Comparison Of Off-Road Specification EPA/CARB Passively Regenerated DPF To Mine Specification Passively Regenerated DPF

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Project Objectives

1) To determine which candidate DPF system had the lowest balance point temperature

2) To determine which candidate DPF system had the lowest NO2 make

3) To determine which candidate DPF system could be considered for CARB/EPA verification

4) To determine which candidate DPF system would also meet underground mine standards

Definitions

Balance Point Temperature (BPT):

BPT is determined by monitoring DPF back pressure and BPT is defined as the DPF temperature where the rate of PM collection equals the rate of PM oxidation

Test Engine

John Deere Diesel Engine

Model Number:	4039DF004
Horsepower:	58 hp @ 1800 rpm
Displacement:	3.9 liters (239 CID)
Exhaust flow:	305 ft^3/minute
Exhaust temp:	1040°F
Cylinders:	4 cylinder
Engine type:	Inline 4-cycle
Aspiration:	Natural

Test Instruments

DPM = Sierra Instruments BG2

NO/NO2/NOX
= CAI model 600HCLD
= Rosemount Analytical Model 955 Analyzer
= Beckman Instruments Model 955 Analyzer

CO/CO2/O2 = CAI model 602P

THC/NMHC = CAI model 600M HFID

Description Of Passively Regenerated DPF

System A – 3 components consisting of cordierite DOC, cordierite DPF and a cordierite NO2 suppression catalyst

System B – 2 components consisting of metallic DOC and cordierite DPF with NO2 suppression coating

System C – 2 components consisting of metallic DOC and silicon carbide DPF with high NO2 suppression coating

System D – 2 components consisting of metallic DOC and silicon carbide DPF with medium NO2 suppression coating

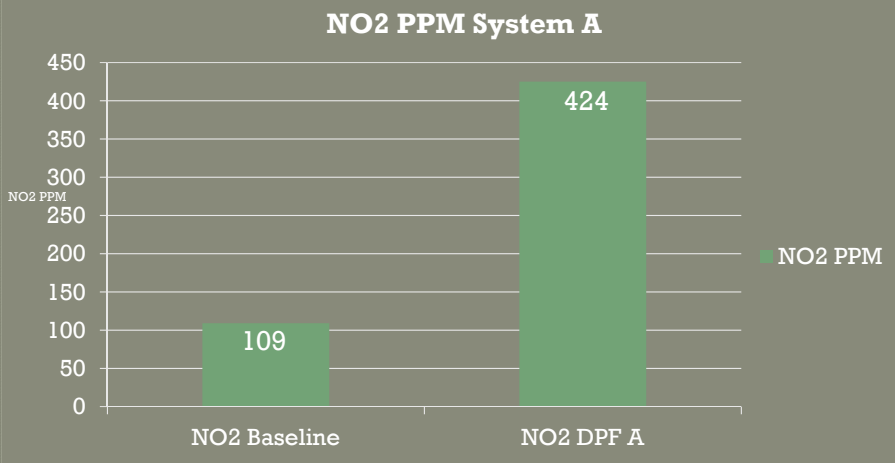
System E – 1 component consisting of cordierite DPF with low platinum loading

System F - 1 component consisting of cordierite DPF with NO2 suppression coating

System A – 3 components consisting of cordierite DOC, cordierite DPF and a cordierite NO2 suppression catalyst


DOC
DPF

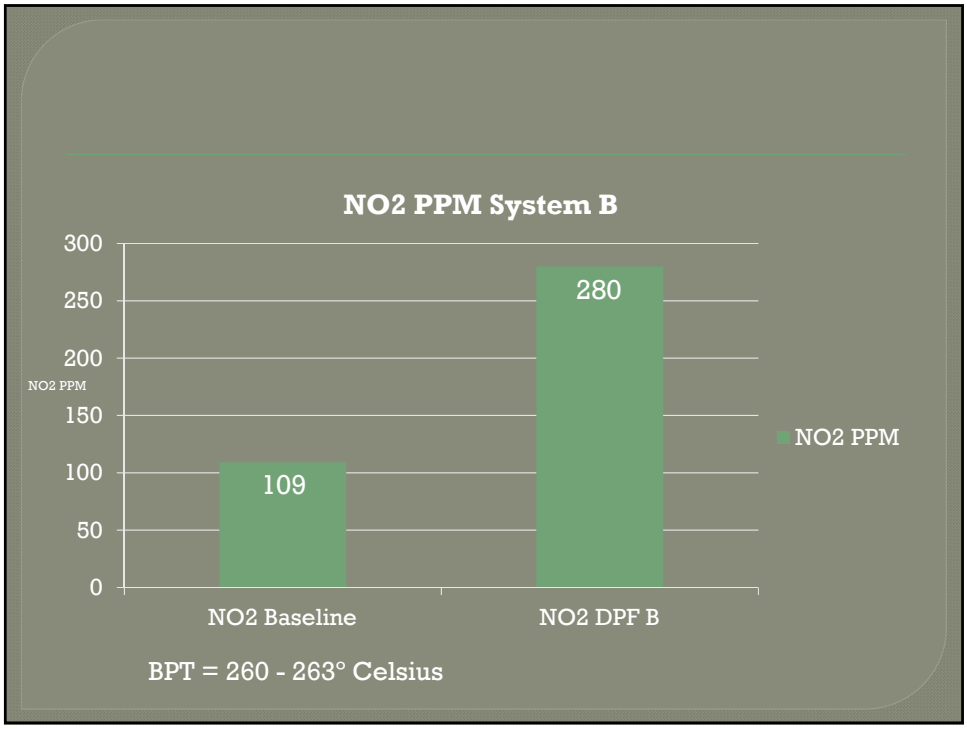

DPF



BPT = 317 - 324° Celsius


DOC
DOC
DPF

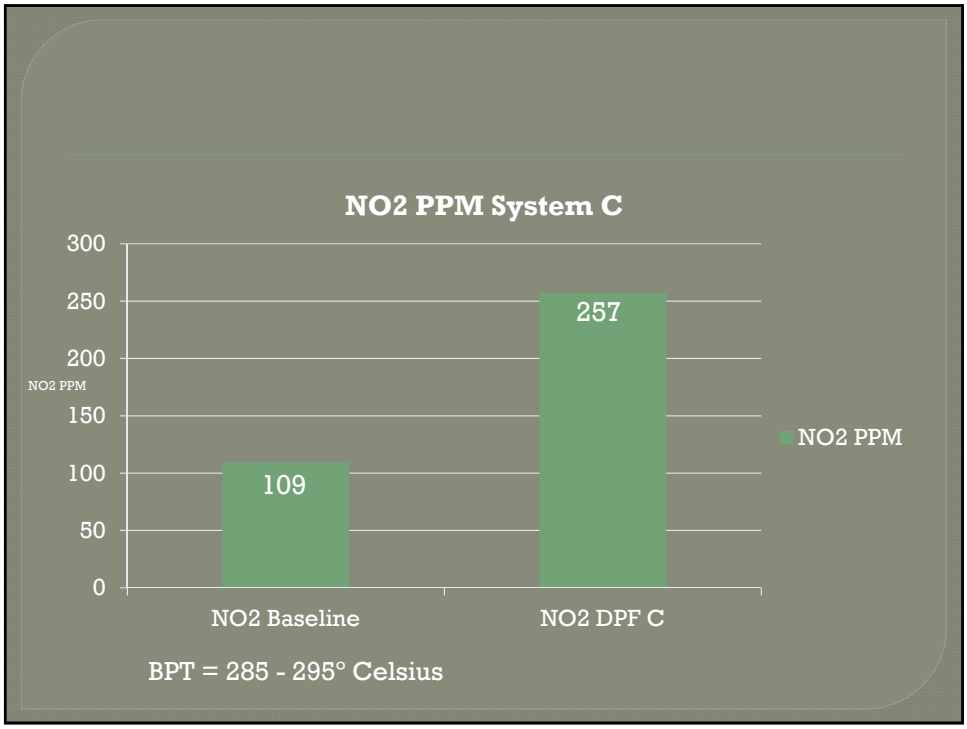

DOC
DPF


NO2 PPM System B
300
250
200
NO2 PPM
150
100
50
0
109
280
NO2 Baseline
NO2 DPF B
NO2 PPM
BPT = 260 - 263° Celsius


DOC
DOC
DPF
DOC
DOC
DPF


DOC
DPF

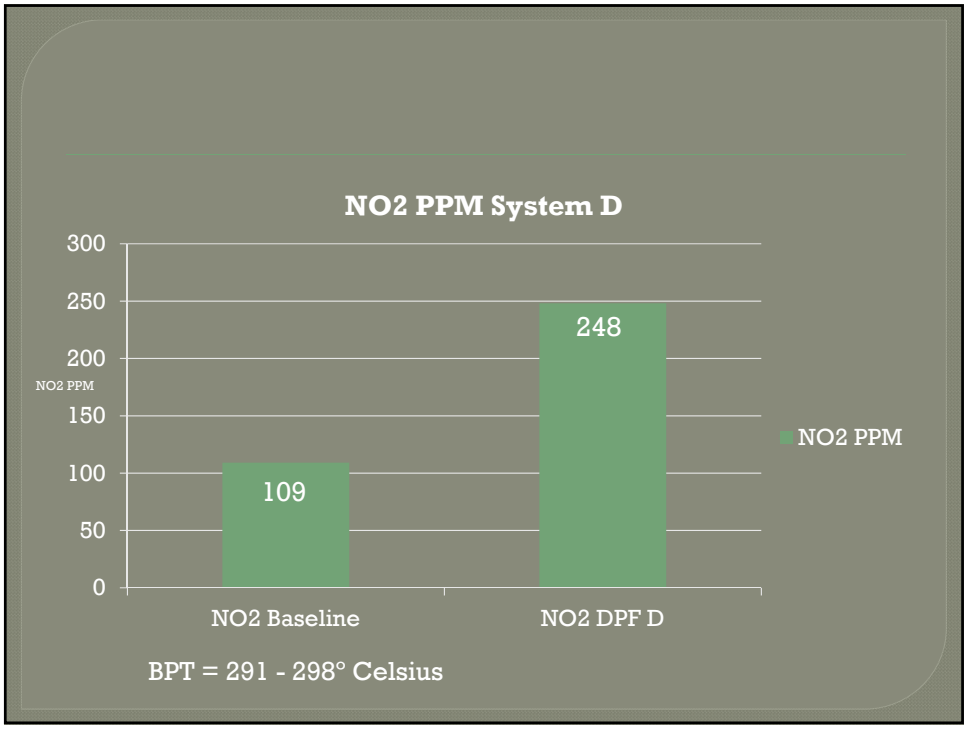

DPF


NO2 PPM System C
300
250
200
150
100
50
0
NO2 PPM
257
109
NO2 Baseline
NO2 DPF C
NO2 PPM
BPT = 285 - 295° Celsius


DOC
DOC
DPF
DOC
DOC
DPF
DOC DOC DPF

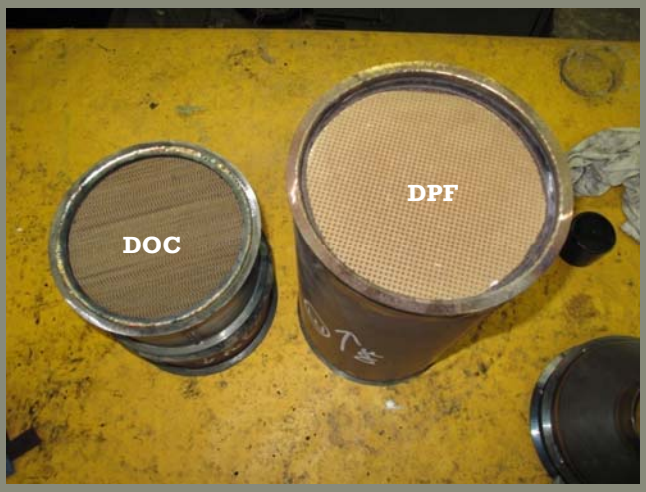

DPF
DOC
DPF

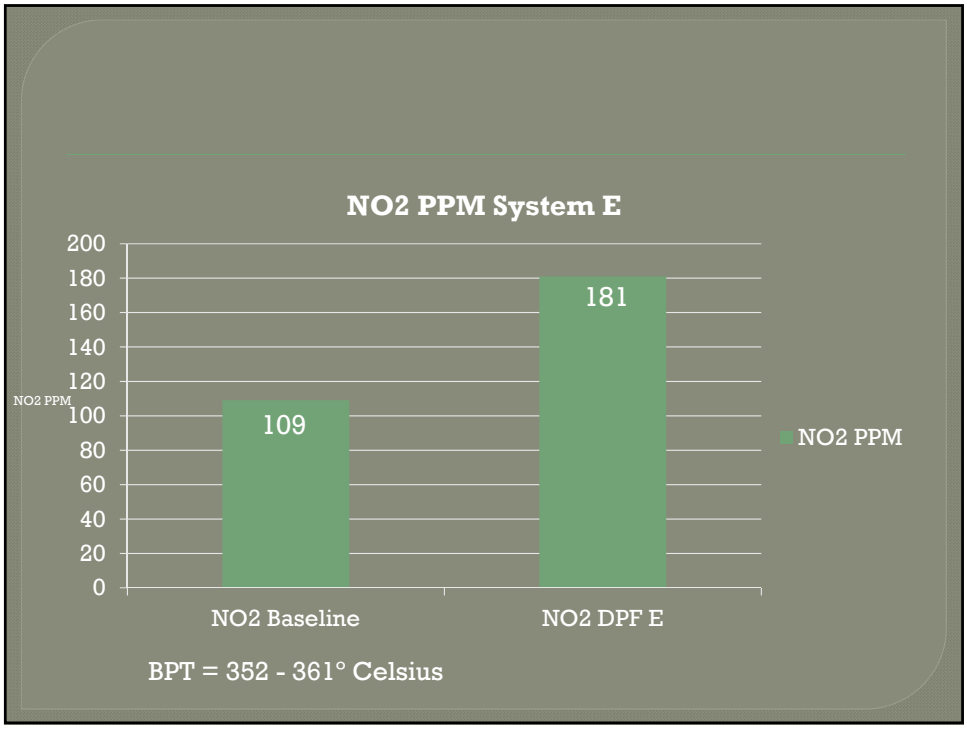

DPF
DPF



BPT = 291 - 298° Celsius

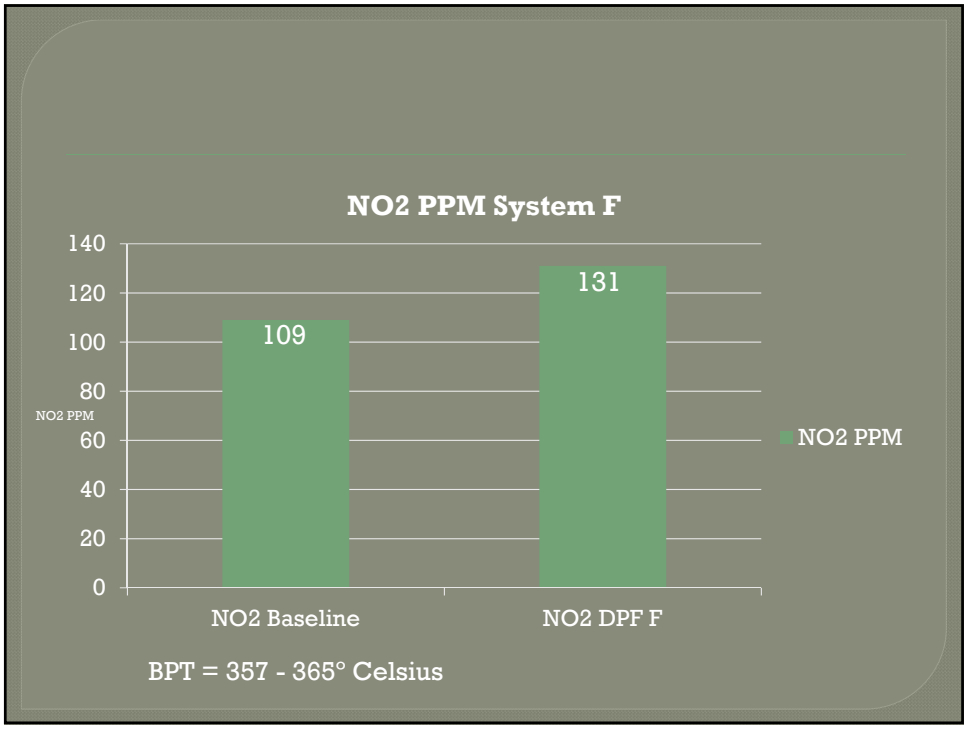

E
DPF

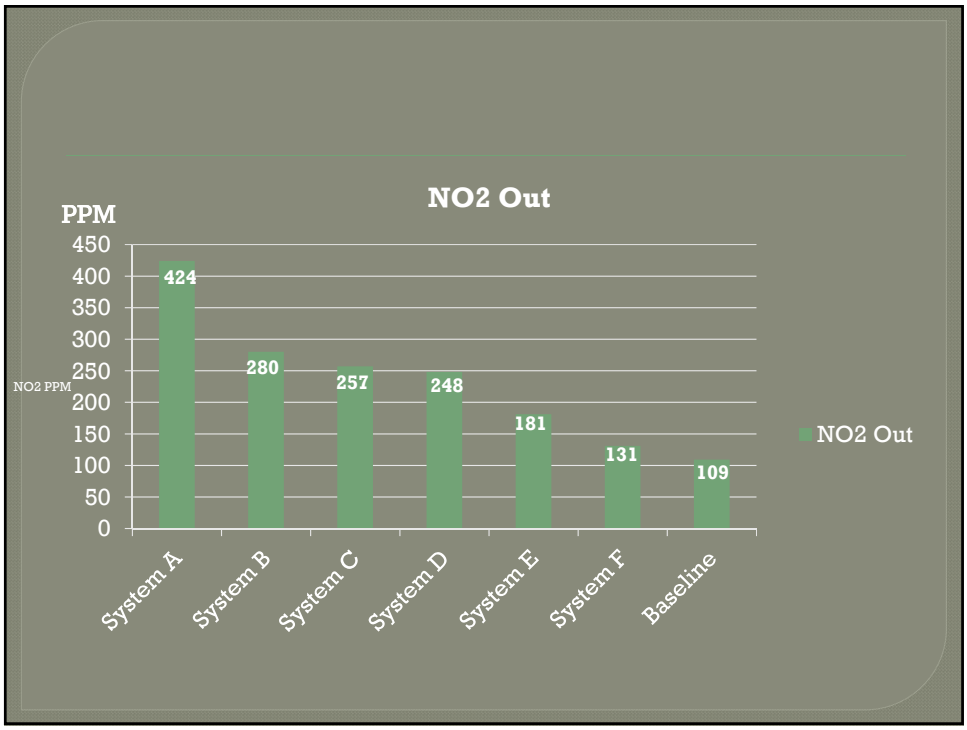

DOC
DPF

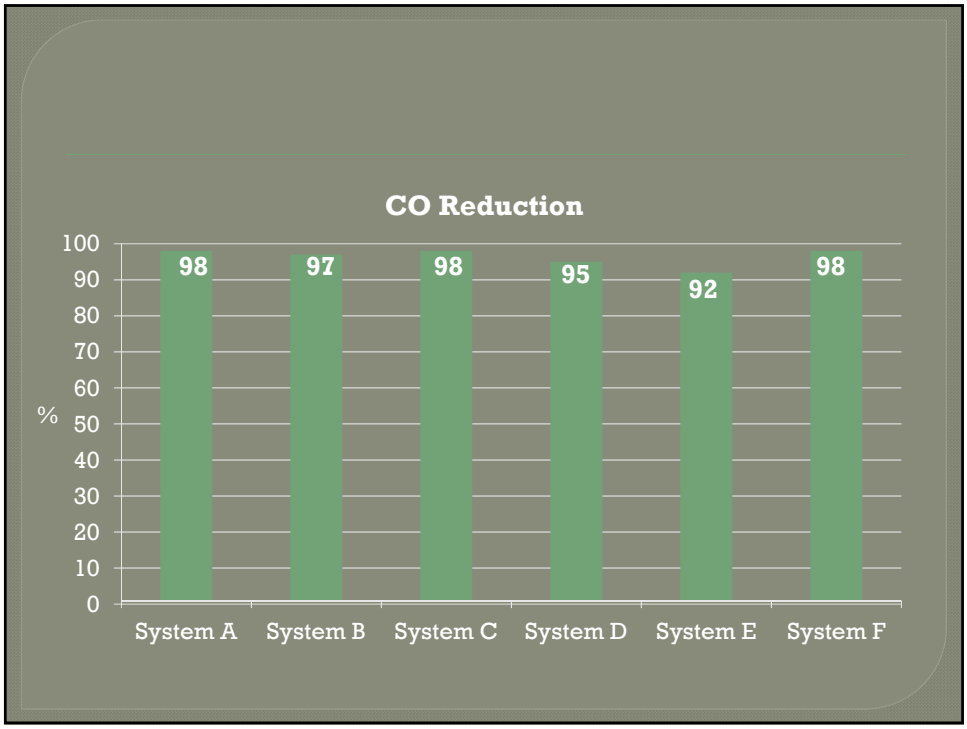


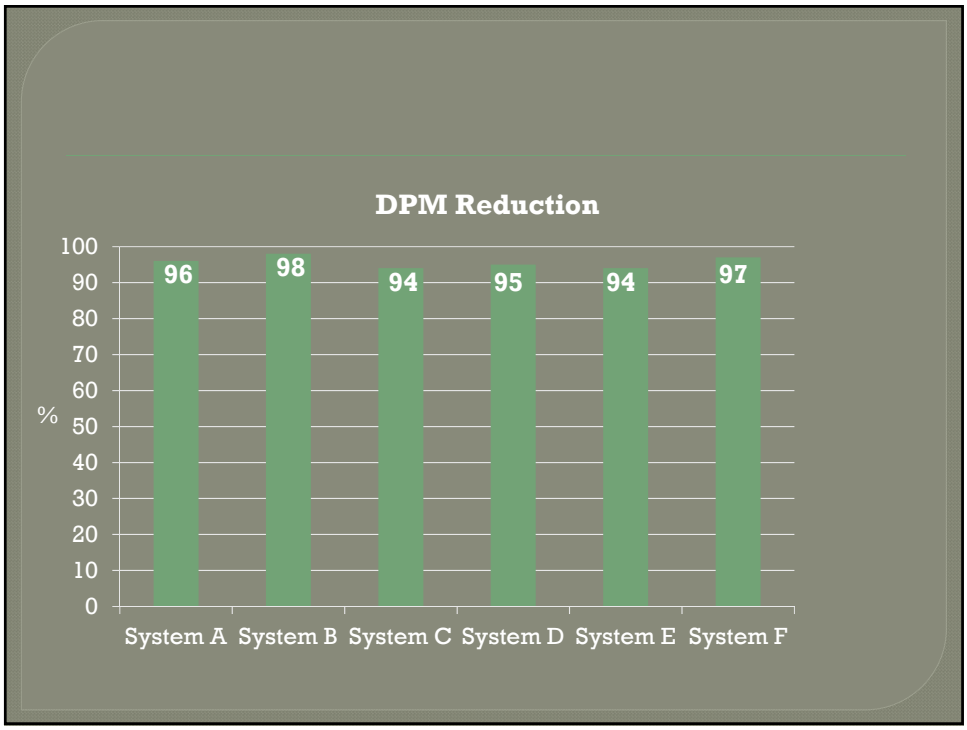
BPT = 352 - 361° Celsius

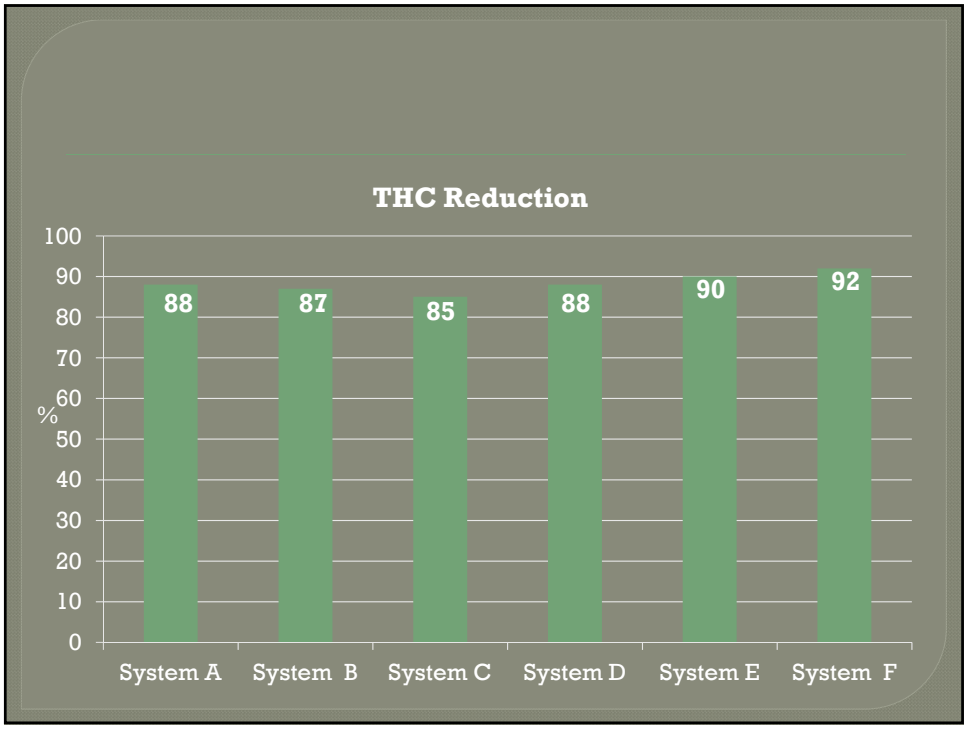
DPF


NO2 PPM System F
140
120
100
80
NO2 PPM
60
40
20
0
109
131
NO2 Baseline
NO2 DPF F
NO2 PPM
BPT = 357 - 365° Celsius


NO2 Out
PPM
450
400
350
300
250
NO2 PPM
200
150
100
50
0
424
280
257
248
181
131
109
System A
System B
System C
System D
System E
System F
Baseline
NO2 Out


CO Reduction
100
90
80
70
60
%
50
40
30
20
10
0
98
97
98
95
92
98
System A
System B
System C
System D
System E
System F


DPM Reduction
100
90
80
70
60
%
50
40
30
20
10
0
96
98
94
95
94
97
System A
System B
System C
System D
System E
System F



Conclusion

1. EPA/CARB passively regenerated DPF produced significantly more NO2 than comparable mine specification DPF
2. Certain components of EPA/CARB passively regenerated DPF may be suitable for underground mine applications
3. Additional testing of DPF components is ongoing