Pre-Feasibility Report

On

Drilling of CBM Exploration & Development

Wells

For

Block: Identified as Ring Fenced PSC

Area – CB-ON/3,

Mehsana, Gujarat.

Submitted by

Essar Oil and Gas Exploration and Production Limited
(EOGEPL)

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List of Abbreviations

BTC	-Buttress Thread Connection	PCP	-Progressive Cavity Pump
CBL	-Cement Bond Log	PEC	-Prior Environmental Clearance
CCL	-Casing Collar Locator	PEL	-Petroleum Exploration License
CBM	-Coal Bed Methane	PSC	-Production Sharing Contract
CTE	-Consent for Establishment	PSV	-Pressure Safety Valve
CTO	-Consent for Operate	PPG	-Part Per Gallon
CNG	-Compressed Natural Gas	PHPA	-Partially Hydrolyzed Poly Acryl amide
DTH	-Down Through Hole	PLC	-Programmable Logic Controller
EOL	-Essar Oil Limited	RN	-Raniganj coal seam nomenclature
GOI	-Government of India	SP	-Spontaneous Potential Log
HP	-High Pressure	TD	-Target Depth
JCB	-Company name that provide excavators.	VDL	-Variable Density Log
KCL	-Potassium Chloride KVA -Kilo Volt Ampere	WBPCB	-West Bengal Pollution Control Board
LP	-Low Pressure	WOC	-Wait on Cement
MoEF	-Ministry of Environment & Forests	P&A	-Plug and Abandonment

1.0 INTRODUCTION

1.1 Background

Block CB-ON/3 was awarded to Essar under the 7th Round of Exploration in 1995/96. The PSC was executed in July, 1998 and PEL awarded in Feb, 2003. As per MWP for different phases of exploration, in Phase-1, Essar acquired, 35 SKM of 3D API and drilled 3 exploratory wells. In Phase-II, Essar acquired 145 SKM of 3D API and drilled 9 wells including 4 appraisal wells. In Phase-III, Essar drilled 5 exploratory wells and one development well (ESU-4). Total of 18 wells drilled till date under MWP in the block. In first phase of the PSC, Essar carried out drilling and production testing in 3 wells based on Environmental Clearance (EC) received from MoEF Vide file No:J-11011/147/2007-IAII(I) dated 28th June 2007. The Second EC which includes drilling of 25 wells, establishing surface facility and R&D activities to establish CBM potentiality in the block under Phase – II and III was received.

Essar has made 4 nos. of oil & gas discoveries, namely, ESU, EEU, ENP and ENS in the block, out of which ESU (under joint operation with ONGC having 30% PI) is on production since June 2007. EEU, ENP and ENS on 100% Essar basis, has been put on production from September, December 2017 and January 2018 respectively. In addition to the committed work programs, as part of its endeavor to realize the full hydrocarbon potential of this block, Essar, with due MOPNG approval (letter dated 19/7/2004), carried out Coal Bed Methane (CBM) R&D work. Based on the two R&D campaigns, our assessment is that a substantial CBM resource lies in the CB-ON/3 block.

CBM resource in contingent category is estimated to be 1.27 TCF of which about 0.5 TCF is recoverable. Available data has shown the unconventional gas potential in Sobhasan coal seams in Kadi formation within the block. The Sobhasan seams are thick around Mehsana and forms the target coal reservoir. It is further found that an area of about 118.96 sq. km is prospective and used for assessment of CBM resources and its production potential.

Current scope of work

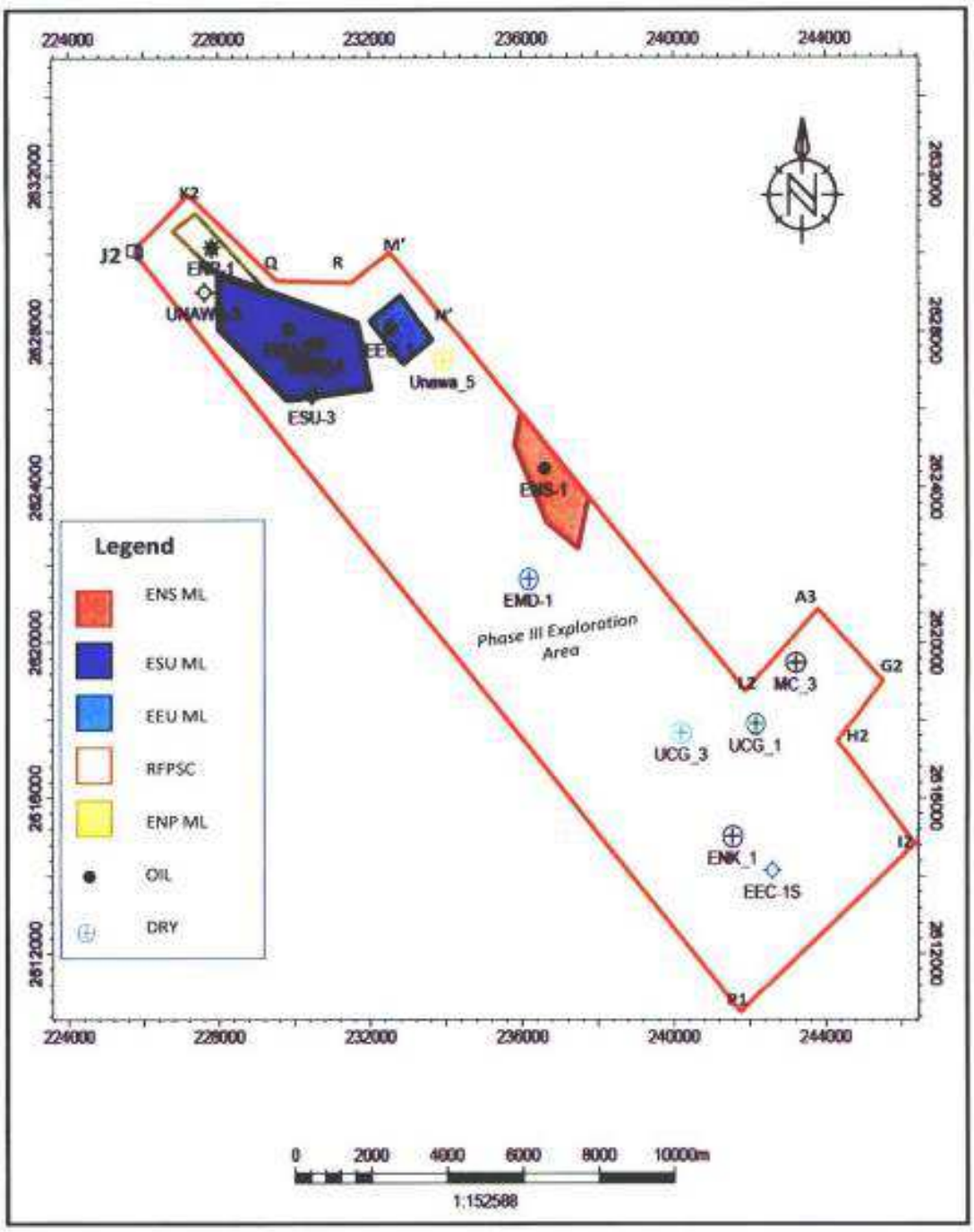
Post expiry of exploration phase, Essar requested for entering into a Ring Fenced PSC (RFPSC) for about 118.96 sq.km covering the aforesaid CBM interest area as per the Policy for Extension beyond Exploration Phase. EOGEPL wants to undertake

exploration and eventually exploitation of CBM/ unconventional hydrocarbon resources from the block. The Govt. of India has on 20th August, 2018 announced the Policy for Exploration and Exploitation of Unconventional Hydrocarbons which will allow Essar to undertake CBM extraction from the said RFPSC area.

Figure 1: Location Map of the CB-ON/3 Block Area

Figure 2: Index Map of the RFPSC Area (118.96 sq., km) showing location of ML areas

The area comprising approximately 118.96 sq km onshore, India identified as Block CB-ON/3-RF described herein and shown on the map Fig-2. Longitude and Latitude measurements commencing at points J2, K2, Q, R, M', N', L2, A3, G2, H2, I2, P1 and J2 are respectively are shown in table-1.



The latitude and longitude of the Ring Fenced PSC CB-ON/3 block area are given in Table 1

Points	Latitude	Longitude
J2	23 45 29.4238	72 18 32.6666
K2	23 46 17.1804	72 19 23.1583
Q	23 45 7.0000	72 20 47.0000
R	23 45 6.0000	72 21 57.0000
M’	23 45 31.8065	72 22 32.6894
N’	23 44 19.6191	72 23 42.5781
L2	23 39 31.8835	72 28 10.3315
A3	23 40 42.009	72 29 16.0228
G2	23 39 42.5558	72 30 18.0321
H2	23 38 51.2458	72 29 37.0664
I2	23 37 27.2870	72 30 50.7614
P1	23 35 4.04000	72 28 11.1900
J2	23 45 29.4238	72 18 32.6666

Proposed CBM Work Program

The RFPSC has provision for 18 months exploration program. EOGEPL planned to drill 2 No. 5 spot pilot wells and 1 vertical test well to assess the production potentiality which is shown in Figure 3a. Based on the result we will enter the Development Phase which consists of drilling of 450 (439 additional wells) Development wells, construction of 5 Group Gathering Stations (GGS) and 1 Main Compressor Station (MCS) & laying of inter-connecting and transportation pipeline network (4”-18”) for the purpose of CBM gas and water production, collection & transportation and sale.

Table 2:

Sr. No.	Phase-I Work Program	Quantum
A	**Exploratory and Appraisal Phase**	**18 months**
1	**Drilling of Exploration / Test wells** Two 5 spot pilot wells and 1 vertical test Wells and its completion, stimulation (hydro Fracturing or cavitations etc.), well testing, dewatering (production testing).	11 wells
2	**Site / Lab studies** Analysis of Gas content, coal grade, rank, cleat spacing from retrieved drill core samples.	50 samples
3	**Other studies** Injection/ Fall off test for carrying out permeability test and reservoir simulation study	40 tests
5	**CBM test production** Installation of in-situ pumps, separators, pipeline, measuring instruments, etc. for test gas flow.	11 wells

Sr. No.	Development Phase	Quantum
1	Development Wells drilling and completion	439
2	Gas Gathering Stations	5
3	Main Compressor Station	1
4	Interconnecting pipelines (4"-18" dia)	200 Km

1.2 Purpose of the report

As per the EIA notification dated 14th Sep 2006, any project seeking modernization or expansion should obtain Prior Environmental clearance from Ministry of Environment and Forests (MoEF), New Delhi. The proposed project activity falls under the category of **Category 'A', Schedule 1(b).**

In line with this EIA Notification, the prefeasibility report is prepared for obtaining Prior Environmental Clearance (PEC) from MoEF, GOI, New Delhi and the Consents (CTE & CTO) from Gujarat State Pollution Control Board (GSPCB). The objective of this report is to provide details on the proposed exploration and production of the CBM area and its associated environmental aspects.

It is pertinent to mention here that, Essar while fulfilling the minimum work program commitment under the PSC for the block CB-ON/3, obtained 1st EC dated 28/7/2007 for drilling 3 O&G wells and 2nd EC dated 4/2/2010 for drilling 25 wells from MoEF. As a part of requirement to obtain EC, public hearing of the project were conducted in the district of Mehsana and Patan.

EOGEPL planned to drill 11 (5 spot pilot & vertical test wells) exploration test well to assess the CBM production potentiality. Based on the result we will enter into development phase The development consists of drilling of 439 Production and Development wells, construction of 5 Group Gathering Stations (GGS) and 1 Main Compressor Station (MCS) & laying of inter-connecting and transportation pipeline network (4"-18") for the purpose of CBM gas production, collection & transportation and sale.

2.0 PROJECT DESCRIPTION

2.1 Criteria for Site Selection

The following points will be considered by Essar while selecting the drill sites.

- Area with low vegetation.
- Away from organized human habitats.
- Easy access to area of interest

In addition to the above, roads will be required in order to provide access to each operating well as well as for drilling stage. In some cases permanent access roads will have to be built so that equipment can be moved in and out of the locations initially and during later maintenance. While siting access roads following guidelines will be followed.

- Use existing roads, to prevent further soil disturbance.
- Avoid potential disturbance to water course.

- Avoid designing roads with sharp curves, blind spots and steep grades.

Rough estimate indicates that about 5 - 6 km of access roads might be required to construct for proposed test wells. Details will be obtained during survey phase.

2.2 Proposed Locations of 2 No. 5 spot Pilot and 1 vertical test wells

Table 3

Sl No	Test Wells	Latitude	Longitude
1	TW-1	23°37' 18.313" N	72°28' 18.156" E
2	TW-2	23°37' 31.801" N	72°28' 2.627" E
3	TW-3	23°37' 32.429" N	72°28' 32.404" E
4	TW-4	23°37' 4.819" N	72°28' 33.365" E
5	TW-5	23°37' 4.182" N	72°28' 3.738" E
2nd 5 Spot well			
1	TW-6	23°37' 18.313" N	72°28' 18.156" E
2	TW-7	23°37' 32.429" N	72°28' 32.404" E
3	TW-8	23°37' 31.801" N	72°28' 2.627" E
4	TW-9	23°37' 4.182" N	72°28' 3.738" E
5	TW-10	23°37' 4.819" N	72°28' 33.365" E
1 Vertical test well (Additional area)			
1	CBM-1	23°35' 13.083" N	72°30' 6.912" E

All CBM wells are proposed outside the forest land.

Each test well and pilot well plot size will be between 1.5-2 acres, exact size will be based on land availability at each location. This size will accommodate drilling rig, site office, generators, mud tanks, storage space, drilling waste pits and other rig equipment. Same site will be used for surface facility after well completion. Sites will be leveled and top soil will be stored for future site restoration. Water sprinkling will be done during site preparation to avoid dust exposure. Based on the production result of the test/pilot wells. Development wells will be decided. An indicative location of the 450 development wells is given in Figure 3b. There is a provision of about 25 sq, km expansion area to the South East of the RFPSC area which has also been included in the development map. This is as per relevant provisions in the contract allowing for such expansions based on continuity of reservoir. In addition to the above, Gas Gathering Stations (GGS) will be established for compressing gas from the wells and about 90 production wells will be connected to one GGS. Each GGS will occupy an area of about 5 acres. All GGS will be connected to Main Compressor Station (MCS) which will occupy about 8 acres of land. There will be 5 GGS and 1 Main Compressor Station and the tentative locations of GGS & MCS are marked in **Figure 3b.**

There will be pipeline of sizes ranging from 4" to 18" dia. for interconnecting wells to the respective GGS and MCS based on the gas flow rates from various wells. The gas from GGS after compressing will be tied to the pipeline networks for supplying prospective customers.

2.3 Description of 5 spot Pilot Well & Vertical test well Drilling:

2.3.1 Drilling & Completion Operations

Essar follows the international practice of drilling a CBM well. The location of Exploratory/Test wells are fixed on the basis of available Geological & Geophysical data with tentative target depth between 1200- 1500m. A rig will be deployed at the fixed site of drilling after thorough inspection for its working capability and quality standards. Well spudding is the start of drilling activity. A hole is made into the ground at the identified location. Essar as a practice, in most of the wells is drilling a hole of 12 ¼ inch (called as surface hole) followed by 8 ½ inch (called as production hole). The vertical depth of the well in the field varies from 600mts to 2000mts approx. A rig is deployed to drill the well. After the well is drilled it is taken under wire line logging to identify the different formations and coal seam zones followed by lowering of casing (a steel pipe) and it is cemented by good quality cement so that there is no communication in between the rock type and the inner-side of the casing.

Essar initially has planned to drill vertical wells to optimally exploit the field. As the advent of technology of drilling directional, horizontal and multilateral wells and due to the surface constraints, and in the direction to minimize foot prints, the concept of pad drilling proposed wherein several wells can be drilled from a single pad (well site) along with mother vertical well. In a Horizontal well, the surface hole is drilled to a target depth or formation. After reaching the target formation the well is drilled into the targeted formation. Accordingly, three categories of wells are in drilling /planned in the field. Directional well and horizontal wells will be based on the feasibility studies based on the data acquired during the course of development program.

1. **Vertical well** – In a vertical well surface hole as well as production hole is a straight well drilled into the subsurface.
2. **Directional well** – In the directional well, surface hole is drilled vertically and then the production hole is a deviated hole.

3. **Horizontal well**- In a Horizontal well, the surface hole is drilled to a target depth or formation. After reaching the target formation the well is drilled into the targeted formation.

Proposed layout of the well site is given in **Figure 4.** Schematic diagram of the test/pilot well (vertical & Horizontal) is given in **Figure 5a & 5b.** Photograph showing the typical well site used for the drilling activity is shown in **Figure 6.**

Figure 3a: Map showing Proposed Two 5 Spot and 1 vertical well Locations

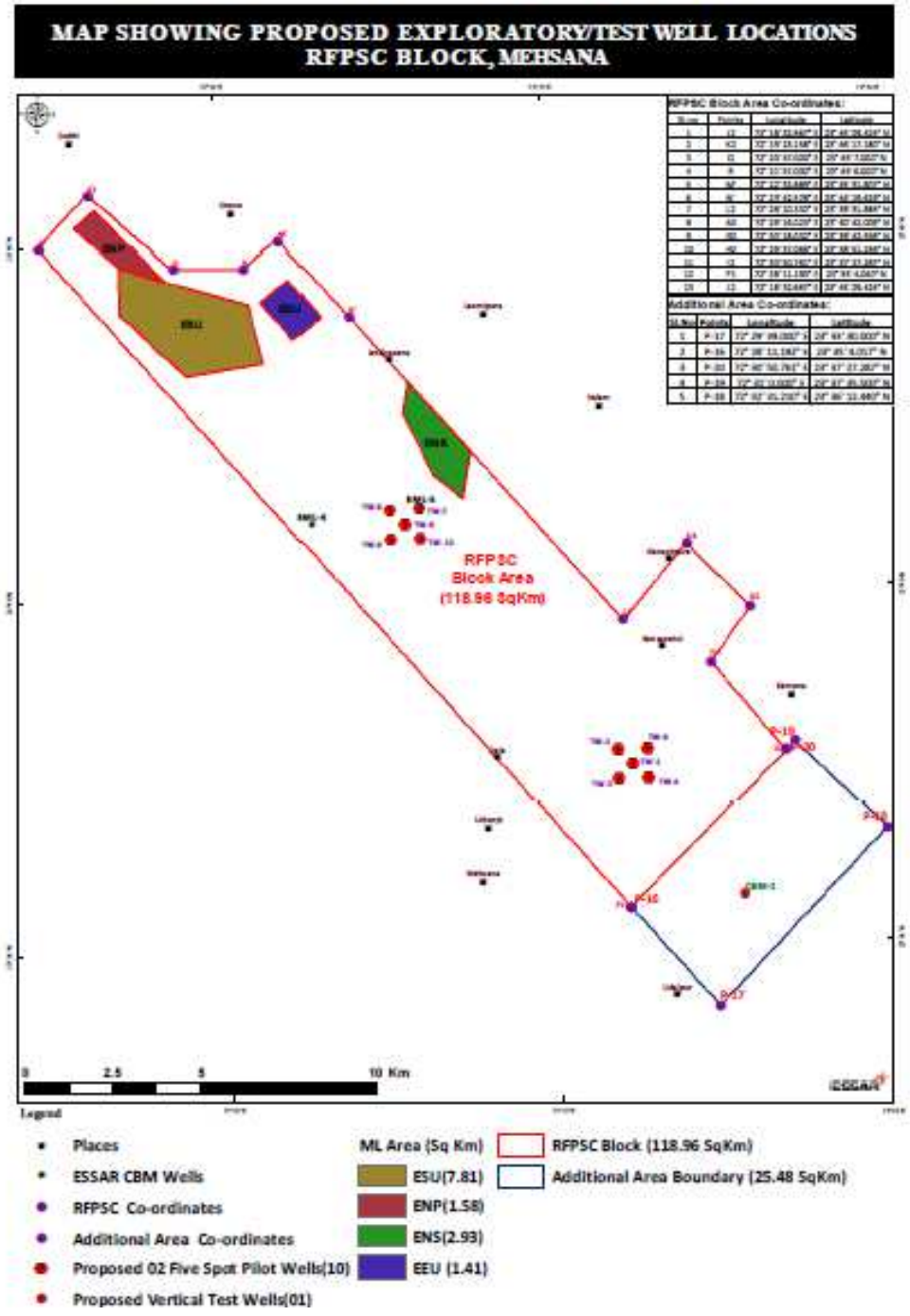


Figure 3b: Map showing proposed Development well, GGS/MCS locations

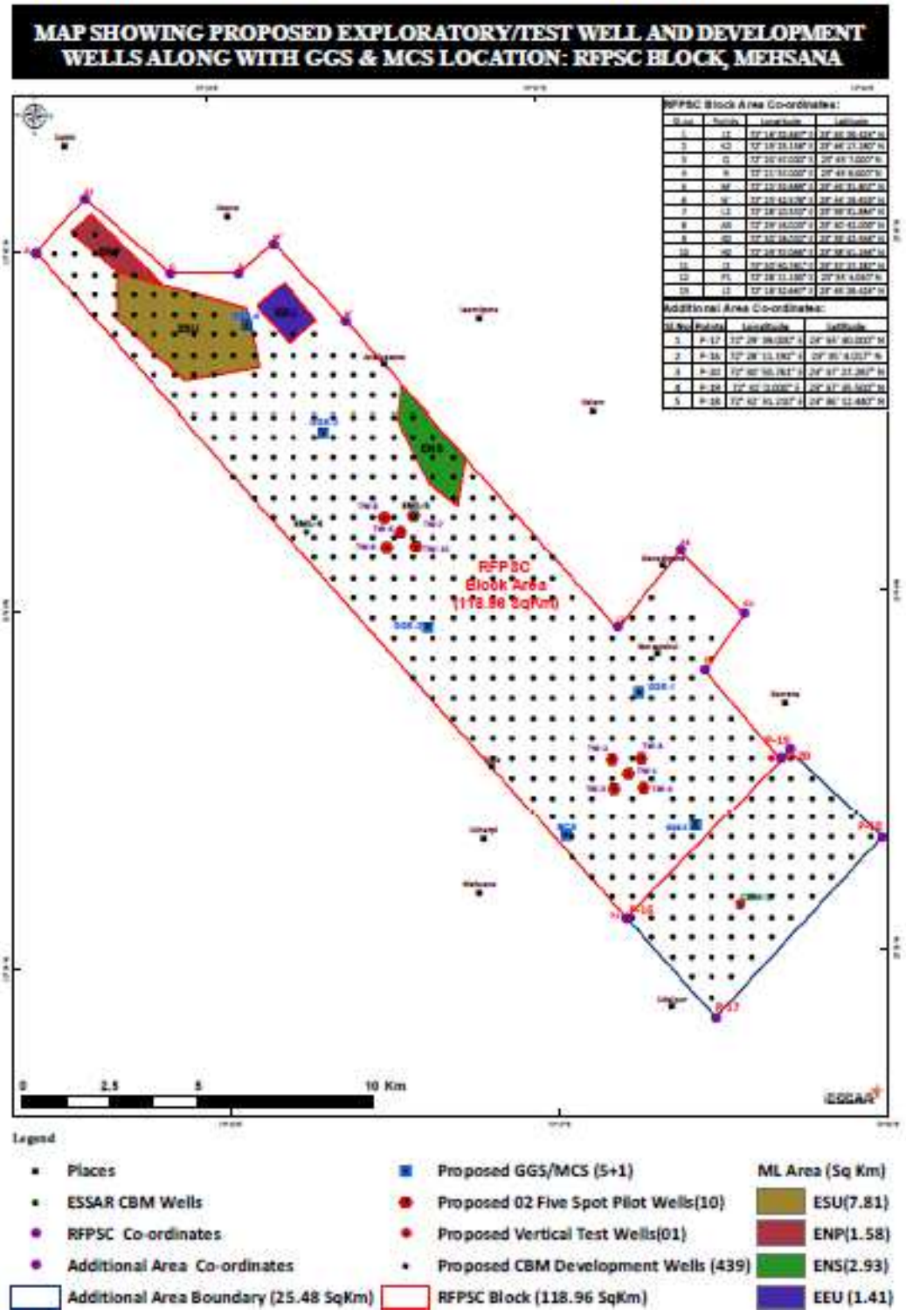


Figure 4: Proposed layout of Drill Site (Indicative)

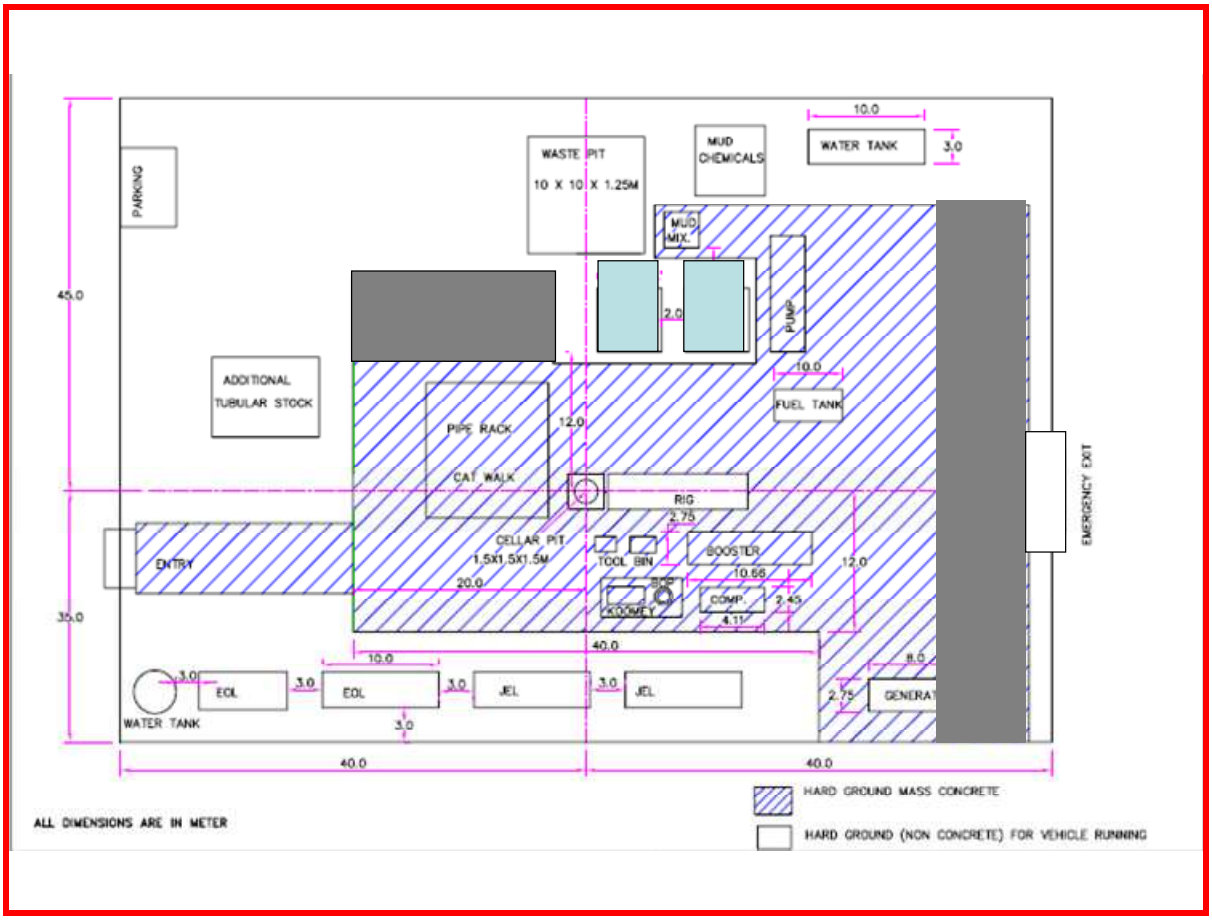


Figure 5a: Schematic Diagram of Test -Well Section (Vertical)

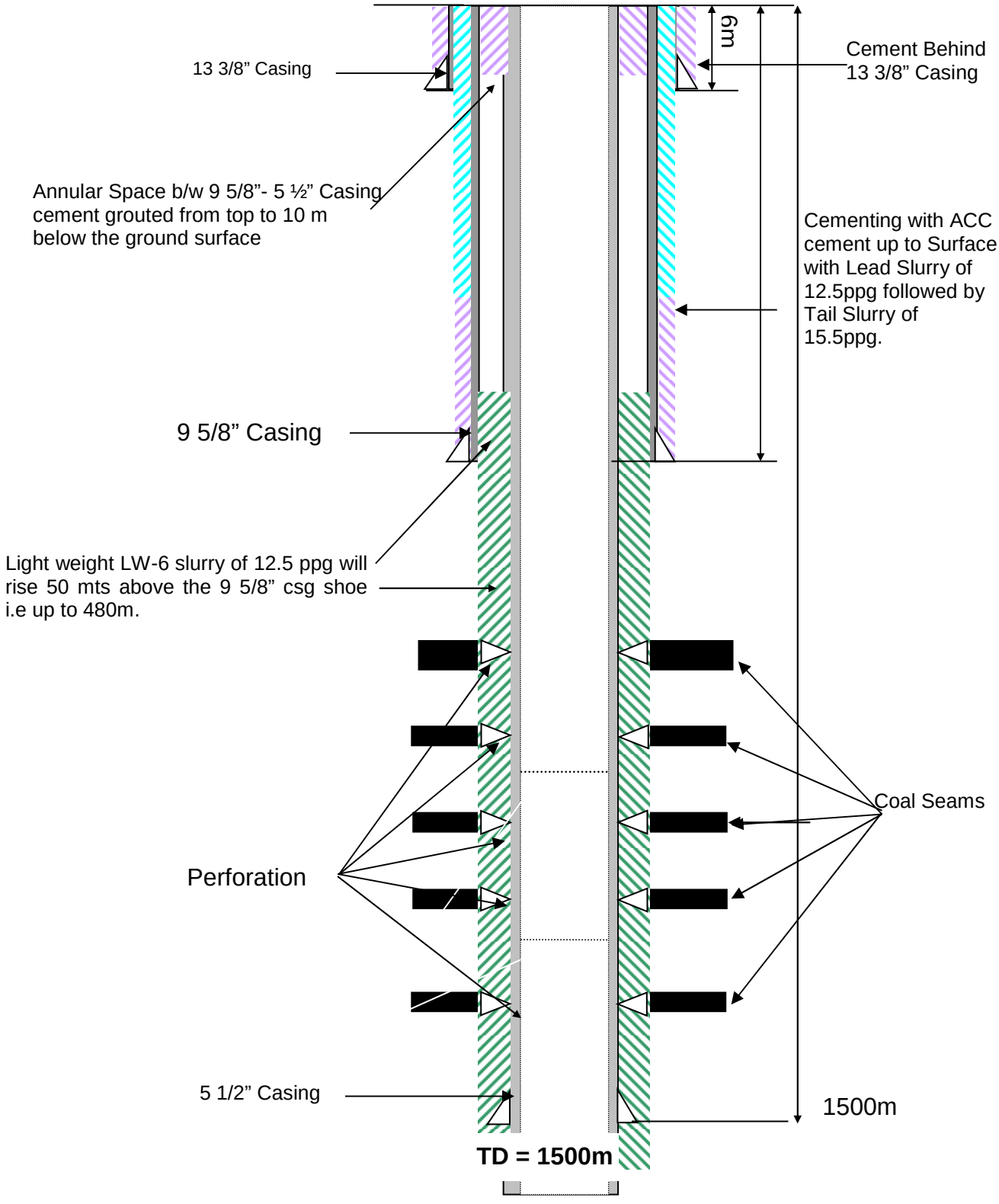


Figure 5b: Schematic Diagram Of Test -Well Section (Horizontal)

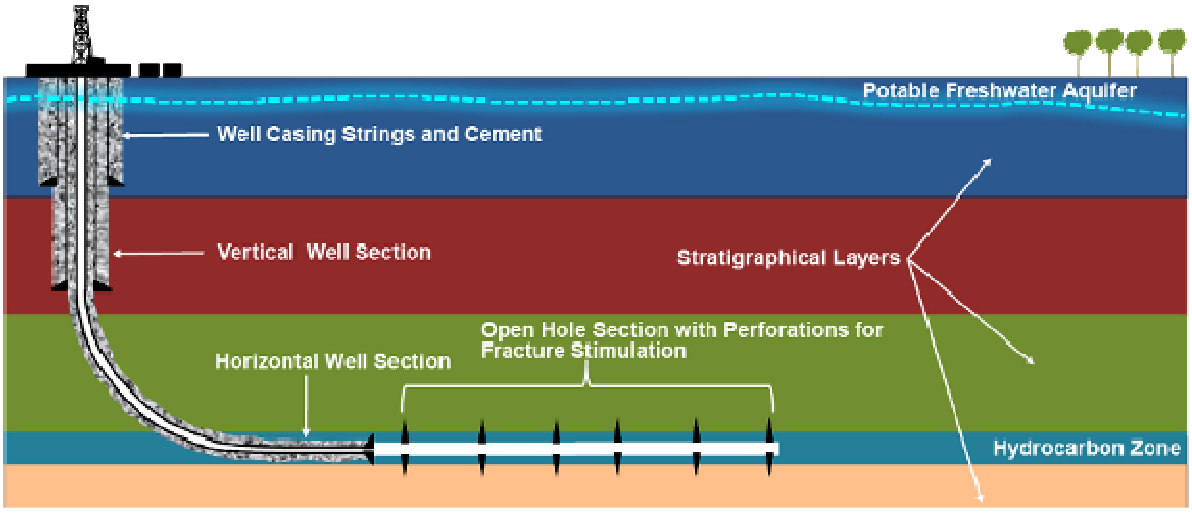


Figure 6: Photograph showing typical well site drilling activity

Drilling rigs to be deployed

Coal core sampling

Desorption studies

Wire Line Logging - Weatherford

HF unit: BJ Services

HF unit: Halliburton

Cementing unit - BJ Services

2.3.2 Well Stimulation

Hydro fracturing is the most common stimulation method for CBM wells worldwide. In this process fractures are induced by a pressurized fluid to create conduits to enhance the migration of gas along with water into the well bore. The fluids are injected into the target zones. A hydro fracturing unit is involved in carrying out the total activity.

2.3.3 Well Completion & Surface facility

After completion of hydro fracturing job in the well the next process involves is taking out the gas on the surface and transferring it to the utility places.

The gas which comes along with water is made to come, through the tubing with the help of high capacity pumps and the process is called dewatering. As soon as the gas along with the water comes on the surface it is then separated with the help of a separator. The gas and water are supplied in separate pipelines by setting up a

surface facility therein the gas lines of each wells are connected to major pipelines and finally to the utility places.

PC Pump in operation

Surface facility and gas flare

Schematic process flow diagram of the surface facility is shown in **Figure 7.**

2.3.4 Well Kick Situation

CBM reservoir is generally a low pressure reservoir. The possibilities of well kick due to high formation pressure are rare. For some reason if an unexpected over pressurized formation is encountered while drilling and if the well control situation arises, rig is equipped with equipment to control this situation.

Casing and Production Testing Details

All the wells will be drilled using rotary drilling method. The proposed rig to be used is RD-20 having pulled back capacity of 55 tonnes. The well is planned to be drilled using two casing policies- 9-5/8" and 5-1/2". The depth of the casings will depend on

the formation encountered. The Target depth of the wells is expected around 1500m. The well will be first drilled with 12-1/4" bit to a suitable depth of around 460m. Then the 9-5/8" casing will be lowered and cemented up to surface. Thereafter the well will be drilled to target depth by drilling with 8 1/2" bit up to TD (~ 1500m).

Casing Design

Details	13 3/8" casing design	9 5/8" casing design	5 1/2" casing design
Hole Size	17 1/4 "	12 1/4"	8 ½ "
Casing Size	13 3/8"	9 5/8"	5 ½"
Depth	0 – 6m	0 - 460 mts	0 - 1500 mts.

Open hole logs like Natural Gamma, Bulk Density, Pe Index , Single Arm Caliper, Neutron Porosity, SP, Micro resistivity, Medium induction resistivity, Deep induction resistivity, and Temperature logs will be recorded, following which the production casing of 5-1/2" will be lowered cemented with 100m cement rise inside the 9-5/8"casing. After this WOC, Natural Gamma ray, CBL-VDL and CCL logs will be recorded.

There are plans to retrieve some conventional cores in the Kadi coal seams which will be used for assessment of the CBM parameters. Permeability studies by way of Injection/Fall-off studies will also be carried out in the target coal seams.

The production testing will be done by perforating the target coal seams based studies of the coal seams. A specialized service company will perforate the coal seams using explosives in a safe manner. After the completion of perforation job the coal seams are hydro-fractured by injecting sand prop pant with water and gel. The well will be then tested by dewatering the coal seams through submersible\PC pumps. The production of CBM gas is there it will be taken through a test separator and reservoir studies will be performed depending on the response from the well. The well, if qualified, will be converted in to a production well or else will be abandoned using standard procedure.

2.3.5 Surface facility

After drilling, open-hole logging, casing and cementation, perforation, logging,

hydro fracturing and work-over is sequentially completed at each well. The PC pump/electrical submersible pump is lowered into the well till target depth. These pumps are installed for dewatering and to bring gas to the surface. Dewatering includes the suction of formation water from the well and routing it through separator, where water and dissolved gas are separated. Produced gas from the wells is sent to GGS for further compression.

Flare of 9 m height is provided at each well location to take care of produced gas in case of system failure and till the well is not hooked up to the GGS network.

In case of process upsets, Emergency Shut Down (ESD) valves at the inlet & outlet battery limits, shall be closed remotely from the control room. These valves shall also have provision for manual closing, as standby system. The dewatering pumps installed at well site have the provision to switch off by SCADA telemetry system from control room.

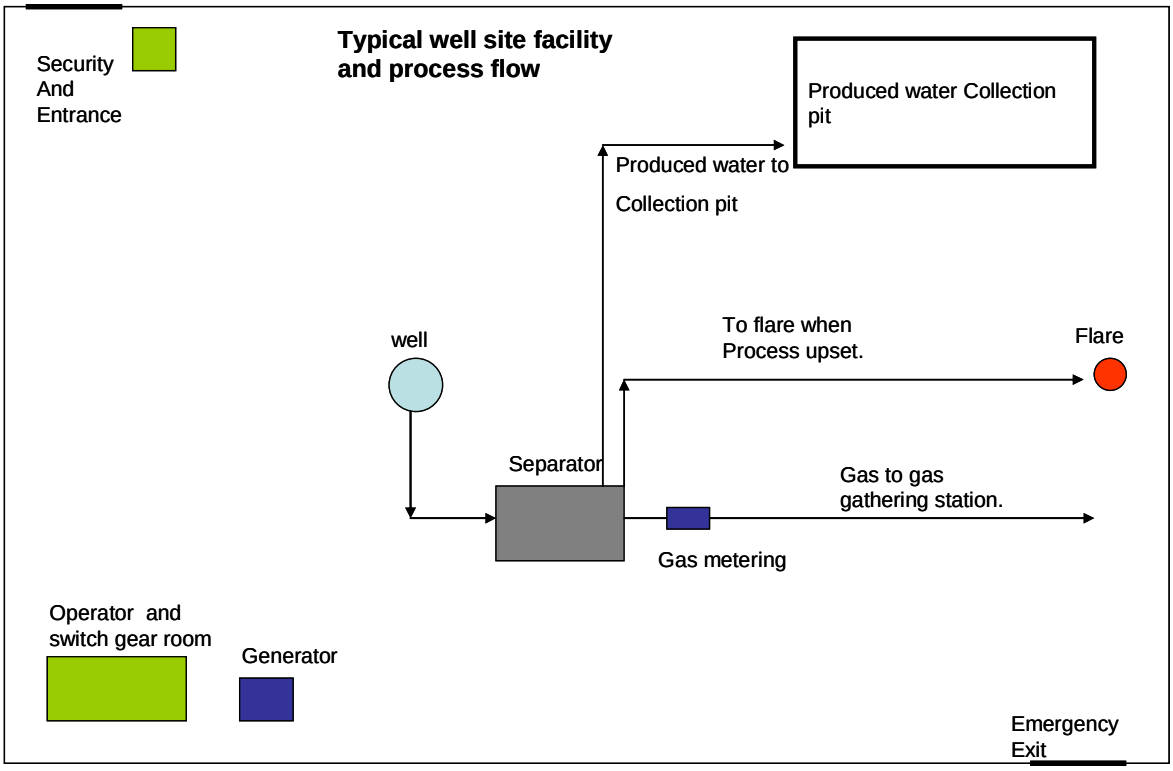


Figure 7: Schematic flow diagram of the surface facility

The gas is compressed by the compressors up to 15-20 bar pressure and is dried in

the dehydration unit before being pushing into the main line to prospective customer(s)/MCS. The compressors will be screw/reciprocating type gas engine/motor driven. Gas from the GGS collected and transported in the 16/18" header will be routed to Main Compression Station. The MCS will have turbine/engine driven centrifugal/reciprocating compressors. Gas will be compressed to about 60 bar and will be supplied to prospective customer. GGS/ MCS flare stack will be designed as per applicable standards to handle appropriate quantity of gas being flared.

2.3.6 Work over and completion

- Post frac sand cleaning: - Completion Rig is Used after fracturing for sand cleaning
- Ball and baffle milling: - Rig is used for the ball and baffle milling if ball and baffle is used for the Zone Isolation.
- Well Testing: - Work over rig is used for the Injection Fall Off test, Interference Test etc.
- Down Hole Pump Installation: - Used for lowering different Types of Down hole pumps like Barrel and Plunger Pump, Progressive cavity Pump, submerged pumps.
- Well Maintenance Job: - used for replacing the Down hole Pump.
- Fishing Operations: - As required
- Cement Repair Jobs: - work over rig is used for the Cement Squeeze job
- Well Logging:

2.3.7 Instrumentation control system envisaged for the Surface Facility

Magnetic Float Operated Level Switch is installed on the Gas & water separator. As the water level rises to the set level, dump valve will open and allows passing the water. This is On-Off type level control. Safety valve (PSV) has been provided on separator.

Measurement: A differential pressure type flow meter is provided to measure the pressure & temperature compensated gas flow. Turbine meter is provided for water flow measurement.

2.3.8 Anticipated production of CBM from well

The gas production from the wells may vary from well to well and is anticipated to be in the range of 5000 to 15000 M^3 per well.

2.3.9 Transportation of CBM from Well to GGS

There will be pipeline network of suitable sizes ranging from 4" to 18" based on the estimated gas flow rates after drilling, to hook up with GGS and subsequently to MCS. All wells will be connected to the respective GGS with suitable size pipelines. From well site CBM gas will be transported by underground pipeline from wells to the GGS at normal temperature. The gas flow will be varying based on the gas flowing from the formation. The interconnecting underground piping would be of MDPE or Carbon steel of suitable size and the pressure in the lines will be around 1-2.5 bar

2.3.10 Transport of CBM from GGS/MCS to End Users

This will be done with pipeline of 16/18" pipeline of carbon steel, which will collect the compressed gas at 15-20 bar from each GGS. Gas collected from GGS will be taken to MCS for further compression to a pressure of about 60 bars, depending upon customer requirements. Gas will be supplied to prospective customers through a 12-18" pipeline.

2.4 Instrumentation Control System at Well Site:

The instrumentation control system shall cover level & pressure control system for the separators, flow measurement system for gas & water. The SCADA system shall be installed for monitoring of wells from GGS control room.

At GGS & MCS:

- It will cover level and pressure control system for vessels.
- Fire and Gas detectors will be provided at all critical locations as per standards.
- All compressors will have its own logic based monitoring & control

system for pressure, temperature, over speed, vibrations, capacity etc.

- For gas turbine operations in MCS, start up and shutdown controls will be in place.

- Alarm annunciation facility is also provided on Field / in

Control room Panels. All the GGS and the MCS will be hooked up to SCADA system.

2.4.1 Gas Flaring

During normal operation no gas will be flared but the flaring system will comply with applicable standards. The CBM gas from the wells will be pumped into the existing in-field gas pipeline to existing GGS. If required, a temporary gas flare of 9 meter height will be erected at well site. The flare at GGS & MCS will be designed and erected as per the applicable standards.

Though the provision has been made for flaring of gas at all GGS, technical study will be carried out for the requirement of flaring. The flaring will be required only during emergency and not during normal process upset, a proposal will be put up to DGMS/OISD for vent provisions instead of flare. This is in line with CBM installations in other parts of the world like USA/Australia.

2.5 Power, water, man power requirement and its source

About 10 people will be working at the site per shift during drilling phase. The number might increase up to 20 per shift during perforation and hydro fracturing.

During drilling the DG set of capacity 125 KVA will be used and for well site surface facility 40 KVA DG sets will be installed for initial purpose. Consequently the DG sets will be replaced by gas generator sets run by using CBM gas from the well.

Average water requirement for drilling of each test and pilot well is about 75 M^3 including the water requirement for domestic purpose. Water will be procured through approved local water suppliers.

2.6 Raw Materials (For construction) Water

Average water requirement for drilling of development & production well will be about 125 m3 for complete well including the water requirement for domestic purpose. Water will be procured through approved local water suppliers and also it is proposed to use the produced water from the existing production wells which are on dewatering.

For GGS & MCS operations, about 10 M^3 / per day water will be required for domestic consumption for each of installations. Water will be procured through authorized local water suppliers and also from wells put on dewatering.

Cement, Sand & Chemicals

Raw materials used for the project are given in the table below.

Table 4: Construction Raw Materials

Raw Material	450 Wells	5 GGS	1 MCS	Total
Cement (MT)	5400	1250	850	7500
Sand (M^3)	1000	2500	1500	5000
Earth fill (M^3)	461600	37500	8500	507600

2.7 Vehicular movement expected in various project phases

For site preparation about 2 no. of JCB, 2 to 3 no. of dumper truck and road roller will be used. For drilling phase 2 no of trailers for material movement and 2 no of cranes will be used. For perforation, hydro fracturing and dewatering 3 to 4 specialized vehicles will be used. Apart from this 3 to 4 light vehicles will be used for staff movement.

2.8 Land Acquisition Methodology

From private owners land will be either purchased or taken on leased basis. Leased land will be mainly for shorter term. The land will be procured on case by case.

In case of forest land, required departments will be contacted and proper permission/ agreement will be in place. Applicable legislative requirements will be complied with during land occupation.

2.9 Base camp

The staff and workers will be provided accommodation in camps or nearest town.**3.0**

3.0 ENVIRONMENTAL ASPECTS

3.1 Flaring of gas quantity and its composition

The gas will be predominantly methane with minor concentration of CO_2 and N_2. There will not be continuous gas flaring but flaring will take place during dewatering process. Gas flow can be stopped by stopping the pump. Fugitive emissions will be controlled by proper design and regular maintenance.

3.2 Air pollution control measures

The stacks of the DG sets will be designed as per the guidelines of Central Pollution Control Board, based on the rating of DG sets in KVA, with a minimum height of 9m. As soon as possible, all DG sets will be replaced by gas generators which will use gas from the well.

3.3 Water pollution control measures

Initially the formation water quantity may be high and will vary from well to well. Once established, about 5 to 10 $M^{3/}$ day formation water will be produced. Formation water will be collected in a pit with proposed dimensions of 20 m X 25 m X 1.5m. The pit will be covered by HDPE liner. Based on quality of the surrounding water treatment will be carried out. Normally the formation water is suitable for agriculture purpose. However, water may be released into the nearby nallah or water way after meeting the MoEF & SPCB discharge standards. Other suitable methods of disposal of water will also be considered based on site conditions and infrastructure availability.

3.4 Noise pollution control measures

- All the high generating machinery (rotary machines, pumps etc.) will be installed with acoustics /enclosures;
- Diesel generator to be provided with enclosure as per the requirement under EPA Rules;
- Vibration isolators will be provided to reduce vibration and noise in all process equipment;
- All personnel at the site will be provided with PPE's such as earmuffs, earplugs etc;

3.5 Solid waste generation and its treatment:

It is estimated that about 150 tones of solid waste may be generated at the end of each well drilling (1500m depth well) the well. This will be collected in the drilling waste pit which will be lined with HDPE and allowed to dry. Drilling Waste is mainly of drilled formation (sandstone, shale, coal etc.) and since air drilling is used it will be non hazardous in nature.

Apart from this very small amount of domestic and industrial solid waste will be generated. This will be disposed through local contractors at approved municipal sites.

4.0 PROJECT COST

PROJECT SCHEDULE AND PROJECT COST

Table 5: Project Cost

Sr. No.	Operation/ Activity	Quantum of Job	Total Cost (In Rs. Crores.)
1	CBM Exploratory cum appraisal Test well drilling	2 No. 5 spot pilot wells and 1 vertical wells	77

(450 wells and evacuation network)

Operation/ Activity	Quantum Of Job	Unit Cost (Rs. In Crores)	Total Cost (Rs. Crores)
Development well drilling & surface facility	439	5.6	2459
Gas Gathering Station	5	45	225
Main Compressor Station	1	224	224
Water treatment	1	100	100
Cost of project activities			3008
Project establishment & overhead cost (10% of Project Cost)			300
Total cost of the project			3308

The financial resources for Environmental Management and Corporate Social Responsibility would be to the tune of 1% and 0.1% of total project cost, respectively.

The total project cost would be 77 crores for Exploration Phases.

The financial resources for environmental management and corporate social responsibility would be to the tune of 2% of total project cost.

5.0 CONCLUSION.

India is one of the strongest growing nations in terms of economy. Primary fossil fuels have been and will continue to one of the leading contributor to the economic growth. India is also a net hydrocarbon deficit country with a hefty import bill. Hence, at this stage, it is critical to produce unconventional gas. CBM by its inherent nature is the cleanest form of energy with a huge growth market. CBM is also reality in India now with Essar's Raniganj CBM block in West Bengal and a few others producing, thereby a learning curve is in place.

The learning from CBM so far will be extraction and production of Coalbed Methane Gas from the coal seams will otherwise help exploit these unexploited and idling resources. This will help in meaningfully contribute in our hydrocarbon independency drive.

The use of CBM is also of great environment significance due to its clean nature as a fuel. Further, the use of the CBM gas will be an alternate source of Fuel Energy in form of- CNG in automobiles, replacement of furnace oil, Electricity generation, as a feed stock in for preparation of ammonia for the fertilizer plants. Thus, there is considerable market potential for Coal Bed Methane gas in energy deficient country like India and in view of this, it is recommended to implement the project at a fast track.