

Noble Energy's Path to Operational Excellence

Presented by **Joe Hill, Sr. Enterprise Systems Analyst**
Shawn Cole, Sr. Automation Foreman



Noble Energy

Energizing the world, Bettering People's Lives

- Over 80 years in the Oil and Gas industry
- Independent producer around the world
- Leaders in Environment, health, safety and Energy teamwork
- Business Partner of Choice

Implementing the PI System:

Change the way we operate domestically and globally

- Become a data driven company
- Increase production
- Have reliable and consistent automation systems
- Where Wonderware fits (SCADA)
- Where OSIsoft PI System fits (Data Management)

The Start of PI System at Noble

Evaluated 3 companies for the replacement of Israel Cygnet system and for a system that would be able to scale and become the standard for Noble

2010

Testing for domestic

Various tests and pilots are done to see how the PI System could be used domestically (DTS, etc)

2011

1st Install

Replaced Cygnet for system monitoring at Mari-B and AOT.
Installed PI System on Aseng FPSO prior to start up.

2012

Marcellus Implemented

Integration

PI System is integrated with Allegro and Merrick

2013

Tamar and Alen
The PI System was essential in monitoring the startup of both Tamar and Alen

Gulf of Mexico

PI System is used to monitor Galapagos and Ticonderoga Neptune Spar and Thunderhawk to be added

2014

PI AF and Analytics

Build PI AF structure to support data needs and analytics for multiple departments and Bus DJ Integrated to Merrick

2015

Current State of our PI Systems

Noble Global Presence:

- Eastern Mediterranean
- Gulf of Mexico
- West Africa
- Pennsylvania
- Colorado (in progress)



1. Providing Seamless Real Time Data
2. Daily Production Reporting
3. Primary Tool Used for Optimization and Production Metrics
4. One Source Record for all Departments

Wonderware (SCADA)

Provides a High level view for Production Foremen and Operators

The screenshot displays the Wonderware SCADA interface. At the top left is the 'ne Automation' logo. The main header area includes 'Production' and 'Water Data' tabs, 'Well Data Trends', 'CONE Midstream Meter Trends', and a 'WELL ESD' indicator. On the right, there is a 'Log Off' button with the user ID '9999' and the name 'joehill', along with the time '9:15:37 AM' and date '6/9/2014'. Below the header is a data table with 15 columns: Pad Name, Current Gas Flow, Gas TDay, Gas YDay, Cond TDay, Cond YDay, MCFE Today, MCFE Yesterday, Water TDay, Water YDay, Line Pressure, Pad Commands, and Communications. The table lists 11 pads, with the last one, OXF 1 PAD, having zero values for all production and flow metrics.

Pad Name	Current Gas Flow	Gas TDay	Gas YDay	Cond TDay	Cond YDay	MCFE Today	MCFE Yesterday	Water TDay	Water YDay	Line Pressure	Pad Commands	Communications
SHL 1 PAD	POLL 4,382.88	4,849.80	5,577.11	45.46	53.78	5,115.96	5,899.80	40.19	80.13	510.22	ESD Reset	6/9/2014 9:14:50 AM
SHL 3 PAD	POLL 3,907.60	4,193.92	4,886.80	38.39	37.87	4,414.43	5,114.02	15.90	56.06	466.28	ESD Reset	6/9/2014 9:12:31 AM
SHL 6 PAD	POLL 4,728.34	4,374.34	5,532.14	44.95	53.95	4,647.21	5,855.87	24.69	96.73	470.88	ESD Reset	6/9/2014 9:12:31 AM
Web 4 PAD	POLL 26,154.38	9,390.18	37,637.98	24.41	62.55	24,330.83	21,730.14	66.38	126.45	476.19	ESD Reset	6/9/2014 9:10:06 AM
SHL 8 PAD	POLL 30,539.84	15,583.33	22,911.00	56.65	75.57	30,058.03	21,973.88	150.66	168.50	451.77	ESD Reset	6/9/2014 9:14:26 AM
WFN 1 PAD	POLL 21,661.54	18,791.87	15,569.65	157.06	168.40	21,933.19	15,906.30	297.91	223.94	489.62	ESD Reset	6/9/2014 9:13:33 AM
SHL 17 PAD	POLL 22,395.51	21,490.19	12,876.96	418.45	283.85	23,908.02	14,580.07	1,258.69	800.32	470.09	ESD Reset	6/9/2014 9:14:07 AM
NORM 1 PAD	POLL 3,910.50	3,596.78	3,806.68	69.71	56.82	4,001.58	4,147.59	265.20	286.81	1.22	ESD Reset	6/9/2014 9:13:51 AM
WFN 3 PAD	POLL 14,404.73	14,695.42	14,084.20	66.03	52.54	15,022.59	14,399.45	340.87	362.96	511.60	ESD Reset	6/9/2014 9:11:58 AM
WFN 6 PAD	POLL 56,391.27	53,329.15	44,559.95	427.99	361.87	55,798.50	46,731.18	1,328.57	856.25	526.25	ESD Reset	6/9/2014 9:09:51 AM
OXF 1 PAD	POLL 0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ESD Reset	

Real time view of field and detail information of pad / wells allows for control of field and remote well optimization

Automation Production Water Data Well Data Trends CONE Midstream Meter Trends WELL ESD Log Off 9999 9:20:38 AM 6/9/2014

RTU Clock 6/9/2014 9:14:33 AM CTL_VLV_pg

WEBB 4L Control Valve

GPU Pressure: 504.3
 Output: 100
 Type: Override Control
 Mode: Disabled
 Set Point: 600

Pad_Meter_Data WEBB 4L

Status Data

Current Flow Rate	1,218	MCF
Todays Accum Flow	0	MCF
Yesterdays Flow	1,399	MCFD
Yesterdays MMBTU	1,697	MMBTU
Line Pressure	509.2	PSIG
Diff Pressure	31.41	InH2O
Gas Temperature	70.0	DegF
Battery Voltage	0.0	VDC
Accum Volume	663,632.56	MCF
MCFE Today	1,214.25	MCFE
MCFE Yesterday	1,416.45	MCFE

EFM Configuration

BTU	1,213	BTU
Specific Gravity	0.69	G/CM3
Atmospheric Pres	0.00	PSIA
Pipe Diameter	3.826	Inches
Pipe Temp	0.0	DegF
Orifice	1.250	Inches
Orifice Temp	0.0	DegF

Gas Analysis

Methane	81.1730	Pct	Octane	0.0000	Pct
Ethane	12.9556	Pct	Nonane	0.0000	Pct
Propane	3.4330	Pct	Decane	0.0000	Pct
IsoButane	0.0000	Pct	Water	0.0000	Pct
nButane	0.7340	Pct	Hydrogen	0.0000	Pct
IsoPentane	0.0000	Pct	Nitrogen	0.4114	Pct
nPentane	0.1703	Pct	Hydrogen Sulfide	0.0000	Pct
Hexane	0.3520	Pct	Oxygen	0.0000	Pct
Heptane	0.0000	Pct	CO2	0.1316	Pct
Total		99.23	Pct		

Condensate

Current Flow Rate	0.0	MCFD
Current Density	40.2	
Current Temp	63.9	
Current Inventory	963.2	
Today's Volume	3.1	
Yesterday's Volume	2.9	

Water

Current Flow Rate	0.0	MCFD
Current Density	70.9	
Current Temp	67.9	
Current Inventory	11368.8	
Today's Volume	11.8	
Yesterday's Volume	16.9	

ALARMS

- Water Lo
- Cond Hi
- Cond Lo
- GPU HiAlm
- GPU LoAlm
- GPU PSL
- Burner SW
- Flow Line Lo
- Flow Line Hi
- ESD Bypass
- ESD Trip
- SCADA ESD
- Site ESD
- Midstream ESD

Water Today 15.0

Trend and data analysis using PI Coresight embedded into InTouch



PI AF Elements and Attributes

\\CPA-PI-AF1\D30_Wells - PI System Explorer (Administrator)

File Edit View Go Tools Help

Database Query Date Back Check In Refresh New Element New Attribute Search Elements

Elements

D30_SHL 1BHS

General Child Elements Attributes Ports Analyses Version

Filter

Name	Value
Category: <None>	
7 Day Avg Casing Pressure	716.703130596525 psig
7 Day Avg GPU Pressure	422.077790598267 psig
7 Day Avg Tubing Pressure	430.976988686904 psig
Compressor Run Status	True
Cond Yield	0.0024633000182823 bbl/d
COND_INV	12371.9609375
Critical Gas Flow Rate_Critical G...	166.826744797994 mscfd
Critical Gas Flow Rate_Critical G...	207.857264178815 mscfd

Group by: Category Template

Name: 7 Day Avg Casing Pressure

Description: 7 Day Avg Casing Pressure

Configuration Item:

Categories:

Default UOM: rel. pound-force per square inch

Value Type: Double

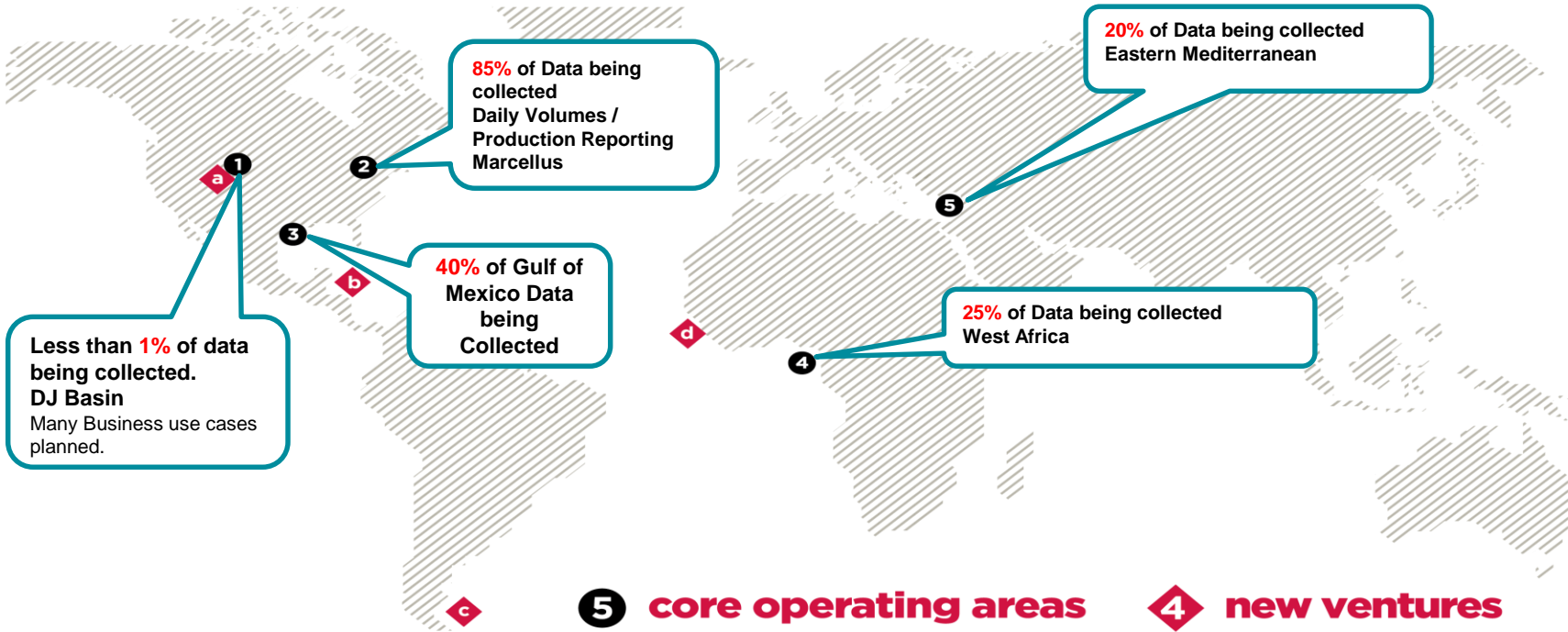
Value: 716.703130596525 psig

Data Reference: PI Point

Settings...

\\CPA-PI-DB1\D30_SHL 1BHS Casing Pressure;TimeMethod=TimeRange;RelativeTime=T-7d;TimeRangeMethod=Average

Core Area Crucial Data Collection today:



5 core operating areas

- 1** Denver-Julesberg Basin
- 2** Marcellus Shale
- 3** Gulf of Mexico
- 4** West Africa
- 5** Eastern Mediterranean

4 new ventures

- a** Nevada
- b** Nicaragua
- c** Falkland Islands
- d** Sierra Leone

Marcellus Fully Integrated System

-  Management
-  Production, Accounting
-  Engineering
-  Automation, Managers
-  Operators & Foremen

DISTRICT 30 TREND DISPLAYS

MBU Field Summary Trends
MBU Gas Meter Variance Trends
MBU Produced Water
Majorsville EFM
Morning Report
Oxford Frac Monitor
PENS 1 Frac Monitor

MBU Field Summary

	Line Pressure	Flow Rate	Gas TDY	Gas YDY	Oil TDY	Oil YDY	Water TDY	Water YDY	MCFE YDY	BOE YDY
SHL 1	391.26	6,190.27	5,540.88	6,035.64	42.15	42.66	56.89	79.47	7,390.06	1,231.68
SHL 3	372.41	8,687.65	7,930.84	8,449.81	56.61	45.36	72.15	91.30	10,259.85	1,709.97
SHL 6	381.39	5,746.75	5,364.49	5,756.55	40.47	38.39	59.44	75.14	7,034.57	1,172.43
SHL 8	351.01	31,555.26	30,482.48	35,104.58	47.06	53.93	301.98	356.92	41,817.20	6,969.53
WEB 4	382.48	25,258.38	24,511.07	25,915.07	32.82	22.78	186.43	173.56	30,788.32	5,128.05
WFN 1	376.96	23,276.64	22,268.77	23,604.13	112.66	109.43	317.82	341.39	28,438.44	4,739.74
SHL 17	353.98	25,054.59	24,257.62	24,740.60	335.59	337.98	1,158.51	1,231.44	31,271.28	5,211.88
WFN 3	388.07	8,911.56	8,302.06	3,462.80	65.81	69.70	313.43	223.45	4,511.22	751.87
MBU North Totals	374.69	134,681.10	128,658.21	132,969.19	732.97	720.23	2,466.65	2,572.67	161,490.94	26,915.16
NORM 1	463.15	1,637.32	890.26	652.22	9.82	17.75	145.11	77.69	877.44	146.24
MBU Totals	384.52	136,318.41	129,548.47	133,621.41	742.80	737.98	2,611.76	2,650.36	162,368.37	27,061.40

SHL Area

SHL 1 Well Trends

SHL 1 Pad Total Trends

SHL 3 Well Trends

SHL 3 Pad Total Trends

SHL 6 Well Trends

SHL 6 Pad Total Trends

SHL 8 Well Trends

SHL 8 Pad Total Trends

SHL 17 Well Trends

SHL 17 Pad Total Trends

WEB Area

WEB 4 Well Trends

WEB 4 Pad Total Trends

WFN Area

WFN 1 Well Trends

WFN 1 Pad Total Trends

WFN 3 Well Trends

NORM Area

NORM 1 Well Trends

NORM 1 Pad Total Trends



PI AF Analyses

CPA-PI-AF1\D30_Wells - PI System Explorer (Administrator)

File Edit View go Tools Help

Database Query Date Back Check-In Refresh New Element

Search Elements

Elements

D30_SHL 3CHS

General Child Elements Attributes Ports Analyses Version

Name Critical Gas Flow Rate

Description:

Categories:

Analysis Type: Expression Rollup Event Frame Generation

Name	Expression	Value	Output Attribute
tubingpresspsia	'Tubing Pressure'+14.73		Click to map
Variable1	'WTR_DEN'-(0.0031*tubingpresspsia)		Click to map
Variable2	5.62*Variable1		Click to map
Variable3	Pow(Variable2,0.25)		Click to map
Variable4	0.0031*tubingpresspsia		Click to map
Variable5	Pow(Variable4,0.5)		Click to map
CVWater	Variable3/Variable5		Critical Velocity_CVWater
Variable6	'COND_DEN'-(0.0031*tubingpresspsia)		Click to map
Variable7	4.02*Variable6		Click to map
Variable8	Pow(Variable7,0.25)		Click to map
CVCondensate	Variable8/Variable5		Critical velocity_CV Condensate
tubing2	3.14*Pow(1.995,2)		Click to map
A	tubing2/576		Click to map
Variable10	(3.06*tubingpresspsia)*(CVWater*A)		Click to map
Variable9	('Temp'+460)*.99		Click to map
Criticalgasrate	(Variable10/variable9)*1000		Critical Gas Flow Rate Critical Gas FR_Water
Criticalgasratecond	(3.06*tubingpresspsia)*(CVCondensate*A)		Click to map
CGFR	(Criticalgasratecond/Variable9)*1000		Critical Gas Flow Rate Critical Gas FR_COND
	Add a new expression		

Scheduling: Event-Triggered Periodic

Period: 00h 02m 00s

Functions

Insert functions into the expression

All

- Abs
- Acos
- And
- Ascii
- Asin
- Atn
- Atn2
- Avg
- BadVal
- Bad
- Bom
- Bonm
- Celling
- Char
- Compare
- Concat
- Convert
- Cos
- Cosh
- Cot
- Coth
- Csc
- Csch
- Curve
- Day
- DaySec
- DigState
- DigText
- E
- Else
- EventCount
- Exp
- FindEq
- FindGE
- FindGT
- FindLE
- FindLT
- FindNE
- Abs(number x)
- Return the absolute value of an integer or real number. Example: Abs(1)
- Attributes

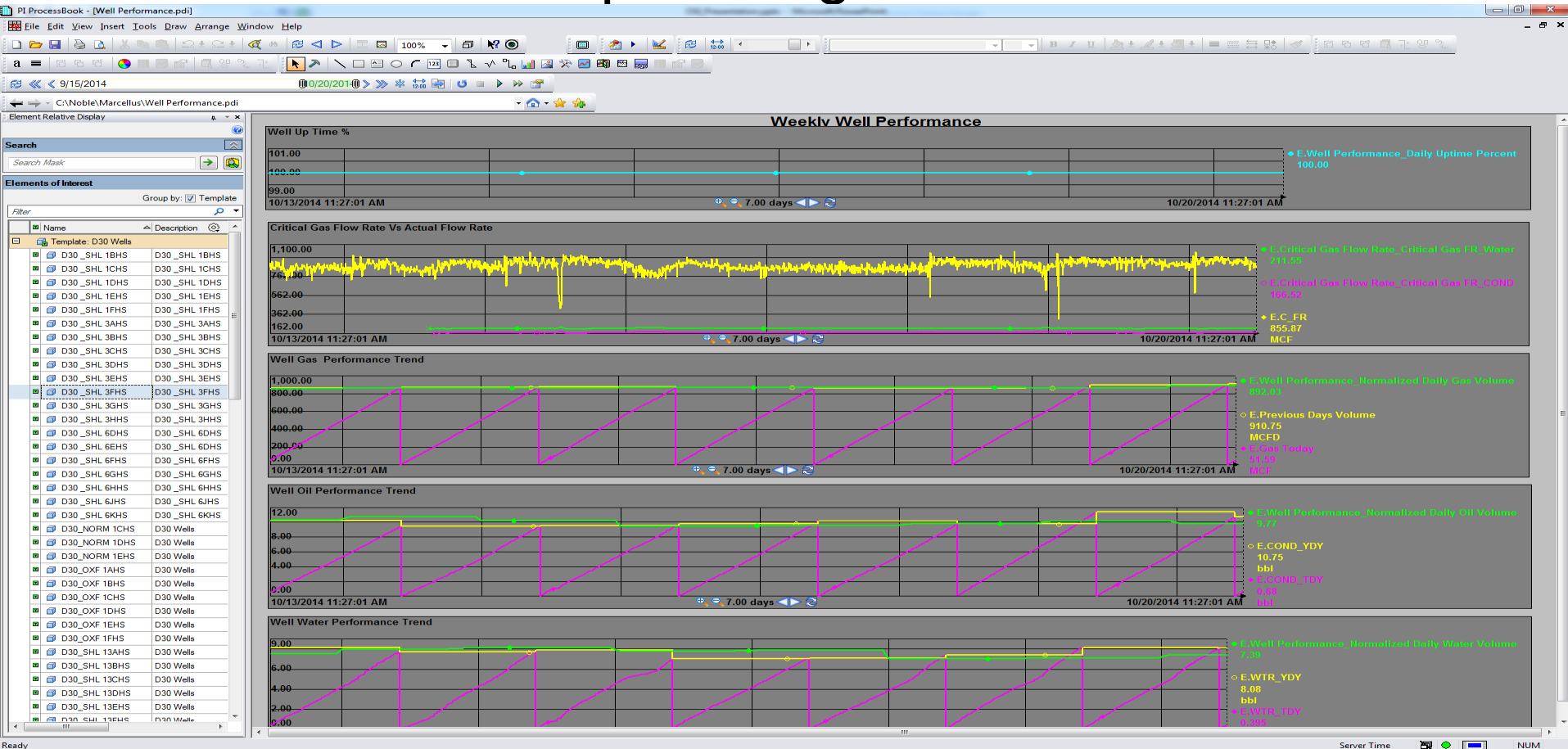
Connected to the PI Analysis Service.

D30_SHL 3CHS Modified:10/14/2014 3:17:28 PM. Version: 1/1/1970 12:00:00 AM, Revision 39

Start

11:22 AM 10/20/2014

Optimizing Wells



Recent Major Project where the PI System was implemented prior to startup

- The PI System was used to monitor the startup of Aseng, Tamar, and Alen
 - Aseng – with the PI System in place engineers were able to increase production by an estimated 10,000 Barrels of Oil a day!
 - Tamar – the PI System was used to remote monitor key information during startup – pictured below



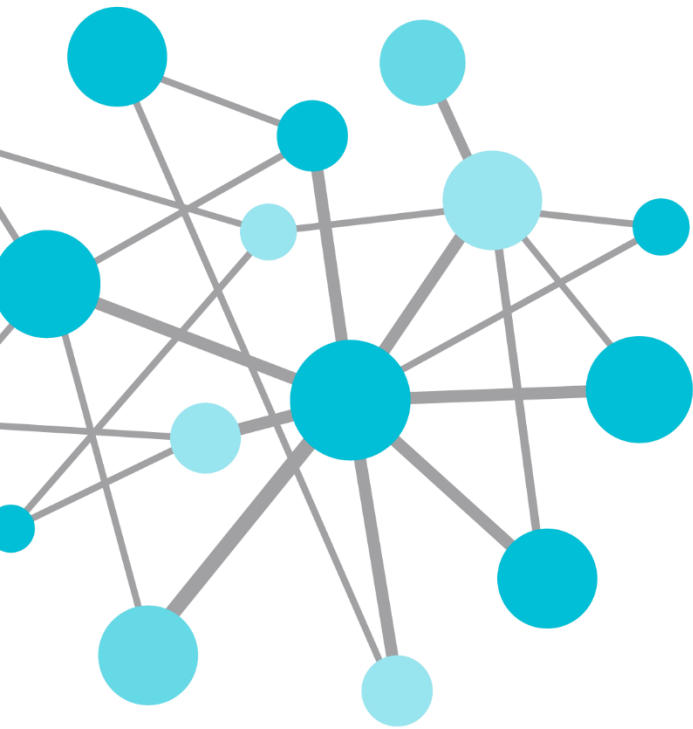
Next Steps

- Get PI Event Frames rolled out
- Get an OSIsoft Enterprise Agreement (EA) signed and delivered!
- Focus on making our PI System **THE** primary source of record for production data
- One version of the truth globally

Pursuit of an Enterprise Agreement (EA)



- **Recruit champions**
- **Provide business use cases**
- **Prove the value of the PI System (ROI)**

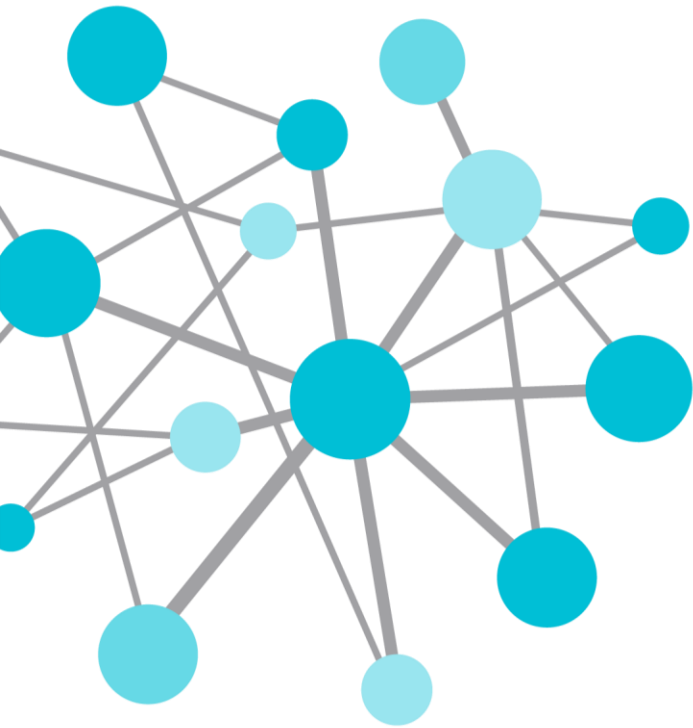


Questions

Please wait for the microphone before asking your question



Please state your name
and your company



THANK
YOU

Brought to you by  **OSIsoft.**

Joe Hill

jhill@nobleenergyinc.com

Noble Energy Inc.

Shawn Cole

scole@nobleenergyinc.com

Noble Energy Inc.