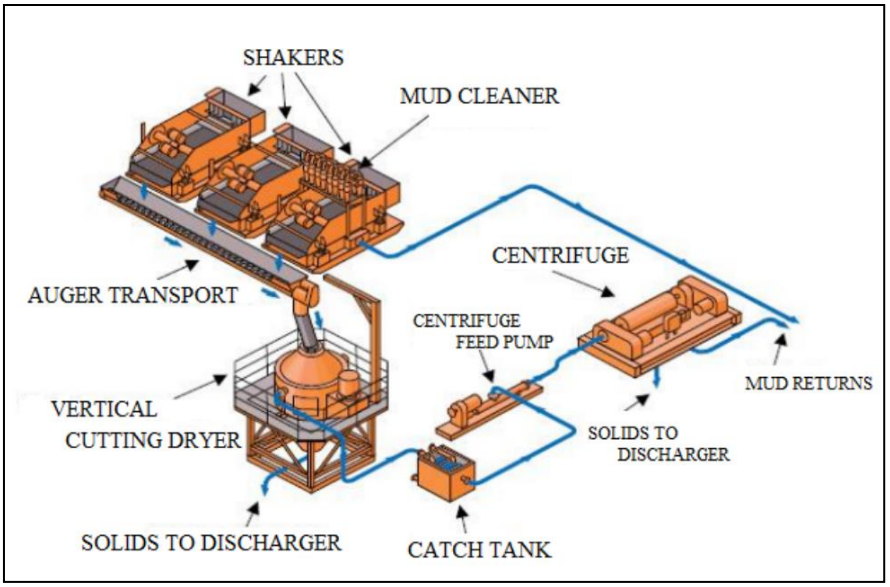

Fig 3.8 A typical view of drill cutting separation & treatment System

Cementing

Cementing is a necessary aspect of exploratory and appraisal drilling oil and gas wells. Cement is used to fulfill the following works:

- Secure/support casing strings
- Isolate zones for production purposes

Cementing generally utilizes Portland cement (API Class G Oil Well Cement) with various additives in small quantities as accelerators/retarders, density adjusters, dispersants, fluid loss additives, anti-gas migration additives etc.

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. No emissions to the environment or any environmental harm is associated with wire line logging operations. The radioactive source required for well logging operations are kept in specially designed container.

A drill-stem test is frequently performed to evaluate the formation or zone from which the gas show was observed. A drill-stem test enables the exploration company to obtain a sample of the fluids and gases contained in the formation or interval being tested as well as pressure information, which is determined by special gauges within the test tool. The test tool contains a valve which may be opened and closed to allow formation fluids to enter the test tool and drill string. If there is sufficient fluid and pressure within the zone being tested, the formation fluid may rise to the surface and flow into special test tanks used for that purpose. If gas is present, it is burned at the surface as a flare.

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 m3 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.

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 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 equipment 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, equipment 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.

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.

Setting up of Early Production Units (EPUs)/ Quick Production Units (QPUs) and Early Production

Vedanta Ltd (Cairn Oil & Gas), as an interim plan, in case of commercially viable discovery (s) of hydrocarbons in the block and having established the size of the hydrocarbon field (s), proposes to immediately bring the field (s) into production using one or more of the appraisal wells for the production of crude oil by setting up of Early Production Units (EPUs) or QPUs (Quick Production Units). Early production of the Crude oil will enable the Country to reduce dependence on import of crude oil.

Here, it may be noted that after the commercially viable discovery (s) of the hydrocarbon field(s), following the typical life cycle of Oil & Gas Exploration & Production sector, full-fledged field development plan including development well drilling, establishing crude oil & natural gas processing facilities, laying of intra-field & cross country pipelines and other associated physical and social infrastructures will be taken up and prior development EC and other approval will be obtained as applicable. The lead time for entire process is about 3 – 4 years for the production of crude oil and natural gas.

Once the full-fledged field development comes up, the Early Production Unit(s)/ Quick Production Unit(s) will suitably be integrated with the full-fledged facilities and/ or phased out.

Early Production Units (EPUs) or QPUs (Quick Production Units) will be installed for the processing of produced well fluid. A EPU/ QPU will be a packaged/ modular mobile unit and will mainly consists of a three phase separator & production heater or heater-treater, oil storage tanks, oil tanker loading system, produced water (PW) separation and disposal system, power generation (GEG or DG), utility systems such as fuel gas, flare & Inst. Air packages, firefighting equipment, etc. Each EPU/ QPU capacity will be ~2,000 BFPD (Barrels of Fluid per Day).

The EPUs/ QPUs will be installed near the already established exploration and appraisal well location within the well pad in the commercially viable discovered oil field. The separated crude oil will be stabilized further, stored in storage tanks and subsequently send through road tankers to the nearing available facilities like terminals/ depots. The produced gas will be used for internal heating, power generation purpose as far as possible & surplus gas will be safely disposed off using flare system.

The produced water will be treated to achieve MoEF/ CPCB/ SPCB specification (discharge standards) and will be disposed off. The treated effluent (produced water) will be disposed off using either a nearby down hole disposal well (by reinjection in abandoned well) or other available & suitable onshore disposal medium or solar/ mechanical evaporators depending on the quantity.
The power requirement will be met through state electricity grid and/ or installation of Diesel/ Gas Engine Generator(s) using produced gas.
The water requirement for the oil and gas processing will be sourced locally through approved authorities or through extraction of ground water. In case of extraction of ground water, permission (NOC) will be obtained from CGWA/ CGWB (Central Ground Water Authority/ Board) of from State Govt. Installation of raw water treatment plant will be done depending on the need for process water and domestic water consumption.
The typical broad requirements envisaged for the well fluid processing and production of crude oil and associated natural gas through QPF are the following:

- Wells with selected artificial lift; & flow lines;

- Combination of Heater (using produced gas) & 3 phase separator or single heater-treater
- Stabilized Crude oil storage, pumping & tanker loading facilities;
- PW separation and disposal system;
- Fuel gas system, Instrument air/ gas system;
- Flare system, Firefighting equipment, Raw water treatment plant;
- Diesel/ Gas Engine Generator (s);
- Domestic sewage treatment facility (STP or septic tank & soak pit system);

3.6 Raw materials required and source

Broad requirements of raw materials:

Seismic Acquisition

The seismic survey will be conducted using dynamite charges. The explosive sources (dynamites) and drilling fluid chemicals for shot hole drilling will be procured by the company before commencement of the operations. During surveying the main tasks include initial installation of a small number of survey control points, then setting-out source points and receiver stations for use. This would be done by the conventional survey method of using RTK GPS backpack surveying units and biodegradable markers. Cutting activities though minimal for the receiver and source lines shall be done manually or mechanically where appropriate. In open areas where there is clear line of sight no cutting shall be done. Recording involves laying of geophones on the receiver stations and generating energy (vibrations) on the perpendicular source lines to generate seismic energy, which are reflected and recorded on magnetic tapes via the recording instrument.

Drilling

During drilling activities, materials like HSD, Steel (in the form of casings & tubulars) and chemicals like barite, oil well cement and bentonite will be required. Other production equipments like tubular (Casing and tubings), 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 unlike oil based mud (OBM) is biodegradable but 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.

- Requirement WBM (approx.) 800-1000 m3/well
- Requirement SBM (approx.) 600-800 m3/well

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 Availability of Water and Energy / Power

3.8.1 Water Requirement

Seismic Operations

The water required during seismic operation will be mostly for domestic use, which is about 20 – 30 m3/day. The water requirement will be sourced locally through approved authorities.

Drilling Operations

Wells will be drilled by using either water-based mud or synthetic oil based mud. The water requirement in drilling rig is mainly meant for preparation of drilling mud apart from washings and domestic use. The water requirement for all the project activities will be sourced locally through approved/ authorized sources of surface water and/ or ground water (e.g. PHD bore wells, privately owned bore wells, Irrigation Dept./ Water Resources Dept. of State Govt.). In case, required water could not be sourced from locally available approved sources, ground water will be extracted after obtaining permission from CGWA/ State Govt. The water requirement per well is shown in **Table 3.5**.

Table 3-4 Water requirement per well

Description	Quantity
WBM preparation	600 to 1000 m3/well
SBM preparation	150 to 300 m3/well
Drilling water consumption	25-50 m3/day/well
Water for domestic use	20-30 m3/day/well

3.8.2 Power Requirement

Seismic Operations

The power will be required in the campsite and the same will be supplied using diesel generators.

Drilling Operations

The power requirement in the drilling site and the campsites will be provided through diesel generator (DG) sets. The rated capacity of the DG sets required for onshore drilling site is provided in following table.

Table 3-5 Details of DG sets of Onshore Drilling Activity

Location	DG Capacity
Camp site	2*350 KVA

Drilling site	3*1000 KVA
Radio Room	2*100 KVA

3.9 Quantity of wastes generated and disposal

3.9.1 Seismic Operations

Seismic upholes will be drilled at regular intervals along the seismic lines. The drilling fluids used in uphole drilling consist of soil, ground sandstone and locally sourced groundwater as a wet mix. Apart from soil, ground sandstone and groundwater, no chemicals will be added to the drilling fluid only small quantities of bentonite clay if required during backfilling to seal off any encountered groundwater. The cuttings present no risk to the environment in toxicity terms. Excess cuttings at each uphole, if any, are placed on top of the uphole and will integrate into the soil over time. Domestic effluent of about 15-25 m3/day is anticipated. Also, non-hazardous solid wastes like food waste, paper, etc. are expected.

3.9.2 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 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 50mx20mx1.5m. 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 **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 spent oil will be generated which 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.

All kinds of waste will be disposed in accordance with the requirements of CPCB / RSPCB.

Table 3-6 Details of waste generation during drilling operations

Waste Water Generation	Domestic Waste Water	15-25 m3/day/well
Solid Waste Generation	Hazardous Waste: 1. Drill Cuttings associated with WBM 2. Drill Cuttings associated with SBM 3. Spent/Residual Drilling Mud 4. Sludge containing oil & other drilling wastes	1. 250 - 750 tons/well 2. 500 - 1500 tons/well 3. 250 - 500 tons/well 4. 250 - 500 tons/well

	5. Used oil	5. 1-2 tons/well
	Non-Hazardous Waste: 1. Food waste 2. Non-combustible waste containing metallica residues, glass 3. Left over chemicals and materials, scrap metal 4. Cement, grit, blasting and painting wastes	1. 25-30 kg/day/well 2. 1000-1200 kg/well 3. 250 - 500 kg/well 4. 500 - 600 kg/well

3.10 Schematic of feasibility drawing

The well 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. The land requirement for the well drill site would therefore vary from approximately 300m X 300m size maximum. The typical layout of the well site is as below:

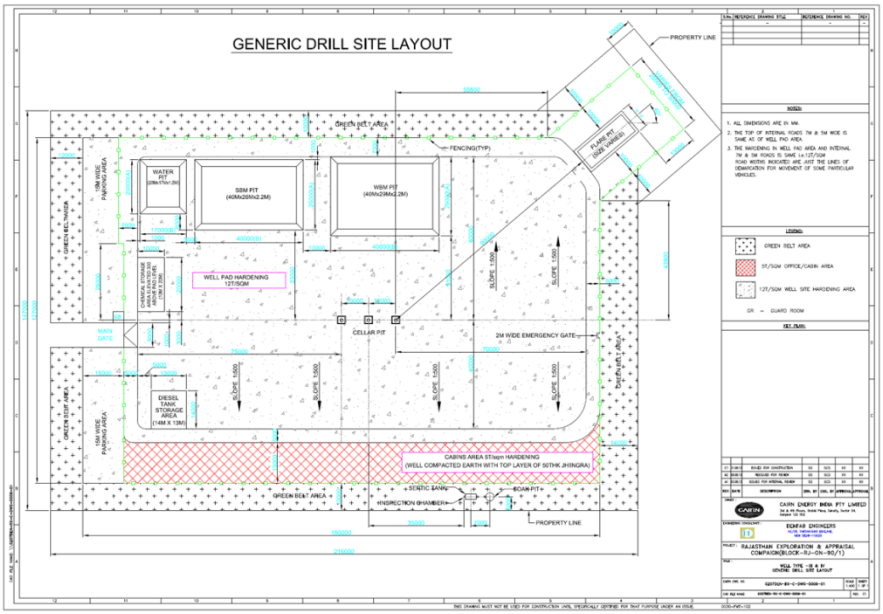

Fig 3.9 Schematic for a typical Well Pad

Each exploratory 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 acquired block is easily accessible through the rail and road network. The nearest city from the block is Barmer (32 Km), which is well connected through state highway. Barmer is connected with proper road and railway connectivity. The length of the road (asphalt) in Barmer in 2007-08 was 7494.37 km. While in 2006-07, there were 6078 km of Bituminous Tar Roads. Further, the district had 481 post offices and 84 telephonic facilities.

SH-28 Passes through the block & NH-15 is 2.7 km from the block boundary. Jodhpur airport is 164 Km from the block boundary.

4.2 Land Form, Land use and Land Ownership

The study area is covered primarily with fallow land, agricultural land. Human habitation is relatively lower with minimum land being used for settlements. The only river in the vicinity of the block is Luni River. There is no eco sensitive or designated biodiversity located within the block area.

4.3 Topography (along with map)

The general topography is plain with undulating terrains and sand dunes of varied heights and lengths. No major hills and valley systems, archeologically important monuments, ecologically sensitive zones are observed in RJ-ONHP-2017/01block. The study area does not fall under seismically active zone.

Refer Topo-sheet given in the Figure 3.5 of chapter 3.

4.4 Existing land use pattern

The block comprises of small scale and cottage industries using gypsum and lime as raw material. The nearest industrial area is Balotra, at about 100 km from MPT. Barmer District has rich reserves of lignite managed by the Rajasthan State Mines and Minerals Limited (RSMML). There are two operational thermal power plants near the Block; operated by Raj West Power Limited (RWPL) and Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RRVUNL) of capacity 1080 MW and 150 MW respectively. The power plant of RWPL uses lignite as fuel, sourced from two captive lignite mines at nearby villages of Kapurdi and Jalipa. The region is characterized by arid and semi-arid zones, with vast areas of sand covered tracts.

4.5 Existing Infrastructure

Availability or non-availability of social infrastructure amenities and facilities indicates the development pattern of the area and the well-being and quality of life of the population. The particulars of the existing public amenities in both Barmer Districts have been mentioned in this sub-section.

4.6 Soil Classification

In reference to the EIA carried out in the year 2014, the physical and chemical concentrations of the soil samples were determined and compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) and as given below in **Table 4-1**

Table 4-1 Summary of Soil classification

Soil Parameters	Classification
pH (northern field: 8.6 – 9.3 & Southern field: 8.3 – 9.6)	Normal to saline 6.0 – 8.5 Tending towards Alkaline 8.5 – 9.0 Alkaline Above 9.0
Electrical conductivity (mmhos/cm) (northern field: 0.08 - 13.3 mmhos/cm & Southern field: 0.07 - 8.78 mhos/cm)	Up to 1.00 Normal 1.01- 2.00- Critical to germination 2.01-4.00- Critical for growth of the sensitive crops Above 4.00 Injurious to most crops
Organic Carbon (northern field: 0.06-0.72% & Southern field: 0.06- 0.53%)	Low Below 0.5 % Medium 0.5 to 0.75 % High Above 0.75 %

4.7 Climatic Data from secondary sources

The Block experiences hot and arid climate typical of desert region. The predominant wind direction is from west and southwest during the months of April to August and from north and northeast during the months of September to March. The annual average wind speed was observed to be 7.4 kmph in Barmer District. As per long term trends, the total annual precipitation of Barmer District is 260mm/year.

4.8 Social Infrastructure

The potential socio economic impacts envisaged in the study area due to the setting up of this expansion projects are mainly Loss of land and livelihood and Issues pertaining to the compensation (due to acquire of the land). Thus the proposed management / mitigation measures that would be adopted are detailed below

- Any required land (site) will be selected after considering options to avoid agricultural land with preference for any fallow land in the vicinity;
- Shortest possible distance between identified site and road head will be considered for developing new access road;
- Consultations will be carried out with land owners for finalizing compensation packages;
- Information disclosure will be done to community and individual land owners about the project activities;
- Adequate compensation for any standing crops and loss of income for the lease period shall be provided.

This project does not envisage any rehabilitation and resettlement of the project affected persons, since the parcel of land would be required less. Terminals are set up mainly in fallow land or sand dune areas where there is no human settlement available.

5 PLANNING BRIEF

5.1 Planning Concept

The project is green field oil and gas exploration & appraisal and early production in RJ-ONHP-2017/1. The present area of the block is 542 Km^2.

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 international 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 the project. Temporary influx of people will be there as the managerial and supervisory staff will generally be outsider.

5.3 Land use planning

The land 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 anticipated. The infrastructure demand will be very less as the number of employee at drilling wells for a short duration. Temporary road will be taken up by Vedanta (Cairn Oil & Gas) for the drilling well site for the movement of heavy equipment.

5.5 Amenities / Facilities

The amenities / facilities will be required for the activities.

- Potable drinking water
- Fire-fighting / alarm system and ambulance will be available in case of emergency
- Drinking water, canteen and electrical facilities
- Separate sanitation facilities will be provided for men and women

6 PROPOSED INFRASTRUCTURE

No major 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

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 temporary and short-term 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 till life of the project.

For sites selected are having any settlements, 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 will be ensured by Vedanta Ltd. (Cairn Oil & Gas).

Vedanta Ltd. (Cairn Oil & Gas) 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 & COST ESTIMATES

Vedanta Ltd. (Cairn Oil and Gas) has planned to carry out the proposed project activities in the RJ-ONHP-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 36 Crore.
2) Average Cost per well for exploratory & appraisal well is estimated to be INR 14 Crore.
3) Average cost of each EPU (Early Production Unit)/ QPU (Quick Production Unit) is estimated to be INR 44 Crore.

9 ANALYSIS OF PROPOSAL (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.