Optimizing Natural Gas Compression, Storage, and Gas Quality with the PI System

Presented by   Keary Rogers, Ionut Buse

Columbia Pipeline Group

Agenda

Industry and Company Overview

Business Challenges

Project Infrastructure Overview

Present Strategy

Past Success

Future Project Plans
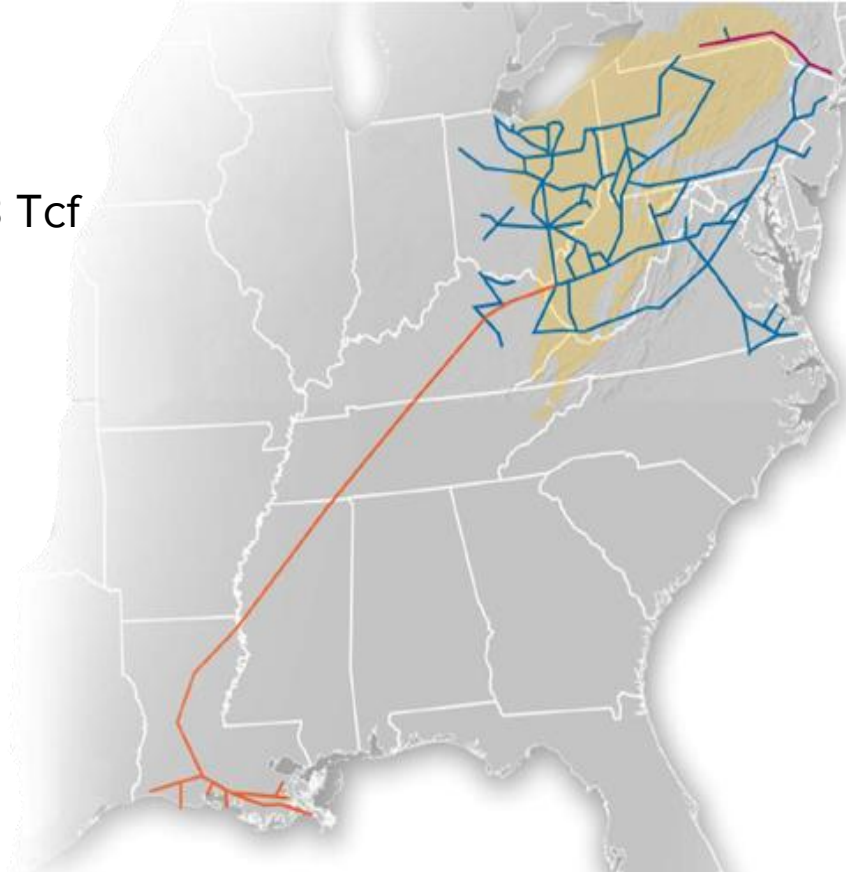
North American Foot Print

Pipeline

- More than 15,000 Miles
- Delivers Approximately 1.3 Tcf per Year

Compression
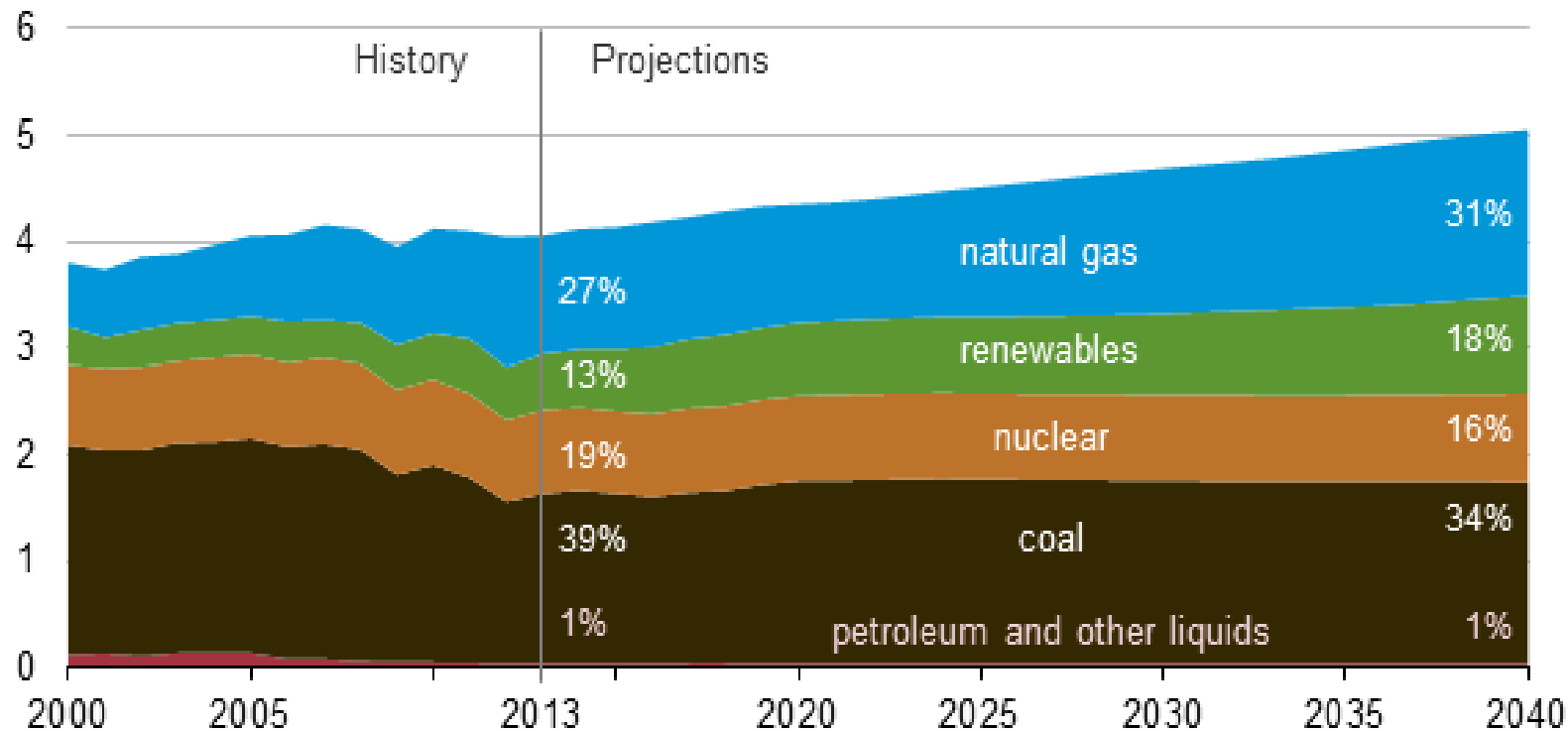
- 1.2 Million Horsepower
- 100+ Stations

Storage

- 4.7 Bc/d Deliverability
- 37 Storage Fields in Four States
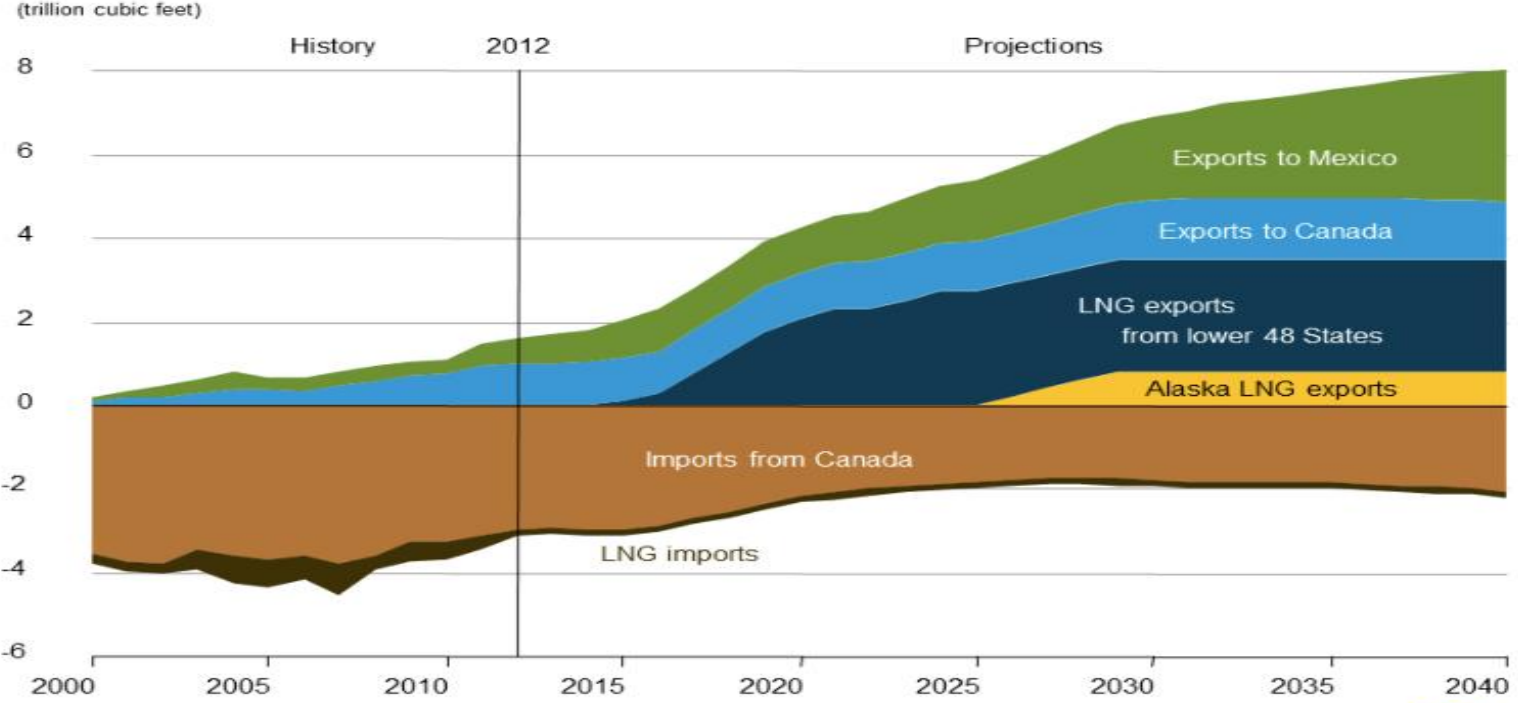
U.S. Electricity Generation By Fuel Type 2000-2040

(trillion kilowatt hour)

History

Projections

natural gas — 27% ... 31%

renewables — 13% ... 18%

nuclear — 19% ... 16%

coal — 39% ... 34%

petroleum and other liquids — 1% ... 1%

Source: U.S. Energy Information Administration, *Annual Energy Outlook 2015*

U.S. LNG Export 2000-2040

(trillion cubic feet)

History — 2012 — Projections

Exports to Mexico
Exports to Canada
LNG exports from lower 48 States
Alaska LNG exports
Imports from Canada
LNG imports

Business Challenges

! Major Compression Asset Failures

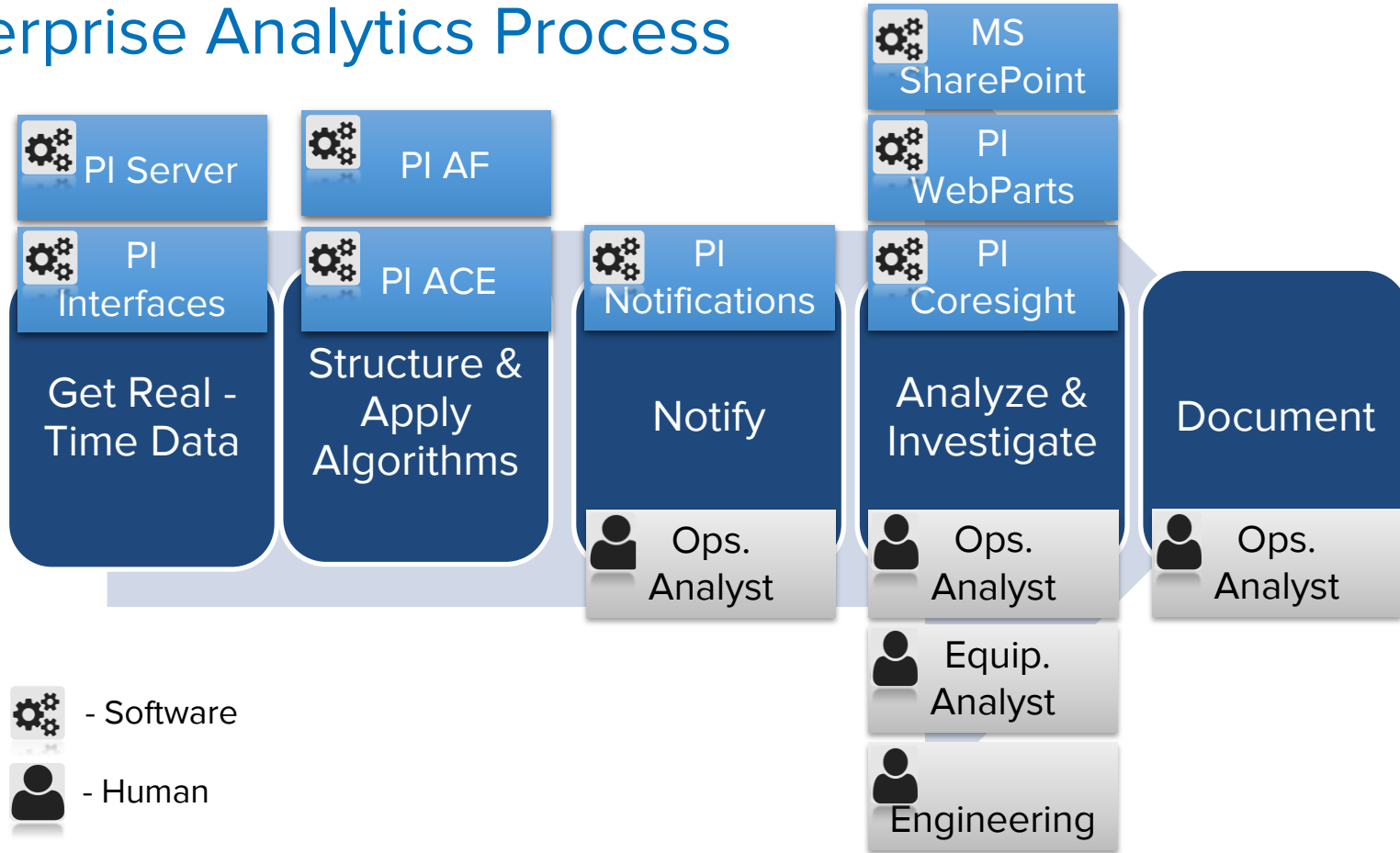! Reactive vs Proactive Use of Data

! Concerns Around Operational Data Integrity

! Lost and Unaccounted For (LAUF) Gas Issues

! Storage Deliverability

Enterprise Analytics Process

Suite of Tools

PI System

PI Data Archive Server

- Histories Operational Time- series Data
- Over 200K PI Tags
- High Availability

Asset Framework (AF)

- Algorithms to monitor equipment condition & performance
- Operational time series data & equipment attribute (relational) data
- High Availability

Notifications

- Notification Templates
- High Availability

OLEDB Enterprise

- Batch Queries
- Data Access Layer

PI ACE

- Complex calculations
- High Availability

AF SDK

- Custom Development

Event Frames

- Capture equipment up / down time
- High Availability

MS SQL

- Attribute data
- SSRS reports
- High Availability

PI Coresight

- Visual Analysis
- Share meaningful information
- Mobile App

PI ProcessBook

- Visualization & Analysis

PI WebParts

- Data visualization
- High Availability

SharePoint

- Hosts Dashboards
- High Availability

Asset Framework Implementation
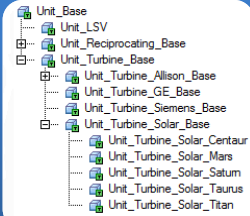
Scalability

- Highly Scalable Solution
- Take advantage of Element Templates
- Inheritance
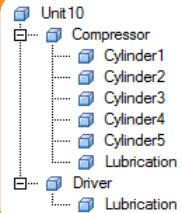
Logical Asset Structure

- Model our equipment fleet using a logical structure that is familiar to our engineers and analysts
- Bring operational time-series data and relational asset data together to implement complex calculations
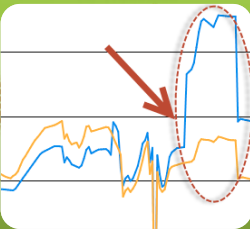
Test and Validate

- Run the calculations back in time to test and validate our algorithms
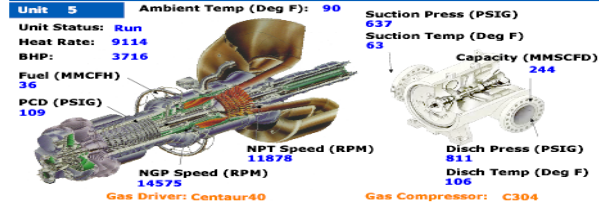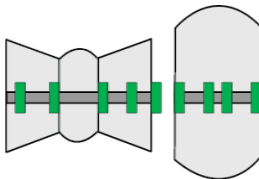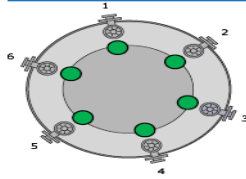
Enterprise Analytics
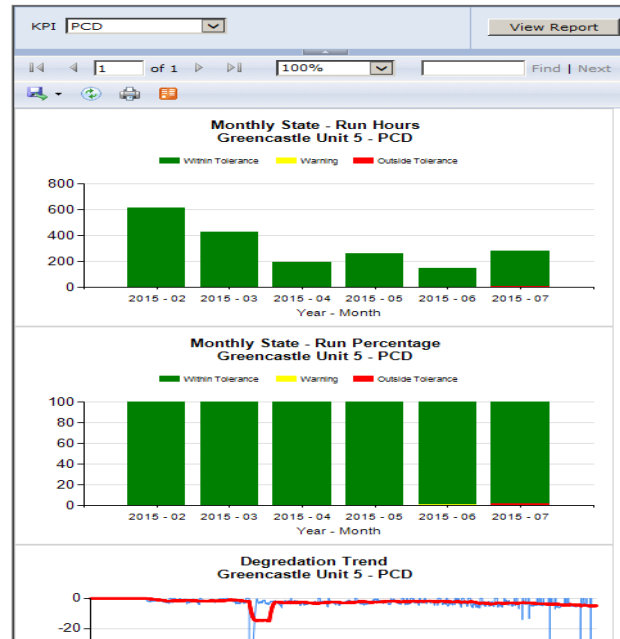
What do we monitor?

- Abnormal data trends
    - Vibrations, Bearing Temperatures, etc.
    - Shorter lead time (usually)
    - SQC Rules
    - Account for correlation

- Key Performance Indicators
    - Heat Rate, BHP, Fuel Rate, Discharge Temperature, etc.
    - Degradation over longer time frame
    - Real-time measurement vs. nominal (expected)
    - Nominal calculated 'on-the-fly' given the current operating conditions

Gas Quality and Advanced Analytics

- Measurement Station Overview
    - Equipment Data and Configuration Settings
    - Tariff Compliance KPIs
    - Meter Summaries
    - Communication Status
    - Measurement Health
    - Equipment Health (Heaters, Odorizers, RTU, Transmitters)

Meter Station Overview

	Cor Flow (MCFH)	Static Pressure (psig)	Temp (°F)	DP/UnCor (MCFH)	SeqVlv	Open SP	Close SP
Run 1	5925.1	869.03	60.458	86.229	Bad Input	N/A	N/A
Run 2	0	869.59	83.061	0	Closed	0	140
Run 3	0	870.03	90.843	0	Closed	65	0
Run 4							

Compliance

BTU	SG	CO2 (%)	N2 (%)	
1033.6	0.5931	1.1833	0.5605	UnNorm (%)
H2S (grain/100cf)	H20 (lbs/mmcf)	O2 (%)	Total Sulfur (grain/100cf)	100.03
N/A	N/A	N/A	N/A	Mercaptan
CHDP (°F)	Compressibility	Wobbe		N/A
-40.599	1.0022	1342.1		

OSIsoft.

Gas Quality and Advanced Analytics

- Gas Chromatograph
    - Internal diagnostics software alarms
    - Response factors – indicate inaccurate analysis results

- Ultrasonic Meters
    - Chord values and KPIs
    - SOS comparisons

Equipment Health Status			
Flow Velcocity Chord Average Status	Good	System Status	OK
Flow Velocity Chord A to D for Large Diameter Status	Alarm	Meter Data Valid Status	Good
Flow Velocity for Small Diameter Status	Good	AGA Flow Calc Status	OK
Chord Gain Status	Good	Chord A Status	OK
Chord Performance Status	Good	Chord B Status	OK
Profile Factor Status	Good	Chord C Status	OK
SOS AGA10 Calc VS SOS Average Status	Good	Chord D Status	OK
SOS Chord VS SOS AGA10 Calc Status	Good	Chord SNR Status	Good
USM VS RTU Index Status	Alarm	Swirl Angle Status	Good

Storage Analytics

- Well Pressures

- Tubing Pressures

- Casing Pressures

- Flow Control Valves

- Flow Rates Out

- Injection Rates In

- Reservoir Levels

- Pipeline Pressures
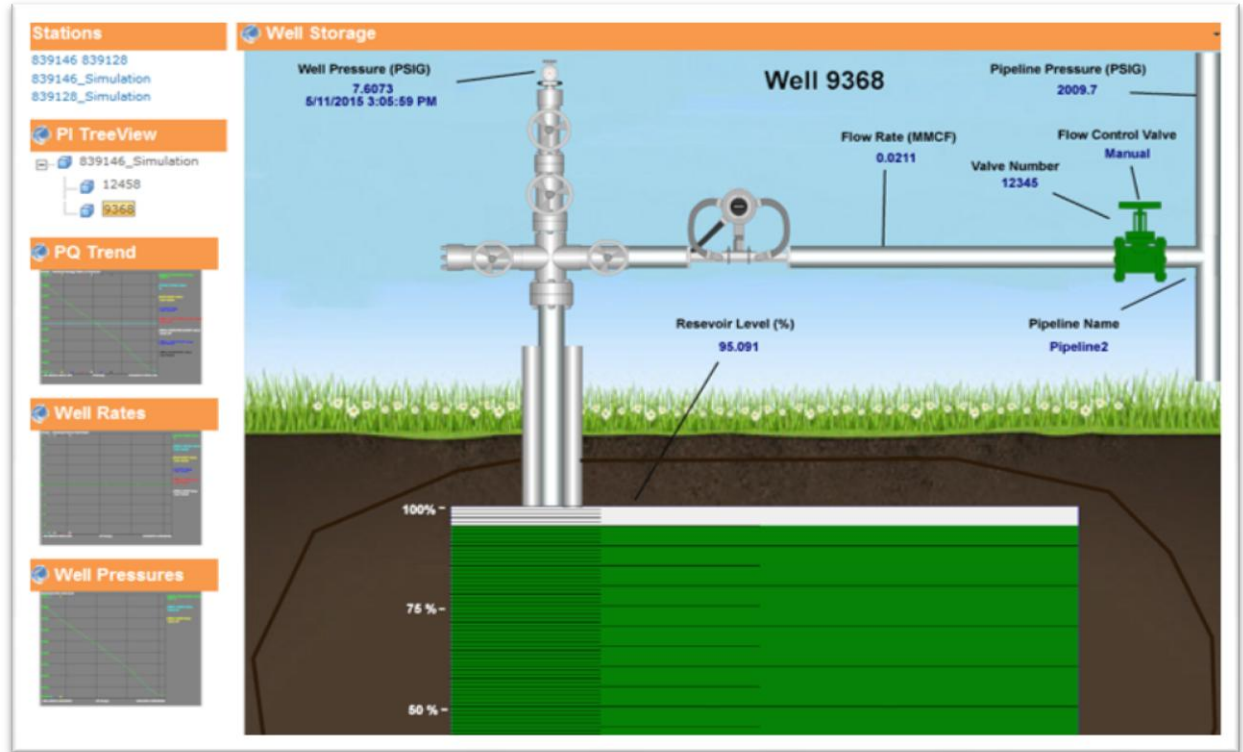
Storage Analytics

Increased Deliverability

- Field Optimization

- Energy Management

- Streaming Data

- Next Day Forecast
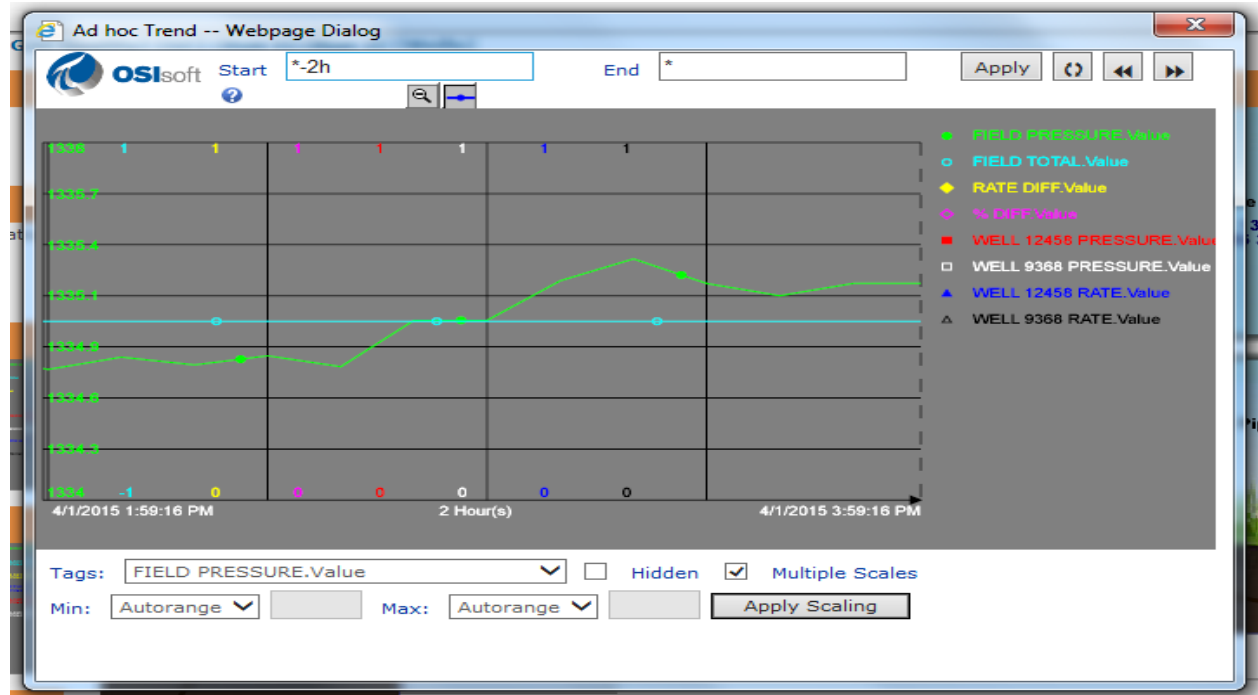
Storage Analytics

Operational Intelligence

- Freeze Plugs

- Chemical Injection

- Downhole

- Bridging

Operational Efficiency

- Well Performance

- Flow Rate & Pressure

  Abnormal Behavior

Recent EA Findings

Operations Analyst received a 'Compressor Vibration' Email Notification
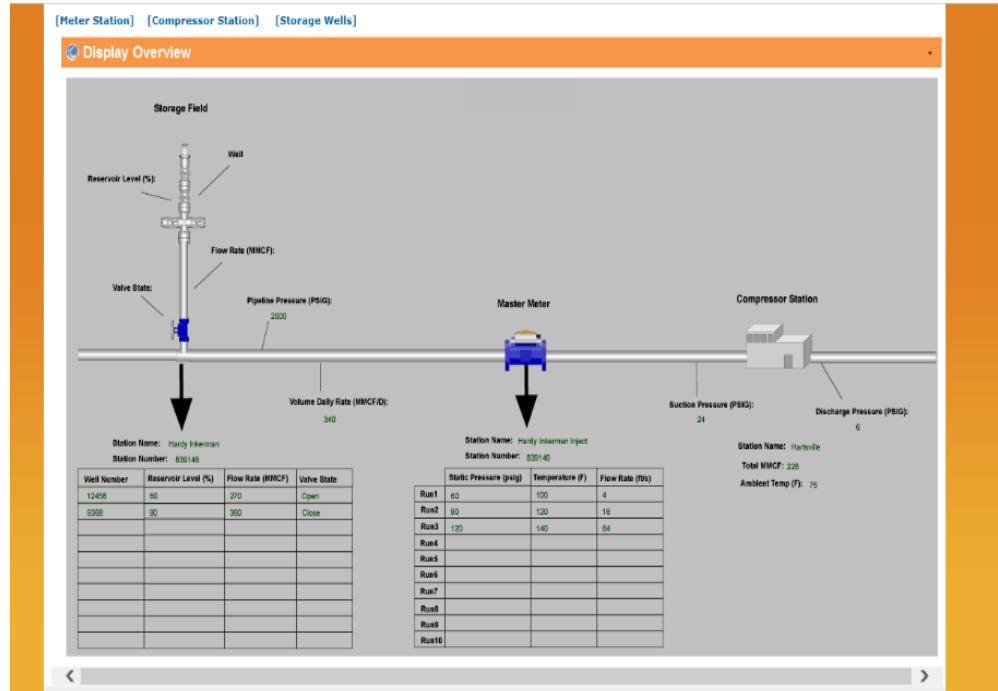
Trigger Time: 4:00:00 AM Eastern Daylight Time (GMT-04:00:00)

Description: The algorithm compares the compressor vibrations (vibration 1 and vibration 2) to the running averages. Notification gets triggered if any difference is greater than 50 percent for 2 hours.

Compressor KPI Status:
- Discharge Temperature: Within Tolerance
- Lubrication Oil Consumption: N/A
- Vibration: Outside Tolerance

Trending Links:
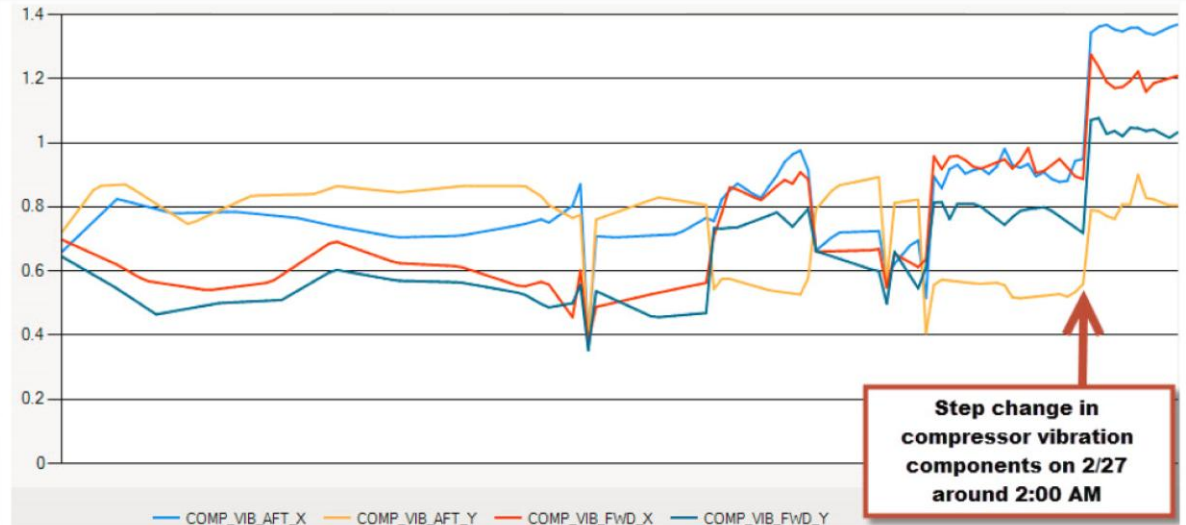- PC: Coresight
- Mobile Device: Transpara

Note: You must be on the NiSource network to access the links.
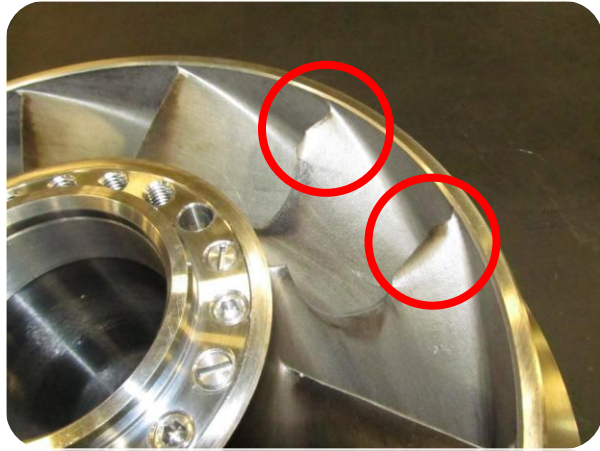
Acknowledge this notification:
- Acknowledge
- Acknowledge With Comment

Data Analysis

Step change in compressor vibration components on 2/27 around 2:00 AM

COMP_VIB_AFT_X — COMP_VIB_AFT_Y — COMP_VIB_FWD_X — COMP_VIB_FWD_Y
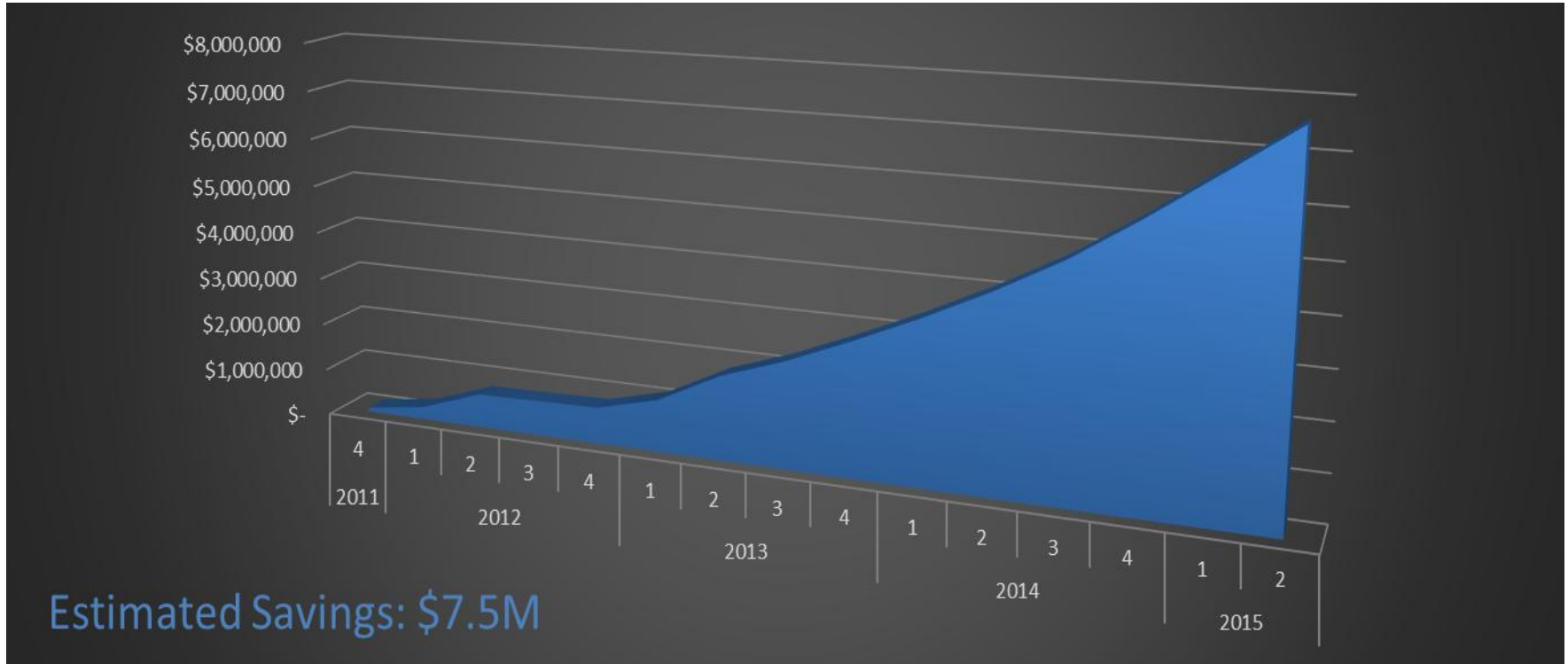
Recent EA Findings (cont.)

(actual picture of the compressor impeller)

- The Equipment Analyst was notified

- After further investigations, it was concluded that the impeller was damaged

- The compressor bundle was removed and shipped to the vendor facility for disassembly, inspection and repair

- The EA System allowed us to identify the issue under controlled conditions and repairs were performed in a planned and safe manner without affecting contract obligation

Gas Quality and Advanced Analytics Findings

- Ultrasonic Meter Health Monitoring

  - reduced time to detect measurement errors

- Notifications of Tariff Violations High H_2O, O_2, and CO_2

  - high H_2O producers shut in until gas brought back to tariff quality levels

  - producers ordered to reduce rate

  - notified producers about failures of there own equipment

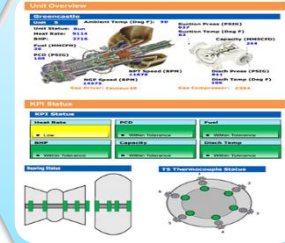# Tangible Savings From Event Prevention

Estimated Savings: $7.5M

Future Project Plans

PI Data Archive Future Data

Gas Quality & Advanced Analytics

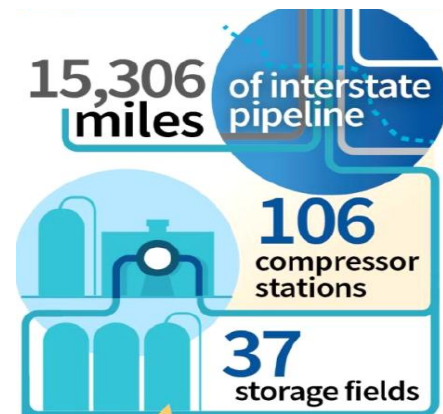PI Integrator for Esri ArcGIS

Enterprise Analytics

ESRI

Storage Analytics

Summary

"The term Enterprise Analytics refers to a program aimed at leveraging leading technology tools to analyze data to enable the execution of proactive actions intended to avoid a negative event entirely or minimize the impact of such an event."

Columbia Pipeline Group

15,306 miles of interstate pipeline

106 compressor stations

37 storage fields

BUSINESS CHALLENGES

- Major Compression Asset Failures Affecting Reliability of System
- Reactive vs. Proactive Use of Data
- Concerns Around Operational Data Integrity
- Lost and Unaccounted For (LAUF) Gas Issues
- Storage Deliverability

SOLUTION

- Implement Real-time monitoring system
- Enter into Enterprise Agreement and expand use of OSIsoft PI System tools across company
- Design and build robust HA PI System Infrastructure

RESULTS AND BENEFITS

- Minimize risk of major failures at critical assets
- Deployment of the PI System Infrastructure and tools across system

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Questions

Please don't forget to...

Please wait for the **microphone** before asking your questions

State your
name & company

Complete the Online Survey
for this session

http://eventmobi.com/emeauc15

감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

Columbia Pipeline Group

Transforming Data into Action