

PRE-FEASIBILITY REPORT

1. Introduction

Oil and Natural Corporation Ltd, a “MAHARATNA” company, is actively pursuing hydrocarbon exploration activities in acreage of Tripura Fold Belt for more than four decades. Covered by 18 different Petroleum Mining Lease (PML) areas, a lot of scope still exists in exploring new sub-surface structures in this area for hydrocarbons. The total area of PML's in West Tripura is 3075.29 sq. km, in which Kunjaban, Konaban, Agartala Dome, Manikyanagar-Sonamura, Sundalbari, Baramura, Tulamura and Gojalia structures and its adjoining areas are the important gas producing fields.

Earlier, MoEF&CC has granted ONGC Environmental Clearances (EC) Vide letter F.No. J-11011/633/2007-IA II (I) dated 22.10.2007 to drill 13 locations in 2 PML blocks of Tripura. Among these thirteen (13) locations, EC for BMST and BREB in Baramura Extn-IV PML of Gomati district were expired. Similarly, MoEF&CC has granted ONGC, EC Vide letter F.No. J-11011/634/2007-IA II (I) dated 22.10.2007 to drill 4 locations in 2 PML blocks of Tripura of which EC for the location BMSD in Baramura Extn-IV PML of West Tripura district has expired. In addition to these, MoEF&CC has granted ONGC EC Vide letter F.No. J-11011/213/2008-IA II (I) dated 11.06.2008 to drill 67 locations in 9 PML blocks of Tripura of which EC of GOAI in Gojalia PML of South Tripura district and AMAA & BRMAD of West Tripura PML in Khowai and West Tripura districts respectively had expired. Further, ONGC has also applied EC for 50 locations out of which 37 locations got EC Vide letter F.No. J-11011/109/2015-IA II (I) dated 13.09.2017 and remaining 13 locations were excluded as these locations were falling in forest and ESZ which include the forest location BRMAE and GOAN. Presently for the location BRMAE, the ROFR Certificate has been received and online submission for forest clearance has been initiated and is under process. Furthermore EC are required, for another three available locations GOAO of Gojalia PML, BRMAJ of West Tripura PML and ROBL of Manikyanagar-Sonamura Extn-I PML which are falling in forest areas of South Tripura, West Tripura and Shipahijala districts respectively. RoFR certificate has been received for nine locations except for the two locations ROBL and GOAN, the RoFR certificates are yet to receive. The online submission for forest clearance has been submitted for all 11 locations and is under process.

The present proposal is for granting TOR pertaining to drilling of 11 exploratory wells in forest areas of Tripura covering four PML blocks for which ONGC has received RoFR Clearance for 9 locations and online proposal for forest clearance has been submitted for all 11 locations and which are in advance stage for clearance. These wells have been planned to explore a number of newly identified sub-surface structural, strati-structural and stratigraphic prospect and also to accommodate generation of more drillable exploratory locations through ongoing active G&G activities.

Subsequent to grant of Environment Clearances, the pre-drilling activities (e.g. land acquisition, civil works and approach road preparation etc.) will be taken up prior to deployment of a drilling rig.

2. Details of PML Block:

2.1 West Tripura PML:

This PML block covers the northern part, southern part, Bulge part and both rising flank of Baramura Anticline, part of the northern plunge of Atharamura Anticline, northern and southern part and both rising flank of Tulamura Anticline, in addition the northern plunge and eastern flank part of Gojalia

Anticline is also covered by West Tripura PML. The central part of Baramura and Gojalia anticlines has been extensively explored and gas has been established from Upper and Middle Bhuban formations. The northern and southern plunge part of the Baramura structure along with Atharamura Anticline and Tulamura Anticline are under exploration to establish the full potential of this structure. This PML has the largest coverage area among all PML's of West Tripura i.e. 1327.58 Sq. Km. The grant from Government of India (GoI) obtained vide F No. O-12012/52/2003-ONG-II, Dt.:08.02.2013, and effective period w.e.f. 04.01.2013 to 03.01.2020, with MWP of 5 wells.

The coordinates of the West Tripura PML boundary are

PML NAME (AREA)	AREA (Sq. Km.)	BOUNDARY POINTS	LATITUDE			LONGITUDE			
			DEG.	MIN.	SEC.	DEG.	MIN.	SEC.	
WEST TRIPURA PML	1327.58	Block-I							
		A	24.00	6.00	0.00	91.00	26.00	8.19	
		B	23.00	53.00	47.00	91.00	30.00	18.00	
		C	23.00	43.00	22.51	91.00	27.00	20.00	
		D	23.00	43.00	22.51	91.00	29.00	10.16	
		E	23.00	31.00	42.42	91.00	29.00	40.41	
		F	23.00	31.00	53.51	91.00	25.00	43.35	
		G	23.00	30.00	54.45	91.00	25.00	43.35	
		H	23.00	30.00	54.45	91.00	26.00	50.51	
		I	23.00	29.00	18.27	91.00	26.00	32.96	
		J	23.00	30.00	8.18	91.00	30.00	33.86	
		K	23.00	25.00	3.55	91.00	33.00	16.02	
		L	23.00	25.00	17.86	91.00	34.00	20.17	
		M	23.00	19.00	11.35	91.00	36.00	19.41	
		N	23.00	19.00	17.14	91.00	39.00	7.05	
		O	23.00	37.00	25.94	91.00	37.00	30.00	
		P	24.00	3.00	22.70	91.00	36.00	1.76	
		Q	24.00	3.00	22.70	91.00	38.00	9.70	
		R	24.00	2.00	35.00	91.00	38.00	16.00	
		S	24.00	5.00	16.00	91.00	47.00	18.00	
		T	24.00	13.00	29.00	91.00	47.00	12.21	
		A	24.00	6.00	0.00	91.00	26.00	8.19	
		Note: Boundaries between points T & A follows International boundary between India-Bangladesh							
		Exclusion from Block I							
		A	23.00	55.00	16.24	91.00	34.00	11.02	
		B	23.00	40.00	0.00	91.00	36.00	13.47	
		C	23.00	40.00	0.00	91.00	32.00	51.42	
		D	23.00	55.00	16.24	91.00	30.00	48.98	
		A	23.00	55.00	16.24	91.00	34.00	11.02	
		Block-II							
		A	23.00	18.00	0.00	91.00	43.00	30.00	

		B	23.00	21.00	40.72	91.00	42.00	55.26
		C	23.00	22.00	11.80	91.00	43.00	35.36
		D	23.00	14.00	43.64	91.00	46.00	44.69
		E	23.00	2.00	25.57	91.00	46.00	18.41
		F	23.00	6.00	57.08	91.00	44.00	24.36
		G	23.00	10.00	30.00	91.00	44.00	5.60
		H	23.00	8.00	51.90	91.00	44.00	34.44
		I	23.00	6.00	51.87	91.00	45.00	45.03
		J	23.00	7.00	25.54	91.00	48.00	24.56
		K	23.00	18.00	0.00	91.00	44.00	30.00
		A	23.00	18.00	0.00	91.00	43.00	30.00
		Note: Boundaries between points D & E follows International boundary between India-Bangladesh;						
		Block-III						
		A	23.00	27.00	35.51	91.00	24.00	0.00
		B	23.00	27.00	35.22	91.00	26.00	33.69
		C	23.00	23.00	45.86	91.00	27.00	53.03
		D	23.00	24.00	23.30	91.00	30.00	0.00
		E	23.00	8.00	22.66	91.00	35.00	57.85
		F	23.00	8.00	28.69	91.00	35.00	17.89
		G	23.00	23.00	40.54	91.00	28.00	45.88
		H	23.00	22.00	34.05	91.00	25.00	8.82
		A	23.00	27.00	35.51	91.00	24.00	0.00

2.2 Gojalia PML:

The Gojalia PML block covers the Gojalia structure in the south of Tripura Fold Belt. It is a NNW-SSE trending, elongated, and doubly plunging asymmetric anticline, with flat crest and steeply dipping flanks. The anticline grades into the Bogapha Syncline to the east and the Abhaya Syncline to the west. Two major longitudinal structure defining reverse faults, Bhuratali in the east and Belonia in the west, affect the two limbs of the anticline. The Bokabil Formation is exposed in the core of the anticline, whereas the Tipam Formation is exposed along the down-faulted flanks.

This PML Block has an area of 271.17 Sq. Km. The GoI approval was obtained Vide F.1-07.02.2006 to 06.02.20026 and the effective period is from 07.02.2006 to 06.02.20026. The area has been established as gas field and reservoirs from both Upper and Middle Bhuban formations.

The southern part is covered by 2D seismic campaign and newly 3D seismic data was acquired in the northern part of Gojalia.

The coordinates of the Gojalia PML boundary are

PML NAME (AREA)	AREA (Sq. Km.)	BOUNDARY POINTS	LATITUDE			LONGITUDE		
			DEG.	MIN.	SEC.	DEG.	MIN.	SEC.
GOJALIA PML	271.17	A	23	22	48.65	91	26	0
		B	23	23	40.54	91	28	45.88
		C	23	8	28.69	91	35	17.89
		D	23	8	28.69	91	38	7.5

		E	23	1	38.91	91	38	7.5
		F	22	59	40.81	91	39	7.06
		G	22	58	29.19	91	36	24.71
		A	23	22	48.65	91	26	0

2.3 Manikyanagar-Sonamura Extn-I:

The PML block covers the central and southern parts of Rokhia Anticline. It is outermost structure of the Frontal Fold Belt of Tripura. It is tectonically the least disturbed and is an elongated gently folded doubly plunging, flat topped, near symmetrical anticline, trending NNW-SSE. The oldest sediments exposed in the core of the anticline are Tipam Group of sediments, comprising alternating argillaceous and arenaceous beds and on the flanks by the younger Dupitila formation.

Manikyanagar-Sonamura Extn-I has an area of 138.55 Sq.Km for that The GoI approval was obtained Vide F.1-2(55)/GEO/DI/2006/1941-42, Dt.:04.02.2009 and is effective from w.e.f. 01.02.06 to 31.01.2026, The Manikyanagar-Sonamura a prolific gas field in the south western part of the Tripura Fold Belt. Both Upper & Middle Bhuban sand are the main producers.

The coordinates of the Manikyanagar-Sonamura Extn-I PML boundary are

PML NAME (AREA)	AREA (Sq. Km.)	BOUNDARY POINTS	LATITUDE			LONGITUDE		
			DEG.	MIN.	SEC.	DEG.	MIN.	SEC.
MANIKYANAGAR - SONAMURA EXTN-I	138.55	A	23	40	31.62	91	14	24.71
		B	23	28	52.14	91	19	6.18
		C	23	27	55.95	91	16	7.06
		D	23	36	12.97	91	12	39.11
		E	23	35	32.07	91	11	4.41
		F	23	36	7.55	91	10	13.23
		G	23	39	14.59	91	10	7.06
		H	23	39	10.54	91	11	37.94
		I	23	38	40.54	91	11	30.88
		J	23	38	42.97	91	12	8.82
		K	23	38	55.13	91	12	13.23
		L	23	38	55.13	91	12	32.65
		M	23	40	31.62	91	12	35.29
A	23	40	31.62	91	14	24.71		

2.4 Baramura Extn-IV PML:

The Baramura anticline is an elongated, doubly plunging, cross-faulted asymmetrical anticline trending NNW-SSE with convexity to the west forming the Baramura bulge part. The eastern limb of the anticline is affected by steep longitudinal structure bounding reverse fault heading towards west. Bokabil (Late Miocene) formation is exposed at the crestal part of the Baramura anticline whereas, in the surrounding area, younger Tipam formation is exposed at the surface.

This PML was obtained from Government of India (GoI) for 150.25 Sq. Km area with effective period w.e.f. 01.02.2006 to 31.01.2026. This PML block covers part of central/crestal part and small part of northern part of Baramura Anticline. The central part of the Baramura Anticline has been extensively

explored and gas has been established from Upper and Middle Bhuban formations but the northern plunge part of the structure are under exploration to establish the full potential of this structure. The hydrocarbon prospectivity of this PML is already established in the form of gas discoveries from drilled wells but to delineate and establish the full production potential of the PML further exploratory program is needed.

The coordinates of the Baramura Extn-IV PML boundary are

PML NAME (AREA)	AREA (Sq. Km.)	BOUNDARY POINTS	LATITUDE			LONGITUDE		
			DEG.	MIN.	SEC.	DEG.	MIN.	SEC.
Baramura Extn -IV	150.25	A	23	55	16.24	91	34	11.02
		B	23	40	0	91	36	13.47
		C	23	40	0	91	32	51.42
		D	23	55	16.24	91	30	48.98
		A	23	55	16.24	91	34	11.02

3. Location Description of 11 locations for applying EC

Sl. No	Location	Area (ha) proposed for diversion	Online Proposal Number for Forest Clearance	Online submission date	PML	District	FC Status
1	GOAI	3.34	FP/TR/MIN/21541/2016	03.05.2017	Gojalia PML	South Tripura	Forest clearance from MOEF, Shillong awaited
2	GOAO	1.863	FP/TR/MIN/38549/2019	24.01.2019			
3	AMAA	1.74	FP/TR/MIN/38162/2019	11.01.2019	West Tripura PML	Khowai	
4	BRMAD	3.32	FP/TR/MIN/21545/2016	13.06.2017		West Tripura	
5	BRMAE	1.74	FP/TR/MIN/21546/2016	13.06.2017			
6	BRMAJ	1.74	FP/TR/MIN/38786/2019	13.02.2019			
7	BMST	1.74	FP/TR/MIN/19169/2016	19.05.2016	Baramura Extn-IV PML	Gomati	Proposal pending with Nodal Officer and DFO.
8	BMSD	3.069	FP/TR/MIN/26931/2012	14.05.2012		West Tripura	Proposal pending with Nodal Officer (forest)
9	BREB	1.74	FP/TR/MIN/38526/2019	01.05.2019		Gomati	Proposal pending with User Agency
10	ROBL	1.783	FP/TR/MIN/38943/2019	15.02.2019	Manikyanagar-Sonamura Ext-1 PML	Shipahijala	RoFR certificate pending with DM office. Proposal pending with User Agency (ONGC)
11	GOAN	3.052	FP/TR/MIN/40655/2019	12.06.2019	Gojalia PML	South Tripura	

4. Planned Activities:

After grant of environment clearance, mostly revenue land or agricultural land will be acquired on temporary lease. This will be followed by civil work and hardening of drill-sites and if required, preparation of approach roads.

The land will be acquired on a temporary basis and if commercial quantity of oil or gas is found, the land will be taken on long lease and if oil and gas is not found in commercial quantities, the land will be returned to the owner by bringing back to its original status and adequate compensation as per the guidelines of local administration will be provided.

The trajectory of well course will depend on the availability of land above the sub-surface position. A vertical well will be planned if land is available above the planned sub-surface position, else a deviated well will be planned. The planned depths range from 1500-3500m, however, + 300m variation in depths may be possible due to inherent geological uncertainties of exploratory and development wells.

4.1 Details of the drilling rig proposed to be deployed

Type of rig	Electrical Rig
Drilling mud composition	Water based Drilling Fluid
Power generator type & nos.	AC – SCR Type. (06 Nos.)
Diesel consumption	@ 6 M3 / Day per day for each well
Qty. of fresh water requirement & source	1000 M3. Transported from nearby source through contractor
Manpower on rig	25 per shift of 12 Hrs. Two shifts/day
Material requirement & Mobilization	From nearest ONGC base in West Tripura
Details of solids handling system on rig	Shale Shakers - 1200 GPM Capacity Desander – 1200 GPM Capacity Desilter – 1200 GPM Capacity
Details of Sewage treatment facility, if any	Not applicable
Waste Pit availability & Size	30' x 33' x 5' - 2 Nos. 38' x 33' x 5' – 1 No. 23' x 20' x 5' – 1 No.
Oil Pit availability & Size	3' x 3' x 4' – 1 No.

4.2 Drilling Operations

Only water based drilling mud will be used. The quantity of drill cuttings generated will be around 300-500m³. The quantity of wastewater produced will be about 15 m³/day. The rig will be provided with solids handling system comprising Shale shakers (1200 GPM), Desander (1200 GPM) and Desilter (1200 GPM) and Degasser with vacuum pump.

Drilling operations will be carried out using an electrical type rig. Drilling unit for drilling of oil and gas wells consists of a derrick at the top of which is mounted a crown block and a hoisting block with a hook. From the swivel is suspended a Kelly stem passes through a square or hexagonal Kelly bush

which fits into the rotary table. The rotary table receives the power to drive it from an electric motor. The electric motor rotates the rotary table which passes through the Kelly bush and the rotations are transmitted to the bit as the drilling progresses, the drill pipe in singles are added to continue the drilling process. At the end of the bit life, the drill pipes are pulled out in stands and stacked on the derrick platform. A stand normally has 3 single drill pipes. After changing the bit, the drill string is run back into the hole and further drilling is continued. This process continues till the target depth is reached.

During the course of drilling, rock cuttings are generated due to crushing action of the bit. These cuttings are removed by flushing the well with duplex/triplex mud pumps. The mud from the pump discharge through the rotary hose connected to stationary part of the swivel, the drill string and bit nozzles. The mud coming out of the bit nozzles pushes the cuttings up hole and transports them to the surface through the annular space between the drill string and the hole. The mud not only carries away crushed rock from the bottom of the hole but it also cools the bit as it gets heated due to friction with formation while rotating. The mud also helps in balancing subsurface formation pressures and by forming a cake on the walls of the well diminishes the possibility of crumbling or caving of the well bore.

At the surface, the mud coming out from well along with the cuttings falls in a trough, passes through the solids control equipments i.e. shale shaker, desander and desilter. These equipments remove the solids of different sizes which get mixed with the mud during the course of drilling. The cleaned mud flows back to the suction tanks to be again pumped into the well. The drilling mud/fluid circulation is thus a continuous cyclic operation. The most suitable clay for mud preparation is bentonite which is capable of forming highly dispersed colloidal solutions. Various other chemicals are also used in mud preparation as per requirements dictated by the temperature/pressure conditions of the wells. The mud is continuously tested for its density, viscosity, yield point, water loss, pH value etc. to ensure that the drilling operations can be sustained without any downhole complications.

4.3 Drilling Facilities

Drilling is a temporary activity which will continue for about 90-120 days depending on well depth for each well in the block. The rigs are self-contained for all routine jobs. Once the drilling operations are completed, and if sufficient indications of hydrocarbons are noticed while drilling, the well is tested by perforation in the production casing. This normally takes 2-3 days. If the well is found to be a successful hydrocarbon bearing structure, it is sealed off for future development, if any.

4.4 General Requirements of Drilling

Exploratory and development drilling programme requires the following common facilities:

a. Drilling muds

Drilling of wells requires specially formulated muds which basically comprise inert earth materials like bentonite, barite in water with several additives to give mud weight, fluidity and filter cake characteristics while drilling. The drilling muds have several functions like lubrication and cooling of the drill bit, balancing subsurface formation, bringing out the drill cuttings from the well bore, thixotropic property to hold cuttings during non-operations, formation of thin cake to prevent liquid loss along well bore etc. Several additives are mixed into the mud system to give the required

properties. Water based mud will be used to the possible extent in exploratory drilling but use of synthetic based mud may require due to complexities associated with the geological formations and associated hole stability problems. The constituents of water based mud (WBM) are given in **Table 2**. The special additives and their functions in WBM are shown in **Table 3**.

b. Power Generation

The drilling process requires movement of drill bit through the draw works which require power. The power requirement of the drilling rig will be met by using the six Diesel Generator sets with a diesel consumption of about 06 Kl/day. The exhaust stacks of the DG sets are likely to vent the emissions.

c. Water requirements

The water requirement in a drilling rig is mainly meant for preparation of drilling mud apart from washings and domestic use. While the former consumes the majority of water requirement, the water requirement for domestic and wash use is very less. The daily water consumption will be 25 m³/d of which 15 m³/d will be used for mud preparation and 10 m³/d will be used for domestic purposes including drinking.

d. Domestic wastewater

The operating personnel in the drilling rigs will operate from drill site accommodation (DSA) in the vicinity of the location. Suitable soak pits will be available at the DSA.

e. Solids removal

The rock cuttings and fragments of shale, sand and silt associated with the return drilling fluid during well drilling will be separated using shale shakers and other solids removal equipment like desanders and desilters. The recovered mud will be reused while the rejected solids will be collected and discharged into the waste pit.

f. Drill cuttings and waste residual muds

During drilling operations, approx 300-500 m³ per well of wet rock cuttings are expected to be generated depending on the type of formation and depth of drilling. In addition to the cuttings 15-20 m³/day of wastewater is likely to be generated during well drilling. The waste residual muds and drill cuttings which contain clay, sand etc. will be disposed into the waste pit.

g. Testing

Testing facilities will be available at drilling rig for separation of liquid phase and burning of all hydrocarbons during testing. The test flare boom will be located at a distance from the drilling rig.

h. Chemical storage

The drilling rig will have normal storage facilities for fuel oil, required chemicals and the necessary tubulars and equipment. The storage places will be clearly marked with safe operating facilities and practices.

i. Manpower

The drilling rig will be operated by approx. 30-40 persons on the rig at any time. The manpower will operate in two shifts with continuous operations on the rig.

j. Logistics

Crew transfers to and fro the drilling rig, materials, diesel and chemicals will be through light vehicles, trucks and trailers.

4.5. Project Investment

The total cost of drilling of 11 wells including daily drilling rates, consumables, well accessories etc. is approximately Rs. 550 Crores. (Approximately Rs 50 Crores per well)

Table 2 Ingredients of Water Based Drilling Fluid

S. No	Chemicals
1.	Barite
2.	Bentonite
3.	Carboxy Methyl Cellulose
4.	Mud Thinner / Conditioner
5.	Resinated Lignite
6.	Non-Weighted Spotting Fluid
7.	Weighted Spotting Fluid
8.	EP Lube
9.	Drilling Detergent
10.	Caustic Soda
11.	Potassium Chloride
12.	Soda Ash

Table 3 Special Additives and their Functions in Water-based Drilling Fluids

Sr. No.	Discharge Category	Exploration
1.	Sodium bicarbonate	Eliminate excess calcium ions due to cement contamination
2.	Sodium chloride	Minimize borehole washout in salt zone
3.	Groundnut shells, mica or cellophane	Minimise loss of drilling mud to formation
4.	Cellulose polymers or starch	Counter thick, sticky filter cake, decrease filter loss to formation
5.	Aluminium stearate	Minimize foaming
6.	Vegetable oil lubricant	Reduce torque and drag on drill string
7.	Pill of oil-based mud spotting fluid	Counter differential pressure sticking of drilling string; Pill is placed down hole opposite contact zone to free pipe