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Committee on Sustainable Energy

Ad Hoc Group of Experts on Coal Mine Methane**Sixth session**

Geneva, 11-12 October 2010

Report of the Ad Hoc Group of Experts on Coal Mine Methane on its sixth session**Introduction**

1. The sixth session of the Ad Hoc Group of Experts on Coal Mine Methane (AHGE on CMM) was held from 11 to 12 October 2010. Additional information and details of the items summarized in this report are available on ECE website: <http://www.unece.org/energy/se/docs/cmm6.html>.

Attendance

2. The session was attended by representatives of the following ECE member countries: Germany, Poland, Russian Federation, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America.

3. Representatives of the International Energy Agency (IEA), the International Labour Organization (ILO) and the Global Methane Initiative (former Methane to Markets Partnership) were also present.

Item 1**Adoption of the Agenda****Documentation:** ECE/ENERGY/GE.4/2010/1

4. The provisional agenda was adopted without amendment.

Item 2**Activities and priorities of the Committee on Sustainable Energy and any matters for consideration by the Ad Hoc Group of Experts****Documentation:** ECE/ENERGY/80

5. The Chief of the Industry Energy Section of the Sustainable Energy Division briefed the meeting about the outcomes of the 18th session of the Committee on Sustainable

Energy which had featured a dialogue on “Energy Security in the Financial Crisis” focused on the underinvestment in energy industry and responses by governments. The Committee reviewed cooperation with other international organizations, the regional advisory services programme in energy, and coordination with other sectoral committees of the Commission, the programme of work in energy for 2009-2010, and the assessment of performance of sustainable energy sub-programme. He reminded that to continue AHGE on CMM work, a new 2-year mandate must be requested from the Committee at its 19th session in November 2010.

Item 3 Election of officers

6. The meeting expressed appreciation for the efforts of the Bureau of the AHGE on CMM and acknowledged its contribution to the activities of the Sustainable Energy Division in 2008-2010.

7. The AHGE on CMM elected a new bureau for 2010-2012: Mr. R. Pilcher (United States of America) as the Chair, and Mr. Y. Bobrov (Ukraine), Mr. D. Creedy (United Kingdom), Mr. C. Davies (United Kingdom), Ms. P. Franklin (United States of America), Mr I. Yashchenko (Ukraine), Mr. R. Mader (Germany), Mr. J. Skiba (Poland), and Mr. S. Shumkov (Russian Federation) as Vice Chairs.

Item 4 Opening remarks

8. The Chair welcomed the participants and thanked the previous Bureau for its work. He expressed his continuous commitment to serve the AHGE on CMM in the next term. He expressed his appreciation for the work undertaken by the members of the group in developing the recently published “Best Practices Guidance on Effective Methane Drainage and Use in Coal Mines” (ECE/ENERGY/73). To draft, review and prepare the document for publication required cooperation among the technical experts, steering committee, stakeholders, and peer reviewers, he stressed. The publication has been well received, but it is only the first step in promoting best practices. There is more work to do to effectively disseminate information and encourage adoption of the principles endorsed by the publication.

9. The Officer-in-charge of the Sustainable Energy Division stated that in recent years a series of disasters had demonstrated the vulnerability of humanity to climate change and related extreme weather events. That is why governments from developed and developing countries pledged to cut greenhouse gas emissions. Many developed countries promised both short and long-term funding to help developing countries deal with climate change. It is therefore important that policies are designed and implemented in a way that would continue to build investors’ confidence in the carbon markets.

10. He underlined that the past work of the AHGE on CMM contributed to climate change mitigation and, if duly mandated, would continue to do so. Indeed, the AHGE on CMM since its inception has developed specific approaches to identifying projects to reduce methane emissions, encourage clean energy development and save lives by promoting practices that enhance the safety of coal mines.

Item 5 Review of the programme of work for 2009/2010

Documentation: ECE/ENERGY/GE.4/2007/2, ECE/ENERGY/GE.4/2008/3;
ECE/ENERGY/GE.4/2008/4

11. The Chair reviewed progress in the programme of work for 2008/2010 adopted at the fifth session of the AHGE on CMM.

- (a) **Documents/publications:** at its third and fourth sessions, the AHGE on CMM agreed that the global coal mining industry lacked a set of recommended (or 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 fourth session of the AHGE on CMM (October 2008). The organizations supporting the initiative (UNECE and M2M Partnership) 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 new UNECE 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 property, reduce greenhouse gas emissions and efficiently utilize valuable energy resources.
- (b) **Workshops, conference:** the Secretary and Chair of the AHGE on CMM took an active role in the M2M Partnership Expo in India in March 2010, where they launched the new UNECE-M2M publication “Best Practice Guidance for Effective Methane Drainage and Use” (ECE/ENERGY/73). The AHGE on CMM was also represented at the CMM International Investment Forum, in Donetsk, Ukraine and at 2010 International Workshop on CBM/CMM Recovery and Use in Changsha, China.
- (c) **Recovery and use of CMM:** the AHGE on CMM surveyed coal mining countries to determine if legislation might act as a barrier to best practices in CMM recovery and use. It further investigated technical options for using low-quality coal mine methane because of its health and safety hazards, and also because of its energy resource potential in many ECE countries.
- (d) **Cooperation with the Methane to Markets Partnership, United States Environmental Protection Agency (US EPA):** the AHGE on CMM worked closely with Methane to Markets Partnership. As a follow-up to the Best Practice Guidance publication, UNECE received funds from the United States Environmental Protection Agency (US EPA) to disseminate the best practices guidance to a targeted audience through a series of regional workshops (China, Ukraine, Kazakhstan) held close to coal mines that frequently experience accidents caused by methane gas emissions into the coal mines.
- (e) **Activities with respect to mine safety:** to initiate organisation of the UNECE workshops planned for 2010-2011, the Chair and Secretary of the AHGE on CMM conducted assessment missions to China, Ukraine, and Kazakhstan and tried to identify problems that hamper improvement in recovery and use of coal mine methane and negatively impact mine safety.

Item 6

Activities of the Ad Hoc Group of Experts with respect to mine safety

12. The AHGE on CMM is currently analyzing country-specific laws and regulations that could impact implementation of gas drainage and utilization. In fact, the meeting of the AHGE on CMM received presentations regarding recent and planned changes to legislation and regulations in Kazakhstan, the Russian Federation, and Ukraine.

13. The meeting also discussed a Standard issued in the People's Republic of China that impacts the drainage and use of methane from coal mines, as well as the potential viability of CMM capture and use projects. The referenced Standard called "*Emission Standard of Coal bed Methane/Coal Mine Gas (On trial)*", was issued by the Chinese Ministry of Environmental Protection on 2 April 2008 and became effective on 1 July 2008 for newly-built mines and on 1 January 2010 for existing coal mines.

14. The main concern of the AHGE on CMM was the potential for mine safety to be compromised through the dilution and transport of lower concentration methane to avoid compliance. The explosive range of methane is 5-15% methane in air. The meeting also noted that the drive to dilute drainage gas would also result in more venting limiting the intended climate change benefits. Should the mine owner/operators choose to dilute methane – which is the least-cost option for meeting the emission Standard – this practice would drive concentrations toward, rather than away from, the explosive range. This contradicts the principles outlined in the UNECE publication: Best Practice Guidance for Effective Methane Drainage and Use" (ECE/ENERGY/73), which recommends that mine gas should be drained, transported, and used at a concentration well above the upper explosive limit, including a factor of safety.

Item 7

Status of Coal Mine Methane and carbon markets

15. The AHGE on CMM had a video conference with the United Nations Framework Convention on Climate Change (UNFCCC) in Bonn and discussed coal mine methane, in particular:

16. The goal of UNFCCC to reduce green house gas emissions and mitigate climate change, which coincides with and is supported by the ongoing work of AHGE on CMM.

17. The mutual recognition of the importance of economic incentives, such as those provided by the Clean Development Mechanism (CDM) process, which are designed to stimulate the development of CMM projects that reduce methane emissions, increase mine safety, and provide clean energy.

18. The AHGE on CMM's efforts to promote the best practices in implementing CMM recovery and use, including review of laws and regulations that impact mine safety at coal mines in the UNECE region and other countries, such as the People's Republic of China.

19. Potential avenues for cooperation between the AHGE on CMM and UNFCCC to promote mutual interests, and enhance effective communication and cooperation, consistent with their mandates.

20. The need to help Member States in finding most effective ways of addressing both climate change and safety of coal mines.

Item 8

Ventilation Air Methane: technologies and markets

21. The meeting underlined that international progress in Ventilation Air Methane utilization and destruction projects was slow and remained unlikely to accelerate in the near future, though improvements in some areas of this sector did occur. There are four primary drivers for VAM destruction project implementation: technology risk, technology cost, security/longevity of carbon pricing mechanisms, and the carbon price.

22. Besides the compliance as a driver to force implementation of VAM destruction, other drivers to force mitigation of VAM emissions are heat recovery, electricity generation and carbon price. Production and use of heat or electricity from destruction of VAM are

both proven and technologically simple. Many mines have the opportunity to use waste heat available from VAM destruction; however the value of the waste heat is insufficient to warrant investment to the level necessary for a VAM project to be implemented. Generation of electricity from waste heat from VAM destruction is still not commercially viable.

23. The meeting also stated that at the start of the CDM in 2006/7, VAM technology risk and cost were relatively high, so projects did not take off, despite the long time period for commercial returns. With the CDM end date of 2012 approaching, though technology risk is dramatically reduced and costs are slowly dropping, the short period left to make returns is a major factor in project development risk for investors (coupled with the high "CDM Risk" involved in the CDM administration and registration). The main driver behind uptake of VAM projects is carbon price. At the current price of carbon via the JI, CDM and CAR markets, VAM projects are theoretically still attractive where coal mine shafts are delivering relatively high concentrations of methane, but risk issues of carbon mechanism security, administration and longevity usually work against a positive investment decision. For a project to be attractive (notwithstanding the other variables mentioned above) methane concentration in the ventilation air must usually be above 0.5% CH₄ to be even considered as a viable project.

24. The most commercially and environmentally attractive projects internationally are those where the methane concentrations from the ventilation shaft are highest. Countries where bleeder ventilation is used have the best cost to return ratio where a relatively small oxidiser can be installed on a high methane concentration shaft (up to say 2% CH₄). This type of ventilation is common in the Russian Federation, Ukraine, Kazakhstan, Mexico and the United States. Were carbon price to dramatically increase within a long-term carbon mechanism, VAM project implementation would accelerate as it is clear that they have low technology risk, and low cost per tonne of emission reduction. It is believed that VAM mitigation is a low hanging fruit of emission mitigation applications.

25. With lower project costs, increased carbon security and increased carbon price, widespread development may enable the technology to reach the point where compliance regulation could be practicable, but at current rate of project evolution and implementation, this could not occur for at least 10 years.

Item 9

Activities of and cooperation with various intergovernmental bodies and non-governmental organizations and other related bodies

26. The meeting participants were updated on the Methane to Markets Partnership (M2M) Expo, in India in March 2010 and were informed that the Methane to Markets Partnership (M2M) was renamed to as Global Methane Initiative (GMI) at the Methane to Markets Partnership Ministerial Meeting in Mexico City on 1st October 2010.

27. Also the meeting received presentations on coal mine related activities/programs by representatives of the International Energy Agency, the International Labour Organization, as well as on a UNDP/GEF project in the Russian Federation.

28. These presentations provided are available on the ECE website (<http://www.unece.org/energy/se/docs/cmm6.html>).

Item 10

Programme of work for 2010-2012

29. After discussion, the Ad Hoc Group of Experts:

- (a) Welcomed the final UNECE-M2M publication “Best Practices Guidance for Effective Methane Drainage and Use in Coal Mines” (ECE/ENERGY/73) and expressed appreciation for the opportunity to cooperate with the Methane to Markets Partnership on the new publication “Best Practices Guidance for Effective Methane Drainage and Use at Coal Mines”; and thanked US EPA colleagues, the Steering Committee members, experts, advisors that contributed to the publication;
- (c) Agreed to request the Committee on Sustainable Energy, at its nineteenth session in November 2010, to extend its mandate for two years, 2010-2012 and to change the name into the **Group of Experts on Coal Mine Methane**;
- (e) Agreed on its new Term of Reference, annexed to this report;
- (f) Agreed to start cooperation with UNFCCC on standards and methodologies (i.e.: *Approved consolidated baseline and monitoring methodology ACM0008*) related to coal mine methane and explore possible cooperation in creating a working group and UNECE best practice workshops, and link web sites to promote mutual goals;
- (g) Agreed to conduct an updated survey of the AHGE and the industry at large to assess the current state of the CMM/VAM market;
- (h) Expressed appreciation to the China Coal Information Institute and State Administration of Coal Mine Safety for having co-organized the first UNECE Best Practice Guidance workshop held during the 10th International Symposium on MM/CBM, in China and *requested* the Secretariat to insert the final report as Annex II to this report;
- (i) Requested the Secretariat to explore the possibility and funding available to publish the “Best Practices Guidance for Effective Methane Drainage and Use at Coal Mines” under the ECE Energy Series in Chinese;
- (j) Agreed to start preparing the Term of Reference for the BPG web page linked to the UNECE/CMM web site;
- (k) Reiterated the decision of the fourth session to assess whether regulatory requirements are inhibiting innovation in methane capture and utilization with the goal of preparing a briefing paper on possible problems with existing regulatory requirements;
- (l) Welcomed the continued cooperation with other international and intergovernmental organizations, including the International Energy Agency, the International Labour Organization, and the United Nations Development Program.

Item 11

Other business

30. The Secretariat made a corrective statement about the inaccuracy reported on the “Report of the workshop on new trends in coal mine methane recovery and utilization (ECE/ENERGY/GE.4/2008/4), para. 17-18: the Biothermica VAMOX is a non-catalytic oxidizer.

31. For the future success of the AHGE on CMM, it was considered essential that the meetings take place with substantial participation and contributions from the coal sector. The AHGE on CMM requested that the Bureau and the Secretariat consider and pursue options for increasing participation.

32. The meeting requested the Secretariat to issue in the future as official documents in the three ECE working languages all relevant documents for its work such as agendas, reports, programme of work, calendar of meetings, questionnaires, terms of reference,

progress reports and final reports of its ongoing activities, studies and surveys as well as any other documents deemed important for the work of the Ad Hoc Group of Experts, including all those considered during the fifth session. In needed, the Secretariat should remain in close contact with the Bureau of the Ad Hoc Group of Experts on this matter.

Item 12
Adoption of the report of the meeting

33. It was agreed that a concise report of the session focusing on the conclusions and recommendations would be prepared by the Secretariat and circulated to the Bureau for approval, upon which it would be circulated to member countries.

Annex I

Terms of reference of the Ad hoc group of experts on coal mine methane

34. **Background:** The Ad Hoc Group of Experts on Coal Mine Methane, an intergovernmental body launched in December 2004 to specifically support the activities of the Ad Hoc Group of Experts on Coal in Sustainable Development in the area of coal mine methane (CMM), was established by the Committee on Sustainable Energy at its 14th session in November 2005 (ECE/ENERGY/65, para.37). In recognition of the ongoing need to continue to develop and promote the work on coal mine methane, the name was changed to the Group of Experts on Coal Mine Methane before submission to the Committee on Sustainable Energy on its nineteenth session in November 2010 (ECE/ENERGY/84).
35. **Mandate:** The Group of Experts on its sixth session decided to request Committee on Sustainable Energy in November 2010 to renew its mandate for a period of two years starting in 2010 and report its achievements and plans yearly. (ECE/ENERGY/84)
36. Under the Committee's guidance, the tasks of the Group of Experts are:
- (a) To carry out activities related to development and profitable recovery and use of CMM and abandoned mine methane (AMM), with a specific focus on the three pillars of sustainable development: economic, social and environmental – recovery and use of CMM otherwise emitted mitigates climate change, improves mine safety and productivity, and generates revenues and cost savings;
 - (b) To promote and provide support where applicable to the UNECE extra-budgetary project on “Cooperative Project on Methane Drainage and Use in Coal Mines”. This project, which is financed by the United States Environmental Protection Agency (US EPA), will run for two years commencing in 2010;
 - (c) To seek to facilitate financing of CMM projects in Central and Eastern Europe and the CIS, including through actively engaging in a dialogue with the international finance community to understand their needs and the barriers to funding of CMM projects in this region;
 - (d) To provide a forum for exchange of information and experience on ongoing activities in the area of CMM development and for enhanced collaboration and cooperation thereof;
 - (e) To identify and seek to mitigate the problems associated with the creation of incentives for CMM recovery;
 - (f) To establish a clear link between the economic benefits and the mining of gassy coal seams based on the safe drainage and use of the gas, and to facilitate this through the establishment of a dedicated Working Group/Task Force with membership from the technical, business and regulatory communities;
 - (g) To explore opportunities for the CMM sector, in particular in UNECE member States with economies in transition, to participate in and benefit from the various public and private greenhouse gas emissions markets;
 - (h) To identify any significant new developments affecting CMM, in particular in UNECE member countries;

- (i) To join forces of with UNFCCC as to find most effective ways of addressing both the challenges related to climate change and safety of coal mines; and
- (j) To seek to strengthen inter-agency cooperation and to cooperate and collaborate with all stakeholders, including other governmental and non-governmental organizations and the business community/private sector, in order to realize the above objectives.

Annex II

Report on the first UNECE Workshop on Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines¹

Beijing – China, 20 October 2010

37. **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).

38. 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.

39. 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.

40. 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

41. 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 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.

42. 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).

43. Aims of the workshop:

44. The workshop was designed to deliver the following:

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

- (a) 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.
- (b) Illustrate a principles-based approach for reducing explosion risk in coal mines.
- (c) An analysis of data on gas-related problems experienced in China's coal mines gathered using questionnaires issued to selected coal mines.
- (d) Discussion and debate of issues raised by an invited panel of Chinese mining experts from applied research institutes and coal mining companies.
- (e) Dissemination of the best practice guidance (the advance version of the Chinese translation was provided on CD ROM).

Opening remarks

45. 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 was presented by the Chair of the Group of Experts.

46. 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

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

48. 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.

49. 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.

50. 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

51. 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.

52. 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.

53. 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

54. 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:

- (a) General Questions
- (b) Gas Reservoir Conditions
- (c) Gas Emissions in Your Coal Mine
- (d) Methane Drainage – Pre and Post drainage
- (e) Mine Ventilation
- (f) Underground Gas Pipelines and Monitoring Systems
- (g) Methane Utilization

55. Each section had between 5 and 12 detailed questions; a total of 14 mines responded to the questionnaire. Having examined and analyzed 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 are less than one liter per second. Most mines indicated that pre-drainage was helpful in lowering the gas content of the coal seam.

56. 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.

57. 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 ($> 30\% \text{CH}_4$) was used for residential/industrial customers in some cases. One mine had a VAM utilization facility.

58. Major concerns expressed by the responding mines included the following:

- (a) Gas outburst, coal extrusion and sudden roof falls;
- (b) Limited volume of pre-drainage gas, low permeability;
- (c) Prevention and control of coal and gas outbursts;
- (d) Borehole stability due to high pressure and mining depth or soft coal;
- (e) Inability to achieve planned borehole length;

- (f) Difficulty drilling pre-drainage holes, high pressure, low permeability.

Key topics

59. Key topics raised for discussion by the Chinese delegates were:

60. **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 fracturing (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.

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

62. **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.

63. **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 these difficulties on the basis of personal experience.

64. **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.

65. **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.

66. **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

67. 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.

68. 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.

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

70. 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.

71. 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.