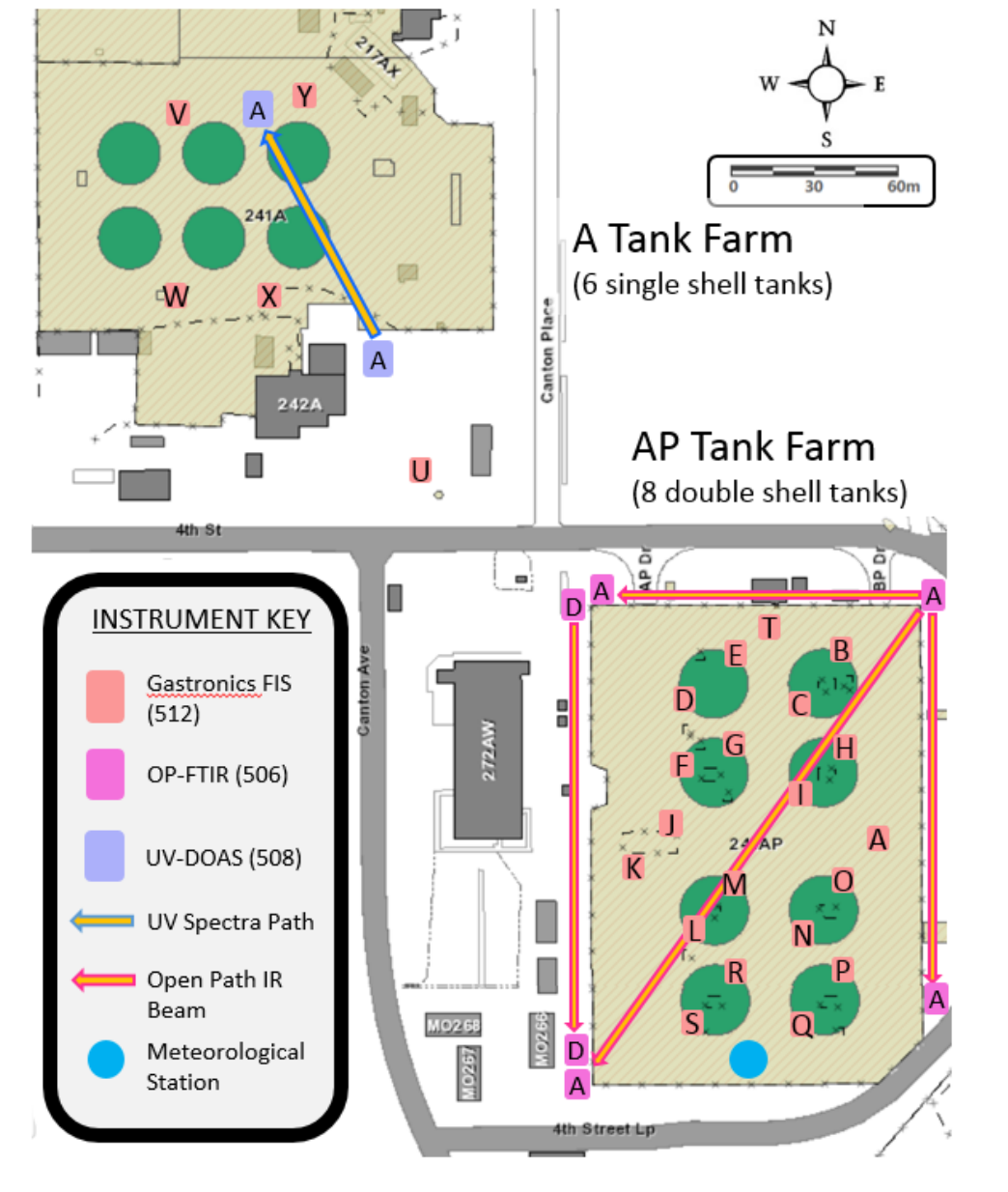


Vapor Monitoring and Detection System Weekly Report – A and AP Tank Farm Field Instrument Report

Revision 0 – Initial Release of Report

4/12/2017 6:00 – 4/19/2017 6:00

Instrument/Sampling Locations – A and AP Tank Farms



Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

Abbreviations and Units

CH ₄	=	methane
COPC	=	chemicals of potential concern
DRI	=	direct reading instrument
FIS	=	fixed instrument skid
IR	=	infrared
ND	=	not detected
NH ₃	=	ammonia
NO	=	nitric oxide
N ₂ O	=	nitrous oxide
NO ₂	=	nitrogen dioxide
OEL	=	occupational exposure limit
OP-FTIR	=	open path Fourier transform infrared spectrometer ¹
OSHA	=	Occupational Safety and Health Administration
PEL	=	permissible exposure limit
ppb	=	parts per billion
ppm	=	parts per million
TFMCS	=	Tank Farm Monitoring and Control System
UV	=	ultraviolet
UV-DOAS	=	ultraviolet differential optical absorption spectrometer ²
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	=	OP-FTIR Single-Path
508A	=	UV-DOAS
512	=	FIS Gastronics Direct Reading Instrument

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

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

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week (4/12/2017 at 6:00 a.m. through 4/19/2017 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 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 identification for the single-path FTIR instrument 506B has been changed to 506D in the OSI Pi³ system. The change from 506B to 506D was necessary to be consistent with TFMCS (Tank Farm Monitoring and Control System), which refers to this unit as 506D. Open path

³ OSI PI System is a data visualization software package from [OSIsoft](http://www.osisoft.com).

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

reports for 4/12/2017 forward will identify this instrument as 506D. At this time there are no plans to update previous weekly reports, which identified this instrument as 506B.

The direct read instruments (DRI) located within AP and A Tank Farms include the Fixed Instrument Skid (FIS) Gastronics (512) units with sensors for detecting NH₃ and VOCs. Communications issues, due to random Wi-Fi signal interruption, result in frequent loss of FIS Gastronics data.

Summary for 4/12/2017 through 4/19/2017

The following sections summarize data reporting for vapor monitoring and detection instruments at AP and A Tank Farms for the 4/12/2017 through 4/19/2017 period. Instruments at AP Tank Farm include open path FTIR instruments (multi-path and single-path) and most of the FIS Gastronics direct reading instruments. Instruments at A Tank Farm include the UV-DOAS spectrographic instrument and a few FIS Gastronics direct reading instruments. Supernatant waste was transferred between two double-shell tanks, AN-101 and AN-106, on 4/14/2017 and 4/15/2017. No increased readings or changes in data which correlate to this work were observed in the A and AP Tank Farms VMDS instrumentation during or after the completion of this transfer.

AP TANK FARM

AP Tank Farm OP-FTIR Instruments

During the week in review, both the OP-FTIR multi-path and single-path instruments (506A and 506D) detected nitrous oxide (N₂O) and methane (CH₄) (Table 1). Nitrous oxide and methane are typically found in the atmosphere at background levels of approximately 0.33 ppm for N₂O and 1.8 ppm for CH₄⁴. Values reported are consistent with background levels, see Table 1 and Figures 1 and 2 below. Consistency in measured values for these compounds indicates that the OP-FTIR units were effectively measuring composition of the gas components within its path.

⁴ Climate Change Indicators: Atmospheric Concentration of Greenhouse Gases: <https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases>

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

Table 1. Chemical Species Detected^a on Open Path FTIRs at AP Tank Farm.

Chemical Compound	506A: OP-FTIR Multi-Path (ppm)	506D: OP-FTIR Single-Path (ppm)
Nitrous Oxide*	0.17 – 0.45 ^b	0.29 – 0.37 ^b
Ammonia*	ND	ND
Methane	1.0 – 2.5 ^b	1.4 – 1.7 ^b
1,3-Butadiene*	ND	ND
1-Butanol*	ND	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) Isolated concentrations of zero or near zero do not follow the general trend for nitrous oxide and methane at background levels in the atmosphere, and therefore these concentrations are not included in the table
- *Chemical is on COPC list
 ND – Not detected

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

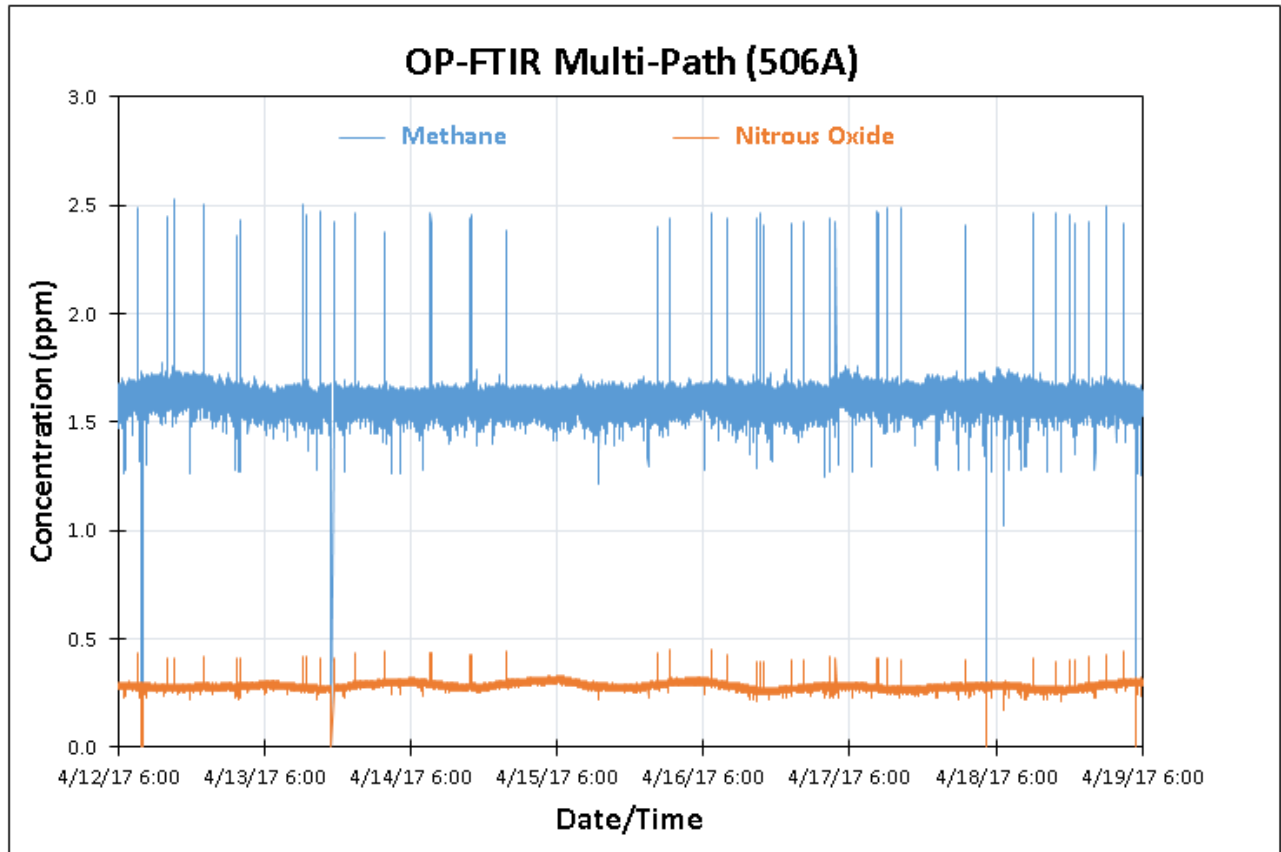


Figure 1. Chemical Compounds Detected by the OP-FTIR Multi-Path (506A) Instrument.

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

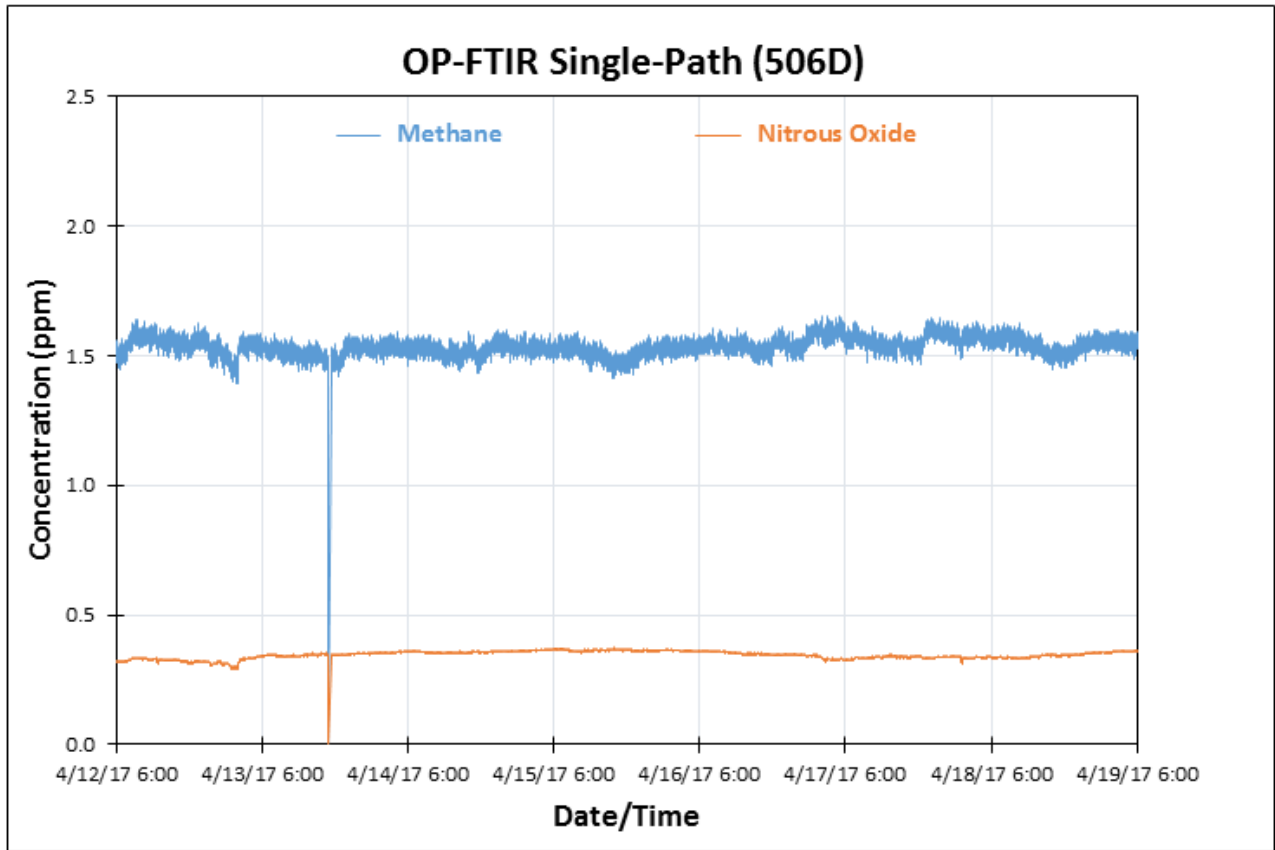


Figure 2. Chemical Compounds Detected by the OP-FTIR Single-Path (506D) Instrument.

AP Tank Farm Direct Reading Instruments

Instrument 512U, located between AP and A tank farms, is included.

FIS Gastronics (512 - NH₃, VOCs, N₂O): 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. Calibrations for VOC and NH₃ were performed on units 512C, D, F, G, I, J, L, and N on 4/12/2017. Calibration checks for VOC and NH₃ were performed on all 512 instruments on either 4/17/2017 or 4/18/2017. All ammonia sensors were in calibration, except for 512R, P, and U. No ammonia was detected by Gastronics instruments that were in calibration and reporting this week.

Four of the instruments (512E, K, R, and T) were in calibration for VOC during the entire week, and five of the VOC sensors (512A, B, M, O, and U) were in calibration for part of the week. Two units reported VOC non-zero VOC at concentrations <2 ppm and no units reported VOCs

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

≥2 ppm. A total VOC action limit of 2 ppm currently is prescribed by Fact Sheet EH-09-001.⁵ The N₂O sensors do not hold calibration and are not reported. Only instruments that are reporting to OSI PI 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 ₃ (ppm)	No ammonia detected	25	12	1 – 100
VOC (ppm)	<p>In Calibration*: 512C, D, E, F, G, H, I, J, K, L, N, P, Q, R, S, and T</p> <ul style="list-style-type: none"> • Instruments that reported no VOCs detected: 512C, F, G, H, I, K, L, N, Q, R, S, and T • Instruments that reported a maximum value of <2 ppm: 512D and P • Instruments that reported maximum values ≥2 ppm: None 	N/A	2	0.005 – 50 ⁶

* VOC: Only instruments reading within 10% of the calibration gas concentration during their most recent bump/calibration test are reported here. Many of the VOC sensors were in calibration during different periods of the week⁷.

⁵ 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>

⁶ FIS Gastronics Overview: <https://hanfordvapors.com/wp-content/uploads/2016/11/Gastronics-FIS-Fact-Sheet.pdf>

⁷ Calibrating and Testing Direct-Reading Portable Gas Monitors: <https://www.osha.gov/dts/shib/shib093013.html>

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 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. Ammonia concentrations are discussed in Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring during Waste Disturbing Activities and Background Study⁸. The PEL for nitric oxide is 25 ppm⁹. Analyte concentrations are reported in Table 3 and Figure 3 below.

Table 3. Chemical Species Detected^a by UV-DOAS at A Tank Farm

Chemical Compound	508A: UV-DOAS (ppm)	Chemical Compound	508A: UV-DOAS (ppm)
Ammonia*	ND – 0.052	Methyl Nitrite*	ND
Nitric Oxide	ND – 0.050	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

⁸ Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study (Figure 6-9): <https://hanfordvapors.com/wp-content/uploads/2018/01/PTR-MS-Targeted-Campaign-FY2017-Report-PBI-34.0.2.pdf>

⁹ Background concentrations of nitric oxide are not typically reported, however, its concentration is significantly lower than the PEL of 25 ppm: <https://www.osha.gov/dsg/annotated-pels/tablez-1.html>

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

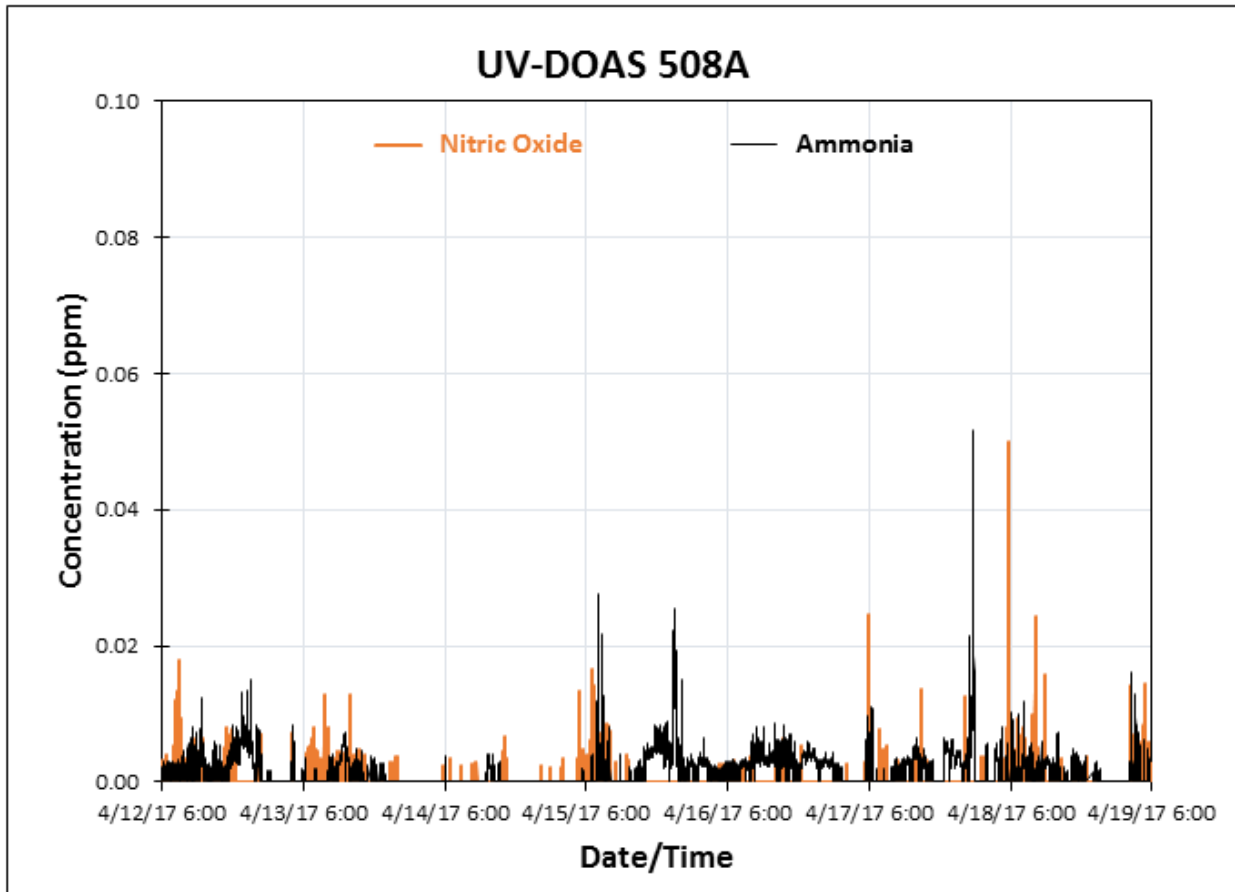


Figure 3. Chemical Compounds Detected by UV-DOAS (508A).

Vapor Monitoring and Detection System Weekly Report

4/12/2017 6:00 – 4/19/2017 6:00

A Tank Farm Direct Reading Instruments

FIS Gastronics (512 - NH₃, VOCs, N₂O): Units located in A Tank Farm include: 512V, W, X, and Y. None of these instruments reported data during the week. Calibration checks were performed on 512V, W, X, and Y during this week (4/18/2017). All four of the NH₃ sensors were in calibration and only 512Y was in calibration for VOC. Since these instruments did not communicate with the OSI Pi system, no data is available and a summary table is not provided.

4/12/2017 – 4/19/2017 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^a.

Instrument	% Time Reporting	Instrument	% Time Reporting
512A	96	512N	61
512B	94	512O	0
512C	97	512P	60
512D	90	512Q	36
512E	0	512R	56
512F	94	512S	<1
512G	65	512T	7
512H	97	512U	>99
512I	96	512V	0
512J	<1	512W	0
512K	96	512X	0
512L	97	512Y	0
512M	95		

(a) % time reporting based on NH₃.

Table 5. Spectrometer Instruments Time Reporting.

Instrument	% Time Reporting
506A	>99
506D	>99
508A	>99