OSIsoft®

REGIONAL SEMINARS 2012

The Power of Data

Integrated Process Optimization in Green Crude Production using OSIsoft's PI System

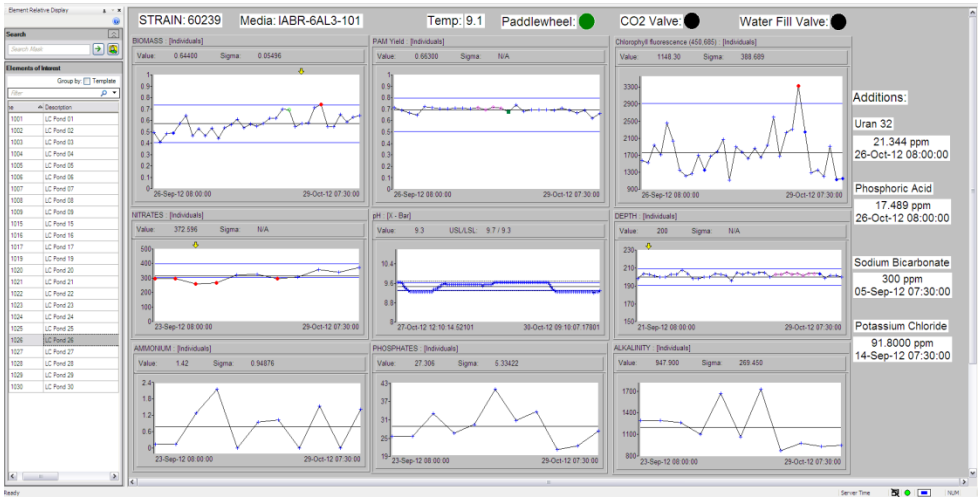
Presented by **Sally Taggart, Senior Director**
IABR Launch

Sapphire Energy™

Sapphire Energy: Integrated Process Optimization in Green Crude Production using OSIsoft's PI System

"OSIsoft's PI System enables Sapphire Energy to quickly gather, process, and evaluate data, and in turn, make better, more intuitive decisions as we move our business forward."…. Dean Venardos, VP of Operations

Sapphire Energy™



Business Challenge

- Having operational data readily accessible from the first day of production
- Comparing results between our Demonstration and Test Facilities
- Having real time visibility to our operations at all locations

Solution

- Load operational history from test site into the PI System using ODBC
- Set up Excel upload sheets to capture operator round information using PI DataLink
- Establish interfaces to PLC and weather stations to capture critical operations data
- Develop PI ProcessBook reports and graphics and Excel workbooks for ongoing analysis

Results and Benefits

- Operations data from day one in our company's history is in one place for analysis and troubleshooting
- Ability to identify and respond to issue within hours instead of day or more after the fact
- Use of data to build variable cost models to help identify operational improvement areas

Introducing Sapphire Energy:

Sapphire creates crude oil from CO_2 and sunlight

- *Enormous market opportunity*
  Addressable markets are over $3 trillion and span multiple product segments (oil, chemicals, agriculture)
- *Strong market pull*
  Sapphire's process is economically competitive, low carbon, and sustainable
- *Sapphire's process commands the full oil production margin and is low cost*
  Sapphire has demonstrated a fully-integrated, high-yield, scalable, outdoor, open pond algae oil production system
- *Sapphire is an attractive investment with strong and sophisticated backers*
  Sapphire has raised over $340 million from private investors and non-dilutive U.S. Government funding

San Diego R&D facility

Las Cruces pilot facility

Commercial demonstration facility

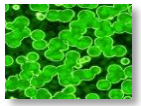
What is Sapphire

Advanced algae strain development

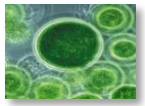
Algae-derived fuel process units

Algae facility

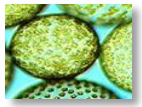
Strain creation



Cultivation



Harvesting



Extraction & processing

Refining (final products)*

* Upgraded in a refinery or by a stand-alone processor;
Sapphire's oil quality enables processing in today's refineries with no modifications

Sapphire Operations Data: Late 2011

- Test Facility:
  - Set of Excel spreadsheets / Access DB
  - Difficult to access PLC data
  - Manually created graphics / reports for review
- Demonstration Facility:
  - Understanding that we wanted something to start up in Spring 2012

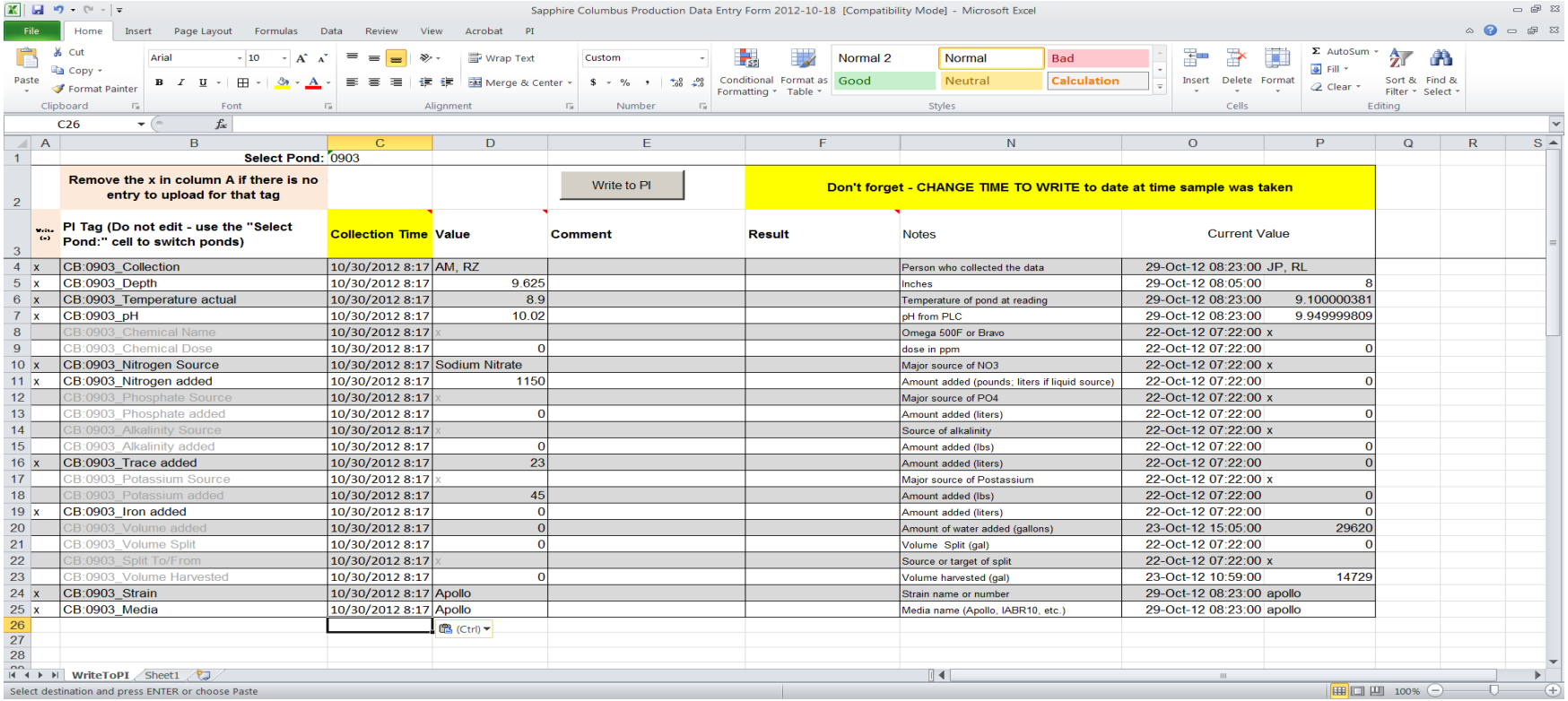
Sapphire Operations Data: Why PI System?

- Knew it met our immediate / future business requirements
- Allowed us to grow into the software / capabilities
- Worked well with our infrastructure and allowed us a single database across the company

Sapphire's OSIsoft PI System Implementation:

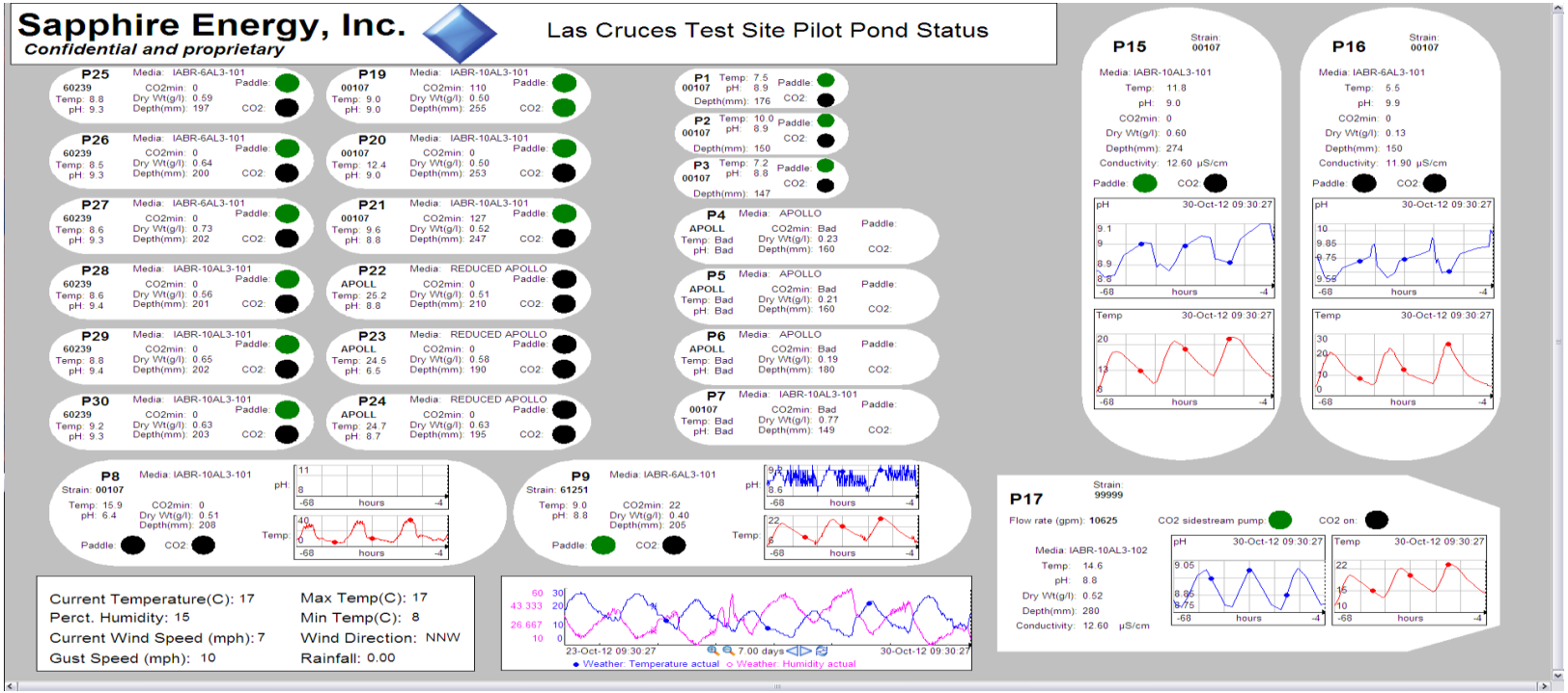
- Implementation Partner: Rovisys
- Scope:
  - Test facility historical data load
  - Interface set-up with PLC and weather stations
  - Excel data entry sheets for operator round information
- Timing:
  - Planning: 1/2012
  - System Set-up Start: 2/2012
  - Demonstration Facility Begins Data Entry: 3/2012
  - Test Facility Transition to PI System: 5/2012
  - Demonstration Facility Set-up Complete: 6/2012
  - Project Close Out: 7/2012

Sapphire: Sample Data Input Sheets

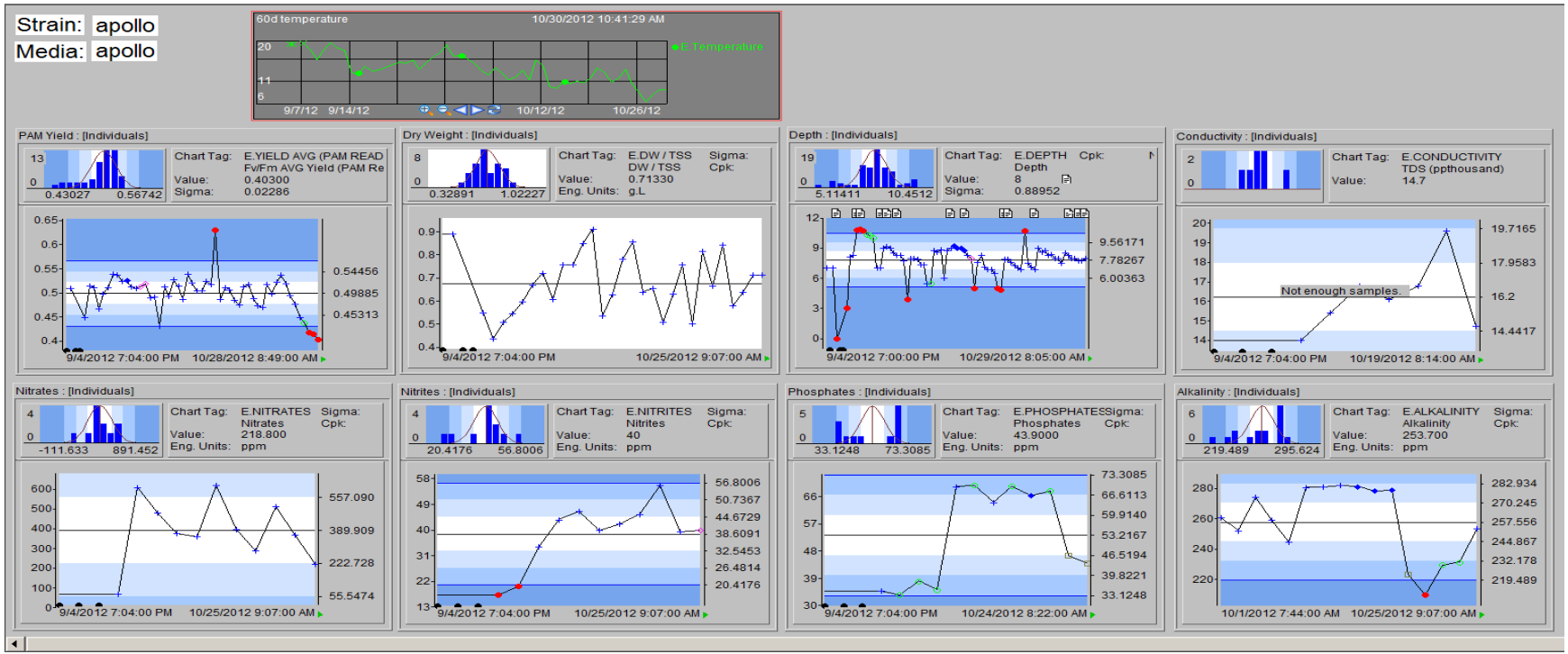


	PI Tag (Do not edit - use the "Select Pond:" cell to switch ponds)	Collection Time	Value	Comment	Result	Notes	Current Value	
x	CB:0903_Collection	10/30/2012 8:17	AM, RZ			Person who collected the data	29-Oct-12 08:23:00	JP, RL
x	CB:0903_Depth	10/30/2012 8:17	9.625			Inches	29-Oct-12 08:05:00	8
x	CB:0903_Temperature actual	10/30/2012 8:17	8.9			Temperature of pond at reading	29-Oct-12 08:23:00	9.100000381
x	CB:0903_pH	10/30/2012 8:17	10.02			pH from PLC	29-Oct-12 08:23:00	9.949999809
	CB:0903_Chemical Name	10/30/2012 8:17	x			Omega 500F or Bravo	22-Oct-12 07:22:00	x
	CB:0903_Chemical Dose	10/30/2012 8:17	0			dose in ppm	22-Oct-12 07:22:00	0
x	CB:0903_Nitrogen Source	10/30/2012 8:17	Sodium Nitrate			Major source of NO3	22-Oct-12 07:22:00	x
x	CB:0903_Nitrogen added	10/30/2012 8:17	1150			Amount added (pounds; liters if liquid source)	22-Oct-12 07:22:00	0
	CB:0903_Phosphate Source	10/30/2012 8:17	x			Major source of PO4	22-Oct-12 07:22:00	x
	CB:0903_Phosphate added	10/30/2012 8:17	0			Amount added (liters)	22-Oct-12 07:22:00	0
	CB:0903_Alkalinity Source	10/30/2012 8:17	x			Source of alkalinity	22-Oct-12 07:22:00	x
	CB:0903_Alkalinity added	10/30/2012 8:17	0			Amount added (lbs)	22-Oct-12 07:22:00	0
x	CB:0903_Trace added	10/30/2012 8:17	23			Amount added (liters)	22-Oct-12 07:22:00	0
	CB:0903_Potassium Source	10/30/2012 8:17	x			Major source of Postassium	22-Oct-12 07:22:00	x
	CB:0903_Potassium added	10/30/2012 8:17	45			Amount added (lbs)	22-Oct-12 07:22:00	0
x	CB:0903_Iron added	10/30/2012 8:17	0			Amount added (liters)	22-Oct-12 07:22:00	0
	CB:0903_Volume added	10/30/2012 8:17	0			Amount of water added (gallons)	23-Oct-12 15:05:00	29620
	CB:0903_Volume Split	10/30/2012 8:17	0			Volume Split (gal)	22-Oct-12 07:22:00	0
	CB:0903_Split To/From	10/30/2012 8:17	x			Source or target of split	22-Oct-12 07:22:00	x
	CB:0903_Volume Harvested	10/30/2012 8:17	0			Volume harvested (gal)	23-Oct-12 10:59:00	14729
x	CB:0903_Strain	10/30/2012 8:17	Apollo			Strain name or number	29-Oct-12 08:23:00	apollo
x	CB:0903_Media	10/30/2012 8:17	Apollo			Media name (Apollo, IABR10, etc.)	29-Oct-12 08:23:00	apollo

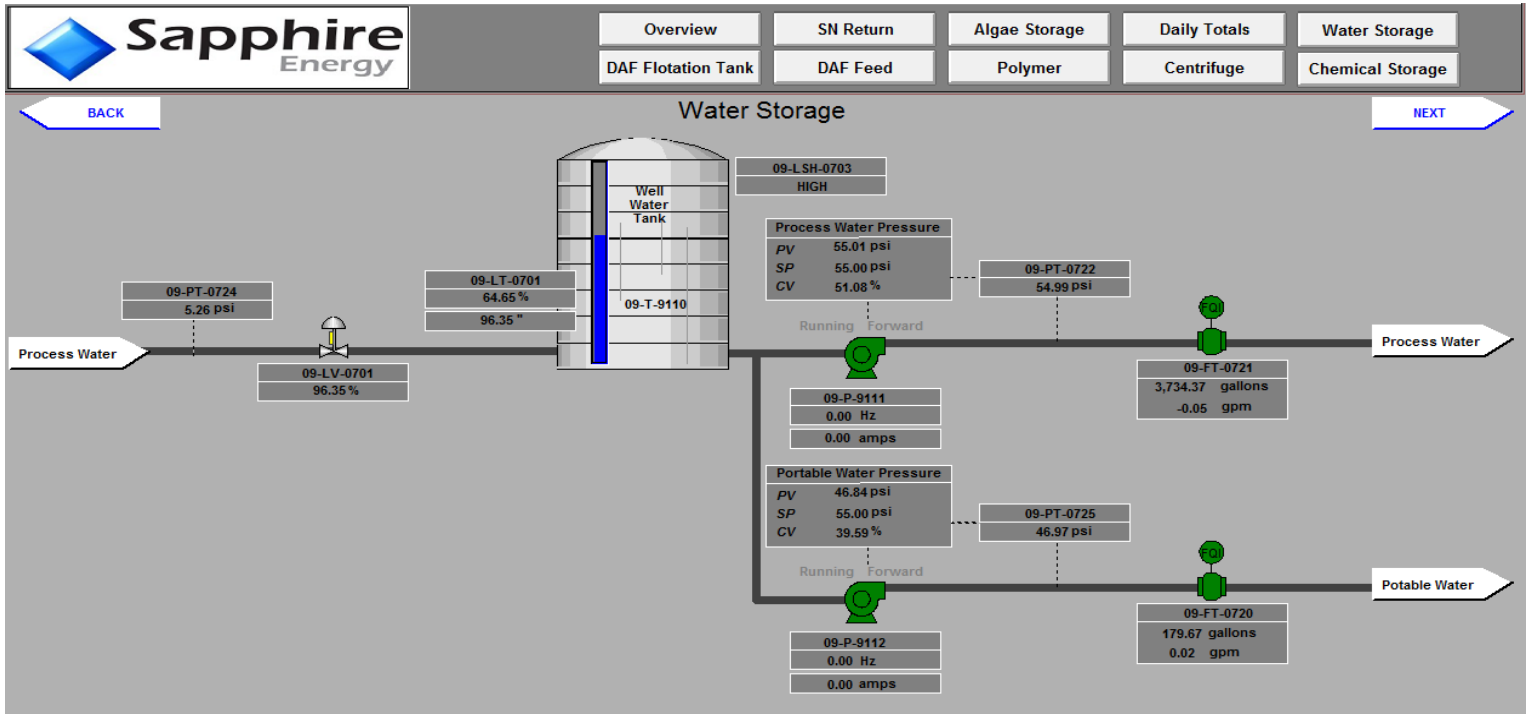
Sapphire: Real Time Pond Monitoring (PLC Data)



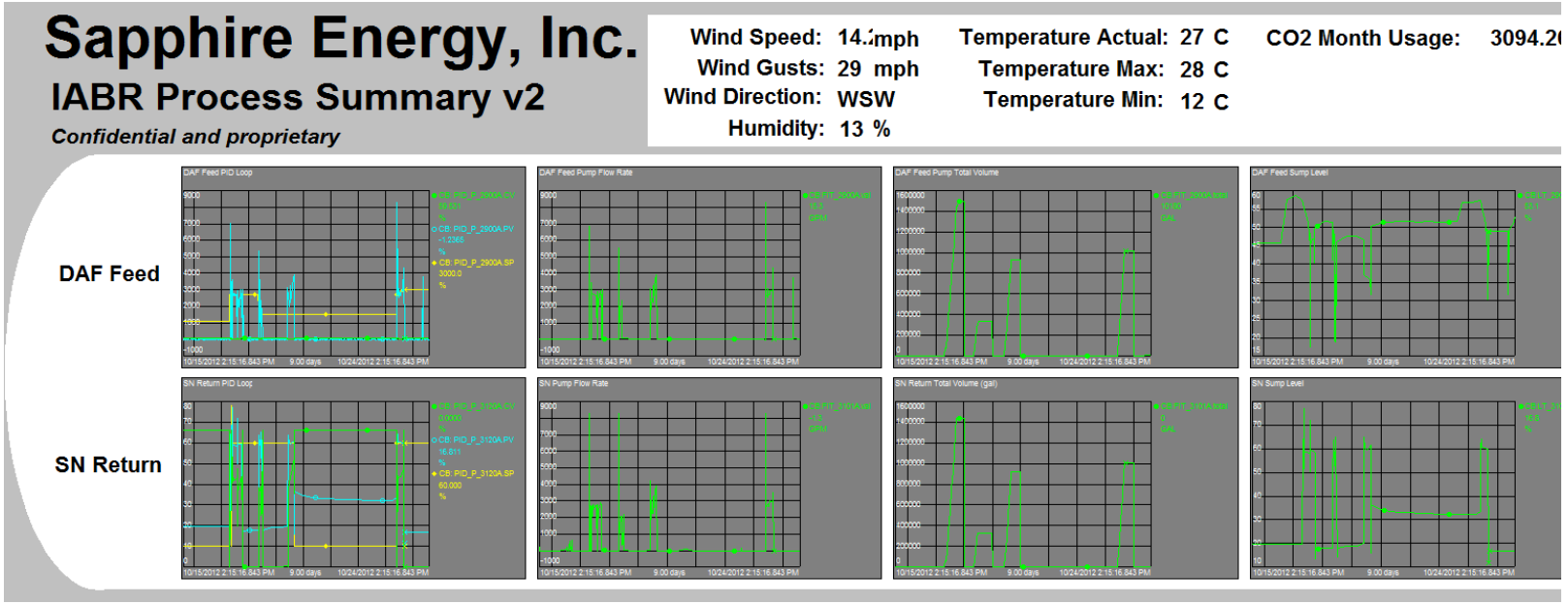
Sapphire: 60 Day Pond Monitoring



Sapphire: Harvest Area Graphics (PLC Data)



Sapphire: Harvest Area Monitoring



Sapphire: What Did We Learn

- **Starting small worked for us**
  - Staged deployment of the system to match the staged system ramp-up at our commercial demonstration facility
  - Matched existing reports at our Las Cruces reports before building new ones allowed people to trust the system
  - Did not try to “over-automate” data entry where processes weren’t well defined

- **Defining Data Elements is hard and took time to get consistent across our sites**

- **Being able to see what is happening in the field real-time anywhere is invaluable**
  - Same data is available to everyone ~ we’re removed multiple sources
  - More process dependent than people dependent for reports and graphics
  - Earlier identification and action around issues
  - Remote troubleshooting when we were doing activities for the first time at our commercial demonstration facility

- **Continuing to rely on expertise from Rovisys for system improvements and changes as we build knowledge**

Sapphire: What's Next with OSIsoft's PI System?

- Expanding the user base at our test facility and continuing to remove dependency on Excel spreadsheets
- Evaluating next steps:
  - Lab Data into PI System
  - Handhelds and PI Manual Logger for daily data collection
  - Extraction data into the system so we can see from "green ponds through black oil"

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THANK YOU

Brought to you by OSIsoft.