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# BHARAT COKING COAL LIMITED

**(A Subsidiary of Coal India Limited)**

# FEASIBILITY REPORT

## ON

# MOONIDIH COAL BED METHANE PROJECT

# (DEMONSTRATION PROJECT)

# (Part of Cluster XI)

**Capacity - 15000 $m^3$/day**

**Lease Hold Area : within the LH of Moonidih Mine of area 2063.45 Ha**

(Part of Cluster –XI Mines for which EC has already been granted
Vide letter no. J-11015/77/2011-IA.II (M) Dated: 26th August, 2013)

**(March, 2015)**

Prepared by

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# CONTENTS



## List of Plates

# Abbreviations

| | |
|---|---|
| AMM | Abandoned Mine Methane |
| AIDS | Acquired Immune Deficiency Syndrome |
| BCCL | Bharat Coking Coal Limited |
| BGL | Below Ground Level |
| CBM | Coal bed Methane |
| CIL | Coal India Limited |
| CIMFR | Central Institute of Mining and Fuel Research |
| CMM | Coal Mine Methane |
| DDT | Dichlorodiphenyltrichloroethane |
| daf | Dry ash free |
| dmmf | Dry mineral matter free |
| E.P. Fitter | Excavation Project Fitter |
| FCC | False Colour Composite |
| FLP | Flame Proof |
| GEF | Global Environmental Facility |
| GHG | Green House Gas |
| GoI | Govt. of India |
| GT Road | Grand Trunk Road |
| Kw | Kilowatt |
| MoC | Ministry of Coal |
| mD | Milli Darcy |
| NH | National Highway |
| NM | Newton-metre |
| ONGC | Oil and Natural Gas Commission |
| PCP | Progressive Cavity Pump |
| SRP | Succor Rod Pump |
| S&T | Science and Technology |
| TVD | True Vertical Depth |
| UNDP | United Nations Development Program |

# CBM Demonstration Project at Moonidih

## 1.0 Introduction

### General

Coal is globally the most reliable primary energy resource and its use is crucial to the economics of developing countries. The reserve of coal in India is far more abundant than oil and gas reserves and therefore coal provides a much needed energy security to the country.

Methane contained in coal seams, formed during coalification process, is known as Coalbed Methane. Its composition and commercial potential is almost similar to that of Natural gas and therefore has significant commercial value. Methane in coal seams has been safety hazard for coal mining operations on account of its explosive behaviour when its concentration is between 5 to 15 % and arrangements of proper ventilation are made in the underground mines to make it safe. Coal Mine Methane (CMM) and Abandoned Mine Methane (AMM) are sub-sets of Coalbed Methane, while CMM is methane produced before mining from active and would be mining areas; AMM is recovery of methane from abandoned mines.

Development of methane resources has attracted attention in the recent years as an alternate clean energy source in many parts of the world.

Efforts are now being made worldwide to control the emission of greenhouse gases and thereby reduce the pressures for accelerated climate change. Methane is a powerful greenhouse gas, as its adverse impacts are felt more intensely due to its shorter residence time and higher potency in the atmosphere than carbon dioxide. However methane is a remarkable clean fuel when burnt, and its combustion produces no $SO_2$ or particulates and only about half of the $CO_2$ associated with coal combustion.

Reduction of methane emissions by utilizing it as an energy resource will yield a significant short term climate benefits. The post Kyoto protocol scenario and environmental concern has focused attention on increasing the share of utilization of non-conventional energy resource. Harnessing and utilization of CBM is, therefore, globally an emerging important environment friendly, non-conventional, alternate clean energy resource.

### Background

This project "Coalbed Methane Recovery & Commercial Utilization" was jointly funded by the Global Environmental Facility (GEF), United Nations Development Program (UNDP) and The Government of India S&T. The project was perceived in 1996 and project document was prepared by an International Consultant hired by UNDP. The project was

granted ₹92.427 crores with completion schedule in Dec 07, which was further extended to Dec 09.

Under R&D efforts, a demonstration project on "Coalbed Methane Recovery & Commercial Utilization" has been successfully implemented at Moonidih coal mine of BCCL in Jharia Coalfield. The project has acquired suitable infrastructure like heavy duty high-tech drilling rig unit and other equipment required for taking up CBM related large diameter deep drilling. Three wells have been successfully drilled and methane gas embedded in coal seams have been successfully recovered through vertical wells on surface and the recovered gas is being used as fuel in gas-based generators for electricity generation since 27th June, 2008. Total 10,62,948 kwh of electricity has been generated and 5,53,042 kwh has been generated during 2009-10, the generated electricity is being supplied for domestic use in Moonidih project colony.

This research project was undertaken by Central Mine Planning & Design Institute Ltd., (CMPDI) in association with Bharat Coking Coal Limited, (BCCL) in September, 1999. This was a multi funded project totaling ₹92.427 Crores out of which ₹18.058 Crore was the S&T grant of Ministry of Coal (MoC).Since the objective of the CBM project was to demonstrate the production and utilization technique, which has been fulfilled, the project has been formally financially closed on 30th June, 2010 and project equipments have been transferred to BCCL on 13th August, 2010 for continuing activities.
and all Project equipments have been handed over to BCCL.

**Project Justification**

- Recovery of the CBM provides a clean source of energy which is much more environmental friendly as compared to burning of coal.
- The CBM, a highly potent GH gas, if not recovered in advance of coal mining would otherwise be released to the atmosphere with the mine ventilation air, contributing to global warming.
- The extraction of CBM from coal seams in advance of mining will provide a much-reduced incident of Methane and would create much safer conditions in mine working for mine workers, when the area is subsequently mined in future.
- The extraction of CBM will reduce lot of ventilation cost as well as electrical installation.
- The project has brought to the country state of art technology for planning and execution of such projects in Indian conditions. It is expected that this project will be a front runner in generating useful data on CBM recovery and utilization besides imparting experience and confidence in private and public investor in India.

**Scope of work**

Scope of Work is limited to the demonstration project "Coalbed Methane Recovery & Commercial Utilization" jointly funded by the Global Environmental Facility (GEF), United Nations Development Program (UNDP) and The Government of India S&T and undertaken by Central Mine Planning & Design Institute Ltd. (CMPDI) in association with Bharat Coking Coal Limited, (BCCL) in September, 1999.

## 2.0 Identified CBM Demonstration Project at Moonidih

### 2.1 Area & Location

The CBM Demonstration Project at Moonidih lies within the leasehold of Moonidih mine with leasehold of 2063.45 Ha. It is located in the central part of the Jharia Coalfield of Dhanbad District of Jharkhand State (India) and is included in the Survey of India Toposheet Nos. 73 I/5 & I/6 (R.F 1:50,000). The area is also covered in Sheet Nos. 4 (R.F 1:15,840) of the Geological Map of Jharia Coalfield published by Geological Survey of India. Geographically it is bounded as detailed below :

| | | |
|---|---|---|
| Leasehold | : | Moonidih Leasehold |
| North & northeast | : | Pootkee-Bulliary Project |
| East & southeast | : | Fault F3-F3 (XV Seam Position) & Lease hold area of Moonidih/CBM demonstration Project/ TISCO Mines |
| South | : | Lease hold area of Moonidih/CBM demonstration Project |
| Southwest | : | Singra/CIL-ONGC CBM Block |
| North & Northwest | : | Jarian Nalla & Kapuria U/G block |
| Latitude | : | 23° 43'12" N - 23° 45'58" N |
| Longitude | : | 86° 19'23" E - 86° 22'04" E |

### 2.2 COMMUNICATION

The area is well connected by road and rail. The Dhanbad –Chas section of the NH-32 passes through the north-western part of the Leasehold. The Dhanbad which is the main township of the Jharia Coalfield is about 7 kms. north-east of the Leasehold and is

connected by NH-32, Grand Trunk Road (GT Road), NH-2 can be approached by a metalled road at Govindpur which is around 16 kms from the Leasehold. A number of fair weather roads also pass through the Leasehold. Dhanbad Railway station on the Grand Chord line of the East-Central Railway is well connected with a number of major cities. A railway siding passing through the central part connects it with Bhojudih-Chandrapura railway line (S.E Railway) near Mohuda railway station.

## 2.3 Topography

The area is represented by gently undulating topography and the general slope is towards south and west. The maximum elevation observed in the area is about 202m in the northern part whereas the minimum elevation is about 163m in the southern part of the area.

## 2.4 Drainage

Southerly flowing Jarian nala also known as BansJore nala in the northern part of the Jharia coalfield forms the north- western boundary of the Leasehold. This joins to southerly flowing Katri nadi in the southwest of the Leasehold which joins Damodar River at further south-west of the Leasehold. The Easterly flowing Damodar River traverses along the entire length of the Jharia coalfield and provides the main drainage channel in the region.

## 2.5 Climate and Vegetation

The coalfield lies in the sub humid belt of Jharkhand, and the climate is extreme in this region. The maximum temperature during summer (April to middle of June) rises up to $46^0$C to $48^0$C while during winter (December to January) the mercury often drops to $5^0$C to $7^0$C. The eastern monsoon usually breaks out during the second fortnight of June with maximum precipitation in the months of June to September. The average annual rainfall in the area varies from 1197 to 1380 mm.

The area is fairly vegetated with shrubs of Lentana and at places Dhotras. Trees like Mahua, Palas, Bair,Pipal, Shishu, Karanj, Mango and Banyan are common, most abundant being Palas.

## 2.6 Forest

Based on the details given in Survey of India Toposheets and also from the details available with the BCCL, there is forest land in the south-east corner of the delineated Leasehold.

## 2.7 Geology of the Moonidih Leasehold

The Moonidih Leasehold located in the central part of the Jharia coalfield is completely covered by the rocks of the Barren Measure Formation (Middle Permian), overlying Barakar Formation (Lower Permian). The thickness of the Barren Measures towards the north is less and its thickness increases towards the southern part of the Leasehold.

The generalised stratigraphic sequence of rock formations in Moonidih Leasehold as established by Geological mapping and data of sub-surface drilling & mining is as given in table-1

**Table-1**
**Generalized stratigraphic sequence in Moonidih Mine, Jharia coalfield**

| Age | Formation | Th. (m) | Lithology |
|---|---|---|---|
| Recent/ Sub-recent | - | 12m | Sandy soil/ Alluvium |
| ^^^^^^^^^^^^^^^^^^^^^^^^^^^^Unconformity^^^^^^^^^^^^^^^^^^^^^^^^^^^^ | | | |
| Post Gondwana | Igneous Intrusives | - | Dykes and sills of dolerite & Mica – peridotite. |
| ---------- Time Laps---------- | | | |
| Middle Permian | Barren Measures | 451 m | Massive sandstone with ferruginous bands, shale, intercalated shale & and stone and carbonaceous shale and sometimes uneconomical coal seams. |
| Lower Permian | Barakar | 1250 m | Pebbly sandstone, medium to fine grained sandstone, shale, intercalated shale & sandstone, |

| Age | Formation | Th. (m) | Lithology |
|---|---|---|---|
| | | | carbonaceous shale and contains all the 18 correlatable coal horizons. |
| Upper Carboniferous | *Talchir | - | Coarse grained greenish sandstone, splintery shales etc. |
| ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^Unconformity^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^ | | | |
| Archean | Metamorphics | - | Granite Gneisses and schists. |

**( * Talchir Formation has not been intersected in any of the boreholes in Moonidih colliery)**

### 2.7.1 Structure of Coal Seams in Moonidih Mine Leasehold

The Moonidih Mine occupies the central part of the Jharia coalfield and is covered by the rocks of Barren measure Formation. There is paucity of good rock exposures; as such the structure is mostly deciphered on the basis of the sub-surface data obtained from boreholes as well as mine workings.

The general strike of the Formations is found to be NW-SE in the major part of the area at west of the fault F2-F2, swinging to NE-SW in the south-eastern part of the Leasehold. An anticlinal fold axis is interpreted to run along NNW-SSE. The amount of dip of beds generally varies from $10^0$ to $15^0$ South-westerly in major part of the area lying west of fault F2-F2 and southerly to south-easterly in areas lying east of fault F2-F2

Based on available borehole data and colliery workings 14 Nos. of faults (dip generally 60 degree) have been interpreted to have affected the seams under consideration in Moonidih Mine leasehold. In addition to these faults many minor faults have been encountered during developments of overlying worked seams viz. seams XVIII, XVII-Top, XVII-Bottom & XVI.

Interpretation and the directional analysis of lineaments in and around Moonidih area based on FCC imagery shows development of three prominent directions i.e. NNW-SSE ($345^O$-$165^O$), E-W ($100^O$- $280^O$) and NE – SW. This shows that the rocks in the area under study have undergone at least three stages of major tectonic events. The spatial trend of faults development in the area also corresponds to the directional trend of Lineaments. The

lineament analysis shows that the major forces operated in this part of Jharia Coalfield were in the NW-SE, N-S and ENE-WSW directions, which were responsible for the generation of above three sets of lineaments.

### 2.7.2 Coal Seams

Although up to 51 coal seams including splits and local seams/coal bands occur in the Barakar Formation of block, however, 18 of them are persistent and correlatable Based on sub-surface data generalized sequence of 18 persistent and a few correlatable seams, its thickness and parting range are as given in table-2:

**Table-2**
**Generalized Coal Seam Sequence, Thickness and Parting range of Correlatable Seams in Moonidih Mine, Jharia Coalfield**

| Coal Seams & Parting | Thickness Range (m) | |
|---|---|---|
| | Minimum | Maximum |
| XVIII | 1.25 | 6.10 |
| P | 32 | 60 |
| XVII Top | | UP TO 2.65 |
| P | 14 | 40 |
| XVII Bot. | 0.25 | 2.05 |
| P (XVII Bot. to XVI-Top/ Comb.) | 96 | 125 |
| XVI Comb. | 4.15 | 6.31 |
| XVI Top | 1.52 | 8.53 |
| P | | UP TO 28 |
| XVI Bot. | 0.58 | 4.40 |
| P (XVI Bot./Comb. to XV-Top/Comb.) | 87 | 128 |
| XV Comb. | 5.99 | 9.25 |
| XV Top. | 1.53 | 4.18 |
| P | | Up to 12 |
| XV Bot. | 1.93 | 5.92 |
| P | 37 | 73 |
| XIV | 4.25 | 12.04 |

| Coal Seams & Parting | Thickness Range (m) | |
|---|---|---|
| | Minimum | Maximum |
| P | 3 | 18 |
| XIII | 1.90 | 8.69 |
| P | 10 | 25 |
| XII | 3.43 | 5.59 |
| P | 6 | 24 |
| XI | 1.59 | 6.19 |
| P | 18 | 60 |
| X | 2.44 | 4.41 |
| P | 2 | 68 |
| IX | 2.51 | 4.12 |
| P | 62 | 69 |
| VIII C | 2.56 | 2.71 |
| P | 4 | 5 |
| VIII B | 1.85 | 2.64 |
| P | 8 | 10 |
| VIII A | 0.71 | 1.52 |
| P (FROM VIII A) | 18 | 55 |
| P (FROM IX) | 58 | 105 |
| VIII | 4.75 | 8.21 |
| P | 8* | 26* |
| V/VI/VII | 32.91* | 37.56* |
| P | 2* | 8* |
| IV | 5.66* | 10.62* |
| P | 9* | 51* |
| III | 5.76* | 11.82* |
| P | 9* | 31* |
| II | 1.65* | 7.38* |
| P | 15* | 20* |
| I | 7.63* | 10.67* |

* Data considered from adjacent block.

### 2.7.3 Temperature Gradient in Moonidih Sub-Basin

The temperature gradient study of sub-surface formation carried out so far in the Jharia coal field mostly for Barren measures and Barakar formation, the minimum and maximum temperature gradient is expected to vary from 2-3$^0$ C per 100m increase of depth.

### 2.7.4 Hydrogeology

In Jharia coal field drainage pattern is controlled by easterly flowing Damodar River which traverses along the entire length of coalfield from west to east. Moonidih Mine leasehold is located in the central part of the coalfield on northern limb of synclinal axis. All geological formation dip southerly to southwesterly. Water table map of Jharia coalfield shows movement of underground water from north to south. Based on available mine data, hydrogeological data, and geological structure in Moonidih Mine leasehold secondary enrichment of coal bed methane cannot be ruled out unless confirmed by isotopic study of carbon.

The Moonidih area is covered by alluvium which is the product of Barren measure rocks. The ground water occurs under water table and as confined to semi-confined conditions. The water table aquifers are limited to weathered and partially weathered sandstones and exist up to a depth of 10-20m below ground level from the surface. Five zones were identified for testing of hydraulic properties of borehole No.MNH-1, located in Moonidih area, drilled up to a depth of 544.85m.In this borehole coal seams from XVIII to XV-Top were encountered. The results of tests are as given in table-3 :

**Table-3**
**Summarized Aquifer Parameter from borehole No.MNH-1**

**Moonidih colliery, Jharia coalfield**

| Zone | Depth range (m.bgl) | Thickness (m) | Pizeometric Head in m.bgl | Transmissivity (T) $m^2$/day | Permeability (K) m/day |
|---|---|---|---|---|---|
| I | 290-296 | 10 | 271.28 | 0.036 | 0.0036 |

| Zone | Depth range (m.bgl) | Thickness (m) | Pizeometric Head in m.bgl | Transmissivity (T) $m^2$/day | Permeability (K) m/day |
|---|---|---|---|---|---|
| II | 337-345 | 8 | 290.40 | 0.057 | 0.007 |
| III | 391-399 | 8 | 265.62 | 0.016 | 0.002 |
| IV | 414-433 | 19 | 230.75 | 0.026 | 0.0014 |
| V | 433-460 | 23 | 199.24 | 0.029 | 0.0012 |

(m.bgl)- Meter below ground level

### 2.7.5 Dewatering from Moonidih Mine

Presently mine water from all the worked out seams are collected in main sump in XV seam and 1037850 gallon of water is pumped out daily from the sump.

## 3.0 CBM area and selection of seams

Keeping in view the fact that upper seams have been worked out in majority of the area, the virgin seams lying below the worked out seams viz. seams XV and below (up to Seam-II) in an area of about 13 sq.km, have been considered as target seams for CBM development. The maximum depth of the bottommost Seam-II is projected at about 1225m. The average cumulative thickness of these targeted seams (XV and below) is about 80m.

### 3.1 Details of Coal Seams

Details of coal seams encountered during the UNDP demonstration project for CBM production in the three vertical wells are given in table-4 :

**Table-4**

| Seam | 1st well (CBM 4) | | 2nd Well (CBM 10) | | 3rd Well (CBM 3) | |
|---|---|---|---|---|---|---|
| | Roof Depth (m) | Thickness (m) | Roof Depth (m) | Thickness (m) | Roof Depth (m) | Thickness (m) |
| XVIII | 538.90 | 4.6 (J+MP) | 532.80 | 3.5 (J+MP+C+J) | 468.41 | 3.52 (J+MP) |
| XVII Top | **594.40** | ***1.80 (C)*** | **588.30** | ***2.10 (C+J+M+C)*** | 523.23 | 1.84 (C) |
| XVII Bot | 632.65 | 1.10(SC) | 612.05 | 1.55 | 552.57 | 1.34 |

| Seam | 1st well (CBM 4) | | 2nd Well (CBM 10) | | 3rd Well (CBM 3) | |
|---|---|---|---|---|---|---|
| | Roof Depth (m) | Thickness (m) | Roof Depth (m) | Thickness (m) | Roof Depth (m) | Thickness (m) |
| XVI Top | **733.77** | ***5.12 (C+J)*** | 725.50 | 6.1(J) | 666.37 | 6.14(J+MP) |
| XVI Bot | 747.10 | 0.90 | 740.20 | 1.40 | 681.49 | 0.98 (L5) |
| XV Top | **879.70** | ***4.0 (C)*** | **867.70** | ***4.2 (C)*** | **802.69** | ***3.88 (C)*** |
| XV Bot | **884.70** | ***5.45 (C)*** | **872.60** | ***5.05 (C)*** | **807.71** | ***4.87 (C)*** |
| XIV | 951.40 | 10.45 (J+MP) | 951.00 | 8.10 (J) | 878.69 | 14.46 (J+MP) |
| XIII | 965.85 | 12.80 (J+MP) | 963.35 | 13.55 (J+MP) | 897.73 | 8.48 (J+MP) |
| XII | | | **1016.25** | ***5.75 (C )*** | **940.21** | ***5.50 (C )*** |
| XI | | | 1036.15 | 9.80 (J+MP) | 957.01 | 9.32 (J+MP) |
| X | | | | | **1006.03** | ***7.62 (C )*** |
| Closing Depth | | 1059.30 | | 1071.30m | | 1108.40m |

**Note: Seams indicated with bold letters and italics have been subjected to hydro-fracturing**

## 3.2 Reserve

As per available desorption studies from the demonstration project wells and surrounding boreholes, the in-situ gas content of the considered seams (XV to II) varies from 2-16 m3/ton (on daf basis).

The Gas-in Place resource of the considered seams (seams XV to II) within the identified CBM block has been estimated based on traditional resource equation taking into consideration coal reserves vis-à-vis the average available gas content in the area. The seam wise prognosticated Gas-in-Place resource within the identified Moonidih CBM block has been estimated which comes to about 7970.47 million cubic meters. Seam wise net prognosticated Gas-in-Place (GIP) of the considered coal seams in Moonidih CBM block in table-5 :

**Table-5**

**Seam wise net prognosticated CBM resource of the considered coal seams in Moonidih CBM block, Jharia CF.**

| Seams | Coal Resource In million tones | Average in-situ gas content of the seam ($m^3$/te of coal) | Prognosticated CBM Resource In million cubic meter |
|---|---|---|---|
| **XV-Top** | 44.39 | 6 | 266 |
| **XV-Bot** | 57.03 | 2.5 | 143 |
| **XV-Comb** | 19.96 | 6 | 120 |
| **XIII** | 25.07 | 5.6 | 140 |
| **XII** | 36.48 | 5.6 | 204 |
| **XI** | 40.18 | 5.6 | 225 |
| **X** | 58.82 | 5.5 | 324 |
| **IX** | 58.94 | 5.6 | 330 |
| **VIII** | 82.3 | 5.6 | 461 |
| **V/VI/VII-Comb.** | 402.41 | 8.9 | 3581 |
| **IV** | 134.14 | 8 | 1073 |
| **III** | 67.07 | 8 | 537 |
| **II** | 50.3 | 8 | 402 |
| **Grand Total** | **1077.09** | | **7806 Say 7.8 BCM** |

## 3.3 Chemical Characteristics of Coal Seams

Results of ultimate analysis carried out by CBM Cell, CMPDI on coal samples of considered coal seams collected from Moonidih colliery and adjacent working mines of Jharia coalfield are given in table-6. It is evident from the results that coal seams in Moonidih CBM block are highly mature having C% and H% ranging from 88.30-92.80% and 4.10-5.27% on dmmf basis .

**Table-6**

**Result of ultimate analysis on coal samples of considered seams (Seam XV Top to II) collected from Moonidih and adjoining working mines, Jharia coalfield**

| Colliery | Seam | Depth (m) | Ultimate analysis result (dmf basis) | | | |
|---|---|---|---|---|---|---|
| | | | C% | H% | N% | S% |
| Moonidih | XV Top | 500 | 88.94 | 5.17 | 1.57 | 0.43 |
| Bulliary 10/12 Pit UG Mine | XV | 223 | 88.60 | 5.24 | 2.01 | 0.42 |
| Pootkee-Bulliary Project | XII | 412 | 88.93 | 5.25 | 1.97 | 0.70 |
| Pootkee-Bulliary Project | XI | 320 | 88.71 | 4.97 | 1.97 | 0.59 |
| Gopalichuk UG Mine | X | 142 | 89.52 | 5.22 | 2.08 | 0.48 |
| Gopalichuk 2-Pit MARIN | VIII | 220 | 89.33 | 5.19 | 1.62 | 0.52 |
| Kusunda OCP | V/VI/VII/VIII | 55 | 91.02 | 5.19 | 1.80 | 0.32 |
| Angarpathara-Ramkanali-4 Seam Pit | IV Top | 170 | 89.97 | 5.12 | 1.88 | 0.67 |
| Angarpathara-Ramkanali-RKPIT | III | 150 | 90.88 | 5.25 | 1.72 | 0.53 |
| East Basseria UG Mine | II | 64 | 90.05 | 5.27 | 1.80 | 0.37 |

## 3.4 Permeability and Porosity

Permeability is one of the most important considerations in determining CBM/CBM producibility and productivity. The permeability measurement of coal core samples collected from Well No-CBM#4 measured under reservoir simulated confining pressure varies from 0.28 to 1.04mD (CIMFR). The detail is given in table-7 :

**Table-7**

**Permeability measurement of coal core samples collected from Well No-CBM#4, Demonstration Project for Production and Utilization of Coal Mine Methane in Moonidih mine of BCCL, Jharia coalfield**

| Sample No. | Helium Inlet Pressure (psi) | Reservoir Simulated Confining Pressure (psi) | Permeability (mD) |
|---|---|---|---|
| CBM#4/1 | 620.82 | 761.26 | 0.37 |
| CBM#4/2 | 735.60 | 854.16 | 0.76 |
| CBM#4/3 | 926.37 | 1045.89 | 0.28 |
| CBM#4/4 | 932.63 | 1052.23 | 0.57 |
| CBM#4/5 | 1146.42 | 1258.06 | 0.98 |
| CBM#4/6 | 1156.92 | 1262.28 | 0.66 |
| CBM#4/7 | 1172.07 | 1263.13 | 1.02 |
| CBM#4/8 | 1176.81 | 1266.32 | 1.04 |

The porosity of the same samples determined under reservoir simulated confining pressure varies from 2.41 to 4.86%. The result of porosity measurement on coal core samples collected from Well No-CBM#4 (CIMFR) is given in table-8:

**Table-8**

**Result of Porosity measurement on coal core samples Collected from Well No-CBM#4 (CIMFR)**

| Sample No. | Reservoir Simulated Confining Pressure (psi) | Helium Initial Reference Pressure (psi) | Equilibrium Helium Pressure (Reference cell + Sample) (psi) | Porosity (%) |
|---|---|---|---|---|
| CBM#4/1 | 758.22 | 923.49 | 596.18 | 2.41 |
| CBM#4/2 | 851.66 | 1041.54 | 648.29 | 4.26 |
| CBM#4/3 | 1055.06 | 1262.11 | 766.85 | 2.92 |
| CBM#4/4 | 1058.13 | 1268.84 | 779.15 | 4.37 |
| CBM#4/5 | 1250.30 | 1452.63 | 882.91 | 3.16 |
| CBM#4/6 | 1267.45 | 1450.59 | 899.36 | 2.48 |
| CBM#4/7 | 1259.33 | 1466.92 | 895.28 | 4.86 |
| CBM#4/8 | 1269.36 | 1471.68 | 901.45 | 5.23 |

## 3.5 Composition of Coal Gas

The composition of combustible gas produced from 2nd CBM well has been analyzed for determining the concentration of methane content in it. The result shows a very high percentage of methane. The details are furnished in table-9:

**Table-9**

**Composition of coal gas in 2nd CBM well, CBM Recovery and Utilization Demonstration Project, Moonidih, Jharia coalfield**

| Date of Sample Collection | Combustible Gas | | | | $CO_2$ (%) | $N_2$ | $O_2$ |
|---|---|---|---|---|---|---|---|
| | $CH_4$ (%) | $C_2H_6$ (%) | $C_2H_4$ (%) | $C_3H_8$ (%) | | | |
| 04.06.2008 | 97.81 | 0.97 | Traces | 0.07 | 0.23 | Traces | 0.02 |
| 09.06.2008 | 87.88 | 1.02 | Traces | 0.05 | 0.31 | Traces | Traces |
| 18.06.2008 | 98.02 | 0.99 | Traces | Traces | 0.08 | Traces | Traces |

## 3.6 Gas Content Estimation

### 3.6.1 Desorption Study

Gas content of coal seams is most important aspect for assessment of in-situ gas resource of any CBM block. The best method of measurement of gas content of coal seams is real-time desorption study, which in conjunction with adsorption isotherms study gives saturation level of the seam with methane at a particular depth as well.

Desorption test study carried out in the coal core samples of the upper seams (XV and above) collected from Moonidih CMM wells of Jharia coalfield viz. CBM# 3 and 4, under CBM Demonstration Project, near the adjacent western down dip boundary of the considered CBM block, is given in table-10:

**Table-10**

**In-situ gas content of coal core samples collected from Well Nos. CBM #3 & 4, Moonidih, Jharia coalfield.**

| Sl.No. | Well/Sample No. | Seam | Desorbed Interval (m) | Gas Content (daf) ($m^3$/t) | Sorption Time (days) |
|---|---|---|---|---|---|
| 1. | CBM#4/2 | XVII-Top | 594.87-595.42 | 5.31 | 1.23 |
| 2. | CBM#4/3 | XVI-Top | 733.91-734.40 | 9.43 | 2.02 |
| 3. | CBM#4/4 | XVI-Top | 735.71-736.21 | 6.94 | 1.63 |
| 4. | CBM#3/1 | XV-Top | 802.77-803.27 | 7.20 | 2.15 |
| 5. | CBM#3/2 | XV-Top | 805.16-805.66 | 9.49 | 1.09 |

The above table indicates that the in-situ gas content of the upper seams (viz. seam XV and above) increases, in general, from 5.31$m^3$/ton to 9.49$m^3$/ton (on daf basis) with increase in depth within the considered CBM block.

### 3.6.2 Assessment of Gas-In-Place Resource

As per available desorption studies from the demonstration project wells and surrounding boreholes as mentioned earlier, the in-situ gas content of the seams (XV to II) varies from 2-16 $m^3$/ton (on daf basis).

The Gas-in Place resource of the considered seams (seams XV to II) within the identified CBM block has been estimated based on traditional resource equation taking into consideration coal reserves vis-à-vis the average available gas content in the area. The seam wise prognosticated Gas-in-Place resource within the identified Moonidih CBM block has been estimated which comes to about 7970.47 million cubic meters.

## 4.0 Method of Work

## 4.1 General

Coalbed methane (CBM) is the natural gas found in most coal deposits. It is formed during coalification. Under most circumstances, CBM consists of pure methane whereas it also contains carbon dioxide ($CO_2$) and nitrogen ($N_2$).

Methane is contained within the coal seams where it is adsorbed or absorbed to the coal. Pressure from the overlying rock and the water within the coal cleats (natural fractures) keeps the methane adsorbed onto the coal. CBM remain sorbed (adsorbed and absorbed both) with formation water in coal seam. As water is being drawn out from formation, which is known as depressurization, slowly methane starts flowing out by the mechanism of desorption as well as diffusion and brought to surface normally through vertical wells. CBM produced through vertical wells is collected at central point for end uses. CBM is a low pressure gas and at times needs artificial lift for favorable production flow as simply penetrating the coal seam will not cause the CBM to flow. On the surface there is CBM drilling rig which looks much like one used in any oil and gas drilling operation.

## 4.2 Geological parameters of the project site

**Table-11**

| Geological Parameters | Moonidih |
|---|---|
| Area ( Sq.Km) of Moonidih Mine leasehold | 20.63 |
| Number of coal seams | Over 30 |
| Coal seams worked/being worked | Seam-XVIII to XV mined to varied extent by Longwall method |
| Geological reserves | 1000 Mt ( for Seam-I to XVIII in ascending order) |
| Geological structure | Complex |
| Dip of coal seams | Moderate (5-$10^0$ ) |
| Pyrolitisation in coal seams | Most of the seams are pyrolitised to varied extent. |
| Seams considered for CBM extraction | Seam-XVIII-XI |
| Gassiness of coal seams | Degree-III (5 to more than $10m^3/t$) |
| Permeability of coal seams | < 1mD |

## 4.2 Drilling, Logging, Casing & Cementation

To recover CBM gas, initially drilling and casing of well is required to develop production well. The depths of coal seams are determined considering several operational factors for efficient and cost effective drilling. The drilling team draws a detailed plan for non-coring & coring drilling, design the drilling string and casing. Geophysical logging follows at each stage of completion of drilling followed by casing of the well and thereafter cementation.

The overall drilling plan and well architecture are systematically described below:

i. Drilling of 12¼" section to a depth, as per disposition of the top most coal seam.
ii. Setting of surface casing(9⅝") accordingly.
iii. Drilling of 8½" hole vertically down to Target Depth, depending on the targetted seam.
iv. Setting of 5½" production casing up to desired depth, depending on the target seams and considering a sump of 100m below the bottom most object seam.
v. Water based mud is used. Bentonite suspension is used while drilling the 12¼" section. Low solid polymer mud (PHPA) with 2-3% bentonite suspension used as drilling fluid during drilling of the 8½" section.
vi. The 5½" production casing is cemented in single stage with the use of low weight cement slurry with sufficient compressive strength.

## 4.3 Hydro Fracturing

Hydro fracturing is conducted to increase well productivity by injecting fluids at high pressure to create more fractures resulting more permeable zone. Fluid is pumped from the surface down the well bore and into the coal seams, a process known as hydro fracturing. The fluid is forced into the existing natural fractures (cleat system) and widens them. It is maintained by propping with sand. Gas and water then flow through these enlarged and interconnected sand-filled fractures. Fracturing provides conductive flow path between the natural fractures in the coal seam and the well. The length of fracturing depends on many variable like permeability, physico mechanical properties of different formations/lithology. Perforation provides the cost effective efficient method for assessing coalbeds in multiple zones.

Three potential coal seams in three wells were hydro-fractured and stimulation data are tabulated in table-12:

**Table-12**

| Seam | Depth Interval (m) | Thickness (m) | Perforation Interval (m) | Maximum Pressure (psi) | Proppant Pumped ( tonne) | Fluid Pumped (BBL) |
|---|---|---|---|---|---|---|
| **1st CBM Well** | | | | | | |
| XVIIT | 594.40-596.20 | 1.80 | 595.10-596.10 | 2383 | 40 | 1145 |
| XVIT | 733.77-738.90 | 5.12 C+J+C+J | 734.50-736.50 | 1540 | 40 | 847 |
| XVT & XVB | 879.70-883.70 884.70- | 4.00 5.45 | 881.50-883.50 886.60- | 3855 | 52 | 1000 |

| Seam | Depth Interval (m) | Thickness (m) | Perforation Interval (m) | Maximum Pressure (psi) | Proppant Pumped ( tonne) | Fluid Pumped (BBL) |
|---|---|---|---|---|---|---|
| | 890.15 | | 889.00 | | | |
| **2nd CBM Well** | | | | | | |
| XVIIT | 588.30-590.40 | 2.10 C+J+C+MP | 588.40-589.50& 589.90-590.40 | 2763 | 40 | 979 |
| XVT & XVB | 867.70-871.90 872.60-877.65 | 4.20 5.05 | 874.40-877.40 | 4858 | 47 | 950 |
| XII | 1016.25-1022.00 | 5.75 | 1020.0-1022.0 | 2253 | 45 | 1050 |
| **3rd CBM Well** | | | | | | |
| XVT & XVB | 802.69-806.57 807.71-812.57 | 3.88 4.87 | 805.50-806.50 810.50-812.50 | 4300 | 35 | 1325 |
| XII | 940.21-945.71 | 5.50 | 943.60-945.60 | 4300 | 46 | 1200 |
| X | 1006.03-1013.65 | 7.62 | 1010.50-1013.50 | 1200 | 58 | 1330 |

## 4.4 Dewatering

To initiate and maintain gas flow from low pressure coal formations, removing of water from well is require to be done continuously. De-watering is the process of removing water from a coal seam in the vicinity of a producing CBM well. The water in the coal is pumped to the surface. To encourage the CBM to flow, natural pressure on the coal seam is decreased through dewatering of the coal zone. Therefore it is essential to reduce pressure within the coal seam which in turn allows the methane gas to be released from the coal. To maximize gas production from a CBM well pumping is done continuously to minimize bottom hole pressure so that gas easily flows through the well. Water production will be high when multiple coal seams are taken for production. The volume of produced water will depend on the properties of coal seams and adjoining strata. Initially a PC Pump and thereafter SRP Pump located at the wellhead remove the water that naturally occupies the cleats. This lowers the reservoir pressure along a particular coal seam, draws the gas out of the coal and allows it to flow into the well bore.

## 4.5 Production

Upon reaching the surface (wellhead), the gas and water are separated and piped to a small metering facility where the production volume from each well is recorded. The CBM is collected from a number of wells and then flows to a gas collection center. CBM production must be continuous to ensure a constant low-pressure gas flow and sustain a commercially viable operation. If a CBM well is shut down for an extended period after it has started producing gas, the water in the coal will be collect at the well bore, requiring a repeat of the long de-watering process.

## 4.6 Production Profile

During start-up operations, CBM wells produce large quantities of water at first and only small amounts of gas. During the initial de-watering phase (usually several months), gas production increases steadily while the amount of water decreases. Eventually, production levels begin to resemble a conventional gas well and the gas flow gradually declines until it is no longer economically viable. However, even with its longer lifespan, a typical CBM well produces less gas at a much lower rate than a conventional gas well. Average economic productive life of a CBM well varies from ten to fifteen years.

# 5.0 Present status

Five CBM wells were proposed at Moonidih under the Demonstration Project out of which three wells were drilled with estimated production capacity of 5000 $m^3$/day/well. The gas flow pressure at CBM well head is less than 1 bar. Two gas collecting points are provided at Moonidih.

Initially PCP pumps were used for dewatering the CBM wells for pumping rock fines and coal fines along with water, which mostly occurs at this phase caused by hydraulic fracturing. Presently SRP piston pump is being used to pump out water. Lowering of water level inside the well due to pumping decreases the water pressure on the hydraulically fractured seams. As soon as the water pressure on the seams are lower than the desorption pressure of the coal, methane starts desorbing and flows as free gas (bubbles) to the well reaching the wellhead via the annulus between 5 ½" casing and 2 7/8" tubing. Water with gas bubbles and damp gas with droplets of water reach the well head on separate routes. From there, they are guided to the separator above ground along separate pipelines.

The separator above ground further removes droplets of water from the damp gas and gas bubbles from the water. From there, the water flows via pipes to tanks or into

an open pit, for intermediate store and the gas flows via pipes to the collecting station.

Details of the CBM wells drilled are given in table-13:

**Table-13**

| Sl. No. | Well No. | Site | Depth | Purpose | Present Production (approx.) | Well capacity ($m^3$/day) | (ø) Well dia | Additional Life (Years) |
|---|---|---|---|---|---|---|---|---|
| 1. | CBM 4 | Near C.P.P. | 1056 m | To extract CH4 gas | Nil | 5000 | 5½" | Nil |
| 2. | CBM 3 | D.M. Colony | 1111 m | To extract CH4 gas | 600 $m^3$/day | 5000 | 5½" | 6 |
| 3. | CBM 10 | D.M. Colony | 1072 m | To extract CH4 gas | 500 $m^3$/day | 5000 | 5½" | 8 |

## 5.1 List of Equipment

**On Surface Office:**

a) 4 no. Generators (Gas Engine type) - 4 x 250 KW

b) Drill Rig - 1

c) Mud pump - 2

d) Height of the DG set stock – 5 m

Near Well :

a) PCP & SRP Pumps

b) 1 no. of Generator - 375 KVA

Details of SRP (Succor Rod Pump) -

Make - AMP SCOT SRP Pump (U.S.A.)

Type - FLP

Motor - FLP motor ALSTOM 440 V/15 KW, 50 Hz

Insulation - Class-A, RPM-730

MIC No. - 25620520005

Pressure rating of SRP - 210 bar for Casing and top flange of it and is 80 bar for pressure exposed well head components.

Details of PCP (Progressive Cavity Pump) -

Make - Kundu Industries, Canada

Model - VH 60

Sl.No. - 3058

Brake capacity - 2034 NM

Power rating - 45 KW, RPM – 750

Motor - FLP, RPM-975, Voltage – 415,

Frequency – 50 Hz

Lifting capacity of Pumps - 1200m TVD as lifting capacity of PCP & piston pumps.

## 5.2 Gas Production & Electrical energy generation in the Last Five Years

**Table-14**

| Year | **1st well (CBM 4)** ($m^3$) | **2nd Well (CBM 10)** ($m^3$) | **3rd Well (CBM 3)** ($m^3$) | Elect. energy generated (Kwh) |
|---|---|---|---|---|
| 2008-09 | 15000 | 220000 | Nil | 377259 |
| 2009-10 | 10000 | 380000 | Nil | 553042 |
| 2010-11 | 5000 | 27000 | Nil | 39346 |
| 2011-12 | Nil | 50000 | 80000 | 146679 |
| 2012-13 | Nil | 83800 | 100000 | 187299 |

## 5.3 Linkage & transportation:

Collected gas is transported through pipelines laid for the purpose to the generating station where is supplied to two no. of 250 Kw capacity gas based electric generator

## 5.4 Present Pumping

**Table-15**

**Detail of water pumped out well wise**

| Year | 1st well (CBM 4) ($m^3$) | 2nd Well (CBM 10) ($m^3$) | 3rd Well (CBM 3) ($m^3$) |
|---|---|---|---|
| 2008-09 | 3000 | 6000 | Nil |
| 2009-10 | 2000 | 8000 | Nil |
| 2010-11 | 500 | 5000 | Nil |
| 2011-12 | Nil | 6000 | 7500 |
| 2012-13 | Nil | 6000 | 7500 |

## 5.5 Present power supply

The present power supply is from 2X30 KW (with 2 motors) from CPP unit/DVC unit

## 5.6 Existing workshop and store

There is a well equipped workshop and store near CBM office for day to day work . Moonidih Colliery workshop caters for repair of vital items.

## 5.7 Existing Manpower

| | | |
|---|---|---|
| Project Officer | - | 1 |
| Engineer-in-charge | - | 1 |
| Foreman-in-charge | - | 3 |
| Asstt. Foreman | - | 2 |
| Chemist | - | 1 |
| Electrician | - | 3 |
| Fitter | - | 3 |
| E.P. Fitter | - | 5 |
| Tyndel | - | 11 |
| General Mazdoor | - | 1 |
| Guards | - | 10 |
| | | ---- |
| Total | - | 41 |
| | | ---- |

## 6.0 Proposal for future production

The Demonstration Project has been formally closed on 30th June, 2010 and all Project equipments have been handed over to BCCL for continuing activities. At present the existing three CBM wells are continuing their gas production and will continue to do so till the end of their life. The scope of the FR is limited to Demonstration project. The project will continue with its existing infrastructure and manpower.

## 7.0 Land

To continue with the Demonstration Project there will be no additional requirement of land. The existing infrastructures are located on the land owned by BCCL within the lease hold of Moonidih Colliery.

## 8.0 Civil Construction Work If Any :

No civil construction has been proposed for the future operation of the Demonstration Project project.

## 9.0 Rehabilitation if any (no. of villages and persons involved, place where to be rehabilitated, R & R package to be offered) :

No rehabilitation required for CBM Demonstration Project at Moonidih.

## 10.0 Status of community development work undertaken with their detail.

Following community development works are undertaken :

- Drinking water facility to local people.
- Free health check-up camps are organized.
- Community centre provided to locals.
- Preventive measures for common diseases like Malaria, Diarrhea are done by sprinkling of DDT, cleaning of drains etc.
- Organizing AIDS awareness programme.
- Games & sports are organized every year.
- Cultural programme are organized time to time.
- School, Community Centre, PCC road, mine water for domestic use, lighting are provided.

## 11.0 Environmental measures being taken presently and proposed to be taken, closure:

Dust suppression is being done regularly by water sprinkling. Plantations has been proposed for an area of 18.52 Ha at a cost of Rs. 10.20 lakhs within the leasehold of Moonidih Colliery. After exhaustion of the gas reserve the project will be closed by taking suitable safety measures and in line with the closure plan. The CBM Project area falls within the lease hold area of Cluster XI mines of BCCL. The cost of environmental protection measures for the cluster includes that of the CBM demonstration project at Moonidih which is given below:

### Cost of environmental protection measures

**Capital Cost**

| Sl No | Specification | Nos | Investments (Rs. In lakhs) |
|---|---|---|---|
| 1 | Water Sprinkler (10 KL) | 4 | 64.00 |
| 2 | **POLLUTION MONITORING** | | |
| | a) Respirable dust sampler | | 26.0 |
| | b) Micro-meteorological station | | 7.0 |
| | c) Laboratory for testing | | 8.0 |
| | d) Acoustics for noise pollution control | | 10.0 |
| 3 | Lab Equipments for monitoring and analysing air , dust , water , soil , noise , vibration & lighting standards | LS | 25.00 |
| 4 | Domestic Effluent Treatment Plant (Septic tanks) | | 15.00 |
| 5 | Industrial Effluent Treatment Plant | | 15.00 |
| 6 | Storm water drains | | 35.50 |
| 7 | Drains along roads | | 8.0 |
| | **Sub Total** | | **213.5** |
| | **Contigency @ 5%** | | **10.675** |
| | **Total** | | **224.175** |

**Revenue cost**

| Sl. No. | Item | Total Cost (in lakhs Rs) | Phasing | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1st yr. | 2nd yr | 3rdYr | 4th to 28th Yr | 29th Yr | 30th Yr |
| 1 | Air quality Monitoring Cost | **11.37 pa** | **11.37** | **11.37** | **11.37** | **284.25** | **11.37** | **11.37** |
| 2 | Water quality Monitoring Cost | **3.00 pa** | **3.00** | **3.00** | **3.00** | **75.00** | **3.00** | **3.00** |
| 3 | Noise Monitoring Cost | **2.60 pa** | **2.60** | **2.60** | **2.60** | **65.00** | **2.60** | **2.60** |
| 4 | Green Belt Development | **127.77** | **3** | **3** | **4.1** | **102.5** | **7.17** | **8** |
| 5 | Physical Reclamation | **25.25** | **5** | **5** | **5** | **10.25** | | |
| 6 | Ecological Restoration | **14.43** | **-** | | | **7.43** | **3** | **4** |
| 7 | Miscellaneous | | **10** | **10** | **10** | **250** | **10** | **10** |
| | **Total** | | **34.97** | **34.97** | **36.07** | **794.43** | **37.14** | **38.97** |

## 12.0 *Cost of CBM/CMM recovery from one producing well & Cost of Power generation (250 kW) at Moonidih

**Table-16**

| Sl# | Items | Cost in ₹ | Remarks |
|---|---|---|---|
| 1 | Capital Cost of completion of one well in all respect up to CBM recovery. (in ₹ Crores) Life of one well considered 10 years. | 15.12 | |
| 2 | Capital Cost of completion of one well for one year ( in ₹Lakhs) Assuming life of well 10 years<br>No of useful working days being used in | 151.18 | 1512/10<br><br>360 |

| Sl# | Items | Cost in ₹ | Remarks |
|---|---|---|---|
| | Gas production and power generation | | |
| 3 | Capital Cost of completion of one well for one day in ₹ | 41,995 | 15118000/360 |
| 4 | Current gas production per day | 5,000 $m^3$/day | |
| 5 | Variable cost of running the plant per day in ₹ | 8,000 | |
| 6 | Total Cost of CBM/CMM Recovery per day(Sl#3+Sl#5) in ₹ | 49,995 | |
| 7 | Cost 1 Cubic M CBM/CMM Recovery (Sl#6/Sl#4) | 10.00 | 49995/5000 |
| 8 | Cost of 250kW Gas engine Generator, its installation and gas supply pipe line etc.in ₹ | 50,00,000 | |
| 9 | Cost of 250kW Gas engine Generator, its installation and gas supply pipe line etc per year (Considering the well life 10years) in ₹ | 5,00,000 | |
| 10 | Cost of 250kW Genset, its installation and supply gas pipe line per day in ₹ | 1,389 | 500000/360 |
| 11 | Total cost for Power generation per day in ₹ | 51,384 | 49995+1389 |
| 12 | **Cost of one cubic meter CBM gas recovery and Power generation equipments** | 10.28 | 51384/5000 |
| 13 | Cost of 103 cubic meter per hour Gas required for generation of 250 kW power, in ₹ considering standard consumption rate/hr | 1,058.52 | 10.28x103 |
| 14 | **Cost of 1 kWh (₹/Unit)** | 4.23 | 1058/250 |

*Based on "Closure Report, Project Number: S&T/CE-27, prepared by CMPDI.

The cost of one well is normally around ₹ 5.5 Crore but being a R&D demonstration project there has been a lot of delay on account of procurement of equipment & capacity building and delay in completion of field activities, brought about due to learning of this new technology, resulting in higher cost. It is likely that in later wells,

cost would be reduced considerably and, therefore, the cost of power generation would consequently be reduced considerably.

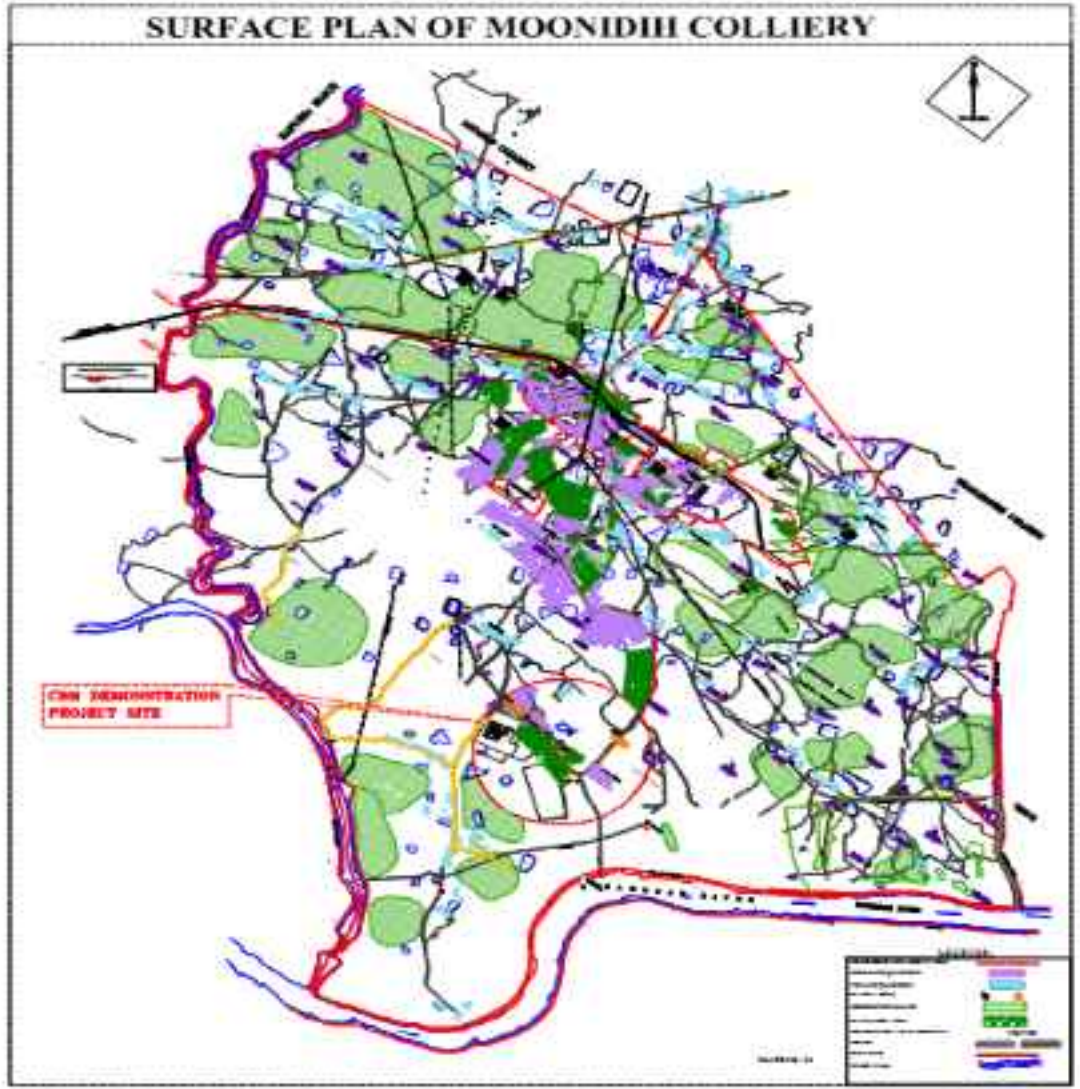
In this Project case, in spite of being a R&D demonstration project at a pilot scale, the cost of production of CBM is ₹ 10.28 per cubic M. The sale price of CBM in Indian market is USD 7 per million BTU which is ₹ 10.50 per cubic meter against our cost of production of ₹ 10.28 per cubic meter.

**Table-17**

***Coalbed Methane Recovery and Commercial Utilization Project Fund (IND/98/GN34 AND S&T/CE-27)**

| Sl No. | Source of Fund | Unit | Approved RCE – June'2004 | Expenditure up to June'2010 | Percentage of fund utilization | Remarks |
|---|---|---|---|---|---|---|
| 1 | UNDP/GEF | Million US$ | 9.198 | 9.198 | 100 | Utilized on procurement of major International equipment. |
| 2 | UNDP/INDIA | Million US$ | 1.210 | 1.210 | 100 | Major activities completed. |
| 3 | ONGC Co-sharing for Hydro Fracturing & Cementation units | Million US$ | 2.699 | 2.699 | 100 | ONGC has provided Cementation & Hydro-fracturing services. |
| 4 | GoI (Cash) S&T | ₹ Crore | 18.058 | 17.8974 | 100 | Total ` 1789.74 Lakh was disbursed which has been fully utilized. Additional expenditure incurred under recovery and utilization related activities are borne by BCCL funding which has been advanced by BCCL in its 256th Board of Directors meeting. |
| 5 | GoI (Kind) | ₹ Crore | 6.994 | 6.994 | 100 | Expenditure upto September, 2008 was met from the sanctioned fund. There after it is borne by BCCL for their manpower. |
| 6 | Part of the revenue cost met out of the income generated from the project on account of utilization of exploited CBM in the initial time period. | ₹ Crore | 8.33 | 3.113 | 37.37 | It has been advanced to the Project in 256th Board of Directors of BCCL held on 8th December, 2007. This is being utilized for recovery & utilization related activities and revenue expenditure of respective BCCL areas for the project. |

*Based on "Closure Report, Project Number: S&T/CE-27, prepared by CMPDI.


SURFACE PLAN OF MOONIDIH COLLIERY
CBM DEMONSTRATION
PROJECT SITE

| STRICTLY RESTRICTED |
| --- |
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| The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL/Government. |

# BHARAT COKING COAL LIMITED

## FORM-I & PROPOSED TERMS OF REFERENCE

**(As per EIA Notification, 2006)**

***For***

## CBM DEMONSTRATION PROJECT AT MOONIDIH
## (Part of Cluster XI)

## Capacity - 15000 $m^3$/day

**Lease Hold Area : within the LH of Moonidih Mine of area 2063.45 Ha**

(Part of Cluster –XI Mines for which EC has already been granted
Vide letter no. J-11015/77/2011-IA.II (M) Dated: 26th August, 2013)

**(March, 2015)**

**Prepared by**


**Regional Institute – II**
**Central Mine Planning & Design Institute Ltd.**
**(A Subsidiary of Coal India Ltd.)**
**Koylanagar, Dhanbad – 826005**



**Document No.-**CMPDI/Form-I/BCCL/2014-15/March/22/01

# CBM Demonstration Project at Moonidih

## 1.0 Introduction

### General

Coal is globally the most reliable primary energy resource and its use is crucial to the economics of developing countries. The reserve of coal in India is far more abundant than oil and gas reserves and therefore coal provides a much needed energy security to the country.

Methane contained in coal seams, formed during coalification process, is known as Coalbed Methane. Its composition and commercial potential is almost similar to that of Natural gas and therefore has significant commercial value. Methane in coal seams has been safety hazard for coal mining operations on account of its explosive behaviour when its concentration is between 5 to 15 % and arrangements of proper ventilation are made in the underground mines to make it safe. Coal Mine Methane (CMM) and Abandoned Mine Methane (AMM) are sub-sets of Coalbed Methane, while CMM is methane produced before mining from active and would be mining areas; AMM is recovery of methane from abandoned mines.

Development of methane resources has attracted attention in the recent years as an alternate clean energy source in many parts of the world.

Efforts are now being made worldwide to control the emission of greenhouse gases and thereby reduce the pressures for accelerated climate change. Methane is a powerful greenhouse gas, as its adverse impacts are felt more intensely due to its shorter residence and higher potency in the atmosphere than carbon dioxide. However methane is a remarkable clean fuel when burnt, and its combustion produces no $SO_2$ or particulates and only about half of the $CO_2$ associated with coal combustion.

Reduction of methane emissions by utilizing it as an energy resource will yield a significant short term climate benefits. The post Kyoto protocol scenario and environmental concern has focused attention on increasing the share of utilization of non-conventional energy resource. Harnessing and utilization of

CBM is, therefore, globally an emerging important environment friendly, non-conventional, alternate clean energy resource.

**Background**

This project "Coalbed Methane Recovery & Commercial Utilization" was jointly funded by the Global Environmental Facility (GEF), United Nations Development Program (UNDP) and The Government of India S&T. The project was perceived in 1996 and project document was prepared by an International Consultant hired by UNDP. The project was granted `92.427 crores with completion schedule in Dec 07, which was further extended to Dec 09.

Under R&D efforts, a demonstration project on "Coalbed Methane Recovery & Commercial Utilization" has been successfully implemented at Moonidih coal mine of BCCL in Jharia Coalfield. The project has acquired suitable infrastructure like heavy duty high-tech drilling rig unit and other equipment required for taking up CBM related large diameter deep drilling. Three wells have been successfully drilled and methane gas embedded in coal seams have been successfully recovered through vertical wells on surface and the recovered gas is being used as fuel in gas-based generators for electricity generation since 27th June, 2008. Total 10,62,948 kwh of electricity has been generated and 5,53,042 kwh has been generated during 2009-10, the generated electricity is being supplied for domestic use in Moonidih project colony.

This research project was undertaken by Central Mine Planning & Design Institute Ltd., (CMPDI) in association with Bharat Coking Coal Limited, (BCCL) in September, 1999. This was a multi funded project totaling `92.427 Crores out of which `18.058 Crore was the S&T grant of Ministry of Coal (MoC).Since the objective of the CBM project was to demonstrate the production and utilization technique, which has been fulfilled, the project has been formally financially closed on 30th June, 2010 and project equipments have been transferred to BCCL on 13th August, 2010 for continuing activities. and all Project equipments have been handed over to BCCL.

**Project Justification**

- Recovery of the CBM provides a clean source of energy which is much more environmental friendly as compared to burning of coal.
- The CBM, a highly potent GHG gas, if not recovered in advance of coal mining would otherwise be released to the atmosphere with the mine ventilation air, contributing to global warming.
- The extraction of CBM from coal seams in advance of mining will provide a much-reduced incident of Methane and would create much safer conditions in mine working for mine workers, when the area is subsequently mined in future.
- The extraction of CBM reduce lot of ventilation cost as well as electrical installation.
- The project has brought to the country state of art technology for planning and execution of such projects in Indian conditions. It is expected that this project will be a front runner in generating useful data on CBM recovery and utilization besides imparting experience and confidence in private and public investor in India.

**Scope of work**

Scope of Work is limited to the demonstration project "Coalbed Methane Recovery & Commercial Utilization" jointly funded by the Global Environmental Facility (GEF), United Nations Development Program (UNDP) and The Government of India S&T and undertaken by Central Mine Planning & Design Institute Ltd. (CMPDI) in association with Bharat Coking Coal Limited, (BCCL) in September, 1999.

## 2.0 Area & Location

The CBM Demonstration Project at Moonidih lies within the leasehold of Moonidih mine with LH of 2063.45 Ha. It is located in the central part of the Jharia Coalfield of Dhanbad District of Jharkhand State (India) and is included in the Survey of India Toposheet Nos. 73 I/5 & I/6 (R.F 1:50,000). The area is also covered in Sheet Nos. 4 (R.F 1:15,840) of the Geological Map of Jharia

Coalfield published by Geological Survey of India. Geographically it is bounded as detailed below :

| | | |
|---|---|---|
| Leasehold | : | Moonidih Leasehold |
| North & northeast | : | Pootkee-Bulliary Project |
| East & southeast | : | Fault F3-F3 (XV Seam Position) & Lease hold area of Moonidih/CBM demonstration Project/ TISCO Mines |
| South | : | Lease hold area of Moonidih/CBM demonstration Project |
| Southwest | : | Singra/CIL-ONGC CBM Block |
| North & Northwest | : | Jarian Nalla & Kapuria U/G block |
| Longitude | : | 23° 43'12" N - 23° 45'58" N |
| Latitude | : | 86° 19'23" E - 86° 22'04" E |

## 3.0 Gas Production & Electrical energy generation in the Last Five Years

| Year | 1st well (CBM 4) ($m^3$) | 2nd Well (CBM 10) ($m^3$) | 3rd Well (CBM 3) ($m^3$) | Elect. energy generated (Kwh) |
|---|---|---|---|---|
| **2008-09** | 15000 | 220000 | Nil | 377259 |
| **2009-10** | 10000 | 380000 | Nil | 553042 |
| **2010-11** | 5000 | 27000 | Nil | 39346 |
| **2011-12** | Nil | 50000 | 80000 | 146679 |
| **2012-13** | Nil | 83800 | 100000 | 187299 |

## 4.0 Leasehold Area

The CBM Demonstration Project at Moonidih Colliery (Within Cluster XI) is located within the leasehold of Moonidih Colliery with Leasehold area of 2063.45 Ha.

## 5. Existing Environmental Condition:

### 5.1 Land Use:

The current land use pattern, the proposed land use pattern and post-mining land use pattern of the mines of cluster is presented in the following tables-

**Land Use Pattern of Moonidih UG Mine**

| Sl. No. | Type of land use | Present mining land use (in Ha) | Post-mining land use (in Ha) |
|---|---|---|---|
| 1 | Running Quarry | | |
| | Backfilled | Nil | Nil |
| | Not Backfilled | Nil | Nil |
| 2 | Abandoned Quarry | | |
| | - Backfilled | Nil | Nil |
| | - Not Backfilled | Nil | Nil |
| 3 | External OB dump | Nil | Nil |
| 4 | Service building/ Mine Infrastructure | 114.40 | 114.40 |
| 5 | Coal dump | Nil | Nil |
| 6 | Homestead Land | 128.50 | 128.50 |
| 7 | Agricultural Land | 480.75 | 480.75 |
| 8 | Forest Land | 80.44 | 80.44 |
| 9 | Plantation | 33.93 | 52.45 |
| 10 | Water Body | 74.25 | 74.25 |
| 11 | Barren Land | 1118.52 | 1100.00 |
| 12 | Fire area | Nil | Nil |
| 13 | Others (rail/road) | 32.66 | 32.66 |
| | **Total** | **2063.45** | **2063.45** |

### 5.2 Air Quality

The Baseline data for Cluster XI group of mines of BCCL was generated during the period from February '2012 to April'2012 which shows that conscentration of $PM_{2.5}$ varies from 46 to 60 $\mu g/m^3$, $PM_{10}$ varies from 81 to 100 $\mu g/m^3$, $SO_2$ varies from 15 to 64 $\mu g/m^3$ and $NO_X$ varies from 21 to 40 $\mu g/m^3$The monitoring data reveals that ambient air quality parameters are mostly within the prescribed limits.

## 5.3 Water Quality

**Surface Water Quality:**

The pH value is found to be in the range of 7.50 to 7.82.

BOD values are found to be 6.2 mg/l to 8.2 mg/l.

Chlorides and Sulphates are found to the maximum extent of 96 mg/l and 312 mg/l respectively.

Heavy metal values except Iron are within the IS: 2296 - 1982 (Inland surface water) class C norms.

**Drinking Water Quality Assessment:**

The pH value is found to be in the range of 6.9 to 7.4.

Total Hardness is in the range of 282 – 525 mg/l.

Chlorides and Sulphates are found to the maximum extent of 104 mg/l and 84 mg/l respectively.

Phenolic compounds, Cyanides and Insecticides are found to be absent.

Heavy metal values are found to be within the IS: 10,500 - 1991 limit.

E-coli was absent.

**Effluent Water Quality:**

The pH value is found to be in the range of 7.76 to 7.86.

BOD values are found to be 7.0 mg/l to 9.0 mg/l.

COD values are found to be 40 mg/l to 46 mg/l.

Suspended solids are found to the maximum extent of 60 mg/l.

Kjeldahl Nitrogen are found to the maximum extent of 2.6 mg/l

## 5.5 Resettlement & Rehabilitation

No additional land is proposed to be acquired for the existing CBM Demonstration Project at Moonidih. Hence, no R&R issue is involved.

## 5.6 Flora & Fauna

Since the CBM Demonstration Project at Moonidih has been formally closed in 2010 and gas production being continued by BCCL, no flora & fauna will be affected.

## 6. Mitigation Measures

The following mitigation measures have been taken by the project for control of environmental pollution:

a. **Air Pollution Control**: The dust suppression measures are taken to keep the air quality within acceptable limits.
b. **Domestic Wastewater Pollution Control**: The domestic wastewater is being treated in septic-tank-cum-soak pit.
c. **Industrial Effluent:** Mine water is allowed to settle into settling tank for treatment.
d. **Plantation**: Plantation has been taken up on 185.60 ha of land.

## 7. Environmental benefits

Coal Bed Methane derived from the coal seams is being used for gainful purpose i.e for electricity generation which otherwise will be released into the atmosphere during the mining process posing danger during mining. Moreover methane 22 times more GHG potential compared to carbon dioxide.

**APPENDIX- I**
**(See paragraph – 6)**
**FORM 1**

## (I) Basic Information

<table>
<tr><th>S.No.</th><th>Item</th><th>Details</th></tr>
<tr><td>1</td><td>Name of the Project:</td><td>CBM Demonstration Project at Moonidih</td></tr>
<tr><td>2</td><td>Serial no. in the schedule</td><td>Schedule 1(b)</td></tr>
<tr><td>3</td><td>Proposed capacity/ area / length /tonnage to be handled / command area / lease area / no. of wells to be drilled</td><td>Five CBM wells were proposed at Moonidih under the Demonstration Project out of which three wells were drilled with estimated production capacity of 5000 m3/day/well. The gas flow pressure at CBM well head is less than 1 bar. The Project is located within the Moonidih Mine with LH of 2063.45 Ha</td></tr>
<tr><td>4</td><td>New / expansion / modernization</td><td>Existing</td></tr>
<tr><td>5</td><td>Existing capacity / area etc.</td><td>Planned Capacity of CBM Demonstration Project at Moonidih - 15000 m3/day from three wells. The project is located within the LH of Moonidih Mine of area 2063.45 Ha</td></tr>
<tr><td>6</td><td>Category of the project i.e. ‘A’ or ‘B’</td><td>‘A’</td></tr>
<tr><td>7</td><td>Does it attract the general conditions? If yes, please specify.</td><td>No</td></tr>
<tr><td>8</td><td>Does it attract the specific conditions? If yes, please specify.</td><td>No</td></tr>
<tr><td rowspan="2">9</td><td>Location</td><td>Longitude : 23° 43’12” N - 23° 45’58” N<br>Latitude : 86° 19’23” E - 86° 22’04” E</td></tr>
<tr><td>Plot/Survey/Khasra No.</td><td>
<table>
<tr><th>Name of the mouza</th><th>Mouza No.</th></tr>
<tr><td>▪ Manjhiadih</td><td>91</td></tr>
<tr><td>▪ Karitand</td><td>89</td></tr>
<tr><td>▪ Bardubhi</td><td>348</td></tr>
<tr><td>▪ Parsia</td><td>84</td></tr>
<tr><td>▪ Baludih</td><td>93</td></tr>
<tr><td>▪ Garbudih</td><td>86</td></tr>
<tr><td>▪ Dhandabar</td><td>82</td></tr>
<tr><td>▪ Gopinathdih</td><td>97</td></tr>
<tr><td>▪ Pandarkanali</td><td>80</td></tr>
<tr><td>▪ Chirudih</td><td>83</td></tr>
<tr><td>▪ Chakfutah</td><td>98</td></tr>
<tr><td>▪ Rajeshbera</td><td>102</td></tr>
<tr><td>▪ Futaha</td><td>99</td></tr>
<tr><td>▪ Sabaldih</td><td>103</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>S.No.</th><th>Item</th><th>Details</th></tr>
<tr><td></td><td></td><td><table>
<tr><td>▪ Jarma</td><td>106</td></tr>
<tr><td>▪ Lakarkhawali</td><td>88</td></tr>
<tr><td>▪ Tatangabad</td><td>90</td></tr>
<tr><td>▪ Gansadih</td><td>105</td></tr>
<tr><td>▪ Sarihdaha</td><td>87</td></tr>
</table></td></tr>
<tr><td></td><td>Village</td><td>The name of the villages are as under:<table>
<tr><th>Name of the mouza</th></tr>
<tr><td>▪ Manjhiadih<br>▪ Karitand<br>▪ Bardubhi<br>▪ Parsia<br>▪ Baludih<br>▪ Garbudih<br>▪ Dhandabar<br>▪ Gopinathdih<br>▪ Pandarkanali<br>▪ Chirudih<br>▪ Chakfutah<br>▪ Rajeshbera<br>▪ Futaha<br>▪ Sabaldih<br>▪ Jarma<br>▪ Lakarkhawali<br>▪ Tatangabad<br>▪ Gansadih<br>▪ Sarihdaha</td></tr>
</table></td></tr>
<tr><td></td><td>Tehsil</td><td>Dhanbad</td></tr>
<tr><td></td><td>District</td><td>Dhanbad</td></tr>
<tr><td></td><td>State</td><td>Jharkhand</td></tr>
<tr><td>10</td><td>Nearest railway station / airport along with distance in kms.</td><td>Railway Station : Dhanbad at a distance of 12 kms<br>Airport : Ranchi at a distance of 165 kms</td></tr>
<tr><td>11</td><td>Nearest town, city, district head quarters along with distance in kms</td><td>Dhanbad at a distance of 12 kms</td></tr>
<tr><td>12</td><td>Village Panchayats, Zilla Parishad, Municipal Corporation, Local Body (Complete postal address with telephone nos. to be given)</td><td>Dhanbad Zila Parishad<br>Hatia More<br>Dhanbad – 826 001, (Jharkhand)<br>Telephone No. 0326-223178</td></tr>
</table>

| S.No. | Item | Details |
|---|---|---|
| 13 | Name of the applicant | **Shri S.K. Mukhopadhyay**,<br>General Manager,<br>Western Jharia Area |
| 14 | Registered Address | Office of the General Manager, Western Jharia Area, Moonidih<br>PO : Moonidih, District – Dhanbad, JHARKHAND – 828 129 |
| 15 | Address for correspondence | |
| | Name | **Shri S.K. Mukhopadhyay**, |
| | Designation (owner/partner/CEO) | General Manager (Western Jharia Area) |
| | Address | Office the General Manager,<br>Western Jharia Area, Moonidih PO : Moonidih, District – Dhanbad<br>JHARKHAND – 828 129 |
| | Pin Code | 828129 |
| | E-mail | Area14gm@sify.com |
| | Telephone no. | 0326-2273445 |
| | Fax No. | 0326-2273445 |
| 16 | Details of alternative sites examined, if any. Location of these sites should be shown on a topo sheet. | The site was selected for the demonstration project based on the suitability of the coal seams below for harnessing CBM. |
| 17 | Interlinked projects | Moonidih Mine ( Part of Cluster XI ) |
| 18 | Whether separate application of interlinked project has been submitted | Not applicable |
| 19 | If yes, date of submission | Not applicable |
| 20 | If no, reason | Not applicable |
| 21 | Whether the proposal involves approval / clearance under:<br>a) The Forest (Conservation) Act, 1980<br>b) The Wildlife (Protection) Act, 1972<br>c) The C.R.Z. Notification, 1991<br>If yes, details of the | No |

| S.No. | Item | Details |
|---|---|---|
| | same and their status be given | |
| 22 | Whether there is any Government Order/ Policy relevant / relating to the site? | No |
| 23 | Forest land involved (in hectares) | No |
| 24 | Whether there is any litigation pending against the project and/or land in which the project proposed to be set up?<br>a) Name of the Court<br>b) Case No.<br>c) Orders/ directions of the Court, if any and its relevance with the proposed project | State Govt./ Jharkhand State Pollution Control Board had issued closure orders for all the mines of BCCL in Aug., 2011 and March 2012 stating that BCCL is operating all its mines without the Env. Clearance. BCCL had approached and filed Writ Petition in the Hon'ble High Court of Jharkhand, Ranchi for legal relief against the closure of mines by JSPCB with the following facts that BCCL had already initiated the process of Env. Clearance in 2008 onwards and was approved the cluster concept in 2009. BCCL is completing all its EMP process well within the validity periods of two years stipulated in the Terms of Reference (TOR). Further all the mines of BCCL are infected by coal fires and a PIL case is being dealt in this regard in the Hon'ble Supreme Court of India. By closing the mines, the fires will not stop and shall aggravate and cause more devastation and pollution. The court had taken cognizance of the facts and appreciating the sincere efforts of BCCL in obtaining the Env. Clearance had granted "Status Quo" to be observed and admitted the case i.e. No. WP(C) 4944/2011. BCCL is submitting action taken report to the Hon'ble High Court of Jharkhand, as per its direction. |

## (II) Activity

### 1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

<table>
<tr><th>Sl.No.</th><th>Information/Checklist confirmation</th><th>Yes/ No</th><th>Details thereof (with approximate quantities /rates, wherever possible) with source of information data.</th></tr>
<tr><td>1.1</td><td>Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)</td><td>Yes</td><td>The project is located within the LH of Moonidih Mine with LH of 2063.45 Ha.
<table>
<tr><th>Sl. No.</th><th>Type of land use</th><th>Present mining land use (in Ha)</th><th>Post-mining land use (in Ha)</th></tr>
<tr><td>1</td><td>Running Quarry</td><td></td><td></td></tr>
<tr><td></td><td>Backfilled</td><td>Nil</td><td>Nil</td></tr>
<tr><td></td><td>Not Backfilled</td><td>Nil</td><td>Nil</td></tr>
<tr><td>2</td><td>Abandoned Quarry</td><td></td><td></td></tr>
<tr><td></td><td>- Backfilled</td><td>Nil</td><td>Nil</td></tr>
<tr><td></td><td>- Not Backfilled</td><td>Nil</td><td>Nil</td></tr>
<tr><td>3</td><td>External OB dump</td><td>Nil</td><td>Nil</td></tr>
<tr><td>4</td><td>Service building/ Mine Infrastructure</td><td>114.40</td><td>114.40</td></tr>
<tr><td>5</td><td>Coal dump</td><td>Nil</td><td>Nil</td></tr>
<tr><td>6</td><td>Homestead Land</td><td>128.50</td><td>128.50</td></tr>
<tr><td>7</td><td>Agricultural Land</td><td>480.75</td><td>480.75</td></tr>
<tr><td>8</td><td>Forest Land</td><td>80.44</td><td>80.44</td></tr>
<tr><td>9</td><td>Plantation</td><td>33.93</td><td>52.45</td></tr>
<tr><td>10</td><td>Water Body</td><td>74.25</td><td>74.25</td></tr>
<tr><td>11</td><td>Barren Land</td><td>1118.52</td><td>1100.00</td></tr>
<tr><td>12</td><td>Fire area</td><td>Nil</td><td>Nil</td></tr>
<tr><td>13</td><td>Others (rail/road)</td><td>32.66</td><td>32.66</td></tr>
<tr><td></td><td>Total</td><td>2063.45</td><td>2063.45</td></tr>
</table>
Area for each site of the well is about 80m x 80m and for the generating station is 80m x 100m. The Area was barren initially and at present infrastructure has been developed in the area. After closure abandonment of the project the sites will be reclaimed technically and biologically.</td></tr>
</table>

<table>
<tr><th>Sl.No.</th><th>Information/Checklist confirmation</th><th>Yes/ No</th><th>Details thereof (with approximate quantities /rates, wherever possible) with source of information data.</th></tr>
<tr><td></td><td></td><td></td><td>(Source = As per details and record available at Colliery Office)</td></tr>
<tr><td>1.2</td><td>Clearance of existing land, vegetation and buildings?</td><td>No</td><td>The Area was barren initially. No vegetation and building clearance was required.</td></tr>
<tr><td>1.3</td><td>Creation of new land uses?</td><td>Yes</td><td>Land use is as per details given in Point No. 1.1. No change in land use pattern is envisaged.<br><br>(Source = As per details and record available at Colliery Office)</td></tr>
<tr><td>1.4</td><td>Pre-construction investigations e.g. bore holes, soil testing?</td><td>Yes</td><td>The details of pre-construction investigations are as under :<br><table><tr><th>Name of Mine</th><th>No. of boreholes</th><th>Borehole Density</th></tr><tr><td>Moonidih</td><td>86</td><td>5.70 nos /sq. km.</td></tr></table><br>(Source = As per details and record available at Colliery Office)</td></tr>
<tr><td>1.5</td><td>Construction works?</td><td>No</td><td>The following construction work for CBM demonstration project has been done at the well site<br>• Construction and preparation of pilot cum production well drill<br>site of dimensions 80m X 80m.<br>• Construction of cellar pit of dimensions 1.5mX1.5mX1.5m for<br>placing of well head .<br>• Guard room, store room and a Multipurpose room.<br>No further construction work is proposed at the site.</td></tr>
<tr><td>1.6</td><td>Demolition works?</td><td>No</td><td>No Demolition work is proposed.</td></tr>
<tr><td>1.7</td><td>Temporary sites used for construction works or housing of construction workers?</td><td>No</td><td>No temporary housing at the site for construction workers is proposed.</td></tr>
<tr><td>1.8</td><td>Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations</td><td>No</td><td>Not Applicable</td></tr>
</table>

| Sl.No. | Information/Checklist confirmation | Yes/ No | Details thereof (with approximate quantities /rates, wherever possible) with source of information data. |
|---|---|---|---|
| | | | |
| 1.9 | Underground works including mining or tunneling? | No | Well holes are already drilled in the CBM demonstration project. |
| 1.10 | Reclamation works? | Yes | After closure abandonment of the project the sites will be reclaimed technically and biologically. |
| 1.11 | Dredging? | No | Not Applicable. |
| 1.12 | Offshore structures? | No | Not Applicable. |
| 1.13 | Production and manufacturing processes? | Yes | Coal bed Methane (CBM) gas will be produced. |
| 1.14 | Facilities for storage of goods or materials? | Yes | A store room is constructed on the well site for storage of equipments, lubricants etc. |
| 1.15 | Facilities for treatment or disposal of solid waste or liquid effluents? | Yes | No solid waste is generated from the well in the operational phase.<br>The solid waste generated during the drilling were disposed off as per guidelines.<br>At present about 5 to 10 M3 per day water is pumped out. The water is being treated and disposed after the initial treatment trough the cellar pit.<br>Domestic sewage is being treated in septic tanks & soak pits.<br>Waste oil generated from the pump is being sent to CPCB registered recyclers. |
| 1.16 | Facilities for long term housing of operational workers? | Yes | Housing facility has already been provided to the operational workers in all the operating projects in accordance with the company norms.<br><br>*(Source = As per details and record available at Colliery Office)* |
| 1.17 | New road, rail or sea traffic during construction or operation? | No | Not required |

| Sl.No. | Information/Checklist confirmation | Yes/ No | Details thereof (with approximate quantities /rates, wherever possible) with source of information data. |
|---|---|---|---|
| 1.18 | New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc? | No | Not required |
| 1.19 | Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements? | No | Not required |
| 1.20 | New or diverted transmission lines or pipelines? | No | Not required |
| 1.21 | Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers? | No | Not required |
| 1.22 | Stream crossings? | No | Not required |
| 1.23 | Abstraction or transfers of water from ground or surface waters? | Yes | At present about 5 to 10 M3 per day water is pumped out. The water is being treated and disposed after the initial treatment trough the cellar pit. *(Source = As per details and record available at Colliery Office)* |
| 1.24 | Changes in water bodies or the land surface affecting drainage or run-off? | No | Not Applicable |
| 1.25 | Transport of personnel or materials for construction, operation or decommissioning? | Yes. | Transport of materials is being done through trucks, jeep *etc.* Personnel are transported by the public / personal conveyance or conveyance provided by the Company. *(Source = As per the data and records available in colliery office)* |
| 1.26 | Long-term dismantling or decommissioning or restoration works? | No | After closure abandonment of the project the sites will be reclaimed technically and biologically. |

| Sl.No. | Information/Checklist confirmation | Yes/ No | Details thereof (with approximate quantities /rates, wherever possible) with source of information data. |
|---|---|---|---|
| 1.27 | Ongoing activity during decommissioning which could have an impact on the environment? | No. | Ongoing activity during decommissioning will have an impact on the environment |
| 1.28 | Influx of people to an area in either temporarily or permanently? | No | - |
| 1.29 | Introduction of alien species? | No | - |
| 1.30 | Loss of native species or genetic diversity? | No | - |
| 1.31 | Any other actions? | No | No other actions are proposed. |

2. **Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):**

| Sl. No. | Information/checklist confirmation | Yes/No | Details thereof (with approximate quantities /rates, wherever possible) with source of information data |
|---|---|---|---|
| 2.1 | Land especially undeveloped or agricultural land (ha) | Yes | The three well sites of each 80mx80m, its infrastructures of size 80m x 100m and approach roads have been developed over barren land *(Source = As per details and record available at Colliery Office)* |
| 2.2 | Water (expected source & competing users) unit: KLD | No | No water is required for operation of the gas wells at present<br><br>(Source = As per details and record available at Colliery Office) |
| 2.3 | Minerals (MT) | Yes | The three gas wells were developed with an expected capacity of 15000$m^3$ of CBM per day |
| 2.4 | Construction material – stone, aggregates, sand / soil (expected source – MT) | No | No additional constructions have been proposed. |

| Sl. No. | Information/checklist confirmation | Yes/No | Details thereof (with approximate quantities /rates, wherever possible) with source of information data |
|---|---|---|---|
| 2.5 | Forests and timber (source – MT) | No | - |
| 2.6 | Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW) | No | - |
| 2.7 | Any other natural resources (use appropriate standard units) | No | ---- |

**3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 3.1 | Use of substances or materials, which are hazardous (as per MSIHC Rules) to human health or the environment (flora, fauna and water supplies). | No | Spent oil aforesaid are being taken care of as per Hazardous Waste (Management & Handling) Rules, 1989 and 2003 and sent to stores for disposal through authorized agents.<br><br>*(Source = As per details and record available at Colliery Office)* |
| 3.2 | Changes in occurrence of disease or affect disease vectors (*e.g.* insect or water-borne diseases) | No | ---- |
| 3.3 | Affect the welfare of people *e.g.* by changing living | No | The project have positive impact on the underground mining conditions and increases safety. The gas generated is being used for producing electricity. |

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| | conditions? | | Which has a positive impact on the living conditions of the local people. |
| 3.4 | Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc., | No | ---- |
| 3.5 | Any other causes. | No | ---- |

**4. Production of solid wastes during construction or operation or decommissioning (MT/month).**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 4.1 | Spoil, overburden or mine wastes. | No | Not Applicable |
| 4.2 | Municipal waste (domestic and or commercial wastes). | No | No municipal waste is generated |
| 4.3 | Hazardous wastes (as per Hazardous Waste Management Rules). | Yes | Spent oil are being taken care as per Hazardous Waste (Management & Handling) Rules, 1989 and 2003 and sent to stores for disposal through authorized agents. *(Source = As per details and record available at Colliery Office)* |
| 4.4 | Other industrial process wastes | No | Not Applicable |
| 4.5 | Surplus product | No | Not Applicable |
| 4.6 | Sewage sludge or other sludge from effluent treatment. | No | Not Applicable |
| 4.7 | Construction or demolition wastes | No | Not Applicable |
| 4.8 | Redundant machinery or equipment | No | Not Applicable |
| 4.9 | Contaminated soils or other materials | No | Not Applicable |
| 4.10 | Agricultural wastes | No | Not Applicable |

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 4.11 | Other soil wastes | No | Not Applicable |

5. **Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 5.1 | Emissions from combustion of fossil fuels from stationary or mobile sources. | No | Preventive maintenance of vehicles will be ensured to mitigate any possible impact that may arise during their operations. Individual transport equipment is being maintained to comply with the emission norms. The emissions of $SO_2$ & $NO_X$ from diesel operated trucks, tippers are insignificant.<br><br>*(Source =As per details and record available at Colliery Office)* |
| 5.2 | Emissions from production processes. | Yes | Gas produced from the wells is used to produce electricity. $CO_2$ is generated from the gas based generators. |
| 5.3 | Emissions from materials handling including storage or transport. | No | As the CBM demonstration project is in operation, only limited material handling /transportation is envisaged to sustain the process of gas generation. |
| 5.4 | Emissions from construction activities including plant and equipment. | No | Not Applicable. |
| 5.5 | Dust or odors from handling of materials including construction materials, sewage and waste. | No | Not Applicable. |
| 5.6 | Emissions form incineration of waste. | No | Not Applicable. |
| 5.7 | Emissions from burning of waste in open air (e.g. slash | No | Not Applicable. |

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| | materials, construction debris). | | |
| 5.8 | Emissions from any other sources. | No | Not Applicable. |

**6. Generation of Noise and Vibration and Emissions of Light and Heat:**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 6.1 | From operation of equipment e.g. engines, ventilation plant, crushers. | Yes | Noise and vibrations is generated from the gas based generated. However the generators are located away from the habitations and are enclosed so their impact is negligible. |
| 6.2 | From industrial or similar processes. | No | Not Applicable. |
| 6.3 | From construction or demolition. | No | Not Applicable. |
| 6.4 | From blasting or drilling | No | Not Applicable. |
| 6.5 | From construction or operational traffic. | Yes | Movement of vehicular traffic on the site approach & access roads will result in increased noise levels. However, taking into account movement of very minimum No. of vehicles per day on an average no potential impact to this regard is envisaged. |
| 6.6 | From lighting or cooling systems | No | Not Applicable. |
| 6.7 | From any other sources. | No | Not Applicable. |

7. **Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 7.1 | From handling, storage, use or spillage of hazardous materials. | Yes | Hazardous materials like spent oil are disposed off as per the existing Rules & Guidelines of Hazardous Waste (Management & Handling) Rules, 1989 and 2003 and sent to stores for disposal through authorized agents.<br><br>*(Source = As per details and record available at Colliery Office)* |
| 7.2 | From discharge of sewage or other effluents to water or the land (expected mode and place of discharge) | Yes | 5 to 10 M3 per day water is coming out during the operation of the well pump which is adequately treated and disposed/recycled in compliance with regulatory requirements. |
| 7.3 | By disposition of pollutants emitted to air into the land or into water. | No | Considering the potential air emissions from the project activities like emissions from the generators and vehicular<br>movement, any resultant contamination of land or water is not envisaged. |
| 7.4 | From any other sources. | No | Not Applicable. |
| 7.5 | Is there a risk of long term buildup of pollutants in the environment from these sources? | No | Not Applicable. |

8. **Risk of accidents during construction or operation of the Project, which could affect human health or the environment.**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 8.1 | From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances. | No | Possible risks associated with the CBM demonstration project is that of fire while handling methane at well facility,<br>while handling transporting through pipe lines Appropriate risk control measures are being implemented. |
| 8.2 | From any other | No | Not Applicable. |

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| | causes. | | |
| 8.3 | Could the project be affected by natural disasters causing environmental damage (*e.g.* floods, earthquakes, landslides, cloudburst etc.)? | Yes | The area does not have any previous flood history in the near past.<br>The cluster is falling within the seismically active Zone-III. |

**9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality.**

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 9.1 | Lead to development of supporting, facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g. | Yes | Economic growth associated with project activity leads to semi urban like development. This supports development of ancillary and supporting industries and other related activities. |
| | Supporting infrastructure (roads, power supply, waste or waste water treatment etc.). | Yes | Housing, roads, power supply, water supply & other community facility improved. |
| | • Housing development | Yes | Housing facility with market and basic amenities is existing. |
| | • Extractive industries | Yes | Ancillary & supply industries have developed which in turn generated employment in directly and lead to growth in income generation. |
| | • supply industries | Yes | |
| | • other | No | Not Applicable |
| 9.2 | Lead to after-use of the site, which could have an impact on the environment. | Yes | Community development like health care facilities, educations facilities & Self Employment Scheme will improve the quality of life.<br><br>Beyond this, physically and biologically reclaimed land would undergo transformation over time which would have positive impact on environment. |
| 9.3 | Set a precedent for later developments. | Yes | Activities at 9.1 & 9.2 above do culminate in conjunction with local set up and in a number of cases has set precedence of economic development leading to overall socio-economic growth of the area. |

| Sl. No. | Information / Checklist confirmation | Yes / No. | Details thereof (with approximate quantities / rates, wherever possible) with source of information data. |
|---|---|---|---|
| 9.4 | Have cumulative effects due to proximity to other existing or planned projects with similar effects. | Yes | Coal occurs in layers continuously for long distances. Associated mining activity with numerous such closely located centers as indicated at 9.1, 9.2 and 9.3 along with other activities could have cumulative impact. *(Source = As per details and record available at Colliery Office)* |

**III) Environmental Sensitivity**

| Sl. No. | Areas | Name / Identity | Aerial distance (within 15 Km.) Proposed project location boundary. |
|---|---|---|---|
| 1 | Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value. | Yes | The details of Reserve/Protected forest is as under:<br>▪ Brindavanpur PF is 9.0 kms away<br>▪ Mayrakuli protected forest is 9 Kms away.<br>▪ Topchachi Reserve Forest is 5.5 Kms away.<br>▪ Dhangi RF is 14 kms away.<br>*(Source Topo sheet no: 73 I/2, 73 I/6)* |
| 2 | Areas which are important or sensitive for ecological reasons – wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests. | Yes | ▪ River Damodar is at the southern periphery.<br>▪ Bansjora nallah at the western boundary.<br>▪ Kari jore at the eastern boundary.<br>*(Source Topo sheet no: 73 I/2, 73 I/6)* |
| 3 | Area used by protected, important or sensitive species of flora or fauna for breeding, resting, foraging, resting, over wintering, migration. | No | Not Applicable. |
| 4 | Inland, coastal, marine or underground waters. | No | Not Applicable. |
| 5 | State, National | No | Not Applicable. |

| Sl. No. | Areas | Name / Identity | Aerial distance (within 15 Km.) Proposed project location boundary. |
|---|---|---|---|
| | boundaries. | | |
| 6 | Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas. | Gomoh-Adra line (SER)<br>NH-2<br>NH-32 | 2.0 kms<br><br>11 Kms<br>Passes through the LH of Moonidih colliery<br>*(Source Topo sheet no: 73 I/2, 73 I/6)* |
| 7 | Defense installations | No | Not Applicable. |
| 8 | Densely populated or built-up area | Jharia<br>Dhanbad | 4.0 kms<br>6.0 kms<br>*(Source Topo sheet no: 73 I/2, 73 I/6)* |
| 9 | Areas occupied by sensitive man-made land uses (*hospitals, schools, places of worship, community facilities*). | Yes | Hospitals, Schools, Places of warship, Community facilities exist in general in and around the cluster. |
| 10 | Areas containing important, high quality or scarce resources (*ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals*). | No | Not Applicable. |
| 11 | Areas already subjected to pollution or environmental damage. (*those where existing legal environmental standards are exceeded*) | No | Not Applicable. |
| 12 | Areas susceptible to natural hazard which could cause the project to present environmental problems. (*earthquakes, subsidence, landslides, erosion,* | No | The area does not have any previous flood history in the near past.<br>The cluster is falling within the seismically active Zone-III. |

| Sl. No. | Areas | Name / Identity | Aerial distance (within 15 Km.) Proposed project location boundary. |
|---|---|---|---|
| | *flooding or extreme or adverse climatic conditions*). | | |

## (IV) Proposed Terms of Reference for EIA studies

Following aspects are proposed to be covered in the EIA/ EMP document:-

1 Location map showing Moonidih mine, CBM Block and Demonstration Project boundaries along-with major surface features like road, rail line, surface water bodies, pits etc.

2. The buffer zone will comprise of 10 kms zone around the Moonidih mine lease area.
3. Present land use of core zone (Moonidih LH area) as per our record and by satellite imagery for buffer zone.
4. Description of the technology used for the project and allied activities.
5. Detail of the gas collection, transportation and its end use
6. A site plan showing the areas earmarked for various activities for the project.

**Baseline studies**

1. List of flora and fauna in the core and buffer zones with conservation measures as per recent survey of the block.
2. Description of the present environmental scenario based on one-season (non-monsoon) primary base-line data of core and buffer Zone on Ambient Air Quality (SPM, $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_X$), Water Quality, Noise Level, Soil Characteristics, and Socio-economic study.
3. Detailed Hydro-geological studies covering the entire block for ground water clearance from Central Ground Water Authority and also to study the impact of the project on ground water resources. The same shall form part of the EMP.

4. Water balance study showing the impact of pumping of ground water (if any) and its discharge into surface water bodies.
5. Incremental impact on following components of environment due to increase in production-

    i) Air including noise
    ii) Water
    iii) Soil
    iv) Flora & Fauna
    v) Socio-economic scenario

    Air quality impact modeling will be done by using ISCST3 model for the entire cluster taking into account the incremental impact from the project and predicting the increase in $PM_{10}$ levels *vis-a-vis* known levels as on date. Isopleths showing the resultant $PM_{10}$ levels over the whole block shall be drawn.

6. Impact due to noise and vibration.
7. Environmental management plan for mitigation of impacts.
8. Detail of health-care facilities available for local population.
9. Safety and risk-analysis study.
10. Brief description of profiles of various agencies involved in the preparation of the EIA/EMP report.
11. Contain an organizational structure for implementation of the control measures.
20. Status of Ground-water clearance, Project Approval of BCCL Board etc where applicable.
21. The generic structure of the EIA will be based on the guidelines as per EIA Notification, 2006.

I hereby give undertaking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance given, if any to the project will be revoked at our risk and cost.

Date:

Place:

10/3/15

Shri S.K. Mukhopadhyay,
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