

Pre-Feasibility Report for Drilling of ERD Wells in Baghjan Area in Tinsukia District in the State of Assam

1.0 PREAMBLE:

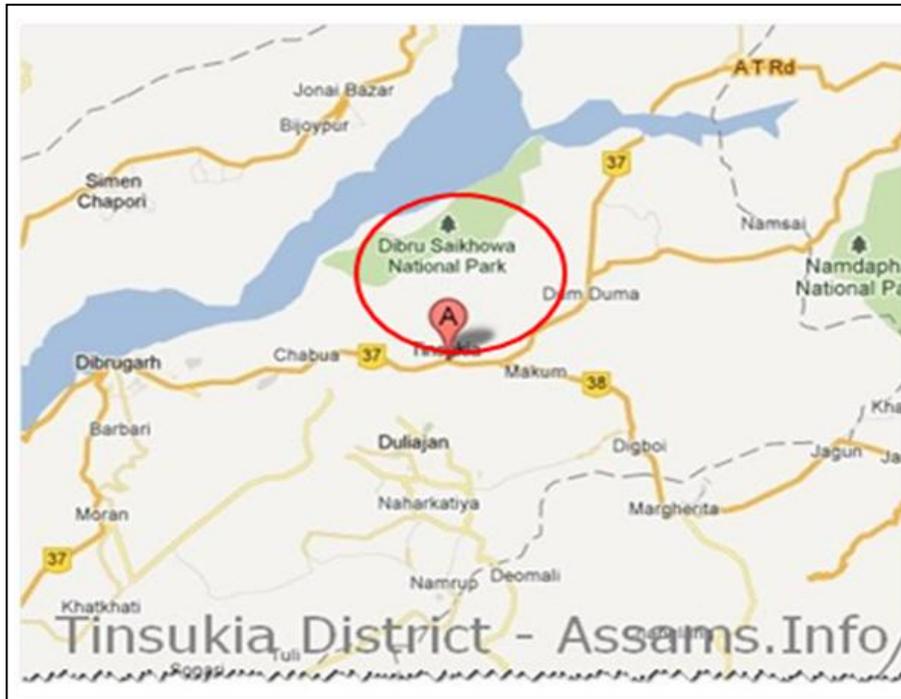
India is one of the fastest growing economies in the world with the demand for oil and gas rising at a matching rate and the dependence on fossil fuels is likely to continue in the foreseeable future. The imports of crude oil during 2014-15, in terms of quantity was 189.7 MMT valued at USD 142 billion. During the period 2009-10 to 2013-14 the crude oil production has remained in the range 33.7 to 38.1 MMT with year to year variations. Natural gas production was also in the range of 47.49 BCM in 2011-12 to 35.41 BCM in 2013-14. In order to address the country's energy security concerns, one of the measures undertaken by the Government has been the implementation of the New Exploration Licensing Policy (NELP). For exploration of hydrocarbon resources in the country Petroleum Exploration Licenses are granted under the New Exploration Licensing Policy (NELP).

India has an estimated sedimentary area of 3.14 million sq km. comprising of 26 sedimentary basins, out of which, 1.35 million sq km. area is in deepwater and 1.79 million sq km. area is in onland and shallow offshore. Before implementing the New Exploration Licensing Policy (NELP) in 1999, 11% of Indian sedimentary basins were under exploration, which has now increased significantly.

Oil India Limited (OIL), a Government of India Navaratna Enterprise, is currently engaged in carrying out exploration activities for hydrocarbon in its operational areas of Upper Assam, Arunachal Pradesh and Mizoram in the North Eastern part of India. OIL has significant presence in pan-India and overseas.

Following the discovery of oil and gas in Baghjan area (2003) by OIL, extensive geoscientific works have been carried out in by 3D seismic survey. Around 75 sqkm of PEL area was converted into Baghjan Mining Lease and OIL has so far drilled 19 wells. Currently 5000 bbl of oil has been produced from this field per day. Gas wells are being kept in shut in condition due to non-availability of evacuation infra-structure.

Due to presence of ML boundary towards north of Baghjan ML as well as the Dangori river and Dibru-Saikhowa National Park (DSNP), further exploration work could not be continued beyond the ML boundary towards northern side. However, it has been observed from the geoscientific data that the oil/gas



Physiographic map of Baghjan Area

2.0 GEOGRAPHICAL POSITION OF THE ERD BAGHJAN LOCATIONS

The ERD locations (sub-surface) lie in Dibru-Saikhowa National Park (DSNP) with the Dangori River flowing south marking the southern boundary of the national park in Tinsukia district of Assam and the mighty Brahmaputra River marking the northern boundary of DSNP area. The coordinates of the proposed drilling locations are given in Table 1 and in Figure 1.

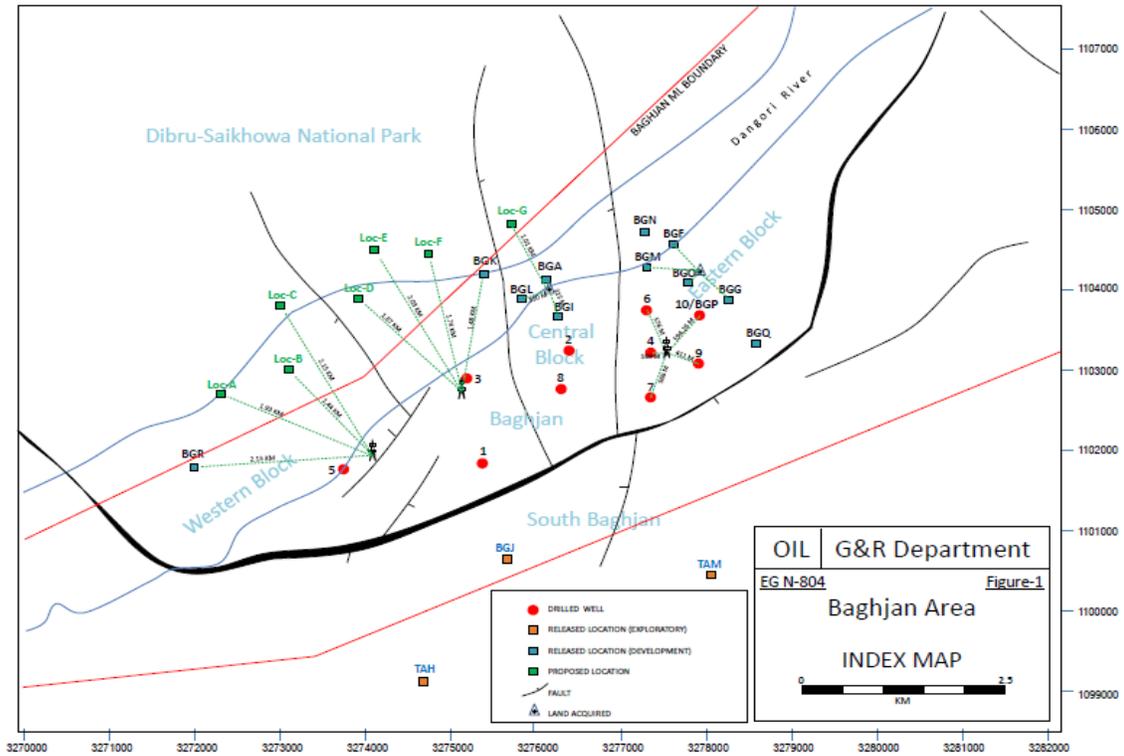


Figure-1

Table-1

POINT	Latitude	Longitude
A	27°36'11.8757"N	95°21'58.7298"E
B	27°36'20.5540"N	95°22'28.3568"E
C	27°36'46.6790"N	95°22'25.9099"E
D	27°36'48.5098"N	95°22'59.1363"E
E	27°37'7.9496"N	95°23'7.0839"E
F	27°37'5.1939"N	95°23'30.0919"E
G	27°37'17.9866"N	95°24'6.0105"E

3.0 **TECHNICAL FEASIBILITY FOR DRILLING OF BAGHJAN ERD WELLS:**

Location of the Block

Baghjan ERD locations are located within the proven petroliferous Assam-Arakan Basin. The Assam Shelf, Belt of Schuppen and the Assam-Arakan Fold Belt are the prime geological features of the Assam-Arakan Shelf-Slope basinal system. Baghjan is geologically located in the vicinity of already proven fields in Assam Plains with major oilfields like Barekuri, Makum-Hapjan, Borhapjan in south and Mechaki field in north-east having established Oligocene-Eocene (Barail-Lakadong+Therria) hydrocarbon system. Towards immediate south of the proposed ERD locations, commercial oil and gas field (Baghjan) have been discovered way back in 2003 and subsequently, developed by drilling of 19 wells till date. These ERD locations are the northern extension of the same Baghjan structure towards north below the periphery of Dibru Saikhowa National Park (DSNP).

Earlier Exploration in adjacent Baghjan Area

Baghjan structure was identified way back in 1991 based on limited seismic data and later re-defined based on additional 2D seismic of 1999-2000. The presence of commercial hydrocarbon in the area was first established in the first well (Baghjan-1) drilled in the structure in March 2003, when two sands within Lakadong+Therria produced gas with minor amount of light oil/condensate. In 2004-05, the Baghjan area was covered with 3D seismic for further development of the field. It is worth mentioning that subsequent wells (19 Nos.) proved to be oil and gas bearing.

Geophysical Survey

In DSNP Park area, no geophysical activities have been carried out so far by OIL due to environmental restriction. However, as referred earlier the entire Baghjan oilfield has been covered with extensive 2D and 3D seismic surveys.

Exploratory Drilling

No wells have been drilled in the DSNP area till date. OIL is planning to drill ERD wells with high technology to drill 7 wells from the existing plinth of Baghjan PML.

Technical Assessment & Geological Modeling

Based on the overall geoscientific studies carried out in Baghjan area, 7 (seven) drillable prospects have been identified inside DSNP area. Also, should there be any drilling in this area, more subsurface data becomes available, the above locations may have to be shifted/ optimally placed, if required. The co-ordinates of the identified drillable prospects are shown in Table 2.

Table 2

Sl. No.	Location	Latitude	Longitude
1	A	27°36'11.8757"N	95°21'58.7298"E
2	B	27°36'20.5540"N	95°22'28.3568"E
3	C	27°36'46.6790"N	95°22'25.9099"E
4	D	27°36'48.5098"N	95°22'59.1363"E
5	E	27°37'7.9496"N	95°23'7.0839"E
6	F	27°37'5.1939"N	95°23'30.0919"E
7	G	27°37'17.9866"N	95°24'6.0105"E

Please Note: Issue to be taken up with NBWL and State Government, Assam, for consent/clearance for the drilling of locations within 10 km/Eco-sensitive Zone of Dibru-Saikhowa National Park.

Stratigraphy of the Area:

Based on the lithology encountered in wells drilled by OIL in nearby Baghjan area, the expected stratigraphy of the area is as follows:

AGE	FORMATION	LITHOLOGICAL DESCRIPTION
Pleistocene to Recent	Alluvium	Unconsolidated sands with gravel, silt and minor clays
Mio-Pliocene	Girujan	Absent
Miocene	Tipam	Fine to medium grained sugary sandstone with bluish sticky clay and coaly matters
Oligocene	Barail	Fine grained sandstone with bluish mudstone and coal
Late Eocene	Kopili	Bluish Splintery Shale
Mid Eocene	Prang	Brownish Limestone bands with Splintery shale and microfauna
Mid Eocene	Narpuh	Fine grained silty sandstone with bluish splintery shale
Early Eocene	Lakadong+Therria	Fine to medium grained sandstone with splintery shale and whitish claystone
Late Palaeocene	Langpar	Medium to coarse grained sandstone with bluish/reddish splintery shale
Precambrian	Basement	Angular rocks of Quartz, Feldspar, Biotite etc

Petroleum System:

Source Rock:

The Langpar and Lakadong+Theria Formation encountered in nearby OIL's wells of Baghjan area consist of rich organic matter, TAI values more than 2.0 and VRo ranges consists of rich TOC (>2%). The TAI value 2.0+ suggests initial stage of maturation.

Reservoir Rocks:

In the wells drilled in the Upper Assam Basin by OIL in the vicinity of the area, reservoir facies are present within the Langpar, Lakadong+Theria and Narpuh formations. The Tipam and Girujan section also contain sandy facies in certain parts.

Cap Rock:

Kopili shale and Girujan Formation act as regional cap rock throughout Upper Assam Basin.

Entrapment:

The ERD area is the northern extension of Baghjan Oilfield and hence entrapment mechanism as envisaged is mainly structural closures abutting against NE-SW trending major faults within the Pre-Barails. Subsequent tilting and generation of strike-slip faults along with transpression possibly gave rise to inversion structures at younger levels. Compensating antithetic faults provided trapping mechanism while some of the major faults have acted as conduits for the vertical migration. The major trap formation has occurred during the close of Girujan deposition nearly 1.8 Ma, with the Critical Moment for hydrocarbon accumulation being 1.8 Ma as per the Events Chart for Petroleum System of the Assam Shelf (Pahari et. al. 2008).

Volumetric Estimation:

A total in-place resource of 11.5 MMSKLS has been estimated for the identified prospects. The recoverable resources are estimated at 3.45 MMSKLS. Resources pertaining to the extended area will additionally enhance the quantum of entire Greater Baghjan Field.

4.0 SITE ANALYSIS

Logistics and Topography:

Baghjan ERD area primarily falls within the depositional plains of the River Brahmaputra and its tributaries whilst the northern boundary is close to the Arunachal foothills. The key physical features of the Block are described below:

- The ERD locations are lying in the river bed of Dangori and in the periphery of southern part of DSNP park. Hence, the subsurface position of these locations are flood prone during rainy season (Fig. 1). Dangori river flows down from East Arunachal Hills finally falling in Brahmaputra river.
- The main river near ERD locations are Dibru river. Few locations (Sub-surface) lie in the riverbed of Dibru river. The main river channel of mighty Brahmaputra flows in the northern side of the area.
- The area primarily comprises of rural areas with settlements, homestead plantations and agricultural lands of Dighaltarang and Baghjan villages surrounded by Baghjan, Diamuli and Dighaltarang Tea gardens etc.
- Many tea gardens (TG) are surrounding the project site and clustered at the eastern portion of the area. The names of the important tea gardens in the area are Baghjan, Dighaltarang, Diamuli and Longswai etc.
- There is no forest near the existing plinth of the well from where the ERD wells have been planned to be drilled except the northern DSNP park. Dibru river separates the DSNP park and the Baghjan oilfield. The nearest boundary of DSNP park is about 2 km from the project site.
- The land-use and land-cover of Baghjan and nearby DSNP area have been interpreted from the satellite data (LANDSAT Imagery), top sheet of the area and subsequently by ground trudging during reconnaissance surveys. The land use pattern of Baghjan area shows that majority of the land (60%) is used for agriculture purpose with paddy and tea garden. The settlements cover about 20% of the total area. The roads including part of NH 37 within the Block covers 2% of the total area. Open mixed jungle and open scrub cover an area of 2% and 3% of the total area. The Dibru river is the main water channel flowing southwest towards Tinsukia. Maguri beel, a major wetland of Tinsukia District lies south of the project site (Fig. 5).

Accessibility to the Block Area

The National Highway 37 (NH-37) is the major road towards south of the Block area connecting the district headquarters, Tinsukia, with other major cities of Assam viz. Dibrugarh, Sibsagar and Guwahati etc. A railway line of the North East Frontier Railway runs also south of the Block connecting Dum Duma with Tinsukia, Dibrugarh and Guwahati. Dibrugarh is the nearest Airport located about 86 kilometers from the Block. Flights are available daily for Guwahati, Delhi, Kolkata and well connected to other parts of the country.

Dum Duma is the nearest town at a distance of 22 km. Baghjan OCS is located about 2 km from the project site. The approximate distance of Dum Duma from major and nearby towns is as follows:

From	To	Distance (km)
Dum Duma	Tinsukia	27
Dum Duma	Duliajan	50
Dum Duma	Dibrugarh	75
Dum Duma	Sibsagar	154
Dum Duma	Guwahati	517
Dum Duma	Delhi	2400



Figure: Accessibility Map of the Block Area

Climatic and Soil Data

The DSNP area falls under the humid subtropical climate zone with warm summer and the following are the well-defined seasons of the region:

Pre-monsoon	: March-May
Monsoon	: June- September
Post-monsoon	: October- November
Winter	: December- February

The months with high temperatures are generally from May to September. Temperature normally remains low from November to February. Rainfall begins from late April and continues upto early October, with June-September receiving maximum downpour. Morning relative humidity values are generally comparable for all months with values ranging from 91-97%. The afternoon relative humidity values generally varies between 43-78%. Comparatively higher relative humidity values are noted during monsoon months (May-September) which was comparatively lower during the winter months (December-February).

Samples collected from near DSNP area were found to be silty and loamy in nature. Moisture content varied between 1.72-3.98% with the agricultural land sample showing the maximum moisture content. The soil samples collected from the sites were found to be strongly acidic in nature with pH values varying between 4.81-4.94.

5.0 PROJECT SCHEDULE & ECONOMIC FEASIBILITY

The ERD Project in Baghjan area was planned in May 2010 and accordingly seven (7) locations were proposed for drilling in this area. Baghjan PML license was obtained in 2003 from MoPNG and is effective upto 2023. Major part of the oil and gas bearing horizons is extending towards North and North-western part beyond the ML boundary beneath the Dibru-Saikhowa National Park Area. Therefore drilling is required to commence as early as possible after obtaining of pre drilling EIA & EMP and NBWL clearance.

The estimated expenditure for completing each well is about ₹ 40 Crore. Based on the preliminary technical study with available geoscientific data & operational feasibility, OIL expects that the DSN Block is expected to offer a tenable cost- benefit scenario for carrying out the exploration activities.

The surface sites for drilling of the proposed wells generally avoids or causes minimal displacement of homes, human and existing workforce. Technology

will be utilized to reach the subsurface targets by using available technology from alternate nearby surface position.

If commercial viability of hydrocarbon production is established, then production of oil/ gas will help in meeting energy needs of the country and will lead directly to socio-economic development of the area and its vicinity.
