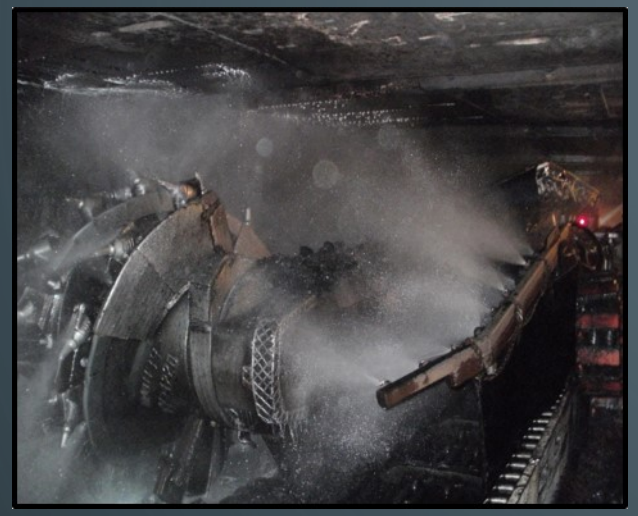
DESERADO MINE
BLUE MOUNTAIN ENERGY

DIESEL TECHNOLOGY WORKSHOP

CURRENT BARRIERS TO DEPLOYMENT OF TECHNOLOGIES



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BARRIERS OF PROPOSED REGULATIONS/TECHNOLOGY

- Current Underground Technologies for DPM
- Light Duty and Tier 4 Technology
- DPM in Underground Coal
- Cost of Tier 4 Technology

CURRENT TECHNOLOGY UNDERGROUND

- 3 Types of Equipment: Permissible, Heavy Duty, Light Duty
- Permissible – Scoop(s) - Dry Systems Technology

CURRENT TECHNOLOGY UNDERGROUND

- Heavy Duty – ASV Skid Steer, Getman Haul Trucks, Boom, and Grader
- DPM – Air Flow Catalyst System – Engine Control System

CURRENT TECHNOLOGY UNDERGROUND

- Current DPM Systems For Large Underground Equipment
  - DPM Systems Already Approved
  - Current Systems – Efficient
  - Easy to Maintain for Both Equipment Operators and Maintenance Personnel

LIGHT DUTY

- Dodge Ram 2500, Welders

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Tier 4 Technology vs Light Duty Pickups

  Passive regeneration occurs during normal driving whenever conditions are right to "burn" the particulates in the filter. This typically occurs during long periods of highway driving.

  Active regeneration occurs once a predetermined filter capacity has been reached. At this point, the engine will release fuel into the exhaust stream, allowing temperatures to be reached such that particulate mater in the filer will be burned off.

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Tier 4 Technology vs Light Duty Pickups
  - Approved Underground Cummins Engines are De-Rated and Governed to 25 MPH
  - Engines Run at a Fraction of Their Rated Power
    - Our Study – 2005 Dodge Ram 2500, Cummins 5.9L
      - 0-10% Load - 34.9%
      - 11-20% Load - 14.1%
      - 21-30% Load - 8.9%
      - 31-40% Load - 3.8%
      - 41-50% Load – 3.6%
      - 51-60% Load – 3.5%
      - 61-70% Load – 2.1%
      - 71-80% Load – 1.5%
      - 81-90% Load – 1%
      - 91-100% Load – 2.3%

> 34.9 % Engine Run Time – 0-10% Engine Load

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Tier 4 Technology vs Light Duty Pickups
  - Always in Active Regeneration
  - Overcoming Current System for Regeneration Process
  - Technical Side of the Regeneration Process
  - Temperatures of the Regeneration Process

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Temperatures
  - Tier 4 Technology is based on heat to decrease DPM
    - U.S. Department of Agriculture – Forest Service (Diesel Exhaust Emission System Temperature Study
    - https://www.fs.fed.us/eng/pubs/pdf/08511816.pdf - 5100 Fire Management 085101816 – SDTDC December 2008

Table 1. Average maximum temperatures along the exhaust system.

Maximum Measured Temperature	Average Temperature (°F)	
	DPF Equipped	Non-DPF Equipped
Exhaust gas inside tailpipe	757	416
Exhaust gas outside tailpipe	695	396
Exhaust gas before exhaust cooler	1,089	~
Diesel particulate filter	494	~
After diesel particulate filter	707	~
Before diesel oxidizing catalyst	557	416
Diesel oxidizing catalyst	497	264

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Temperatures
  - Coal Dust Explosion Hazards – Clete R. Stephan P.E. – Mine Safety and Health Administration Pittsburgh, Pennsylvania - https://pdfs.semanticscholar.org/c050/3cda4f235e9ab14fd92d196baa12be4fd985.pdf

Minimum Ignition Temperature of Coal Dust Layers

Coal Rank or Type	Min. Ignition Temp (C)	Min. Ignition Temp (F)
Pittsburgh Seam Bituminous	170 C	338 F
Rhode Island (Cranston) Anthracite	520 C	968 F
Illinois No. 7 Bituminous	160 C	320 F
Pocahontas Seam Bituminous	220 C	428 F

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Temperatures
  - 30 CFR 7.101(b) Surface temperatures of any external surface of the diesel power package shall not exceed 302 F
  - 30 CFR 7.102(b)(1)&(2) Exhaust Gas Cooling Efficiency Test
    - Exhaust gas temperature at discharge from a wet exhaust conditioner before the exhaust gas is diluted with air shall not exceed 170 F
    - Exhaust gas temperature at discharge from a dry exhaust conditioner before the exhaust gas is diluted with air shall not exceed 302 F
  - 30 CFR 18.23 – Electric Motor-Driven Mine Equipment and Accessories - Limitation of external surface temperatures 302 F

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Temperatures

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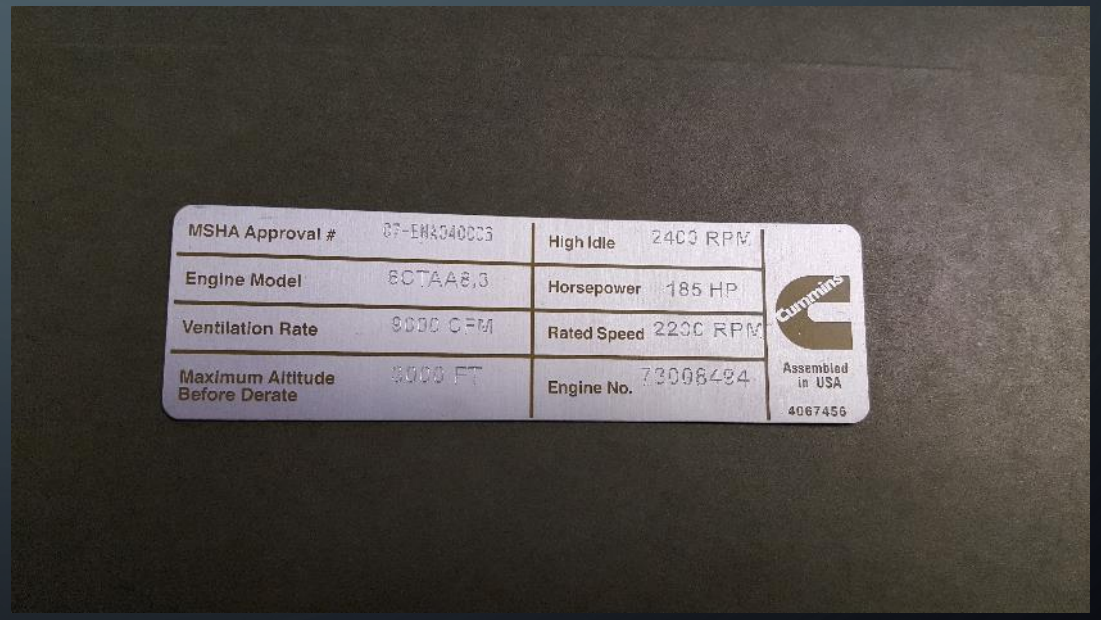
BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- DPM in Underground Coal
  - Already Have Requirements – 2.5 Grams/Hour (Heavy Equipment), 5 Grams/Hour (Light Duty)
  - Limited data or studies of DPM in the underground coal environment
  - Underground Coal and Ventilation Requirements
    - 8000 CFM – Dodge Truck
    - 8500 CFM – Getman Hauler
    - 9000 CFM – Wagner Scoop
    - 4500 CFM – Skid Steer



BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Cost of Proposed Technology
  - Permissible and Heavy Duty Equipment – Redesign Equipment
  - Light Duty - Pickups
    - No Supplier to Retrofit Current Fleet to Tier 4
    - Replace Current Fleet
      - Current Fleet 42 Pickups
        - $45,000 (New Truck), $10,000 (MSHA REGS/BODY WORK), $12,000 (Fire Suppression)
        - $67,000 x 42 = $2,814,000
  - Maintenance Cost
    - Labor Maintaining System
    - Parts – DPM Filters $3,500
    - Training

BARRIERS TO PROPOSED REGULATIONS/TECHNOLOGY

- Summary
  - Permissible and Heavy Duty Equipment – Current DPM System Works
  - Light Duty – Tier 4 Technology (High Maintenance)
    - Temperatures Underground
  - Lack of Data and Cost

THANK YOU…