



भारत सरकार / Government of India  
श्रम एवं रोजगार मंत्रालय / Ministry of Labour & Employment  
खान सुरक्षा महानिदेशालय / Directorate General of Mines Safety



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To

Owner/Agent/Manager of belowground coal mines.

**Subject:** Prevention of inflammable gas hazards in belowground coal mines - reg.

- 1.0 Accidents/disasters in belowground mines due to methane (generally termed as 'Gas') ignition and explosion are well known for many centuries in the coal mining history. Indian Belowground coal mines are no exception and have a number of gas-related accidents/disasters on record. History, by far, have revealed the lack of adequate precautions to deal with the unpredictable nature of mine gas emissions during mine development and coal extraction, particularly by the Longwall caving method, as the major causative factor of such accidents/disasters. Recent gas-related incidents in belowground coal mines have prompted to review the adequacy of the Coal Mine Regulations 2017 to safeguard the mineworkers from gas hazards, especially, of Jharia and Raniganj coal seams which are highly gassy in nature.
- 2.0 Globally, over the years, a significant body of knowledge has been developed in understanding the prediction of gas emission in belowground coal mines and effective techniques have been developed and successfully implemented to mitigate gas problems. Knowledge of the gas occurrence, emission characteristics and expected gas flow from a coalmine as a function of the coal production rate are therefore, the essential ingredients of safe operations, mine planning, ventilation, gas utilisation, Greenhouse gas (GHG) emission control purposes, etc. Coal extraction and effective gas management will become increasingly challenging as shallow coal reserves are exhausted and deeper and gassier seams are being mined.
- 3.0 In view of the above, the following measures are suggested for the prevention of gas hazards in belowground coal mines.
- 3.1 **Determination of degree of gassiness:** This is the first step to reduce hazards due to gas emissions during the mining process. Merely knowing the degree of gassiness of the coal seam only gives a probability of gas emissions which changes with coal production technology, barometric pressure, fan failure, roof falls, etc.

Hence, the gassiness of coal seams shall be determined on a scientific basis by measurement of in-situ gas content of working seams, overlying and underlying seams and immediate coal measure strata. The gas content of a coal seam shall be determined by appropriate scientific methods by taking freshly cut coal cores either from surface drilling or UG drill bore cores, as may be applicable, and sealing the cores in a canisters and carryout gas desorption measurements by well known national/international standards like 'Determination of Gas Content of Coal and Carbonaceous material - Direct Desorption Method' (AS 3980-2016 or ASTM D7569 / D7569M-10(2015)e1). The measured gas content data need to be interpreted for gas reservoir size and estimation of gas emission rates during mine development and production cycles.

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3.2 **Ventilation Planning:** knowledge of the gas occurrence, emission characteristics and expected gas flow from a coal mine/panel as a function of the rate of coal production is essential for ventilation planning. In some mines, a gas emission to the tune of 36 m<sup>3</sup>/t of coal had been reported, which is a potential for outburst conditions. To dilute such a high gas emission rates to the safe level of <1.25% CH<sub>4</sub> in general body air and <0.75% CH<sub>4</sub> in return airways of the district by increasing quantity of intake air may lead to a very high air velocities at Longwall face due to limited maximum span of the face causing dusty atmosphere and leakage of more air into the goaf that leads to spontaneous combustion problems and further potential increase in gas percentage in the return airways. Hence, it is necessary to determine the gas outburst threshold limits for the pre-drainage of the coal seam to safe limits before mining the coal.

3.3 **Gas drainage:** A suitable pre-mining methane drainage system shall be adopted in coal seams with gas content > 10 m<sup>3</sup>/t to reduce gas content of coal seam below the critical level to achieve safe belowground working conditions and for improving panel ventilation. The pre-gas drainage system also takes care of the gas blowers and outbursts encountered during mining of seam having high gas contents, low-permeability zones and geological structural features such as faults or shear zones.

The mine Owner/ Operator/ Contractor may characterize the gas reservoir size (i.e. cu.m of gas per sq.m. area, m<sup>3</sup>/m<sup>2</sup>) to determining the pre-drainage requirements before initiating the production activities, to ensuring that mining activity and ventilation planning match with the planned production with due regard to safe operations belowground.

3.4 **Monitoring:** A Tele-monitoring system having a sensor for continuous monitoring of methane (CH<sub>4</sub>) and carbon monoxide (CO) at the face, goaf edges and in the return airway of the panel may be provided and maintained in every mine having seams of 2<sup>nd</sup> and 3<sup>rd</sup>-degree gassiness. A telemonitoring sensor may be installed at the immediate return of the longwall panel/depillaring panel to detect the presence of inflammable and noxious gases continuously and having a feature to automatically cut off power in case the percentage of CH<sub>4</sub> exceeds 0.75% and noxious gases exceed 50ppm along with the automatic alarming system.

In addition, Local Methane Detector (LMD) to trip the power supply at 0.75% methane may be installed just out by of the Longwall face in the return airway and LMD to trip the power supply at 0.5% methane may be installed at the Longwall face. The methane sensor of the telemonitoring system and LMD may be placed within 1.0m of the roof. Approved type of methane monitors installed on the shearer/cutting machine as required under Reg. 214(2) of CMR, 2017, shall be kept functional which shall record inflammable gas continuously and trip the power of the face equipment if the percentage of CH<sub>4</sub> gas exceeds 0.5%.

3.5 **Ignition of gas:** In all the mines having seams of 2<sup>nd</sup> or 3<sup>rd</sup>-degree gassiness, the cutter drum having water spraying arrangement with a jet directed towards the tip of the pick shall only be provided to prevent a generation of frictional spark and the subsequent possibility of ignition of the gas.

A nitrogen/carbondioxide plant may also be installed at the surface of every mine having seams of 3<sup>rd</sup> degree gassiness with intricate network of connected pipelines for conveying nitrogen/carbondioxide gas within the mine. An automatically operated fire suppression device shall be provided at every face cutting machine as required under Reg. 139(1)(f) of CMR, 2017.

3.6 **Post goaf drainage:** The post goaf drainage plans may be prepared, formulated and implemented in every mine having gassy seams of 2<sup>nd</sup> and 3<sup>rd</sup> degree for safe

periodical drainage of gas accumulated inside the panel after its extraction and sealing for the safety of the mine workings.

3.7 **Gas Hazard Safety Management Plan:** In all belowground gassy mines of 2<sup>nd</sup> and 3<sup>rd</sup> degree, a safety management plan also containing the following elements of the principal gas hazard management, shall be prepared, monitored and reviewed periodically.

- Emergency Response;
- Gas emission assessment and determine gas content threshold limits;
- Gas Monitoring;
- Mine ventilation planning;
- Methane drainage i.e. Pre- and post drainage plans;
- Outburst management;
- Prevention of Gas ignition;
- Spontaneous combustion.

Every belowground coalmine shall prepare, formulate and implement a 'Gas Emission Control and Management Plan' and 'Emergency response and evacuation plan'.

All Owners, Agents and Managers of belowground coal mines are advised to ensure compliance of this circular. It is also advised that wherever new belowground mines/belowground mining operations are planned, the scope shall include gas reservoir studies, gas emission modelling and gas drainage plans.

  
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(R. Subramanian)  
Director General of Mines Safety

