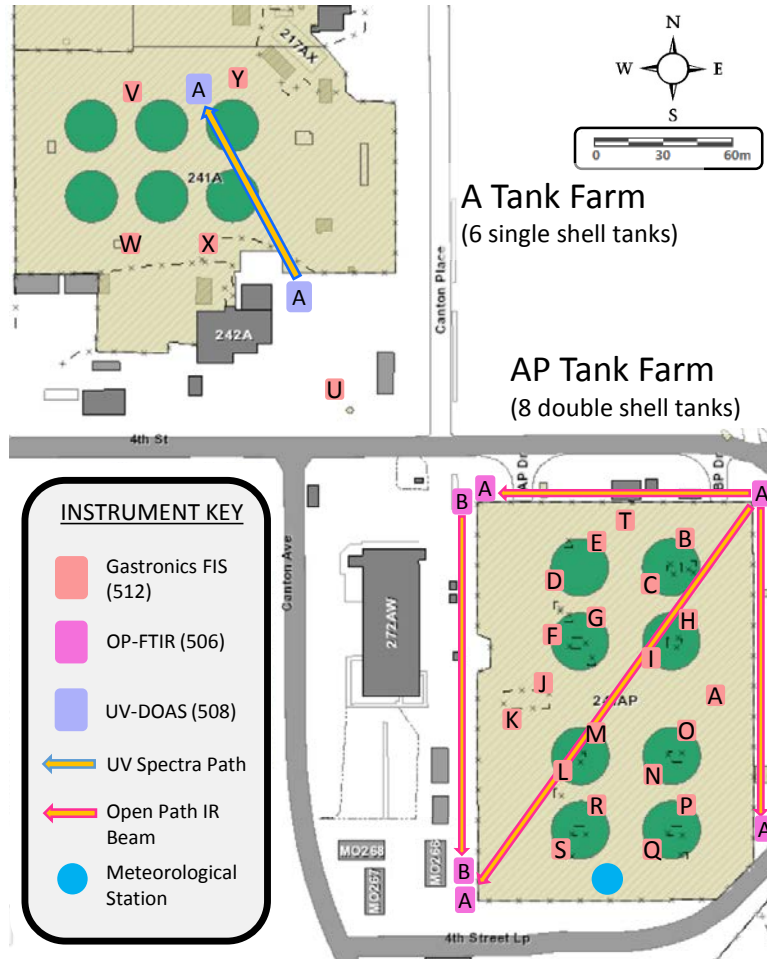


# Vapor Monitoring and Detection System Weekly Report – A and AP Tank Farm Field Instrument Report

## Revision 0 – Initial Release of Report

3/22/2017 6:00 – 3/29/2017 6:00

### Instrument/Sampling Locations – A and AP Tank Farms



# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

## Abbreviations and Units

CH <sub>4</sub>	=	methane
COPC	=	chemicals of potential concern
DRI	=	direct reading instrument
FIS	=	fixed instrument skid
IR	=	infrared
ND	=	not detected
NH <sub>3</sub>	=	ammonia
NO	=	nitric oxide
N <sub>2</sub> O	=	nitrous oxide
NO <sub>2</sub>	=	nitrogen dioxide
OEL	=	occupational exposure limit
OP-FTIR	=	open path Fourier transform infrared spectrometer <sup>1</sup>
OSHA	=	Occupational Safety and Health Administration
PEL	=	permissible exposure limit
ppb	=	parts per billion
ppm	=	parts per million
UV	=	ultraviolet
UV-DOAS	=	ultraviolet differential optical absorption spectrometer <sup>2</sup>
VMDS	=	vapor monitoring and detection system
VOC	=	volatile organic compounds, which include both volatile and semi-volatile compounds

## VMDS Instruments

506A	=	OP-FTIR Multi-Path
506B	=	OP-FTIR Single-Path
508A	=	UV-DOAS
512	=	FIS Gastronics Direct Reading Instrument

---

<sup>1</sup> OP-FTIR Fact Sheet: <http://hanfordvapors.com/wp-content/uploads/2016/10/OP-FTIR-fact-sheet.pdf>

<sup>2</sup> UV-DOAS Quick Sheet: <http://hanfordvapors.com/wp-content/uploads/2016/10/UV-DOAS-Fact-Sheet.pdf>

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

## Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week (3/22/2017 at 6:00 a.m. through 3/29/2017 at 6:00 a.m.) using direct reading vapor detection instruments, the open path Fourier transform infrared spectrometer (OP-FTIR), and the ultraviolet differential optical absorption spectrometer (UV-DOAS).

Pilot-scale testing is focused on evaluating component integration and functionality. Data shown may include results for calibration and calibration check (bump test) tests performed to verify sensors are functioning; these tests are visible in the data as spikes. Raw spectra (data) may need to be reprocessed and reviewed as understanding of the particular instruments being used as part of the VMDS pilot test are deployed and the company's ability to align the instruments with the overall objectives of the pilot test improves.

The spectrometer instruments—OP-FTIR and UV-DOAS—provide real-time multi-gas measurement (qualitative and quantitative) of gases. Even though the instrument is very accurate regarding the quantification of chemical compounds, reported results cannot be directly calculated into a concentration for a specific location, this is due to its sample size – an open path between two points. The sample path is defined by the location of the emitter and the reflector which may be tens to hundreds of meters apart. Therefore data from these instrument types will not be directly compared to the Occupational Exposure Limits (OELs) and Action Levels, but used to determine concentrations of compounds along the path of the instrument's beam.

For the spectrographic instruments (OP-FTIR and UV-DOAS), each analyte has a specific reference spectrum, which represents the absorption characteristics for that chemical in the IR or UV spectral regions. Reference spectra for each analyte are stored in an instrument software library (library) that specifies which absorption features are analyzed, how analysis is performed, and reporting criteria. Revisions to the library are periodically performed to improve accuracy of analysis for analytes; the optimization of the library is iterative and periodic changes to the library are being performed. Revisions to the library may result in the identification of a compound not previously thought to be present, or conversely determine that a previously reported analyte was not actually present. Identification of an analyte depends on the analytical method (UV or IR), the library used, analyte concentration, other chemical compounds present, and other factors. The compounds present can interfere/overlap with the analyte spectral signature, especially for compounds having the same functional groups (e.g., methyl or ketone groups). Work is ongoing to optimize the library and minimize these interferences.

The direct read instruments located within AP and A Tank Farms include the Fixed Instrument Skid (FIS) Gastronics (512) units with sensors for detecting NH<sub>3</sub> and VOCs.

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

## Summary for 3/22/2017 through 3/29/2017

The following sections summarize data reporting for vapor monitoring and detection instruments at AP and A Tank Farms for the 3/22/2017 through 3/29/2017 period. Instruments at AP Tank Farm include open path FTIR instruments (multi-path and single-path) and the FIS Gastronics direct reading instruments. Instruments at A Tank Farm include UV-DOAS spectrographic instrument and Gastronics direct reading instruments. No waste retrieval activities occurred during this reporting period.

### AP TANK FARM

#### AP Tank Farm OP-FTIR Instruments

During the week in review, instrument 506A reported nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>), ammonia (NH<sub>3</sub>), and 1-butanol (BuOH) (Table 1). Nitrous oxide and methane are typically found in the atmosphere at background levels of approximately 0.33 ppm for N<sub>2</sub>O and 1.8 ppm for CH<sub>4</sub><sup>3</sup>. Instrument 506A experienced a disruption in the data at the beginning of the week due to high humidity conditions (between 06:00 and 12:00, 3/22/2017) (Figure 1). Instrument 506A reported values for 1-butanol, however these values occurred during the data disruption associated with high humidity, and therefore these values are not considered representative. The 506A instrument reported repeated values between 15:00 on 3/22/2017 and 10:00 on 3/23/2017 and between 15:00 on 3/24/2017 and 16:30 on 3/27/2017. The software locked up and did not report new data, but only reported the last value during these periods.

Instrument 506B detected N<sub>2</sub>O, CH<sub>4</sub>, and NH<sub>3</sub> during this week (Table 1). Similar to instrument 506A, instrument 506B also experienced a disruption in the data at the beginning of the week due to high humidity conditions, and therefore these data are not considered representative (Figure 2). After this disruption, the instrument reported normally through the remainder of the week.

Most compounds detected by both instruments are typically present in air at detectable levels and the levels reported for these compounds fall within those typically reported, this includes the trace amounts of ammonia<sup>4</sup>. Consistency in measured values for these compounds indicates that the OP-FTIR units are effectively measuring composition of the gas components within its path. Specific instrument information is reported in Table 1 and Figures 1 and 2 below.

---

<sup>3</sup> Climate Change Indicators: Atmospheric Concentration of Greenhouse Gases: <https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases>

<sup>4</sup> Air Composition from "The Engineering ToolBox": [http://www.engineeringtoolbox.com/air-composition-d\\_212.html](http://www.engineeringtoolbox.com/air-composition-d_212.html)

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

**Table 1. Chemical Species Detected<sup>a</sup> on Open Path FTIRs at AP Tank Farm.**

Chemical Compound	506A: OP-FTIR Multi-Path (ppm)	506B: OP-FTIR Single-Path (ppm)
Nitrous Oxide*	0.17 – 0.45 <sup>b</sup>	0.27 – 0.38 <sup>b</sup>
Ammonia*	ND – 0.080	ND – 0.064
Methane	0.99 – 2.5 <sup>b</sup>	1.5 – 1.8 <sup>b</sup>
1-3-Butadiene*	ND	ND
1-Butanol*	ND <sup>b</sup>	ND
2-Hexanone*	ND	ND
3-Buten-2-one*	ND	ND
Acetaldehyde*	ND	ND
Acetonitrile*	ND	ND
Benzene*	ND	ND
Butanal*	ND	ND
Butyl Nitrite*	ND	ND
Ethylamine*	ND	ND
Formaldehyde*	ND	ND
Furan*	ND	ND
Methanol*	ND	ND
Methyl Isocyanate*	ND	ND
Methyl Nitrite*	ND	ND
N-Nitrosodiethylamine*	ND	ND
N-Nitrosodimethylamine*	ND	ND
N-Nitrosomorpholine*	ND	ND
Propanenitrile*	ND	ND
Pyridine*	ND	ND
Tributyl Phosphate*	ND	ND

- Notes:
- (a) Based on data retrieved from OSI PI; OSI PI System is a data visualization software package from OSIsoft.
  - (b) Disrupted data associated with high humidity conditions at the beginning of the week are not considered representative, and therefore are not included in the table for nitrous oxide, methane, and 1-butanol
- \*Chemical is on COPC list  
 ND – Not detected

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

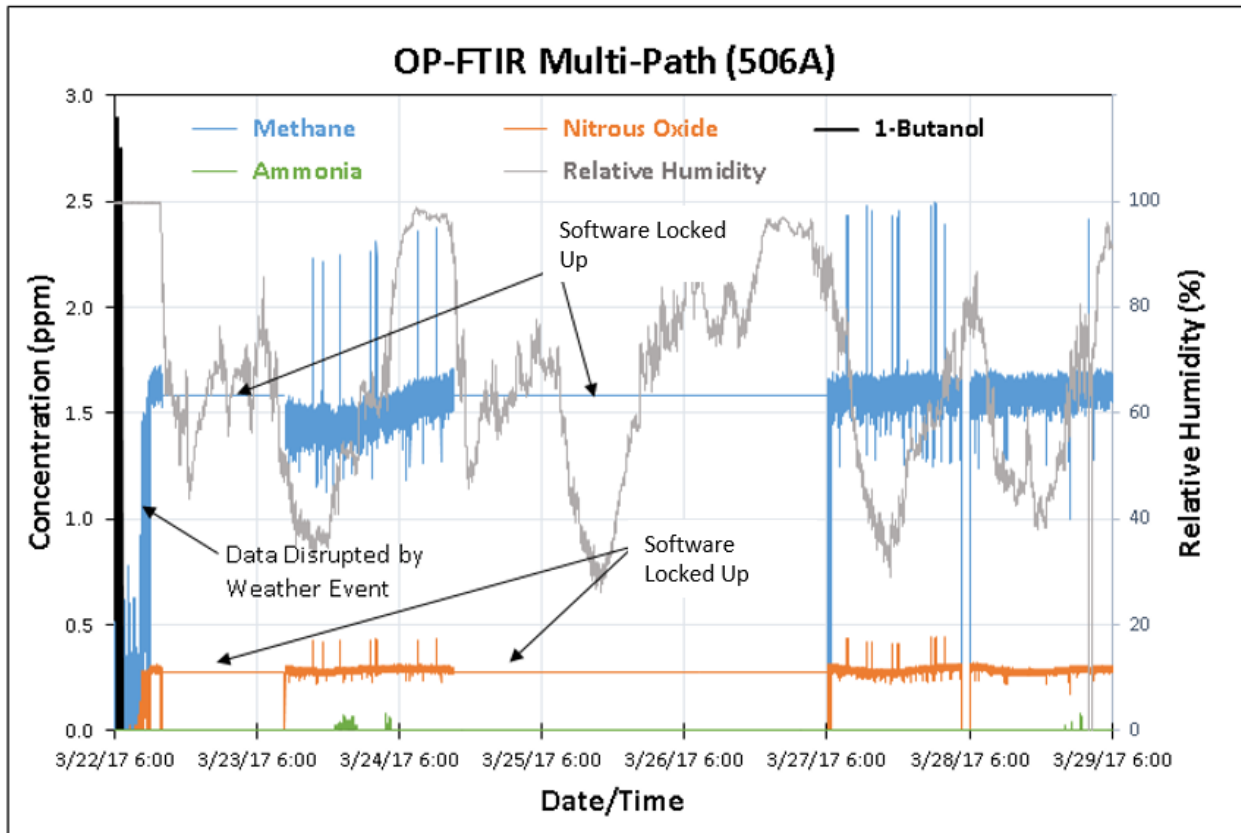
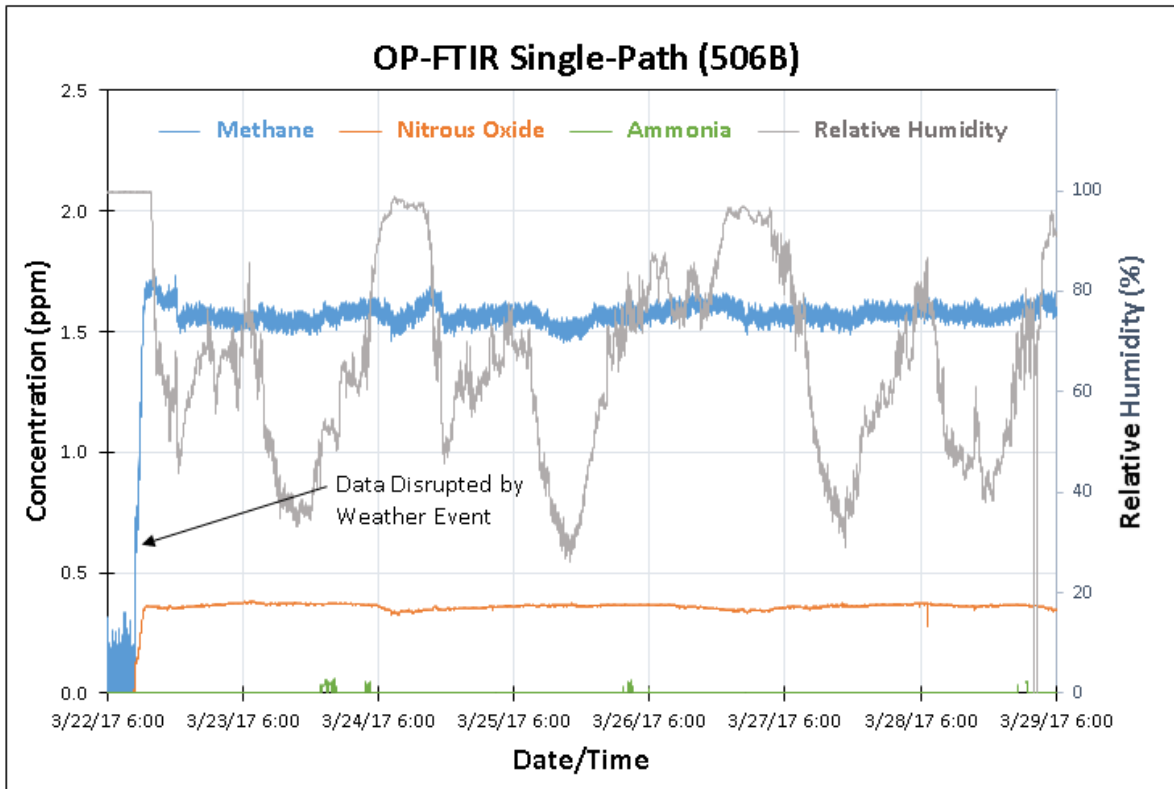


Figure 1. Chemical Compounds Detected by the OP-FTIR (506A) Instrument. Relative Humidity Data Provided by the Coastal Meteorological Station.

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00



**Figure 2. Chemical Compounds Detected by the OP-FTIR (506B) Instrument. Relative Humidity Data Provided by the Coastal Meteorological Station.**

## **AP Tank Farm Direct Reading Instruments**

Instruments located between A and AP Tank Farm, are included.

Gastronics FIS (512 - NH<sub>3</sub>, VOCs, N<sub>2</sub>O): Units located in AP Tank Farm include: 512A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, and T. Unit 512U is located between AP Tank Farm and the A Tank farm. All of the 512 instruments except for 512N, R, and S were in calibration this week for NH<sub>3</sub>, based on the latest calibration checks performed on 3/20/2017 the previous week (see Table 2). No ammonia was detected by Gastronics instruments that were in calibration and reporting this week.

Only instruments 512L, N, S, and T were in calibration for VOC this week, but unit 512S did not report to OSI PI. Two units reported VOC greater than zero but less than 2 ppm and no units reported VOCs  $\geq$  2 ppm (Table 2). A total VOC action limit of 2 ppm currently is

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

prescribed by Fact Sheet EH-09-001<sup>5</sup>. The N<sub>2</sub>O sensors do not hold calibration and are not reported. Only instruments that are reporting to OSI PI<sup>6</sup> and in calibration are reported in Table 2.

**Table 2. AP Tank Farm Gastronics (512) Comments.**

Chemical Compound (units)	Comment	OEL	Action Level	Detection Range
NH <sub>3</sub> (ppm)	No ammonia detected on any instrument in calibration	25	12	1 – 100
VOC (ppm)	<ul style="list-style-type: none"> <li>In Calibration*: 512L, N, S, and T</li> <li>Instruments that reported no VOCs detected: 512N</li> <li>Instruments that reported a maximum value of &lt;2 ppm: 512L and T</li> <li>Instruments that reported maximum values ≥2 ppm: None</li> </ul>	N/A	2	0.005 – 50 <sup>7</sup>

\* VOC: Only instruments reading within 10% of the calibration gas concentration<sup>8</sup> during their most recent bump/calibration test are reported here.

<sup>5</sup> Fact Sheet for Action Limit for Volatile Organic Compounds, Washington River Protection Solutions, Richland, Washington: [\\ap014\EnvironmentalHealth\Fact Sheets\EH-09-001 Turnback value for VOCs.pdf](https://www.wrp.wa.gov/eh/eh09001turnbackvalueforvocspdf)

<sup>6</sup> OSI PI System is a data visualization software package from [OSIsoft](http://www.osisoft.com).

<sup>7</sup> One-Page Fact Sheet for Gastronics Fixed Instrument Skid, Tank Farm Vapors Control Team, Version 1.0 2016/7/21 RBC: <https://hanfordvapors.com/wp-content/uploads/2017/07/RPP-RPT-59729-draft-2-20-17-Vapor-Monitoring-and-Detection-System-Pilot-Scale-Test-Phase-1-Report.pdf>

<sup>8</sup> Calibrating and Testing Direct-Reading Portable Gas Monitors: <https://www.osha.gov/dts/shib/shib093013.html>



# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

## A TANK FARM

### A Tank Farm UV-DOAS Instrument

Ammonia and nitric oxide (NO) were reported by the instrument during the period under review (Table 3). These compounds are typically found in detectable quantities in air<sup>9</sup>. Similar to the OP-FTIR instruments, instrument 508A was affected by high humidity conditions during the first few hours of the week, as indicated by zero readings for ammonia and nitric oxide during this period (Figure 3). Analyte concentrations are reported Table 3 and Figure 3 below.

**Table 3. Chemical Species Detected<sup>a</sup> by UV-DOAS at A Tank Farm**

Chemical Compound	508A: UV-DOAS (ppm)	Chemical Compound	508A: UV-DOAS (ppm)
Ammonia*	ND – 0.10	Methyl Nitrite*	ND
Nitric Oxide	ND – 0.041	Pyridine*	ND
1,3-Butadiene*	ND	1,2,4-Trimethylbenzene	ND
2-Methyl-2-butenal*	ND	1,3,5-Trimethylbenzene	ND
2-Methylfuran*	ND	Ethylbenzene	ND
Acetaldehyde*	ND	m-Xylene	ND
Benzene*	ND	Nitrogen Dioxide	ND
Butanal*	ND	o-Xylene	ND
Ethylamine*	ND	p-Xylene	ND
Formaldehyde*	ND	Styrene	ND
Furan*	ND	Sulfur Dioxide	ND
Mercury*	ND	Toluene	ND

Notes: (a) Based on data retrieved from OSI PI; OSI PI System is a data visualization software package from OSIsoft.

\*Chemical is on COPC list

ND – Not detected

<sup>9</sup> Air Composition from "The Engineering ToolBox": [http://www.engineeringtoolbox.com/air-composition-d\\_212.html](http://www.engineeringtoolbox.com/air-composition-d_212.html)

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

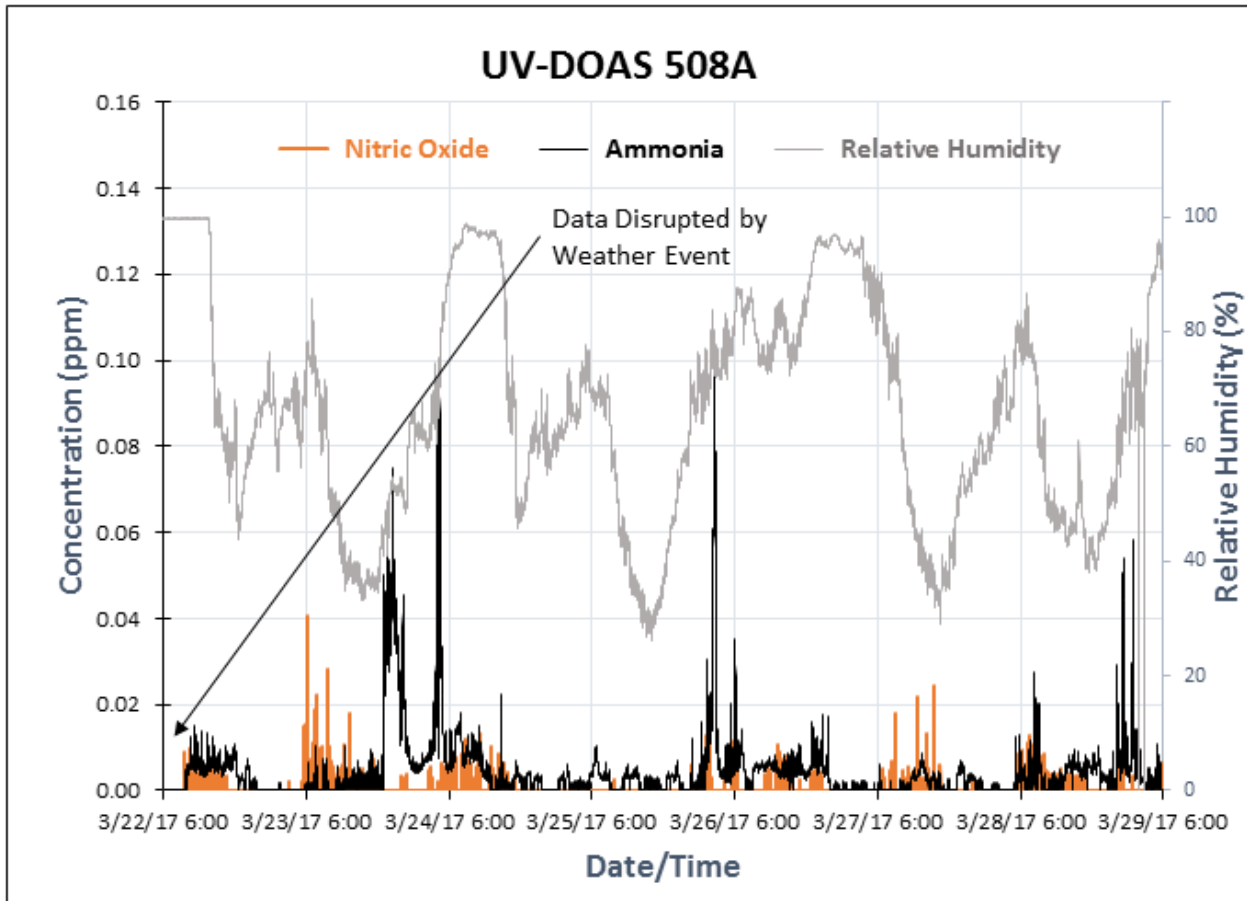


Figure 3. Chemical Compounds Detected by the UV-DOAS (508A) Instrument.

## **A Tank Farm Direct Reading Instruments**

Gastronics FIS (512 - NH<sub>3</sub>, VOCs, N<sub>2</sub>O): Units located in A Tank Farm include: 512V, W, X, and Y (Table 4). None of these instruments reported data during the week. No calibrations or calibration checks were performed on these sensors during this week. The latest calibrations/checks performed on 512V, W, X, and Y (3/20/2017) indicated that none of them were in calibration for VOC.

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

**Table 4. A Tank Farm Gastronics (512) Comments.**

Chemical Compound (units)	Comment	OEL	Action Level	Detection Range
NH <sub>3</sub> (ppm)	No ammonia reported on any instrument	25	12	1 – 100
VOC (ppm)	<ul style="list-style-type: none"> <li>Out of Calibration*: 512V, W, X, and Y</li> <li>Instruments that reported no VOCs detected: None</li> <li>Instruments that reported a maximum value of &lt;2 ppm: None</li> <li>Instruments that reported maximum values ≥2 ppm: None</li> </ul>	N/A	2	0.005 – 50

\* VOC: Only instruments reading within 10% of the calibration gas concentration during their most recent bump/calibration test are reported here.

## 3/22/2017 – 3/29/2017 Instrument Operational Status:

Time reporting is calculated using the time sensors that report to OSI PI System for each instrument (Tables 5 and 6).

**Table 5. Gastronics Direct Reading Instruments (512) % Time Reporting<sup>a</sup>.**

Instrument	% Time Reporting	Instrument	% Time Reporting
512A	80	512N	22
512B	0	512O	25
512C	0	512P	0
512D	4	512Q	68
512E	0	512R	0
512F	17	512S	0
512G	9	512T	29
512H	72	512U	>99
512I	49	512V	0
512J	4	512W	0
512K	30	512X	0
512L	72	512Y	0
512M	41		

(a) % time reporting based on NH<sub>3</sub>.

# Vapor Monitoring and Detection System Weekly Report

3/22/2017 6:00 – 3/29/2017 6:00

**Table 6. Spectrometer Instruments Time Reporting.**

<b>Instrument</b>	<b>% Time Reporting</b>
506A	49 <sup>a</sup>
506B	100
508A	>99

(a) Instrument reporting time does not include time the instrument software locked up