
Retrofitting Nonroad Equipment With Diesel Emissions Control Technologies

Croton Water Treatment Plant Case Study

2006 MDEC Conference
October 11, 2006
Toronto

Glenn P. Goldstein
Michael C. Block
Emisstar LLC



1



Presentation Outline

- **Emisstar LLC – "who we are & what we do"**
- **Project Overview**
 - New York City Local Law 77
- **Project Implementation**
 - Croton Vehicle Profile
 - Equipment characterization
 - Supplier Identification Process
 - Technology Deployment
 - EGBP/EGT Monitoring
 - In-Use Emissions Testing
- **Challenges and Issues**
 - Successes
 - Lessons Learned
- **Technology Transfer to Mining**



2



Emisstar LLC

*“Mobile Emissions Technology, Policy,
and Implementation”*

- Formed in April 2005
- Focus on mobile sources diesel emissions remediation
- Over 60 years collective experience
 - Air quality science & engineering
 - Engineering/project management
 - Business development & strategic planning
 - Diesel engine and emissions control technology
 - Regulatory & policy analysis
- 3 Offices in United States



3



Emisstar LLC

Focus Areas

- Advanced Technology Development
- Project Management and Implementation
- Research, Technical and Market Analysis
- Technology and Policy Coalitions
- Strategic Advisory Services
- Portable Emissions Monitoring (PEMS)
- Grant Writing and Related Support



4



Project Overview

- Drinking Water Treatment Plant
- EPA consent decree
- North Bronx (Van Cortland Park)
- 3 phases
 - Excavation → '05 – early '07
 - Tunneling → early '07 – '10
 - Construction → '07 – '12
- \$1.5+B
- 1st U.S. Construction project using “BAT”



5



Croton – Site Overlook



6



Croton – Sept '06



EMISSTAR

7

mdec
Municipal Development Corporation

Site Activities

- 16 acre site
 - 9 acre excavation to approx. 100 feet
- Hydraulic Line Drilling
- Blasting
- Excavating
- Loading
- On-site hauling
- Rock crushing / stockpiling
- Off-site hauling

EMISSTAR

8

mdec
Municipal Development Corporation

NYC Local Law 77

- Law enacted by NYC Council in 2003
- DEP Rulemaking in 2005
 - Ch. 14 of Title 15, Rules of City of New York
- Addresses emissions from “non-road” diesel equipment using cleaner fuel (ULSD) and “Best Available Technology” or BAT
- All City Agencies and their contractors



9



Requirements

- Any diesel powered equipment > 50 HP must be:
 - Powered by ULSD
 - Utilize BAT for reducing emissions
- Equipment includes:
 - Excavators, backhoes, cranes, compressors, generators, bulldozers, etc.
- Does not include on-highway vehicles



10



What is BAT?

- Definition:
“technology shall achieve the greatest reduction in emissions of particulate matter (PM) and shall in no event result in an increase in the emissions of either PM or nitrogen oxides (NOx)”



11



BAT Categories

- Category I
 - System using diesel particulate filter (DPF)
 - Control PM + NOx or
 - PM Only
- Category II
 - System using diesel oxidation catalyst (DOC) or flow-through filter (FTF)
 - PM + NOx or
 - PM Only
- Category III
 - Emulsified Diesel Fuel (ULSD compatible)



12



BAT Selection Criteria

- Technology must be verified by either:
 - US EPA
 - California Air Resources Board (ARB)
- Non-verified if:
 - OEM installed without compromising performance
 - Demonstration-stage technology

<http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm>

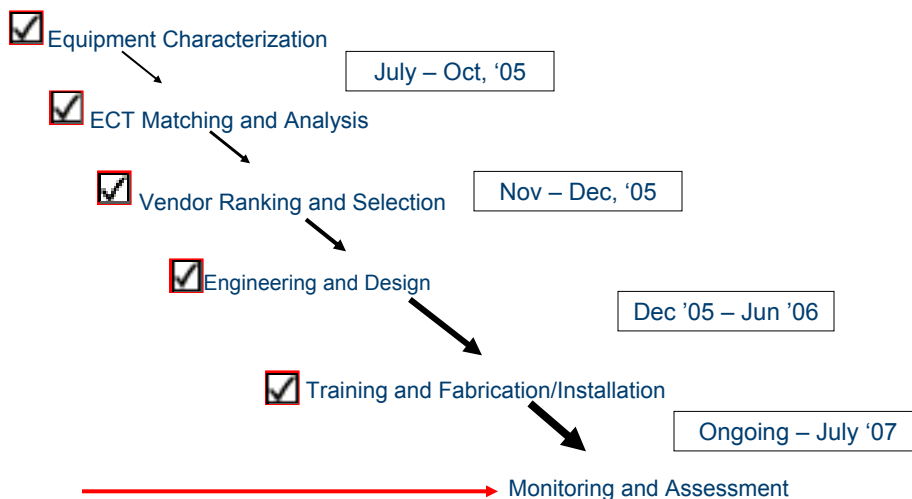
<http://www.arb.ca.gov/diesel/verdev/level1/level1.htm?PF=Y>



13



Project Implementation



14



Croton Vehicle Profile

- 25 – 30 Non-Road machines
- Major categories
 - Compressors
 - Loaders
 - Excavators
 - Dozers
 - Drills
 - Quarry Trucks
- 50+ On-Highway Dump Trailers



15



Equipment Characterization

- Tier 2 or 3 machines
- High EGT profiles, on average
 - 300 deg. C > 70 % duty cycle
- Quarry Trucks
 - Low to medium EGT
 - ADPF candidates
- Well maintained (Service ~ 250 hours)

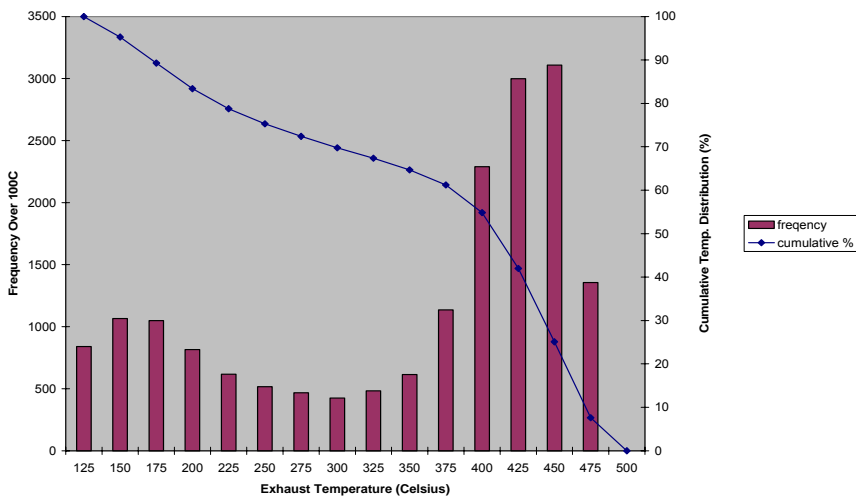


16



High EGT profile – Komatsu PC-750

Komatsu PC 750 Excavator

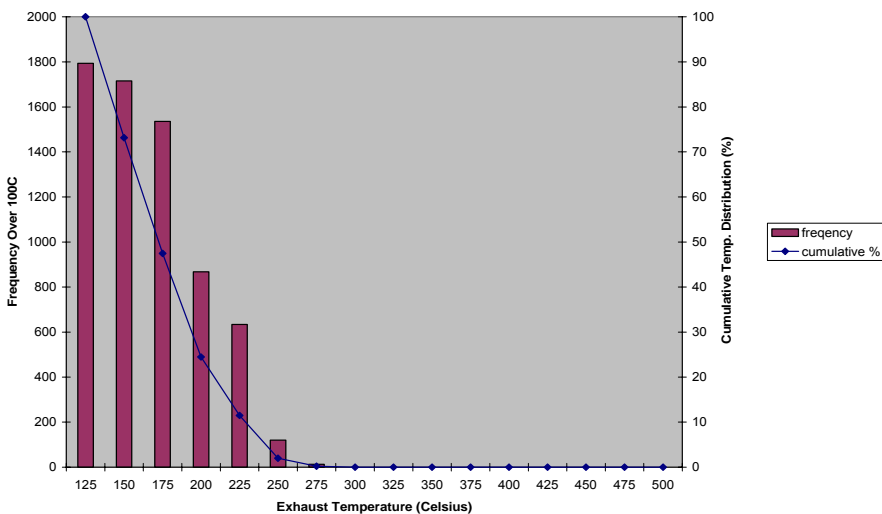


17



Low EGT profile – Terex TR70

Terex TR70 Quarry Truck (Trial 1)



18



Supplier Identification Process

- Prepared & issued RFP (16)
- Economic / Feasibility Analysis of Responses (7)
- Recommendations to NYCDEP
 - Verified Technologies
 - Advance Development Technologies



19



ECT Providers

- Engine Control Systems
 - Passive Diesel Particulate Filter (PDPF) – *Purifilter*
 - 80-90% PM Reduction
 - EPA & ARB Verified
 - 75% of the construction equipment –
 - Excavators, dozers, compressors, drills, loaders
- CAT / Johnson Matthey
 - Passive Diesel Particulate Filter (PDPF) – *CRT*
 - 80-90% PM Reduction
 - EPA & ARB Verified
 - 1x Large HP excavator



20



Providers (cont.)

- Cummins Emissions Solutions/JMI
 - Selective Catalytic Reduction (SCR) + PDPF – *SCRT*
 - 80-90% PM and 70%-90% NOx reductions
 - Advanced Development
 - 1x IR 600 Compressor
- Rypos
 - Active Diesel Particulate Filter (ADPF) – *RT-500 24 volt*
 - On-board electrical regeneration.
 - Terex TR 70 700 HP Quarry Trucks (3)
 - ARB verification for stationary back-up generators (BUGs), Level 2.
 - ARB verification for stationary BUGs, Level 3, in process.



21



Technology Deployment

- Custom, On-site Installations
 - Mechanics
 - Welders/metal fabricators
 - Technicians
- 8 to 16 hours per installation
- Nights and weekends
- Not pre-designed systems



22



Technology Deployment

Emistar Retrofit ID #	Schiavone Equip. ID #	Type	Manufacturer	Model #	BAT Mfg	Type	Status	DPF Installation Date	Monitor Installation Date	Comments
E35		Cleaning Station	ECS	Auto CombiClean	ECS	-	Delivered	pending		Target completion on 6/19.
E38		Compressor	Ingersoll Rand	IR 600	FES	SCRT	Installed	6-Jul-06	9/1 JMI install CRT/Gen7	BAT system reconfigured from E02. Install week of 6/25.
E37	728	Compressor	Ingersoll Rand	IR 785	ECS	Purifier	Delivered	27-Jan-06		New machine #06. Installed BAT from E31.
E43		Compressor	Ingersoll Rand	IR-445	ECS	Purifier	REMOVED	2-Feb-06		BAT installed. Removed when machine left site.
E42		Compressor	Ingersoll Rand	IR-445	-	-	REMOVED			Machine removed. BAT system reconfigured for E38.
E03		Dozer	Komatsu	D155-Ax-5B	ECS	Purifier	Installed	10-Mar-06		Completed. Machine on site.
E04		Dozer	Komatsu	D275 Ax-5B	ECS	Purifier	Installed	20-Jan-06		Completed. Machine on site.
E26	1	Excavator	Hitachi	Z Axis-800	ECS	Purifier	Installed	15-Jan-06		Completed. Machine on site.
E06	2	Excavator	Hitachi	Z-Axis-800	ECS	Purifier	Installed	14-Jan-06		BAT system & monitor removed, and in stock.
E05		Excavator	Hitachi	EX-1200-5C	ECS	JMI CRT	On-Chase			No BAT will be retrofitted. Machine being decommissioned.
E28		Excavator	Komatsu	PC-200	ECS	Purifier	REMOVED. BACK ON SITE IN JUNE 06.			BAT delivered. Machine removed prior to installation, but now back on-site.
E07		Excavator	Komatsu	PC-750	ECS	Purifier	Installed	18-Jan-06		monitor on, amber & red lights on (move port)
E08		Excavator	Komatsu	PC-450	-	-	REMOVED			Machine removed.
E09	-	Hydraulic Drill	Atlas-Copco	RA20-LE-44	ECS	Purifier	REMOVED			BAT delivered. Machine removed prior to installation.
E22		Hydraulic Drill	Furukawa	HCR1500-ED	ECS	Purifier	Installed	8-Apr-06		BAT delivered. Machine removed prior to installation.
E14	2	Hydraulic Drill	Sandvik Tamrock	Pantera 1100	ECS	Purifier	Installed	26-Mar-06		monitor on, working OK
E13	10	Hydraulic Drill	Sandvik Tamrock	Pantera 1100	ECS	Purifier	Installed	25-Mar-06		monitor on, working OK
E23	2	Hydraulic Drill	Tamrock	Scout 700-B	ECS	Purifier	Installed	24-May-06		monitor on, working OK
E24	4	Hydraulic Drill	Tamrock	Scout 700-B	ECS	Purifier	Installed	23-May-06		needs monitor
E25	-	Compressor	Ingersoll Rand	IR-445	-	-	REMOVED			Machine removed.
E49		Line-Drill	Ingersoll Rand	ESM-550	ECS	Purifier	REMOVED			BAT delivered. Machine removed prior to installation.
E50		Line-Drill	Ingersoll Rand	ESM-550	ECS	Purifier	REMOVED	4/4-Jan-06		BAT installed. Removed when machine left site.
E41		Line-Drill	Ingersoll Rand	ESM-550	ECS	Purifier	REMOVED	4-Jan-06		BAT installed. Removed when machine left site.
E15	855	Loader	Caterpillar	955C	CAI	JMI CRT	Installed	5-Sep-05		Completed. Machine on site.
E16		Loader	Caterpillar	988H	ECS	CR2	On-Chase			No BAT will be retrofitted.
E17		Loader	Komatsu	WA600-3	ECS	CR2	On-Chase			No BAT will be retrofitted.
E24		Quarry-Truck	Caterpillar	722B	-	-	REMOVED			Machine removed due to non-compliance (Tier 2 or better)
E28		Quarry-Truck	Terex	TR70	ADPF	ADPF	On-Chase			Removed from site.
E29		Quarry-Truck	Terex	TR70	ADPF	ADPF	On-Chase			Removed from site.
E20	3	Quarry Truck	Terex	TR70	Rypos	ADPF	Installed	18-Mar-06		Rypos' own monitor. Completed. Machine on site.
E18	2	Quarry Truck	Terex	TR70	Rypos	ADPF	Installed	12-Mar-06		Rypos' own monitor. Completed. Machine on site.
E19	1	Quarry Truck	Terex	TR70	Rypos	ADPF	Installed	11-Mar-06		Rypos' own monitor. targeted for Interleaf GPS. Completed. Machine on site.
E20	3	Tiger Drill	Tamrock	CHA 700	ECS	Purifier	Installed	17-May-06		Completed. Machine on site.
E20	3	Tiger Drill	Tamrock	CHA 700	ECS	Purifier	Installed	16-May-06		Completed. Machine on site.
E31	4	Tiger Drill	Tamrock	CHA 700	ECS	Purifier	Installed	15-May-06		needs monitor
E22	4	Tiger Drill	Tamrock	CHA 700	ECS	Purifier	Installed	15-May-06		No monitor ever installed.
E39	5	Tiger Drill	Tamrock	CHA 700	ECS	Purifier	Awaiting Installation			DPF needs to be removed from this machine (E29) and installed on this machine (E39)
E21		Water Truck	Mack				REMOVED. BACK ON SITE IN JUNE 06			On-road truck.

EGBP/EGT Monitoring

- All Croton Category 1 BAT systems require monitoring
- Utilized:
 - CRTdm for PDPF
 - Supplier installed monitors for ADPF & SCRT
 - Handheld digital manometers as backup
- Periodic diagnostics
- Alarm Triggered Event
 - Establish Retrofit Case History



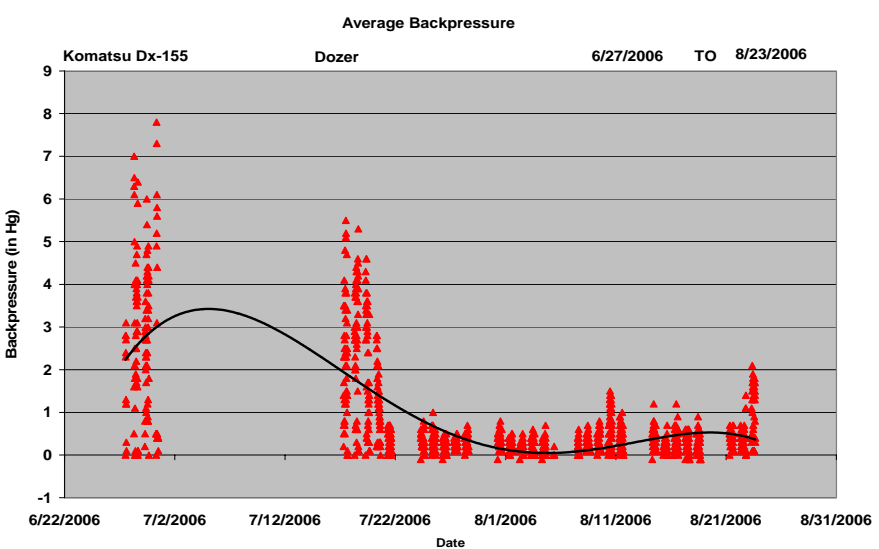
EGBP/EGT Monitoring



25



Komatsu Dx-155 EGBP



26



In-Use Emissions Testing

Environment Canada DOES2

- Objectives
 - Conduct exhaust emission measurements on six diesel powered pieces of construction equipment operating under both real world and repeatable conditions.
 - Evaluate the impact of various emission control technologies – pre and post ECT.
- Why 'DOES2?'
 - It most closely replicates engine laboratory conditions.
 - Is the most accurate and repeatable under varying equipment operation and climatic conditions.
 - Is capable of measuring PM.
 - It references EPA's CFR new engine certification techniques for PM measurement.



27



In-Use Emissions Testing



28



In-Use Emissions Testing



EMISSTAR

29

mdec

Equipment Tested

Type	Manufacturer	Model #	Date of Mfg.	Engine	HP	Tier	ECT Type	Mfg
Compressor	Ingersoll Rand	IR 600	2005	John Deere-6IRF8TE	170 HP	2	SCR+DPF	JMI SCRT
Dozer	Komatsu	D155-Ax-5B	2004	Komatsu SDA6D140E-3	332 HP	2	DPF	ECS
Excavator	Hitachi	Z Axis-800		Isuzu GWG1XAB	483 HP	2	DPF	ECS
Hydraulic Drill	Tamrock	CHA 700	2005	Caterpillar 3506E	173 HP	2	DPF	ECS
Rubber Tire Loader	Caterpillar	966G	2004	Caterpillar 3176C ATAAC	259 HP	2	DPF	CAT/JMI CCRT
Quarry Truck	Terex	TR70	2005	Detroit Diesel 12V 2000	700 HP	2	ADPF	RYPOS ADPF-C

EMISSTAR

30

mdec

Challenges and Issues

- Rotating equipment stock (66% turnover)
- ECT Suppliers for the nonroad market
- Technical
 - OEM Backpressure compliance
 - Well engineered & robust design
- Operational
 - Interrupting site-operations
 - Harsh conditions
 - Vibration
 - Dust
- Variability in Service & Support
 - Lead times
 - Servicing units



31



Challenges and Issues



32



Filter substrate failure



EMISSTAR

33

mdec

Successes

- Assuaged community concerns about health impacts of pollution.
- Deployed Category 1 BAT or higher on all 25+ machines.
- Working for over 1 year w/minimal downtime or interference.
- Quantified in-use emission reductions through ISS testing

EMISSTAR

34

mdec

Lessons Learned

- Fleet participation is critical
- Trained mechanic/support for large deployments
- Move project from “orphan” to “owner” phase as quickly as possible
- Engineer for Nonroad environment
- Keep spare parts, supplies & filter cleaning station on-hand (cost justified)
- Documentation – installation, maintenance, repair, warranty



35



Technology Transfer To Mining

What are the similarities;
what are the differences?

- Operating environment?
- Variability of equipment type?
- Interest from ECT providers?

What do you think?



36



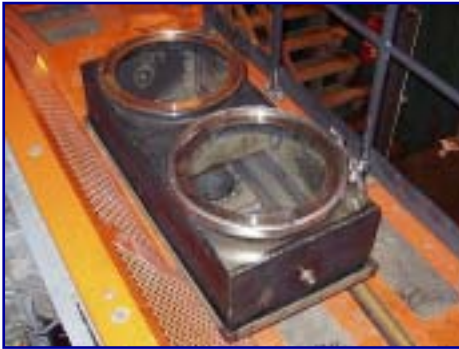
Croton Picture Gallery



Croton – Furukawa Hydraulic Drill



Croton – Hitachi Z-Axis 800 Excavator (2)



39



Croton – Hitachi Z-Axis 800 Excavator (2)



40



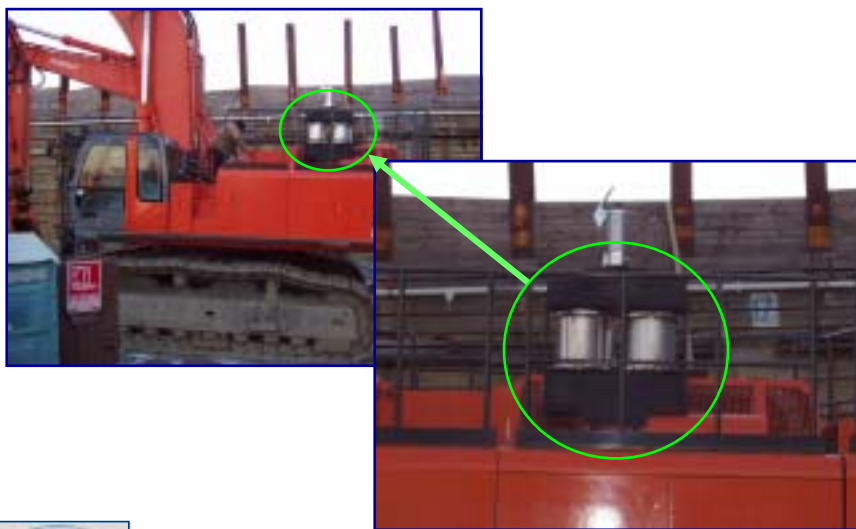
Croton – Hitachi Z-Axis 800 Excavator (2 machines)



41



Croton – Hitachi Z-Axis 800 Excavator (2)



42



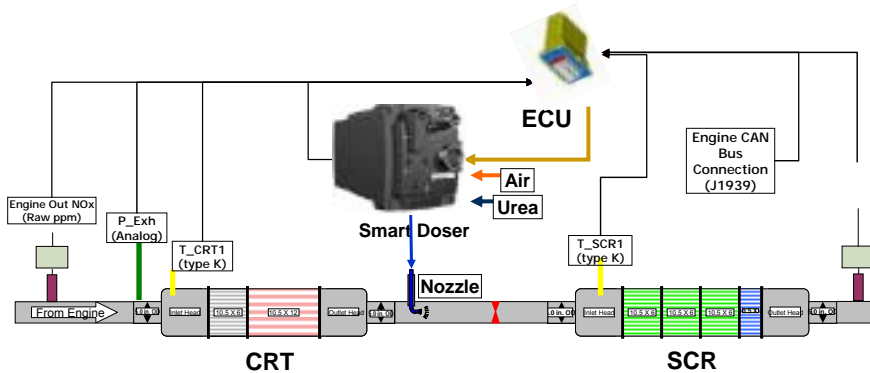
Croton – Terex TR 70 w/Rypos ADFP/C



43



JMI SCRT



44



SCRT (cont.)



45



Contact Information – Emisstar LLC

Glenn P. Goldstein, Principal
631-363-3730
glenn.goldstein@emisstar.com

Michael C. Block, Principal
603-520-4147
michael.block@emisstar.com



46

