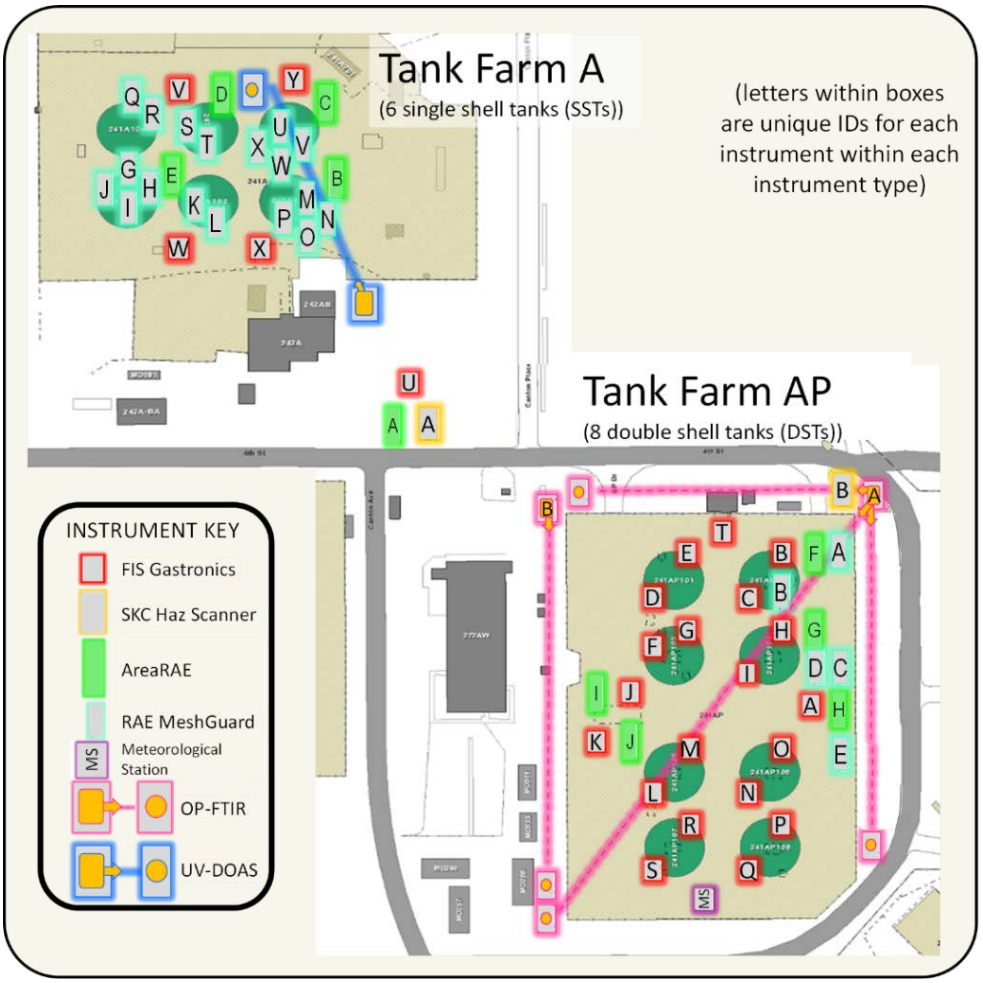
UV-DOAS Weekly Summary

12/28/16 6:00 – 01/04/17 6:00



The following information is for the time period from December 28th at 6:00 a.m. through January 4th at 6:00 a.m. This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week for the ultraviolet differential optical absorption spectrometer (UV-DOAS). Pilot-scale testing is focused on evaluating component integration and functionality. Data shown may include results from calibration and bump tests performed to verify sensors function. These tests result in data spikes.

Abbreviations:

NH_3 = ammonia
ND = not detected
NO = nitric oxide
O_2 = oxygen
O_3 = ozone
OEL = Occupational Exposure Limit
PEL = Permissible Exposure Limit
R^2 = R-squared
UV-DOAS = Ultraviolet Differential Optical Absorption Spectrometer
VMDS = Vapor Monitoring and Detection System

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Weekly Summary: Even though the instrument is very accurate regarding the quantification of compounds, reported results cannot be directly calculated into a concentration for a specific location. This is because the sample encompasses 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, discussion for these instrument types will not be with regards to Operational Exposure Limits (OELs) and Action Levels.

Each analyte has a specific predetermined UV trace which represents the model for that chemical. The detection and reporting of that chemical is based on evaluation of the R-squared (R^2) values (coefficient of determination) calculated by comparing the detection trace to the model trace for that chemical. R^2 is a statistical value representing the "percent of variance explained" by evaluating the detected trace with the model trace, or an estimate of how well the two traces match. R^2 values range from 0 to 1 with higher values indicating a better fit. R^2 values for UV-DOAS data are dependent on sample concentration, chemical compounds [chemicals present can interfere/overlap with each other at key locations; typically those having the same functional groups (e.g., methane or ketone groups)], and many other factors. Results presented here are for compounds having an R^2 value of greater than or equal to 0.5.

The UV-DOAS spectrometer provides real-time multi-gas measurement (qualification and quantification) of gases[1]. While sampling during the period under review ammonia (NH_3), nitric oxide (NO), ozone (O_3), nitrogen dioxide (NO_2), and p-xylene were reported by the instrument. Many of these are typically found in detectable quantities in background air[2]. P-xylene has a permissible exposure limit (PEL) of 100 ppm[3] and ambient air concentrations (as mixed xylenes) range from 0.001 to 0.088 ppm[4] in urban areas of the United States. No other chemicals were detected during this monitoring period.

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[1] UV-DOAS Quick Sheet: http://hanfordvapors.com/wp-content/uploads/2016/10/UV-DOAS-Fact-Sheet.pdf

[2] Air Composition from "The Engineering ToolBox": http://www.engineeringtoolbox.com/air-composition-d_212.html

[3] OSHA: https://www.osha.gov/dts/chemicalsampling/data/CH_276400.html

[4] EPA: https://www.epa.gov/sites/production/files/2016-09/documents/xylenes.pdf

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December 28th 2016 – January 4th 2017 Instrument Notes:

Table 1. Chemical Species Detected on UV-DOAS at A Tank Farm.

Chemical	508A: UV-DOAS	Chemical	508A: UV-DOAS
Ammonia*	ND – 0.044 ppm	Methyl Nitrite*	ND
Nitric Oxide	ND – 0.089 ppm	Pyridine*	ND
Ozone	ND – 0.128 ppm	1-2-4 Trimethylbenzene	ND
1-3 Butadiene*	ND	1-3-5 Trimethylbenzene	ND
2-Methyl-2-butenal*	ND	Ethylbenzene	ND
2-Methylfuran*	ND	m-Xylene	ND
Acetaldehyde*	ND	Nitrogen Dioxide	ND – 0.308
Benzene*	ND	o-Xylene	ND
Butanal*	ND	p-Xylene	ND – 0.023 ppm
Ethylamine*	ND	Styrene	ND
Formaldehyde*	ND	Sulfur Dioxide	ND
Furan*	ND	Toluene	ND
Mercury*	ND		

Notes: *Chemical is on COPC list

ND – Not detected by instrument (either 0 was reported or the R2 value was <0.5)

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Figure 1. Concentrations of Chemicals Detected by UV-DOAS (508A).

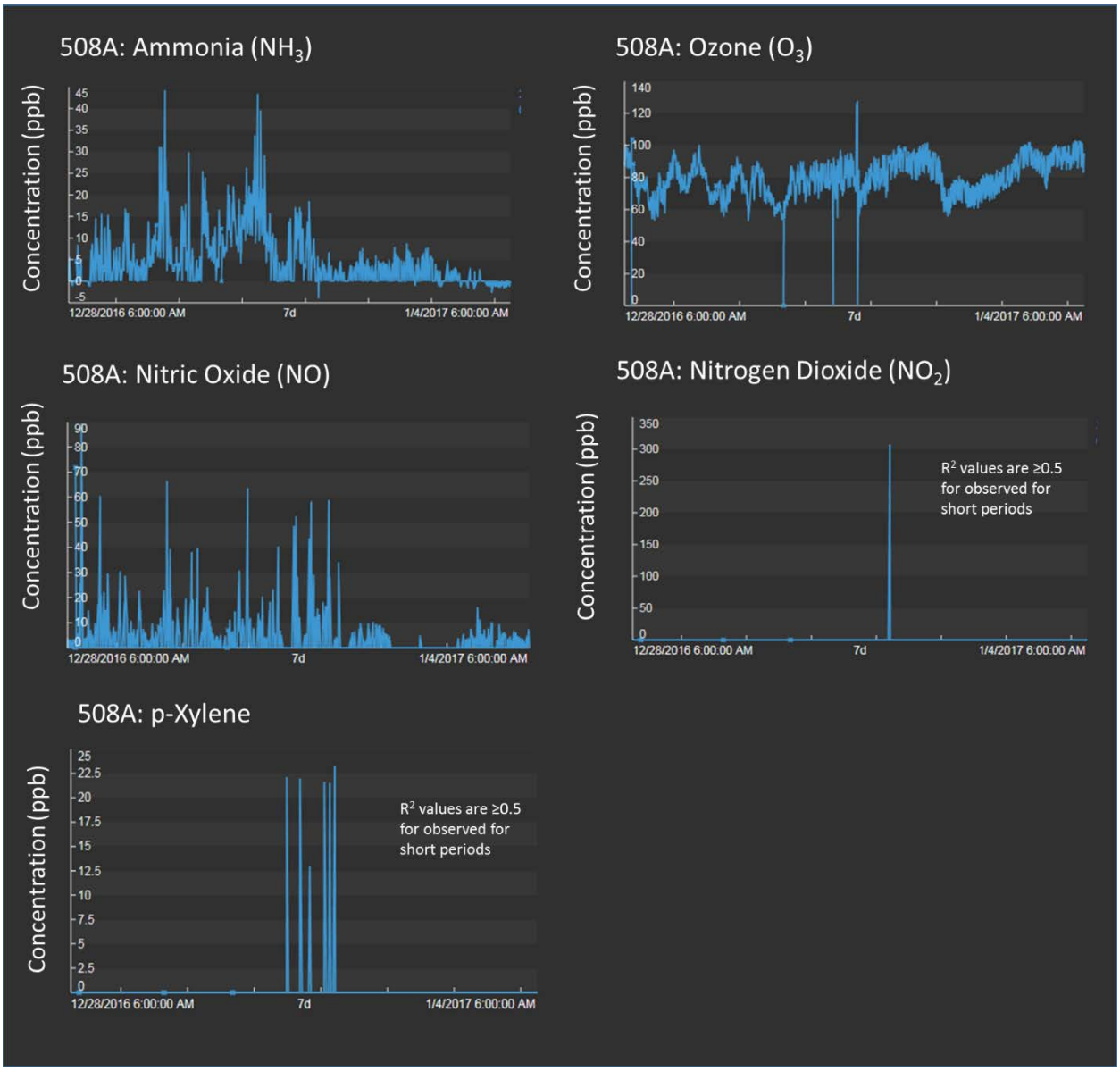

Table 2. UV-DOAS Instrument Time Reporting[a].

Instrument	Comments
508A	The instrument was reporting 100% of the time.

Notes: % time reporting is based on review of OSI PI System[5] data.

[5] OSI PI System is a data visualization software package from OSIsoft.