Report on the first UNECE Workshop on Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines[1]

Beijing – China, 20 October 2010

Background

At its third and fourth sessions, the UNECE Ad Hoc Group of Experts (AHGE) on CMM agreed that the global coal mining industry lacked a set of recommended (accepted) principles and standards to guide mine operators, regulators, government officials and technical professionals in more effectively managing their methane problems, especially in emerging economies. In this respect the Cooperative Project on Methane Capture and Use to Improve Mine Safety was launched at the 4th session of the AHGE on CMM (October 2008) (ECE/ENERGY/GE.4/2008/2).

The organizations supporting the initiative (UNECE and Methane to Markets Partnership – M2M) aimed to contribute to improving mine safety practices through the development of a publication providing ***"Best Practices Guidance on Effective Methane Drainage and Use in Coal Mines"*** (ECE/ENERGY/73). The publication details the benefits, objectives and principles of coal mine methane drainage and utilization in order to reduce fatalities and injuries of mine workers, protect mine property, reduce greenhouse gas emissions and efficiently utilize valuable energy resources.

Although the benefit of developing and publishing the best practice guidance is obvious, the value of the project is maximised only if the content of the document is exposed to a wide audience that subsequently adopts the best practices as a part of the normal course of coal mining. Therefore, the best practices guidance are disseminated to a targeted audience through a series of regional workshops that are held at locations central to coal mines that frequently experience accidents caused by methane gas emissions into the coal mines.

These workshops focus on the problems that local mines are experiencing, include analysis of safety issues related to CMM, and presentations of potential options for resolving the issues in a cost effective manner.

Introduction

In line with the above, the first UNECE Workshop on Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines was held in Beijing, China on 20th October 2010, in the framework of the 10th International Symposium on CBM/CMM thus extending its

[1] The document has been principally prepared by the UNECE consultants Dr. D. Creedy and Dr. H. von Schonfeldt.

reach and the number of delegates presented. Its main focus was on safety and technical issues relating to gas extraction and control in the underground environment.

The workshop was supported by the China Coal Information Institute (CCII), State the Administration of Coal Mine safety (SACMS), the United State Environment Protection Agency (US EPA) and the Global Methane Initiative (GMI).

Aims of the workshop:

The workshop was designed to deliver the following:

- Highlight aspects of the best practice document pertinent to current safety issues of concern in China as identified by the Group of Experts on CMM.
- Illustrate a principles-based approach for reducing explosion risk in coal mines.
- An analysis of data on gas-related problems experienced in China's coal mines gathered using questionnaires issued to selected coal mines.
- Discussion and debate of issues raised by an invited panel of Chinese mining experts from applied research institutes and coal mining companies.
- Dissemination of the best practice guidance (the advance version of the Chinese translation was provided on CD ROM).

Opening remarks

The Secretary Group of Experts on Coal Mine Methane (CMM), Sustainable Energy Division, UNECE introduced the aims of the workshop and a general overview of the Best Practices were presented by the Chairman of the Group of Experts.

Mr. Zhen Xingzhou, Deputy Director General of the State Administration of Coal Mine Safety (SACMS) made an introductory speech, moderate the session and guided concrete and discussions between the UNECE Experts and the Chinese coal mining sector representatives. Up to ten Chinese technical experts representing major coalfield areas in northern, central and western Provinces of China participated actively in focused roundtable discussions.

Programme

The programme consisted of formal presentations made by UNECE international Experts on "Best practice gas control" and "Analysis of the responses to UNECE questionnaires."

It was a good opportunity for Chinese coal mine engineers, mining institutions representatives/researchers to learn, debate and exchange best practices. During the protracted roundtable discussion Chinese coal mine sector experts posed questions on drilling, outburst prevention, gas drainage and gas utilization issues to the international panel, and also stated their opinions.

Mr. Zhen summarized the discussions and stated explicitly that China welcomes the guidance document as an important contribution to enhancing understanding and to improving mine safety. He recommended that it should be developed further and adapted by China to address the specific problems encountered in its coal mines.

The secretary of the Group of Experts in her closing speech stressed that the Best Practice guidance is a living document which would be continually refined and enhanced and that the UNECE Group of Experts would continue to assist its Members States as well as China in eliminating explosion risks in coal mines.

Key messages

The meeting underlined the importance of designing mine gas control systems to ensure that gas is captured and drained at concentrations with a factor of safety above the explosive range of 5-15% methane in air.

China has developed a method for utilizing mine gas mixtures within the explosive range which incorporates a number of safety features to prevent the propagation of an explosion should an ignition occur in the feed gas pipeline. However, these precautions do not extend underground and the Group of Experts believes there is an unacceptably high underground explosion risk. Furthermore, permitting the use of dangerous gas mixtures removes the incentives for coal mines to raise gas drainage standards.

It was reminded that methane concentrations are very high in coal seams in the natural state and that dilution only occurs as a result of interaction with mining. Methods for capturing gas and limiting its dilution to maintain a factor of safety above the explosive range are well developed. Gas mixtures in the explosive range should be diluted rapidly with ventilation air to a permitted safe concentration. Best practice is to essentially "drain well above (the explosive range), ventilate well below."

Questionnaire

Prior to the workshop the Chinese Coal Information Institute (CCII) had sent out the UNECE questionnaire to Chinese Coal Mines and Coal mining Companies. The questionnaire contained the following nine sections:

- General Questions
- Gas Reservoir Conditions
- Gas Emissions in Your Coal Mine
- Methane Drainage – Pre and Post drainage
- Mine Ventilation
- Underground Gas Pipelines and Monitoring Systems
- Methane Utilization

Each section had between 5 and 12 detailed questions; a total of 14 mines responded to the questionnaire. Having examined and analysed the responses the UNECE expert concluded that most mines use pre-drainage system by drilling horizontal boreholes in long-wall blocks and/or alongside development headings. However, because of generally low permeability of the coal seams reported pre-drainage flow rates per boreholes were generally low varying between 0.05 l/s to 137 l/s, most were < 1L. Most mines indicated that pre-drainage was helpful in lowering the gas content of the coal seam.

For post drainage systems most mines construct drainage galleries above the longwall block drilled in advance of mining. In case of gas outburst prone areas cross measure holes are drilled from advance headings. In one case the mine drilled vertical bore holes from the surface in advance of mining to a depth within 50m – 120 m of the coal seam as goaf drainage holes.

Most mines representatives at the workshop underlined that they used the drained methane for power generation. The average methane concentrations in the piping systems varied between 5% and 30% Ch_4. Gas with higher concentration (> 30% Ch_4) was used for residential/industrial customers in some cases. One mine had a VAM utilization facility.

Major concerns expressed by the responding mines included the following:

- Gas outburst, coal extrusion and sudden roof falls;
- Limited volume of pre-drainage gas, low permeability;
- Prevention and control of coal and gas outbursts;
- Borehole stability due to high pressure and mining depth or soft coal;
- Inability to achieve planned borehole length;
- Difficulty drilling pre-drainage holes, high pressure, low permeability.

Key topics

Key topics raised for discussion by the Chinese delegates were:

Pre drainage of low permeability coals especially for outburst prevention – coal seams are of very low permeability in many coalfield areas in China and pre drainage is very slow and often ineffective. The UNECE Expert explained how underground borehole fraccing (hydraulic fracturing) could be used where pre drainage is essential for outburst prevention, provided adequate standpipe sealing could be achieved. The intensity of drilling also needed to be increased to compensate for low permeability. Chinese coal mines are required to drain before and after mining and in some mines a disproportionate amount of effort is put into recovering minimal flows before mining and not sufficient in controlling large volumes released from roof and floor seams as a consequence of mining.

The Chairman of the UNECE group of Experts highlighted the importance of considering stress orientation when designing in-seam drainage systems to maximize flow recovery.

Quality of borehole sealing – poor borehole sealing is endemic, and a major cause of excessive dilution of drained gas. A delegate requested further detail on the two stage sealing method for gas drainage boreholes: while a number of variants of this method have been successfully demonstrated in China, the focus by drillers on number of meters drilled rather than quality of borehole performance is a barrier to its widespread adoption.

Drilling and installing effective surface goaf wells – problems of deformation leading to borehole failure were being encountered as longwalls passed beneath pre-drilled wells. The UNECE expert explained how to overcome there difficulties on the basis of personal experience.

Longhole drilling from surface and underground – guided longhole drilling techniques, both surface and underground based, have been demonstrated internationally in both pre and post drainage applications but success in China has been limited. However, soft coals and difficult geology encountered in some coalfields in China present serious challenges and it was recommended that underground trials should be undertaken first before attempting more costly surface to in-seam drilling. An advantage of use of steered longholes for post drainage is that drilling and borehole control activities are located away from congested coal production areas.

Gas content sampling - a special constant pressure technique has been developed in China to increase the accuracy of surface borehole sampling of coal seams for gas content determination used in resource appraisal. The possible applicability of this technique underground was queried. However, it was explained that such a level of accuracy was not warranted for mine use and more practical sampling methods are available.

Use of ventilation air methane – China is very focused on optimizing energy recovery and there is considerable interest in the potential for utilizing ventilation air methane (VAM). It was explained that VAM oxidation units could operate down to 0.12% methane but economic operation relied on the availability of carbon credits and is currently not viable at VAM concentrations less than say 0.5%. Heat is released by the oxidation process and this can be utilized but at permissible VAM concentrations in China power generation is not feasible. While VAM could be enriched with drained methane, a supply is not always available at shaft sites (and the Best Practice document suggests that the lowest cost option for power generation is to improve conventional gas drainage).

Outcomes and Recommendations

The Chinese version of the Best Practice Guidance, was successfully launched and distributed widely. The credibility of the UNECE Group of Experts on CMM was reinforced to SACMS, the government body responsible for administering mine safety.

It was underlined that the Best Practice Guidance is a living document which would be continually refined and enhanced and that the UNECE Group of Experts would continue to assist China in its ambitions to eliminate explosion risks in its coal mines. Although China is not a member country of UNECE, such an action is justified economically by the fact that China is the world's largest emitter of mine methane and that continuing American and European technology transfer and investment in China is essential to global climate change mitigation.

Representatives of the UNFCCC Secretariat who are responsible for administering the application of Clean Development Mechanisms (CDM) to, amongst others, CMM projects where present in the audience and this provided a unique opportunity to gain an introduction to gas capture, mining processes and critical safety issues.

The meeting also underlined that the UNECE Group of Experts should attempt to establish a working group with SACMS to assist in developing a China specific best practice document and to encourage adoption of international safety standards.

The representative from Mongolia requested UNECE to explore possible ways and funds to hold a Best practice workshop in Mongolia with case studies. Also the Chinese Coal Information Institute (CCII) requested UNECE to explore the possibility to hold a second best practice workshop in China in a region central to coal mines.