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

Presented by Keary Rogers, Ionut Buse
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

(Source: U.S. Energy Information Administration, Annual Energy Outlook 2015)
U.S. LNG Export 2000-2040
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

- Software
- Human

PI Server
PI AF
PI ACE
PI Notifications
MS SharePoint
PI WebParts
PI Coresight

Get Real - Time Data
Structure & Apply Algorithms
Notify
Analyze & Investigate
Document

Ops. Analyst
Ops. Analyst
Equip. Analyst
Engineering

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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

**PI ACE**

- Complex calculations
  - High Availability

**Event Frames**

- Capture equipment up/downtime
  - High Availability

**MS SQL**

- Attribute data
  - SSRS reports
  - High Availability

**PI ProcessBook**

- Visual Analysis
- Share meaningful information
- Mobile App

**PI Coresight**

- Visual Analysis
- Share meaningful information
- Mobile App

**PI WebParts**

- Data visualization
  - High Availability

**SharePoint**

- Hosts Dashboards
  - High Availability

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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
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)
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
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: Cognos Insight
- Mobile Device: Transpara
Note: You must be on the NSource 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
Recent EA Findings (cont.)

- 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 H2O, O2, and CO2
  - high H2O producers shut in until gas brought back to tariff quality levels
  - producers ordered to reduce rate
  - notified producers about failures of their own equipment
Tangible Savings From Event Prevention

Estimated Savings: $7.5M
Future Project Plans

Gas Quality & Advanced Analytics

PI Data Archive Future Data

ESRI

PI Integrator for Esri ArcGIS

Storage Analytics

Enterprise 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.”

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

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Thank You

Columbia Pipeline Group
Transforming Data into Action