JSC TOXICOLOGY GROUP

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Memorandum Number

TOX-VM-2015-06

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DATE: May 20, 2015

SUBJECT: Toxicological Assessment of ISS Air and Water Quality: Sept 2014 – Nov 2014 (Increment 41)

SUMMARY: Based on these data, air quality was acceptable on ISS for this period, and potable water remains acceptable for crew consumption.

AIR QUALITY

Four mini grab sample containers (mGSCs) were collected on ISS during Increment 41 and were returned on 39S. All four were collected as routine monthly samples in the US Laboratory (Lab) and either the Japanese Pressurized Module (JPM) or the Columbus module (Col). Two pairs of passive-diffusion formaldehyde badges were deployed in the US Lab and Russian Service Module (SM) in September. The formaldehyde resupply kit was lost on Orb-3, and therefore, sampling was limited to the US Lab in October. A summary of the analytical results is provided in Table 1.

Table 1. Analytical Summary of ISS air analyses

Sample Location	Sample Date	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	Alcohols[b] (mg/m^3)	T-Value[c] (units)	CO_2 (mg/m^3)	Formaldehyde (µg/m^3)
Lab	9/29/2014	19	2.5	16	0.3	8200	31
SM	9/29/2014	--	--	--	--	--	29
JPM	9/29/2014	20	3.3	17	0.4	8200	--
Lab	10/29/2014	14	3.8	11	0.4	8200	33
Col	10/29/2014	13	2.4	10	0.4	7700	--
Guideline		*<25*	---	*<5*	*<1*[d]	*<9300*	*<120*

[a]Non-methane volatile organic hydrocarbons, excluding Freon 218
[b]Includes acetone
[c]Sum of the ratios of the measured concentration and the corresponding 180-day SMAC for each compound, excluding CO_2
[d]T-value <1 used to evaluate routine monthly sampling; T-value <3 used to evaluate first ingress samples

Complete data tables of all measured concentrations and corresponding T-values based on 180-day SMACs for the routine archive samples are enclosed. The detection limit for all target compounds was 0.025 mg/m^3, with the exception of m/p-xylenes and 1,2,4-trichlorobenzene, which were 0.05 mg/m^3, and hexachloro-1,3-butadiene, which was 0.075 mg/m^3. The average relative recoveries of the 3 surrogate standards from the mGSCs were as follows: ^{13}C-acetone, 101 ± 2%; fluorobenzene-d_5, 97 ± 2%; and chlorobenzene-d_5, 81 ± 3%. For the passive-diffusion formaldehyde badges, positive control recoveries (1 trip and 1 lab control) were 96% and 110%, respectively.

During Increment 41, an Air Quality Monitor (AQM) unit 2 (S/N 1004) was located in Col from 9/19/2014-11/20/2014, and then it was relocated to the JEM. AQM unit 1 (S/N 1003) remained in the US Lab throughout the Increment. Simultaneous automated sampling sessions are scheduled every 73 hours, which results in 2-3 sampling sessions per unit per week. Nominally, data are received weekly. Monthly average concentrations as well as the Increment average concentrations are presented in Table 2.

Table 2. Average monthly concentrations (mg/m^3) of AQM target compounds.

	September	October	November	Average
2-Propanol	0.1[a]	0.2[a]	0.2[a]	0.2
Acetone	0.2[a]	0.2[a]	0.2[a]	0.2
Acrolein	ND	ND	ND	ND
Benzene	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND
DMCPS[c]	1.5[a]	1.6[a]	1.7[a]	1.6
Hexanal	ND	ND	ND	ND
Hexane	ND	ND	ND	ND
m,p-Xylenes	ND	ND	ND	ND
Methanol	0.4[a]	0.4[a]	0.4[a]	0.4
o-Xylene	0.1[a]	TRACE	TRACE	0.1
OMCTS[d]	TRACE	TRACE	TRACE	TRACE
Toluene	ND	ND	ND	ND
2-Butanone	TRACE	ND	TRACE	TRACE
Acetaldehyde	0.1[a]	0.2[b]	0.2[b]	0.2
Dichloromethane	0.1[a]	0.1[b]	0.1[b]	0.1
Ethanol	6.4[a]	8.2[b]	7.1[b]	7.2
Ethyl Acetate	TRACE	TRACE	0.1[b]	0.1
HMCTS[e]	1.8[a]	1.6[b]	1.8[b]	1.7
n-Butanol	0.2[a]	0.1[b]	0.1[b]	0.1
Trimethylsilanol	0.3[a]	0.3[b]	0.3[b]	0.3

[a]Concentrations detected in Lab
[b]Concentrations detected in Col
[c]Decamethylcyclopentasiloxane
[d]Octamethylcylcotetrailoxane
[e]Hexamethycyclotrisiloxane

Toxicological Evaluation of ISS Air Quality

Routine monthly mGSC sampling provides a limited set of samples on which to perform an air quality assessment, but is complementary to in-flight air monitoring data collected by the AQMs. **All measured values (mGSC and AQM) were below 1 T unit, indicating no concern for crew health.** Increment T-values from mGSCs (Figure 1) and the AQM (Figure 2) correlate well, with average total values ~0.4 units. The primary contributors to the total T-value across all routine sampling locations throughout this time period were hexamethylcyclotrisiloxane (HMCTS) and acetaldehyde. These compounds were measured well below levels of health concern, but HMCTS may contribute to periodic accumulation of siloxane compounds in the water recovery system (see Water Quality discussion below).

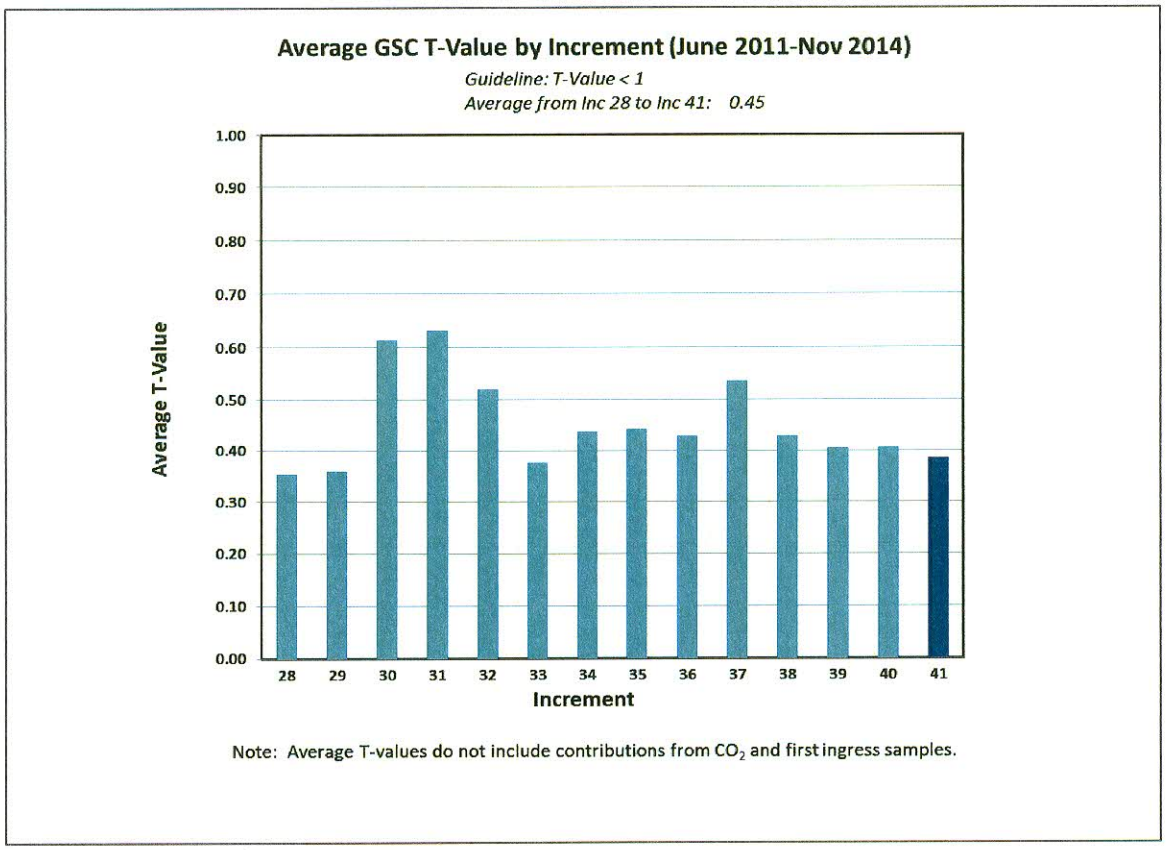

Figure 1. GSC T-values

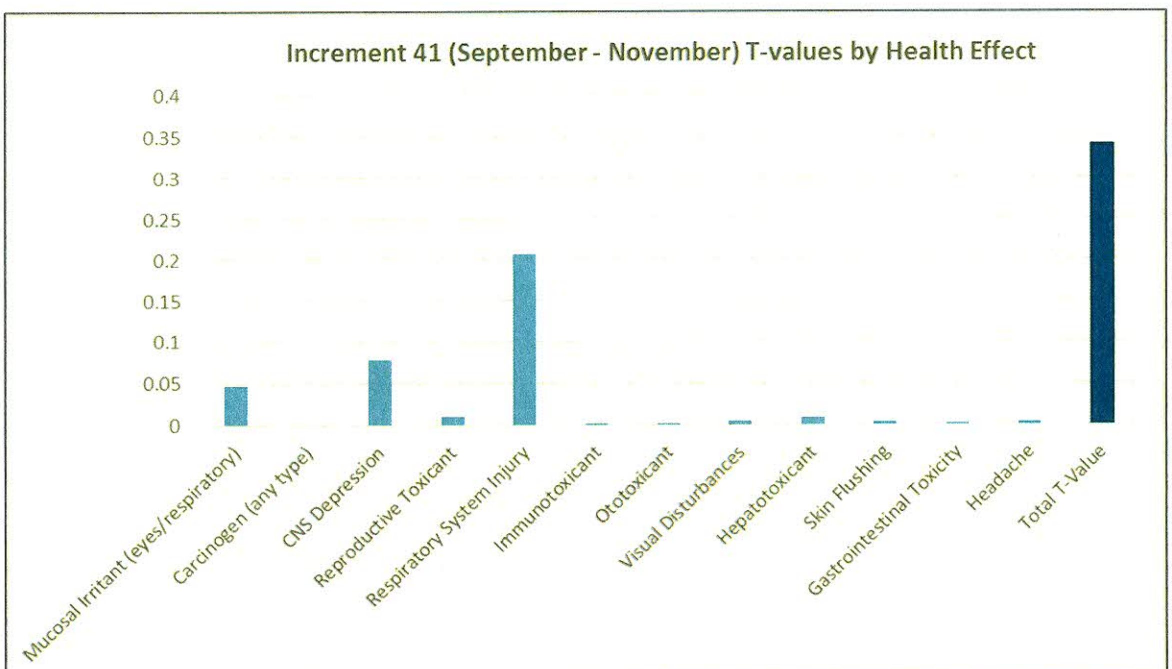

Figure 2. AQM T-values

The mGSCs provide only a snapshot of conditions and are not ideal for evaluating potential CO_2 exposures; however, reported levels were below 4 mmHg (9300 mg/m^3), as requested for this Increment in Chit 012729. **Notably, alcohol values in all routine monthly samples continue to exceed the alcohol guideline of <5 mg/m^3, which is intended to protect the water recovery system from risk of overloading.** These levels are primarily due to a sustained increase in ethanol levels on ISS. Elevated ethanol levels were also detected in US water samples during this Increment (see Water Quality discussion below). Formaldehyde levels in the US Lab (shown in Table 1 and Figure 3) are generally consistent with historic levels, and remain below the SMAC of 120 µg/m^3.

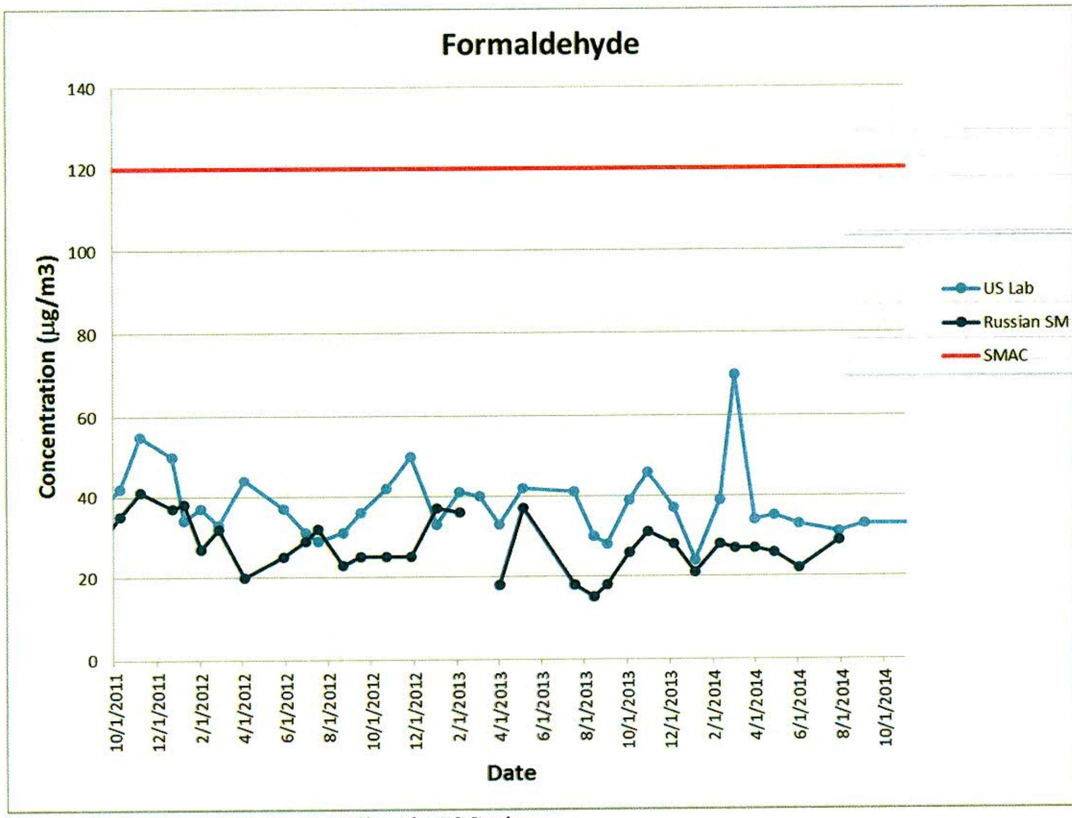

Figure 3. Formaldehyde trending in ISS air.

WATER QUALITY

Archive samples were collected from the potable water dispenser (PWD) in the US segment and the SVO-ZV and SRV-K systems in the RS during Increment 41 and were returned on 39S. A sample of humidity condensate was also collected from the US segment during this increment and returned on 39S. A summary of select analytical results from those samples is provided in Table 2. Complete data tables with results from all chemical analyses run on the samples are found in report #2015-WFL-ISSWQ-001.1.

Table 3. Analytical Summary of ISS Water Analyses

Sample Location	Sample Date	TOC (µg/L)	DMSD (µg/L)	Conductivity (µS/cm)	Total Iodine (mg/L)	Total Silver (µg/L)
PWD (hot)	10/25/2014	1500	5500	2	<0.05	<1
SVO-ZV	10/25/2014	1100	<500	317[a]	--	67
SRV-K (warm)	10/25/2014	3000	<500	182[a]	--	**760[b]**
Condensate	11/3/2014	183,000[c]	25,000	210	--	191

[a]Russian water system is intentionally mineralized.

[b]Level exceeds long-term MORD and SWEG limits but does not exceed contingency SWEGs

[c]TOC levels are high in condensate, but the water recovery system successfully scrubs these compounds prior to consumption.

Toxicological Evaluation of ISS Water Quality: Routine water quality monitoring is performed in-flight using the total organic carbon analyzer (TOCA) and the colorimetric water quality monitor kit (CWQMK). Results from these analyses provide a general indication of overall water quality. Archive water samples are collected during each Increment and returned for analysis in ground laboratories. Data from the ground analyses complement the in-flight data and provide a more complete understanding of water quality on the ISS.

Potable Water

Total organic carbon (TOC) data from in-flight and archival sampling of the US potable water system conducted between November 2013 and November 2014 are shown in Figure 4. There was excellent agreement between in-flight levels measured using the TOCA and archival samples. **TOC levels during Increment 41 were notably elevated in the in-flight US potable water samples, and briefly exceeded the Spacecraft Water Exposure Guideline (SWEG) of 3.0 mg/L.** Consistent with previous TOC increases, the primary contributor to the TOC rise was dimethylsilanediol (DMSD). Throughout this time period, DMSD levels remained well below the SWEG of 35 mg/L and did not present a risk to crew health. The multi-filtration (MF) beds in the US Water Processor Assembly were replaced on 10/17/2014, and TOC levels were notably reduced by the time the archive sample was collected on 10/25/2014. The TOC concentration in the SRV-K warm sample were similar to historical results. Acetone (6 µg/L) and chloroform (45 µg/L) were the only organic compounds detected in the sample, and the measured concentrations are well below SWEGs.

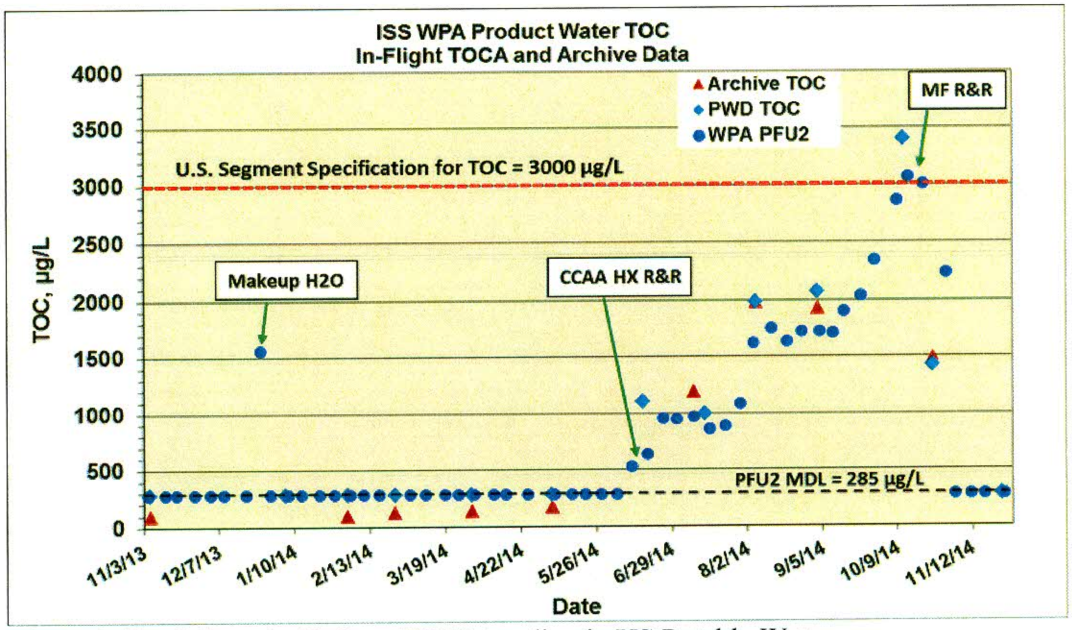

Figure 4. Total Organic Carbon (TOC) trending in US Potable Water

Conductivity provides an indication of the total amount of inorganic contaminants present in water. The conductivity in the sample from the PWD was very low, as expected. Inorganic levels are higher in Russian water, which is mineralized to improve palatability. The conductivities measured in the Russian samples are consistent with historical averages and do not present any risk for crew health. Iodine and silver are biocides used on the US and Russian segments, respectively. Iodine is added to the water produced by the WPA, but it is removed prior to crew consumption to avoid potential thyroid dysfunction. Total iodine levels in the sample collected from the PWD were below detection limits, indicating successful removal of iodine prior to crew consumption. Conversely, silver levels in Russian water samples are expected to remain above the minimal effective biocidal level of 100 μg/L. Levels in the SVO-ZV (67 μg/L) are higher than those reported for the prior Increment, but remain below the minimal effective biocide level, which increases the risk of microbial growth. See the Soyuz 39 post-flight report issued by the Environmental Microbiology Laboratory for results from microbial analyses run on this sample. **Silver was notably elevated in the SRV-K warm sample (760 μg/L) and exceeded both the MORD (500 μg/L) and 100-day SWEG (600 μg/L) limits.** It is believed that the high silver concentration and particulate load in the SRV-K sample resulted from the crew inadvertently connecting a ЕДВ of disinfectant to the БРП-М РП port. Russian crew members confirmed that particles were present in the hose that is used to connect ЕДВs to this port. Crew were instructed to reconfigure the system to bypass the clogged hose and flush the dispensing ports with clean water. New hoses are being launched to replace the ones that contained precipitate. The SWEG is set to protect against long-term exposures that may result in potential motor control impacts or argyria, an aesthetic condition that results from silver depositing in skin cells and other organs. As a precaution, US crew were asked to limit consumption from the SRV-K for a time. The silver level measured in the archive sample was below short-term (contingency) SWEGs (5000 μg/L) and would not be expected to result in argyria or any adverse health effects, although there is the possibility that the high silver and other characteristics would have impacted the palatability of the water during this timeframe. In the SVO-ZV, manganese levels (57 μg/L) exceeded the MORD limit of 50 μg/L but remained well below the US SWEG of 300 μg/L. All other compounds measured in archive samples were below MORD limits, indicating no concern for crew consumption.

Condensate

The ethanol concentration in the condensate sample collected during Increment 41 was the highest level measured in U.S. condensate. The high ethanol concentration in the condensate is likely related to the elevated levels of ethanol seen in the ISS atmosphere during the Increment. Ethanol levels in the air have been elevated over historical averages since April 2014. The observed levels do not pose a concern for crew health, but may negatively impact the performance of the water recovery system. Continued monitoring of the condensate and wastewater is important since significant changes in composition could result in contaminants breaking through the water recovery systems and adversely impacting the potable water supply.

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5/20/15
Date

Enclosures Table 1: Analytical concentrations of compounds found in the mGSCs returned on 39S
Table 2: T-values corresponding to concentrations in Table 1, based on 180-day SMACs

TABLE 1
ANALYTICAL RESULTS OF
39S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)			
	AA05848 SN2081 LAB 09/29/14 @ 17:05 GMT	AA05849 SN2085 JPM 09/29/14 @ 17:05 GMT	AA05850 SN2084 LAB 10/29/14 @ 17:00 GMT	AA05851 SN2088 COL 10/29/14 @ 17:01 GMT
TARGET COMPOUNDS (TO-15)				
FREON 12	<0.025	<0.025	<0.025	<0.025
CHLOROMETHANE	<0.025	<0.025	<0.025	<0.025
FREON 114	<0.025	<0.025	<0.025	<0.025
METHANOL *	**0.50**	**0.49**	0.37	0.36
ACETALDEHYDE	0.35	0.33	0.28	0.25
VINYLCHLORIDE	<0.025	<0.025	<0.025	<0.025
BROMOMETHANE	<0.025	<0.025	<0.025	<0.025
ETHANOL *	**15**	**16**	**9.5**	**8.8**
CHLOROETHANE	<0.025	<0.025	<0.025	<0.025
ACETONITRILE	<0.025	<0.025	<0.025	<0.025
PROPENAL	<0.025	<0.025	<0.025	<0.025
ACETONE	0.37	0.37	0.38	0.36
PROPANAL	<0.025	<0.025	<0.025	<0.025
ISOPROPANOL	0.35	0.42	0.18	0.30
FREON11	<0.025	<0.025	<0.025	<0.025
FURAN	<0.025	<0.025	<0.025	<0.025
ACRYLONITRILE	<0.025	<0.025	TRACE	TRACE
PENTANE	<0.025	<0.025	<0.025	<0.025
2-METHYL-2-PROPANOL	<0.025	<0.025	<0.025	<0.025
METHYLACETATE	<0.025	<0.025	<0.025	<0.025
1,1-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025
DICHLOROMETHANE	TRACE	TRACE	TRACE	TRACE
3-CHLOROPROPENE	<0.025	<0.025	<0.025	<0.025
FREON113	<0.025	<0.025	<0.025	<0.025
N-PROPANOL	0.025	TRACE	0.032	0.058
1,1-DICHLOROETHANE	<0.025	<0.025	<0.025	<0.025
BUTANAL	<0.025	<0.025	<0.025	<0.025
2-BUTANONE	TRACE	TRACE	TRACE	TRACE
CIS-1,2-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025
2-METHYLFURAN	<0.025	<0.025	<0.025	<0.025
ETHYLACETATE	TRACE	TRACE	TRACE	TRACE
HEXANE	<0.025	<0.025	<0.025	<0.025
CHLOROFORM	<0.025	<0.025	<0.025	<0.025
2-BUTENAL	<0.025	<0.025	<0.025	<0.025
1,2-DICHLOROETHANE	<0.025	<0.025	TRACE	TRACE
1,1,1-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025
N-BUTANOL	0.052	0.055	0.060	0.062
BENZENE	<0.025	<0.025	<0.025	<0.025
CARBONTETRACHLORIDE	<0.025	<0.025	<0.025	<0.025
2-PENTANONE	<0.025	<0.025	<0.025	<0.025
2-METHYLHEXANE	<0.025	<0.025	<0.025	<0.025
2,3-DIMETHYLPENTANE	<0.025	<0.025	<0.025	<0.025
PENTANAL	<0.025	<0.025	<0.025	<0.025
3-METHYLHEXANE	<0.025	<0.025	<0.025	<0.025
1,2-DICHLOROPROPANE	<0.025	<0.025	<0.025	<0.025
1,4-DIOXANE	<0.025	<0.025	<0.025	<0.025
TRICHLOROETHENE	<0.025	<0.025	<0.025	<0.025
2,5-DIMETHYLFURAN	<0.025	<0.025	<0.025	<0.025
N-HEPTANE	<0.025	<0.025	<0.025	<0.025
4-METHYL2-PENTANONE	<0.025	<0.025	<0.025	<0.025
CIS-1,3-DICHLOROPROPENE	<0.025	<0.025	<0.025	<0.025
2-PENTENAL	<0.025	<0.025	<0.025	<0.025
TRANS-1,3-DICHLOROPROPENE	<0.025	<0.025	<0.025	<0.025
1,1,2-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025
TOLUENE	<0.025	TRACE	<0.025	<0.025
HEXANAL	<0.025	<0.025	<0.025	<0.025
MESITYLOXIDE	<0.025	<0.025	<0.025	<0.025
1,2-DIBROMOETHANE	<0.025	<0.025	<0.025	<0.025
BUTYLACETATE	<0.025	<0.025	<0.025	<0.025
OCTANE	<0.025	<0.025	<0.025	<0.025
TETRACHLOROETHENE	<0.025	<0.025	<0.025	<0.025
CHLOROBENZENE	<0.025	<0.025	<0.025	<0.025
ETHYLBENZENE	<0.025	<0.025	<0.025	<0.025
M/P-XYLENES	<0.050	<0.050	<0.050	<0.050
2-HEPTANONE	<0.025	<0.025	<0.025	<0.025
CYCLOHEXANONE	<0.025	<0.025	<0.025	<0.025
HEPTANAL	<0.025	<0.025	<0.025	<0.025
STYRENE	<0.025	<0.025	<0.025	<0.025
1,1,2,2-TETRACHLOROETHANE	<0.025	<0.025	<0.025	<0.025
O-XYLENE	TRACE	0.026	TRACE	TRACE
NONANE	<0.025	<0.025	<0.025	<0.025
1,3,5-TRIMETHYLBENZENE	<0.025	<0.025	<0.025	<0.025
1,2,4-TRIMETHYLBENZENE	<0.025	<0.025	<0.025	<0.025
1,3-DICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025
1,4-DICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025
1,2-DICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025
1,2,4-TRICHLOROBENZENE	<0.050	<0.050	<0.050	<0.050
HEXACHLORO-1,3-BUTADIENE	<0.075	<0.075	<0.075	<0.075

TABLE 1
ANALYTICAL RESULTS OF
39S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)			
	AA05848 SN2081 LAB 09/29/14 @ 17:05 GMT	AA05849 SN2085 JPM 09/29/14 @ 17:05 GMT	AA05850 SN2084 LAB 10/29/14 @ 17:00 GMT	AA05851 SN2088 COL 10/29/14 @ 17:01 GMT
SPECIAL INTEREST COMPOUNDS **				
1,3-BUTADIENE &	<0.050	<0.050	<0.050	<0.050
ETHYLENE OXIDE	<0.050	<0.050	<0.050	<0.050
2-METHYL-2-PROPENAL	<0.050	<0.050	<0.050	<0.050
3-BUTEN-2-ONE	<0.050	<0.050	<0.050	<0.050
2-ETHOXYETHANOL	<0.050	<0.050	<0.050	<0.050
DIMETHYL DISULFIDE	<0.050	<0.050	<0.050	<0.050
OCTAFLUOROPROPANE &	2.5	3.3	3.8	2.4
PERFLUORO-2-METHYLPENTANE &	<0.050	<0.050	<0.050	<0.050
CARBONYL SULFIDE &	<0.025	<0.025	<0.025	<0.025
ISOBUTANE &	<0.025	<0.025	<0.025	<0.025
2-METHYL-1-PROPENE &	0.026	0.025	TRACE	0.025
DIMETHYL SULFIDE &	<0.025	<0.025	<0.025	<0.025
CARBON DISULFIDE &	TRACE	<0.025	<0.025	<0.025
TRIMETHYLSILANOL &	0.083	0.11	0.11	0.13
OCTAMETHYLCYCLOTETRASILOXANE &	<0.075	<0.075	<0.075	<0.075
DECAMETHYLCYCLOPENTASILOXANE &	0.24	0.32	0.45	0.45
HEXAMETHYLCYCLOTRISILOXANE %	1.2	1.7	1.6	1.8
NON-TARGET COMPOUNDS **				
PROPENE &	<0.050	<0.050	TRACE	TRACE
PROPANE &	<0.050	<0.050	<0.050	<0.050
BUTANE &	<0.050	<0.050	<0.050	<0.050
ISOPRENE &	TRACE	TRACE	TRACE	TRACE
SULFURHEXAFLUORIDE	<0.050	<0.050	0.080	<0.050
1,1,1,2-TETRAFLUOROETHANE	0.54	0.56	0.17	0.16
CHLORODIFLUOROMETHANE	<0.050	<0.050	0.29	0.31
C11-ALKANE	<0.050	<0.050	<0.050	<0.050
2-ETHYLHEXANAL	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	<0.050	<0.050
LIMONENE	<0.050	<0.050	<0.050	<0.050
TOTAL ALCOHOLS PLUS ACETONE	16	17	11	10
TARGET COMPOUNDS (GC)				
CARBON MONOXIDE	<0.23	<0.23	0.45	0.42
METHANE	19	19	15	15
HYDROGEN	3.4	3.3	5.1	5.2
CARBON DIOXIDE	8200	8200	8200	7700
TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**21**	**24**	**17**	**16**
TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	**19**	**20**	**14**	**13**

* GC/FID data results are in bold
** Quantified using "B" response factor except where noted
& Quantified using a multi-point calibration
% Response factor generated from an internal study
<: Value is less than the laboratory report detection limit.
TRACE: Amount detected is sufficient for compound identification only.
OFP - Octafluoropropane

TABLE 2
T-VALUES FOR 39S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)			
	AA05848 SN2081 LAB 09/29/14 @ 17:05 GMT	AA05849 SN2085 JPM 09/29/14 @ 17:05 GMT	AA05850 SN2084 LAB 10/29/14 @ 17:00 GMT	AA05851 SN2088 COL 10/29/14 @ 17:01 GMT
TARGET COMPOUNDS (TO-14/POLAR)				
FREON12	ND	ND	ND	ND
CHLOROMETHANE	ND	ND	ND	ND
FREON114	ND	ND	ND	ND
METHANOL	0.00555	0.00540	0.00414	0.00405
ACETALDEHYDE	0.08706	0.08125	0.07056	0.06300
VINYLCHLORIDE	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND
ETHANOL	0.00751	0.00789	0.00474	0.00440
CHLOROETHANE	ND	ND	ND	ND
ACETONITRILE	ND	ND	ND	ND
PROPENAL	ND	ND	ND	ND
ACETONE	0.00719	0.00721	0.00738	0.00700
PROPANAL	ND	ND	ND	ND
ISOPROPANOL	0.00235	0.00278	0.00118	0.00199
FREON11	ND	ND	ND	ND
FURAN	ND	ND	ND	ND
ACRYLONITRILE	ND	ND	0.01250	0.01250
PENTANE	ND	ND	ND	ND
2-METHYL-2-PROPANOL	ND	ND	ND	ND
METHYLACETATE	ND	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND
DICHLOROMETHANE	0.00125	0.00125	0.00125	0.00125
3-CHLOROPROPENE	ND	ND	ND	ND
FREON113	ND	ND	ND	ND
N-PROPANOL	0.00026	0.00013	0.00033	0.00059
1,1-DICHLOROETHANE	ND	ND	ND	ND
BUTANAL	ND	ND	ND	ND
2-BUTANONE	0.00042	0.00042	0.00042	0.00042
CIS-1,2-DICHLOROETHENE	ND	ND	ND	ND
2-METHYLFURAN	ND	ND	ND	ND
ETHYLACETATE	0.00007	0.00007	0.00007	0.00007
HEXANE	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND
2-BUTENAL	ND	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	0.00781	0.00781
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND
N-BUTANOL	0.00131	0.00138	0.00151	0.00156
BENZENE	ND	ND	ND	ND
CARBONTETRACHLORIDE	ND	ND	ND	ND
2-PENTANONE	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND
PENTANAL	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND
1,4-DIOXANE	ND	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	ND
2,5-DIMETHYLFURAN	ND	ND	ND	ND
N-HEPTANE	ND	ND	ND	ND
4-METHYL2-PENTANONE	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND
2-PENTENAL	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND
TOLUENE	ND	0.00083	ND	ND
HEXANAL	ND	ND	ND	ND
MESITYLOXIDE	ND	ND	ND	ND
1,2-DIBROMOETHANE	ND	ND	ND	ND
BUTYLACETATE	ND	ND	ND	ND
OCTANE	ND	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND
M/P-XYLENES	ND	ND	ND	ND
2-HEPTANONE	ND	ND	ND	ND
CYCLOHEXANONE	ND	ND	ND	ND
HEPTANAL	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND
O-XYLENE	0.00034	0.00070	0.00034	0.00034
NONANE	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND	ND	ND

TABLE 2
T-VALUES FOR 39S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)			
	AA05848 SN2081 LAB 09/29/14 @ 17:05 GMT	AA05849 SN2085 JPM 09/29/14 @ 17:05 GMT	AA05850 SN2084 LAB 10/29/14 @ 17:00 GMT	AA05851 SN2088 COL 10/29/14 @ 17:01 GMT
SPECIAL INTEREST COMPOUNDS				
1,3-BUTADIENE	ND	ND	ND	ND
ETHYLENE OXIDE	ND	ND	ND	ND
2-METHYL-2-PROPENAL	ND	ND	ND	ND
3-BUTEN-2-ONE	ND	ND	ND	ND
2-ETHOXYETHANOL	ND	ND	ND	ND
DIMETHYL DISULFIDE	ND	ND	ND	ND
OCTAFLUOROPROPANE	0.00003	0.00004	0.00004	0.00003
PERFLUORO-2-METHYLPENTANE	ND	ND	ND	ND
CARBONYL SULFIDE	ND	ND	ND	ND
ISOBUTANE	ND	ND	ND	ND
2-METHYL-1-PROPENE	0.00002	0.00002	0.00001	0.00002
DIMETHYL SULFIDE	ND	ND	ND	ND
CARBON DISULFIDE	0.00078	ND	ND	ND
TRIMETHYLSILANOL	0.02063	0.02726	0.02819	0.03229
OCTAMETHYLCYCLOTETRASILOXANE	ND	ND	ND	ND
DECAMETHYLCYCLOPENTASILOXANE	0.01613	0.02134	0.03001	0.03003
HEXAMETHYLCYCLOTRISILOXANE	0.13660	0.19408	0.17731	0.20159
NON-TARGET COMPOUNDS				
PROPENE &	ND	ND	0.00058	0.00058
PROPANE &	ND	ND	ND	ND
BUTANE &	ND	ND	ND	ND
ISOPRENE &	0.00833	0.00833	0.00833	0.00833
SULFURHEXAFLUORIDE	ND	ND	0.00007	ND
1,1,1,2-TETRAFLUOROETHANE	0.00524	0.00536	0.00163	0.00158
CHLORODIFLUOROMETHANE	ND	ND	0.00008	0.00009
C11-ALKANE	ND	ND	ND	ND
2-ETHYLHEXANAL	ND	ND	ND	ND
C12-ALKANE	ND	ND	ND	ND
LIMONENE	ND	ND	ND	ND
TARGET COMPOUNDS (GC)				
CARBON MONOXIDE	0.00678	0.00678	0.02629	0.02488
METHANE	0.00549	0.00554	0.00434	0.00439
HYDROGEN	0.01008	0.00981	0.01513	0.01518
CARBON DIOXIDE	0.62750	0.63016	0.63145	0.59227
TOTAL T-VALUE	**0.95092**	**1.01802**	**1.03570**	**1.01625**
TOTAL T-VALUE - CO2	**0.32342**	**0.38787**	**0.40425**	**0.42397**

ND : Value is less than the laboratory report detection limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.