

Amount Awarded:

- \$ 10K

Amount Expended:

- \$ 10K

# FY'11: Get a "TrueSense" of Water in Spaceflight

ICA Categorization;

- Process Improvement
- Technological Advancement
- Other

## Innovation Description:

- Assessment of the spaceflight merit of an innovative approach to water monitoring, specifically GE "TrueSense" device

## **Project Scope and Approach:**

- ICA funds allowed for collaboration with GE, and scientific testing of a commercial device that is currently used for water quality monitoring in the cooling tower industry

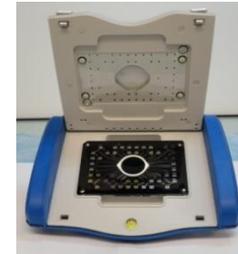
## **Relevance / Value to NASA:**

- In a post-Shuttle world, inflight water/fluid monitoring tools to allow better operational decision making are essential to ISS, and will serve a role in ensuring environmental control, system stability, and crew health protection

TRL Start: 4 TRL Finish: 4

## Graphics/Pictures:

GE "TrueSense" Personal Water Analyzer



Analysis cards, left – unused; right – exposed to ISS ITCS coolant pH standard

## Resources:

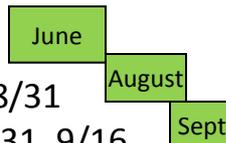
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(Valuable contribution from Dr. Ariel Macatangay, NASA Dr. Dan Gazda and Ms. Marie Hwang, Wyle Laboratories)

## Project Schedule (12 Week)

- Project development start: 6/04
- Project development completed: 8/31
- Final review or report or demo: 8/31, 9/16



**Technical Objectives:** To obtain device and evaluate "TrueSense" analytical performance, including its ability to address matrices and compounds directly relevant to ISS operations

**Outcomes:** Despite an uncertain start, a solid collaboration formed

- Device was challenged with urine, water, and cooling fluid to assess field performance (e.g., accuracy, ease of use)
- Testing showed significant promise as a remote analysis tool, and demonstrated many attractive traits for spaceflight applications.

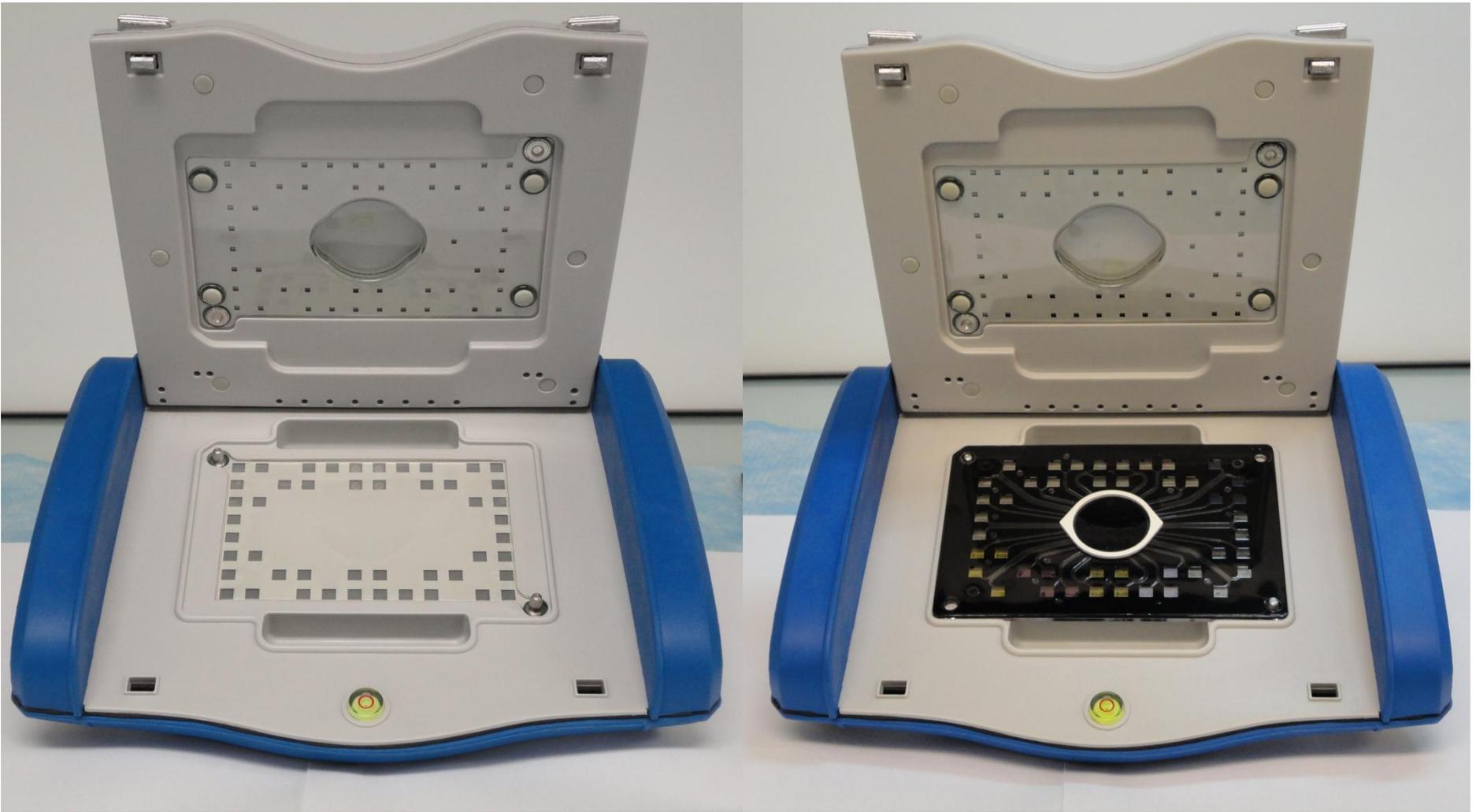
**Next Steps:** Findings/feedback to be provided to GE/ISS stakeholders through briefings. Gaps and merit to be further assessed.

**Risks to future technology project development:**

- Interest level from GE in spaceflight adaptations
- Impacts of microgravity on critical fluid dynamics



***GE TrueSense Personal Water Analyzer (PWA)***



Left – PWA opened, Right – with Cooling-HPS-1 card loaded

# Analysis Card

Liquid sample introduced in center of card.



- Cooling-HPS-1 analysis cards, left – unused; right – exposed to ITCS coolant standard, pH 9.3
- All analyses performed in this evaluation used the Cooling-HSP-1 card provided by GE Global Research
- Cooling-HSP-1 Analysis Cards used “as-is” with the understanding that our testing was not the intended application and the results not a reflection of the technology

## Results – Mineral and Hardness Standards

ERA Mineral Standard, Lot # P159-506				
Parameter	Certified Value	Acceptable range	PWA Result	% Difference
Alkalinity, ppm as CaCO <sub>3</sub>	54.9	47.7 - 62.2	6.7	-87.8
Chloride, ppm	81.8	70.1 - 93.7	ND*	N/A
* Cooling card measures total chlorine.				

ERA Hardness Standard, Lot # P165-507				
Parameter	Certified Value	Acceptable range	PWA Result	% Difference
<i>Ca, ppm</i>	<i>62.7</i>	<i>56.0 - 71.0</i>	<i>58.4*</i>	<i>-6.9</i>
Mg, ppm	31.9	27.4 - 36.6	41.8*	31.09
<i>Ca Hardness, ppm as CaCO<sub>3</sub></i>	<i>156</i>	<i>139 - 177</i>	<i>146</i>	<i>-6.49</i>
<i>Total Hardness, ppm as CaCO<sub>3</sub></i>	<i>288</i>	<i>253 - 328</i>	<i>318</i>	<i>10.49</i>
* Calculated results based on PWA data, which is reported as ppm CaCO <sub>3</sub> .				

Note: ERA Standards are routinely used in the Water and Food Laboratory to validate the performance of instruments.

# Results – Nutrient and Coolant Standards

ERA Nutrient Standard, Lot # 125547				
Parameter	Certified Value*	Acceptable range*	PWA Result	% Difference
<i>Phosphate, ppm</i>	<i>7.23</i>	<i>5.85 - 8.68</i>	<i>6.76</i>	<i>-6.5</i>
* Calculated values based on ERA standard , which is reported as ppm P.				

ITCS Coolant pH standards		
Lab Result	PWA Result	% Difference
<i>8.56</i>	<i>8.78</i>	<i>2.6</i>
<i>8.77</i>	<i>9.01</i>	<i>2.7</i>
<i>8.98</i>	<i>9.1</i>	<i>1.3</i>
<i>9.17</i>	<i>9.34</i>	<i>1.8</i>
<i>9.37</i>	<i>9.46</i>	<i>0.96</i>
<i>9.56</i>	<i>9.5</i>	<i>-0.63</i>

## Results – Ca and Mg range evaluation

Cooling HPS-1 Calcium Range, 30-900 ppm as CaCO <sub>3</sub> 12-360 ppm as Ca		
Lab Result	PWA Result	% Difference
10.9	<DR	N/A
<b>186</b>	<b>190.8</b>	<b>2.5</b>
<b>358</b>	<b>404.8</b>	<b>13.1</b>

Cooling-HPS-1 Magnesium Range, 30-600 ppm as CaCO <sub>3</sub> 7.3-146 ppm as Mg		
Lab Result	PWA Result	% Difference
8.8	20.0	127
77.8	100.8	29.6
144	183.2	27.2

## Results – Iodine and Urinary Analysis

Iodine, ppm		
Lab Result	PWA Result*	% Difference
2.29	2.74	19.5
*21.3 % RSD on 3 PWA measurements		

Urine Analysis Using the Cooling-HSP-1 Analysis Card			
Parameter	Lab Result	PWA Result	% Difference
<i>Calcium, ppm</i>	<i>344</i>	<i>373</i>	<i>8.5</i>
<i>Magnesium, ppm</i>	<i>105</i>	<i>108</i>	<i>2.5</i>
Phosphate, ppm	1303	19	-98%

# Observations

- Well-designed, convenient, robust platform that is relatively easy to use
- Method of introducing samples into analysis card will require redesign for micro-gravity
- General performance.....
  - Very good results with calcium (ppm), calcium hardness (ppm as  $\text{CaCO}_3$ ), total hardness (ppm as  $\text{CaCO}_3$ ), and phosphate (ppm) in water standards → % difference <15%
  - Excellent results with ITCS Coolant pH Standards → % difference <3% (from pH 8.56-9.56)
  - Limited testing for alkalinity (ppm as  $\text{CaCO}_3$ ), chloride (ppm), and magnesium (ppm); showed higher variability when compared to water standards (*It should be noted that analysis cards measure total chlorine, not chloride.*)
  - Excellent results with urinary calcium and urinary magnesium → % difference <10%
  - The urinary phosphate was outside of the analytical range of the instrument, so the results were understandably discrepant
- Expect better results overall with cards specifically tailored for ISS samples
- Preliminary testing of GE TrueSense provided very favorable impression of technology