ISS Potable Water Sampling and Chemical Analysis Results for 2016

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Presentation

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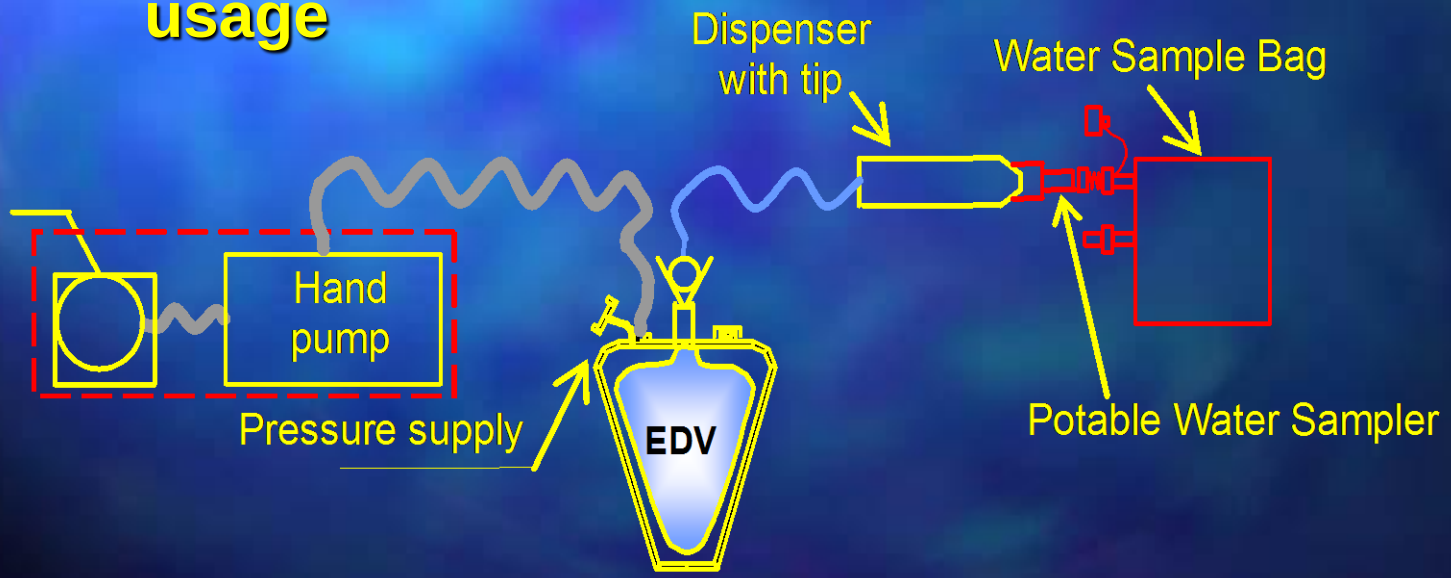
  - Water Quality Requirements
- Archival Sample Data for Expeditions 46-49
  - Returned Sample Summary
  - Sample Handling & Analysis
  - SRV-K Samples Analytical Results
  - SVO-ZV Samples Analytical Results
  - PWD Samples Analytical Results
- Conclusions
- Recommendations

Background

Russian Segment Potable Water Systems

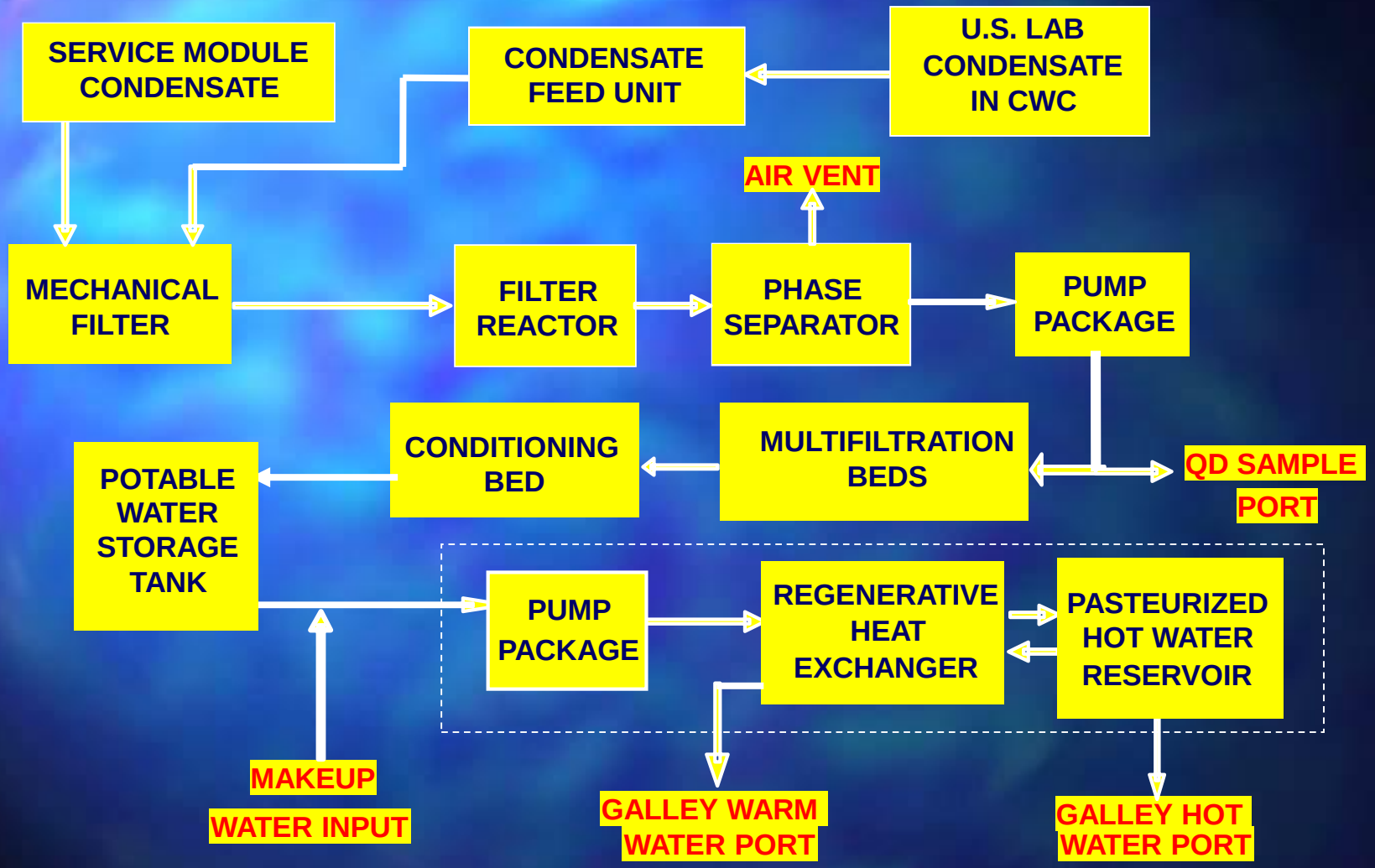
- **Stored potable water system (SVO-ZV):**
  - **Provides crew access to Russian ground-supplied potable water (Rodnik)**
  - **Water often stagnant due to infrequent crew usage**



Russian Segment Potable Water Systems

- **Condensate H_2O recovery system (SRV-K):**
  - **Processes humidity condensate received direct from the Service Module heat exchangers**
  - **U.S. condensate can be processed via the Condensate Feed Unit (CFU)**
  - **Water in EDVs can be used as makeup to supplement recovered water**

SRV-K Condensate H_2O Recovery System

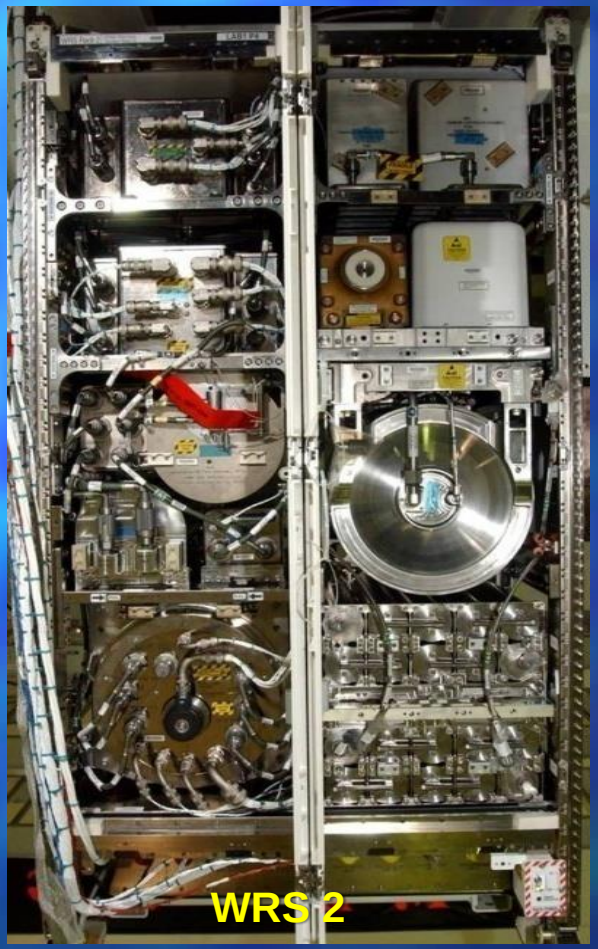


U.S. Segment Potable Water System

- **Water Recovery System (WRS):**
  - Urine Processor Assembly (UPA) processes pretreated urine by distillation and delivers distillate to a wastewater tank where it is combined with humidity condensate.
  - Water Processor Assembly (WPA) treats the wastewater using multifiltration and thermal catalytic oxidation, adds iodine biocide, and stores product water for delivery to the potable water bus.
- **Potable Water Dispenser (PWD):**
  - Receives WPA product water direct from the bus and dispenses either hot or ambient water after removing iodine at the point of use

U.S. Segment Potable Water System

WRS 1

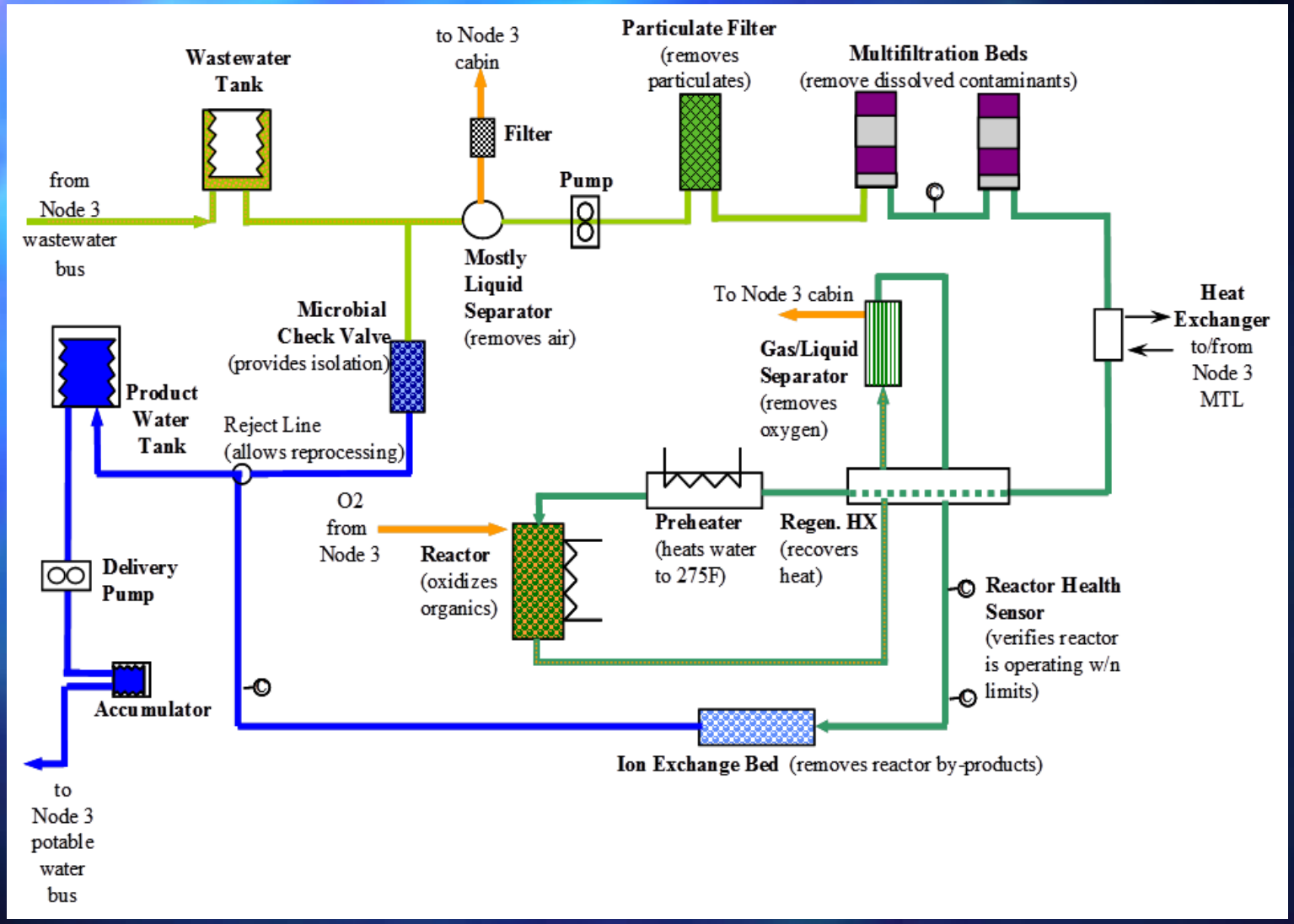


WRS 2

Water Recovery System (WRS)

Potable Water Dispenser (PWD)

U.S. Segment Potable Water System



ISS Water Quality & Monitoring Requirements

ISS Program established water quality & monitoring requirements for regenerated and stored potable water.

- **SSP 41000, *System Specification for ISS*, specifies water quality requirements for U.S. potable water.**
- **SSP 50260, *ISS Medical Operations Requirements Document (MORD),* specifies:**
  - **Water quality requirements for Russian potable water**
  - **In-flight and archival sampling requirements**
- **Sampling of Russian Segment potable water by the U.S side is now performed only as needed on a contingency basis.**
  - **The last SRV-K and SVO-ZV samples were collected during Expedition 46**

E46-49 Archival Sample Data

Expeditions 46-49 Returned Samples

- **Expedition 46:**
  - PWD Ambient: 1/25/16
  - PWD Hot: 2/2/16
  - SRV-K Hot: 2/2/16
  - SVO-ZV: 2/2/16
    - *All returned on Soyuz 44*
- **Expedition 47:**
  - PWD Ambient: 4/4/16
  - PWD Hot: 5/25/16
    - *Returned on Soyuz 45*
- **Expedition 48:**
  - PWD Hot: 8/2/16
  - PWD Ambient: 8/23/16
    - *Returned on Soyuz 46*
- **Expedition 49:**
  - PWD Hot: 9/19/16
  - PWD Ambient: 10/18/16
  - *All returned on Soyuz 47*

Sample Handling & Analysis

- Samples returned on Soyuz were received from the Russian side, then placed in coolers with ice packs and transported back to Houston on the NASA crew plane.
- Chemical analyses were performed at Johnson Space Center's Toxicology and Environmental Chemistry (TEC) Laboratory using a combination of standard and custom analytical methods.

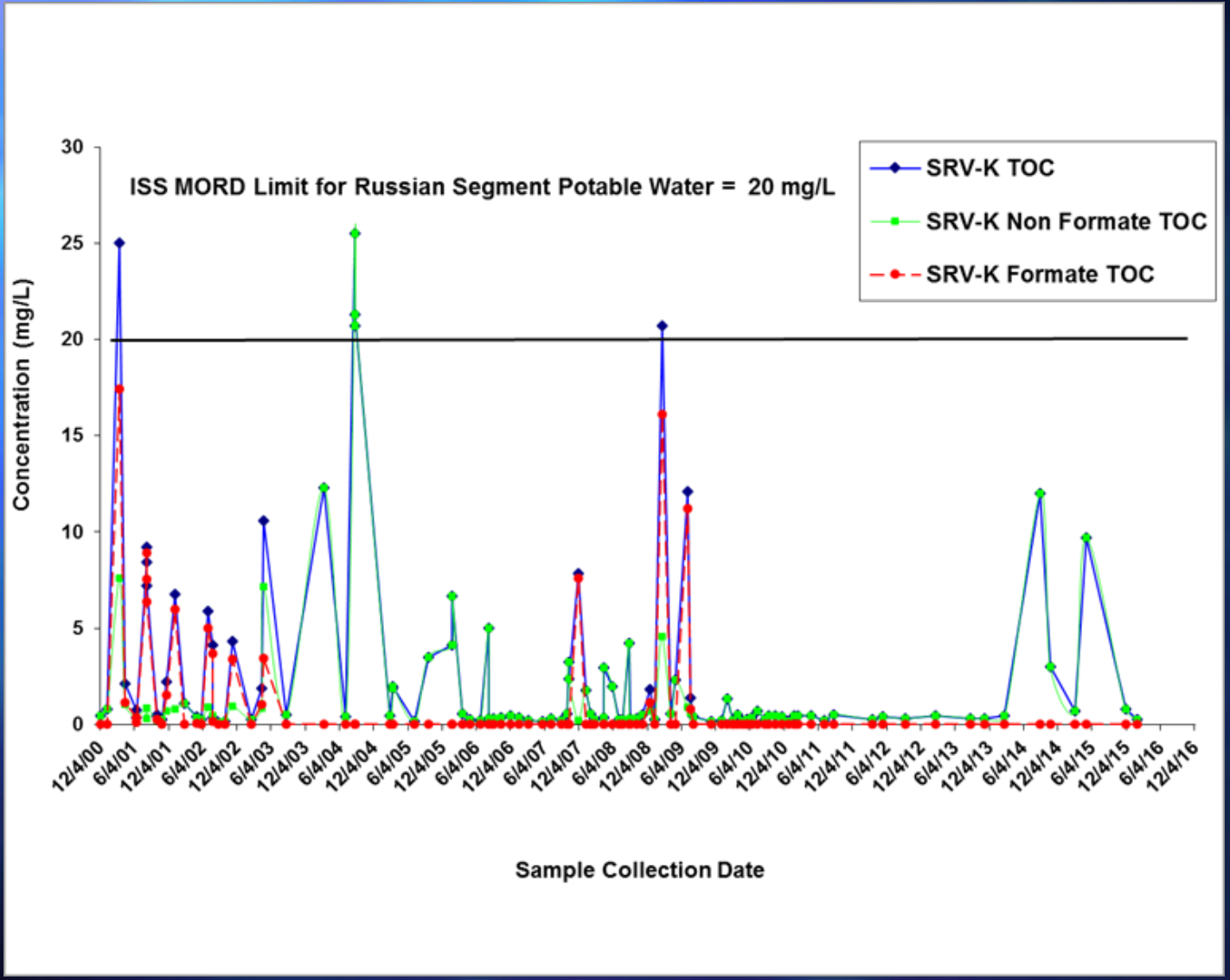
Expedition 46 SRV-K Sample Results
(1 Sample)

Met all ISS MORD quality requirements:

- **Total silver: 36 µg/L *(500 µg/L MORD)***
  - ***Below minimum effective biocidal level of 100 µg/L***
- **TOC: 0.25 mg/L *(20 mg/L MORD limit)***

Total, Formate, and Nonformate Organic Carbon in SRV-K Water Samples from ISS Flights 4A to Soyuz 44

(2016 data are from Expedition 46)



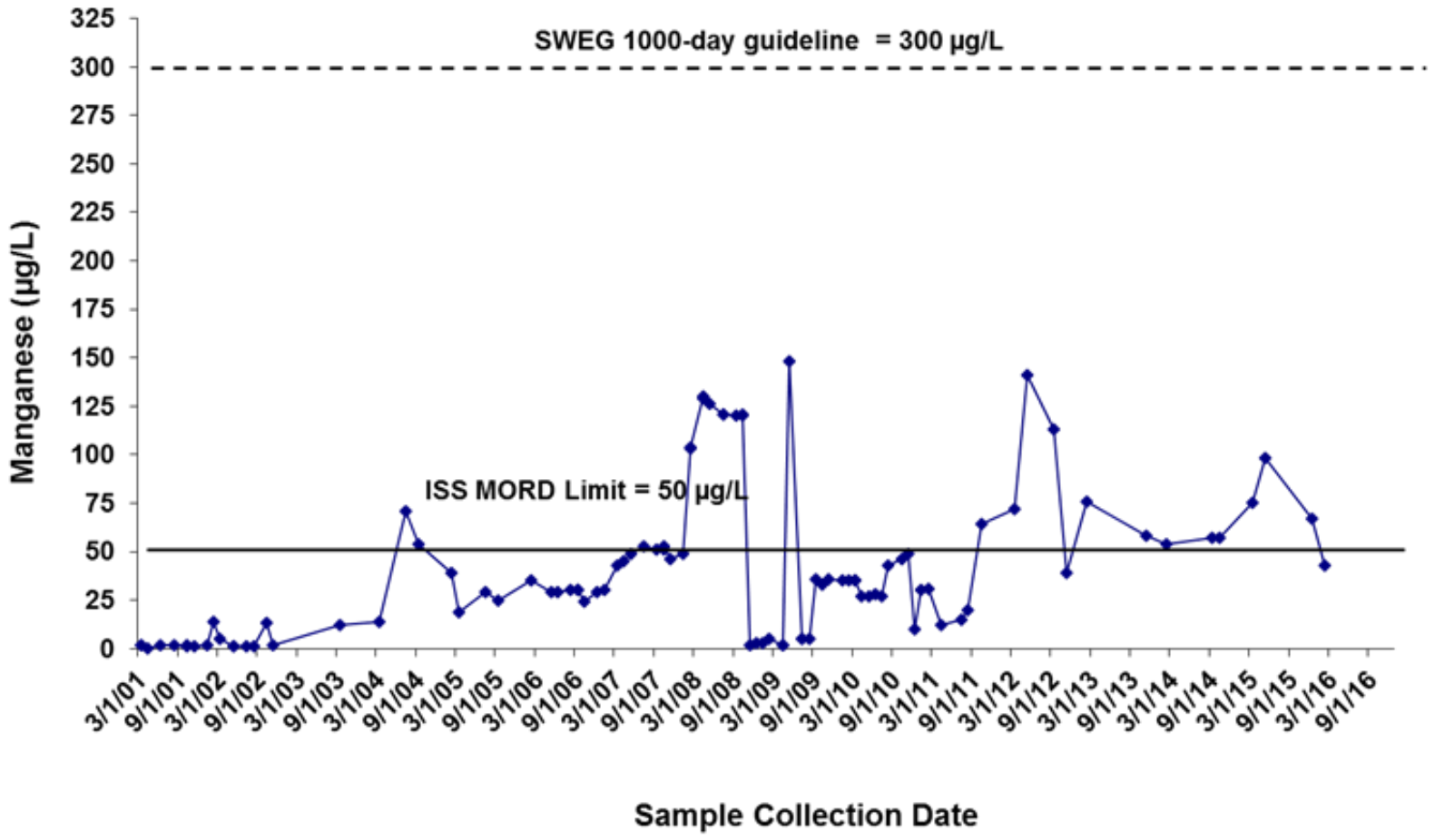
Expedition 46 SVO-ZV Sample Results
(1 Sample)

Met all ISS MORD quality requirements:

- **Manganese: 43 µg/L *(50 µg/L MORD)***
  - ***Well below 1000-d SWEG of 300 µg/L***
- **TOC: 1.14 mg/L *(20 mg/L MORD limit)***
- **Total silver: 90 µg/L *(500 µg/L MORD)***
  - ***Below minimum effective biocidal level of 100 µg/L***

Manganese in SVO-ZV Water Samples from ISS Flights 5A to Soyuz 44

(2016 data are from Expedition 46)



E46 - E49 US Product Water (PWD) Samples

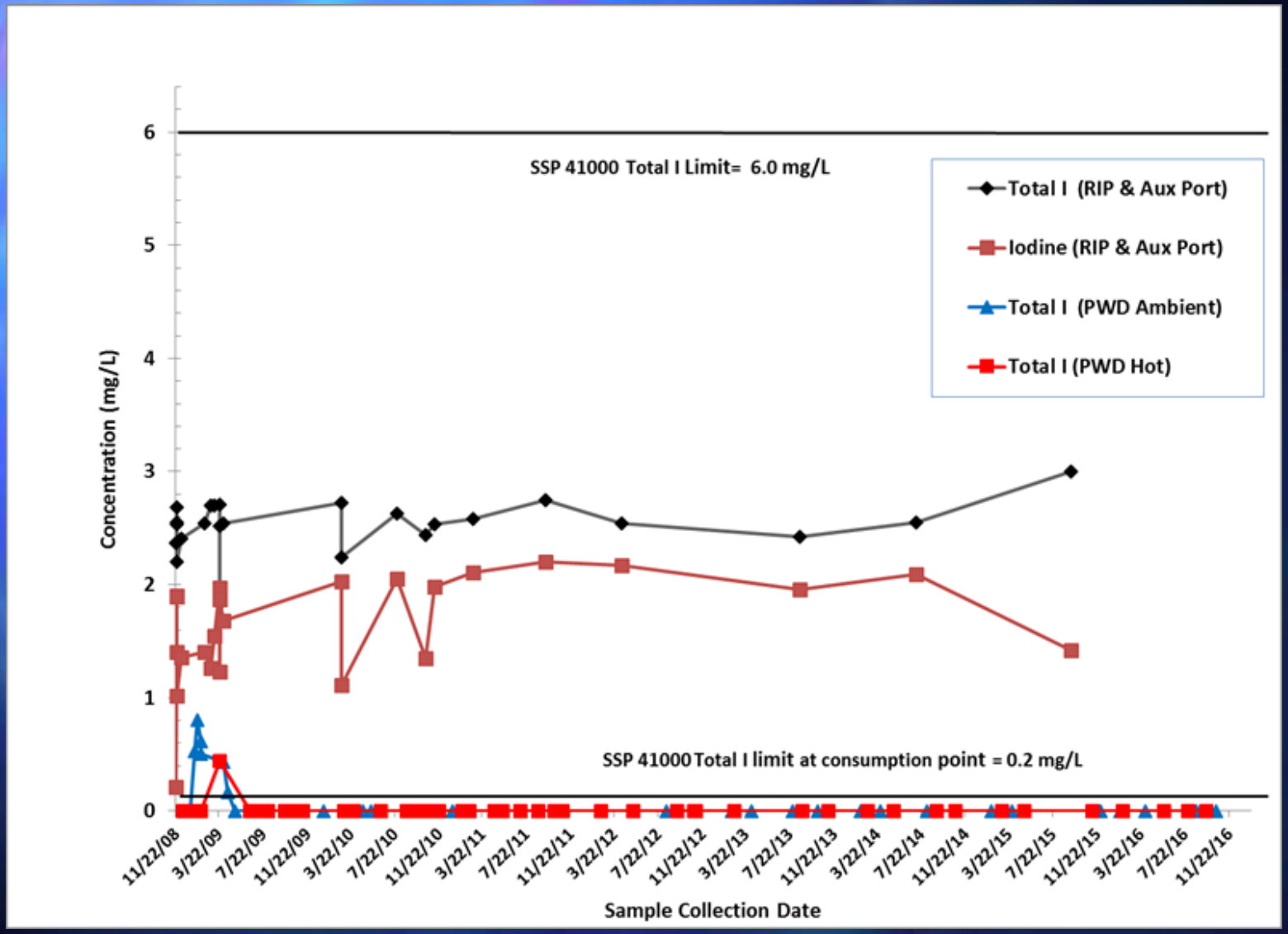
(8 samples)

Met all ISS potable water requirements (SSP 41000):

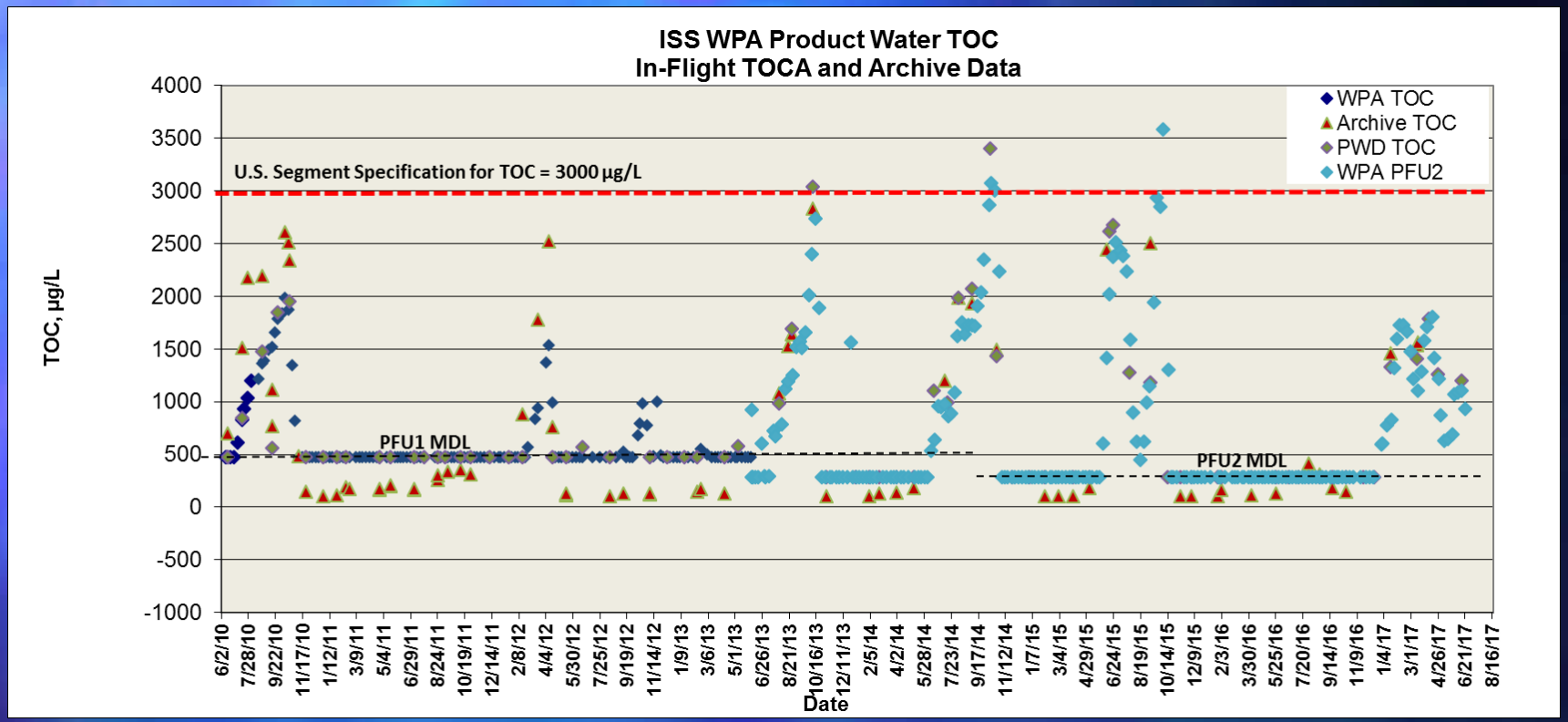
- **TOC: <0.10 to 0.41 mg/L *(3 mg/L limit)***
- **Total I (PWD Hot/Ambient): non-detect, <0.05 mg/L *(0.2 mg/L limit)***
  - ***PWD provides iodine removal at point-of-use***
- **Nickel: <1 to 5 µg/L *(300 µg/L limit)***
- **Methyl Sulfone: 88 to 127 µg/L**

Total I & Iodine in WPA Archival-Water Samples from ISS ULF2 to Soyuz 47

(2016 data are from Expeditions 46-49)

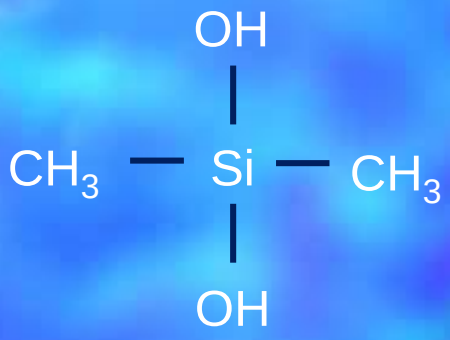


Archive Sample TOC vs. In-flight TOCA

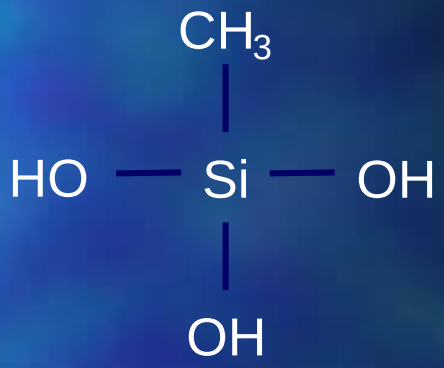


- The 6th instance of increasing Total Organic Carbon (TOC) concentrations in the water produced by the US Water Processor Assembly (WPA) did not occur as anticipated during 2016 but began on 12/30/16 and is ongoing.
- So far, modifications to WPA operations have successfully mitigated the increase without replacement of multifiltration (MF) beds.
  - Increased percentage of urine distillate versus humidity condensate in waste feed stream
  - Dilution of waste feed stream with clean water from Oxygen Generation Assembly

Source of TOC



DMSD



MMST

- Primary source of the current TOC increase has been determined to be dimethylsilanediol (DMSD).
- MMST (monomethylsilanetriol) was not detected as it was for the previous TOC increase.

Conclusions and Recommendations

Conclusions

- Chemical analysis results for archival water samples collected from SRV-K, SVO-ZV, and PWD and returned during Expeditions 46-49 indicate that all ISS potable water supplies were acceptable for crew consumption.

- Primary source of currently elevated TOC in WPA product water has been identified as dimethylsilanediol (DMSD).

Recommendations

- Continue in-flight monitoring of TOC in WPA and PWD water samples using TOCA
- Investigate environmental source of DMSD and root cause for its presence in WPA product water
- Continue to watch MMST/DMSD, total iodine, and metal levels in PWD return samples