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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: 5/9/05

Report for the **Monthly** period: April, 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 2 Accomplishments:

- Task 2.2.4
  - Completed the written report detailing the design of the testing program as shown in attachment 1
- All work associated with task 2 has now been completed

Task 3 Accomplishments

- Task 2.3.1
  - 100% of the Denton XononD components have been received at CESI
- Task 2.3.2
  - Both Denton XononD units have been fully assembled and are ready for dynamometer testing
- Task 2.3.4
  - Completed the written report detailing the hardware status for the Denton XononD units as shown in attachment 1
- All work associated with task 3 has now been completed

Task 4 accomplishments

- Task 2.4.1
  - The XononD unit designated as Denton AD002 was instrumented in preparation for the 24 hour green run test
- Task 2.4.2

- The XononD unit designated as Denton AD001 completed 100 hours of endurance testing running a variety of simulated FTP, Denton refuse cycles and steady-state AVL points

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 Tasks 2 through 4 in the Grant Agreement. Tasks 1 through 3 as described in the Grant Activities have been completed.

Section II: Problems/Solutions

Problem(s) Identified *(Please report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project)*	
Proposed Solution(s) *(Please report any possible solution(s) to the problem(s) that were considered/encountered)*	
Action(s) Conducted and Results *(Please describe the action(s) taken to resolve the problem(s) and its effect)*	

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) *Complete Task 2.4.1 activities*

   a. *Complete the 24 green run of Denton AD002 at the Gilbert AZ dynamometer*

(2) *Complete Task 2.4.5 activities*

   a. *Submit a written endurance and emissions performance test report on the two Denton units*

(3) *Complete Task 2.5.2 activities*

   a. *Complete the emission survey of the Denton vehicles without XononD installed*

   b. *This task will actually be completed in conjunction with Task 2.5.4 since we can measure engine out emissions at the same time as we measure tailpipe emissions*

(4) *Complete Task 2.5.3 activities*

   a. *Complete the installation of the XononD Denton units*

(5) *Complete Task 2.5.4 activities*

   a. *Complete the emission survey of engine out (Task 2.5.2) and tail pipe emissions while running a simulated AVL8 steady-state cycle on the Cummins Southern Plains chassis dynamometer*

Jay W Kinney

_____ Date: *5/9/05*

Authorized Project Representative's Signature

Attachment 1
Task 2 – Testing Program Report

Task 2 - Dynamometer Testing Using Xonon-D Prototype

In fulfillment of the TCEQ task 2 contract requirements, CESI has completed a Xonon-D after-treatment device test program. Task 2 requires that the PERFORMING PARTY (CESI) perform the following subtasks utilizing the vehicle data collected on the Denton vehicles under Task 1:

2.2.1 Develop a testing program to perform advanced testing of the Denton retrofit units using established AVL 8 mode cycle procedures, simulated FTP cycles and measured durability testing in a dynamometer cell for identification of issues associated with the retrofit unit. The dynamometer test cell at CESI's Gilbert, AZ facility offers a controlled environment to establish baseline performance and identify necessary improvements to ensure safe operation of the units in the field.

2.2.2 The testing program specified in task 2.2.1 relates to completion of dynamometer testing to gather durability data, estimate FTP performance and identify safety related improvements for the field installation.

Retrofit Dynamometer Cycle Test Description

Heavy duty transient FTP performance testing, AVL 8 mode testing and additional supplemental testing (Central Business District - CBD cycle) based on Denton vehicle data collected in Task 1 has been completed on Denton field units (SN AD001). The testing serves several purposes including: (1) provides a baseline measure of system performance from which field degradation effects can be assessed at controlled time intervals over the course of the demonstration program and, (2) highlights any early infant mortality issues related to the base field unit or any of its supporting sub-components including the fuel and electrical systems. The pre-installation performance and durability test of the first field unit (S/N AD001) has been completed and it was approximately 100 hrs in duration. The cycle consisted of a continuously repeating "loop" of AVL 8 mode points preceded each day by a full FTP cycle sequence. The FTP cycle speed and torque profiles are shown below for reference. The morning FTP sequence consisted of a cold start following an overnight soak followed by three subsequent warm restarts with 20 minute engine off periods between each individual cycle.

The individual FTP cycles were run in accordance with standard, established EPA procedures for that particular type of cycle. The EPA FTP speed and torque profiles are shown on the following page as Figure 1. Since the FTP cycle contains segments which are intended to replicate both urban and highway driving cycles, it is reasonable to conclude that a combination of the FTP cycle along with particular parts of the AVL 8 mode cycle are suitable for drawing performance and durability conclusions based on the duty cycle of the Denton refuse trucks.

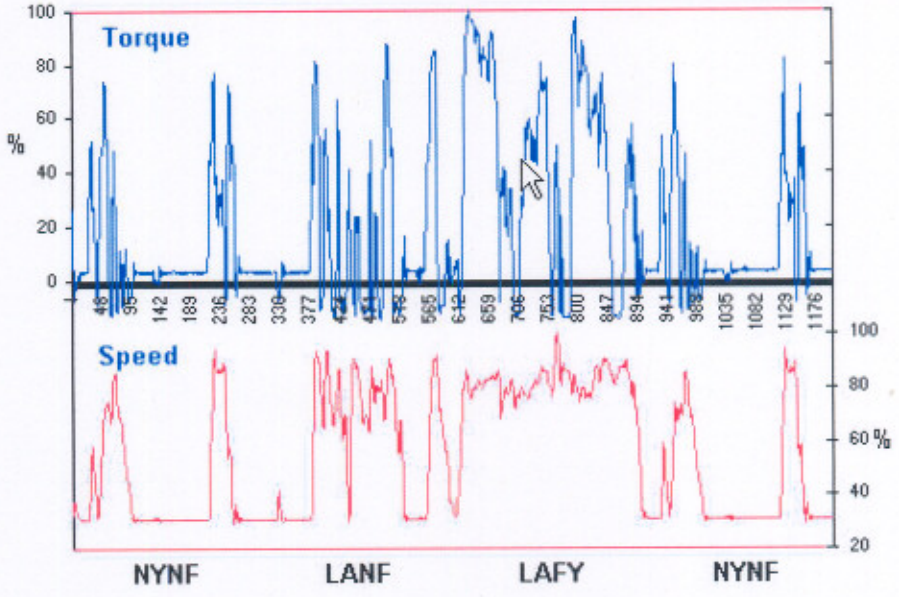

Figure 1: EPA FTP Speed and Torque Profiles

The test hardware configuration of the initial Denton unit (AD001) as tested in the 100 hr test program consisted of the actual catalyst and container hardware, fuel delivery system, electrical system and controls that will be used in the Denton vehicle installation in May 2005. Since real time improvements to the control software are being identified on an ongoing basis, controls upgrade patches were implemented at several points during the 100 hr test period. Software improvement "patches" may also be installed periodically during the Denton field demonstration program as necessary. Installation of these upgrades will require little time and effort and will generally be transparent to the vehicle operators.

The second unit (AD002) is scheduled to undergo performance and durability testing as well but with fewer hours (24 run hours) prior to installation. The same transient FTP test sequence followed by the looping AVL 8 mode sequence will be used to accumulate the 24 hrs of performance and durability tests on the second Denton unit and its related sub-systems. In addition to the AVL 8 mode and FTP transient tests, CESI has developed a customized cycle based on the EPA CBD (Central Business District) cycle (see Figure 2) which we believe may be a reasonable approximation of the vehicle duty of the Denton refuse trucks. The customized cycle was developed by combining (1) the measured engine speeds from a DT466E company test vehicle recorded whilst replicating the vehicle speed profile shown in figure 1 and, (2) the measured Denton exhaust gas temperature data collected under Task 1 as defined in the grant activities. The exhaust gas temperature data from the Denton refuse vehicle mapping is shown as Figure 3. The throttle and torque settings were established on the dynamometer to maintain the appropriate upper and lower exhaust gas temperature limits coupled with the appropriate engine speed ranges and excursions.

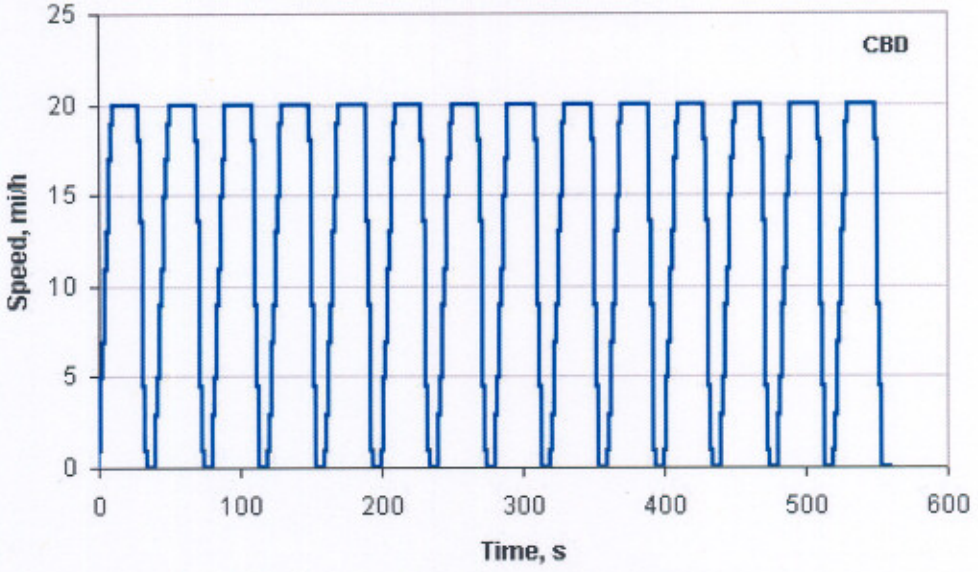

Figure 2 Central Business District Vehicle Cycle Profile

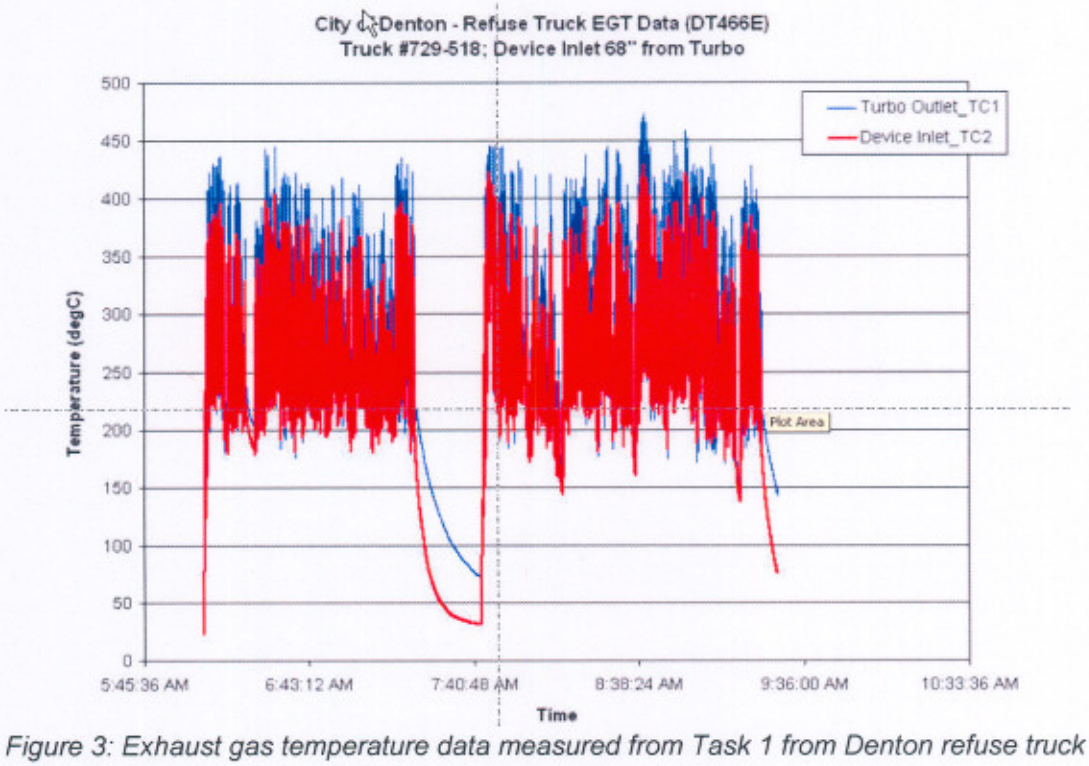

Figure 3: Exhaust gas temperature data measured from Task 1 from Denton refuse truck

The CBD cycle contains a repeating series of accelerations from zero to 20 mph over 10 seconds, a 20 second constant speed (20 mph) condition followed by a deceleration to zero speed in 5 seconds. This transient sequence repeats 14 times over approximately 10 minutes. It should be noted that since we were only able to gather exhaust gas

temperature data on the Denton vehicles and not engine exhaust flowrates, oxygen or torque levels, there are some assumptions that feed into the establishment of the "CESI equivalent" CBD cycle but we believe it is a reasonable approximation of the Denton vehicle engine exhaust conditions.

To summarize, CESI has completed the following dynamometer testing in fulfillment of Task 2:

Cycle	Denton Unit S/N	Total Test Hrs
EPA FTP/AVL8 Loops	AD001	100
CBD cycle	AD001	< 5
EPA FTP/AVL8 Loops	AD002	~24
CBD cycle	AD002	< 5

Table 1 Summary of performance and durability testing

Successful completion of the 100 hr and 24 hr acceptance testing of the sub-systems in conjunction with the main catalytic units will be important in proving out the "short term" reliability of the components and ensuring operational safety of the units prior to installation on the Denton refuse trucks.

Attachment 2
Task 3 – Hardware Status Report

09-May-2005
Darren Bisaro

Hardware Status Summary

- The two XononD™ Retrofit units are assembled, and have been serialized as AD001 and AD002. See Figures 1-10.
- Hardware kits necessary for the installation of units AD001 & AD002 onto vehicles have been procured.
- Unit AD001 has completed 100 hours of durability testing, and is awaiting shipment to customer's site.
- Unit AD002 will undergo at least 24 hrs of durability testing starting in early May.

Description	Qty Per Vehicle	CESI P/N	Qty Received
CATALYST MODULE ASSEMBLY	1	PP0060-1	2
TRANSITION TUBE ASY, 3.5"	1	PP0103	2
BACKING PLATE ASY	1	PP0152	2
THERMOCOUPLE ENCLOSURE	1	PP0145	2
MOUNTING PLATE ASY	1	PP0116	2
AUXILIARY CONTROL UNIT	1	PP0166	2
HANGER ASY	2	PP0097	4
PROTECTIVE SHIELD	2	PP0084	2
VEHICLE MOUNTING COMPONENT KIT	1	KT0001	2
DASHBOARD KIT	1	KT0002	2
ELECTRICAL SYS KIT	1	KT0003	2
FUEL DELIVERY KIT	1	KT0004	2

Table 1: Hardware Status of Key XononD Components & Assemblies

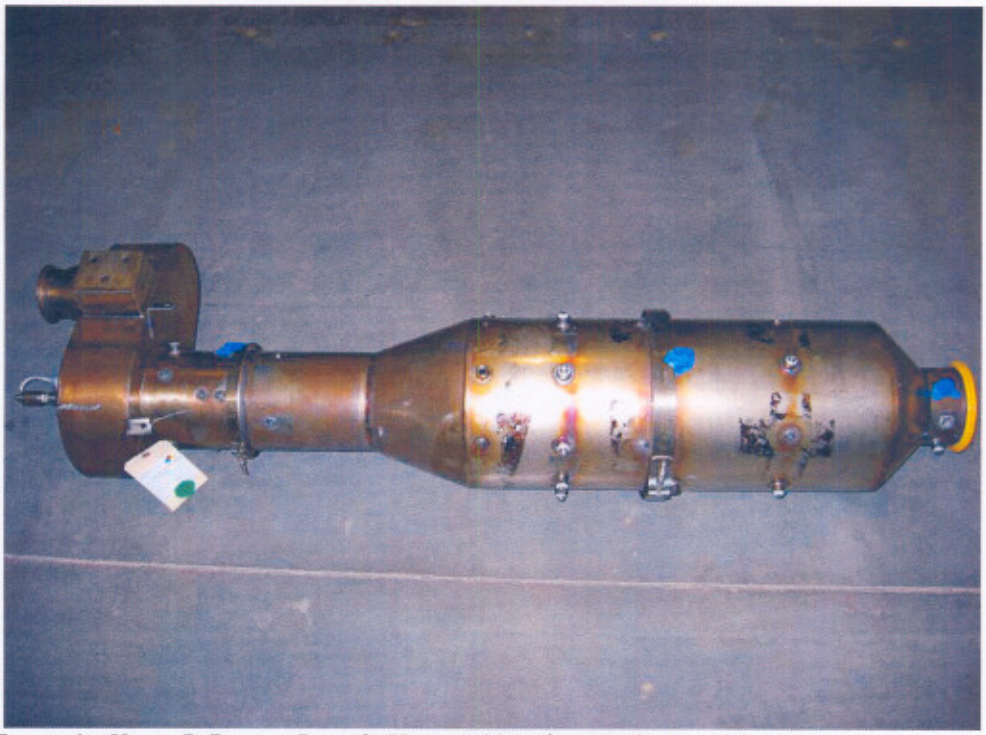

Figure 1: XononD Denton Retrofit Unit AD001 after 100 hours of dynamometer operation

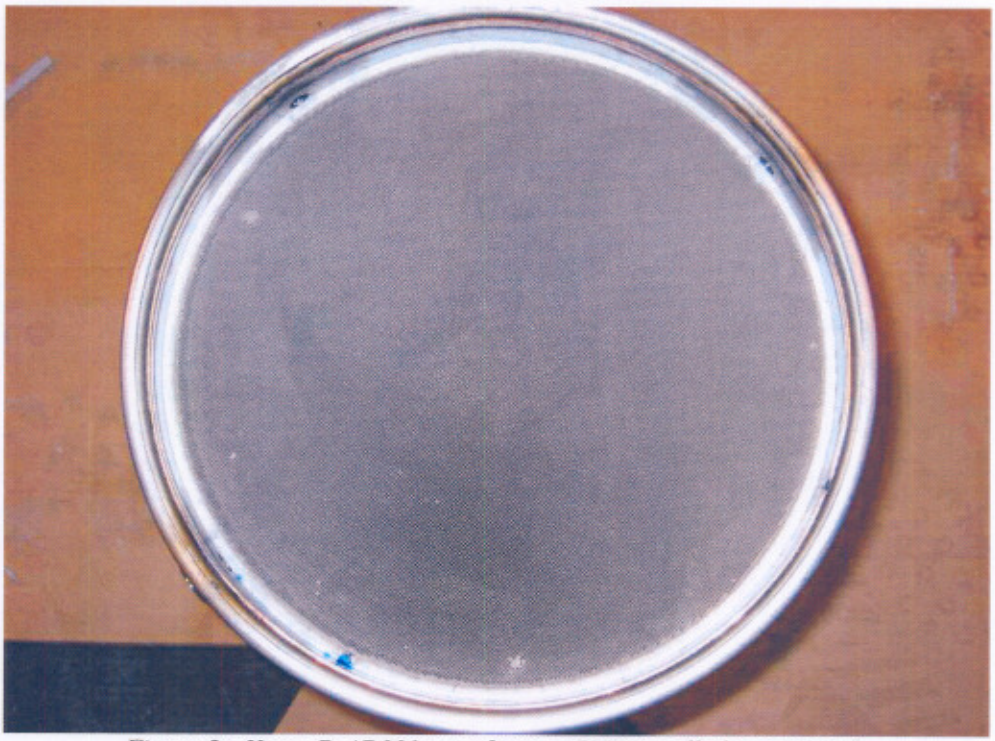

Figure 2: XononD AD001 unit showing LNT installed in container

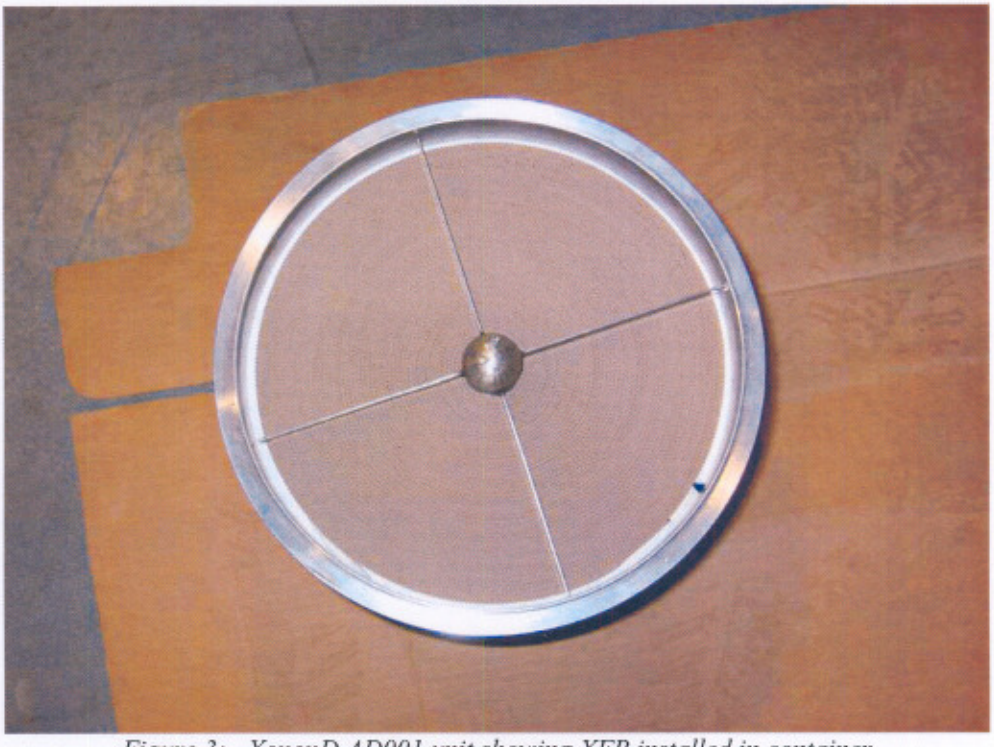

Figure 3:. XononD AD001 unit showing XFP installed in container

Figure 4: XononD Denton Retrofit Unit AD002 installed in engine test cell

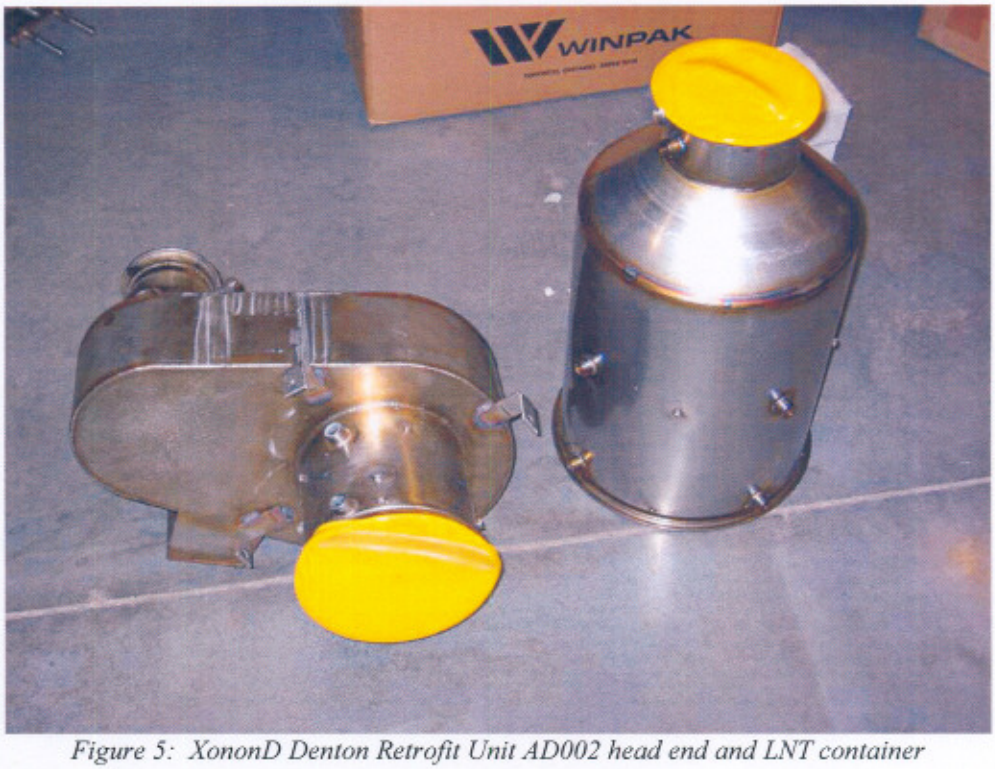

Figure 5: XononD Denton Retrofit Unit AD002 head end and LNT container

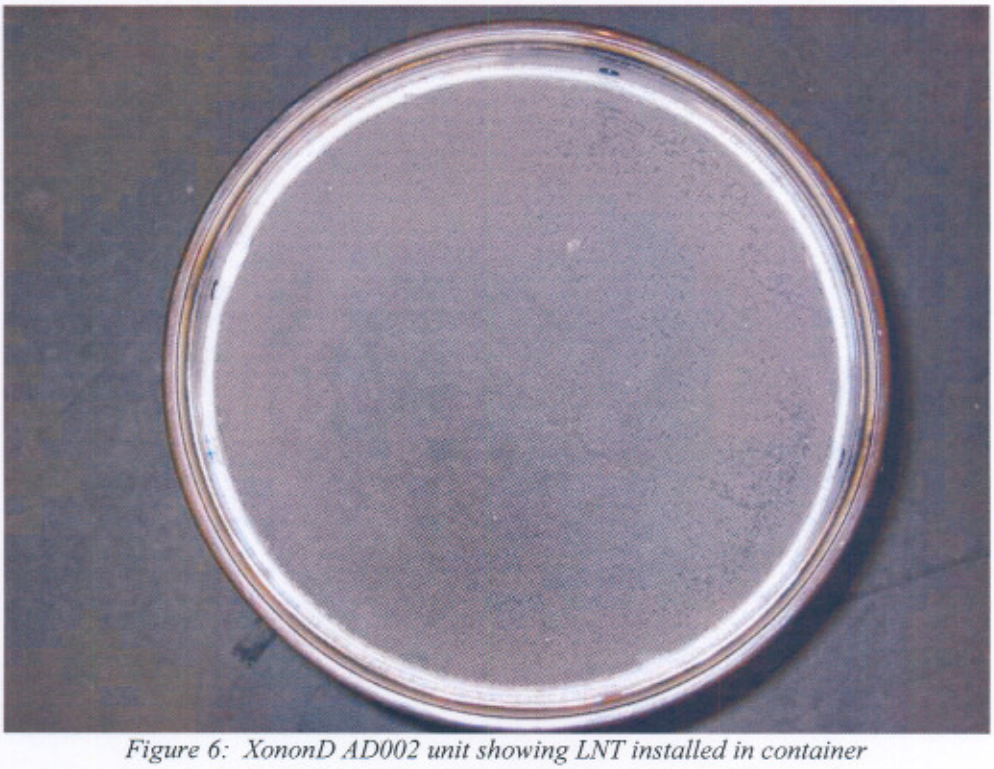

Figure 6: XononD AD002 unit showing LNT installed in container