

NTRD Program Disclaimers

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**Texas Commission on Environmental Quality
New Technology Research & Development (NTRD) Program
Monthly Project Status Report**

Contract Number: 582-5-655-91-0007

Grantee: Converter Technology Inc

Date Submitted: August 10, 2005

Report for the **Monthly** period:

Starting Date July 1, 2005 Ending Date July 31, 2005

Section I. Accomplishments *(Please provide a bulleted list of project accomplishments as well as a description of their importance to the project.)*

- Completed AVL 8-mode and 4 additional intermediate modes testing for the CAT 3406 engine. Test results are enclosed.
- Continued design and testing upgrade of the converter for incineration/separation to cope with EGR increased particulate emission.
- Recruited host company for CTI retrofit system in Los Angeles, continued dialogue with CARB to expedite verification turnaround.
- System design for the CAT 3406 engine is complete.

Indicate which part of the Grant Activities as defined in the grant agreement, the above accomplishments are related to:

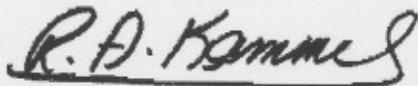
1. Task #3 Design of EGR System for CAT 3406 is complete.
2. Task #4 Construction of converter system design, in progress
3. Task #5 EGR mapping for 50-60% NOx reduction, work is complete for CAT 3406.
4. Task #6 EGR Mapping for 60-70% NOx reduction, work is complete for CAT 3406.
5. Task #9 Verification program with EPA/CARB, in progress.

Section II: Problems/Solutions

<p>Problem(s) Identified</p> <p><i>(Please report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project)</i></p>	<p>After procurement of a pick-up truck with 7.3L engine and setting it up in our lab on the PTO dyno, the engine horsepower rating was low, due to age. It was decided to discard the truck (1988 model year) and explore a newer truck.</p>
<p>Proposed Solution(s)</p> <p><i>(Please report any possible solution(s) to the problem(s) that were considered/encountered)</i></p>	<p>Replace the 7.3L diesel truck with another one and verify engine performance before mapping.</p>
<p>Action(s) Conducted and Results</p> <p><i>(Please describe the action(s) taken to resolve the problem(s) and its effect)</i></p>	<p>Efforts are in place to lease/purchase a new diesel truck with an engine as close to rated horsepower. Anticipate to restart EGR mapping by August 15, 2005.</p>

Section III. Goals and Issues for Succeeding Period: (*Please provide a brief description of the goal(s) you hope to realize in the coming period and identify any notable challenges that can be foreseen*)

1. Conduct independent emission tests for PM only at Lotus Testing Lab in Ann Arbor, Michigan (still awaiting permission from CARB to proceed)
2. Start EGR mapping for the International 7.3L diesel engine.
3. Construct and finish 5(five) data acquisition system for collecting emission on-the-road.



Date: 8/10/2005

Authorized Project Representative's Signature

NOTE: *Please attach any additional information that you feel should be a part of your report or that may be required to meet the deliverable requirements for tasks completed during this reporting period.*

Attached is the summary of results of EGR mapping for the CAT 3406. We have demonstrated 63% reduction in NOx. Since NOx baseline emissions are low and specific fuel rates (gm/bhp.hr) are high, we suspect the engine could have a low compression ratio. This is being checked now. CTI believes that the current EGR injection strategy could achieve 70% reduction in NOx on old engines, but in good conditions. It should be noted that final NOx reduction will be verified through chassis dynamometer testing. Further, the new data acquisition system will monitor NOx emission on the road for baseline and emission control system, and the corresponding percentage NOx reduction can be computed based on actual driving cycles. The real world NOx emission reduction could be higher than the chassis testing cycle. In exploring this issue with CARB, they declined to give credence to NOx emission reduction data from road testing, but such data will be part of the verification documents. This issue will be visited again with CARB after verification through amendment to our application.

Calculation of Mass Emissions

for the CAT 3406B Engine, 1985 Model Year
Average of the Sum of weighted power and final NOx reductions

Mode (Baseline)	Mass Emission gms/hour	Weight Factor for AVL 8-Mode Heavy Duty Cycle (WF)	Mass Emission x Weight Factor	Mode (Selected) EGR	Mass Emission gms/hour	Weight Factor for AVL 8-Mode Heavy Duty Cycle (WF)	Mass Emission x Weight Factor	NOx Reduction
1	13.2	35.00	460	1	2.2	35.00	75	83.65%
2	72.2	6.34	458	2	13.9	6.34	88	80.73%
3	182.2	2.91	530	3	50.7	2.91	147	72.19%
4	387.8	3.34	1,295	4	138.0	3.34	461	64.41%
5	150.6	8.40	1,265	5	39.8	8.40	334	73.57%
6	263.0	10.45	2,748	6	88.1	10.45	921	66.50%
7	577.3	10.21	5,895	7	144.7	10.21	1,478	74.93%
8	636.6	7.34	4,673	8	414.8	7.34	3,045	34.83%
Σ Mass Emission x Weight Factor =			17,324	Σ Mass Emission x Weight Factor =			6,550	

Calculation of Average of sum of weighted power of the AVL 8-modes

Mode (Baseline)	Horse Power (HP)	Weight Factor for AVL 8-Mode Heavy Duty Cycle (WF)	HP x WF	Mode (Selected) EGR	Horse Power (HP)	Weight Factor for AVL 8-Mode Heavy Duty Cycle (WF)	HP x WF
1	0	35.00	0	1	0	35.00	0
2	32	6.34	203	2	32	6.34	203
3	95	2.91	276	3	95	2.91	276
4	160	3.34	534	4	158	3.34	528
5	46	8.40	386	5	46	8.40	386
6	101	10.45	1,055	6	102	10.45	1,066
7	181	10.21	1,848	7	188	10.21	1,919
8	234	7.34	1,718	8	234	7.34	1,718
Σ HP x WF =			6,021	Σ HP x WF =			6,096

$$\text{Baseline AVL Composite Brake Specific Emission} = \frac{\sum \text{Mass Emission} \times \text{Weight Factor}}{\sum \text{HP} \times \text{WF}} = 2.88 \text{ gms/bhp.hr}$$

$$\text{Selected Modes (EGR) Composite Brake Specific Emission} = \frac{\sum \text{Mass Emission} \times \text{Weight Factor}}{\sum \text{HP} \times \text{WF}} = 1.07 \text{ gms/bhp.hr}$$

$$\text{Composite AVL NOx Reduction} = \frac{(2.88 - 1.07) \times 100}{2.88} = \mathbf{63\%}$$

Note: The average NOx emission reduction of 63% is equivalent to that generated from EPA transient test procedures according to AVL.

Calculation of Fuel Rate & Penalty

for the CAT 3406B Engine, 1985 Model Year

Mode (Baseline)	Fuel Consumption gms/hr	Weight Factor for AVL 8-Mode Heavy Duty Cycle (WF)	Fuel Consumption x Weight Factor	Fuel Rate lbs/bhp.hr	Mode (Selected) EGR	Fuel Consumption gms/hr	Weight Factor for AVL 8-Mode Heavy Duty Cycle (WF)	Fuel Consumption x Weight Factor	Fuel Rate lbs/bhp.hr	
1	5.2	35.00	181	-	1	4.5	35.00	158	-	
2	17.6	6.34	111	0.548	2	18.0	6.34	114	0.563	
3	43.4	2.91	126	0.457	3	46.4	2.91	135	0.489	
4	68.6	3.34	229	0.429	4	71.8	3.34	240	0.449	
5	33.7	8.40	283	0.733	5	37.1	8.40	311	0.806	
6	55.9	10.45	584	0.554	6	60.4	10.45	631	0.592	
7	92.8	10.21	947	0.513	7	98.4	10.21	1,005	0.523	
8	102.6	7.34	753	0.438	8	103.6	7.34	760	0.443	
Σ Fuel Consumption x Weight Factor =			3,216				Σ Fuel Consumption x Weight Factor =			3,354
Fuel Penalty =									$\frac{(\sum \text{ Selected Fuel Consumption x Weight Factor} - \sum \text{ Baseline Fuel Consumption x Weight Factor}) \times 100\%}{\sum \text{ Baseline Fuel Consumption}}$	
									= 4.28%	

Note: The fuel penalty calculated here is equivalent to that generated from EPA transient test procedure according to AVL.