US MINE SAFETY REGULATIONS AND METHANE HAZARD PREVENTION

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ANKARA, TURKEY
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WORKSHOP ON BEST PRACTICES IN COAL MINE METHANE CAPTURE AND UTILIZATION

Global Methane Initiative

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HISTORY AND EXAMPLES OF COAL MINE REGULATION

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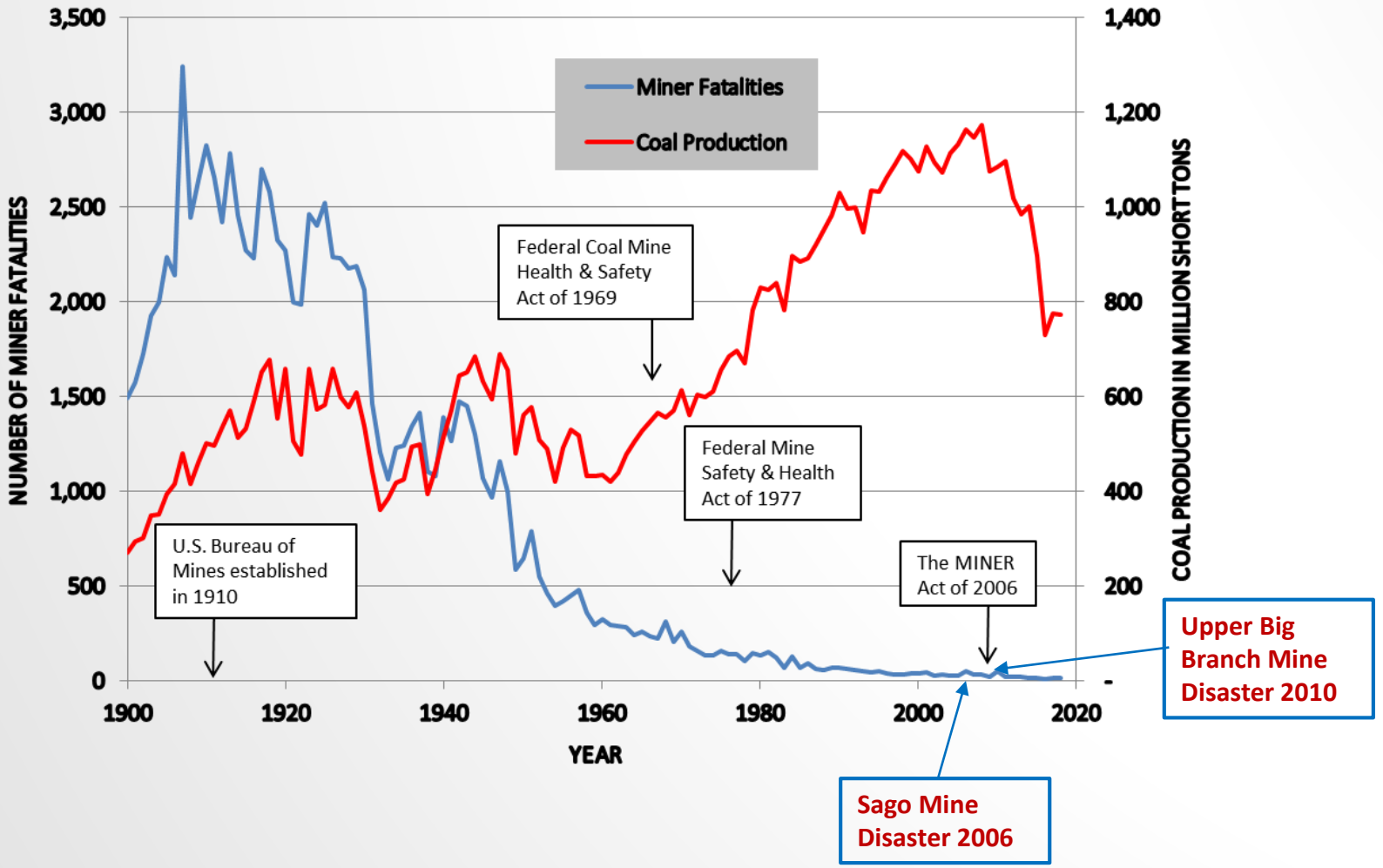
HISTORY OF U.S. MINE FATALITIES



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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

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 MSHA 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

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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

EXAMPLE: UPPER BIG BRANCH MINE

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UPPER BIG BRANCH MINE

- Located in Montcoal West Virginia, USA
- Operated by Performance Coal Company, was a former subsidiary owned by Massey Energy Company
- 5 April 2010 at 15:02 EDT a small methane explosion occurred quickly followed by a massive coal dust explosion
- 29 miners died making it the largest coal mine disaster in 40 years
- The disaster resulted in intensive investigations, prosecution of mine managers and the Chairman and CEO of Massey Energy

FINDINGS OF THE POST MINE DISASTER INVESTIGATIONS

- Investigations were conducted under the authority of the Federal Mines Safety and Health Act 1977 (Mine Act)
- Investigation based on interviews, data and information gathered at the site determined that:
  - Miners died in massive coal dust explosion that started as a methane ignition transitioned into a methane explosion and followed by a massive dust explosion
  - The disaster was the result of:
    - Basic safety violations
    - Unreported and disregarded hazards
    - Unlawful policies and practices
  - **The disaster was entirely preventable**

WHAT WERE THE UNDERLYING CAUSES OF THE DISASTER?

- The methane ignition and ensuing explosion would not have occurred if the longwall shearer was maintained in safe condition—the bits on the rotating drum were worn and the water spray was missing or functioning poorly
- Methane concentration was not measured properly, therefore there was no opportunity to prevent or contain the methane ignition
- The MSHA approved ventilation and roof control plans were not followed, so fresh air flow was impeded by a roof fall; volume and velocity of air flow was unreliable and changed direction frequently
- Float coal dust, coal dust, and loose coal was allowed to accumulated—rock dust was not sufficiently applied to suppress fire and explosion
- Regular pre-shift, on shift, and weekly inspections for hazards and follow-up remediation did not take place

BEST PRACTICES

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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
- Miners empowered to report unsafe conditions and protected from retribution
- Dust control

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.

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