Pre-Feasibility Report

Onshore Development and Production of Oil & Gas from 656 Wells in 52 PML and 1 NELP blocks in Kheda, Gandhinagar, Mehsana and Ahmedabad Districts of Gujarat by M/s ONGC

OIL AND NATURAL CORPORATION LIMITED

AHMEDABAD ASSET

1.0 Brief Introduction

Oil and Natural Gas Corporation Ltd (ONGC) a Maharatna company, is the largest crude oil and natural gas Company in India, contributing around 70 per cent to Indian domestic production. Crude oil is the raw material used by downstream companies like IOC, BPCL, and HPCL to produce petroleum products like Petrol, Diesel, Kerosene, Naphtha, and Cooking Gas-LPG.

It is involved in exploring for and exploiting hydrocarbons in 26 sedimentary basins of India, and owns and operates over 11,000 kilometers of pipelines in the country. ONGC has discovered 6 of the 7 commercially producing Indian Basins, in the last 50 years, adding over 7.1 billion tonnes of In-place Oil & Gas volume of hydrocarbons in Indian basins. The Company holds the largest share of hydrocarbon acreages in India (61% in PEL Areas & 81% in ML Areas).

ONGC also has established its global footprints by acquiring stake in 41 oil and gas projects in 20 Countries, viz. Azerbaijan (2 projects), Bangladesh (2 Projects), Brazil (2 projects), Colombia (7 projects), Iran (1 project), Iraq (1 project), Israel (1 project), Kazakhstan (1 project), Libya (1 project), Mozambique (1 Project), Myanmar (6 projects), Namibia (1 project), New Zealand (1 Project), Russia (3 projects), South Sudan (2 projects), Sudan (2 projects), Syria (2 projects), UAE (1 project), Venezuela (2 projects), and Vietnam (2 projects).

ONGC has a unique distinction of being a company with in-house service capabilities in all areas of Exploration and Production of oil & gas and related oil-field services.

- ONGC received Dun & Bradstreet Award 2018 in the 'Oil and Gas Exploration' category
- ONGC received 4 PSE Excellence Awards from Indian Chamber of Commerce in 2016
- This Top Energy Company in India, ranked 11th globally as per Platts Top 250 Global Energy Rankings, 2017

ONGC has prepared a roadmap for its growth over the next two decades through PP2030. It aims to double ONGC's production over the plan period with 4-5 per cent growth against the present growth rate of 2 percent.

ONGC also has prepared the 'Roadmap for Import Reduction' for reducing oil import dependence by 10 per cent, from 77 per cent in 2013-14 to meet Prime Minister Narendra Modi's target of cutting India's import dependence by 10 per cent.

This public sector enterprise has a dedicated team of over 33,500 professionals who toil round the clock in challenging locations and spread all over India.

1.1 Summary of areas and fields in Ahmedabad Asset

Area	AREA-I	AREA-II	AREA-III	AREA-IV	Total
Fields	Kalol	Ahmedabad	South Kadi	Limbodra	**22**
	Motera	Nawagam	Jhalora	Gamij	
	Wadu-Paliyad	Nandej	Sanand	Halisa	
	Veera-Govindpura	Wasna	Wamaj	Walod	
		Hirapur	Wadsar	Limbodra-East	
			Viraj		
			South Viraj		
			Karannagar*		
	4	**5**	**8**	**5**	

*** 01 NELP Block**

1.1.1 <u>Area-I:</u>

- **KALOL FIELD**

Kalol is the largest field in Ahmedabad Asset discovered in 1961 comprising of nine pay zones, Pay zones II, III and IV are both oil and gas bearing while pay zones V, VI + VII, IX + X, XI and XII are oil bearing. This field was put on production in 1964.

As on 01.04.2019 a total of 752 wells have been drilled in the Kalol field, of which 464 wells are currently oil producers, 118 wells are water injectors, 28 wells are gas wells, 8 wells are Effluent disposals, 1 well is polymer injector, 83 wells are Abandoned, 15 wells are yet to be abandon, 10 wells are observation wells, 25 wells are future utility wells.

- **WADU-PALIYAD FIELD**

The Wadu-Paliyad field located north of Kalol field in Ahmedabad-Mehsana block of Cambay basin was discovered in 1983 and put on production in 1989. This field has four main producing sands i.e. K-IX, VI-VII, V & IV which are developed as discreet sand bodies. In addition to this, there is local development of pay zones K-VIII, XI and Wadu pay. Pay zones Wadu Pay, K-XI, IX+X, VIII, VI+VII and V are oil bearing while pay zone K-IV is both oil and gas bearing.

As on 01.04.2019, 115 (Wadu: 72, Paliyad: 43 (40+3 side tracked) wells have been drilled in Wadu-Paliyad field, of which 66 wells are oil wells, 20 wells are water injectors, 23 wells are Abandoned, 3 wells are yet to be abandon, 1 well is observation well, 2 wells are future utility wells.

❖ MOTERA FIELD

Motera field is discovered in 1988 and put on production since 1989. It is a multi-layered reservoir with oil-bearing zones in Kalol and Younger Cambay shale formations. Pay Zone K-III & V are gas bearing while pay zones K-VII, VIII and IX+X are oil bearing.

As on 01.04.2019, total 58 numbers of wells have been drilled in Motera field which includes 46 oil wells, 2 gas wells, 6 water injectors, 3 wells were abandoned, 1 well is yet to be abandon.

❖ VERAGOVINDPURA FIELD

A new structure named VERAGOVINDPURA was added to the Area-I based on the discovery exploratory well VGP-3 (VRAA). This field basically produced gas only. Based on testing results Gas Initially In place (GIIP) were estimated in K-XI and K-XII. The field has 89 MMm3 & 142.3 MMm3 Gas Initially In place in Proved Developed (PD) category with ultimate component of 53.4 MMm3 and 85.4 MMm3 in K-XI and K-XII respectively. As on 01.04.2019, total 5 numbers of wells have been drilled in Veragovindpura field which includes 2 oil wells, 1 gas well, 1 water injectors, 1 well was abandoned.

❖ NARDIPUR LOW AREAS

The area lies to the east of Kalol field in Nardipur Low between Kalol and Limbodara fields. In this area K-IX sand is developed. The area was in focus for exploration since 1993 wherein exploratory well LM-19 was drilled to test small amplitude seismic closure based on 2-D data. As on 01.04.2019, total 20 numbers of wells have been drilled in Nardipur Low field which includes 13 oil wells, 5 water injectors, 2 well was abandoned.

1.1.2 Area-II:

❖ NAWAGAM FIELD

Nawagam field was discovered in 1963. There are two major hydrocarbon bearing pay zones namely Upper and Lower pays besides Deeper and Middle pay sands. The Upper pay (IX+X) mainly comprises of oil bearing sands/silts which are extensive and spread over the entire field of over 55 sq. km. Lower pay is multilayered and heterogeneous reservoir. Hydrocarbon production was started from Nawagam field in 1967 from Lower Pay.

As on 01.04.2019, total 299 wells have been drilled, out of which 216 wells are oil producers, 46 wells are water injector, 7 wells are ED well, 4 wells are identified for Future utility, 22 wells are abandoned, 4 wells are to be abandoned.

❖ AHMEDABAD FIELD

Ahmedabad field is situated 12 km SE of Ahmedabad city in southern part of the Ahmedabad-Mehsana tectonic block of Cambay Basin. Aerial extent of the field is about 120 sq. km. The field

was discovered in 1965 with drilling of well AM-001 and put on production on 1981 through well AM-018 (K-IX+X). It has multilayered silt/sandstone reservoirs in Kalol Formation. The pay zones encountered in Ahmedabad fields are K-III, K-IV, K-V, K-VII, K-VIII, K-IX & K-X. The pays K-III, K-IV & K-V are gas bearing whereas K-VII, VIII and K-IX+X are oil bearing. The pay zones K-IX and X are the main reservoirs in the field with about 80% of the total OIIP. All the reservoirs are producing under depletion drive, where pressure maintenance in K-IX+X and partly in K-VII & K-VIII sands is done by water injection.

As on 01.04.2019, total 215 wells have been drilled, out of which 160 wells are oil producers, 2 wells are gas well, 31 wells are water injector, 15 wells are abandoned, 2 wells are to be abandoned, 4 wells are in observation, 1 well is future utility well.

❖ NANDEJ FIELD

Nandej field was discovered in the year 1990 with drilling of well NJ-001 and is situated in Ahmedabad-Mehsana tectonic block of Cambay Basin. It was bounded by Jetalpur depression in the west, Ahmedabad field in NE and Wasna field in south. The aerial extent of the field is around 27 sq. km. K-IX is the main reservoir of the field with more than 90% of total production and is extensively developed throughout the field. Nandej field is on production since Aug'90 from the main pay zone K-IX. Pay sand K-X is also developed with limited extent in the northern sector of the field. The general lithology of K-IX and K-X reservoirs consists of siltstone, coal and shale. The pay zones K-IX and K-X are low permeability silt/shaly silt reservoirs deposited under tidal flat environment. The north western part of the field has better reservoir facies and permeability varies from 10-40 md.

As on 01.04.2019, total 128 wells have been drilled, out of which 90 wells are oil producers, 33 wells are water injector, 5 wells are abandoned

❖ WASNA FIELD

The field was discovered in May'69 and is on regular production since Nov'85. Three pays comprising of K-VIII, K-IX, and K-X of Kalol Formation are the main producing pay sands. The K-IX & X units are widely distributed throughout the field whereas the development of K-VIII unit is localized and encountered in the western and central part of the field. The K-VIII, IX & X pay sands together have thickness of about 25 m of which 15-20 m sand forms the K-IX+X pay.

As on 01.04.2019, total 135 wells have been drilled, out of which 92 wells are oil producers, 33 wells are water injectors, 8 wells are abandoned, 1 well is to be abandoned, 1 well is in observation.

❖ HIRAPUR FIELD

Hirapur field is one of the five marginal fields which were collectively named as Satellite fields. Other four fields i.e. Mahelaj, Asmali, Vatrak and Sadra were handed over to Cambay Asset on 1st April 2016 so that these marginal fields, in proximity of Cambay Asset, would get more attention for exploitation of the reserves.

The field is situated at a distance of 16 km south of Ahmedabad city and lies in Ahmedabad–Mehsana tectonic block. As an outcome of tender for Development of Onshore Marginal Field in July 2003, a service contract was signed between Prize Petroleum Co. and ONGC Limited in April 2004.

At the time of handing over, ONGC had drilled 4 wells of which 2 were oil wells (H-1: flowing on SRP, H-2: N/F, poor facies) and 2 abandoned wells (H-3, H-4). After taking over, Prize Petroleum had drilled 3 wells viz. P-1, P-2, P-3 which were later renamed as H-5, 6 & 7, respectively in revised REC maps.

1.1.3 Area-III:

❖ JHALORA

Jhalora field is located 50 km NW of Ahmedabad city. The field was discovered during 1965 when the well SA-9 (renamed as JH-1) produced oil and gas from a Kalol pay. It has an aerial extent of 30 sq. km and is on production since 1977. This asymmetrical anticline is trending NW-SE and is plunging towards North West. The field consists of three main pay zones viz. K-III, K-IV & K-IX+X which are operating under active water drive. Besides, there are two more pays, viz. K-VIII and Chhatral has developed.

In Jhalora field, as on 01.04.2019, a total of 166 wells have been drilled. Out of these, 102 wells are oil wells, 29 wells are ED wells, 1 well is Polymer Injection, 31 wells are abandoned, 3 wells are future utility wells.

❖ SOUTH KADI

South Kadi field is located about 50 Km N-N-W of Ahmedabad. It was discovered in Feb'1967 and was put on regular production in Aug'1968. This field comprises mainly 12 Lower Kadi sands (viz. A, A1, A2, A3, B1, B2, C, D, E1, E2, E3 & F in older Cambay Shale, 3 sands in Mehsana formation and sand K-III in Kalol formation) forming more than sixty small/medium sized oil pools. The Lower Kadi pays are discrete sand bodies with limited aerial extent and associated rapid lateral variations in petro-physical characteristics. These sands are developed over an area of 90 sq. km. Prediction of the vertico-lateral dispersal of the Lower Kadi sands is fraught with high risk. Development and reservoir management of these pools is a challenge and requires close monitoring.

As on 01.04.2019, 148 wells have been drilled in South Kadi field, out of these, 87 wells are oil wells, 4 wells are ED wells, 23 wells are Water Injectors, 33 wells are abandoned, 1 well is to be abandoned.

❖ SANAND

The Sanand field is located on South Kadi-Jhalora-Sanand high trend in the Mehsana-Ahmedabad tectonic block in north Cambay basin. The field was discovered in 1962. Testing of well Sanand-1 established presence of oil in horizons Kalol-III, IV, IX+X and Cambay Shale. The commercial oil

production from the field started in 1969 from well SAN-15 from K-III sand. Production of hydrocarbon from sand K-IV started from March 1988 through well SAN-57.

As on 01.04.2019, 161 wells have been drilled in Sanand field, out of these, 66 wells are oil wells, 17 wells are ED wells, 4 wells are gas wells, 6 wells are Water Injectors, 18 wells are polymer injectors, 39 wells are abandoned, 3 wells are to be abandoned, 2 wells are observation wells, 6 wells are for future utility.

❖ VIRAJ FIELD

Viraj field was discovered in 1978 and is located in the north of Jhalora field in Ahmedabad-Mehsana tectonic block of Cambay basin. It is a doubly plunging anticline trending NNE-SSW. Sands K-III, K-VIII, K-IX+X, Mandhali and sand C+D are found to be hydrocarbon bearing in Viraj field.
Keeping in view of the reservoir characteristics and the properties of crude oil, IRS conducted laboratory studies to test the effectiveness of various Enhanced Oil Recovery processes including chemical and thermal processes to enhance recovery. Based on the encouraging laboratory results, application of Alkaline Surfactant Polymer (ASP) flooding was implemented in the Viraj field on pilot scale. After Successful pilot, Viraj ASP project is planned to implement in field form 2019-20.

As on 01.04.2019, 65 wells have been drilled in Viraj field, out of these, 49 wells are oil wells, 7 wells are ED wells, 1 well is polymer injector, 8 wells are abandoned.

❖ SOUTH VIRAJ FIELD

This is an additional structure located in south-west of Viraj field. This structure is separated from the main Viraj field by a NW-SE trending fault. It comprises of two pay zones viz. K-VIII & K-IX+X. As on 01.04.2019 ten wells have been drilled in this structure out of which 7 wells are oil wells and 3 wells (SV- 02, 04, 05) have been abandoned.

❖ WAMAJ

Wamaj structure was discovered during the year 2004-05 and it mainly covers western flank of Kalol, Wamaj low and Eastern flank of Sanand and Jhalora fields. Wamaj low which has NNW-SSE orientation extends from around South Kadi in the North to Ognaj in the South and bounded by NNW-SSE Trending axial horst of Kalol high in the east and South Kadi-Jhalora high in the west.

As on 01.04.2019, 18 wells have been drilled in Wamaj field, out of these, 6 wells are oil wells, 1 well is water injector, 10 wells are abandoned, 1 well is future utility well.

❖ WADSAR

Wadsar field was discovered in 2006 and is situated in the East of Sanand field and falls in the central part of Ahmedabad-Mehsana tectonic block of Cambay basin. It is bounded by Kalol field in the North east and Sanand field in the west. From Wadsar-1 in the south, gradual low is observed

northward towards Wamaj-8. Deepening is observed further north around South Wamaj-1 & also continues further northward between Wamaj-1 and Kalol-344 & 305.

As on 01.04.2019, 22 wells have been drilled in Wadsar field, out of these, 21 wells are oil wells, 1 well is abandoned.

1.1.4 Area-IV:

❖ LIMBODRA FIELD:

Limbodra field, discovered in 1985 is spread over an area of about 140-150 Sq.km. Till date 268 wells, including five substitutes (LM-28A, 44A, 66A, 103A, 115A) and 3 side tracks (LM-9Z, 32Z and107Z), have been drilled (including wells of Nardipur Low). Oil-bearing sands occur in Olpad, Cambay Shale (Older Cambay Shale), Kadi (Mandhali & Chhatral Members), Kalol (K-IX, K-VIII & K-III+IV) and Tarapur Shale (Limbodra Pays) formations. Sands within Chhatral Member of Kadi Formation alone contribute more than 50% of the production from the field.
As on 01.04.2019, total 273 wells have been drilled in Limbodra field out of which 168 wells are oil wells, 44 wells are water injectors, 49 wells are abandoned, 4 wells are to be abandoned, 8 wells is future utility well. 20 wells are under Area-I.

❖ HALISA FIELD

Halisa field was discovered in 1994 and oil production started from June 1995. Halisa structure located on the eastern margin of Ahmedabad block, between Limbodra and Gamij fields and covers a large aerial extent of approximately 150 sq. km. The emphasis for exploration has been on the fault closures at K-IX+X levels and reservoirs within Olpad formation.
A total number of 21 wells have been drilled on Halisa structure so far (11 oil producer, 4 non flowing, 5 abandoned & 1 is to be abandoned). The spacing between the wells being very high, reservoir limits are yet to be established.

❖ GAMIJ FIELD

Gamij field, discovered in 1982, is spread over an area of 100-150 sq.km and has an elongated geometry. Hydrocarbon accumulation has been established at three stratigraphic levels, Olpad, Cambay Shale (mainly Chhatral) and Kalol formations. The most significant accumulation is in sands within middle Kalol Formation. Commercial production from the field started in 1994. Development plan was submitted by Ahmedabad asset in 2002 and by IRS in 2002 for K-V, VI and VII. Surface facilities were created in Gamij field at GGS-1 in 2002. Subsequently surface facilities at GGS-II & III were also created.
As on 01.04.2019, total 238 wells have been drilled out of which 187 wells are oil wells, 23 wells are water injectors, 23 wells are abandoned, 1 well is to be abandoned, 1 well is under observation.

❖ WALOD

Drilling activities in Walod field started during 1969 and till date a total of 8 exploratory wells have been drilled in the field. Pay sand K-VII, Chhatral and YCS are found to be oil bearing in the field. Production from the field commenced from 2012-13 and currently 3 wells are on production.

❖ **LIMBODRA EAST**

Limbodra East field was discovered in 2010 through drilling of well LM#187 and oil production started from August 2010. The field is currently on production from Limbodra pay through 1 well.

2.0 Ahmedabad Asset

Since its inception in 1961, Ahmedabad Asset is one of the major onshore assets of ONGC operating in four revenue districts of Gujarat state viz. Kheda. Ahmedabad, Gandhinagar and Mehsana. Operations of Ahmedabad asset are divided in to four areas spread across about 6200 square kilometres. The Asset has following installations and establishments

Drilling Rigs	: 06 [05(own) and 01(hired rig)]
Work Over Rigs	: 14 [05- Deptt. (Own-1, O&M-4), 09 chartered hired]
Production Installations	: 41
Auxiliary Services	: Logging Services, Cementing Services, Asset Workshop, Logistic Services, Asset Chemistry laboratory
Support Services	: HR/ER, Finance, Material Management, Legal, Medical, Security and Fire
Corporate Services	: Planning, Infocom, Vigilance, Audit, Marketing, Infocom and Asset HSE.

There are 22 oil fields divided into Geographical areas in the Asset with proved in-place oil of over 559.35 Million Metric Tons. The Asset has already produced approx. 59.04 Million Metric Tons of oil till 01.04.2019 since inception.

2.1 Drilling activity:

Entire gamut of Exploration and Production activities of Asset primarily involve geological studies, well logging, well completion, reservoir studies and laboratory services as exploration activities, drilling of oil and gas wells, casing and cementing of wells as drilling activities whereas processing of the crude oil in production installations and subsequent transportation of processed crude oil and gas to the customer along with well stimulation operations and well maintenance jobs, work over and wire line operations, artificial lift, gas compression in gas compression stations, pressure maintenance operations and process plant maintenance etc. fall in fold of production activities.

Crude oil and natural gas resources are found in subsurface reservoirs. The drilling of oil and gas wells is necessary to produce these hydrocarbons. Drilling through the earth's crust is accomplished by using rigs to handle pipes for drilling the well bore to allow fluids to flow to the surface for processing at production facilities. Thus, the purpose of oil /gas well drilling is to exploit oil and gas deposits in the reservoir to the surface. Rotary drilling is the most common process for this purpose. Major equipment used in drillings are- DG sets and PCR(Power control room),Mud pumps, Mud circulation system, Blow out prevention equipment, Choke and kill manifold, kelly, kelly hose, rotary table, safety devices like chronometric and floriated devices, Escape line, cat head and cat lines, tongs and handling tools etc. Drilling of oil well is carried out through drilling rigs operating with rotary drilling technology in conformance to geotechnical order wherein casing policy and drilling parameters at various depths are explicitly defined.

Drilling operations shall be conducted round-the-clock for 24 hrs. The time taken to drill a borehole depends on the depth of the hydrocarbon bearing formation and the geological conditions. ONGC intends to drill wells to a depth of 1600 m. This would take around 25 days' time for each well.

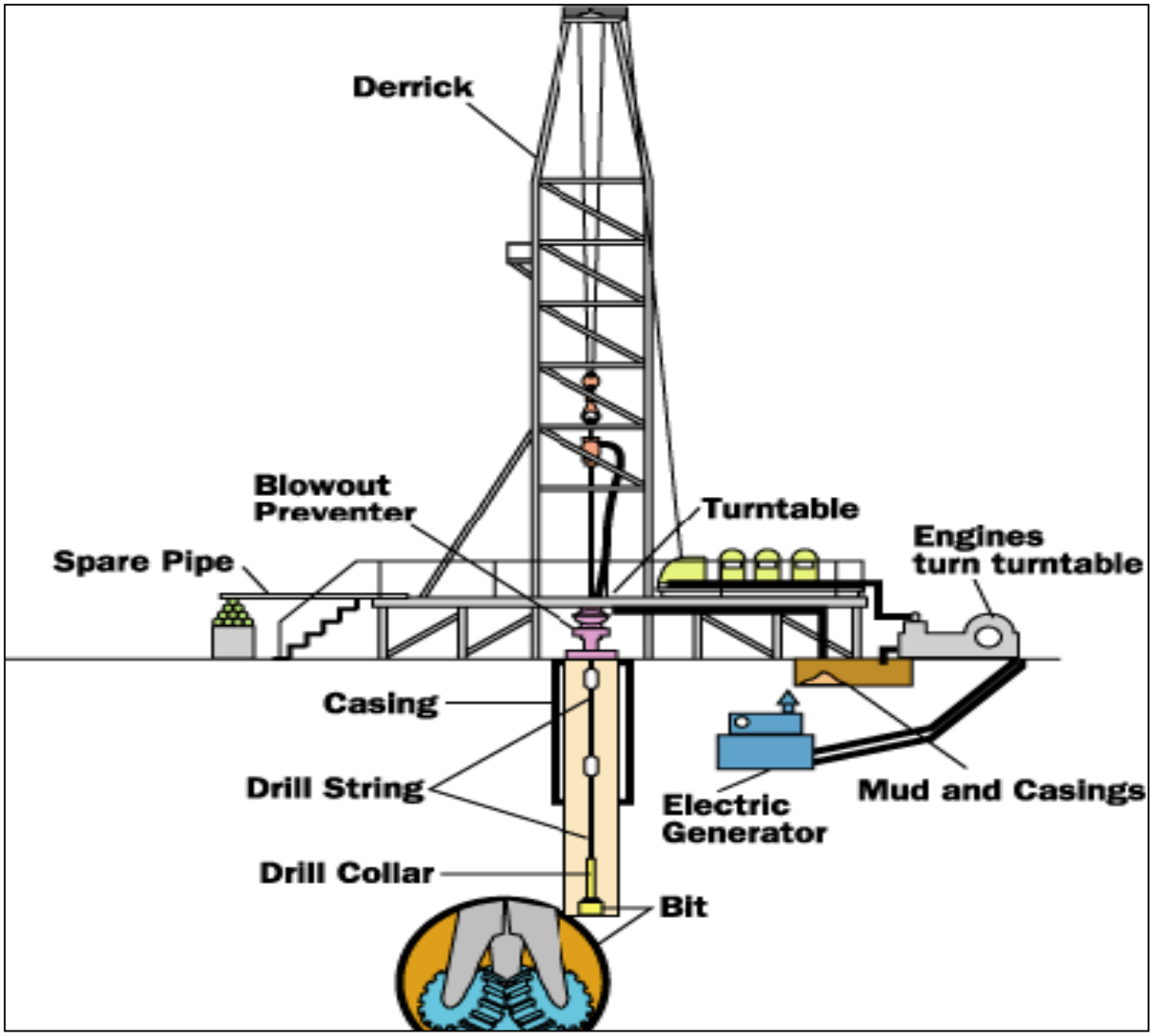
There is also possibility of drilling a number of wells from a single site, which increases the time during which the site is occupied and is termed as directional drilling or cluster well drilling. Some of the wells may be drilled horizontal also to improve sweep efficiency and in turn enhance production. This mode of drilling would also reduce the land used or "foot print".

a. Equipment Required for Drilling:

The key items of equipment that will be used for drilling are summarized below:

- Drill bit, Drill string, connecting sections of drill pipes and drill collars
- Kelly (situated on the derrick floor allows the drill string to be rotated)
- Top drive / rotary table
- Drilling rig
- Swivel, to which the high pressure flexible drilling fluid hoses are attached
- Diesel engines to supply the necessary power to run the drilling operation and supporting logistics
- BOP blow out preventer
- Tanks for mud fluid, Diesel storage.

A typical stationary Drilling Outfit is presented in **Error! Reference source not found.**



While drilling, ONGC is taking world class Environment safety precautions as per stipulated Government of India guidelines. All necessary safety standards for Noise, solid, water pollution are being adhered to by ONGC with its technical audits on time to time**.**

2.2. Testing activity:

Where a hydrocarbon formation is found, initial well tests - possibly lasting one more month are conducted to establish flow rates of oil & gas and formation pressure along with other reservoir parameters. These tests may then generate oil, gas and formation water. On completion of testing the well would be declared as oil/gas producer or dry.

In the event that economic quantities of hydrocarbons are found, the well will be completed with a well head in place at surface along with x-mass tree and casing & tubing inside the hole down to the desired reservoir depth (say 1600 m), but all the other equipment and materials will be removed from the site.

In the event that no economic quantities of hydrocarbons are found, the site would be restored to its original form (as far as possible) and the well abandoned, following standard practices.

2.3. Production facility:

Processing of crude oil produced as a result of drilling and completion of well is carried out in production installation named as Group gathering stations/Central tank forms. Processing of crude oil is primarily meant to knock out the basic sediments and water co produced with crude oil and gas so as to generate crude oil and gas acceptable to the customers. Crude oil processing is comprised of a series of processes namely well manifold, bath heater, separator, heater treater, storage tanks and dispatch facilities. The well manifolds regulate the flow of crude and gas to bath heater where it is preheated to maintain its fluidity. From bath heater crude and gas are subjected to separator wherein phase separation (Crude, gas and water) takes place. From here crude oil is subjected to heater treater. Prior to heater treaters dosing of demulsifier, a surface active chemical is done. This ensures chemical de-emulsification of crude oil which is an emulsion. In heater treater, heating provision and electrical chamber with very high potential difference are there which ensures heating and electrical de-emulsification. Thus, processing of crude oil emulsion is done through a combination of chemical, heating and electrical de-emulsification. This demulsified crude is collected in storage tanks from where it is transported through trunk lines to de salter plant where fine tuning of crude is done by way of further removal of emulsified water and inherent salt content. From here the crude is dispatched to refinery. Gas separated during the phase separation is compressed to transport to the customer.

Other important allied activities are work over and wire line operations and logging of wells. Work over stimulation and wire line operation means to perform one or more of a variety of remedial operations on a producing well or ceased oil well with the intention of retaining and /or increasing production. Various such operations are scrapping, plugging back, squeeze cementing, shooting, artificial lift installation, fishing, stimulation etc. A work over rig may be used for the purpose depending upon the total expected load to be handled. Logging activities are related with the collection of information like characteristic of the formation, location and thickness of oil sand, type and nature of hydrocarbon deposits etc. pertaining to the well.

2.4 Drilling fluid chemicals:

Exploration and production of hydrocarbon is not a raw material intensive business, however some chemicals are used preparation of chemical drilling fluid.

Raw Materials:

Drilling mud used during the proposed drilling activity includes additives for providing viscosity, lubrication, and well bore stability, etc. ONGC use an environment friendly mud system, which is non-toxic and non-hazardous, for the drilling campaign. Water Based Mud (WBM) will be used for the drilling operation.

Drilling Mud Additives:

The chemicals of drilling mud required to drill a typical 1600 m well along with their function are given in as follows:

Chemical	Function	Dosage
Bentonite	For viscosity and fluid loss control	3-5%
Caustic soda	pH controller	For 8.0-9.0 pH
Chrome lignite	Dispersant	Symptomatic
CMC	Water/fluid loss control	0.8% (max.)
Chrome free de-flocculent (CFD)	Dispersant	Symptomatic
Sulphonated asphalt	Shale stabliser	1.0% (max.)
Barite	Weighting agent	As per requirement
KCl	Inhibitor	5.0%
PHPA	Shale encapsulater	0.3% (max.)

During drilling program the material required at the drill rig will be transported by the authorized transporters.

2.5 Workforce Arrangements:

During the drilling operations, about 50 persons will be working in 12 hour shifts at site. Since locally available manpower will be used, workers will be able to return to their homes at night and hence no camping is required at or near the well site. Maximum 10 knowledgeable & technically skilled people will stay in mobilized bunk houses. Once drilling is over no person is required at site, except for security cover through a contractor.

2.6 Water and Energy:

Water :

The drilling operation and maintenance of the drill site facilities have various water requirements. The most significant of these requirements in terms of quantity is that for mud preparation. The other requirements would be for engine cooling, floor/equipment/string washing, sanitation, fire-fighting storage/make-up and drinking. The requirement of water expected for sanitation and drinking purposes of the workers shall be insignificantly low in terms of quantity. Groundwater transported from nearby installations of ONGC will be used for drilling activity. For drilling oil and gas well, approx. 35 KLD water is consumed.

Fuel:

The power requirement of the drilling rig is met by using the Diesel Generator sets. HSD will be used to run drilling rig and DG sets 1430 KVA during operation. HSD: (approx. 45 KL per well).

3.0 Activities and performance

The major activities of upstream Exploration and production activities of Ahmadabad Asset are to produce and market crude oil and natural gas. The major customer of Asset are Koyali refinery, Gas authority of India limited (GAIL) and approx. 25 local gas consumers.

The Asset has a Human Resource base of 2300 employees (approx.) which includes Scientists, Engineers and other professionals.

❖ **The physical performance of Asset during 2018-19:**

PARAMETER	UNIT	TARGET MOU	ACTUAL
Oil Production	MMt	1.335	1.3406
Gas Production	MMSCM	149	154.45
Development Wells drilled	Number	91	100
Exploratory wells drilled	Number	8	9
WO Job carried out	Number	488	490

❖ **Financial performance of Asset during 2018-19:**

Particulars	All figures are in Rs. (Crores)
Revenues	
Crude Oil	4407.32
Natural gas	99.74
Other Income	235.17
Change in Stock	7.31
Total Revenue	**4749.54**
Expenses	
Statutory levies	1453.46
Operating expenses	1468.41
Recouped Cost	423.40
Provisions & write offs	22.03
Others	32.85
Total expenses	**3400.15**
Profit/Loss	**1349.39**

4.0 Proposed Project, Project cost and Expected gain

656 wells are planned to be drilled in various fields of Ahmedabad Asset from 2019-20 to 2025-26. The incremental Oil gain from the drilling of these development wells is 3.81 MMt and incremental gas gain is 329.75 MMSCM.

ONGC is oil major and strives to continually hike the production of hydrocarbon to meet the ever growing national demand. In Ahmedabad asset, about 50.75 MMt (3P) reserve as on 01.04.2019 is available for exploitation in different fields. Development drilling is one of the main activities to exploit the available reserves.

4.1 Project Cost

In 2018-19, total 100 development wells have been drilled and cumulative meterage of development drilling is 157566 m. So, the average meter-age per well is around 1575.66 m. So,

- The average depth of wells to be drilled is considered 1600m (approx.).
- During 18-19, average cost of drilling per meter is Rs. 34,369/- (till monetization).
  4% acceleration for first 3 years & 5% acceleration for next 4 years are considered on the average drilling cost per year cost per year.

So, the total cost for drilling of 656 wells from 2019-20 to 2025-26 will be Rs. 4253.62 crore (approx.).

The summary of the project is given below:

Year	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**Total**
No of Wells to be drilled	105	105	105	90	90	83	78	**656**
Average cost of Drilling per meter	35744	37174	38660	40593	42623	44754	46992	-
Average depth	1600	1600	1600	1600	1600	1600	1600	-
Drilling Cost Per Well, in Cr	5.72	5.95	6.19	6.49	6.82	7.16	7.52	-
Drilling Cost for the year, in Cr	600.50	624.51	649.50	584.55	613.77	594.34	586.46	4253.62

❖ Number of development wells to be drilled from 2019-20 to 2025-26:

Field	Sl No	ML	Total
Kalol	1	Wadu Extn-I	162
	2	RJPR Extn-I	
	3	RJPR ML	
	4	Kalol Extn-I ML	
	5	WMJ ML	
	6	PL-KL-LM ML	
	7	KL-NE ML	
	8	Kalol Main ML	
	9	Kalol Extn-II ML	
	10	Valod-Extn-I-C-ML	
	11	ValoD ML	
	12	Motera Extn-I ML	
	13	Motera ML (part)	
	14	Motera Extn-II ML	
	15	KL-W-Extn-II-ML-II	
	16	SWMJ ML	
	17	KL-W-Extn-I-ML-I	
	18	Rupal ML	
Wadu- Paliyad	1	Wadu ML	36
	2	Wadu Extn-I	
	3	PL-KL-LM ML	
Motera	1	Motera ML	8
	2	Motera Extn-I ML	
	3	Motera Extn-II ML	
	4	VLDD-Extn-I-C-ML	
Limbodra - Nardipur Low	1	RUPAL	4
Ahmedabad	1	Ahmedabad Ext-I	54
	2	Ahmedabad Ext-II	
	3	Ahmedabad Ext-III	
	4	Ahmedabad Ext-IV	
	5	Ahmedabad Ext-V	
	6	Ahmedabad-Bakrol	
	7	Hirapur	
Nawagam	1	Nawagam Main	47
	2	Nawagam Ext-I	
	3	Nawagam Ext-II	
	4	Nawagam Ext-III	
	5	Nawagam South Ext-I	
Nandej	1	Nandej	54
	2	Nandej East	
	3	Nandej Ext-I	
Wasna	1	Nandej East	29
	2	Nandej East ext-I	
	3	Nandej ML	
	4	Ahmedabad Ext-II	
	5	Nawagam ML	
	6	Nawagam Ext-II	
South Kadi	1	BALASAR	25
	2	KADI EXTn-III	
	3	KADI EXTn-IV	
	4	KADI EXTn-V	
	5	KALOL WEST	
	6	Kadi ML	
Viraj & S.Viraj	1	Viraj ML	0
	2	Kadi ML	
Jhalora	1	Sanand ML	4
	2	Viraj ML	
	3	KALOL WEST EXT-I	
	4	SANAND EXTn-II	
Sanand	1	Sanand ML	36
	2	SANAND EXTn-I	
	3	KALOL WEST EXT-I	
	4	KALOL WEST EXT-II	
	5	SANAND EXTn-III	
Wamaj	1	KALOL WEST EXT-I	0
	2	KALOL_W_EXTENSION_II	
	3	CB-ONN-2004/1	
Wadsar	1	KALOL WEST EXT-I	18
	2	KALOL WEST EXT-II	
Gamij	1	GAMIJ	121
	2	GAMIJ EXTn-I	
	3	GAMIJ EXTn-II	
	4	GAMIJ EXTn-III	
	5	VARSODA-HALISA	
Limbodra	1	LIMBODRA	46
	2	LIMBODRA Extn-I	
	3	LOHAR	
	4	PALIYAD-KALOL-LIMBODRA	
Walod	1	VALOD EXTn-I	0
	2	VALOD EXTn-II	
Halisa	1	VARSODA-HALISA EXTn-I	12
	2	HALISA	
			656

❖ Incremental Oil Gain (MMt) from drilling of development wells from 2019-20 to 2025-26:

Field	Sl No	ML	Total
Kalol	1	Wadu Extn-I	0.949
	2	RJPR Extn-I	
	3	RJPR ML	
	4	Kalol Extn-I ML	
	5	WMJ ML	
	6	PL-KL-LM ML	
	7	KL-NE ML	
	8	Kalol Main ML	
	9	Kalol Extn-II ML	
	10	Valod-Extn-I-C-ML	
	11	ValoD ML	
	12	Motera Extn-I ML	
	13	Motera ML (part)	
	14	Motera Extn-II ML	
	15	KL-W-Extn-II-ML-II	
	16	SWMJ ML	
	17	KL-W-Extn-I-ML-I	
	18	Rupal ML	
Wadu- Paliyad	1	Wadu ML	0.227
	2	Wadu Extn-I	
	3	PL-KL-LM ML	
Motera	1	Motera ML	0.022
	2	Motera Extn-I ML	
	3	Motera Extn-II ML	
	4	VLDD-Extn-I-C-ML	
Limbodra - Nardipur Low	1	RUPAL	0.010
Ahmedabad	1	Ahmedabad Ext-I	0.276
	2	Ahmedabad Ext-II	
	3	Ahmedabad Ext-III	
	4	Ahmedabad Ext-IV	
	5	Ahmedabad Ext-V	
	6	Ahmedabad-Bakrol	
	7	Hirapur	
Nawagam	1	Nawagam Main	0.364
	2	Nawagam Ext-I	
	3	Nawagam Ext-II	
	4	Nawagam Ext-III	
	5	Nawagam South Ext-I	
Nandej	1	Nandej	0.306
	2	Nandej East	
	3	Nandej Ext-I	
Wasna	1	Nandej East	0.191
	2	Nandej East ext-I	
	3	Nandej ML	
	4	Ahmedabad Ext-II	
	5	Nawagam ML	
	6	Nawagam Ext-II	
South Kadi	1	BALASAR	0.321
	2	KADI EXTn-III	
	3	KADI EXTn-IV	
	4	KADI EXTn-V	
	5	KALOL WEST	
	6	Kadi ML	
Viraj & S.Viraj	1	Viraj ML	0.000
	2	Kadi ML	
Jhalora	1	Sanand ML	0.014
	2	Viraj ML	
	3	KALOL WEST EXT-I	
	4	SANAND EXTn-II	
Sanand	1	Sanand ML	0.211
	2	SANAND EXTn-I	
	3	KALOL WEST EXT-I	
	4	KALOL WEST EXT-II	
	5	SANAND EXTn-III	
Wamaj	1	KALOL WEST EXT-I	0.000
	2	KALOL_W_EXTENSION_II	
	3	CB-ONN-2004/1	
Wadsar	1	KALOL WEST EXT-I	0.107
	2	KALOL WEST EXT-II	
Gamij	1	GAMIJ	0.502
	2	GAMIJ EXTn-I	
	3	GAMIJ EXTn-II	
	4	GAMIJ EXTn-III	
	5	VARSODA-HALISA	
Limbodra	1	LIMBODRA	0.258
	2	LIMBODRA Extn-I	
	3	LOHAR	
	4	PALIYAD-KALOL-LIMBODRA	
Walod	1	VALOD EXTn-I	0.000
	2	VALOD EXTn-II	
Halisa	1	VARSODA-HALISA EXTn-I	0.066
	2	HALISA	
Total			**3.814**

❖ Incremental Gas Gain (MMSCM) from drilling of development wells from 2019-20 to 2025-26:

Field	Sl No	ML	Total
Kalol	1	Wadu Extn-I	122.18
	2	RJPR Extn-I	
	3	RJPR ML	
	4	Kalol Extn-I ML	
	5	WMJ ML	
	6	PL-KL-LM ML	
	7	KL-NE ML	
	8	Kalol Main ML	
	9	Kalol Extn-II ML	
	10	Valod-Extn-I-C-ML	
	11	ValoD ML	
	12	Motera Extn-I ML	
	13	Motera ML (part)	
	14	Motera Extn-II ML	
	15	KL-W-Extn-II-ML-II	
	16	SWMJ ML	
	17	KL-W-Extn-I-ML-I	
	18	Rupal ML	
Wadu- Paliyad	1	Wadu ML	36.65
	2	Wadu Extn-I	
	3	PL-KL-LM ML	
Motera	1	Motera ML	7.82
	2	Motera Extn-I ML	
	3	Motera Extn-II ML	
	4	VLDD-Extn-I-C-ML	
Limbodra - Nardipur Low	1	RUPAL	0.00
Ahmedabad	1	Ahmedabad Ext-I	73.16
	2	Ahmedabad Ext-II	
	3	Ahmedabad Ext-III	
	4	Ahmedabad Ext-IV	
	5	Ahmedabad Ext-V	
	6	Ahmedabad-Bakrol	
	7	Hirapur	
Nawagam	1	Nawagam Main	15.94
	2	Nawagam Ext-I	
	3	Nawagam Ext-II	
	4	Nawagam Ext-III	
	5	Nawagam South Ext-I	
Nandej	1	Nandej	11.82
	2	Nandej East	
	3	Nandej Ext-I	
Wasna	1	Nandej East	6.73
	2	Nandej East ext-I	
	3	Nandej ML	
	4	Ahmedabad Ext-II	
	5	Nawagam ML	
	6	Nawagam Ext-II	
South Kadi	1	BALASAR	18.32
	2	KADI EXTn-III	
	3	KADI EXTn-IV	
	4	KADI EXTn-V	
	5	KALOL WEST	
	6	Kadi ML	
Viraj & S.Viraj	1	Viraj ML	0.00
	2	Kadi ML	
Jhalora	1	Sanand ML	0.54
	2	Viraj ML	
	3	KALOL WEST EXT-I	
	4	SANAND EXTn-II	
Sanand	1	Sanand ML	6.68
	2	SANAND EXTn-I	
	3	KALOL WEST EXT-I	
	4	KALOL WEST EXT-II	
	5	SANAND EXTn-III	
Wamaj	1	KALOL WEST EXT-I	0.00
	2	KALOL_W_EXTENSION_II	
	3	CB-ONN-2004/1	
Wadsar	1	KALOL WEST EXT-I	0.00
	2	KALOL WEST EXT-II	
Gamij	1	GAMIJ	17.90
	2	GAMIJ EXTn-I	
	3	GAMIJ EXTn-II	
	4	GAMIJ EXTn-III	
	5	VARSODA-HALISA	
Limbodra	1	LIMBODRA	12.00
	2	LIMBODRA Extn-I	
	3	LOHAR	
	4	PALIYAD-KALOL-LIMBODRA	
Walod	1	VALOD EXTn-I	0.00
	2	VALOD EXTn-II	
Halisa	1	VARSODA-HALISA EXTn-I	0.00
	2	HALISA	
Total			329.75

4.2 Employment Opportunities

The drilling process will involve a number of skilled and unskilled workers. There is possibility that local people will be engaged for the purpose and hence improve the existing employment scenario of the region. The drill site construction would be done largely by employing local labour. At each drill site construction about local employment for about 600 people will be generated.

4.3 Improvement in infrastructure

The villagers would be benefited as the approach roads to drilling sites will be upgraded and would ensure better accessibility to villages. Large number of workers residing in site area will obviously give rise to developmental and commercial activities in that region.

5.0 ONGC adheres to various Environment Management systems as per International standards. All the drilling rigs and work over rigs are maintaining third party certified Environment Management System based on ISO 14001, integrated with Quality Management System (ISO 9001) and Health and Safety Management System (OHSAS 18001). Monitoring and management of environmental aspects being done for (a) Noise monitoring (b) Ambient air quality monitoring (c) Stack monitoring (d) Water and waste water quality monitoring (e) Condition monitoring of equipment and (f) Hazardous Waste.