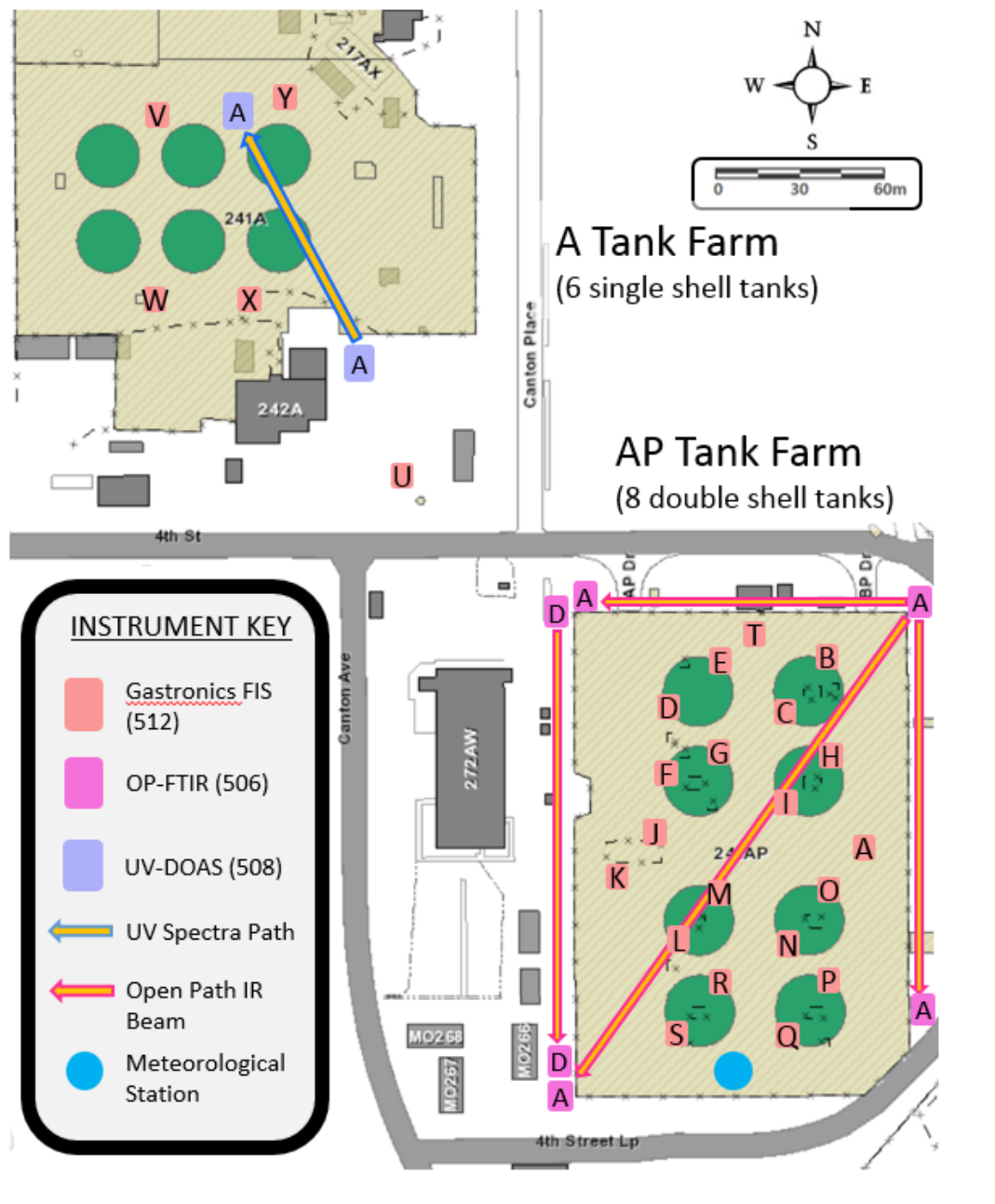


# Vapor Monitoring and Detection System Weekly Report – A and AP Tank Farm Field Instrument Report

## Revision 0 – Initial Release of Report

5/10/2017 6:00 – 5/17/2017 6:00

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



# Vapor Monitoring and Detection System Weekly Report

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## **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
506D <sup>3</sup>	=	OP-FTIR Single-Path
508A	=	UV-DOAS
512	=	FIS Gastronics Direct Reading Instrument

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<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>

<sup>3</sup> The OP-FTIR single-path instrument identification number was changed from 506B to 506D in the OSI PI System in September 2017. The instrument identification number was changed to be consistent with the Tank Farm Monitoring and Control Systems number.

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## Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week (5/10/2017 at 06:00 through 5/17/2017 at 06:00) 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 spectroscopic 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.

Each analyte measured by the OP-FTIR and the UV-DOAS 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. At times, communications between the Gastronics radio and the Wi-Fi receiver were frequently and randomly interrupted resulting in loss of the Wi-Fi signal and data drops.

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## **Summary for 5/10/2017 through 5/17/2017**

The following sections summarize data reported by vapor monitoring and detection instruments at AP and A Tank Farms from 5/10/2017 through 5/17/2017. Instruments at AP Tank Farm include open path FTIR spectroscopy instruments (multi-path and single-path) and the FIS Gastronics direct reading instruments. Instruments at A Tank Farm include a UV-DOAS spectroscopy instrument and Gastronics direct reading instruments. No waste disturbing activities were performed near A and AP Tank Farms during this week.

## **AP TANK FARM**

### **AP Tank Farm OP-FTIR Instruments**

During the week in review, the AP Tank Farm electrical outage ended near the end of the week and the OP-FTIR instruments 506A and 506D resumed reporting data to OSI PI System<sup>4</sup> on 5/16/2017 at 14:05 and 14:09, respectively. The single-path OP-FTIR, 506D, reported N<sub>2</sub>O and CH<sub>4</sub> data during this week (Table 1, Figure 1). However, the 506A OP-FTIR did not report data properly through the end of the week because the parameters aligning the beam between the emitter and reflector were incorrect (Figure 2). Nitrous oxide and CH<sub>4</sub> 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>5</sup>; values reported by 506D are consistent with atmospheric background.

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<sup>4</sup> OSI PI System is a data visualization software package from [OSIsoft](#).

<sup>5</sup> Climate Change Indicators: Atmospheric Concentration of Greenhouse Gases: <https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases>

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

Chemical Compound	506A: OP-FTIR Multi-Path (ppm)	506D: OP-FTIR Single-Path (ppm)
Nitrous Oxide*	NR	0.26 – 0.32
Ammonia*	NR	ND
Methane	NR	0.94 – 1.4 <sup>b</sup>
1,3-Butadiene*	NR	ND
1-Butanol*	NR	ND
2-Hexanone*	NR	ND
3-Buten-2-one*	NR	ND
Acetaldehyde*	NR	ND
Acetonitrile*	NR	ND
Benzene*	NR	ND
Butanal*	NR	ND
Butyl Nitrite*	NR	ND
Ethylamine*	NR	ND
Formaldehyde*	NR	ND
Furan*	NR	ND
Methanol*	NR	ND
Methyl Isocyanate*	NR	ND
Methyl Nitrite*	NR	ND
N-Nitrosodiethylamine*	NR	ND
N-Nitrosodimethylamine*	NR	ND
N-Nitrosomorpholine*	NR	ND
Propanenitrile*	NR	ND
Pyridine*	NR	ND
Tributyl Phosphate*	NR	ND

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

(b) Zero concentration values do not follow the general background trend for methane, therefore these data are not included in the table.

\*Chemical is on Chemical of Potential Concern (COPC) list

ND – Not detected

NR – Not reported properly

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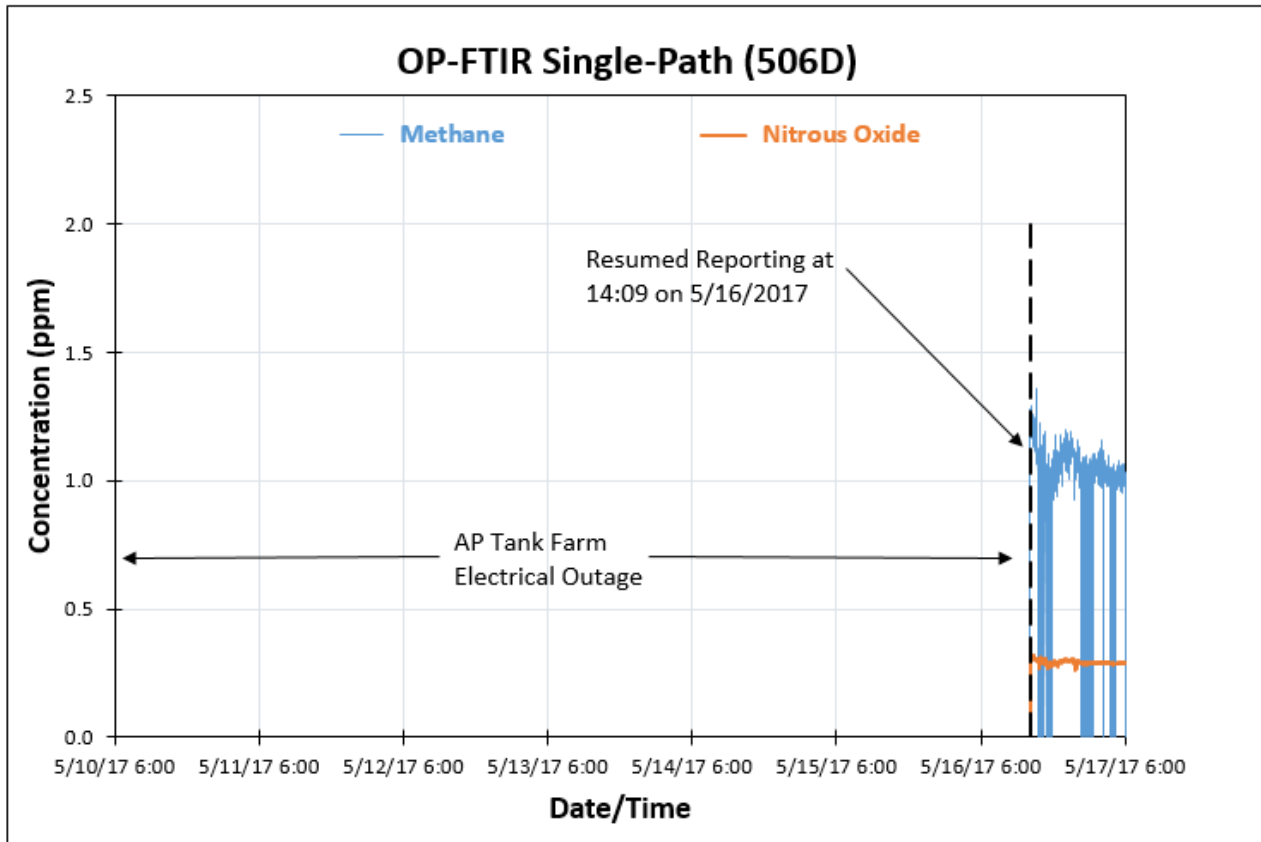
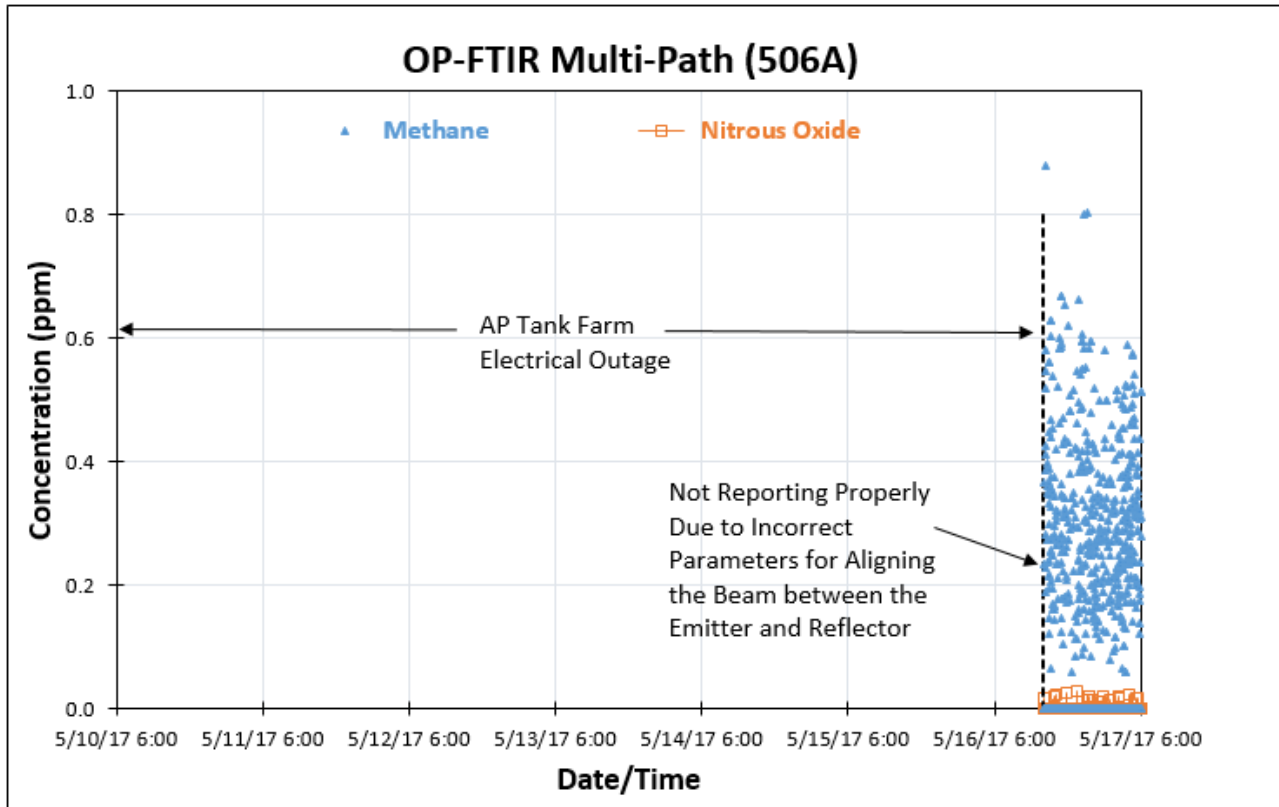


Figure 1. Chemical Compounds Detected by OP-FTIR Single-Path Instrument 506D

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**Figure 2. Chemical Compounds Reported by OP-FTIR Multi-Path Instrument 506A**

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

Instrument 512U, located between A and AP Tank Farm, is included.

FIS Gastronics (512 - NH<sub>3</sub>, VOCs): 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. All of these 512 instruments were calibrated successfully for NH<sub>3</sub> except for 512H, L, Q, P, and R in early May (5/1/2017 through 5/3/2017). The 512 instruments that passed calibration for VOC were 512A, B, C, D, E, F, H, I, J, L, O, P, and T. Early May was the last time these instruments were calibrated and no bump tests have been performed since this time. Instruments 512E, G, M, O, and S did not report data to OSI PI this week (for either NH<sub>3</sub> or VOC).

No ammonia was detected by Gastronics instruments that were in calibration and reporting this week. Five of the 512 units reported non-detects for VOC. Five units reported VOC at <2 ppm

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and no units reported VOCs  $\geq 2$  ppm (Table 2). A total VOC limit of 2 ppm currently is prescribed by Fact Sheet EH-09-001<sup>6</sup>.

**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	25	12	1 – 100
VOC (ppm)	<ul style="list-style-type: none"> <li>Out of Calibration: 512G, K, M, N, Q, R, T, and U</li> <li>Instruments that reported no VOCs detected: 512A, F, H, I, and J</li> <li>Instruments that reported a maximum value of &lt;2 ppm: 512B, C, D, L, and P</li> <li>Instruments that reported maximum values <math>\geq 2</math> ppm: None</li> </ul>	N/A	2	0.005 – 50 <sup>7</sup>

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

<sup>6</sup> Fact Sheet for Action Limit for Volatile Organic Compounds, Washington River Protection Solutions, Richland, Washington: <https://hanfordvapors.com/wp-content/uploads/2017/12/EH-09-001-Turnback-value-for-VOCs.pdf>

<sup>7</sup> FIS Gastronics Overview: <https://hanfordvapors.com/wp-content/uploads/2016/11/Gastronics-FIS-Fact-Sheet.pdf>

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



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## A TANK FARM

### A Tank Farm UV-DOAS Instrument

Ammonia, nitric oxide (NO), and p-xylene were reported by the instrument during the period under review. Only ammonia and nitric oxide were detected when instrument signal strengths were reliable and thus only these two compounds are reported in Table 3. The ammonia and nitric oxide concentrations listed in Table 3 are consistent with ammonia and nitric oxide background concentrations typically found in air<sup>9</sup>. Reported concentrations of p-xylene (ranging up to 0.018 ppm) and the maximum reported concentration of nitric oxide (0.11 ppm) occurred during the latter part of the week, on 5/16/2017, when the instrument signal strength was low (see Figure 3). Observations reported during periods when the signal strength is low (optical path between the instruments source and reflector is inhibited) are not considered valid and are not included in Table 3.

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

Chemical Compound	508A: UV-DOAS (ppm)	Chemical Compound	508A: UV-DOAS (ppm)
Ammonia*	ND – 0.044	Methyl Nitrite*	ND
Nitric Oxide	ND – 0.069	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.

(b) Data reported during intermittent times of low instrument signal strength are not included in the table

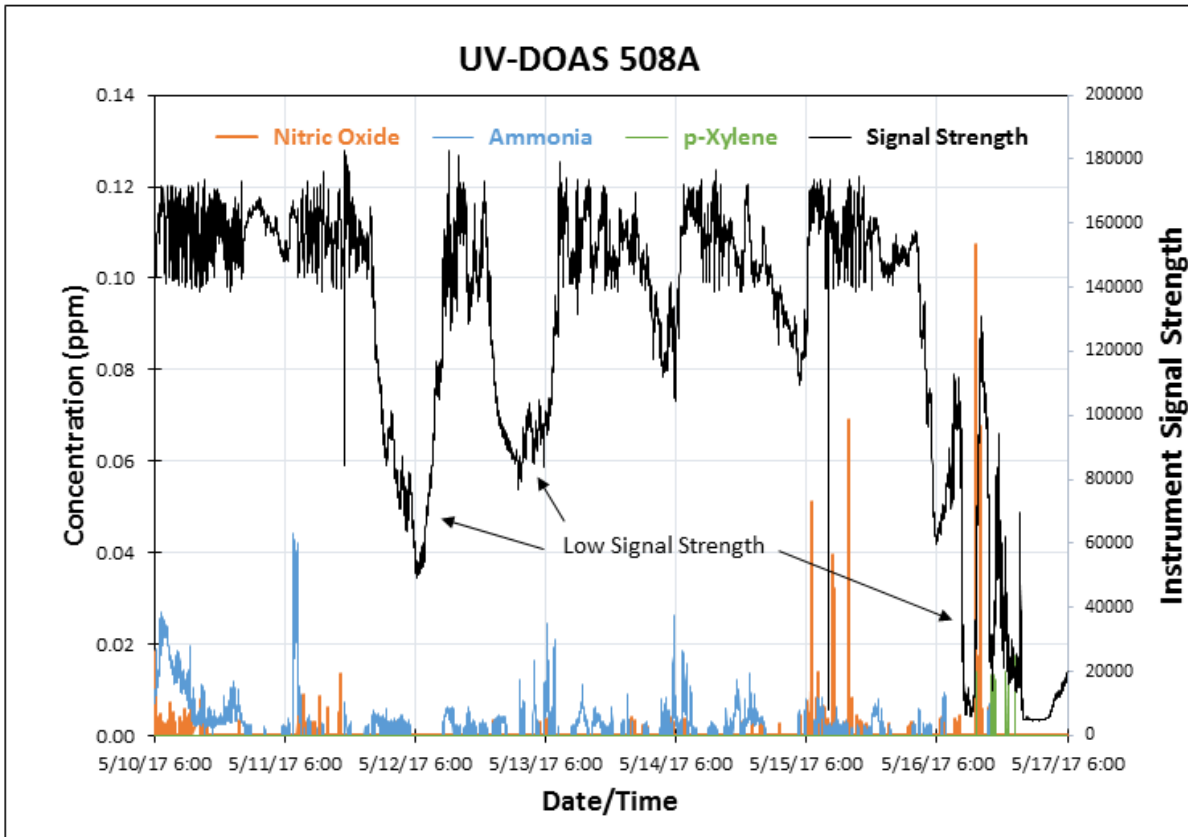
\*Chemical is on COPC list

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)

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**Figure 3. Chemical Compounds Detected by UV-DOAS Instrument 508A**

(signal strength data was obtained from files stored on the instrument, i.e., not OSI PI)

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

FIS Gastronics (512 - NH<sub>3</sub>, VOCs): Units located in A Tank Farm include: 512V, W, X, and Y. None of these instruments reported data to OSI PI due to lack of communication system capabilities. All of these instruments passed calibration for NH<sub>3</sub> on 5/2/2017. None of these instruments passed calibrated for VOC on 5/2/2017.

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## 5/10/2017 – 5/17/2017 Instrument Operational Status:

Time reporting is calculated using the time sensors that report to OSI PI System for each instrument (Tables 4 and 5).

**Table 4. Gastronics Direct Reading Instruments (512) % Time Reporting<sup>a</sup>**

Instrument	% Time Reporting	Instrument	% Time Reporting
512A	97	512N	1
512B	93	512O	0
512C	97	512P	51
512D	91	512Q	95
512E	0	512R	53
512F	98	512S	0
512G	0	512T	4
512H	97	512U	>99
512I	96	512V	0
512J	0	512W	0
512K	96	512X	0
512L	99	512Y	0
512M	0		

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

**Table 5. Spectrometer Instruments Time Reporting**

Instrument	% Time Reporting
506A	9
506D	9
508A	100