Hidden Valley Lake Community Services District Pilots Innovative Cr(VI) Remediation System

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Agenda

- Site/Project Overview
- Technology Overview
- Pilot Study Results
- Summary and Next Steps

Background

HIDDEN VALLEY LAKE COMMUNITY SERVICES DISTRICT

Hidden Valley Lake Community Services District

Hidden Valley Lake Community Services District

- Well output 1,100 gpm
- Cr (VI) levels 18-22 ppb
  - Variance attributed to a small annual drop in the water table toward the end of summer
- Treatment Challenges
  - Small rural water agency
  - Little to no capital reserves
  - Maintenance issues throughout the distribution system have been deferred

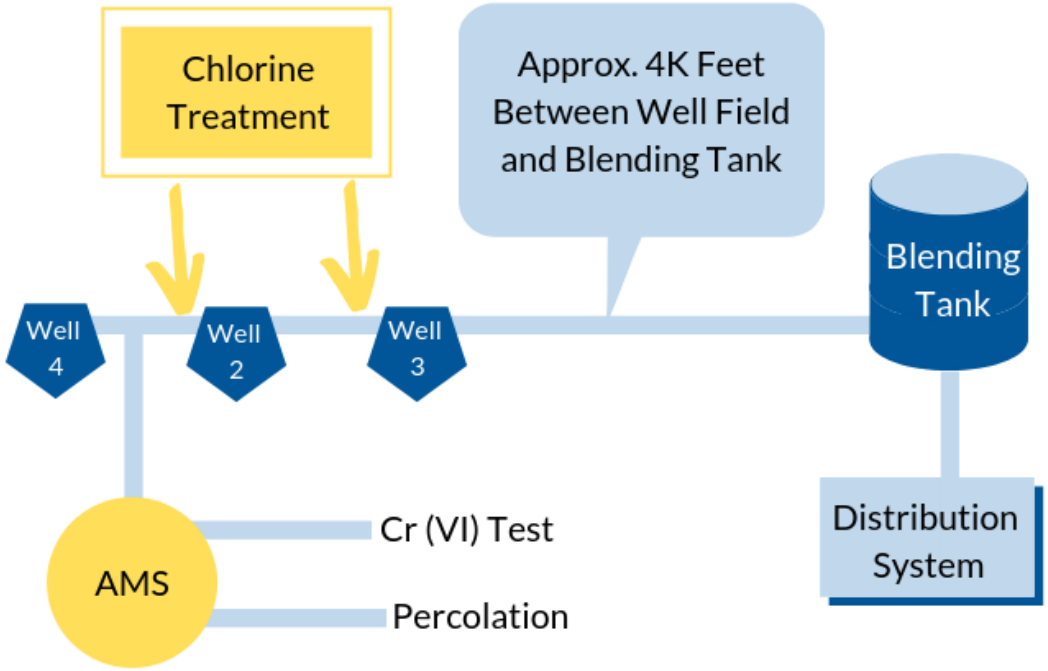
Hidden Valley Lake Community Services District

- SafeGuard™ Cr(VI) remediation demonstration initiated in Nov' 2018
  - 2 gpm flow rate
- 2 stage study
  - Without chlorinated water (2019, completed)
  - With chlorinated water (Q3 2019, planned)

SafeGuard™ H2O Cr(VI) remediation system pilot demonstration at Hidden Valley Lake Community Services District

Hidden Valley Lake Community Services District

Pilot Demonstration Diagram



Novel Cr(VI) Remediation System

SAFEGUARD™ H2O SYSTEM

Cr(VI) Treatment Costs

Cost of Cr(VI) Removal Based on Los Banos (CA) Water Characteristics

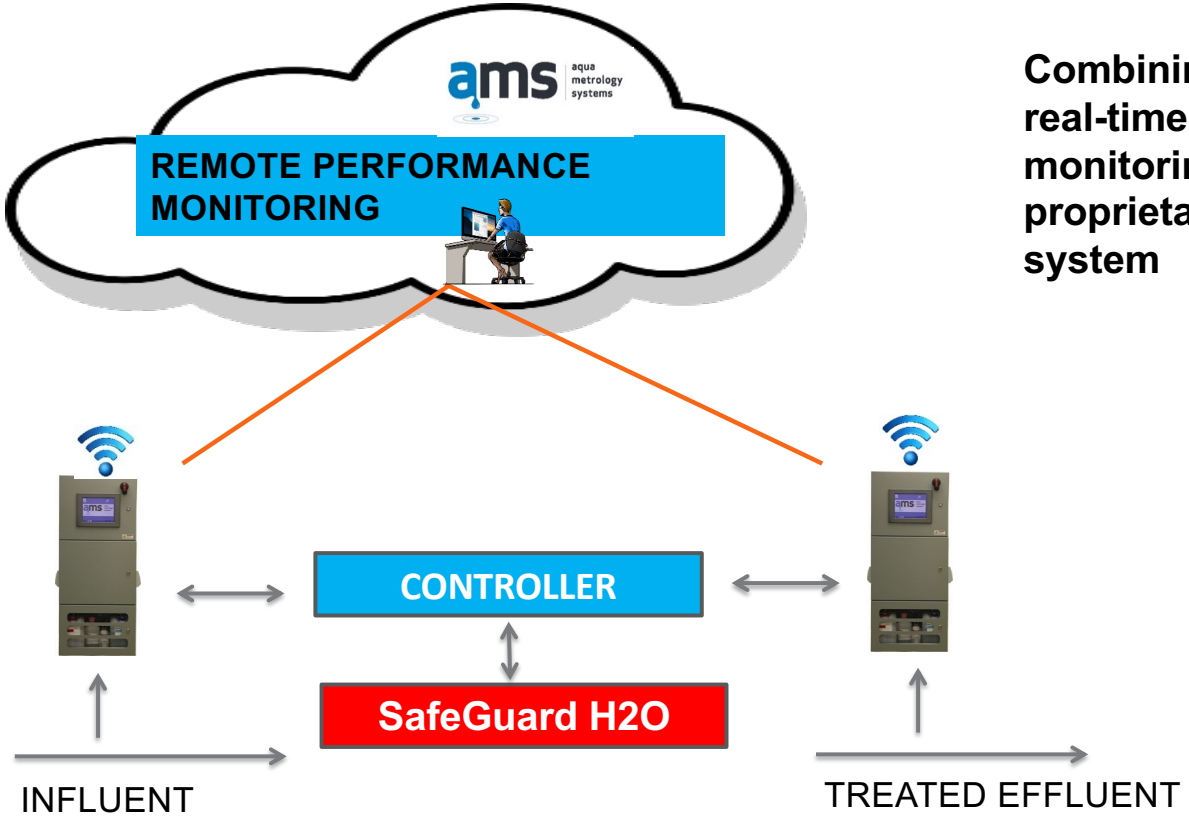
SafeGuard H2O treatment system, without filtration, ranges between $0.7-1.4/1,000 gal treated. Includes 3 monitors.

This cost is dependent on monitoring implemented, both influent Cr(VI) levels and targeted effluent level (MCL).

(Based on WQTS Model)

Capital Cost ($M)	Lower End	Upper End
SBA Treatment	$2.1	$4.5
WBA Treatment	$2.7	$5.9
RCF Treatment	$2.5	$5.3
SafeGuard H2O Treatment	<$0.95	
Annual O&M Cost ($/yr.)	**Lower End**	**Upper End**
SBA Treatment	$260,000	$558,000
WBA Treatment	$259,000	$555,000
RCF Treatment	$166,000	$356,000
SafeGuard H2O Treatment	$96,000	$165,000
Annualized Cost ($/yr.)	**Lower End**	**Upper End**
SBA Treatment	$429,000	$920,000
WBA Treatment	$478,000	$1,025,000
RCF Treatment	$363,000	$779,000
SafeGuard H2O Treatment	$240,000	$480,000

SafeGuard H2O™ Cr- An Intelligent Water Treatment System



Combining market leading real-time trace metal monitoring capability with proprietary treatment system

SafeGuard H2O™ Micro Pilot Goals

- Demonstrate ability of novel SafeGuardH2O Cr removal system to convert Cr(VI) into non toxic Cr(III) reliably down to non-detect levels;
- Demonstrate high stability of the treatment system during continuous, unattended field operation;
- Demonstrate advantage of online Cr(VI) monitoring for system optimization and control;
- Compare and correlate online chromium results obtained online with certified laboratory analysis.

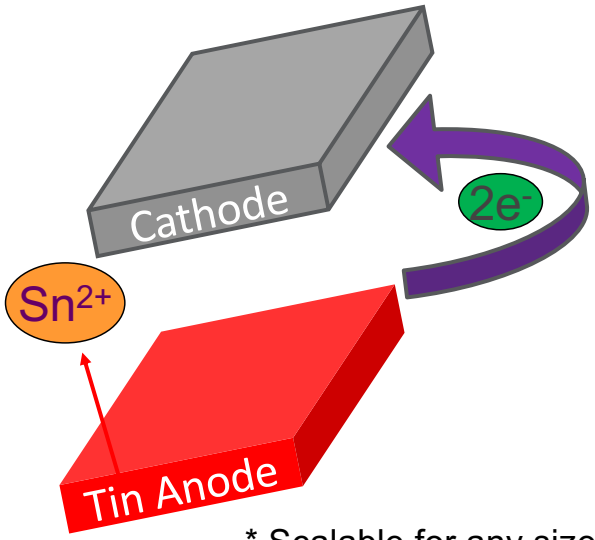
SafeGuard™ H2O Cr Micro Pilot System

- Rack dimensions: 2.5x1x6
- Overall system foot print: 3.5x2
- Water flow: up to 2 gal/min
- Cr(VI) analysis frequency: up to 4/hr

Background- Electrolytic Stannous Reagent Generation

Step 1- electrolytic tin dissolution (reagent generation)

$Sn^0 - 2e^- \rightarrow Sn^{2+}$



Step 2 – Hexavalent chromium reduction (contaminant conversion)

$3Sn^{2+} + 2Cr_2O_7^{2+} + 14H^+ \rightarrow 3Sn^{4+} + 2Cr^{3+} + 7H_2O$

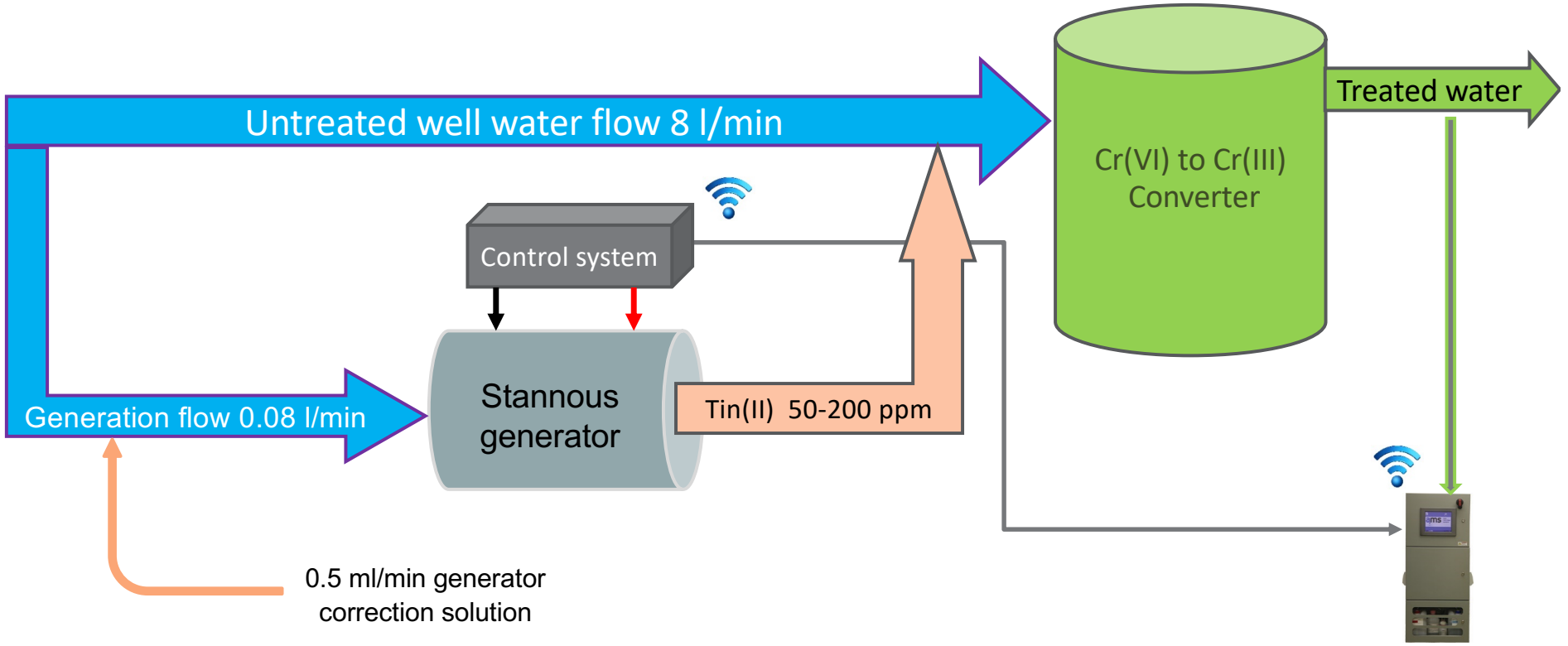
- Spontaneous, fast reaction
- Thermodynamically favorable, reaction proceeds to completion (E^0 ~ 1.1V)
- Broad temperature, pH range

* Scalable for any size treatment system

Advantages of Electrolytic Stannous Reagent Generation

- **Stable, non toxic, food grade** stannous reagent precursor material with unlimited shelf life;
- **Highly** accurate and reliable reagent generation and dosing on demand through manipulating process parameters
- **Simple, compact and flexible** reagent generation system design, easy system scalability;
- **Low** entire reagent cost, storage and shipping expenses.

SafeGuard™ H2O Cr Flow Diagram



Measurement Principle: Online Cr(VI) Monitoring

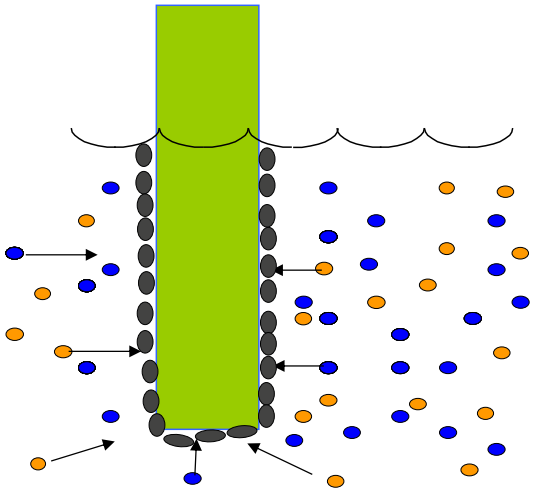
Step 1- Accumulation

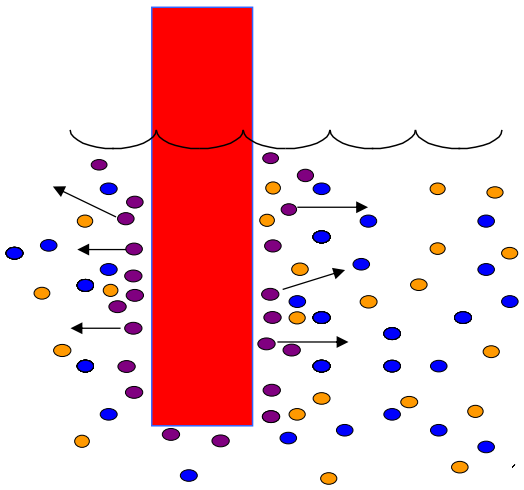
$Chel + Cr^{6+} + 3e^- \rightarrow ChCr^{3+}$

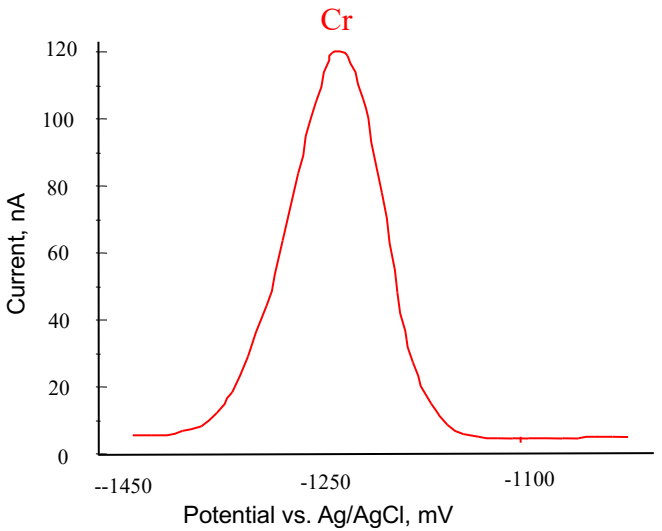
Step 2- Stripping

$ChelCr^{3+} + e^- \rightarrow ChelCr^{2+}$

Resulting Signal

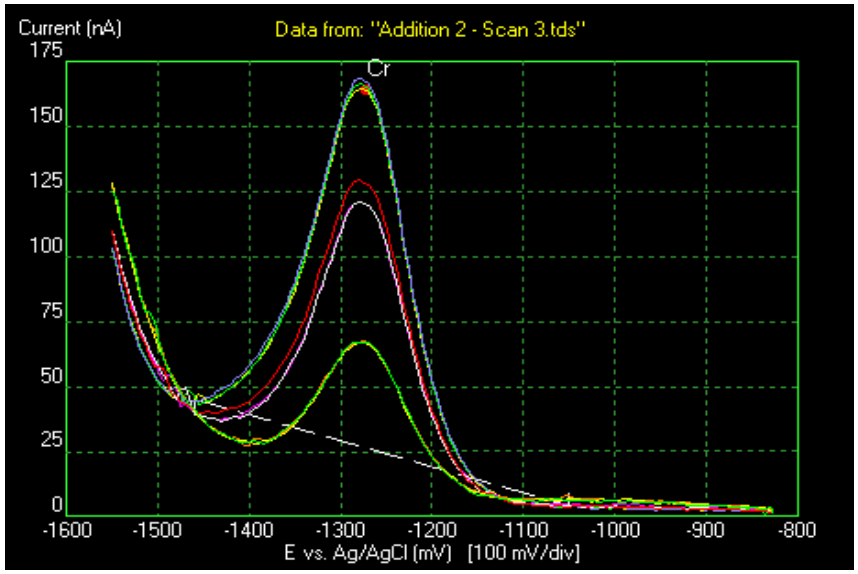


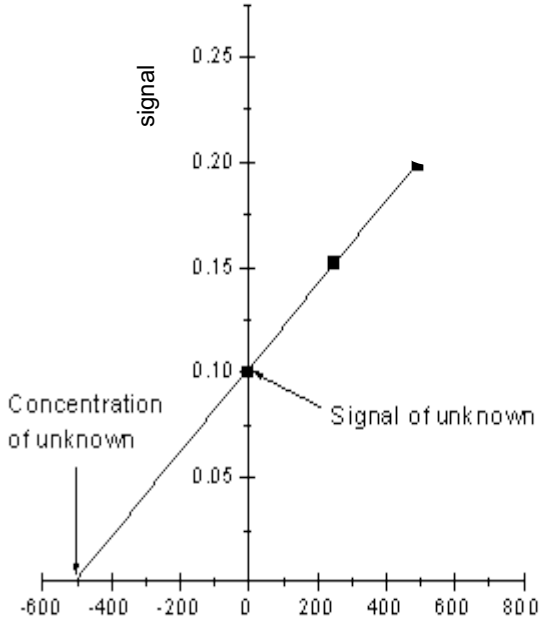




Cr^{6+} Chelant $CatCr^{3+}$ Cr^{2+}

Cr (VI) Quantification by MSA





MetalGuard™ Online Chromium Monitor

MetalGuard™ Chromium Features

Automated online operation

- Eliminates operator variability
- Accuracy down to 1 ppb
- Measurement time less than 30 min
- Correlation with lab methods +/- 10% typical
- Multiple streams including grab sample port

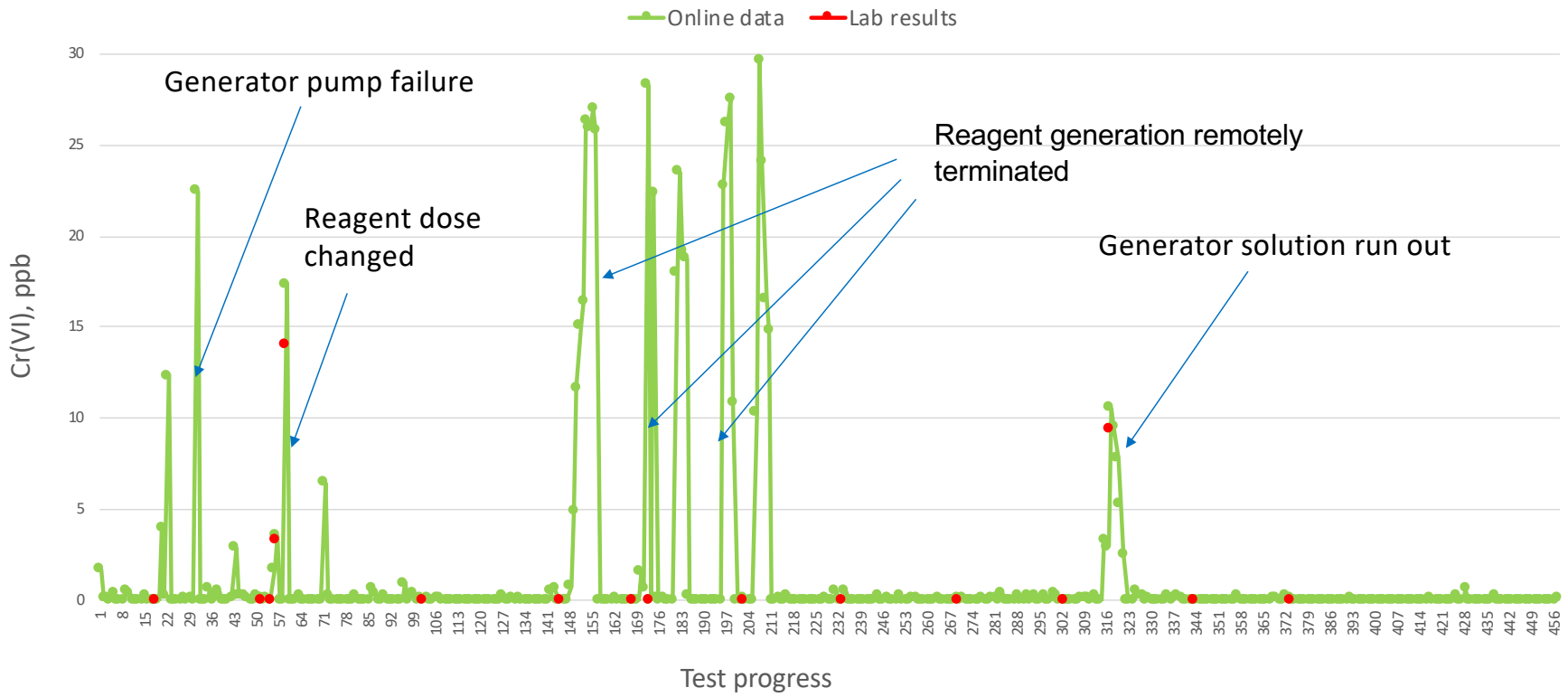
Comprehensive data acquisition

- Programmable contact closure for local contaminant level annunciation
- Easy-to-use front panel HMI
- Programmable on-board data acquisition

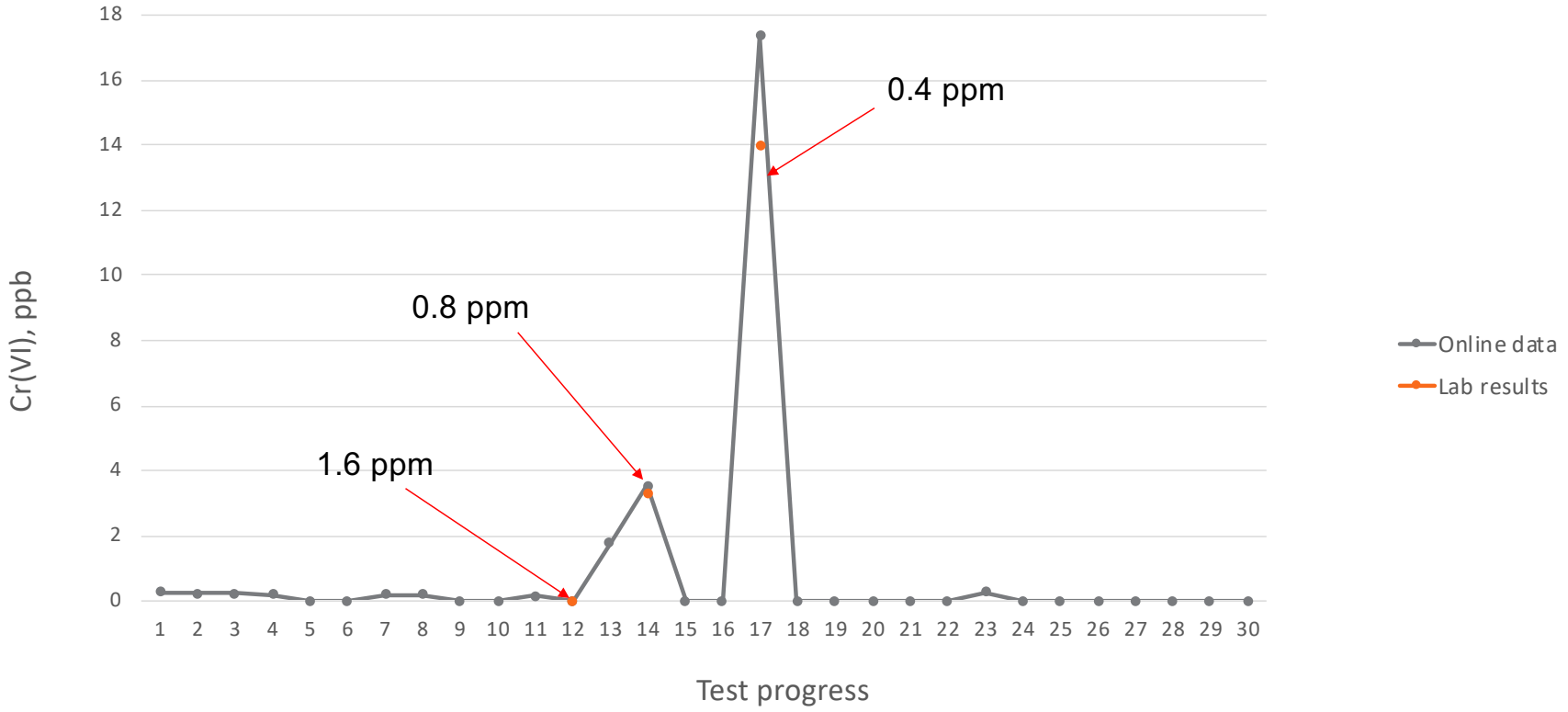
Low operational costs

- Replaceable reagent tray provides up to 1,000 measurements
- Employs a self-regenerating sensor and is auto-calibrating
- NEMA 4X enclosure
- Climate control

Cumulative Online Cr (VI) Data vs Laboratory Results



Effect of Stannous Reagent Dose on Cr(VI) Conversion Efficiency



Benefits of Intelligent Water Treatment Micro Pilot

- Reduced capital and operating pilot costs (design, commissioning, monitoring, labor logistics);
- Permitted real time optimization of Cr VI remediation processes (e.g. chemical feed, pH etc);
- Allowed rapid identification of operational trends and better understanding of treatment process behavior;
- Significantly reduces pilot supervision costs and time for results to be available;
- Enhanced performance data frequency.

Summary

- SafeGuardH20 Cr(VI) remediation pilot has demonstrated high ability to convert Cr(VI) into Cr(III) to practical non detect levels;
- Online Cr(VI) monitoring system has provided highly accurate, frequent and reliable Cr(VI) data during entire test period;
- The pilot demonstrated the effectiveness of intelligent micro piloting approach to the validation of innovative cost-effective treatment system for the removal of hexavalent chromium.

Next Steps

Q3-Q4 2019 pilot projects to demonstrate:

- Micro pilot system performance in chlorinated water systems
- Integration of SafeGuard H2O™ system with filtration module to remove Cr(VI) conversion byproducts (total chromium and tin)

Thank you!