

**Pre-Feasibility Report**  
**For**  
**Onshore Oil and Gas Exploration & Appraisal in Block KG-  
ONHP-2017/2 in Guntur and Krishna Districts of Andhra  
Pradesh**

**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 and Gas) is the operator of the onshore KG-ONHP-2017/2 block. The block covers an area of 668 Sq.Km in Guntur and Krishna district of Andhra Pradesh. Vedanta Ltd. (Cairn Oil and Gas) has been allotted the KG-ONHP-2017/2 hydrocarbon block for exploration and exploitation of hydrocarbon by government of India (MoP&NG) under the Revenue Sharing Contract (RSC) on 1<sup>st</sup> October 2018.

### **1.1 Project Details**

#### **1.1.1 Proposed facilities**

Vedanta Limited (Cairn Oil and Gas) proposes to carryout seismic survey, exploratory (including appraisal) well drilling in the block KG-ONHP-2017/2.

#### **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 5.29% 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 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 study area experiences a humid and warm sub-tropical climate throughout the year except for a cold winter in December till February. Hourly micro-meteorological data collected during the pre-monsoon of Machillipatnam, Andhra Pradesh reveals that the pre-dominant wind direction is from South to North with an average speed of 8.4kmph.

#### **1.2.2 Tides, currents and waves**

Not applicable to the study area.

### **1.2.3 Water quality**

## **1.3 Water and power requirements**

### **1.3.1 Water Requirement**

#### A. Water Requirement during Seismic Survey

The water requirement is 20 - 30 m<sup>3</sup>/day for domestic needs of the temporary campsite and 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 m<sup>3</sup>/well. The water requirement for SBM preparation will be 150-300 m<sup>3</sup>/well. The other requirement approx. 25-50 m<sup>3</sup>/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 m<sup>3</sup>/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

Each camp site shall have access to 2x350KVA (1 standby). The required power supply will be provided either from diesel generators or state electricity grid.

#### 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), 2\*350 KVA for drilling camp site and 2\* 100 KVA for the radio room respectively.

## **1.4 Pollution control measures**

### **1.4.1 Pollution Control measures during Seismic Operations**

#### 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 insignificant 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 to 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 Generation:

Domestic waste water of 15-25 m<sup>3</sup>/day is envisaged and will be treated suitably.

### **1.4.2 Pollution Control measures during Drilling Operations**

#### A. Air Emissions and Control Measure

The emissions to the atmosphere from the drilling operations shall be from the diesel engines, power generator and temporary from flaring activity (during testing/extended testing of wells).

#### 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 minimize exposure to noise.

#### C. Waste treatment and disposal

##### Hazardous waste:

250-750 tons/well for drill cuttings associated with WBM and 500-1500 tons/well for drill cuttings associated with SBM and 250-500 tons/well WBM spent/residual drilling mud will be generated at site during drilling operations. This will be stored in well-designed HDPE line pit.

Used /waste Oil – During the drilling approx. 1-2 tons of used oil, sludge containing oil and other drilling wastes will be 250-500 tons/well 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.

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

#### D. Waste water Treatment:

Domestic waste water of 15-25 m<sup>3</sup>/day per well will be generated and the domestic waste water will be treated suitably.

### **1.5 Project schedule and cost estimate**

Vedanta Ltd (Cairn Oil and gas) has planned to carryout seismic data acquisition and 29 exploration (including appraisal) well drilling in the KG-ONHP-2017/2 Block in next 10-12 years.

The estimated cost of the project is given below:

- 1) Physical Surveys Cost estimated to be approximately INR 2 Crore.
- 2) Average Cost per well for exploratory & appraisal well drilling is estimated to be INR 18 Crore.

### **1.6 Employment Generation**

The seismic survey is 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. It is anticipated that, at any given time, there will be 80-100 (approx.) personnel working on site including technical staff, drilling crew, security staff etc.

## **1.7 Rehabilitation and Resettlement**

For exploration, appraisal activities, the project does not envisage any Rehabilitation and Resettlement of the project, since the land requirement would be very less and on temporary 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. Introduction of the project**

### **2.1 Identification of the project**

Vedanta Ltd (Cairn Oil & Gas) has been awarded the KG-ONHP-2017/02 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 the reservoir oil parameter, as part of exploration & appraisal. Vedanta Limited has planned to acquire seismic data covering the block area and subsequently drill 29 exploratory & appraisal wells.

### **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 appraisal. The project will include seismic data acquisition, exploratory (including appraisal) and well testing.

### **2.3 Need for the project and its importance to 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-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.

### **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 5.29% 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 produced 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 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. It is anticipated that, at any given time, there will be 80-100 (approx.) personnel working on site including technical staff, drilling crew, security staff etc.

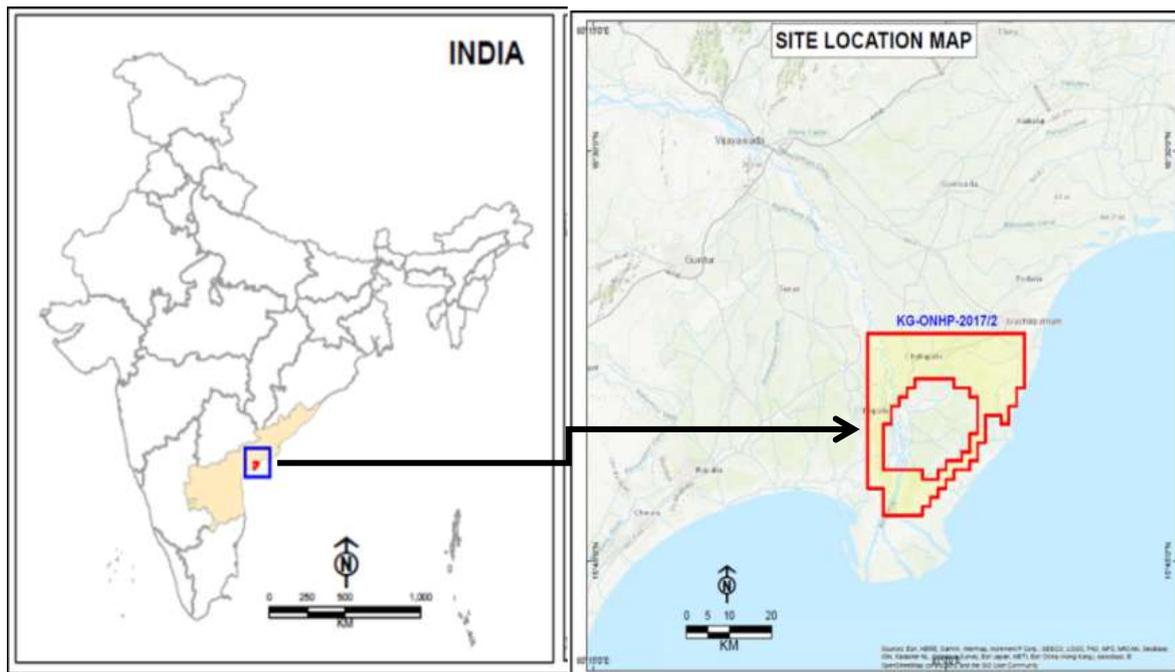
### 3. Project Description

#### 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 KG-ONHP-2017/2 is located in Guntur and Krishna district of Andhra Pradesh. It encloses an area of 668 Sq. Km. and is bounded by the points having following coordinates (Table-1). A map of the contract area is shown in Figure 1.



**Figure-1: Location map of block KG-ONHP-2017/2 with state and district boundary**

**Table-1: Apex Co-ordinates of Block KG-ONHP-2017/2 boundary (as per RSC)**

GEOGRAPHIC CO-ORDINATES OF THE BLOCK AS IN NDR					
Pt.	Longitude (E)	Latitude (N)	Pt.	Longitude (E)	Latitude (N)
1	81.1667	16.0833	66	80.9667	16.1667
2	81.1667	16.0667	67	80.9833	16.1667
3	81.1500	16.0667	29	81.0000	16.1667
4	81.1500	16.0500	69	81.0167	16.1667
5	81.1500	16.0333	70	81.0333	16.1667
6	81.1333	16.0333	71	81.0500	16.1667
7	81.1333	16.0167	72	81.0667	16.1667
8	81.1333	16.0000	73	81.0833	16.1667
9	81.1167	16.0000	74	81.1000	16.1667
10	81.1167	16.0167	75	81.1167	16.1667

11	81.1000	16.0167	76	81.1333	16.1667
12	81.0833	16.0167	77	81.1500	16.1667
13	81.0833	16.0000	78	81.1667	16.1667
14	81.0833	15.9833	79	81.1667	16.1500
15	81.0833	15.9667	80	81.1667	16.1333
16	81.0667	15.9667	81	81.1667	16.1167
17	81.0667	15.9500	82	81.1667	16.1000
18	81.0667	15.9333	83	81.1667	16.0833
19	81.0500	15.9333	84	80.8667	15.9333
20	81.0500	15.9167	85	80.8667	15.9167
21	81.0333	15.9167	86	80.8833	15.9167
22	81.0167	15.9167	87	80.9000	15.9167
23	81.0167	15.9000	88	80.9167	15.9167
24	81.0000	15.9000	89	80.9333	15.9167
25	81.0000	15.8833	90	80.9500	15.9167
26	80.9833	15.8833	91	80.9500	15.9000
27	80.9833	15.8667	92	80.9667	15.9000
28	80.9667	15.8667	93	80.9833	15.9000
29	80.9667	15.8500	94	80.9833	15.9167
30	80.9500	15.8500	95	81.0000	15.9167
31	80.9500	15.8333	96	81.0000	15.9333
32	80.9333	15.8333	97	81.0167	15.9333
33	80.9167	15.8333	98	81.0333	15.9333
34	80.9000	15.8333	99	81.0333	15.9500
35	80.8833	15.8333	100	81.0500	15.9500
36	80.8667	15.8333	101	81.0500	15.9667
37	80.8667	15.8500	102	81.0500	15.9833
38	80.8667	15.8667	103	81.0667	15.9833
39	80.8667	15.8833	104	81.0667	16.0000
40	80.8500	15.8833	105	81.0667	16.0167
41	80.8333	15.8833	106	81.0667	16.0333
42	80.8333	15.9000	107	81.0667	16.0500
43	80.8333	15.9167	108	81.0500	16.0500
44	80.8333	15.9333	109	81.0500	16.0667
45	80.8333	15.9500	110	81.0333	16.0667
29	80.8333	15.9667	111	81.0167	16.0667
47	80.8333	15.9833	112	81.0167	16.0833
48	80.8333	16.0000	113	81.0000	16.0833
49	80.8333	16.0167	114	80.9833	16.0833
50	80.8333	16.0333	115	80.9667	16.0833
51	80.8333	16.0500	116	80.9500	16.0833
52	80.8333	16.0667	117	80.9333	16.0833

53	80.8333	16.0833	118	80.9333	16.0667
54	80.8333	16.1000	119	80.9167	16.0667
55	80.8333	16.1167	120	80.9167	16.0500
56	80.8333	16.1333	121	80.9000	16.0500
57	80.8333	16.1500	122	80.9000	16.0333
58	80.8333	16.1667	123	80.8833	16.0333
59	80.8500	16.1667	124	80.8833	16.0167
60	80.8667	16.1667	125	80.8833	16.0000
61	80.8833	16.1667	126	80.8667	16.0000
62	80.9000	16.1667	127	80.8667	15.9833
63	80.9167	16.1667	128	80.8667	15.9667
64	80.9333	16.1667	129	80.8667	15.9500
65	80.9500	16.1667	130	80.8667	15.9333

### 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 field/block. The locations of wells are selected considering the drilling configuration (reach to reservoirs), potential source of hydrocarbon as general environmental & social factor.

### 3.4 Size/ magnitude of operation

The proposed onshore oil and gas exploration project is expected to carry out

1. Seismic data acquisition
2. Drilling of 29 exploratory (including appraisal) and testing of wells
3. The exploratory and appraisal wells will be drilled to explore the reservoirs depth is 4500-5000m.

### 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. This wave travels into and through the earth strata, where it is reflected and refracted by various subsurface formations, and returns to the surface where receivers called geophones are used to detect the waves and convey them to a recorder for analysis. Seismic waves can be induced by the following methods: small explosive charges, primarily dynamite, set off in shallow holes known as 'shot holes'; or by large 'Vibroiseis' trucks equipped with heavy plates that vibrate on the ground or air guns for water based surveys. 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. 3D surveys are acquired by laying out energy source points (vibroiseis or dynamite charges) and receiver points (geophones) 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 case of 2D seismic survey, the receiver points to record the reflected vibrations from the source points, are laid down in between the receiver lines.

To estimate the thickness and seismic velocity of the weathered zone as well as the sub-weathering velocity, Seismic 'upholes' (drill holes (20–50m in depth)) placed at regular intervals (1–2km) along exploration seismic lines. These data are then used in computing time corrections to a nominal seismic datum, which is a fundamental step in computer processing of seismic field data. 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. 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.

3D seismic surveys are generally conducted in a similar way to 2D seismic surveys but with the variation of setting up six or eight geophone cables side by side at the same time at a distance in most cases of about 100 to 400 metres apart. Several “shots” from calculated positions along and between the receiver lines are taken, before the cables are moved up and the process repeated. 3D seismic surveys must be conducted over a large area in order to provide sufficient data for accurate interpretation of the subsurface geology. The data collected can later be combined into a single data set for processing and analysis, provided there is sufficient overlap of the areas covered by the surveys. Computer analyses of the recorded seismic waves provide a profile of the underlying rock strata and offer the basis for identifying potential hydrocarbon traps.

### ***3.5.2 Location & Description of Drilling of Exploration and 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 KG-ONHP-2017/2 is situated in Guntur and Krishna district of Andhra Pradesh. The tentative drilling locations are presented on satellite image and Survey of India topo-sheet (**Figure-2 & 3**) . The tentative co-ordinates of the wells are given in the **Table 2**.



**Figure2: Google map with tentative location of proposed wells on satellite map.**



Table-2: Proposed well co-ordinates to be drilled in block KG-ONHP-2017/2

Well_id	Longitude	Latitude
1	80° 55' 1.353" E	15° 51' 28.783" N
2	80° 57' 4.557" E	15° 52' 34.047" N
3	80° 51' 7.190" E	15° 54' 29.547" N
4	80° 52' 48.179" E	15° 53' 38.908" N
5	80° 55' 37.739" E	15° 53' 38.966" N
6	80° 51' 7.095" E	15° 56' 39.729" N
7	81° 2' 55.661" E	15° 56' 24.982" N
8	80° 51' 6.999" E	15° 58' 49.911" N
9	81° 4' 34.461" E	15° 58' 50.046" N
10	80° 51' 6.904" E	16° 1' 0.093" N
11	81° 6' 1.031" E	16° 1' 31.554" N
12	80° 51' 2.332" E	16° 3' 32.650" N
13	81° 5' 16.329" E	16° 3' 10.409" N
14	81° 7' 30.954" E	16° 3' 10.350" N
15	80° 55' 30.043" E	16° 6' 2.363" N
16	80° 57' 44.693" E	16° 6' 2.397" N
17	80° 59' 59.343" E	16° 6' 2.408" N
18	81° 2' 13.993" E	16° 6' 2.395" N
19	81° 4' 15.033" E	16° 6' 10.385" N
20	81° 6' 19.214" E	16° 6' 2.648" N
21	81° 8' 57.942" E	16° 6' 2.216" N
22	80° 53' 15.321" E	16° 8' 12.485" N
23	80° 55' 29.996" E	16° 8' 12.543" N
24	80° 57' 44.670" E	16° 8' 12.578" N
25	80° 59' 59.344" E	16° 8' 12.589" N
26	81° 2' 14.018" E	16° 8' 12.576" N
27	81° 4' 51.374" E	16° 8' 19.170" N
28	81° 6' 58.720" E	16° 8' 23.646" N
29	81° 8' 56.993" E	16° 8' 26.005" N

*Note: Actual geographical surface coordinates of exploratory and appraisal well locations will be within 4000m radius of the proposed coordinates.*

### **3.5.3 Exploratory & Appraisal well Drilling Process**

All the exploration & appraisal 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. Vedanta will appoint a Drilling Contractor to carry out the drilling work.

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

- 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/offloading 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.

The following shows the various phases of the drilling activities and model of drilling process respectively.

- Site selection after prospect Identification
- Temporary land acquisition on lease
- Site and access road preparation
- Site preparation
- Drilling activities
- Well testing
- Complete the well and suspend for production in case of hydrocarbon find
- Decommissioning & closure of wells in case no success

The model drilling process is followed in forthcoming sections and is represented in Figure-4.



**Figure-4: A typical model onshore drilling process**

The various activities involved as a part of the drilling of exploration wells are described in detail in the subsequent sections.

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

- **Site Preparation**

Site preparation will involve all activities required to facilitate the operation of the drilling rig and associated equipment's 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. Leveling 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 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.

**Mobilization of 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 4500 meters (TVDSS) as planned for the project. The typical configuration of a Drilling Rig is shown in the **Figure 5**. 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.

**Table-3: Specification of the Drilling Rig**

Type of Rig	Electrical Rig
Drilling mud composition	Water based mud in shallower section and synthetic based mud in deeper section
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



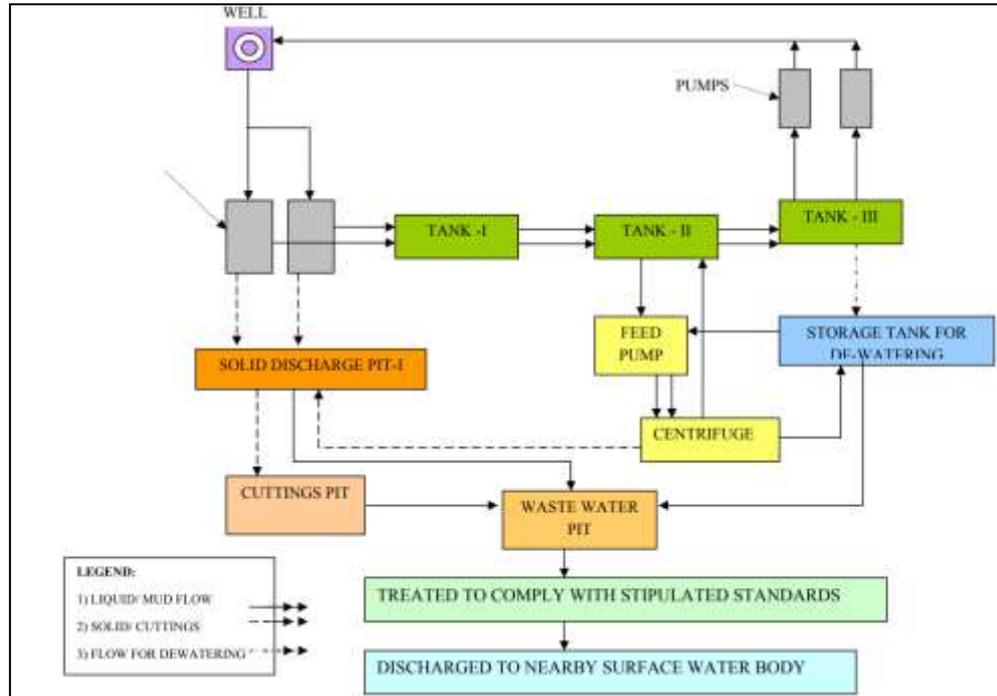
(target) is achieved. Drilling process is associated with various hazards such as well active situation (kicks), blowouts, H<sub>2</sub>S situation etc

- **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.

Figure 6 Flow chart for drilling mud & solid discharge, Figure 8 indicates a typical view of drill cutting separation & Treatment system



**Figure 6: Flow chart for drilling mud & solid discharge**

- **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. 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<sup>3</sup> 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 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. The Crude oil produces during the well testing at appraisal stage will be collected and sent to nearby and approved waste oil recyclers.

- **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.

### **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 m<sup>3</sup>/well
- Requirement SBM (approx.) 600-800 m<sup>3</sup>/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 is biodegradable and will be re-used in further drilling activities.

### **3.8 Water and power requirement**

#### **3.8.1. Water Requirement**

##### **3.8.1.1. Water Requirement during Seismic Operations**

Seismic Operations: The water required during seismic operation will be mostly for domestic use which is about 20-30 m<sup>3</sup>/day.

##### **3.8.1.2. Water Requirement during Drilling Operations**

Drilling Operations: The water requirement in drilling rig is mainly meant for preparation of drilling mud apart from washings and domestic use. While former constitutes majority of water requirement, latter or the water requirement for domestic and wash use is minor. Water for both process and domestic uses would be procured through surface water sources. The water requirement per well is shown in below in Table 4.

**Table-4: Typical Water requirement per well**

Description	Quantity (m3/d)
Water for Water based mud	600-1000 (m3/well)
Water for synthetic based mud	150-300 (m3/well)
Water for domestic use	20-30 (m3/day)
Miscellaneous use	20-50 m3/well/day

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.

**3.8.2. Power Requirement**

**3.8.2.1. Power Requirement during Seismic Operations**

The power requirement during seismic is 350 KVA will be provided through diesel generator (DG) sets or state grid.

**3.8.2.2. Power Requirement during 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-5.

**Table-5: Details of DG sets of Onshore Drilling Activity**

Location	DG Capacity
Camp site	2 X 350 kVA (one working and one standby)
Drilling site	3 x 1000 kVA ( two working and one standby)
Radio Room	2 x 100 kVA

**3.9 Quantity of wastes 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. Domestic effluent of about 15-25 m<sup>3</sup>/day is anticipated. Also, non-hazardous solid wastes like food waste, paper, etc. are expected.

**3.9.2. During Drilling Operations:**

**3.9.2.1. Waste water generation & mitigation**

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 m<sup>3</sup>/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 m<sup>3</sup>/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 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. 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 lined 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.

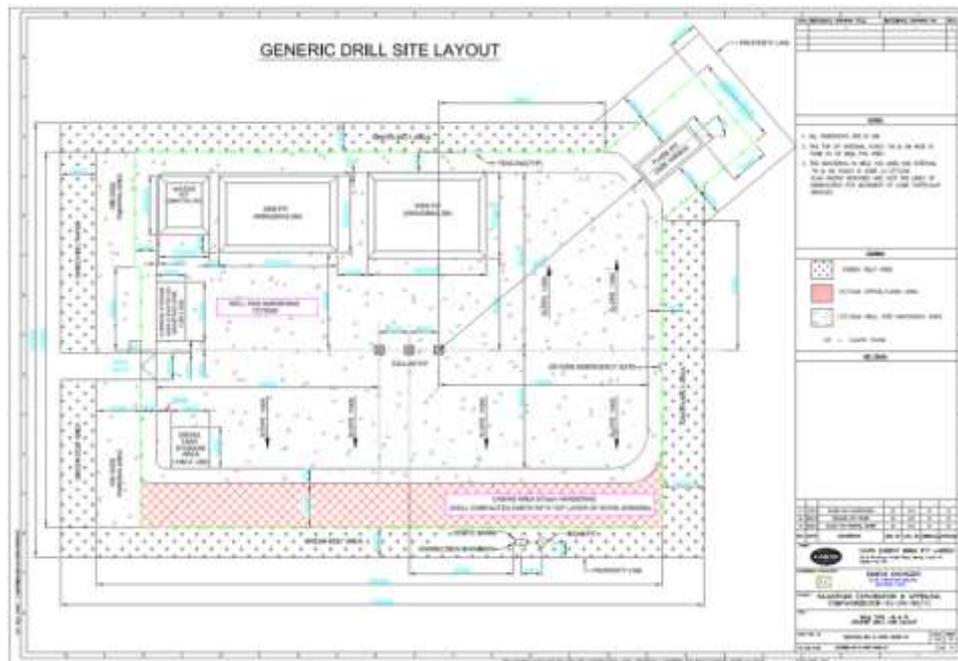
The expected waste generation from well drilling will be as per Table 6

**Table-6: Quantity of generated waste from drilling.**

S.No	Nature of waste	Quantity
<b>A</b>	<b>Hazardous Waste</b>	
1	Drill cuttings associated with SBM	250-750 tons/well
2	Drill cuttings associated with WBM	500-1500 tons/well
2	Residual drilling mud, sludge and other drilling waste	250-500 tons/well
3	Used Lubricating oil	1-2 tons/well
<b>B</b>	<b>Non Hazardous Waste</b>	
4	Food waste	25-30 Kg per/day
5	Non-combustible waste containing metallic residues.	1000-1200 Kg per well
6	Packaging wastes including drums, wooden pallets, plastic containers, plastic foils.	1000-1200 kg per well
7	Left over chemicals and materials, scrap metal, sludges, scales, batteries, spent acids, spent lubricants, filters etc.	250-300 kg per well
8	Cement, grit, blasting and painting wastes.	600 kg per well

### 3.10 Schematic of Feasibility Drawing

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



**Figure 7: 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 situated Guntur and Krishna district of Andhra Pradesh. The nearest major town for this project is Rajamundri. Nearest airport is in Vijayawada Airport in 40.7Km towards NW from the block. Kakinada is the nearest port. The project location is well connected by road, rail and by Air. Repalle Railway Station is 480m towards Western side from the block, Machilipatnam Railway Station is 574Km Northern direction from the block. NH-216 and SH-47 passes through the block. Machilipatnam town is 2.1 km from the block.

##### **4.2 Land form, land use and land ownership**

20% area covered by fish ponds and fisheries is major activity. Krishna River flows through the block.

##### **4.3 Topography (along with map)**

The region has an average elevation of 33 m (108 ft) and is situated on the plains. The terrain of the block is flat level plain Topography sheet is given as Fig. 4B of Chapter-3 in this document.

##### **4.4 Existing land use pattern and relative location of protected areas**

The entire block area is divided into following land use types,

- Mangrove forest
- Habitation
- Water bodies

##### **4.5 Existing infrastructure/ industries**

The block area is located in Guntur & Krishna 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 major soil classification in the region are Black cotton soils, Red loamy soils, and sandy loam. Geomorphologically the district is classified into three units based on relief, slope factor and soil. The three groups are (i) Hilly region (ii) The pediplain region and (iii) The fluvial and marine land forms.

##### **4.7 Climate data from secondary sources**

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

Month	Daily mean Temp. (0C)		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	28.6	19.5	85	68	6.7	0.3	2.3	2.1	5.9
February	30.3	21.2	82	68	4.9	0.4	2.6	1.8	6.7
March	32.7	22.9	79	67	3.9	0.2	2.8	1.5	7.6
April	34.7	25.8	73	69	10.2	0.7	3.9	2.6	10.2
May	37.2	27.7	68	63	18.6	1.5	4.4	3.4	11.9
June	36.6	27.3	67	58	83.7	5.5	5.7	5.8	11.9
July	33.6	26.0	77	67	160.9	10.1	6.2	6.3	9.8
August	32.7	25.8	79	69	179.5	9.6	6.1	6.3	9.3
September	32.6	25.7	81	73	153.2	8.1	5.7	5.8	7.0
October	31.5	24.3	82	75	182.1	8.1	4.7	5.2	6.0
November	30.1	22.0	79	72	145.3	4.5	3.8	4.4	7.2
December	28.8	19.9	79	69	22.7	0.9	2.8	3.3	6.9
Annual or Mean	32.5	24.0	78	68	971.8	49.8	4.3	4.0	8.4

Source: India Meteorological Department (IMD)

#### 4.7.1 Wind

The monthly mean wind speed varied from 5.9 to 11.9km/hr occurring in January and May & June months respectively. The predominant wind during winter season was recorded from W and N direction.

#### 4.7.2 Storms and cyclones

Machilipatnam city is frequently hit by cyclones originating in the Bay of Bengal. The Andhra Pradesh coast between Ongole and Machilipatnam is vulnerable to high surges of the sea due to cyclones. The 1977 Andhra Pradesh cyclone crossed the coast near Nizampatnam and took approximately 10,000 lives.

#### 4.7.3 Rainfall

Rainfall occurred maximum in October (182.1 mm) followed by August (179 mm). The total rainfall received in the year is about 971.8 mm with total number of rainy days of about 50 days.

#### 4.7.4 Temperature and humidity

The monthly mean maximum temperature varied from 28.6°C in January to 37.2°C in May while monthly mean minimum varied from 19.5°C in January to 27.7°C in May indicating January as the coldest while May as hottest month.

### 5. Planning Brief

#### 5.1 Planning concept

The project is a green field oil and gas exploration, spread over in KG-ONHP-2017/2

The Block is spread over in an area 668 km<sup>2</sup> in Guntur and Krishna district of Andhra Pradesh.

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

## **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, First Aid Facility/Centre, Para-medics will be provided for emergency
- ✓ Drinking water, canteen and electricity facilities is provided
- ✓ 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 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**

Vedanta Ltd. (Cairn oil & gas) plans to carry out the proposed project activities in the KG-ONHP-2017/2 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 2 Crore.
- 2) Average Cost per well for exploratory & appraisal well drilling is estimated to be INR 18 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.