Measurement and Characterization of LNT Regeneration

Posting Data on CLEERS Website For Model Development

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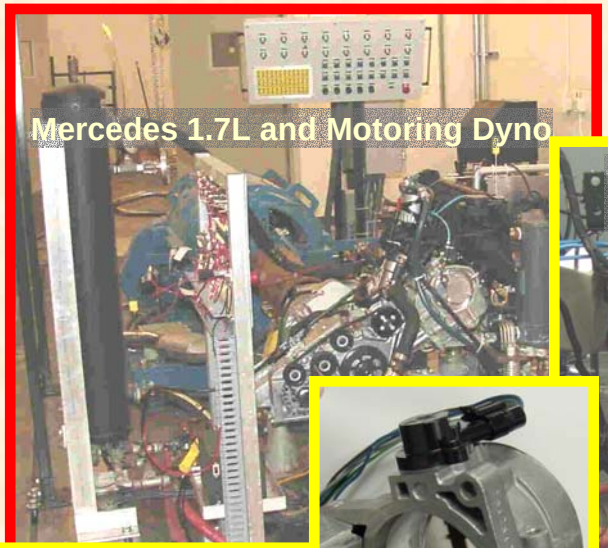
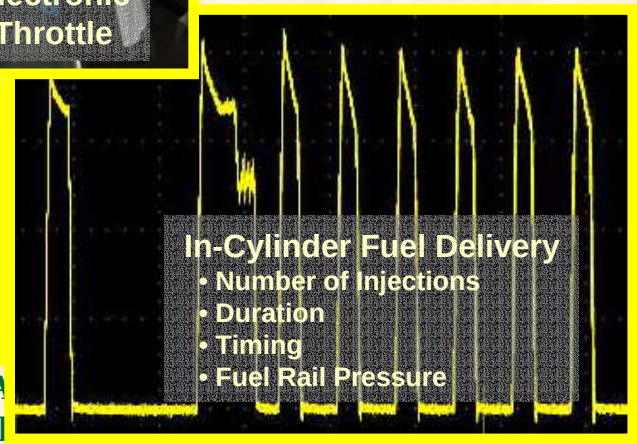
Common Rail Engine with full-pass control used for LNT regeneration experiments at ORNL





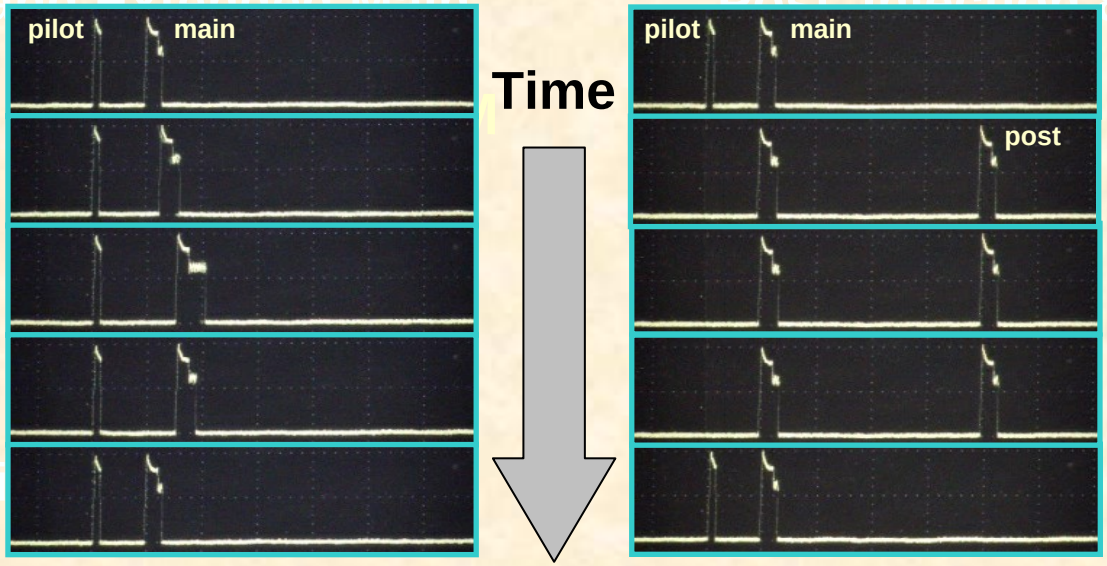
Objectives

- Characterize H_2, CO, and HC's generated by the engine
  - FTIR, GC/MS, SpaciMS to characterize reductant species
  - Select strategies with most distinct reductant pools
- Characterize candidate Lean NOx traps
  - Correlate various reductants with catalyst performance
    - Engineer strategies to be identical in all but chemistry

Two strategies for achieving intermittent rich combustion have been well characterized

- **Both strategies employ no EGR for highest engine-out NOx (fastest LNT loading)**
- **Rich excursion is achieved by a combination of intake throttling and the following injection strategies:**

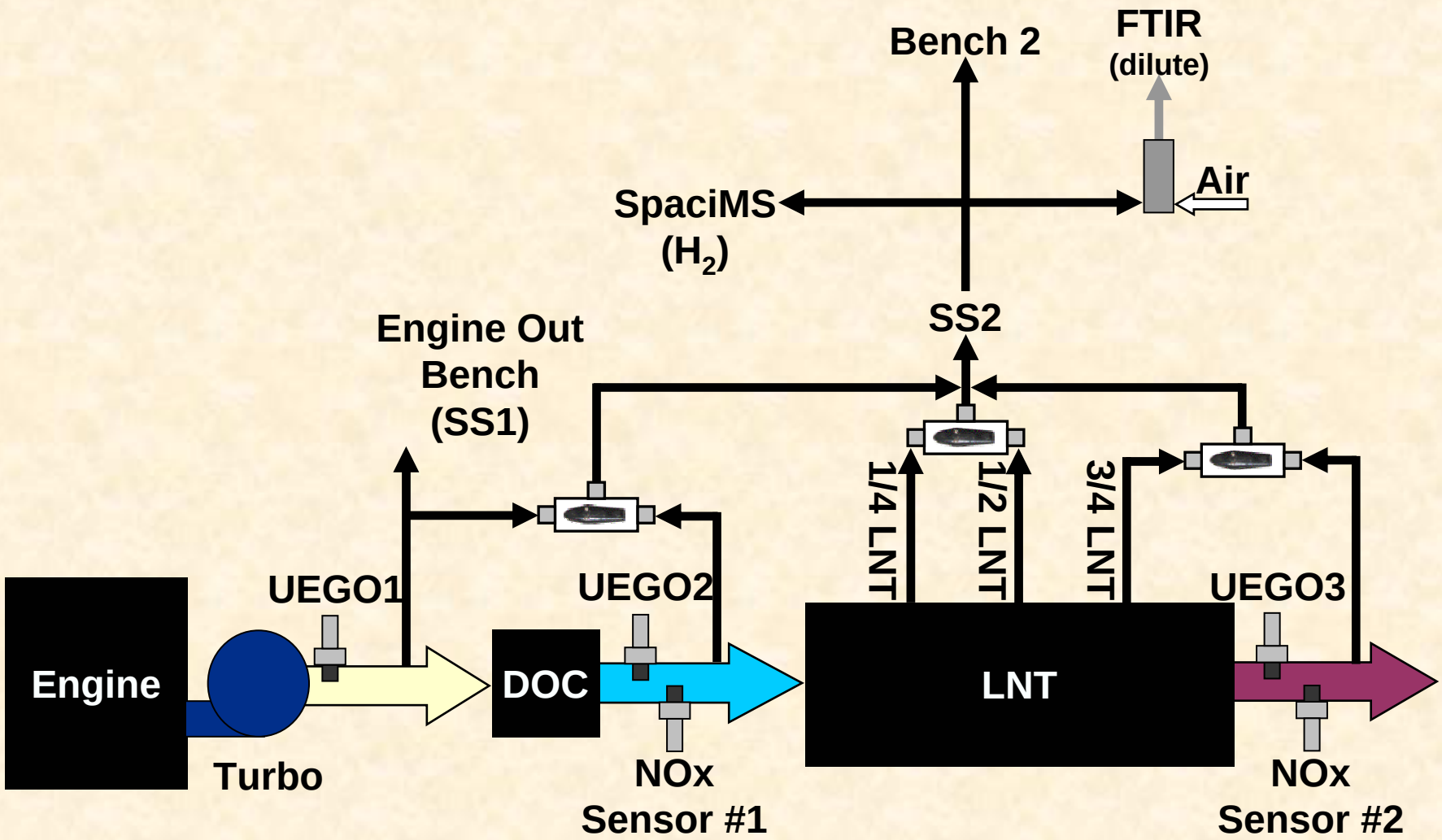
Delayed and Extended Main (DEM)



Post 80 Injection (P80)

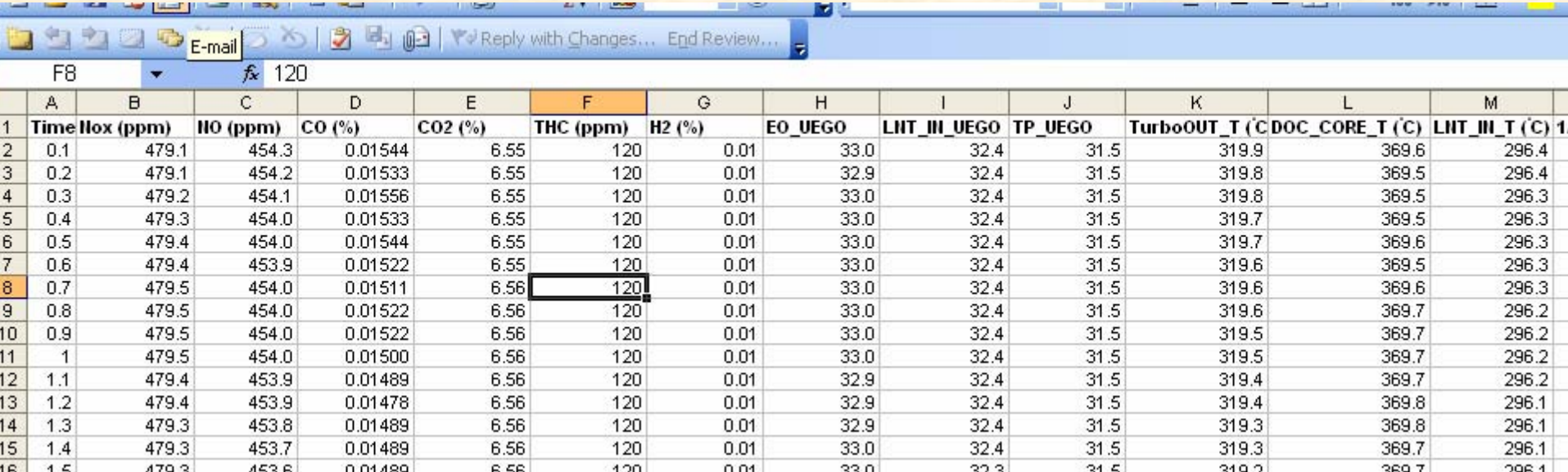
- **Experiments conducted at 1500 RPM, 5 bar BMEP (~50 ft-lb), LNT inlet temperature of ~300°C**

All experiments used DOC upstream of LNT. 6 sample locations, 3 intra-catalyst samples



Detailed data being posted to share with modeling community

- **Recently posted data includes:**
  - **Gas sampling at 6 locations**
    - **Engine-out**
    - **LNT in**
    - **LNT ¼, ½, ¾**
    - **LNT out**
  - **Species of interest:**
    - **NOx, NO, CO, CO_2, HC, H_2**
  - **Gas and catalyst core temperatures**
  - **Air:Fuel ratio, mass air rate, fuel flow rate**
  - **Engine Speed and Torque**



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Time	Nox (ppm)	NO (ppm)	CO (%)	CO2 (%)	THC (ppm)	H2 (%)	EO_UEGO	LNT_IN_UEGO	TP_UEGO	TurboOUT_T (°C	DOC_CORE_T (°C)	LNT_IN_T (°C)
2	0.1	479.1	454.3	0.01544	6.55	120	0.01	33.0	32.4	31.5	319.9	369.6	296.4
3	0.2	479.1	454.2	0.01533	6.55	120	0.01	32.9	32.4	31.5	319.8	369.5	296.4
4	0.3	479.2	454.1	0.01556	6.55	120	0.01	33.0	32.4	31.5	319.8	369.5	296.3
5	0.4	479.3	454.0	0.01533	6.55	120	0.01	33.0	32.4	31.5	319.7	369.5	296.3
6	0.5	479.4	454.0	0.01544	6.55	120	0.01	33.0	32.4	31.5	319.7	369.6	296.3
7	0.6	479.4	453.9	0.01522	6.55	120	0.01	33.0	32.4	31.5	319.6	369.5	296.3
8	0.7	479.5	454.0	0.01511	6.56	120	0.01	33.0	32.4	31.5	319.6	369.6	296.3
9	0.8	479.5	454.0	0.01522	6.56	120	0.01	33.0	32.4	31.5	319.6	369.7	296.2
10	0.9	479.5	454.0	0.01522	6.56	120	0.01	33.0	32.4	31.5	319.5	369.7	296.2
11	1	479.5	454.0	0.01500	6.56	120	0.01	33.0	32.4	31.5	319.5	369.7	296.2
12	1.1	479.4	453.9	0.01489	6.56	120	0.01	32.9	32.4	31.5	319.4	369.7	296.2
13	1.2	479.4	453.9	0.01478	6.56	120	0.01	32.9	32.4	31.5	319.4	369.8	296.1
14	1.3	479.3	453.8	0.01489	6.56	120	0.01	32.9	32.4	31.5	319.3	369.8	296.1
15	1.4	479.3	453.7	0.01489	6.56	120	0.01	33.0	32.4	31.5	319.3	369.7	296.1
16	1.5	479.3	453.6	0.01489	6.56	120	0.01	33.0	32.3	31.5	319.2	369.7	296.1

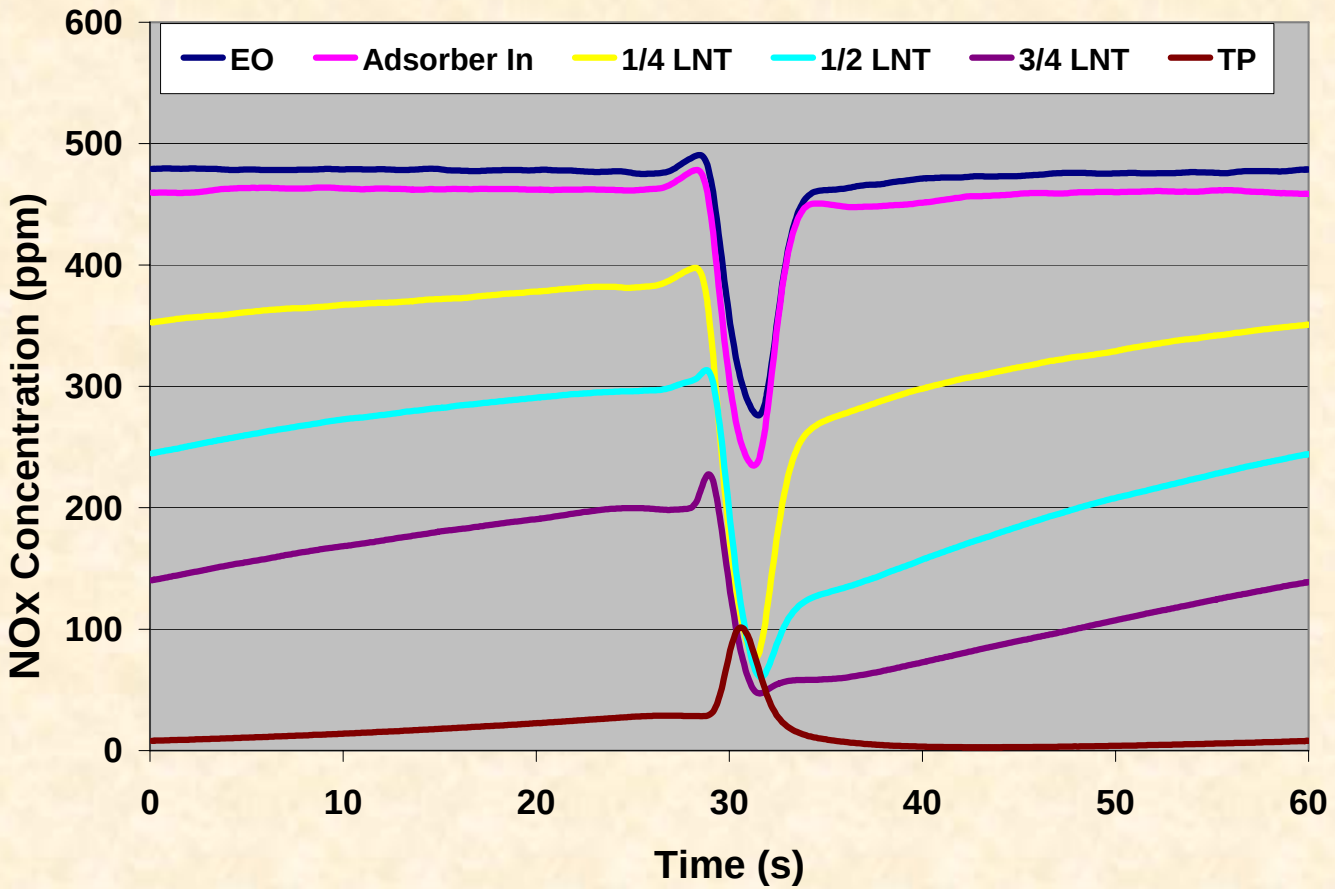
MECA Catalyst Specifications

Catalyst Specifications		
Catalyst	DOC	LNT
Cells/in^2 (Cells/cm^2)	400 (62)	400 (62)
Diameter x length, inches (mm) Volume, in^3 (liter)	4.16x3 (106x76) 41 (0.67)	5.66x6 (144x152) 151 (2.5)
Precious metal,g/ft^3 (g/liter)	70 (2.5)	120 (4.2)
Formulation	Pt	Ba-based Pt/Pd/Rh
Space Velocity (1/hr) Normal lean/ Regeneration	97,000/ 77,000	26,000/ 21,000

Posted dataset for “Fresh” MECA LNT catalyst with upstream DOC

- **Coming soon:**
  - **Same LNT catalyst in sulfated, desulfated, and aged conditions**
  - **Model catalysts**
  - **Umicore GDI catalyst**
  - **More MECA catalysts**
  - **Other strategies or rich/lean cycles**

Data collected at 10 Hz for 10 minutes. Typical strategy uses 3 second rich regeneration with 60 second cycle



- **Ten regeneration data file reduced to 1 average cycle. Example shows NOx concentration versus time for 6 positions**

To download data file, SAE papers, other information

- www.cleers.org
- **Questions about data, contact**
- **Shean Huff, huffsp@ornl.gov**
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- **Jim Parks, parksjeii@ornl.gov**