RESULTS OF THE AUGUST 2011 EMISSIONS TESTING OF THE CONDENSER

3V, Inc. Corporation
Georgetown, South Carolina

1.0 INTRODUCTION

GEL Engineering, LLC (GEL) performed emissions testing of the Condenser located at the 3V, Inc. Corporation (3V, Inc.) facility in Georgetown, South Carolina on August 16-17, 2011. These tests were necessary to demonstrate compliance condition 12.1 of Construction Permit 1140-0031-FJ issued by the South Carolina Department of Environmental Control (DHEC).

The testing was performed in accordance with the approved Site-Specific Test Plan (SSTP) that 3V, Inc. submitted to DHEC on June 22, 2011. Test parameters and sampling methods for the test program are summarized in Table 1. Kirk Alexander and Sean Huber of GEL performed the testing. John Schroer of 3V, Inc. was the company representative.

2.0 PROCESS DESCRIPTION AND OPERATION

The 3V, Inc. Condenser is a pair of cryogenic condensation units. The condensation units act in tandem so that while one is defrosting, the other one can operate normally. The Condenser removes methylene chloride emissions from multiple batch processes. The Condenser was operating normally during testing. Process rates and the Condenser operating conditions are included in Appendix III.

3.0 SUMMARY OF TEST RESULTS

Three test runs measuring methylene chloride on the inlet and the exhaust of the Condenser were conducted on August 16-17, 2011. The test results obtained for this sampling program, including the removal efficiency (RE), are summarized in Tables 2-4.

To comply with condition 12.1 of Construction Permit 1140-0031-FJ, the emissions from the process must be less than 10,000 pounds per year. The average exhaust emission rate for the three test runs was 0.124 pounds per hour (lbs/hr). This would yield an annual emission rate of 1,086 pounds based on 24-hour a day operation. The average RE of the Condenser during testing was 99.99 percent.

Based on these results, the Condenser at 3V, Inc. is operating in compliance with the emission requirements set forth in the Construction Permit.

The summary of test results, test method equations and nomenclature, process/production data, field data, instrument analyzer calibration data, instrument analyzer tabulated data, and protocol gas certificates of analysis are presented in Appendices I through VI, respectively.

4.0 SAMPLING METHODS AND ANALYTICAL PROCEDURES

Sampling and analytical procedures recommended by the United States Environmental Protection Agency (EPA) were used for the stack testing portion of this evaluation. The sampling and analytical procedures that were used are described below.

4.1 Stack Sampling Locations

EPA Method 1A was employed to determine the number and location of the sampling points used for velocity measurements during the test program. Two sample ports located 90 degrees apart were located eight duct diameters downstream of the test port for the EPA Method 25A probe on the exhaust duct. As specified by Method 1A, the appropriate number of traverse points were selected to accurately characterize the stack gas velocity. Four traverse points along each of the two traverse lines were selected for the 6-inch diameter exhaust.

4.2 Velocity and Volumetric Flow Rates

EPA Method 2C was used to determine the stack gas velocity and volumetric flow rate of the exhaust of the Condenser. Velocity measurements were performed every ten minutes during each run. As specified by Method 2C, the calculated mean of the velocity measurements was used to calculate the volumetric flow rate. The Condenser inlet gas volumetric flow was assumed to be equal to that of the exhaust plus the addition of the methylene chloride that was present in the inlet stream. Therefore, the inlet flow volume was calculated as follows:

$$Vm_i = Vm_o(100 - MeCl_{out})/(100 - MeCl_{in})$$

where: Vm_i = volume of gas of the inlet
Vm_o = volume of gas of the outlet
$MeCl_{in}$ = methylene chloride concentration of the inlet, percent.
$MeCl_{out}$ = methylene chloride concentration of the outlet, percent.

The gas stream fed to the Condenser is primarily composed of nitrogen; therefore a dry molecular weight of 28.0 was used for the outlet flow calculations. Temperatures of

the exhaust gas stream ranged from 32 to 52 degrees Fahrenheit. Maximum moisture concentrations ranged from 0.6 to 1.1 percent, assuming saturated conditions.

4.3 Methylene Chloride Emissions

Three one-hour test runs were conducted on the outlet of the Condenser using EPA Method 25A. The inlet and exhaust concentrations of total hydrocarbons were measured using two JUM VE7 heated total hydrocarbon analyzers equipped with flame ionization detectors (FID). A dilution probe was utilized for the inlet sampling. The dilution probe incorporates an interchangeable critical orifice which is aspirated with ultra high purity air. The dilution rate for the inlet sampling was maintained at 40x ratio. The tabulated results have the dilution factor incorporated into them. A response factor for methylene chloride was established by analyzing a standard of methylene chloride mixed in a Tedlar bag filled with 10 liters of high purity nitrogen. The response of the methylene chloride was found to be 2.68 times less than that of propane for the inlet analyzer and 2.72 times less than that of propane for the exhaust analyzer.

Method 25A calibration gases were generated using an Environics Gas Dilution System in accordance with EPA Method 205 using EPA protocol propane calibration gases. The THC calibration data and tabulated data are included in Appendices IV and V, respectively.

TABLE 1

STATIONARY SOURCE TEST LOG
Condenser

3V, Inc.
Georgetown, South Carolina

Parameter	Duration	EPA Methods	Dates
Gas Flow Rates and Temperature	18 runs	1 & 2	8/(16-17)/11
Total Hydrocarbons (Methylene Chloride)	3 runs	25A	8/(16-17)/11

TABLE 2

FLOW SUMMARY
Condenser

3V, Inc.
Georgetown, South Carolina

Parameter	Units	Run Number 1	2	3	Average
Exhaust	dscf/min	232	225	182	213
Exhaust	acf/min	218	214	175	202
Inlet*	dscf/min	323	335	265	308
Inlet*	acf/min	305	317	255	292

Notes:

dscf/min = dry standard cubic feet per minute

acf/min = actual wet cubic feet per minute

* inlet flow calculated based on exhaust flows plus inlet methylene chloride concentrations

TABLE 3

CONCENTRATION SUMMARY
Condenser

3V, Inc.
Georgetown, South Carolina

Parameter	Units	Run Number 1	2	3	Average
Methylene Chloride (Exhaust)	ppm	43.4	59.5	34.3	45.7
Methylene Chloride (Inlet)	ppm	285,151	327,283	312,784	308,406

Notes:
ppm = parts per million by volume

TABLE 4

EMISSIONS SUMMARY
Condenser

3V, Inc.
Georgetown, South Carolina

Parameter	Units	Run Number 1	2	3	Average
Methylene Chloride (Exhaust)	lbs/hr	0.125	0.168	0.080	0.124
Methylene Chloride (Inlet)	lbs/hr	1,150	1,371	1,055	1,192
Methylene Chloride RE	percent	99.989	99.988	99.992	99.990

Notes:
lbs/hrs = pounds per hour
lbs/ton = pounds per ton
RE = recovery/ removal efficiency

APPENDIX I

SUMMARY OF TEST RESULTS

SUMMARY OF TEST RESULTS

VOC (Methylene Chloride)
Condenser Exhaust
[Raw Data]

3V Inc.
Georgetown, South Carolina

		Run 1	Run 2	Run 3	Mean
Date	Date of Test	8/16/2011	8/16/2011	8/17/2011	
Start	Start Time	11:42 AM	1:00 PM	9:48 AM	-
Stop	Stop Time	12:42 PM	2:00 PM	10:48 AM	-
θ	Total Sampling Time	60.0	60.0	60.0	60.00
Pbar	Barometric Pressure, in. Hg	29.92	29.95	29.94	29.94
Ds(w)	Stack Diameter (width), inches	6.00	6.00	6.00	6.00
Ds(d)	Stack Diameter (Depth), inches	0.00	0.00	0.00	0.00
Δp	Average Velocity Head of Stack Gas, in. H2O	0.082	0.078	0.051	0.070
√Δp	Average Squareroot Velocity Head of Stack Gas, in. H2O	0.279	0.272	0.221	0.257
Ts	Absolute Stack Temperature, °F	35.2	41.6	48.2	41.7
Pg	Stack Static Pressure, in. H2O	0.02	0.02	0.02	0.02
Cp	Pitot Coefficient	0.99	0.99	0.99	0.99
Tstd	Standard Temperature, °R	528	528	528	528
Pstd	Standard Pressure, in. Hg	29.92	29.92	29.92	29.92
Mn(VOC)	VOC Concentration, ppm (as propane)	15.9	21.9	12.6	16.8
Mn(CH_2Cl_2)	VOC Concentration, ppm (as methylene chloride)	43.4	59.5	34.3	45.7
Mw(CH_2Cl_2)	Molecular Weight of Methylene Chloride, gram/gram-mole	84.9	84.9	84.9	84.9

SUMMARY OF TEST RESULTS
VOC (Methylene Chloride)
Condenser Exhaust
[Calculations]

3V Inc.
Georgetown, South Carolina

		Run 1	Run 2	Run 3	Mean
As	Cross Sectional Area of Stack, square feet	0.20	0.20	0.20	0.20
An	Cross Sectional Area of Nozzle, square feet	0.00034	0.00034	0.00034	0.00034
Ts	Absolute Stack Temperature, °R	495	502	508	502
Bws	Water Vapor in the Gas Stream, proportion by volume*	0.000	0.000	0.000	0.000
Md	Molecular Weight of Stack Gas, Dry Basis, lb/lb-mole	28.00	28.00	28.00	28.00
Ms	Molecular Weight of Stack Gas, Wet Basis, lb/lb-mole	28.00	28.00	28.00	28.00
Ps	Absolute Stack Gas Pressure, in. Hg	29.92	29.95	29.94	29.94
Vs	Average Stack Gas Velocity, ft/sec	18.14	17.80	14.55	16.83
Qa	Wet Volumetric Stack Gas Flow Rate at Actual Conditions, acf/hr	13,100	12,800	10,500	12,100
Qa	Wet Volumetric Stack Gas Flow Rate at Actual Conditions, acf/min	218	214	175	202
Qs	Wet Volumetric Stack Gas Flow Rate corrected to Standard Conditions, wscf/hr	13,900	13,500	10,900	12,800
Qs	Wet Volumetric Stack Gas Flow Rate corrected to Standard Conditions, wscf/min	232	225	182	213

* assumed zero percent moisture content based on condenser temperature of negative 170+ °F

SUMMARY OF TEST RESULTS
VOC (Methylene Chloride)
Condenser Exhaust
[Concentration and Emissions Data]

3V Inc.
Georgetown, South Carolina

		Run 1	Run 2	Run 3	Mean
Mp(CH_2Cl_2)	**Methylene Chloride Concentration, ppmv (wet basis)**	**43.4**	**59.5**	**34.3**	**45.7**
Mp(CH_2Cl_2)	**Methylene Chloride Emissions Rate, lbs/hr**	**0.125**	**0.168**	**0.080**	**0.124**
RE	**Condenser Recovery Efficiency, percent**	**99.989**	**99.988**	**99.992**	**99.990**

SUMMARY OF TEST RESULTS
VOC (Methylene Chloride)
Condenser Inlet
[Raw Data]

3V Inc.
Georgetown, South Carolina

		Run 1	Run 2	Run 3	Mean
Date	Date of Test	8/16/2011	8/16/2011	8/17/2011	
Start	Start Time	11:42 AM	1:00 PM	9:48 AM	-
Stop	Stop Time	12:42 PM	2:00 PM	10:48 AM	-
θ	Total Sampling Time	60.0	60.0	60.0	60.00
Mn(VOC)	VOC Concentration, ppm (as propane)	106,399	122,121	116,710	115,077
Mn(CH_2Cl_2)	VOC Concentration, ppm (as methylene chloride)	285,151	327,283	312,784	308,406
MW(CH_2Cl_2)	Molecular Weight of Methylene Chloride, gram/gram-mole	84.9	84.9	84.9	84.9

SUMMARY OF TEST RESULTS
VOC (Methylene Chloride)
Condenser Inlet
[Calculated Flow Rates]

3V Inc.
Georgetown, South Carolina

		Run 1	Run 2	Run 3	Mean
Qa	Wet Volumetric Stack Gas Flow Rate at Actual Conditions, acf/hr	18,300	19,000	15,300	17,500
Qa	Wet Volumetric Stack Gas Flow Rate at Actual Conditions, acf/min	305	317	255	292
Qs	Dry Volumetric Stack Gas Flow Rate corrected to Standard Conditions, dscf/hr	19,400	20,100	15,900	18,500
Qs	Dry Volumetric Stack Gas Flow Rate corrected to Standard Conditions, dscf/min	323	335	265	308

Note: Inlet flows calculated based on exhaust flow plus the additional gas volume of methylene chloride present in the inlet gas stream

SUMMARY OF TEST RESULTS
VOC (Methylene Chloride)
Condenser Inlet
[Concentration and Emissions Data]

3V Inc.
Georgetown, South Carolina

		Run 1	Run 2	Run 3	Mean
Mp(CH_2Cl_2)	Methylene Chloride Concentration, ppmv (wet basis)	285,151	327,283	312,784	308,406
Mp(CH_2Cl_2)	Methylene Chloride Emissions Rate, lbs/hr	1,150	1,371	1,055	1,192