THE FINAL TECHNICAL REPORT OF A PRE-FEASIBILITY STUDY ON METHANE RECOVERY AND UTILIZATION IN THE NALAIKH MINE AREA, MONGOLIA (#833970)

Ulaanbaatar, Mongolia
2010
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Introduction

This report presents to you final report a Pre-feasibility study on Methane Recovery and Utilization in the Nalaikh Mine Area, Mongolia.

Mongolia has rich coal resources. The coal resources of Mongolia are 162 billions tones, the 10\textsuperscript{th} largest in the world. In recent years, the Mongolian Government and the Coal industry have attached great importance on Coal methane mine (CMM) and coalbed methane (CBM) development and utilization. On 27th March 2008 the Government of Mongolia became the 24\textsuperscript{th} member of the Methane to Markets Partnership Program operated by the US Environmental Protection Agency’s Climate Change Division.

The Government of Mongolia supports the Methane to Markets Partnership. It will provide more financing channels and technical support, and accelerate development of methane recovery and utilization. In the framework of the Methane to Market Partnership Program, Mongolia has implemented small pre-feasibility studies on methane recovery and utilization possibilities in Nalaikh mine.

The Mongolian Nature and Environment Consortium is implementing the EPA’s grant award on pre-feasibility studies of methane recovery and utilization in Nalaikh mine area, Mongolia. The EPA grant award activities started from 30 September 2008 and were completed 30 December, 2009.

The main goals of the EPA’s grant are to conduct a pre-feasibility study on data collection at the Nalaikh coal mine, make an assessment of coal methane resource potential at Nalaikh mine, prepare the Global environment facility (GEF) project outline for larger efforts to remove barriers and promote investment in CMM recovery in Mongolia, strengthen capacity building through organizing workshops and meetings and publication of materials, identify and remove barriers to CMM recovery on investment opportunities and review and revise the existing methane and petroleum laws and policy documents.

The report consists of seven parts as Identification of barriers for the recovery and utilization of coal mine methane, Coal mine project opportunity: Nalaikh mine power generation and heating project, Tsagaan Shonkhor Holding company, Nalaikh district, Mongolia, Assessment of coal mine methane resources potential at Nalaikh mine, The detailed study of the geological conditions of Nalaikh mine deposit, National capacity building on CMM/CBM through organizing workshops, meetings and publication of materials, Revision of the existing petroleum laws and procedures in order to support policy on coal mine methane recovery and utilization opportunities in Mongolia and annexes.

Finally, we would like to express my great attitude to the Coalbed Methane Outreach Program, US EPA, Raven Ridge Resources Incorporated, Lunagas Pty Limited, Australia to support for successful implementation of this EPA’s grant.
The results of the EPA’s grant award

1. Identification of barriers for the recovery and utilization of coal mine methane

   Major barriers for the recovery and utilization of methane have been identified. The barriers to developing clean energy resources including coal bed methane (CBM) and coal mine methane (CMM) recovery and utilization in Mongolia are:

   • Poor understanding of the CMB and CMM resource. The Mongolian mining community has long had to deal with the safety concerns of the liberation of methane within underground coal mines. However it has not developed the expertise to drain the gas from mine workings at high enough concentrations to provide a usable fuel. It is also important to be able to estimate the volume of the resource that may be present and the rate at which it can be extracted.

   • The lack of legal foundation for CBM/CMM development. A transparent legal framework addressing the ownership of the gas within the mine and how to facilitate the profitable extraction and utilization of the gas needs to be developed through legislative and ministerial processes.

   • A shortage of human and technical capacity. Drainage of methane from abandoned mines is a relatively common practice in the United States and Europe where technologies, best practices and safety procedures have been developed. This capacity needs to be transferred to local Mongolian professionals.

   • Shortage of funding. Although significant funding can be provided by in-kind efforts from various Mongolian ministries and educational institutions, additional funding is required for specific needs requiring resources beyond the capacities of those institutions.

   In order to remove the above barriers we have developed a GEF (Global environmental facility) proposal on the removal of barriers for methane recovery and use in Mongolia.

   The objective of the GEF project outline is to develop a full scale project (main project) with the assistance of GEF resources to reduce greenhouse gas emissions related to methane emissions from the Nalaikh abandoned coal mine, as well as to displace a portion of the carbon dioxide emissions from burning coal. This Project Preparation and Development Request for a Project Preparation Grant (PPG) will support this effort by providing technical assistance to build the capacity of local stakeholders to further develop and implement this type of project. A pilot demonstration project will also result from this initial funding which will capture and use the methane as a beneficial fuel.

   We conducted the following activities for development of the GEF project outline:

   • Mr. Roland Collings, President of Ruby Canyon Engineering (RCE) visited Mongolia on 16 July 2009 and collected data for development of the GEF proposal on coal mine methane recovery and utilization.

   • Mr. Roland Collings visited Nalaikh mine site and collected some data for development of GEF proposal.

   • Mr. Roland Collings made a presentation on US experiences of recovery and utilization of abandoned mine sites and presented this at a meeting of relevant representatives and stakeholders.

   • The project concept and institutional arrangements for the project have been discussed with representatives of relevant ministry and agencies.
• A presentation was prepared and presented on the initial draft of the PPG Form to a stakeholders meeting to enable stakeholders to give feedback on the Consultant’s work. Feedback will be incorporated into the PPG Form.

• Organized a stakeholder’s meeting for discussion of the GEF project outline prepared by Mr. Roland Collings.

The desired outcome of this project is to secure the PDF Block B Grant which will hopefully demonstrate the feasibility of implementing a project that utilizes the recovered coal mine methane as a clean fuel source, thereby reducing local reliance on coal while reducing greenhouse gas emissions from the Nalaikh mine. (Annex 1. The GEF project document including Budget).

The project summary are below:

The objective of the full scale project (main project) to be developed with the assistance of GEF resources requested here is to reduce greenhouse gas emissions related to methane emissions from the Nalaikh abandoned coal mine as well as to displace a portion of the carbon dioxide emissions from burning coal. This Project Preparation and Development Request for Project Preparation Grant (PPG) will support this effort by providing technical assistance to build the capacity of the local stakeholders to further develop and implement this type of project. A pilot demonstration project will also result from this initial funding which will capture and use the methane as a beneficial fuel.

**Country Ownership of project**

**Country Eligibility**
Mongolia ratified the Framework Convention on Climate Change on September 3, 1994. As a Party to the Convention and as a developing economy Mongolia is eligible for assistance from the Global Environmental Facility for projects related to the climate change focal area. Specifically, the project is consistent with the GEF short-term criteria to reduce greenhouse gas emissions. Besides these short-term impacts, there is a strong potential for replicating this project in other developing countries.

**Country Drivenness**
Winter air pollution is worsening in the Nalaikh and Ulaanbaatar districts and is five to six times the permissible level. Respiratory diseases are on the increase. The primary cause of this pollution is the burning of raw coal. Replacing this fuel source with cleaner burning fuels is a high priority of the government because of the direct effect the burning of raw coal has on the health of its citizens.
Mongolia has ten times the GHG emissions per GDP than the world average. It is necessary to begin reducing those emissions in the most economically and environmentally effective manner possible. Mongolia has a very large resource of coal, however, the government recognizes that in order to utilize this resource clean coal technology needs to be developed. One of the ways to begin using this coal resource in a more environmentally effective way is to exploit the clean burning methane gas trapped within the coal and within active and abandoned underground coal mines.

Emissions from the 40 active surface mines, 1 active and 4 abandoned underground mines are significant and mitigation of these sources of emissions could significantly reduce the total GHG emissions of Mongolia.
Justification
Winter air pollution in Ulaanbaatar has reached the disaster level. Recent studies estimate that the city exceeds the allowable pollution level by five to six times. One critical impact of this pollution is a rapidly growing rate of respiratory diseases. The primary cause of this pollution is the burning of raw coal. The sources of this pollution include:

- Over 135,000 stoves and wall-stoves in gers and private households;
- Over sixty water heating boilers of schools, hospitals, and public apartments not connected to district heating system;
- Over 1000 low-pressure boilers in small scale businesses and service buildings

Because of the reliance on coal for heat and power and the large number of livestock relative to the population, Mongolia has ten times the GHG emissions per GDP than the world average. Therefore it is necessary to begin reducing those emissions in the most economically and environmentally effective manner. Capturing and using CMM currently escaping from the abandoned Nalaikh coal mine will reduce GHG emissions by preventing the release of methane into the atmosphere (methane has a global warming potential 21 times greater than carbon dioxide) and by displacing coal as an energy source (oxidation of methane contributes about half as much carbon dioxide as the oxidation of coal).

Description of Proposed Preparation Activities
In order to prepare for the main project, the size of which still needs to be determined, the following activities need to be undertaken: (1) Perform a resource assessment of CMM at the Nalaikh mine; (2) Strengthen the legal and regulatory framework to make it more supportive for CMM recovery and utilization; (3) Identify technical assistance needs; (4) Implement a training program for technical needs; (5) Develop a risk management strategy and; (6) Develop a full GEF project proposal.

Activity 1. Perform a resource assessment of CMM at the Nalaikh mine

- Step 1: Identify two (2) drilling locations: This involves acquiring and analyzing historical mine data especially mine maps compiled at abandonment. Documented historical gas outbursts and water entry locations will be identified. A geologic structure map, a topographic map and land ownership and surface use maps will be combined with the mine maps in order to find suitable drilling locations. This will require the cooperation of the Mineral Resource Agency and the assistance of the Mining Institute of the Mongolian University of Science and Technology.

- Step 2: Drill two (2) locations: This is necessary to ascertain the presence of free gas within the abandoned mine workings. There is the possibility of the mine being at least partially flooded so these wells will be drilled to determine the possible extent of flooding. Drilling into the mine must be done safely and may require the consultation of an expert outside of Mongolia. A qualified local drilling company will be identified. This may require the cooperation of the Agency of Petroleum and the assistance of the
Petroleum and Drilling Engineering Department of the Mongolian University of Science and Technology.

- Step 3: Test the wells to determine the probable size of the resource: Flow wells and monitor gas rate and pressure as well as gas composition. This requires specialized equipment that may or may not be available in Mongolia. The wells will be tested over an extended period of time to determine if a demonstration project will be feasible. To do this a compressor, flare and monitoring equipment will be purchased or leased. Expert consultation concerning the analysis of the test will be acquired.

- Step 4: Implement the demonstration project: Should the testing of the wells signify an adequate resource, the gas can then be utilized in a beneficial manner. Several end use options exist with the most common being; (1) Use as fuel for a boiler and; (2) use as fuel for an internal combustion engine driving an electric generator. This small scale demonstration project will hopefully demonstrate that a resource exists significant enough to move on to main project supplying a significant fuel source to the Nalaikh area.

Activity 2. Strengthen the legal and regulatory framework for CMM recovery and utilization

- Step 1: Establish transparent ownership laws for CMM: There are often conflicting ownership laws regarding CMM and Coalbed methane (methane from coal undisturbed by mining activities). Because of the unique nature of the resource it can be argued that the methane belongs to the coal owner or leaser because it resides within the coal. It can also be argued that the methane is part of the petroleum resource because it is a hydrocarbon gas.

- Step 2: Evaluate regulatory standards regarding CMM recovery and use: There may be health, environmental and safety issues related to the production and use of CMM that need to be addressed. Because of the scarcity of natural gas infrastructure in Mongolia there may need to be regulatory reform related to the installation of gas pipelines, gas compression facilities and gas fueled boilers.

- Step 3: Provide specific incentives to promote CMM development under the law: Natural gas, CMM and coalbed methane (CBM) are not yet significant fuel sources in Mongolia and widespread development of these resources will require significant investments in exploration, production and distribution facilities. In order to attract local and international investment for such activities a series of financial incentives such as tax relief or price supports should be considered.

Activity 3. Identify technical assistance needs:

- Step 1: Assess the current capacity of the local stakeholders to Implement a CMM recovery project: The relevant stakeholders will be identified. This will include government ministries, local regulatory bodies, educational institutions and local service
providers. Individuals within those organizations will be identified that can provide management and technical expertise to the project. Their understanding of the proposed project activities will be assessed by an expert consultant in the international CMM industry.

- **Step 2: CMM resource assessment:** Expert assistance will be obtained to determine the selection criteria for choosing CMM drilling sites. Expert assistance will also be obtained to identify appropriate drilling equipment and well design as well as the equipment needed to produce and flare the gas during testing and to use the gas during the demonstration phase. Estimating the resource volume based on the testing is also specialized knowledge that will be obtained.

- **Step 3: Legal system improvement:** A survey will be conducted of how various countries have handled CMM legal issues including in Ukraine, Russia and the United States.

**Activity 4. Implement a training program for technical needs:**

- **Step 1: Resource assessment capacity building:** Domestic and international consultants for training technical personnel and decision makers will be secured. These consultants will conduct local, targeted training workshops. Similar, successful international project types will be identified and travel to such sites organized to provide a more in-depth experience for selected technicians and decision makers. A project information database will be constructed that will be available to all project participants so that all project related data and background information will be readily accessible. All project equipment vendors will be required to provide on-the-job training for all equipment placed into operation at the project.

- **Step 2: Legal system improvements:** A domestic consultant familiar with Mongolian mineral policy and tax law will be contracted to work with an international expert in CMM/CBM law and policy development and the responsible government agencies to determine the most favorable policies to advance CMM development.

**Activity 5. Develop a risk management strategy:**

- **Step 1: Identify those items that put the project at risk of failure:** As in any natural resource development project, risk of financial failure is always present. Mitigating this risk as much as possible is essential. Specific risks will be identified in a rigorous manner through the steering committee composed of members from the key stakeholders. Common risks often encountered in AMM projects include:
  
  - Resource risk such as the possibility of encountering a small resource because of water flooding of the mine.
  
  - Commercial risk related to realizing sufficient value for the captured methane.
- Legal and regulatory risk involving ownership and regulatory barriers that may be costly to overcome.
- Not being able to secure the expertise and equipment needed to implement the project in a timely manner.

- Step 2: Determine how these risks can be mitigated prior to project implementation: A prioritized list of risks to the successful implementation of the main project will be compiled through the work of the steering committee. Measures to be implemented to mitigate those risks will be developed and roles and responsibilities for implementing those measures assigned to members of the steering committee and project implementation unit.

**Activity 6. Develop a full GEF project proposal:**

- Step 1: Develop a detailed project design document: This document will be based on the information acquired and lessons learned during the project preparation activities including the demonstration project. The document will include: a borehole design and gas gathering and transportation system layout; a description of the equipment required to recover and utilize the AMM; a discounted cash flow economic analysis based on expected capital and operating costs as well as revenue through time; a description of all legal and regulatory documents that need to be approved in order to implement the project; and a description of potential stakeholders, and their rights and responsibilities.

- Step 2: Formulate technical assistance component of the project: Based on the resource assessment performed during the demonstration project and subsequent capacity building any additional assistance will be identified and plans made to obtain this assistance in a timely manner.

- Step 3: Undertake a detailed incremental cost analysis for the project: Based on the economic analysis of the main project, a detailed incremental analysis will be performed that will estimate the U.S. dollar per ton of carbon dioxide equivalent reduced by the project. The analysis will also describe the other associated local social and environmental benefits of the project.

- Step 4: Obtain an agreement on co-funding: Negotiations to agree on cost-sharing arrangements will be initiated after local and international sources of funding are identified. Potential sources of funding include local and foreign private sector project developers and multilateral development banks.

- Step 5: Develop a plan to measure and monitor the results of the project: The financial and technical performance of the project will be monitored. A plan will be developed that specifies a set of technical, economic and environmental audits that will be performed during the implementation of the project. Parties selected from the steering committee will be responsible for performing these audits.
Outputs from Preparation Activities

After the preparation activities have been implemented the following results will be contained in a project brief for the main project:

1. A feasibility study will have been produced that addresses the technical, economic, environmental and social aspects of the study.

2. An incremental cost analysis of the cost of greenhouse gas reduction will be completed.

3. Deficiencies in the legal and regulatory system have been identified and addressed.

4. The risks to the successful implementation of the main project will have been identified and a plan developed to mitigate those risks.

5. Project Management issues will have been resolved by establishment of a steering committee and project implementation unit drawn from key stakeholders. Key service providers will have been identified and working relationships established.

6. A financing plan will have been made with co-funding agreements in-place.

7. A measuring and monitoring plan will be in place with commitments from various stakeholders to be responsible for carrying out the plan.

8. The end use of the CMM will have identified and legal contracts negotiated for monetary compensation to the project for use of the methane as fuel.

9. The capacities of the domestic service providers will have been assessed and, where lacking, the required capacity has been identified through international vendors and consultants.

2. Coal mine project opportunity: Nalaikh mine power generation and heating project, Tsagaan Shonkhor Holding Company, Nalaikh district, Mongolia

We have developed with support of a Consultant of the EPA, a Power generation and heating project at Nalaikh mine (Nalaikh district). Project details, mine information, type of assistance sought, project finances, environmental benefits of the project, coal production, methane emissions and market analysis/demand analysis are presented (in Annex 2.)

That was the first business proposal on CMM that was demonstrated at Methane to Markets Partnership Expo which was held in New Delhi, India 2-5 March 2010.

Overview of the project opportunity:

The Nalaikh coal deposit is located approximately 40 km to the south-east of Ulaanbaatar, the capital city of Mongolia. The Nalaikh colliery was established in 1922 and stopped its operation in 1992-1994 with a mining history of 70 years. There are still many small scale, artisanal mines operating at shallow depth to supply rather high quality coal to Ulaanbaatar and Nalaikh customers. Also, some private companies possess mining licenses in the coal deposit area and when mining resumes in 2011, the Nalaikh mine will be Mongolia’s second underground coal mine. Tsagaan Shonkhor Holding Company holds mining licenses in the western part of Nalaikh
deposit area. The license area has five mineable coal seams and coal reserves are estimated to approximately 24 million tonnes. Designed production capacity of the mine will be 600,000 tonnes per year for a service period of 17 years.

No CMM is currently being used at the Nalaikh mine, nor does the mine have a drainage system in place. The first component of the project is to drill test boreholes in the projected mining area (western Nalaikh) to determine gas potential and make a reserve estimate. Second, assistance is sought for onsite training and studies and clarification of recovery possibilities of remaining methane gas from the abandoned area of the Nalaikh coal mine. Following a reserve estimate and trial methane production using test boreholes, the project would include installation of a drainage system and utilization of methane for electricity generation to support mine power supply. A 3.6 MW power plant is anticipated. Geologic and mining conditions at Nalaikh could allow both surface boreholes and/or in-mine boreholes. If the reserve estimate and study of recovery possibilities determines sufficient resources, methane gases may also be used for the needs of a district heating plant, which is located nearby and uses coal. In this case, coal boiler rehabilitation and gas supply pipeline are required. The test boreholes, reserve estimate, and training activities have an estimated budget of US$800,000. A study will be required to determine the cost of the potential power and heat projects; however, a preliminary estimate determined capital costs of the power project to be approximately US$5 million. The project(s) are expected to last through the mine’s service period of 17 years.

ESTIMATED ANNUAL EMISSION REDUCTIONS: 96,390 TCO2E
PROJECTED COAL PRODUCTION AND METHANE EMISSIONS

COAL PRODUCTION AND METHANE EMISSION CHARTS

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**Projected Annual Coal Production and Methane Emissions**

- **Coal Production (tonnes/year)**
- **Total Methane Emissions (Mm³/year)**

![Projected Annual Coal Production and Methane Emissions Chart](chart.png)
Total Projected Annual Methane Emissions and Methane Recovered And Utilized Expressed as CO2e

GREENHOUSE GAS EMISSION REDUCTIONS

TOTAL VOLUME OF METHANE EXPECTED TO BE RECOVERED/UTILIZED

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<th>YEAR</th>
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<th>2020</th>
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<th>2025</th>
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<td>6,750,000</td>
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<tr>
<td>Total CH4 recovered and utilized (tCO2e)</td>
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<td>1,392,300</td>
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Proposed technologies for the Nalaikh project include a methane distribution system that will carry high, medium, and low quality gas to internal combustion engines. Given the preliminary resource assessment, it is estimated that two 1.8 MW engines will be deployed for a 3.6 MW power project.

3. Assessment of coal mine methane resources potential at Nalaikh mine.

In 1973, Research Institute of the former Soviet Union identified that the methane gas grade of Nalaikh Colliery was Grade I (i.e., relative gas emission rate was less than \(5\text{m}^3/\text{t}\)) according to the coal bed methane content. In 1975, with the mining depth reaching 120 m and the rich information, gathered in the mining process during the past 2-3 years, the gas grade was appraised to be Grade II (relative gas emission rate was \(5\sim10\text{m}^3/\text{t}\)). In 1990, a gas explosion happened at the air return way of 541 working face, and the Mine Rescue Team of Mongolia appraised the grade to be Grade III (relative gas emission rate was \(10\sim15\text{m}^3/\text{t}\)). In 2-3 years, when the gas grade was identified as Grade III, the mine was shut down. According to Term 133 of the Coal Mine Safety Regulations of China, the mine is a gassy mine. From 1959 to 1991, spontaneous combustion of the coal seam occurred 84 times during the mining process, so the coal is prone to spontaneous combustion. In 1973, the Soviet Union Institute drew a conclusion from the coal dust explosibility experiment made on sampling from Coal Seam II, that the coal dust was in danger of explosion. However, the geological report did not mention the coal dust explosion index, flame length, minimum rock dust content for preventing explosion and coal bed methane content. The colliery is in an area of abnormal earth temperature.

As requested by the Mongolian Nature and Environment Consortium (MNEC) in Ulaanbaatar Mongolia, Lunagas Pty Limited (Lunagas) was to conduct a professional review of available gas data, assess the coal mine’s methane resource potential and predict the coal mine’s methane decline trend for the abandoned (1994) Nalaikh underground coal mine. It also includes professional advice regarding information about Coal Mine Methane and Coal Bed Methane resources in the area that Lunagas has collected (when in Ulaanbaatar) and received later by
email. Information includes the particular gas and mining information/data from the Mongolian Nature & Environment Consortium, Mining Institute of Mongolian University of Science and Technology.

The following additional necessary data collected for predicting coal methane from the abandoned coal mine (Nalaikh mine) was collected:

- In situ gas content of any individual coal seam (III, IV or V)
- Number of working days per year for coal production
- Date of finish coal production
- Date of discontinue ventilation system
- Was the mine sealed, if so when
- Date of water pumping stopped
- Relation between methane percentage presented in tables and various
- Underground workings including inclined air return shaft
- Ventilation air quantities in different underground workings
- Water pumped from the mine and water quantity used for underground activities
- Capacity air ventilation and water pump
The Nalaikh deposit is present within the Middle-East Magablock, in Tov province approximately 37 km south-east of Ulaanbaatar (Fig.1). The land surface of the deposit forms a hilly prairieland at 1,410 - 1,500 metres above sea level. The Nalaikh deposit belongs to the Choir-Niarga coal bearing basin, with an area ~ 35 km². Coal seams are embedded in the coal bearing bed of Early Cretaceous Age. The basic geological structure is formed of a homoclinal structure tending north-west and dipping 8-10 deg south-west (Fig.2). Bearing bed is 280-350 metres in thickness and contains 11 coal seams of which 5 seams are minable - Nos: I, II, III, IV & V. The average thickness and interval are listed in Table 1:

Table 1
Table 2

<table>
<thead>
<tr>
<th>Period</th>
<th>Tonnage (U/G)</th>
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<td>1922 - 1953</td>
<td>3,868,500</td>
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<td>1954 - 1974</td>
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<td>10,867,800</td>
</tr>
<tr>
<td>1922 - 1994</td>
<td>25,634,700</td>
</tr>
</tbody>
</table>

During the last five years (before mine was closed) production was substantially reduced to 1,514,500 tonnes with an average of 302,900 tonnes per year (Table 3 and Figure 9).

Table 3
<table>
<thead>
<tr>
<th>Period</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>531.7</td>
</tr>
<tr>
<td>1989</td>
<td>434,500</td>
</tr>
<tr>
<td>1990</td>
<td>234,900</td>
</tr>
<tr>
<td>1991</td>
<td>199,400</td>
</tr>
<tr>
<td>1992 (U/G only)</td>
<td>114,000</td>
</tr>
<tr>
<td>1988 - 1993</td>
<td>1,514,500</td>
</tr>
</tbody>
</table>

2.2 Methane content and absolute gas emission
There are several data and information regarding ‘relative gas emission’ which characterizes the quantity of methane (m3CH4 per one tonne of coal mined), that was released to the underground workings when one tonne of coal was mined. This represents the total quantity of methane released from worked (IV) & other coal seams in the roof (I, II, III) and in the floor (V). Threshold values of ‘relative gas emission’ rates; 5, 10 & 15 m3CH4/t was used for establishing ‘Gas grade category’ for the mine. It was also used for calculation of absolute gas emission for various coal production level planned for the mine.

For an average 400,000 t/year and 180 working days = 2,200 t/day
\[(2,200 \text{ t/day} * 15 \text{ m3CH4/t}) / (1.440 * 60\text{sec}) = 382 \text{ litres CH4/sec}\]

However, there were no results (data) regarding ‘IN SITU GAS CONTENT’ - it is how much methane is stored (sorbed) in one tonne of the individual coal seam. On the basis of available technical papers and other information it is estimated that worked seam (IV) in situ gas content could be 3 - 5 m3CH4 per tonne in situ.

2.3 Methane quantity for the last 5 years before mine was closed
Methane quantity which was releasing to the underground workings and vented to the atmosphere have been calculated using available data and assumptions applicable for the time before mine was closed (1988 -1994).

Relative and absolute gas emission calculations:
_ Relative gas emission = 15 m3/t - Grade III (Coal seam IV-V, LW 541, Dec’90)
_ 1988-1993 average yearly coal production = 1,514,500 tonnes / 5 = 302,900 tonnes per year = 1,682 tonnes/day (for 180 working days a year = ~50% of shearer working time and shift time utilisation)
_ Methane quantity = (1,682 *15) / (1.440*60) = 292 litres CH4 /sec

_ Relative gas emission = 25 m3/t - Grade III or higher (Selected areas only)
_ Methane quantity = (1,682 *25) / (1.440*60) = 486 litres CH4 /sec, and

Absolute gas emission using data provided by Mining Institute of Mongolian University of Science
_ Air quantity in the inclined air return shaft = 71 m3/sec
_ Methane concentration = 0.5% CH4
_ Methane quantity = 71*0.5*1000/100 = 355 litres CH4 /sec

This quantity of methane was released to the underground workings and vented to the atmosphere for the annual coal production of 511,000 tonnes in the area classified as ‘Grade III’ or higher.

2.4 Methane quantity after mine was closed
It was assumed (Email dated 4 Feb’09) that after mine was closed the mine outlets (shaft etc) have not been sealed and all available gas from underground workings has been vented to the atmosphere.
An average quantity of coal mine methane calculated for various conditions is used for gas reservoir simulation;
(292 + 486 + 355) / 3 = 378 litres CH4/sec.

2.5 Hypothetical methane quantity calculations
There is also a list of methane concentration in the underground workings (Figure 10) which shows very high methane percentages (over lower explosive limit i.e. 5% CH4), however, that represents the overall period 1985-1950 and unknown details such as ventilation air quantity in the particular underground workings and the specific date (year) of the occurrences.
Two selected cases have been analysed which show 7.4 %CH4 and 1.2 %CH4 in the ‘Main incline’ (KLMNOPQRMST UVQWM). Assuming that air quantity was 71m3air/sec, then methane quantity released to the underground workings (in that time) was:

Table of methane concentration 1982-1950 (Figure 10)
- Air quantity in the inclined air return shaft = 71 m3/sec
- Methane concentration = 7.4 & 1.2 %CH4, than

Methane quantity Q1 = 71*7.4*1000/100 = 5,254 litres CH4 /sec, and
Q2 = 71*1.2*1000/100 = 852 litres CH4 /sec
Both results indicate that it was either very poor ventilation (much less than 71m3air/sec), incorrect readings of methane concentration or coal extraction was carried out in the area with the relative gas emission over 30 m3CH4/t and daily coal production higher than 2,000 t/day. When comparing with other information, data and results, this is unlikely and was not taken into consideration for the decline curves and gas reservoir capacity simulation/calculations.

2.6 Mine water
Source 1 (Mining Institute) = 1,920 m3/day = 22 litres/sec
Source 2 (Mr S. Batdorj) = 600 m3/day = 6.9 litres/sec
Due to uncertainties in relation to both sources of information an average water inflow quantity of 14.5 litres of water per second is used for the Wetsim decline curve simulation.
It was assumed, that the mine stopped pumping water when it was closed (abandoned).

2.7 Coal parameters & extraction area
Coal density = 1.36 t/m3
Coal extraction area = 1,000,000 m2 on the basis of mine maps - coal seams II, III, IV & V, provided by Mining Institute of Mongolian University of Science (Fig.5) & my partial knowledge regarding coal extraction sequence, dates and its influence on adjacent roof/floor coal seams.

3. SIMULATION AND PROJECTION
3.1 Gas resources and mathematical models
During coal production activities, the coal mine gas emission to the underground workings has been identified as a summary of production gas (PG) and background gas (BG) (Figure 3).
When longwall or coal mine ceases coal production, the background gas (BG) quantity and decline trends are stabilising throughout major three stages.
After the mine is sealed and/or decommissioned the production gas rapidly declines during the first 3 and 12 months, then the slow-long term decline phase takes place up to 20 years (Figures 3 & 4).
Mathematical formulae for the decline curves of those phases have been developed using empirical results from Australian, Asian and European coal mines, and are presented as the relationship between quantities of gas BGIN (litres CH$_4$ per second) and Time (months).
Long-slow decline formulae for ‘Drysim’ mine:

\[ B\text{GIN} = a \times \exp(-b \times \text{Time}) \]

- **BGIN** - background gas initial emission 12 months after mine ceases coal production
- **a** - methane quantity constant (coefficient)
- **b** - decline rate constant (coefficient)
- **Time** - number of months since ceases coal production

3.2 Water inflow and flooded conditions

Water enters mine workings from aquifers disturbed by mining and also through mine entries from surface sources. Water levels are controlled during mining by a pumping system. After abandonment, if water pumping operations in the mine ceases, there will be a gradual flooding of the abandoned mine workings up to some surface outflow level. The rate of minewater recovery depends on the rate of water inflow, the volume of void space and the geometry of the mine workings.

Once a goaf area has been flooded, the associated primary gas sources can no longer release gas into the workings. The resource is not lost but de-watering will be required before desorption processes can be re-established.

Water recovery will not only reduce the volume of the accessible gas reservoir, but can also isolate parts of the workings by flooding connecting roadways limiting the ability of the surface extraction pumps to exert a negative suction pressure throughout the abandoned workings and thus constrain gas reservoir production rates.

3.3 Void space estimation

Water inflow is assumed to be filling void space which is defined by the volumes of abandoned goaves, roadways and enhanced fracture space within the surrounding strata. Underground workings/roadway collapse and strata consolidation over time make precise determination of the void volume. Initial void space estimates can be made using mine workings geometry or total tonnage of coal extracted and the empirical factors. This factor is considered to take account of residual goaf porosity, roadway volume and natural porosity of dewatered strata (0.17, 0.20, 0.24 etc).

4. COMPUTER SIMULATION AND PROJECTION

Lunagas has developed specialised software titled ‘Abandoned coal mine gas predictor’ (ACMG) which assess gas reservoir conditions and simulate decline rate (curves) of coal mine methane quantities for closed and abandoned coal mines.

The program calculates ‘Drysim’ curve for temporary closed mine and ‘Wetsim’ curve for abandoned coal mine where ventilation system and water pumping from underground workings were stopped as well quantity of coal mine methane in local gas reservoir.
4.1 Input data for Nalaikh mine

- Final quantity of methane before mine was closed = 378 litres CH4/sec
- Annual (average) tonnage for the period 1988 - 1993 = 302,900 tonnes/year
- Daily (average) coal production (180 working days) = 1,682 tonnes/day
- Total coal extracted (1922-1994) = 25,634,700 tonnes
- Coal average density = 1.36 t/m³
- Water inflow = 14.5 litres/sec
- Gas releasing extracted area = 1,000,000 m² (Figure 5)
4.2 Outputs for Nalaikh coal mine

The Lunagas Pty Limited professional software “Abandoned Coal Mine Gas Predictor (ACMGP)” is used to simulate ‘Drysim’ and ‘Wetsim’ gas decline curves and calculate gas reservoir parameters using available input data.

Figure 6. Drysim & wetsim gas decline curves for abandoned Nalaikh coal mine when using the above presented input data.
Figure 7. Decline curves & gas reservoir simulation outputs for dry & flooded Nalaikh coal mine

<table>
<thead>
<tr>
<th>Coal seam name</th>
<th>Depth (m)</th>
<th>Coal seam thickness (m)</th>
<th>Gas content (m^3/t)</th>
<th>Distance from Worked Seam (m)</th>
<th>Remaining gas FACTOR</th>
<th>Desorbed gas (m^3)</th>
<th>Residual gas (m^3)</th>
<th>Coal volume (M m^3)</th>
<th>Available gas (M m^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>251.00</td>
<td>1.50</td>
<td>3.07</td>
<td>69.00</td>
<td>0.54</td>
<td>1.40</td>
<td>1.67</td>
<td>1.67</td>
<td>2.04</td>
</tr>
<tr>
<td>II</td>
<td>271.00</td>
<td>2.60</td>
<td>3.63</td>
<td>49.00</td>
<td>0.37</td>
<td>2.28</td>
<td>1.35</td>
<td>1.35</td>
<td>3.54</td>
</tr>
<tr>
<td>III</td>
<td>309.00</td>
<td>3.00</td>
<td>4.69</td>
<td>11.00</td>
<td>0.00</td>
<td>4.69</td>
<td>0.00</td>
<td>0.00</td>
<td>4.08</td>
</tr>
<tr>
<td>IV - WS</td>
<td>320.00</td>
<td>3.00</td>
<td>5.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>350.00</td>
<td>8.00</td>
<td>5.84</td>
<td>30.00</td>
<td>0.537</td>
<td>2.70</td>
<td>3.14</td>
<td>3.14</td>
<td>10.88</td>
</tr>
</tbody>
</table>

Grant total: 42.28

4. CONCLUSIONS AND RECOMMENDATIONS

1) For the water inflow of 14.5 litres per second during the year 2004 i.e. 10 years after Nalaikh mine was closed all the underground workings have been flooded, which stopped coal mine gas emission to the underground workings and/or to the atmosphere.

2) When the mine stopped coal production (1994), 378 litres CH4/sec was released to the underground workings and/or to the atmosphere, which was reduced to 223 litres CH4/sec after 12 months (1995).

3) Currently, after 180 months (15 years) since Nalaikh Mine was closed there is approximately 30 litres CH4/sec dry sim methane available if the flooded water is pumped out.

4) Gas reservoir capacity in 1994 equals 42,280,000 m3 CH4 (within the coal extraction areas only); however, during the period of 15 years since Nalaikh Mine was closed the remaining background gas was vented to the atmosphere. During that time the existing and new gas sources could not be further relaxed and/or stimulated due to the lack of mining activities.

5) Input data used for the above simulation and predictions are very limited or unobtainable, and some of them unreliable. For further detailed analysis the below listed data are required:

a) In situ gas content of any individual coal seam (III, IV or V)
b) Ventilation air quantities in the inclined air return shaft vs methane percentage and dates
c) Water pumped from the mine and water quantity used for underground activities (service water)
d) Gas composition (calculated on air free basis)
e) Relative gas emission during the last 5 -10 years of mining activities

6) It is recommended to drill the test hole from the surface to the latest longwall goaf area (the highest point of the mine void space) to check the quantity of coal mine gas currently releasing to the atmosphere.

7) Gas quantity could be measured using simple measuring set - orifice plate (manufactured by local workshop) as illustrated in the appendixes 1 & 2 (Fig. 11 & 12). More details regarding gas quantity calculations (using measurements across the orifice plate) could be available in the future, if required.
4. The detailed study of the geological conditions of Nalaikh mine deposit

A detailed study of the geological condition of Nalaikh mine deposit was conducted, the results of which are presented in this part of report. Mongolia open cut mined the coal with deflecting wells in the mine area. Up to 1958, the output of the mine area reached 600 thousand tons per year. From 1970 to 1974, the designers from Kuzbassenproshakhkht Research Institute and the Mongolian Mineral Research Institute joined hands to work out a plan with an output of 600 to 800 thousand tons per year for the Nalaikh mine area and introduced a whole set of mechanized equipment. From 1978 to 1987 the output of the mine was 413.9 to 870.9 thousand tons per year. But at the end of the 1980's, faults were frequently encountered, which were not mentioned in the geological reports and the hydrogeology conditions also deteriorated. In order to solve the problem and evaluate the reserves once again, supplementary exploration was conducted in 1991/2 for all aspects for the west part 1.9972 km of Nalaikh mine area (the design range this time). But the mining of Nalaikh mine area had to be stopped due to the worsened economy, more gas emissions and self ignition of the coal formation, which resulted individual digging and confused mining.

Locality and topography
The Nalaykh Deposit is present within the Middle-East Megablock and in Tov Province. The center of the deposit is in latitude 47° 40' N and in longitude 107° 18', 37 km southeast of Ulaanbaatar. The land surface of the deposit forms a hilly steppe at 1,410-1,500 m above the sea level.

History of exploration
1912 : Start of opencut mining by Chinese
1918 : Start of underground mining by Chinese 1922 : Start of underground mining by Mongolia
1925-26: Exploration by former Soviet Union
1931: Detailed exploration area : 1.5 km x 250-300m
1944: Detailed exploration area : 7 km2 estimated reserves : 19.5 million tons (A + B + Ci)
1949 : Additional detailed exploration
1954 : Additional detailed exploration
1959-60 : Detailed exploration for the Seam I
1965-66 : Detailed exploration at southeast area
1970-76 : Detailed exploration at southwest area
1977-78 : Detailed exploration- drilling : 93 holes, 2,831 m, max.138 m/hole 1989 : Detailed exploration

Coal geology
The Nalaikh Deposit belongs to the Choir-Niarga Coal-bearing Basin. The deposit extends for 10 km east-west long and 3.5 km north-south wide, with an area of about 35 km2. Coal seams are embedded in the coal-bearing bed of Early Cretaceous age. The basic geological structure is formed of a homoclinal structure tending northwest and dipping 8-10° southwest. The coal-bearing bed is 280-350 m in thickness and contains 11 coal seams, of which 5 seams are minable seams in the deposit. They are named the Seam I, II, III, IV and V in descending order.
The average thickness and intervals are below:

<table>
<thead>
<tr>
<th>Seam</th>
<th>Thickness (m) at various locations</th>
<th>Interval (m) at various locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1.5 m (2-3 m at the west)</td>
<td>15-20 m (0 m at shallows)</td>
</tr>
<tr>
<td>II</td>
<td>2.6 m (splitting into 2-17 seams)</td>
<td>10-60 m</td>
</tr>
<tr>
<td>III</td>
<td>3.0 m (0.05-4.85 m)</td>
<td>8-15 m</td>
</tr>
<tr>
<td>IV</td>
<td>3-4 m (2.15-3.27 m)</td>
<td>0-20 m (2-5 m at the west) (12-29 m at the center) (28-38 m at the east)</td>
</tr>
<tr>
<td>V</td>
<td>8.0 m</td>
<td></td>
</tr>
</tbody>
</table>

The interval between the Seam I and the Seam V ranges from 90 to 210 m. The Seam I shows pinching out at portions deeper than 400 m below the surface, although it is the thickest seam.

Nalaikh coal deposit is located in the middle-east part of Mongolia. The Nalaikh Colliery is within the northwest of the basin and under the jurisdiction of the Central Province of Mongolia. The high mountains surrounding the coal mine have an elevation of 1760m-1890m. The mine field is within the seismic zone and the magnitude can be as high as 6-7. It is a typical continental climate where lowest temperature is -48°C in winter and the highest temperature 35°C in summer with great temperature difference between day and night. The summer is short and suffocating hot and the winter long and cold with little snowfall. The spring are windy, especially northeast wind. The annual average rainfall is merely 200-220mm, mostly in summer. Nalaikh mine field has a widely-spread permanent frozen layer. The wind speed in Nalaikh Township is 5~6m/s in average, maximum 17m/s.

**GEOLOGICAL CONDITION AND SETTING OF THE DEPOSIT**

The geological setting in Nalaikh’s deposit, its surrounding comprised of sedimentation deposits of the Devonian (D), Carboniferous (C), and lower Cretaceous, tertiary, quaternary stages.

a) Devonian stages: Sedimentation accumulations in this stage are outcropped in the east, and the rimming hillock that surrounds the Nalaikh’s basin in the south. Outcrops near the Elstei and Bayandavaa composed of interbedded thick sandstone beds in greenish tinge, fine grain, and siliceous clayey argillite bearing thin beds of red colored silica. Also interbeds of tuffaceous rock in medium grade with igneous composition are occurred in this part of section. An interbed of siltstone and sandstone are rested on above this section, on the interbedded sets of marbled limestone, jady tuff rock and sets of silicified igneous rock the agglomerate. Thickness of interbeds fluctuates from 250 to 350 m. A total thickness of Devonian stage sediments are 2500 to 3000 m.

b) Carbonaceous stage: Sediments of this stage are recovered along the hills that are settled down in the western and northern portion of Nalaikh’s basin. It composed of dominantly from fine grained sandstone, phyllitic clayey schist with small presence of limestone, jade, conglomerate. This is included into sandstone –argillaceous schist massif which belongs to lower section the carboniferous sediment. Thicknesses of carboniferous sediments that are distributed near the Nalaikh’s basin do range from 1500-2500 m.

c) Cretaceous stage /lower section: Sedimentation deposit in lower cretaceous stage are rested by angular unconformity on terrigenous sediment in Lower while filling the intermontane basins that are collectively called to be the Nalaikh’s mountain which were developed beneath the middle Paleozoic sediments by tectonic faulting. It composed of the Zuunbayan’s suite which
has been included into Goterive –Alpian series, and it divided up two massifs due to its lithological and coalification feature, and these are:

a) Lower massif of argillaceous schist
b) The coal bearing upper massif

Lower massif of argillaceous schist: this massif is composed of dark gray to grayish colored siltstone and argillite that are containing minor amount of smaller beds the conglomerate and sandstone.

starts from here on:

Coalified rock beds in low thicknesses do occur in the upper part of section occasionally; also several beds of combustible shale in thickness of 1.0 m were noted in the lower portion. The lower massif of argillaceous schist the Zuunbayan’s suite is widely distributed in the northern side of deposit where it covered by the quaternary sediment. During the geologic exploration process, the upper contact of argillaceous schist in lower massif was delineated roughly at straight continuation of the conglomerate bed which rests beneath the VIII –coal seam, but the lower contact wasn’t determined indeed in a frame of Nalaikh’s basin. The absolute thickness of lower massif is defined to be 300 to 350 m.

The coal bearing upper massif: this massif is sub-divided into 2 parts again due to its lithological features and these are:

The upper section of this massif composed of thick beds of conglomerate, gravelite, sandstone dominantly which are containing fewer thin beds of argillite /siltstone. Rarely, a thin coal beds and lenses are present in middle of coarse grained sediment.

The participation of coarse grained sediment has reduced gradually in the lower section of massif, and this sediment is distributed dominantly along the western side of the deposit. The coarse grained sediments are gradually shifted to the argillaceous sediment of argillite /siltstone type to the east from the west. The coal beds with production capacity are accelerated at this lower section of the coal –bearing massif.

There are 12-coal seams such as the “New” -1.2.3.4, Zero “O” 1.2, and an “Intermediate” III, IV, V, VII in a frame of this deposit, and these are subdivided into several packages in the eastern and southern parts.

In addition to, the coal seam “New” comprises of several thin beds of coal that are distributed randomly, and those are named as the “New-1” “New-2” “New-3” and “New-4”.

The seam II, III, IV, and V are the main coal seams that are bearing production resources, and seam I, VIII have random distribution, and low thickness, thus these are considered having a limited capability

The remaining seams such as “New”, “Zero O” and “Intermediate” are distributed randomly in the western part of deposit, also poor low thickness, inconsistent, thus, almost these don’t have the production capacity.

The seams II, V have the highest thicknesses in a frame of Nalaikh’s deposit and do reach up to 11 to 15 meters in some area.

The thickness of lower section the coal –bearing massif from “Zero O” up to V seam do range up to 40-45m in the western part of deposit where coal seams are located closer, and then it do reach up to 100 m near the prospecting profile XVIII which is in the eastern side of deposit where coal seams are dispersed from one another.

The summarized thicknesses of coal –bearing massifs are 280 to 350 m. Relativity ages of Zuunbayan’s suite was determined to be Goteriv-Albian series based on a flora –faunal remaining, finding that are collected by researchers during exploration made of at Nalaikh’s
The summarized thickness of Zuunbayan’s suite in lower cretaceous age which fills in the Nalaikh’s basin has been estimated to be 580-700 m.

Neogene stage: No distinct sorting is made of in sediments that are roughly included into neogene ages. This sediment lay on the eroded surface of lower Cretaceous rock, basically in horizontal position by angular unconformity, and it composed of sand containing multi-colored clay/ pebble, and sandstone with poor density /compactness. This neogene sediments are distributed along marginal side of Nalaikh’s basin, surrounding mountains, in slope of the hummock, slowly it appears thinner in the basin center, and then disappears gradually.

Quaternary sediment:
In a frame of Nalaikh’s basin, origin of this sediment is various, and it overlies the Paleozoic, neogene and sediments of lower cretaceous in thickness of 0.5 to 10-20 m. Sediments of eolian – diluvium, alluvium –proluvium and alluvial –aeolian are most widely distributed ones here. Eolian –diluvium composed of brown colored clayey –loam bearing broken particles of basement/bedrock rock which are distributed along side slope of mountains 
Alluvium –proluvium sediments composed of mixed grained sandstone with high quantity of poorly rounded gravel, grits, poor sorting out, which are interbedded obliquely. Alluvium sediments are developed along river basins and composed of pebble grits with fine to medium grained sandstone beds.
For the age, these sediments belong to the upper quaternary and contemporary stage of sedimentary accumulations.
Eolian sediments composed of sand the siliceous rocks in fine grains dominantly. These sediments are spread out widely along river sourcing side of the Elstei.
Intrusion rock /Intrusive: This rock is distributed along the eastern limb of Nalaikh’s basin and the granite bodies of Bogd Mountain are close to frontier side of basin.
Intrusive rocks composed of light granite with variegated structure in porphyritic type that had developed until middle of Mesozoic stage staring from end stage of the Paleozoic period. The Nalaikh’s basin is the most important element of regional tectonical setting. This is an intermontane depression –basinal structure that has been developed in sediments of middle Paleozoic stage, and it filled by coal –bearing sediments of lower cretaceous. The coal- bearing lower cretaceous Zuunbayan suite has monoclinal structure of one member that stretches to SE from NW direction, dips to SW from NE, and sheared by numerous tectonic faulting.
The upper section of Zuunbayan suite is containing about 14-16 coal seams, dipping angular fluctuates 10-20 degrees.
Twenty four (24) tectonic faulting in strike–slip type were noted in a frame of studied fields during detailed exploration made of B.M.Krillow in 1976 , thereon the largest ones such as the 2,7,10,12, and 20 are studied and logged in details, have explanatory notes, and the identification support and, reliance rank of other smaller faulting are explained too.
Geological map of Nalaikh deposit area is presented on Figure 1.
The Nalaikh’s brown coal deposit comprises of twelve (12) seams such as the “New”-1.2.3. and 4, and “O” I, II, and the” Intermediate”-III, IV, V, VIII, so further each seams are divided into several coal interbeds, and finally became about 20-30 thin beds at the end of exploration profile of VII and VIII.
The coal seams of “VIII”, “New” , “O” and “ the Intermediates” within Nalaikh’s coal deposit are classified as an inconsistent seams due to its thickness conversion rank, have a complex structure for the stratigraphy, and have thin to medium decree of thickness, due to thickness categorization made of coal beds. Instead on the coal seams of II, III, IV and V composed of coal beds mainly with the medium
range (1.21 to 3.5 m) to the very thick ones ranging in thickness (3.51 to 15.0 m), and for their seam structure, they have very complex structure staring from simplified ones and belongs to comparatively consistent seams due to their conversional rank in thickness grade.

For the rank of its geological setting features, the Nalaikh’s coal deposit is included into II –

Fig.1
Geological Map of the deposit

. group of deposit due based on appraisals issued by the above-mentioned indications.

. **Fig.1** Geological map of the deposit

According to results of scoping exploration, conducted at Nalaikh coal deposit in 1991-1992, coal balance reserves were estimated and upgraded at 58845.8 thousand tons, of which 4520.2 thousand tons by A category, 15950.8 thousand tons by B category and 38374.8 thousand tonnes by C1 as of January, 01, 1993.

The average coal quality characteristics of the deposit can be summarized as follows:

Ash content - 18%
Analyticall moisture - 9.3%
Volatile matter - 47.3%
Sulfur content 0.75%
Calorific value - 6536 kcal /kg

III. PAST MINE OPERATIONS

review of past mine operations
The Nalaikh colliery was established in 1922 and stopped its operation in 1992-1994 with a mining history of 70 years. However, there are still operating many small scale, artisanal mines at shallow depth to supply rather high quality coal to Ulaanbaatar and Nalaikh customers. Since 1922, the Nalaikh underground coal mine extracted in total ~25,634,700 tonnes of coal with an average of 400,000 tonnes per year (Table 1).

<table>
<thead>
<tr>
<th>Period</th>
<th>Tonnage (U/G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1922 - 1953</td>
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<tr>
<td>1954 - 1974</td>
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During the last five years (before mine was closed) production was substantially reduced to 1,514,500 tonnes with an average of 302,900 tonnes per year (Table 2).

<table>
<thead>
<tr>
<th>Period</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>531.7</td>
</tr>
<tr>
<td>1989</td>
<td>434,500</td>
</tr>
<tr>
<td>1990</td>
<td>234,900</td>
</tr>
<tr>
<td>1991</td>
<td>199,400</td>
</tr>
<tr>
<td>1992 (U/G only)</td>
<td>114,000</td>
</tr>
<tr>
<td>1988 - 1993</td>
<td>1,514,500</td>
</tr>
</tbody>
</table>

During the past mine operations, there were used both vertical shaft and inclined shaft to entry into the coal deposit. Figure 2 shows layout for opening up the deposit by inclined shaft.
According to past working experience of Nalaikh mine in the 1970-1990’s, the mine was operated all around the year. (365 days) Since 1970’s, long wall mining system with Russian ade coal shearers of cycle operation was used at the mine. Long wall length equal to 100 meters, shearer advance – 0.63 meters and cutting height – 2.8 meters. Maximum daily production was 1000 tons of coal. Situational plans of mine workings and mining plans by some basic coal seams are presented on Figures 3, 4 and 5. Fig 3. Situational plan of mine workings.
There were worked 3 shifts per day, shift duration was 7 hours, 3 hours of working day were designated to equipment maintenance and other organizational issues. However, shift time

Fig. 4 Situational plan of mining coal seam VIII

Fig. 5 Situational plan of mine working and mining plan
utilization and shearer working time was very low (50-60%), because of many reason and
problems, including unplanned maintenance, equipment features, parts availability, electricity
cut-off, sift organization etc.

3.2 Methane gas emission quantity mine and disaster overview

In 1973, Research Institute of former Soviet Union identified that the methane gas grade of
Nalaikh Colliery was Grade I (i.e., relative gas emission rate was less than 5m3/t) according to
the coal bed methane content. In 1975, with the mining depth reaching 120 m and the rich
information, gathered in the mining process during the past 2-3 years, the gas grade was
appraised to be Grade II (relative gas emission rate was 5~10m3/t). In 1990, a gas explosion
happened at the air return way of 541 working face, and Mine Rescue Team of Mongolia
appraised the grade to be Grade III (relative gas emission rate was 10~15m3/t). In 2-3 years,
when the gas grade was identified as Grade III, the mine was shut down.

According to Term 133 of the Coal Mine Safety Regulations of China, the mine is a gassy mine.
From 1959 to 1991, spontaneous combustion of coal seam had occurred for 84 times during the
mining process, so the coal is prone to spontaneous combustion. In 1973, Soviet Union Institute
drew a conclusion from the coal dust explosibility experiment made on sampling from Coal
Seam II that, the coal dust was in danger of explosion. However, the geologic report did not
mention about coal dust explosion index, flame length, minimum rock dust content for
preventing explosion and coal bed methane content. The colliery is in an area of abnormal earth
temperature.

POSSIBILITY AND PROJECTIONS FOR FUTURE MINE OPERATIONS

Present time, some private companies possess mining licenses in the coal deposit area. Biggest
license area in the western part of the deposit belongs to Tsagaan Shonkhor Holding Company.
The licence area has five mineable coal seams and coal reserves are estimated to approximately
24 million tonnes. The company jointly with Chinese company prepared feasibility study to
develop western part of the deposit by under-ground mine. Designed production capacity of the
mine will be 600,000 tonnes per year and service period – 17 years.

Some design projections for new mine operation are given below;

Gas emission estimates

Plans and projections are based on relative gas emission rate of 15m3/t.

When the design output is 600,000t/a, daily output - 1818t, the absolute gas emission rate is to
be:

\[
\frac{(1818t \times 15m3/t)}{(24 \times 60 \text{min})} = 18.93 \text{m3/min} < 20 \text{m3/min}
\]

According to the exploitation and mining area layout, a blasting mining face is set at coal seam
VIII, and a mechanized mining face is set at coal seam II, when the mine can be put into
production. For similar to same-type mine in China, absolute gas emission rate at stope makes up
approximately 60% of the total value, that at the gob makes up approximately 15%, and that at
driving face makes up approximately 25%. Therefore,

\[
Q_{\text{stope}} = 18.93 \times 60\% = 11.36 \text{m3/min}
\]
According to output makeup, absolute gas emission rate at blasting mining face makes up approximately 25% of the value at stope, and that at mechanized mining face makes up approximately 75% of the value at stope. Therefore,

\[ q_{\text{blasting}} = 1.36 \times 25\% = 2.84 \text{ m}^3/\text{min}, \]
\[ q_{\text{blasting gob}} = 2.84 \times 25\% = 0.71 \text{ m}^3/\text{min}, \]
\[ q_{\text{mechanized gob}} = 1.36 \times 75\% = 8.52 \text{ m}^3/\text{min}, \]
\[ q_{\text{mechanized gob}} = 2.84 \times 75\% = 2.13 \text{ m}^3/\text{min} \]

Gas emission rate at blasting mining face of coal seam VIII is 2.84 m³/min or (<5 m³/min).
Gas emission rate at mechanized mining face of coal seam II is 8.52 m³/min or (>5 m³/min).
Gas emission rate at each driving face is 1.58 m³/min (<3 m³/min).
It is provided according to the condition on gas discharge from Coal Mine Safety Regulations that, if gas emission rate at a mining face is greater than 5 m³/min or that at a driving face greater than 3 m³/min and ventilating method is unreasonable, or absolute gas emission rate is greater than 20 m³/min, then a permanent ground gas-discharge system or temporary underground gas-discharge system must be established for the mine.

Considering the possibility of gas entering to the stope after emitting from the gob, the plan calculates \( q_{\text{mechanized mining}} = 8.52 + 2.13 = 10.65 \text{ m}^3/\text{min} \). For the abovementioned, a permanent ground discharge system is designed to discharge gas at the stope, so as to reduce working face wind rate and velocity. Gas discharge rate is considered 20% temporarily, so gas emission rate at working face is \((8.52 + 2.13) \times 0.8 = 8.52 \text{ m}^3/\text{min}\). The gas will be diluted by the mine ventilation system. Gas emission rate at blasting mining face (3.55 m³/min) and that at driving face (1.58 m³/min) are comparatively low, and the gas emission can be solved by ventilation, so gas discharge is temporarily not considered.

**Water Supplies and Drainage**

**Water Supply**

**Overview of Design**

The design of water supply works is made in accordance with the development method; ground and underground equipment; general layout and manning; the Code for Design of Mine for Coal Industry; Code for Design of Outdoor Water Supply and Drainage; Fire Protection Design of Buildings.

According to the design, the water supply will cover: water for production and use in industrial sites; water for ground and underground fire fighting and dust suppression.
**Water Consumption**

The water consumption of the Colliery is calculated according to the relevant PRC regulations and specifications of coal industry as well as the local physical circumstances.

The water consumption of the Colliery is 965.86m³/d.

Table 1 shows water consumption calculation for Nalaikh Colliery.

**Table 1** The Water Consumption of Nalaikh Colliery

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Num of Persons</th>
<th>Quota</th>
<th>Water Consumption</th>
<th>Rm ks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>24 hrs</td>
<td>Max shift</td>
<td>24 hrs</td>
<td>Unbalanced</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>m³</td>
</tr>
<tr>
<td>1</td>
<td>Water for living</td>
<td>832</td>
<td>169</td>
<td>SOL/man-shift</td>
<td>24.96</td>
</tr>
<tr>
<td>2</td>
<td>Water for dining</td>
<td>621</td>
<td></td>
<td>20L/man-meal</td>
<td>24.84</td>
</tr>
<tr>
<td>3</td>
<td>Water for bathroom</td>
<td>48</td>
<td></td>
<td>540L/head •h</td>
<td>77.76</td>
</tr>
<tr>
<td>4</td>
<td>Water for dormitory</td>
<td>250</td>
<td></td>
<td>80L/man •d</td>
<td>59.64</td>
</tr>
<tr>
<td>5</td>
<td>Water for laundry</td>
<td>497</td>
<td>134</td>
<td>80L/kg-dry clothes</td>
<td>6.05</td>
</tr>
<tr>
<td>6</td>
<td>Water for compress or house</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Water for repair</td>
<td>11.4</td>
<td></td>
<td></td>
<td>11.4</td>
</tr>
<tr>
<td>8</td>
<td>Water for car washing</td>
<td>500L/car •d</td>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Make-up water of boiler</td>
<td></td>
<td></td>
<td>57.6</td>
<td>3.6</td>
</tr>
<tr>
<td>10</td>
<td>Water for greening and other use</td>
<td></td>
<td></td>
<td>0.03m³/t</td>
<td>54.54</td>
</tr>
<tr>
<td></td>
<td>Water for underground dust control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>481.77</td>
<td>23.64</td>
<td>6.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>821.56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Contingent water use</td>
<td>82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Water used by water treatment plant</td>
<td>62.3</td>
<td>T=5min/times,15L/s.m²</td>
<td>3~</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water supply from water treatment plant</td>
<td>1857.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>965.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Ground fire water</td>
<td>25L/s</td>
<td>270mJ/time</td>
<td>90</td>
<td>25</td>
</tr>
<tr>
<td>15</td>
<td>Underground fire water</td>
<td>7.51/s</td>
<td>162</td>
<td>27</td>
<td>~</td>
</tr>
</tbody>
</table>

### Selection of Water Source

Nalaikh basin has an underdeveloped surface drainage system. There are only two ravines that have an unclear valley form. The river beds of the two ravines are 1~2m deep. After rainfall, they serve as seasonal river courses and the river water thereof runs into the Tuul River. Tuul River is a perennial river and can satisfy the water demand of the Colliery. The drinking water for Nalaikh Colliery and the production water supply required during construction are to be taken from Tuul River. After treated in the water treatment plant, the quality of treated river water meets criteria specified in the Drinking Water Sanitary Standard. Use serviceable pipeline system for both production and fire water supply and use independent water supply system for living use. The water for living and water for production during shaft construction are taken from Tuul River. The intake point is about 7km away from the coal mine. The pump station delivers the water through DN150 steel pipe into the water treatment device (purified and chlorinated) which treats the water to Sanitary Standard for Drinking Water and then, the treated water can be used by water consumers in the Colliery. On completion of the mine water treatment plant, the treated mine water will be used as production water supply source.

### Water Supply System
The water supply system is designed as follows according to the actual conditions of each water source and the elevation of each water consumer:

Use serviceable pipeline system for production and fire water supply and use independent water supply system for living use. If necessary, take sterilized industrial water as a backup source for living use. The domestic water supply system comprises: Chlorine dioxide mixed disinfection solution generator. The chlorine dioxide disinfectant can directly oxidize the natural organics, like humic acid etc., in water without hydrolization or reaction with ammonia nitrogen therein. This agent can effectively eliminate, by oxidation, alga, phenols and sulphide in water and can also effectively kill and destroy sporus. The sterilizing effect of the agent can last for a long time. The treated domestic water satisfies the drinking & living water standard. The water quota is as follows: living & drinking water: SOLAnan-shift: water for dining hall: 20L/man-meal; water for shower: 540L/h-head; water for single's apartment: 80L/man-d.

In the initial construction stage, the water for construction and preliminary production can be taken directly from Tula River because the mine has no water inflow problem at that time. After put into production, however, the production water will be supplied mainly from the underground water treatment plant and the emergency water supply for production use will come from Tula River. A 400m*5 clean water reservoir is to be built within the water treatment plant to supply water directly to underground consumers.

A 400m3 clean water reservoir is used to supply production and fire water to industrial sites and through the industrial water pump house, this reservoir also supply water to the coal yard, screening building, repair workshop, pit timber house, silo and substations etc. A high pressure water supply system is used to supply outdoor and indoor fire water to industrial sites. The 400m clean water reservoir in the water treatment plant can be used to accommodate the unbalance between supply and demand and to store fire water for use in event of fire disaster for which some technical measures are to be taken.

The water for underground production and fire fighting is supplied from a 400 m3 clean water reservoir. The water flows, through the auxiliary inclined shaft, main inclined shaft, return-air inclined shaft, to the working face #1801 and #22101 as well as to other underground consumers. Steel pipe is used for industrial and domestic water supply. The outdoor pipe is laid down in trench and all pipes, except steam pile, which is insulated with compound silicate product, are insulated with polyethylene foam product. A moisture proof barrier made up of asphalt cement and waterproof woven glass cloth is used. Flanged connection is used for steel pipes with DN>50. Flanged connection is also used for steel pipes used to supply steam.

**Water Drainage**

The waste water and sewage water sources mainly include daily washing, domestic waste water, feces, dining hall, waste water from repair, underground discharged water etc. The total water discharge from ground production and living is 361.88m3/d, of which production water discharge is 123.56m /d and domestic water discharge is 238.32m3/d. The waste water is discharged ultimately into Tula River of which the water body is of Class III and therefore, the Class I Standard as defined in the Integrated Wastewater Discharge Standard shall be carried into execution. The mine water satisfies the requirements of Emission Standard for Pollutants from Coal Industry. The water discharge from the mine is listed in Table 2.

**Table 2. The Water Discharge of Nalaikh Colliery**

<table>
<thead>
<tr>
<th>SN</th>
<th>Items</th>
<th>Discharge</th>
<th>Rmks</th>
</tr>
</thead>
</table>
### Underground Drainage

The underground discharged water has a high turbidity and colourity. Only after treated to standard, the water can then be discharged. Such treatment is mainly to get rid of suspended matters and lower down the colourity so that the discharged water can meet the requirements as specified in the Emission Standard for Pollutants from Coal Industry. According to the geological data of Nalaikh Colliery, the max inflow of water is 140m3/h (3360 m3/d) and the normal inflow of water is about 80m3/h (1920m3/d).

According to design, a YZJ-B water purifier, which is an integration of dosing, mixing, reaction, settling and filtering, is to be used to achieve full capacity automatic sludge discharging and back flushing. This purifier is featured by: rapid waste water processing, great processing capacity, small occupation of land, investment saving, short construction period, and less management required.

Its process flow as follows: mine water flows out of the auxiliary inclined shaft and into the 400 m3 pre-settling regulating tank where the acid mine water has a neutralization reaction with lime milk put into the tank and its quality and quantity are regulated, finally, the mine water is lifted into the integrated purifier. Before into the purifier, coagulant agent (polyaluminium chloride, 20~40mg/L) is to be added. Through the line mixer, the coagulant agent is mixed perfectly with raw water and the addition of organic high molecule coagulant aid is 0.5~1 mg/L, which is to be made after mixed. After treated by the water purifier, the water goes into the 400 m3 industrial clean water reservoir for recycling.

According to the normal and maximum inflow of water in the mine, the mine water treatment equipments are designed for continuous duty. The design processing capacity takes the normal inflow of water, together with the regulating effect of the pre-settling regulating tank, the water processing capacity of the purifier is 80m3/h. Two water purifiers with an processing capacity of 80 m3/h each are selected: only one in running under normal conditions and both when water quantity is large.

After treated (reacting and settling), the size of suspended matters in the water out of the water treatment plant is less than 0.3mm and the turbidity is below 10 mg/L, which satisfies the Emission Standard for Pollutants from Coal Industry. Because the treated water meets the quality requirements for underground fire fighting, therefore, about 701.06 m3/d (29.21 m3/h) will be recycled and the rest (1156.64m3/d) is discharged into Nalaikh River nearby.

### Drainage of Domestic Sewage and Ground System

The domestic sewage and waste water flow through the drainage pipeline system into the sewage treatment plant and then discharged after treated. The sewage and waste water from the repair workshop and dining hall flow through the oil separation tank, which will separate oil from water, and then into the sewage treatment plant, finally, discharged after treated.
The domestic sewage and waste water discharge is 238.32m3/d and one WCB-1 -20 small-sized full automatic integrated waste water treatment equipment is selected for biochemical treatment. The main technical parameters of this equipment are as follows:
Processing capacity: 20 m3/h Inlet BOD5<200m g/L and outlet BOD5<20m g/L Inlet SS<200m g/L and outlet SS<70m g/L Ph value of outflow water: 6-9
After treated, sewage and waste waters are discharged through the drainage ditch in industrial sites into Nalaikh River nearby.UPVC pipe is used for domestic wastewater.

Rain Water
Industrial sites are equipped with gutters and concrete rain water pipeline system to collect surface water and carry them into Nalaikh River. The 3”_a precipitation is 200-220ml, concentrated in summer.

Fire Protection and Spraying
The treated mine water is used as the water source for underground fire fighting and for fire fighting in industrial sites. After treated, the size of suspended natter in water is less than 0.3mm and the turbidity is less than 10 mg/L. After treated, the integrated water purifier and entering into 400m3 clean water reservoir, the clean water is then supplied through pipeline to the auxiliary inclined shaft for underground fire fighting. AXBD6/20-100G/3 industrial water pump is used to supply fire water to industrial sites.
In order to ensure that the water pressure at the outlet of indoor fire hydrant will not exceed 80m hg, a pressure release valve is mounted on the DN80 pipeline in the main inclined shaft and return-air inclined shaft as well as on the DN100 pipeline in the auxiliary inclined shaft.
A SN50 indoor fire hydrant is placed within a 15m range around the underground central substation, working district substation #2, pump house, sump in the working district #2, driving heading, mouth of intake/return airway of working face, head of rubber belt conveyor. For inclined shaft and main rubber belt conveyor roadway, a SN50 indoor fire hydrant is placed every other 50m; for roadway with timber support, a SN50 indoor fire hydrant is placed every other 50m; for main roadway of coal seam, district rise, track haulage of working faces and return air gateway, a SN50 indoor fire hydrant is placed every other 100m; for main rock roadway and cross-cut, a SN50 indoor fire hydrant is placed every other 300m. The total number of SN50 indoor fire hydrants to be placed is 158.

In order to improved underground working conditions, the following equipments are selected and used: 1. shearer (MG150/375-W) with spray pump (XPB250/5.5) and its water consumption is 250L/min. 2. wet electric coal drill (ZMS-12A) and its water consumption is 5L/min; 3. wet dust remover (SCF-6) and its water consumption is 60L/min; 4. duckbilled sprayer to be installed at underground coal chute, conveyor, loader and other reloading points and the water consumption each is 0.2 L/S. 5. coal seam injection drill with water injection pump and its water consumption is 3.6m3/h (the water injection rate is subject to adjustment by actual conditions).
The coal produced by the mine is B-3 brown coal. The properties of the coal as follows: average ash content: 18%; lab water content: 9.8%; natural water content: 24.6%; volatile: 47.3% and 8=0.75%. The coal is has spontaneous ignition property and therefore, retardant is used as a supplementary means against fire and the grouting system is used as the primary means against fire. See preceding chapters for details of the grouting system. Because the Colliery is located where water and soil are in shortage, therefore, the industrial calcium chloride is taken as retardant. Using retardant for fire extinguishment and prevention is simple and requires less
investment. In addition, the retardant itself is low in price and can be supplied from various sources. The retardant rate of industrial calcium chloride (20%) is 75-^90%. According to design, two WJ-24 retardant injection pumps are used and the specifications as follows: pressure: 2-3Mpa; maximum range: 30m; flow: 2.4 m³/h; power of motor: 2.2kw. The quantity of retardant required by blast working face at one time is about 560kg and that by mechanical working face is about 963kg.

Because coal dust is explosive, water bag/barrier is therefore used for fire control and explosion isolation. Three sets of water bags are placed in the main inclined shaft, auxiliary inclined shaft and return-air inclined shaft, of which: one (51 bags) (GBSD-80) in the main inclined shaft and return-air inclined shaft each; one (45 bags) in the auxiliary inclined shaft, totally 147 GBSD-80 water bags. 25 sets, totally 732 GBSD-40 water bags, are placed in: track dip driving head (along Vseam) in the working district #2; return air gateway, track gateway and conveyor gateway in the working face 1801; track driving head in the working face 22102; conveyor gateway, return air gateway and track gateway in the working face 22101.

SN65 indoor fire hydrants are placed in: repair workshop, grease & oil house, substation, supply house, boiler house, gas pump station, fan house, loading bridge of rubber belt conveyor, waste picking building, relogging station, coal bunker etc. Totally 18 sets of SN65 indoor fire hydrants are to be placed. A set of SS150 outdoor fire hydrant is to be placed: between hoist house and coal yard; between coal bunker and coal yard; between dining hall and dormitory; and outside the substation. Four sets of SS150 outdoor fire hydrants are to be placed in total.

**Flood Control and Drainage**

The northeast part of industrial site is rather high, elevation 1494m, and southwest lower, elevation 1469m. The surface water from rain and snow shall be discharged from northeast to southwest. There is no river nearby the Nalaikh Colliery. The rainfall of this area is not heavy and the surface water is little, average 200—220mm, mostly in summer. The elevation of main inclined shaft entrance is 1485.50m, that of auxiliary inclined shaft entrance is 1485.50m, and that of air shaft entrance is 1480.0m. The average elevation of industrial site is 1885.5m in the high land. Hence, there is no risk of flood. If it is filled with rainfall, some ditches shall be built.

5. **National capacity building on CMM/CBM through organizing workshops, meetings and publication of materials.**

The coal mine methane is currently viewed as a safety hazard only rather than a valuable energy resource. As such, the exiting air-methane mixture and its suitability for capturing and further use has not been considered in the past. In general, there is still a lack of awareness and local experience on modern coal mine methane recovery and utilization technologies and their benefits to the mines’ operations as well as to the environment in Mongolia.

Given the above, a significant effort was made on training and raising the awareness for the mines’ management and operation personnel, the of the engineering/drilling companies’ personnel currently assisting the mines in meeting their degasification needs as well as relevant regional and federal authorities. Training included modern approaches and technologies for underground coal mine degasification and methane recovery and utilization.
Eight workshops were organized on possible methane recovery and utilization in Nalaikh mine area. The objectives of the workshops were to better understand methane recovery and utilization development issues. Coal experts and scientists, international coal mine methane experts, government officials and representatives of the private sector discussed the opportunities for using methane for sustainable development. (Annex 3. Some selected presentations submitted to the workshops and seminars)

A special workshop was organized for staff of the Ministry of Fuel and Mineral Resources and its agencies such as the Petroleum Authority and Mineral Resources Authority, where the results of coal mine methane resource potential at Nalaikh mine, the GEF project proposal on methane recovery and utilization and the coal mine project opportunity on CMM in the Nalaikh mine was introduced. Also, for relevant staff of the Ministry of Nature, Environment and Tourism, a workshop was held on CMM and CBM possibilities for the reduction GHG emissions in Mongolia (Annex 4. Pictures of workshops and Seminars)

Mr. A. Erdenepurev, Director of the Fuel Coordination Department of the Ministry of Mineral Resources and Fuel and Ms. Altanchimeg, Officer of the above department, participated in the international Coalbed & Shale Gas Symposium which was held in Alabama, USA on 18-22, May, 2009.

There was organized inception workshop on methane recovery and utilization possibility in Nalaikh mine area. The objectives of the Workshop were to a better understanding of the methane recovery and utilization development issues. During the workshop more than 20 coal experts and scientists of Mongolia, international coal mine methane experts, Government officials, and representatives of provide sector discussed the opportunities of use of methane for sustainable development.

The workshop was inaugurated by Mr. Tumurbaatar, senior officer of energy coordination policy department of the Ministry fuel and Energy of Mongolia. Mr. Tumurbaatar noted that Mongolia will actively taken part in all activities of the methane to market partnership program.

The workshop particularly benefitted from the presence and contributions of Dr. Pamela, Coalbed Methane Outreach Program, US Environmental Protection Agency and Dr. Ray President, Raven Ridge Resources, Incorporated.

The workshop proceedings published (English and Mongolian) and distributed the Public. Also, we have included in this workshop proceedings some articles which were published in another countries. (Annex 5. Methane recovery and utilization opportunities (English and Mongolian). This proceedings contributed to promote public awareness for methane recovery and utilization development.

Also, we have selected the Mining Institute as a leading company which will have responsibility for developing coal mine methane recovery and utilization activities in Mongolia. Several workshops were organized for selected companies on the recovery and utilization of methane. Stakeholders meetings were also organized for discussing newly developed policy documents.

**The brief information of the mining Institute (leading company for CMM and CBM in Mongolia)**

The Mining Institute has begun its activity based on the establishment of the group of elaborating a mining industry's drawing under the control of Ministry of Mining Industry in 1959. The Mining Institute was established as Mining Project Bureau to respond to the increased demand for development and utilization of coal and other mineral resources.

During the past time, the Institute elaborated a feasibility study, drawing and budget for using the mining field of minerals such as coal, gold, non-ferrous metal and non-metal mineral, made a
scientific and research works and it had a main role of development for the mining industry's technique and technology. There are following basic units in the Mining institute as the units of elaborating and introducing the mining industries leading technology, making a drawing and plan, and a sector of mining technique and technology equipped by modern and developed equipments for the experimentation, coal manufacturing, automation, information, drawing, coal testing arbiter laboratory, invention sector, work shop of experimental and administration. Total staff members are working at the Mining Institute, of which about 88.3% of total employees have high education and among the scientists there are Ph.D and Dr.Sc. professor 23.5%.

Since 1990, the scientific unit made about 20 projects according to a state subscription such as "Master plan for developing the coal sector", Elaboration of the seismoacustique method of evaluating the quality of rocky of open mining soil and the technology of preparing and using a simple and cheap explosive", "The research of elaborating the diagnosis technology of EKG-8I excavator, Belaz-540 truck of the open pit", "Invention of the complete and small-sized equipment for preparing the explosive", "The software of the automation system for the mining technology process", "New technology of mining the minerals from the mine completely", "Increasing the profit of the mining technique and technology". 5 projects were implemented to the industries and it gives a real profit of millions tugrugs in one year.

And also we implemented above 30 research works under the contract such as the technology definition of the coal mines of Shivee-Ovoo, Baganuur and Sharin gol for the decision of faced problems to the coal mines and Erdenet mine, the accountancy completely program, the renovation project for the local 10 coal mines' technique, technology, the restoration project the gold alluvial deposit, the feasibility study for using the central part of the Erdenet mine and made a work to define a parameter of the ore crushing, drilling and explosion work and then a crackly quality of rock. We made 82.5 million tugrug's work and its result influenced in the industrial practice, well.

The mining project sector implemented above 20 works of 46.8 million tugrugs in 1990-2003, as the coal mines' extension drawing of Shivee-Ovoo, Eldev, Tavan tolgoi, Saikhan-Ovoo and Aduun chuluun, the feasibility study of using the mines of Nariin sukhait, Tsagaan chuluut and Eldev and the drawing for using the coal mine of Ulaan-Ovoo.

The coal testing arbiter laboratory renovates the coal quality standard most of the mines of Mongolia and makes about 6.0 million tugrug's testing work in year. The sector is going to pay attention to possess a new method of laboratory investigation.

In 2003, the mining Institute has implemented a restoration research and technique's drawing works of Tolgoit Gold mining with "IRGIREDMET" Institute of Russian federation. In this time, we are implementing 5 projects such as a new technique ana technology for preparation of usual explosive, progressive technology for completely mining a schist mine, and the research work ,of -the renovation energy renovation *at the Mongolian territory.

Main activities of mining institute

- Definition of r the crackly quality of rock and ore's formation by Japanese modern seismic graph instrument :
- Drawing and feasibility study of using all kind of minerals of the mining industry with a high quality
- Test of the coal technique according to a standard
- We invent small-sized equipment for using an alluvial deposit mine’s technology part
- Definition of the indicators of physics, mechanic quality of rock and parameter of drilling and explosion work
- Information system of accountancy in the internal network for the mining industries.
• Diagnosis of the damages to heavy machinery and mechanism without dismantling.
• Assistance to take the news about technique and technology from the foreign countries in short time.

Also we can make a plan, drawing and technology of restoration for the mine's destructed area and environmental plan and program of monitoring control in short time.

6. Revision of the existing petroleum laws and procedures in order to support policy on coal mine methane recovery and utilization opportunities in Mongolia.

A detailed review of the existing legal and regulatory framework was conducted. There is need to continue activities for improving existing energy and other relevant laws and procedures, including technical safety standards and degasification requirements, gas ownership issues, possible tax and other incentives.

Review and revision activities were continued for existing energy, land ownership laws and procedures, foreign investment and regulation to exempt import tariffs and value-added tax when importing CMM related equipment and technology. Also, the Coal program is being developed by the Ministry of Fuel and Energy, including a special chapter relevant to CMM development and utilization. This coal program has been submitted to Parliament for approval. (Annex 9. Revise the existing methane and petroleum laws and policy documents)

The gas supply law was developed, but it not yet approved by the Parliament. (The draft gas supply is presented in Annex 6). The purpose of the law of gas supply is to regulate relations between the state, man and the legal body of activities on gas supply. This law will address regulations for creating conditions to supply gas to customers, to fulfill safety, security and the effectiveness of construction and networking for gas production and supply and to gather and use the gas fuel resource. The Law on Petroleum Oil will regulate natural gas research activity. The Law on Petroleum Oil products will regulate gas fuel import activities.

The legislation on gas supply is comprised of the Constitution, the Law on Energy, the Law on Petroleum oil, the Law on Minerals, the Law on Special License of Industrial Activities, the Law on Construction, the Law on Urban construction, the Law on Natural Protection, the Law on Fire Security, the Law on United Measure, the Law on Prohibiting Unfair Competition, the Law on Assessment of Standard Agreements, the Law on Auto Transportation, the Law on Legislation of Apartment Owners and Publicly Dedicated Property of Apartments, the Law on Disaster Protection and other relevant Legislative Acts of Mongolia.

The Petroleum Law was revised in order to support coal methane opportunities in Mongolia. The purpose of this Law is to regulate the operations of Mongolian and foreign entities or individuals involved in the exploration for and the protection, processing, transportation, storage and marketing of petroleum originating in Mongolia. (Annex 7 revised the petroleum law)
GEF project document including budget

Annex 1

Proposal for PDF block & grants

Country: Mongolia

Project title: Reduction of coal methane emission in Nalaikh coal mining, Mongolia (project preparation fund Block B)

GEF focal area: Climate change

Amount of PDF Funding Request: USD 340,000

Government Co-funding: USD 115,000

GEF Implementing Agency: WB or UNDP

Executing Agency:

Block _B_ Block C

Block A Grant Awarded:

Part I

Project summary
Identify and remove barriers for recovery and utilization of coal mine methane in Nalaikh, Mongolia

Objective
The objective of the small project:
The objective of the full scale project (main project) to be developed with the assistance of GEF resources requested here is to reduce greenhouse gas emissions related to methane emissions from the Nalaikh abandoned coal mine as well as to displace a portion of the carbon dioxide emissions from burning coal. This Project Preparation and Development Request for Project Preparation Grant (PPG) will support this effort by providing technical assistance to build the capacity of the local stakeholders to further develop and implement this type of project. A pilot demonstration project will also result from this initial funding which will capture and use the methane as a beneficial fuel.
Background

Underground mining at Nalaikh began in 1922 and continued until closure in 1993, producing 25.5 million tons of coal. As the mine became deeper the amount of methane per ton of coal mined increased, going from 5 m$^3$/ton to over 15 m$^3$/ton. Deteriorating mining conditions plus a disastrous methane gas explosion caused the mine to be closed. Closure of the mine caused widespread unemployment in the area. This stimulated the establishment of numerous small operations mining the near surface coal of poor quality which is stockpiled for sale in the winter to the local Nalaikh market where it is burned in inefficient stoves and boilers contributing to the extreme air pollution in the district. This project is the first step in an effort to reduce hazardous air pollution and greenhouse gas (GHG) emissions in the Nalaikh and Ulaanbaatar districts of Mongolia by replacing a portion of the coal used in area boilers with clean burning methane from the abandoned underground Nalaikh coal mine. Winter air pollution in the Nalaikh and Ulaanbaatar districts has exceeded the permissible pollution level by five to six times. Respiratory diseases are on the increase. The primary cause of this pollution is the burning of raw coal.

Utilizing methane from this source has the added benefit of reducing GHG emissions associated with the leakage of methane from the mine through poorly sealed boreholes and shafts and from diffuse emissions associated with the subsidence and fracturing of the strata above the mined out area. Mongolia has ten times the GHG emissions per GDP than the world average. It is necessary to begin reducing those emissions in the most economically and environmentally effective manner possible.

The barriers to developing this clean energy resource include:

- Poor understanding of the resource. The Mongolian mining community has long had to deal with the safety concerns of the liberation of methane within underground coal mines. However it has not developed the expertise to drain the gas from mine workings at high enough concentrations to provide a usable fuel. It is also important to be able to estimate the volume of the resource that may be present and the rate at which it can be extracted.

- The lack of legal foundation for coal mine methane (CMM) development. A transparent legal framework addressing the ownership of the gas within the mine and how to facilitate the profitable extraction and utilization of the gas needs to be developed through legislative and ministerial processes.

- A shortage of human and technical capacity. Drainage of methane from abandoned mines is a relatively common practice in the United States and Europe where technologies, best practices and safety procedures have been developed. This capacity needs to be transferred to local Mongolian professionals.

- Shortage of funding. Although significant funding can be provided by in-kind efforts from various Mongolian ministries and educational institutions, additional funding is required for specific needs requiring resources beyond the capacities of those institutions.

This project will hopefully demonstrate the feasibility of capturing and using the methane currently escaping from the abandoned Nalaikh coal mine. In order to do this the following steps need to be taken.
1. Key stakeholders need to be identified. These stakeholders are governmental, nongovernmental and industrial organizations that would be either positively or negatively affected by the implementation of the project.

2. A steering committee composed of members from the key stakeholders needs to be formed together with a project implementation unit to oversee daily operations.

3. The legal system needs to be investigated in order to assure that mineral rights are respected and to determine if changes need to be made to facilitate this and future CMM activities.

4. Domestic capacities need to identified that can contribute to the implementation of the project together with identifying those capacities that are not sufficient and need to be supplemented or improved.

5. Drill at least one well and, if gas is encountered, implement a pilot demonstration project which will utilize the methane fuel in a beneficial way.

6. Pending the successful implementation of the demonstration project prepare documentation to acquire additional funding for full scale implementation of the CMM capture and utilization project.

The end result of the main project is, hopefully, the development of a long-term supply of clean burning methane for use in local boilers, displacing coal and reducing both hazardous pollution and GHG emissions. Developing the capacity of local mining and drilling companies to capture coalmine methane in either active or abandoned underground mines will lead to further implementation of this emission reduction technology in the future. Another end result will be capacity building that can be utilized in developing a potentially larger methane source; coalbed methane (CBM) from un-mined coal bearing areas adjacent to the Nalaikh mine. This could provide an entirely new industry that would supply clean burning fuel as well as employment opportunities for the local population.

Country Ownership

1. Country Eligibility
Mongolia ratified the Framework Convention on Climate Change on September 3, 1994. As a Party to the Convention and as a developing economy Mongolia is eligible for assistance from the Global Environmental Facility for projects related to the climate change focal area. Specifically, the project is consistent with the GEF short-term criteria to reduce greenhouse gas emissions. Besides these short-term impacts, there is a strong potential for replicating this project in other developing countries.

2. Country Drivenness
Winter air pollution is worsening in the Nalaikh and Ulaanbaatar districts and is five to six times the permissible level. Respiratory diseases are on the increase. The primary cause of this pollution is the burning of raw coal. Replacing this fuel source with cleaner burning fuels is a
high priority of the government because of the direct effect the burning of raw coal has on the health of its citizens. Mongolia has ten times the GHG emissions per GDP than the world average. It is necessary to begin reducing those emissions in the most economically and environmentally effective manner possible. Mongolia has a very large resource of coal, however, the government recognizes that in order to utilize this resource clean coal technology needs to be developed. One of the ways to begin using this coal resource in a more environmentally effective way is to exploit the clean burning methane gas trapped within the coal and within active and abandoned underground coal mines. Emissions from the 40 active surface mines, 1 active and 4 abandoned underground mines are significant and mitigation of these sources of emissions could significantly reduce the total GHG emissions of Mongolia.

Institutional Coordination and Support

1. Core Commitments and Linkages
The primary stakeholders that will be involved in this project includes the following organizations

a. Ministry of Mineral Resources and Energy – This Ministry will be responsible for strengthening the legal and regulatory framework to make it more supportive of CMM recovery and utilization and provide specific economic incentives to promote CMM development under the law. This effort will involve the following agencies under its authority.

   i. Agency of Petroleum

   ii. Mineral Resource Agency

   iii. Geologic Information Center

b. Ministry of Nature Environment and Tourism – This Ministry will necessarily be involved in evaluating regulatory standards addressing health, environment and safety issues related to CMM recovery and use.

c. Current license holders for coal exploration and mining and petroleum exploration and development in the area – Conflicts over the ownership of the CMM between the mining and petroleum sectors must be addressed.

d. Private drilling Companies – Local drilling companies will be involved in supplying services related to the pilot demonstration project.

e. Local government agencies, Nalaikh District – These entities will be concerned about land and water use and environmental compliance.
f. Non Governmental Organizations – Various environmental groups should be included to ensure that inadvertent adverse environmental consequences don’t occur.
   
   i. Mongolian Nature and Environment Consortium
   
   ii. World Wildlife Fund

   g. Mongolian University of Science and Technology – In-kind participation will be valuable in facilitating the capacity building efforts of this program as well as providing expertise in selecting appropriate drilling sites and designing an appropriate drilling program.
   
   i. Mining Institute
   
   ii. Petroleum and Drilling Engineering Department

Local utilities – The cooperation of the appropriate heat or power utility will be essential to successfully implementing the demonstration project as well as the main project.

2. **Consultation Coordination and Collaboration Between and Among Implementing Agencies, Executing Agencies and the GEF Secretariat, If Appropriate**

Implementing agencies:

- Ministry of Mineral Resources and Energy, Department of Fuel Policy
  - Petroleum Agency,
  - Mineral Resource Agency,
- Ministry of Nature Environment and Tourism
  - Department of Environmental Resources and Sustainable Development

Executing agencies:

- Ministry of Mineral Resources and Energy (primary)
- Ministry of Nature Environment and Tourism
Part II

Justification
Winter air pollution in Ulaanbaatar has reached the disaster level. Recent studies estimate that the city exceeds the allowable pollution level by five to six times. One critical impact of this pollution is a rapidly growing rate of respiratory diseases. The primary cause of this pollution is the burning of raw coal. The sources of this pollution include:
- Over 135,000 stoves and wall-stoves in gers and private households;
- Over sixty water heating boilers of schools, hospitals, and public apartments not connected to district heating system;
- Over 1000 low-pressure boilers in small scale businesses and service buildings

Because of the reliance on coal for heat and power and the large number of livestock relative to the population, Mongolia has ten times the GHG emissions per GDP than the world average. Therefore it is necessary to begin reducing those emissions in the most economically and environmentally effective manner. Capturing and using CMM currently escaping from the abandoned Nalaikh coal mine will reduce GHG emissions by preventing the release of methane into the atmosphere (methane has a global warming potential 21 times greater than carbon dioxide) and by displacing coal as an energy source (oxidation of methane contributes about half as much carbon dioxide as the oxidation of coal).

Description of Proposed Preparation Activities
In order to prepare for the main project, the size of which still needs to be determined, the following activities need to be undertaken: (1) Perform a resource assessment of CMM at the Nalaikh mine; (2) Strengthen the legal and regulatory framework to make it more supportive for CMM recovery and utilization; (3) Identify technical assistance needs; (4) Implement a training program for technical needs; (5) Develop a risk management strategy and; (6) Develop a full GEF project proposal.

Activity 1. Perform a resource assessment of CMM at the Nalaikh mine

- Step 1: Identify two (2) drilling locations: This involves acquiring and analyzing historical mine data especially mine maps compiled at abandonment. Documented historical gas outbursts and water entry locations will be identified. A geologic structure map, a topographic map and land ownership and surface use maps will be combined with the mine maps in order to find suitable drilling locations. This will require the cooperation of the Mineral Resource Agency and the assistance of the Mining Institute of the Mongolian University of Science and Technology.

- Step 2: Drill two (2) locations: This is necessary to ascertain the presence of free gas within the abandoned mine workings. There is the possibility of the mine being at least partially flooded so these wells will be drilled to determine the possible extent of flooding. Drilling into the mine must be done safely and may require the consultation of
an expert outside of Mongolia. A qualified local drilling company will be identified. This may require the cooperation of the Agency of Petroleum and the assistance of the Petroleum and Drilling Engineering Department of the Mongolian University of Science and Technology.

- Step 3: Test the wells to determine the probable size of the resource: Flow wells and monitor gas rate and pressure as well as gas composition. This requires specialized equipment that may or may not be available in Mongolia. The wells will be tested over an extended period of time to determine if a demonstration project will be feasible. To do this a compressor, flare and monitoring equipment will be purchased or leased. Expert consultation concerning the analysis of the test will be acquired.

- Step 4: Implement the demonstration project: Should the testing of the wells signify an adequate resource, the gas can then be utilized in a beneficial manner. Several end use options exist with the most common being; (1) Use as fuel for a boiler and; (2) use as fuel for an internal combustion engine driving an electric generator. This small scale demonstration project will hopefully demonstrate that a resource exists significant enough to move on to main project supplying a significant fuel source to the Nalaikh area.

Activity 2. Strengthen the legal and regulatory framework for CMM recovery and utilization

- Step 1: Establish transparent ownership laws for CMM: There are often conflicting ownership laws regarding CMM and Coalbed methane (methane from coal undisturbed by mining activities). Because of the unique nature of the resource it can be argued that the methane belongs to the coal owner or leaser because it resides within the coal. It can also be argued that the methane is part of the petroleum resource because it is a hydrocarbon gas.

- Step 2: Evaluate regulatory standards regarding CMM recovery and use: There may be health, environmental and safety issues related to the production and use of CMM that need to be addressed. Because of the scarcity of natural gas infrastructure in Mongolia there may need to be regulatory reform related to the installation of gas pipelines, gas compression facilities and gas fueled boilers.

- Step 3: Provide specific incentives to promote CMM development under the law: Natural gas, CMM and coalbed methane (CBM) are not yet significant fuel sources in Mongolia and widespread development of these resources will require significant investments in exploration, production and distribution facilities. In order to attract local and international investment for such activities a series of financial incentives such as tax relief or price supports should be considered.

Activity 3. Identify technical assistance needs:
Step 1: Assess the current capacity of the local stakeholders to Implement a CMM recovery project: The relevant stakeholders will be identified. This will include government ministries, local regulatory bodies, educational institutions and local service providers. Individuals within those organizations will be identified that can provide management and technical expertise to the project. Their understanding of the proposed project activities will be assessed by an expert consultant in the international CMM industry.

Step 2: CMM resource assessment: Expert assistance will be obtained to determine the selection criteria for choosing CMM drilling sites. Expert assistance will also be obtained to identify appropriate drilling equipment and well design as well as the equipment needed to produce and flare the gas during testing and to use the gas during the demonstration phase. Estimating the resource volume based on the testing is also specialized knowledge that will be obtained.

Step 3: Legal system improvement: A survey will be conducted of how various countries have handled CMM legal issues including in Ukraine, Russia and the United States.

Activity 4. Implement a training program for technical needs:

Step 1: Resource assessment capacity building: Domestic and international consultants for training technical personnel and decision makers will be secured. These consultants will conduct local, targeted training workshops. Similar, successful international project types will be identified and travel to such sites organized to provide a more in-depth experience for selected technicians and decision makers. A project information database will be constructed that will be available to all project participants so that all project related data and background information will be readily accessible. All project equipment vendors will be required to provide on-the-job training for all equipment placed into operation at the project.

Step 2: Legal system improvements: A domestic consultant familiar with Mongolian mineral policy and tax law will be contracted to work with an international expert in CMM/CBM law and policy development and the responsible government agencies to determine the most favorable policies to advance CMM development.

Activity 5. Develop a risk management strategy:

Step 1: Identify those items that put the project at risk of failure: As in any natural resource development project, risk of financial failure is always present. Mitigating this risk as much as possible is essential. Specific risks will be identified in a rigorous manner through the steering committee composed of members from the key stakeholders. Common risks often encountered in AMM projects include:

- Resource risk such as the possibility of encountering a small resource because of water flooding of the mine.
o Commercial risk related to realizing sufficient value for the captured methane.

o Legal and regulatory risk involving ownership and regulatory barriers that may be costly to overcome.

o Not being able to secure the expertise and equipment needed to implement the project in a timely manner.

- Step 2: Determine how these risks can be mitigated prior to project implementation: A prioritized list of risks to the successful implementation of the main project will be compiled through the work of the steering committee. Measures to be implemented to mitigate those risks will be developed and roles and responsibilities for implementing those measures assigned to members of the steering committee and project implementation unit.

Activity 6. Develop a full GEF project proposal:

- Step 1: Develop a detailed project design document: This document will be based on the information acquired and lessons learned during the project preparation activities including the demonstration project. The document will include: a borehole design and gas gathering and transportation system layout; a description of the equipment required to recover and utilize the AMM; a discounted cash flow economic analysis based on expected capital and operating costs as well as revenue through time; a description of all legal and regulatory documents that need to be approved in order to implement the project; and a description of potential stakeholders, and their rights and responsibilities.

- Step 2: Formulate technical assistance component of the project: Based on the resource assessment performed during the demonstration project and subsequent capacity building any additional assistance will be identified and plans made to obtain this assistance in a timely manner.

- Step 3: Undertake a detailed incremental cost analysis for the project: Based on the economic analysis of the main project, a detailed incremental analysis will be performed that will estimate the U.S. dollar per ton of carbon dioxide equivalent reduced by the project. The analysis will also describe the other associated local social and environmental benefits of the project.

- Step 4: Obtain an agreement on co-funding: Negotiations to agree on cost-sharing arrangements will be initiated after local and international sources of funding are identified. Potential sources of funding include local and foreign private sector project developers and multilateral development banks.

- Step 5: Develop a plan to measure and monitor the results of the project: The financial and technical performance of the project will be monitored. A plan will be developed that specifies a set of technical, economic and environmental audits that will be performed
during the implementation of the project. Parties selected from the steering committee will be responsible for performing these audits.

Outputs from Preparation Activities
After the preparation activities have been implemented the following results will be contained in a project brief for the main project:

10. A feasibility study will have been produced that addresses the technical, economic, environmental and social aspects of the study.

11. An incremental cost analysis of the cost of greenhouse gas reduction will be completed.

12. Deficiencies in the legal and regulatory system have been identified and addressed.

13. The risks to the successful implementation of the main project will have been identified and a plan developed to mitigate those risks.

14. Project Management issues will have been resolved by establishment of a steering committee and project implementation unit drawn from key stakeholders. Key service providers will have been identified and working relationships established.

15. A financing plan will have been made with co-funding agreements in-place.

16. A measuring and monitoring plan will be in place with commitments from various stakeholders to be responsible for carrying out the plan.

17. The end use of the CMM will have identified and legal contracts negotiated for monetary compensation to the project for use of the methane as fuel.

18. The capacities of the domestic service providers will have been assessed and, where lacking, the required capacity has been identified through international vendors and consultants.

Financing

1. Estimated Project Cost

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<th>Project Components/Outcomes</th>
<th>Co-financing ($)</th>
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<td>Resource Assessment</td>
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Timetable for the Pilot Project and Preparation Activities

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<td>Pilot project Implementation</td>
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NALAIKH MINE POWER GENERATION AND HEATING PROJECT  
TSAGAAN SHONKOR HOLDING COMPANY  
NALAIKH DISTRICT, MONGOLIA  

OVERVIEW OF THE PROJECT OPPORTUNITY:  
The Nalaikh coal deposit is located approximately 40 km to the south-east of Ulaanbaatar, the capital city of Mongolia. The Nalaikh colliery was established in 1922 and stopped its operation in 1992-1994 with a mining history of 70 years. There are still many small scale, artisanal mines operating at shallow depth to supply rather high quality coal to Ulaanbaatar and Nalaikh customers. Also, some private companies possess mining licenses in the coal deposit area and when mining resumes in 2011, the Nalaikh mine will be Mongolia’s second underground coal mine. Tsagaan Shonkhor Holding Company holds mining licenses in the western part of Nalaikh deposit area. The license area has five mineable coal seams and coal reserves are estimated to approximately 24 million tonnes. Designed production capacity of the mine will be 600,000 tonnes per year for a service period of 17 years.

No CMM is currently being used at the Nalaikh mine, nor does the mine have a drainage system in place. The first component of the project is to drill test boreholes in the projected mining area (western Nalaikh) to determine gas potential and make a reserve estimate. Second, assistance is sought for on site training and studies and clarification of recovery possibilities of remaining methane gas from the abandoned area of the Nalaikh coal mine. Following a reserve estimate and trial methane production using test boreholes, the project would include installation of a drainage system and utilization of methane for electricity generation to support mine power supply. A 3.6 MW power plant is anticipated. Geologic and mining conditions at Nalaikh could allow both surface boreholes and/or in-mine boreholes. If the reserve estimate and study of recovery possibilities determines sufficient resources, methane gases may also be used for the needs of a district heating plant, which is located nearby and uses coal. In this case, coal boiler rehabilitation and gas supply pipeline are required. The test boreholes, reserve estimate, and training activities have an estimated budget of US$800,000. A study will be required to determine the cost of the potential power and heat projects; however, a preliminary estimate determined capital costs of the power project to be approximately US$5 million. The project(s) are expected to last through the mine’s service period of 17 years.

ESTIMATED ANNUAL EMISSION REDUCTIONS: 96,390 TCO2E

PROJECT DETAILS
- Name of Project: Nalaikh Mine Power Generation and Heating Project
- Name of Mine: Nalaikh Mine
- Type of Ownership: Private
- Have other pre-feasibility or feasibility reports been prepared for this site?: No

MINE INFORMATION
- Mine owner (name of company: Tsagaan Shonkor Holding Company
- Status of mine: Active
- Type of mine: Underground
- Mining Method: Longwall

TYPE OF ASSISTANCE SOUGHT
- Financial Assistance for drilling of boreholes in projected mine area (western Nalaikh)
- Technical Assistance including resource assessment
• Overcoming legal or regulatory issues: Ownership of gas depends on obtaining a license according to petroleum law, separate from coal license issued according to minerals law

PROJECT FINANCES
• Projected capital costs for first phase (resource assessment and test boreholes):
  US$800,000
## PROJECTED COAL PRODUCTION AND METHANE EMISSIONS

### COAL PRODUCTION AND METHANE EMISSION CHARTS

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<td>2,250</td>
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<tr>
<td>Total Methane Emissions</td>
<td>4,000</td>
<td>9,000</td>
<td>9,000</td>
<td>9,000</td>
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<table>
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<th>YEAR</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
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<td>Coal (tonnes/yr)</td>
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<td>600,000</td>
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<td>600,000</td>
<td>600,000</td>
<td>600,000</td>
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<tr>
<td>Methane (Mm³/yr)</td>
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<tr>
<td>Released to Atmosphere (drained and vented)</td>
<td>2,250</td>
<td>2,250</td>
<td>2,250</td>
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### Projected Annual Coal Production and Methane Emissions

- **Coal Production (tonnes/year)**
- **Total Methane Emissions (Mm³/year)**

![Projected Annual Coal Production and Methane Emissions Chart](image-url)
Total Projected Annual Methane Emissions and Methane Recovered And Utilized Expressed as CO2e

![Graph showing projected methane emissions and methane recovered and utilized from 2011 to 2025.]

GREENHOUSE GAS EMISSION REDUCTIONS

**TOTAL VOLUME OF METHANE EXPECTED TO BE RECOVERED/UTILIZED**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Total CH4 recovered and utilized (m3/year)</td>
<td>3,000,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
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<tr>
<td>Total CH4 recovered and utilized (tCO2e)</td>
<td>42,840</td>
<td>96,390</td>
<td>96,390</td>
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<table>
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<tr>
<th>YEAR</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>Total Reductions</th>
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<tr>
<td>Total CH4 recovered and utilized (m3/year)</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>6,750,000</td>
<td>97,500,000</td>
</tr>
<tr>
<td>Total CH4 recovered and utilized (tCO2e)</td>
<td>96,390</td>
<td>96,390</td>
<td>96,390</td>
<td>96,390</td>
<td>96,390</td>
<td>96,390</td>
<td>96,390</td>
<td>1,392,300</td>
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Proposed technologies for the Nalaikh project include a methane distribution system that will carry high, medium, and low quality gas to internal combustion engines. Given the preliminary resource assessment, it is estimated that two 1.8 MW engines will be deployed for a 3.6 MW power project.

MARKET ANALYSIS/DEMAND ANALYSIS
The primary end use for the methane would be for electricity generation to support the mine's power supply. A 3.6 MW power plant is anticipated. If enough methane is available for a second stage of the project, coal mine methane could also be supplied to the district heating plant, which is located nearby and currently uses coal. For this second stage of the project, the boiler would need to be converted from coal to gas and construction of a gas supply pipeline of 3 to 4 kilometers would be required.

Costs for implementation of the power project are estimated to be US$5 million. Costs for the second stage district heating plant have not yet been estimated. The project would require capital investment.
Annex 4

Pictures of workshops and Seminars
Provision One. Purpose of the law.
1.1. The purpose of this law is to regulate relations between state, man and legal body of activities on gas supply.

Provision Two. Law framework
2.1. This law will regulate regulations for creating condition to supply gas for customer, furthermore to fulfill safety, security and effectiveness of construction and network for gas production and supply, to gather and use of gas fuel resource.
2.2. The law on Petroleum oil will regulate for natural gas research activity.
2.3. The law on Petroleum oil product will regulate for gas fuel importing activity.

Provision Three. Legislation on Gas Supply
3.1. The legislation on gas supply is comprised of the Constitution, the Law on Energy, the Law on Petroleum oil, the Law on Mineral, the Law on Special license of industrial activity, the Law on Construction, the law on Urban construction, the law on Natural protection, the Law on Fire security, the Law on United measure, the Law on Prohibiting Unfair competition, the Law on Assessment of standard agreement, the Law on Auto transportation, the law on Legislation of apartment owner and public dedicated property of apartment, the law on Disaster protection, this law and other relevant legislative acts of Mongolia.
3.2. If an international treaty to which Mongolia is a party provides otherwise, the provisions of the international treaty shall prevail.

Provision Four. Definitions
4.1. In this law the terms shall have the following meaning:
   4.1.1. “Gas fuel” means natural or synthetic gas, which could use for energy resource, existence, auto transportation and industry as a fuel.
   4.1.2. “Natural gas” means flammable gas, methane of copper level, follow gas of petroleum gas and their condensate in the nature.
   4.1.3. “Synthetic gas” means flammable gas which mixture that contains varying amounts of carbon monoxide and hydrogen
   4.1.4. “Gas industry” means technological activity of elaborate, purify and classification for exploring natural gas and produce synthetic gas.
   4.1.5. “Gas supply” means one type of energy supply network which consist usage and service of gas production, gas network and gas delivery construction; delivery and sale
   4.1.6. “Gas transferring network” means technological complex with economical and structure which consists centralized preservation building for compressed or diluted gas, equipments and pipes for transferring high pressured gas.
4.1.7. “Gas dispense network” means usage complex and enterprises with gas supplying network which consists usage gas equipment, pipe line and its engineering appliances)
4.1.8. “Gas supplying construction” means building or construction of gas industry, gas transfer network; technological complex and techniques for gas energy resource
4.1.9. “Gas supplying security zone” means region or zone with distinct limited condition for necessary secure work of around gas industry and network
4.1.10. “Gas enterprises” means legal entity with special license for gas supplying service and work
4.1.11. “Gas equipment” means techniques, accompaniment fuel tank, dispense pipe and appliances for gas usage
4.1.12. “Gas user” means person or legal entity with industry, auto transport equipment and appliances, which uses gas fuel for energy resources

ARTICLE TWO
Government organizations plenary right on gas supply

Provision Five. State Great Hural’s right
5.1. State Great Hural will implement those plenary rights on gas supply;
5.1.1. Determine united policy of state on gas supply
5.1.2. Conclusive issues for transferring natural gas pipe lines through land of Mongolia

Provision Six. Government’s plenary right
6.1. Government will implement those plenary rights on gas supply;
6.1.1. Manage implementation of state united policy on gas supply
6.1.2. Acknowledge state general plan and program of management on gas supply
6.1.3. Acknowledge resource of gas fuel

Provision Seven. Right of State central organization’s on gas supply
7.1. State central organization’s on gas supply will implement those plenary rights;
7.1.1. Elaborate development plan and program on gas supply; manage implementation work
7.1.2. Give, suspend and abate a special license of gas supply enterprises; adopt form and necessity of special license
7.1.3. Elaborate consideration of research and investigation on gas fuel recourse to Government for conclusive and implement it
7.1.4. Elaborate, make follow rules and orders of technical norm, warranty, standardize on gas supply and determine of gas fuel quality
7.1.5. Elaborate, make follow rules, guidelines and instructions of security usage activity of gas fuel, gas industry, gas transferring and gas dispense network complex
7.1.6. Prosecute united information database on gas supply
7.1.7. Other plenary rights provided by law

Provision Eight. Plenary rights of the Governors of aimag, capital, soum and district
8.1. Governors of aimag, capital, soum and district shall have plenary rights on gas supply;
8.1.1. Give license for location and determine security zone boundary of gas supply complex
8.1.2. Other plenary rights provided by law

ARTICLE THREE
Economical adjustment on gas supply activity

Provision Nine. Gas fuel resource
9.1. Gas fuel resource shall have consist of warranted resource of natural gas occurrence and gas fuel which keeping in united preservation complex of gas supply network
9.2. Prohibit to investigate, to seek and to use minerals in occurrence belongs to gas fuel resource without Government license

**Provision Ten. Ownership on Gas supply**

10.1. According to Provision 1 and 2, in Article Six of Mongolian Constitution, State is owner of natural gas fuel resource.
10.2. Legal entity of state and private sector could be owner of Synthetic gas fuel resource.
10.3. No less than 51 percent of natural gas industry and transferring network belongs to State.
10.4. Mongolian and foreign citizens or legal entity could be proprietors and holder of Gas supply network which created by their own assets or taken proprietary rights according to Mongolian law

**Article Eleven. Price and tariff of gas fuel**

11.1. The Energy Regulatory Authority shall have assign price and tariff of gas fuel in each activity of industry, transfer, dispense network supply work.
11.2. According to Article 1 of this Law, Government shall have assign price and tariff of natural gas based on consideration of State central administration body on gas supply issues
11.3. Adherence those principles for assigning tariff;
   11.3.1. Base on actual cost and consumption of gas industry
   11.3.2. Assign different rate of gas tariff related cost and consumption in each level of customers
   11.3.3. Possibility to regulate with energy appliance
   11.3.4. Provide price sustainability
   11.3.5. Income level of special license owner shall have to keep his financial capacity
   11.3.6. Tariff constitution shall have simply and understandable for customers
   11.3.7. Cost shall have to base on consumption of implementation in latest years.
11.4. The Energy Regulatory Authority shall have make assessment for calculated validity of cost and consumption by special license owners and could reject it for re-elaborate. The Energy Regulatory Authority should not have make assessment and calculation by their consideration instead of special license owner.
11.5. The Energy Regulatory Authority shall have elaborates and publish guideline for investigate and control of tariff and price determine methodology.
11.6. The Energy Regulatory Authority shall have determines non-adjustment supply users, based on their gas fuel usage. Those customers have a right to choose a service of adjustment or non-adjustment supply.
11.7. The Energy Regulatory Authority shall have to inform directly to customers or through by media concerning changes of price or tariff of gas fuel, before less than 15 days to start obey.
11.8. Tariff could be different for some group of users depended on those indicators of gas supply and other factors:
   11.8.1. Subscription measure of gas fuel
   11.8.2. Distinct customer group
   11.8.3. Supplier’s subject region
   11.8.4. Agreement period
   11.8.5. Other factors

**Provision Twelve. Payment and tax of gas enterprises**

12.1. Enterprise shall have to pay natural gas usage payment to State budget. The Government shall have assigns the measure of payment based on consideration of State central administration body on gas supply.
12.2. If gas enterprises are working in under condition of product share agreement, may calculate his payment into product share accountancy
12.3. Gas enterprises have to pay tax as well as in Mongolian law

**Provision Thirteen. Technical standardize and guarantee of Gas supply**
13.1. There shall have standard of working, usage and security of gas fuel quality, gas supply construction and gas equipment.
13.2. According to Mongolian Law and rules, technique, equipment and tools for gas supply are shall have warranty.
13.3. Depends on norm and standard made by State central administration body on gas supply, State standardize administration make warranty for gas technology equipment as a list.

**Provision Fourteen. Information database on gas supply**
14.1. In the purpose of provide security condition for gas supply, make widening of participants, support competition and provide information for interested legal entity and people, State central administration body on gas supply shall have prosecute united information database.
14.2. United information database on gas supply consists those information, such as;
   14.2.1. Gas fuel resource, its occurrence, illustration of gas supply security zone
   14.2.2. Information regarding to gas industry and network activity
   14.2.3. List of gas supply service enterprises, and their capacity information
   14.2.4. Record of gas technique, equipment indicator, standard, norm and warranty.
   14.2.5. Price and tariff of gas fuel, resource measure of gas fuel, report of gas enterprises

**ARTICLE FOUR**

**Special license**

**Provision Fifteen. Special license on gas supply service**
15.1. Gas supply service depend only special license.
15.2. Special license on Gas supply service shall cover those activities;
   15.2.1. Gas industry
   15.2.2. Gas transfer
   15.2.3. Elaborate design of gas supply construction
   15.2.4. Build construction of gas supply
   15.2.5. Gas fuel sale
   15.2.6. Gas distribute
   15.2.7. Install gas equipment for auto transportation and its service
   15.2.8. Industry, trade and repair service of gas equipment

**Provision Sixteen. General requirement for special license on gas supply service**
16.1. Legal entity, who meets with requirement on Provision 16 and wants to have special license on gas supply service, shall to send his application to State central administration body on gas supply. Application shall have attached, as well as the following documents;
   16.1.1. Technical and economical background
   16.1.2. Research on usage of gas fuel resource
   16.1.3. Activity plan on gas supply service
   16.1.4. Equipment introductions of activity use
   16.1.5. Environment impact assessment
   16.1.6. Finance, capital resource and economic capacity of legal entity
   16.1.7. Land license for construction of gas supply
   16.1.8. Analysis of Professional control central organization for security on gas supply
   16.1.9. Analysis of fire security
   16.1.10. Insurance documents for staffs and properties
16.1.11. Starting date of activation beginning, investment amount, financial resource
16.1.12. Human resource condition, and their experience and practice

Province Seventeen. Special claim for staffs of gas supply service
17.1. No less than 70 percents of total workers of legal entity which holding special license on
gas supply service must be professional staffs.
17.2. Professional rank will be given by procedure, which adopted from State central
administration body on gas supply

Provision Eighteen. Special license on gas industry
18.1. Special license on gas industry will cover actions such as, to extractive gas, to produce
synthetic gas, to transfer gas, dispense network and to connect energy resource.
18.2. The holder of special license on gas industry has right to get a license for use gas
occurrence from Government.

Province Nineteen. Special license on gas transfer
19.1. Special license on gas transfer will cover actions such as, to preserve gas fuel in bigger than
25 cubic meter, and transferring gas fuel by 0.3-1.2 MPa high pressed vat pipe to connect into
gas dispense network.
19.2. The holder of special license on gas transfer has duty to reliable supply by gas fuel for
customer, to preserve, to use transfer network, repair service and to wide them.

Provision Twenty. Special license on elaborate design of gas supply construction
20.1. Special license on elaborate design of gas supply construction will cover actions such as, to elaborate and design of engineer technical working plan, technique economical background, technological research, analysis, depiction and make general budget of construction consumption, which requires to construct, to repair, and to broad of gas supply construction.

Provision Twenty-One. Special license on construct of gas supply construction
21.1. Special license on construct of gas supply construction could be given to legal entity, which
has financial capacity, and interested to construct or repair of those constructions.
21.2. The holder of special license on construct of gas supply construction shall have to make implement a plan of construction, assemblage work of gas technique and equipment by organization, which has related rights.
21.3. The holder of special license on construct of gas supply construction shall have make control and warrant for State investigation on technique and technological plan of construction, by State central administration body on gas supply.

Provision Twenty-Two. Special license on gas fuel sale
22.1. Special license on gas fuel sale will entitle to legal entity for having an accumulate station of liquid and pressed flammable gas and retailing of gas fuel.

Provision Twenty-Three. Special license on gas distribution
23.1. Special license on gas distribution would be entitle for distribute gas fuel by low and medium pressured pipe and to care its essential part of construction, emergency call for breakdown maintenance service for gas use.
23.2. The holder of special license on gas distribution shall have make agreement with the holder of special license on gas transfer regarding gas supply.

Provision Twenty-Four. Special license on install gas equipment for auto transportation and its service
24.1. Special license on install gas equipment for auto transportation and its service will entitle make those services to customers.
Provision Twenty-Five. Special license on industry, trade and repair service of gas equipment
25.1. Special license on industry, trade and repair service of gas equipment will entitle to manufacture, sale and repair of equipment, part and connecting unit for industrial or commodity gas equipment. 
25.2. This kind of special license will entitle for sale a packed gas fuel less than 1 litter.

**Provision Twenty-Six. Other arrangements for special license.**

26.1. Legal entity would be holding few special licenses on gas supply service.

**Provision Twenty-Seven. Duration and extension of special license.**

27.1. Special licenses on gas industry, network and usage service are valid for 10 years, special licenses on elaborate construction plan and to build gas supply construction are valid for 5 years, and other special licenses are valid for 3 years, and extension will be in same deadline.

**ARTICLE FIVE.**

**Securities on gas supply**

**Provision Twenty Eight. Make construction plan, to construct or repair construction on gas supply**

28.1. For making construction plan, to construct or repair construction on gas supply shall obey the Law on Construction, this Law, technical norm and standard.

28.2. Construction plan documents shall have investigated as well as related law and orders.

28.3. It is prohibited to build constructions on gas supply without construction plan.

**Provision Twenty Nine. Accomodate security condition on gas supply**

29.1. Gas service entity must provide security activity condition as following;

29.1.1. According to law on Fire security, Law on control for flammable matter and blast, and Law on protect from disaster, shall have to implement actions for preventing from fire and emergency.

29.2. If there’s potential danger to human life and health, security due to violation of environmental security standard and fire standard of gas supply, gas consumption regulations, defective gas equipments the gas selling company will be closed.

29.3. The gas company must organize 24-hour duty sectors that ensure safety operation and special sectors that will operate in case of accident. The company with special licenses according to 15.2.3, 15.2.4, 15.2.7, 15.2.8 provision has right to not organize duty sectors.

29.4. The gas company must obey following instructions to ensure safety.

29.4.1. At the gas stations favorable working and living conditions must be created, and ensure safe conditions to human health without any negative effects according to standard.

29.4.2. During special license term ensure and protect integrity/good condition of equipments at the gas stations.

29.4.3. Keep the safety regime at the security zone of the gas station.

29.5. The gas companies, gas suppliers, and gas customers must were insured to live, health, property, responsibility insurances according to the Mongolian Law.

**Provision Thirty. Usage of gas supply facilities at the public and joint owned buildings.**
30.1. Gas supplying facilities, equipments in the public and joint owned buildings will be at possession of legal entity with special licenses according to 15.2.2, 15.2.5., 15.2.6 provisions of the law.

30.2. Apartment owners should not cause an obstacle to the specialized organizations that uses, repairs, provides services to the equipments and pipelines of gas supply network when implementing its right to posses properties at the joint owned buildings.

**Provision Thirty-one. To measure and calculate for gas consumption.**

31.2. Gas will be supply from gas supply network according to agreements.
31.3. Gas consumption payment must be paid according to gas consumption measuring equipments.
31.4. It has prohibited using gas without gas consumption measuring equipments, while consuming gas through gas supplying pipelines.
31.5. If gas consumption measuring equipments are not installed in buildings with gas pipelines and new, overhauled buildings it is prohibited to get those buildings into use.

**Provision Thirty. Examination of gas supply.**

32.1. Gas supply examination must be done by authorized special inspection organizations.
32.2. Gas supply state examinations are:
   32.2.1 Examine and evaluate projects on building, repairing, renewing gas supply buildings/gas stations.
   32.2.2. Organize controlling operation and examinations on fire, environmental and production security of gas supply buildings/gas stations.
   32.2.3. Examine control methods of gas supply, implementation of requirements for gas equipments and gas quality.
   32.2.4. Examine safe gas consumption of citizens.
   32.2.5. Organize measurements examine.
   32.2.6. Examine and evaluate gas supplier’s activities.
32.3. The organization responsible for protecting customer’s right will organize public control on basis of gas supply prices.

**ARTICLE SIX. Other Issues**

**Provision Thirty-three. Special Conditions with unexpected and insurmountable factors.**

33.1. Gas companies must compensate material damages; reestablish damages that occurred to their own gas stations due to unexpected accident, unintentional action of victim, special conditions with unexpected and insurmountable factors.

**Provision Thirty-four. Compensate damages.**

34.1. Gas company must compensate loss of customers that occurred because of gas company did not fulfill its agreement duties and stopped gas supply without any respectful reason.
34.2. If Gas Company did not implement provision 29.4 of the law it must compensate loss of customers.
34.3. Gas company is not responsible for damage of person who broke into gas supply security zone.

**Provision Thirty-Five. Solve disputes in gas supply.**

35.1. State organization, which responsible for gas supply will solve disputes between gas companies with special licenses and if they will not agree with decisions they may complain/appeal to the court.
35.2. Disputes between customers and gas companies with special licenses will be solved by judicial procedures according to the Mongolian Law.

**Provision Thirty-Six. Penalty for gas supply lawbreakers.**

36.1. Legal entity who breaks gas supply law will receive penalty according to the Mongolian law.

36.2. Citizen and legal entity who caused accident and damages at the station will receive penalty according to the Mongolian law.

36.3. If caused damage and harm to the nature, population due to making projects for gas supply building, constructing buildings, construction work, renewing buildings, using buildings, going into use, detaining and stopping for gas supply construction, will get property penalty according to the Mongolian Law.

36.4. If guilty person who broke gas supply law is not holding criminal characteristics judge and state inspector of gas supply control will impose following administrative penalties:

   36.4.1. If functioned without special licenses, transferred special licenses to other person, functioned with other’s special licenses, if sold gas by other prices than approved by authorities illegal incomes will be confiscated and imposed a fine 200000-250000 tugrugs for officials, 300000-500000 tugrugs for companies.

   36.4.2. If did not implement demand and tasks of gas supply control state inspector, to caused obstacles in examination and control, broke regulations of keeping a record, keeping a report and 30.2 provision of the law will be imposed a fine 50000-200000 tugrugs for citizens and officials, 300000-800000 tugrugs for companies.

   36.4.3. Citizens and officials who did not implement duties that stated in 29.5 provision will be imposed a fine 100000-260000 tugrugs for citizens and officials, 200000-600000 tugrugs for companies.

   36.4.4 If broke customer’s rights by demanding requirements that hasn’t stated in law, agreement, special licenses and suspended gas supply and gas consumption on the other basis than stated in 31.4 provisions will be imposed a fine up to 100000 tugrugs for officials, 50000 tugrugs for companies.

   36.4.5. If freely/arbitrarily changed gas consumption meter, measuring equipment and its sealing, location, connection, parts and disrupted its normal function, broke regulations for gas consumption and protection of pipelines guilty legal entity must compensate loss and will be imposed a fine 50000-250000 tugrugs for citizens and officials, 500000-1500000 tugrugs for companies.

   36.4.6. If broke special licenses requirements, instructions that stated in provision 13.2, 17.1, 29.1-29.4 of the law, supply regulation of gas net and gas supply, constructing gas supply buildings, creating projects, broke safety standards, regulations and caused industrial accident, material loss, equipment defect guilty legal entity must compensate loss and will be imposed a fine 50000-100000 tugrugs for citizens and 100000-250000 tugrugs for officials, 2000000-5000000 tugrugs for companies.

**Provision Thirty-seven. The law coming into force.**

37.1. The law will come into force from …… of 2007.
Revised the Petroleum law

MONGOLIAN LEGISLATIONS related to

PETROLEUM OPERATIONS

1. PETROLEUM LAW OF MONGOLIA

2. REGULATION FOR IMPLEMENTING THE PETROLEUM LAW OF MONGOLIA

3. AMENDMENTS AND REVISIONS TO THE CORPORATE INCOME TAXES LAW

4. AMENDMENTS TO THE CUSTOMS TARIFF LAW

5. AMENDMENTS TO THE EXCISE TAXES LAW

6. AMENDMENTS TO THE VALUE ADDED TAXES LAW

7. AMENDMENT TO THE FOREIGN INVESTMENT LAW OF MONGOLIA

Official Translation

PETROLEUM LAW OF THE MONGOLIAN PEOPLE'S REPUBLIC

January 18, 1991 Ulaanbaatar

CHAPTER ONE GENERAL PROVISIONS

Article 1 Purpose of the Law

The purpose of this Law is to regulate the operations of mongolian and foreign entities or individuals involved in the exploration for and the protection, processing, transportation, storage and marketing of petroleum originating in Mongolia.

Article 2 Definition

1. "Petroleum" means liquid petroleum and different compounds of hydrocarbons occurring under the surface of the earth and which may be extracted in a liquid, gaseous or solid state individually or in combination.

2. "Petroleum operations" means the operations related to the exploration for and protection, production, processing, transportation, storage and marketing of petroleum.

3. "Petroleum administration" means an organization authorised by the MPR Government to enter into contracts related to petroleum operations and to supervise their implementation.

4. "Contractor" means Mongolian or foreign entities or individuals who has entered into a Contract with the petroleum administration to carry out petroleum operations in the territory of the MPR.

Article 3 Ownership of Petroleum

All Petroleum occurring under the surface of the earth in MPR shall belong to the State.
Article 4  State management of petroleum operations

1. Petroleum operations in MPR territory shall be carried out only in accordance with permits issued by the MPR Government and the petroleum administration.

2. The MPR Government may decide to prohibit or restrict production of petroleum in any part of its territory for reasons of national security or to prevent damage to natural oil reserves, the population, or to protect relics of historical and cultural importance.

3. The petroleum administration shall have the sole right to draw up a work programme for petroleum exploration and supervise its implementation.

4. The MPR Government shall adopt the regulation for implementation of this Law.

Article 4  Status of Foreign Contractors

Unless the international treaties to which MPR is a Party provide otherwise, foreign Contractors shall be protected by and obliged to obey the laws of MPR and to fulfil their obligations under their contracts in the same manner as any legal person or citizen of the MPR.

CHAPTER TWO PETROLEUM OPERATIONS

Article 6  Basic requirements of petroleum contracts

Petroleum contracts shall meet the following basic requirements:

1. machinery and technology capable to extracting not less than 20 percent of a field's resources occurring under the surface of the earth shall be used;

2. there shall be consistency with the establishment and development of the petroleum processing industry in MPR;

3. programmes for the training of qualified personnel and for the employment of foreign citizens shall be developed;

4. machinery and technology of high economic efficiency shall be used in petroleum operations and the ecological balance of the affected environment shall not be disturbed;

5. all original information, data and reports related to petroleum operations shall be submitted to the petroleum administration;

6. any measures necessary to provide for the safety of the population, the protection of the life and health of staff, the prevention of accidents, the avoidance of damage to property, natural resources, soil, subsoil, and ecology, and for the restoration of areas used shall be taken.

Article 7  Grant of tenure to Contractors

1. In order to enable the conduct of petroleum operations, local authorities shall grant land tenure permits and the Government shall grant mine tenure permits.

2. Exploration for and production of petroleum beyond the boundaries of permitted tenures shall be prohibited.

Article 8  Term of Contractors' operations

1. The term of exploration period shall be up to 5 years.

2. The Petroleum Administration may, upon mutual agreement with a Contractor on the relevant terms and conditions, extend the term of the exploration period 2 times for 2 years each time.
3. The period for oilfield development may be up to 20 years beginning on the day the petroleum administration grants permission for the production of petroleum.

4. If a Contractor sets up additional industrial infrastructure, such as by building processing plants or oil or natural gas pipelines, the petroleum administration may extend the period for oil-field development 2 times for not more than 5 years each time.

Article 9 Royalties, taxes levied on Contractors

1. Contractors shall pay royalties to State in respect of the production of petroleum. The MPR Government shall fix the amount of royalties. In the case production-sharing contracts, the amount of royalty for production of petroleum may be included in production-sharing calculations.

2. Contractors carrying out petroleum operations shall be liable for tax in accordance with the rates provided in the laws of the MPR.

3. The MPR Government shall establish methods for the payment of royalties and taxes in respect of the production of petroleum, taking into account the recommendations of contractors and the petroleum administration.