Challenges for O&G Midstream

**Gathering & Processing**
- Leak Detection
- Meter management/accuracy
- Remote assets, telemetry issues

**NGL Fractionation**
- Contamination extraction and disposal
- Plant balance
- Maintenance

**Transmission & Storage**
- Rotating equipment reliability
- Pipeline Integrity
- Asset Performance
- Leak Detection
- System Awareness

**LNG**
- Safety: High operating pressures, extreme temperatures
- Managing LNG Transfer: trucks, vessels

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Product Delivery Pipeline
Product Delivery Pipeline
LNG
Transmission
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Product Delivery Pipeline
Product Delivery Pipeline
LNG
Transmission
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Product Delivery Pipeline
Product Delivery Pipeline
LNG
Transmission
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Product Delivery Pipeline
Product Delivery Pipeline
LNG
Transmission
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractionation Plant
Dry Gas Transmission and Storage
Product Delivery Pipeline
LNG Transmission
Market
Refinery Chemical Plant

Production Wellhead
Gathering System
Gas Treatment Plant
Gas Processing Plant
NGL Fractional
Traditional Use Cases
Predictive and Proactive

PG&E

Implementation of the PI System has enabled the transformation of PG&E’s ability to provide safe and reliable gas T&D to our customers. We now have proactive alarm management and enhanced visualization, collaboration, and an crisis management capability. The PI System has provided significant benefits and value.

Sr. Consulting Engineer, PG&E

### CHALLENGES

Mandated Implementation of NTSB and PHMSA 49 CFR 192 to address findings of gas explosion 9/9/2010

Large gas T&D network:
- 4.2 million customers
- 6,500 miles transmission
- 43,000 miles distribution
- 4500 RTUs

Diversity of systems, no integration

No collaboration or proactive CBM alarm management

### SOLUTION

Used the PI System as a real-time data integration for Situational Awareness

Used PI AF for:
- Advanced alarm management and notification
- Critical asset CBM
- Collaboration, visualization, & mobility foundation

Video Wall to provide system-wide status in Gas Distribution Control Center

### RESULTS

Improved alarm management, response, and crisis management capability

Significantly improved real-time situational awareness, visualization, and collaboration

Increased visibility into Gas Operations

Safer, more reliable gas T&D operations
Situational Awareness

Convert data into Information
Actionable Knowledge
NiSource Gas Transmission and Storage

“To meet the needs of the customers and maintain total system awareness of the entire transmission and storage process, NGT&S is changing the way we think about data; data becoming information; and information becoming actionable knowledge.”

John Cox,
Reliability Engineer, NiSource

<table>
<thead>
<tr>
<th>CHALLENGES</th>
<th>SOLUTION</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting customer delivery obligations with an aging automation system.</td>
<td>Role Based Dashboards using PI Web Parts and DataLink for Excel Services.</td>
<td>Providing knowledge empowers stakeholder employees to autonomously monitor and maintain assets for which they are responsible.</td>
</tr>
<tr>
<td>Meeting the requirements of an expanding natural gas market spurred by increased production in the Marcellus Shale formation.</td>
<td>Core to NiSource’s “Enterprise Analytics” reliability improvement program</td>
<td></td>
</tr>
</tbody>
</table>
Asset Performance Monitoring

Real-time and Historical perspectives
Reliability Focused Maintenance
Alyeska Pipeline

“Implementation of the PI System has enabled the transformation of Alyeska’s ability to provide safe and reliable gas T&D to our customers. We now have proactive alarm management and enhanced visualization, collaboration, and an crisis management capability. The PI System has provided significant benefits and value.

Maintenance Strategies Program Lead
Alyeska Pipeline Service Company

<table>
<thead>
<tr>
<th>CHALLENGES</th>
<th>SOLUTION</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need to improve pipeline integrity and reliability – regulation &amp; scrutiny</td>
<td>Developed Reliability Centered Maintenance and Diagnostics (RCM) integrated with the Maintenance system including master data management (MDM) synchronization</td>
<td>Significant improvement in asset integrity and reliability</td>
</tr>
<tr>
<td>Difficult operating environment</td>
<td>Web-Based equipment, alarm, and event visualization &amp; collaboration</td>
<td>Captured knowledge from SMEs by developing (CBM) algorithms</td>
</tr>
<tr>
<td>Attrition of SMEs</td>
<td>Automated 200+ Calendar/Runtime-based PMs, root cause analysis</td>
<td>Addressed cyber security and SCADA data to the enterprise</td>
</tr>
<tr>
<td>SCADA based system closed, difficult to work with, poor integration</td>
<td></td>
<td>Reduced maintenance and IT costs</td>
</tr>
<tr>
<td>SCADA data to the enterprise &amp; cyber security</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Evolution of Maintenance Strategies
Innovative Use Cases
Building Business Intelligence in Pipeline Operations
Chevron Pipeline Company

Leverage PI System (AF, SDK) and Microsoft components to create a set of multifunctional analytical tools for a broad user base.

<table>
<thead>
<tr>
<th>CHALLENGES</th>
<th>SOLUTION</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Functional groups and Operational data silos create fragmented access to information</td>
<td>• Operational Data Console • Real-time tiered visualization customized for a broad user base</td>
<td>• Sharing Information = Improved Communication</td>
</tr>
<tr>
<td>• Holistic view unavailable</td>
<td>• Built in analytic tools for proactive system monitoring, evaluating bottlenecks, and cost reduction opportunities</td>
<td>• Reduction of gap between data and information</td>
</tr>
<tr>
<td>• Multiple tools, sources, gatekeepers</td>
<td>• Spill Elimination performance and sensitivity evaluations</td>
<td>• Development of enhanced leading metrics, failure predictions, and preventative measures</td>
</tr>
<tr>
<td>• Independent retrieval of operational data beyond baseline key system performance indicators was limited.</td>
<td>• Data trending/exporting capability</td>
<td>• Driving data utilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Closing the gap between “I think” and “I know”</td>
</tr>
</tbody>
</table>
Advanced Analytics Toolbox
CPLView: Visualization Track
Advanced Analytics Toolbox
Data Integration Solution

Field Data
- Calibration and Proving
- Maintenance and Repairs
- Product Quality
- Inventory

Spill Elimination
- Sensitivity Improvements
- Alarm Limits Optimization
- Performance metrics
- Compliance Audit

Alarm Management
- Alarm Audits
- Reports
- Alarm Analysis
- Cause and Effect Analysis

Operations PI AF

Business PI AF

Advanced Analytics
- Spill Elimination analysis
- Operations and equipment optimization
- History playback
- Event/Incident analysis
- Predictive analysis
- Diagnostics

CC SharePoint Business Intelligence Center
Advanced Analytics Toolbox: Operational Visualization: In-Depth
Advanced Analytics Toolbox
CPLView: Advanced Analytics Tools

Events Analysis Tool

Analog Analysis Tool
Enabled Integrated Refinery Information System

YASREF

“Selecting the PI System and EA early in the grass roots project cycle enabled us to develop, install, and commission IRIS on time, reduce costs, support the refinery start up, and set the foundation for an integrated, data based decision making, collaborative culture that supports YASREF’s vision of Operational Excellence”.

Mahmoud M. Madani, IRIS Lead Project Engineer

### CHALLENGES

- Grassroots Refinery JV
- Complex Business Processes
- Aggressive schedule
- 23 applications & requirement of a single integrated system
- Collaborative, data based decision making in context

### SOLUTION

- PI System selected as a strategic element of IRIS early in the project
- Enterprise Agreement selected as best way to support IRIS goals
- Asset Framework and PI Coresight 2014 key to IRIS
- Microsoft BI and BizTalk leveraged

### RESULTS

- Integrated quality data with business process workflow
- Integrated applications environment
- Enabled smooth start-up
- Foundation for vision of a collaborative, data based operational excellence culture
Asset Framework – Data Federation

External data required for real-time calculations and visualization in PI Process Book / PI Coresight is brought into Asset Framework as Linked Tables and connected to Element Attributes

- **No data replication** – Data is refreshed directly from the source and is always in sync.
- **Relational Data Sets** can be treated as **Time Series** data in AF as long as values correspond to timestamps.
- Use cases in IRIS are
  - Laboratory data (LIMS)
  - Mass & Energy Balance (Vali)
Self Serve BI with Ad-hoc Dashboards
Thank You