



# SCR System for On-road and Off-road Applications (N-003)

tom@impactprinting.net  
**HARC New Technology R & D Workshop**

**February 13, 2008**

M.A. Mannan  
**Nett Technologies Inc.**



# Outline

- Introduction
- Technology Options for NOx Control
- Nett BlueMAX™ System Description
- Acknowledgement



# Profile

Nett Technologies is a privately owned Canadian company founded in 1994 and located in the metropolitan Toronto area.

The company's primary focus is on the design and manufacture of high quality exhaust systems and emission control products for LPG, CNG, gasoline and diesel fueled engines used in on-road, off-road and stationary applications.

# Capabilities and Strengths

- Design, manufacturing and R&D center under one roof
- Over 5000 direct-fit designs
- Extensive equipment database
- Engineered custom designs
- Well established dealer network
- Excellent after-sales support

Jigs	Make	OEM	Nett	Engine	Oem make	
Equipment make					▶ Caterpillar	
Caterpillar						
Cummins						
Cushion Cut						
Cushman						
DBT						
Daewoo/Doosan						
Damascus Corp.						
David Brown						
Desta						
Detroit Diesel						
Deutz						
Diedrich Dril						
Diesel Engines						
Dimas						
Dimex						
Drexel						
Designs found					1	
-->						
<--						
New note						
Type					Make	Model
Construction					Caterpillar	966F
					Caterpillar	970F
Nett Part Number					01CT1786-1422	
Engineering					01-CT-01786-10422-DH 01	
Part description					Catalytic Muffler	
Sales drawing					<a href="M:\Caterpillar (CT)\01CT1786">M:\Caterpillar (CT)\01CT1786</a>	

# Product Mix

- Catalytic Mufflers
- Diesel Oxidation Catalysts
- Flow Through Filters
- Passive Diesel Particulate Filters
- Active Diesel Particulate Filters
- SCR Systems



# Why NOx Control ?

Nitrogen oxides (NOx), one of the most troublesome emissions from the diesel engine, is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. NOx contributes to:

- the formation of ground-level ozone (smog) – which can trigger respiratory problems
- the formation of acid rain
- global warming
- atmospheric particles, that cause visibility impairment (most noticeable in parks)
- nutrient overload that deteriorates water quality
- reactions which form toxic chemicals



# Technology Options for NOx Control

Technology	NOx Reduction	Comments
<b>Engine Repower or Upgrade</b>	80% on-road 60% off-road	Ultra-low NOx engines available only in 2010 (on-road) and ~2014 (off-road).
<b>Exhaust Gas Recirculation (EGR)</b>	30-40%	Applicable mostly to OEM applications. Retrofit application is problematic.
<b>Lean NOx Catalysts (HC-SCR)</b>	10-50%	Higher conversions possible only in active systems with fuel injection. Fuel economy penalty.
<b>NOx adsorbers (traps)</b>	50-80%	Applicable to OEM applications only. Require tight integration with the engine management system.
<b>Fuel Emulsions</b>	10-20%	Negative engine performance impact. Limited to centrally fueled fleets.
<b>Selective Catalytic Reduction (urea-SCR)</b>	65-90%	Widely used in OEM applications. Retrofit systems in the process of EPA verification.



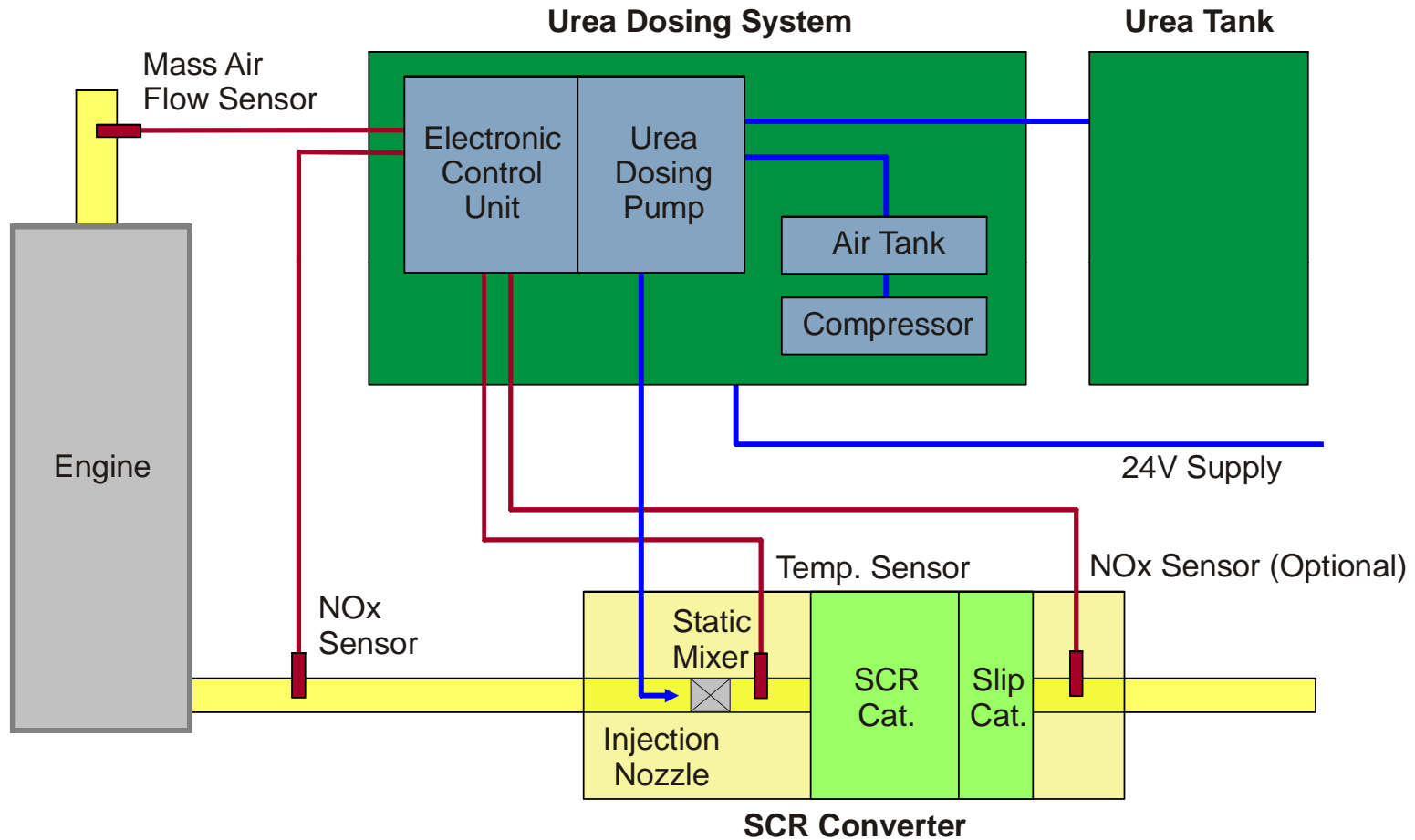
# Nett BlueMAX™ System

The Nett BlueMAX™ is a urea-SCR system. NOx is reduced over the SCR catalyst through a series of chemical reactions with a reducing agent (urea).

The main components of the BlueMAX™ system include:

- SCR Converter
  - SCR Catalyst
  - Ammonia Slip Catalyst
  - Mixer and Urea Injection Nozzle
  - Temperature and NOx sensors
- Urea Dosing System
  - Electronic Control Unit and Dosing Pump
  - Air Tank and Compressor
- Urea Tank

# System Diagram





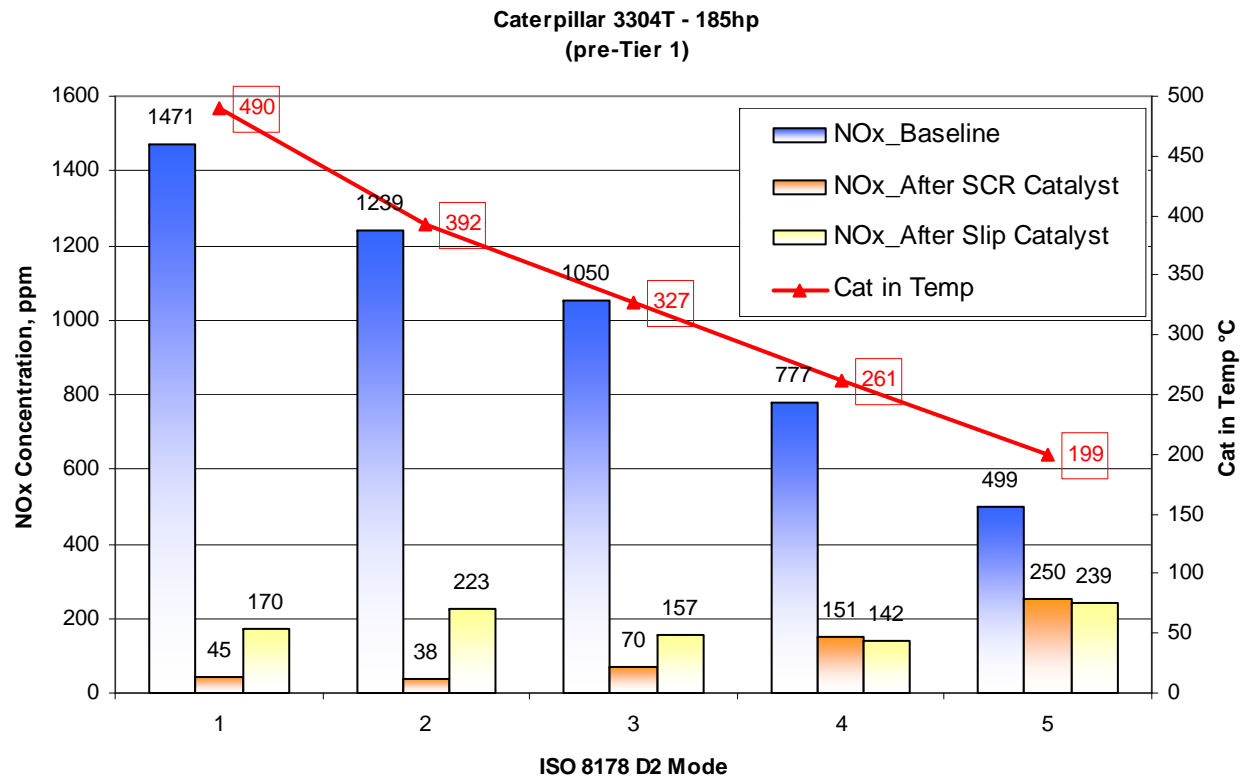
# BlueMAX™ Installation



**Case 821B Loader**

*...the emission control authority*

# Emission Data Test Cell Results



# System Performance

	ISO 8178 D2 Composite	
	NOx (g/bhp-hr)	CO (g/bhp-hr)
Baseline	11.21	2.23
With SCR Catalyst	1.05	2.47
With Slip Catalyst	1.98	0.16
Conversion	82 %	93%

- 65-90% NOx reduction
- Temperature range 250-600°C
- Minimal increase in back pressure
- Combination with diesel particulate filter available



# Urea Consumption

The Nett BlueMAX™ system requires that aqueous urea solution (in the form of a 32.5% water-based solution) be carried in an on-board storage tank and that it is periodically replenished.

Urea consumption can vary from 1-5% (by vol.) relative to the diesel fuel consumption. For every 1g/bhp-hr of NO<sub>x</sub> that is reduced, the amount of urea consumed is equal to ~0.9% of the diesel fuel consumed. So a 2g/bhp-hr NO<sub>x</sub> reduction would require a urea consumption of approximately 1.8% relative to the diesel fuel consumption.



# Development Status

## **Nett BlueMAX™ Off-road System**

- System architecture has been established
- System has been tested in the laboratory and in the field
- Multiple systems will be field tested in Texas as part of the verification requirement (durability)
- EPA verification is in process

## **Nett BlueMAX™ On-road System**

- Final stages of system design
- Undergoing laboratory testing
- Field tests to commence in Texas within 2 months
- EPA verification process will commence within 1 month



# Acknowledgement

*The development of the Nett BlueMAX™ SCR system for on-road and off-road applications is based on work supported by the State of Texas through a Grant from the Texas Environmental Research Consortium and the Texas Commission on Environmental Quality*



# Contacts

## **Nett Technologies Inc.**

2-6707 Goreway Drive

Mississauga, ON

L4V 1P7

**(800) 361-6388**

**[www.nett.ca](http://www.nett.ca)**

M.A. Mannan

e-mail: [mamannan@nett.ca](mailto:mamannan@nett.ca)