UNECE

Overview of Ventilation Characteristics, Practices, and Regulations in the U.S.

Poland ICE-CMM

Operating under auspices of the UNECE Group of Experts on Coal Mine Methane

Coal Mine Methane as a Valuable Energy Source

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RAVEN RIDGE RESOURCES INCORPORATED

History of the U.S. mining industry

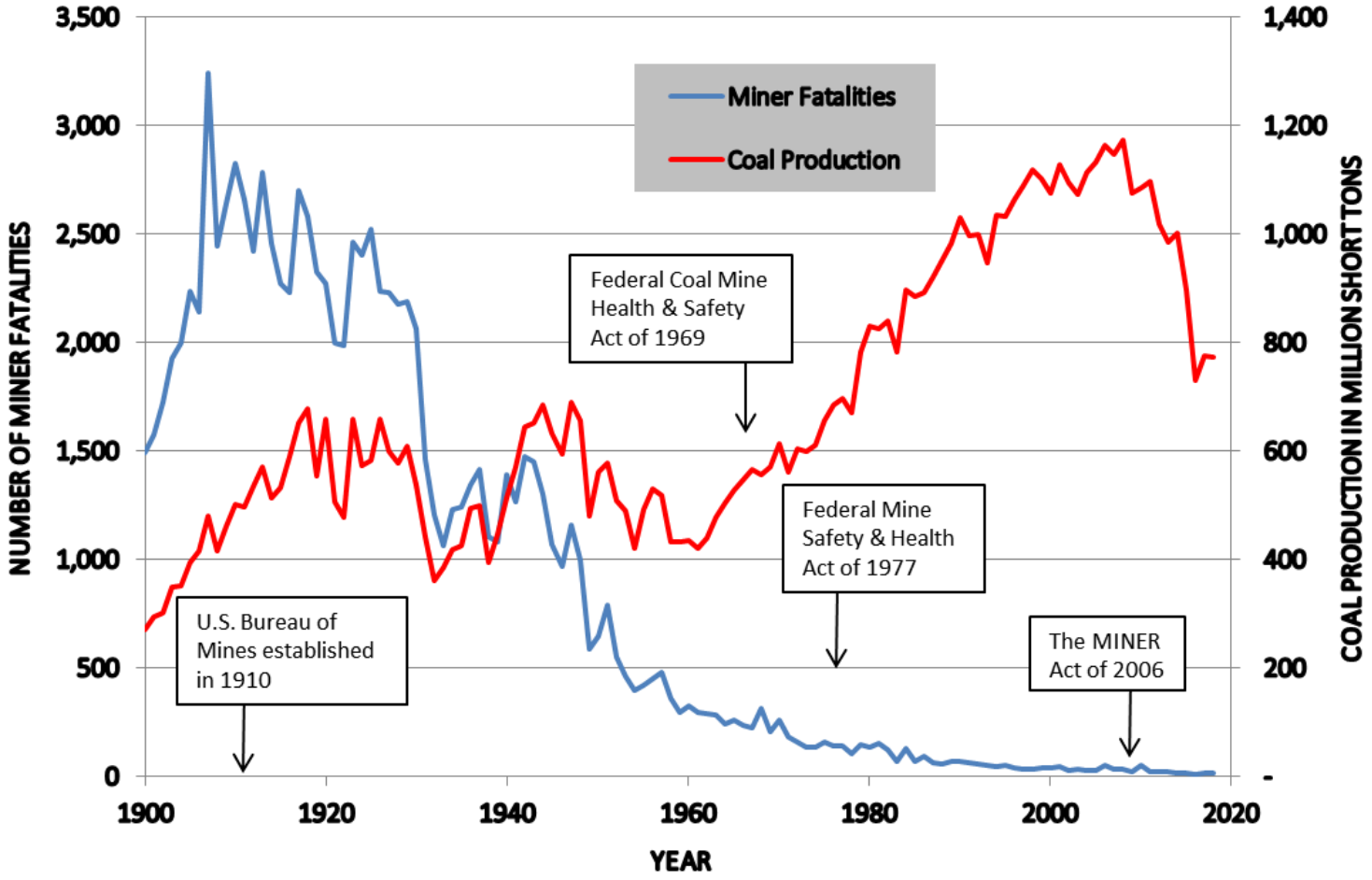
Regulation History of the U.S. Coal Industry

- *U.S. Bureau of Mines – Congress passed the Organic Act, which established the agency in 1910.*
- *Federal Coal Mine Health & Safety Act of 1969* – followed the No. 9 Mine explosion that killed 78 miners in West Virginia.
  - Mine Enforcement Safety Administration (MESA)
  - Inspections
  - No smoking or open flame sources
  - Ventilation plans
  - Training of miners
  - Separate splits of air
  - Air changes essential personnel only
  - Permissible equipment

Regulation History of the U.S. Coal Industry

- *Federal Mine Safety & Health Act of 1977*
  - Coal, metal & non-metal mines under single legislation
  - Separate health & safety standards for coal mining
  - MESA became MSHA
  - Mandated miner training
  - Mine rescue teams established for all underground mines
  - Increased involvement of miners
- *Miner Act of 2006*
- *Communications & tracking*
- *Civil penalties*

History of U.S. Mine Fatalities



Mine Safety & Health Administration (MSHA)

- *Mandatory Safety Standards for Underground Mines (30 CFR Part 75)*
  - Separate split of air to each section, exhaust to return
  - Main fan on surface with explosion proof installation
  - Minimum air quantities
  - Set methane limits and actions
  - Intrinsically safe, incapable of causing ignition of the most easily flammable mixture of methane or natural gas
  - All face equipment built & maintained to be permissible
  - Equipment and personnel charged with atmospheric monitoring must be certified

Mine Safety & Health Administration (MSHA)

- *Mandatory Safety Standards for Underground Mines (30 CFR Part 75)*
  - Fire suppression systems
  - Control of combustible materials
  - Seals, appropriately designed, installed, maintained and monitored
  - Ventilation plan approved by district manager
  - Escapeways
  - Maps
  - Communications & tracking
  - Oil and Gas wells

Mine Safety & Health Administration (MSHA)

- *Mandatory Safety Standards for Underground Mines (30 CFR Part 75)*
  - §75.325 prescribes the required minimum air quantity for different coal types and mine locations.
  - §75.326 mandates that a mean entry air velocity of at least 60 feet per minute must reach each working face.

Location within the Mine	Bituminous/Lignite Mines	Anthracite Mines
	Minimum Air Quantity (Cubic feet per minute)	
Working face where coal is being cut	3,000	1,500
Last open crosscut or end of pillar line	9,000	5,000
Longwall or shortwall mining systems	30,000	30,000

Methane and coal mining

Causes of Methane Explosions

- *Human Factors*
  - Ventilation duct at face not close enough
  - Use of scavenger system with inadequate overlap
  - Fan turned off
  - Ductwork leaky or pinched
  - Smoking
  - Methane monitor calibration
  - Equipment permissibility not maintained explosion proof
  - Gas checks not made prior to and during welding

Causes of Methane Explosions

- *Combination of Human Factors & Engineering Specifications*
  - Methane monitoring off or not present
  - No other warning system for excess gas
  - Engineering specifications
  - Ductwork undersized
  - Equipment not explosion-proof by design
- *Neither*
  - Cutter pick sparks

Preventions of Explosions

- Three Basic Elements
  - Main mine system of intake and return and sweep of working face with fresh air by line brattices or ventilation duct with fan
  - Regular monitoring of methane gas concentrations with action levels including equipment shut down
  - Ignition sources eliminated

Overview of U.S. mine ventilation practices

Ventilation Design

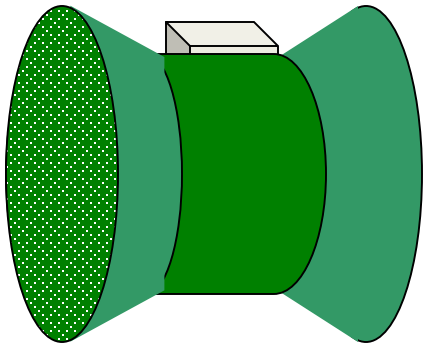
- Adequate if:
  - Ample dilution to safe levels. Methane emitted at high concentration levels reduced to as far below LEL as soon as possible.
  - Main ventilation system circulate air from the portal to sections. Main entries to circulate air at least one for intake and one for return. No duct work or booster fans in mains. Large quantities long distances.
  - Face ventilation system last hundred meters to face where coal is broken and removed.

Air Flow

- Low air velocities can lead to poor mixing between methane and air.
- Poor mixing leads to fluctuations in the methane concentration that makes ignition more likely.

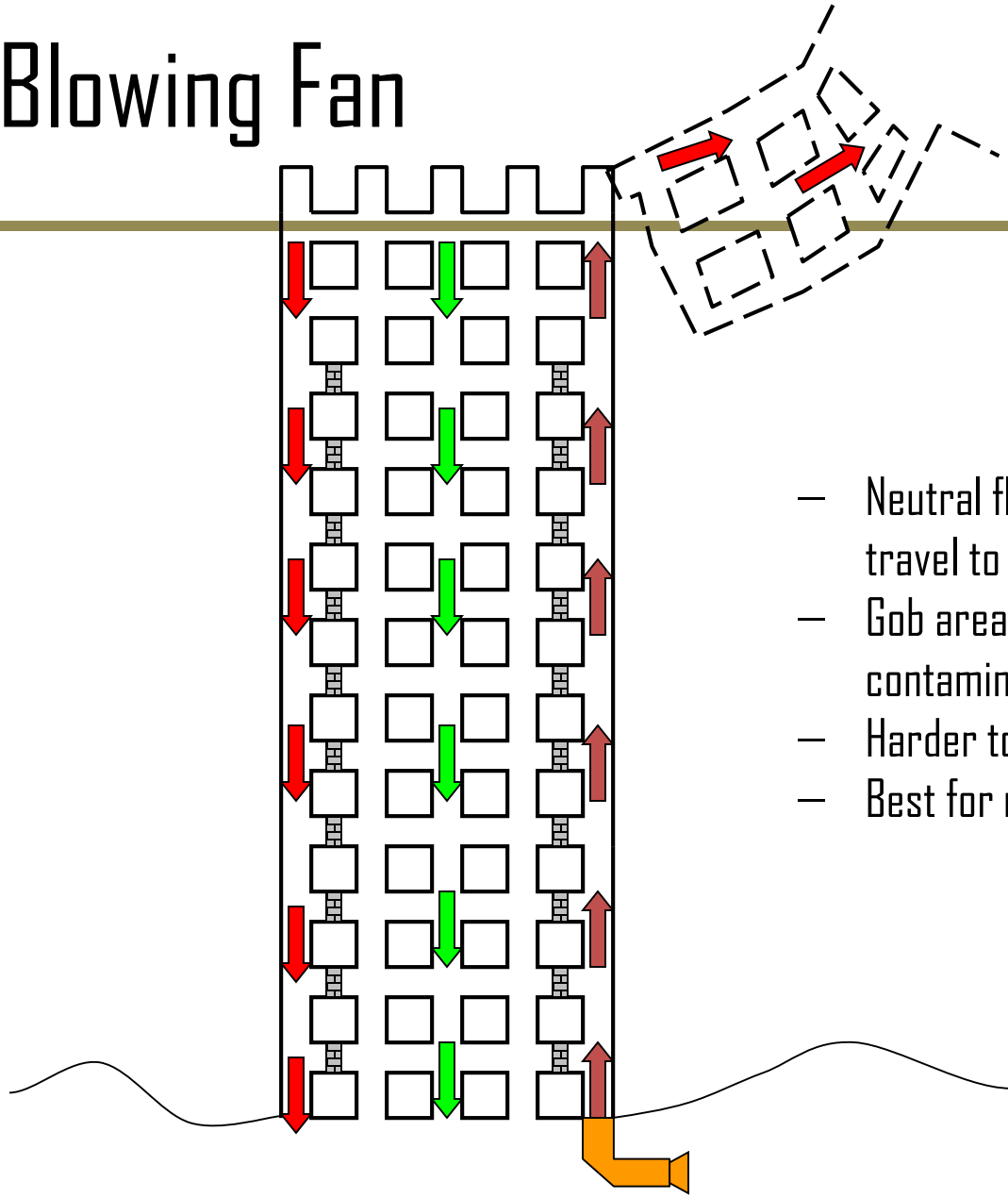
Air Flow

- Air always flows from a point of higher pressure to lower pressure



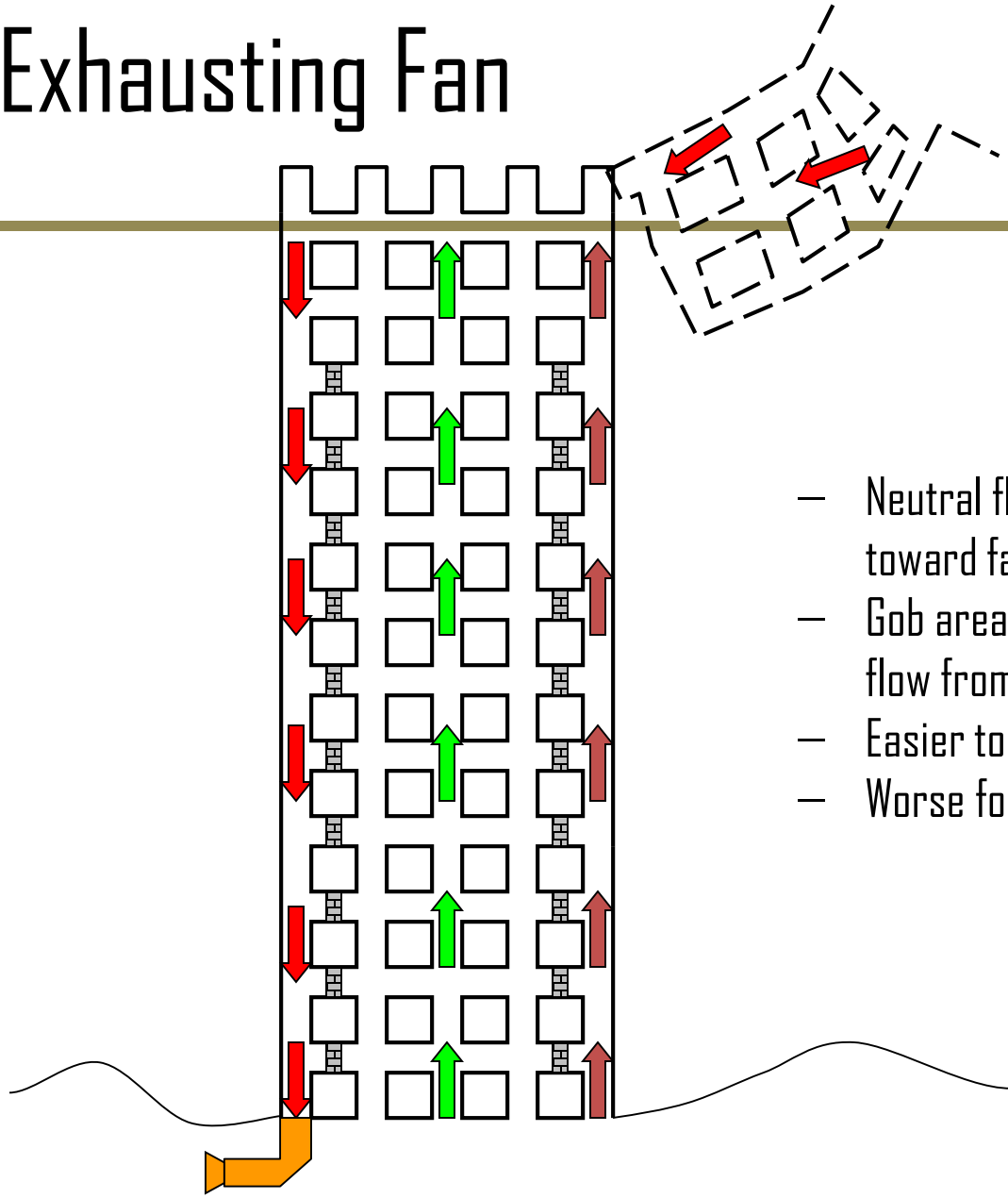
  - **Blowing fans** create a high pressure point immediately inby the fan. Air travels from this high point through the mine to the surface.
  - **Exhausting fans** create a low pressure point immediately inby the fan. Air travels from the surface through the mine to this low pressure point.

Blowing Fan



- Neutral flows to outside. Smoke will not travel to face area.
- Gob area is "pressurized". Less influx of contaminants from gobs until fan stops.
- Harder to maintain required LOC quantities.
- Best for mining near OLD WORKS.

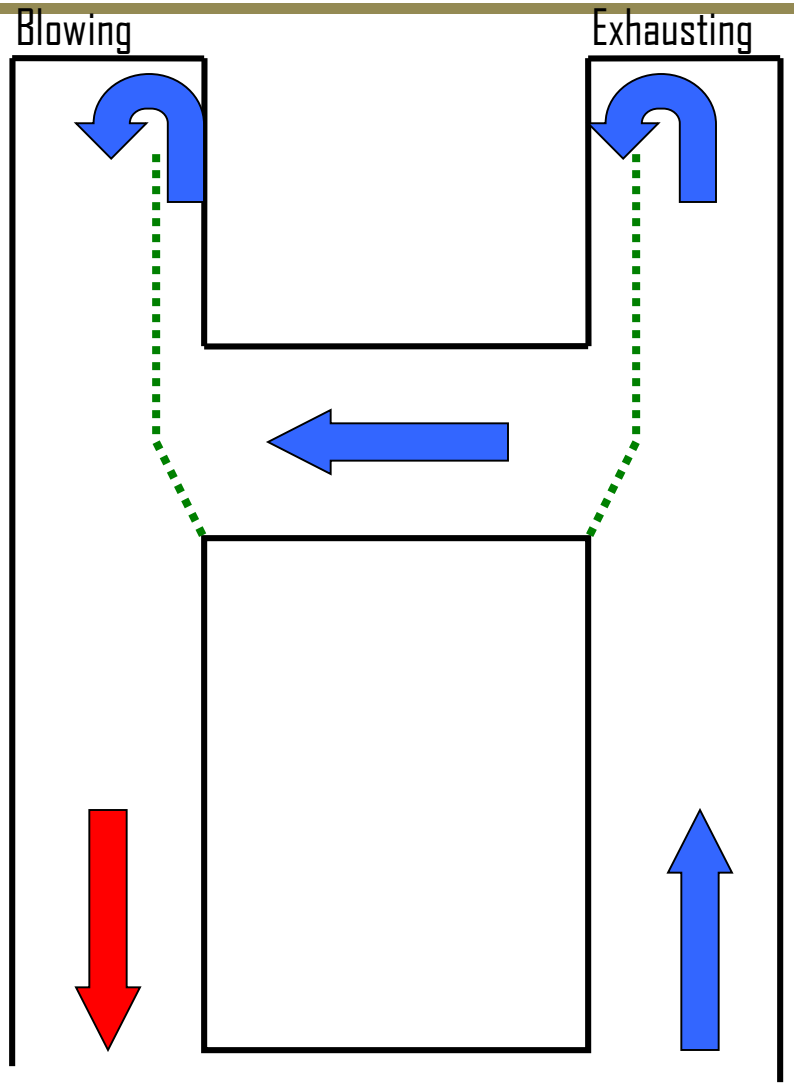
Exhausting Fan



- Neutral flows toward face. Smoke will travel toward face area.
- Gob area is "under suction". Contaminants flow from gobs until fan stops.
- Easier to maintain required LOC quantities.
- Worse for mining near OLD WORKS.

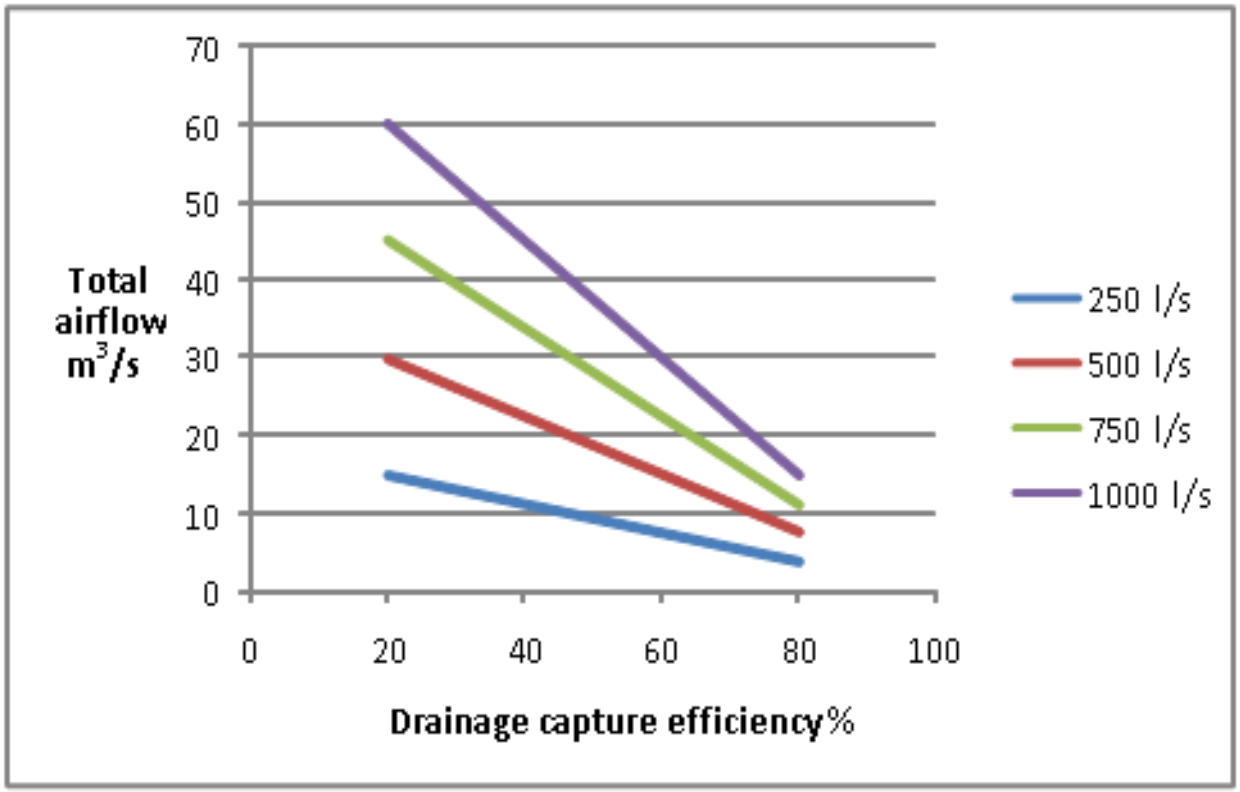
Face Ventilation

- Higher velocity at face.
- Best for gas.
- Worse for dust.



- Lower velocity at face.
- Worse for Gas.
- Good for Dust.

Airflows Required for Diluting Longwall Methane Emissions to 2%



Best practices

Best Practices for the Prevention of Mine Explosions

- Maximum 1% methane
- Single pass ventilation
- Prevention of face ignitions
- Bleeder systems
- Mine atmospheric and ventilation system monitoring including gobs for spontaneous combustion
- Dedicated ventilation officer

References

- Kissell, F.N., Jerry CJ Tien and Edward D. Thimons, "Methods for Controlling Explosion Risk at Coal Mine Working Faces"
- CFR Part 75: Title 30 Code of Federal Regulations, U.S. Printing Office, Washington DC
- MSHA.gov
- Patton, S., 2018, Best Practices in Effective Ventilation of Underground Coal Mines – U.S. Practices and Regulations, Workshop on Best Practices in Coal Mine Methane Capture and Utilization, Bogotá, Colombia, July 2018.

Dziękuję Ci I Gracias!

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