# Executive Summary

Dow Silicones Corporation, a subsidiary of Dow, operates a chemical manufacturing facility in Midland, Michigan. EU604-08 is a Fluoro Cyclics Process. This emission unit is subject to the requirements of 40 CFR Part 63, Subpart FFFF. Within 360 days of permit reissuance (February 20, 2019), VOC and hydrogen chloride (HCl) emissions must be verified.

The compliance test measuring emissions of VOC and HCl was completed on February 14th, 2020 from vent nos. SV604-043 and SV604-044, respectively. Emissions for VOC and HCl were significantly less than their corresponding pound per hour limits. As communicated in the sample plan, emissions from the remaining vents covered by table EU604-08 in the renewable operating permit (ROP) are included as calculated emissions in the test report to demonstrate compliance with the overall VOC and HCl emission rates.

Please note the analyzer drifted high by 14% during Run 1. However, the majority of the VOC load was seen during Run 1. As suggested by the EGLE field inspector, we applied the drift correction factors and noted the deviation. A fourth run was completed meeting the proper QA requirements. To provide worst case emissions, Runs 1-3 were used for emission results. The majority of VOC emissions in the beginning of sampling trends with previous test events.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (February 2008). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

The results of the test results are summarized in the tables below.

**EU604-08 Emission Results HCl**

| Sample Type | Allowable Emission Rate | Actual Emission Rate |
|---|---|---|
| **HCl Reported Emissions (lb/hr)** | **0.3 lb/hr** | **< 0.1 lb/hr** |
| HCl Measured Emissions (lb/hr) | ---------- | 0.0115 lb/hr |
| HCl Calculated Emissions (lb/hr) | ---------- | 0.0016 lb/hr |

Please note measured emissions are based on the average of three one-hour runs and calculated emissions are based on the worst case basis.

**SV604-044 HCl Testing Run Data**

| PARAMETER | RUN 1 | RUN 2 | RUN 3 | AVERAGE |
|---|---|---|---|---|
| Run Date | 02/14/20 | 02/14/20 | 02/14/20 | N/A |
| Run Times | 1320/1420 | 1525/1625 | 1700/1800 | N/A |
| Dry Stack Gas Flow Std Cond (dscfm) | 171.4 | < 21.5 | < 21.1 | 71.3 |
| Conc. HCl (ppmv) | 28.89 | 17.32 | 34.88 | 27.03 |
| **HCl Emissions (Lb/Hr)** | **0.0281** | **< 0.0021** | **< 0.0042** | **0.0115** |

**SV604-045 and SV604-046 Calculated Emission Summary**

| Sample Type | Actual Emission Rate Calculated |
|---|---|
| **HCl Calculated Emissions (lb/hr)** | **0.0016 lb/hr** |
| SV604-045 Calculated Emissions (lb/hr) | 0.0008 lb/hr |
| SV604-046 Calculated Emissions (lb/hr) | 0.0008 lb/hr |

Please note calculation variables are considered confidential pursuant to Section 324.5516 of Act 451. Disclosure of this information would jeopardize the competitive position of the Dow Silicones Corporation. Therefore, this information will be submitted under separate cover letter.

**Operational Rates for 22753 Scrubber (HCl)**

| Run | Run Time | Scrubber Water Flow (lb/hr) | Chloride Feed (lb/hr) |
|---|---|---|---|
| Run 1 | 1320/1420 | 1570 | 501 |
| Run 2 | 1525/1625 | 1571 | 500 |
| Run 3 | 1700/1800 | 1583 | 501 |
| **Average** | **N/A** | **1575** | **501** |

## EU604-08 Emission Results VOC

| Sample Type | Allowable Emission Rate | Actual Emission Rate |
|---|---|---|
| **VOC Reported Emissions** | **16.7 lb/hr<br>11.8 tons/yr** | **15.7 lb/hr<br>6.0 ton/yr** |
| VOC Measured Emissions | ---------- | 0.04 lb/hr<br>0.18 ton/yr |
| VOC Calculated Emissions | ---------- | 15.7 lb/hr<br>5.8 ton/yr |

Please note measured emissions are based on the average of three one-hour runs and calculated emissions are based on the worst case basis.

## SV604-043 VOC Testing Run Data

| PARAMETER | RUN 1 | RUN 2 | RUN 3 | RUN 4 | AVERAGE |
|---|---|---|---|---|---|
| Run Date | 02/14/20 | 02/14/20 | 02/14/20 | *02/14/20* | N/A |
| Run Times | 1342/1442 | 1525/1625 | 1645/1745 | *1805/1905* | N/A |
| Dry Stack Gas Flow Std Cond (scfm) | 4.424 | 6.081 | 6.755 | *5.588* | 5.75 |
| Conc. VOC as Propane (ppmv) | 2312 | 647 | 470 | *428* | 1143 |
| **VOC Emissions (Lb/Hr)** | **0.07** | **0.03** | **0.02** | ***0.02*** | **0.04** |

Runs 1-3 were used for run averages.

## Calc. Emission Summary

| Vent ID | VOC Emissions | |
|---|---|---|
| **EU604-08** | **15.7 lb/hr** | **5.8 ton/yr** |
| SV604-007 | 0.001 lb/hr | 0.006 ton/yr |
| SV604-012 | 9.47 lb/hr | 3.86 ton/yr |
| SV604-021 | 0.0001 lb/hr | 0.0005 ton/yr |
| SV604-022 | 0.0001 lb/hr | 0.0004 ton/yr |
| SV604-029 | 0.008 lb/hr | 0.037 ton/yr |
| SV604-030 | 4.92 lb/hr | 0.033 ton/yr |
| SV604-038 | 0.008 lb/hr | 0.0002 ton/yr |
| SV604-042 | 0.41 lb/hr | 0.011 ton/yr |
| SV604-043 | 0.04 lb/hr | 0.175 ton/yr |
| SV604-047 | 0.0001 lb/hr | 0.0005 ton/yr |
| SV604-050 | 0.41 lb/hr | 1.79 ton/yr |
| SV604-051 | 0.005 lb/hr | 0.023 ton/yr |
| SV604-052 | 0.0003 lb/hr | 0.0011 ton/yr |
| SV604-053 | 0.032 lb/hr | 0.024 ton/yr |
| SV604-054 | 0.0001 lb/hr | 0.0005 ton/yr |
| SV604-055 | 0.41 lb/hr | 0.011 ton/yr |

Please note calculation variables are considered confidential pursuant to Section 324.5516 of Act 451. Disclosure of this information would jeopardize the competitive position of the Dow Silicones Corporation. Therefore, this information will be submitted under separate cover letter.

## Operational Rates for 22713 Condenser (VOC)

| Run | Run Time | Service Water Return Temp (Deg F) | TFP Feed (lb/hr) |
|---|---|---|---|
| Run 1 | 1342/1442 | 69.4 | 450 |
| Run 2 | 1525/1625 | 69.4 | 450 |
| Run 3 | 1645/1745 | 69.4 | 450 |
| Run 4 | 1805/1905 | 69.4 | 450 |
| **Average** | **N/A** | **69.4** | **450** |

## 1. Summary of Test Program/Introduction

Dow Silicones Corporation, a subsidiary of Dow, operates a chemical manufacturing facility in Midland, Michigan. EU604-08 is a Fluoro Cyclics Process. This emission unit is subject to the requirements of 40 CFR Part 63, Subpart FFFF. Within 360 days of permit reissuance (February 20, 2019), VOC and hydrogen chloride (HCl) emissions must be verified.

The compliance test measuring emissions of VOC and HCl was completed on February 14th, 2020 from vent nos. SV604-043 and SV604-044, respectively. Emissions for VOC and HCl were significantly less than their corresponding pound per hour limits. As communicated in the sample plan, emissions from the remaining vents covered by table EU604-08 in the ROP are included as calculated emissions in the test report to demonstrate compliance with the overall VOC and HCl emission rates.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (February 2008). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

### a) Identification, location and dates of tests

A compliance test measuring emissions of VOC and HCl was completed on February 14th, 2020 on the EU604-08 Fluoro Cyclics Process in Midland Michigan.

### b) Purpose of testing

The purpose of this test was to demonstrate compliance with the regulations for the EU604-08 Fluoro Cyclics Process at Dow Silicones Corporation, a wholly owned subsidiary of Dow in Midland, Michigan. The specific objectives were:

- Determine VOC and HCl emissions from EU604-08 in order to demonstrate compliance with the pound per hour limits specified in the ROP for the emission unit.

### c) Brief Description of source

SV604-043 Control Equipment

- 22753 scrubber
  - ROP operational limit 3 gpm minimum flow rate
  - Spray type water scrubber
  - 12 inches in diameter
  - 6 ft in length
  - Runs continuously
- 22713 service water condenser
  - ROP operational limit service water return temperature maximum 105˚F

SV604-044 Control Equipment

- No air pollution control equipment is associated with this vent.

## d) Test program contacts

The contact for the source and test report is:

Ms. Jenny Kraut, Air Specialist
Dow
1400 Building
Midland, Michigan 48674
989-496-7133

Names and affiliation of personnel including their roles of the test program is summarized below.

| Role | Role Description | Name | Affiliation |
|---|---|---|---|
| Process Focal Point | • Coordinate plant operation during the test<br>• Ensure the unit is operating at the agreed upon conditions in the test plan<br>• Collect any process data required<br>• Provide all technical support related to process operation | Kevin Srebinski | Dow |
| Environmental Focal Point | • Ensure all regulatory requirements and citations are reviewed and considered for the testing | Dan Droste | Dow |
| Test Plan Coordinator | • Leadership of the sampling program<br>• Develop the overall testing plan<br>• Determine the correct sample methods | Chuck Glenn | Dow |
| Test Plan Coordinator Back-up | • Leadership of the sampling program<br>• Develop the overall testing plan<br>• Determine the correct sample methods | Spencer Hurley | Dow |
| Technical Reviewer | • Completes technical review of the test data | Michael Abel | Dow |
| Field Team Leader | • Ensures field sampling meets the quality assurance objectives of the plan | James Edmister | AECOM |
| Sample Project Leader | • Ensures data generated meets the quality assurance objectives of the plan | Daniel Nuñez | AECOM |
| Analytical Project Manager | • Oversees laboratory analysis<br>• Ensures data generated meets the quality assurance objectives of the plan | Ashley Miller | Enthalpy |

## 2. Summary of Results

### a) Operating Data – See Appendix B for Raw Data

**Operational Rates for 22753 Scrubber (HCl)**

| Run | Run Time | Scrubber Water Flow (lb/hr) | Chloride Feed (lb/hr) |
|---|---|---|---|
| Run 1 | 1320/1420 | 1570 | 501 |
| Run 2 | 1525/1625 | 1571 | 500 |
| Run 3 | 1700/1800 | 1583 | 501 |
| **Average** | **N/A** | **1575** | **501** |

**Operational Rates for 22713 Condenser (VOC)**

| Run | Run Time | Service Water Return Temp (Deg F) | TFP Feed (lb/hr) |
|---|---|---|---|
| Run 1 | 1342/1442 | 69.4 | 450 |
| Run 2 | 1525/1625 | 69.4 | 450 |
| Run 3 | 1645/1745 | 69.4 | 450 |
| Run 4 | 1805/1905 | 69.4 | 450 |
| **Average** | **N/A** | **69.4** | **450** |

### b) Applicable permit number, State Registration Number (SRN) and Emission Unit ID or designation for the source.

Applicable Regulations

- MI-ROP-A4043-2019
- 40 CFR Part 63, Subpart FFFF
- 40 CFR Part 64

Pollutants/Diluent Measured - Compliance Test – EU604-08

- VOC 16.7 lb/hr and 11.8 tons/yr
- HCl 0.3 lb/hr
- Emissions testing covered vent nos. SV604-043 and 044 since they represent a majority of the continuous emissions at EU604-08. Emissions from condenser 7791 associated with vent no. SV604-012 is also a significant contributor to the overall emissions from the process. However, due to the sporadic nature of its operation, emissions from this vent and the remaining vents covered by table EU604-08 in the ROP is included as calculated emissions in the test report to demonstrate compliance with the overall VOC and HCl emission rates.

### c) Results expressed in units consistent with the emission limitation applicable to the source and comparison with emission regulations

**EU604-08 Emission Results**

| Vent ID | Vent Type | Emissions Basis | HCl Emissions | VOC Emissions |
|---|---|---|---|---|
| **EU604-08** | **----------** | **----------** | **< 0.1 lb/hr** | **15.7 lb/hr<br>6.0 ton/yr** |
| SV604-007 | Batch (~ 1 per yr) | Calculated | ---------- | 0.001 lb/hr<br>0.006 ton/yr |
| SV604-012 | Batch (~11 per yr) | Calculated | ---------- | 9.47 lb/hr<br>3.86 ton/yr |
| SV604-013 | No longer in use | ---------- | ---------- | ---------- |
| SV604-014 | No longer in use | ---------- | ---------- | ---------- |
| SV604-015 | No longer in use | ---------- | ---------- | ---------- |
| SV604-016 | No longer in use | ---------- | ---------- | ---------- |
| SV604-017 | No longer in use | ---------- | ---------- | ---------- |
| SV604-018 | No longer in use | ---------- | ---------- | ---------- |
| SV604-020 | No longer in use | ---------- | ---------- | ---------- |
| SV604-021 | Batch | Calculated | ---------- | 0.0001 lb/hr<br>0.0005 ton/yr |
| SV604-022 | Batch | Calculated | ---------- | 0.0001 lb/hr<br>0.0004 ton/yr |
| SV604-029 | Continuous | Calculated | ---------- | 0.008 lb/hr<br>0.037 ton/yr |
| SV604-030 | Batch | Calculated | ---------- | 4.92 lb/hr<br>0.033 ton/yr |
| SV604-038 | Batch | Calculated | ---------- | 0.008 lb/hr<br>0.0002 ton/yr |
| SV604-042 | Batch | Calculated | ---------- | 0.41 lb/hr<br>0.011 ton/yr |
| SV604-043 | Continuous | Measured | ---------- | 0.04 lb/hr<br>0.175 ton/yr |
| SV604-044 | Continuous | Measured | < 0.011 lb/hr | ---------- |
| SV604-045 | Continuous | Calculated | 0.001 lb/hr | ---------- |
| SV604-046 | Continuous | Calculated | 0.001 lb/hr | ---------- |
| SV604-047 | Batch | Calculated | ---------- | 0.0001 lb/hr<br>0.0005 ton/yr |
| SV604-048 | Batch | Calculated | ---------- | ---------- |
| SV604-049 | Batch | Calculated | ---------- | ---------- |
| SV604-050 | Batch | Calculated | ---------- | 0.41 lb/hr<br>1.79 ton/yr |
| SV604-051 | Batch | Calculated | ---------- | 0.005 lb/hr<br>0.023 ton/yr |
| SV604-052 | Batch | Calculated | ---------- | 0.0003 lb/hr<br>0.0011 ton/yr |
| SV604-053 | Batch | Calculated | ---------- | 0.032 lb/hr<br>0.024 ton/yr |
| SV604-054 | Batch | Calculated | ---------- | 0.0001 lb/hr<br>0.0005 ton/yr |
| SV604-055 | Batch | Calculated | ---------- | 0.41 lb/hr<br>0.011 ton/yr |

Please note measured emissions are based on the average of three one-hour runs and calculated emissions are based on the worst case basis. Calculation variables are considered confidential pursuant to Section 324.5516 of Act 451. Disclosure of this information would jeopardize the competitive position of the Dow Silicones Corporation. Therefore, this information will be submitted under separate cover letter.

## SV604-043 VOC Testing Run Data

| PARAMETER | RUN 1 | RUN 2 | RUN 3 | RUN 4 | AVERAGE |
|---|---|---|---|---|---|
| Run Date | 02/14/20 | 02/14/20 | 02/14/20 | *02/14/20* | N/A |
| Run Times | 1342/1442 | 1525/1625 | 1645/1745 | *1805/1905* | N/A |
| Dry Stack Gas Flow Std Cond (scfm) | 4.424 | 6.081 | 6.755 | *5.588* | 5.75 |
| Conc. VOC as Propane (ppmv) | 2312 | 647 | 470 | *428* | 1143 |
| **VOC Emissions (Lb/Hr)** | **0.07** | **0.03** | **0.02** | ***0.02*** | **0.04** |

Runs 1-3 were used for run averages.

## SV604-044 HCl Testing Run Data

| PARAMETER | RUN 1 | RUN 2 | RUN 3 | AVERAGE |
|---|---|---|---|---|
| Run Date | 02/14/20 | 02/14/20 | 02/14/20 | N/A |
| Run Times | 1320/1420 | 1525/1625 | 1700/1800 | N/A |
| Dry Stack Gas Flow Std Cond (dscfm) | 171.4 | < 21.5 | < 21.1 | 71.3 |
| Conc. HCl (ppmv) | 28.89 | 17.32 | 34.88 | 27.03 |
| **HCl Emissions (Lb/Hr)** | **0.028** | **< 0.002** | **< 0.004** | **< 0.011** |

## 3. Source Description

### a) Description of process, including operation of emission control equipment

**604 LS Chlorides South process tower**.
The reactor and the distillation columns are a single process. That is, when the reactor is running, the distillation columns must also run.

a. The side draw from 22690 distillation column is the desired product. It is continuously removed and flows to 22694 rework tank or to the product tanks in the tank farm.
b. The small amount of unreacted TFP (trifluoropropene) exits out of the top of 22690 distillation column and will not condense in the service water condenser (EX22687). This, along with some Methylhydrogendichlorosilane (MeHSiCl2) is vented to the refrigerated condenser (EX22750) where most of these materials are recovered. Any other vents not condensed continue to the process water scrubber 22753 and emission point SV604-043.
c. 22695 column removes high boilers from the excess MeHSiCl2 stream before it is recycled back to the reactor feed tank, 22672. Any overheads vents pass through the overheads condenser (EX22697). Any other vents not condensed continue to the process water scrubber 22753 and emission point SV604-043.
d. All other equipment in the LS chlorides south process tower, such as, storage, feed, and receiving tanks have nitrogen pad and blanket systems that vent to the process water scrubber 22753 and emission point SV604-043. The water scrubber 22753 is monitored and maintains water flow above 1500 lb/hr through a controller and flow meter FT11763.

**604/606 Hydrolysis Process**
The reaction loop consists of a centrifugal pump, a carbon block cubical 22704 heat exchanger, a static mixer, and Teflon-lined pipe to return the mixture to the suction of the pump. The loop provides extremely good mixing, and the heat exchanger regulates the temperature of the acid/siloxane mixture. All of the separator tanks and overflow drains are open to atmosphere and drain to SV604-044.

LS Chlorides are fed into the loop through a flow controller. Water is also flow controlled into the P1-22703 pump. This causes the loop to overflow through to the separator tank (22705). Hydrochloric acid separates from the hydrolyzate here and flows out of the top of the separator and is diverted directly to the chemical sewer. Hydrolyzate flows out of the bottom and then down into the wash loop. A second separator, 22709, separates the wash water from the acid-free hydrolyzate. The aqueous phase wash water flows out of the top of the separator to the chemical sewer. The acid-free hydrolyzate flows by gravity into the 22712 Dehydroxylator located inside the building.

The Dehydroxylator process is closely linked to the Hydrolysis process. First, it removes small amounts of suspended water remaining in the hydrolyzate feed. Second, it removes chemically bound water by means of heat and catalyst. Any vents from the Dehydroxylator are passed through a cooling water exchanger (EX22713) which is monitored and controlled by outlet cooling water temperature TT11399.

**b) Process flow sheet or diagram**

RC

Vent

7791 Vent Recovery Condenser

HX 22747

22750 Chiller

22751 Vent Recovery Accumulator

22680 Sylthern Expansion Tank

22682 Heater

22683 Cooler

22678 Hydrosilylation Rxt

Vent

22753 Scrubber

Chem Sewer

22697 Condenser

22699 Accumulator

GC

7788 HP Surge

7789 TFP Cooler

7790 TFP Condenser

7785 LP Surge

7786 Compressor

TFP/Water Separator

7792 TFP Tank

22669 TFP Tank

22670 TFP Cooler

22687 Condenser

GC

22691 Accumulator

22695 MeH Recovery Column

22696 Reboiler

Vent

22744 Seal Fluid Tank

22743/22746 Liquid Ring Nash Vacuum Pumps

22745 Condenser

22673 MeH Cooler

Bulk TFP 8065 Tank

22694 Rework Tank

22689 Reboiler

22690 Product Column

22693 Accumulator

22692 Sidedraw Condenser

GC

22672 MeH Tank

22741 Liquid Ring KO Tank

22731 Condenser

GC

22740 Tempered Water Heater

502 Bldg Highline

7827 Waste Handler

8052 Waste Tank

8045 Tank

109 Bldg PI Fluid

22704 Carbon HE

22706 Tempered Water Heater

DI Water

22707 Coalescer

Vent

22705 Reaction Separator

22730 Batch Still Column

22733 Forecut Tank

7875 Forecut Tank

7732 Product Tank

7768/ 7874/ 7871/ 7870 Product Tanks

Chem Sewer

22738 Condenser Separator

Vent

22737 SJ Condenser

22736 2-stage SJ

22735 SJ KO Tank

22728 Batch Still Holding Tank

22709 Wash Separator

Chem Sewer

22713 Condenser

8044 Overflow Tk

8038 Surge Tk

8037 Boiler

22718 Condenser

22719 Cracker Column Feed Tank

22721 Preheater

22723 Condenser

GC

22724 Accumulator

602

External 109 2901 3104

500 gal 22712 Dehydroxylator

1500 gal 22714 Dehydroxylator

22716 Sylthern Heater

22715 Cracker

22720 Cracker Column

22722 Reboiler

22725 Batch Still Feed Accumulator

Dempster

321 Bldg

Vent

22711 NaOH Tank

8053 Waste Tank

**c) Type and quantity of raw and finished materials processed during the tests**

SV604-043 VOC Vent

- Trifluoropropene (23% of stream)
- Heptane (77% of stream)
- Less than 0.4% of stream is made up of
    - Methylhydrogendichlorosilane
    - Methyltrichlorosilane
    - Trifluoro-2methylethylmethyldichlorosilane
    - Trifluoropropylmethyldichlorosilane

SV604-044 HCl Vent

- HCl

**d) Maximum and normal rated capacity of the process**

Each process was operated in the desired range for feed rates.

| Product | Flow Rate** |
|---|---|
| TFP | 350-450 lbs/hr |
| Chlorides | 450-550 lbs/hr |

**Flow rates were monitored and recorded during testing.

**e) A description of process instrumentation monitored during the test**

| Process Variable | Process Tag Unit |
|---|---|
| 22753 scrubber water flow rate | Lb/hr FT 11763 |
| Chloride Feed to 606 Process | Lb/Hr FT-11069 |
| Service water return temp 22713 | Degrees C FT-11399 |
| TFP Feed to Chloride Process | Lb/Hr FT-10857 |

## 4. Sampling and Analytical Procedures

### a) Description of sampling train(s), field procedures, recovery and analytical procedures

**Proposed Test Method Modifications**

- Dow Silicones Corporation requested to use EPA Method 26A equipment (i.e., Method 5 meter box and large impingers) to conduct Method 26. The use of the larger equipment yields better leak checks and moisture values. This is an approach that has been approved as a minor method change by state agencies. EPA agrees that this is a modification that can be routinely approved by the states or the EPA Regional Offices at their discretion on the FAQ section of EPA M26.

**Procedures**

**EPA Method 1 (Sample Point Determination)**

Both sample points exceed the optimal sampling requirements of 8 duct diameters downstream and 2 duct diameters upstream from the nearest disturbance. The vent sizes are as follows:

- SV604-043 – 2 inch diameter
- SV604-044 – 6 inch diameter

**EPA Method 2 (Flue Gas Velocity and Volumetric Flow Rate)**

The flue gas velocity and volumetric flow rate was determined according to the procedures outline in 40 CFR 60, Appendix A, EPA Method 2. Velocity measurements were made using S-type pitot tubes conforming to the geometric specifications outlined in EPA Method 2. Differential pressures were measured with a low-flow manometer. Flue gas temperature, velocity and volumetric flow rate data were recorded.

**EPA Method 3 (Flue Gas Composition and Molecular Weight)**

EPA Method 3 was used to determine molecular weight of each gas stream. Samples were collected in a Tedlar bag over each sample period, and Fyrite analysis was completed to determine O2/CO2 concentrations.

**EPA Method 4 (Moisture)**

For SV604-043 (VOC sampling), a wet/dry bulb method was used for moisture determination. The temperatures fell below chart limits. Therefore, the moisture content was determined to be zero.

For SV604-044 (HCl sampling), the M4 was incorporated into the M26 sample train.

**EPA Method 25A (Total VOC Sampling and Analysis)**

EPA Method 25A was utilized to determine total THC as propane concentrations during each run on the outlet.

A gas sample is extracted from the source through a heated line to a flame ionization analyzer (FIA).

**EPA Method 26 (HCl Sampling and Analysis)**
The EPA Method 26 sampling train was used to determine HCl emissions. Each test run was one hour in duration. To avoid possible contamination, Teflon tubing was used for sample collection. The sampling train is described as follows:

- The first, second and third impingers were charged with 0.1N H2SO4.
- A fourth impinger was filled with silica gel to prevent water from getting to the dry gas meter.
- The three impingers containing sulfuric acid were analyzed for HCl by Ion Chromatography (EPA Method 26).

## 5. Test Results and Discussion

### a) Detailed tabulation of results including process operating conditions and flue gas conditions

Detailed results can be found in the executive summary and section 2(c).

### b) Discussion of significance of results relative to operating parameter and emission regulations

All air permit limits were achieved during sampling. Both VOC and HCl results were significantly below allowed limits. These results are similar to previous test events.

### c) Discussion of variations from normal sampling procedures or operating condition which could have affected the results.

Please note the THC analyzer drifted high by 14% during Run 1. However, the majority of the VOC load was seen during Run 1. As suggested by the EGLE field inspector, we applied the drift correction factors and noted the deviation. A fourth run was completed meeting the proper QA requirements. To provide worst case emissions, Runs 1-3 were used for emission results. The majority of VOC emissions in the beginning of sampling trends with previous test events.

### d) Discussion of any process or control equipment upset condition which occurred during test

There were no process or control equipment upset conditions during testing.

### e) Description of any major maintenance performed on the air pollution devices during the three month period prior to testing

Annual maintenance turn-around conducted in September 2019. Typical maintenance and calibration performed.

### f) In the event of a re-test, a description of any changes made to the process or air pollution devices since the last test.

N/A

**g) Results of any quality assurance audit sample analysis required by the reference method**

HCl audit sample was within specified guidelines.

**h) Calibration sheets for the dry gas meter, orifice meter, pitot tube and any other equipment or analytical procedure that require calibration**

Appendix A.

**i) Sample calculations of all formulas used to calculate the results**

*Stack Gas Volumetric Rates*

$$V_S = K_P C_P \left(\sqrt{\Delta p}\right)_{AVG} \sqrt{\frac{T_{S(AVG)}}{P_S M_S}}$$

$$Q_W = V_S A_S (3600\ sec/hr)$$

$$Q_{SW} = Q_W \left(\frac{528\ °R}{T_S}\right)\left(\frac{P_S}{29.92"\ Hg}\right)$$

Where: $V_S$ = Stack gas velocity $ft/sec$

$K_P$ = Pitot Tube Constant, $85.49\ \frac{ft}{sec}\sqrt{\frac{(lb/lb\ mol)(" Hg)}{(°R)("H_2O)}}$

$C_P$ = Pitot Tube Coefficient, 0.84 (dimensionless)

$\Delta p$ = Velocity Head of Stack Gas $(" Hg)$

$T_S$ = Stack Temperature $(°R)$

$P_S$ = Absolute Stack Pressure $(" Hg)$

$M_S$ = Molecular weight of stack gas, wet basis $(lb/lb\ mol)$

$Q_W$ = Stack Gas Wet Volumetric Flow at Stack Conditions $(ft^3/hr)$

$Q_{SW}$ = Stack Gas Wet Volumetric Flow at Standard Conditions $(ft^3/hr)$

$A_S$ = Stack Area $(ft^2)$

$Q_{SD}$ = Stack Gas Flow @ Std. Conditions, dry basis $(dscf/hr)$

$DGF$ = Dry Gas Fraction

**Stack Gas Velocity and Vol Rate Example**
**VOC Run 1**

$$V_S = \left(85.49\ \frac{ft}{sec}\sqrt{\frac{(lb/lb\ mol)(" Hg)}{(°R)("H_2O)}}\right)(0.84)(0.0530\ "Hg)\sqrt{\frac{480\ °R}{(30.51\ "Hg)(28.8\ lb/lb\ mol)}} = \underline{2.813\ ft/s}$$

$$Q_W = \left(\frac{2.813\ ft}{sec}\right)\left(\frac{0.023\ ft^2}{1}\right)\left(\frac{60\ sec}{min}\right) = \underline{3.945\ cfm}$$

$$Q_{SW} = \left(\frac{3.945\ ft^3}{min}\right)\left(\frac{528\ °R}{480\ °R}\right)\left(\frac{30.51"\ Hg}{29.92"\ Hg}\right) = \underline{4.424\ scfm}$$

*Analyzer Calibration Error Calculations*

The calibration error test consisted of challenging each reference monitor at three measurement points against known calibration gas values. Calibration error for the reference is calculated using the following equation:

$$CE_{RM} = \frac{|Analyzer\ Response - Expected\ Response|}{Span\ of\ Analzyer} \times 100$$

**Run #1 Example Low Gas**

$$CE_{RM} = \frac{|1178\ ppmv - 1189.3\ ppmv|}{2233.0\ ppmv} \times 100 = \underline{1.0\ \%}$$

*System Calibration Bias Calculations*

The system bias calibration test consisted of challenging the reference sample system at two measurement points against the local calibration values. Calibration bias calculations for the reference sample system are calculated using the following equation:

$$CB_{RM} = \frac{|System\ Calibration\ Response - Analzyer\ Calibration\ Response|}{Span\ of\ Analzyer} \times 100$$

**Run #1 Example Zero Gas**

$$CB_{RM} = \frac{|23.9\ ppmv - 0.0\ ppmv|}{2233.0\ ppmv} \times 100 = \underline{1.1\ \%}$$

*Calibration Drift Calculations*

The calibration drift tests were conducted at the beginning and end of each run. Analyzer maintenance, repair or adjustment could not be completed until the system calibration response was recorded. Calibration drift for the reference is calculated using the following equation:

$$CD_{RM} = \frac{|Final\ System\ Cal\ Response - Initial\ System\ Cal\ Response|}{Span\ of\ Analzyer} \times 100$$

**Run #1 Zero Example**

$$CD_{RM} = \frac{|38.0\ ppmv - 23.9\ ppmv|}{2233.0\ ppmv} \times 100 = \underline{0.6\ \%}$$

*System Calibration Drift Correction*

The gas concentrations are corrected for the system calibration bias. The concentrations are calculated using the following equations:

$$C_{Gas} = (\overline{C} - C_O)\left(\frac{C_{MA}}{C_M - C_O}\right)$$

where: $C_{Gas}$ = Effluent Concentration, dry ppm or %
$\overline{C}$ = Average Analyzer Concentration, ppm or %
$C_O$ = Average Initial and Final System Calibration Responses for Zero Gas, ppm or %
$C_M$ = Average Initial and Final System Calibration Responses for Upscale Calibration Gas, ppm or %
$C_{MA}$ = Actual Concentration of Upscale Calibration Gas, ppm or %

**Run 1 THC Run 1 Examples**

$$C_{Gas} = (2588\ ppmv - 31.0\ ppmv)\left(\frac{1178\ ppmv}{1334\ ppmv - 31.0\ ppmv}\right) = \underline{2312\ ppmvw}$$

*THC Emission Rate*

$$E_{THC} = \frac{(THC_{Gas})(Q_{SW})(Gas_{MW})(60\ min)(28.32\ L/ft^3)}{(10^6\ ppmv)(24.056\ L/mol)(453.6\ g/lb)}$$

where: $E_{THC}$ = Emission of THC, $(lb/hr)$
$THC_{Gas}$ = Concentration of THC Gas, $(wet\ ppmv)$
$Q_{SW}$ = Stack Gas Flow @ Std. Conditions, wet basis $(scf/hr)$
$Gas_{MW}$= Molecular Weight of Gas $(g/g\ mol)$ Where:
$VOC_{MW}$ = Molecular Weight of VOC as Propane $(44.1\ g/g\ mol)$

**Run 1 THC Run 1 Examples**

$$E_{THC} = \frac{(2312\ ppmv)(4.424\ scfm)(60\ min)(44.1\ g/mol)(28.32\ L/ft^3)}{(10^6\ ppmv)(24.056\ L/mol)(453.6\ g/lb)} = \underline{0.07\ lb/hr}$$

**j) Copies of all the field sheets, cyclonic flow checks including pre-testing, aborted tests and/or repeated attempts**

All data sheets can be found in Appendix A.

**k) Copies of all laboratory data including QA/QC**

All laboratory data can be found in Appendix C.