

## **NTRD Program Disclaimers**

### **1. Disclaimer of Endorsement:**

The posting herein of progress reports and final reports provided to TCEQ by its NTRD Grant Agreement recipients does not necessarily constitute or imply an endorsement, recommendation, or favoring by TCEQ or the State of Texas. The views and opinions expressed in said reports do not necessarily state or reflect those of TCEQ or the State of Texas, and shall not be used for advertising or product endorsement purposes.

### **2. Disclaimer of Liability:**

The posting herein of progress reports and final reports provided to TCEQ by its NTRD Grant Agreement recipients does not constitute by TCEQ or the State of Texas the making of any warranty, express or implied, including the warranties of merchantability and fitness for a particular purpose, and such entities do not assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights.

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

Contract Number: 582-5-65591-0001

Grantee: Catalytica Energy Systems

Date Submitted: 8/9/05

Report for the **Monthly** period: July, 2005

Starting Date 10/18/04

Ending Date 10/31/05

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

Task 5 Accomplishments:

(1) Task 2.5.4 activities

- a. The on-road demonstration has completed its second month. Emissions data has been gathered for several different cycles and duty cycle conditions. See the report in the appendix for a more detailed summary of the test results.

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

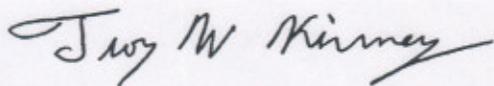
The accomplishments listed above are all part of Task 5 in the Grant Agreement.

Section II: Problems/Solutions

<p><b>Problem(s) Identified</b></p> <p><i>(Please report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project)</i></p>	<p>(1) <i>Having difficulty in getting the exhaust gas temperatures high enough during the simulated refuse pickup cycle to light off the reforming catalyst which results in low NOx reduction performance</i></p>
<p><b>Proposed Solution(s)</b></p> <p><i>(Please report any possible solution(s) to the problem(s) that were considered/encountered)</i></p>	<p>(1) <i>Modify the simulated cycle to include increase load on the vehicle</i></p>
<p><b>Action(s) Conducted and Results</b></p> <p><i>(Please describe the action(s) taken to resolve the problem(s) and its effect)</i></p>	<p>(1) <i>CESI is currently reviewing the data and will define and test modifications to the cycle during the scheduled emissions testing activities</i></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) *Task 2.5.4: Complete third month of on-board operation and emissions testing*
- (2) *Task 2.5.5: Remove units from Denton vehicles*



Date: 8/9/05

\_\_\_\_\_  
Authorized Project Representative's Signature

## Appendix

### XononD Testing – July 2005 Period

Continued mobile emissions testing was performed in the month of July on both project vehicles (9858 and 9735). The mobile testing plan consists of (1) two standard highway driving cycle (loop 288) segments, (2) a simulated trash pickup segment following the completion of the highway loop, and (3) standard daily trash pickup schedules. The test intent with the highway loop cycle and the simulated trash pickup cycles are to gather them during the same test segment on a "back-to-back" basis. Only one simulated trash pickup cycle has been performed to date (6/29) due to lower than expected exhaust gas temperatures. That particular cycle type will likely be modified to include more municipal type driving conditions where EGT's may be higher resulting in better catalyst performance.

#### Mobile Testing Overview

CESI proposed an amendment to the emissions testing protocol in the memo to the TCEQ dated 7/27/05. The proposal recommended that we focus strictly on mobile emissions and performance measurements going forward for the duration of the demonstration program. This was deemed necessary due to the technical challenges associated with obtaining consistent, repeatable data using various stationary approaches. A detailed description is contained in the July 27 document but generally consists of a standard highway loop portion of the test lasting approximately 45-60 minutes followed by a simulated trash pickup portion of the cycle lasting approximately 15-20 minutes. A second highway segment is then run to complete the route. As stated above, the simulated pickup portion of the testing may be changed. Typically, more than one loop is completed on a given test day to maximize data collection for periods during which catalyst lightoff can be obtained.

#### Results

A summary of the key overall cumulative program performance metrics through the month of July for both project vehicles is shown below as table 1. The fuel penalty and NOx conversion values for "all modes" represent time averages based on all data. Cumulative NOx conversions values are shown for both vehicles in Figures 1 & 2.

Parameter	9858 (unit AD001)	9735 (unit AD002)
XononD up hours (cum hrs)	181	169
Truck hours (hrs)	234	229
Estimated fuel penalty (%)	11.2	4.9
Ave NOx conversion (%) (all modes)	27.8	43.6
Ave NOx conversion (%) (highway only)	20.8 – 41.1	52.1 – 73.9
Ave NOx conversion (%) (neighborhood only)	13.9 – 42.7	21.6 – 61.8

*Table 1 XononD July cumulative performance summary (all modes)*

The open triangles in Figure 1 show very low NOx conversions for truck 9858 which are attributed to an O<sub>2</sub> sensor failure and a failed fuel pump. After these items were replaced, the NOx conversion improved markedly (see Figure)

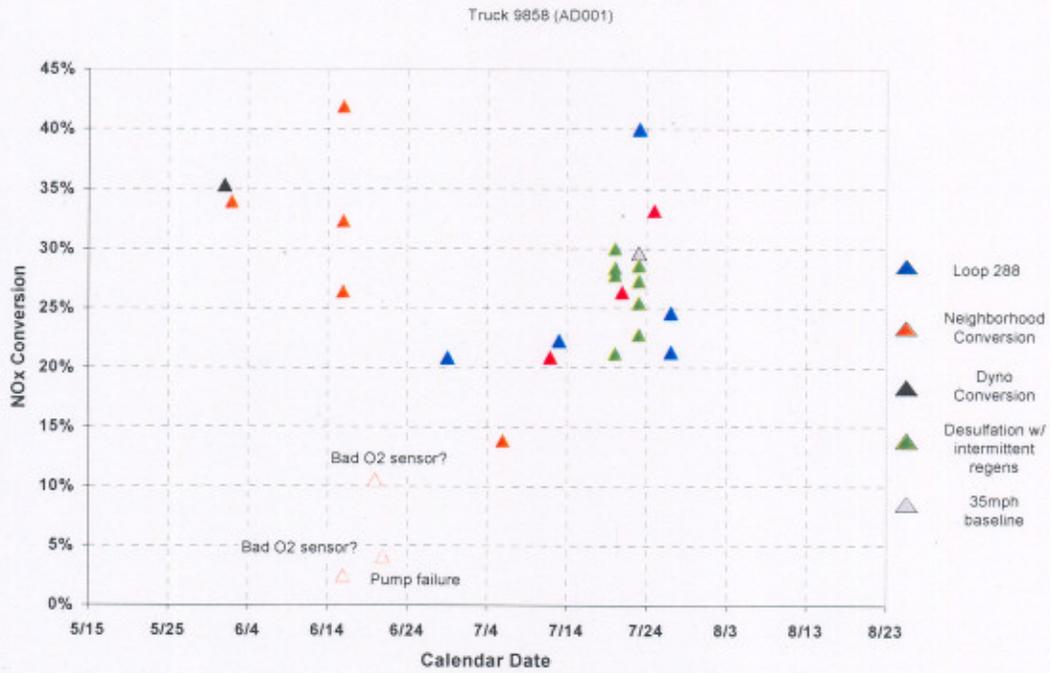


Figure 1 – Mobile NOx conversions for truck 9858 (all driving cycles thru 7/31)

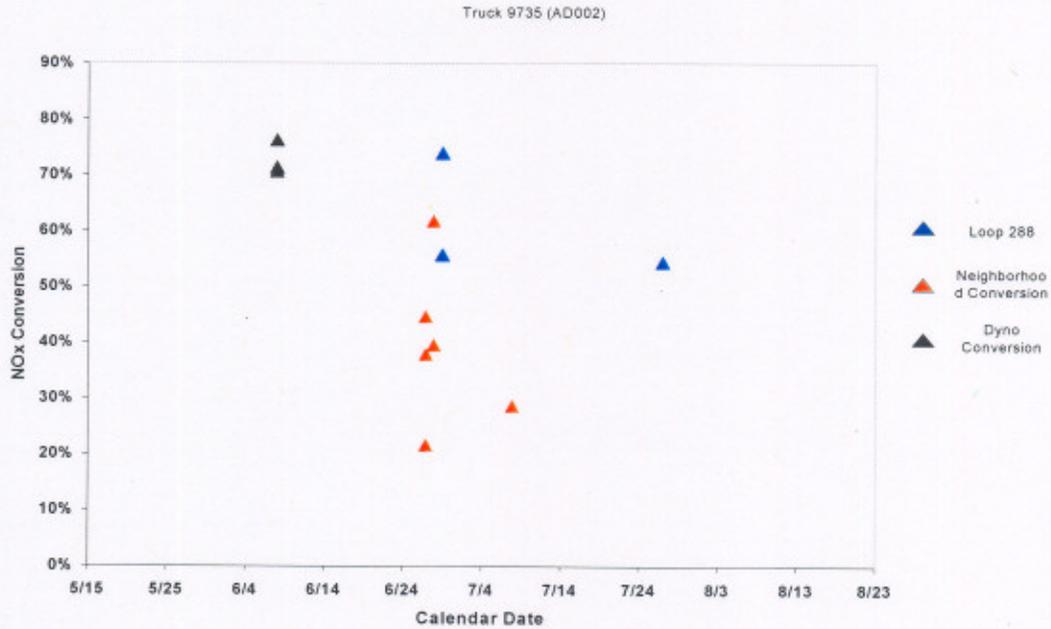


Figure 2 – Mobile NOx conversions for truck 9735 (all driving cycles thru 7/31)

It is clear from Figures 1 and 2 that duty cycle is one of the more important factors in maximizing the NOx reduction capabilities of the XononD system. It will be very important to select appropriate vehicle application targets before the verification process begins.

Figure 3 shows typical LNT regeneration trends and highlights capability of fully regenerating the LNT bricks while driving on highway mode. The green line represents the NOx trapping capacity of the system (from zero to 100%). As the traps fill up with NOx regeneration occurs to "clean" the NOx out of the trap and restore its trapping capacity. The red and blue lines represent engine out NOx and device out (tailpipe) NOx respectively. The data were measured using the Horiba NOx sensors which are located at both the device inlet and outlet ports as shown in Figure 4. Overall NOx reduction for this cycle was 54.5%.

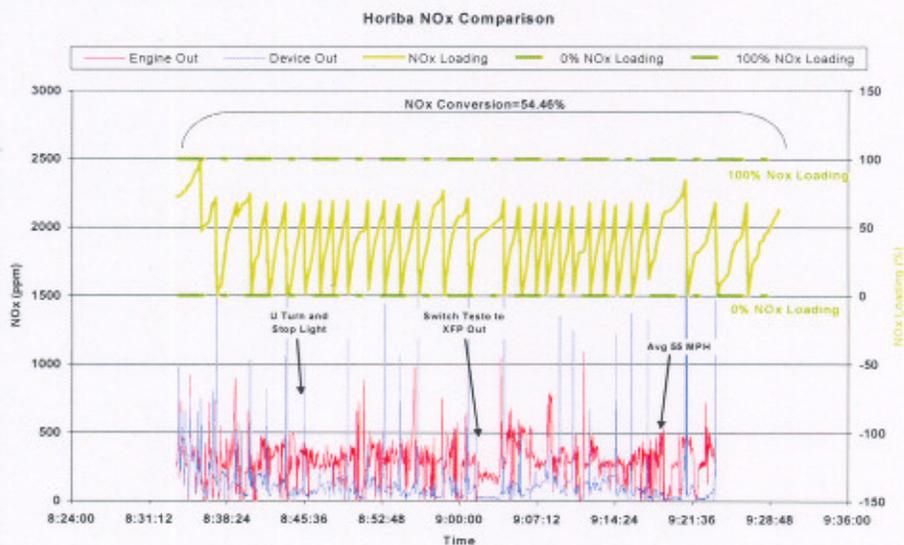


Figure 3 – Truck 9735 highway LNT NOx regeneration profiles

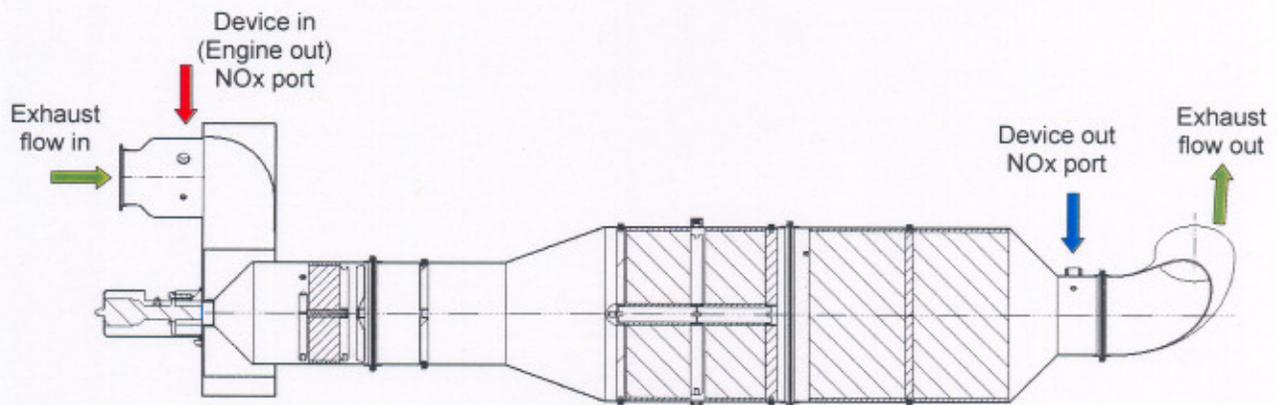


Figure 4 – XononD system showing exhaust measuring ports