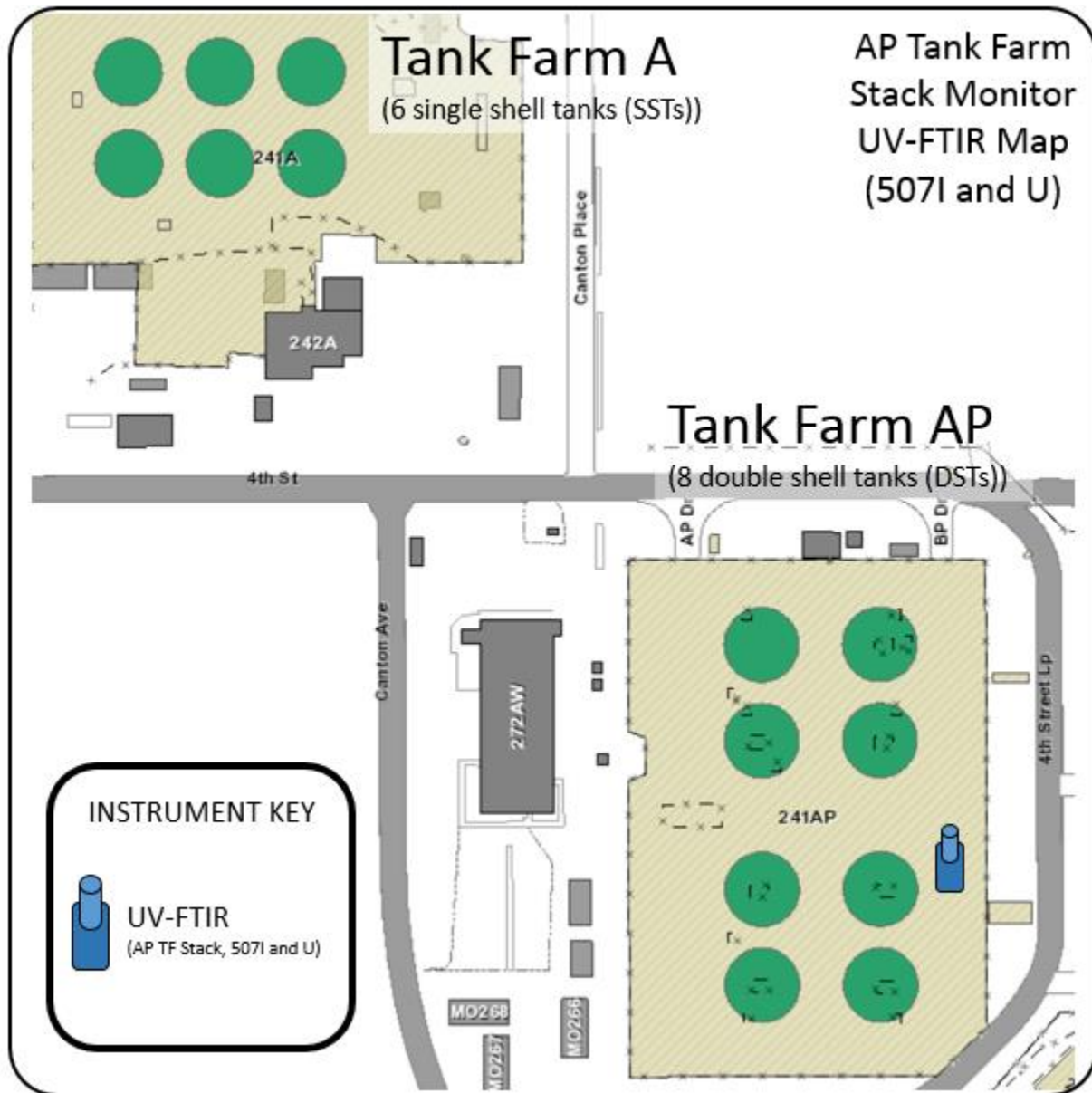


Vapor Monitoring Detection System Weekly Report – AP Tank Farm Stack Monitoring

Revision 0: Initial Release of Report

12/21/2016 – 12/28/2016

AP-Tank Farm Stack Monitor (north is up)



Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

Abbreviations and Units

CH ₄	=	methane
CO	=	carbon monoxide
CO ₂	=	carbon dioxide
COPC	=	chemicals of potential concern
IDMS	=	Integrated Document Management System
FTIR	=	Fourier transform infrared spectrometer
IR	=	infrared
ND	=	not detected
NH ₃	=	ammonia
NO	=	nitric oxide
N ₂ O	=	nitrous oxide
NO ₂	=	nitrogen dioxide
O ₃	=	ozone
OEL	=	occupational exposure limit
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
UV-FTIR	=	ultraviolet - Fourier transform infrared (representing both analytical elements of the instrument, the UV and IR modules)
VMDS	=	vapor monitoring detection system

VMDS Instruments

507	=	ultraviolet - Fourier transform infrared (UV-FTIR) AP Farm Stack
507I	=	FTIR AP Farm Stack
507U	=	UV-DOAS AP Farm Stack

Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week (12/21/2016 at 6:00 a.m. through 12/28/2016 at 6:00 a.m.) using the AP-Farm stack monitor¹. This instrument is a dual channel FTIR/UV-DOAS spectrometer that provides real-time multi-gas measurement (qualitative and quantitative) of gases. The concentrations detected for the 507I (FTIR) and 507U (UV-DOAS) shall be reported separately. The implementation method for this instrument allows for very accurate identification and quantification of compounds found in the AP-Farm exhaust stack.

Chemical compounds found in the stack are not representative of what is found in the work environment, so their concentrations are not reviewed against Occupational Exposure Limits (OELs) or other limits implemented in work environments. This review focuses on chemicals present, patterns, and observations during waste disturbing activities.

Pilot-scale testing is focused on evaluating component integration and functionality. Data shown may include results for calibration and calibration check (bump test) 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.

For the stack monitor, 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.

¹ AP-Farm Stack Monitor Fact Sheet: <https://hanfordvapors.com/wp-content/uploads/2016/11/UV-FTIR-Fact-Sheet.pdf>

Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

12/21/2016 through 12/28/2016 Summary

Retrieval activities associated with AY-102 included several nights when the slurry and supernate pumps were utilized during the reporting period. Retrieval activities that started at 21:19 on 12/21/2016 and ended at 19:40 on 12/23/2016 had six pump stops and restarts where the longest retrieval downtime was approximately two hours. Retrieval activity resumed on 12/27/2016 and 12/28/2016. Note that, in the figures below, the supernate pump start time lines have been widened to make them more readily visible – start and stop times are often very close together, resulting in difficulty to distinguish them. Figure 1 below shows the observed concentrations of ammonia measured by the 507I (FTIR) instrument in the AP Farm stack. Figure 2 shows the nitrous oxide concentrations from the 507I. The nitrous oxide concentrations responded to the start of retrieval activities throughout the week, with the highest increasing increase in concentration, to 5.6 ppm, occurring on 12/22/2016, Figure 2. Table 1 shows that ammonia concentrations were from 39 to 63 ppm (507I and 507U), nitrous oxide concentrations ranged from 2.7 to 5.6 ppm (507I), mercury concentrations ranged from non-detect to 0.00015 ppm (507U), and m-xylene concentrations ranged from non-detect to 0.095 ppm (507U). The 507U (DOAS) instrument detected ammonia during the reporting period as shown in Figure 3. Figure 3 shows that the concentrations of ammonia do not appear to respond to retrieval activities during the reporting period. Figures 4 and 5 show concentrations measured from 507U of mercury and m-xylene, respectively. Mercury concentrations did respond to retrieval activities with the highest peak occurring on 12/27/2016 shortly after the start of operations. Table 2 shows the reporting time of the stack monitors. Both the 507I and the 507U monitored for 100% of the reporting period.

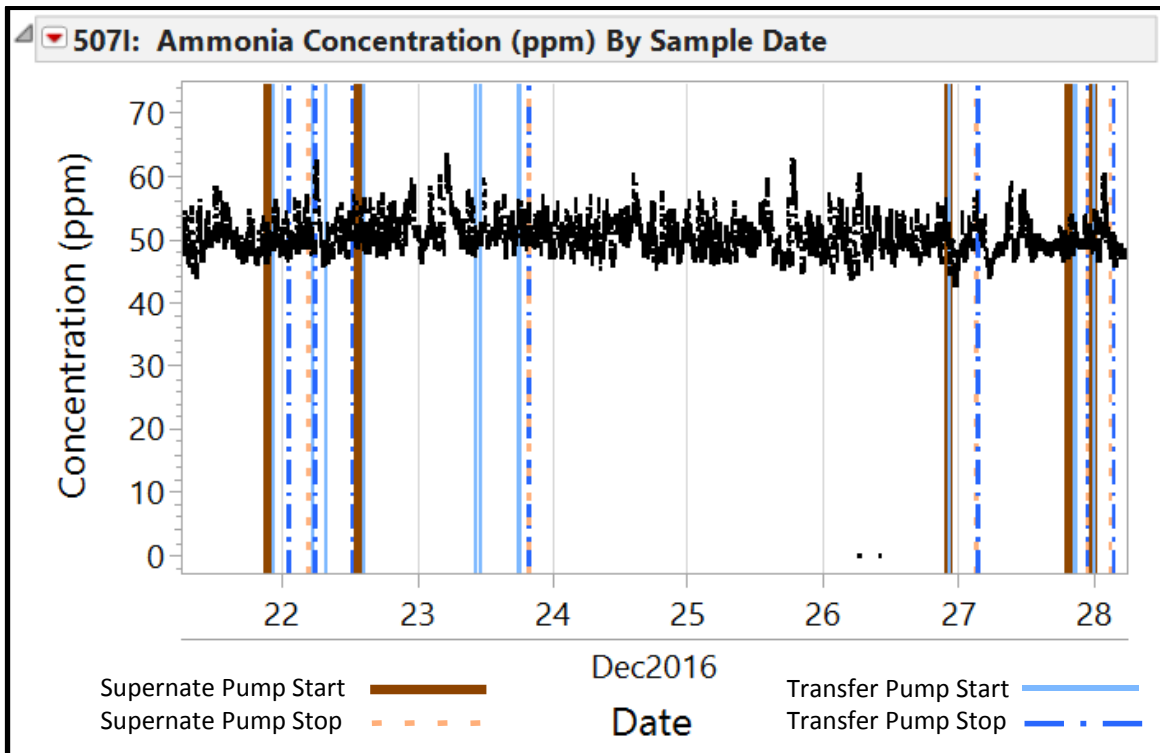
The collection of 507U data for this reporting week preceded library changes performed on 3/8/2017, so data were reprocessed to determine if compounds were correctly detected by the instrument. The reprocessed data with the optimized library minimizes false-positive and false negative readings of compounds that showed as detections and reported in OSI PI². The data were reprocessed and the output data can be obtained from Integrated Document Management System (IDMS).

² OSI PI System is a data visualization software package from [OSIsoft](#).

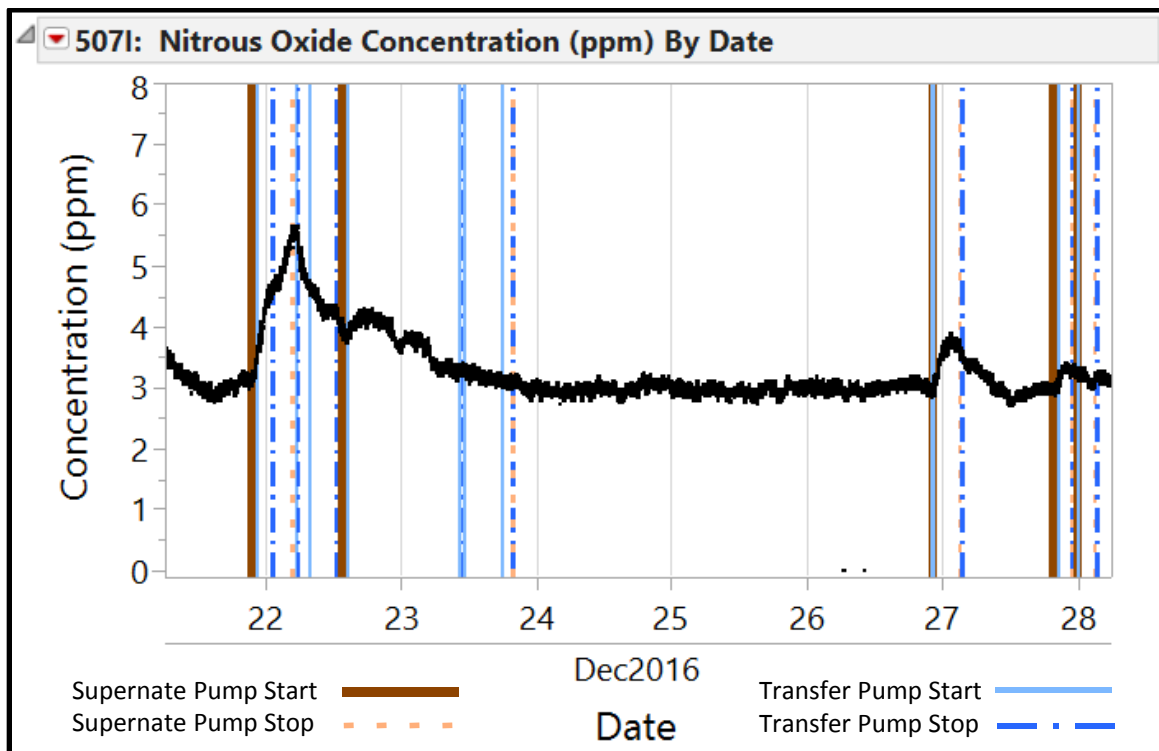
Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

**Figure 1. FTIR (507I) NH₃ Data recorded from AP Farm Exhauster
(Note that concentration units are ppm)**



**Figure 2. FTIR (507I) N₂O Data recorded from AP Farm Exhauster
(Note that concentration units are ppm)**



Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

Table 1. Chemical Species Detected in the AP Tank Farm Stack by Method

Chemical	507I ^a (FTIR) ppm	Chemical	507U ^b (UV-DOAS) ppm
Ammonia*	43 – 63 ^c	Ammonia*	39 – 59
Nitrous Oxide*	2.7 – 5.6 ^c	Nitric Oxide	ND
Methane	ND	Oxygen	ND
1,3-Butadiene*	ND	Ozone	ND
1-Butanol*	ND	1,3-Butadiene*	ND
2-Hexanone*	ND	2-Methyl-2-butenal*	ND
3-Buten-2-one*	ND	2-Methylfuran*	ND
Acetaldehyde*	ND	Acetaldehyde*	ND
Acetonitrile*	ND	Benzene*	ND
Benzene*	ND	Butanal*	ND
Butanal*	ND	Ethylamine*	ND
Butyl Nitrite*	ND	Formaldehyde*	ND
Ethylamine*	ND	Furan*	ND
Formaldehyde*	ND	Mercury*	ND – 0.00015
Furan*	ND	Methyl Nitrite*	ND
Methanol*	ND	Pyridine*	ND
Methyl Isocyanate*	ND	1,2,4 Trimethylbenzene	ND
Methyl Nitrite*	ND	1,3,5 Trimethylbenzene	ND
N-Nitrosodiethylamine*	ND	Ethylbenzene	ND
N-Nitrosodimethylamine*	ND	m-Xylene	ND – 0.095
N-Nitrosomorpholine*	ND	Nitrogen Dioxide	ND
Propanenitrile*	ND	o-Xylene	ND
Pyridine*	ND	p-Xylene	ND
Tributyl Phosphate*	ND	Styrene	ND
		Sulfur dioxide	ND
		Toluene	ND

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

b) Chemical concentration data was reprocessed to eliminate false-positive data and correct library input

c) Isolated spikes equal to zero do not follow the general trend for nitrous oxide and ammonia, and therefore these data spikes were not included in the table

* Chemical is on COPC list

ND – Not detected

Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

Figure 3. UV-DOAS (507U) Ammonia Data Review.
(Note that concentration units are ppb)

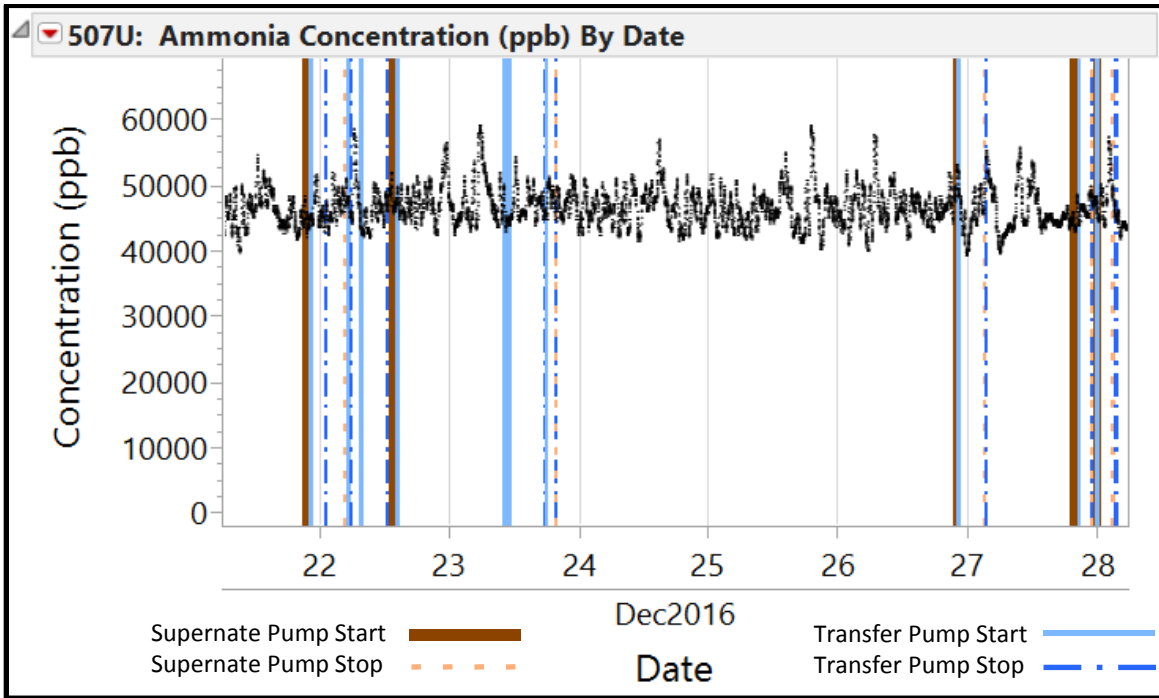
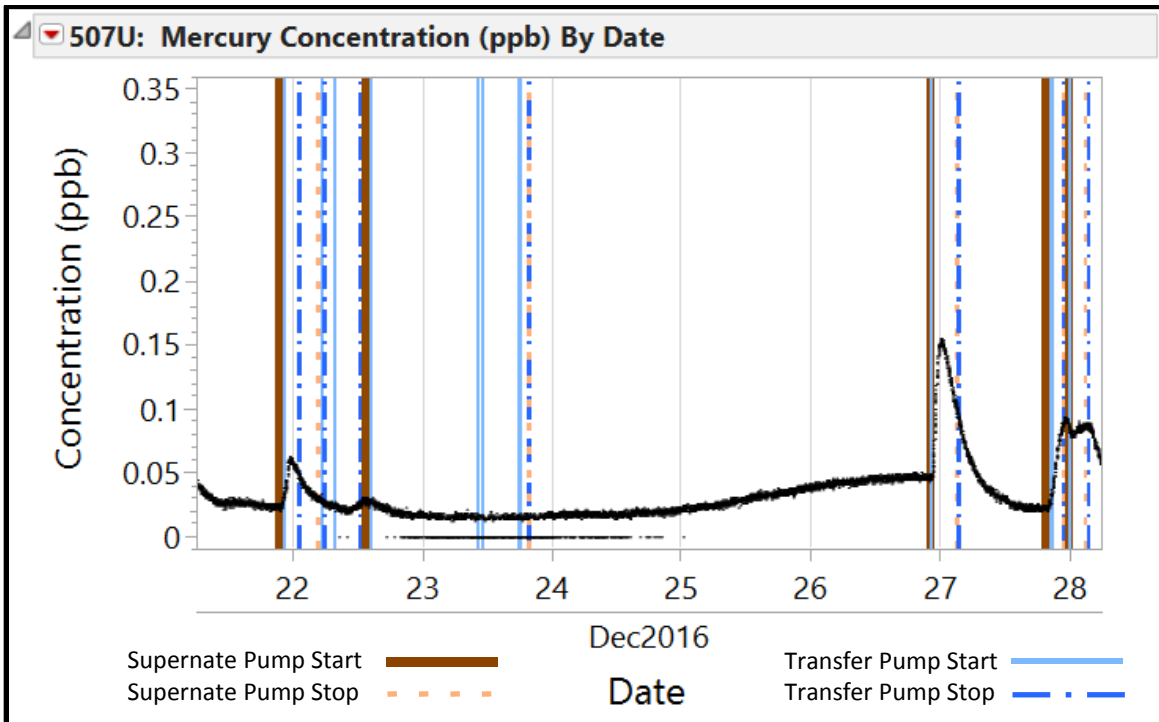


Figure 4. UV-DOAS (507U) Mercury Data Review.
(Note that concentration units are ppb)



Vapor Monitoring Detection System Weekly Report

12/21/2016 6:00 – 12/28/2016 6:00

Figure 5. UV-DOAS (507U) m-Xylene Data Review.
 (Note that concentration units are ppb)

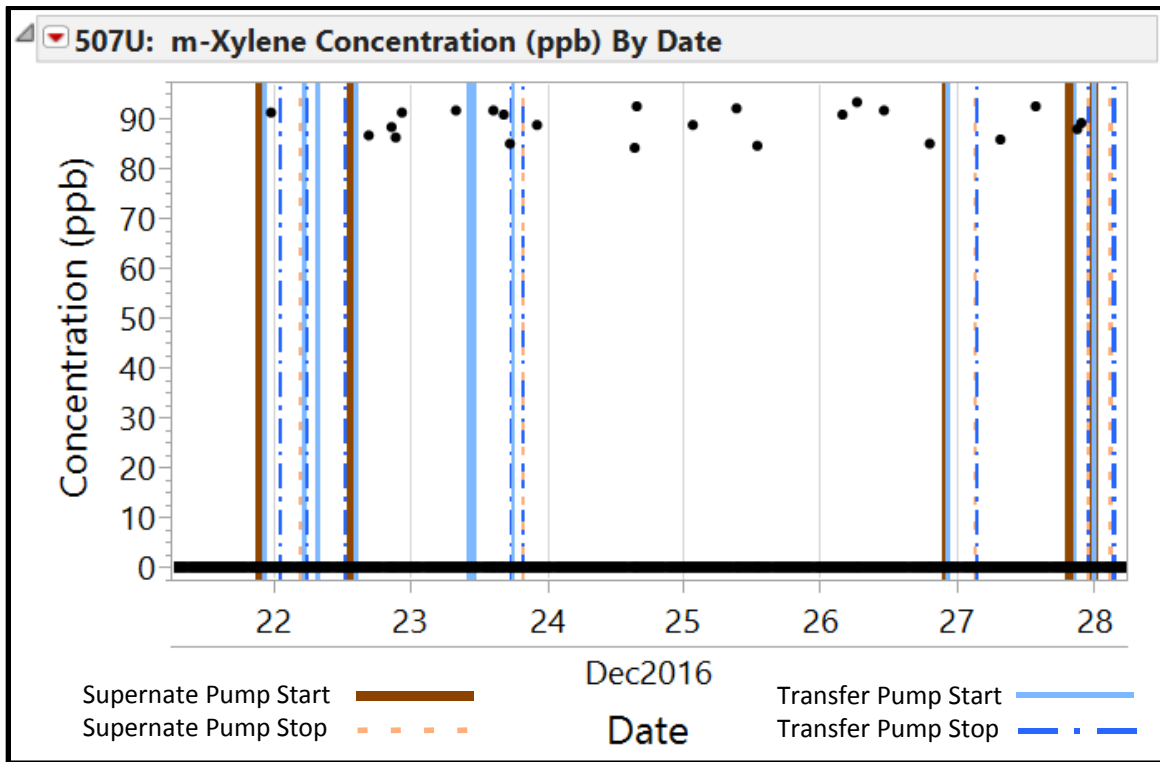


Table 2. Stack Monitor Time Reporting.

Instrument	% Time Reporting
507I	100%
507U	100%

Notes: % time reporting is based on data reported to OSI PI System³

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