

30th October 2007

Methane to Markets
Beijing



Neil Butler
Harworth Power Ltd

Coal Mine Methane Drainage and Utilisation

Major Firedamp Ignitions – The Need for Change

1964	Gresford (Last Coal Dust)	265 killed
1960	Six Bells	45 killed
1962	Hapton Valley	19 killed
1962	Tower	9 killed
1965	Cambrian	31killed
1974	Houghton Main	5 killed
1979	Golbourne	10 killed
1982	Cardowan (seriously hurt)	40
1982	Coventry (seriously hurt)	8

Gresford Colliery 1964



Coal Dust Explosion – Killing 265

Houghton Main Colliery 1974

The National Coal Board wrote off equipment worth £250,000 this week when they sealed off the Newhill seam where five men were killed in a violent explosion last Thursday night.

The decision was taken by Mr. John Kiers, the board's Harrogate area coalfield director, after consultations with union leaders.

Teams of men worked over the weekend to put permanent 17½ inch seals on the Newhill seam and part of the adjacent Welton Field seam mountain.

Tables have been left in the seals to monitor conditions in the sealed off areas but it isn't expected that any attempt to reopen the Newhill seam will be made for at least nine months.

Five men die in underground blast at Houghton Main

AS THE SUN SET on Thursday night, crowds of grim faced miners gathered in the yard of Houghton Main Colliery, just a short distance from the village of Little Houghton.

They had just heard that five of their workmates had died in a terrible underground explosion — 1,000 feet from the surface — that neither they had known about, and their relatives were missing in the night and death.

The pit, which employs 1,400 men, had been closed, and Great Britain Colliery, which is linked to Houghton, evacuated.

"This was a safety job," said Mr. Kiers, Area Director of the Coal Board, as he hurriedly called press into the pit at the colliery.

"The explosion appears to have been caused by gas. The reason there hasn't been a big outburst on the surface and out of the dead men has been sealed in.

There has been a lot of gas in the mine, but we don't know what caused it. It may be a safety job, but we don't know what caused it. It may be a safety job, but we don't know what caused it.

When rescue teams from the surface were sent down to the mine and got stuck in the mine, they were rescued. The rescue teams were sent down to the mine and got stuck in the mine, they were rescued.

On the morning after the blast, families in the village gathered on the street to see the bodies of the five men who died in the blast. They were buried in the village.

Energy Minister and NCB chief visit the pit

REMINDER

Quote by Mr. Bean: "This tragedy may remind people, as it has reminded me, that there is still a very high price to be paid in human life for the coal we get in this country."

CONVINCING NCB PRESIDENT Mr. Arthur Beckett with Energy Secretary Mr. Tony Benn at Houghton Main.



Firedamp ignited when CMM drawn through an auxiliary fan
Killing 5

Golbourn Colliery 1978



CMM ignited when drawn over live switchgear – Killing 10

Prince of Wales Colliery



A controlled methane explosion for research purposes



Lessons Learned

- Look at the way we determine the methane source and control methane on a modern coal face.
- Change the way we manage the methane drainage infrastructure, underground and on the surface.
- The need to educate personnel on best practises in methane drainage techniques at each individual mines.

Requirement for CMM drainage

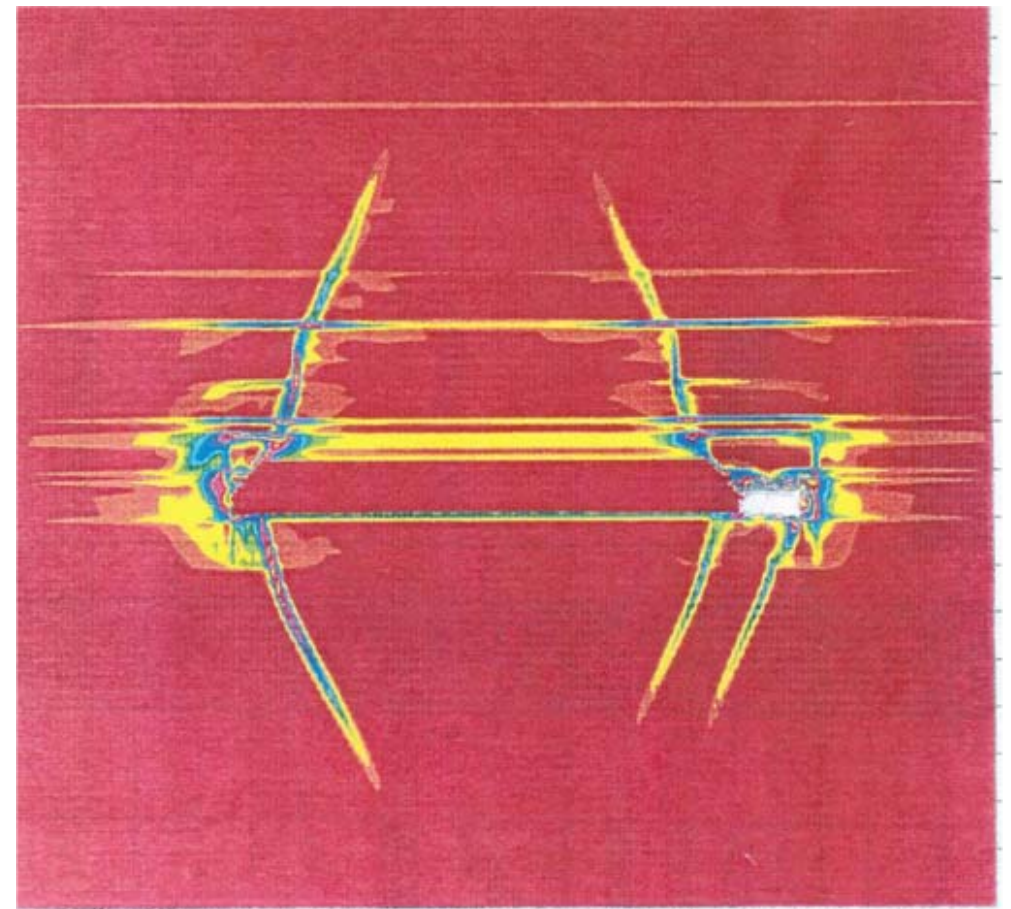
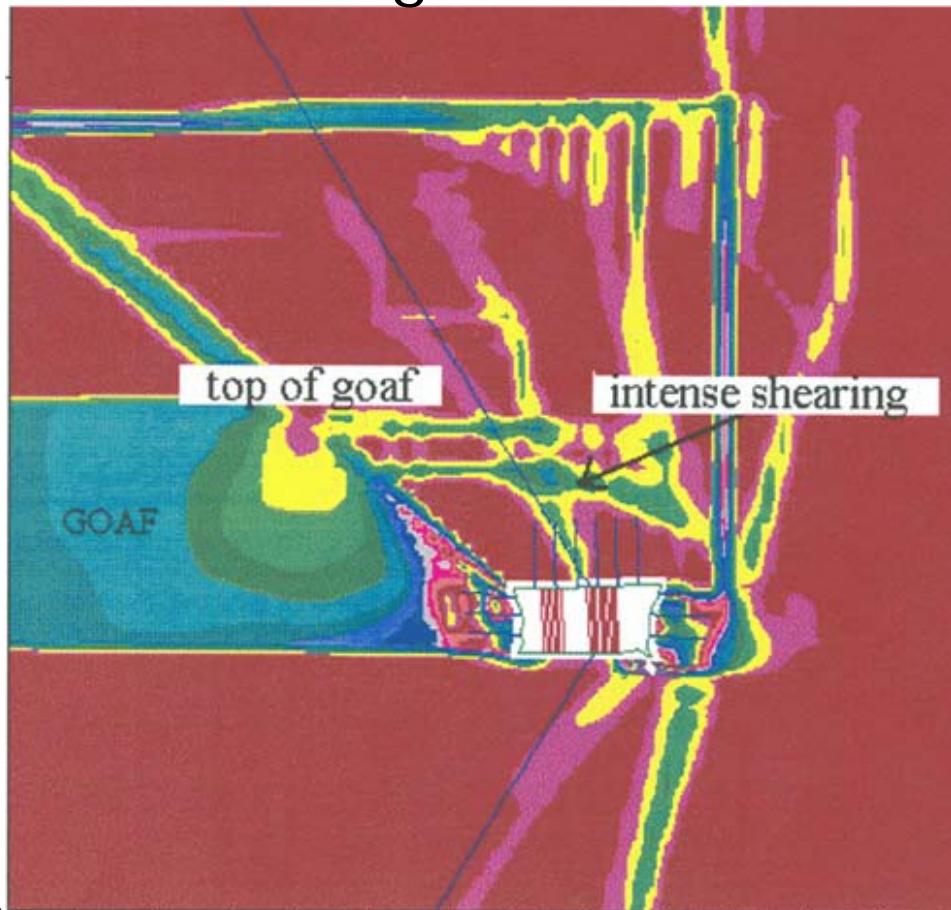
CMM drainage is needed when the quantity of gas into coal mine workings exceeds flow that can be practically diluted to safe and statutorily permissible concentrations with ventilation air alone.

Requirement for CMM drainage

- Post drainage methods can adequately control CMM emissions for the current planned rates of coal production provided they are **effectively managed**
- Boreholes are drilled in the coal face return roadways close to the face at angles above and below the goaf
- Coal Mines in the UK are relatively deep, the coal fields have been heavily worked over a long period of time and most mines are gassy.
- UK coal mines use cross measure drilling methods of drainage.

Computer modelling of long wall coal mining

FEA analysis results showing de-stressing of surrounding rock strata. These can be used to ensure effective targeting of CMM drainage boreholes.



Cross measures CMM boring

Techniques:

- Depending on the geology above and below the working face and calculated gas source, the boreholes are usually 50m in length with varying angles of inclination/declination.
- The return gate is supported against collapse through the use of secondary support, normally wooden block towers. These help to prevent the boreholes from closing as the rock strata relaxes and shears.
- Steel standpipes are inserted and sealed into the borehole the length being dictated by the local strata, this prevents the borehole closing as the rock strata relaxes.
- The methane boring area needs to be ventilated, normally through the use of the Back Return technique (Sherwood Curtain).

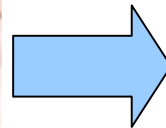
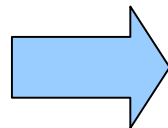


Benefits of CMM Drainage

Various drainage techniques are used to capture as much CMM as possible before it migrates into mine ventilation air.

The rewards for a well set up and managed drainage system are:

- Highest possible coal production rates are not constrained by unsafe levels of CMM in the ventilation.
- The capture of high purity CMM allows its utilisation for the generation of heat and power.



The management of CMM drainage infrastructure

As previously stated it is paramount to provide measuring points / stations so that the adopted techniques can be evaluated.

EXAMPLES:

- The flow measurement along with the methane concentration will determine the vacuum required.
- A low flow with high methane concentration indicates potential for an increase in vacuum. The reverse can be said with high flow low CMM concentrations.
- High flow and high purity and low suction probably indicates incorrect range(s) sizes

Surface CMM drainage system

- A surface methane plant should be designed to meet the requirements of the underground mining operations.
- Full monitoring of the methane plant and the underground infra-structure is advantageous.
- Transmission of data to a central control unit is advantageous
- Education of the workforce to ensure the maximum efficiency of the CMM drainage system
- Careful consideration of ignition sources, especially lightning incorporated in the design of the plant

Importance of Concentration

- Methane will combust when at atmospheric temperature and pressure in the nominal range 5% to 15%
- When enclosed in an underground road tunnel or a pipe the combustion will accelerate and cause an explosion to propagate
- Methane will not combust when outside the flammable range
- Lightning has significant electrical current to ignite methane and will pass flame arresters easily

CMM Destruction Technology – Gas Flaring

This technology destroys the drained CMM through combustion in a gas flare

Benefits:

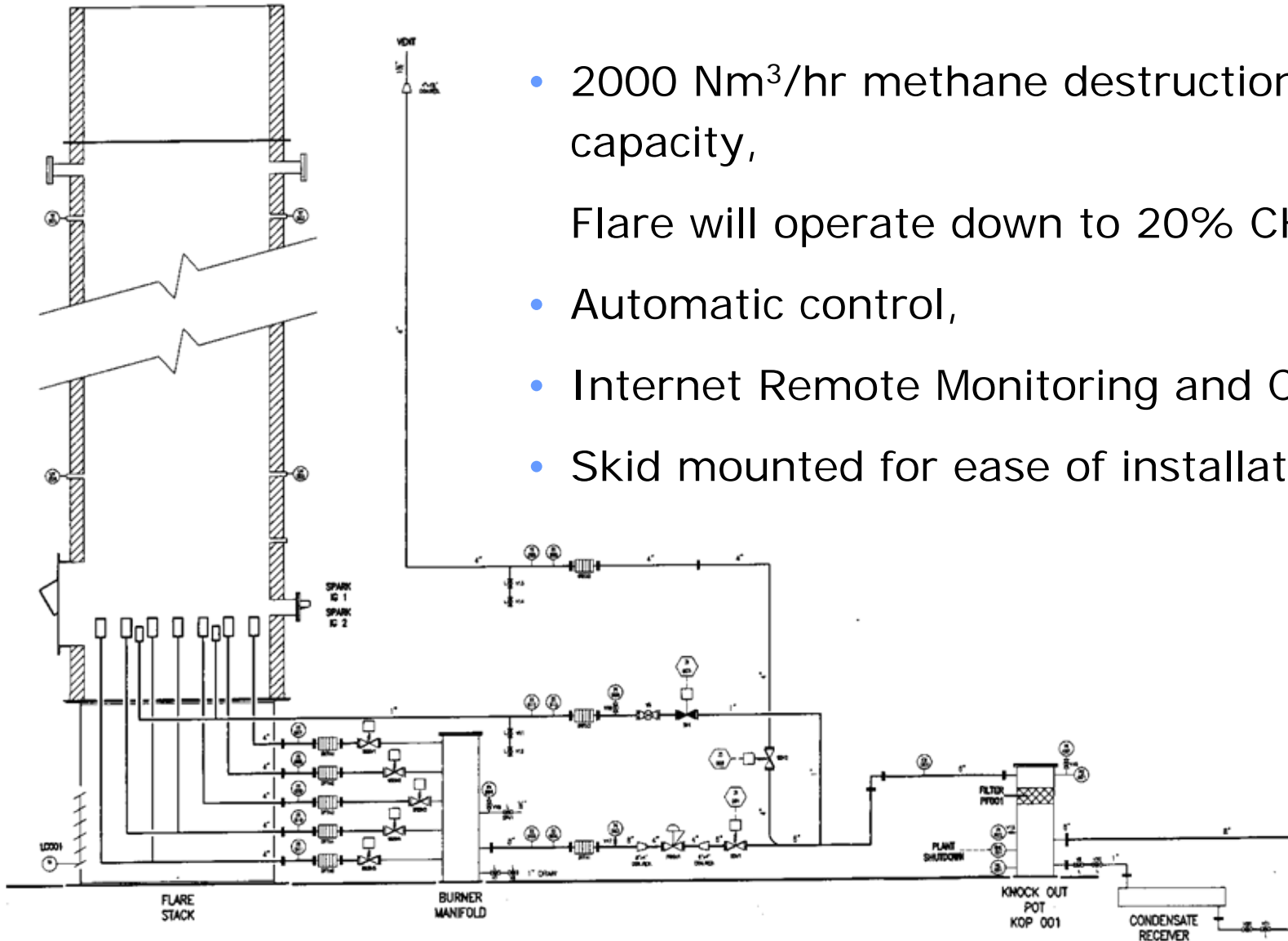
A low cost technology with a short manufacture and installation lead time

Simple and reliable to operate, gas flaring offers a very high potential for significant GHG reduction

Low maintenance requirements



CMM Destruction Technology – Gas Flaring



- 2000 Nm³/hr methane destruction capacity,
Flare will operate down to 20% CH₄,
- Automatic control,
- Internet Remote Monitoring and Control,
- Skid mounted for ease of installation.

CMM Utilisation Technology – Gas Boilers

This technology destroys the drained CMM through combustion in a gas fired boiler.

Benefits:

A low cost technology with a short manufacture and installation lead time.

Low maintenance requirements.

Installation Requirements:

- Suitable flame arrestor technology installed to prevent flame propagation.
- A gas fired boiler rated at 10,000 kg/hr requires methane at a concentration purity of 27% or above.



CMM Utilisation Technology – Gas Generators

This technology destroys the drained CMM through combustion in a reciprocating gas generator set to produce electricity

Benefits:

A highly efficient method of generating useful energy from CMM

A significant reduction in the overall electrical import of the mine can be realised

Installation Requirements:

A commitment must be made to ensure the required service and maintenance is carried out on the generator sets. This, together with high purity CMM supply will ensure high availability

A reciprocating gas generator rated at 1.4 MWe requires a methane pure flow of 100 normal litres per second at 25% concentration or above

Suitable technology installed to prevent flame propagation into the mine

CMM Utilisation Technology – Gas Generators



Harworth Power currently operate 5 installations with a total electrical output of 30 MW. We achieve high availability on all of our generating equipment with an annual CO₂ abatement of 780,000 tonnes.

We have developed and evolved the design of our installations to obtain maximum efficiency and availability, even in the most challenging CMM capture environments.



CMM Utilisation Technology – Vocsidisers

Harworth Power installed megtec Vocsidiser technology for the destruction of Ventilation Air Methane (VAM).

Requirements:

Vocsidiser technology can be used to destroy methane down to a purity of 0.2%.



Key Lessons

- Manage gas capture underground, make decisions, regulate suction, target drilling to the location of the gas
- Carefully consider ignition risks at the surface methane plant
- Ensure that gas is not drained at low concentrations

Design CMM utilization with appropriate dewatering and dirt removal equipment

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Thank you



Neil Butler

Technical Director

+44 (0)7979245874

nbutler@harworthpower.com