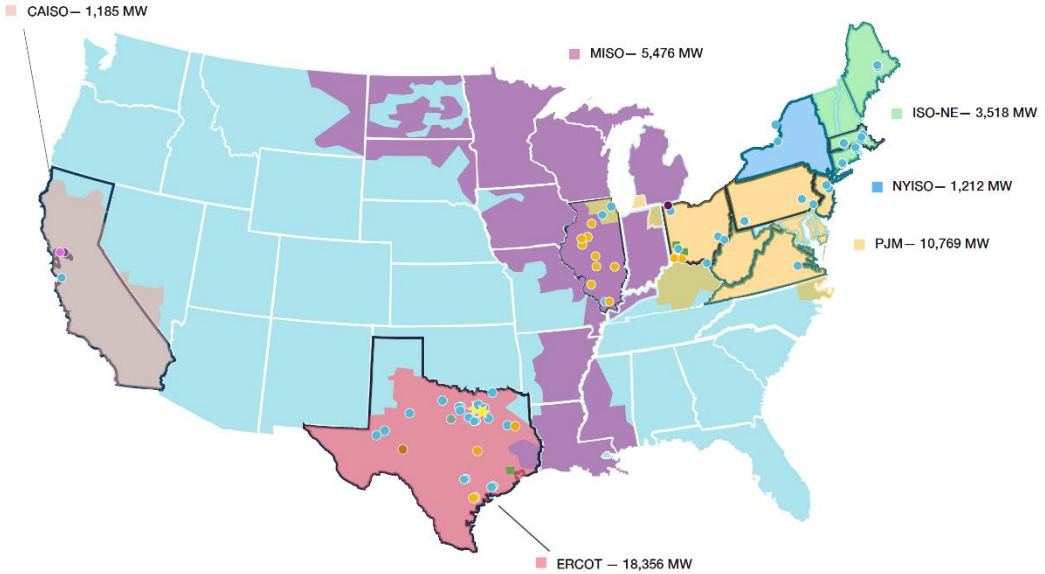
Cloud Transformation in a Nationwide Power Producer

Chris Jackson, Coal Swann, and Mike Hull

Vistra Energy is creating the leading integrated power company



- Plant Operations
- Retail and Plant Operations
- Company Headquarters (Irving Texas)

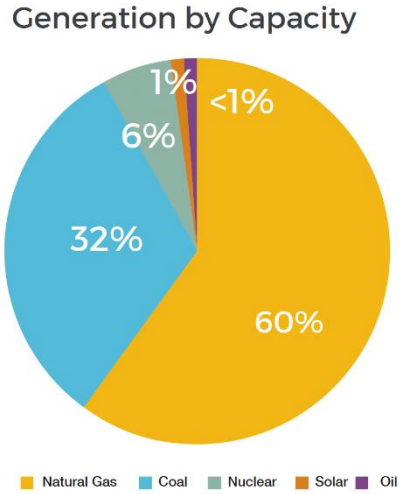
Vistra Energy Power Plants*

- Natural Gas
- Coal
- Nuclear
- Solar/Battery
- Oil
- Battery (under development)

~40 GWs Capacity

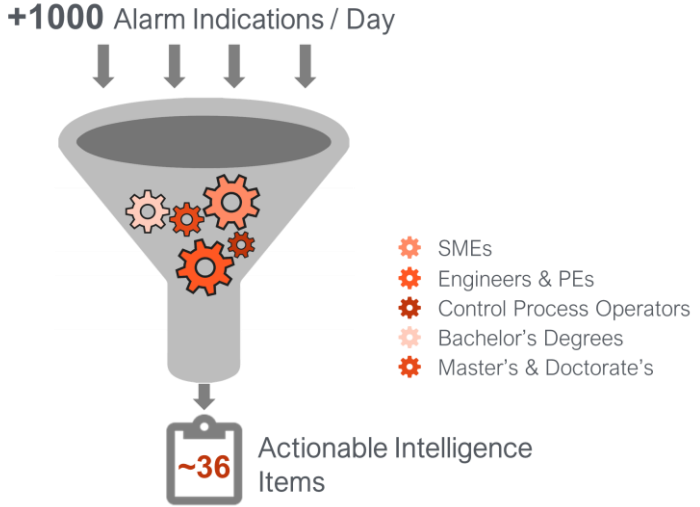
~180 TWh Generated

Vistra Energy (NYSE: VST) combines an innovative, customer-centric approach to retail with a focus on safe, reliable, and efficient power generation. Through its retail and generation subsidiaries, Vistra operates in 12 states and six of the seven competitive power markets in the U.S.

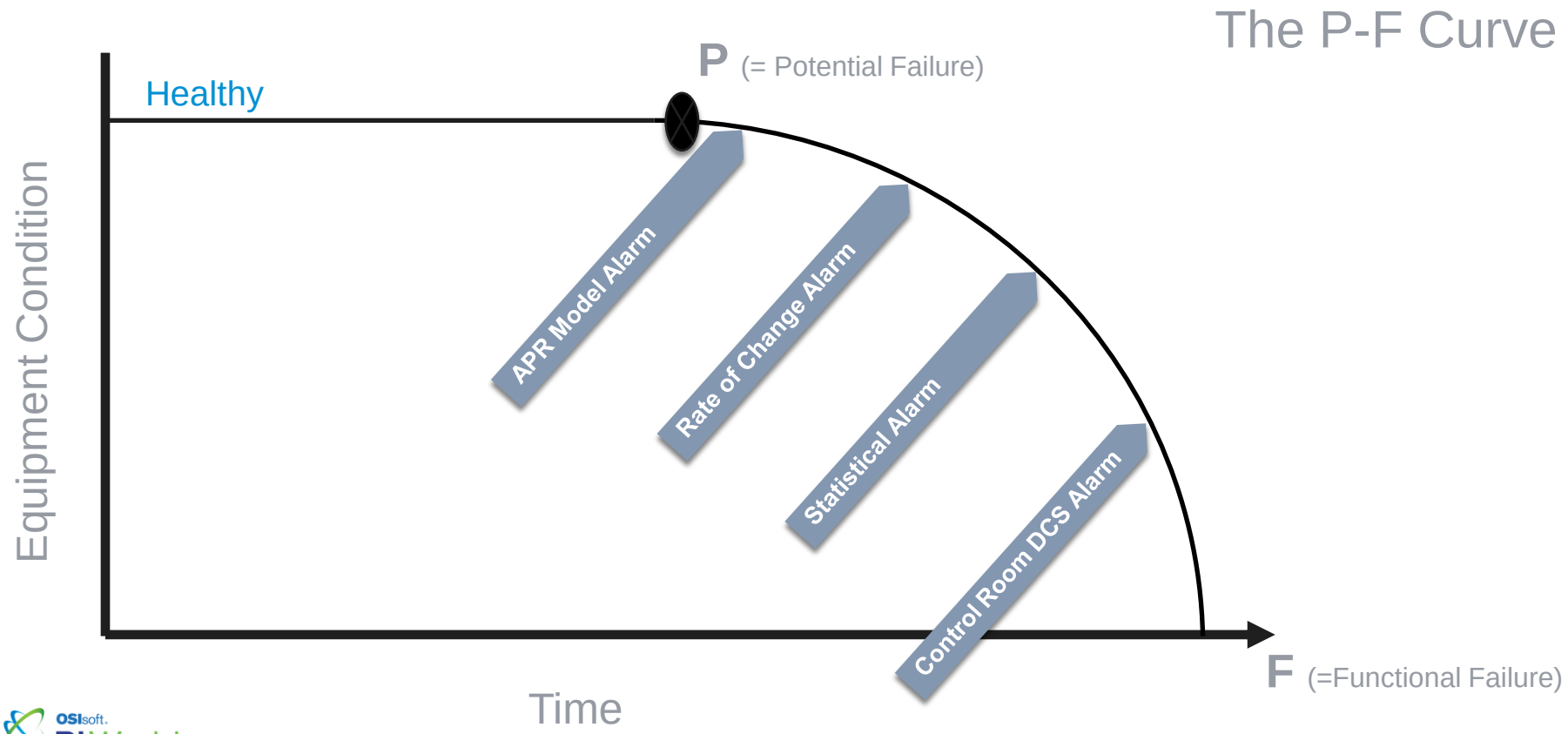


The Power Optimization Center delivers actionable intelligence to plant-level operations

- Fleet-Wide Monitoring and Diagnostics
- 24/7 Operations Support
- Advanced Pattern Recognition Software
- Generation Critical Assets
- Statistical-Based Alarms
- Advanced Alarm Schemes
- Data Analysis



Operational Levels of Defense



The following applications are used to build out the monitoring and diagnostics platform:

- PI System
- Cloud Computing
- Advanced Pattern Recognition (APR) Application
- PowerSuite Application
- Ideal Asset Framework Models

The onboarding effort was segregated into four separate phases:

- Phase 1 – Plant Visits and Infrastructure Buildout
- Phase 2 – Intern onboarding and Fleet PI Server buildout
- Phase 3 – APR Model Buildout
- Phase 4 – PowerSuite Alarm Buildout

The Power Optimization Center was challenged to expand monitoring services across the entire 40,000-megawatt fleet within six months of closing with no additional long-term resources.

- 72 generating units
- 33 Local PI servers
- 1 corporate cloud server
- Complete basic alarming for all assets
- Deploy Advanced Pattern Recognition to support the fleet
- Complete the task in five months

During Phase 1 of the project we set up our infrastructure and identified generation critical assets.

- Onboard new engineering support team
- Identify Generation Critical Assets for each unit
- Hire 30 college interns to complete the buildout
- Set up cloud PI server and Asset Framework Server
- Build Asset Framework Structure to support the fleet assets
- Gain access to each of the 33 PI servers
- Contract with software vendors to allow for expanded buildout

We leveraged 30 college interns to comb through each site's PI server, identifying plant PI tags that matched our fleet AF Attributes. We then built a fleet-level tag on a common naming convention.

- Onboard 30 college interns
  - One week of intense training
  - Divide into teams by generation technology
- Fleet Server PI tag creation
  - Six-week effort

Advanced Pattern Recognition models were built in Phase 3, leveraging guidance from Asset Framework and the fleet PI server tags created in Phase 2.

- APR Model Building Training
  - Two-day focused training
- APR Model Build Out
  - Five-week effort

PowerSuite alarms were deployed in Phase 4 leveraging guidance from Asset Framework and the APR model results from Phase 3.

- PowerSuite Alarm Training
  - One-day focused training
- PowerSuite Alarm Build Out
  - Three-week effort

Results of the Onboarding Effort

Transition to a cloud-based server

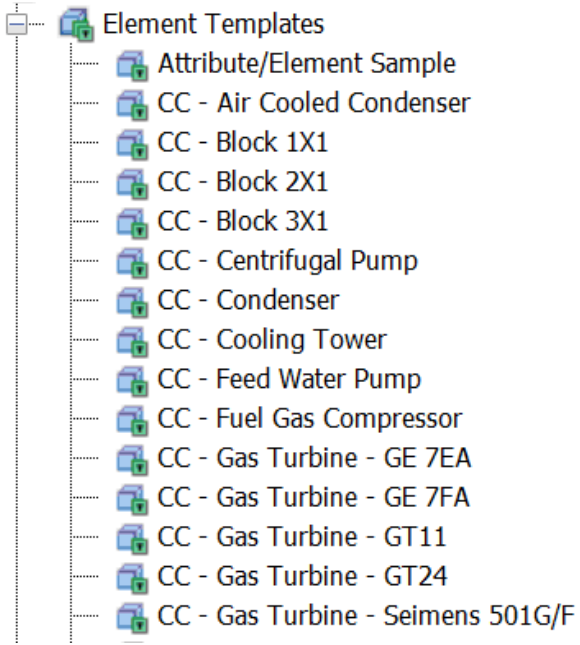
- Pros
  - Server instance was easy to set up and deploy
  - Processing and storage capacity is increased with ease
  - Lower-cost alternative
- Cons
  - Learning Curve

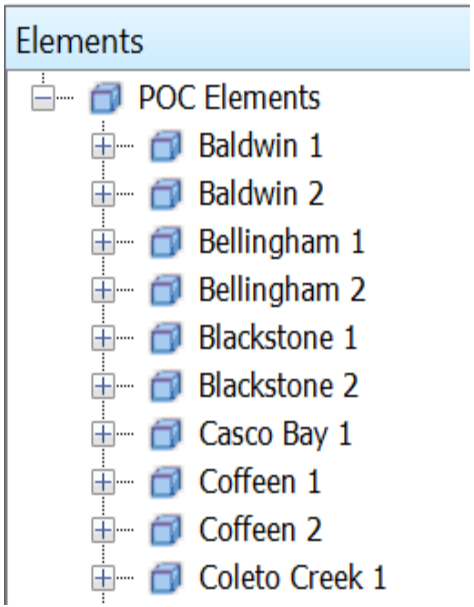
Fleet PI Tag Description
UNIT 1 PULVERIZER B INBOARD MOTOR TEMPERATURE (1_1BFPVRA100B:A14780.MEAS)
PULV 1B MTR IBRG (BYA028)
MILL B INBD MOTOR BRG TEMP (1SMG10:1TBM003B.PNT)
MILL B INBD MOTOR BRG TEMP (3SMG11:3TBM003B.PNT)
MILL B INBD MOTOR BRG TEMP (2SMG10:2TBM003B.PNT)
MILL 6B MTR IBRG TEMP (BYA029)
MILL B MOTOR DRIVE END BEARING TEMPERATURE (DC.1.MILL-B-DRV-END-BRG-TEMP)
PULV 8-2 MOTOR INBOARD BRG (8TEBY152)
MILL 1B MTR IBRG TMP (BYIA1168)
PULV #2 MOTOR INBOARD BEARING (1TE90-L198)
PVR B DE MOTOR BRG TMP (2BF-TE-B101B) (2_2BFPVRB010B:A1604.MEAS)
PULV 7-2 MOTOR INBOARD BRG TMP (7TEBY152)

⇐ Typical Plant PI tag name and description

With the robust AF architecture, we are able to maximize asset comparison across the fleet with minimal effort.

- 35 Templates
- 3,100 Elements
- 11,000 Analysis
- 250 PI Vision Screen





We were able to quickly build asset models in Predict-It and identify equipment functional failures with minimal training and experience.

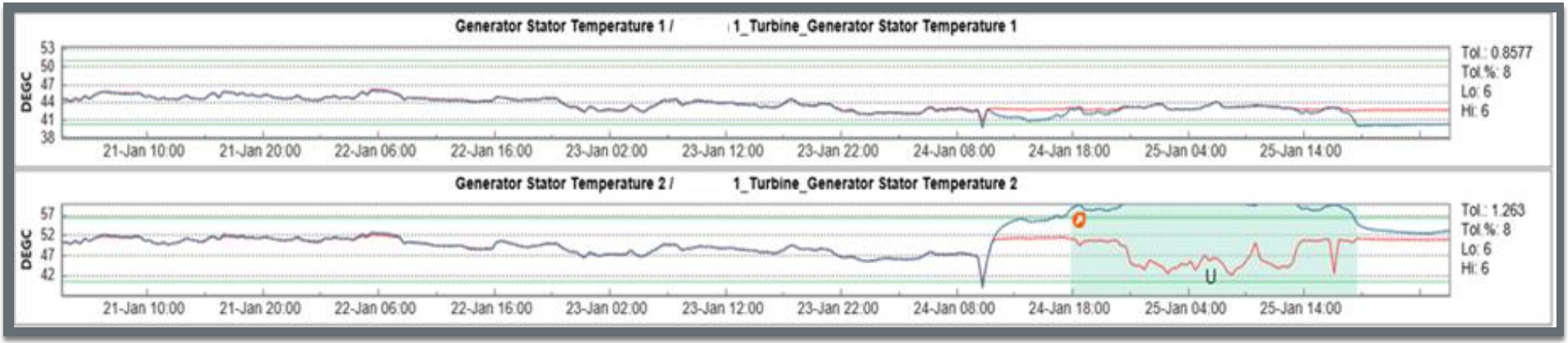
- Highlights
  - AF and Predict-It Assets Hierarchies are identical
  - Predict-It Templates were leveraged for future prognostics
  - Model training results were used for PowerSuite alarm setpoints
  - 2,600 APR models trained and deployed
  - Equipment functional failures identified during build out

We completed the build out with a complement of statistical-based alarms that support our monitoring efforts

- Asset Framework used to identify attribute alarm conditions
- Predict-It Model results used for initial alarm values
- 4,000 alarms developed and deployed

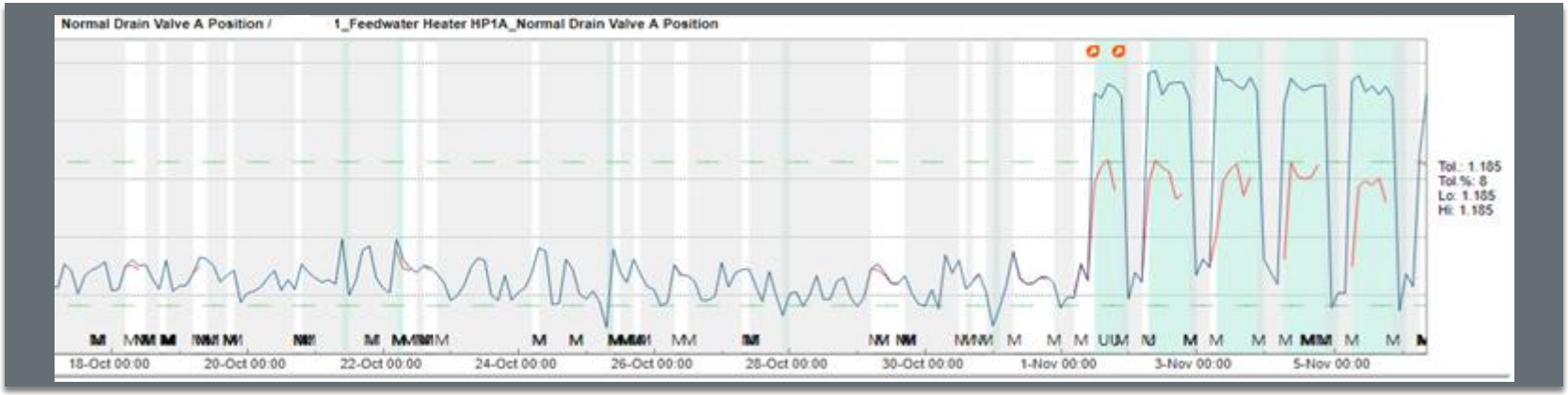
APR Model Plant Assists

Early identification of high generator winding temperature



Action Taken	**Plant notification and subsequent investigation**
Corrective Action	**Hydrogen Cooler leak repaired**
Consequence Avoided	**Internal inspection and repair**

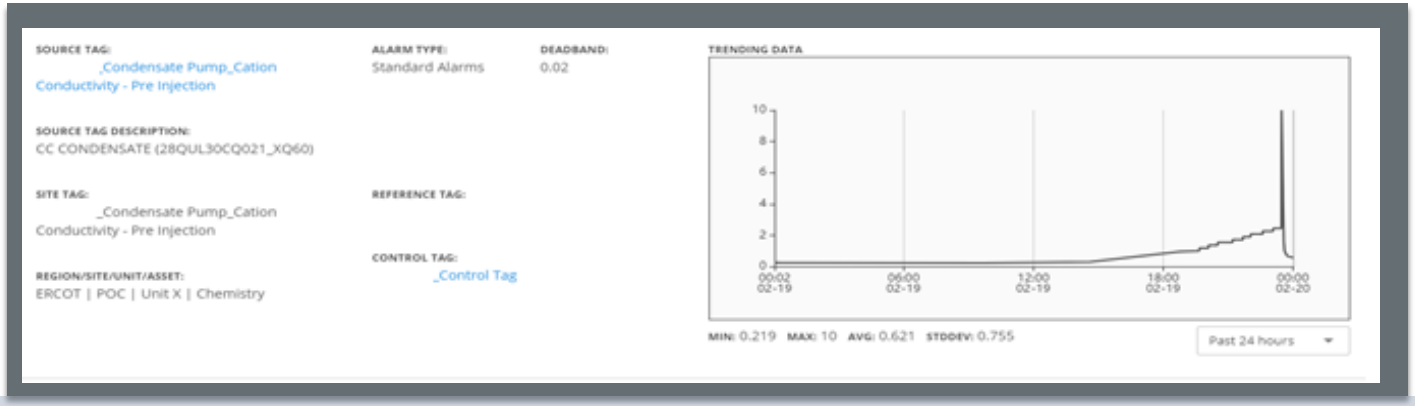
Identification and resolution of Feedwater Heater Normal Drain Position allowed for maximum heat cycle performance



Action Taken	**Plant notification and subsequent investigation**
Corrective Action	**Valve repaired and returned to service**
Consequence Avoided	**55 Btu/kWh heat rate loss**

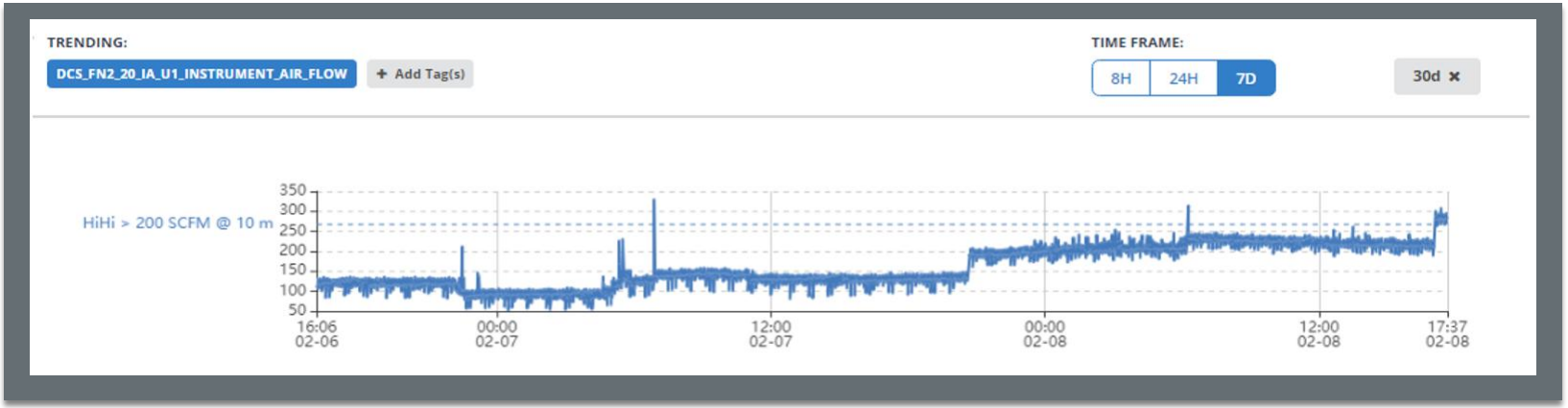
PowerSuite Plant Assists

Identified increased process chemistry



Action Taken	**Plant notification and subsequent investigation**
Corrective Action	**Resin Columns replaced**
Consequence Avoided	**Potential shutdown**

Early identification of a compressed air leak



Action Taken	**Plant notification and subsequent investigation**
Corrective Action	**Air leak on a main control valve repaired**
Consequence Avoided	**Unit trip**

There are several lessons learned to consider when building out a fleet-level solution

- Start with the end in mind
- Strive to keep template count to a minimum
- Flat hierarchies are easier to maintain
- Limit and discourage the use of acronyms
- Naming convention is important for PI Vision
- Partner with someone who has proven experience in Asset Framework

Phase 5 – Agile Project Management to Support a Fleet of PI Servers

Vistra Fleet PI Ecosystem

PI Ecosystem Facts	Solutions
Multiple PI system architectures across the fleet.	1. Outsource PI support 100%. 2. Continue as-is by fighting fires as fleet support's main purpose. 3. Stop fleet support and focus on site-by-site-standards. 4. Invest to create a low-cost ongoing fleet support model.
68 PI Servers with 9 different PI application versions across 58 sites.	
Multiple 32bit PI server hardware implementations.	
Operating systems ranging from 2003 to 2012.	
1 FTE assigned to Fleet Site PI Support.	

High-Level 2019 Project Overview

February 1 | Q2 | Q3 | Q4 2019

MVP Phase – Reduce Ongoing Costs, Sites made Secure & Cloud-Ready

Two-week sprints per site to add value with the following deliverables:

- *Standardize PI Server (Hardware, OS, and, Application) to achieve DHS standards*
- *Client Application Standardization*
- *Optimizing Site Architecture to minimize the number of PI server licenses required*
- *PI Interface Upgrades*
- *Mobile Capability Introduced for compatible Process Book screens*
- *Remote Monitoring Dashboard for Vistra TS troubleshooting*

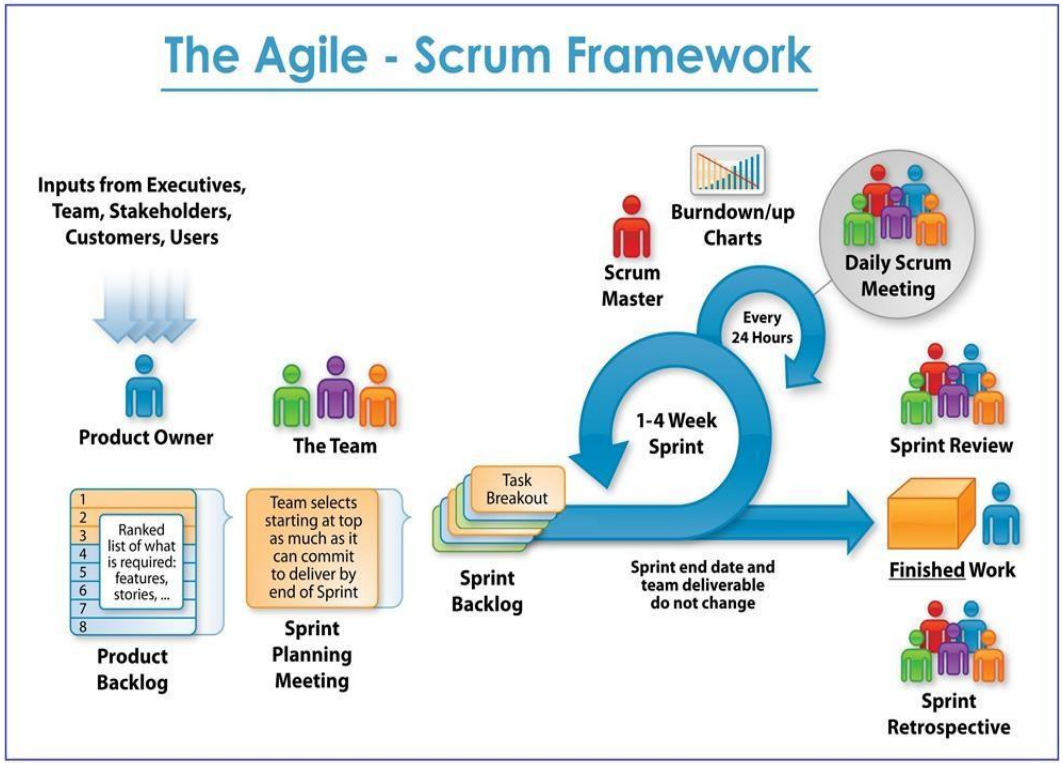
Cloud POC

Cloud Phase - Site PI Cloud Migrations

Following successful MVP Phase, PI ecosystem ready for Cloud Migrations, dependent on network and security variables:

- *Working with network and cyber teams, planning a site-by-site plan for Cloud migration readiness*
- *Migration of all feasible PI servers to Cloud*

Agile Project Management



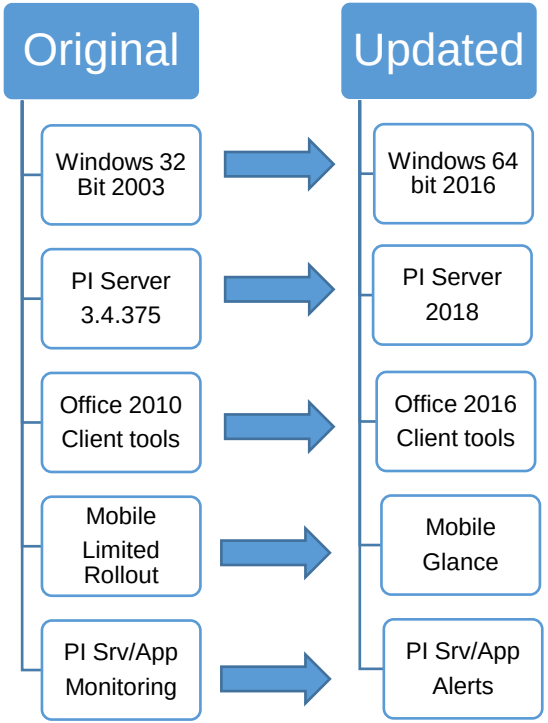
Team Make-up – ½ VST FTE, two contractors, revolving site, cyber-security, networking team support.

Meeting Cadence – One-week sprints, daily 15-minute check-ins, weekly 30-minute planning sessions.

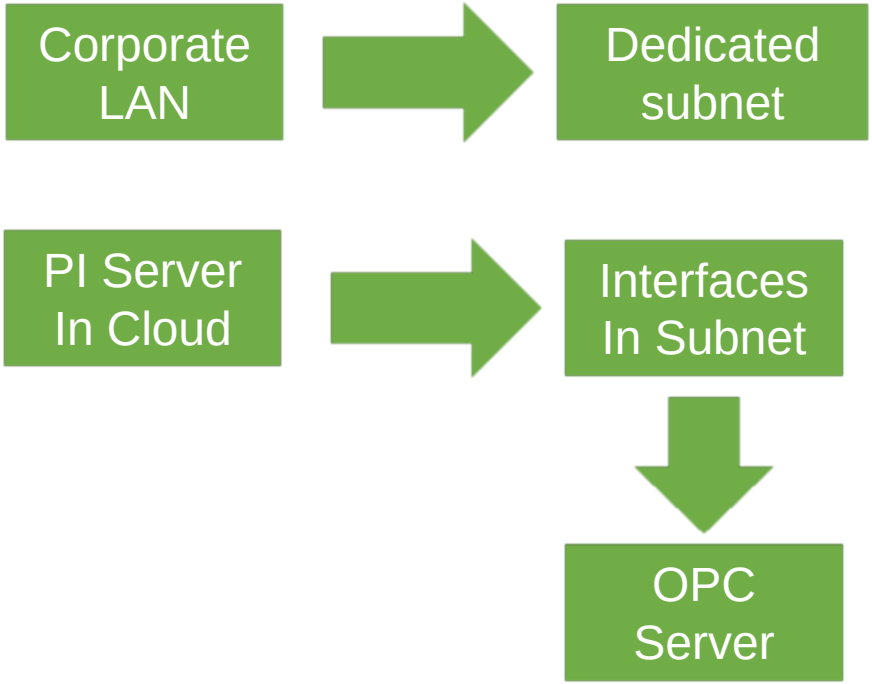
Compared to Waterfall – Less upfront planning, more forced interactions and communications, better ability to react to changing needs and conditions.

Site Transformation Example

Application/Infrastructure



Site Architecture

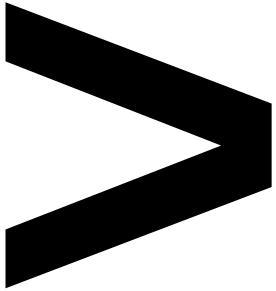


Transformation occurred via two-day onsite work

Next Steps - The Cloud Journey

Why would we keep PI servers at the site instead of the Cloud?

- Lack of Trust (“you’re not taking my PI server away!”)
- Network
- Compliance
- Business Process Impacts (known but especially unknown)



So…Why would we want to expend the effort to move to the Cloud?

- Low ongoing cost
- Simplified ongoing support and security model

- ***Run pilots of parallel data flows to site and Cloud PI servers***
- ***Building Cloud expertise in the PI support team – same support group***
- ***Improve trust between sites and IT – deliver what we say***

Fleet PI Ecosystem Recap

Utilizing Agile Methodology…

- Phase I - Standardize across the fleet:
  - PI system architecture
  - PI server versioning
  - PI server security
- Phase II – Evaluate moving onsite PI server to the cloud
  - Reduce onsite PI server support footprint
  - Select plant sites where it makes business sense
  - Select sites where the PI architecture is hardened

Vistra Energy

Cloud Transformation in a Nationwide Power Producer

Luminant

CHALLENGE

Onboard 72 generation units and create a low cost, high performance monitoring environment leveraging a cloud solution

- Merging a combined 40,000 MW nationwide power producer
- Complete the initial build out in 5 months
- Improve Security, Reliability and Sustainability of 68 PI servers and one Fleet Cloud Server

SOLUTION

Setup a cloud infrastructure with a robust Asset Framework architecture to facilitate fast and accurate deployment. Standardize site footprints and enable cloud migrations

- PI System
- Cloud Computing
- APR Modeling Application
- PowerSuite
- Agile Project Management

RESULTS

- Fleet-wide monitoring and diagnostics support.

- Low-cost, reliable and secure site PI ecosystem

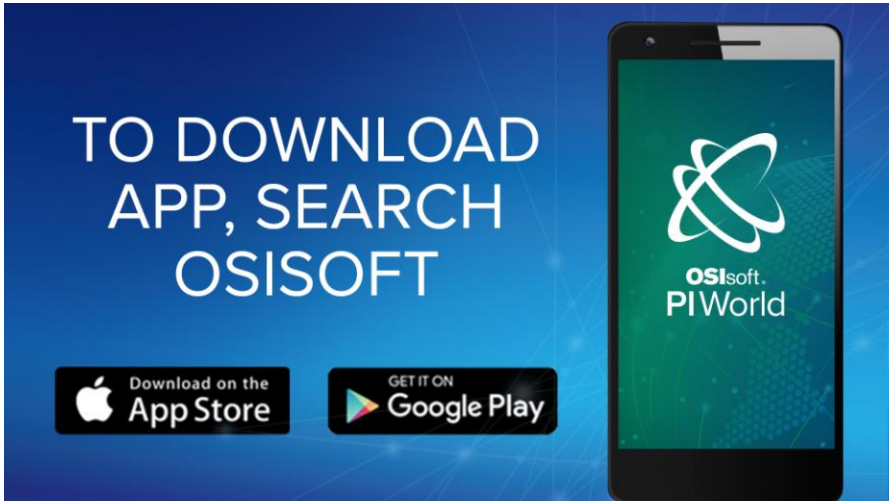
- 80,000 PI tags
- 2,600 APR Models
- 4,000 Statistical Based Alarms
- 68 PI servers standardized
- Reduction of site infrastructure

Questions?

Please wait for the **microphone**

State your **name & company**

Please remember



Contact Information

Chris Jackson

Chris.Jackson@Luminant.com

Principal Engineer – Monitoring and Diagnostics

Vistra Energy

Coalen Swann

Coalen.Swann@Luminant.com

Sr. Functional Specialist – Generation Applications

Vistra Energy

Mike Hull

Michael.Hull@Luminant.com

Sr. Manager - Generation Applications

Vistra Energy