



OIL AND NATURAL GAS CORPORATION LIMITED



Executive summary for Drilling of Exploratory wells in 30 Blocks in Mehsana and Patan Districts of Gujarat

Introduction and Background

About ONGC

Founded on August 14, 1956, Oil and Natural Gas Corporation Limited (ONGC) is the largest Indian *public sector* company. It is also the second largest Indian company in terms of net profit and the third largest Indian company by market capitalization.

The Government of India has vested ONGC with the responsibility to plan, promote, organize and implement programs for development of petroleum resources as well as the production and sale of petroleum and its products within India. Consequently, it is involved in exploring and exploiting hydrocarbons in 26 sedimentary basins within the country. The most important contribution of ONGC, however, has been its pioneering role in developing the nation's capabilities in exploration and production activities, at a globally competitive level.

Due to these capabilities, ONGC currently produces ~80% of India's crude oil production. It owns and operates more than 11,000 kilometers of pipelines in India and owns other assets across the hydrocarbon value chain in India, and through its joint venture company, *ONGC Videsh Limited* (OVL), abroad as well.

About the 30 Block and the Proposed Project

The subject 30 blocks ('the Block') covers an area of ~1122.25 km², and blocks are located in 4 districts of North Gujarat namely Gandhinagar, Mehsana, Patan and Ahmedabad. It covers three talukas of Patan District, five talukas of Mehsana District, two talukas of Gandhinagar district and one taluka of Ahmedabad district.

ONGC proposes drilling *exploratory* wells within the 30 Blocks – '*the subject project*' that is the focus of this study report.

Regulatory Framework

As per the Schedule attached to the EIA Notification 2006, as amended till date, the proposed project is covered under Project or Activity, 1(b), namely Offshore and Onshore Oil and Gas Exploration, Development and Production. Such activities are also listed as *Category A* under the said Notification, requiring prior Environment Clearance (EC) from the Impact Assessment Authority (IAA), i.e. the Ministry of Environment and Forests (MoEF), New Delhi.

Project Chronology till Date

As part of its EC process, ONGC submitted relevant documents, namely Form-1 (as per the EIA Notification 2006, as amended till date) along with a Pre-feasibility Report and proposed Terms of References (ToR) for carrying out environmental studies, to the Expert Appraisal Committee (Industrial Projects-2) of the MoEF (*EAC, Industry-2*), vide letter No BDA/BASIN/BLOCK – III/EC/30 BLOCKS/331 dated 17th February 2011. A presentation to the EAC, Industry-2, to finalize the ToR for the EIA study was held on 29th – 30th April, 2011 at New Delhi. The EAC, Industry-2 prescribed the Terms of Reference (ToR) for conducting the study vide its letter F. No. J-11011/125/2011-IA II (I) dated 8th June 2011.

Thereafter ONGC awarded the work of undertaking relevant environmental and other studies required as part of the EC process to Kadam Environmental Consultants (*'Kadam'*) vide its work order dated 29th February 2012. Kadam is accredited by the National Accreditation Board for Education and Training (NABET) to undertake EIA and related studies in the onshore oil and gas, exploration, development and production sector, a mandatory requirement for agencies submitting such studies to regulators for the purpose of seeking EC.

Kadam undertook the study during the summer season 2012, in accordance with the ToR issued by the EAC-Industry 2 / MoEF and presented the preliminary study findings in its draft report released for the purpose of public consultation as per the EIA Notification.

Project Description

Location of the Project

Location details are as follows:

- State: Gujarat
- District: Gandhinagar, Mehsana, Patan and Ahmedabad
- Taluka: Kalol and Mansa Taluka of Gandhinagar District
Kadi, Unjha, Visnagar, Vijapur and Mehsana of Mehsana District,
Chanasma, Harij and Patan of Patan District,
Detroj Rampura of Ahmedabad District,

The Drilling Process

Exploratory drilling will be carried out to test the occurrence of hydrocarbons in the already productive North Cambay Basin and assess its commercial viability. Drilling operations shall be conducted round-the-clock for 24 hrs. The time taken to drill a well depends on the depth of the hydrocarbon bearing formation and the geological conditions. ONGC intends to drill wells to a depth up to 3000 m. This would typically take ~30 - 35 days for each well – however drilling period *may increase* depending on well depth. Conventional rotary drilling methods will be used and the drill sites would be demobilized after completion of drilling activities, leaving a limited footprint covering the well head and fence in place, pending future development operations.

Water based mud, that is ecologically sensitive, will be used and all drilling activities will be conducted as per the requirements of the Oilfield and Mineral Development Rules, 1984 as amended till date. Guidelines issued by the Oil Mines Regulation (OMR) will be followed throughout the drilling process.

Workforce Management

During the drilling operations, about 20 to 30 persons may be working in 12 hour shifts at site. Workers shall return to their homes at night and hence no camping is required at or near the well site. Once drilling is over, no person is required at site, except security cover through a contractor.

Power Requirement

The power required for driving the drilling rig, circulation system and for providing lighting shall be generated by DG sets of 1250 KVA (3 No. one standby), which will consume 326 litres/hr of diesel conforming to *Bharat Stage IV* norms including a sulphur content of <50 mg/kg.

Water Requirement

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. Water for emergency fire fighting would be stored in a pit of 25 m diameter and make-up of the same will have to be made on a regular basis.

The requirement of water expected for sanitation and drinking purposes of the workers shall be insignificantly low in terms of quantity. ONGC has planned to meet the requirement of water at the drilling site through water supplied by tankers and sourced from nearest ONGC installation.

Since, there is no quality criterion for usage of raw water for the various uses mentioned above (other than drinking), the tanker water shall be directly used without any treatment. The potable water requirement shall be met by procuring adequately treated water from off-site locations. A water pit shall be constructed at the site for providing storage of water required for fire fighting in case of an emergency. The storage of fire water shall be done in 25 m diameter pit at site.

Waste Water Generation

The drilling operation would generate waste water in the form of wash water due to washing of equipment, string etc. This waste water along with spill over mud will be diverted to waste water mud pit whose bottom would be lined with HDPE sheet so as to avoid percolation of water contaminants in the soil. Approximately 3 m³ per day of waste water will be discharged in HDPE lined evaporation pit. The other source of waste water is sewage generated from sanitation facilities, which shall be disposed through soak pits.

Air Emissions

The emissions to the atmosphere from the drilling operations shall be from the diesel engines and power generator, and flaring of associated gas during testing operation in case of hydrocarbon is discovered. In accordance with the Oil Mines Regulations Rules, a flare stack of 9m height will be provided.

Solid and Hazardous Waste Management

The drilling rig system to be employed for drilling will be equipped for the separation of drill cuttings and solid materials from the drilling fluid. The drill cuttings, cut by the drill bit, will be removed from the fluid by the shale shakers (vibrating screens) and centrifuges and transferred to the cuttings containment area. Once the drilling fluid / mud have been cleaned it will be returned to the fluid tank and pumped down the drill string again. It is estimated that 30-50 MT of formation cuttings and few hundred m³ of mud from spent drilling fluid will be generated in the form of solid waste, during the drilling operation.

Drill cuttings and drilling mud will be disposed off in accordance with the Gazette Notification dated 30th August 2005 - G.S.R 546 (E), Section C '*Guidelines for Disposal of Solid Waste, Drill Cuttings and Drilling Fluids for Offshore and Onshore Drilling Operation*'. Under these guidelines:

- Drill cuttings separated from Water Based Mud (WBM) will be properly washed and unusable drilling fluids will be allowed to evaporate in a HDPE lined pit. In case the drill cuttings have oil and grease level in excess of 10 grams/kg, these will be sent to a GPCB authorized Treatment, Storage and Disposal Facility (TSDF).
- WBM will be re-used at the next drill site where feasible. If this is not feasible, the WBM will be disposed off in a HDPE lined pit or sent to a GPCB authorized TSDF for disposal.
- Waste oils generated during the drilling process, if any, will be sent to authorized reprocessors or incinerated at a GPCB authorized TSDF.

Description of the Environment

Baseline environmental studies were carried out during summer season of year 2012, during the non-monsoon season, as per the TOR received from the EAC-Industry 2 / MoEF.

Study Area

The study area is defined as area within 10.0 km radius from the said 30 blocks.

Landuse of the Study Area

A recent satellite image for the study area was collected using Google Earth Pro. The image was interpreted for identification of various landuse / land cover classes. Ground truthing was done to confirm and edit the interpreted landuse / land cover classes.

The key landuse landcover classes identified during the study have been provided in the report and are reproduced in **Table Error! No text of specified style in document.-1**.

Table Error! No text of specified style in document.-1: Area Statistics of Identified Land Use/ Land Cover Categories in the Study Area

S. No.	Primary Classification	Secondary Classification	Area, Secondary Class			Area, Primacy Class		
			Ha.	~km2	~%	Ha.	~km2	~%
1.	Built-up Land or Habitation	Residential / Commercial	15546.47	155.46	3.26	18553.11	185.53	3.89
		Industrial	3006.64	30.07	0.63			
2.	Agricultural Land	Crop Land/Fallow Land	393140	3931.4	82.43	400121.49	4001.21	83.89
		Plantations	6981.49	69.81	1.46			
3	Wastelands	Land without Scrub	2962.57	29.63	0.62	2962.57	29.63	0.62
4.	Water Bodies	Reservoir / Lakes / Ponds / Tanks	1671.31	16.71	0.36	4773.82	47.74	1.01
		River Beds	3102.51	31.03	0.65			
5.	Vegetation Cover	Vegetation	50524	505.24	10.59	50524	505.24	10.59

Landuse of study area has been broadly classified into categories such as built up land or habitation, agricultural land, vegetation cover, water bodies. The major portion of land is covered by agricultural land (83.89%), vegetation (10.59%) and habitation (3.89%). The major crops cultivated in the study area are cotton, castor and wheat. The plantation is mainly of fruit trees like *amla*, *chickoo*, and *ber*.

Climatology

The climate of the study area is characterized by a hot summer and general dryness except in the southwest monsoon season. The year may be divided into four seasons. The cold season from December to February is followed by the hot season from March to middle of June. The period from middle of June to September is the southwest monsoon season. October and November constitute the post-monsoon or retreating monsoon season¹.

- Mean average temperature recorded during study period was 31.8 °C with mean maximum temperature of 39.3°C and mean minimum of 25.3°C.
- Predominant wind direction during study period is observed to be from West direction.
- Mean average wind speed was observed to be 9.4 km/hr.
- The mean average relative humidity recorded was 41.2% with mean maximum humidity of 64.1% and mean minimum of 21.1%.

¹ District Gazetteer, Ahmedabad and Mehsana Districts

- There was no rainfall recorded during the study period

Ambient Air

Ambient air quality monitoring was carried out for summer season of 2012. The ambient air quality monitoring stations were set up at 14 different locations.

- The average concentration of PM_{2.5} recorded at 14 locations ranged from 19 µg/m³ (Ridrol village) to 34 µg/m³ (Chandrumana and Bilodra Villages). All these values are within the specified limit of CPCB (60 µg/m³).
- The average concentration of PM₁₀ recorded at 14 locations ranged from 58 (Ajol Village) to 76 µg/m³ (Bilodra Village). All these values are within the specified limit of CPCB (100 µg/m³).
- The average concentration of SO₂ were found in range from 9.0 µg/m³ (Ubkhal Village) to 10.9 µg/m³ (Ridrol Village) All these values are within the specified limit of CPCB (80 µg/m³).
- The average concentration of NO_x were found in range from 16.1 µg/m³ (Irana Village) to 12.4 µg/m³ (Ridrol Village) All these values are within the specified limit of CPCB (80 µg/m³).

Noise

Noise levels were recorded at 35 different locations within the study area.

- Noise level during day time was observed in range of 63.2dBA (Ambasana Village) to 52.8 (Suraj Village)
- Night time Noise level was in range of 52.8 dBA (Mehsana) to 44.0 dBA (Bhatariya Village)

Soil

Soil samples were collected from 30 locations within the study area.

- Porosity of soil samples were in the range of 41% (Kotavad Village) to 56% (Chadasana Village)
- Water Holding Capacity of Soil samples were in range of 27.14% (Balisana Village) to 52.6% (Kungher Village)
- Permeability of Soil samples were in range of 3.63 X 10⁻⁴ cm/sec (Fatepura Village & Kanpur Village) to 2.04 X 10⁻³ cm/sec (Ambaliyasan Village)
- Cation Exchange Capacity of Soil samples were in range of 11.6 mg/100gm (Bechrpura) to 17.6 mg/100gm (Lodra Village)
- Electrical Conductivity of Soil samples were in range of 59.3 µmho/cm (Tejpura Village) to 680.4 µmho/cm (Ajol Village)

The texture of soil is observed to be mainly Sandy Loam and Loamy sand in the study area based on analysis of the samples collected.

Ground Water Quality

Groundwater samples were collected from 30 different locations within the study area and analyzed for parameters mentioned in the Indian Standard IS 10500:1991.

- pH of sample was found to vary from 7.02 (Nani Rantej Village) to 8.48 (Modhera Village). All samples were within the permissible limit (6.5 to 8.5)
- TDS of sample was found to vary from 184 mg/l (Indrap Village) to 2972 mg/l (Nana Village). TDS in all samples were below the permissible limit (2000 mg/l) except Anawara and Nana villages

- Electrical Conductivity of sample was found to vary from 264.3 $\mu\text{mho/cm}$ (Indrap Village) to 4305 $\mu\text{mho/cm}$ (Nana Village).
- Chlorides content of sample were found to vary from 41 mg/l (Indrap Village) to 1330mg/l (Nana Village). Chlorides in all samples were below the permissible limit (1000 mg/l) except at Nana Village
- Total Hardness of samples were found to vary from 190 mg/l (Modhera and Lagnaj Village) to 960 mg/l (Nana Village). Total Hardness in all samples were below the permissible limit (600 mg/l) except at Nana Village, Ridrol Village, Chandrumana Village, Kherva
- Calcium content of sample were found to vary from 23.25 mg/l (Shapawada Village) to 160.32 mg/l (Kungher Village). Calcium in all samples were below the permissible limit (200 mg/l)
- Fluoride content was found to be higher than the permissible limit of 1.5 at Kanpura and Indrap Villages it was found to be 1.51 and 1.57 respectively. It was observed that Fluoride content tend to increase as we move from Mehsana towards Patan.
- Magnesium content of sample was found to vary from 23.33 mg/l (Rupal and Golthara Villages) to 43.74mg/l (Vasan Village). Magnesium in all samples were below the permissible limit (100 mg/l)
- Iron content of sample were found to vary from 0.07 mg/l (Kasra Village) to 6.09mg/l (Nani Rantej Village). Iron in all samples were below the permissible limit (1.0 mg/l) at Nani Rantej, Anwara, Linch, Ubkhal, Chadasana, Lodra

Analysis of collected samples revealed that all other parameters are satisfy the permissible limits as per IS 10500:1991 specified for drinking water and hence are suitable for drinking, however it is suggested that water may disinfected by boiling or by use of chorine tables before use.

Surface Water Quality

Surface water Samples were collected from four different locations within the study area and analyzed for parameters mentioned in IS 10500:1991

- pH of sample was found to vary from 7.05 (Balisana) to 8.70 (Shapawada Village). All samples were within the permissible limit (6.5 to 8.5) except at Shapawada Village
- TDS of sample was found to vary from 172 mg/l (Lodra Village) to 1404 mg/l (Nani Rantej Village). TDS in all samples were below the permissible limit (2000 mg/l)
- Electrical conductivity in all samples was found to be vary from 245 $\mu\text{moh/cm}$ (Lodra Village) to 1535 $\mu\text{moh/cm}$ (Shapawada Village)
- Total Hardness of all samples was found to vary from 150mg/l (Ajol Village) to 520mg/l (Chandrumana Village) Total Hardness of All Samples were below the permissible limit (600 mg/l).
- Total Alkalinity of all samples was found to vary from 1.7 mg/l (Tejpura Village) to 380 mg/l (Shapawada Village) Total Alkalinity of All Samples were below the permissible limit (600 mg/l).
- Magnesium content of samples was found to vary from 20.41 mg/l (Indrap Villages) to 93.31 mg/l (Rupal Village). Magnesium in all samples were below the permissible limit (100 mg/l)
- Iron content of sample was found to vary from <0.01 mg/l to 4.856mg/l (Ajol Village). Iron in all samples were below the permissible limit (1.0 mg/l) Except at Bilodra village, Ajol Village, Chandrumana Village, Kherva Village, Langhnaj Village, Rupal Village, Ambaliyasan, Linch, Modhera, Nana, Kanpura Village and Thalod Village
- Total coliforms and Fecal Coliforms are exceeding the permissible limit at all locations.

Based on the analyzed parameters, it is recommended that water of these ponds should not be used for drinking purpose.

Biological Environment

The list of floral species is prepared based on visual observation during site visit and through review of site literatures and secondary data available with various government offices is referred for identifying rare or endangered species in the region.

No rare or threatened faunal species are present at proposed site and surrounding area except Pavo cristatus (Indian peafowl) (Schedule I) was observed in study area.

Aquatic Ecology

Samples were collected from 22 different locations and analyzed for phytoplanktons and zooplanktons in study area.

Phytoplankton

Gandhinagar District

Total 12 nos. of phytoplankton genera were observed in the study area in which Nitschia, Rhizosolenia and Zygnema were major dominant at almost all sampling locations. The highest cell counts of phytoplankton were recorded at Aajol Village Pond where as lowest cell counts of phytoplankton were recorded at Delwada Village Pond.

Mehsana District

Total 11 nos. of phytoplankton were observed at all sampling locations in which Anabaena, Diatom and Rhizosolenia were major dominant genera at almost all sampling locations. The highest cell count of phytoplankton was recorded at Langhnaj village pond where as lowest cell count was recorded at Kanpura village pond

Patan District

Total 8 nos. of phytoplankton genera were observed at all the sampling locations in which Nitschia was recorded at all the locations. The cell count of phytoplankton was recorded higher at Narmada River Canal as compare to Bhadrana village pond Village Pond.

Ahmedabad District

Total 8 species of phytoplankton were observed in all study locations in which Diatoms and Ulothrix were most dominant species in all sampling locations

Zooplankton

Gandhinagar District

Total 14 nos. of zooplankton groups were observed in the all sampling locations in which Daphnia and Diaphanosoma were major dominant groups at al most all sampling locations. The highest population of zooplankton was recorded at Aajol Village pond where as lowest at Delwada Village Pond. The highest phytoplankton and zooplankton diversity index was recorded at Bilodara village pond where as lowest at Dilwara village pond.

Mehsana District

Total 12 nos. of zooplankton groups were observed at all sampling locations in which Diaphanosoma, Daphnia and Cyclops were major dominant group in the all sampling locations. The highest population of zooplankton was recorded at Bechrpura village pond where as lowest at Kherva village pond.

Patan District

Total 5 nos. of zooplankton groups were observed at all the locations in which Daphnia was recorded at both the locations. The population of zooplankton was recorded higher at Bhadrana Village pond where as lowest at Narmada Canal.

Ahmedabad District

Total 10 species of zooplankton were observed in all sampling locations in which Daphnia was most dominant species in all sampling locations.

Anticipated Environmental Impact Identification, Prediction and Mitigation**Ambient Air**

A number of sources are there to cause potential impacts on air quality, which are as follows:

- Emissions from DG sets used as part of the drilling rig;
- Flaring of gases primarily during the testing phase will contribute to additional air pollution;
- Fugitive emissions during site preparation and closure phases;
- Emissions from vehicular movement;

Impacts of emissions from DG sets on the GLC at various distances were predicted using the dispersion modeling guidelines given by the Central Pollution Control Board, New Delhi and the Industrial Source Complex Short Term Model (ISCST3) of the United States Environment Protection Agency (USEPA) based on type of fuel (HSD), Fuel consumption rate (362 L/hr) and operating conditions.

The maximum 24 hourly GLC's are predicted to be $0.12 \mu\text{g}/\text{m}^3$, $46.65 \mu\text{g}/\text{m}^3$ and $0.21 \mu\text{g}/\text{m}^3$ for SO_2 , NO_x and particulate matter respectively. These GLC's are expected to occur at a distance of 125 m from the source towards the ESE direction.

The predicted impact level due to the operation of DG set is within the limit prescribed in National Ambient Air Quality Standards.

The mitigation measures for air quality impacts are:

- The exhaust of the DG set will be at sufficient height to allow dispersion of the pollutants and DG sets will be properly maintained so that emissions will be under statutory limits;
- The flaring system will be properly managed at all times;
- Location of the flare stack will be decided in accordance with the Oil Mines Regulation Rules, 1984 (Chapter 9, Section 96 – Protection against Pollution of Environment), a flare stack of minimum 9 m height will be provided at the site taking into consideration nearest habitations, campsite location and prevailing wind direction;
- Water spraying will be done on the access roads to control re-entrained dust during dry season (if required);
- The engines and exhaust systems of all vehicles and equipment used in this project will be maintained as such, that exhaust emissions are low and do not breach statutory limits set for the concerned vehicle/equipment type;
- Blow out preventer of sufficient capacity will be installed at well head during drilling operation
- Ensuring the availability of valid Pollution Under Control Certificates (PUCC) for all vehicles used on site.

Noise Environment

The proposed drilling operations and related activities will lead to emission of noise that may have significant impact on the surrounding communities in terms of increase in noise levels and associated disturbances

Following activities would result in increase in noise level

- Noise from rig and associated machinery
- Noise from vehicular movement
- Noise from DG sets

Mitigation measures for noise will include the following:

- Sufficient engineering control during installation of equipments and machineries (like mufflers in DG sets) is to be ensured to reduce noise levels at source;
- Proper and timely maintenance of machineries and preventive maintenance of vehicles is to be adopted to reduce noise levels;
- All noise generating operations, except drilling is to be restricted to daytime only to the extent possible;
- Personnel Protective Equipments (PPE) like ear plugs/muffs is to be given to all the workers at site and it will be ensured that the same are wore by everybody during their shift;

Surface Water /Ground water

Quantity

Drilling operations require the use of water for domestic requirements as well as for operations, but the use will be of temporary nature and limited to a few days for each well (20 m³ per day per well). And the water will be sourced from nearest ONGC installation. Hence these impacts are not significant.

Quality

Wastewater discharged from the drilling/other operations shall be collected in HDPE lined pit for evaporation. Domestic waste water will be disposed off in soak pit.

Following mitigation measures will be implemented for water pollution control:

- Proper treatment of discharged wastewater will be made by disposing waste water in an impervious HDPE lined pit for evaporation;
- The domestic waste water will be discharged into the soak pits;
- All chemical and fuel storage areas will have proper bunds so that contaminated run-off cannot meet the storm-water drainage system;
- ONGC will ensure proper spill control at site
- ONGC will use best engineering technique during drilling operation and also during the cementing job and installation of casing so that drilling mud does not contaminate the ground water

Land

Impact on land environment, due to site preparation shall be loss of vegetation or change in land use from agriculture land use to industrial land use for a parcel of land of 110 m X 110 m. This impact shall be for a period of 30 – 35 days only.

In case of discovery of commercial quantity of hydrocarbon an area of 30 m X 30m shall be retained and rest shall be restored to its original condition. In other case full area shall be restored and returned to the owner.

Mitigation measures

- Necessary efforts will be made during selection of drill site to minimize disruption of current land use to the extent possible;
- Necessary restoration efforts will be made during decommissioning and site closure to restore the site back to its original condition to the extent possible;
- Proper restoration of site will be carried out to bring the physical terrain, soils and vegetation, as closely possible, to their original condition;
- On completion of works (in phases), all temporary structures, surplus materials and wastes will be completely removed till 1m below the surface;
- Temporary new approach roads can be constructed and existing roads can be improved, if required, for smooth and hassle free movement of personnel as well as materials and machineries;
- Optimization of land requirement through proper site layout design will be a basic criteria at the design phase

Soil

During site preparation the topsoil will be removed from the drilling site and the approach road, which contains most of the nutrients and organisms that give soil productivity. This will in turn result in minor changes of topsoil structure

Soil quality may be affected by setting up of rig and associated machinery and will continue till the site is restored to its original condition

Contamination of soil can result from the project activities if certain operations like storage of chemicals and fuels, cement and mud preparation, spent oil and lubricants are not managed efficiently

Improper storage of drilling waste and return/unused drilling mud at the on-site waste disposal facility can also result in contamination of the soil

Mitigation measures

- Store, preserve and protect topsoil separately to use it during restoration period;
- Carry out adequate restoration of soil at the drilling site, to the extent possible using the soil stored from piling and excavation activities;
- Dispose drilling mud and drill cutting temporarily in an impervious HDPE lined pit for evaporation carefully so that there is no spillage.
- The drilling rig system to be employed for drilling will be equipped for the separation of drill cuttings and solid materials from the drilling fluid. The drill cuttings, cut by the drill bit, will be removed from the fluid by the shale shakers (vibrating screens) and centrifuges and transferred to the cuttings containment area and will be disposed off in accordance with Notification dated 30th August 2005 - G.S.R 546 (E);
- Management of spilling of contaminants such as oil from equipments, cement, drilling mud, and etc. on the soil;
- Proper arrangement of soak pits provided at the drilling site for disposal of water per well;

Socio Economic

The proposed exploratory drilling project will have positive impact on socio economic status of the area due to

- Generation of indirect employment in the region due to the requirement of workers in trail making, supply of raw material, auxiliary and ancillary works, which would marginally improve the economic status of the people.
- Result in an increase in local skill levels through exposure to activities.
- As the existing loose / soft surface roads, trails shall be upgraded to facilitate the movement of the heavy equipment required, the project in turn would lead to improvement in transport facilities.

Flora and Fauna

Possible Biological Impacts of proposed Project

- Impact on terrestrial fauna due to noise
- Project infrastructure and well development will disturb agriculture land of site
- Drilling fluids, spillage, leakage and well treatment may produce chemical spillage which will disrupt agriculture of nearby farm
- Drilling activity may increase deposition of dust and dust settling on the vegetation may alter or limit plants' abilities to photosynthesize and/or reproduce

Mitigation Measures

- Flaring will be done through a vent as per OMR standard to minimize effect on nocturnal avifauna.
- Acoustic enclosure shall be provided to D.G. set to reduce the noise intensity during the drilling operation
- ONGC will use water sprinkler so that the deposition of dust on nearby vegetation is reduced
- Development of plantation of native species to substitute the access cutting, site preparation will provide habitat, food and breeding areas to birds, small animals and insects
- Since, the activity is temporary wastewater discharged from the drilling operations shall be collected in HDPE lined collection pit and would be disposed of as per the prescribed norms
- There is no ecologically important area (e.g. National Park, Sanctuary) in the study area so impact on such areas is not expected.
- ONGC will develop and implement a spill management plan in case of spill.
- Use existing facilities (e.g. Access Roads) to the extent possible to minimize the amount of new disturbance
- Avoid use of unnecessary lighting at night to avoid attracting avifauna

Occupational Health and risk to surrounding community

Site preparation, drilling and post drilling activities involve many occupational health hazards to the workers at site.

Noise generated during drilling operation may affect the workers and staff members

Handling of chemicals, fuel, may cause health hazard if not handled properly

Uncontrolled flow of hydrocarbon or other fluids during blow out may cause serious health injuries including fatality of workers as well as surrounding communities

Mitigation measures

- As per ONGC policy period medical checkup would be carried out in two stages which include clinical examination and laboratory test if required

- During site preparation proper care would be taken by ONGC, proper PPE will be provided to site workers and staff members
- Site preparation work will be carried out during day time only
- Acoustic enclosures will be provided to DG sets and other noise generating equipment
- ONGC will develop and implement a spill management plan to prevent risk of spill which may cause health problem
- Blow out preventer of sufficient capacity will be used to mitigate risk of blow out

Additional Studies

Demographic and Socio- Economic Profile

Gandhinagar District

Analysis of the demographical statistics, based on Primary Census Abstract, 2001 & field survey reveals that there are a total of 61 villages in the study area having a population of 390544 and 79541 dwelling units.

Average Scheduled castes constitute about 6.57% of the total population of villages in the study area. Scheduled tribes constitute about 0.51% of the total population of villages in the study area. Villages in the study area have fairly good infrastructure facilities.

Mehsana District

Analysis of the demographical statistics, based on Primary Census Abstract, 2001 & field survey reveals that there are a total of 255 villages in the study area having a population of 1059525 and 212256 dwelling units.

Average Scheduled castes constitute about 8.5% of the total population of villages in the study area. Scheduled tribes constitute about 0.30% of the total population of villages in the study area. Villages in the study area have fairly good infrastructure facilities.

Patan District

Analysis of the demographical statistics, based on Primary Census Abstract, 2001 & field survey reveals that there are a total of 137 villages in the study area having a population of 385776 and 76009 dwelling units.

Average Scheduled castes constitute about 10.70% of the total population of villages in the study area. Scheduled tribes constitute about 0.42% of the total population of villages in the study area. Villages in the study area have fairly good infrastructure facilities.

Ahmedabad District

Analysis of the demographical statistics, based on Primary Census Abstract, 2001 & field survey reveals that there are a total of 25 villages in the study area having a population of 35343 and 7083 dwelling units.

Average Scheduled castes constitute about 7.07% of the total population of villages in the study area. Scheduled tribes constitute about 0.13% of the total population of villages in the study area. Villages in the study area have fairly good infrastructure facilities.

Hazard Identification and Consequence Assessment

Hazards are identified for release of HSD from storage tank at drilling site and also from pipeline. Consequence analysis of all possible containment scenarios was carried out using DNV Technica Software (PHAST).

Result of Consequence Assessment

The result of consequence analysis indicates that the risk contours for fatality are confined within the drilling site only.

Disaster Management Plan

The development of a DMP is to ensure effective control of an emergency to minimize loss to human life and property. First objective of a DMP is to save human life and then comes minimizing damage to property. The DMP describes the role and responsibilities of various authorities under the emergency organization.

Specifically, the DMP contains the following:

- Information about the MCLS and their effect zones;
- Checks and inspections to prevent incidents leading to emergencies;
- Prevention plan of an impending emergency by control of incidents;
- Internal emergency reporting and communication system;
- Offsite plan components;
- Regulatory requirements

It is recommended that the DMP be integrated into the actual operations prior to commencement of project work. Mock drills should be conducted at periodic intervals to check the efficacy of the DMP. ONGC has well developed DMP/ERP integrated with district and national level Disaster Management Plans.

Project Benefits

The project benefits are summarized as follows:

- New oil/gas finds in the block will lead to reduction in India's dependence on imported crude oil and thereby result in considerable savings in foreign exchange.
- There will be a beneficial effect of a flourishing production unit that will directly and indirectly boost the living standards of the people, save foreign exchange and with increase in industrial activities, create more jobs in the local economy.
- The activities would result in an increase in local skill levels through exposure to drilling technology.
- In the event of discovery of commercial quantity of hydrocarbon reserves, more long-term employment opportunities shall be created. Besides, the hydrocarbons brought to the surface shall help in contributing the ongoing efforts of the government to meet the national demand of petroleum resources.
- Development of ancillary activities resulting into indirect jobs and skills of local manpower.

Environmental Management Plan (EMP)

The EMP provides a delivery mechanism to address potential adverse impacts, to instruct contractors and to introduce standards of good practice to be adopted for all project works. For each stage of the programme, the

EMP lists all the requirements to ensure effective mitigation of significant biophysical and socio-economic impacts identified in the EIA. The EMP covers the following:

- Role of ONGC and its contractors;
- A comprehensive listing of the mitigation measures (actions) that ONGC will implement;
- The parameters that will be monitored to ensure effective implementation of the action;
- The timing for implementation of the action to ensure that the objectives of mitigation are fully met.

Expenditure on Environmental Matters

- The one-time expenditure (per well) for environmental management and mitigation is estimated to be Rs. 5,22,500 if economic quantities of hydrocarbon are found or Rs. 32,22,500 if no economic quantities of hydrocarbon are found.
- The recurring expenditure for environmental management and mitigation is estimated to be Rs. 55,000/year for every producing well.

Environmental Mitigation

The drilling program will be designed to avoid or minimize impacts to the environment and local communities wherever practicable & desirable. Where residual impacts remain, which may have moderate or significant effects on the environment, mitigation measures have been described in this EIA (Chapter 5) which will either reduce the impact to an acceptable level or adequately offset it. Some major mitigation measures are:

- Disposal of drill cuttings and drilling mud as per G.S.R. 546 (E) point no C "Guidelines for Disposal of Solid Waste, Drill Cutting and Drilling Fluids for Offshore and Onshore Drilling Operation";
- Acoustic insulation of Diesel Generating Sets;
- Controlling air emission from Diesel Generating Sets to limiting values as per NAAQS, 2009;
- Post-project restoration of site

Environmental Monitoring

The following will be monitored on a regular basis during Drilling operation and also throughout the life of the project to ensure a high level of environmental performance being maintained:

- Chemicals used in drilling fluid make up;
- Fluid losses;
- Post project sampling and effect on baseline data generated during preparation of EIA report
- The general effectiveness of pollution control measures shall also be monitored

Major Recommendations

In depth recommendations covering the following have been made using professional judgment, and national standards;

- General safety practices
- Material handling
- Personnel safety
- Process and equipment safety
- Maintenance of equipment including emergency / firefighting equipment.
- The emergency management includes emergency Prevention, Emergency Response Plan (On-site and off-site), Oil spill Contingency Plan and inspection of fire fighting equipment and systems

It is important that ONGC strictly follows the requirements mentioned in the recommendations.

Conclusions

The study brings out the following points:

- The drill site after completion of drilling operations shall be reinstated to its original condition as soon as possible. The proposed activities are not likely to have any significant adverse effect on the environment and the neighboring population.
- The sources of air emissions include diesel engines/ generator sets, flaring of natural gas at drilling site during well testing. It was observed that the ambient air quality due to proposed activities is not expected to cause an effect on vegetation and human settlements in the vicinity of the operational sites.
- The noise generated due to the diesel engines operating the rig along with the mud circulation system is considered to be significant in the vicinity of the noise generating equipment only. This can be mitigated satisfactorily by the workers wearing ear protection while working. This noise is transient & temporary and lasts for a short period.
- The proposed drilling activities will not cause any significant adverse effect on water resources. Characteristics of wastewater discharged from the drilling operations shall meet the prescribed norms specified by CPCB. Thus, since all emissions shall be within acceptable limits, no adverse impact is anticipated on the water resources.
- The proposed drilling activities shall generate indirect employment in the region due to the requirement of workers in supply of raw material, auxiliary and ancillary works, which shall marginally improve the economic status of the people. The activities shall result in an increase in local skill levels through exposure to drilling technology.
- The hardening of existing loose/soft surface roads to facilitate the movement of the heavy equipment required for drilling shall lead to improvement in transport facilities / infrastructure in the proposed Block area.
- In the event that commercial quantities of hydrocarbon reserves are discovered, more long-term employment opportunities would be generated. Besides, the hydrocarbons brought to the surface shall help in contributing the ongoing efforts of the government to meet the national demand of petroleum resources.
- The risk of occupational hazards, personal injuries, accidents during rig building and operation shall be very less as safety measures shall be adequately implemented by ONGC.

Thus, it can be concluded on a positive note after the implementation of the mitigation measures as suggested in EMP/DMP, the proposed activities of ONGC shall have overall beneficial impact on local population