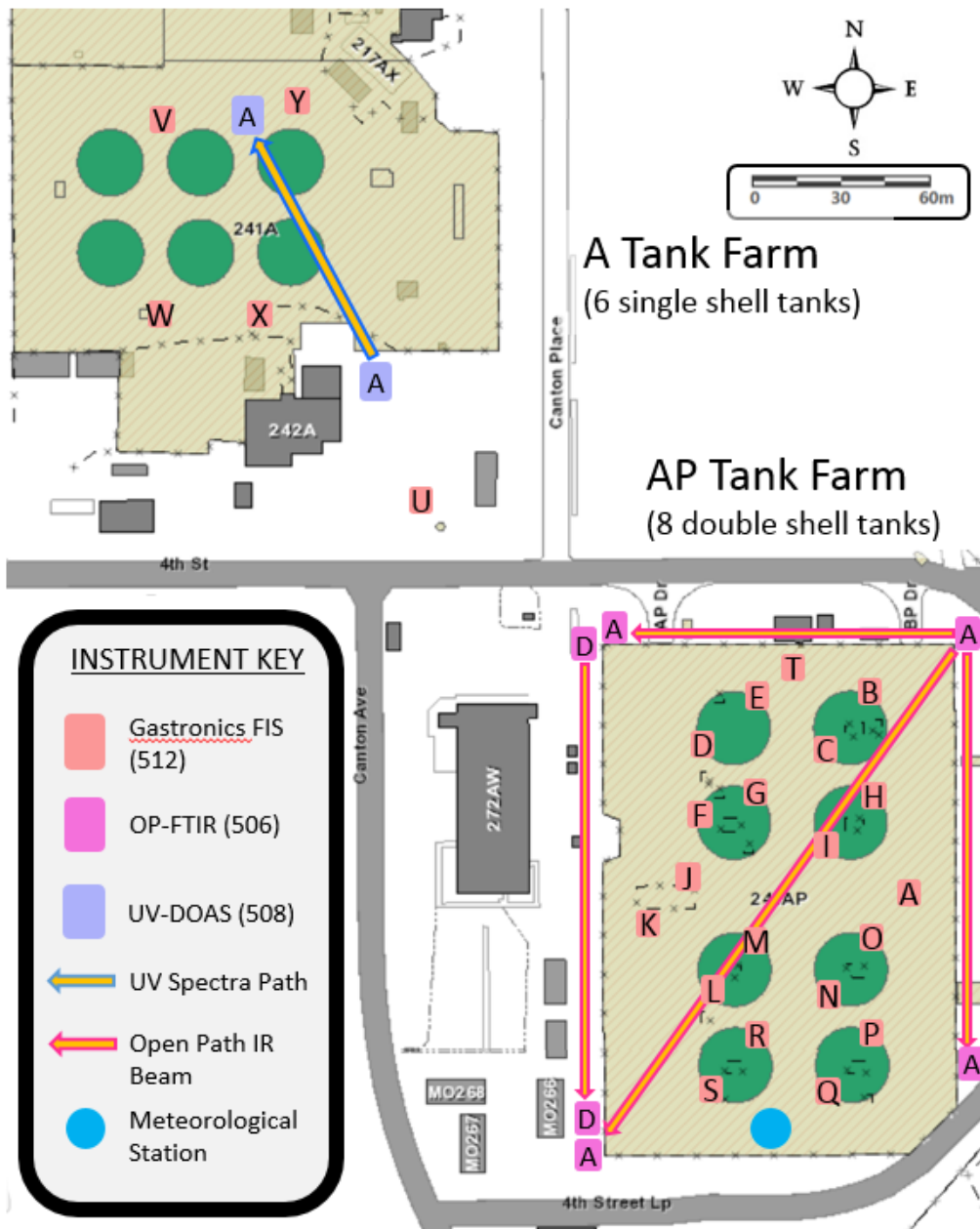


Vapor Monitoring and Detection System Weekly Report – A and AP Tank Farm Field Instrument Report

Revision 0 – Initial Release of Report

5/17/2017 6:00 – 5/24/2017 6:00

Instrument/Sampling Locations – A and AP Tank Farms



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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
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 ³	=	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>

³ 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 (5/17/2017 at 6:00 a.m. through 5/24/2017 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 spectroscopy 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 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 FIS Gastronics (512) units with sensors for detecting NH₃ 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 5/17/2017 through 5/24/2017

The following sections summarize data reporting for vapor monitoring and detection instruments at AP and A Tank Farms for the 5/17/2017 through 5/24/2017 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 an open path UV-DOAS spectroscopy instrument and a few FIS Gastronics direct reading instruments. As of 5/23/2017, it was determined that no further maintenance or calibration would be performed on the Gastronics units. At that time, all alarms for the Gastronics system were inhibited because no calibrations would be performed. Therefore, FIS Gastronics direct reading instrument data are not reported after 5/23/2017. No waste retrieval activities occurred during this reporting period.

AP TANK FARM

AP Tank Farm OP-FTIR Instruments

VMDS testing was put on hold most of the week because access to the AP Tank Farm was restricted due to work on the tank farm ventilation system. During the week in review, instrument 506A instrument's signal strength was poor because the parameters aligning the beam between the spectroscopy emitter and reflector were incorrect, and therefore data reported to OSI Pi System⁴ are not valid and not reported in Table 1. At 09:46 on 5/17/2017, instrument 506A stopped reporting data to the OSI Pi System and did not report data during the remainder of the week.

Instrument 506D detected N₂O and CH₄ during this week (Table 1 and Figure 1). Nitrous oxide and CH₄ are typically found in the atmosphere at background levels of approximately 0.33 ppm for N₂O and 1.8 ppm for CH₄⁵; values reported here are consistent with typical background concentrations. At 13:52 on 5/17/2017, instrument 506D stopped reporting data to the OSI Pi System and did not resume reporting data until 5/23/2017 09:37.

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

⁵ 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^a on Open Path FTIRs at AP Tank Farm.

Chemical Compound	506A: OP-FTIR Multi-Path (ppm) ^b	506D: OP-FTIR Single-Path (ppm)
Nitrous Oxide*	NR	0.27 – 0.36 ^c
Ammonia*	NR	ND
Methane	NR	0.94 – 1.8 ^c
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) Reported data are considered not valid due to low instrument signal strength.

(c) Isolated concentrations of zero do not follow the general background trend for nitrous oxide and methane, therefore these concentrations are not included in the table.

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

ND – Not detected

NR – Not reporting properly

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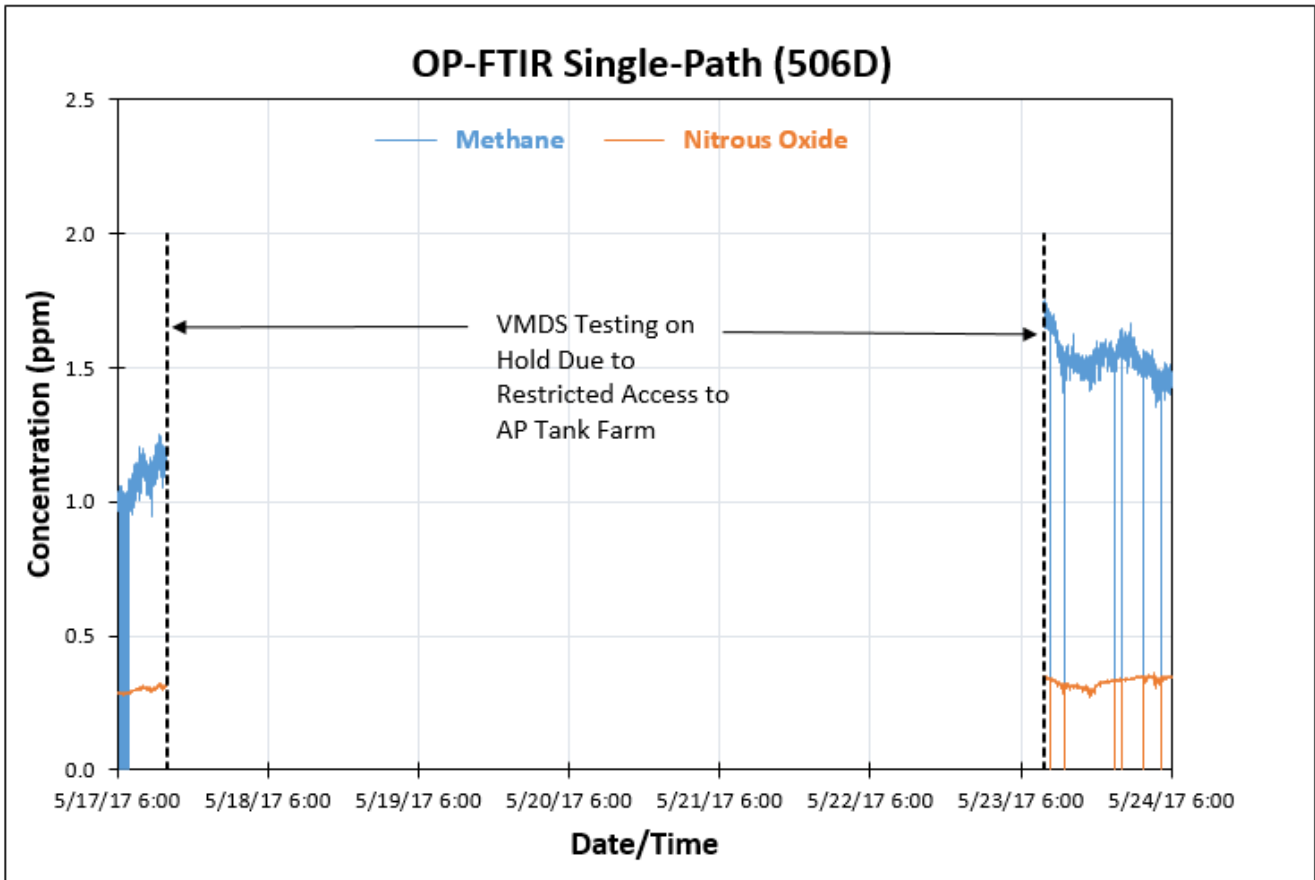


Figure 1. Chemical Compounds Detected by the OP-FTIR Single-Path (506D) Instrument.

AP Tank Farm Direct Reading Instruments

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

FIS Gastronics (512 - NH₃, 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. Unit 512U is located between AP Tank Farm and the A Tank Farm. All of these 512 instruments were calibrated successfully for NH₃ 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 S. VOC calibration was performed at the same time as NH₃ calibration was performed, and that was the last time these instruments were either calibrated or bump tested for NH₃ and VOCs. Instruments 512E, G, M, O, and S did not report data to OSI PI this week.

No ammonia was detected by Gastronics instruments that were in calibration and reporting this week. Four of the NH₃ sensors (512H, L, Q, and R) continued to report repeated values of 2 ppm this week, which began immediately after the early May calibrations. The 2 ppm NH₃

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readings from these four 512 units are the result of incorrectly re-zeroing the instrument during calibration and are not considered to be valid. Six of the 512 units reported non-detects for VOC. Four units reported VOC at <2 ppm and no units reported VOCs \geq 2 ppm (Table 2). A total VOC limit of 2 ppm currently is prescribed by Fact Sheet EH-09-001⁶.

The Gastronics instruments stopped reporting to the OSI Pi System at 5/17/2017 13:52 and did not resume reporting until 5/23/2017 09:38. VMDS testing was put on hold during this time because of restricted access to the AP Tank Farm due to work on the tank farm ventilation system. All alarms for the Gastronics system were inhibited on 5/23/2017 because no calibration checks were performed after May 3, 2017. It was determined that no further maintenance or calibration would be performed on the Gastronics units as of 5/23/2017.

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

Chemical Compound (units)	Comment	OEL	Action Level	Detection Range
NH ₃ (ppm)	No ammonia reported on any instrument	25	12	1 – 100
VOC (ppm)	<ul style="list-style-type: none"> Out of Calibration: 512G, K, M, N, Q, R, T, and U Instruments that reported no VOC detections: 512A, F, H, I, J, and L Instruments that reported a maximum value of <2 ppm: 512B, C, D, and P Instruments that reported maximum values \geq2 ppm: None 	N/A	2	0.005 – 50 ⁷

VOC: Only instruments reading within 10% of the calibration gas concentration during their most recent bump/calibration test are reported here⁸.

⁶ 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>

⁷ One-Page Fact Sheet for Gastronics Fixed Instrument Skid, Tank Farm Vapors Control Team: <https://hanfordvapors.com/wp-content/uploads/2016/11/Gastronics-FIS-Fact-Sheet.pdf>

⁸ 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 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^{9,10}. This instrument stopped reporting to the OSI Pi System at 5/17/2017 13:52 and did not resume reporting until 5/23/2017 09:37. VMDS testing was put on hold because of restricted access to the AP Tank Farm due to work on the tank farm ventilation system during this time. Analyte concentrations are reported in Table 3 and Figure 2 below, and are typical of concentrations found in air.

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

Chemical Compound	508A: UV-DOAS (ppm)	Chemical Compound	508A: UV-DOAS (ppm)
Ammonia*	ND – 0.029	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

⁹ 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>

¹⁰ Background concentrations of nitric oxide are not typically reported, however, the concentration reported is significantly lower than the PEL of 25 ppm: <https://www.osha.gov/dsg/annotated-pels/tablez-1.html>

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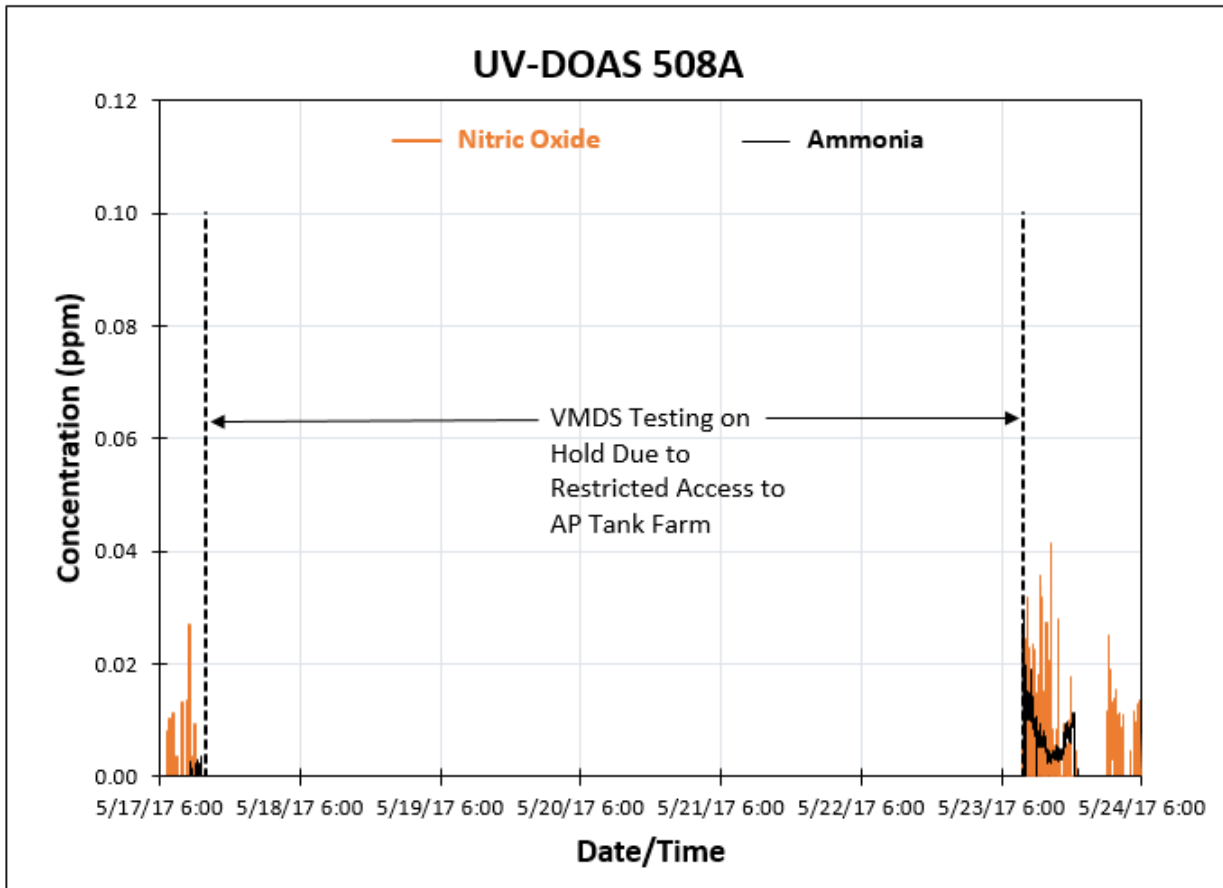


Figure 2. Chemical Compounds Detected by UV-DOAS (508A).

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A Tank Farm Direct Reading Instruments

FIS Gastronics (512 - NH₃, VOCs): Units located in A Tank Farm include: 512V, W, X, and Y. None of these instruments reported data during the week. No calibrations or calibration checks were performed on these instrument during the week. As of 5/23/2017, it was determined that no further maintenance or calibration would be performed on the FIS Gastronics units. At that time, all alarms for the Gastronics system were inhibited because no calibrations would be performed. Therefore, FIS Gastronics direct reading instrument data are not reported after 5/23/2017.

5/17/2017 – 5/24/2017 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	13	512N	4
512B	15	512O	0
512C	13	512P	6
512D	14	512Q	6
512E	0	512R	7
512F	16	512S	0
512G	0	512T	<1
512H	16	512U	15
512I	15	512V	0
512J	<1	512W	0
512K	16	512X	0
512L	16	512Y	0
512M	0		

(a) % time reporting based on NH₃.

Table 5. Spectrometer Instruments Time Reporting.

Instrument	% Time Reporting
506A	2
506D	17
508A	17