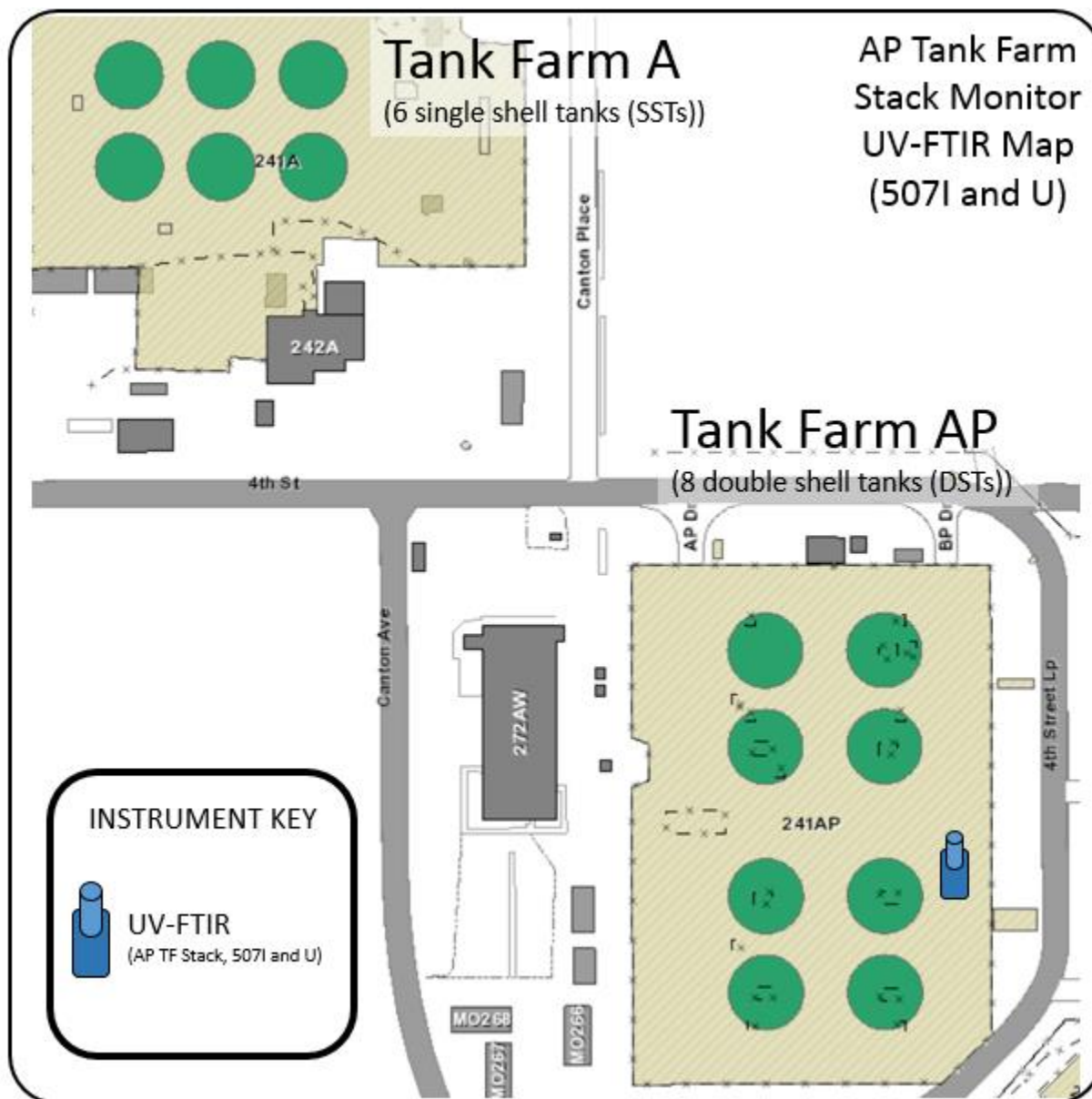


**Vapor Monitoring Detection System Weekly Report – AP Tank Farm Stack Monitoring**

**Revision 0: Initial Release of Report**

12/14/2016 6:00 – 12/21/2016 6:00

AP-Tank Farm Stack Monitor (north is up)



# Vapor Monitoring Detection System Weekly Report

12/14/2016 6:00 – 12/21/2016 6:00

## Abbreviations and Units

|                  |   |  |
|------------------|---|--|
| CH <sub>4</sub>  | = | methane  |
| CO               | = | carbon monoxide  |
| CO <sub>2</sub>  | = | carbon dioxide   |
| COPC             | = | chemicals of potential concern   |
| IDMS             | = | Integrated Document Management System  |
| FTIR             | = | Fourier transform infrared spectrometer  |
| IR               | = | infra-red  |
| LEL              | = | lower explosive limit  |
| ND               | = | not detected   |
| NH <sub>3</sub>  | = | ammonia  |
| NO               | = | nitric oxide   |
| N <sub>2</sub> O | = | nitrous oxide  |
| NO <sub>2</sub>  | = | nitrogen dioxide   |
| O <sub>3</sub>   | = | ozone  |
| OEL              | = | occupational exposure limit  |
| OSHA             | = | Occupational Safety and Health Administration  |
| PEL              | = | permissible exposure limit   |
| ppb              | = | parts per billion  |
| ppm              | = | parts per million  |
| UV-DOAS          | = | ultraviolet differential optical absorption spectrometer   |
| UV-FTIR          | = | Ultra Violet - Fourier transform infrared (representing both analytical elements of the instrument, the UV and IR modules) |
| UV               | = | ultraviolet  |
| VMDS             | = | vapor monitoring detection system  |

## VMDS Instruments

|      |   |   |
|------|---|---|
| 507  | = | Ultra Violet - 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

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## Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week (12/14/2016 at 6:00 a.m. through 12/21/2016 at 6:00 a.m.) using the AP-Farm stack monitor<sup>1</sup>. This instrument is a dual channel FTIR/UV-DOAS spectrometer that provides real-time multi-gas measurement (qualitative and quantitative) of gases. The implementation method for this instrument allows for very accurate identification and quantification of compounds found in the AP-Farm exhauster stack.

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

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

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## **12/14/2016 through 12/21/2016 Summary**

The retrieval activities, associated with the AY-102 to AP-102, had several start and stops of both the slurry and supernate pumps. These activities occurred on the nights of 12/19/2016 from 21:30 until 01:32 on 12/20/2016 and again at 22:30 on 12/20/2016 until 03:00 on 12/21/2016. Figures 1 and 2 show the concentration of ammonia detected in the AP Farm stack during the reporting period by analysis method (IR and UV), as well as the time intervals where slurry and supernate pump activity occurred. The ammonia concentrations recorded are typical ranges observed when no waste disturbing activities have occurred (i.e., there was no correlation of ammonia concentration changes with retrieval activity). Figure 3 shows the concentrations of nitrous oxide detected in the AP Farm stack during the reporting period along with the time intervals where slurry and supernate pump activity occurred. Figure 3 shows an increase in nitrous oxide during the 12/19/2016 and 12/20/2016 retrieval periods (with start of supernate pumps), as well as a decrease in nitrous oxide concentration at the beginning of the reporting period due to the conclusion of a waste transfer at 03:50 on 12/14/2016. Table 1 shows that ammonia concentrations ranged from 36 to 67 ppm, nitrous oxide concentrations ranged from 2.8 to 6.4 ppm, mercury ranged from 0.022 to 0.36 ppb and m-xylene ranged from non-detect to 0.095 ppm. Figure 4 shows the mercury concentrations from UV analysis for the reporting period and also shows a spike in concentrations during retrieval activities (start of supernate pumps) on the nights of 12/19 and 12/20/2016. Figure 5 shows the m-xylene concentrations for the reporting period from 507U, they are somewhat random and do not correlate with retrieval activities. Table 2 shows the reporting time of the stack monitors. The FTIR 507I monitored for 100% and the UV-DOAS 507U monitored for 100% of the reporting period.

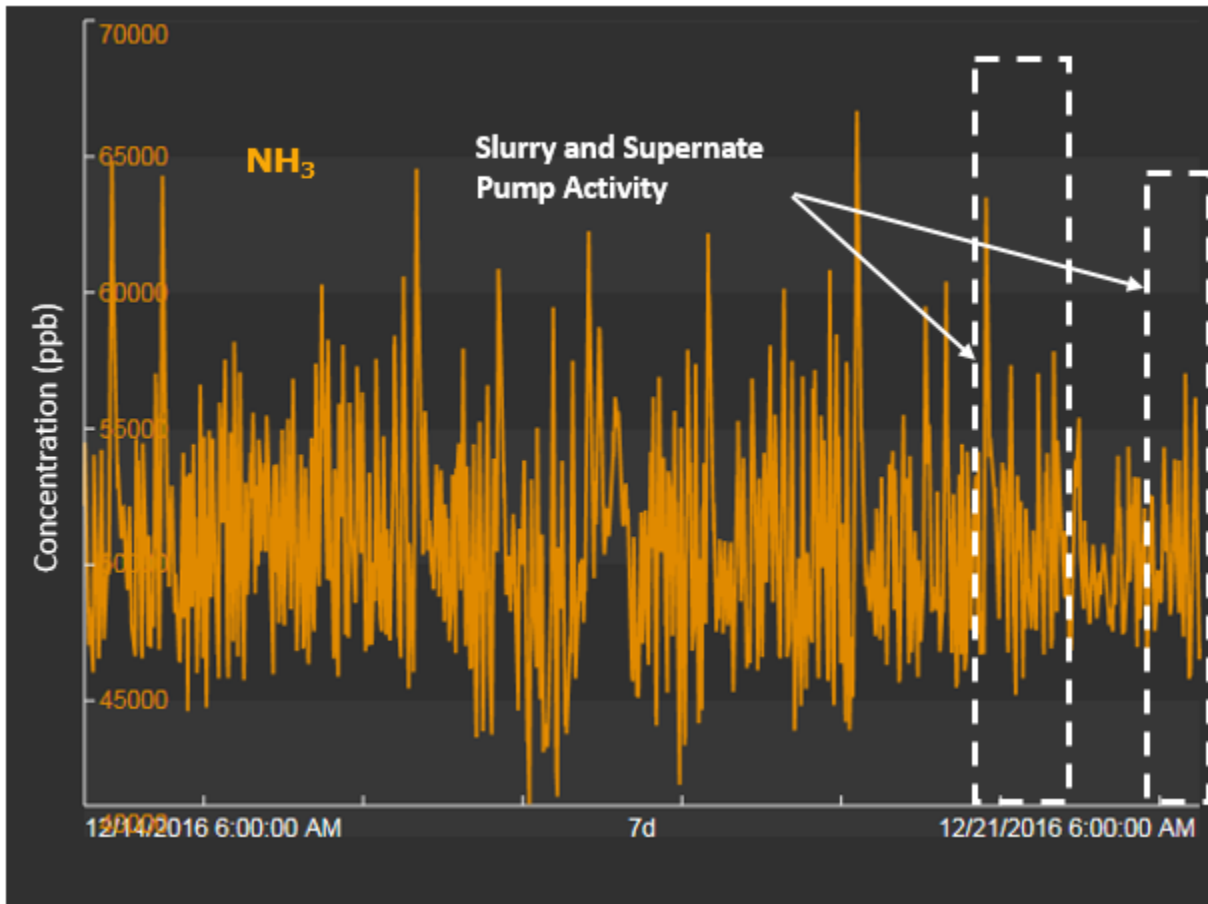
Because the collection of UV-DOAS 507U data for the reporting week preceded library changes performed on 3/8/2017, reprocessing of data was conducted to determine if compounds were correctly detected by the instrument. The reprocessed data with the optimized library eliminates false-positive readings of compounds that showed as detections and reported in OSI PI<sup>2</sup>. The data were reprocessed and the output data can be obtained from Integrated Document Management System (IDMS).

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

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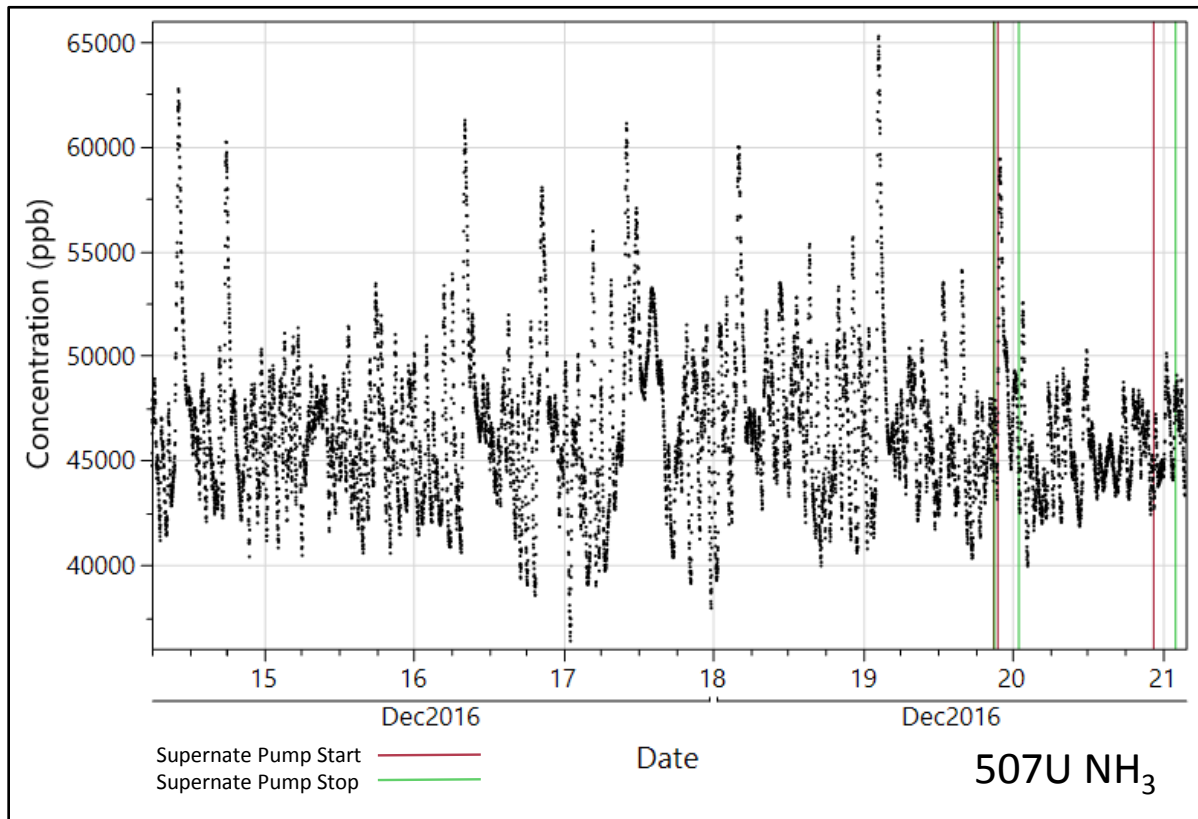
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**Figure 1. FTIR (507I) NH<sub>3</sub> Data recorded from AP Farm Exhauster (Note that concentration units are ppb)**

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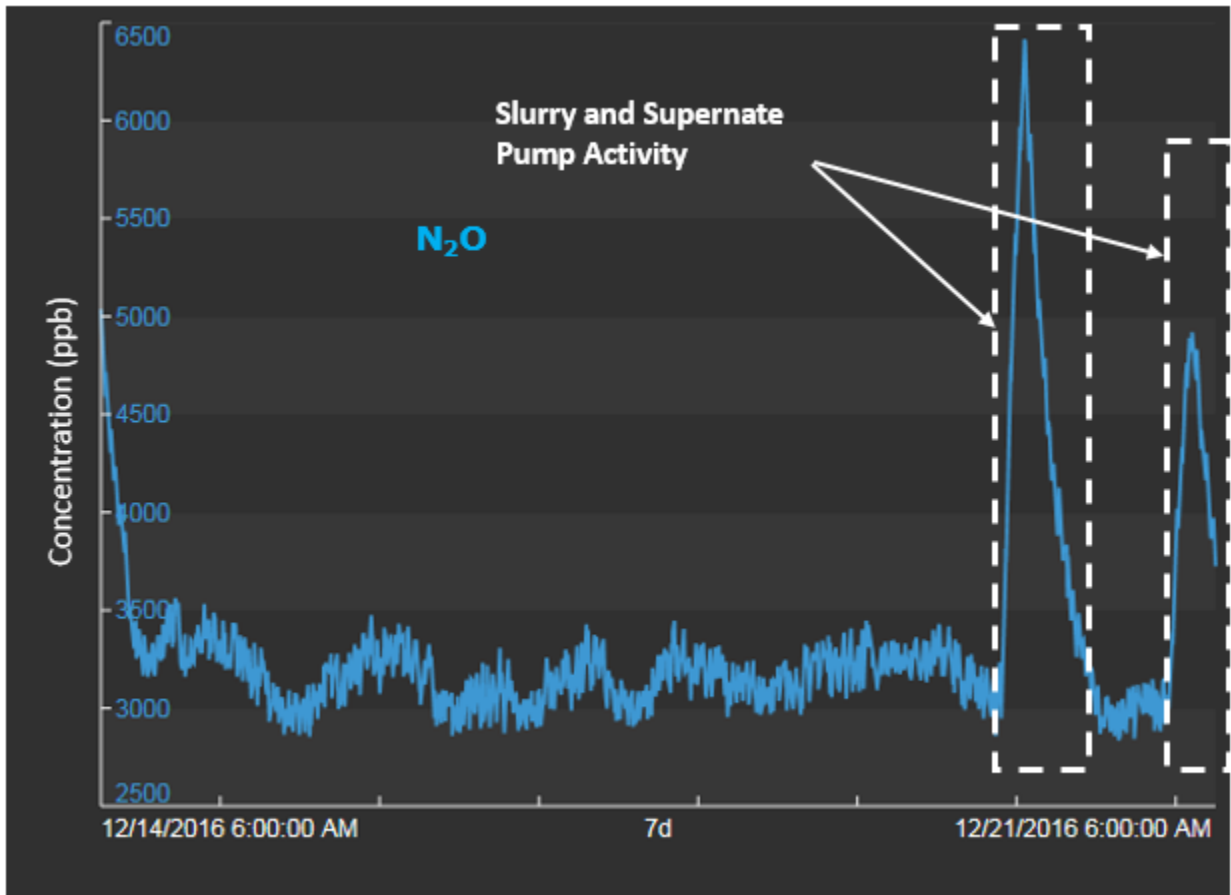
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**Figure 2. 507U Ammonia Data Review.  
(Note that concentration units are ppb)**

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**Figure 3. FTIR (507I) N<sub>2</sub>O Data recorded from AP Farm Exhauster  
(Note that concentration units are ppb)**

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**Table 1. Chemical Species Detected<sup>a</sup> in the AP Tank Farm Stack by Method**

| Chemical                | FTIR<br>(507I) ppm | Chemical                  | UV-DOAS<br>(507U) ppm |
|-------------------------|--------------------|---------------------------|-----------------------|
| Ammonia*                | 41 - 67            | Ammonia*                  | 36 - 65               |
| Nitrous Oxide*          | 2.8 - 6.4          | 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*, <sup>b</sup> | ND                    |
| Butyl Nitrite*          | ND                 | Formaldehyde*             | ND                    |
| Ethylamine*             | ND                 | Furan*                    | ND                    |
| Formaldehyde*           | ND                 | Mercury*                  | 0.000022 –<br>0.00036 |
| Furan*                  | ND                 | Methyl Nitrite*           | ND                    |
| Methanol*               | ND                 | Pyridine*                 | ND                    |
| Methyl Isocyanate*      | ND                 | 1-2-4<br>Trimethylbenzene | ND                    |
| Methyl Nitrite*         | ND                 | 1-3-5<br>Trimethylbenzene | ND                    |
| N-Nitrosodiethylamine*  | ND                 | Ethylbenzene <sup>b</sup> | 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

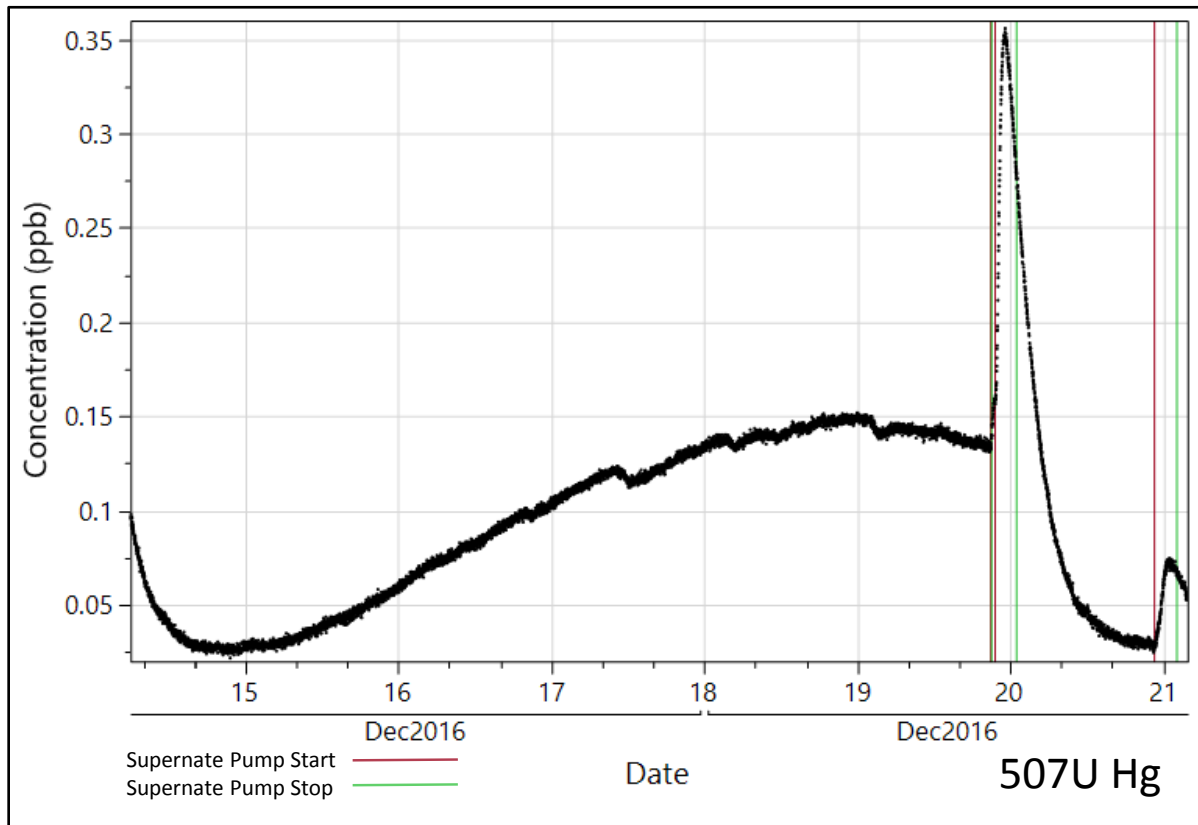
\* Chemical is on COPC list

ND – Not detected



# Vapor Monitoring Detection System Weekly Report

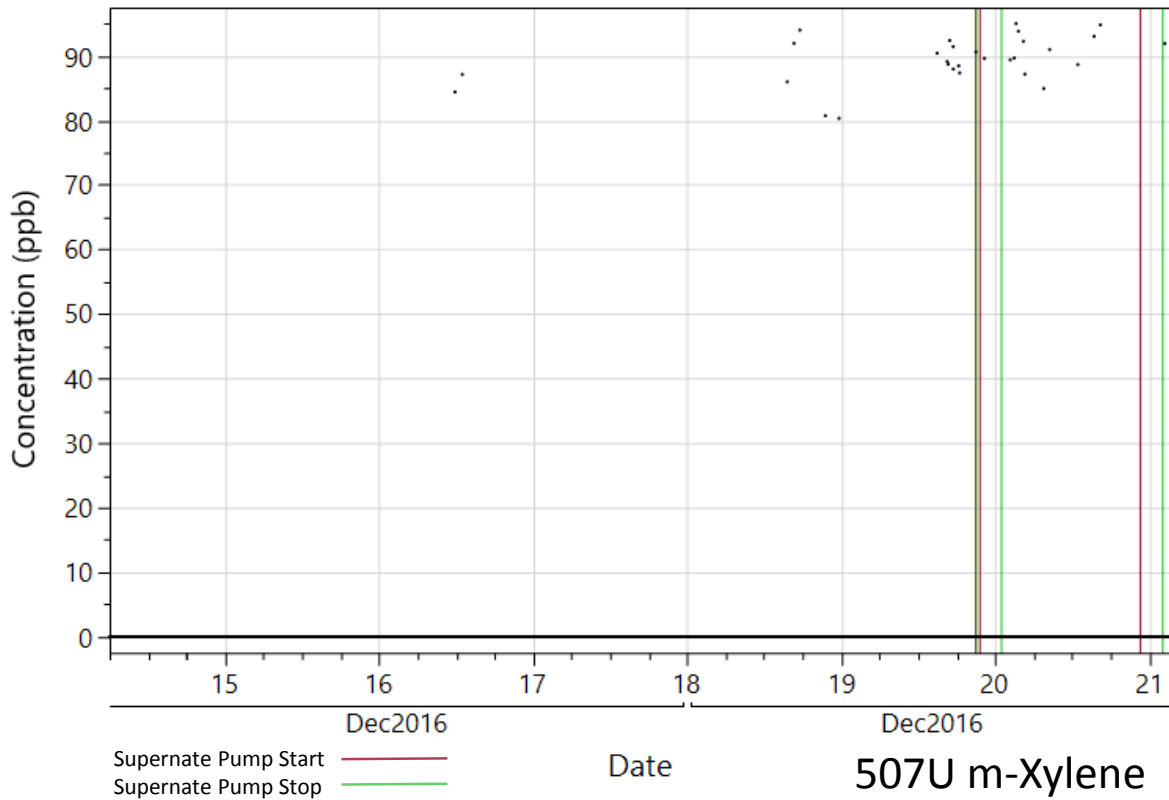
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**Figure 4. 507U Mercury Data Review.  
(Note that concentration units are ppb)**

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**Figure 5. 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 System<sup>3</sup>

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