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TESTING OF FUEL CELLS
TO RECOVER ENERGY
FROM LANDFILL GAS
GROTON LANDFILL

Prepared for

Office of Research and Development

Prepared by

National Risk Management
Research Laboratory
Research Triangle Park, NC 27711

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TESTING OF FUEL CELLS TO RECOVER ENERGY FROM LANDFILL GAS

GROTON LANDFILL
(Final Report)

by

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ABSTRACT

This report summarizes the results of a follow-on demonstration test, after a four-phase program with the U.S. Environmental Protection Agency under Contract 68-D1-0008, "Demonstration of Fuel Cells to Recover Energy from Landfill Gas." The environmental impact of widespread use of this concept would be a significant reduction of global warming gas emissions (methane and carbon dioxide). The follow-on work was conducted over the period from July 1995 through July 1997.

International Fuel Cells Corporation (IFC) conducted the original four-phase program to demonstrate that fuel cell energy recovery using a commercial phosphoric acid fuel cell is both environmentally sound and commercially feasible. Phase I, a conceptual design and evaluation study, addressed the technical and economic issues associated with operation of the fuel cell energy recovery system of landfill gas. Phase II included design, construction and testing of a landfill gas pretreatment unit (GPU) to remove critical fuel poisons such as sulfur and halides from the landfill gas, and to design fuel cell modifications to permit operation on low heating value landfill gas. Phase III was the demonstration test of the complete fuel cell energy recovery system at the Penrose landfill in Sun Valley, CA. Phase IV described how the commercial fuel cell power plant could be further modified to achieve full rated power on low heating value landfill gas.

The demonstration test at the Penrose landfill successfully demonstrated operation of the energy recovery system, including the GPU and commercial phosphoric acid fuel cell modified for operation on landfill gas. Demonstration results included operation of the fuel cell up to 137 kW; 37.1 percent efficiency at 120 kW; exceptionally low secondary emissions (dry gas, 15% O_2) of 0.77 ppmV carbon monoxide, 0.12 ppmV nitrogen oxides, and undetectable sulfur dioxide; no fuel cell related forced outages with adjusted availability of 98.5 percent; and a total of 709 hours operation on landfill gas. The pretreatment (GPU) operated for a total of 2,297 hours, including the 709 hours with the fuel cell, and documented total sulfur and halide removal to much lower than specified <3 ppmV for the fuel cell. The GPU flare safely disposed of the removed landfill gas contaminants by achieving destruction efficiencies greater than 99 percent.

The follow-on testing was conducted by Northeast Utilities at the Groton, CT landfill. Northeast Utilities provided the engineering design and construction for the installation and provided the operation and maintenance of the entire follow-on demonstration. IFC and a subsidiary, On-site Power (ONSI), provided technical support for the follow-on testing.

The follow-on test at the Groton, CT landfill demonstrated the suitability of the landfill gas-to-energy conversion equipment to operate on a wide range of landfill gas composition. Significant test results include successful demonstration of transportability of the landfill gas-to-energy equipment, and operation of the GPU for an additional 4,168 hours (total 6,413 hours) while continuing to remove halides and sulfur compounds to much less than the specified <3 ppmV. The fuel cell operated for an additional 3,313 hours (total 4,020 hours), and demonstrated 38.1% efficiency at 140 kW with a maximum output of 165 kW. Fuel cell adjusted availability was 96.5%, with one forced outage in the entire 4,020 hours of operation on landfill gas.

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2. Chuanteng, H., D. J. Herman, R.G. Minet, and T.T. Tsotsis, A Catalytic/Sorption Hybrid Process for Landfill Gas Cleanup, Ind. Eng. Chem. Res. , Vol. 36, No. 10, 1997.

ABBREVIATIONS

EPA	United States Environmental Protection Agency
IFC	International Fuel Cells Corporation
ONSI	A Subsidiary of IFC (from On-Site Power)
MSW	Municipal Solid Waste
NMOC	Non Methane Organic Compound
GPU	Gas Pretreatment Unit
QAPP	Quality Assurance Project Plan
LFG	Landfill Gas
VOC	Volatile Organic Compound
P&ID	Process and Intrumentation Diagram
ADG	Anaerobic Digester Gas (e.g., from waste water treatment plants)

UNITS AND CONVERSION FACTORS

		To Convert To	Multiply By
POWER			
MW	Megawatt	-	-
kW	Kilowatt	-	-
MASS			
Mg	Megagrams (10^6 grams)	pounds	2,205
Tg	Terragrams (10^9 grams)	pounds	2,204,600
VOLUME			
SCMD	Standard cubic meters per day	SCFD (std cubic feet/day)	35.3
SL/M	Standard liter per minute	SCFM (std cubic feet/min)	0.0353
PRESSURE			
Pa	Pascal	PSI	1.45×10^{-4}
HEATING VALUE			
Kcal/SL	Kilocalories per standard liter	Btu/SCF	112

1.0 EXECUTIVE SUMMARY

The U. S. Environmental Protection Agency (EPA) has promulgated standards and guidelines for the control of air emissions from municipal solid waste (MSW) landfills. This Clean Air Act regulation will result in the control of up to 7 Tg/year of CH_4. The collection and disposal of waste methane, a significant contributor to the greenhouse effect, would result from the emission regulations. This EPA action provides an opportunity for energy recovery from the waste methane that could further benefit the environment. Energy produced from landfill gas could offset the use of foreign oil, and reduce air emissions affecting global warming, acid rain, and other health and environmental issues.

International Fuel Cells Corporation (IFC) was awarded a contract by the US EPA to demonstrate energy recovery from landfill gas using a commercial phosphoric acid fuel cell. IFC conducted a four-phase program to show that fuel cell energy recovery is environmentally feasible in commercial operation. Work was initiated in January 1991. Phase I, a conceptual design and evaluation study, addressed the problems associated with landfill gas as the feedstock for fuel cell operation.

Phase II of the program included construction and testing of the landfill gas pretreatment module to be used in the demonstration. Its objective was to determine the effectiveness of the pretreatment system design in removing critical fuel cell catalyst poisons such as sulfur and halides.

Phase III of this program was a demonstration of the complete fuel cell energy recovery concept.

Phase IV prepared guidelines and recommendations describing how the PC25™ C power plant could be modified to achieve full-rated power of 200 kW on landfill gas, based upon the experience gained testing the PC25 A model in this program.

A follow-on phase was added to continue the energy recovery demonstration for an additional year of operation at a landfill in Groton, CT. The results of the first four phases are summarized in Reference 1. The results of the follow-on activities are described in this report. This work was conducted from July 1995 through July 1997, with the 1 year demonstration period from July 15, 1996 through July 15, 1997.

The follow-on testing was conducted by Northeast Utilities. Northeast Utilities provided the engineering design and construction for the installation and provided the operation and maintenance for the entire follow-on demonstration. IFC and ONSI (a subsidiary of IFC) provided technical support for the follow-on testing.

The objective of the follow-on demonstration is to further demonstrate the suitability of the landfill gas energy conversion equipment, including a modified commercially available fuel cell power plant, for future commercial operation on a wide variety of landfills. Specific goals include: 1) demonstrate the transportability of the equipment; 2) demonstrate the adaptability of the demonstration especially the gas pretreatment unit (GPU), to operation on different landfill gas compositions; 3) obtain longer term operating data for cost and reliability, including operation of the equipment as a remote unmanned site; and 4) obtain additional data which could be used to reduce the cost of the gas cleanup unit.

Figure S-1 shows the energy recovery demonstration system installed at the Groton Landfill site. The demonstration equipment is contained within a 13.1 meter (43 foot) wide by 41 meter (135 foot) long enclosure surrounded by a chain link fence. The demonstration equipment includes, from left to right: 1) a small trailer which serves as a temporary office (the site is unmanned) and houses the GPU controls; 2) the pre-engineered building which houses the Gas Pretreatment Unit (GPU) and

landfill gas compressor; 4) the commercial fuel cell power plant which has been modified for operation on landfill gas; and 5) the step-up transformer which boosts the 480 VAC output from the fuel cell to 13,800 VAC output for use on the utility grid. Not shown on the figure are the GPU flare, and the existing landfill gas flare and condensate storage tank which are maintained by the Town of Groton. The site layout showing the location of all the equipment is shown in Figure S-2.

The landfill gas at the Groton landfill was characterized and compared with the Penrose site to determine if modifications would be required for the demonstration equipment. The results, shown in Table S-1, show that the Groton landfill gas, with 56.95% methane, is at the high end of landfill gas compositions, compared with the Penrose site at 44% methane. The higher methane content is responsible for a 31% increase in the heating value of the gas at Groton, to 5.22 Kcal/SL. The contaminant mix at Groton is also different. Halogenated hydrocarbons as chloride are lower at Groton, 7 to 45 ppmV vs. 45 to 65 ppmV at Penrose. Hydrogen sulfide levels are higher at Groton, at 181 ppmV vs. 100 ppmV at Penrose. Organic sulfur compounds (expressed as equivalent H_2S) is lower at Groton, at 1 ppmV vs. 11 ppmV at Penrose. Due to the higher hydrogen sulfide at Groton, Northeast Utilities installed two additional 992 liter (35 cubic foot) capacity tanks filled with Westates UOCH-KP carbon, for a longer changeout interval.

A simplified diagram for the demonstration equipment used to process contaminated landfill gas into clean electric power at the Groton landfill is shown on Figure S-3. The process proceeds from contaminated landfill gas coming in at the left, with electric power exiting to the right. The shaded components on the left were added to the demonstration at Groton. The additions include two new H_2S removal beds and the landfill gas compressor rated at 2260 SL/M at 2.76×10^5 Pa (80 scfm at 40 psig). The remaining equipment was transported from the Penrose landfill in Sun Valley, CA.

The impregnated UOCH-KP carbon beds remove virtually all of the hydrogen sulfide. These beds are not regenerated on site, but the carbon can be removed and regenerated off site if desired. The gas is regulated down from 2.8×10^5 to 1.5×10^5 Pa, before being cooled to approximately 2° C in the first stage refrigeration condenser. The condenser stage removes most of the water and some hydrocarbons, which are removed from the system as a condensate and returned to the Groton site condensate tank. The next step is a regenerable adsorption bed which removes the water vapor to a dew point of minus 50° C and also removes additional sulfur and halides. The dry gas is then passed over a second stage cooler where the gas temperature is reduced to -28° C before going through a regenerable activated carbon bed at -18° C for final removal of trace hydrocarbons, sulfur, and halides. The final step is fine pore filtration to remove any particulates or dusting which may come from the regenerable adsorbent beds. The clean dry gas is regulated down to about 3.5×10^3 Pa pressure. The resulting gas to the fuel cell is approximately 1560 standard liters per minute at 3.5×10^3 Pa pressure with major contaminants reduced to less than 0.025 ppmV total halides and total sulfur.

The dryer and carbon beds are regenerated using clean dry landfill gas from the exit of the pretreatment system. The regeneration gas is heated to 288° C in an electric heater, and passed counter-current through the regenerable dryer and activated carbon beds to remove the water and contaminants. The contaminants are destroyed in a low NOx flare.

The fuel cell section of the demonstration consists of three major subsections: the fuel processor, the cell stack; and the inverter. The fuel processor removes oxygen and any residual sulfur in the landfill gas and converts the landfill gas to a hydrogen rich fuel. The next stage in the fuel cell power plant is the cell stack. The stack converts air and the hydrogen rich fuel from the the fuel processor to make dc power and thermal energy. DC power is sent to the inverter which converts the dc power

to 60 cycle ac at 480 volts and provides safe, electrical interconnect to the grid. All heat from the power plant during the demonstration is rejected to the air by the cooling module.

The fuel cell power plant emits a clean exhaust stream consisting primarily of carbon dioxide, water vapor, nitrogen, and oxygen. During operation on landfill gas in Phase III the fuel cell exhaust emissions, at 15% oxygen on a dry gas basis, were measured as follows: NOx = 0.12 ppmV; carbon monoxide = 0.77 ppmV; and SO_2 = undetectable. These results are discussed in more detail in Section 6.3.3 of Reference 1.

The follow-on demonstration results are summarized in Table S-2. The GPU operated for an additional 4168 hours at Groton for a total of 6465 hours on landfill gas. Gas cleanup performance at the GPU exit remained significantly better than the design requirements of less than 3 ppmV total halides (as chloride) and less than 3 ppmV total sulfur (as H_2S). Total measured halides varied from nondetectable to 0.014 ppmV as chloride. Total sulfur varied from nondetectable to a maximum of 0.022 ppmV as H_2S. These data indicate the 8,000 hours design life for the GPU beds should be met and probably exceeded.

Fuel cell powerplant performance at Groton is also improved from 137 kW at Penrose, to 165 kW at Groton, due to the 31% increase in higher heating value of the Groton landfill gas. Efficiency also improved, from 37.1% at 120 kW at Penrose, to 38.1% at 140 kW at Groton. The fuel cell operated for 3313 hours at Groton, for a total of 4022 hours on landfill gas. During this 4022 hours, there was only one forced outage due to the fuel cell. Fuel cell adjusted availability was 98.5% at Penrose, and 96.5% at Groton. Based on these results, the fuel cell powerplant operating on landfill gas is expected to have operation and maintenance cost similar to the PC25 powerplants operating on natural gas.

Table S-1 Comparison of Landfill Gas at Groton, CT and at Penrose Landfill in Sun Valley, CA

Item	Units	Penrose (CA)	Groton (CT)
Gas Composition			
CH_4	%	44.0	56.95
CO_2	%	38.0	41.34
N_2	%	17.6	1.29
O_2	%	0.4	0.41
LFG Higher Heating Value	kcal/SL	3.98	5.22
LFG Contaminants			
Total Halides (as Cl)	ppmV	45 to 65	7 to 45
Organic Sulfur (as H_2S)	ppmV	11	1
Hydrogen Sulfide	ppmV	100	181

Table S-2 Summary of Demonstration Performance at Penrose Landfill and Groton Landfills			
Item	**Units**	**Penrose (CA)**	**Groton (CT)**
GPU Performance			
Total Time on LFG	Hours	2297	4168
Exit Total Sulfur (as H_2S)	ppmV	$\leq$0.047	$\leq$0.022
Exit Total Halides (as CL)	ppmV	$\leq$0.032	$\leq$0.014
Fuel Cell Performance			
Maximum Power	kW	137	165
Efficiency		37.1% @ 120 kW	38.1% @ 140 kW
Total Time on LFG	Hours	709	3313
Forced Outages		0	1
Availability		98.5%	96.5%

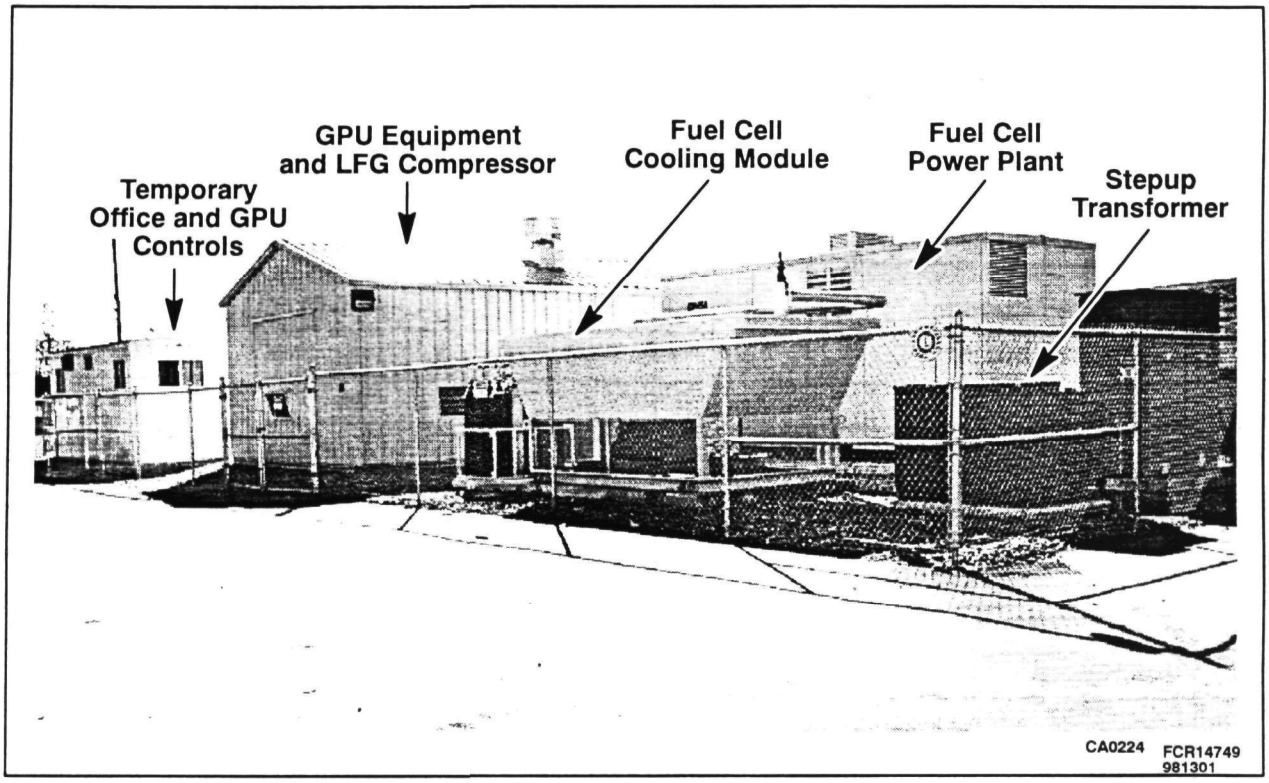


Figure S-1. Energy Recovery Demonstration System Installed at Groton, CT Landfill Site

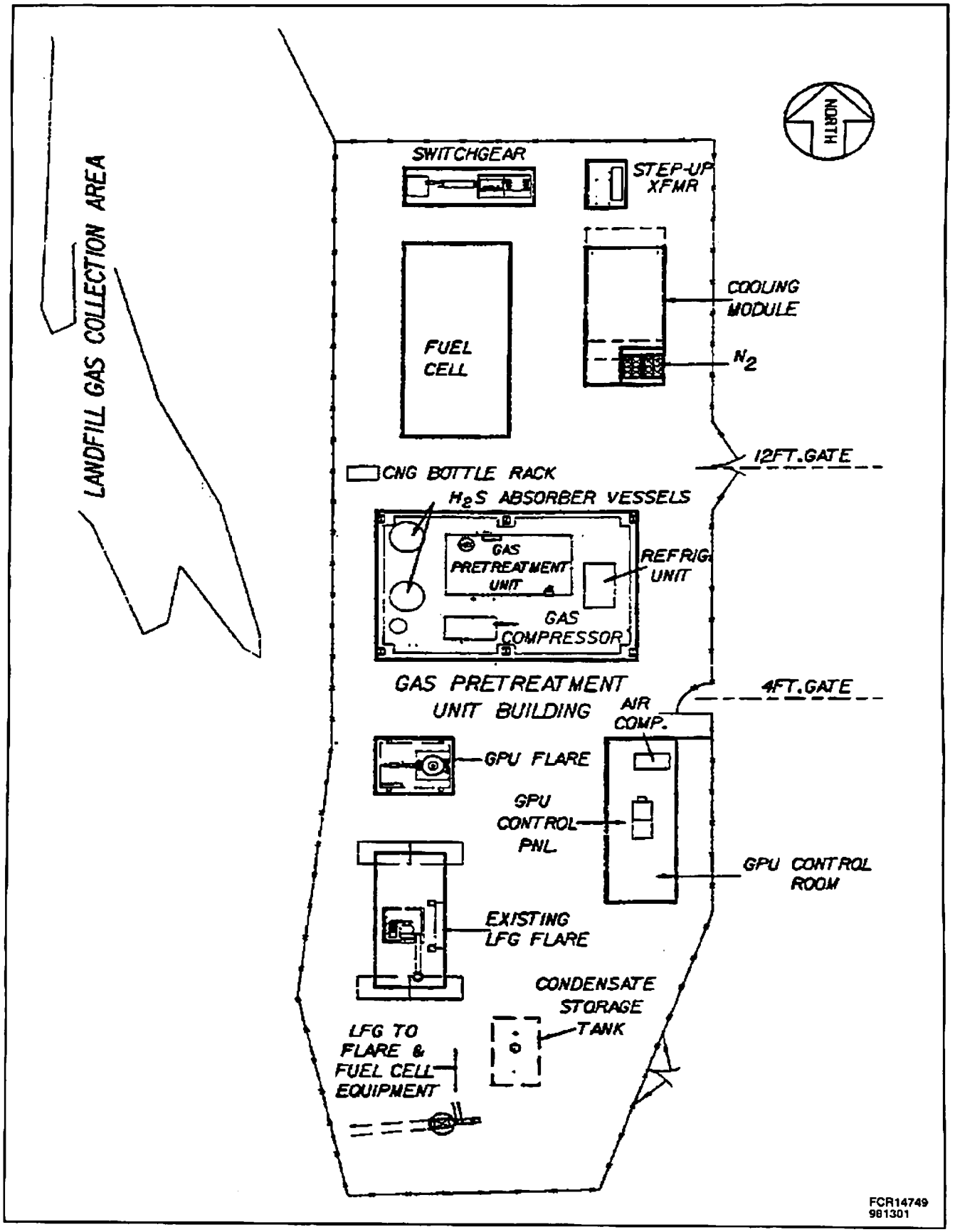


Figure S-2. Groton Fuel Cell Site Layout

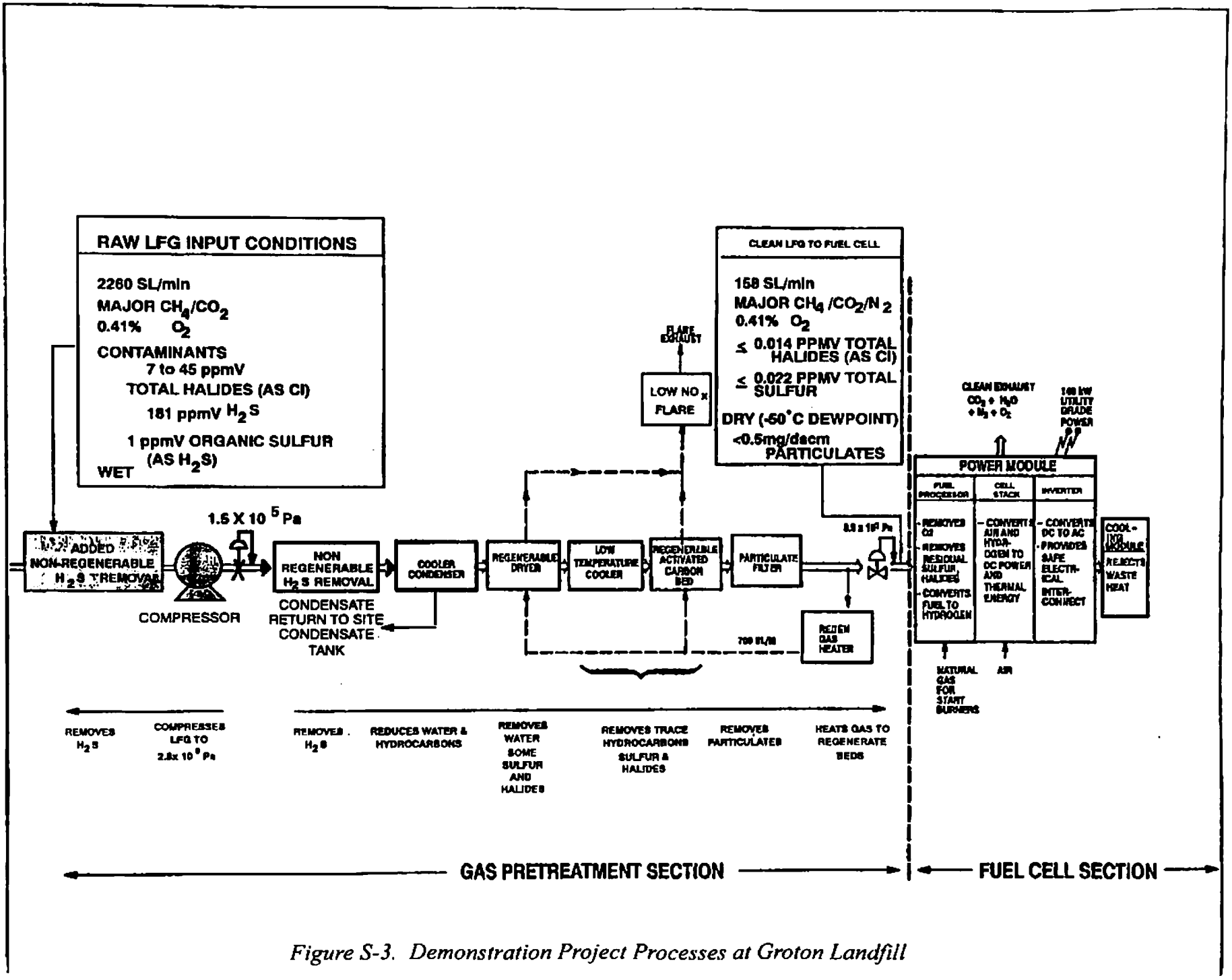


Figure S-3. Demonstration Project Processes at Groton Landfill

2.0 INTRODUCTION

This report summarizes the results of a landfill gas-to-energy demonstration sponsored by the U. S. Environmental Protection Agency under Contract 68-D1-0008, "Demonstration of Fuel Cells to Recover Energy from Landfill Gas". The environmental impact of this concept would be a significant reduction in global warming gas emissions (methane and carbon monoxide). The work summarized in this report was conducted over the period from July 1995 through July 1997, as a follow-on to the demonstration conducted at the Penrose Landfill in Sun Valley, CA. from January, 1991 through June, 1995. The California testing is summarized in Reference 1.

The objective of the follow-on demonstration is to further demonstrate the suitability of the landfill gas energy conversion equipment, including a modified commercially available fuel cell power plant, for future commercial operation on a wide variety of landfills. Specific goals include: 1) demonstrate the transportability of the equipment; 2) demonstrate the adaptability of the demonstration, especially the gas cleanup unit (GPU), to operation on different landfill gas compositions; 3) obtain longer term operating data for cost and reliability, including operation of the equipment as a remote unmanned site; and 4) obtain additional data which could be used to reduce the cost of the gas cleanup unit.

The follow-on demonstration was conducted by Northeast Utilities, at the Groton CT landfill. Northeast designed and constructed the site, and conducted a one year field test from July 15, 1996 through July 15, 1997. International Fuel Cells and their ONSI subsidiary provided technical support for the follow-on testing.

Section 3 of this report summarizes the results of the one year demonstration at Groton, CT. The Groton site design, permitting, and installation activities are described in Section 3.1. This section compares the Groton landfill gas quality including heating value and contaminant levels to those found at the Penrose site in Sun Valley CA. This section also describes the modifications made to the demonstration equipment to permit year round operation at a site where winter temperatures can fall to below -18°C.

Section 3.2 describes the demonstration test results. Section 3.2.1 summarizes the Test Plan and Quality Assurance Plan for the 1 year test. Section 3.2.2 summarizes the GPU results, including operation and reliability, improvements for extended operation, long term contaminant removal performance, and testing conducted to gather data for reducing the cost of the GPU. Section 3.2.3 summarizes the fuel cell performance test results, including operation and reliability, efficiency, and operating costs.

Section 4 gives the conclusions and recommendations for the one year test at the Groton landfill.

3.0 DEMONSTRATION TEST

3.1 GROTON SITE DESIGN AND INSTALLATION

3.1.1 Site Selection

The site selection criteria for the follow on demonstration were based on EPA's desire to demonstrate the fuel cell energy conversion system at a wide variety of site conditions using different landfill gas compositions. The site selection was narrowed down to Connecticut and Massachusetts when Northeast Utilities became the host utility for the test. The Groton landfill was an ideal site, recently closed with a cap and collection system installed and a temporary flare in operation. Preliminary testing indicated adequate gas available at the site, and the Town of Groton was supportive of installing the demonstration at the site, which presently consists of a transfer station and a recycling facility for bottles and cans. Special considerations at Groton included lack of sanitary sewers and natural gas supply at the site.

3.1.2 Comparison Of Groton Landfill Versus Penrose

The first step in the demonstration project is to characterize the landfill gas supply to determine the suitability for energy recovery. Critical issues include gas availability (flow rate, pressure, and reliability of supply), heating value, and levels of contaminants which could require modification to the GPU.

Information provided by the Town of Groton indicated the landfill was producing approximately 11,300 SL/M (400 SCFM) of landfill gas, sufficient to support four 200 kW landfill gas fuel cells. A significant difference between the Groton facility and the Penrose site is pressure of the gas. At the Penrose site the landfill gas was compressed to 6.9×10^5 Pa (100 PSIG) to support the 8.9 MW of internal combustion engines at that site. Groton utilizes only a multistage Lamson electric drive blower to draw the gas out of the landfill at a slight vacuum and push the gas to a temporary flare, so a compressor would be required for the GPU at the Groton site.

A comparison of the Groton landfill gas composition and heating value vs. the Penrose site is shown in Table 3.1.2-1. The data include analyses taken in 1995 prior to the demonstration, to June 1997, near the end of the demonstration test. The fixed gas composition (oxygen, nitrogen, methane, and carbon dioxide) indicate a high quality gas with higher methane content and less diluents than Penrose. The average methane content at Groton is 56.95% versus 44% at Penrose. The higher methane content facilitates a higher maximum output from the fuel cell power plant. The average nitrogen content at Groton is only 1.29% versus 17.6% at Penrose, and the average carbon dioxide content is 41.34% at Groton versus 38% at Penrose. Oxygen content at Groton averages 0.41% versus 0.4% at Penrose. In summary, the Groton landfill gas represents a "high end" landfill gas composition closer to the gas from an anaerobic digester at a waste water treatment plant, while the Penrose site is a good representative of a lower quality landfill gas from an area where landfill management must also take into account the competing requirements to minimize methane and NMOC emissions into the atmosphere.

Table 3.1.2-2 summarizes the results of testing the raw landfill gas at Groton for halogenated hydrocarbons. The gas samples were taken from September 19, 1995 through June 19, 1997. A total of 22 compounds was identified. Total halogenated species varied from 5.463 ppmV to 7.345 ppmV on September 19, 1995, to a maximum of 13.136 ppmV on November 1, 1995, declining to 3.085 ppmV on the last sample taken on June 19, 1997. The most significant change is in the dichlorodifluoromethane, which peaked at 10.2 ppmV on November 11, 1995 and declined to 0.84 ppmV on

June 19, 1997. The total halogen as chlorides (equal to the sum of the individual species times the number of halogen atoms per each species) varied from about 16 ppmV to 45 ppmV. This is less than the 45 ppmV to 65 ppmV found at the Penrose site, and indicated that no modifications were required to the low temperature carbon beds in the GPU for the Groton site. Total halogens declined to 7 ppmV on June 19, 1997 near the end of the test.

The concentration of hydrogen sulfide (H_2S) varied considerably before and during the demonstration test period. Data from 28 individual wells taken on December 29, 1994 (Table 3.1.2-3) shows concentrations varying from 17 to 2000 ppmV, with an arithmetic average concentration of 430 ppmV. A sample taken at the town flare on January 11, 1995 tested at 1380 ppmV H_2S. The H_2S levels at Groton were significantly higher than the 100 ppmV H_2S measured at Penrose and would require higher capacity sulfur removal beds to reduce the operating and maintenance cost associated with the bed changeouts.

Northeast Utilities procured on site measuring equipment (Draeger pump and glass measuring tubes) to measure H_2S in the raw landfill gas. The results, summarized in Figure 3.1.2-1 confirmed that the H_2S is much higher than measured at Penrose, but has declined significantly with time. Northeast measured H_2S levels from 500 ppmV to 300 ppmV during March 1996, and selected 500 ppmV as the basis for sizing the hydrogen sulfide removal beds for the GPU. The H_2S levels as measured by the Draeger tube have continued to decline, reaching a low of just 18 ppmV on May 5, 1997. The average raw landfill gas concentration for the period from March 12, 1997 through May 5, 1997 is 181 ppmV.

An analysis for organic sulfur compounds prior to the demonstration on January 11, 1996, showed 0.9 ppmV dimethyl sulfide. The remaining organic sulfur compounds (dimethyl disulfide, methyl mercaptan, carbonyl sulfide, and carbon disulfide) were not detected at a 0.1 ppmV detection limit. These low levels of organic sulfur would not require any modification to the GPU.

Table 3.1.2-1. Comparison of Groton Landfill Gas Composition and Heating Value Versus Penrose

	DATE SAMPLED AT GROTON												
												Groton	Penrose
GAS (%)	12/1/95	6/18/96	6/19/96	7/15/96	3/20/97	5/19/97	5/19/97	6/19/97	6/19/97	6/19/97	7/9/97	Aver.	Aver.
Oxygen	0.9	0.4	0.2	0.024	0.01	0.49	0.47	0.28	0.67	0.64	0.42	0.41	0.4
Nitrogen	3.2	1.5	0.7	0.17	0.07	1.68	1.68	0.93	1.45	1.36	1.42	1.29	· 17.6
Methane	57.1	55.5	52.0	57.7	57.78	56.59	56.86	57.32	58.7	58.89	57.97	56.95	44.0
Carbon Dioxide	44.5	40.0	44.5	41.5	42.14	41.24	41.0	41.46	39.15	39.09	40.19	41.34	38.0
Total	105.7	97.4	97.4	99.394	100	100	100	100	100	100	100	99.99	100
Gross Heating Value (Btu/Ft^3					585.5	573.4	576.0	580.9	595.5	597.2	587.4	585.1	445.8
Gross Heating Value (Kcal/SL)					5.23	5.12	5.14	5.19	5.32	5.33	5.24	5.22	3.98
Gas Sample Number	#2	#4	#5	#7	#11	#12	#13	#14	#17	#18	#21		

Table 3.1.2-2. Raw Groton Landfill Gas Analysis Results for Halogenated Hydrocarbons

				HALOGEN SPECIES CONC.					TOTAL HALOGENS ASCl				
COMPOUND	FORMULA	MOL. WT.	HAL/ MOL	9-19-95A ppbV	9-19-95B ppbV	1-11-96 ppbV	3-20-97 ppbV	6-19-97 ppbV	9-19-95A ppbV	9-19-95B ppbV	1-11-96 ppbV	3-20-97 ppbV	6-19-97 ppbV
Bromobenzene	C6H5Br	156.9	1	8	9	31			8	9	31	0	0
Bromoform	CHBr3	252.7	3	0	0	100	0	0	0	0	300	0	0
Bromomethane	CH3Br	94.9	1	165	319	0	0	0	165	319	0	0	0
Carbon Tetrachloride	CCl4	153.8	4	70	82	0	0	0	280	328	0	0	0
Chlorobenzene	C6H5Cl	112.45	1	319	339	0	230	0	319	339	0	230	0
Chloroethane	C2H5Cl	64.45	1	464	719	973	640	810	464	719	973	640	810
Chloroform	CHCl3	119.4	3	60	70	100	0	0	180	210	300	0	0
Chloromethane	CH3Cl	50.45	1	82	93	1,070	78	0	82	93	1,070	78	0
Dichlorodifluoromethane	CCl2F2	120.9	4	3,150	4,170	10,200	(1)	840	12,600	16,680	40,800	(1)	3,360
1,1-Dichloroethane	C2H4Cl2	98.9	2	128	149	22	110	69	256	298	44	220	138
1,2-Dichloroethane	C2H4Cl2	98.9	2	12	13	0	0	0	24	26	0	0	0
1,1-Dichloroethene	C2H2Cl2	96.9	2	92	113	0	0	0	184	226	0	0	0
trans-1,2-Dichloroethylene	C2H2Cl2	96.9	2	48	54	0	0	0	96	108	0	0	0
cis-1,2-Dichloroethylene	C2H2Cl2	96.9	2	(1)	(1)	(1)	120	110	(1)	(1)	(1)	240	220
cis-1,3-Dichloropropylene	C3H4Cl2	110.9	2	283	323	0	0	0	566	646	0	0	0
Methylene chloride	CH2Cl2	84.9	2	58	66	55	58	58	116	132	110	116	116
Tetrachloroethylene	CCl4	165.8	4	18	22	12	68	51	72	88	48	272	204
1,1,1-Trichloroethene	CH3Cl3	121.4	3	0	0	18	27	20	0	0	54	81	60
Trichloroethylene	CHCl3	119.4	3	0	0	13	30	34	0	0	39	90	102
Trichlorofluoromethane	CCl3F	137.4	4	12	15	212	260	270	48	60	848	1,040	1,080
Trichlorotrifluoroethane	CCl3F3	175.4	6	(1)	(1)	(1)	12	23	(1)	(1)	(1)	72	138
Vinyl chloride	C2H3Cl	62.45	1	506	789	330	640	800	506	789	330	640	800
Totals				5,463	7,345	13,136	2,273	3,085	15,966	21,070	44,947	3,719	7,028
Notes			(2)	(3)	(3)	(3)	(3), (5)	(3)	(4)	(4)	(4)	(4),(5)	(4)

1. Analysis not performed for this species
2. Number of halogen atoms per molecule
3. ppbV of halogen species
4. ppbV halogens as chlorides, equal to sum of species times number of halogen atoms per molecule
5. Total value low due to no analysis for Dichlorodifluoromethane, and 8 day storage in Tedlar bag

Table 3.1.2-3. Hydrogen Sulfide Level at Individual Wells at the Groton Landfill On December 29, 1994					
Well No.	**H_2S Level (ppm)**	**Well No.**	**H_2S Level (ppm)**	**Well No.**	**H_2S Level (ppm)**
1	*	11	1420	21	160
2	120	12	850	22	78
3	275	13	277	23	160
4	18	14	260	24	25
5	490	15	1078	25	465
6	155	16	225	26	2000
7	*	17	25	27	50
8	525	18	101	28	1250
9	611	19	404	29	390
10	17	20	275	30	345
Average of 28 Wells = 430 ppmV H_2S					

Industrial Scientific H_2S Meter
* = Fitting broken during sampling event
Sampling conducted December 29, 1994

Data taken by Draeger Tube
Raw LFG sampled at Temporary Flare Inlet

Date	Temp. Flare (ppmV)
3/12/96	500
3/12/96	475
3/12/96	450
3/20/96	350
3/20/96	400
3/21/96	375
3/21/96	300
5/7/96	200
5/7/96	200
6/3/96	225
7/17/96	275
8/5/96	300
8/7/96	350
8/8/96	
8/22/96	275
9/3/96	250
12/9/96	140
1/22/97	100
2/11/97	60
3/3/97	45
5/5/97	18
Average	181

Hydrogen Sulfide in Raw Landfill Gas at Groton

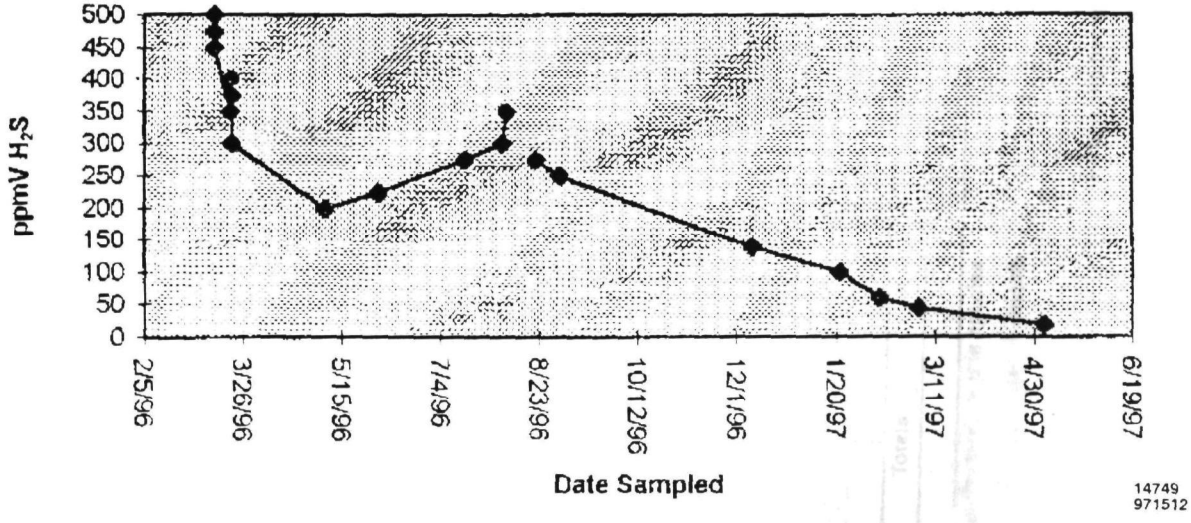


Figure 3.1.2-1. Raw Landfill Gas H_2S Concentration Versus Time at Groton Landfill

3.1.3 Permitting

Northeast Utilities is exempt from local permitting requirements due to its status as a regulated utility. However, all new facilities must be reviewed and approved by the Connecticut Siting Council. Application was made to the Connecticut Siting Council on October 1995. After the required public hearings, a permit was granted on January 23, 1996.

The State of Connecticut has approved a blanket exemption for fuel cells for air emissions permitting, so no air permitting was required for the demonstration project at Groton. The State also regulates water discharges, and required Northeast to provide water analyses from the fuel cell, which can produce a small overflow of clean condensate water from the water treatment system. This condensate flow is normally directed into a sanitary sewer, which was not available at the Groton site.

3.1.4 Modifications for Groton Site

A photograph of the completed site is shown in Figure 3.1.4-1. The entire site is enclosed within a 13 meter wide by 41 meter long (43 foot x 135 foot) security fence and the surface is covered with crushed rock for dust and weed suppression. The existing LFG blower, flare, and a condensate tank owned by the town of Groton are included at the south end of the site.

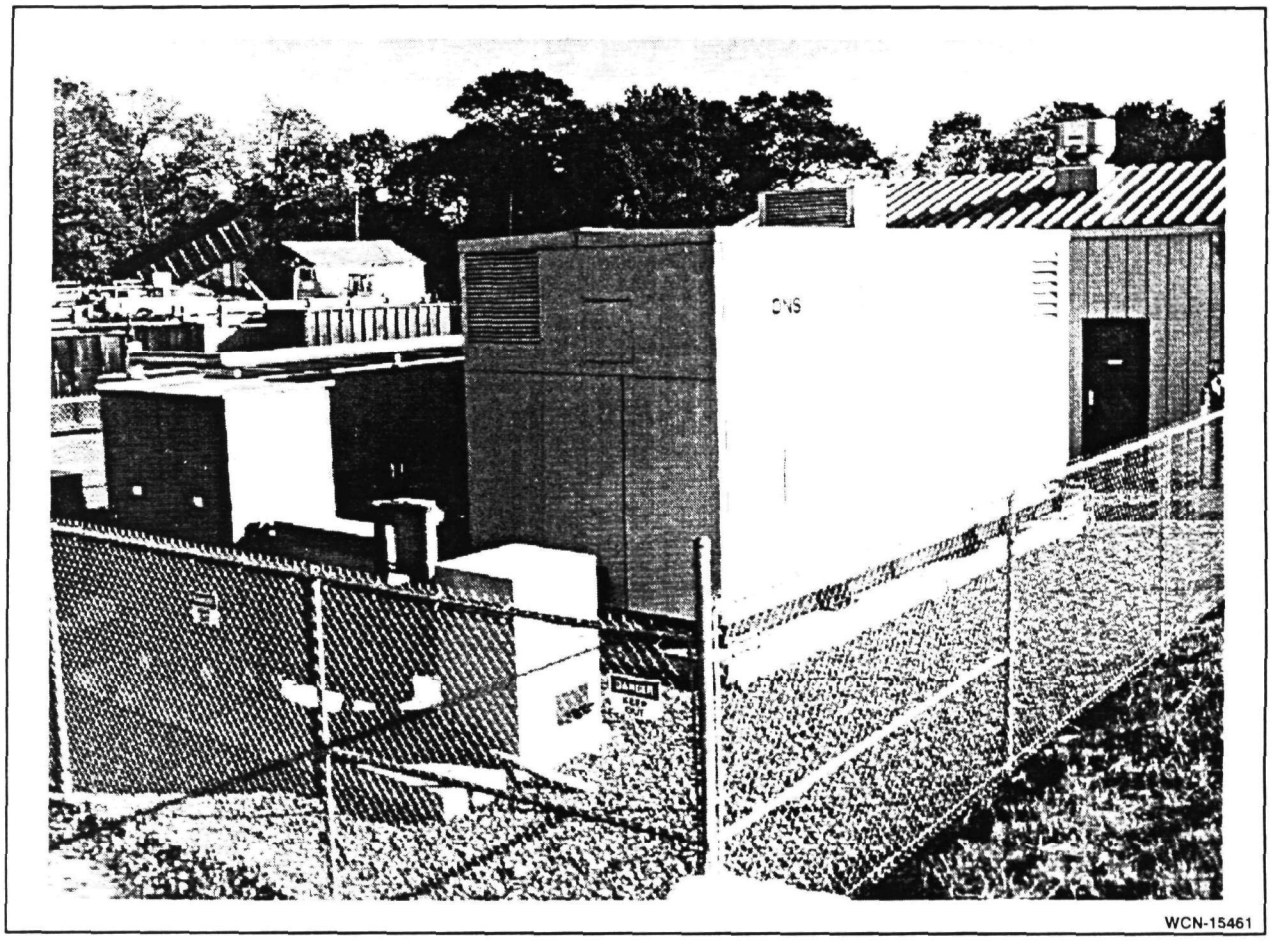


Figure 3.1.4-1. Groton Site Showing Installation of Demonstration Equipment

The Groton fuel cell site layout and a listing of the major modifications is shown in Figure 3.1.4-2. The most significant modification for the Groton site is the addition of a pre-engineered all-weather building to house the GPU and all associated gas processing equipment. The building is 6.1 meters x 9.1 meters (20 feet by 30 feet), and includes heating, ventilation, and a combustible gas sensor. The building was added to protect against potential freezing of wet landfill gas and the associated condensate, since the GPU was originally designed and specified for the non-freezing climate at the Penrose site in southern California.

The second major modification for the Groton site was the addition of a landfill gas compressor to replace the 6.90×10^5 Pa (100 PSIG) landfill gas supply which was available at the Penrose site. Northeast Utilities installed a Norwalk dual piston positive displacement, lubrication free continuous duty compressor Model NQ-DV1-O (SVDA) rated for 2260 SL/M at 2.76×10^5 Pa (80 SCFM at 40 PSIG). This gas supply was regulated down to approximately 1.52×10^5 Pa (22 PSIG) at the inlet to the GPU.

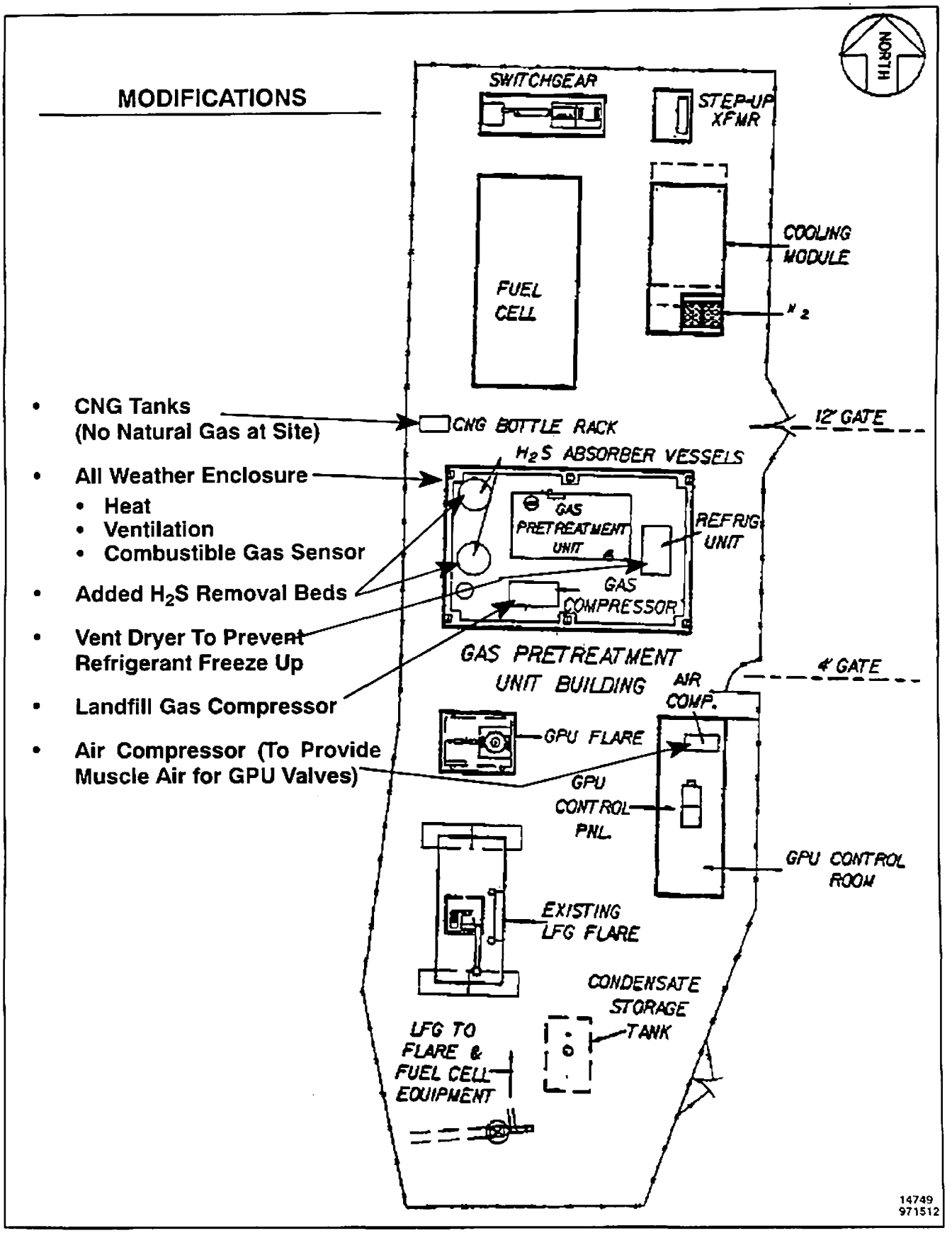


Figure 3.1.4-2. Groton Fuel Cell Site Layout Showing Modifications

Based on the estimated 500 ppmV hydrogen sulfide in the landfill gas (see Section 3.1.2), the H_2S removal beds were modified to increase capacity compared to the Penrose site, where the H_2S concentration averaged only 100 ppmV. Two 992 liter (35 cubic foot) capacity tanks were installed and filled with Westates UOCH-KP carbon. A photograph of the carbon bed installation is shown in Figure 3.1.4-3. The beds are plumbed so either bed can be isolated from the gas flow, to facilitate bed changeout "on the fly". A compressor bypass line returns excess flow back to the inlet of H2S removal tank #1 during periods when the GPU is operating without the fuel cell, or when the fuel cell is operating at low power. For normal operation the two beds are operated in series to provide maximum protection against breakthrough. The projected life for the two beds operating in series was conservatively estimated at over 3 months, based on continuous 140 kW operation with 500 ppmV H_2S in the landfill gas.

Figure 3.1.4-3. High Capacity Hydrogen Sulfide Removal Tank Installation at Groton Landfill

An air compressor was also added to provide muscle air for the pneumatic valves used on the GPU, since no compressed air is available at the Groton site. Northeast Utilities initially installed a small compressor, with bottle nitrogen for a backup. This was replaced with an industrial grade compressor, and the bottled nitrogen was eliminated from the system.

The final modification was the addition of compressed natural gas to the site, to provide start up fuel for the GPU flare, and for the reformer start burner in the fuel cell. This change was required because the site does not have a pipeline natural gas supply.

The P&ID (Process and Instrumentations Diagram) for the Groton fuel cell facility is shown in Figure 3.1.4-4. The existing equipment and the new equipment for the fuel cell demonstration are included. The 3 sampling locations for obtaining landfill gas are shown.

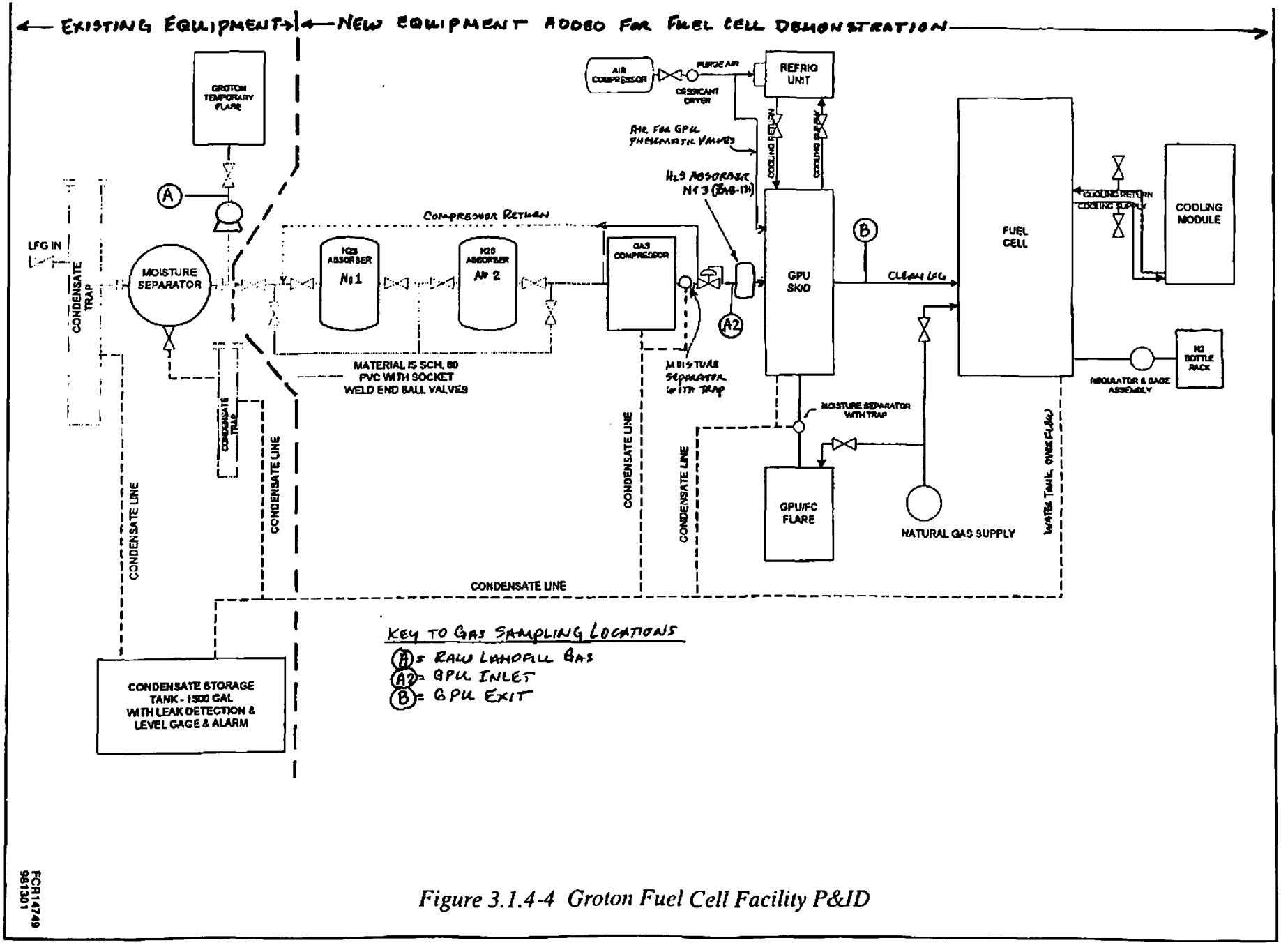


Figure 3.1.4-4 Groton Fuel Cell Facility P&ID

3.2 DEMONSTRATION TEST RESULTS

3.2.1 Test Plan and Quality Assurance

The objective of the follow-on demonstration is to further demonstrate the suitability of the landfill gas energy conversion equipment, including a modified commercially available fuel cell power plant, for future commercial operation on a wide variety of landfills. Specific goals include: 1) demonstrate the transportability of the equipment; 2) demonstrate the adaptability of the demonstration, especially the gas cleanup unit (GPU), to operation on different landfill gas compositions; 3) obtain longer term operating data for cost and reliability, including operation of the equipment as a remote unmanned site; and 4) obtain additional data which could be used to reduce the cost of the gas cleanup unit.

The test plan was to continue the demonstration test begun at the Penrose site for an additional year. Operating output was to be increased to 140 kW if possible. Gas analyses would be conducted in the same way as at Penrose to maintain a consistent data set.

The data measurement summary for the Groton demonstration is given in Table 3.2.1-1. Landfill gas analyses include sulfur compounds measured by EPA method 16 and 18, volatile organic compounds (including halides) measured by EPA method TO-14, and GPU output gas heat content measured by ASTM D3588-91. The majority of these critical gas analyses were provided by Performance Analytical, Inc. in Canoga Park, CA. Performance Analytical was selected because they were the contractor for the Penrose testing, and performed admirably during the testing and for the quality assurance tests required by EPA. In addition to the sulfur and VOC analyses, Performance Analytical also analyzed for heat content, so all critical analyses were obtained from a common sample. GPU exit samples were taken in an evacuated stainless steel summa canister. Additional gas samples, especially raw landfill gas containing H_2S (which can be adsorbed onto the summa canister walls) were taken in Tedlar bags. The sampling technique was observed by the EPA Quality Assurance Officer during an on-site visit to the Groton site on May 19,1997. Performance Analytical included method blanks and duplicate test analyses with all reports.

Table 3.2.1-1. Proposed Test Plan Measurement Data Summary EPA Landfill Gas - Northeast Utilities/Groton Landfill Extension

Parameter	Method	Sample Location[2]	Frequency	Comments
Sulfur Compounds	EPA 16 & 18	GPU Exit GPU Inlet[1]	Prior to start, then Monthly	GPU exit sample taken during last hour before regeneration
Volatile Organic Compounds (including halides)	EPA TO-14	GPU Exit GPU Inlet[1]	Prior to start, then Monthly	GPU exit sample taken during last hour before regeneration
GPU Output Gas Heat Content	ASTM D3588-91	GPU Exit	Monthly	
GPU Output Gas Cumulative Flow Rate	Process monitor	GPU Exit	Weekly	Northeast Utilities
Fuel Cell Electrical Output	kWh meter	GPU Exit	Weekly	Northeast Utilities
Hydrogen Sulfide	Draeger tube	GPU Inlet H_2S Bed Exit	Weekly	Northeast Utilities
Availability, Maintenance Requirements, and Operation Requirements	Operator log	N/A	Monthly	Northeast Utilities

Note: [1] Raw landfill gas at GPU inlet taken prior to start, and at end of test only.

[2] Gas sampling locations are shown on Figure 3.1.4-4

The Performance Analytical H_2S measurements were supplemented by more frequent readings taken by Northeast Utilities using Draeger Tubes. These readings were taken to provide a more detailed history of the raw landfill gas sulfur content, which appeared to be changing with time, and to monitor the performance of the H_2S removal bed, for changeout.

The remaining data are site readings taken by Northeast Utilities personnel from the nearby Montville generating station. Data from these site readings include GPU output gas cumulative flow rate and fuel cell electrical output (for determining fuel cell efficiency). Copies of these site logs are attached in Appendix A.

A summary of all gas analyses used in this report is shown in Table 3.2.1-2. This table includes data which were obtained from local suppliers prior to the demonstration test. Table 3.2.1-1 includes the sample date and time, location, GPU hours and process counter, type of sample container, name of analysis lab, analyses performed including duplicates and blanks, and fuel cell power level. The gas sampling locations are shown in Figure 3.1.4-4. A complete collection of all gas analyses is provided in Appendix B.

Table 3.2.1-2. Index Groton Gas Analyses

Sample Identification			GPU		Sample Location⑩	Sample Container	Analysis Lab	Analysis Type				Fuel Cell Power	Comments
No.	Date	Time	Hours	Counter				Sulfur	VOC	BTU	Other		
0	12/29/94	N/A	N/A	N/A	Indiv. well heads	N/A	N/A	N/A	N/A	N/A	H_2S Only	N/A	28 wells vary from 17 ppmV to 2000 ppmV average = 430 ppmV.
1A	09/19/95	A	N/A①	N/A	(A) Raw LFG	TB②			✓			N/A	
1B	9/19/95	B	N/A	N/A	(A) Raw LFG	TB			✓			N/A	
2	12/1/95	N/A	N/A	N/A	(A) Raw LFG	TB	ME⑥		✓			N/A	
3	1/11/96	1334	N/A	N/A	(A) Raw LFG	TB	ME⑥	✓	✓	✓	✓	N/A	Bag #2 only (Bag #1 leaking).
4	6/18/96	N/A	N/A	N/A	(B) GPU Exit	TB	IFC				FG⑦	N/A	
5	6/19/96	N/A	N/A	N/A	(B) GPU Exit	TB	IFC				FG	N/A	
6	6/19/96	1440	2320	N/A	(B) GPU Exit	SC③	PAI④	✓ D⑨ B⑧	✓ D B			N/A	
7	7/15/96	N/A	N/A	N/A	(B) GPU Exit	Flow Tube	IFC				FG	N/A	
8	3/20/97	0830	4645	N/A	(B) 105/107	SC	PAI	✓ D B	✓ B			110 kW	VOC analyses done after 11 days in SC. Sulfur analyses done after 8 days in SC.
9	3/20/97	0840	4645	N/A	(A) Raw LFG	TB	PAI	✓	✓ B			110 kW	
10	3/20/97	0850	4645	N/A	(A2) GPU Inlet	TB	PAI	✓ B		✓	FG	110 kW	Air in bag sample.
11	3/20/97	1430	4651	N/A	(B) 104/106	SC	PAI	✓	✓ D	✓	FG	110 kW	VOC analyses done after 11 days in SC and sulfur analyses after 8 days.
12	5/19/97	1015	5514	N/A	(B) 105/107	SC	PAI	✓ B	✓	✓	FG	106 kW	
13	5/19/97	1453	5518	N/A	(B) 104/106	SC	PAI	✓ D	✓	✓		100 kW	
14	6/19/97	1015	5803	45,500	(B) 104/106	SC	PAI	✓ B	✓ D B	✓	FG	140 kW	
15	6/19/97	1015	5803	45,500	(B) 104/106	TB	PAI	✓				140 kW	
16	6/19/97	1230	5805	1,000	(B) 105/107	SC	PAI	✓ D	✓			140 kW	
17	6/19/97	1230	5805	N/A	(A) Raw LFG	TB	PAI	✓	✓ B	✓	FG	140 kW	Look for S, halides removal in H_2S beds.
18	6/19/97	1235	5805	N/A	(A2) GPU Inlet	TB	PAI	✓ D	✓ D B	✓	FG	140 kW	Look for S, halides removal in H_2S beds.
19	6/19/97	1240	5805	1,300	(B) 105/107	TB	PAI	✓				140 kW	
20	7/9/97	1330	6286	48,600	(B) 104/106	SC	PAI	✓ B	✓ B			140 kW	Carbon bed CAB106 at -18° C.
21	7/9/97	1415	6287	600	(B) 105/107	SC	PAI	✓	✓	✓	FG	140 kW	Carbon bed CAB107 at -18° C.
Totals								15	15	8			

Notes: ① N/A = Not Available ② TB = Tedlar Bag ③ SC = Summa Canister ④ PAI = Performance Analytical, Inc. ⑤ N. U. = Northeast Utility ⑥ ME = Mayfly Environmental ⑦ FG = Fixed Gases (O_2, N_2, CO_2, CH_4) ⑧ B = Analysis Blank ⑨ D = Duplicate Analysis ⑩ = See Figure 3.1.4-4

3.2.2 GPU Performance

3.2.2.1 Operation and Reliability

The GPU operated for 4168 hours during the demonstration period in 32 runs, with the longest run being 827 hours. During this time, Northeast Utilities identified and corrected all recurring causes of GPU shutdowns, so that by the end of the demonstration period the sole remaining cause of shutdowns was the landfill gas compressor, which was the major new piece of equipment (with the least development time on landfill gas) which was added to the demonstration at Groton. The compressor shutdowns were caused by excessive wear on the exhaust valves, which required replacement every 6 to 8 weeks. (The manufacturer has identified a fix to the problem, but it was not available until after the end of the demonstration test period).

The Groton GPU run summary, including start and stop dates and times, period run hours/ Groton run hours/ total run hours, reason for shutdown, and corrective actions taken, is shown in Table 3.2.2.1-1. There were 32 GPU runs beginning with run G-0 on June 17, 1996 and ending with run G-31 which shut down on July 14, 1997 after a continuous run of 827 hours. The 32 shutdowns can be summarized as follows: 21 forced outages due to the GPU; 5 voluntary shutdowns; 4 grid outage related shutdowns; and 2 fuel cell related shutdowns. An uninterruptible power supply was installed on the instrument and control circuit for the GPU and compressor in early 1997, to prevent additional shutdowns due to momentary grid outages. Of the 21 GPU related shutdowns, about half were one-of -a-kind mechanical failures which were corrected and did not reoccur. The remainder were due to 3 system issues which were diagnosed during the demonstration test: (1) recurring high GPU pressure drop was corrected by adding two new coalescing filters and water traps in September 1996 to prevent any landfill gas condensate from entering the small H_2S removal bed downstream of the compressor, which caused carbon to escape from the bed and cause blockage of downstream regulators and the coalescing filter; (2) periodic freeze-ups of the refrigeration system were eliminated by adding an in-line dryer to the d-limonene refrigerant in May of 1997 (this is in addition to the d-limonene air vent dryer which was installed based on the Penrose operating experience); and (3), an improved landfill gas compressor exhaust valve was identified to prevent periodic failures which occurred about every 6 to 8 weeks. This last fix was not available for installation until after the completion of the demonstration test on July 15, 1997. As a result of these improvements, run times steadily increased, to an average of 370 hours (over 15 days) for the last 7 runs, and the last two runs were 359 and 827 hours. The last two shutdowns were caused by the compressor valves.

The gross availability of the GPU for the demonstration test period from July 15, 1996 to July 15, 1997 is 45%. Most of the GPU down time occurred during the first 6 months of the period, when the one-time mechanical failures were resolved, and the recurring issues which required system fixes became evident. Several of these failures required considerable non-recurring troubleshooting time to determine the root cause, and to design a suitable solution to the problem, then procure and install the appropriate fix. Manpower availability was also occasionally an issue, since the manpower assigned to the demonstration project were based at a 440 MW generating plant whose operation took priority over the demonstration. The GPU availability for the second half of the demonstration period improved to 70% from February 11, 1996 through July 14, 1997.

Table 3.2.2.1-1. Groton Gas Pretreatment Unit Run Summary								
Run No.	Start Date - Time	Stop Date - Time	Period Run Hours	Groton Run Hours	Total Run Hours	Reason for GPU Shutdown	Corrective Action to GPU
	1996	- - - - -	- - - -	0	2281	- - - - -	- - - - -
G-0	6/17//96 1030	6/17/96 1700	6	6	2287	Voluntary shutdown	None required
G-1	6/17/96 1900	6/19/96 0220	31	37	2318	Flare low temp S/D	Turn CNG on to supply supp. heat when req'd
G-2	6/19/96 1215	6/22/96 0721	55	92	2373	Failed solenoid valve V-141	Close hand valve V-142
G-3	6/22/96 0750	6/22/96 0850	1	93	2374	Power outage	None required
G-4	6/22/96 0930	6/27/96 0240	137	230	2511	flare low temp S/D	Adjust CNG supply to 1 psig at flare
G-5	6/27/96 0740	6/27/96 1126	4	234	2515	Voluntary shutdown	None required
G-6	7/8/96 1100	7/9/96 1800	31	265	2546	Voluntary shutdown	None required
G-7	7/15/96 1153	7/18/96 2101	81	346	2627	Loss of N2 pressure to GPU valves	Repair leaking N_2 solenoid valve by removing grit
G-8	7/22/96 0920	7/24/96 1852	55	401	2682	Low LFG flow to flare	None
G-9	7/25/96 1000	7/25/96 1410	4	405	2686	Low LFG flow to flare	Remove GPU inlet orifice, Replace leaking condensate drain valve.
G-10	7/29/96 0930	7/29/96 1515	6	411	2692	Voluntary shutdown	Replace plugged LCS-103 coalescing filter element
G-11	8/2/96 1000	8/5/96 1115	73	484	2765	Low flare flow - Low GPU pressure	Inst new drain valve, New carbon in ZAB-131, Repl. filter in LCS-103
G-12	8/8/96 0750	8/8/96 1100	3	487	2768	Voluntary shutdown	Started GPU for tour
G-13	8/9/96 0906	8/9/96 1215	3	490	2771	Voluntary shutdown	Started GPU for tour
G-14	8/22/96 0804	8/22/96 2007	12	502	2783	Loss of N2 pressure to GPU valves	GPU sol vlv. V-110 leaking - cycled vlv.
G-15	8/23/96 1545	8/24/96 1026	19	521	2802	Low flare flow - low GPU pressure	Repaired leaking relief valve PRV-101A @ H2S adsorber inlet
G-16	8/30/96 1350	9/3/96 0828	67	588	2869	Voluntary S/D, 120 ppmV H_2S @ GPU, Water in GPU inlet line	Install new coalescing filters, inst 0_2 meter vlv. @ H_2S adsorber inlet
G-17	10/2/96 1230	10/4/96 0449	40	628	2909	Low flare temp & flow	None
G-18	10/4/96 1100	10/5/96 0228	15	643	2924	Low flare temp & flow	Changed temp set point &time delay on flow

Note: S/D = Shutdown
CNG = Compressed Natural Gas

Continued

Table 3.2.2.1-1. Groton Gas Pretreatment Unit Run Summary (Continued)							
Run No.	Start Date - Time	Stop Date - Time	Period Run Hours	Groton Run Hours	Total Run Hours	Reason for GPU Shutdown	Corrective Action
G-19	10/7/96 1150	10/7/96 1715	6	649	2930	Gas compressor relief valve "popping"	Removed & tested valve found no problem
G-20	10/9/96 1400	10/19/96 2009	246	895	3176	Grid outage due to "Noreaster"	None
G-21	10/25/96 1700	11/8/96 2051	340	1235	3516	Momentary grid outage due to storm	None
G-22	11/14/96 1005	11/21/96 1021	168	1403	3648	Momentary grid outage cause unknown	Plans for installation of UPS on GPU controls
G-23	12/09/96 1100	12/16/96 1345	170	1573	3818	Manual shutdown because of fuel cell shutdown	None
G-24	02/04/97 1005	2/04/97 1614	6	1579	3824	Manual shutdown because of fuel cell shutdown	None
G-25	02/11/97 1102	2/25/97 1611	341	1920	4165	Refrig unit/D-Limonene hi temp	Prepare D-Limonene Deicing procedure
G-26	02/28/97 0830	3/22/97 0420	524	2444	4689	Refrig unit/ D-Limonene hi temp	Perform de-icing procedure, plan for moisture removal modification
G-27	03/22/97 0834	3/23/97 1456	30	2474	4719	Manual shutdown because of LFG compressor valves	Prepare to replace suction & discharge valves
G-28	04/04/97 0749	4/15/97 0741	264	2738	4983	Low discharge pressure from LFG compressor	Replace suction & discharge valves
G-29	04/25/97 1030	5/05/97 1442	244	2982	5227	Refrig unit/D-Limonene hi temp	Prepare for moisture removal modification
G-30	05/07/97 1115	5/22/97 1044	359	3341	5586	Manual shutdown because of LFG compressor valves	Prepare to replace suction & discharge valves
G-31	6/10/97 0900	7/14/97 2022	827	4168	6413	Low discharge pressure from LFG compressor	Replace suction & discharge valves

Note: S/D = Shutdown
CNG = Compressed Natural Gas

3.2.2.2 Contaminant Removal Performance

The GPU has continued to remove sulfur and halide compounds to well below the design limits of 3 ppmV total sulfur and less than 3 ppmV total halides during the extended demonstration test at Groton. Data from the standard summa canisters at normal GPU operating conditions showed no detectable sulfur or halides through June 16, 1997 (5805 total GPU hours), and only trace increases out to July 9, 1997 (6286 total GPU operating hours, or 8.7 months). The July 9, 1997 data was taken during a test of simplified GPU operating conditions which are believed to be the cause of the slight increase in exit halogens (see discussion in Section 3.2.2.4). The continuing low exit levels of sulfur and halide compounds indicate that the original GPU bed design life of 8,000 hours is likely to be achieved.

The contaminant removal performance data at the GPU exit from the Groton Connecticut landfill is summarized in Table 3.2.2.2-1. A single exit sample was taken at Groton before the beginning of the one year test, on June 19, 1996 to verify that the GPU was still removing total sulfur and total halides to less than 3 ppmV. Total sulfur measured 0.022 ppmV (all as carbonyl sulfide), and total halides measured 0.014 ppmV (all as methylene chloride) met the requirements and the one year test was initiated.

During the demonstration test, exit gas samples were then taken from both parallel sets of beds in the GPU (dryer bed DAB105 plus carbon bed CAB107, and dryer bed DAB104 plus carbon bed CAB106) on March 20, 1997, May 19, 1997, June 19, 1997, and July 9, 1997. Total sulfur remained below detection limits through June 19, 1997, when measured from the summa canister, but duplicate analyses from Tedlar bags on June 19, 1997 indicated 0.017 ppmV carbon disulfide (0.033 ppmV total sulfur as H_2S) at 5803 hours, and 0.014 ppmV carbon disulfide (0.027) ppmV total sulfur as H_2S) at 5805 hours. This finding raises the possibility that low levels of carbon disulfide may adsorb onto the summa canister walls. These low levels of organic sulfur are not a concern to the fuel cell, which contains a fuel preprocessor designed to remove up to 30 ppmV of organic sulfur from natural gas.

The GPU exit total halide results also show no detectable halides through June 19, 1997. A slight increase to 0.012 ppmV and 0.019 ppmV on July 9, 1997 is due to a change in GPU operating conditions as part of a test to obtain data for reducing the cost of the GPU (see Section 3.2.2.4).

Table 3.2.2.2-1. GPU Contaminant Removal Performance at Groton, CT

All samples taken in Summa canister unless otherwise noted.

Sampling Date	Jun 19 1996	Mar 20 1997	Mar 20 1997	May 19 1997	May 19 1997	Jun 19 1997	Jun 19 1997	Jul 19 1997	Jul 19 1997
Total GPU Operating Time (Hours)	2320	4645	4651	5514	5518	5803	5805	6286	6287
Sampling Time	14:40	08:30	14:30	10:15	14:53	10:15	12:30	13:30	14:15
Sample Location	GPU Exit	GPU Exit	GPU Exit	GPU Exit	GPU Exit	GPU Exit	GPU Exit	GPU Exit	GPU Exit
GPU Process Counter	N.A.	N.A.	N.A.	N.A.	N.A.	45,500	1,000	48,600	600
SULFUR COMPOUNDS (ppmV)									
hydrogen sulfide ⑨	N.A.	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
methyl mercaptan	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
ethyl mercaptan	<0.004	<0004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
dimethyl sulfide	<0.004	<0004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
dimethyl disulfide	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
carbonyl sulfide	0.022	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.010	0.080
carbon disulfide	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Sulfur	**0.022**	**nd**	**nd**	**nd**	**nd**	nd (5)	**nd (5)**	**0.010**	**0.080**
VOLATILE ORGANIC COMPOUNDS (ppmV)									
dichlorodifluoromethane	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1, l-dichloroethane	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
benzene	<0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	0.00042
chlorobenzene	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ethyl benzene	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
methylene chloride									
styrene	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0001
trichloroethene	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
toluene	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00039
tetrachloroethene	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
vinyl chloride	<0.004	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	0.0022
xylene isomers	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0002	<0.001
cis-1,2-Dichloroethene	<0.002	<.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00015
Total Halides as Cl	**0.014**	**nd**	**nd**	**nd**	**nd**	**nd**	**nd**	**0.012 (6), (8)**	**0.019 (7), (8)**

NOTES:

1. nd = non-detected
2. Methylene chloride is dichloromethane
3. Number reported as less than (e.g.,<0.001) is the detection limit, and means the compound was not detected
4. N.A. means data not available
5. Carbon disulfide was not detected in summa canister sample, but was detected in a Tedlar bag sample at 0.017 ppmV (0.033 ppmV total sulfur) at 5803 hours, and at 0.014 ppmV (0.027 ppmv total sulfur) at 5805 hours.
6. Chloromethane detected at 0.012 ppmV and bromomethane at 0.00044 ppmV.
7. Also detected: Chloromethane = 0.013
   Bromomethane = 0.00046
   Chloroethane = 0.0016
   Trichlorofluoromethane = 0.00033
8. Shaded data taken with final carbon adsorption beds operating warmer than normal as part of testing for reduced cost GPU (See Section 3.2.2.4)
9. Hydrogen sulfide detection limit is <0.004 ppmv. Hydrogen sulfide adheres to summa canister walls with time, so results for low H_2S levels may not be reliable. Duplicate Tedlar bag samples taken on June 19, 1997 confirmed no H_2S at a detection limit of <0.004 ppmv.

3.2.2.3 GPU Exit Gas Heat Content

The summary of ASTM method heat content measurements at the Groton landfill is compared to the average values taken at Penrose in Table 3.2.2.3-1. The heating values are reported on a dry gas basis at 15.6°C and 1.01 x 10^5 Pa (60 degrees F, 14.696 psia), from gas samples taken at the GPU exit. The average higher heating value at Groton is 5.18 Kcal/SL (580.6 Btu/cubic foot) versus 3.98 Kcal/SL (445.8 Btu/cubic foot) at Penrose. The most significant difference is the lower nitrogen content and higher methane content in the Groton gas. Both sites contained very little higher hydrocarbons, with Groton measuring none heavier than methane, and Penrose measuring just 0.02% ethane. A sample of raw landfill gas at Groton measured 0.01% heavier than hexanes, indicating the low concentration of heavier compounds in the GPU exit gas is due to the incoming gas, rather than removal of heavier compounds by the GPU.

Table 3.2.2.3-1. Summary of ASTM Method Heat Content Measurements at Groton Landfill Compared with Penrose, CA

Sampling Date	3-20-97	5-19-97	5-19-7	6-19-97	6-19-97	7-9-97	Groton Average	Penrose Average
Sampling Time	14:30	10:15	14:53	10:15	12:30	14:15		
Treated Landfill Gas Composition Measured by ASTM Method at GPU Exit (%)								
Nitrogen	0.07	1.68	1.68	0.93	1.45	1.42	1.16	17.31
Carbon dioxide	42.14	41.24	41.00	41.46	39.19	40.19	41.21	37.88
Methane	57.78	56.59	56.86	57.32	58.70	57.97	57.30	44.11
Ethane	<.01	<.01	<.01	<.01	<.01	<.01	<.01	0.02
Propane	<.01	<.01	<.01	<.01	<.01	<.01	<.01	nd
Butane	<.01	<.01	<.01	<.01	<.01	<.01	<.01	nd
Pentane	<.01	<.01	<.01	<.01	<.01	<.01	<.01	nd
Hexanes	<.01	<.01	<.01	<.01	<.01	<.01	<.01	nd
> Hexanes	<.01	<.01	<.01	<.01	<.01	<.01	<.01	nd
GPU Exit HHV by ASTM Method (1)								
Btu/standard cubic foot	585.5	573.4	576.0	580.9	595.5	587.4	580.6	445.8
Kcal/standard liter	5.23	5.12	5.14	5.19	5.32	5.24	5.18	3.98
GPU Exit LHV by ASTM Method								
Btu/standard cubic foot	527.2	516.3	518.7	523.0	536.2	528.9	522.8	401.3
Kcal/standard liter	4.71	4.61	4.63	4.67	4.79	4.72	4.67	3.58

Note: (1) Dry Gas, at 15.6°C and 1.01 x 10^5 Pa (60°F, 14.696 psia)
(2) All samples taken at GPU exit

3.2.2.4 Testing for Reduced Cost GPU

An objective of the Groton testing is to demonstrate means to reduce the cost of the GPU. The projected cost of the commercial scale, 800 kW, GPU included in the original economic study reported in Section 3 of Reference 1 is $190 per kW. This cost projection was based on scale-up and simplification of the 200 kW demonstrator equipment, plus higher production volume. Testing was undertaken at Groton to demonstrate a significant simplification to the present demonstrator GPU.

The proposed simplification approach is to combine the dryer bed and carbon bed media into a single vessel. This approach eliminates 2 vessels and the low temperature cooler, along with the associated valves, plumbing, instrumentation, and simplifies the refrigeration system.

On July 9, 1997 GPU exit gas samples were taken as part of a test to determine the feasibility of reducing the cost of the GPU by combining the two dryer beds plus the two final carbon beds into just two vessels instead of the 4 vessels currently used. The objective of the test was to determine if the carbon beds would maintain acceptable performance if the temperature were increased from the normal -18°C (0 degrees F) to about 2°C (35 degrees F) which is the inlet temperature to the dryer beds. The temperature setpoint of the GPU refrigeration system was increased to raise the temperature of the d-limonene refrigerant used to cool the carbon beds. The inlet gas temperature to the carbon bed was limited to about -11°C (12 degrees F) by the refrigeration unit controller but the GPU strip chart showed that it takes several hours for the carbon bed to achieve this low temperature, so that a sample taken early in the make cycle would have a higher average temperature. GPU exit gas samples were taken near the end of the make cycle, at 48,600 counts, and near the beginning of the make cycle, at 600 counts when the average bed temperature was 20°C (68 degrees F). The results are shown in the last two columns of Table 3.2.2.2-1 and in Table 3.2.2.4-1. The data taken near the end of the make cycle at 48,600 counts show a slight increase in carbonyl sulfide and total halides. Carbonyl sulfide was detected at 0.010 ppmV, which is less than the maximum detected previously at Groton and at Penrose. The regular halogens were non-detected, but low levels of chloromethane (0.012 ppmV) and bromomethane (0.00044 ppmV) were detected. The data taken early in the make cycle at 600 counts with an average carbon bed temperature of 20°C show additional increases in carbonyl sulfide, which increases to 0.080 ppmV, and total halides which increase to 0.019 ppmV (consisting of 0.00026 ppmV methylene chloride, 0.002 ppmV vinyl chloride, 0.013 ppmV chloromethane, 0.00044 ppmV bromomethane, and 0.00033 trichlorofluoromethane). The data summary in Table 3.2.2.4-1 indicates that operation of the carbon bed in the dryer bed vessel at 2°C may be feasible. The effect of the low halide levels on long term fuel processor life would need to be reviewed.

Table 3.2.2.4-1. GPU Performance vs. Final Carbon Bed Temperature and Time

CARBON BED CONDITIONS		GPU PERFORMANCE	
Average Temperature ((°F)	Time on Make Cycle (Hrs)	Total Exit Sulfur as H_2S (ppmV)	Total Exit Halogens as Chloride (ppmV)
-18° C (0° F)	7	nd	nd
-11° C (12° F)	7	0.010	0.012
+20° C (68° F)	1	0.080	0.019

The initial GPU, while technically successful, requires high production volume and large scale (800 kW) units to meet overall cost objectives. As a result of this demonstration IFC recommends a lower cost approach which has the potential to meet the $190/kW cost goal at lower production volume and smaller scale. This approach dramatically simplifies the GPU by upgrading the existing fuel cell power plant gas cleanup system to remove halides, so most of the GPU active components can be eliminated.

The second approach to GPU cost reduction is based on experience with gas cleanup for waste water treatment plants, where the H_2S is removed in the same type of impregnated carbon bed used in the landfill GPU, and the halides are removed inside the PC25 C power plant. This approach utilizes the existing hydrotreater bed in the power plant to react the halogenated hydrocarbons to HCl, HF,

and HBr, which in turn are removed over a bed of commercially available halogen guard material. Testing demonstrating hydrotreating and disposable absorbents as a means to remove halides from landfill gas have been reported in the literature (Reference 2). Tests to confirm the feasibility of this approach are also planned under an EPA sponsored program using a 200 kW fuel cell at an existing waste water treatment plant in Yonkers, New York.

Landfill gas analyses were taken at the inlet and exit of the H_2S beds, to determine the effect of the impregnated carbon on the levels of organic sulfur compounds, and volatile organic compounds including halogenated species. The effect of the H_2S removal beds on H_2S and organic sulfur compounds is shown in Table 3.2.2.4-2. In addition to the 117 ppmV of hydrogen sulfide removed, the impregnated carbon also caused a net reduction in total organic sulfur species of 0.388 ppmV (equivalent to 0.457 ppmV as H_2S). Species reduced include methyl mercaptan (-0.095 ppmV), ethyl mercaptan (- 0.127 ppmV), carbon disulfide (- 0.068 ppmV), isopropyl mercaptan (- 0.068 ppmV), and thiophene (- 0.074 ppmV). Increases in dimethyl sulfide (0.072 ppmV) and dimethyl disulfide (0.002 ppmV) were recorded.

The effect of the H_2S removal beds on volatile organic compounds is shown in Table 3.2.2.4.-3. Most halogenated compounds showed slight increases in concentration at the exit, with an overall increase in total halogen content of 1.489 ppmV as chloride. A possible explanation for this result is that the impregnated carbon initially absorbs halogenated species, which are then gradually driven off as the bed removes hydrogen sulfide and converts it to elemental sulfur.

The small changes observed in total sulfur as H_2S and total halides as chloride exiting the H_2S carbon bed are not expected to have any significant impact on the feasibility of using the fuel cell hydrotreater bed and a halide guard bed.

Table 3.2.2.4-2. Effect of H_2S Removal Beds on Sulfur Compounds in Raw Landfill Gas					
Compound	**Reporting Limit ppbV**	**Raw Landfill Gas 6-19-97 12:30 ppbV**	**H2S Bed Exit 6-19-97 12:35 ppbV**	**Change in Sulfur Species ppbV**	**Change in Total Sulfur (as H_2S) ppbV**
Hydrogen Sulfide	40.0	117,000	ND	-117,000	-117,000
Carbonyl Sulfide	40.0	ND	ND	0	0
Methyl Mercaptan	40.0	95.2	ND	-95.2	-95
Ethyl Mercaptan	40.0	127	ND	-127	-127
Dimethyl Sulfide	40.0	ND	41.9	+71.9	+42
Carbon Disulfide	20.0	138	69.6	-68.4	-137
Isopropyl Mercaptan	40.0	68.4	ND	-68.4	-68
tert-Butyl Mercaptan	40.0	ND	ND	0	0
n-Propyl Mercaptan	40.0	ND	ND	0	0
Ethyl Methyl Sulfide	40.0	ND	ND	0	0
Thiophene	40.0	96.7	23.1	-73.6	-74
Isobutyl Mercaptan	40.0	ND	ND	0	o
Diethyl Sulfide	40.0	ND	ND	0	o
n-Butyl Mercaptan	40.0	ND	ND	0	0
Dimethyl Disulfide	20.0	ND	2.30	+2.3	+2
3-Methylthiophene	40.0	ND	ND	0	0
Tetrahydrothiophene	40.0	ND	ND	0	0
2,5-Dimethylthiophene	40.0	ND	ND	0	0
2-Ethylthiophene	40.0	ND	ND	0	0
Diethyl Disulfide	20.0	ND	ND	0	0
			TOTAL Organic Sulfur	**-388.4**	**-457**
			TOTAL (including H_2S)	**-117,384**	**-117,457**
Notes: (1) ND = non detected **(2) Matrix - Tedlar Bag**					

Table 3.2.2.4-3. Effects of H_2S Removal Beds on Volatile Organic Compounds in Raw Landfill Gas					
		6-19-97 (12:30)	6-19-97 (12:35)		
Compound	Reporting Limit ppbV	Raw Landfill Gas ppbV	H_2S Bed Exit ppbV	Change in Contaminant-Species ppbV	Change in Total Halogens as Chloride ppbV
Dichlorodifluoromethane	41	840	940	+100	+400
Chloromethane	98	ND	ND	0	0
Vinyl Chloride	79	800	960	+160	+160
Bromomethane	52	ND	ND	0	0
Chloroethane	76	810	ND	-810	-810
Acetone	84	590	790	+200	0
Trichlorofluoromethane	36	270	400	+130	+520
1, 1-Dichloroethene	51	ND	ND	0	0
Methylene Chloride	58	58	79	+21	+42
Trichlorotrifluoroethane	26	23 TR	37	+14	+84
trans-1, 2-Dichloroethene	51	ND	ND	0	0
1, 1-Dichloroethane	50	69	120	+51	+102
Methyl tert-Butyl Ether	56	96	330	+234	0
Vinyl Acetate	57	ND	ND	0	0
2-Butanone	68	310	210	-100	0
cis-1, 2-Dichloroethene	51	110	230	+220	+440
Chloroform	41	ND	ND	0	0
1, 2-Dichloroethane	50	ND	ND	0	0
1,1,1-Trichloroethane	37	20 TR	47	+27	+81
Benzene	63	450	2,200	+1,750	0
Carbon Tetrachloride	32	ND	ND	0	0
1,2-Dichloropropane	44	ND	ND	0	0
Bromodichloromethane	30	ND	ND	0	0
Trichloroethene	38	34 TR	160	+126	+378
cis-1, 3-Dichloropropene	44	ND	ND	0	0
4-Methyl-2-pentanone	49	66	ND	-66	0
trans-1, 3-Dichloropropene	44	ND	ND	0	0
1, 1, 2-Trichloroethane	37	ND	ND	ND	0
Toluene	53	1,600	630	-970	0
2-Hexanone	49	ND	ND	0	0
Dibromochloromethane	24	ND	ND	0	0
1, 2-Dibromoethane	26	ND	ND	0	0
Tetrachloroethane	30	51	74	+23	+92
Chlorobenzene	44	ND	ND	0	0
Ethylbenzene	46	650	ND	-650	0
m- & p-Xylenes	46	1,700	ND	-1700	0
Bromoform	20	ND	ND	0	0
Styrene	47	ND	ND	0	0
o-Xylene	46	220	ND	-220	0
1, 1, 2, 2-Tetrachloroethane	29	ND	ND	0	0
1, 3-Dichlorobenzene	34	ND	ND	0	0
1, 4-Dichlorobenzene	34	ND	ND	0	0
1, 2-Dichlorobenzene	34	ND	ND	0	0
Total Halogens (as Chloride)					+1,489

Notes: (1) ND = Not detedted
(2) TR = Detected below indicated reporting limit
(3) Matrix = Tedlar Bag

3.2.3 Fuel Cell Performance

3.2.3.1 Operation and Reliability

The fuel cell operation on landfill gas at Groton is summarized in Table 3.2.3.1-1. The fuel cell ran for a total of 3313 hours on landfill gas in 16 runs at the Groton landfill. Total operating time on landfill gas is 4020 hours (5.5 months), including the 707 hours at Penrose. Total fuel cell operating time is 4,135 hours, which includes 115 hours operation on natural gas at Penrose during initial checkouts. The longest Groton run was Run 16, at 825 hours. There was one forced outage caused by the fuel cell. The adjusted reliability for the fuel cell was 96.5%.

The causes for the 16 shutdowns can be categorized as follows: 11 due to GPU shutdowns (see section 3.2.2.1); 4 site related (3 due to loss of grid power and 1 due to loss of site landfill gas supply); and 1 due to mechanical failure within the fuel cell power plant. The fuel cell shut down on February 4, 1997 was due to failure of several electrical space heating elements inside the fuel cell, which in turn resulted in damage to a pump, valve and flow switch due to freezing. The mechanical components and heaters were replaced, and normal operation was resumed.

The raw availability of the fuel cell is: 3313/8760 = 38%. As discussed in section 3.2.2.1, the availability of the demonstration improved during the second half of the demonstration test at Groton. The raw availability for the last 5 runs from February 11, 1997 through July 14, 1997 improved to 67%.

The fuel cell adjusted availability was computed as follows:

- Fuel cell availability is adjusted to compensate for factors which are not caused by the power plant, as follows:

  Raw availability (OPERATING TIME divided by elapsed clock time since first start) is adjusted to account for

  - unforced outages not due to power plant
  - shutdowns due to operator error
  - waiting time for replacement parts where parts were recommended the customer have on hand
  - periods of time when power plant could be worked but manpower not available (weekends, vacations)

$$\text{Adjusted availability} = \frac{\text{OPERATING HOURS}}{[(\text{elapsed clock time}) - \text{adjustment}]}$$

The adjusted availability for the fuel cell for the 1 year test is:

$$3313/(8760\text{-}5328) = 96.5\%$$

Table 3.2.3.1-1. Groton Fuel Cell Run Summary							
Run No.	Start Date - Time	Stop Date - Time	Period Run Hours	Groton Total Run Hours	FC Total Run Hours	Reason for Fuel Cell Shutdown	Fuel Cell Corrective Action
0	1996	- - - - -	- - - -	- - - -	822	- - - - -	- - - - -
G-1	7/15/96 1645	7/18/96 2059	76	76	898	GPU shutdown	None required
G-2	7/22/96 1324	7/24/96 1938	54	130	952	GPU shutdown	None required
G-3	7/25/96 1445	7/25/96 1445	0	130	952	GPU shutdown	None required
G-4	7/29/96 1337	7/29/96 1609	5	135	957	GPU service	None required
G-5	8/5/96 1037	8/05/96 1044	0	135	957	GPU service (Run G-11)	None required
G-6	10/12/96 1338	10/19/96 2009	175	310	1132	GPU shut down due to grid outage from "Noreaster"	None required
G-7	10/28/96 1314	11/08/96 2047	271	581	1403	Momentary grid outage due to storm	None required
G-8	11/14/96 1344	11/21/96 1016	165	746	1568	GPU shutdown due to momentary grid outage, cause unknown	None required
G-9	12/10/96 1150	12/14/96 0633	91	837	1659	High level of O_2 in LFG resulting from failure of motorized valve in Groton town flare	None required
G-10	2/4/97 1241	2/04/97 1446	2	839	1661	Accumulator not filling due to damaged feed water pump	Replace feed water pump, solenoid valve and flow switch. Repair heaters.
G-11	2/11/97 1334	2/25/97 1542	338	1177	1999	GPU shutdown	None required
G-12	3/03/97 1223	3/22/97 0420	448	1625	2447	GPU shutdown	None required
G-13	4/04/97 1040	4/15/97 0715	261	1886	2708	Manual Shutdown (Low LFG compressor discharge press)	None required
G-14	4/25/97 1126	5/5/97 1442	243	2129	2951	GPU shutdown	None required
G-15	5/7/97 1156	5/22/97 1044	359	2488	3310	Manual shutdown (Low LFG compressor discharge press)	None required
G-16	6/10/97 1123	7/14/97 2025	825	3313	4135	GPU shutdown (Low LFG compressor discharge press)	None required

3.2.3.2 Efficiency

Fuel cell efficiency was calculated over a 9 day period from June 10, 1997 through June 19, 1997, while the fuel cell was operating at a constant 140 kW. Efficiency during this 9 day period of continuous operation was 38.1% on a lower heating value basis. This calculated efficiency is slightly higher than the 37.1% efficiency calculated over a continuous 6 day period at 120 kW at the Penrose landfill in California, where the heating value of the landfill gas is lower.

The details of the efficiency calculation are summarized in Table 3.2.3.2-1. The fuel cell net energy output was measured using the fuel cell output voltage and amperage sensors, with an adjustment factor based on a comparison of the fuel cell calculations with the utility calibrated site meter used at Penrose. The gas consumption by the fuel cell was measured at the GPU exit using the same Yokogawa YFCT Flow Computing Totalizer (Style B) used at Penrose, with an adjustment to correct for a compensating temperature which was reading erroneously low during this time. The heating value used were the average of the samples taken on June 19, 1997, near the end of the 9 day period.

Table 3.2.3.2-1. Fuel Cell Electrical Efficiency on Landfill Gas at Groton, CT.

Period	Energy Output (FCPP Meter) (kWh)	Gas Consumption (Yokogawa Meter) (SL)	Lower Heating Value (Kcal/SL)	Energy Input (Kcal)	LHV Efficiency
6-10-97 (1322) to 6-19-97 (1432)	28,682 (2)	1.38×10^7 (3) (1)	4.70 (4)	6.47×10^7	38.1%

Notes:

(1) Data from NU site logs in Appendix A.

(2) FCPP meter reading (30,109 kW Hr) x 0.953 correction factor, based on comparison with calibrated utility meter at Penrose, CA.

(3) Yokogawa meter reading (529,701 SCF) x 0.919 correction factor to adjust faulty -7.8°C (17.9°F) temperature compensation to 15.6°C (60°F) exit gas temperature.

(4) Average of two measurements taken 6-19-97: (4.67 +4.72)/2 = 4.695 Kcal/SL.

(5) Efficiency =

$$\frac{\text{Energy output (kWHr) (860.5 Kcal/kWh) x 100\%}}{\text{Gas consumed (SL) x LHV (Kcal/SL)}} = 38.1\%$$

3.2.3.3 Maintenance and Operator Requirements

The operation and maintenance cost factors for the landfill gas fuel cell power plant are compared with the PC25A commercial fuel cell experience in Table 3.2.3.3-1. After 3313 hours operation on landfill gas at Groton, and 4020 total hours including Penrose, the O&M cost factors for the landfill gas fuel cell power plant continue to be comparable to the natural gas power plant.

Table 3.2.3.3-1. Operation and Maintenance Cost Factors for Commercial Applications

Factor	PC25 A Natural Gas Fuel Cell Commercial Experience	PC25 A Landfill Gas Fuel Cell Demonstration (Penrose)	PC25 A Land Fill Gas Fuel Cell Demonstration (Groton)	Comments
Operation				
Startup from energized off	5 hours or less	5 hours or less	5 hours or less	LFG utilizes electric start option
Normal operation	Unattended, automatic	Unattended, automatic	Unattended, automatic	
Availability	95%	98.5%	96.5%	
Rated output	200 kW	120 kW (137 kW max).	140 kW (164 kW max.)	PC25 C can be modified to make 200 kW on LFG
Efficiency (LHV)	40%	37%	38%	Lower efficiency requires 8% higher fuel flow, but this is offset by lower fuel costs for Landfill Gas
Heat recovery	192,000 Kcal/hr @ 200 kW	Not demonstrated	Not demonstrated	Projected heat recovery 208,000 Kcal/hr on LFG
Fuel Heating Value HHV LHV	Natural gas 8.72-10.68 Kcal/SL 7.86-9.62	LFG 3.92 Kcal/SL 3.53 Kcal/SL	LFG 5.18 Kcal/SL 4.67 Kcal/SL	Penrose LFG heating value at low end of the range, Groton near high end
Maintenance				
Scheduled	@ 2,000 hours (during operation) @ 8,000 hours (While shutdown)	Not demonstrated Not demonstrated	Not demonstrated Not demonstrated	Projected same as natural gas
Unscheduled MTBFO (1) Availability	2,600 hours 95%	None in 707 hours 98.5%	1 Forced outage in 3,313 hours 96.5%	Operation to date indicates LFG fuel cell comparable to natural gas experience
Note: (1) Mean time between forced outages				

Operation factors for the landfill gas fuel cell power plant demonstration including start-up, normal operation, and availability continue to be comparable to natural gas. Availability, at 96.5% for Groton, continues to be slightly better than the 95% for the natural gas, and would be expected to be similar to the commercial natural gas power plants in the future. The electrical efficiency on landfill gas is 38% at Groton, slightly lower than the 40% for natural gas, but this is partially offset by the lower cost for the landfill gas fuel. Rated output for the Groton site is 140 kW (maximum 165 kW), which is improved from the 120 kW (maximum 137 kW) rating at Penrose, due to the higher heating value for the landfill gas at Groton. The means to achieve 200 kW using a PC25 C power plant are discussed in REF 1.

The maintenance cost factors for unscheduled maintenance continue to project to be comparable to the natural gas power plant based on the comparable forced outage rating (1 forced outage in 4020 total landfill gas operating hours, versus 2600 hours MTBFO for commercial PC25 A natural gas power plants).

4.0 CONCLUSIONS AND RECOMMENDATIONS

1. The landfill gas-to-energy demonstration equipment, including the fuel cell and Gas Pretreatment Unit (GPU) were removed from the Penrose, CA. site, transported to the Groton, CT. site, re-installed, and successfully operated for a year. This test demonstrated the transportability, of the equipment and the applicability of the equipment to varying landfill gas compositions, and climatic conditions.

2. The GPU for cleaning the landfill gas was successfully adapted to a new landfill site and demonstrated the following:

    - Operated for an additional 4,168 hours at Groton (total of 6,413 hours)
    - Longest run of 827 hours
    - Documented total sulfur removal significantly better than the design requirement (less than 3 ppmV)
    - Documented total halide removal significantly better than the design requirement required (less than 3 ppmV total halides)
    - Demonstrated use of reduced cost commercial sulfur removal tanks with extended changeout interval

3. The commercial PC25 A fuel cell, modified for operation on landfill gas, was restarted and successfully demonstrated the following:

    - Operation up to 165 kW on landfill gas
    - Efficiency of 38.1% at 140 kW
    - Additional 3,313 hours operation on landfill gas (total 4,020 hours)
    - Adjusted availability of 96.5%, with only one forced outage in the 3,313 hours

4. Tests were completed to determine means to reduce the cost of the GPU. Based on these tests, the recommended approach for a low cost GPU consists of external H_2S removal, followed by organic sulfur and organic halide removal within the fuel cell power plant.

APPENDIX A

Northeast Utilities Site Logs

GROTON FUEL CELL

NOTES:	Flare Only 25 scfm	→	→	Flare + Vent to H2S Tank	FC @ 130 KW	FC @ 115 KW	Flare Only Filters Changed Leaks Fixed
DATE:	10-9-96	10-9-96	10-10-96	10-10-96	10-16-96	10-18-96	10-25-96
GPU TIME:	1430	1457	1005	-	0915	1730	1730
COUNTER:	43890	45323	-	50000	41025	-	2050
STEP:	16	17	-	6	16	-	5
FE 103 - INLET TOTAL FLOW:	-	-	-	-	-	-	-
FE 134 - EXIT TOTAL FLOW:	-	-	-	-	-	-	-
FE 135 - REGEN TOTAL FLOW:	-	-	-	-	-	-	-
CHART ALARMS, y/n	n	n	n	n	n	n	n
FLARE FLOW, scfm	25	25	25	25	26	25	25
FC FLOW, scfm	0	0	0	+ Vent	34	30	0
N2 TANK #1, psig	-	-	-	-	1850	-	2650
N2 TANK #2, psig	-	-	-	-	1900	-	900
AIR COMP HDR, psig	-	-	-	-	-	-	-
LFG COMP SUCT P, in Hg	2.5	2.5	2.0	2.0	2.5	2.0	2.5
LFG COMP DISC P, psig	42.5	42.5	42	40	32	37.5	43
HOUR METER, hrs	504.4	504.4	→	→	→	→	→
COALESC FILT IN, psig	42.5	42.5	42	39.5	30.5	36.0	43
PI-144 PRV OUTLET, psig	27.5	27.0	27.5	25	24	25.0	26.0
ZAB-131 OUTLET P, psig	27.0	27.0	26.5	24.5	23	23.5	25.0
PI-130, psig	27.5	26.8	27.1	24.7	23.2	23.9	25.7
PI-101, psig	28	27.5	28	25	23.5	24	26.5
PI-205, psig	27	26	26.5	24	22.5	23	25.5
PI-105, psig	27	26	26.2	22.5	17.5	19	26
PI-112/DAB 105, psig	1.4	.2	25.8	21.8	2.0	18	25.5
PI-111/DAB 104, psig	26	25.2	2.0	2.0	16.8	2.4	1.0
FE103, scfm	0	0	0	22	62	56	0
PI-120, psig	-	-	-	-	-	-	-
PI-119, psig	-	-	-	-	-	-	-
CST-118 Dessicant Dryer, % Left	80	80	80	80	-	-	
Refrig Unit Cabinet Pressure, "wc	.22	.22	.22	.22	-	-	
Refrig Unit Exit Temp, °F	-18	-18	-18	-18	-	-	
Refrig Unit Pressure, Hi/Low	-/-	-/-	-/-	-/-	-		
PI-128/CAB 107, psig	1.2	1.6	25.4	21.6	1.4	17.6	25.2
PI-127/CAB 106, psig	26.4	25.6	1.6	1.6	16.4	1.7	1.8
DPI-129, psi in H_2O	4	4	4	4	4	4	3
PI-106, psig in H_2O	46	46	46	45.8	45	46	46
PI-136, psig	27	26.2	26.2	22	16.3	16.8	26.0
Worster Valve, % Open	1/2	1/2	1/2	1/2 +	2/3	2/3	1/2
FE135, scfm	25	25	25	25	25	25	25
PI-138, psig	2	2.2	3.6	3.6	2.7	2.8	3.2
FE134, scfm	0	0	0	0	34	30	0
Dwyer Gage, scfh	16	16	16	16	39	40	16
LFG SUCTION MANOMETER, in H2O	5	5	5	5	7	6.2	5
CNG PRIMARY P, psig							
# of CNG BOTTLES IN SVC							
FC N2 PRI/SEC PRESSURE, psig							
FC NET OUTPUT, kW							
Fuel Cell Time, hr:min							
Operating Time (Load Time), hrs							
Hot Time							
Gross AC Mwhrs							
Net AC Mwhrs							
H2S at GPU Inlet							

GROTON FUEL CELL

(A) (B)

NOTES:	Flare Only	FC @ 140 KW	FC @ 140 KW	FC @ 140 KW	FC @ 140 KW	FC @ 140 KW	FC @ 140 KW
DATE:	10-28-96	10-28-96	10-28-96	10-29-96	11-1-96	11-5-96	11-5-96
GPU TIME:	1125	1400	1630	1500	1731	1607	1646
COUNTER:	35103	—	5475	22,000	44765	28290	30649
STEP:	16	-	5	16	17	14	14
FE 103 - INLET TOTAL FLOW:	—	-	—	-	1599844	1991568	1984282
FE 134 - EXIT TOTAL FLOW:	—	—		—	684583	901644	903153
FE 135 - REGEN TOTAL FLOW:	—	—	—	-	1585154	1726945	1727930
CHART ALARMS, y/n	n	n	n	n	n	Y(28)	n
FLARE FLOW, scfm	25	25	25	25	24.9	24.9	25.0
FC FLOW, scfm	0	41	38	39	39	38	38
N2 TANK #1, psig	—	—	—	—	2600	2600	2600
N2 TANK #2, psig	—	—	—	—	2100	1500	1500
AIR COMP HDR, psig	-	—	—	—	120	121	117
LFG COMP SUCT P, in Hg	2.1	2.5	2.5	2.5	2.5	2.5	2.0
LFG COMP DISC P, psig	42.8	36	36	36	34	28?	30
HOUR METER, hrs	504.4						→
COALESC FILT IN, psig	37-42	31-36	34-36	33-36	33-34	26-28	28-30
PI-144 PRV OUTLET, psig	27	24.5	25	24.5	24.5	23.0	24.0
ZAB-131 OUTLET P, psig	26	23.5	24	23.6	23.5	22.0	22.5
PI-130, psig	26.8	23.4	23.8	23.3	23.2	21.8	22.7
PI-101, psig	27	23.5	24	23.6	23.2	22.0	23.0
PI-205, psig	26.5	22.5	22.5	22.0	22.2	21.0	22.0
PI-105, psig	26.5	21.6	22.0	21.5	21.5	19.5	20.5
PI-112/DAB 105, psig	2.0	.8	21.4	2.0	.9	1.1	1.1
PI-111/DAB 104, psig	26	21	1.2	20.8	20.6	19.0	19.9
FE103, scfm	0	67	66	64	65	70	68
PI-120, psig	—	-	—	-	22	22	22
PI-119, psig	-	-	—	-	16	16	16
CST-118 Dessicant Dryer, % Left	—	—	-	—	70	70	70
Refrig Unit Cabinet Pressure, " wc	-	-	-	-	.22	.22	.22
Refrig Unit Exit Temp, °F	-	-	-	-	-17	-19	-19
Refrig Unit Pressure, HI/Low psi	-	-	-	-		0076	0016
PI-128/CAB 107, psig	1.4	2.0	20.8	1.4	2.0	2.2	2.2
PI-127/CAB 106, psig	26.2	20.6	1.9	20.4	20.4	19.4	19.6
DPI-129, psi in H_2O	4	4	4	4	4	4	4
PI-106, psig in H_2O	46	46	46	46	46	46	46
PI-136, psig	26.8	20.4	21	20.4	20.4	18.2	19.3
Worster Valve, % Open	1/2	1/2	2/3	1/2	2/3	2/3	1/2+
FE135, scfm	25	25	25	25	25	25	25
PI-138, psig	3.8	2.7	3.3	3.7	2.7	3.9	3.8
FE134, scfm	0	40	38	39	39	38	37
Dwyer Gage, scfh	16	40	40	40	40	40	40
LFG SUCTION MANOMETER, In H2O	4.5	7	7	7	7	7	7
CNG PRIMARY P, psig				—	—	1760	1700
# of CNG BOTTLES IN SVC				—	—	3(2400)	→
FC N2 PRI/SEC PRESSURE, psig				—	—	400/70	→
FC NET OUTPUT, kW				140	140	140	140
Fuel Cell Time, hr:min				17:23	17:36	16:09	16:46
Operating Time (Load Time), hrs				1159.8	1232.2	1327.1	1387.7
Hot Time					1360	1455	1455
Gross AC Mwhrs				160.082	167.248	181.581	181.625
Net AC Mwhrs				122.654	127.129	140.376	140.462
H2S at GPU Inlet					0		0

Tank #1 only — Tank #1 only

GROTON FUEL CELL

NOTES:	#1 (OVER)	#2 (OVER)	#3 UNIT ON @ 140KW	#4 → "	FC @ 140 KW	FC @ 400 KW	FLARE ONLY
DATE:	11/6/96	11/7/96	11/7/96	11/7/96	11/8/96	11/8/96	11-14-96
GPU TIME:	1310	1600	1615	1630	1625	1711	1131
COUNTER:	50699	47250	48200	49300	33470	34245	25055
STEP:	19	17	17	17	15	15	5
FE 103 - INLET TOTAL FLOW:					2216015	2227208	2285190
FE 134 - EXIT TOTAL FLOW:					1051224	1063021	1066039
FE 135 - REGEN TOTAL FLOW:					1835333	1846494	1843895
CHART ALARMS, y/n	4/28	4/28	NO	NO	NO	NO	NO
FLARE FLOW, scfm	25	25	25	25	24.8	25.1	25.1
FC FLOW, scfm YECT	39	0	39	39	40	0	0
N2 TANK #1, psig	2650	2650	2650	2650	2700	2700	2600
N2 TANK #2, psig	1400	1225	1221	1221	1050	1050	2550
AIR COMP HDR, psig	--	—	—	—	125	125	105
LFG COMP SUCT P, in Hg	2.5	2.5	2.5	2.5	2.5	2.5 (Flare off)	6
LFG COMP DISC P, psig	28.5	39	24	27.5	20.5	23	34.1
HOUR METER, hrs	504.4	→ "	"	"	504.4	504.4	504.4
COALESC FILT IN, psig	28.5	37	24	27	19.5	34	40
PI-144 PRV OUTLET, psig	23.5	25	20	23	17.0	18.5	26
ZAB-131 OUTLET P, psig	21.8	24.5	19	22	15.5	17	25
PI-130, psig	22.2	25.1	18.5	21.5	15.4	17.6	25.7
PI-101, psig	22.2	25.0	18.0	21	15.5	17.0	27
PI-205, psig	21.0	25.0	18.0	21	14.5	16.5	25
PI-105, psig	20.1	24.5	16.0	19	13.0	15.0	25.8
PI-112/DAB 105, psig	19.5	0.8	0.8	0.8	2.0	2.8	25.4
PI-111/DAB 104, psig	1.5	23.5	14.5	18.5	11.8	12.4	6
FE103, scfm	70.0	24	50.0	70.0	88	90	10
PI-120, psig	22	22.2	22.2	22.2	22	23	22.2
PI-118, psig	16	16	16	16	16	16	16
CST-118 Dessicant Dryer, % Left	75	75	75	75	70	70	70
Refrig Unit Cabinet Pressure, " wc	.23	.23	.23	.23	.23	.23	.23
Refrig Unit Exit Temp, °F	-19	-19	-19	-19	-19	-19	-18
Refrig Unit Pressure, Hi/Low	7/1 → "		"	"	100/6	100/7	100/6
PI-128/CAB 107, psig	17.4	2.0	2.0	2.0	14	14	26.5
PI-127/CAB 106, psig	2.0	24.4	13.5	18.4	10.6	12.6	2
DPI-129, in H2O	5	5	5	5	4	4	4
PI-106, in H2O	46	47	46	46	46	46	47
PI-136, psig	17.4	25	17.5	18.2	10	18.5	27.2
Worster Valve, % Open	60	50	70	70	2/3+	2/3	50
FE135, scfm	24.9	25	31	31	25	25	25
PI-138, psig	3.2	2.8	2.7	2.6	3.8	3.8	3.4
FE134, scfm	36	Forgot to note	44	38	40	42	0
Dwyer Gage, scfh	38/5/10	32/8/10	38/5/10	38/5/10	39	40	30
LFG SUCTION MANOMETER, in H2O	6.5	160	6.5	6.5	6.5	6	3.5
CNG PRIMARY P, psig					1700		950
# of CNG BOTTLES IN SVC					3 (2a6000)		3
FC N2 PRI/SEC PRESSURE, psig					400/70		0/0
FC NET OUTPUT, kW					140	420	0
Fuel Cell Time, hr:min					1657	1714	1142
Operating Time (Load Time), hrs					1400.1	1410.4	1404
Hot Time					1528	1528	1534
Gross AC Mwhrs					191.847	191.885	192.59
Net AC Mwhrs					149.525	149.557	149.90
H2S at GPU Inlet					Open		0 PPM

Tanks Only

NOTE #1 - KWACNET S.POINT - 140
ACTUAL - 140

LT450 WAT. LVL. - 24.2" (ON SCREEN)

EVENTS - 0

OVERIDES - 1

ALL SHUTDOWNS - CLEAR

P/P 9034 P160 R150 S60 W20 A30 N40 C30 L10 I50

NOTE #2 KWACNET S.P. — 140
ACTUAL - 0 (UNIT IN IDLE)

LT450 WAT. LVL. - 26.5" (ON SCREEN)

EVENTS - 1 (RESET & STARTED UNIT — GRID CONNECT 100KW)

AS FOUND → IN IDLE. P150 R160 S60 W20 A30 N40 C30 L10 I26

GPU A.R TEMP. — 75° / OVER HEAD EXH. - ON

OPENED PEPPER EXIT VENT REMAINING POSITION — 100%

INCREASED OUTPUT FROM 100KW TO 140KW AFTER 10 MINUTES.

ALL SYSTEMS GO!

GROTON FUEL CELL

NOTES:	FC @ 130KW	FC(a) 110kw	FC @ 110 KW	GPU Pressure Test	Tripped 6PM		Post relief valve mod. Flare Only
DATE:	11-14-96	11-20-96	11-20-96	12-3-96	12-3-96	12-3-96	12-9-96
GPU TIME:	1521	0915	1115	1703	1225/1250	1346/	1233
COUNTER:	16060	2434	9610	416606	416606	0	3813
STEP:	7	5	6	16		5	5
FE 103 - INLET TOTAL FLOW:	2291309	2938930	2947223	3050335			3050832
FE 134 - EXIT TOTAL FLOW:	1063503	1351795	1355415	1397500			1397500
FE 135 - REGEN TOTAL FLOW:	1849593	2052730	2055734	2090641			2094051
CHART ALARMS, y/n	N	Y 28	N	N			N
FLARE FLOW, scfm	25.1	25.5	25.0	24.8		25.0	25.1
FC FLOW, scfm	37	30	30	0		0	0
N2 TANK #1, psig	2600	2550	2550	2600			2600
N2 TANK #2, psig	2550	1600	1600	1175			1050
AIR COMP HDR, psig	110	105	120	130			111
LFG COMP SUCT P, in Hg	6.2	6	6	6(2)	4	6(2)	1.5
LFG COMP DISC P, psig	29	18	19	40	0	42	43
HOUR METER, hrs	504.4	—	—	—	—	—	504.4
COALESC FILT IN, psig	23	17	19	37-41	21/19.5	39-44	41-44
PI-144 PRV OUTLET, psig	23	15	19	27.5	21/20	27	27.5
ZAB-131 OUTLET P, psig	22	14	15.5	27	20/18.5	26.5	27
PI-130, psig	21.9	14	15.6	27.4	19.4/19.4	26.8	27.5
PI-101, psig	22	14.5	16	28.0	20.5/20.5	27.5	28.0
PI-205, psig	21	13.5	15	27.0	20.0/20.0	26.5	27.0
PI-105, psig	20	11.0	13	27.5	20.1/20.1	26.2	26.75
PI-112/DAB 105, psig	19.6	10.5	12	1.4	18.8/18.4	25.6	26.0
PI-111/DAB 104, psig	2.2	1.2	2	26.2	19.1/18.4	1.2	1.2
FE103, scfm	66	95	92	0	0	0	0
PI-120, psig	22	22	22.4	22.2	+1		22.2
PI-119, psig	16	16	16	16	+1		16
CST-118 Dessicant Dryer, % Left	70	70	70	60			60
Refrig Unit Cabinet Pressure, " wc	.24	.23	.23	.23			.23
Refrig Unit Exit Temp, °F	-19	-19	-19	-17/-20			-20/-17
Refrig Unit Pressure, Hi/Low	∞/8	∞/6	∞/6	∞/7			∞/8
PI-128/CAB 107, psig	19	10.5	11.4	1.0	11.4/11.4	25.4	25.8
PI-127/CAB 106, psig	1.5	1.8	1.8	26.6	19.4/19.0	1.8	1.8
DPI-129, in H_2O	4	4	4	2	1	2	2
PI-106, in H_2O	46	46	46	48	47/47	47	47
PI-136, psig	19	11	11.5	27.2	19.2/18.2	26.0	26.6
Worster Valve, % Open	60	70	70	50		50	50
FE135, scfm	25	25.5	25	25		26	25
PI-138, psig	2.7	3.2	3.6	2.1	18.0/17.1	3.3	3.2
FE134, scfm	36	29	30	0		0	0
Dwyer Gage, scfh	38	36	36	30			30
LFG SUCTION MANOMETER, in H_2O	4.5	4.5	4.5	11.0	9+		4.5
CNG PRIMARY P, psig	1700	700	700	525			500
# of CNG BOTTLES IN SVC	2	2	2	1			2
FC N_2 PRI/SEC PRESSURE, psig	220/68	1400/70	1500/90	200/85			0/180
FC NET OUTPUT, kW	130.4	110.3	110.2	0			
Fuel Cell Time, hr:min	1524	0919	1115	1209			
Operating Time (Load Time), hrs	1405	1544	1546	1569.1			
Hot Time	1538	1676	1678	1703			
Gross AC Mwhrs	192.825	212.299	212.518	215.891			
Net AC Mwhrs	150.055	168.010	168.226	170.660			
H_2S, ppm: at GPU Inlet/ at Temp Flare	-0-PPM	-0- PPM	-0- PPM				0/140

New valves into FC comp

GROTON FUEL CELL

NOTES:	GPU Flare Only Starting FC	FC @ 100 KW	FC @ 106 KW	FC to idle then 100KW FC @ 100 KW	GPU Flare Only		
DATE:	12-10-96	12-10-96	12-10-96	12-10-96	1-22-97		
GPU TIME:	0942	1449	1603	1640	1456		
COUNTER:	28870	47163	832	3043	7634		
STEP:	14	17	5	5	6		
FE 103 - INLET TOTAL FLOW:	3050870	2061749	3066260		2372788		
FE 134 - EXIT TOTAL FLOW:	1397500	1402675	1404851		1550081		
FE 135 - REGEN TOTAL FLOW:	2125771	2133432	2135286		2350987		
CHART ALARMS, y/n	n	n	n	n	n		
FLARE FLOW, scfm	25.0	25.1	25.0	25.0	25.3		
FC FLOW, scfm	0	28	29	27	0		
N2 TANK #1, psig	2500	2550	2550		2500		
N2 TANK #2, psig	900	900	900		2603		
AIR COMP HDR, psig	115	115	115		100		
LFG COMP SUCT P, In Hg	1.5	2.0	2.0	2.0	2.1		
LFG COMP DISC P, psig	43	24.0	21.5	24.0	43.5		
HOUR METER, hrs	504.4	—	—		1.7		
COALESC FILT IN, psig	41-44	23.5	21.0	23.5	44.0		
PI-144 PRV OUTLET, psig	26.5	21.5	19.0	21.0	27.5		
ZAB-131 OUTLET P, psig	24.5	20.5	17.5	20.0	26.5		
PI-130, psig	25.2	20.7	18.0	20.0	27.4		
PI-101, psig	26.0	21.0	18.0	20.5	28.0		
PI-205, psig	25.0	20.0	17.5	19.5	27.0		
PI-105, psig	24.3	18.0	15.0	17.5	25.1		
PI-112/DAB 105, psig	1.2	.8	13.9	16.4	24.6		
PI-111/DAB 104, psig	22.4	17.2	1.4	1.4	2.1		
FE103, scfm	0	58.0	66	59	0		
PI-120, psig	22.2	22.2	22.2	→	22.4		
PI-119, psig	16.0	16.0	16.0	→	16.0		
CST-118 Dessicant Dryer, % Left	60	60	60	→	60		
Refrig Unit Cabinet Pressure, "wc	.23	.23	.23	→	.23		
Refrig Unit Exit Temp, °F	-17 to -20	-20	-19	→	-19		
Refrig Unit Pressure, Hi/Low	00/8	00/8	00/8	→	00/8		
PI-128/CAB 107, psig	2.2	2.0	13.4	16.0	24.6		
PI-127/CAB 106, psig	23.5	17.0	2.0	2.0	1.6		
DPI-129, in H_2O	4	4	4	4	3		
PI-106, in H_2O	46	46	46	46	47		
PI-138, psig	24.0	17.0	13.4	16.0	25.2		
Worster Valve, % Open	50	65	70	65	55		
FE135, scfm	25.0	25.0	25.0	25	25.0		
PI-136, psig	3.9	2.7	3.2	3.3	3.7		
FE134, scfm	0	30	28	27	0		
Dwyer Gage, scfh	22	30	30	30	16		
LFG SUCTION MANOMETER, in H_2O	5.5	6.5	6.6	6.5	2.0		
CNG PRIMARY P, psig	1350	1600	1750				
# of CNG BOTTLES IN SVC	2	1	2				
FC N_2 PRI/SEC PRESSURE, psig	2000/65	1850/65	1850/65				
FC NET OUTPUT, kW	0	100	105				
Fuel Cell Time, hr:min	0945	1450	1606				
Operating Time (Load Time), hrs	1569.1	1572	1573				
Hot Time	1704	1709	1710				
Gross AC Mwhrs	216.194	216.543	216.689				
Net AC Mwhrs	170.611	170.879	171.013				
H_2S, ppm: at GPU Inlet/ at Temp Flare					0/100		

GROTON FUEL CELL

NOTES:	WN	FC @ 100kW	FC @ 100kW	FC OFF	FC OFF	FC 100kW	FC @ 140 kW
DATE:	12-11-96	12-12-96	12-13-96	12-16-96	2-4-97	2-4-97	2-11-97
GPU TIME:	1017	1332	1338	1328	1204	1316	1505
COUNTER:	15745	11604	47211	61	12574	46837	40425
STEP:	7	6	17	2	7	7	16
FE 103 - INLET TOTAL FLOW:		3222045	3305040	3392224	3372917	3374349	3385372
FE 134 - EXIT TOTAL FLOW:		1480117	1519629	1550019	1550081	1550913	1567385
FE 135 - REGEN TOTAL FLOW:		2208807	2339649	2347260	2353239	2355010	2376593
CHART ALARMS, y/n	N	N	N	Y(68):OK	N	N	N
FLARE FLOW, scfm		24.9	25.1	25.3	24.8	24.9	24.9
FC FLOW, scfm		28	28	-0-	-0-	32	41
N2 TANK #1, psig	2550	2600	2600	2600	2490	2490	2350
N2 TANK #2, psig	800	650	500	-0-	2600	2600	2600
AIR COMP HDR, psig	105	125	125	125	90	115	115
LFG COMP SUCT P, In Hg	6	6	6	7	-1	-1	1.5
LFG COMP DISC P, psig	25	22	23	42	46	39.9	38.5
HOUR METER, hrs	504.4	—	—	—	3.2	4.4	18.7
COALESC FILT IN, psig		21	22	42	45	39	39.0
PI-144 PRV OUTLET, psig		19	20	27	26	26	25.0
ZAB-131 OUTLET P, psig		18	19	27	24	24	24.0
PI-130, psig		18	19.6	27.2	25.2	26.1	24.0
PI-101, psig		18	18	28	26	25	24.0
PI-205, psig		18	18	27	25	24	23.0
PI-105, psig		15	17	26	25	23.5	21.0
PI-112/DAB 105, psig		14.2	.8	25.5	25	23	2.0
PI-111/DAB 104, psig		2	15.8	2	1.8	2.2	20.5
FE103, scfm		62	56	-0-	-0-	52	65
PI-120, psig		22	22	22	22	22	22
PI-119, psig		16	16	16	16	16	16
CST-118 Dessicant Dryer, % Left		70%	70%	70%	70%	70%	60%
Refrig Unit Cabinet Pressure, "wc		.23	.24	.24	.23	.24	.23
Refrig Unit Exit Temp, °F		-19	-19	-17	-17	-19	-19
Refrig Unit Pressure, HI/Low		00/10	00/15	00/5	00/18	00/20	0/18
PI-128/CAB 107, psig		14	2	24.2	27	22	1.4
PI-127/CAB 106, psig		1.6	15	2.2	1.6	1.6	20.0
DPI-129, in H_2O		4	3	4	2	4	3
PI-106, in H_2O		46	46	48	46	46	46
PI-136, psig		13.8	15.6	25	27.6	21.4	20.2
Worster Valve, % Open		60%	60%	50%	50%	50%	60%
FE135, scfm		25	25	25	25	25	25
PI-138, psig		4	2.7	3	2.2	2.6	2.7
FE134, scfm		27	27	-0-	-0-	30	41
Dwyer Gage, scfh		29	29	48	16	31	40
LFG SUCTION MANOMETER, In H_2O		8	7	EMPTY	2 1/2	3 1/2	4.0
CNG PRIMARY P, psig		1800	1800	1650	1900	1300	1750
# of CNG BOTTLES IN SVC		2	2	2	1	1	1
FC N_2 PRI/SEC PRESSURE, psig		1700/65	1550/70	600/70	1600/70	1500/70	1200/70
FC NET OUTPUT, kW		100.3	99.1	-0-	-0-	100.6	140.9
Fuel Cell Time, hr:min		1337	1344	1331	1212	1319	1509
Operating Time (Load Time), hrs		1619	1643	1660	1660	1660	1663
Hot Time		1756	1780	1799	1801	1802	1810
Gross AC Mwhrs		221.724	224.340	226.357	228.787	228.860	229.534
Net AC Mwhrs		175.548	177.955	179.607	179.246	179.313	179.608
H_2S, ppm: at GPU Inlet/ at Temp Flare		0	0	0	0	0	0/60

Inlet only

13 #7

GROTON FUEL CELL

NOTES:	FC @ 150 KW	FC @ 160 KW	FC @ 140 KW	FC @ 110 KW	FC @ 140 KW	FC @ 140 KW	FC @ 140 KW
DATE:	2-11-97	2-11-97	2-11-97	2-13-97	2-18-97	2-21-97	2-21-97
GPU TIME:	1547	1600	1653	1326	1313	0752	1300
COUNTER:	42940	43756	46644	31455	26486	11447	29817
STEP:	16	16	17	5	14	6	14
FE 103 - INLET TOTAL FLOW:			3397590	3564130	3980467	4233206	4252430
FE 134 - EXIT TOTAL FLOW:			156/835	166 4103	1939812	2094680	2106566
FE 135 - REGEN TOTAL FLOW:			237128	2446131	2625930	2725694	2733369
CHART ALARMS, y/n			N	Y (28)	Y (28)	N	N
FLARE FLOW, scfm	25.0	24.9	25.3	24.9	24.9	24.9	25.1
FC FLOW, scfm	44	48	39	38	38	39	39
N2 TANK #1, psig			2300	1980	1100	600	550
N2 TANK #2, psig			2150	2600	2550	2500	2550
AIR COMP HDR, psig			115	117	135	100	118
LFG COMP SUCT P, in Hg	1.5	1.5	1.5	1.0	1.0	1.0	1.0
LFG COMP DISC P, psig	37.5	35.2	39.5	28.5	37.5	37.5	37.5
HOUR METER, hrs			20.5	65.1	184.8	251.5	256.6
COALESC FILT IN, psig	37.5	35.0	39.5	28.5	37.5	32.5	37.5
PI-144 PRV OUTLET, psig	24.5	23.0	25.5	25.0	24	24	25.0
ZAB-131 OUTLET P, psig	23.0	22.0	24.0	24.0	23	23	24.0
PI-130, psig	23.2	21.7	24.0	24.0	22.8	22.9	24.0
PI-101, psig	23.0	21.5	24.0	24.0	23	22.5	24.0
PI-205, psig	22.0	20.2	23.5	23.0	22	22.0	23.0
PI-105, psig	20.6	19.5	21.5	19.2	17.5	17.0	18.0
PI-112/DAB 105, psig			0.8	18.6	1	16.0	1.0
PI-111/DAB 104, psig			20.6	1.4	16.5	2.4	17.2
FE103, scfm	70	76	64	60	68	66	64.5
PI-120, psig			22	22	22.5	22.8	22.8
PI-119, psig			16	16	16	16.4	16.4
CST-118 Desiccant Dryer, % Left			60	60%	60%	60%	60%
Refrig Unit Cabinet Pressure, "wc			.23	.23	.24	.24	.22
Refrig Unit Exit Temp, °F			-17	-20	-19	-19	-19
Refrig Unit Pressure, Hi/Low			0/9	0 9	0 10	0 2	0/5
PI-128/CAB 107, psig			2.0	18	2	15.4	2.2
PI-127/CAB 106, psig			20.2	2.0	16	1.8	16.8
DPI-129, In H_2O	3	3	3	3	4	4	4
PI-106, In H_2O	46	46	46	46	46	46	46
PI-136, psig	19.2	16.6	20.2	17.8	15.6	15.0	16.5
Worster Valve, % Open	60%	60%	60%	60%	60%	60%	60%
FE135, scfm	25.0	25.0	25.0	25.5	25	25.5	25.0
PI-138, psig	2.8	2.7	2.8	3.4	3.8	4.0	4.0
FE134, scfm	44	46	38	38	36	38.5	39
Dwyer Gage, scfh	40	41	40	40	38	38	30
LFG SUCTION MANOMETER, In H_2O	4"	4"	4"	3½"	3"	3.25	3"
CNG PRIMARY P, psig			2100	2800	2200	2100	2200
# of CNG BOTTLES IN SVC			3	3	1	1	1
FC N_2 PRI/SEC PRESSURE, psig			1200/70	1200/70	2400/75	1900/65	1950/65
FC NET OUTPUT, kW	150.0	160.3	140.2	140.0	139.6	140.9	140.2
Fuel Cell Time, hr:min	1544	1607	1652	1336	1315	0800	1302
Operating Time (Load Time), hrs	Gr. 164.2	171.4	1665	1710	1830	1899	1902
Hot Time	Aux 14.2	11.5	1812	1857	1977	2044	2049
Gross AC Mwhrs	Net 150	160.3	227.805	236.596	254.757	264.911	265.678
Net AC Mwhrs			179.944	186.113	202.891	212.223	213.926
H_2S, ppm: at GPU Inlet/ at Temp Flare				-0-	-0-	-0-	

Fg #8

GROTON FUEL CELL

NOTES:	FC @ 140.2	FC OFF PARTIAL ✓ REFRIG	FC OFF	FC @ 130kW	FC @ 120KW	FC @ IDLE	FC @ 100 kW
DATE:	2-25-97	2-28-97	3-3-97	3-3-97	3-3-97	3-3-97	3-7-97
GPU TIME:	1324	0944	0840	1318	1434	1334	1352
COUNTER:	19810	31520	31792	48395	2162	37962	39024
STEP:	8	14	14	17	5	16	16
FE 103 - INLET TOTAL FLOW:	4613107	4621913	4621775	4624364	4628838	4871997	4872500
FE 134 - EXIT TOTAL FLOW:	2332888	2338155	2338155	2339792	2342456	2483937	2484103
FE 135 - REGEN TOTAL FLOW:	2877919	2882917	2889235	2996182	2998085	3140519	3140960
CHART ALARMS, y/n	Y 18/19/37/38	N	Y 28	N	N	Y 28	N
FLARE FLOW, scfm	25.0	24.9	24.9	25.2	25.2	25.2	25.1
FC FLOW, scfm	39	-0-	-0-	38	34	-0-	29
N2 TANK #1, psig	2700	2700	2700	2750	2750	2700	
N2 TANK #2, psig	2800	2250	1800	1800	1750	1100	
AIR COMP HDR, psig	110	105	135	130	135	120	
LFG COMP SUCT P, in Hg	0	-0.5	-0-	-0-	-0-	-0-	0
LFG COMP DISC P, psig	37.9	43.5	43.5	37.5	38	41	39
HOUR METER, hrs	353.0	356.3	427.2	431.8	433.1	528.1	528.4
COALESC FILT IN, psig	37.8	43.5	44	37.5	38	41	38.5
PI-144 PRV OUTLET, psig	25.5	25.5	26.5	25.5	25.0	27.0	25.0
ZAB-131 OUTLET P, psig	24.0	25.0	25.5	24.0	23.5	26.0	24.0
PI-130, psig	24.6	25.5	26.4	24.3	23.8	26.5	24.5
PI-101, psig	25.0	26.0	27.0	25.0	24.0	27.0	25.0
PI-205, psig	24.0	25.0	26.0	23.0	23.0	25.5	23.5
PI-105, psig	19.0	24.0	24.0	17.5	17.5	22.2	23.0
PI-112/DAB 105, psig	18.2	1.0	2.0	0.8	17.0	2.2	2.0
PI-111/DAB 104, psig	1.2	22.8	23.2	16.7	1.4	21.8	19.2
FE103, scfm	40	-0-	-0-	58	56	12	50
PI-120, psig	24.0	22.0	22.0	22.0	22.0	22.4	22.4
PI-119, psig	17.6	16.0	16.0	15.8	15.8	16.0	16.0
CST-118 Dessicant Dryer, % Left	60%	60%	60%	60%	60%	60%	60%
Refrig Unit Cabinet Pressure, " wc	.21	.23	.22	.23	.23	.23	.23
Refrig Unit Exit Temp, °F	39°	-19	-19	-19	-19	-18	-20
Refrig Unit Pressure, HI/Low	0	00/10	-/5	-/15	-/16	-/0	-/0
PI-128/CAB 107, psig	17.6	2.2	1.8	2.0	16.5	1.5	1.4
PI-127/CAB 106, psig	1.8	22.8	23.8	16.6	2.0	21.5	17.0
DPI-129, in H_2O	4	4	4	4	4	4	4
PI-108, in H_2O	46	46	47	46	46	46	46
PI-136, psig	17.4	23.2	24.2	16.5	16.6	21.5	17.0
Worster Valve, % Open	60%	60%	60%	70%	60%	60%	60%
FE135, scfm	25.0	25	26	26	25.5	25.5	25.0
PI-138, psig	2.4	4	4	2.8	3.5	2.6	2.6
FE134, scfm	38.0	-0-	-0-	35	33	2	28
Dwyer Gage, scfh	30	22	23	30	30	26	30
LFG SUCTION MANOMETER, in H_2O	3.25	2.5	2.5	3.5	3.5	2.5	3.5
CNG PRIMARY P, psig	2000	1900	1800	1000	1000	960	
# of CNG BOTTLES IN SVC	1	1	1	2	2	2	
FC N_2 PRI/SEC PRESSURE, psig	1600/66	1400/70	1250/70	1000/70	1000/70	950/70	
FC NET OUTPUT, kW	140.2	-0-	-0-	130.2	120.1	0	100.0
Fuel Cell Time, hr:min	1329	0945	0839	1318	1432	1333	1349
Operating Time (Load Time), hrs	1999	2001	2001	2002	2003	2098	2098
Hot Time	2145	2149	2149	2153	2154	2249	2249
Gross AC Mwhrs	280.344	280.811	280.940	281.070	281.244	292.244	292.270
Net AC Mwhrs	226.436	226.669	226.640	226.730	226.886	235.671	235.689
H_2S, ppm: at GPU Inlet/ at Temp Flare	-0-	-0-	-0-/45m	-0-	-0-	-0-	

GROTON FUEL CELL

NOTES:	FCQ 120kW	Fc Q IDLE	Fc Q 120 KW	FCQ 119 KW	FcQ 119.8kW	FcQ 120.3kW	Fc Q 110 KW
DATE:	3-7-97	3-11-97	3-11-97	3-14-97	3-18-97	3-19-97	3-19-97
GPU TIME:	1437	0807	0943	1319	0809	0828	0913
COUNTER:	41922	6946	12692	29758	50543	36135	38833
STEP:	16	6	7	14	17	15	16
FE 103 - INLET TOTAL FLOW:	4895029	4990810	4995379	5249457	5594635	5667180	
FE 134 - EXIT TOTAL FLOW:	2485686	2496149	2499390	2643796	2818873	2865215	
FE 135 - REGEN TOTAL FLOW:	3142098	3276243	3278640	3392003	3528087	3564093	
CHART ALARMS, y/n	N	Y EB	N	Y EB	Y EB	N	N
FLARE FLOW, scfm	25.0	25.0	25.1	25.1	24.3	24.4	25.0
FC FLOW, scfm	36	-0-	34	33	33	32	30
N2 TANK #1, psig	2700	2700	2700	2700	2700	2700	
N2 TANK #2, psig	1100	400	400	0/1650	2100	200	
AIR COMP HDR, psig	125	125	130	110	130	135	
LFG COMP SUCT P, In Hg	0	-0-	-0-	0	-0-	-0-	-0-
LFG COMP DISC P, psig	37.5	40.0	30.5	30.0	23.0	22.5	27.5
HOUR METER, hrs	529.0	618.6	620.2	695.9	786.7	811.0	811.7
COALESC FILT IN, psig	37.5	40.5	30.5	29.0	22.0	22.0	27.5
PI-144 PRV OUTLET, psig	25.5	26.0	24.0	24.0	20.0	20.0	24.0
ZAB-131 OUTLET P, psig	24.0	25.0	23.0	23.0	18.0	18.5	23.0
PI-130, psig	24.4	25.8	23.6	23.2	18.0	18.8	23.5
PI-101, psig	25.0	27.0	24.0	23.0	18.0	19.0	24.0
PI-205, psig	23.5	26.5	23.0	22.5	17.5	18.0	22.5
PI-105, psig	22.5	21.0	15.5	16.0	9.5	10.0	16.0
PI-112/DAB 105, psig	2.2	20.5	15.0	1.1	8.5	1.8	2.2
PI-111/DAB 104, psig	16.6	2.0	2.2	15.0	4.8	9.0	15.2
FE103, scfm	55	10	58	58	68	64	50
PI-120, psig	22.4	22.4	22.4	23.0	23.0	23.2	23.2
PI-119, psig	16	16	16	16.4	16.6	16.8	16.8
CST-118 Dessicant Dryer, % Left	60%	50%	50%	50%	50%	50%	50%
Refrig Unit Cabinet Pressure, " wc	.23	.24	.24	.22	.22	.22	.23
Refrig Unit Exit Temp, °F	-19	-19	-19	-19	-19	-19	-18
Refrig Unit Pressure, Hi/Low	-/0	-/15	-/0	-/0	130/15	120/0	115/0
PI-128/CAB 107, psig	1.4	20.0	15.2	2.2	8.2	1.4	1.6
PI-127/CAB 106, psig	16.4	1.8	1.6	14.8	5.0	8.8	15.0
DPI-129, in H_2O	4	4	4	4	4	4	4
PI-106, in H_2O	46	46	46	46	45	45	46
PI-136, psig	16.2	20.6	15.4	14.6	8.8	8.6	15.0
Worster Valve, % Open	60%	60%	60%	60%	85%	90%	60%
FE135, scfm	25.5	25.5	25.0	25.5	26.0	25	25
PI-138, psig	3.0	3.6	2.6	4.0	2.2	3.6	2.8
FE134, scfm	32	-0-	33	32	30	30	28
Dwyer Gage, scfh	30	24	30	26	30	30	28
LFG SUCTION MANOMETER, in H_2O	3.5	2.5	3.0	2.5	3.5	3.5	3.5
CNG PRIMARY P, psig	950	900	900	850	850	800	
# of CNG BOTTLES IN SVC	2	2	2	2	2	2	
FC N_2 PRI/SEC PRESSURE, psig	850/70	850/70	850/70	econ/70	700/70	700/70	
FC NET OUTPUT, kW	121.2	-0-	120.9	119.3	119.8	120.3	110.0
Fuel Cell Time, hr:min	1427	0805	0941	1322	0810	0825	
Operating Time (Load Time), hrs	2094	2188	2190	2265	2356	2380	
Hot Time	2250	2339	2340	2416	2506	2530	
Gross AC Mwhrs	292.357	297.845	298.042	308.062	320.063	323.262	
Net AC Mwhrs	235.969	236.072	236.213	245.292	256.181	259.106	
H_2S, ppm: at GPU Inlet/ at Temp Flare	-0-	-0-	-0-	-0-	-0-	-0-	

GROTON FUEL CELL

NOTES:	FC @ 110.2kw	FC @ 110Kw	FC OFF	FC off GPU Flare Only	FC OFF	FC @ IDLE	FC @ 130 kw
DATE:	3-20-97	3-20-97	3-22-97	3-27-97	4-4-97	4-4-97	4-4-97
GPU TIME:	0845	1406	0821	1016	0920	1055	1403
COUNTER:	21598	40740	22100	32310	35866	41557	2004
STEP:	8	16	14	15	15	16	5
FE 103 - INLET TOTAL FLOW:	5744570	5762181	5892118	5893831	5893982	5894139	5904240
FE 134 - EXIT TOTAL FLOW:	2907853	2917434	2986359	2986359	2986377	2986493	2992590
FE 135 - REGEN TOTAL FLOW:	3600500	3609517	3666459	37117K	3713362	3715945	3720440
CHART ALARMS, y/n	N	N	N	19:27	N	N	N
FLARE FLOW, scfm	24.9	24.7	25.1	25.1	25.0	25.5	25.1
FC FLOW, scfm	31	31	0	?	0	20	35
N2 TANK #1, psig	2700	2700	2700	2700	2600	2600	2650
N2 TANK #2, psig	1800	1750	1300	0	2200	2200	2100
AIR COMP HDR, psig	130	115	125	100	115	135	110
LFG COMP SUCT P, in Hg	-0-	-0-	-0-	-0-	-0.5	-1.0	-1.0
LFG COMP DISC P, psig	33	30.5	41.5	41.5	44.0	40.5	33.5
HOUR METER, hrs	835.3	840.6	879.4	909.6	910.7	912.2	915.7
COALESC FILT IN, psig	32.5	30.0	41.5	42.0	44.5	41.0	33.0
PI-144 PRV OUTLET, psig	24.0	24.0	26.5	26.0	26.0	26.5	23.0
ZAB-131 OUTLET P, psig	23.0	23.0	25.5	25.0	25.0	25.5	22.0
PI-130, psig	23.2	23.5	26.4	25.8	25.5	26.0	22.0
PI-101, psig	24.0	24.0	27.0	26.6	26.0	27.0	22.0
PI-205, psig	23.0	23.0	26.0	26.0	25.0	25.5	21.5
PI-105, psig	15.5	16.0	23.0	23.0	26.0	25.5	20.5
PI-112/DAB 105, psig	141.8	2.2	1.0	1.7	2.0	2.0	19.4
PI-111/DAB 104, psig	1.2	15.0	22.4	22.0	25.0	25.0	1.3
FE103, scfm	52	52	0	0	0	20.0	66
PI-120, psig	23.2	23.2	24.2	21.5	22.2	22.2	22.2
PI-119, psig	17.0	17.0	18.0	15.0	16.0	16.0	16.0
CST-118 Dessicant Dryer, % Left	50%	50%	50%	50%	50%	50%	50%
Refrig Unit Cabinet Pressure, "wc	.23	.23	.22	.22	.24	.24	.24
Refrig Unit Exit Temp, °F	-19	-19	-19	off	-18	-19	-19
Refrig Unit Pressure, Hi/Low	140/0	135/5	145/0	off	140/0	160/0	170/10
PI-128/CAB 107, psig	14.4	1.4	2.0	1.2	1.4	1.2	19.6
PI-127/CAB 106, psig	1.8	14.4	22.8	22.2	25.4	25.0	2.0
DPI-129, in H_2O	4	4	4	4	4	4	4
PI-106, in H_2O	46	46	47	47	47	46	46
PI-136, psig	14.6	14.4	23.0	22.6	25.8	25.2	19.5
Worster Valve, % Open	60%	60%	50%	50%	50%	50%	60
FE135, scfm	25.5	25	25.5	25	25.6	25.0	25.0
PI-138, psig	2.4	2.8	4.0	3.8	3.8	2.6	2.2
FE134, scfm	29	30	0	0	0	20	36
Dwyer Gage, scfh	28	27	22	20	21	30	30
LFG SUCTION MANOMETER, in H_2O	3.0	2.5	3.5	2.5	2.0	4.0	4.5
CNG PRIMARY P, psig	800	1450	1850	1750	400	1050	1100
# of CNG BOTTLES IN SVC	2	4	4	2	2	3	3
FC N_2 PRI/SEC PRESSURE, psig	650/70	650/70	2300/75	2000/65	1450/70	1400/70	1400/70
FC NET OUTPUT, kW	110.2	110.0	0	0	0	0	130
Fuel Cell Time, hr:min	0844	1410	0820			1052	1402
Operating Time (Load Time), hrs	2404	2410	2410.2			2418	2451
Hot Time	2555	2560	2560			2603	2606
Gross AC Mwhrs	326.225	326.891	331.054			232.146	337.547
Net AC Mwhrs	261.779	262.376	266.561			266.567	266.897
H_2S, ppm: at GPU Inlet/ at Temp Flare	-0-		-0-		-0-		

GROTON FUEL CELL

New LFG Compressor Values

NOTES:	FC @ 115 kw	FC @ 115 kw	FC @ IDLE	FC @ 110KW	FC @ 140KW	FC @ 140 KW	Fc @ 150kw
DATE:	4-4-97	4-10-97	4-15-97	4-25-97	4-25-97	4-30-97	4-30-97
GPU TIME:	1625	0933	0656	1248	1324	0702	0753
COUNTER:	10455	44993	86I5	18458	20610	21553	24593
STEP:	6	17	6	7	8	8	8
FE 103 - INLET TOTAL FLOW:	5912964	6406636	6644501	6649360	6651510	7087000	7090219
FE 134 - EXIT TOTAL FLOW:	2997627	3255013	3345533	3348410	3349458	3612847	3614844
FE 135 - REGEN TOTAL FLOW:	3723979	3929650	4105108	4109322	4110214	4290637	4281900
CHART ALARMS, y/n	N	28	28	N	N	N	N
FLARE FLOW, scfm	24.6	24.9	25.0	25.2	24.6	25.0	25.0
FC FLOW, scfm	33	33	-0-	33	41	39	43
N2 TANK #1, psig	2650	2600	2500	2500	2500	2500	2500
N2 TANK #2, psig	2100	1250	0/2550	2600	2600	1900	1900
AIR COMP HDR, psig	110	130	125	100	110	117	115
LFG COMP SUCT P, In Hg	-1.0	0	0	-2.0	-2.0	-1.6	-1.5
LFG COMP DISC P, psig	38	23	38	40.5	39.0	39.0	38.0
HOUR METER, hrs	917.8	1054.9	1172.3	1175.0	1175.6	1289.3	1290.1
COALESC FILT IN, psig	38	22	38	40	38	38.5	38.0
PI-144 PRV OUTLET, psig	25.0	20	26.0	25.0	24.5	25.0	25.0
ZAB-131 OUTLET P, psig	24.0	19	25.0	24.0	23.5	23.5	24.0
PI-130, psig	24.4	19.3	25.8	24.2	23.5	23.8	24.0
PI-101, psig	25.0	20.0	26.5	25.0	24.0	24.0	24.5
PI-205, psig	20.7	19.0	25.5	23.5	22.5	23.0	23.0
PI-105, psig	23.0	19.0	24.5	22.5	21.0	21.5	21.5
PI-112/DAB 105, psig	22.4	1.0	23.8	21.8	20.8	20.8	21.0
PI-111/DAB 104, psig	2.0	16.4	2.2	1.8	1.0	1.2	1.2
FE103, scfm	66	62	10.0	54	66	63	67
PI-120, psig	22.4	22.5	22.5	22.4	22.4	22.6	22.6
PI-119, psig	16.2	16.2	16.2	16.0	16.0	16.2	16.2
CST-118 Dessicant Dryer, % Left	50	50%	50%	45%	45%	45%	45%
Refrig Unit Cabinet Pressure, " wc	.24	.23	.23	.23	.23	.23	.23
Refrig Unit Exit Temp, °F	-19	-18	-18	-19	-19	-19	-19
Refrig Unit Pressure, Hi/Low	160/8	130/0	140/0	160/0	160/0	158/8	170/0
PI-128/CAB 107, psig	22.0	2.0	22.8	21.4	20.0	20.6	20.2
PI-127/CAB 106, psig	1.6	16.2	1.8	1.4	1.4	1.8	1.8
DPI-129, In H_2O	4	4	4	4	4	4	4
PI-106, In H_2O	46	46	47	46	46	46	46
PI-136, psig	21.6	16.0	23.0	21.8	20.0	20.4	20.2
Worster Valve, % Open	60	65%	50%	50%	50%	50%	50%
FE135, scfm	25.2	25.0	25.0	25.0	25.5	25.5	25.0
PI-138, psig	3.4	2.8	3.8	2.4	2.0	2.4	2.2
FE134, scfm	32	30	4	32	40	38	41
Dwyer Gage, scfh	30	29	24	26	28	30	30
LFG SUCTION MANOMETER, In H_2O	5	4.5	4.5	4.5	5.0	5.0	5.0
CNG PRIMARY P, psig	2350	2100	2050	1300	1300	2200	2200
# of CNG BOTTLES IN SVC	2	2	2	1	1	2	2
FC N_2 PRI/SEC PRESSURE, psig	1400/68	1150/70	1000/70	2250/70	2250/90	1650/70	1700/70
FC NET OUTPUT, kW	115	114.9	0	110.2	140.5	140.1	150.4
Fuel Cell Time, hr:min	1625	0937	0657	1247	1321	0703	0750
Operating Time (Load Time), hrs	2453	2590	2707	2709	2709	2822	2823
Hot Time	2608	2745	2862	2868	2869	2982	2983
Gross AC Mwhrs	332.876	350.200	360.113	360.941	360.823	377.965	378.086
Net AC Mwhrs	267.196	283.023	288.405	288.432	288.506	304.376	304.488
H_2S, ppm: at GPU Inlet/ at Temp Flare		-0-		-0-	—		-0-

GROTON FUEL CELL

NOTES:	FC @ 150 KW	FC @ 130KJ	FC @ 130KW	FC @ 130KW			
DATE:	4/30/97	5-5-97	5-7-97	5-9-97			
GPU TIME:	1202	1324	1327	1523			
COUNTER:	39431	17366	29119	4962			
STEP:	16	7	14	5			
FE 103 - INLET TOTAL FLOW:	7107526	7450507	7458688	7637611			
FE 134 - EXIT TOTAL FLOW:	3125393	3816713	3821433	3925787			
FE 135 - REGEN TOTAL FLOW:	4288120	4470449	4475372	4550219			
CHART ALARMS, y/n	N	N	N	N			
FLARE FLOW, scfm	25	24 9	25.0	25.0			
FC FLOW, scfm	44	37	38	36			
N2 TANK #1, psig		2500	2500	2450			
N2 TANK #2, psig		1100	550	2600			
AIR COMP HDR, psig		115	100	105			
LFG COMP SUCT P, in Hg	-2	-1.5	-1.0	-1.0			
LFG COMP DISC P, psig	38	37.5	35	34			
HOUR METER, hrs	1294	1415.6	1419.0	1469			
COALESC FILT IN, psig	37.5	36	34	33			
PI-144 PRV OUTLET, psig	25.0	25.0	25.0	25.0			
ZAB-131 OUTLET P, psig	23.5	24.0	23.5	24.0			
PI-130, psig	23.4	24.0	23.8	23.8			
PI-101, psig	24.0	24.5	21.0	24.0			
PI-205, psig	23.0	23.0	23.0	23.0			
PI-105, psig	21.0	22.0	21.5	22.0			
PI-112/DAB 105, psig		21.0	1.2	21.0			
PI-111/DAB 104, psig		2.4	20.8	1.2			
FE103, scfm		62	64	60			
PI-120, psig		23.0	22.4	22.4			
PI-119, psig		16.8	16.0	16.0			
CST-118 Dessicant Dryer, % Left		40%	40%	40%			
Refrig Unit Cabinet Pressure, " wc		.24	.23	.24			
Refrig Unit Exit Temp, °F		—	-19	-18			
Refrig Unit Pressure, Hi/Low		155/20	130/15	140/8			
PI-128/CAB 107, psig		20.5	2.0	21.0			
PI-127/CAB 106, psig		1.6	20.4	2.0			
DPI-129, in H_2O		4	4	4			
PI-106, In H_2O		46	46	46			
PI-136, psig	19.6	20.8	20.2	21.0			
Worster Valve, % Open	60	55%	50%	55%			
FE135, scfm	25.0	25.0	25.5	25.0			
PI-138, psig	2.6	2.8	4.0	3.4			
FE134, scfm	43	36	36	36			
Dwyer Gage, scfh	30	27	30	30			
LFG SUCTION MANOMETER, in H_2O	5	4.5	5.0	5.0			
CNG PRIMARY P, psig		2250	900	700			
# of CNG BOTTLES IN SVC		2	2	2			
FC N_2 PRI/SEC PRESSURE, psig		1300/90	2000/90	1700/70			
FC NET OUTPUT, kW	150	131.0	130.3	130.0			
Fuel Cell Time, hr:min	1159	1322	1323	1523			
Operating Time (Load Time), hrs	2927	2948	2951	3000			
Hot Time	2957	3108	3115	3165			
Gross AC Mwhrs	278.353	393.152	393.544	400.596			
Net AC Mwhrs	305.109	316.286	316.502	323.002			
H_2S, ppm: at GPU Inlet/ at Temp Flare		0/18	-0-				

GROTON FUEL CELL

NOTES:

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 5
To Larry Preston | From Chuck Tripodi
Co. FC | Dept. | Phone # 8 | Fax # 727-2319

	FC @ 150 kW	FC @ 130KW	FC @ 130KW	FC @ 130KW	FC @ 130 KW chg to 100KW	FC @ 105KW	FC @ 105 KW
DATE:	4/30/97	5-5-97	5-7-97	5-9-97	5-16-97	5-19-97	5-19-97
GPU TIME:	1202	1324	1327	1523	0941	0625	1443
COUNTER:	39431	39566	39569	4962	28039	illegible	42317
STEP:	16	2	14	5	14	8	16
FE 103 - IN	7107526	7450507	7458628	7637611	8257024	illegible	9314211
FE 134 - EX	3125393	3816713	3821433	3925787	4272126	illegible	4293442
FE 135 - RI	4258120	4470447	4475322	4550219	4797633	illegible	4909145
CHART AL	N	N	N	N	N	N	N
FLARE FL	25	24.9	25.0	25.0	25.0	24.9	25.2
FC FLOW,	44	37	38	36	36	0-9	30/980485 *ALA 5-14
N2 TANK #		2500	2500	2450	1400	700	800
N2 TANK #:		1100	550	2600	2600	illegible	2600
AIR COMP		115	100	105	105	illegible	125
LFG COMP	-2	-1.5	-1.0	-1.0	-1.0	0	-1.0
LFG COMP	38	37.5	35	34	34	29.5	28.0
HOUR MET	1294	1415.6	1419.0	1469	1631.3	1700.1	1708.5
COALESC...	37.5	36	34	33	30.0	29.2	36.5
PI-144 PRV OUTLET, psig	25.0	25.0	25.0	25.0	21.0	illegible	23.0
ZAB-131 OUTLET P, psig	23.5	24.0	23.5	24.0	24.0	25.2	22.0
PI-130, psig	23.2	24.0	23.8	23.8	19.0	25.5	21.9
PI-101, psig	24.0	24.5	24.0	24.0	20	26.0	20.4
PI-205, psig	23.0	23.0	23.0	23.0	18	25.0	20.2
PI-105, psig	21.0	22.0	21.5	22.0	17.0	24.5	19.5
PI-112/DAB 105, psig		21.0	1.2	21.0	1.0	25*	2.0
PI-111/DAB 104, psig		2.4	20.8	1.2	16.4	1.2	19.0
FE103, scfm		62	64	60	70	3	56
PI-120, psig		23.0	22.4	22.4	22.6	22.6	22.6
PI-119, psig		16.8	16.0	16.0	16.2	16.2	16.2
CST-118 Dessicant Dryer, % Left		40%	40%	40%	40%	35%	35%
Refrig Unit Cabinet Pressure, " wc		.24	.23	.24	.25	.24	.25
Refrig Unit Exit Temp, °F		—	-19	-18	-19	-18	-18
Refrig Unit Pressure, HI/Low		155/20	130/15	140/8	145/0	143/7	160/8
PI-126/CAB 107, psig		20.5	2.0	21.0	2.0	24.0	1.4
PI-127/CAB 106, psig		1.6	20.4	2.0	15.8	1.8	18.8
DPI-129, in H_2O		4	4	4	4	4	4
PI-106, in H_2O		46	46	46	46	46	46
PI-136, psig	19.6	20.8	20.2	21.0	14.4	20.8	19.0
Worster Valve, % Open	60	55%	50%	55%	55%	50%	55%
FE135, scfm	25.0	25.0	25.5	25.0	25.0	25.0	25.0
PI-138, psig	2.6	2.8	4.0	3.4	3.8	2.4	2.6
FE134, scfm	43	36	36	36	36.0	0	30
Dwyer Gage, scfh	20	27	30	30	26.0	20.0	24
LFG SUCTION MANOMETER, in H_2O	5	4.5	5.0	5.0	5.0	4.0	4.0
CNG PRIMARY P, psig		2250	900	700	600	650	700
# of CNG BOTTLES IN SVC		2	2	2	2	2	2
FC N_2 PRI/SEC PRESSURE, psig		1300/70	2000/70	1700/70	1250/70	illegible	1000/75
FC NET OUTPUT, kW	150	131.0	130.3	130.0	100.00	illegible	104.8
Fuel Cell Time, hr:min	1159	1322	1323	1523		0625	1444
Operating Time (Load Time), hrs	2827	2948	2951	3000	3163	illegible	3239
Hot Time	2957	3108	3115	3165	3327	illegible	3403
Gross AC Mwhrs	278.753	393.152	393.544	401.596	423.557	illegible	428.36
Net AC Mwhrs	305.109	316.286	316.502	323.002	344.187	illegible	345.099
H_2S, ppm: at GPU Inlet/ at Temp Flare	NT/NT	0/18	0/NT	NT/NT	NT/NT	NT/NT	0/100

Pg. 13
2

GROTON FUEL CELL

NOTES:	FC @ 100KW	Fc @ 100KW	Fc@ 140KW	Fc@ 140KW	FC@ 140KW	FC@ 140KW	Fc@ 140KW
DATE:	5-19-97	6-10-97	6-10-97	6-13-97	6-17-97	6-19-97	6-19-97
GPU TIME:	1537	1211	1322	1232	0927	0856	1432
COUNTER:	45481	41051	45300	46492	24000	41833	11133
STEP:	17	16	17	17	8	16	6
FE 103 - INLET TOTAL FLOW:	8317011	8397496	8402117	8686429	9058794	9250895	9274290
FE 134 - EXIT TOTAL FLOW:	4294956	4328459	4331267	4500555	4722194	4835862	4849583
FE 135 - REGEN TOTAL FLOW:	4910471	5014966	5016744	5123477	5262820	5334044	5342472
CHART ALARMS, y/n	N	N	N	N	N	N	N
FLARE FLOW, scfm	25.3	25.0	25.0	25.0	25.0	25.0	24.9
FC FLOW, scfm / Total Flow, scfm	28/988977	32/015991	44/018835	41/19183	41/418359	41/524573	43/548536
N2 TANK #1, psig	800	300	2700	2650	2650	2600	2600
N2 TANK #2, psig	2600	2600	2600	2550	2475	2200	2200
AIR COMP HDR, psig	120	130	115	105	115	125	105
LFG COMP SUCT P, in Hg	-1.0	-2.0	-2.0	-2.0	-1.0	-2.0	-2.0
LFG COMP DISC P, psig	30.0	40.5	38.0	38.0	39.0	38.9	38.0
HOUR METER, hrs	1709.2	1728.8	1780.0	1851.2	1944.1	1991.7	1997.2
COALESC FILT IN, psig	29	40	38	38	39	39	38
PI-144 PRV OUTLET, psig	24	24.0	24.5	24.0	24.5	24.0	23.0
ZAB-131 OUTLET P, psig	23	23.0	23.0	22.0	23.0	23.0	22.0
PI-130, psig	23.2	23.4	23.0	22.4	23.2	23.0	21.8
PI-101, psig	23.5	24.0	23.0	22.0	23.0	23.0	22.0
PI-205, psig	22.0	22.5	22.0	21.0	22.0	22.0	21.0
PI-105, psig	21.0	21.5	20.5	20.0	21.0	20.2	19.0
PI-112/DAB 105, psig	0.8	1.6	0.2	0.8	20.0	1.9	18.0
PI-111/DAB 104, psig	20.2	21.0	19.8	18.8	1.2	19.8	2.0
FE103, scfm	54	55	70	70	66	66	67
PI-120, psig	22.6	22.4	22.4	23.0	22.6	21.9	21.8
PI-118, psig	16.2	16.2	16.0	17.0	16.2	16.0	16.0
CST-118 Desiccant Dryer, % Left	35%	35%	35%	100%	80%	75%	75%
Refrig Unit Cabinet Pressure, "wc	.24	.24	.24	.23	.22	.23	.23
Refrig Unit Exit Temp, °F	-17	-17	-19	-19	-18	-19	-19
Refrig Unit Pressure, HI/Low	170/8	180/0	200/0	160/20	120/0	180/0	180/10
PI-128/CAB 107, psig	1.8	1.0	1.4	1.8	19.6	1.1	17.6
PI-127/CAB 106, psig	20.0	20.8	19.0	18.2	1.8	19.0	1.6
DPI-128, in H_2O	4.0	4.0	4.0	4.0	4.0	4.0	4.0
PI-106, in H_2O	46	46	45	46	46	46	46
PI-136, psig	20.2	20.8	19.0	18.4	19.3	19.1	17.4
Worster Valve, % Open	55%	50%	50%	50%	50%	50%	50%
FE135, scfm	25	25.5	25.0	25.5	25.0	25.1	25
PI-138, psig	2.6	2.2	2.4	2.6	2.2	2.4	3.6
FE134, scfm	28	33	42	40	40	40	42
Dwyer Gage, scfh	24	20	26	26	24	20	28
LFG SUCTION MANOMETER, in H_2O	4.0	4.0	5.0	5.0	5.0	4.5	4.8
CNG PRIMARY P, psig	700	800	800	750	700	700	750
# of CNG BOTTLES IN SVC	2	1	1	1	1	1	1
FC N_2 PRI/SEC PRESSURE, psig	1000/13	1400/70	1400/70	1250/70	1000/70	950/70	950/70
FC NET OUTPUT, kW	100.5	100.4	141.1	140.5	140.0	140.6	140.7
Fuel Cell Time, hr:min	1532	1208	1318	1228	0927	0700	1433
Operating Time (Load Time), hrs	3240	3307	3308	3379	3472	3519	3525
Hot Time	3404	3476	3477	3548	3641	2688	3654
Gross AC Mwhrs	428.458	434.069	434.238	444.925	459.010	466.209	467.07
Net AC Mwhrs	345.179	346.658	346.811	358.543	365.514	276.149	276.92
H_2S, ppm: at GPU Inlet/ at Temp Flare	NT/NT	0-/48PPM, NT/NT		0/NT	0/200	0/90	NT/NT

LFG COMP VALVES ↓ 1/9 14

GROTON FUEL CELL

NOTES:	FC 140 kW	FC @ 140 kW	FC @ 140 kW	FC @ 140 kW	FC @ 140 kW	[illegible]	FC @ 140 kW
DATE:	6-24	6-27-97	7-1-97	7-2-97	7-9-97	7-1[illegible]	7-24-97
GPU TIME:	12.27	1.04	1404	1014	1329		15[illegible]1
COUNTER:	27456	23056	25940	47424	1002		[illegible]
STEP:	14	8	14	17	5		7
FE 103 - INLET TOTAL FLOW:	5759472	10020[illegible]	10158095	10241414	10789[illegible]		113[illegible]
FE 134 - EXIT TOTAL FLOW:	5137886	5297677	5354557	5464054	5712470		[illegible]
FE 135 - REGEN TOTAL FLOW:	5519806	5623671	5773610	5843867	6060677		[illegible]
CHART ALARMS, y/n	N	N	N	N	19+27		N
FLARE FLOW, scfm	25.0	25.0	25.1	25.0	25.2		[illegible]
FC FLOW, scfm (Temp = 17.9°F)	42/849190	42/[illegible]	42/63725	42/114287	41/4[illegible]3		[illegible]
N2 TANK #1, psig	2600	2600	2600	2600	1950		[illegible]
N2 TANK #2, psig	1500	1050	500	460	2500		[illegible]
AIR COMP HDR, psig	115	112	125	125	12[illegible]		125
LFG COMP SUCT P, in Hg	-1.5	-2.0	-2.0	-1.[illegible]	-2.0		[illegible]
LFG COMP DISC P, psig	38	35	38	35.[illegible]	33.0		[illegible]
HOUR METER, hrs	2115.2	2184.7	2284.7	2304.9	2476.1	2603	[illegible]
COALESC FILT IN, psig	38	38	38	38	37.[illegible]		[illegible]
PI-144 PRV OUTLET, psig	26	24.5	22.5	[illegible]	23.0		[illegible]
ZAB-131 OUTLET P, psig	27	22	21.0	22	22.[illegible]	[illegible]	[illegible]
PI-130, psig	21.7	22.2	20.9	[illegible]	21.6		[illegible]
PI-101, psig	22.0	23.1	21.0	[illegible]	22.[illegible]		[illegible]
PI-205, psig	20.5	22.0	20.0	[illegible]	[illegible]		21.0
PI-105, psig	18.2	20.1	18.0	[illegible]	19.0	[illegible]	18.[illegible]
PI-112/DAB 105, psig	1.1	20.0	1.0	[illegible]	17.5	[illegible]	17.4
PI-111/DAB 104, psig	17.5	1.[illegible]	16.6	[illegible]	1.2	[illegible]	[illegible]
FE103, scfm	78.	66	76	[illegible]	[illegible]		[illegible]
PI-120, psig	21.6	21.8	21.8	[illegible]	21.6		23.0
PI-119, psig	15.8	16.0	16.0	[illegible]	[illegible]		16.4
CST-118 Dessicant Dryer, % Left	75%	65%	62%	[illegible]	[illegible]		[illegible]
Refrig Unit Cabinet Pressure, " wc	.22	.23	.23	[illegible]	.2[illegible]		.24
Refrig Unit Exit Temp, °F	-17°F	-17°F	-18°F	[illegible]	-4		-1[illegible]
Refrig Unit Pressure, Hi/Low	160/8	160/8	170/9	[illegible]	[illegible]		160/0
PI-128/CAB 107, psig	2	16.5	2.0	[illegible]	[illegible]		16.5
PI-127/CAB 106, psig	17.8	1.5	16.0	[illegible]	2.[illegible]		1.6
DPI-129, in H_2O	4	4	4	4	[illegible]		[illegible]
PI-106, in H_2O	55	44	46	[illegible]	4[illegible]		4[illegible]
PI-136, psig	17.2	18.[illegible]	15.6	[illegible]	17.[illegible]		17.0
Worster Valve, % Open	60%	60%	60%	[illegible]	6[illegible]		[illegible] %
FE135, scfm	25	25.5	25.0	[illegible]	25.[illegible]		25.0
PI-138, psig	3.8	2.2	3.5	[illegible]	[illegible]		3.8
FE134, scfm	41	4[illegible]	40	[illegible]	40.0		42.0
Dwyer Gage, scfh	25	22	28	[illegible]	25		[illegible]
LFG SUCTION MANOMETER, in H_2O	5	4.5	4.6	5.0	4.5		11.5
CNG PRIMARY P, psig	700	625	750	[illegible]	[illegible]		1000
# of CNG BOTTLES IN SVC	1	1	1	1	1	2	3
FC N_2 PRI/SEC PRESSURE, psig	750/72	[illegible]	500/72	[illegible]	400/[illegible]		1300/[illegible]
FC NET OUTPUT, kW	140.9	140.5	140.3	[illegible]	1[illegible]	0	140.5
Fuel Cell Time, hr:min	1240	[illegible]	1408	[illegible]	132[illegible]	1301	1530.
Operating Time (Load Time), hrs	3643	3712	3811	[illegible]	4[illegible]	4[illegible]	4[illegible]9
Hot Time	3811	3881	3980	[illegible]	4171	[illegible]	4324
Gross AC Mwhrs	484.007	495.024	502.687	[illegible]	[illegible]	[illegible]	[illegible]
Net AC Mwhre	393.393	[illegible]	405.368	4[illegible]	4[illegible]	[illegible]	[illegible]
H_2S, ppm: at GPU Inlet/ at Temp Flare	0/60	0/NT	0/NT	[illegible]	[illegible]/70	NT/NT	[illegible]

GROTON FUEL CELL

NOTES:	FC@ 125kw	FC@ 140KW	FC@ 140Kw	FC@ 130 kw	FC@ 115kw	FC@ 130kw	FC@ [illegible]
DATE:	9-3-97	9-4-97	9-9-97	9-10-97	9-18-97	9-19-97	9-[illegible]
GPU TIME:	1310	1107	0912	1422	0801	1251	[illegible]
COUNTER:	27709	4625	21914	23053	28297	40120	[illegible]
STEP:	14	6	8	8	14	16	7
FE 103 - INLET TOTAL FLOW:	11580492	11659326	12133519	12252909	12784827	12789947	13393524
FE 134 - EXIT TOTAL FLOW:	6163832	6210626	6497230	6561789	6888765	6892007	[illegible]
FE 135 - REGEN TOTAL FLOW:	6351129	6364073	6661109	6604839	6883244	6888295	713[illegible]
CHART ALARMS, y/n	N	N	N	N	N	N	N
FLARE FLOW, scfm	24.9	25.2	25.0	24.9	25.0	25.0	25.2
FC FLOW, scfm /TOTAL	37	40	41/579432	37/598546	35/620154	39/673661	[illegible]
N2 TANK #1, psig	500	300	2600	—	—	—	—
N2 TANK #2, psig	2450	2450	2450	—	—	comp. 0.6	14.[illegible]
AIR COMP HDR, psig	130	120	135	102	102	102	10[illegible]
LFG COMP SUCT P, in Hg	-1	-1	-1	-1	-1	-1.5	-[illegible]
LFG COMP DISC P, psig	37	34.5	34.5	38.5	38.5	37.5	3[illegible].0
HOUR METER, hrs	2669.9	2691.9	2810.0	2839.1	3024.7	3028.1	319[illegible]
COALESC FILT IN, psig	38	24	35	39.0	40	38	32
PI-144 PRV OUTLET, psig	25.5	24.0	25	25.0	25.5	25.0	2[illegible]
ZAB-131 OUTLET P, psig	24.5	22.0	24	24.0	[illegible]	24.5	2[illegible]
PI-130, psig	24.4	22.4	24	24.0	24.2	24.5	22.8
PI-101, psig	25.0	23.0	24.5	24.0	25.0	25.0	23.5
PI-205, psig	23.0	22.0	23	23.0	23.0	23.0	2[illegible]
PI-105, psig	21.0	19.0	20	20.5	21.0	20.5	19.0
PI-112/DAB 105, psig	1.0	18.2	19.8	19.8	1.0	1.8	18.[illegible]
PI-111/DAB 104, psig	20.0	1.1	1.0	1.0	20.0	19.8	[illegible]
FE103, scfm	63	68	64	61	53.0	64.0	63
PI-120, psig	22.5	22.4	22.4	22.4	22.5	22.5	2[illegible]
PI-118, psig	16.2	16.4	16.4	16.2	16.2	16.2	16.4
CST-118 Dessicant Dryer, % Left	50%	[illegible]	40%	40%	30%	100%	75%
Refrig Unit Cabinet Pressure, "wc	.24	.24	.23	.23	.23	.24	.2[illegible]
Refrig Unit Exit Temp, °F	-19	-18	-19	-19	-19	-19	-19
Refrig Unit Pressure, Hi/Low	175/5	[illegible]/5	160/5	170/7	170/7	170/7	160/0
PI-128/CAB 107, psig	1.8	19.[illegible]	19	19.4	2.0	1.2	19.[illegible]
PI-127/CAB 106, psig	20.0	1.[illegible]	1.8	1.8	20.0	19.5	1.[illegible]
DPI-129, in H_2O	4	4	4	4	4	4	4
PI-106, in H_2O	45	45	45	46	45	45	46
PI-136, psig	19.5	17.8	19	19.4	19.8	19.2	19.
Worster Valve, % Open	60%	60%	50%	60%	50%	50%	60%
FE135, scfm	25.5	25.0	25	25	25.5	25.5	25.5
PI-138, psig	2.6	[illegible]	2.2	2.2	3.5	2.5	2.[illegible]
FE134, scfm	37	40	40	36	32	38	37
Dwyer Gage, scfh	22	20	22	22	18	18	18
LFG SUCTION MANOMETER, in H_2O	4.5	[illegible]	4.5	3	3	3.5	
CNG PRIMARY P, psig	1650	1600	1600	1700	1600	1400	1300
# of CNG BOTTLES IN SVC	1	1	1	1	1	1	1
FC N_2 PRI/SEC PRESSURE, psig	2150/70	[illegible]/65	1700/70	1600/70	1050/90	1600/70	[illegible]
FC NET OUTPUT, kW	125.0	140.0	139.[illegible]	130.3	115.0	130.0	12[illegible]
Fuel Cell Time, hr:min	1302	1104	0905	1416	0753	1243	745
Operating Time (Load Time), hrs	4136	4208	4335	4354	453[illegible]	4541	[illegible]
Hot Time	4391	4413	4530	4559	4744	4751	49[illegible]
Gross AC Mwhrs	555.183	[illegible].172	576.089	580.489	602.454	602.653	[illegible]
Net AC Mwhrs	449.954	452.709	469.179	473.239	491.898	492.043	51[illegible]
H_2S, ppm: at GPU inlet/ at Temp Flare	0/90	0/100	0/N.T.	0/N.T.	N.T.	0/150	110/100

GROTON FUEL CELL

NOTES:	FC @ IDLE	FC @ 100KW	FC @ 100KW	FC @ 100KW			
DATE:	10-30-97	11-5-97	11-10-97	11-13-97			
GPU TIME:	1213	1110	0919	0824			
COUNTER:	41009	46375	12794	13694			
STEP:	16	17	7	7			
FE 103 - INLET TOTAL FLOW:	18415538	13654464	14028008	14260017			
FE 134 - EXIT TOTAL FLOW:	7264766	7279093	7580364	7721435			
FE 135 - REGEN TOTAL FLOW:	7144357	7358727	7535901	7642532			
CHART ALARMS, y/n	N	N	N	N			
FLARE FLOW, scfm	24.8	24.9	24.9	25.2			
FC FLOW, scfm [redacted]	51-789	31 1/2-41	31	32			
~~N2 TANK #1, psig~~	—	~~[illegible]~~	328990	455819			
~~N2 TANK #2, psig~~ AIR COMP. HRS.	391.4	406.9	417.3	423.5			
AIR COMP HDR, psig	102	125	120	125			
LFG COMP SUCT P, in Hg	-.5	-.5	-.5	0			
LFG COMP DISC P, psig	41	33.5	31	28			
HOUR METER, hrs	3198.8	3341.8	3459.9	3531.1			
COALESC FILT IN, psig	41	35	31	28			
PI-144 PRV OUTLET, psig	25.5	24	24.5	22.5			
ZAB-131 OUTLET P, psig	23.5	23	23.5	21.0			
PI-130, psig	23.6	23.2	23.8	21.5			
PI-101, psig	24.5	24.5	23.5	22.0			
PI-205, psig	23.0	23.0	22.5	21.0			
PI-105, psig	21.5	19.5	20.0	18.0			
PI-112/DAB 105, psig	1.9	1.0	19.8	17.0			
PI-111/DAB 104, psig	20.4	18.4	2.2	2.4			
FE103, scfm	40	56	52	57			
PI-120, psig	22.5	[illegible]	22.5	22.5			
PI-118, psig	16.4	[illegible]	16.2	16.2			
CST-118 Dessicant Dryer, % Left	75%	70%	70%	70%			
Refrig Unit Cabinet Pressure, " wc	.24	.24	.22	.23			
Refrig Unit Exit Temp, °F	-17	-19	-19	-19			
Refrig Unit Pressure, HI/Low	180/5	160/0	155/10	120/2			
PI-128/CAB 107, psig	1.2	2.2	19.2	16.6			
PI-127/CAB 106, psig	20.2	19.8	1.8	1.6			
DPI-129, in H_2O	4	4	4	4			
PI-106, in H_2O	47	46	46	47			
PI-136, psig	20.4	18.0	19.5	17			
Worster Valve, % Open	50%	[illegible]	60%	60%			
FE135, scfm	25	25	25	25			
PI-138, psig	2.6	2.7	2.6	2.8			
FE134, scfm	18	26	30	29			
Dwyer Gage, scfh	22	28	28	26			
LFG SUCTION MANOMETER, in H_2O	4"	11	12"	12"			
CNG PRIMARY P, psig	1350	1400	1300	1200			
# of CNG BOTTLES IN SVC	1	1	1	1			
FC N_2 PRI/SEC PRESSURE, psig	2000/70	1[illegible]/[illegible]	1000/70	800/70			
FC NET OUTPUT, kW	0	100.5	100.1	100.2			
Fuel Cell Time, hr:min	1204	1104	0911	0819			
Operating Time (Load Time), hrs	4908	4851	4968	5039			
Hot Time	4924	5066	5184	5255			
Gross AC Mwhrs	628.201	[illegible]	652.788	660.647			
Net AC Mwhrs	613.864	[illegible]	531.415	638.447			
H_2S, ppm: at GPU Inlet/ at Temp Flare	0/95PPM	.2/80PPM	.2/100	2.4/100			

APPENDIX B

Groton Gas Analyses

Table 3.2.1-2. Index Groton Gas Analyses

Sample Identification			GPU		Sample Location ⑨	Sample Container	Analysis Lab	Analysis Type				Fuel Cell Power	Comments
No.	Date	Time	Hours	Counter				Sulfur	VOC	BTU	Other		
0	12/29/94	N/A	N/A	N/A	Indiv. well heads	N/A	N/A	N/A	N/A	N/A	H_2S Only	N/A	28 wells vary from 17 ppmV to 2000 ppmV average = 430 ppmV.
1A	09/19/95	A	N/A①	N/A	(A) Raw LFG	TB②			✓			N/A	
1B	9/19/95	B	N/A	N/A	(A) Raw LFG	TB			✓			N/A	
2	12/1/95	N/A	N/A	N/A	(A) Raw LFG	TB	N.U.⑤ ME⑥		✓			N/A	
3	1/11/96	1334	N/A	N/A	(A) Raw LFG	TB	ME⑥ NUL⑤	✓	✓	✓	✓	N/A	Bag #2 only (Bag #1 leaking).
4	6/18/96	N/A	N/A	N/A	(B) GPU Exit	TB	IFC				FG⑦	N/A	
5	6/19/96	N/A	N/A	N/A	(B) GPU Exit	TB	IFC				FG	N/A	
6	6/19/96	1440	2320	N/A	(B) GPU Exit	SC③	PAI④	✓ D B	✓ D B			N/A	
7	7/15/96	N/A	N/A	N/A	(B) GPU Exit	Flow Tube	IFC				FG	N/A	
8	3/20/97	0830	4645	N/A	(B) 105/107	SC	PAI	✓ D B	✓ B			110 kW	VOC analyses done after 11 days in SC. Sulfur analyses done after 8 days in SC.
9	3/20/97	0840	4645	N/A	(A) Raw LFG	TB	PAI	✓	✓ B			110 kW	
10	3/20/97	0850	4645	N/A	(A2) GPU Inlet	TB	PAI	✓ B		✓	FG	110 kW	Air in bag sample.
11	3/20/97	1430	4651	N/A	(B) 104/106	SC	PAI	✓	✓ D	✓	FG	110 kW	VOC analyses done after 11 days in SC and sulfur analyses after 8 days.
12	5/19/97	1015	5514	N/A	(B) 105/107	SC	PAI	✓ B	✓	✓	FG	106 kW	
13	5/19/97	1453	5518	N/A	(B) 104/106	SC	PAI	✓ D	✓	✓		100 kW	
14	6/19/97	1015	5803	45,500	(B) 104/106	SC	PAI	✓ B	✓ D B	✓	FG	140 kW	
15	6/19/97	1015	5803	45,500	(B) 104/106	TB	PAI	✓				140 kW	
16	6/19/97	1230	5805	1,000	(B) 105/107	SC	PAI	✓ D	✓			140 kW	
17	6/19/97	1230	5805	N/A	(A) Raw LFG	TB	PAI	✓	✓ B	✓	FG	140 kW	Look for S, halides removal in H_2S beds.
18	6/19/97	1235	5805	N/A	(A2) GPU Inlet	TB	PAI	✓ D	✓ D B	✓	FG	140 kW	Look for S, halides removal in H_2S beds.
19	6/19/97	1240	5805	1,300	(B) 105/107	TB	PAI	✓				140 kW	
20	7/9/97	1330	6286	48,600	(B) 104/106	SC	PAI	✓ B	✓ B			140 kW	Carbon bed CAB106 at -18° C.
21	7/9/97	1415	6287	600	(B) 105/107	SC	PAI	✓	✓	✓	FG	140 kW	Carbon bed CAB107 at -18° C.
Totals								15	15	8			

Notes: ① N/A = Not Available ②TB = Tedlar Bag ③SC = Summa Canister ④ PAI = Performance Analytical, Inc. ⑤ N. U. = Northeast Utility
⑥ME = Maytly Environmental ⑦FG = Fixed Gases (O_2, N_2, CO_2, CH_4) ⑧B = Analysis Blank ⑨D = Duplicate Analysis ⑨ = See Figure 3.1.4-4

#0

Groton, Connecticut
Flanders Road Landfill
Gas Well H2S Measurement

Well Number	H2S Level (ppm)
1	*
2	120
3	275
4	18
5	490
6	155
7	
8	525
9	611
10	17
11	1420
12	850
13	277
14	260
15	1078
16	225
17	25
18	101
19	404
20	275
21	160
22	78
23	160
24	25
25	465
26	2000
27	50
28	1250
29	390
30	345

AVG OF 28 WELLS = 430 PPM_V H_2S

Industrial Scientific H2s Meter
* = fitting broken during sampling event
Sampling conducted December 29, 1994

#1A, #1B

Groton Landfill Gas Sample Results

O2, N2, CO2 H2S and Heat Content

Units: ppm at 1 atmosphere pressure and 25 degrees Celsius

Formula	Name		%
O2	Oxygen	6,248	0.6% O_2
N2	Nitrogen	22,723	2.3% N_2
CH4	Methane	471,900	47.2% CH_4
CO2	Carbon Dioxide	406,950	40.7% CO_2
H2S	Hydrogen Sulfide	2.6	2.6 PPM H_2S

Heat Content calculated on above results in B.t.u./cubic foot

Heat Content	616

Halogenated Compounds

Units: ng/L gas at 1 atmosphere pressure and 25 degrees Celsius

PRESENT AT PENROSE (✓ = DETECTED AT PENROSE, — = NO AT GROTON)

CAS #		8010 Compounds			Minimum Detection Limit
108-86-1		Bromobenzene	59	68	10.
75-27-4	—	Bromodichloromethane	nd	nd	10.
75-25-2	—	Bromoform	nd	nd	10.
74-83-9		Bromomethane	1,350	700	10.
56-23-5		Carbon Tetrachloride	480	560	10.
108-90-7	✓	Chlorobenzene	1,600	1,700	10.
75-00-3		Chloroethane	1,355	2,100	10.
67-66-3		Chloroform	60	70	10.
74-87-3		Chloromethane	185	210	10.
95-49-8	—	2-Chlorotoluene	nd	nd	10.
124-48-1	—	Dibromochloromethane	nd	nd	10.
74-95-3	—	Dibromomethane	nd	nd	10.
75-71-8	✓	Dichlorodifluoromethane	22,500	17,000	10.
75-34-3	✓	1,1-Dichloroethane	565	660	10.
107-06-2		1,2-Dichloroethane	55	59	10.
75-35-4		1,1-Dichloroethylene	400	490	10.
156-60-5	✓	trans-1,2-Dichloroethylene	235	210	10.
78-87-5	—	1,2-Dichloropropane	nd	nd	10.
10061-01-5		cis-1,3-Dichloropropylene	1,400	1,600	10.
10061-02-6	—	trans-1,3-Dichloropropylene	nd	nd	10.
75-09-2	✓	Methylene Chloride (Dichloromethane)	220	250	10.
630-20-6	—	1,1,1,2-Tetrachloroethane	nd	nd	10.
79-34-5	—	1,1,2,2-Tetrachloroethane	nd	nd	10.
127-18-4	✓	Tetrachloroethylene	135	160	10.
71-55-6	—	1,1,1-Trichloroethane	nd	nd	10.
79-00-5	—	1,1,2-Trichloroethane	nd	nd	10.
79-01-6	✓	Trichloroethylene	nd	nd	10.
75-69-4		Trichlorofluoromethane	76	95	10.
96-18-4	—	1,2,3-Trichloropropane	nd	nd	10.
75-01-4	✓	Vinyl Chloride	1,410	2,200	10.

17 CPDS DETECTED AT GROTON

#2

Mayfly
ENVIRONMENTAL

(203) 658-2660
357 Bushy Hill Road
Simsbury, Connecticut 06070

REDUCED SULFUR COMPOUND ANALYSIS RESULTS

Client: **Northeast Utilities System** Date: Received: **12/1/95** Reported: **12/2/95**
Project: 41NUS Sample ID: **AIR** Sample Type: **Tedlar bags** Sample Vol: **1-6 ml**

SULFUR GAS ANALYSIS by GC/FPD

Sample Ident: **NUS, Groton Landfill 950121 flare inlet** Analysis Date: **12/1/95**

Sample Location	Sampling Time	Analysis Compounds (PPM)					
		H_2S	DMS	DMDS	MM	COS	CS_2
Flare Inlet # 1	**12:58**	2.580	0.40	<0.1	3.2	<0.1	<0.1

H2S	=	hydrogen sulfide	ND	=	(0.1 ppm)
DMS	=	dimethyl sulfide	ND	=	(0.1 ppm)
DMDS	=	dimethyl disulfide	ND	=	(0.1 ppm)
MM	=	methyl mercaptan	ND	=	(0.1 ppm)
COS	=	carbonyl sulfide	ND	=	(0.1 ppm)
CS2	=	carbon disulfide	ND	=	(0.1 ppm)

ND = not detected

#3

Mayfly
ENVIRONMENTAL

(203) 658-2660
357 Bushy Hill Road
Simsbury, Connecticut 06070

REDUCED SULFUR COMPOUND ANALYSIS RESULTS
Client: Northeast Utilities System Date: Received: 1/11/96 Reported: 1/14/96
Project: 602NUS Sample ID: AIR Sample Type: Tedlar bags Sample Vol.: 0.02-1 ml

SULFUR GAS ANALYSIS by GC/FPD

Sample Ident: NUS, Groton Landfill 960111 flare inlet Analysis Date: 1/11/96

Sample Location	Sampling Time	Analysis Compounds (PPM)					
		H_2S	DMS	DMDS	MM	COS	CS_2
Flare Inlet # 1	13:34	1380	0.90	<0.1	<0.1	<0.1	<0.1

The sample was taken by MAYFLY Environmental at the subject site at 13:34. The flare was shutdown upon arrival at the site at 12:15. The problem was reported to the Groton City staff. They responded quickly and restarted the compressor and ignited the flare. The Sulfur gas sample was taken about 10 minutes after restart.

H2S	=	hydrogen sulfide	ND	=	(0.1 ppm)
DMS	=	dimethyl sulfide	ND	=	(0.1 ppm)
DMDS	=	dimethyl disulfide	ND	=	(0.1 ppm)
MM	=	methyl mercaptan	ND	=	(0.1 ppm)
COS	=	carbonyl sulfide	ND	=	(0.1 ppm)
CS2	=	carbon disulfide	ND	=	(0.1 ppm)
		ND = not detected			

(#3)
BTL

I N T E R O F F I C E M E M O R A N D U M

NNNN NN UUU UU
NNN NN NN UUU UU
NNN NNNN UUU UU
NNN NNN UUUUU

Date: 19-Jan-1996 03:09pm EST
From: JOSEPH J. MARINACCIO
MARINJJ
Dept: LAB SERVICES
Tel No: (203)665-5000 x3186

TO: CYNTHIA L. KARLIC-SMITH (KARLICC)
TO: GREGORY A. MARTEL (MARTEGA)
TO: JO ANNE K. DE RICO (DERICJK)

CC: RICHARD C. PECK (PECKRC)
CC: JAMES R. MOUSER (MOUSEJR)

Subject: Groton Landfill Gas Analysis - January 11, 1996

As requested, we analyzed two gas samples from the Town of Groton landfill delivered to the lab on January 11, 1996 for halogenated compounds, oxygen, nitrogen, methane, carbon monoxide, carbon dioxide and heat content. We tested for halogenated compounds found on the EPA SW846 Method 8010 list using a modified purge & trap procedure. Since bag #1 was leaking it was not tested for halogenated compounds. Heat content was calculated based on test results below. Our results follow:

O2, N2, CO2 H2S and Heat Content

Date Sampled:	01/11/96	01/11/96
Date Tested:	01/11/96	01/11/96
Sample Identification:	Bag #1**	Bag #2

Units: ppm at 1 atmosphere pressure and 25 degrees Celsius

Formula:	Name:		
O2	Oxygen	52,700	18,280
N2	Nitrogen	251,000	92,100
CH4	Methane	390,900	459,300
CO2	Carbon Dioxide	294,800	355,500

Heat Content calculated on above results in B.t.u./cubic foot

Heat Content	402	485

** Note: Bag #1 was leaking.

(#3)

Groton Lanfill Gas
01/19/96 Page 2

Halogenated Compounds

Units: ng/L gas at 1 atmosphere pressure and 25 degrees Celsius

Date Sampled:		01/11/96	
Sample Identification:		Bag #2	Minimum
Date Tested:		01/16/96	Detection
Reference Number:		3280	Limit
CAS #:	8010 Compounds:		
108-86-1	Bromobenzene	220	50.
75-27-4	Bromodichloromethane	nd	50.
75-25-2	Bromoform	100	50.
74-83-9	Bromomethane	nd	50.
56-23-5	Carbon Tetrachloride	nd	50.
108-90-7	Chlorobenzene	nd	50.
75-00-3	Chloroethane	2,800	50.
67-66-3	Chloroform	56	50.
74-87-3	Chloromethane	2,400	50.
95-49-8	2-Chlorotoluene	nd	50.
124-48-1	Dibromochloromethane	nd	50.
74-95-3	Dibromomethane	nd	50.
75-71-8	Dichlorodifluoromethane	55,000	50.
75-34-3	1,1-Dichloroethane	98	50.
107-06-2	1,2-Dichloroethane	nd	50.
75-35-4	1,1-Dichloroethylene	nd	50.
156-60-5	trans-1,2-Dichloroethylene	nd	50.
78-87-5	1,2-Dichloropropane	nd	50.
10061-01-5	cis-1,3-Dichloropropylene	nd	50.
10061-02-6	trans-1,3-Dichloropropylene	nd	50.
75-09-2	Methylene Chloride	210	50.
630-20-6	1,1,1,2-Tetrachloroethane	nd	50.
79-34-5	1,1,2,2-Tetrachloroethane	nd	50.
127-18-4	Tetrachloroethylene	88	50.
71-55-6	1,1,1-Trichloroethane	99	50.
79-00-5	1,1,2-Trichloroethane	nd	50.
79-01-6	Trichloroethylene	67	50.
75-69-4	Trichlorofluoromethane	1,300	50.
96-18-4	1,2,3-Trichloropropane	nd	50.
75-01-4	Vinyl Chloride	920	50.

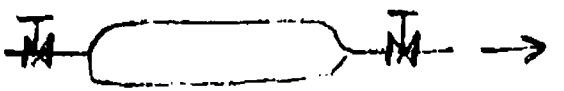
** Note: Bag #1 was not tested due to a leak.

LANDFILL GAS ANALYSIS FROM GROTON SITE

DATE	O2	N2	CH4	CO2	CO	THETA	PSI	COMMENTS
6/18/96	0.406	1.519	55.504	40.028				AFTER GPU/20 CFM FLOW/BAG No. 1
6/18/96	0.367	1.363	54.4	40.859				AFTER GPU/20 CFM FLOW/BAG No. 2
6/19/96	0.203	0.731	52.002	44.541				GPU EXIT AT SV132. 25 CFM FLOW.
7/15/96	0.0305	0.1895	57.74	41.48				GPU EXIT AT SV132. INJECTED SAMPLE #1
7/15/96	0.0489	0.2407	57.64	41.27				GPU EXIT AT SV132. INJECTED SAMPLE #2
7/15/96	0.0334	0.2038	57.68	41.49				GPU EXIT AT SV132. FLOW THRU SAMPLE #1
7/15/96	0.0263	0.1751	57.72	41.42				GPU EXIT AT SV132. FLOW THRU SAMPLE #2
7/15/19	0.0247	0.1721	57.71	41.47				GPU EXIT AT SV132. FLOW THRU SAMPLE #3
7/15/19	0.0245	0.1735	57.71	41.46				GPU EXIT AT SV132. FLOW THRU SAMPLE #4
7/15/96	0.0241	0.1735	57.71	41.49				GPU EXIT AT SV132. FLOW THRU SAMPLE #5
7/15/96	CHECKED FOR SULFUR IN SAMPLE, NONE FOUND							
7/17/96	0.1726	0.5374	57.47	43.04				GPU EXIT AT SV132. FLOW THRU SAMPLE #1 ONLY ENOUGH GAS FOR ONE SAMPLE.

7/25/96
RRL

FLOW SAMPLE HAS VALVE AT BOTH ENDS, TO INSURE NO AIR LEAKAGE INTO SAMPLE



GPU EXIT PRIOR TO START

#6

Performance Analytical Inc.
Air Quality Laboratory

LABORATORY REPORT

Client:	NORTHEAST UTILITIES	Date of Report:	06/21/96
Address:	P.O. Box 270	Date Received:	06/20/96
	Hartford, CT 06141	PAI Project No:	P9601047
Contact:	Mr. Chuck Trippel	Purchase Order:	65352P

Client Project ID: Groton Fuel Cell

One (1) Stainless Steel Summa Canister labeled: "GFC-001"

The sample was received at the laboratory under chain of custody on June 20, 1996. The sample was received intact. The client requested and received 24 hour rush results. The dates of analysis are indicated on the attached data sheets.

Sulfur Analysis

The sample was analyzed for 19 Sulfur compounds by gas chromatography/flame photometric detection (FPD). The analytical system used was comprised of a Hewlett Packard Model 5890 equipped with a flame photometric detector (FPD). A thick film (5 micron) crossbonded 100% Dimethyl polysiloxane megabore column (60 meter x 0.53mm RT_x-1, Restek Corporation, Bellefonte, PA) was used to achieve chromatographic separation.

Data Release Authorization:

Christopher Casteel
Manager of Technical Operations

Reviewed and Approved:

Michael Tuday
Laboratory Director

Performance Analytical Inc.
Air Quality Laboratory

#6

Volatile Organic Compound Analysis

The sample was also analyzed by combined gas chromatography/mass spectrometry (GC/MS) for volatile organic compounds. The analyses were performed according to the methodology outlined in EPA Method TO-14 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600/4-84-041, U.S. Environmental Protection Agency, Research Triangle Park, NC, April, 1984 and May, 1988. The analyses were performed by gas chromatography/mass spectrometry, utilizing a direct cryogenic trapping technique. The analytical system used was comprised of a Hewlett Packard Model 5989 GC/MS/DS interfaced to an Entech 7000 automated whole air inlet system/cryogenic concentrator. A 100% Dimethylpolysiloxane capillary column (RT_x-1, Restek Corporation, Bellefonte, PA) was used to achieve chromatographic separation.

The results of analyses are given on the attached data summary sheets.

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Performance Analytical Inc.
Air Quality Laboratory

20954 Osborne Street
Canoga Park, California 91304
Phone 818 709-1139
Fax 818 709-2915

Chain of Custody Record
Analytical Services Request

Client/Project Name	Address/Phone	ANALYSES	PAI Project No.
Northeast Utilities	P.O. Box 270 (860) 665-3467 Hartford, CT 06141-0270		P960947
Project Location	**Client Project No.**		
Groton Fuel Cell-Groton, CT			
Contact	**Sampler (Signature)**	**P.O. No.**	
C Trippel	CE Trippel	65352P	

Sample Identification No.	Date	Time	Lab Sample No.	Type of Sample	EPA method 16 S+I for Analysis	TO-14 Analysis					Expected Turnaround Time	Remarks
46 GFC-001	6/19/96	1440 hrs.	P960947-001	Landfill Gas	1	1					24 hour By 6/20/96 A.M.	FAX Results to 860 536-8511

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
CE Trippel	6/19/96	1515	RAzzam Gill	6/20/96	0900
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Disposal Method					
Disposed by: (Signature)	Date	Time			

White Copy : Accompanies Samples

Yellow Copy : Sampler

B-12

#6 CHAIN OF CUSTODY

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : J. Dan Taliaferro
Instrument : HP5890A / FPD #4
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/21/96
Volume(s) Analyzed : 10.0 (ml)

Pi= 0.0 Pf= 0.0 D.F.= 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/21/96

[illegible]

Performance Analytical Inc.
Air Quality Laboratory

#6 Sulfur

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GFC-001
PAI Sample ID : P9601047-001

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : J. Dan Taliaferro
Instrument : HP5890A / FPD #4
Matrix : Summa Canister

Date Sampled : 6/19/96
Date Received : 6/20/96
Date Analyzed : 6/21/96
Volume(s) Analyzed : 10.0 (ml)

Pi= 1.1 Pf= 3.0 D.F.= 1.12

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
463-58-1	Carbonyl Sulfide	49.0	9.80	19.9	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/21/96

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Performance Analytical Inc.
Air Quality Laboratory

#6 - Dup Sulfur

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GFC-001
PAI Sample ID : P9601047-001 Laboratory Duplicate

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : J. Dan Taliaferro
Instrument : HP5890A / FPD #4
Matrix : Summa Canister

Date Sampled : 6/19/96
Date Received : 6/20/96
Date Analyzed : 6/21/96
Volume(s) Analyzed : 10.0 (ml)

Pi= 1.1 Pf= 3.0 D.F.= 1.12

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
463-58-1	Carbonyl Sulfide	60.5	9.80	24.6	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/21/96

[illegible] • Phone 818 [illegible] • Fax 818 [illegible]

Performance Analytical Inc.
Air Quality Laboratory

#6 VOC Halides Blank

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Chris Casteel
Instrument : HP 5989A/Entech 7000
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/20/96
Volume(s) Analyzed : 1.000 Liter(s)

Pi 1 = 0.0
Pf 1 = 0.0

D.F. = 1.00

CAS #	COMPOUND	RESULT (UG/M3)	REPORTING LIMIT (UG/M3)	RESULT (PPB)	REPORTING LIMIT (PPB)
74-87-3	Chloromethane	ND	1.0	ND	0.49
75-01-4	Vinyl Chloride	ND	1.0	ND	0.39
75-00-3	Chloroethane	ND	1.0	ND	0.38
74-83-9	Bromomethane	ND	1.0	ND	0.26
67-64-1	Acetone	ND	1.0	ND	0.42
75-69-4	Trichlorofluoromethane	ND	1.0	ND	0.18
75-35-4	1,1-Dichloroethene	ND	1.0	ND	0.25
75-09-2	Methylene chloride	ND	1.0	ND	0.29
75-15-0	Carbon Disulfide	ND	1.0	ND	0.32
76-13-1	Trichlorotrifluoroethane	ND	1.0	ND	0.13
156-60-5	trans-1,2-Dichloroethene	ND	1.0	ND	0.25
156-59-2	cis-1,2-Dichloroethene	ND	1.0	ND	0.25
75-34-3	1,1-Dichloroethane	ND	1.0	ND	0.25
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	ND	0.28
108-05-4	Vinyl Acetate	ND	1.0	ND	0.28
78-93-3	2-Butanone	ND	1.0	ND	0.34
67-66-3	Chloroform	ND	1.0	ND	0.21
107-06-2	1,2-Dichloroethane	ND	1.0	ND	0.25
71-55-6	1,1,1-Trichloroethane	ND	1.0	ND	0.19
71-43-2	Benzene	ND	1.0	ND	0.31
56-23-5	Carbon Tetrachloride	ND	1.0	ND	0.16
78-87-5	1,2-Dichloropropane	ND	1.0	ND	0.22

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : _____

Date : 6/21/96

Performance Analytical Inc.
Air Quality Laboratory

#6 VOC Halides Blank

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Chris Casteel
Instrument : HP 5989A/Entech 7000
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/20/96
Volume(s) Analyzed : 1.000 Liter(s)

Pi 1 = 0.0
Pf 1 = 0.0

D.F. = 1.00

CAS #	COMPOUND	RESULT (UG/M3)	REPORTING LIMIT (UG/M3)	RESULT (PPB)	REPORTING LIMIT (PPB)
75-27-4	Bromodichloromethane	ND	1.0	ND	0.15
79-01-6	Trichloroethene	ND	1.0	ND	0.19
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	ND	0.22
108-10-1	4-Methyl-2-pentanone	ND	1.0	ND	0.24
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	ND	0.22
79-00-5	1,1,2-Trichloroethane	ND	1.0	ND	0.19
108-88-3	Toluene	ND	1.0	ND	0.27
124-48-1	Dibromochloromethane	ND	1.0	ND	0.12
591-78-6	2-Hexanone	ND	1.0	ND	0.24
106-93-4	1,2-Dibromoethane	ND	1.0	ND	0.13
127-18-4	Tetrachloroethene	ND	1.0	ND	0.15
108-90-7	Chlorobenzene	ND	1.0	ND	0.22
100-41-4	Ethylbenzene	ND	1.0	ND	0.23
75-25-2	Bromoform	ND	1.0	ND	0.10
100-42-5	Styrene	ND	1.0	ND	0.24
1330-20-7	m,p-Xylenes	ND	1.0	ND	0.23
95-47-6	o-Xylene	ND	1.0	ND	0.23
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	ND	0.15
541-73-1	1,3-Dichlorobenzene	ND	1.0	ND	0.17
106-46-7	1,4-Dichlorobenzene	ND	1.0	ND	0.17
95-50-1	1,2-Dichlorobenzene	ND	1.0	ND	0.17

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 6/21/96

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Performance Analytical Inc.
Air Quality Laboratory

#6 VOC Halides

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GFC-001
PAI Sample ID : P9601047-001

Test Code : GC/MS EPA TO-14
Analyst : Chris Casteel
Instrument : HP 5989A/Entech 7000
Matrix : Summa Canister

Date Sampled : 6/19/96
Date Received : 6/20/96
Date Analyzed : 6/20/96
Volume(s) Analyzed : 0.100 Liter(s)

Pi 1 = 1.1
Pf 1 = 3.0
D.F. = 1.12

CAS #	COMPOUND	RESULT (UG/M3)	REPORTING LIMIT (UG/M3)	RESULT (PPB)	REPORTIN LIMIT (PPB)
74-87-3	Chloromethane	ND	10	ND	4.9
75-01-4	Vinyl Chloride	ND	10	ND	3.9
75-00-3	Chloroethane	ND	10	ND	3.8
74-83-9	Bromomethane	ND	10	ND	2.6
67-64-1	Acetone	ND	10	ND	4.2
75-69-4	Trichlorofluoromethane	ND	10	ND	1.8
75-35-4	1,1-Dichloroethene	ND	10	ND	2.5
75-09-2	Methylene chloride	24	10	7.1	2.9
75-15-0	Carbon Disulfide	ND	10	ND	3.2
76-13-1	Trichlorotrifluoroethane	ND	10	ND	1.3
156-60-5	trans-1,2-Dichloroethene	ND	10	ND	2.5
156-59-2	cis-1,2-Dichloroethene	ND	10	ND	2.5
75-34-3	1,1-Dichloroethane	ND	10	ND	2.5
1634-04-4	Methyl tert-Butyl Ether	ND	10	ND	2.8
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	10	ND	2.1
107-06-2	1,2-Dichloroethane	ND	10	ND	2.5
71-55-6	1,1,1-Trichloroethane	ND	10	ND	1.9
71-43-2	Benzene	ND	10	ND	3.1
56-23-5	Carbon Tetrachloride	ND	10	ND	1.6
78-87-5	1,2-Dichloropropane	ND	10	ND	2.2

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : [illegible]

Date : 6/21/96

Performance Analytical Inc.
Air Quality Laboratory

#6 VOC Halides

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GFC-001
PAI Sample ID : P9601047-001

Test Code : GC/MS EPA TO-14
Analyst : Chris Casteel
Instrument : HP 5989A/Entech 7000
Matrix : Summa Canister

Date Sampled : 6/19/96
Date Received : 6/20/96
Date Analyzed : 6/20/96
Volume(s) Analyzed : 0.100 Liter(s)

Pi 1 = 1.1
Pf 1 = 3.0
D.F. = 1.12

CAS #	COMPOUND	RESULT (UG/M3)	REPORTING LIMIT (UG/M3)	RESULT (PPB)	REPORTING LIMIT (PPB)
75-27-4	Bromodichloromethane	ND	10	ND	1.5
79-01-6	Trichloroethene	ND	10	ND	1.9
10061-01-5	cis-1,3-Dichloropropene	ND	10	ND	2.2
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	10	ND	2.2
79-00-5	1,1,2-Trichloroethane	ND	10	ND	1.9
108-88-3	Toluene	26	10	7.0	2.7
124-48-1	Dibromochloromethane	ND	10	ND	1.2
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	10	ND	1.3
127-18-4	Tetrachloroethene	ND	10	ND	1.5
108-90-7	Chlorobenzene	ND	10	ND	2.2
100-41-4	Ethylbenzene	ND	10	ND	2.3
75-25-2	Bromoform	ND	10	ND	0.98
100-42-5	Styrene	ND	10	ND	2.4
1330-20-7	m,p-Xylenes	4.7 TR	10	1.1 TR	2.3
95-47-6	o-Xylene	ND	10	ND	2.3
79-34-5	1,1,2,2-Tetrachloroethane	ND	10	ND	1.5
541-73-1	1,3-Dichlorobenzene	ND	10	ND	1.7
106-46-7	1,4-Dichlorobenzene	ND	10	ND	1.7
95-50-1	1,2-Dichlorobenzene	ND	10	ND	1.7

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : [illegible]

Date : 6/21/96

[illegible]

Performance Analytical Inc.
Air Quality Laboratory

20954 Osborne Street
Canoga Park, California 91304
Phone 818 709-1139
Fax 818 709-2915

Chain of Custody Record
Analytical Services Request

Client/Project Name	Address/Phone	ANALYSES	PAI Project No.
Northeast Utilities / CL&P	Attn: C. Trippel (860)665-3427 Northeast Utilities P.O. Box 270 Hartford CT 06141-0270		P9702743
Project Location Groton Fuel Cell - Groton, CT	Client Project No.		
Contact C. Trippel (860)665-3427 W. Hall (860)848-6027	Sampler (Signature) CE Trippel	P.O. No. Φ2Φ16738	

Sample Identification No.	Date	Time	Lab Sample No.	Type of Sample	EPA Method 16 20 compound Sulfur Analysis	BTU Content ASTM D3588-91	TO-14 Analysis	Expected Turnaround Time	Remarks	
DAB105/CAB107	3/20/97	0830	P9702743 #6 -001	Landfill Gas	1		1	10 bus. day	Summa canister	8
DAB104/CAB106	3/20/97	1430	#11 -002	"	1	1	1	"	Summa Canister	11
RAW LFG	3/20/97	0840	#10 -003	"	1		1	"	Tedlar bag	10
GPU Inlet LFG	3/20/97	0850	#9 -004	"	1	1		"	Tedlar bag	9

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
CE Trippel	3/21/97	1430	Robin Gill	3/28/97	0900
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Disposal Method

Disposed by: (Signature) | Date | Time

White Copy : Accompanies Samples
Yellow Copy : Sampler

110 KW

B-20

PERFORMANCE ID: 818-709-1139

CHAIN OF CUSTODY & 93-11

#8 #11
Sulfur
Summa Canister
Blank

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 3/31/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/4/97

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#8

105/107
EXIT S = ZERO

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : DAB105/CAB107
PAI Sample ID : P9702743-001

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97 } 11 Days
Date Analyzed : 3/31/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/4/97

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#8
105/107 Day
Exit 5 = Zero

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : DAB105/CAB107
PAI Sample ID : P9702743-001 (Laboratory Duplicate)

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97 } 11 Days
Date Analyzed : 3/31/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/4/97

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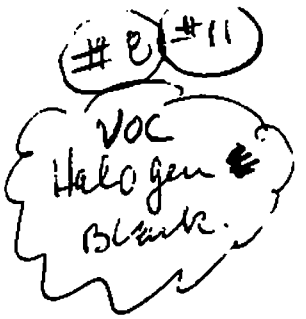
Performance Analytical Inc.
Air Quality Laboratory



RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Teknmar 5010
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi l = 0.0 Pf l = 0.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/4/97

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Performance Analytical Inc.
Air Quality Laboratory

#11
#5 VOC
Halogen
Blank

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi] = 0.0 Pf] = 0.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75
79-01-6	Trichloroethene	ND	5.0	ND	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93
108-88-3	Toluene	ND	5.0	ND	1.3
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75
108-90-7	Chlorobenzene	ND	5.0	ND	1.1
100-41-4	Ethylbenzene	ND	5.0	ND	1.2
75-25-2	Bromoform	ND	5.0	ND	0.49
100-42-5	Styrene	ND	5.0	ND	1.2
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2
95-47-6	o-Xylene	ND	5.0	ND	1.2
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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(±B) VOC - HAL

1005/107
EXIT HAL = ZECC

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 2

Client : Northeast Utilities

Client Sample ID : DAB105/CAB107
PAI Sample ID : P9702743-001

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Teknar 5010
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97 } 14 Days
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 8.3 Pf 1 = 8.3
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	ND	5.0	ND	2.4	
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0	✓
75-00-3	Chloroethane	ND	5.0	ND	1.9	
74-83-9	Bromomethane	ND	5.0	ND	1.3	
67-64-1	Acetone	ND	20	ND	8.4	
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90	
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3	
75-09-2	Methylene chloride	ND	5.0	ND	1.5	✓
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66	
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3	
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3	✓
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2	✓
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4	
108-05-4	Vinyl Acetate	ND	10	ND	2.8	
78-93-3	2-Butanone	ND	10	ND	3.4	
67-66-3	Chloroform	ND	5.0	ND	1.0	
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2	
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93	
71-43-2	Benzene	ND	5.0	ND	1.6	✓
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80	
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#3 VOC-HAL
105/107
Exit HAL

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : DAB105/CAB107
PAI Sample ID : P9702743-001

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 8.3 Pf 1 = 8.3
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75	
79-01-6	Trichloroethene	ND	5.0	ND	0.94	✓
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1	
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4	
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1	
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93	
108-88-3	Toluene	ND	5.0	ND	1.3	✓
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59	
591-78-6	2-Hexanone	ND	10	ND	2.4	
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66	
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75	✓
108-90-7	Chlorobenzene	ND	5.0	ND	1.1	✓
100-41-4	Ethylbenzene	ND	5.0	ND	1.2	✓
75-25-2	Bromoform	ND	5.0	ND	0.49	
100-42-5	Styrene	ND	5.0	ND	1.2	✓
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2	✓
95-47-6	o-Xylene	ND	5.0	ND	1.2	✓
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74	
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84	
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84	
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#9, #10 VOC HAL BLANK
Halogen Blank Tedlar

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 2

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS Mod. EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 3/28/97
Volume(s) Analyzed : 1.00 Liter

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 4/14/97

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#9, #10 VOC Halogen Blank

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 2 OF 2

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS Mod. EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 3/28/97
Volume(s) Analyzed : 1.00 Liter

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75
79-01-6	Trichloroethene	ND	5.0	ND	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93
108-88-3	Toluene	ND	5.0	ND	1.3
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75
108-90-7	Chlorobenzene	ND	5.0	ND	1.1
100-41-4	Ethylbenzene	ND	5.0	ND	1.2
75-25-2	Bromoform	ND	5.0	ND	0.49
100-42-5	Styrene	ND	5.0	ND	1.2
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2
95-47-6	o-Xylene	ND	5.0	ND	1.2
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#9 VOC-Halo

Raw LFG TO-14 Halogens Tedlar

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 2

Client : Northeast Utilities

Client Sample ID : RAW LFG
PAI Sample ID : P9702743-003

Test Code : GC/MS Mod. EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Tedlar Bag

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 3/28/97
Volume(s) Analyzed : 0.10 Liter
0.040 Liter

8 days

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	160	50	78	24	✓
75-01-4	Vinyl Chloride	1,600	50	640	20	✓
75-00-3	Chloroethane	1,700	50	640	19	✓
74-83-9	Bromomethane	ND	50	ND	13	✓
67-64-1	Acetone	1,100	200	450	84	X
75-69-4	Trichlorofluoromethane	1,500	50	260	9.0	✓
75-35-4	1,1-Dichloroethene	ND	50	ND	13	✓
75-09-2	Methylene chloride	200	50	58	15	✓
75-15-0	Carbon Disulfide	310	50	100	16	X
76-13-1	Trichlorotrifluoroethane	89	50	12	6.6	X (1)
156-60-5	trans-1,2-Dichloroethene	ND	50	ND	13	✓
156-59-2	cis-1,2-Dichloroethene	490	50	120	13	X (2)
75-34-3	1,1-Dichloroethane	440	50	110	12	✓
1634-04-4	Methyl tert-Butyl Ether	300	50	83	14	X
108-05-4	Vinyl Acetate	ND	100	ND	28	X
78-93-3	2-Butanone	2,000	100	660	34	X
67-66-3	Chloroform	ND	50	ND	10	✓
107-06-2	1,2-Dichloroethane	ND	50	ND	12	✓
71-55-6	1,1,1-Trichloroethane	150	50	27	9.3	✓
71-43-2	Benzene	1,500	50	460	16	X
56-23-5	Carbon Tetrachloride	ND	50	ND	8.0	✓
78-87-5	1,2-Dichloropropane	ND	50	ND	11	X

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

↑ Higher TR PSNN – 5X volume

Verified by : RG

Date : 4/14/97

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#9 VOC-Pollutec

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : RAW LFG
PAI Sample ID : P9702743-003

Test Code : GC/MS Mod. EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Tedlar Bag

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 3/28/97
Volume(s) Analyzed : 0.10 Liter
0.040 Liter

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	50	ND	7.5	✗
79-01-6	Trichloroethene	160	50	30	9.4	✗ ✓
10061-01-5	cis-1,3-Dichloropropene	ND	50	ND	11	✓
108-10-1	4-Methyl-2-pentanone	350	100	85	24	✗ Combine
10061-02-6	trans-1,3-Dichloropropene	ND	50	ND	11	✓
79-00-5	1,1,2-Trichloroethane	ND	50	ND	9.3	✗
108-88-3	Toluene	9,400	50	2,500	13	✗
124-48-1	Dibromochloromethane	ND	50	ND	5.9	✗
591-78-6	2-Hexanone	ND	100	ND	24	✗
106-93-4	1,2-Dibromoethane	ND	50	ND	6.6	✗
127-18-4	Tetrachloroethene	460	50	68	7.5	✓
108-90-7	Chlorobenzene	1,100	50	230	11	✓
100-41-4	Ethylbenzene	3,000	50	700	12	✗
75-25-2	Bromoform	ND	50	ND	4.9	
100-42-5	Styrene	ND	50	ND	12	✗
1330-20-7	m- & p-Xylenes	8,400	50	1,900	12	✗
95-47-6	o-Xylene	1,100	50	240	12	✗
79-34-5	1,1,2,2-Tetrachloroethane	ND	50	ND	7.4	✗
541-73-1	1,3-Dichlorobenzene	ND	50	ND	8.4	✗
106-46-7	1,4-Dichlorobenzene	ND	50	ND	8.4	✗
95-50-1	1,2-Dichlorobenzene	ND	50	ND	8.4	✗

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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(#9) SULFUR

RAW LFG FOR SULFUR (TEDLAR, 14 DAYS)

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

Client : Northeast Utilities

Client Sample ID : RAW LFG
PAI Sample ID : P9702743-003

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 4/3/97
(14 Days)
Volume(s) Analyzed : 1.0 (ml)
0.010 (ml)

CAS #	COMPOUND	PPM	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	80.9	113,000	56.0	80,900	40.0
463-58-1	Carbonyl Sulfide	.215	528	98.0	215	40.0
74-93-1	Methyl Mercaptan	.070	138	79.0	70.1	40.0
75-08-1	Ethyl Mercaptan	.068	174	100	68.4	40.0
75-18-3	Dimethyl Sulfide	ND	ND	100	ND	40.0
75-15-0	Carbon Disulfide (x2)	.191	595	62.0	191	20.0
75-33-2	Isopropyl Mercaptan	.042	131	120	42.2	40.0
75-66-1	tert-Butyl Mercaptan	ND	ND	150	ND	40.0
107-03-9	n-Propyl Mercaptan		ND	120	ND	40.0
624-89-5	Ethyl Methyl Sulfide		ND	120	ND	40.0
110-02-1	Thiophene		ND	140	ND	40.0
513-44-0	Isobutyl Mercaptan		ND	150	ND	40.0
352-93-2	Diethyl Sulfide		ND	150	ND	40.0
109-79-5	n-Butyl Mercaptan		ND	150	ND	40.0
624-92-0	Dimethyl Disulfide		ND	77.0	ND	20.0
616-44-4	3-Methylthiophene		ND	160	ND	40.0
110-01-0	Tetrahydrothiophene		ND	140	ND	40.0
638-02-8	2,5-Dimethylthiophene		ND	180	ND	40.0
872-55-9	2-Ethylthiophene		ND	180	ND	40.0
110-81-6	Diethyl Disulfide		ND	100	ND	20.0

ES = 81.7 PPM as H_2S

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : PG

Date : 4/4/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client: Northeast Utilities

Client Sample ID: GPU Inlet LFG
PAI Samplet ID: P9702743-004

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Tedlar Bag

Date Sampled: 3/20/97
Date Received: 3/28/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	6.93	8.02
Nitrogen	24.25	24.58
Carbon Monoxide	< 0.01	< 0.01
Methane	41.70	24.20
Carbon Dioxide	27.10	43.15
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	0.01	0.02
TOTALS	99.99	99.97

Components	Mole %	Weight %
C	19.54	29.93
H	47.38	6.09
O	19.31	39.40
N	13.77	24.59
S	< 0.10	< 0.10

Specific Gravity (Air = 1)	0.9542
* Specific Volume, cu. ft./lb	13.73
* Gross Heating Value, BTU/cu. ft.	414.3
** Gross Heating Value, BTU/cu. ft.	422.5
** Gross Heating Value, BTU/lb.	5802.0
** Net Heating Value, BTU/cu. ft.	380.4
** Net Heating Value, BTU/lb.	5224.2
* Net Heating Value, BTU/cu. ft.	373.1
Compressibility Factor "Z" (60 F, 14.696 psig)	0.9980

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by : RG Date : 4/14/97

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#10, #11 S-BLANK
Sulfur Tedlar Blank.

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 4/3/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#10 Sulfur

GPU Inlet LFG - Tedlar Sulfur

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9702743-004

Test Code : GC/PPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 4/3/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	70.0	9.80	28.5	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	16.8	10.0	6.60	4.00
75-15-0	Carbon Disulfide	89.0	6.20	28.6	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#11 - BTU

HEATING VALUE GPU EXIT

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client: Northeast Utilities

Client Sample ID: DAB104/CAB106
PAI Sample ID: P9702743-002

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Summa Canister

Date Sampled: 3/20/97
Date Received: 3/28/97 } 8 Days

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	< 0.01	< 0.01
Nitrogen	0.07	0.07
Carbon Monoxide	< 0.01	< 0.01
Methane	57.78	33.29
Carbon Dioxide	42.14	66.63
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	< 0.01	< 0.01
TOTALS	99.99	99.99

Components	Mole %	Weight %
C	24.05	43.12
H	55.63	8.37
O	20.29	48.45
N	< 0.10	< 0.10
S	< 0.10	< 0.10

	Specific Gravity (Air = 1)	0.9611
*	Specific Volume, cu. ft./lb	13.63
*	Gross Heating Value, BTU/cu. ft.	573.4
**	Gross Heating Value, BTU/cu. ft.	585.5
**	Gross Heating Value, BTU/lb.	7982.5
**	Net Heating Value, BTU/cu. ft.	527.2
**	Net Heating Value, BTU/lb.	7187.4
*	Net Heating Value, BTU/cu. ft.	516.3
	Compressibility Factor "Z" (60 F, 14.696 psig)	0.9967

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by: RG Date: 4/14/97

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#11 SULFUR

104/106
EXIT S = ZERO

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client : Northeast Utilities

Client Sample ID : DAB104/CAB106
PAI Sample ID : P9702743-002

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 3/31/97
} 11 Days
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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(#11) VOC-PAL

104/106
EXIT HAL = ZERO

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : DAB104/CAB106
PAI Sample ID : P9702743-002

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97 } 14 DAYS
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 12.3 Pf 1 = 12.3
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

↑ LAB LIMITS

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 2 OF 2

Client : Northeast Utilities

Client Sample ID : DAB104/CAB106
PAI Sample ID : P9702743-002

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 12.3 Pf 1 = 12.3
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75
79-01-6	Trichloroethene	ND	5.0	ND	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93
108-88-3	Toluene	ND	5.0	ND	1.3
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75
108-90-7	Chlorobenzene	ND	5.0	ND	1.1
100-41-4	Ethylbenzene	ND	5.0	ND	1.2
75-25-2	Bromoform	ND	5.0	ND	0.49
100-42-5	Styrene	ND	5.0	ND	1.2
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2
95-47-6	o-Xylene	ND	5.0	ND	1.2
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#1 VOC-1AL Duplicate
104/106 Dup.
Exit Flow = Zero

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 2

Client : Northeast Utilities

Client Sample ID : DAB104/CAB106
PAI Sample ID : P9702743-002 (Laboratory Duplicate)

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 4/3/97
} 14 DAYS
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 12.3 Pf 1 = 12.3
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	ND	5.0	ND	2.4	
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0	✓
75-00-3	Chloroethane	ND	5.0	ND	1.9	
74-83-9	Bromomethane	ND	5.0	ND	1.3	
67-64-1	Acetone	ND	20	ND	8.4	
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90	
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3	
75-09-2	Methylene chloride	ND	5.0	ND	1.5	✓
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66	
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3	
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3	✓
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2	✓
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4	
108-05-4	Vinyl Acetate	ND	10	ND	2.8	
78-93-3	2-Butanone	ND	10	ND	3.4	
67-66-3	Chloroform	ND	5.0	ND	1.0	
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2	
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93	
71-43-2	Benzene	ND	5.0	ND	1.6	✓
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80	
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#11 VOC-HAL Duplicate
104/106 Exit Hall Duplicates

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 2 OF 2

Client : Northeast Utilities

Client Sample ID : DAB104/CAB106
PAI Sample ID : P9702743-002 (Laboratory Duplicate)

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 3/20/97
Date Received : 3/28/97
Date Analyzed : 4/3/97
Volume(s) Analyzed : 1.00 Liter

Pi] = 12.3 Pf] = 12.3
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75	
79-01-6	Trichloroethene	ND	5.0	ND	0.94	✓
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1	
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4	
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1	
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93	
108-88-3	Toluene	ND	5.0	ND	1.3	✓
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59	
591-78-6	2-Hexanone	ND	10	ND	2.4	
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66	
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75	✓
108-90-7	Chlorobenzene	ND	5.0	ND	1.1	✓
100-41-4	Ethylbenzene	ND	5.0	ND	1.2	✓
75-25-2	Bromoform	ND	5.0	ND	0.49	
100-42-5	Styrene	ND	5.0	ND	1.2	✓
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2	✓
95-47-6	o-Xylene	ND	5.0	ND	1.2	✓
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74	
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84	
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84	
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 4/14/97

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#12 #13

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Air Quality Laboratory

LABORATORY REPORT

Client:	NORTHEAST UTILITIES SYSTEM	Date of Report:	06/10/97
Address:	74 Lathrop Road	Date Received:	05/22/97
	Uncasville, CT 06382	PAI Project No:	P9703093
Contact:	Mr. Walter Hall	Purchase Order:	02025913

Client Project ID: CL&P - Groton Fuel Cell

Two (2) Stainless Steel Summa Canisters labeled: "DAB-105/CAB-107" and "DAB-104/CAB-106"

The samples were received at the laboratory under chain of custody on May 22, 1997. The samples were received intact. The dates of analyses are indicated on the attached data sheets.

BTU and CHONS Analysis

The results for BTU and CHONS were determined according to ASTM Method D3588-91. The following analyses were performed and used to calculated the BTU and CHONS results.

C2 through C6 Hydrocarbon Analysis

The samples were analyzed for C_2 through $>C_6$ hydrocarbons by direct injection GC/FID according to EPA Mothod 18. The analytical system consisted of a Hewlett-Packard model 5890A gas chromatograph equipped with a flame ionization detector.

Data Release Authorization:

Cindy Yoon
Analytical Chemist

Reviewed and Approved:

Ku-Jih Chen
Principal Chemist

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#12, #13

Performance Analytical Inc.
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Fixed Gases Analysis

The samples were also analyzed for fixed gases (Hydrogen, Oxygen, Nitrogen, Carbon monoxide, Methane and Carbon dioxide) using a Hewlett Packard Model 5890 gas chromatograph equipped with a thermal conductivity detector (TCD).

Sulfur Analysis

The samples were also analyzed for twenty Sulfur compounds by gas chromatography/flame photometric detection (FPD). The analytical system used was comprised of a Hewlett Packard Model 5890 equipped with a flame photometric detector (FPD).

Volatile Organic Compounds Analysis

The samples were also analyzed by combined gas chromatography/mass spectrometry (GC/MS) for volatile organic compounds. The analyses were performed according to the methodology outlined in EPA Method TO-14 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600/4-84-041, U.S. Environmental Protection Agency, Research Triangle Park, NC, April, 1984 and May, 1988. The method was modified for using Tedlar bags. The analyses were performed by gas chromatography/mass spectrometry, utilizing a direct cryogenic trapping technique. The analytical system used was comprised of a Finnigan Model 4500 GC/MS/DS interfaced to a Tekmar 5010 Automatic Desorber. A 100% Dimethylpolysiloxane capillary column (RT_x-1, Restek Corporation, Bellefonte, PA) was used to achieve chromatographic separation.

The results of analyses are given on the attached data sheets.

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Performance Analytical Inc.
Air Quality Laboratory

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Chain of Custody Record
Analytical Services Request

Client/Project Name	Address/Phone	ANALYSES	PAI Project No.
Northeast Utilities / CL&P	Attn: C. Trippel Northeast Utilities (860)665-3467 P.O. Box 270 Hartford, CT 06141-0270		9703093
Project Location: Groton Fuel Cell - Groton, CT	Client Project No.		
Contact: C. Trippel (860)665-3467 W. Hall (860) 848-6037	Sampler (Signature): Jean Martinez	P.O. No.	

Sample Identification No.	Date	Time	Lab Sample No.	Type of Sample	EPA Method 16 + 10 compound Sulfur Gas Cmpnt	ASTM D3588-91	TO-14 Analysis				Expected Turnaround Time	Remarks
(#12) 102 DAB-105/CAB-107	5/19/97	1015	-001	Landfill Gas	1	1	1				10 bus. day	Summa Canister
(#13) 456 DAB-104/CAB-106	5/19/97	1453	-002	LANDFILL GAS	1	1	1				10 Bus. DAY	SUMMA CANISTER

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Jean Martinez	5-19-97	1500	[illegible]	5/20/97	9:30 AM
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Disposal Method			White Copy : Accompanies Samples		
Disposed by: (Signature)	Date	Time	Yellow Copy : Sampler		

#12-#13 CHAIN OF CUSTODY

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code :	GC/FPD Reduced Sulfur Analysis	Date Sampled :	N/A
Analyst :	J. Dan Taliaferro	Date Received :	N/A
Instrument :	HP5890A/FPD #4	Date Analyzed :	5/23/97
Matrix :	Summa Canister	Volume(s) Analyzed :	10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/5/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 0.0 Pf 1 = 0.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

#12,13

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/5/97
Volume(s) Analyzed : 1.00 Liter

Pf 1 = 0.0 Pf 1 = 0.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75
79-01-6	Trichloroethene	ND	5.0	ND	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93
108-88-3	Toluene	ND	5.0	ND	1.3
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75
108-90-7	Chlorobenzene	ND	5.0	ND	1.1
100-41-4	Ethylbenzene	ND	5.0	ND	1.2
75-25-2	Bromoform	ND	5.0	ND	0.49
100-42-5	Styrene	ND	5.0	ND	1.2
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2
95-47-6	o-Xylene	ND	5.0	ND	1.2
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

BTU

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client: Northeast Utilities

Client Sample ID: DAB-105/CAB-107
PAI Samplet ID: P9703093-001

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Summa Canister

Date Sampled: 5/19/97
Date Received: 5/22/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	0.49	0.56
Nitrogen	1.68	1.69
Carbon Monoxide	< 0.01	< 0.01
Methane	56.59	32.59
Carbon Dioxide	41.24	65.15
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	< 0.01	< 0.01
TOTALS	100.00	99.99

Components	Mole %	Weight %
C	23.80	42.18
H	55.08	8.19
O	20.30	47.93
N	0.82	1.69
S	< 0.10	< 0.10

	Specific Gravity (Air = 1)	0.9617
*	Specific Volume, cu. ft./lb	13.62
*	Gross Heating Value, BTU/cu. ft.	561.6
**	Gross Heating Value, BTU/cu. ft.	573.4
**	Gross Heating Value, BTU/lb.	7811.8
**	Net Heating Value, BTU/cu. ft.	516.3
**	Net Heating Value, BTU/lb.	7033.7
*	Net Heating Value, BTU/cu. ft.	505.6
	Compressibility Factor "Z" (60 F, 14.696 psig)	0.9968

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by : RG Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#1 12 Sulfur

Client : Northeast Utilities

Client Sample ID : DAB-105/CAB-107
PAI Sample ID : P9703093-001

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : J. Dan Talinferro
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 5/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#12 VOC-Hal

Client : Northeast Utilities

Client Sample ID : DAB-105/CAB-107
PAI Sample ID : P9703093-001

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 6/5/97
Volume(s) Analyzed : 1.00 Liter

PI 1 = 7.0 PF 1 = 7.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	ND	5.0	ND	2.4	
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0	✓
75-00-3	Chloroethane	ND	5.0	ND	1.9	
74-83-9	Bromomethane	ND	5.0	ND	1.3	
67-64-1	Acetone	ND	20	ND	8.4	
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90	
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3	
75-09-2	Methylene chloride	ND	5.0	ND	1.5	✓
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66	
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3	
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3	✓
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2	✓
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4	
108-05-4	Vinyl Acetate	ND	10	ND	2.8	
78-93-3	2-Butanone	ND	10	ND	3.4	
67-66-3	Chloroform	ND	5.0	ND	1.0	
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2	
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93	
71-43-2	Benzene	ND	5.0	ND	1.6	✓
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80	
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : BG

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#12 VOC-HAL

Client : Northeast Utilities

Client Sample ID : DAB-105/CAB-107
PAI Sample ID : P9703093-001

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 6/5/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 7.0 Pf 1 = 7.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75	
79-01-6	Trichloroethene	ND	5.0	ND	0.94	✓
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1	
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4	
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1	
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93	
108-88-3	Toluene	ND	5.0	ND	1.3	✓
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59	
591-78-6	2-Hexanone	ND	10	ND	2.4	
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66	
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75	✓
108-90-7	Chlorobenzene	ND	5.0	ND	1.1	✓
100-41-4	Ethylbenzene	ND	5.0	ND	1.2	✓
75-25-2	Bromoform	ND	5.0	ND	0.49	
100-42-5	Styrene	ND	5.0	ND	1.2	✓
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2	✓
95-47-6	o-Xylene	ND	5.0	ND	1.2	✓
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74	
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84	
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84	
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

13 BTU

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client: Northeast Utilities

Client Sample ID: DAB-104/CAB-106
PAI Sample ID: P9703093-002

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Summa Canister

Date Sampled: 5/19/97
Date Received: 5/22/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	0.47	0.54
Nitrogen	1.68	1.69
Carbon Monoxide	< 0.01	< 0.01
Methane	56.86	32.82
Carbon Dioxide	41.00	64.93
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	< 0.01	< 0.01
TOTALS	100.00	99.98

Components	Mole %	Weight %
C	23.78	42.30
H	55.26	8.25
O	20.15	47.76
N	0.81	1.69
S	< 0.10	< 0.10

Specific Gravity (Air = 1)	0.9592
* Specific Volume, cu. ft./lb	13.66
* Gross Heating Value, BTU/cu. ft.	564.2
** Gross Heating Value, BTU/cu. ft.	576.0
** Gross Heating Value, BTU/lb.	7868.5
** Net Heating Value, BTU/cu. ft.	518.7
** Net Heating Value, BTU/lb.	7084.8
* Net Heating Value, BTU/cu. ft.	508.0
Compressibility Factor "Z" (60 F, 14.696 psia)	0.9968

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by : RG Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 1

Sulfur

Client : Northeast Utilities

Client Sample ID : DAB-104/CAB-106
PAI Sample ID : P9703093-002

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : J. Dan Taliaferro
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 5/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

#13
S-dup

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client : Northeast Utilities

Client Sample ID : DAB-104/CAB-106
PAI Sample ID : P9703093-002 (Laboratory Duplicate)

Test Code : GC/FPD Reduced Sulfur Analysis
Analyst : J. Dan Taliaferro
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 5/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RCS

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS
PAGE 1 OF 2

#13
VOC - HAL

Client : Northeast Utilities

Client Sample ID : DAB-104/CAB-106
PAI Sample ID : P9703093-002

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 6/5/97
Volume(s) Analyzed : 1.00 Liter

Pi I = 9.6 Pf I = 9.6
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	ND	5.0	ND	2.4	
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0	✓
75-00-3	Chloroethane	ND	5.0	ND	1.9	
74-83-9	Bromomethane	ND	5.0	ND	1.3	
67-64-1	Acetone	ND	20	ND	8.4	
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90	
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3	
75-09-2	Methylene chloride	ND	5.0	ND	1.5	✓
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66	
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3	✓
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3	
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2	
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4	
108-05-4	Vinyl Acetate	ND	10	ND	2.8	
78-93-3	2-Butanone	ND	10	ND	3.4	
67-66-3	Chloroform	ND	5.0	ND	1.0	
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2	✓
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93	
71-43-2	Benzene	ND	5.0	ND	1.6	✓
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80	
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RCS

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#13 VOC-PAL

Client : Northeast Utilities

Client Sample ID : DAB-104/CAB-106
PAI Sample ID : P9703093-002

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 5/19/97
Date Received : 5/22/97
Date Analyzed : 6/5/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 9.6 Pf 1 = 9.6
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75	
79-01-6	Trichloroethene	ND	5.0	ND	0.94	✓
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1	
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4	
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1	
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93	
108-88-3	Toluene	ND	5.0	ND	1.3	
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59	
591-78-6	2-Hexanone	ND	10	ND	2.4	
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66	
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75	✓
108-90-7	Chlorobenzene	ND	5.0	ND	1.1	✓
100-41-4	Ethylbenzene	ND	5.0	ND	1.2	✓
75-25-2	Bromoform	ND	5.0	ND	0.49	
100-42-5	Styrene	ND	5.0	ND	1.2	
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2	
95-47-6	o-Xylene	ND	5.0	ND	1.2	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74	
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84	
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84	
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 6/9/97

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Performance Analytical Inc.
Air Quality Laboratory

#14-19

LABORATORY REPORT

Client:	NORTHEAST UTILITIES SYSTEM	Date of Report:	07/17/97
Address:	74 Lathrop Road	Date Received:	06/23/97
	Uncasville, CT 06382	PAI Project No:	P9703305
Contact:	Mr. Walter Hall	Purchase Order:	02030899

Client Project ID: CL&P - Groton Fuel Cell

Two (2) Stainless Steel Summa Canisters labeled: "DAB-105/CAB-107" and "DAB-104/CAB-106"

Four (4) Tedlar Bag Samples labeled:

"DAB104/CAB106" "Raw LFG" "GPU Inlet LFG" "DAB105/CAB107"

The samples were received at the laboratory under chain of custody on June 23, 1997. The samples were received intact. The dates of analyses are indicated on the attached data sheets.

BTU and CHONS Analysis

The results for BTU and CHONS were determined according to ASTM Method D3588-91. The following analyses were performed and used to calculated the BTU and CHONS results.

C2 through C6 Hydrocarbon Analysis

Three of the samples were analyzed for C_2 through $>C_6$ hydrocarbons by direct injection GC/FID according to EPA Method 18. The analytical system consisted of a Hewlett-Packard model 5890A gas chromatograph equipped with a flame ionization detector.

Data Release Authorization:

Cindy Yoon

Cindy Yoon
Analytical Chemist

Reviewed and Approved:

Michael Tuday
Laboratory Director

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#14-19

Fixed Gases Analysis

The sample three samples were also analyzed for fixed gases (Hydrogen, Oxygen, Nitrogen, Carbon monoxide, Methane and Carbon dioxide) using a Hewlett Packard Model 5890 gas chromatograph equipped with a thermal conductivity detector (TCD).

Sulfur Analysis

All of the samples were analyzed for twenty Sulfur compounds by gas chromatography/flame photometric detection (FPD). The analytical system used was comprised of a Hewlett Packard Model 5890 equipped with a flame photometric detector (FPD).

Volatile Organic Compounds Analysis

Four of the samples were analyzed by combined gas chromatography/mass spectrometry (GC/MS) for volatile organic compounds. The analyses were performed according to the methodology outlined in EPA Method TO-14 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600/4-84-041, U.S. Environmental Protection Agency, Research Triangle Park, NC, April, 1984 and May, 1988. The method was modified for using Tedlar bags. The analyses were performed by gas chromatography/mass spectrometry, utilizing a direct cryogenic trapping technique. The analytical systems used were comprised of a Finnigan Model 4500 GC/MS/DS interfaced to a Tekmar 5010 Automatic Desorber and a Hewlett Packard Model 5972 GC/MS/DS interfaced to an Entech 7000 automated whole air inlet system/cryogenic concentrator. A 100% Dimethylpolysiloxane capillary column (RT_x-1, Restek Corporation, Bellefonte, PA) was used to achieve chromatographic separation.

The results of analyses are given on the attached data sheets.

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Performance Analytical Inc.
Air Quality Laboratory

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Canoga Park, California 91304
Phone 818 709-1339
Fax 818 709-2915

Chain of Custody Record
Analytical Services Request

Client/Project Name	Address/Phone	PAI Project No.
Northeast Utilities/CCFC	Northeast Utilities Attn: C. Trippel (860)665-3467 P.O. Box 270 Hartford, CT 06141-0270	P9703305
Project Location	**Client Project No.**	
Groton Fuel Cell - Groton, CT		
Contact	**Sampler (Signature)**	**P.O. No.**
C. Trippel (860) 665-3467 W. Hall (860) 848-6027	CE Trippel	PO will follow (verbal)

	Sample Identification No.	Date	Time	~~Lab~~ Sample No. GPU Counter	Type of Sample	EPA Method 16 20 Compounds Reduced Sulfur Analysis	BTU Content/Comp. ASTM D3588-91	EPA Method TO-14 incl Dichlorodifluoromethane				Expected Turnaround Time	Remarks
(4) 54	DAB 104/CAB106	6-19-97	1015	45,500 -024	Landfill Gas	1	1	1				10 Business Day	Summa Canister
(6) 49	DAB 105/CAB107	6-19-97	1230	1,000 -002	"	1		1				"	Summa Canister
(5) ✓	DAB 104/CAB 106	6-19-97	1015	45,500 -024	"	1						"	Tedlar bag
(7) B-1 ✓	RAW LFG	6-19-97	1230	1,000 -002	"	1	1	1				"	Tedlar bag
(8) 50 ✓	GPU Inlet LFG	6-19-97	1235	-005	"	1	1	1				"	Tedlar bag
(9) ✓	DAB105/CAB 107	6-19-97	1240	-006	"	1						"	Tedlar bag

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
CE Trippel	6-19-97	1245	[signature]	6/23/97	9:30 am
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Disposal Method					
Disposed by: (Signature)	Date	Time			

White Copy : Accompanies Samples

Yellow Copy : Sampler

#14-19

Performance Analytical Inc.
Air Quality Laboratories

#14 BTU

RESULTS OF ANALYSIS

Client: Northeast Utilites

Client Sample ID: DAB 104 / CAB 106
PAI Samplet ID: P9703305-001

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Summa Canister

Date Sampled: 6/19/97
Date Received: 6/23/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	0.28	0.32
Nitrogen	0.93	0.94
Carbon Monoxide	< 0.01	< 0.01
Methane	57.32	33.08
Carbon Dioxide	41.46	65.65
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	< 0.01	< 0.01
TOTALS	99.99	99.99

Components	Mole %	Weight %
C	23.89	42.69
H	55.47	8.32
O	20.19	48.06
N	0.45	0.94
S	< 0.10	< 0.10

Specific Gravity (Air = 1)	0.9596
* Specific Volume, cu. ft./lb	13.65
* Gross Heating Value, BTU/cu. ft.	568.9
** Gross Heating Value, BTU/cu. ft.	580.9
** Gross Heating Value, BTU/lb.	7931.6
** Net Heating Value, BTU/cu. ft.	523.0
** Net Heating Value, BTU/lb.	7141.6
* Net Heating Value, BTU/cu. ft.	512.3
Compressibility Factor "Z" (60 F, 14.696 psig)	0.9967

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by: RG Date: 7/14/97

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Performance Analytical Inc.

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 7/14/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 0.0 Pf 1 = 0.0
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

[illegible] • Phone [illegible] • Fax [illegible]

Performance Analytical Inc.

RESULTS OF ANALYSIS

#1, 14, 16 VOC Blank

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code :	GC/MS EPA TO-14	Date Sampled :	N/A
Analyst :	Cindy Yoon	Date Received :	N/A
Instrument :	Finnigan 4500C/Tekmar 5010	Date Analyzed :	7/14/97
Matrix :	Summa Canister	Volume(s) Analyzed :	1.00 Liter

Pi 1 = 0.0 Pf 1 = 0.0

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75
79-01-6	Trichloroethene	ND	5.0	ND	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93
108-88-3	Toluene	ND	5.0	ND	1.3
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75
108-90-7	Chlorobenzene	ND	5.0	ND	1.1
100-41-4	Ethylbenzene	ND	5.0	ND	1.2
75-25-2	Bromoform	ND	5.0	ND	0.49
100-42-5	Styrene	ND	5.0	ND	1.2
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2
95-47-6	o-Xylene	ND	5.0	ND	1.2
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84

GC / MS SCAN NO.	TENTATIVE COMPOUND IDENTIFICATION	ESTIMATED CONCENTRATION ug/m3
	Dichlorodifluoromethane	ND

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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Performance Analytical Inc.

RESULTS OF ANALYSIS

#14 VOC-HML

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106
PAI Sample ID : P9703305-001

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 15.1 Pf 1 = 15.1
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	ND	5.0	ND	2.4	
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0	✓
75-00-3	Chloroethane	ND	5.0	ND	1.9	
74-83-9	Bromomethane	ND	5.0	ND	1.3	
67-64-1	Acetone	ND	20	ND	8.4	
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90	
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3	
75-09-2	Methylene chloride	ND	5.0	ND	1.5	✓
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6	
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66	
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3	
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3	✓
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2	✓
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4	
108-05-4	Vinyl Acetate	ND	10	ND	2.8	
78-93-3	2-Butanone	ND	10	ND	3.4	
67-66-3	Chloroform	ND	5.0	ND	1.0	
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2	
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93	
71-43-2	Benzene	ND	5.0	ND	1.6	✓
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80	
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

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Performance Analytical Inc.

RESULTS OF ANALYSIS

#14 VOC-1HR

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106
PAI Sample ID : P9703305-001

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 15.1 Pf 1 = 15.1

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75	
79-01-6	Trichloroethene	ND	5.0	ND	0.94	✓
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1	
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4	
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1	
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93	
108-88-3	Toluene	ND	5.0	ND	1.3	✓
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59	
591-78-6	2-Hexanone	ND	10	ND	2.4	
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66	
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75	✓
108-90-7	Chlorobenzene	ND	5.0	ND	1.1	✓
100-41-4	Ethylbenzene	ND	5.0	ND	1.2	✓
75-25-2	Bromoform	ND	5.0	ND	0.49	
100-42-5	Styrene	ND	5.0	ND	1.2	✓
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2	
95-47-6	o-Xylene	ND	5.0	ND	1.2	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74	
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84	
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84	
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84	

GC / MS SCAN NO.	TENTATIVE COMPOUND IDENTIFICATION	ESTIMATED CONCENTRATION ug/m3
	Dichlorodifluoromethane	ND

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

Performance Analytical Inc.

RESULTS OF ANALYSIS

#14 VOC-Dup

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106
PAI Sample ID : P9703305-001 (Laboratory Duplicate)

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 15.1 Pf 1 = 15.1
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

Performance Analytical Inc.

RESULTS OF ANALYSIS

#14 VOC - Dup

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106
PAI Sample ID : P9703305-001 (Laboratory Duplicate)

Test Code :	GC/MS EPA TO-14	Date Sampled :	6/19/97
Analyst :	Cindy Yoon	Date Received :	6/23/97
Instrument :	Finnigan 4500C/Tekmar 5010	Date Analyzed :	7/14/97
Matrix :	Summa Canister	Volume(s) Analyzed :	1.00 Liter

Pi 1 = 15.1 Pf 1 = 15.1

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75
79-01-6	Trichloroethene	ND	5.0	ND	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93
108-88-3	Toluene	ND	5.0	ND	1.3
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59
591-78-6	2-Hexanone	ND	10	ND	2.4
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75
108-90-7	Chlorobenzene	ND	5.0	ND	1.1
100-41-4	Ethylbenzene	ND	5.0	ND	1.2
75-25-2	Bromoform	ND	5.0	ND	0.49
100-42-5	Styrene	ND	5.0	ND	1.2
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2
95-47-6	o-Xylene	ND	5.0	ND	1.2
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84

GC / MS SCAN NO.	TENTATIVE COMPOUND IDENTIFICATION	ESTIMATED CONCENTRATION ug/m3
	Dichlorodifluoromethane	ND

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

± 1.2 Sulfur

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106
PAI Sample ID : P9703305-001

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A / FPD #4
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

Pi = 15.1 Pf = 15.1 D.F.= 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00	✓
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00	✓
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00	✓
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00	✓
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00	
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00	
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00	
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00	
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00	
110-02-1	Thiophene	ND	14.0	ND	4.00	
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00	
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00	
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00	
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00	✓
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00	
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00	
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00	
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00	
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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Performance Analytical Inc.
Air Quality Laboratories

#15,17,18,19 Sulfur Blank (Tedlar Bag)

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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Performance Analytical Inc.
Air Quality Laboratories

RESULTS OF ANALYSIS

#15 Sulfur

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106
PAI Sample ID : P9703305-003

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	52.0	6.20	16.7	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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Performance Analytical Inc.
Air Quality Laboratories

RESULTS OF ANALYSIS

#16 Sulfur

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107
PAI Sample ID : P9703305-002

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A / FPD #4
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

Pi = 14.1 Pf = 14.1 D.F.= 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00	✓
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00	✓
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00	✓
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00	✓
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00	✓
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00	
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00	
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00	
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00	
110-02-1	Thiophene	ND	14.0	ND	4.00	
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00	
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00	
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00	
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00	✓
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00	
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00	
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00	
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00	
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/1/97

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RESULTS OF ANALYSIS

2-10
VOC-HAL

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107
PAI Sample ID : P9703305-002

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 14.1 Pf 1 = 14.1
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	5.0	ND	2.4
75-01-4	Vinyl Chloride	ND	5.0	ND	2.0
75-00-3	Chloroethane	ND	5.0	ND	1.9
74-83-9	Bromomethane	ND	5.0	ND	1.3
67-64-1	Acetone	ND	20	ND	8.4
75-69-4	Trichlorofluoromethane	ND	5.0	ND	0.90
75-35-4	1,1-Dichloroethene	ND	5.0	ND	1.3
75-09-2	Methylene chloride	ND	5.0	ND	1.5
75-15-0	Carbon Disulfide	ND	5.0	ND	1.6
76-13-1	Trichlorotrifluoroethane	ND	5.0	ND	0.66
156-60-5	trans-1,2-Dichloroethene	ND	5.0	ND	1.3
156-59-2	cis-1,2-Dichloroethene	ND	5.0	ND	1.3
75-34-3	1,1-Dichloroethane	ND	5.0	ND	1.2
1634-04-4	Methyl tert-Butyl Ether	ND	5.0	ND	1.4
108-05-4	Vinyl Acetate	ND	10	ND	2.8
78-93-3	2-Butanone	ND	10	ND	3.4
67-66-3	Chloroform	ND	5.0	ND	1.0
107-06-2	1,2-Dichloroethane	ND	5.0	ND	1.2
71-55-6	1,1,1-Trichloroethane	ND	5.0	ND	0.93
71-43-2	Benzene	ND	5.0	ND	1.6
56-23-5	Carbon Tetrachloride	ND	5.0	ND	0.80
78-87-5	1,2-Dichloropropane	ND	5.0	ND	1.1

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

Performance Analytical Inc.

RESULTS OF ANALYSIS

#16 VOC-HAL

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107
PAI Sample ID : P9703305-002

Test Code : GC/MS EPA TO-14
Analyst : Cindy Yoon
Instrument : Finnigan 4500C/Tekmar 5010
Matrix : Summa Canister

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 1.00 Liter

Pi 1 = 14.1 Pf 1 = 14.1

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	5.0	ND	0.75	
79-01-6	Trichloroethene	ND	5.0	ND	0.94	✓
10061-01-5	cis-1,3-Dichloropropene	ND	5.0	ND	1.1	
108-10-1	4-Methyl-2-pentanone	ND	10	ND	2.4	
10061-02-6	trans-1,3-Dichloropropene	ND	5.0	ND	1.1	
79-00-5	1,1,2-Trichloroethane	ND	5.0	ND	0.93	
108-88-3	Toluene	ND	5.0	ND	1.3	✓
124-48-1	Dibromochloromethane	ND	5.0	ND	0.59	
591-78-6	2-Hexanone	ND	10	ND	2.4	
106-93-4	1,2-Dibromoethane	ND	5.0	ND	0.66	
127-18-4	Tetrachloroethene	ND	5.0	ND	0.75	✓
108-90-7	Chlorobenzene	ND	5.0	ND	1.1	✓
100-41-4	Ethylbenzene	ND	5.0	ND	1.2	✓
75-25-2	Bromoform	ND	5.0	ND	0.49	
100-42-5	Styrene	ND	5.0	ND	1.2	✓
1330-20-7	m- & p-Xylenes	ND	5.0	ND	1.2	
95-47-6	o-Xylene	ND	5.0	ND	1.2	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.0	ND	0.74	
541-73-1	1,3-Dichlorobenzene	ND	5.0	ND	0.84	
106-46-7	1,4-Dichlorobenzene	ND	5.0	ND	0.84	
95-50-1	1,2-Dichlorobenzene	ND	5.0	ND	0.84	

GC / MS SCAN NO.	TENTATIVE COMPOUND IDENTIFICATION	ESTIMATED CONCENTRATION ug/m3
	Dichlorodifluoromethane	ND

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

Performance Analytical Inc.

#17 BTU

RESULTS OF ANALYSIS

Client: Northeast Utilites

Client Sample ID: RAW LFG
PAI Samplet ID: P9703305-004

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Tedlar Bag

Date Sampled: 6/19/97
Date Received: 6/23/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	0.67	0.78
Nitrogen	1.45	1.49
Carbon Monoxide	< 0.01	< 0.01
Methane	58.70	34.51
Carbon Dioxide	39.15	63.15
Hydrogen Sulfide	0.01	0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	0.01	0.03
TOTALS	99.99	99.97

Components	Mole %	Weight %
C	23.57	43.12
H	56.57	8.68
O	19.16	46.70
N	0.70	1.49
S	< 0.10	< 0.10

Specific Gravity (Air = 1)	0.9420
* Specific Volume, cu. ft./lb	13.91
* Gross Heating Value, BTU/cu. ft.	583.3
** Gross Heating Value, BTU/cu. ft.	595.5
** Gross Heating Value, BTU/lb.	8283.5
** Net Heating Value, BTU/cu. ft.	536.2
** Net Heating Value, BTU/lb.	7458.7
* Net Heating Value, BTU/cu. ft.	525.2
Compressibility Factor "Z" (60 F, 14.696 psig)	0.9968

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by : RG Date : 7/14/97

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RESULTS OF ANALYSIS

#17
VOC ISOPROPYL
TO 01/98

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/24/97
Volume(s) Analyzed : 1.00 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-71-8	Dichlorodifluoromethane	ND	1.0	ND	0.20
74-87-3	Chloromethane	ND	1.0	ND	0.49
75-01-4	Vinyl Chloride	ND	1.0	ND	0.39
74-83-9	Bromomethane	ND	1.0	ND	0.26
75-00-3	Chloroethane	ND	1.0	ND	0.38
67-64-1	Acetone	ND	1.0	ND	0.42
75-69-4	Trichlorofluoromethane	ND	1.0	ND	0.18
75-35-4	1,1-Dichloroethene	ND	1.0	ND	0.25
75-09-2	Methylene chloride	ND	1.0	ND	0.29
76-13-1	Trichlorotrifluoroethane	ND	1.0	ND	0.13
75-15-0	Carbon Disulfide	ND	1.0	ND	0.32
156-60-5	trans-1,2-Dichloroethene	ND	1.0	ND	0.25
75-34-3	1,1-Dichloroethane	ND	1.0	ND	0.25
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	ND	0.28
108-05-4	Vinyl Acetate	ND	1.0	ND	0.28
78-93-3	2-Butanone	ND	1.0	ND	0.34
156-59-2	cis-1,2-Dichloroethene	ND	1.0	ND	0.25
67-66-3	Chloroform	ND	1.0	ND	0.21
107-06-2	1,2-Dichloroethane	ND	1.0	ND	0.25
71-55-6	1,1,1-Trichloroethane	ND	1.0	ND	0.19
71-43-2	Benzene	ND	1.0	ND	0.31
56-23-5	Carbon Tetrachloride	ND	1.0	ND	0.16

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

#17 VEC BLANK TOUR

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/24/97
Volume(s) Analyzed : 1.00 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
78-87-5	1,2-Dichloropropane	ND	1.0	ND	0.22
75-27-4	Bromodichloromethane	ND	1.0	ND	0.15
79-01-6	Trichloroethene	ND	1.0	ND	0.19
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	ND	0.22
108-10-1	4-Methyl-2-pentanone	ND	1.0	ND	0.24
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	ND	0.22
79-00-5	1,1,2-Trichloroethane	ND	1.0	ND	0.19
108-88-3	Toluene	ND	1.0	ND	0.27
591-78-6	2-Hexanone	ND	1.0	ND	0.24
124-48-1	Dibromochloromethane	ND	1.0	ND	0.12
106-93-4	1,2-Dibromoethane	ND	1.0	ND	0.13
127-18-4	Tetrachloroethene	ND	1.0	ND	0.15
108-90-7	Chlorobenzene	ND	1.0	ND	0.22
100-41-4	Ethylbenzene	ND	1.0	ND	0.23
1330-20-7	m- & p-Xylenes	ND	1.0	ND	0.23
75-25-2	Bromoform	ND	1.0	ND	0.10
100-42-5	Styrene	ND	1.0	ND	0.24
95-47-6	o-Xylene	ND	1.0	ND	0.23
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	ND	0.15
541-73-1	1,3-Dichlorobenzene	ND	1.0	ND	0.17
106-46-7	1,4-Dichlorobenzene	ND	1.0	ND	0.17
95-50-1	1,2-Dichlorobenzene	ND	1.0	ND	0.17

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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RESULTS OF ANALYSIS

#17 VOC-HAL

Client : Northeast Utilities

Client Sample ID : RAW LFG
PAI Sample ID : P9703305-004

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/25/97
Volume(s) Analyzed : 0.0050 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-71-8	Dichlorodifluoromethane	4,100	200	840	41
74-87-3	Chloromethane	ND	200	ND	98
75-01-4	Vinyl Chloride	2,000	200	800	79
74-83-9	Bromomethane	ND	200	ND	52
75-00-3	Chloroethane	2,100	200	810	76
67-64-1	Acetone	1,400	200	590	84
75-69-4	Trichlorofluoromethane	1,500	200	270	36
75-35-4	1,1-Dichloroethene	ND	200	ND	51
75-09-2	Methylene chloride	200	200	58	58
76-13-1	Trichlorotrifluoroethane	180 TR	200	23 TR	26
75-15-0	Carbon Disulfide	490	200	160	64
156-60-5	trans-1,2-Dichloroethene	ND	200	ND	51
75-34-3	1,1-Dichloroethane	280	200	69	50
1634-04-4	Methyl tert-Butyl Ether	350	200	96	56
108-05-4	Vinyl Acetate	ND	200	ND	57
78-93-3	2-Butanone	920	200	310	68
156-59-2	cis-1,2-Dichloroethene	410	200	110	51
67-66-3	Chloroform	ND	200	ND	41
107-06-2	1,2-Dichloroethane	ND	200	ND	50
71-55-6	1,1,1-Trichloroethane	110 TR	200	20 TR	37
71-43-2	Benzene	1,400	200	450	63
56-23-5	Carbon Tetrachloride	ND	200	ND	32

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

#17
VOC-HAL

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : RAW LFG
PAI Sample ID : P9703305-004

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/25/97
Volume(s) Analyzed : 0.0050 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
78-87-5	1,2-Dichloropropane	ND	200	ND	44
75-27-4	Bromodichloromethane	ND	200	ND	30
79-01-6	Trichloroethene	180 TR	200	34 TR	38
10061-01-5	cis-1,3-Dichloropropene	ND	200	ND	44
108-10-1	4-Methyl-2-pentanone	270	200	66	49
10061-02-6	trans-1,3-Dichloropropene	ND	200	ND	44
79-00-5	1,1,2-Trichloroethane	ND	200	ND	37
108-88-3	Toluene	6,000	200	1,600	53
591-78-6	2-Hexanone	ND	200	ND	49
124-48-1	Dibromochloromethane	ND	200	ND	24
106-93-4	1,2-Dibromoethane	ND	200	ND	26
127-18-4	Tetrachloroethene	340	200	51	30
108-90-7	Chlorobenzene	ND	200	ND	44
100-41-4	Ethylbenzene	2,800	200	650	46
1330-20-7	m- & p-Xylenes	7,400	200	1,700	46
75-25-2	Bromoform	ND	200	ND	20
100-42-5	Styrene	ND	200	ND	47
95-47-6	o-Xylene	970	200	220	46
79-34-5	1,1,2,2-Tetrachloroethane	ND	200	ND	29
541-73-1	1,3-Dichlorobenzene	ND	200	ND	34
106-46-7	1,4-Dichlorobenzene	ND	200	ND	34
95-50-1	1,2-Dichlorobenzene	ND	200	ND	34

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

(=17 sulfur

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : RAW LFG
PAI Sample ID : P9703305-004

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 1.0 (ml)
0.020 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	163,000	56.0	117,000	40.0
463-58-1	Carbonyl Sulfide	ND	98.0	ND	40.0
74-93-1	Methyl Mercaptan	187	79.0	95.2	40.0
75-08-1	Ethyl Mercaptan	323	100	127	40.0
75-18-3	Dimethyl Sulfide	ND	100	ND	40.0
75-15-0	Carbon Disulfide	429	62.0	138	20.0
75-33-2	Isopropyl Mercaptan	213	120	68.4	40.0
75-66-1	tert-Butyl Mercaptan	ND	150	ND	40.0
107-03-9	n-Propyl Mercaptan	ND	120	ND	40.0
624-89-5	Ethyl Methyl Sulfide	ND	120	ND	40.0
110-02-1	Thiophene	333	140	96.7	40.0
513-44-0	Isobutyl Mercaptan	ND	150	ND	40.0
352-93-2	Diethyl Sulfide	ND	150	ND	40.0
109-79-5	n-Butyl Mercaptan	ND	150	ND	40.0
624-92-0	Dimethyl Disulfide	ND	77.0	ND	20.0
616-44-4	3-Methylthiophene	ND	160	ND	40.0
110-01-0	Tetrahydrothiophene	ND	140	ND	40.0
638-02-8	2,5-Dimethylthiophene	ND	180	ND	40.0
872-55-9	2-Ethylthiophene	ND	180	ND	40.0
110-81-6	Diethyl Disulfide	ND	100	ND	20.0

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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Performance Analytical Inc.

#18
BTU

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client: **Northeast Utilites**

Client Sample ID: **GPU Inlet LFG**
PAI Samplet ID: **P9703305-005**

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Tedlar Bag

Date Sampled: 6/19/97
Date Received: 6/23/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	0.64	0.75
Nitrogen	1.36	1.40
Carbon Monoxide	< 0.01	< 0.01
Methane	58.89	34.67
Carbon Dioxide	39.09	63.14
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	0.01	0.02
TOTALS	99.99	99.98

Components	Mole %	Weight %
C	23.57	43.22
H	56.67	8.72
O	19.10	46.66
N	0.65	1.40
S	< 0.10	< 0.10

Specific Gravity (Air = 1)	0.9408
* Specific Volume, cu. ft./lb	13.93
* Gross Heating Value, BTU/cu. ft.	585.0
** Gross Heating Value, BTU/cu. ft.	597.2
** Gross Heating Value, BTU/lb.	8318.0
** Net Heating Value, BTU/cu. ft.	537.8
** Net Heating Value, BTU/lb.	7489.7
* Net Heating Value, BTU/cu. ft.	526.7
Compressibility Factor "Z" (60 F, 14.696 psig)	0.9968

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by : RC Date : 7/14/97

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Air Quality Laboratory

RESULTS OF ANALYSIS

+ sulfur

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9703305-005

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	106	10.0	41.9	4.00
75-15-0	Carbon Disulfide	217	6.20	69.6	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	79.5	14.0	23.1	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	8.86	7.70	2.30	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#16 Duplicate Sulfur

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9703305-005 (Laboratory Duplicate)

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	109	10.0	42.8	4.00
75-15-0	Carbon Disulfide	221	6.20	71.1	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	84.3	14.0	24.5	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	8.86	7.70	2.30	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

18
VOC BLANK

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/25/97
Volume(s) Analyzed : 1.00 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-71-8	Dichlorodifluoromethane	ND	1.0	ND	0.20
74-87-3	Chloromethane	ND	1.0	ND	0.49
75-01-4	Vinyl Chloride	ND	1.0	ND	0.39
74-83-9	Bromomethane	ND	1.0	ND	0.26
75-00-3	Chloroethane	ND	1.0	ND	0.38
67-64-1	Acetone	ND	1.0	ND	0.42
75-69-4	Trichlorofluoromethane	ND	1.0	ND	0.18
75-35-4	1,1-Dichloroethene	ND	1.0	ND	0.25
75-09-2	Methylene chloride	ND	1.0	ND	0.29
76-13-1	Trichlorotrifluoroethane	ND	1.0	ND	0.13
75-15-0	Carbon Disulfide	ND	1.0	ND	0.32
156-60-5	trans-1,2-Dichloroethene	ND	1.0	ND	0.25
75-34-3	1,1-Dichloroethane	ND	1.0	ND	0.25
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	ND	0.28
108-05-4	Vinyl Acetate	ND	1.0	ND	0.28
78-93-3	2-Butanone	ND	1.0	ND	0.34
156-59-2	cis-1,2-Dichloroethene	ND	1.0	ND	0.25
67-66-3	Chloroform	ND	1.0	ND	0.21
107-06-2	1,2-Dichloroethane	ND	1.0	ND	0.25
71-55-6	1,1,1-Trichloroethane	ND	1.0	ND	0.19
71-43-2	Benzene	ND	1.0	ND	0.31
56-23-5	Carbon Tetrachloride	ND	1.0	ND	0.16

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 6/25/97
Volume(s) Analyzed : 1.00 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
78-87-5	1,2-Dichloropropane	ND	1.0	ND	0.22
75-27-4	Bromodichloromethane	ND	1.0	ND	0.15
79-01-6	Trichloroethene	ND	1.0	ND	0.19
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	ND	0.22
108-10-1	4-Methyl-2-pentanone	ND	1.0	ND	0.24
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	ND	0.22
79-00-5	1,1,2-Trichloroethane	ND	1.0	ND	0.19
108-88-3	Toluene	ND	1.0	ND	0.27
591-78-6	2-Hexanone	ND	1.0	ND	0.24
124-48-1	Dibromochloromethane	ND	1.0	ND	0.12
106-93-4	1,2-Dibromoethane	ND	1.0	ND	0.13
127-18-4	Tetrachloroethene	ND	1.0	ND	0.15
108-90-7	Chlorobenzene	ND	1.0	ND	0.22
100-41-4	Ethylbenzene	ND	1.0	ND	0.23
1330-20-7	m- & p-Xylenes	ND	1.0	ND	0.23
75-25-2	Bromoform	ND	1.0	ND	0.10
100-42-5	Styrene	ND	1.0	ND	0.24
95-47-6	o-Xylene	ND	1.0	ND	0.23
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	ND	0.15
541-73-1	1,3-Dichlorobenzene	ND	1.0	ND	0.17
106-46-7	1,4-Dichlorobenzene	ND	1.0	ND	0.17
95-50-1	1,2-Dichlorobenzene	ND	1.0	ND	0.17

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#18 VOC-HAL

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9703305-005

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/26/97
Volume(s) Analyzed : 0.0050 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-71-8	Dichlorodifluoromethane	4,600	200	940	41
74-87-3	Chloromethane	ND	200	ND	98
75-01-4	Vinyl Chloride	2,400	200	960	79
74-83-9	Bromomethane	ND	200	ND	52
75-00-3	Chloroethane	ND	200	ND	76
67-64-1	Acetone	1,900	200	790	84
75-69-4	Trichlorofluoromethane	2,200	200	400	36
75-35-4	1,1-Dichloroethene	ND	200	ND	51
75-09-2	Methylene chloride	270	200	79	58
76-13-1	Trichlorotrifluoroethane	280	200	37	26
75-15-0	Carbon Disulfide	330	200	100	64
156-60-5	trans-1,2-Dichloroethene	ND	200	ND	51
75-34-3	1,1-Dichloroethane	460	200	120	50
1634-04-4	Methyl tert-Butyl Ether	1,200	200	330	56
108-05-4	Vinyl Acetate	ND	200	ND	57
78-93-3	2-Butanone	620	200	210	68
156-59-2	cis-1,2-Dichloroethene	880	200	230	51
67-66-3	Chloroform	ND	200	ND	41
107-06-2	1,2-Dichloroethane	ND	200	ND	50
71-55-6	1,1,1-Trichloroethane	250	200	47	37
71-43-2	Benzene	7,100	200	2,200	63
56-23-5	Carbon Tetrachloride	ND	200	ND	32

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

#18 VOC-HAL

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9703305-005

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/26/97
Volume(s) Analyzed : 0.0050 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
78-87-5	1,2-Dichloropropane	ND	200	ND	44
75-27-4	Bromodichloromethane	ND	200	ND	30
79-01-6	Trichloroethene	830	200	160	38
10061-01-5	cis-1,3-Dichloropropene	ND	200	ND	44
108-10-1	4-Methyl-2-pentanone	ND	200	ND	49
10061-02-6	trans-1,3-Dichloropropene	ND	200	ND	44
79-00-5	1,1,2-Trichloroethane	ND	200	ND	37
108-88-3	Toluene	2,400	200	630	53
591-78-6	2-Hexanone	ND	200	ND	49
124-48-1	Dibromochloromethane	ND	200	ND	24
106-93-4	1,2-Dibromoethane	ND	200	ND	26
127-18-4	Tetrachloroethene	500	200	74	30
108-90-7	Chlorobenzene	ND	200	ND	44
100-41-4	Ethylbenzene	ND	200	ND	46
1330-20-7	m- & p-Xylenes	ND	200	ND	46
75-25-2	Bromoform	ND	200	ND	20
100-42-5	Styrene	ND	200	ND	47
95-47-6	o-Xylene	ND	200	ND	46
79-34-5	1,1,2,2-Tetrachloroethane	ND	200	ND	29
541-73-1	1,3-Dichlorobenzene	ND	200	ND	34
106-46-7	1,4-Dichlorobenzene	ND	200	ND	34
95-50-1	1,2-Dichlorobenzene	ND	200	ND	34

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

#18 VOC-Hnl Duplica

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9703305-005 (Laboratory Duplicate)

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/26/97
Volume(s) Analyzed : 0.0050 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-71-8	Dichlorodifluoromethane	4,800	200	980	41
74-87-3	Chloromethane	ND	200	ND	98
75-01-4	Vinyl Chloride	2,500	200	990	79
74-83-9	Bromomethane	ND	200	ND	52
75-00-3	Chloroethane	ND	200	ND	76
67-64-1	Acetone	1,700	200	710	84
75-69-4	Trichlorofluoromethane	2,100	200	380	36
75-35-4	1,1-Dichloroethene	ND	200	ND	51
75-09-2	Methylene chloride	250	200	74	58
76-13-1	Trichlorotrifluoroethane	270	200	35	26
75-15-0	Carbon Disulfide	280	200	91	64
156-60-5	trans-1,2-Dichloroethene	ND	200	ND	51
75-34-3	1,1-Dichloroethane	420	200	100	50
1634-04-4	Methyl tert-Butyl Ether	1,000	200	290	56
108-05-4	Vinyl Acetate	ND	200	ND	57
78-93-3	2-Butanone	510	200	170	68
156-59-2	cis-1,2-Dichloroethene	830	200	210	51
67-66-3	Chloroform	ND	200	ND	41
107-06-2	1,2-Dichloroethane	ND	200	ND	50
71-55-6	1,1,1-Trichloroethane	240	200	45	37
71-43-2	Benzene	6,400	200	2,000	63
56-23-5	Carbon Tetrachloride	ND	200	ND	32

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

#18
VOC-HAL
Duplicate

RESULTS OF ANALYSIS

Client : Northeast Utilities

Client Sample ID : GPU Inlet LFG
PAI Sample ID : P9703305-005 (Laboratory Duplicate)

Test Code : GC/MS Mod. EPA TO-14
Analyst : Chris Parnell
Instrument : HP5972/Entech 7000
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/26/97
Volume(s) Analyzed : 0.0050 (Liter)

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
78-87-5	1,2-Dichloropropane	ND	200	ND	44
75-27-4	Bromodichloromethane	ND	200	ND	30
79-01-6	Trichloroethene	790	200	150	38
10061-01-5	cis-1,3-Dichloropropene	ND	200	ND	44
108-10-1	4-Methyl-2-pentanone	ND	200	ND	49
10061-02-6	trans-1,3-Dichloropropene	ND	200	ND	44
79-00-5	1,1,2-Trichloroethane	ND	200	ND	37
108-88-3	Toluene	2,200	200	570	53
591-78-6	2-Hexanone	ND	200	ND	49
124-48-1	Dibromochloromethane	ND	200	ND	24
106-93-4	1,2-Dibromoethane	ND	200	ND	26
127-18-4	Tetrachloroethene	440	200	65	30
108-90-7	Chlorobenzene	ND	200	ND	44
100-41-4	Ethylbenzene	ND	200	ND	46
1330-20-7	m- & p-Xylenes	ND	200	ND	46
75-25-2	Bromoform	ND	200	ND	20
100-42-5	Styrene	ND	200	ND	47
95-47-6	o-Xylene	ND	200	ND	46
79-34-5	1,1,2,2-Tetrachloroethane	ND	200	ND	29
541-73-1	1,3-Dichlorobenzene	ND	200	ND	34
106-46-7	1,4-Dichlorobenzene	ND	200	ND	34
95-50-1	1,2-Dichlorobenzene	ND	200	ND	34

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/17/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

± 19 sulfur

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107
PAI Sample ID : P9703305-006

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Tedlar Bag

Date Sampled : 6/19/97
Date Received : 6/23/97
Date Analyzed : 6/23/97
Volume(s) Analyzed : 10.0 (ml)

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	42.6	6.20	13.7	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/14/97

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#20,21

Performance Analytical Inc.
Air Quality Laboratory

LABORATORY REPORT

Client:	NORTHEAST UTILITIES SYSTEM	Date of Report:	07/30/97
Address:	74 Lathrop Road	Date Received:	07/11/97
	Uncasville, CT 06382	PAI Project No:	P9703442
Contact:	Mr. Walter Hall	Purchase Order:	02030899

Client Project ID: CL&P - Groton Fuel Cell

Two (2) Stainless Steel Summa Canisters labeled:

"DAB104/CAB106-Hi Temp" and "DAB105/CAB107-Hi Temp"
Sample @ 48,600 cts. → Sample @ 600 cts.

The samples were received at the laboratory under chain of custody on July 11, 1997. The samples were received intact. The dates of analyses are indicated on the attached data sheets.

BTU and CHONS Analysis

The results for BTU and CHONS were determined according to ASTM Method D3588-91. The following analyses were performed and used to calculated the BTU and CHONS results.

C2 through C6 Hydrocarbon Analysis

One of the samples was analyzed for C_2 through $>C_6$ hydrocarbons by direct injection GC/FID according to EPA Method 18. The analytical system consisted of a Hewlett-Packard model 5890A gas chromatograph equipped with a flame ionization detector.

Data Release Authorization:

J. Dan Taliaferro
Analytical Chemist

Reviewed and Approved:

Michael Tuday
Laboratory Director

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Performance Analytical Inc.
Air Quality Laboratory

#20, #21

Fixed Gases Analysis

The same sample was also analyzed for fixed gases (Hydrogen, Oxygen, Nitrogen, Carbon monoxide, Methane and Carbon dioxide) using a Hewlett Packard Model 5890 gas chromatograph equipped with a thermal conductivity detector (TCD).

Sulfur Analysis

Both of the samples were analyzed for twenty Sulfur compounds by gas chromatography/flame photometric detection (FPD). The analytical system used was comprised of a Hewlett Packard Model 5890 equipped with a flame photometric detector (FPD).

Volatile Organic Compounds Analysis

Both samples were also analyzed by combined gas chromatography/mass spectrometry (GC/MS) for volatile organic compounds. The analyses were performed according to the methodology outlined in EPA Method TO-14 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600/4-84-041, U.S. Environmental Protection Agency, Research Triangle Park, NC, April, 1984 and May, 1988. The method was modified for using Tedlar bags. The analyses were performed by gas chromatography/mass spectrometry, utilizing a direct cryogenic trapping technique. The analytical system used was comprised of a Hewlett Packard Model 5973 GC/MS/DS interfaced to a Tekmar AUTOCan Elite automated whole air inlet system/cryogenic concentrator. A 100% Dimethylpolysiloxane capillary column (RT_x-1, Restek Corporation, Bellefonte, PA) was used to achieve chromatographic separation.

The results of analyses are given on the attached data sheets.

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Performance Analytical Inc.
Air Quality Laboratory

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Fax 818 709-2915

Chain of Custody Record
Analytical Services Request

Client/Project Name	Address/Phone	ANALYSES	PAI Project No.
Northeast Utilities / CL&P	Attn: C. Trippel Northeast Utilities (860) 665-3467 P.O. Box 270 Hartford, CT 06141-0270		P9703442
Project Location: Groton Fuel Cell - Groton CT	Client Project No.		
Contact: C. Trippel (860) 665-3467 W. Hall (860) 848-6027	Sampler (Signature): Jean Martinez	P.O. No. 02030899	

Sample Identification No.	Date	Time	Lab Sample No.	Type of Sample	EPA Method 16 Sulfur Compound Analysis	TO-14 Analysis	Btu Content ASTM D3588-91				Expected Turnaround Time	Remarks	
(20) DAB104/CAB106-HiTemp	7/9/97	1330	-001	LandfillGas	1	1					10 Bus. Days	Summa Canister	15
(21) DAB105/CAB107-HiTemp	7/9/97	1415	-002	"	1	1	1				10 Bus Days	Summa Canister	16

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Jean Martinez	7-9-97	1443	Kolur D H	7/11/97	9:00 AM
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Disposal Method

Disposed by: (Signature) | Date | Time

White Copy : Accompanies Samples

Yellow Copy : Sampler

#20
#21

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

#20,21 Sulfur Blank

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 7/14/97
Volume(s) Analyzed : 10.0 (ml)

Pi = 0.0 Pf = 0.0 D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	ND	9.80	ND	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : PG

Date : 7/30/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 2

#20-21
VOC-HAL
BLANK

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code : GC/MS EPA TO-14
Analyst : Chris Parnell
Instrument : HP5973/Tekmar AUTOcan Elite
Matrix : Summa Canister

Date Sampled : N/A
Date Received : N/A
Date Analyzed : 7/28/97
Volume(s) Analyzed : 1.00 (Liter)

Pi 1 = 0.0 Pf 1 = 0.0

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
74-87-3	Chloromethane	ND	1.0	ND	0.49
75-01-4	Vinyl Chloride	ND	1.0	ND	0.39
74-83-9	Bromomethane	ND	1.0	ND	0.26
75-00-3	Chloroethane	ND	1.0	ND	0.38
67-64-1	Acetone	ND	1.0	ND	0.42
75-69-4	Trichlorofluoromethane	ND	1.0	ND	0.18
75-35-4	1,1-Dichloroethene	ND	1.0	ND	0.25
75-09-2	Methylene chloride	ND	1.0	ND	0.29
76-13-1	Trichlorotrifluoroethane	ND	1.0	ND	0.13
75-15-0	Carbon Disulfide	ND	1.0	ND	0.32
156-60-5	trans-1,2-Dichloroethene	ND	1.0	ND	0.25
75-34-3	1,1-Dichloroethane	ND	1.0	ND	0.25
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	ND	0.28
108-05-4	Vinyl Acetate	ND	1.0	ND	0.28
78-93-3	2-Butanone	ND	1.0	ND	0.34
156-59-2	cis-1,2-Dichloroethene	ND	1.0	ND	0.25
67-66-3	Chloroform	ND	1.0	ND	0.21
107-06-2	1,2-Dichloroethane	ND	1.0	ND	0.25
71-55-6	1,1,1-Trichloroethane	ND	1.0	ND	0.19
71-43-2	Benzene	ND	1.0	ND	0.31
56-23-5	Carbon Tetrachloride	ND	1.0	ND	0.16
78-87-5	1,2-Dichloropropane	ND	1.0	ND	0.22

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/30/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 2 OF 2

#20, 21 VOC-HAL BLANK

Client : Northeast Utilities

Client Sample ID : N/A
PAI Sample ID : PAI Method Blank

Test Code :	GC/MS EPA TO-14	Date Sampled :	N/A
Analyst :	Chris Parnell	Date Received :	N/A
Instrument :	HP5973/Tekmar AUTOcan Elite	Date Analyzed :	7/28/97
Matrix :	Summa Canister	Volume(s) Analyzed :	1.00 (Liter)

Pi 1 = 0.0 Pf 1 = 0.0

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	1.0	ND	0.15
79-01-6	Trichloroethene	ND	1.0	ND	0.19
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	ND	0.22
108-10-1	4-Methyl-2-pentanone	ND	1.0	ND	0.24
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	ND	0.22
79-00-5	1,1,2-Trichloroethane	ND	1.0	ND	0.19
108-88-3	Toluene	ND	1.0	ND	0.27
591-78-6	2-Hexanone	ND	1.0	ND	0.24
124-48-1	Dibromochloromethane	ND	1.0	ND	0.12
106-93-4	1,2-Dibromoethane	ND	1.0	ND	0.13
127-18-4	Tetrachloroethene	ND	1.0	ND	0.15
108-90-7	Chlorobenzene	ND	1.0	ND	0.22
100-41-4	Ethylbenzene	ND	1.0	ND	0.23
1330-20-7	m- & p-Xylenes	ND	1.0	ND	0.23
75-25-2	Bromoform	ND	1.0	ND	0.10
100-42-5	Styrene	ND	1.0	ND	0.24
95-47-6	o-Xylene	ND	1.0	ND	0.23
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	ND	0.15
541-73-1	1,3-Dichlorobenzene	ND	1.0	ND	0.17
106-46-7	1,4-Dichlorobenzene	ND	1.0	ND	0.17
95-50-1	1,2-Dichlorobenzene	ND	1.0	ND	0.17

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/30/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

#20 Sulfur

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106 - Hi Temp
PAI Sample ID : P9703442-001

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 7/9/97
Date Received : 7/11/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 10.0 (ml)

Pi = 0.0 Pf = 3.0 D.F.= 1.20

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00
463-58-1	Carbonyl Sulfide	25.3	9.80	10.3	4.00
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00
110-02-1	Thiophene	ND	14.0	ND	4.00
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/30/97

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Air Quality Laboratory

RESULTS OF ANALYSIS

#20 VOC - Hot

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106 - Hi Temp
PAI Sample ID : P9703442-001

Test Code : GC/MS EPA TO-14
Analyst : Chris Parnell
Instrument : HP5973/Tekmar AUTOcan Elite
Matrix : Summa Canister

Date Sampled : 7/9/97
Date Received : 7/11/97
Date Analyzed : 7/28/97
Volume(s) Analyzed : 1.00 (Liter)

Pi 1 = 0.0 Pf 1 = 3.0
D.F. = 1.20

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	25	1.0	12	0.49	
75-01-4	Vinyl Chloride	ND	1.0	ND	0.39	✓
74-83-9	Bromomethane	1.7	1.0	0.44	0.26	
75-00-3	Chloroethane	ND	1.0	ND	0.38	
67-64-1	Acetone	1.9	1.0	0.78	0.42	
75-69-4	Trichlorofluoromethane	ND	1.0	ND	0.18	
75-35-4	1,1-Dichloroethene	ND	1.0	ND	0.25	
75-09-2	Methylene chloride	ND	1.0	ND	0.29	✓
76-13-1	Trichlorotrifluoroethane	ND	1.0	ND	0.13	
75-15-0	Carbon Disulfide	ND	1.0	ND	0.32	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	ND	0.25	
75-34-3	1,1-Dichloroethane	ND	1.0	ND	0.25	✓
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	ND	0.28	
108-05-4	Vinyl Acetate	ND	1.0	ND	0.28	
78-93-3	2-Butanone	ND	1.0	ND	0.34	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	ND	0.25	
67-66-3	Chloroform	ND	1.0	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	1.0	ND	0.25	
71-55-6	1,1,1-Trichloroethane	ND	1.0	ND	0.19	
71-43-2	Benzene	ND	1.0	ND	0.31	✓
56-23-5	Carbon Tetrachloride	ND	1.0	ND	0.16	
78-87-5	1,2-Dichloropropane	ND	1.0	ND	0.22	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/30/97

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Air Quality Laboratory

RESULTS OF ANALYSIS

#20 VOC-HAL

Client : Northeast Utilities

Client Sample ID : DAB 104 / CAB 106 - Hi Temp
PAI Sample ID : P9703442-001

Test Code : GC/MS EPA TO-14
Analyst : Chris Parnell
Instrument : HP5973/Tekmar AUTOcan Elite
Matrix : Summa Canister

Date Sampled : 7/9/97
Date Received : 7/11/97
Date Analyzed : 7/28/97
Volume(s) Analyzed : 1.00 (Liter)

Pi 1 = 0.0 Pf 1 = 3.0
D.F. = 1.20

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
75-27-4	Bromodichloromethane	ND	1.0	ND	0.15	
79-01-6	Trichloroethene	ND	1.0	ND	0.19	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	ND	0.22	
108-10-1	4-Methyl-2-pentanone	ND	1.0	ND	0.24	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	ND	0.22	
79-00-5	1,1,2-Trichloroethane	ND	1.0	ND	0.19	
108-88-3	Toluene	ND	1.0	ND	0.27	
591-78-6	2-Hexanone	ND	1.0	ND	0.24	
124-48-1	Dibromochloromethane	ND	1.0	ND	0.12	
106-93-4	1,2-Dibromoethane	ND	1.0	ND	0.13	
127-18-4	Tetrachloroethene	ND	1.0	ND	0.15	
108-90-7	Chlorobenzene	ND	1.0	ND	0.22	✓
100-41-4	Ethylbenzene	ND	1.0	ND	0.23	✓
1330-20-7	m- & p-Xylenes	0.70 TR	1.0	0.16 TR	0.23	
75-25-2	Bromoform	ND	1.0	ND	0.10	
100-42-5	Styrene	ND	1.0	ND	0.24	
95-47-6	o-Xylene	ND	1.0	ND	0.23	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	ND	0.15	
541-73-1	1,3-Dichlorobenzene	ND	1.0	ND	0.17	
106-46-7	1,4-Dichlorobenzene	ND	1.0	ND	0.17	
95-50-1	1,2-Dichlorobenzene	ND	1.0	ND	0.17	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/30/97

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Performance Analytical Inc.
Air Quality Laboratory

#21
BTU

RESULTS OF ANALYSIS
PAGE 1 OF 1

Client: Northeast Utilities

Client Sample ID: DAB 105 / CAB 107 - Hi Temp
PAI Samplet ID: P9703442-002

Test Code: ASTM D3588-91
Analyst: J. Dan Taliaferro
Matrix: Summa Canister

Date Sampled: 7/9/97
Date Received: 7/11/97

Components	Volume %	Weight %
Hydrogen	< 0.01	< 0.01
Oxygen	0.42	0.48
Nitrogen	1.42	1.44
Carbon Monoxide	< 0.01	< 0.01
Methane	57.97	33.79
Carbon Dioxide	40.19	64.28
Hydrogen Sulfide	< 0.01	< 0.01
Ethane	< 0.01	< 0.01
Propane	< 0.01	< 0.01
Butanes	< 0.01	< 0.01
Pentanes	< 0.01	< 0.01
Hexanes	< 0.01	< 0.01
> Hexanes	< 0.01	< 0.01
TOTALS	100.00	99.99

Components	Mole %	Weight %
C	23.71	42.85
H	56.00	8.49
O	19.61	47.22
N	0.68	1.44
S	< 0.10	< 0.10

	Specific Gravity (Air = 1)	0.9501
*	Specific Volume, cu. ft./lb	13.79
*	Gross Heating Value, BTU/cu. ft.	575.3
**	Gross Heating Value, BTU/cu. ft.	587.4
**	Gross Heating Value, BTU/lb.	8099.9
**	Net Heating Value, BTU/cu. ft.	528.9
**	Net Heating Value, BTU/lb.	7293.1
*	Net Heating Value, BTU/cu. ft.	518.0
	Compressibility Factor "Z" (60 F, 14.696 psig)	0.9968

* = Water Saturated at 0.25636 psig
** = Dry Gas @ 60 F, 14.696 psig

Verified by: RG Date: 7/30/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 1

#21 Sulfur

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107 - Hi Temp
PAI Sample ID : P9703442-002

Test Code : Mod. EPA Method 15/16
Analyst : Wade Henton
Instrument : HP5890A/FPD #4
Matrix : Summa Canister

Date Sampled : 7/9/97
Date Received : 7/11/97
Date Analyzed : 7/14/97
Volume(s) Analyzed : 10.0 (ml)

Pi = 10.6 Pf = 10.6 D.F.= 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
7783-06-4	Hydrogen Sulfide	ND	5.60	ND	4.00	X
463-58-1	Carbonyl Sulfide	19.6	9.80	8.00	4.00	✓
74-93-1	Methyl Mercaptan	ND	7.90	ND	4.00	✓
75-08-1	Ethyl Mercaptan	ND	10.0	ND	4.00	✓
75-18-3	Dimethyl Sulfide	ND	10.0	ND	4.00	✓
75-15-0	Carbon Disulfide	ND	6.20	ND	2.00	✓
75-33-2	Isopropyl Mercaptan	ND	12.0	ND	4.00	
75-66-1	tert-Butyl Mercaptan	ND	15.0	ND	4.00	
107-03-9	n-Propyl Mercaptan	ND	12.0	ND	4.00	
624-89-5	Ethyl Methyl Sulfide	ND	12.0	ND	4.00	
110-02-1	Thiophene	ND	14.0	ND	4.00	
513-44-0	Isobutyl Mercaptan	ND	15.0	ND	4.00	
352-93-2	Diethyl Sulfide	ND	15.0	ND	4.00	
109-79-5	n-Butyl Mercaptan	ND	15.0	ND	4.00	
624-92-0	Dimethyl Disulfide	ND	7.70	ND	2.00	✓
616-44-4	3-Methylthiophene	ND	16.0	ND	4.00	
110-01-0	Tetrahydrothiophene	ND	14.0	ND	4.00	
638-02-8	2,5-Dimethylthiophene	ND	18.0	ND	4.00	
872-55-9	2-Ethylthiophene	ND	18.0	ND	4.00	
110-81-6	Diethyl Disulfide	ND	10.0	ND	2.00	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/30/97

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Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

PAGE 1 OF 2

#21 VOC-HAL

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107 - Hi Temp
PAI Sample ID : P9703442-002

Test Code :	GC/MS EPA TO-14	Date Sampled :	7/9/97
Analyst :	Chris Parnell	Date Received :	7/11/97
Instrument :	HP5973/Tekmar AUTOcan Elite	Date Analyzed :	7/28/97
Matrix :	Summa Canister	Volume(s) Analyzed :	1.00 (Liter)

Pi 1 = 10.6 Pf 1 = 10.6

D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb	
74-87-3	Chloromethane	26	1.0	13	0.49	✓✓
75-01-4	Vinyl Chloride	5.5	1.0	2.2	0.39	✓
74-83-9	Bromomethane	1.8	1.0	0.46	0.26	✓✓
75-00-3	Chloroethane	4.3	1.0	1.6	0.38	✓
67-64-1	Acetone	2.1	1.0	0.88	0.42	
75-69-4	Trichlorofluoromethane	1.9	1.0	0.33	0.18	✓
75-35-4	1,1-Dichloroethene	ND	1.0	ND	0.25	
75-09-2	Methylene chloride	0.88 TR	1.0	0.26 TR	0.29	✓
76-13-1	Trichlorotrifluoroethane	ND	1.0	ND	0.13	
75-15-0	Carbon Disulfide	ND	1.0	ND	0.32	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	ND	0.25	
75-34-3	1,1-Dichloroethane	ND	1.0	ND	0.25	✓
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	ND	0.28	
108-05-4	Vinyl Acetate	ND	1.0	ND	0.28	
78-93-3	2-Butanone	ND	1.0	ND	0.34	
156-59-2	cis-1,2-Dichloroethene	0.59 TR	1.0	0.15 TR	0.25	✓
67-66-3	Chloroform	ND	1.0	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	1.0	ND	0.25	
71-55-6	1,1,1-Trichloroethane	ND	1.0	ND	0.19	
71-43-2	Benzene	1.3	1.0	0.42	0.31	✓
56-23-5	Carbon Tetrachloride	ND	1.0	ND	0.16	
78-87-5	1,2-Dichloropropane	ND	1.0	ND	0.22	

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RC

Date : 7/30/97

Performance Analytical Inc.
Air Quality Laboratory

RESULTS OF ANALYSIS

#21 VOC-HAL

Client : Northeast Utilities

Client Sample ID : DAB 105 / CAB 107 - Hi Temp
PAI Sample ID : P9703442-002

Test Code : GC/MS EPA TO-14
Analyst : Chris Parnell
Instrument : HP5973/Tekmar AUTOcan Elite
Matrix : Summa Canister

Date Sampled : 7/9/97
Date Received : 7/11/97
Date Analyzed : 7/28/97
Volume(s) Analyzed : 1.00 (Liter)

Pi 1 = 10.6 Pf 1 = 10.6
D.F. = 1.00

CAS #	COMPOUND	RESULT ug/m3	REPORTING LIMIT ug/m3	RESULT ppb	REPORTING LIMIT ppb
75-27-4	Bromodichloromethane	ND	1.0	ND	0.15
79-01-6	Trichloroethene	ND	1.0	ND	0.19
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	ND	0.22
108-10-1	4-Methyl-2-pentanone	ND	1.0	ND	0.24
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	ND	0.22
79-00-5	1,1,2-Trichloroethane	ND	1.0	ND	0.19
108-88-3	Toluene	1.5	1.0	0.39	0.27
591-78-6	2-Hexanone	ND	1.0	ND	0.24
124-48-1	Dibromochloromethane	ND	1.0	ND	0.12
106-93-4	1,2-Dibromoethane	ND	1.0	ND	0.13
127-18-4	Tetrachloroethene	ND	1.0	ND	0.15
108-90-7	Chlorobenzene	ND	1.0	ND	0.22
100-41-4	Ethylbenzene	ND	1.0	ND	0.23
1330-20-7	m- & p-Xylenes	ND	1.0	ND	0.23
75-25-2	Bromoform	ND	1.0	ND	0.10
100-42-5	Styrene	ND	1.0	ND	0.24
95-47-6	o-Xylene	ND	1.0	ND	0.23
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	ND	0.15
541-73-1	1,3-Dichlorobenzene	ND	1.0	ND	0.17
106-46-7	1,4-Dichlorobenzene	ND	1.0	ND	0.17
95-50-1	1,2-Dichlorobenzene	ND	1.0	ND	0.17

TR = Detected Below Indicated Reporting Limit
ND = Not Detected

Verified by : RG

Date : 7/30/97

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TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

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Testing of Fuel Cells to Recover Energy from Landfill Gas, Groton Landfill	September 1998
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J. L. Preston and J. C. Trocciola	FCR-14749A
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International Fuel Cells Corporation 195 Governors Highway South Windsor, Connecticut 06074	11. CONTRACT/GRANT NO. 68-D1-0008
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15. SUPPLEMENTARY NOTES APPCD project officer is Ronald J. Spiegel, Mail Drop 63, 919/541-7542.

16. ABSTRACT The report summarizes the results of follow-on tests, following a four-phase EPA program. The environmental impact of widespread use of this concept would be a significant reduction of global warming gas emissions (methane and carbon dioxide). The follow-on testing, conducted by Northeast Utilities at the Groton, CT, landfill, indicated the suitability of the landfill-gas-to-energy conversion equipment to operate on a wide range of landfill gas compositions. Significant test results include successful transportability of the landfill-gas-to-energy equipment, and operation of the gas pretreatment unit (GPU) for an additional 4168 hours (total of 6413 hours) while continuing to remove halides and sulfur compounds to much less than the specified < 3 ppmV. The fuel cell operated for an additional 3313 hours (total of 4020 hours), and reflected 38.1% efficiency at 140 kW with a maximum output of 155 kW. Fuel cell adjusted availability was 96.5%, with one forced outage in the entire 4020 hours of operation on landfill gas. International Fuel Cells Corporation conducted the original four-phase program to show that fuel cell energy recovery using a commercial phosphoric acid fuel cell is both environmentally sound and commercially feasible. The original program was conducted at the Penrose landfill in Sun Valley, CA.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Pollution	Greenhouse Effect	Pollution Control	13B	04A
Earth Fills	Methane	Stationary Sources	13C	07C
Gases	Carbon Dioxide	Global Warming	07D	
Fuel Cells			10B	
Phosphoric Acids			07B	
Energy			14G	

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