

VMDS AP Stack Monthly Report 03292017_004302017

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800



P.O. Box 850
Richland, Washington 99352

VMDS AP Stack Monthly Report 03292017_004302017

S. E. Kelly

Washington River Protection Solutions

Date Published
March 2018

WRPS

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800



P.O. Box 850
Richland, Washington 99352

Copyright License

By acceptance of this article, the publisher and/or recipient acknowledges the U.S. Government's right to retain a non exclusive, royalty-free license in and to any copyright covering this paper.

APPROVED
By Janis D. Aardal at 2:57 pm, Mar 28, 2018

Release Approval

Date

LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced from the best available copy.

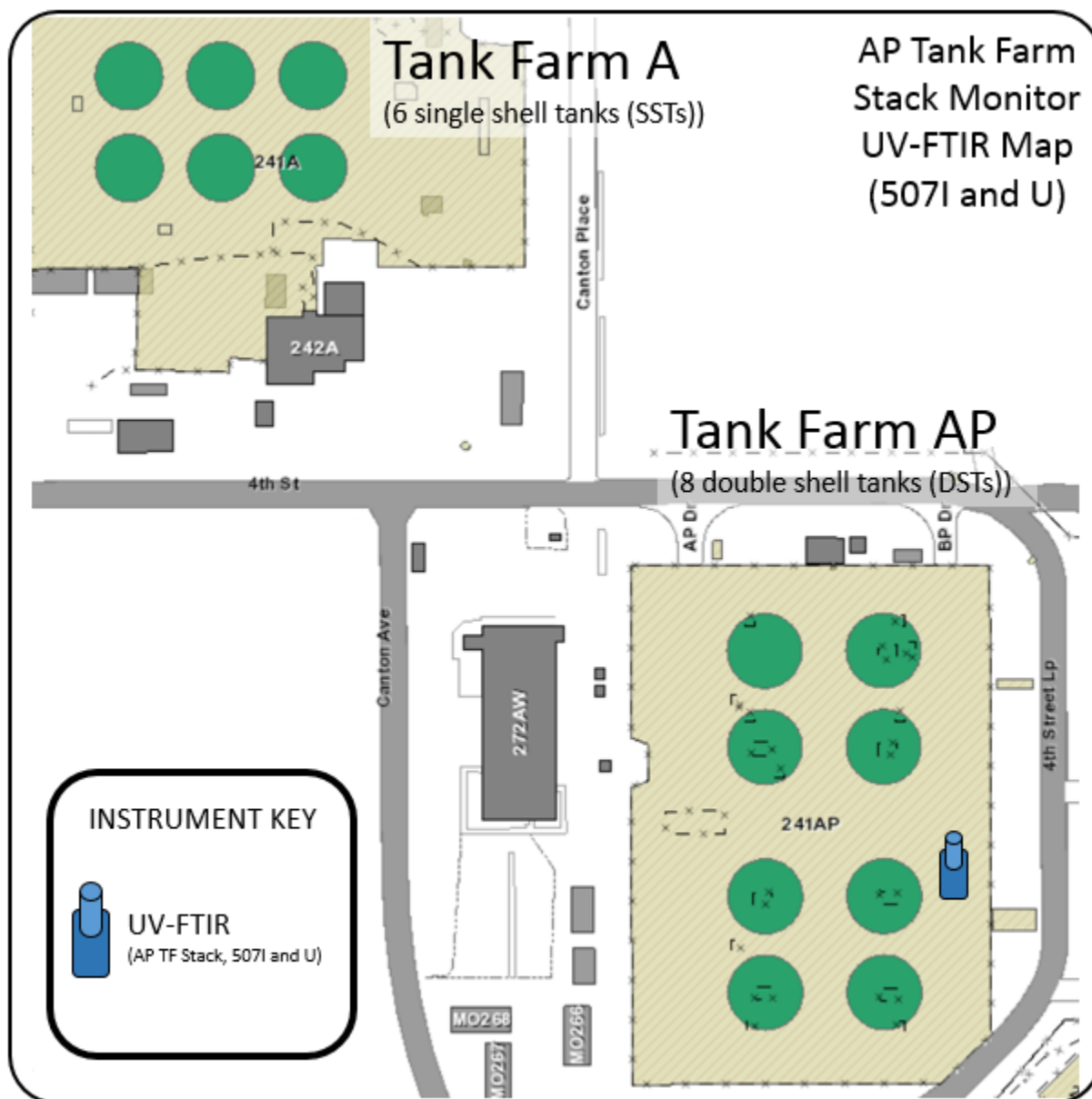
Printed in the United States of America

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

Revision 0: Initial Release of Report

3/29/2017 6:00 – 4/30/2017 11:59

AP-Tank Farm Stack Monitor (north is up)



Vapor Monitoring Detection System Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

Abbreviations and Units

CH ₄	=	methane
COPC	=	chemicals of potential concern
FTIR	=	Fourier transform infrared spectrometer
Hg	=	mercury
IDMS	=	Integrated Document Management System
IR	=	infrared
ND	=	not detected
NH ₃	=	ammonia
NO	=	nitric oxide
N ₂ O	=	nitrous oxide
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 Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one month (3/29/2017 at 6:00 a.m. through 4/30/2017 at 11:59 p.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; they are two independent instruments. The implementation method for this instrument allows for very accurate identification and quantification of compounds found in the AP-Farm exhaust stack. Reporting of the VMDS pilot-scale data was previously summarized on a weekly basis. This report will initiate reporting of AP-Farm exhaust stack on a monthly basis.

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 Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

3/29/2017 through 4/30/2017 Summary

The FTIR and UV-DOAS instruments were interrupted by several events during this month. The events that occurred during the reporting period were exhauster stack changes, instrument errors and communication issues, electrical outages, and calibration activities. The details of these events are given below.

- Exhauster stack alignment changes – There were two time periods when low readings of ammonia concentrations were measured by the FTIR and UV-DOAS due to sampling the non-operating stack – following operations changing stack alignment. The first change in stack alignment occurred at approximately 10:00 on 4/5, with the FTIR and UV-DOAS aligned to the correct stack again at approximately 14:00. A second change in stack alignment occurred on 4/10 at approximately 10:00 and correct stack monitor alignment followed at approximately 14:30.
- Instrument errors and communication issues were reported as stale (constant values or flat line) data by OSI PI for the FTIR (507I) on four occurrences throughout the month:
 - From about 06:00 to 07:30 on 3/29,
 - From approximately 15:45 on 4/4 until 6:00 on 4/5,
 - From approximately 02:00 to 06:00 on 4/12, and
 - From approximately 20:40 on 4/20 until 17:15 on 4/21.
- Electrical outages – The FTIR and UV-DOAS instruments lost communication on 4/20 at approximately 14:30 until 15:00 due to an electrical outage to service a diesel generator. The FTIR 507I and UV-DOAS 507U instruments were shut down for an electrical outage of the AP Farm that started on 4/24 at approximately 10:45 and continued through the rest of the month.
- Calibration activities - The elevated ammonia concentrations between approximately 13:00 and 14:00 on 4/19 are due to calibration and configuration activities performed on the spectrometers.

Table 1 shows the ammonia concentrations ranged from 33 to 73 ppm, mercury concentrations ranged from 0.053 to 0.13 ppb and nitrous oxide ranged from 1.5 to 4.6. Figure 1 and 3 below shows the concentrations of ammonia detected in the AP Farm stack during the reporting period. Figure 2 shows the concentrations of nitrous oxide detected in the AP Farm stack during the reporting period, also with the time intervals where reporting was stale. The mercury levels were within typical levels observed when no waste activities occur (Figure 4). The concentrations of all reported compounds, ammonia, nitrous oxide, and mercury, are typical ranges observed when no waste disturbing activities occurred.

Table 2 shows the reporting time of the stack monitors. The FTIR 507I monitored for 76% and the UV-DOAS 507U monitored for 77% of the reporting period.

Vapor Monitoring Detection System Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

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

Chemical	507I FTIR (ppm)	Chemical	507U UV-DOAS (ppm)
Ammonia*	34 – 73 ^b	Ammonia*	33 – 72 ^b
Nitrous Oxide*	1.5 – 4.6 ^b	Nitric Oxide	ND
Methane	ND ^c	1,3-Butadiene*	ND
1,3-Butadiene*	ND	2-Methyl-2-butenal*	ND
1-Butanol*	ND	2-Methylfuran*	ND ^d
2-Hexanone*	ND	Acetaldehyde*	ND
3-Buten-2-one*	ND	Benzene*	ND
Acetaldehyde*	ND	Butanal*	ND
Acetonitrile*	ND	Ethylamine*	ND
Benzene*	ND	Formaldehyde*	ND
Butanal*	ND	Furan*	ND
Butyl Nitrite*	ND	Mercury*	0.000053 – 0.00013 ^b
Ethylamine*	ND	Methyl Nitrite*	ND
Formaldehyde*	ND	Pyridine*	ND
Furan*	ND ^c	1,2,4 Trimethylbenzene	ND
Methanol*	ND	1,3,5 Trimethylbenzene	ND
Methyl Isocyanate*	ND	Ethylbenzene	ND ^{d,e}
Methyl Nitrite*	ND	m-Xylene	ND
N-Nitrosodiethylamine*	ND	Nitrogen Dioxide	ND
N-Nitrosodimethylamine*	ND	o-Xylene	ND
N-Nitrosomorpholine*	ND	p-Xylene	ND
Propanenitrile*	ND	Styrene	ND
Pyridine*	ND	Sulfur dioxide	ND
Tributyl Phosphate*	ND	Toluene	ND

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

b) Isolated zero concentrations do not follow the general trend for each detected compound, therefore these zero concentrations were not included in the table

c) Reported concentrations of methane and furan are suspect because the UV-FTIR instrument was not in line with the active exhaust train, therefore these detections are not included in the table

d) Reported concentrations of 2-methylfuran and ethylbenzene occurred during transition to active exhaust train after completion of calibration check, therefore these concentrations are not included in the table

e) Two ethylbenzene single point spikes occurred at ~02:00 on 4/7 (45.23ppb) and ~16:30 on 4/18 (45.29ppb); review of downloaded data summary files showed both of these occurrences to be below their method detection limit (MDL) and are considered suspect

* Chemical is on COPC list

ND – Not detected

Vapor Monitoring Detection System Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

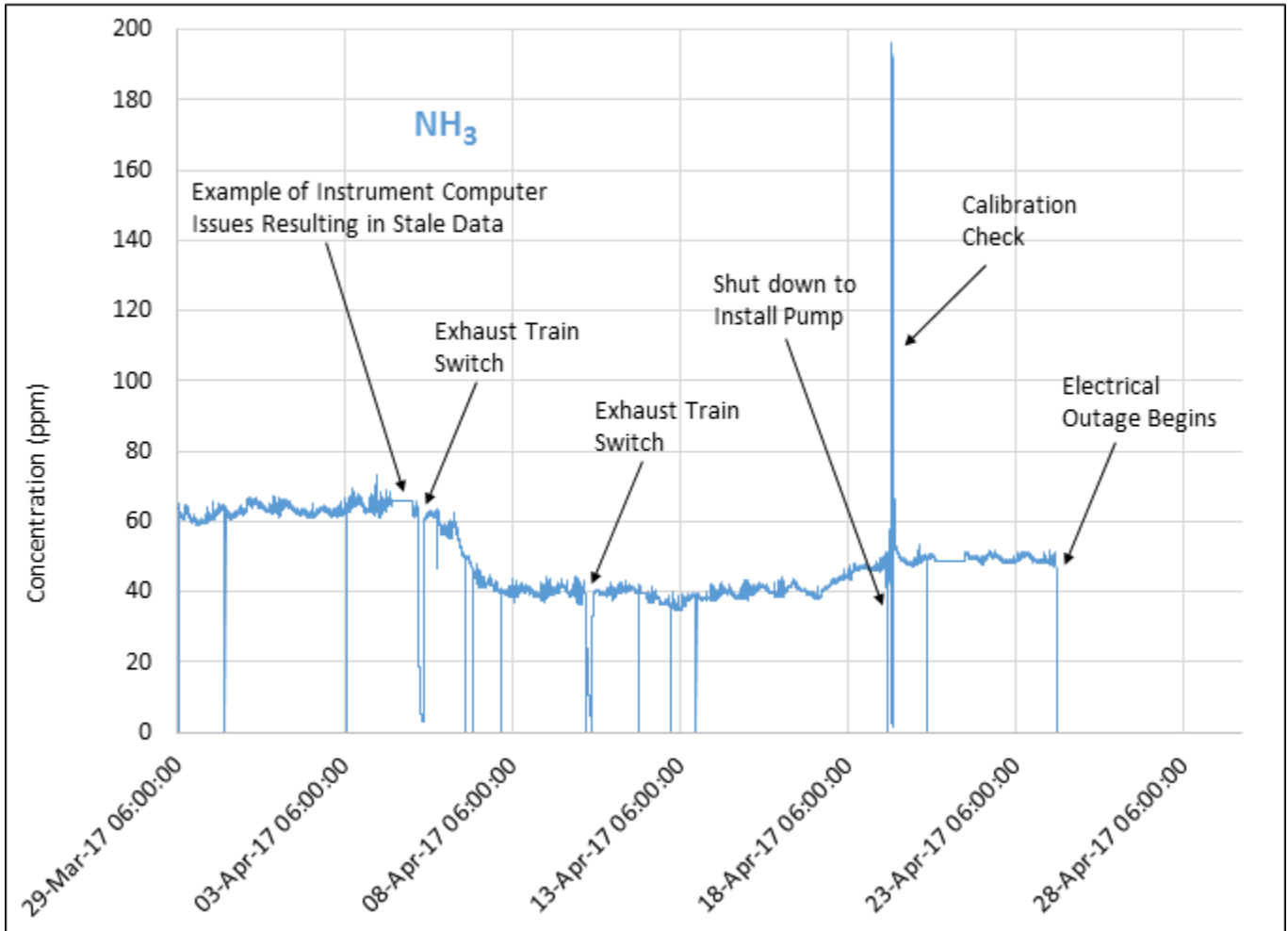
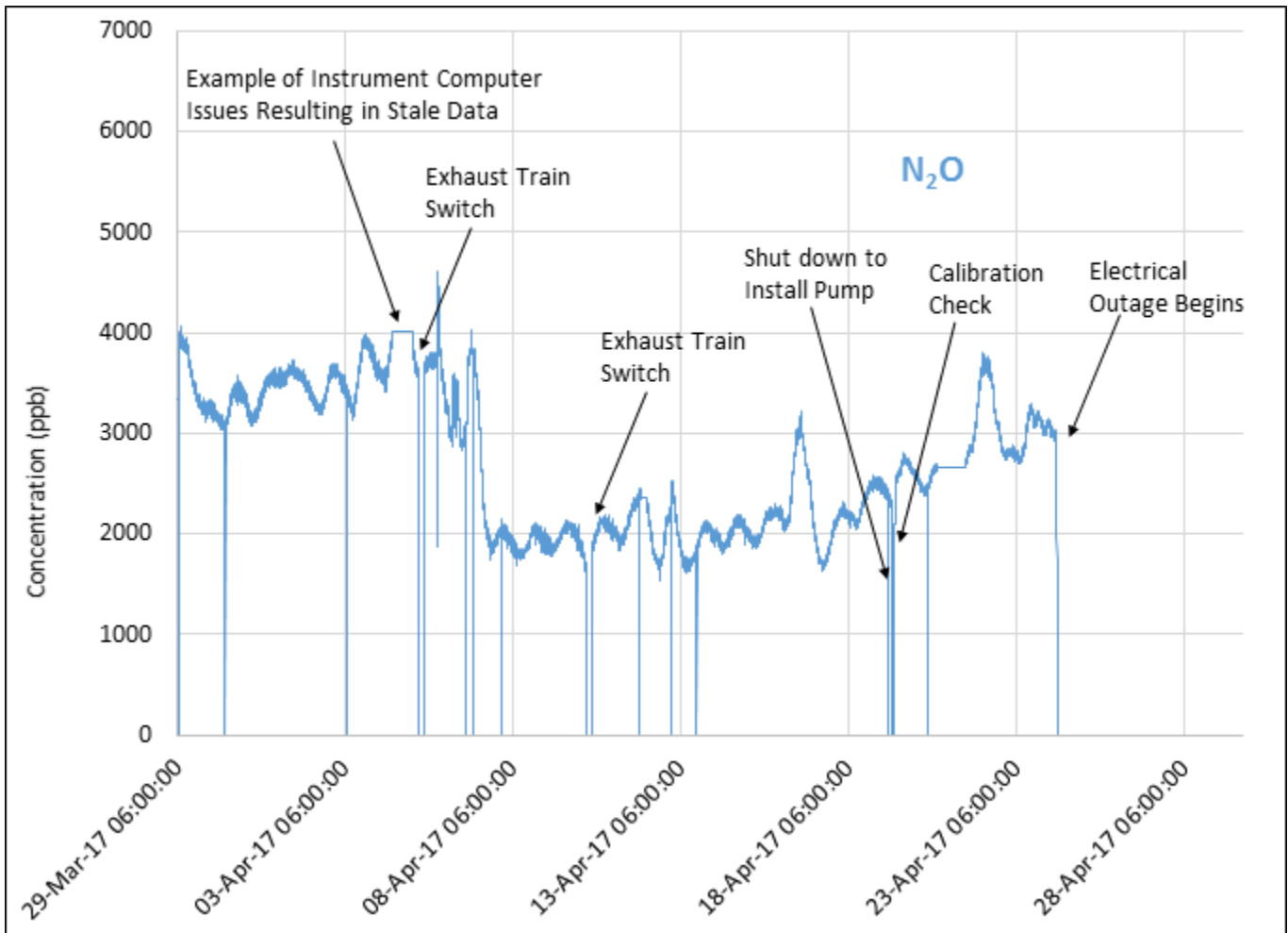


Figure 1. FTIR (507I) NH₃ Data recorded from AP Farm Exhauster
(Note that concentration units are ppm)

Vapor Monitoring Detection System Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59



**Figure 2. FTIR (5071) N₂O Data recorded from AP Farm Exhauster
(Note that concentration units are ppb)**

Vapor Monitoring Detection System Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

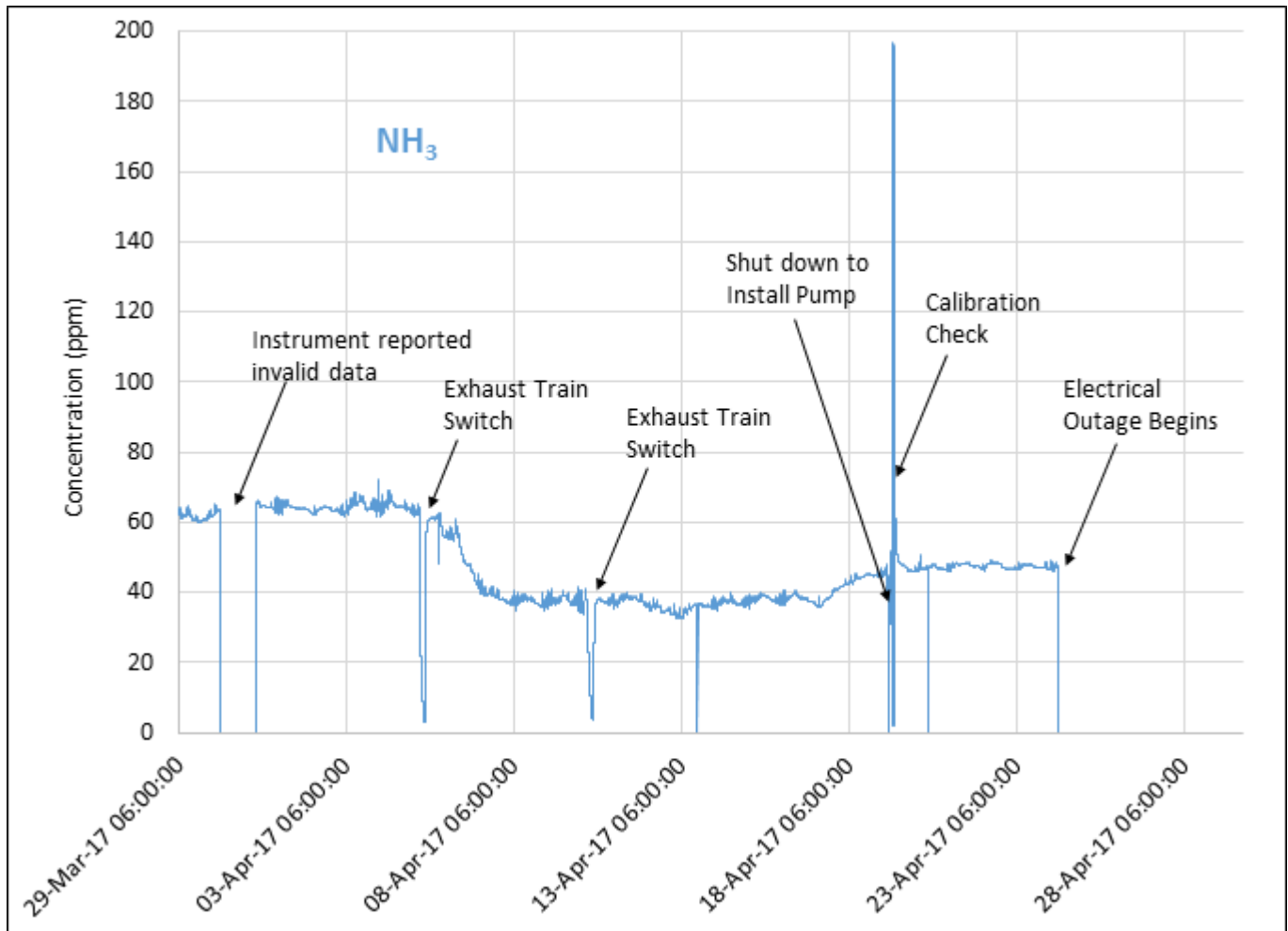


Figure 3. UV-DOAS (507U) Data Review.
(Note that concentration units are ppm)

Vapor Monitoring Detection System Monthly Report

3/29/2017 6:00 – 4/30/2017 11:59

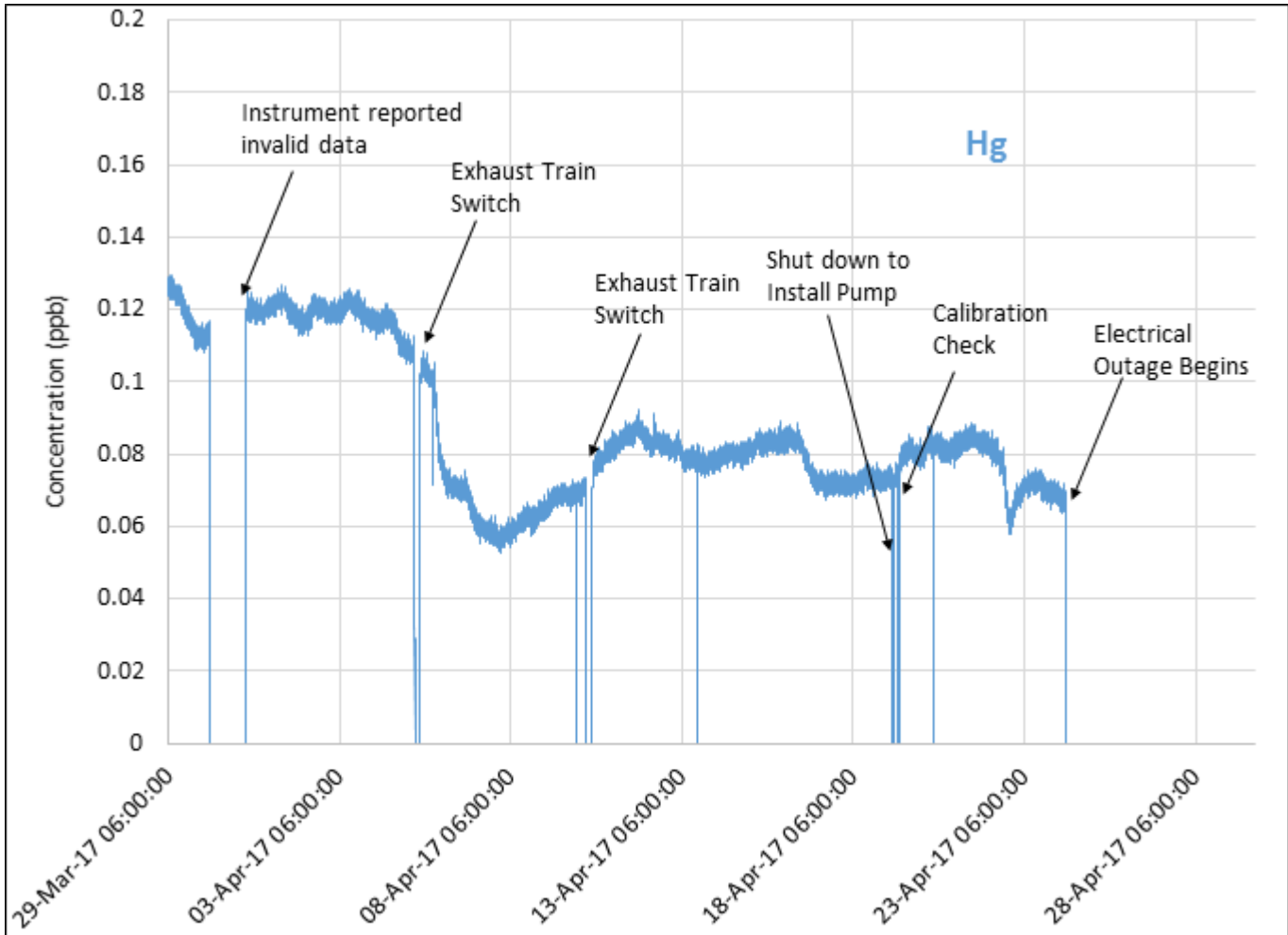


Figure 4. UV-DOAS (507U) Data Review.
 (Note that concentration units are ppb)

Table 2. Stack Monitor Time Reporting.

Instrument	% Time Reporting
507I	76%
507U	77%

Notes: % time reporting is based on data reported to OSI PI System²

² OSI PI System is a data visualization software package from [OSIsoft](http://OSIsoft.com).