



THE  
Water  
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# Aqua Metrology Systems SafeGuard™ H2O

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# About AMS

- Founded in 2010
- Experienced team with history in online, real-time contaminant monitoring and treatment
- Innovative portfolio of intelligent water treatment systems- online water quality analyzers and remediation systems

## Municipal Clients

Cal-American, Suez, SF PUC, City of Phoenix, El Paso, New York City, Birmingham, Des Moines, Scottsdale, Gilbert, Severn Trent ...

## Industrial Clients

Batelle, Barrick Gold, Sumitomo, Coca Cola, Duke Energy, Samsung, Sandia National Laboratories, Teck Resources, Sumitomo, Qorvo, EPRI, Los Alamos ...

## Partners

AECOM, USBR, Carollo, Hazen&Sawyer...

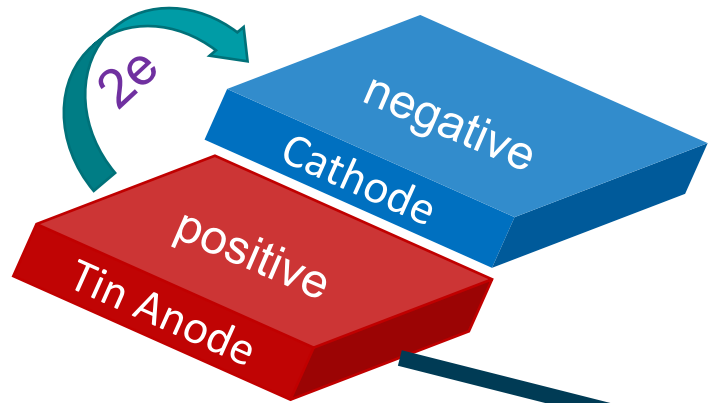
# AMS Innovation Profile

- 2010 launched first real-time THM analyzer (with predictive analytics)
- 2018 patented SafeGuard™ H2O for trace metal treatment (conversion/corrosion)
- 2019 extended SafeGuard™ H2O patents for trace metal and toxic gas treatment (adsorption from aqueous and gaseous matrices)
- 2019 patented real-time lead corrosion risk analyzer
- 2020 launched range of real-time inorganic analyzers
- 2020 patented real-time scale monitor for HVAC

# Problem Statement

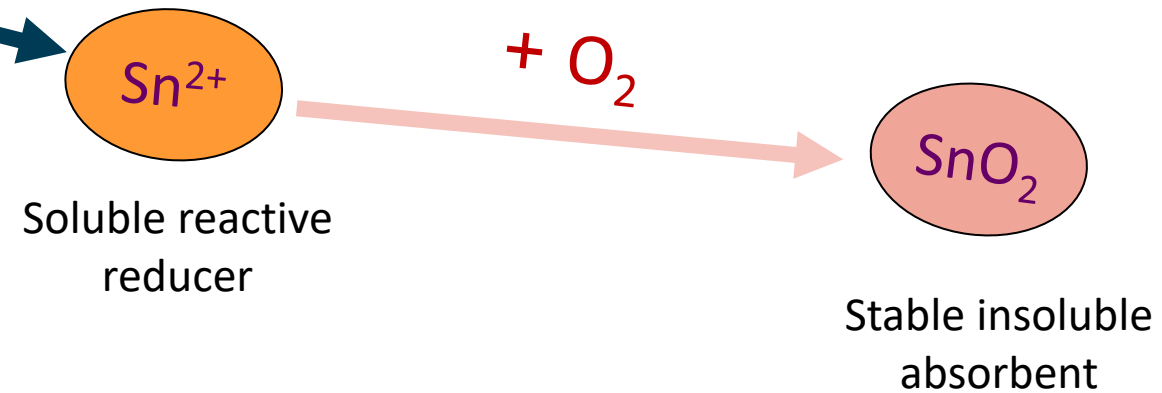
- **Lifetime costs of traditional treatment systems** (membranes, media, chemical storage, handling, toxic waste disposal, skilled personnel) that limit their adoption, especially by small water treatment systems and non-PWS.
- **Lack of visibility of performance of traditional treatment systems.** Integration of real-time monitoring into the stannous generator reduces the need for onsite trained personnel and ensures 24/7/365 compliance (not only when regulatory samples are being taken).
- **Cost, toxicity and environmental impact of traditional corrosion inhibition chemicals** for heating and cooling and drinking water systems. Controlled, demand-driven stannous dosing at points of corrosion risk displaces orthophosphates in drinking water systems.
- **Cost of selenium and mercury waste disposal.** Displaces expensive chemicals, recovery of non-renewable resource (selenium) and reduction in disposal costs of waste from traditional chemical treatment methods.
- **Lack of public funding** for municipal water treatment projects. Intelligent treatment system supports toll pricing that will attract private funding.

# SafeGuard™ H2O- A Novel Method Introduces Tin as Stannous Ions



In-situ, electrolytic  
Stannous generator with  
Tin metal precursor

## The Fate of Electro-Generated Stannous Reagent



# SafeGuard™ H2O System Configuration



← Galvanostat

← Electronics

← Generator →

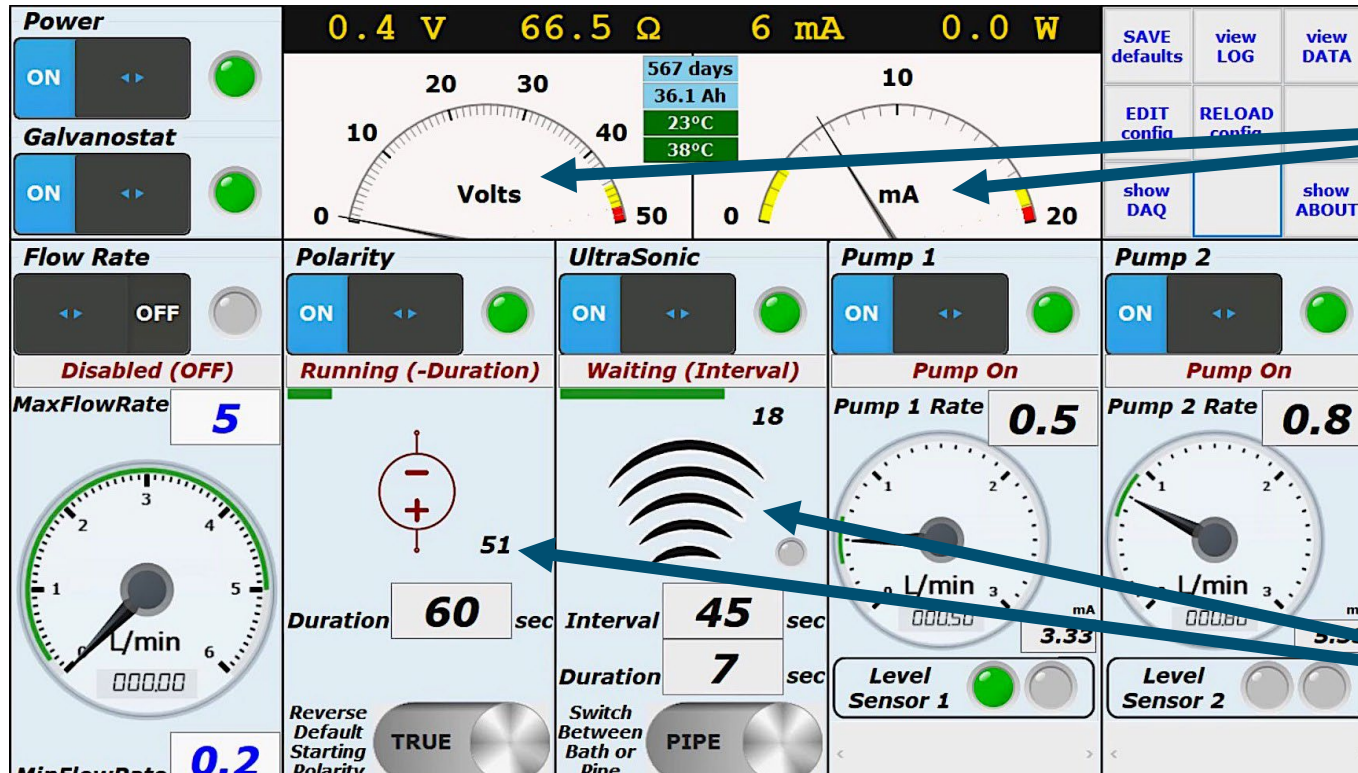
← Fluidics

A fully automated, on-demand, in-situ generator of stannous (reducing agent) and tin dioxide (adsorbent), coupled with online monitoring capability for applications in industrial and municipal markets.



NSF 61  
Pending

# Remote Control of SafeGuard™ H2O System



Voltage and current across reagent generator

Generation electrodes cleaning parameters

There are no similar technologies to SafeGuard™ H2O that integrate a low life-time cost contaminant treatment system with real-time performance controls.

# SafeGuard™ H2O Features & Benefits

Unique Features	Advantages Vs. Alternative Treatment Systems
Removes contaminant to non-detectable levels	Superior effectiveness at lower life-time cost
Stannous generated in-situ, on demand	No bulk chemical deliveries, storage and handling
Skid-mounted (modular), small footprint (compact), scalable from private well to high-volume industrial applications	Ideal for urban locations (point-of-supply/point-of-entry), Requires minimal civil works, reduces engineering overhead Easy to deploy
Tin and electricity are the only consumables	Non-toxic precursors (tin) Economical- low operating costs and maintenance
Dosing controlled automatically	Fully integrated system: Incorporates 24/7 real-time monitoring and control. Operates unattended, controlled reagent dose, reduces site supervision requirements
Backwash reuse	Higher system efficiency (ratio of produced to treated water)
Low system inertia	Higher system efficiency. Ideal for unattended non-continuous well operation
By-product (tin dioxide) can be reused	Reduces net operating costs



# SafeGuard™ H2O Markets & Applications

Market	Application	Arsenic	Chromium (VI)	Iron/Manganese	Lead/Copper	Mercury	Selenium	Iron/Copper	Hydrogen Sulfide	SO <sub>2</sub> /NOX/CO	Biocide
Cooling & Heating Systems	Anti-corrosion							•			•
Municipal & Residential	Groundwater	•	•	•		•			•		
	Anti-corrosion				•						•
Heavy Industry & Energy	Process Effluent	•	•								
	Process Effluent (Resource Recovery)					•	•				
	Process Gases, Flue Gas Resource Recovery, Hydrocarbon Production								•	•	
	Nuclear Power									•	
Mineral Mining	Leaching & Byproducts	•	•	•	•	•	•				
Semi Conductor	Process Effluent	•			•						•

# SafeGuard™ H2O Technology Validation Progress

Application	Status	Comment
Cr(VI) removal from groundwater	Pilots completed. Full system costed vs alternative technologies	Revised California regulatory limit anticipated 2021
As removal from groundwater	California pilots	Micro-pilot in 2021
Fe & Mn removal from groundwater	Alabama and Florida pilots	Micro-pilot in 2021
Anti-corrosion in cooling systems	Institute of Civil Engineers, UK	Micro-pilot underway
Hg removal from groundwater	Florida pilot	Micro-pilot in 2021
Hg recovery from FGD waste	Proven at bench-scale	Seeking micro-pilot site
H <sub>2</sub> S removal	Florida	Micro-pilot in 2021
Replacement of wet-scrubbers for NOx removal and nitrate discharge	Long-term development program with National Nuclear Laboratories, UK	Significant innovation with application in multiple industries

- Cr(VI) systems available for full-scale installation.
- Other contaminant removal systems available for pilot and full-scale demonstration.
- SafeGuard™ H2O treats flow rates of 1gpm to 1500 gpm

# Financial Savings and Environmental Benefits

- SafeGuard™ H2O has a low life-time cost (\$/gallon of produced water or \$/lb of contaminant removed)
- No toxic waste streams
- Low carbon footprint (low power electricity usage, no bulk chemical handling and storage, low maintenance requirement)

## Case Study

Cr(VI) pilot with City of Los Banos, California

SafeGuard™ H2O reduced Cr(VI) to non-detect levels

Annual cost/household in small communities of < \$1700/year

\*\* Other technologies estimated \$6200-\$7800/year \*\*



# Cost Comparison – SafeGuard™ H2O

(presented to California State for Cr(VI) treatment cost review)

City (ppb)	No. of Wells	2017 Estimate** (10ppb) Capital/Annual Operating Cost	AMS Pricing Estimate (0 ppb)	
			Capital Cost	Annual Operating Cost
Coachella Valley (16 ppb)	25	\$278m	\$28-35m	\$6-7m
Patterson (20 ppb)	5	\$65-\$70m/\$3.8-5.0m	\$5-6m	\$0.8-0.9m
Rio Linda Elverta (14 ppb)	6	\$62.5m	\$6-7m	\$1.3-1.5m
Los Banos* (39 ppb)	13	\$41-92m	\$13-15m	\$2.0m
Winters (20 ppb)	5	\$42m	\$5-6m	\$0.8-0.9m
Coachella Water (20 ppb)	6	\$36m	\$12-14m	\$1.5m
Santa Ynez (30 ppb)	6	\$26m	\$6-7m	\$0.9-1.0m
Hidden Valley* (25 ppb)	1	\$4.0m	\$1-\$1.2m	\$0.2m
<b>Total</b>	<b>67</b>	<b>\$554-610m</b>	<b>\$76-90m</b>	<b>\$13.5-15.0m</b>
<b>Cost/well average</b>		<b>\$8.3-9.1m/\$0.76-1.0m</b>	<b>\$1.1-1.3m</b>	<b>\$200-225k</b>
<b>Cost/well range</b>		<b>\$3.1-\$14m</b>	<b>\$1.0-1.4m</b>	<b>\$150-280k</b>

\* AMS Pilots \*\* California Manufacturers Association

# How can WRF help?

## Identify 'early-adopters' and facilitate micro-piloting leading to full-scale deployment and commercial adoption

AMS will conduct an in-house 'go/no go' validation of the SafeGuard™ H2O technology with the actual matrix to be treated using client supplied water samples. This approach mitigates costs and risks of field-based validations for all parties.

**Time frame: 1 week**

AMS will deploy a micro-pilot of the SafeGuard™ H2O technology. This rapid deployment method is an economical approach to assess the performance of this innovation in the field. Real-time remote monitoring and control ensures comprehensive performance reporting and responsiveness of the system to 'challenge' conditions. Micro-pilot data will also support the business case for full-scale adoption.

**Time frame: 1 – 4 weeks**



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# Q & A