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***Mines and  
Minerals  
Development  
(Package # 07)  
Hydrocarbon  
Unit  
Final Report***

30 December, 2013



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## Important Notice

*This report has been prepared for Hydrocarbon Unit, EMRD, Government of the People's Republic of Bangladesh in accordance with the terms of our engagement contract for Mines and Minerals Development (Package#07) dated 16<sup>th</sup> June 2011 and for no other purpose. We do not accept or assume any liability or duty of care for any other purpose or to any other person to whom this report is shown or into whose hands it may come save where expressly agreed by our prior consent in writing.*

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*We would also like to sincerely thank all the participants of the Workshop held from October 02-05, 2011, to capture views of several stakeholders in Bangladesh Mineral Sector and Academicians from Universities on suitable Mineral Resource Classification System for Bangladesh and legal and regulatory regime for administering mineral sector in Bangladesh.*

*Further, we would like to thank all the participants of the Workshop on Mineral Resources Assessment held on September 04, 2012, Workshop on Coal Sector Development Strategy and Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects held on September 05, 2012 and Training on Barapukuria Mine Operations Review and Recommendations held on September 06, 2012 for their valuable views.*

*In addition, we would like to thank all the participants of the Workshop on finalisation of Draft Final Report on Mineral Resources Assessment, Coal Sector Development Strategy, Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects, Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements and Review of the existing Mining Act, Rules and Regulations and Recommendations held on August 26, 2013 at Petrobangla office for their valuable views. Without their participation, completion of these reports would have been difficult.*

*We would also like to thank all the participants of the meeting on acceptance of Final Report on Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects held on October 8, 2013 at meeting room of EMRD for their valuable comments.*

*Last but not the least, we would like to sincerely thank the IMC (Consultant to BCMCL) and Chinese National Machinery Import & Export Corporation (BCMCL's contractor) for according their permission to visit the Mine Site, collect data and for providing valuable guidance and inputs in carrying out this assignment and preparation of this report.*

*PricewaterhouseCoopers Pvt. Ltd.*

*Place: Hyderabad*

*Date: 30 December, 2013*

# Table of Abbreviations

<b>Abbreviation</b>	<b>Full Form</b>
<b>ADB</b>	Asian Development Bank
<b>AMD</b>	Acid Mine Drainage
<b>ARC</b>	Armoured Rear Conveyor
<b>ARD</b>	Airborne Respirable dust
<b>BAPEX</b>	Bangladesh Petroleum Exploration and Production Company Ltd. Company Ltd
<b>BB</b>	Bangladesh Bank
<b>BCMCL</b>	Barapukuria Coal Mining Company Limited
<b>BMD</b>	Bureau of Mineral Development
<b>BPDP</b>	Bangladesh Power Development Board
<b>CBM</b>	Coal Bed Methane
<b>CMC</b>	Chinese National Machinery Import & Export Corporation
<b>CPEF</b>	Coal Price Equalization Fund
<b>CRIRSCO</b>	Committee for Mineral Reserves International Reporting Standards
<b>DG</b>	Director General
<b>DGM</b>	Deputy General Manager
<b>EIA</b>	Environmental Impact Assessment
<b>EMRD</b>	Energy and Mineral Resources Division
<b>GDP</b>	Gross Domestic Product
<b>GNI</b>	Gross National Income
<b>GoB</b>	Government of Bangladesh
<b>GSB</b>	Geological Survey of Bangladesh
<b>GTDP</b>	Gas Transmission and Development Project
<b>HCU</b>	Hydrocarbon Unit
<b>IGF</b>	Intergovernmental Forum
<b>ILO</b>	International Labour Organization
<b>IMCL</b>	International Mining Consultants Limited
<b>IMF</b>	International Monetary Fund
<b>IRR</b>	Internal Rate of Return
<b>ISM</b>	Indian School of Mines, Dhanbad, India
<b>ISO-OHSAS</b>	International Organization for Standardization - Occupational Health and Safety Advisory Services

<b>Abbreviation</b>	<b>Full Form</b>
<b>LDT</b>	Lower Dupi Tila
<b>LTCC</b>	Longwall Top Coal Caving
<b>M&amp;P Contract</b>	Management Production and Maintenance Service Contract
<b>MGMCL</b>	Maddhapara Granite Mining Company Ltd
<b>MMDP</b>	Mines and Minerals Development Project
<b>MMMSD</b>	Mining, Minerals, Metals and Sustainable Development
<b>MMR</b>	Mines and Minerals Rules
<b>Mt</b>	Million Tonne
<b>NPV</b>	Net Present Value
<b>OH&amp;S</b>	Operations Health and Safety
<b>PME</b>	Periodical Mmedical Eexamination
<b>PPE</b>	Personal Protective Equipment
<b>PSC</b>	Profit Sharing Contract
<b>PSU</b>	Public Sector Unit
<b>PwC</b>	PricewaterhouseCoopers Pvt. Ltd., India
<b>R&amp;D</b>	Research and Development
<b>R&amp;R</b>	Rehabilitation and Resettlement
<b>REC</b>	Revised Cost Estimate
<b>S&amp;P</b>	Standard & Poor
<b>SDF</b>	Sustainable Development Framework
<b>SOP</b>	Standard Operating Procedure
<b>SSR</b>	Systematic Support Rule
<b>TEFS</b>	Techno-Economic Feasibility Study
<b>UCG</b>	Underground Coal Gasification
<b>UDT</b>	Upper Dupi Tila
<b>UNFC</b>	United Nations Framework Classification
<b>XMC</b>	Xuzhou Coal Mining Group Company Limited

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# 1. Introduction

## 1.1. Context

- 1.1.1. Bangladesh is one of the world's most densely populated countries with a modest per capita income (USD 700, IMF 2012). The country has posted a consistent growth of around 6% for past several years (IMF, 2007-12) despite the global recession. Its external debt is moderate (22.6% of GNI, 2011) and it has the second best credit rating in the region (BB- for long-term debt, S&P 2012).
- 1.1.2. Despite challenges, prospects in long-term are perceived bright. Bangladesh is seen as one of the next round of global growth leaders and is listed in "Next Eleven" (Goldman Sachs, 2007). The Government's vision document charts a growth rate of 10% by 2017 (Vision 2021). The Bangladesh GDP is expected to grow at 6% (ADB) during 2013-14 supported by revival of exports and improving industrial performance.
- 1.1.3. The primary energy consumption in Bangladesh is 24.3 Mtoe (2011) representing 0.2% of global primary energy consumption, against a global population share of about 2.4% (BP statistical review of World Energy, 2012). Similarly, the per capita power generation is low at 315 kWh (BPDB 2012-13) and electricity access covers only 60% of the population (BPDB 2012-13). This is low even in comparison with other South Asian countries.
- 1.1.4. The country's continued economic stability and growth will depend inter alia on its upgrading public infrastructure, in particular, the energy sector, transport, and urban development.
- 1.1.5. To achieve these objectives, Bangladesh needs to develop its domestic mineral resources to harness energy and infrastructure potential.
- 1.1.6. To assist development of Country's energy sector, Hydrocarbon Unit (HCU) was set up to act as a technical arm of the EMRD.
- 1.1.7. In this pursuit, Bangladesh has formulated policies to attract private sector and foreign investment in petroleum sector and in power generation. The Hydrocarbon Unit (HCU) in its role as the technical arm of the EMRD has been engaged in activities such as:
  - Reserve and resource estimation of the national oil and gas resources;
  - To establish a mini energy sector databank
  - Optimal gas utilization study, which includes long-term supply demand projection and utilization of natural gas;
  - Monitoring of production sharing activities for the Energy and Mineral Resources Division.
- 1.1.8. The Norwegian Government has extended a grant for the project "Strengthening of the Hydrocarbon Unit (Phase-II)", which is being administered by the Asian Development Bank (ADB) under the "Gas Transmission and Development Project (GTDP)". The EMRD advised HCU to include Mining activities in these initiatives towards developing the Mines & Minerals Sector, in particular, the Coal and Hard Rock aspects. Under this grant initiative, the Mines and Minerals Development Project (Package#07) was conceptualized.

## 1.2. The Project Objectives

- 1.2.1. PricewaterhouseCoopers Pvt. Ltd. (PwC) was appointed as the consultant for the Mines and Minerals Development Project (Package#07). PwC has undertaken this project along with sub-consultants from the Indian School of Mines (ISM) and the Infrastructure Investment Facilitation Company (IIFC), Bangladesh.
- 1.2.2. Contract for the project was signed on 16 June 2011 between HCU and PwC at Dhaka followed with project initiation on 20 June, 2011.
- 1.2.3. The objectives of the project, as indicated by the HCU (Annexure A: Description of Services listed in the Contract dated June 16, 2011) are:
  - **Mineral resources assessment:** This module of the project aims to assess the mineral resources (Coal including Peat and Hard Rock minerals) detailing the in-place and recoverable resources, discovered and potential remaining resources. This quantitative assessment would help in identifying the potential of the country in terms of energy production and infrastructure development from these mineral resources. The resource assessment will be conducted based on the results and information available from exploration and field studies conducted in past.
  - **Review of mining proposal/ operations:** The country's solitary coal mine at Barapukuria has faced several operational problems since inception. In this module, consultants will review the existing mining operations at Barapukuria coal mine to suggest measures to improve production from the current operations.
  - **Review the existing mining acts, rules, regulations:** The sustainable development of mineral resources requires a strong and effective mineral policy. The consultants will review the existing mining legislation, rules and regulations and identify key areas not covered in the existing mining law compared to other major mining geographies. This exercise is focused on review of the existing regulatory provisions and to provide recommendations for changes/new initiative for scientific development and exploitation of mineral resources with due emphasis on mineral conservation, safety and environmental protection.
  - **Strategy and Action Plan for development of coal and hard rock sector:** The coal and hard rock sectors in Bangladesh are largely underdeveloped. There is lack of investment from both public as well as private sector. The project aims to overcome this by developing an appropriate strategy and framework for public and private sector investments in these sectors. A sector development strategy will be prepared for systematic investment in the sector.

## ***1.3. The scope of work***

1.3.1. The scope of work for the project is as follows:

- To review the various reports on mineral resources assessment of hard rock and coal (including peat) in Bangladesh. Based on these reports and further analysis, prepare the mineral resources assessment report of hard rock and coal (including peat) detailing the in-place and recoverable resources, discovered and undiscovered as well as produced and remaining resources.
- To review the existing operations of the Barapukuria coal mine and give suggestions for its performance improvement by focusing on approach & methodology, deliverables and managing operation to achieve long-term cost efficiency.
- To review the existing mining acts, rules, regulations and recommend changes in them based on the study of the policies followed in the various mineral rich countries in the world.
- To develop coal sector development strategy (including peat) with appropriate enabling frameworks for public sector and for private sector participation and institutional arrangements for the sector..
- To recommend Action plan and guidelines for the relevant executing agency for sustainable development of Coal Bed Methane (CBM), Underground Coal Gasification (UCG) and Hard Rock projects.

## 2. Project Execution

### 2.1. Module 1

#### Mineral Resources Classification Systems - Suitability and Selection

##### *Activities carried out*

- 2.1.1. The objective of the phase was to select a suitable mineral resources and reserves classification and reporting system for assessment and classification of mineral resources of Bangladesh according to selected system.
- 2.1.2. To achieve these objectives, all the major Mineral Resources Classification systems prevalent globally were reviewed to assess their suitability for Bangladesh.
- 2.1.3. The activities undertaken for selection of suitable classification system and preparation of report are:
- Identification of mineral resources and reserves classification and reporting systems adopted by large mineral based economies like Australia, South Africa, USA, Canada, China, India and Chile.
  - Review of these mineral resources and reserves classification and reporting systems.
  - A comparative study of these classification systems.
  - Identification of key factors on the basis of which the classification system was adopted in these countries.
  - Appraisal of the parameters identified in the context of Bangladesh mineral sector.
  - Identification and selection of the classification system and its justification and consultation with various stakeholders.

##### *Workshop on Mineral Classification and Reporting System*

- 2.1.4. A workshop was held on October 5, 2011 in Dhaka at the office of HCU as a part of Module 1, Mines and Minerals Development Project (Package #07) to facilitate the selection of suitable classification system for the mineral resources of Bangladesh. The workshop was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.
- 2.1.5. A presentation was made by consulting team in the workshop on the different mineral resources and reserves classification and reporting systems. Key factors on the basis of which any classification system was evaluated and adopted and key factors differentiating these mineral resources classification and reporting systems were identified and a comparative study of the same was presented to stakeholders. The presentation discussed the evolution and applications of CRIRSCO Style Codes and UNFC Classification systems along with comparative advantages and disadvantages of these systems.
- 2.1.6. In addition to this, the presentation also highlighted the harmonization between these codes to meet the purposes of comparability and compatibility of different categories of mineral resources and reserves for national and international reporting.

- 2.1.7. The invitees from EMRD, HCU, Petrobangla, BMD, BCMCL, various stakeholders and representatives from the various educational institutes expressed their viewpoints on the Mineral Resource Classification and Reporting System to be adopted in Bangladesh.
- 2.1.8. Based on the presentation and consultation with various stakeholders, UNFC System for classification and reporting of mineral reserves and resources with suitable modification was adopted unanimously for Bangladesh as a common system to report mineral inventory of Bangladesh.

## Mineral Resources Assessment

### *Activities carried out*

- 2.1.9. In this phase of engagement, the aim was to carry out the Mineral resources assessment of Coal, Peat and Hard rock resources of Bangladesh based on the existing exploration data and results available and classify them in accordance with the UNFC system of classification and reporting (selected system).
- 2.1.10. The activities which were carried out in the preparation of this report are:
- Collection of the available geological data, geological reports, exploratory study reports and feasibility study reports related to the Coal, Peat and Hard rock resources of Bangladesh for various deposits.
  - Studying the geology of the Coal, Peat and Hard rock bearing areas of Bangladesh and understanding the level of geological confidence of these areas based on the study of exploration study reports and feasibility study reports already available.
  - Analyzing the geological information collected to assess the mineral resources of coal and hard rock existing in Bangladesh.
  - Carrying out assessment of mineral resource of the Coal, Peat and Hard rock deposits of Bangladesh where resource data are available and classifying them as per the UNFC System of Classification.

### *Site Visits/Meetings*

- 2.1.11. The consulting team conducted site visits/meetings for the purpose of data collection for mineral resources assessment from various agencies and for holding discussions with HCU and other stakeholders. The table below summarizes the details of the site visits/meetings held:

Duration of the Visit	Purpose of the Visit	Meetings held with	Team Members
<b>September 24, 2011 to October 06, 2011</b>	Data collection from various agencies and holding discussions/meetings from the perspective of mineral resources assessment of coal, peat and hard rock	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> <li>• IMC Group</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof. U.K. Singh</li> <li>• Prof S. Chaudhuri</li> <li>• Neeraj Kumar</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> </ul>

			<ul style="list-style-type: none"> <li>• Md. Maqbul-E-Elahi</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> </ul>
<b>November 26, 2011 to December 01, 2011</b>		<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> <li>• Officials of MGMCL</li> <li>• BCMCL Mining Contractor, XZMC</li> <li>• IMC Group</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• Nazrul Islam</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>
<b>August 25, 2012 to September 06, 2012</b>	Holding discussions/meetings, conducting workshops from the perspective of mineral resources assessment of coal, peat and hard rock	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> <li>• Officials of MGMCL and participants from academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• Kameswara Rao</li> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof S. Chaudhuri</li> <li>• B.K. Saha</li> <li>• Nazrul Islam</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>

**Table 1: Details of Site Visits/Meeting for the purpose of mineral resource assessment**

### *Workshop on Mineral Resources Assessment*

- 2.1.12. A workshop was held on September 04, 2012 in Dhaka at the office of HCU as a part of the Module 1, Mines and Minerals Development Project (Package #07). The workshop was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.
- 2.1.13. A presentation was made by consulting team in the workshop on the mineral resources assessment carried out for the coal, peat and hard rock deposits of Bangladesh.
- 2.1.14. The presentation briefed comparison of different mineral resources classification systems studied. Further, consulting team presented UNFC systems of mineral resources classification and reporting (selected system) in detail covering various parameters considered for classification of mineral resources under the system to classify coal, peat and hard rock resources. The methodology adopted for assessment of mineral resources for coal and hard rock based on the existing geological data and report and findings were discussed.

- 2.1.15. Further, the team presented the assessment of resources of coal and hard rock as per UNFC system for various identified coal fields and hard rock areas of Bangladesh.
- 2.1.16. The presentation by consulting team was followed by presentation of representative from GSB briefing GSB's viewpoints on resource assessment, classification and data repository. In the presentation GSB also presented challenges faced and issues to be dealt in implementing UNFC system.
- 2.1.17. The invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes expressed their viewpoints on the Mineral Resources Assessment of the coal, peat and hard rock deposits of Bangladesh.
- 2.1.18. Subsequently, a presentation on "Mineral Resources Assessment" was made by IIFC local consultants on 18 June 2013 at Bangladesh Secretariat in presence of HCU, Petrobangla, EMRD and GSB under the Chairmanship of Hon. State Minister, Ministry of Power, Energy and Mineral Resources.
- 2.1.19. The major points made during the presentation were on Mineral Resources Assessment on five coal fields of Bangladesh, viz., Barapukuria Coal field, Phulbari Coal field, Khalashpir Coal field, Jamalganj Coal field and Dighipara Coal field adopting UNFC system of classification. Further discussion on peat resources of Bangladesh was also made.
- 2.1.20. Final workshop on module for Mineral Resources Assessment was held on August 26, 2013 in Dhaka at the office of Petrobangla. The workshop was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.
- 2.1.21. During this workshop, concept and importance of UNFC based classification system was explained and distribution of coal, peat and hard rock under various categories like Proved Mineral Resources, Probable Mineral Resources in accordance to the UNFC based classification system was presented based on final findings.
- 2.1.22. Lastly, recommendations were made such as:
- Detailed exploration needs to be carried out in the Barapukuria coal basin so as to ascertain the coal reserves.
  - Develop an appropriate mining technology for exploiting the resource of VI seam in the 'open area' in the northern part of Barapukuria mine so that the estimates of recoverable reserve in this area can be firmed up.
  - Intensive exploration work is necessary in all the basins except in Barapukuria and Phulbari basin to upgrade the resource base to measured/proved category.

## ***2.2. Module 2***

### **Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements**

#### ***Activities carried out***

- 2.2.1. The aim of this phase of engagement was to review existing mining operations at Barapukuria coal mine and suggest measures to improve its operational efficiency, operational performance and production. The key areas identified for review of mining operations were based on the discussions held during inception stage and in subsequent meetings and visits including site visits during the course of engagement.
- 2.2.2. The activities which were carried out for the preparation of this report are:

- Collection of data and information related to existing mining operations like TEFS, mining plan, geological information, data related to operations, ventilation, safety etc. subject to the same being made available by BCMCL and other agencies.
- Interaction with BCMCL officials and officials of its consultant IMC and Contractor CMC-XMC Consortium during site visits
- Reviewing the present mining operations in the first slice of Seam VI of Barapukuria coal mine.
- Commenting on the suitability of mining method for mining at the Southern extension of the coal seam.
- Commenting on the suitability of introducing Longwall Top Coal Caving method for second slice of Seam VI.
- Commenting on mining method for coal seams above Seam VI, based on the studies already conducted.
- Commenting on the suitability of operating the Northern extension by opencast mining method, based on the studies already conducted.

### *Site Visits/Meetings*

2.2.3. The consulting team has conducted site visits and meetings with officials of various agencies for the purpose of Review of the existing mining operations of the Barapukuria Coal Mine, holding discussions with HCU, BCMCL and other stakeholders. The table below summarizes the details of the site visits/meetings held:

Duration of the Visit	Purpose of the Visit	Meetings held with	Team Members
<b>September 24, 2011 to October 06, 2011</b>	Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Manager Operations, BCMCL</li> <li>• Department of ventilation and surveying, BCMCL</li> <li>• Geology Department, BCMCL</li> <li>• Manager, Mining BCMCL</li> <li>• IMC Group</li> <li>• CMD, BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. D.C. Panigrahi</li> <li>• Prof S. Chaudhuri</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Md. Maqbul-E-Elahi</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> </ul>
<b>November 26, 2011 to December 01, 2011</b>		<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Kick off Meeting with officials of BCMCL</li> <li>• Department wise meeting with mining officials of BCMCL</li> <li>• BCMCL Mining Contractor</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>

		<ul style="list-style-type: none"> <li>• IMC Group (BCMCL's consultant)</li> </ul>	
<b>August 25, 2012 to September 06, 2012</b>	Holding discussions/meetings, conducting training sessions on Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> <li>• Officials of MGMCL and participants from academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• Prof S. Chaudhuri</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>
<b>January 06, 2012 to January 13, 2012</b>	Site review and data collection for Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements from BCMCL	<ul style="list-style-type: none"> <li>• Officials of BCMCL</li> <li>• MD, BCMCL</li> <li>• IMC Group (BCMCL's consultant)</li> <li>• BCMCL Mining Contractor</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• Prof S. Chaudhuri</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>

**Table 2: Details of Site Visits/Meeting for the purpose of Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements**

### *Training Session*

- 2.2.4. After the submission of Report on Review of existing mining operations of Barapukuria coal mine and recommendations, consulting team conducted a training session on the same. The training session was held on September 06, 2012 in Dhaka at HCU office as a part of the Module 2, Mines and Minerals Development Project (Package #07). The training session was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.
- 2.2.5. A presentation was made by consulting team in the training session on the Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements. The presentation discussed various recommendations made in the report and necessary actions which are required to be taken to improve production from the mine.
- 2.2.6. The Consulting team also discussed various initiatives which need to be taken for improving safety of mining operations, persons employed and increase production level from the mine.
- 2.2.7. The consulting team also discussed various points/comments raised by BCMCL on the draft report submitted by consulting team and clarified various issues to arrive at a common view for finalizing the report.
- 2.2.8. Some of the key comments and recommendations made in the report and during training session are as follows:
- (i) **Suitability of LTCC method:** Various studies were suggested for the adoption of LTCC method of mining such as:
    - a. Height of fracture zone and safe thickness of coal/rock parting above VI seam to prevent disturbance to the UDT aquifer horizon should be established

- b. Support resistance required at the longwall face in LTCC method in 2<sup>nd</sup> and subsequent slices
  - c. Quantum of flow of water from Gondwana aquifer in the goaf of 2<sup>nd</sup> and subsequent slices worked by LTCC method.
  - d. Further, a detailed Techno-economic feasibility study was also proposed to be carried out for successful application of this method of mining, suiting the geological conditions of the Barapukuria coal basin.
- (ii) Improvement of mine environment, ventilation, method of mining, percentage of extraction, establishing hydrogeology, detailed exploration were other areas where recommendations were made for further improvement.
- 2.2.9. The report also discussed various options for future operations in the mine. The key recommendations made for future operations are as follows:
- (i) **Feasibility of opencast mining of VI seam in open window area:** Considering the favorable stripping ratio of coal in open window area and the grade of coal, Open cast method of mining was suggested. However, considering various constraints in any Open cast mining, several studies which need to be conducted were suggested such as, slope stability of highwall as well as dump area, ground bearing capacity for large sized equipment, initial excavation dumping area, effect on water aquifer, additional drilling to ascertain the nature of coal seam and development of a detailed Techno-economic feasibility study. In addition to these studies, commencement of Open cast mining shall also be given due importance considering the ongoing underground mining in the nearby area.
  - (ii) **Mining of VI Seam in southern side of south district:** Various studies were recommended for carrying out underground mining activity in this area including undertaking further exploration to establish coal reserves.
  - (iii) **Mining of upper seams above Seam VI:** It was recommended during the presentation to carry out detailed exploration of this area and prepare a detailed TEFr before carrying out mining in this area. It was also suggested that the commencement of mining of these seams should only begin after completing Seam VI and stabilization of strata above.
- 2.2.10. **Feasibility of adopting stowing:** It was recommended to carry out a comparative study, involving safety, total extraction percentage and overall economics, between the proposed LTCC, conventional longwall mining and stowing in ascending order of mining. In addition, various studies were also recommended for establishing feasibility of stowing in Barapukuria coal mine.
- 2.2.11. The invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes expressed their viewpoints on the recommendations made and the actions which need to be taken.

### *Workshop on Finalisation of Report on Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements*

- 2.2.12. A workshop was conducted on the module “Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements” on August 26, 2013 in Dhaka at the office of Petrobangla. The workshop was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.

2.2.13. A presentation was made by the consulting team on various aspects of the module such as Scope of study, studies and analyses made for the development of Barapukuria coal mine including other areas of improvements such as:

- Suitability of Longwall Top Coal Caving (LTCC) Method
- Feasibility of opencast mining of VI seam in open window area
- Mining of VI Seam in southern side of south district
- Mining of upper seams above Seam VI
- Feasibility of adopting stowing for mining of Seam VI

2.2.14. The consulting team also presented views on various areas of improvements and provided detailed recommendations. Some of these are discussed below:

- (i) **Exploration:** Recommendations were made for further detailed exploration of the complete Barapukuria coal basin which is necessary for up-gradation of reserves presently categorized under Rank 'C'.
- (ii) The upper seams (seams I, II, III, IV and V) are also not adequately explored. Most of the areas of the upper seams occur vertically above the present mining area of Seam VI. Therefore, exploration of these seams should be taken up later after depletion of Seam VI to avoid problems during drilling due to ground movement arising out of mining in Seam VI.
- (iii) **Hydrogeology:** In addition to recommendations made for LTCC method to be supplemented with pumping capacity and use of long hole underground directional drilling machines for safely draining out water under pressure in advance in case of necessity, major suggestion was made to carry out Detailed studies to be carried out through modeling, preferably numerical modeling or any other suitable method, to review the application of LTCC method of mining to predict its impact on the overall stability of the mine and quantity of water inflow into the mine due to unstable conditions arising out of movement/caving of the overlying ground above Seam VI.
- (iv) **Method of Mining:** Recommendation was made for considering and planning for the complete coal block in totality rather than seam wise/slice wise approach.
- (v) Recommendation was also made for carrying out detailed scientific studies for comparing descending slices with caving (for conventional multi-slicing method and LTCC method separately) and ascending slices with hydraulic sand stowing (for conventional multi-slicing with barrier between panels). Primarily this study may result in increase in percentage extraction from the coal mine in case of stowing found to be techno-economically feasible.
- (vi) **Underground mine environment:** As Barapukuria coal mining operations face issues related to Underground mine environment such as heat, humidity, ventilation and spontaneous combustion, recommendations were made to improve upon the existing conditions such as carrying out ventilation survey of the complete developed and extracted mine in totality, carrying out Simulation using the ventilation network model to fix a suitable location of an additional ventilation shaft to reduce the air travel distance, minimize pressure loss and improve ventilation, Ventilation system to be reorganized in such a way that the ventilation pressure requirement of the system is the minimum, properly channelizing mine out-flow water, proper sealing of worked out panels and timely monitoring and in case the fire activity is increasing, inertisation of the goaf areas to be adopted. Recommendations were also made to carry out extensive R&D for improving Underground mine environment, fresh studies to be carried out on the proximate analysis, maceral content, cleat intensity and extension, thermal

conductivity of roof and floor rocks and crossing point and setting of well equipped ventilation laboratory belonging to BCMCL.

- (vii) Other recommendations were made on improving mine safety and targeting on Management capacity building.

## **2.3. Module 3**

### **Review of the existing Mining Act, Rules and Regulations and Recommendation**

#### *Activities carried out*

2.3.1 The aim of this exercise was to review the existing Mining Act, Rules and Regulations and recommend amendments to existing laws/enacting new laws, rules, and regulations for administering the mining sector in line with the global development and regulatory changes in the key mining countries. This report has been prepared based on review of legislations governing mineral sector in Bangladesh to identify the need for changes in the provisions, considering the emerging need of sustainable development of mineral sector. The legislations governing mineral sector in Bangladesh and which are reviewed in this report are as follows:

- The Mines Act, 1923 (as amended in year 2005)
- The Mines and Mineral Resources (Control and Development) Act, 1992
- The Mines and Mineral Rules, 1968 (as amended in years 1989, 1995, 1999, and 2004)
- The Mines and Mineral Rules 2012.

Other laws having potential impact on mining sector have also been discussed in brief.

2.3.2 Key activities undertaken to achieve aims of this exercise and prepare the report making recommendations for changes in legislations and regulatory framework of Bangladesh are as follows:

- Identifying applicable rules, regulations, policies governing coal and hard rock minerals sector in Bangladesh
- Review of these legislative pieces for identifying key areas covered under the legislations and detailed provisions
- A comparative study with regulatory provisions of other countries
- Identify the areas not covered in the existing legislations for smooth and sustainable governance of mineral sector
- Recommendations for amendments and enacting new laws and highlight the provisions which should be covered by these changes

#### *Meetings*

2.3.3 The PwC team held consultative meetings to understand regulatory framework of Bangladesh governing mining sector and perspective of various stakeholders. Further meetings were held with HCU, GSB, BMD, BCMCL, MGMCL and other stakeholders to discuss findings and develop recommendations. The table below summarizes the details of the meetings held:

Duration of the Visit	Purpose of the Visit	Meetings held with	Team Members
<b>September 24, 2011 to October 06, 2011</b>	Review of the existing Mining Act, Rules and Regulations and Recommendation	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof. U.K. Singh</li> <li>• Prof S. Chaudhuri</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Md. Maqbul-E-Elahi</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> <li>• Neeraj Kumar</li> </ul>
<b>November 26, 2011 to December 01, 2011</b>		<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>

**Table 3: Details of Site Visits/Meeting for the purpose of Review of the existing Mining Act, Rules and Regulations and Recommendation**

### *Workshops*

- 2.3.4 The consulting team conducted a workshop on October 02, 2011 at HCU office for discussing the draft findings on review of the existing Mining Act, regulations, and rules. The consulting team presented findings and views to participants of the workshop along with comparison of existing regulatory framework of Bangladesh with regulatory framework of several countries, identifying best practices among them considering the sustainable development framework of Inter Governmental Forum of UN.
- 2.3.5 The workshop was attended by representatives from HCU, BMD, Petrobangla, Department of Explosives and other stakeholders. In the workshop, participants expressed their views on the changes required in the regulatory framework governing mineral sector in Bangladesh.
- 2.3.6 Key findings were also discussed with the stakeholders during the workshop on Coal Sector Development Strategy which was held on September 05, 2012 in Dhaka at HCU Office as a part of the Module 3, Mines and Minerals Development Project (Package #07). The workshop was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.
- 2.3.7 A presentation was made by PwC team in the workshop on the Review of the existing mining act, rules and regulations and recommendations as part of presentation on Coal Sector Development Strategy.

The presentation discussed various recommendations made in the report on Review of the existing mining act, rules and regulations and recommendations which are necessary for effective administration of mineral sector and also for sustainable development. The consulting team discussed the premise of sustainable development and regulatory changes as per the Sustainable Development Framework (SDF) prepared by Intergovernmental Forum (IGF) on Mining, Minerals, Metals and Sustainable Development (MMMSD), which is guiding several countries in formulating their policy and laws as well as helping in strengthening the mineral sector.

2.3.8 The key points discussed in the presentation are as following:

- Key aspects considered for review of the legislative framework governing the mineral sector
- Amendments required in existing statutes/laws for licensing, exploration, ownership, data management, safety, health, labour deployment, mining operations monitoring, mine management, mine closure etc.
- Basis for determining compensation to persons working in mining entities
- Regulatory enablers required for environmental management in and around mining areas
- Recommendation for changes in licencing regime
- Promulgation rules for improvement of mine safety standards
- Adoption of UNFC system for classification and reporting of mineral resources
- Promulgation of new legislation pertaining to occupational health and safety (OH&S)
- Adoption of mineral conservation principles

2.3.9 The participants from HCU, EMRD, Petrobangla, BMD, BCMCL, GSB, various educational institutes expressed their viewpoints on the recommendations made and the actions which need to be taken.

2.3.10 The consulting team further conducted workshop for presenting final findings and recommendations on August 26, 2013 at Petrobangla office.

2.3.11 The workshop was attended by representatives from EMRD, HCU, BMD, Petrobangla and other stakeholders. In the workshop, participants expressed their views on the changes required in the regulatory framework governing mineral sector in Bangladesh.

2.3.12 The consulting team discussed about the principle laws enacted so far to regulate mineral sector in Bangladesh. The team also discussed about the necessity for reforms and updating of regulatory regime in the country and the approach the consulting team adopted while reviewing the current sector scenario and recommendations based on necessity for the mineral sector of the country.

2.3.13 The consulting team henceforth, put forward recommendations for the following sectors:

- Licencing and leasing
- Health and safety management
- Management of Mineral Resource Information and mineral resource classification
- Conservation of Mineral Resources during Mining, Extraction and End-use
- Labour Laws, Workers Compensation, and Welfare Legislation

- Socio-economic benefit optimization
- Environmental Management
- Domestic and Foreign Investment in Mineral Sector
- Taxation and Royalties
- Mine Closure and Post-mining Transition

## Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects

### *Activities carried out*

2.3.14 The aim of this activity of the engagement was to prepare an Action Plan and Guidelines for the relevant executing agency for development of Coal Bed Methane (CBM), Underground Coal Gasification (UCG) and Hard rock projects. This report has been prepared to provide a roadmap for future activities for development of UCG, CBM and Hard Rock sectors in Bangladesh.

2.3.15 The activities which were carried out for the preparation of this report are:

- Study of history of development of CBM and UCG globally and the current status of CBM, UCG and Hard Rock sectors of Bangladesh
- Identification and discussion on key technical studies which need to be undertaken for assessment of potential for CBM and UCG and its development in Bangladesh.
- Developing Action plan and Guidelines for CBM and UCG development in Bangladesh covering:
  - Identification of technical studies that need to be conducted to assess the potential of CBM and UCG development
  - Plan for financing the technical studies
  - Identifying framework for commercial development of CBM and UCG
  - Suggest suitable ways to finance the commercial development of CBM and UCG
  - Suggest policy measures and guidelines for development of CBM and UCG sectors
- Developing Action plan and Guidelines for development of hard rock sector in Bangladesh.

### *Site Visits/Meetings*

2.3.16 The Consulting team has conducted site visits/meetings for the purpose of discussion on Action Plan and Guidelines for development of Coal Bed Methane (CBM), Underground Coal Gasification (UCG) and Hard rock projects. The discussions were held with HCU, GSB, BMD, BCMCL, MGMCL and other stakeholders. The table below summarizes the details of the meetings held:

Duration of the Visit	Purpose of the Visit	Meetings held with	Team Members
<b>September 24, 2011 to October 06, 2011</b>	Action Plan and Guidelines for the relevant executing agency for development of Coal Bed Methane (CBM), Underground Coal Gasification (UCG) and Hard rock projects	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof. U.K. Singh</li> <li>• Prof S. Chaudhuri</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Md. Maqbul-E-Elahi</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> <li>• Neeraj Kumar</li> </ul>
<b>November 26, 2011 to December 01, 2011</b>		<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>
<b>August 25, 2012 to September 06, 2012</b>	Holding discussions/meetings, conducting workshops from the perspective of Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> <li>• Officials of MGMCL and participants from academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• Kameswara Rao</li> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof S. Chaudhuri</li> <li>• B.K. Saha</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>

**Table 4: Details of Site Visits/Meeting for the purpose of Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects**

### *Workshops*

2.3.17 A workshop was held on September 05, 2012 in Dhaka at HCU Office as a part of the Module 3, Mines and Minerals Development Project (Package #07). The workshop was attended by invitees from EMRD,

HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.

2.3.18 A presentation was made by PwC team in the workshop on Action Plan for CBM, UCG and Hard Rock Projects. The presentation discussed the Action Plan and guidelines suggested for development of CBM, UCG and hard rock project.

2.3.19 The key points discussed in the presentation are as following:

#### **CBM and UCG**

- Challenges faced by energy and infrastructure sector of Bangladesh
- Overview of CBM technology and status of CBM development in various countries
- Phases to exploit CBM and technical activities needed to establish CBM potential
- Overview of UCG technology and status of various countries in UCG development
- Studies required for establishing potential and feasibility of UCG
- Action plan and guidelines for development of CBM and UCG suggesting stage wise approach as briefed below:
  - Stage 1: Establishing feasibility - Demarcation of resources and studies for exploration; financing studies
  - Stage 2: Development of commercial projects – Establishing priority between CBM, UCG and conventional mining; contractual issues; infrastructure and carbon credits.

#### **Hard rock**

- An overview of hard rock sector of Bangladesh
- Action plan and guidelines for development of hard rock sector
  - Adoption of UNFC system for classification and reporting of mineral resources
  - Need of developing a knowledge repository
  - Recommendations for modifications in operations of Maddhapara hard rock mine
  - Licencing regime
  - Environmental and safety aspects
  - Suggestions for specific mineral resources like granite, limestone and others.
  - Need of developing new indigenous resources
  - Exploring option of sourcing from other countries

2.3.20 The invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes expressed their viewpoints on the Action Plan to be adopted and the guidelines which need to be implemented.

2.3.21 After the workshop on September 05, 2012 in Dhaka at HCU Office detailed comments on the draft Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects were received from

Petrobangla, BCMCL, MGMCL and GSB. These comments were appropriately addressed by the consulting team in the final report.

- 2.3.22 Subsequently, a workshop on final report covering action plan on CBM, UCG and hard rock and recommendations for sector development was conducted at the office of Petrobangla on August 26, 2013.
- 2.3.23 The workshop was attended by representatives from EMRD, HCU, BMD, Petrobangla and other stakeholders.
- 2.3.24 The consulting team made a presentation during the workshop and discussed the importance of development of these sectors in the context of Bangladesh.
- 2.3.25 Recommendations were made by the consulting team as part of this presentation during the workshop which primarily discussed establishing feasibility of the complete resource base, followed by establishing priority amongst CBM, UCG and mining of coal deposits and finally on designing of exploitation strategy for the resource base based on the scientific studies (or establishing feasibility studies).
- 2.3.26 A meeting was also held regarding finalization of Report on Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects held on 08 October, 2013 at Bangladesh Secretariat in presence of HCU, Petrobangla, EMRD and GSB officials under the Chairmanship of Hon. Secretary, Energy and Mineral Resources Division. IIFC local consultants were also present in the meeting.

## **Coal Sector Development Strategy**

### *Activities carried out*

- 2.3.27 The aim of this activity of engagement was to develop a Coal Sector Development Strategy (including Peat) with appropriate enabling frameworks for the public sector and for private sector participation and institutional arrangements for the sector.
- 2.3.28 The activities which were carried out in the preparation of this report are:
- Review the energy sector of Bangladesh, energy demand etc.
  - Assessment of the demand-supply of coal
  - Identify the technical studies and other studies required to be carried out for different coalfields of Bangladesh to enable development of these coal basins
  - Identify and discuss the activities and studies to be undertaken for development of identified coal deposits
  - Identify and discuss various ways and options to fund/invest in technical studies, exploration, and development of coal resources
  - Suggesting an enabling legal framework for coal sector development
  - Identify changes in the current institutional and administrative structure and suggest new institutions and administrative bodies required for facilitating coal sector development
  - Recommendations for coal sector development
  - Recommendations for development of peat deposits

## Site Visits/Meetings

2.3.29 The consulting team has held meetings/discussions with various stakeholders viz. HCU, GSB, BMD, BCMCL, MGMCL and other stakeholders to understand their points and views on the Coal sector development strategy. The table below summarizes the details of the meetings held:

Duration of the Visit	Purpose of the Visit	Meetings held with	Team Members
<b>September 24, 2011 to October 06, 2011</b>	Coal Sector Development Strategy (including Peat) with appropriate enabling frameworks for the public sector and for private sector participation and institutional arrangements for the sector	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof. U.K. Singh</li> <li>• Prof S. Chaudhuri</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Md. Maqbul-E-Elahi</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> <li>• Neeraj Kumar</li> </ul>
<b>November 26, 2011 to December 01, 2011</b>		<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> </ul>	<ul style="list-style-type: none"> <li>• Prof. S. B. Srivastava</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Piyush Kumar Bharti</li> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>
<b>August 25, 2012 to September 06, 2012</b>	Holding discussions/meetings, conducting workshops from the perspective of Coal sector development strategy	<ul style="list-style-type: none"> <li>• Officials of HCU</li> <li>• Officials of GSB</li> <li>• Officials of Petrobangla</li> <li>• Officials of BMD</li> <li>• Officials of BCMCL</li> <li>• Officials of MGMCL and participants from academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• Kameswara Rao</li> <li>• Prof. D.C. Panigrahi</li> <li>• Prof. S. B. Srivastava</li> <li>• Prof S. Chaudhuri</li> <li>• B.K. Saha</li> <li>• Nazrul Islam,</li> <li>• Md. Mosharraf Hossain</li> <li>• A.K.M. Shamsuddin</li> <li>• Md. Ehsanullah</li> <li>• Pukhraj Sethiya</li> <li>• Piyush Kumar Bharti</li> </ul>

			<ul style="list-style-type: none"> <li>• Bhavesh Singhavi</li> <li>• Dr. D.P. Mishra</li> </ul>
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**Table 5: Details of Site Visits/Meeting for the purpose of Coal Sector Development Strategy**

### *Workshops*

- 2.3.30 A workshop was held on September 05, 2012 in Dhaka at HCU Office as a part of the Module 3, Mines and Minerals Development Project (Package #07). The workshop was attended by invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes.
- 2.3.31 A presentation was made by PwC team in the workshop on coal sector development strategy. The presentation discussed the recommendations made for the development of coal sector.
- 2.3.32 The key points presented in the workshop are as following:
- Global coal overview covering:
    - distribution of coal reserves around the world, coal production and consumption trend, dependence on coal for power generation
    - Key coal producing countries – reserves, production, industry structure, recent reforms and incentives to players operating in coal sector
    - Strategies of major coal producing companies
  - Coal resources and reserves of Bangladesh
  - Overview of energy sector of Bangladesh covering demand - supply analysis of power and demand of coal in various scenarios
  - Strategy for exploration and exploitation of various coal deposits
  - Investment models and commercial aspects
  - Contractual issues
  - Recommendations for developing a conducive and more comprehensive legal framework for facilitating investment and working of mining sector in Bangladesh
  - Existing administrative structure and requirement of new institutions/administrative bodies
  - Development of infrastructure for facilitating growth of Coal sector viz. declaration of Coal Zone; concept of Coal Axis for transporting coal and locating power plants; use of rivers for transporting coal; concept of swing supply for power stations; upgrading rail and road infrastructure etc.
  - Coal depletion policy
  - Coal pricing policy
  - Stepwise action plan for implementation of strategy for coal sector development.
- 2.3.33 The invitees from EMRD, HCU, Petrobangla, BMD, BCMCL and various stakeholders and representatives from the various educational institutes expressed their viewpoints on the coal sector development strategy.

- 2.3.34 After the workshop on September 05, 2012 in Dhaka at HCU Office detailed comments on the draft Coal sector development strategy were received from Petrobangla, BCMCL, MGMCL and GSB. These comments were appropriately addressed by the consulting team in the final report.
- 2.3.35 Subsequently, a workshop for finalization of report covering coal sector development strategy and recommendations was organized at Bangladesh in the office of Petrobangla on August 26, 2013 which was attended by representatives from EMRD, HCU, BMD, Petrobangla and other stakeholders.
- 2.3.36 Consulting team presented importance of developing coal sector specifically in context of Bangladesh given growing energy requirement and diminishing prominent energy resources (gas). In the workshop, prospects, benefits which can be achieved and way forward to achieve objectives were presented.
- 2.3.37 The consulting team presented views on development each of the identified coal fields and coal sector in total and put forward recommendations on way forward for such development. Primarily, recommendations were made on aspects such as Institutional Development (covering role of new institutions), Coal depletion policy, development of separate set of infrastructure for coal zones after declaring a separate coal zone for the country for development and extraction of coal and thereby transportation, various feasible options for investment in the sector and pricing policy for the coal to be exploited (including provisions of tax, duties, etc.), Human Resource development and Land utilization and recovery.
- 2.3.38 The consulting team also presented their views on development of peat resource base available in Bangladesh and its development strategies based on plausible usage.
- 2.3.39 Members attending the workshop affirmed the recommendations made and discussed on the implementation strategy in the country which was also presented during the workshop by the consulting team.

## 3. Findings and Recommendation

### 3.1. Report on Mineral Resources Classification Systems - Suitability and Selection

#### Recommendations and Conclusion

- 3.1.1. There are two main perspectives that must be considered in selecting a suitable mineral resources classification system:
- **The country perspective:** The following key dimensions and parameters relating to a country's mineral wealth management were analyzed from Bangladesh's perspective:
    - ✓ Assessment of mineral endowment of a country
    - ✓ National/ State Mineral Policy
    - ✓ Statistical accounting of mineral inventory
    - ✓ Strategic planning
    - ✓ Roadmap for mineral resource management
  - **The industry and financing perspectives:** The following parameters associated with the mining industry and financing mine developments were analyzed:
    - ✓ Mine Planning
    - ✓ Investment/ development decisions
    - ✓ Property and company valuations
    - ✓ Fund raising
- 3.1.2. The UNFC System is more commonly adopted by developing nations where the mineral sector is likely to be governed and managed by governments or public sector companies, in a manner that aids national interest as opposed to global commodity trade. The former reflects the current context of Bangladesh as well.
- 3.1.3. The UNFC system offers flexibility to meet the needs of the national mineral / coal policy, or development of mineral deposits by public sector companies, or through PPP or for reasons not fully foreseen at the time of adopting the classification system.
- 3.1.4. The compatibility of the UNFC System for reporting and for comparison with other classifications has an additional merit in ensuring past work is not lost. In Bangladesh, for example, exploration works in the past were conducted by external agencies based on CRIRSCO Style codes (JORC Code), which when a decision to use the UNFC System is taken, could still be utilised by harmonizing it.
- 3.1.5. The general guidelines for classifying the mineral resources in the UNFC System are systematic, methodical, and rule based. This means standard rules could be laid in a manner that is applicable to the specific mineralization, geological controls, settings and continuities that are unique to mineral endowments of Bangladesh.

- 3.1.6. The UNFC System provides for classification and reporting of mineral resources by suitably Qualified Persons, but is not a mandatory requirement as for the CRIRSCO Codes. This enables the in-country agencies and experts with better familiarity of the local geology and regional practices to classify the mineral resources, even if they are currently lack membership of CRIRSCO prescribed institutions and scientific bodies and the skills and experience defined therein.
- 3.1.7. The features and implications of the UNFC system of classification were discussed in detail with the stakeholders held during the workshop in Dhaka on October 05, 2011, it was unanimously decided to adopt the UNFC System of mineral classification to classify and report mineral resources of Bangladesh.
- 3.1.8. The Director General (DG), HCU summarized that the workshop on mineral resources classification and reporting systems at Dhaka on October 05, 2011 was very useful and helped participants in familiarizing and developing understanding of various classification systems and international reporting standards and recommended the adoption of UNFC System to classify and report mineral resources of Bangladesh.
- 3.1.9. For classification of mineral resources (Coal, Peat and Hard Rock) according to selected classification system (i.e. UNFC system of mineral resources classification), suitable field guidelines is required to be developed. While the field guidelines will guide classification of mineral resources based on the existing exploration data and results, same will also guide various agencies for further exploration work to be done.

## ***3.2. Mineral Resources Assessment***

### **Summary of Mineral Resources Assessment**

- 3.2.1. The mineral resource (Coal (including Peat) and Hard Rock) of Bangladesh has been assessed in accordance with the guidelines provided in the UNFC System for Mineral Resources Classification.
- 3.2.2. The summary of Coal resources of Bangladesh as per the UNFC System of classification is provided in the table below:

Resources	Deposit	Code 111	Code 112	Code 221	Code 222	Code 332		Code 333		Code 334		Code 3.2;1;1	Code 3.2;1;2	Code 3.2;2;1	Code 3.2;2;2
Coal	Barapukuria	26.13	38.67	9.9	6.76	Code 3.1;3;2	40.24	Code 3.1;3;3	21.06	Code 3.1;3;4	43-64	32.24	53.19	46.05	72.47
						Code 3.2;3;2	-	Code 3.2;3;3	-	Code 3.2;3;4	-				
						Sub Total	40.24	Sub Total	21.06	Sub Total	43-64				
	Phulbari	243.7	191.3						Code 3.1;3;3	58		44.3	34.7		
									Code 3.2;3;3	-					
									Sub Total	58					
	Khalashpir					297.57		225.92							
	Jamalgunj							1053.9							
	Dighipara						105		495						
	<b>Total</b>	<b>269.83</b>	<b>229.97</b>	<b>9.9</b>	<b>304.33</b>	<b>145.24</b>	<b>1358.88</b>	<b>538-559</b>	<b>76.54</b>	<b>87.89</b>	<b>46.05</b>	<b>72.47</b>			

(3.1) – Virgin reserve of intrinsic economic interest based on geological study.. (3.2) – Unrecoverable reserves due to design loss and mining loss based on feasibility study/pre-feasibility study.

Note: Table 6 shows the UNFC in matrix form excluding the codes which are usually not relevant. In Barapukuria and Phulbari deposits, a part of reserves (229.97 Mt as shown in Table 6) have been classified under code 112 as these reserves are economically viable (code 1 in Economic axis) and included within the mineable reserves in the feasibility reports /Basic Mine Design document /Life of Mine report (code 1 in Feasibility axis) but the geology of these reserves are yet to be firmed up (hence considered under code 2 in Geology axis). Usually, reserves for which geology is not firmed up are considered in Pre-feasibility reports (i.e., under code 2 of Feasibility axis) and not in the formulation of Feasibility report; whereas such reserves have been included in the Feasibility reports (i.e., under code 1 of Feasibility axis) of Barapukuria and Phulbari deposits. Therefore, these reserves have been classified under code 112 instead of code 122, in the present case and have been treated as Probable Mineral Reserves along with reserves considered under codes 121 and 122.

**Table 6: Summary of UNFC type classification of Coal resources of Bangladesh (Figures in Million Tonnes)**

3.2.3. The summary of Peat resources of Bangladesh as per the UNFC System of classification is given in the table below:

Resources	Code 331	Code 334
Peat (Dry)	38*	95**

\* Comprises 30 million tonnes (Mt) (dry) of Faridpur deposit and 8 Mt (dry) of Kola Mouza deposit

\*\* Comprises dry peat resource of Faridpur deposit only

**Table 7: Summary of UNFC type classification of Peat resources of Bangladesh (Figures in Million Tonnes)**

3.2.4. The summary of Hard Rock resources of Bangladesh as per the UNFC System of classification is given in the table below:

Resources	Deposit	Code 111	Code 121	Code 232	Code 333
Hard Rock	Maddhapara	125.15*	792.65**	1521.90	1201.50

\*125.15 - Mineable reserve up to 270 m

\*\* 792.65 – Extractable reserve between 160 m and 350 m depths.

**Table 8: Summary of UNFC type classification of Hard Rock resources of Bangladesh (Figures in Million Tonnes)**

3.2.5. A comparative study of CRIRSCO code (based on which codes like JORC, SAMREC etc. are developed) with UNFC System of Classification was also presented for bringing in comparability of resources in different systems. The comparison of coal and hard rock resources in different classes in CRIRSCO code with UNFC System of Classification of Coal, Peat, Hard Rock resources of Bangladesh is given below:

Class	Code	Coal (Mt)	Peat (Mt)	Hard Rock (Mt)
Proved Mineral Reserves	code 111	269.83		125.15
Probable Mineral Reserves	codes 121 + 122	229.97#		792.65
Pre-Feasibility Mineral Resources*	codes 221+222	314.23		
Measured Mineral Resources	code 331		38	
Indicated Mineral Resources	code 332	145.24		
Inferred Mineral Resources	code 333	1358.88		1201.50
Reconnaissance Mineral Resources	code 334	538-559	95	
-	Code 3.2;1;1	76.54		
-	Code 3.2;1;2	87.89		
-	Code 3.2;2;1	46.05		
-	Code 3.2;2;1	72.47		
-	Code 232			1521.90
<b>Total</b>		<b>3139.10 – 3160.10</b>	<b>133</b>	<b>3641.20</b>

#Refer note under Table 2

\*Additional Classes in UNFC System

**Table 9: Comparison of classes in CRIRSCO code with UNFC System of Classification of Coal, Peat, Hard Rock resources of Bangladesh**

## **Recommendations**

- 3.2.6. An appropriate mining technology needs to be developed for exploiting the resource of VI seam in the 'open area' in the northern part of Barapukuria mine so that the estimates of recoverable reserve in this area can be firmed up.
- 3.2.7. Slope stability studies should be taken up for determining the final highwall pit slopes and ultimate internal dump slope so that the recoverable reserves of the Phulbari mine and the volume of internal dump can be firmed up.
- 3.2.8. Intensive exploration work is necessary in all the basins except in Barapukuria and Phulbari basin to upgrade the resource base to measured/proved category.
- 3.2.9. Even for Barapukuria and Phulbari basin, further exploration are required to firm up and upgrade the resources of seams which have not been included in the scope of mining as per the feasibility study reports of the coal mine projects planned in these basins.
- 3.2.10. In order to coordinate the significant exploration and mine planning activities that are to be taken up in near future, Bangladesh needs to strengthen the relevant organisations in terms of internal capacity and skill development, adequate human resources, and computational tools. Some of the key organisations requiring capacity building and institutional strengthening are BMD, GSB, BCMCL among existing organisations.

## **3.3. Review of the existing mining operations of the Barapukuria Coal Mine and Recommendation on improvements**

### **Recommendations and Conclusions**

#### *Exploration*

- 3.3.1. Further exploration of the Seam VI is necessary to achieve the following objectives:
- Delineation of the trend of sub-crop of Seam VI.
  - Up-gradation of reserves presently categorized under Rank 'C'.
  - Firming up of the geological structure, thickness and quality of Seam VI occurring in the southern part of the deposit up to Phulbari exploration block.
- 3.3.2. We understand that in new M&P contract, five new boreholes have been proposed by CMC–XMC consortium in the southern part of the mine. It is recommended that a few more additional boreholes are drilled in the northern, central (in virgin area) and southern part of Seam VI to achieve the above objectives.
- 3.3.3. However, it is recommended that no fresh borehole should be drilled over or in the vicinity of already worked area.
- 3.3.4. All new boreholes are to be geo-physically logged before plugging these holes.
- 3.3.5. Fresh geological plans and sections of Seam VI for the entire area of the seam up to the boundary of Phulbari exploration block need to be prepared incorporating the data obtained from the new

boreholes. The boundaries of different sectors of the area of Seam VI should also be re-defined and sector wise reserves re-estimated on the basis of new geological plans excluding the reserves already depleted.

- 3.3.6. Also floor contours of the 1st slice workings of VI seam need to be drawn using the existing survey data to facilitate control of the level of working horizon of the 2nd slice.
- 3.3.7. Exploration of the upper seams (I, II, III, IV and V) should be taken up later after depletion of Seam VI to avoid problems during drilling due to ground movement arising out of mining in Seam VI.

### *Hydrogeology*

- 3.3.8. Barapukuria coal basin has two major aquifers: one, the Upper Dupi Tila formation and the Lower Dupi Tila formation.
- 3.3.9. It has been observed that the source of underground discharge water is the connate water from large thickness of Gondwana formation.
- 3.3.10. It has also been found that the water inflow from the strata into the mine is almost constant and there is no seasonal variation in the water inflow into the mine. This means that UDT water is not contributing to the mine inflow. The draw down observed in UDT water level in the above table is mainly due to use of UDT water for irrigation and industrial purposes and such draw down of UDT water level is also observed in other areas of Bangladesh.
- 3.3.11. At the end of year 2003 when the mine development was nearly complete and preparations for production of coal from different faces was going on, the average water discharge rate was 1,022.75 m<sup>3</sup>/hr. At the end of October 2011 when first slice of all faces except 1116 was completed, the average discharge rate of water was 1,480.04 m<sup>3</sup>/hr. This water inflow is expected to increase during mining of the 2nd slice by LTCC method. Therefore, the required pumping capacity of the mine shall be increased to tackle this water inflow.
- 3.3.12. There are several faults in the mining area and these faults have considerable water transmissibility. Precautions should be taken to prevent sudden inrush of water while approaching these faults to prevent sudden inrush of water. Procurement of adequate numbers of long hole underground directional drilling machines for the mine is recommended for safely draining out water under pressure in advance in case of necessity.
- 3.3.13. It is further recommended that detailed studies should be carried out through modelling, preferably numerical modelling or any other suitable method, to review the application of LTCC method of mining. If it is expected that there is possibility of sudden inrush of water into the mine workings, adequate precautionary measures may be planned and implemented to safeguard the life and property.

### *Method of mining*

- 3.3.14. Presence of a thick overburden of unconsolidated water bearing strata over the fractured and caved hard rock will result in development of two major problems related to mine safety during extraction of 2nd and subsequent slices of VI Seam and these problems will be gradually more pronounced as the number of slices extracted increases.
- 3.3.15. The first obvious risk is the possibility of ingress of water from the highly water bearing UDT aquifer into the VI Seam workings through flow paths developed due to any of the following reasons:
  - Generation of fracture plane across the strained hard rock and LDT strata (particularly where it is thin) which extends to the base of UDT horizon.
  - Passage of water from UDT through water transmitting faults.

- Opening of fault planes which were previously closed and non-water transmitting.
- 3.3.16. The other possible danger to the mine workings might result from dead weight of the thick unconsolidated strata. These strata, being unconsolidated, do not have any bridging capability and hence a component of the dead weight of these strata may be transmitted to the caved Gondwana rocks filling the goaf of VI Seam below which mining has to be done in different slices.
- 3.3.17. It may be noted that the safe thickness of coal/rock water barrier above the roof of VI seam as has been calculated in the Basic Mine Design report is based on two limiting conditions – (i) individual slice thickness will not be more than 3m and (ii) cumulative thickness of all slices will not be more than 15m.
- 3.3.18. However, both of these limitations of the empirical formula used will be breached as the individual thickness of slice will be 6m in LTCC method and the cumulative thickness of slices will be 24m.
- 3.3.19. However, after working of the 1st slice in Barapukuria mine, valuable geological, hydro-geological and geo-technical data regarding the mine are now available. Therefore, detailed numerical modeling study and/or other scientific studies are required to be carried out considering the data available and experience gained during working of the 1st slice, to predict the stability and behavior of the strata lying above VI Seam during extraction of 2nd and subsequent slices covering full thickness of VI seam.
- 3.3.20. Two sets of such studies should be made – one set considering descending slices with caving (for conventional multi-slicing method and LTCC method separately) and the other set considering ascending slices with hydraulic sand stowing (for conventional multi-slicing with barrier between panels).
- 3.3.21. A short term, slice-wise approach to mine planning must be avoided and a view in totality should be taken for selecting a mining system with an objective to achieve mine safety and conservation in the long term.
- 3.3.22. In addition to the present uncertainties relating to the future projections of ingress of water, stress level in strata and strata behavior; there is problem of existing fire in a panel in the 1st slice. It is imperative that the fire in the 1st slice are effectively dealt with and other protective measures taken to prevent further occurrence of fire in the goaves of 1st slice and other slices in future.

### *Suitability of longwall top coal caving method*

- 3.3.23. The 2nd slice of VI seam is proposed to be worked by longwall top coal caving (LTCC) method. A new set of face equipment for longwall top coal caving method has been included in the M&P contract. The rated capacity of the mine will remain at 1 Mtpa.
- 3.3.24. It is recommended that detailed scientific, technical and feasibility studies must be taken up by BCMCL for an exhaustive evaluation of these two systems and also of alternate mining systems with stowing for safe and efficient extraction of all the slices of the thick VI seam.

### *Method of mining, safety and recovery of coal reserves*

- 3.3.25. As per the approved project document, the 2nd slice was to be worked below the 1st (topmost) slice after leaving a coal parting, the thickness of which is not mentioned. Assuming a parting thickness of 3m and a height of extraction of 2nd slice as 3m, the present mining system could have been continued with the existing sets of longwall equipment.
- 3.3.26. Assuming that the height of longwall face of 2nd slice in LTCC method will be 3m and the thickness of coal parting between floor of 1st slice and roof of 2nd slice longwall face will be 3m, the LTCC system will be achieving a higher coal recovery compared to the conventional multi-slicing system, where the entire parting coal of approximately 3m will be lost in goaf with consequent increased risk of fire.

- 3.3.27. The cavability of the de-stressed coal parting or sublevel coal in LTCC method is not expected to pose much problem (except during initial period till some advance of the 2nd slice longwall face is achieved) considering the physico-mechanical properties of VI seam coal and the pressure of broken strata acting on the coal parting. In any case, regular caving of parting coal is also a pre-requisite for the successful operation of conventional multi-slice mining.
- 3.3.28. However, the rate of advance of the longwall face in LTCC method may be slowed down occasionally due to problem of blocky coal coming down on the rear conveyor or even boulders of roof rock coming on the rear conveyor due to absence of iron mesh netting in most of the panels of the 1st slice causing jamming of ARC which may involve manual intervention.
- 3.3.29. Snapping of ARC chain is also not ruled out. Such situation, apart from causing delay and reducing output, may warrant leaving some of the caved parting (sub-level) coal in goaf thereby increasing the risk of fire as the coal is very much susceptible to spontaneous combustion.
- 3.3.30. Arrangements of nitrogen flushing and chemical treatment will therefore, have to be kept to mitigate risk of fire in goaf in LTCC panels as in case of conventional multi-slice panels.
- 3.3.31. LTCC method will involve extraction of 6m of coal in 2nd slice (cumulative 8.5 to 9m) compared to 3m (cumulative 5.5 to 6m) in case of conventional multi-slice mining. Fresh scientific studies are required to be carried out to determine the height of fracture zone and safe thickness of coal/rock parting above VI seam to prevent disturbance to the UDT aquifer horizon before application of LTCC method.
- 3.3.32. However, it can be generally said that extracting the 2nd slice with 6m thickness (in LTCC method) will result in higher thicknesses of caved and fractured zones in Gondwana rocks compared to that with 3m height of extraction of 2nd slice (as in conventional multi-slicing method) and therefore, the following are to be reassessed during the above scientific studies for application of LTCC method:
- The support resistance required at the longwall face in LTCC method in 2<sup>nd</sup> and subsequent slices, and
  - The quantum of flow of water from Gondwana aquifer in the goaf of 2<sup>nd</sup> and subsequent slices worked by LTCC method.
- 3.3.33. As the successive slices will be extracted by caving in descending order. The dead weight of the caved zone will increase while successive lower slices are worked, more so if LTCC method is adopted.
- 3.3.34. Therefore, the specifications of the powered supports of LTCC panels should be so selected that these can serve for two or three successive slices without being replaced before their stipulated life.
- 3.3.35. In addition to the above considerations, it must also be added that adoption of LTCC method will involve use of more sophisticated mining equipment and will require manpower with advanced skills compared to those required in the operation of conventional multi-slice mining system.

### *Mine production capacity*

- 3.3.36. Studies show that two shearers have never worked in the mine simultaneously except for a brief period between 25.2.2010 and 16.03.2010. But, it must also be mentioned that one of the two longwall sets was not available from end of September 2005 to middle of August 2008 ( almost for 50% of the contract period).
- 3.3.37. The mechanical condition of the shearers, powered supports and other face machineries are not known due to absence of information at the mine.
- 3.3.38. After completion of the rated life of the existing face equipment, these could be replaced with updated versions of the equipment.

3.3.39. On the other hand, to ensure a regular production of 1.0 Mtpa from one set of LTCC equipment, appropriate actions have to be taken to minimize the following delays:

- Delay in face advance due to problem of jamming or damage of ARC, delay in clearing of roof coal etc.
- Delay during salvaging and re-installation of the LTCC equipment to the next longwall panel.
- Delay in taking up due maintenance and breakdown repair works.

3.3.40. It is recommended that a system of proper spares management should be established and effective steps for up-gradation of skills of the operation and maintenance crew should be taken to reduce the above delays.

### *Economics of mining*

3.3.41. For any investment decision, it is necessary to evaluate the comparative economics of the available alternatives. In the present case also, it is necessary to carry out discounted cash flow analyses for at least next 10 years (with 1st year as current year) considering a rated production of 1.0 Mtpa for the existing longwall multi-slice system and the proposed LTCC system to compare the economics of these two systems. For this purpose, the operating and capital costs of the existing system has to be updated and a revised cost estimate (RCE) of the existing mine has to be prepared.

3.3.42. The economics of the two systems may then be compared in terms of their Financial IRRs and Economic IRRs or in terms of their NPVs, before taking a final decision regarding selection of a system.

### *Feasibility of opencast mining of VI seam in open window area*

3.3.43. Considering the selling price of Barapukuria coal, some of the areas in the dip side can tentatively be assumed to have opencast mining potentiality with VI seam as base and therefore, further site specific studies as detailed below may be taken up for identifying a feasible area for opencast mining in this region.

3.3.44. Opencast mining in the open window area is fraught with severe technological and environmental challenges as outlined below.

- Large scale dewatering of UDT aquifer through advance bore well and through mine sump pumping during opencast mining will create significant draw down of water in the aquifer which may result in ground subsidence in the vicinity of opencast excavation. Therefore, hydro-geological studies must be carried out to predict the safe distance of opencast excavation from mine shafts, important surface structures and existing mine workings of VI seam so as not to affect their stability.
- Opencast mining in the area will involve excavation of 94m to 120m thick UDT formation consisting of mainly sand beds, silt etc. The safe slope angles of the quarry high walls in UDT formation on all sides of the quarry have to be estimated by slope stability studies.
- In addition, slope stability studies for internal and external spoil dumps should also be taken up to ascertain maximum height and safe slope of these dumps for dump planning.
- Geo-technical studies need to be carried out to assess the ground bearing capacities of Madhupur clay, selected layers of UDT and LDT formations. There is need to develop an appropriate technology for excavation of such grounds.

3.3.45. In addition to the above, severe environmental degradation may occur.

- 3.3.46. It will therefore be essential to fill up the residual void after productive life of the mine by re-handling the material from surface external dump.
- 3.3.47. It is therefore recommended that the decision on application of opencast mining technology in a part of the 'open window' area should be based on the above results of hydro-geological, geo-technical and slope stability studies are obtained and also a technology for safe excavation of around 100m thick unconsolidated sandy aquifer bed (UDT) is established and, thereafter a techno-economic feasibility study (TEFS) report is prepared using these data and information to arrive at the opencast mine boundaries, other geo-mining parameters of the mine and economics.
- 3.3.48. An environmental impact assessment (EIA) study should also be carried out based on the TEFS to assess the environmental damage to be caused by such opencast mining in the open window area.
- 3.3.49. BCMCL may arrive at an appropriate decision regarding open pit mining of VI seam in the northern part of the deposit after completing the above studies and other activities discussed in this report.

### *Mining of VI seam in the southern side of south district*

- 3.3.50. It is possible that VI seam of Barapukuria mine extends up to Phulbari mine in the south. Therefore, the geology, structure and other details of VI seam in the area between Barapukuria and Phulbari mines need to be firmed up by additional drilling before any mine planning for this area is taken up.
- 3.3.51. As per the present geological map, the minimum depth of VI seam sub-crop in the south is around 230m. It is not advisable to start an opencast operation with such high initial depth and other difficulties associated with opencast mining.
- 3.3.52. It is therefore recommended that this area, lying to the south of latitude 101400 has to be worked by underground mining. A detailed planning exercise has to be taken up for firming up the method of development and extraction of this area and this, in turn, can be done only after the geology of the area is firmed up and reserves estimated.

### *Mining of upper seams*

- 3.3.53. In Barapukuria leasehold area, there are five coal seams above VI seam which is being extracted now. These seams are, from top downwards, Seams I, II, III, IV and V. Major parts of areas of these upper seams lie vertically above the worked out area of VI seam and must have been damaged by subsidence which has already occurred. With the mining of subsequent slices of VI seam by caving, these virgin upper seams will be further damaged.
- 3.3.54. These seams can only be extracted by opencast mining with V seam as base, after allowing some time for stabilization of strata above VI seam following depletion of reserves of this seam.
- 3.3.55. The stripping ratio of the mine with V seam as base is likely to be very high considering the average thicknesses and areas of these upper seams.
- 3.3.56. Exploration of upper seams is not yet complete and hence no concrete picture of structure, reserves and quality of these seams are available at present. In addition, there are technological problems of excavation of the 100m thick water bearing unconsolidated sandy UDT beds and poorly consolidated clayey LDT bed by opencast mining.
- 3.3.57. In view of the above factors, opencast mining of the upper seams may become viable only at a distant future.

## *Feasibility of adopting stowing method for extraction of VI seam*

3.3.58. Adoption of stowing in Barapukuria mine will result in many advantages in mining of the extra thick VI seam as outlined below:

- Reduction in strata control problems while working in multi-slices
- Reduction in the risk of spontaneous combustion
- Improvement in face ventilation as longwall mining with panel barriers can be practised
- Reduction in the make of water from aquifer due to reduction in ground movement.

3.3.59. However, the following constraints are to be overcome for adoption of stowing in Barapukuria mine :

- Sand transportation to mine from Jamuna river located at a distance of 50-60 km.
- Modification in design of Powered supports to accommodate the stowing pipes and rear support extensions etc.
- Production process will slow down due to extra shift time consumed for stowing operation. Hence, additional equipment will be required for achieving the same production level of 1Mty.
- Additional capital investment will also be required for transportation of sand from river and for installation of stowing arrangements in the mine etc.
- Additional operating cost will also be incurred for carrying out stowing operation.

3.3.60. There are problems of fire, strata control and water inflow in the mine which are likely to be more pronounced during mining of subsequent slices of the thick VI seam. It is therefore imperative that other alternative methods like mining of slices in ascending order (in VI seam) with stowing may be considered at this stage for ensuring mine safety and conservation of coal reserves at Barapukuria for the future.

## *Underground mine environment*

### *Heat and humidity problems*

3.3.61. Arrangements should be done for prevention of water evaporation and reduction of humidity in the mine.

3.3.62. The heat and humidity added to the mine air can be diluted by increasing the air quantity flow to the working areas. This will entail larger pressure difference across the longwall faces. If the pressure across the longwall face increases, leakage of intake air to the goaf area also increases. This may cause spontaneous combustion in the goaf resulting in fire in the longwall faces.

3.3.63. Therefore, an optimum quantity of air should be allowed into the longwall faces to avoid this fire problem.

3.3.64. If the heat and humidity problem is not solved by optimizing the air quantity in the longwall panels, a detailed study should be carried out in the longwall panels and air cooling system should be installed for solving the heat and humidity problems in the mine.

### *Ventilation problems of the mine*

3.3.65. In order to improve the ventilation system of the mine, the following measures should be adopted:

- A detailed ventilation survey (pressure-quantity and temperature survey) should be carried out in the mine.
- Ventilation network model of the mine should be developed.
- Exhaustive computer simulation exercise should be carried out by using different variants for reorganizing the ventilation system of the mine.
- One of the conditions worth simulating by using the ventilation network model is the construction of a ventilation shaft at a suitable location, which will reduce the air travel distance, minimize air pressure loss and improve the ventilation of the mine. It is expected that in this condition, the pressure requirement for ventilating the mine may reduce to a significant extent which will reduce the total power consumption of the system, and save a large amount of energy cost for the company.
- A well equipped ventilation laboratory belonging to BCMCL should be set up in the mine with arrangements for chemical analyses of mine air samples, gas chromatography, temperature monitoring, dust monitoring, ventilation surveys, determination of in-seam CH<sub>4</sub> content etc.

### *Spontaneous combustion and fire problems*

- 3.3.66. The worked out panels should be properly sealed with explosion proof stoppings. Wherever water accumulation is taking place behind the seals, gully traps or suitable draining arrangements should be provided and precautions should be taken so that only water is allowed to come out without ingress of air into the sealed off areas.
- 3.3.67. The air leakage around the seals should be monitored. In addition, pressure difference across the seals should also be monitored.
- 3.3.68. In order to avoid the occurrence of fire in the 2nd slice and subsequent panels, pro-active inertisation should be adopted.
- 3.3.69. A fresh study on the proximate analysis, maceral content, cleat intensity and extension, thermal conductivity of roof and floor rocks and crossing point temperature of the coal of Seam VI should be carried.
- 3.3.70. As Seam VI is very much susceptible to spontaneous combustion, rigorous R&D efforts should be initiated in the mine level to deal with the problem of spontaneous combustion effectively. An in-house R&D set up should be established in the mine for this purpose.

### *Other underground environmental problems*

- 3.3.71. Since the mine has been working for a number of years, the gas content of seam should be determined by both direct and indirect methods for authenticating the gas content of the seam.
- 3.3.72. The guidelines for carrying out borehole gas survey in the mine should be developed and in addition the gas survey at a regular interval should be carried out for taking preventing measures if there is an increase in the gas emission in the mine.
- 3.3.73. In addition to CH<sub>4</sub>, other gases emitted by Seam VI should be measured at regular interval of time to avoid the sudden occurrence of other hazardous gases in the mine atmosphere.
- 3.3.74. The statute for ARD sampling should be developed and the method of ARD monitoring including the type of instrument to be used should be defined in the statute.
- 3.3.75. The free silica content of ARD should be determined from time to time as a normal practice.

- 3.3.76. Dust suppression arrangements along the gate belt conveyor and transfer points should be installed for reducing the ARD concentration in the mine atmosphere.
- 3.3.77. In order to prevent the occurrence of coal dust explosion, the guidelines for dust sampling should be developed and it should include the method of sampling, its frequency, parameters to be determined from the samples, etc.

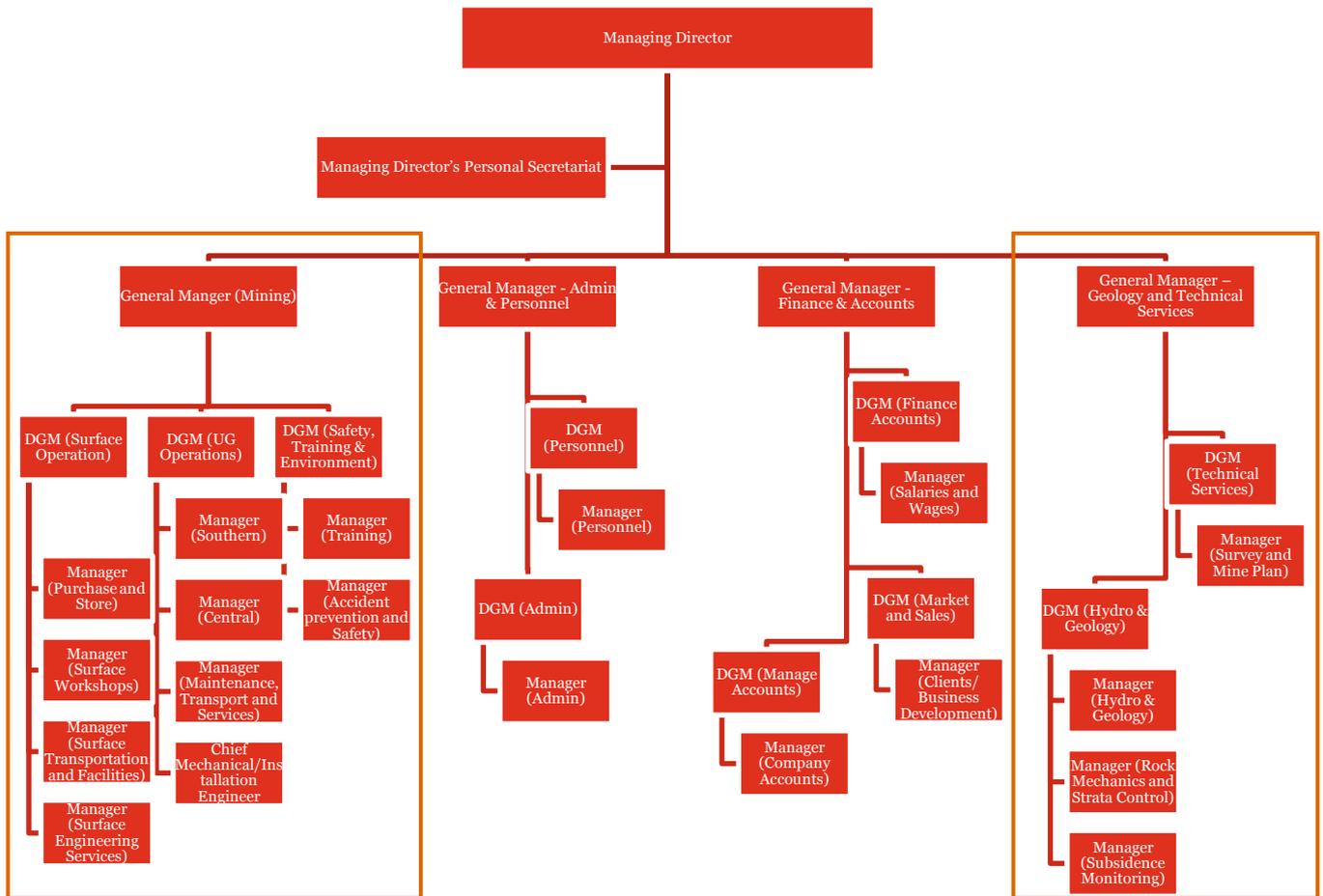
### *Mine Hazards and Safety*

- 3.3.78. Presently to reduce the mine accidents and improve safety, many countries of the world are following the approach of “Risk Assessment and Management”. In Barapukuria Coal Mine, this risk assessment and management technique should be implemented for improving the safety in the mine.
- 3.3.79. Emergency response system should be designed and emergency organization plan should be formulated and implemented.
- 3.3.80. Training and retraining of workers should be put in place for improving their knowledge in the domain of their working and awareness about safety.
- 3.3.81. Periodical medical examination (PME) of workers should be introduced to know the status of their health with respect to dust related and other diseases.
- 3.3.82. In hot and humid environment, apart from heat stroke, people are prone to other types of accidents due to their mental state. Therefore, the mine climatic condition, especially with reference to heat and humidity should be improved as discussed earlier.
- 3.3.83. The systematic support rule (SSR) should be formulated and imposed for reducing the accidents due to roof and side falls.
- 3.3.84. Safety rules, bylaws, standard operating procedure (SOP) and code of practices should be formulated and implemented.
- 3.3.85. The recommendations for preventing the occurrence of other hazards as described in previous sections should be implemented.
- 3.3.86. Some of the important plans, viz. water danger plan, ventilation plan with all ventilation control devices (stoppings, airlocks, regulator, air-crossing, etc.), dust sampling plan etc. should be prepared and updated at regular intervals.
- 3.3.87. Regular subsidence monitoring and treatment of the subsided area on the surface should be undertaken on priority basis. A survey organization should be set up at the mine level for day to day underground survey and also for subsidence survey.
- 3.3.88. Organization at the mine level should be developed for regular safety monitoring with full time management.

### *Mine organization*

#### *Proposed changes in present organizational structure of BCMCL*

- 3.3.89. The figure below shows the present organizational structure of BCMCL:

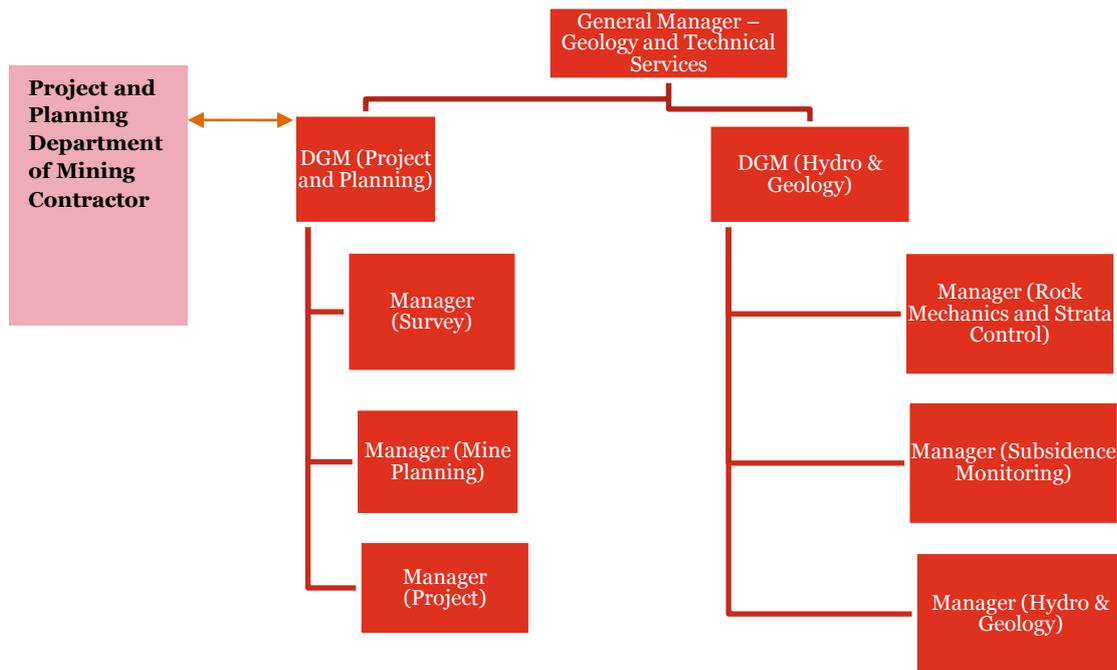


**Figure 1: Organization Structure of Barapukuria Coal Mining Company Limited**

- 3.3.90. As discussed earlier, Barapukuria coal mine faces several challenges including safety aspects, high water make, weak rock conditions, high heat and humidity etc. which raises safety concerns.
- 3.3.91. Further, we understand BCMCL is considering adopting LTCC method. Both longwall and LTCC methods of working specially in thick seam are specialized methods and thus BCMCL management may consider appointment of technical experts with the experience in the similar technologies to support mine oversight.

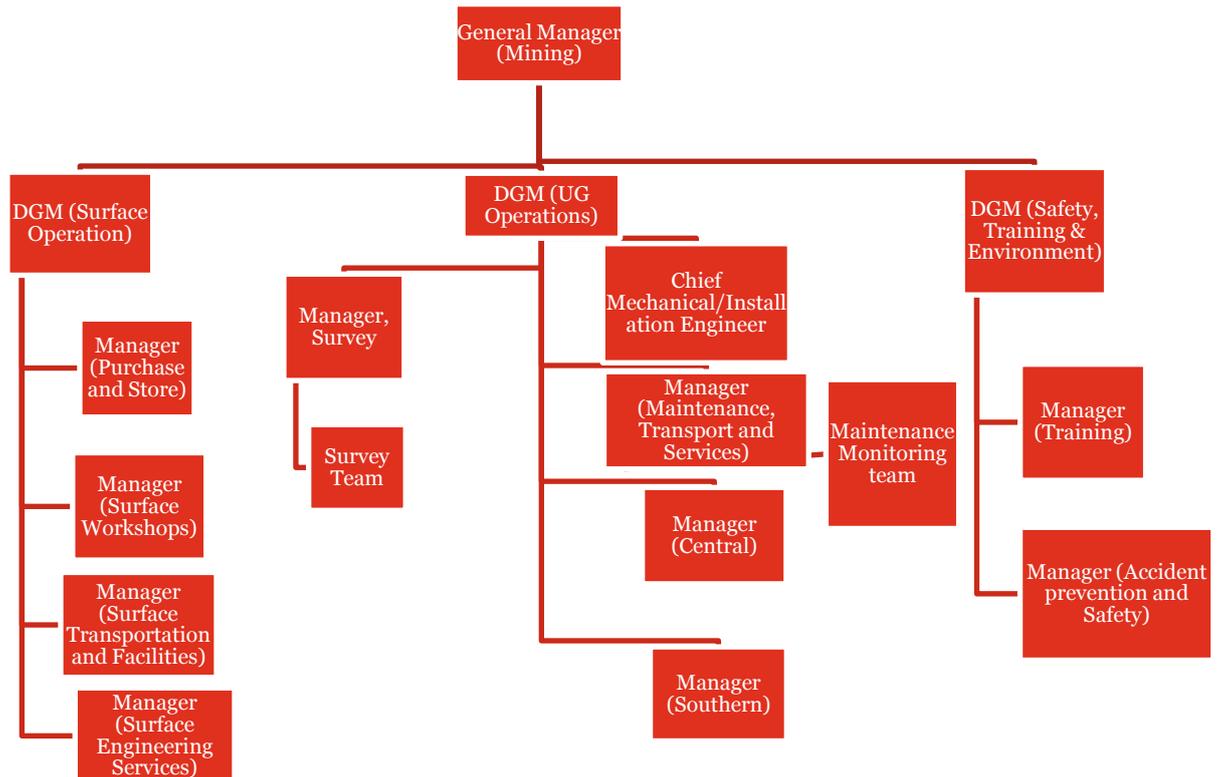
*Proposed Changes in Structure of General Manager, Geology and Technical Services*

- 3.3.92. The structure defined under General Manager, Geology and Technical Services may be redrawn as follows:



**Figure 2: Proposed Structure of General Manager, Geology and Technical Services**

- 3.3.93. As per the Structure proposed above, there would be a dedicated team for Project and Planning focused on the Mine Planning and Scheduling along with the Project works to be carried out in the mining operations. The plans and schedules so developed would be in-line with the Original (Approved) mining plan, as per the Contractual terms.
- 3.3.94. Further, the Project and Planning Department will perform Subsidence Monitoring on a routine basis, preferably, once in a fortnight.
- 3.3.95. The department needs to work in close coordination with the Project and Planning department of the mining Contractor and should have a focus on the mine's future development activities and the present progress, discussed at the micro level.
- 3.3.96. The department will also appraise BCMCL management on the progress of mine working and compliance with M&P Contract and mine plan on weekly/ fortnightly/ monthly/ yearly basis. Deviation from mine plan and agreed contract should be reported on priority.
- 3.3.97. All the reports/ plans generated by this department must be in English language or a language understandable by BCMCL management so as to have an access to these reports/ plans.
- 3.3.98. For initial period, this department may also be operated with consultants appointed to perform BCMCL's duties along with responsibility of knowledge sharing and skill development to BCMCL officials.
- 3.3.99. Proposed Changes in Structure of General Manager, Mining
- 3.3.100. The structure under General Manager, Mining is proposed as below:



**Figure 3: Proposed Changes in Structure of General Manager, Mining**

3.3.101. The above changes in the organization structure are proposed to facilitate the monitoring of the mining activities.

3.3.102. The Manager Survey should be entrusted with following responsibilities:

- Survey and measurement of daily progress of the coal mining face
- Monitoring of production from coal faces by measuring face progress
- Provide a cross-check of the coal production, being measured by belt weighing system, installed on the surface.

3.3.103. This department will work in close coordination with the Project and Planning Department

3.3.104. The Maintenance Monitoring team will have a crucial role to play in the existing operating scenario at BCMCL.

3.3.105. The key responsibility areas for this team would be:

- Generate data for equipment wise breakdown for every shift
- Capture these data to produce daily equipment availability and utilization
- Maintain these data for monthly/ quarterly/annual reporting
- Assist the Purchase and Store department in inventory planning
- Maintain a record for equipment maintenance schedule.
- Evaluate operations performance against agreement

### *Roles for Training Department*

3.3.106. The Training department should have an enhanced role by training and certifying BCMCL's employees from time to time. This will improve in-house capabilities for BCMCL in all operational and mining support related activities. Training department should also be entrusted with responsibility to develop knowledge repository with the help of BCMCL's Contract and BCMCL's technical consultant.

## **3.4. Review of the existing Mining Act, Rules and Regulations and Recommendation**

### **Recommendations**

3.4.1. On the basis of the review of existing Mining Acts, Rules and Regulations, we outline the following steps recommended for amending and enacting the legislations for facilitating development of mineral sector in Bangladesh.

### *Amendments to existing statutes/laws*

3.4.2. Review of principal laws governing the mineral sector in Bangladesh viz. the Mines Act, 1923 and the Mines and Mineral Resources (Control and Development) Act, under the emerging need of sustainable management of mineral sector. These Acts were amended with small changes and lack the elements which are needed to regulate the mining activities effectively in the current scenario.

3.4.3. Revision of the list of terms and their definitions in the principal laws, i.e., the Mining Acts, which can be shared by other Rules and Regulations made there under to bring consistency in legislations and interpretations of different terms and remove any loopholes.

3.4.4. Extension of the current ambit of mining legislations beyond regulation and management of licences and leases under the obligations and covenants prescribed by MMR, 1968 and its amendments. Addition of new provisions for scientific closure of mines and post-closure management, to ensure that this it is mandatorily adhered to by the mining entity, financial guarantee and other obligations, to this effect, shall be framed under Acts and Rules.

3.4.5. Revision of labor laws, workers compensation and welfare measures, which shall regulate and monitor the legal rights of workers employed directly or indirectly by mining entities.

3.4.6. Following the ILO Codes of Practices in the matters related to health, safety, working hours, leaves and holidays of persons employed in mining and allied works.

3.4.7. Compensation of persons working in mining entities shall be determined in following manner:

- The emoluments or compensation are in accordance with the government and company's policy and market forces, prescribing to minimum wages as provided under the existing laws;
- The provisions for superannuation benefits and disbursement of compensation are clearly defined and being made available to workers employed in mining entities by employers;
- A part of profit is being shared with workers; and
- The workers' grievances related to their wages and other benefits are redressed through an effective and transparent mechanism.

3.4.8. Environmental management shall be made more effective for mining activities by adopting the following measures in legislations:

- The mining entities must mandatorily submit environmental management programmes and updates for approval, during the permitting process and whenever there are significant processes or operational changes during the operating life of the mine. The impacts on biodiversity are mitigated or controlled by identifying, monitoring and addressing the potential and actual risks throughout the mining cycle;
- The mining entities shall conduct monitoring on a continuous basis based on national standards and the conditions of the operating permit, compile and submit performance assessments to government and publish regular reports that are readily accessible to the public;
- The mining entities shall design, operate and maintain mine waste structures such as waste dumps and tailings storage facilities. The geotechnical risks and environmental impacts must be appropriately assessed and managed through the entire mine cycle and after mine closure;
- The water resources are managed by having appropriate standards in place for the use of surface and ground water. The standards are strictly monitored, and have appropriate penal measures should they be compromised;
- The mining entities shall ensure that the quality and quantity of mine effluent streams discharged to the environment, including storm water, process effluents and mine water drainage are managed and treated to meet established effluent discharge guideline values. Also, they should ensure that water leaching and percolating in waste dumps, tailings storage areas have protective measures to prevent AMD and other effluents;
- Each mining entity has to develop and implement an emergency preparedness and response programme which is reviewed, tested and updated on a regular basis; and
- Each mining entity has a corporate environmental policy, strategy and plan.
- Formulate a framework in legislation through which progressive mine closure, final mine closure and post mine closure can be effectively monitored and controlled. This would help in minimizing the adverse environmental, economic and social impacts of mining activity.

### *Changes to licencing regime*

- 3.4.9. Splitting of the exploration work in two stages-Prospecting and Detailed Exploration. Accordingly, the provision for exploration licences can be modified, which shall grant a larger area for prospecting and based on the prospecting results, a licence for detailed exploration shall be given. This will also help the investors in identifying the potential prospects and will reduce the risk if they invest on the basis of the results of detailed exploration.
- 3.4.10. Regulation of the licensing and leasing process by Government to be carried out in a way that
- The mining entities, while preparing for a mining permit, hold consultations with local communities and other stakeholders at all stages of the assessment and planning process;
  - An integrated social, economic and environmental assessment is conducted and submitted with the application. This shall contain the baseline description of conditions, possible risks and impacts of the mining activities together with mitigation and management measures;
  - The application for permit identifies and quantifies the opportunities of the proposed programmes which will lead to creation of sustainable benefits over the life of the project;

- The application for permit is considered complete only when it includes acceptable plans for the progressive and eventual closure of the mines along with the provision of adequate financial assurance to cover the costs of closure;
- The application for permit addresses issues related to community safety and security, relocation and resettlement and cultural heritage;
- The mining entities have a dialogue channel or process of consultation which provides the affected communities to express their views on projects risks and impacts, and be consulted on the development of mitigation measures; and
- The process is completed in a timely, transparent, unambiguous and consistent manner.
- Considering the above, the Government may like to create an empowered (advisory) committee to decide (or advice) upon mineral concession applications, renewals, surrenders and cancellations.

3.4.11. Review of the terms of Licences and Leases based on the timeframe for development, economic life and closure. For example- the grant of mining lease for 10 years in first instance in case of open pit mining is low.

### *Promulgation of new laws and statutory authorities*

3.4.12. Enactment of legislation/ regulation to regulate the provisions under Act and Rules at operation level is an important requirement, which will help in increasing the standards of OH&S in currently operating mines. Framing and implementation of Coal Mines Regulation, Metalliferous Mines Regulation, Mines Vocational Training Rules, Mines Rescue Rules under Mines Act in Bangladesh are considered essential for attaining the goal of improvement of mine safety standards.

3.4.13. This will also help the Government in monitoring the safety and occupational health measures undertaken by mining entities. The legislation related to occupational health and safety shall ensure that

- Each mining entity within its jurisdiction accepts corporate responsibility for occupational health and safety and maintains high standards;
- Each mining entity integrates occupational health and safety with its mining process and develops a proactive system based on the likes of ISO-OHSAS Standards;
- The government builds institutional capacity and effective mechanism for monitoring of OH&S compliance by mining entities, to conduct inspection of mines, related facilities and enforcement of legislative measures.
- The failures in occupational health and safety performance are effectively dealt with to prevent reoccurrence and are supported by a system of penalties up to and including the revocation of operating permits;
- The mining entities shall provide appropriate education and training related to safety in order to reduce hazards and minimize the risks of accidents, injury, and disease and create a safety-conscious environment;
- The procurement of safety equipment, Personal Protective Equipment (PPE) and their quality are of high standards and quality checks are done regularly;
- The introduction of new machine, method or system is essentially combined with a code of standard and safe practice; and

- The accidents and injuries at work are reported in transparent manner and being investigated properly.
- 3.4.14. Establishment of Mine Inspectorate as enacted in the Mines Act, 1923 by Government. This institution shall be independent of Ministry or Agency dealing with the matters of mining activities directly. If Mine Inspectorate cannot be established, then the Government should constitute an empowered Committee having representations of Mining Entities, Mine Workers, Government Representatives and International Experts on Mine Safety and Occupational Health Management as an interim measure.
- 3.4.15. Building institutional capacity, primarily of BMD to which Government has delegated the Authority to regulate licences and leases. The legislation shall have provisions under which BMD, or any other agency deemed fit, shall
- Generate baseline data such as topographical, geological, cadastral, environmental and socio-economic information;
  - Collect and systematically manage data pertaining to mineral resources and mineral bearing areas through an administered central data repository;
  - Provide access to information as and when required by planners, mining entities, potential investors and other stakeholders in mineral resource development in a transparent manner; and
  - Develop guidelines for generating, analyzing and reporting the mineral wealth of the country.
- 3.4.16. Mineral Resources classification as per internationally acceptable system is necessary for facilitating entry of global miners. Adoption of UNFC System for mineral resource classification and reporting shall be made mandatory under legislation which has been accepted by all the stakeholders as system to classify Mineral Resources of Bangladesh. Also, for objective development of the mineral sector, the Legislations shall be able to distinguish between different type of minerals as per their value and abundance in Bangladesh.
- 3.4.17. Adoption of mineral conservation principles in the Mineral Policy and framing of appropriate Legislation/ Rules which can ensure that,
- The mineral bearing areas clearly identify the main mineral and co-existing mineral or rocks of potential economic value;
  - The mine development plan takes into account the losses and dilution during the life cycle of mining and extraction process;
  - The mining process is designed for maximum recovery of minerals and mining entities exhibit that they are working towards continuous improvement;
  - Poor recovery of minerals is deterred through effective regulatory and control measures;
  - Stowing of extracted area in coal mines is encouraged through introduction of subsidy;
  - The recovery and losses of minerals during their exploitation are properly accounted and reported by mining entities;
  - The mineral losses during exploitation are classified as temporary and permanent losses;
  - The “marginal value minerals” exploited during mining are handled separately in such a way that these can be used when the economics becomes favorable; and

- The wastes during mining and extraction are assigned values as per the economics of current and potential future uses. Accordingly, the handling, storage and usage of wastes are designed.
- 3.4.18. Frame a suitable policy on FDI in mineral sector in accordance with national priorities, technical and management capability an FDI brings in to develop and manage mineral sector.
  - 3.4.19. Appoint a Regulator or/and an independent committee to decide upon the subject of royalty and taxes on minerals. The policy of periodic revision of royalty shall be adopted and it shall apply on ad-valorem basis.
  - 3.4.20. Formulation of a comprehensive R&R Policy for mining sector based on rights valuation for local community affected by mining or related development projects. The usual practice is to compensate and rehabilitate only those whose land is acquired and does not recognize the livelihood loss of land-less population, who get affected by a development project. The local community shall be provided additional value for loss of livelihood, rights and identity.
  - 3.4.21. Invite objections and concerns related to a mining project in a democratic manner and the legislation should have the provision of public hearing under Rules before grant of any licence, lease or permit.
  - 3.4.22. Formulation of Corporate Social Responsibility policy by mining companies and initiative shall be supported by the Government. Employment avenues shall be generated for local community, wherever possible, and mining entities shall extend support in developing the skills in their current occupations like- farming, poultry and dairy.

### ***3.5. Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects***

#### ***Recommendations for development of CBM and UCG***

##### ***Stage 1: To establish the feasibility of CBM and UCG***

- 3.5.1. The GoB, in consultation with GSB, may demarcate and prioritize the coal fields and potential coal basins into blocks by surveys/studies, which may be explored for identifying the potential of CBM and/or UCG.
- 3.5.2. The Government of Bangladesh may assign the responsibility of conducting the field work and technical studies to a Government Agency. The Agency may tie up with reputed international players having expertise in this field or institutes engaged in R&D in the area.
- 3.5.3. The financing of studies for exploration of CBM and UCG may be done through combinations of Government funding, borrowing funds from donor agencies and private sector investment (both domestic as well as international).

##### ***Stage 2: Development of commercial projects***

- 3.5.4. First step towards commercial development of project is to establish priority between Conventional Mining, CBM and UCG. Since CBM precedes the coal mining, wherever viability and other conditions allows, CBM can be done first followed by mining of coal. Post CBM extraction, conventional coal mining should be preferred over UCG wherever possible unless techno-economic viability establishes otherwise.
- 3.5.5. Since, CBM and UCG technologies are capital intensive with number of risks involved it is preferable to examine different models and modalities of financing without sacrificing national interests in the process. Different models for development of these resource may be adopted which are as follows:

- **Provide license to PSU and make Public Sector Investment**
  - GoB can exploit the CBM and UCG resources on its own through a public sector company. Since, there is no past experience of Bangladesh in these areas it may be necessary for GoB to encourage the option of leasing and/or contracting (as in the case of Barapukuria Coal Mine) so that players with proven technology can be invited.
- **Leasing: An asset can be leased to private sector or foreign investors**
  - The party establishing feasibility may be given right of first refusal for that particular block (at a Reserve Price). If such party is not interested, then the lease to other parties may be granted on the lines of a mining lease and/or the experience gained from the natural gas sector could be adapted to CBM/UCG to determine the terms and conditions including production sharing.
  - The government may roll out incentives to encourage private sector participation in the form of tax holidays, waiver of local taxes, reduction in import duties on equipment, provisions for preferential sale of gas from such sources etc.
- **Contracting:** The contractor should be selected through an international competitive bidding process. The contract may be:
  - Levelised Price contract
  - Production Sharing Contract (PSC)
- **Infrastructure and Carbon Credits**
  - If CBM extraction program can be successfully implemented, benefit of carbon credit has to be availed of.
  - For marketing of CBM, existing gas grids have to be extended to coal mining areas. Appropriate gas processing plants are also to be established for supplying dry and pure methane to the grid.

## Recommendations for Hard Rock sector development

### 3.5.6. Classification of Resources:

- Adoption of UNFC System for mineral resource classification and reporting should be made mandatory under legislation to classify hard rock resources of Bangladesh.
- It is also suggested that all the rocks should be classified in different categories as per value (by use) to be used to prioritize the leasing process and to reserve minerals only for higher value end use which ensures that more returns are generated for the country.

### 3.5.7. Preparation of Knowledge Repository:

- An inventory of the various minerals should be prepared by carrying out systematic surveys and studies to attract both private as well as foreign investment in the minerals sector.
- Need for institutional capacity development of GSB and/or BMD and other related organisations.

### 3.5.8. Changes in Licensing Regime:

- The recommendations made regarding mining licensing in report on Review of Existing Acts, Rules and Regulations and Recommendations, should be implemented.

3.5.9. Modifications in operations of Maddhapara hard rock mine is required to increase production. the measures suggested in this regard in the report on Action Plan and Guidelines for development of CBM, UCG and Hard Rock Projects are mentioned in brief below. We understand that some of these suggestions are considered by MGMCL during the process of engagement of Mine Management Contractor and thus may suitably be incorporated in the Contract

- Additional boreholes may be drilled in the peripheral areas of the deposit to prove the depth of occurrence of hard rock.
- In order to meet increasing demand of hard rock in the country, attempt should first be made to increase the indigenous production. Since the skip shaft hoisting capacity is limited to 1.986 million tons, production at Maddhapara mine can be increased marginally from 1.65 Mtpa to, say, 1.75 Mtpa. Therefore, efforts should be made to utilize the spare capacity of about 0.10 million tons by increasing the number of working stopes.
- The cage shaft hoisting capacity which is 0.112 million tons, should also be marginally increased by making more broken rock available belowground from the new stopes, and by modifying the hoisting schedule.
- The aggregate processing plant capacity on surface needs to be enhanced to cater the increased quantity of rock to be processed due to increased production.
- A trial Room and Pillar stope may be started in the present working horizon(s) for production of hard rock slabs for use in building construction. The slabs could be transported and hoisted through the cage shaft in specially designed/constructed carriages. Reduction in the production of hard rock through cage shaft could be made up by increasing the production through skip shaft.
- The techniques of mining may also be changed to enable extraction of large blocks (say, big enough to produce 50 to 60 centimeter square tiles of 20-25 mm thickness) to be cut into “slices” to make tiles for flooring and other uses in buildings. This is proposed assuming that the quality of granite is suitable for the purpose

3.5.10. If the quality of the limestone varies from mine to mine, the government may restrict its use to the best possible end use to exploit maximum value out of this. (e.g., cement grade limestone be used for making cement).

3.5.11. Thrust on mineral processing and high value use is required.

3.5.12. GoB shall formulate a framework for effective monitoring and control of environmental and safety aspects.

3.5.13. Efforts are required for exploration and exploitation of other construction materials like gravel, sandstone, as well as, other minerals like glass sand, beach sand and white clay etc.

## ***3.6. Coal Sector Development Strategy***

### **Recommendations**

3.6.1. The recommendations for coal sector development strategy are summarized in the table below:

Step	Aspect	Recommended Strategy
1.	Legal framework and Institutional development	<ul style="list-style-type: none"> <li>It is necessary for sustainable development of the coal sector that the current legislations are amended and wherever required, new legislations are enacted as suggested in coal sector development strategy report.</li> <li>Strengthening of existing institutions and establishment of new institutions like National Mines and Minerals Council; Coal Bangla and Khani Bangla; Ministry of Mines and Mineral Resources; Coal Sector Development Institute; Inspectorate of Mines and Minerals; Mines and Minerals Institute</li> </ul>
2.	Depletion policy	<ul style="list-style-type: none"> <li>To ensure the long term energy security of Bangladesh it is desirable that the limited reserves of coal are depleted in a planned manner over a long period of time with a vision of coal conservations and maximum exploitation.</li> <li>There must be a depletion policy which specifies the period over which an existing reserve would be fully mined, say, for example, 30-50 years</li> </ul>
3.	Declaration of Coal Zone	<ul style="list-style-type: none"> <li>Area comprising discovered coal fields and potential coal basins in northwestern Bangladesh may be declared as the Coal Zone</li> <li>Carry out a techno-economic feasibility study for the purpose of assessing the viability of Coal Zone</li> <li>Demarcate the Coal Zone into coal blocks for inviting bids for prospecting and (finally) leasing.</li> </ul>
4.	Decision on investment models and type of contract	<ul style="list-style-type: none"> <li>Government should provide budgetary support in the form of equity or share capital to a public sector enterprise.</li> <li>The possibilities of getting financial assistance from multilateral funding agencies should be explored.</li> <li>Taking into account the various types of coal contracts (Cost plus, levelised price, PSC) and the circumstances prevailing in Bangladesh, a model coal PSC appropriate for attracting investment in the sector may be prepared.</li> <li>To encourage private investors for undertaking exploration of mineral resources with assurance for award of mining license to operate, in case of successful exploration.</li> <li>In view of the need of specialized financing and development need of the coal sector, the tailored mode of investment in terms of PSC may be explored. However, the issue may be professionally examined further and any mode of financing that suits best for the country in the back ground of international financing market may be adopted expeditiously. Contractual issues should be settled with due diligence so that a win-win situation is created for all the involved parties.</li> </ul>
5.	Decision on commercial aspects	<ul style="list-style-type: none"> <li>Coal pricing policy may be revisited to represent a realistic scenario which provides reasonable return to the investors keeping the coal price tolerable. Setting up of Coal Price Equalization Fund (CPEF) may be</li> </ul>

Step	Aspect	Recommended Strategy
		<p>considered to supply coal at uniform price to consumers from all coalfields.</p> <ul style="list-style-type: none"> <li>To encourage private sector participation, the government may roll out incentives for the private sector in the form of tax holidays, waiver of local taxes, reduction in import duties on equipment etc.</li> </ul>
6.	Pre-development activities in coal deposits	<ul style="list-style-type: none"> <li>Invitation of bids for exploration activities.</li> <li>Detailed exploration and other studies along with the preparation of geological reports and other study reports of all the coal basins can be completed within a period of 3-4 years</li> <li>Studies suggested in coal sector development strategy report should be conducted expeditiously to establish feasibility of opencast mining.</li> <li>For introduction of stowing in the mines, studies have to be initiated immediately on high priority basis for assessing availability of sand in Jamuna river/ other rivers and the annual rate of replenishment of sand in these rivers</li> <li>Model bid documents and contract manuals for exploration, mine construction and for mine development and operation have to be prepared expeditiously</li> </ul>
7.	Development of coal deposits	<ul style="list-style-type: none"> <li>Development of different mines should be phased to match with the availability of international contractors and development of internal organization to handle increased scale of operation</li> <li>It is necessary to take decision on the pending applications (Phulbari and Khalashpir coalfield) at the earliest.</li> <li>Invitation of bids</li> </ul>
8.	Coal sector infrastructure development	<ul style="list-style-type: none"> <li>This should be done in conjunction with the concept of coal zone.</li> <li>Coal Axis should to be given due consideration to define a route for development of coal transportation system across the Bangladesh. Its viability (or otherwise) should be established through a techno-economic study by experts.</li> <li>Coal axis is to be used as the sites for locating the major coal fired power stations in Bangladesh such that they have the flexibility to use both local and imported coal.</li> <li>The infrastructural development for coal production and supply must ensure that the transportation cost is kept at minimum and to the best of capacity utilization of the facilities. The river routes mode of transport must be given top priority in addition to the improvement in road and railway modes.</li> </ul>
9.	Peat development	<ul style="list-style-type: none"> <li>Undertake studies to establish suitability of peat resources for power generation and also for domestic fuel.</li> <li>Undertake an integrated detailed socioeconomic survey before extraction/ mining of the peat as peat fields are good paddy fields.</li> </ul>

Step	Aspect	Recommended Strategy
		<ul style="list-style-type: none"> <li>• Conduct research for use of peat as a fertilizer and/or soil conditioner for agriculture and horticulture sector and also for fisheries and water treatment and/or purification.</li> <li>• Detailed surveys should be done to confirm the reserves of peat from the category of resources .</li> <li>• Undertake techno-economic feasibility studies for the areas with proven reserves.</li> <li>• Encourage local entrepreneurs to set up units for producing briquettes from peat for domestic and other use and popularize it.</li> <li>• Frame separate rules for leasing and land acquisition, lease or purchase specifically to suit peat mining operations in Bangladesh</li> </ul>
10.	Human resources development	<ul style="list-style-type: none"> <li>• Setting up of Vocational training Institute that will provide regular trainings to the people deployed in the mines and will also undertake skill development courses for new manpower deployed at mine at operational level</li> <li>• Academic courses in mining, geology and other related fields to be introduced at the college and university level.</li> <li>• As interim measures, bilateral agreements with minerals rich countries to be made to train Bangladeshi personnel in foreign coal mines.</li> </ul>
11.	Land utilization and Reclamation	<ul style="list-style-type: none"> <li>• The mine plan and the PSC/mining contract, if there is one, must make it obligatory for the mine owners to reclaim and rehabilitate the mining area after mine closure as per the mine plan to the extent feasible. Adequate safeguards need to be built in to the lease documents (and the PSC) so that it can be enforced.</li> <li>• A policy may be framed to deal with the rehabilitated land so that while fair play is assured to the lessee, the Government steps in to avoid windfall gains to the lessee by imposing a suitable tax.</li> </ul>

# 4. Way Forward

## 4.1. Legal and Regulatory Framework

### To implement proposed amendments to legislation:

- a) The Government may set up an Empowered Committee from across relevant ministries to study the recommendations made in the report and adopt suitable elements it believes can be taken for amendment in the various mining laws, regulations and rules.
- b) The Empowered Committee and the Government's law ministry will need to assess the proposed changes are compatible with the constitutional law, existing legislation and government policies. This is necessary given the wide range of subjects covered such as the environment, labour, explosives, and various end-use sectors such as energy and infrastructure.
- c) A particular emphasis is needed to cover regulation of mine operations and scientific closure of mines, introducing them either under the existing legislation or by promulgation of new rules. In light of the proposed investments in the mineral sector, and entry of new private sector operators and investors, this legal framework becomes important.
- d) Further, given the specific aspects discussed in the report for coal mines and metalliferous mines, a suitable amendment to existing legislation or new rules such as the Coal Mines Regulations may be introduced.
- e) A separate set of recommendations have been made under health and safety, and the need for rescue rules and emergency response mechanism. These may be pursued covering all the licensees including currently in operation. Similarly, another set of recommendations cover conservation, socio-economic benefit optimisation, and environmental management which should be framed early on in order to cover all new development activity.

### New institutions and capacity building of new and existing institutions

- f) To implement the recommendations of report on "Review of the existing Mining Act, Rules and Regulations and Recommendations" and other reports under this study viz., the Report on "Coal Sector Development Strategy" and "Action Plan for development of CBM, UCG and Hard Rock", the Government of Bangladesh will need to establish new institutions, strengthen the organization structure, and build institutional capabilities in areas that have been detailed in the referred reports.
- g) It may be mentioned that the process of proposed changes in institutional arrangements and capacity building will need to start in parallel with the revision of the legal framework so that the functions can be properly discharged. The Government may set up an Empowered Committee to similarly study the recommendations on the creation of new bodies, institutions and authorities and align these recommendations with policy of the Department of Personnel and with the due process to implement this.
- h) A particular emphasis is recommended for establishment of proposed institutional arrangements for management of mineral resource information. The resource data is important for the country to get better terms for its mineral wealth, securing financing, and use the resource efficiently.
- i) The capacity building of said institutions including transfer or recruitment of suitable personnel, office infrastructure, tools and equipment, and training will be a significant undertaking. It is suggested that

the government take early steps to work with donors and multilateral agencies to develop suitable capacity building program.

#### **Other aspects**

- j) The report in several instances makes observations and presents comparative assessment on related aspects such as of licensing policy, fiscal incentives offered, tax and royalty policy, etc., which have implication outside the mining sector and will need to be reviewed by the government in order to strengthen the policy framework.
- k) On vocational training, the government may take note of recommendations on assessment of skills required and the need for training facilities and galleries. The gestation period for these is longer and early actions are needed in order to maximize opportunities for local population and ensure availability of right skills for anticipated mine development.

## ***4.2. Setting up of enabling structure***

### **Coal Zone and Coal Axis**

- a) To facilitate focused and expedited development of identified coal fields and exploration of the new resources, GoB should demarcate the potential coal bearing region as Coal Zone. The proposed Coal Zone should comprise of the discovered coal fields and potential coal basins in northwestern Bangladesh.
- b) Further as recommended in Report on Coal Sector Development Strategy, Government should set up cross ministry group to study and consider various recommendations on developmental structures and incentives to facilitate development of coal projects.
- c) Thus, GoB may entrust this responsibility on GSB to identify the potential coal bearing areas and help demarcate the Coal Zone to facilitate government take up development of these areas.
- d) Further, Government of Bangladesh should debate on the proposal of Coal Axis and associated recommendations for development of coal transportation system and setting up of coal based power plants to meet its developmental targets. This should include the study for establishing the techno-economic feasibility of Coal Axis.

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