EXECUTIVE SUMMARY

For

EIA study for drilling 48 exploratory locations in 13 ML blocks in the districts of Surat, Bharuch and Vadodara, Gujarat
1. INTRODUCTION

Project Highlights

Oil and Natural Gas Corporation Limited (ONGC), a premier Govt. of India Undertaking and the major National Oil Company, is a vertically integrated company producing crude oil, natural gas and value added products like LPG, NGL, Petrol, HSD etc. Operations of ONGC extend over both onshore as well as offshore within India and outside India.

ONGC has proposed 13 Exploratory Drilling Locations in Thirteen ML Blocks of Western Onshore Basin, spread over Vadodara, Bharuch and Surat Districts of Gujarat. The total Block Area is 1456.58 km². The Total Project Cost is INR 1082.70 Cr. This report is based on the TOR approved by Ministry of Environment and Forests, Government of India vide letter- J-11011/345/2016-IA II(I) dated 31st January, 2017.

Objective and Scope of EIA study

The EIA study is a part of EC process as per EIA Notification 2006, and is essential to conduct for obtaining Environment Clearance from Ministry of Environment, Forest and Climate Change, for any new proposal. The EIA study is a tool to identify the impacts on surrounding environment due to the various activities of the proposed project and quantifying this impact through models considering thorough details of baseline data of all the environmental aspects.

The scope of the EIA study includes detailed characterization of the existing status of the terrestrial and socio-economic environment within the study area, identification of the potential environmental impacts of the project, and formulation of an effective Environmental Management Plan (EMP) to prevent, control & mitigate the adverse environmental impacts, and ensuring the environmental compliance. Apart from suggesting mitigation measures to the negative impacts, the report suggests implementation of various positive and enhancement measures as a part of project benefit program to people of the nearby areas.

2. PROJECT DESCRIPTION

ONGC intends to drill about 48 Exploratory Wells in Thirteen (13) ML Blocks of Western Onshore basin in Gujarat state. The 13 blocks that are the focus of this study are spread over three districts in Gujarat covering

- Four Taluka in Vadodara District
- Five Taluka in Bharuch District, and
- One Taluka of Surat District
The Summarize details are given below:

<table>
<thead>
<tr>
<th>Name of the Project</th>
<th>Exploratory drilling of 48 wells in 13 ML Blocks of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Western Onshore Basin, Vadodara, Bharuch &amp; Surat Districts, Gujarat</td>
</tr>
<tr>
<td>Total Area of the Project</td>
<td>13 ML Blocks covers an area of 1456.58 sq.km, onshore in 3 districts.</td>
</tr>
<tr>
<td>Total Number of Proposed Wells</td>
<td>48 wells in 13 ML Blocks</td>
</tr>
<tr>
<td>Total Estimated Drilling Period for each Well</td>
<td>90-100 days</td>
</tr>
<tr>
<td>Proposed Drilling Fluid for each well</td>
<td>Water-based Mud System</td>
</tr>
<tr>
<td>Water Requirement for each well</td>
<td>25 KLD</td>
</tr>
<tr>
<td>HSD Required per day per well</td>
<td>6 KLD</td>
</tr>
<tr>
<td>Well Depth</td>
<td>4500 m</td>
</tr>
<tr>
<td>Type of Hydrocarbon Expected</td>
<td>Oil and Gas</td>
</tr>
<tr>
<td>Estimated Cost of the Project</td>
<td>INR 1082.70 Cr.</td>
</tr>
</tbody>
</table>

3. DESCRIPTION OF THE BASELINE STUDY

The study area comprises of the 13 Block with a Block Area of 1456.58 km². The existing/ baseline environmental set-up of the proposed operational Areas has been studied during the months of March to May, 2017, i.e. Pre Monsoon Season as described in following sub-headings.
Geology & Topography

The Vadodara district can be divided into two main geomorphic units – the eastern hilly, medium to high relief terrain and the western plain area. The eastern portion of the district comprises the Chhota Udepur, Jambugam and Nasvadi talukas. The western plain has got a flat, low lying surface and a thick pile of alluvium. The Narmada and the Mahi are the major rivers of the district. Besides these two rivers, the Jambuva, the Surya, the Vishwamitri and the Dhadhar flow through the district and end into the Gulf of Cambay (Kambhat). Bharuch district is flat level plain except for small hilly tract in the eastern part covering the talukas of Jhagadiya and Valia where elevation ranges between 200 m to 400 m above msl in remaining areas altitude varies between 5 m to 100 m above msl. Surat district can be described as tilting one from towering hills and plateau in east to rolling plains in the middle part and further to flat coastal ‘Kharland’ in west.

Seismic Consideration

According to seismic-zoning map of India [IS 1893: 2002], the study region falls in Zone III of the seismic zones of India.

Climate and Meteorology

The period from March to May is one of the continuous increase in temperature. May is generally the hottest month with a mean daily maximum temperature of about 41.7°C and mean daily minimum of about 26.2°C. The weather is intensely hot in summer and on some days the day temperature reach upto 45°C. About 93 percent of the annual rainfall in the region is received during the southwest monsoon months i.e. June to September.

Land Use

The Land Use Land Cover (LULC) within the block have been studied and it can be broadly classified into Seven major categories, namely, Built Up Land, Agricultural Land, Wastelands, Water Bodies, Vegetation Cover, Forest and Others. The land use distribution of the study area is given below in Table.

Table : Land use distribution of study area

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Primary Classification</th>
<th>Secondary Classification</th>
<th>Area, Secondary Class</th>
<th>Area, Primary Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Built-up Land or Habitation</td>
<td>Residential / Commercial</td>
<td>198.375, 19837.5</td>
<td>271.97, 27197.3</td>
</tr>
<tr>
<td>S. No.</td>
<td>Primary Classification</td>
<td>Secondary Classification</td>
<td>Area, Secondary Class</td>
<td>Area, Primary Class</td>
</tr>
<tr>
<td>-------</td>
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<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>~km²</td>
<td>Ha</td>
<td>~%</td>
</tr>
<tr>
<td></td>
<td>Industrial</td>
<td>73.598</td>
<td>7359.8</td>
<td>0.92</td>
</tr>
<tr>
<td>2</td>
<td>Agricultural Land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crop Land/Fallow Land</td>
<td>4344.763</td>
<td>434476.3</td>
<td>54.04</td>
</tr>
<tr>
<td></td>
<td>Plantations</td>
<td>24.578</td>
<td>2457.8</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Land without Scrub</td>
<td>92.874</td>
<td>9287.4</td>
<td>1.16</td>
</tr>
<tr>
<td>3</td>
<td>Wastelands</td>
<td>5.041</td>
<td>504.1</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Salt Affected Land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mud flat</td>
<td>907.906</td>
<td>90790.6</td>
<td>11.29</td>
</tr>
<tr>
<td></td>
<td>Sandy Area</td>
<td>7.392</td>
<td>739.2</td>
<td>0.09</td>
</tr>
<tr>
<td>4</td>
<td>Water Bodies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reservoir / Lakes / Ponds / Tanks</td>
<td>42.994</td>
<td>4299.4</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>River Beds</td>
<td>371.797</td>
<td>37179.7</td>
<td>4.62</td>
</tr>
<tr>
<td></td>
<td>Sea</td>
<td>768.942</td>
<td>76894.2</td>
<td>9.56</td>
</tr>
<tr>
<td>5</td>
<td>Vegetation Cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scrub</td>
<td>678.687</td>
<td>67868.7</td>
<td>8.44</td>
</tr>
<tr>
<td></td>
<td>Open Vegetation</td>
<td>266.786</td>
<td>26678.6</td>
<td>3.32</td>
</tr>
</tbody>
</table>
### Air Quality

Air quality was monitored at 10 (ten) different locations within the study area. The 24-hourly average of PM$_{10}$ and PM$_{2.5}$ levels varied station-wise between 44.58 µg/m$^3$ - 74 µg/m$^3$ and 16.54 µg/m$^3$ - 45 µg/m$^3$ respectively. The 24-hourly average values of SO$_2$ varied between 4.0 µg/m$^3$ and 9.0 µg/m$^3$. The 24-hourly average NO$_x$ level measured in the study area ranged between 9 µg/m$^3$ and 18.15µg/m$^3$. The analytical result of value reveals that the concentrations of PM$_{10}$, PM$_{2.5}$, SO$_2$ and NO$_x$ were found within the prescribed standard limits at all the monitoring locations. VOC and CO were found non-traceable limits at all the monitoring locations. It is expected that there will no significant impact on air quality because drill activity is for short duration.

### Noise Quality

Ambient noise intensity at 10 locations within the study area has been collected. Noise monitoring was carried out on a 24-hour basis to assess the baseline noise-levels and to evaluate the impact. The values of noise level, which were recorded, was in the range of 48.4-57.9 dB at day time and 40.8-53.6 dB at night time which is under the permissible limit of CPCB standards in the residential, commercial and industrial area.

### Soil Quality:

Seven soil samples were collected from different places within the study area. The sampling and analysis of soil were carried out as per standards of IS: 2720.

Soil pH varied in the range 7.22-7.63. The textural analysis of soil revealed the loamy sand nature of the soil, with the percentage of sand ranging from 50-64%, whereas the clay and silt quantity ranged from 14 -24% and 18-30%, respectively. The Organic Carbon Value in the sampled soil is in the range
of 0.28-0.39% by weight of the soil. It was observed from the analyzed data that the soil of the study area is sandy loam in nature.

**Water Quality**

Seven water samples were collected from ground water source and twelve samples are collected from surface water bodies in the Study Area. The major use of both surface and ground water is for agricultural purpose since there are very few industries in the study area. Apart from irrigational purposes bore well water was used for drinking purposes in most of the places directly without any treatment by rural population.

The major use of the water w.r.t detailed information was discussed in the Chapter-3 of the present environmental condition. The physico-chemical characteristics of groundwater w.r.t the 13 blocks indicate pH in the range of 7.08-8.19; temperature during study period is in the range of 25\(^\circ\)C-26\(^\circ\)C. The inorganic parameters viz., Alkalinity was in the range of 90-720 mg/l; Total Hardness 80-590 mg/l; Chlorides 24-2080 mg/l; Sulphates 18-152 mg/l; Microbiological parameter *E.coli* and Total coliforms was also present in some of the bore wells in all blocks.

The physico-chemical characteristics of surface water indicate pH in the range of 7.89-8.52; temperature 26-27\(^\circ\)C. The inorganic parameters viz., Total Hardness 150-180 mg/l; Chlorides 285-365 mg/l; Sulphates 36-65 mg/l; Microbiological parameter *Ecoli* and Total coliforms was also present in almost all surface water samples in all blocks.

Based on the analyzed parameters, it can be concluded that the surface water is not fit for drinking purposes unless it is treated and disinfected while the ground water is good for drinking as well as irrigation purpose.

**Biological Characteristics**

The area supports diverse flora rich in rare and endemic elements. The vegetation of the area ranges from small herbs to very large trees. No ecologically sensitive areas such as National Park/Sanctuary/Biosphere Reserve/Elephant Reserve/ Tiger Reserve/ Historical or Archaeological Monument/ World Heritage Centre, etc… are present within the study area. The area has also no grazing and forest land in the close vicinity.

The dominant trees growing this area are, *Mangifera indica*, *Cocos nucifera*, *Azadirachta indica*, *Peltophorum pterocarpum*, *Acacia auriculiformis*, *Prosopis cineraria*, and *Pithecellobium dulce*. The tree species observed in the study area. Shrubs are, represented mainly by, *Prosopis juliflora*, *Lawsonia inermis*, *Calotropis procera*, *C. gigantea*, *Zizyphus nummularia*, *Tecoma stans*, *Cassia auriculata*, *Ipomoea fistulosa*, and *Lantana camara*. Climbers/ twiners in the study area dominated by, *Ipomoea pes-tigridis* (Wagpadi), *Ipomea pes-caprae* (Dariani vel), *Ipomea aquatica* (Nali ni Bhaji), *Coccinia grandis* (Ghiloda) , *Luffa cylindrica* (Galku), and *Abrus precatorius* (Chanothai).
The Tuver (Cajanus indica), Wheat (Triticum aestivum) and Cotton (Gossypium herbaceum) are cultivated as major crops in the Northern side of the Narmada River. Bajra (Pennisetum typhoides) and Jowar (Sorghum bicolar) are cultivated in few pockets immediately after monsoon period in this region while the southern side of the Narmada is dominated by Sugar cane cultivation.

The most commonly spotted water bird species of this area were; Cattle Egret, Intermediate Egret, Little Egret, Indian Cormorant, Black-winged Stilt, Red-wattled Lapwing, Red-naped Ibis, Black-headed Ibis, White-breasted Water hen.

Among the reptiles, Indian cobra (Naja naja) and Common rat snake (Ptyas mucosus) were provided protection as per schedule –II of Wild life protection Act, 1972.

Among mammals; Langur, (Semnopithecus entellus) is Schedule-II animal while Nilgai (Boselaphus tragocamelus) is Schedule-III animal of Wild Life Protection Act, 1972.

The aquatic macrophytes including free floating algae, submerged hydrophytes, emergent hydrophytes and semi aquatic plant like rooted herbs were observed during survey in the study area. Planktonic population: five species of plankton under the order of Bacillariophyceae (Navicula sp., Cyclotella sp.,) Myxophyceae (Anabaena and Nostoc sp.,), Chlorophyceae (Microspora sp., Spirogyra sp.) were found. Six species of Zooplankton under the orders of Cladocera (Daphnia sp., and Moina sp.) Rotifers (Diaptomus sp.,) were identified in the aquatic habitats. Bacillariophyceae as dominant life form in phytoplanktons and largest group of biomass producer on earth are dominated by diatoms like Navicula sp. Followed by Anabaena sp. And Nostoc sp. and Zooplanktons are dominated by Rotifers (Diaptomus sp.)

**Socio-Economic Environment**

The 13 blocks are located in Surat, Bharuch and Vadodara District. The key demographic details of the three districts are given below.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>DETAILS</th>
<th>Vadodara District</th>
<th>Surat District</th>
<th>Bharuch District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RURAL POPULATION</td>
<td>2,099,855</td>
<td>1,232,109</td>
<td>10,26,060</td>
</tr>
<tr>
<td>2</td>
<td>URBAN POPULATION</td>
<td>2,065,771</td>
<td>4,849,213</td>
<td>5,24,959</td>
</tr>
<tr>
<td>3</td>
<td>MALE POPULATION</td>
<td>2,153,736</td>
<td>3,402,224</td>
<td>8,05,707</td>
</tr>
<tr>
<td>4</td>
<td>FEMALE POPULATION</td>
<td>2,011,890</td>
<td>2,679,098</td>
<td>7,45,312</td>
</tr>
<tr>
<td>5</td>
<td>TOTAL POPULATION</td>
<td>4,165,626</td>
<td>6,081,322</td>
<td>15,51,019</td>
</tr>
<tr>
<td>6</td>
<td>POPULATION DENSITY</td>
<td>552</td>
<td>1337</td>
<td>238</td>
</tr>
<tr>
<td>7</td>
<td>SEX RATIO (PER 1000)</td>
<td>934</td>
<td>787</td>
<td>925</td>
</tr>
<tr>
<td>8</td>
<td>LITERATES</td>
<td>2,893,080</td>
<td>4,571,410</td>
<td>11,18,276</td>
</tr>
</tbody>
</table>
4. ANTICIPATED ENVIRONMENT IMPACTS AND MITIGATION MEASURES

The proposed project of Exploratory Drilling includes the following activities during construction and operation phase:

- Site preparation (clearance of land, earthing, digging, etc)
- Drilling Operations (deployment of rigs, etc)
- Atmospheric emissions (gas flaring, vehicular/vessels emissions, etc)
- Operational discharges
- Noise levels
- Solid/Wastewater/Hazardous waste generation
- Use of resources such as water requirement for construction activities & other operations (drilling, etc) and fuel for D.G sets for power generation
- Transport of personnel and materials
- Fuel storage and handling

Based upon the Baseline data of, air , noise, water, soil, biological and socio-economic aspect impact interaction and baseline information, the following impacts are anticipated for which suitable mitigation measures have been proposed.

Air Environment

The site preparation activities (such as clearance of land, etc), operation of generators and other machineries & equipments, gas flaring activities, transportation of materials & personnel, and fugitive emissions have the impact on air quality during construction as well as operation phase. However, the impacts during the construction phase shall be temporary, restricted to the construction site and adoption of suitable measures (such as routine maintenance of the vehicles/vessels/machineries, etc); whereas impacts during the operation phase shall be minimized by adopting good maintenance practices and suitable measures such as Minimization of emissions from drilling machineries, generators and optimize fuel efficiency, adequate stack height, special flare tip design for effective combustion etc.

Noise Quality

The main sources of noise generation during the construction and operation phase are:

- Site preparation activities (earth work, digging, etc)
• Operation of machineries and equipment (such as generators, compressors, fluid pumps, mud pumps, etc)
• Movement of vehicles.

These activities may affect the surrounding social and ecological environment. However, impacts due to these activities have been envisaged to be local and temporary in construction phase and also, adopting suitable measures such as routine maintenance of vehicles/vessels/machineries, use of noise attenuation devices, shall minimize the impacts in construction as well as in operation phase.

**Water Quality**

The water quality is likely to get affected due to installation of pipeline, operational & domestic discharges, hydraulic testing of pipeline and accidental spillage of lubricants, oil & other chemicals from the operation of rigs and other equipment & machineries. However, these impacts shall be minimize by adopting precautionary and suitable measures such as installation of sewage and effluent treatment plant, utilization of produced water, etc.

**Sediments and Soil Quality**

The quality of sediments and soil is likely to get affected due to accidental spillage of lubricants & other chemicals, operational discharges, site preparation activities (such as removal of top soil due to land clearance, etc) wastewater discharges, and deployment of rigs, etc. However impacts shall be mitigated by adoption of suitable measures and implementation of waste management plan.

**Biological Environment**

The impacts on flora and fauna may occur due to site preparation activities (land clearance, etc), gas flaring activities, movement of vehicles, noise generation from machineries & equipment, operational discharges and accidental spillage of oil, lubricants and other chemicals during construction and operation phase. However, these impacts shall be local and minimized by adopting suitable measures (such as adequate flare tip design, use of noise attenuation devices, waste management plan etc).

**Socio-Economic Environment**

The near by human settlement is get meager effects due to proposed activities (such as movement of vehicles, operation of generators, compressors and other machineries & equipment, gas flaring activities, etc) during construction and operation phase (as most of the sites are located far away from human settlements). However, these impacts shall be mitigated by adopting suitable measures such as waste management plan, special flare tip design for effective combustion, etc. The proposed activities will generate indirect employment opportunities (contractual basis) in the region. The proposed project will also result in the implementation of social welfare project as per Company’s CSR policy and improvement in existing infrastructure facilities (such as roads etc.).
5. ADDITIONAL STUDIES

Risk Assessment

ONGC is committed to maintain high standards for health and safety at all times. However, on rare occasions, an unplanned event can have the potential to jeopardize the safety of the crew and cause environmental damage. Potential non-routine events that may occur during the proposed activities of drilling operations, expansion of onshore terminal and installation of pipeline:

- Blowout
- Oil Spills
- H₂S Emissions
- Gas leakage
- Fire (if gas comes in contact with source of ignition)
- Occupational Hazards

Specific procedures and trainings are being be carried out at all the work centers of ONGC to ensure that the correct action would be taken in the event of unplanned occurring. The drill site will be equipped with suitable safety measures such as firefighting facility (fire suit, fire extinguisher, gas sensors etc.), medical facilities, etc. The operating personnel will be provided PPEs and trained for such an eventuality and the key responsible people will be required to hold relevant well control certifications.

Disaster Management Plan and Emergency Response Plan

The Disaster Management Plan (DMP) and Emergency Response Plan (ERP) also includes in this chapter. The objectives of DMP and ERP are to:

- Obtain an early warning of emergency conditions so as to prevent a negative impact on personnel, the environment and assets.
- Immediate response to emergency with effective communication and organized procedures.
- Safeguard personnel to prevent injuries or loss of life by either protecting personnel from the hazard or evacuating them from the facilities.
- Minimize the impact of such an event on the environment and the facilities by mitigating the potential for escalation and, where possible, containing the release.

The following key elements of DMP and ERP are:

- Contingency plan
- Accident prevention procedures/measures
- Accident/emergency response planning procedures
- Onsite and offsite crisis management, communication, contact information etc.
6. ENVIRONMENT MANAGEMENT PLAN

The detailed baseline study has conducted for all the environmental parameters and all the parameters are well within the permissible limits defined by CPCB. Also the proposed activity is for very short duration hence the likely impact on these environmental aspects will not be of much significance. In spite of that various precautionary measures i.e. use of biodegradable chemicals, use of water based mud, proper HDPE lining of pits to prevent ground water contamination, water recycling, proper acoustic enclosures for the DG sets and restoration plan for the sites after completion of activity are undertaken to prevent any harmful impact on environment.

In addition to this, the site-specific Environment Management Plans (EMP) has been developed to prevent and mitigate significant adverse impacts and to accentuate beneficial impacts which shall be implemented by ONGC for the proposed project. The relevant mitigation measures are proposed for the following environment issues.

- Rig Mobilization
- Wastewater and Effluent Management
- Fuels, Lubricants and Chemicals
- Non-routine events and accidental releases (Well kicks, blow out)
- Air emissions
- Noise and Vibration
- Solid wastes (hazardous and non-hazardous waste)
- Sediments and soil quality
- Ecological Impacts
- Socio-economic impacts

To facilitate field level implementation, a waste management plan is framed which will be subjected to fine tuning depending on site conditions. Appropriate measures and engineering practices will be taken as per established standards and requirements such as adequate stack height, effluent discharge as per CPCB standards, installation of generators set as per notified norms by MoEFCC, installation of HSD Tanks, fire protection system and occupational health safety program as per OISD rules and Factories Act etc. Socio-economic welfare plan shall also be implemented as per company’s CSR policy.

Environmental training is also an essential part, which will help to ensure that the requirements of the EMP are clearly understood and followed by all project personnel throughout the project period for operations. The primary responsibility for providing training to all project personnel will be that of the HSE Officer, ONGC.