pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF MINE SAFETY

80A

April 5, 2012

Mr. Jim Coe
BUCYRUS
4041 Wurno Road
Pulaski, Virginia 24301

RE: CAT (Bucyrus) Model 488D Un-A-Trac diesel scoop utilizing the Cummins QSB6.7 engine (MSHA Approval 07-ENA060010 @ 193 HP) derated to 170 HP and a Dry System Technologies DST Model M30 Emissions Control System.

Dear Mr. Coe:

Chapter 4 of the "Bituminous Coal Mine Safety Act" (the Act) provides for the use of diesel-powered equipment in underground bituminous coal mines. Section 424 of the act created a Technical Advisory Committee ("TAC") for the purpose of advising the Department regarding implementation of Chapter 4 and evaluation of alternative technology or methods for meeting the requirements of Chapter 4.

On November 8, 2011 CAT (Bucyrus) submitted a request to the Bureau of Mine Safety (BMS) for approval for a Model 488D Un-A-Trac diesel scoop utilizing the Cummins QSB6.7 engine (MSHA Approval 07-ENA060010 @ 193 HP) derated to 170 HP and a Dry System Technologies DST Model M30 Emissions Control System.

The Director of BMS requested the TAC to evaluate the CAT Model 488D Un-A-Trac diesel scoop utilizing the Cummins QSB6.7 engine (MSHA Approval 07-ENA060010 @ 193 HP) derated to 170 HP and an Dry System Technologies DST Model M30 Emissions Control System and to advise the Department regarding the TAC's recommendation as to whether the referenced equipment meets requirements of Section 403 of the Act. The engine and emissions control package was previously approved by the Department at 193 HP rating and assigned a BOTE-DEES 8-08.

The diesel power package includes the following items:

- Cummins QSB6.7 engine (MSHA Approval 07-ENA060010 @ 193 HP) (Part 7) and derated to 170 HP
- Emissions Control System DST Model M30 Management System

More detailed information on the specifications of the diesel power package is included on the General Specification Sheet which is attached as Attachment 1.

On January 3, 2012 the TAC traveled to Emerald Mine shop to inspect the equipment when it became available. The TAC evaluated the engine and exhaust emissions package.

Emissions testing of the engine and after-treatment system were performed, as well as exhaust gas temperature monitoring and stall test procedure. The results of the emission tests showed the engine was performing within MSHA's approval specifications.

Monitoring of the exhaust gas temperature performed by DEP produced a high exhaust gas temperature reading of 170° F, which is well below the 302° F allowed by Section 403 (b)(4) of the Act. It is our belief that the heat exchanger will maintain the exhaust gas temperature well below the required 302 ° F. The maximum surface temperature observed was 280° F on the exhaust manifold after conducting all the CO testing. There was a small area on the black polyamide coating that measured above 302° F, but that area will be reinsulated by CAT to eliminate the problem.

The after-treatment system is fitted with a DST M30 DPM filter. The filter is rated by MSHA at a 96 % efficiency rating. The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of 0.044 mg/m3 of diesel particulate matter when diluted by 100% of the MSHA approval plate ventilation rate for this engine, which is well below the 0.12 mg/m3 requirement of Section 403 (a)(1) the Act. (Attachment 2)
The design and configuration of the exhaust pipe system beyond the flame arrestor included 3 bends and pipe that extended over 18 inches from the flame arrestor to the discharge. This configuration is addressed by the Director in a directive to industry titled "Directive on Diesel Powered Equipment Flame Arrestors" dated August 17, 2004. This directive, derived from a previous TAC investigation and recommendation, provides for additional safety requirements that must be followed and are included in our recommendation.

In addition to the testing that was conducted, our investigation and our observations confirmed that the diesel power package is capable of meeting all the requirements of Section 403 of the Act.

Our recommendation is based upon the data supplied by CAT (Bucyrus), the results of the tests conducted on January 3, 2011, as well as the data acquired and observations made during our investigation. The TAC has determined that the Cummins QSB6.7 engine (MSHA Approval 07-ENA060010 @ 193 HP) derated to 170 HP and a Dry System Technologies DST Model M30 Emissions Control System meets all requirements of Section 403 of Chapter 4 of the Pennsylvania Bituminous Coal Mine Safety Act. As such, we are recommending approval of the above described diesel power package. This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

Based on the design and configuration of the exhaust pipe beyond the flame arrestor on the CAT 488D Un-A-Trac, the TAC recommends that the additional safety precautions identified in the "Directive on Diesel Powered Equipment Flame Arrestors" dated August 17, 2004 be included. (Attachment 3)

If you have any questions on this request, please contact Joseph Sbaffoni at jsbaffoni@pa.gov or at 724-439-7461.

Sincerely,

Joseph A. Sbaffoni
Director
Bureau of Mine Safety

cc: Bowersox
Borchick

Enclosure(s)

JAS/cd

bcc: Antoon
Gaida
Elias (web)
Dunn/TAC file

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Pennsylvania Technical Advisory Committee
On Diesel Powered Equipment

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January 10, 2012

JAS
ALM
Antzon
Gaida
dum/original

Joseph Sbaffoni, Director
Bureau of Mine Safety
Fayette County Health Center
100 New Salem Road, Room 167
Uniontown, Pa. 15401

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Background

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Investigation

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Emissions testing of the engine and after-treatment system were performed, as well as exhaust gas temperature monitoring and stall test procedure. The results of the emission tests showed the engine was performing within MSHA's approval specifications.

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Recommendation

Our recommendation is based upon the data supplied by CAT (Bucyrus), the results of the tests conducted on January 3, 2011, as well as the data acquired and observations made

during our investigation. The TAC has determined that the Cummins QSB6.7 engine (MSHA Approval 07-ENA060010 @ 193 HP) derated to 170 HP and a Dry System Technologies DST Model M30 Emissions Control System meets all requirements of Section 403 of Chapter 4 of the Pennsylvania Bituminous Coal Mine Safety Act. As such, we are recommending approval of the above described diesel power package. This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

Based on the design and configuration of the exhaust pipe beyond the flame arrestor on the CAT 488D Un-A-Trac, the TAC recommends that the additional safety precautions identified in the "Directive on Diesel Powered Equipment Flame Arrestors" dated August 17, 2004 be included. (Attachment 3)

Paul Borchick

Ron Bowersox

Dry Systems®
Technologies

Technology for a cleaner environment

MODEL M335 EXHAUST SYSTEM

General Specifications of the DST Exhaust Treatment System

Engine	Cummins QSB6.7
Horsepower	193 HP
Rated Speed	2200 RPM
Manufacturer's Maximum Exhaust Back-pressure	41 inches Water Gauge
MSHA Approval	07-ENA060010
MSHA Ventilation Rate	8500 CFM
MSHA Weighted Particulate (DPM)	16.05 gr/hr (267.50 mg/min)
Ambient DPM Exposure	0.044 mg/m^3
Catalyst	DST – P/N M295-225-02
Heat Exchanger	DST - P/N M190-301-01
Exhaust Filter	DST – P/N M30-411-01R (96% efficient)

10420 Rising Court • Woodridge, IL 60517 • 630-427-2051 • FAX 630-427-1036
www.drysystemstech.com

ATTACHMENT 1

Dry Systems® Technologies

Technology for a cleaner environment

AMBIENT DPM CALCULATION SHEET

Engine Model	Cummins QSB6.7
MSHA Number	07-ENA060010 (193 HP)
Ventilation Rate	8,500 CFM
DPM (Weighted)	16.05 g/hr
Filter Type	Dry System Technologies Model M30
Filter Efficiency	96%

CONVERT DPM FROM (grams/hr) to (mg/min)

(16.05 g/hr) X (1hr/60 min) X (1,000mg/g) = 267.50 mg/min

CONVERT VENTILATION RATE FROM (CFM) TO (m^3/min)

(8,500 ft^3/min) X (.028315 m^3/ 1ft^3) = 240.68 m^3/min

DIVIDE DPM (mg/min) BY VENTILATION RATE (m^3/min.)

(267.50 mg/min) ÷ (240.68 m^3/min) = 1.111 mg/m^3

SOLVE FOR AMBIENT DPM LEVEL AT 96% FILTER EFFICIENCY

1.111 mg/m^3 X (100% - 96% Filter Efficiency) = **0.044 mg/m^3**

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ATTACHMENT 2

RE: Directive on Diesel-Powered Equipment
Flame Arrestors

The Bureau of Mine Safety is issuing the following **directive** for guidance concerning diesel-powered equipment as referred to in Chapter 4 of the Pennsylvania Bituminous Coal Mine Safety Act. A recent investigation of a flame exiting the flame arrestor of a piece of diesel-powered equipment has led to the following requirements:

- *During equipment design, exhaust piping and bends outby the flame arrestor are to be avoided when possible.*
- *Exhaust piping should not be installed outby an end-of-the-line flame arrestor if the pipes length exceeds 18 inches or contains more than one elbow which shall not exceed 45 degrees.*
- *Flame arrestors on all equipment must be checked for signs of failure at least every 500 hours.*
- *A pin gauge of the appropriate size of the triangular openings be used to check random openings that appear visually inconsistent with other openings. Should any separation of the flame arrestor cell from its housing or any openings exceed its approved size be found, replacement of the flame arrestor will be required.*
- *Unless approved otherwise, all flame arrestors must be as approved with .064-inch triangular openings.*
- *All flame arrestors be permanently marked or identified with the triangular opening size easily identifiable.*

For all systems where exhaust piping exceeding the above specification is required to be installed outby an end-of-the-line flame arrestor;

- *An additional temperature sensor must be installed as close as possible to the outby side of the flame arrestor. This sensor will shut down the engine at a maximum temperature of 350 degrees Fahrenheit.*
- *Exhaust piping must be cleaned as part of the 100-hour maintenance procedure and more often if excessive smoking of the material in the exhaust pipe is experienced*
- *For all future equipment approvals, the temperature sensor must be installed outby the filter assembly and outby the flame arrestor if possible, in an area that will capture total exhaust emissions.*

Additionally, if a fire or flame should be observed, the equipment should be shut down immediately. The canister for the dry paper filter should not be opened until the equipment has cooled down. If substantial burning of the paper filter is observed or

flames are observed exiting the flame arrestor or piping of any diesel powered equipment, the equipment should be immediately removed from service and the Bureau of Deep Mine Safety contacted so that an investigation can be conducted. All of the information above should be incorporated into the annual retraining program for each mine.

ATTACHMENT 3-2