AVEVAWORLD



Blowout Preventer Real-Time Monitoring

AVEVA PI System and Asset Intellect





Larry Landis

- Worked offshore with Transocean for 17 years.
- Specialized in the inspection, maintenance, troubleshooting and testing of blowout preventers for 12 years.
- Proficient in electrical and hydraulic schematics
- Ability to provide a real-world approach to the Real-Time monitoring of BOPs
- With Subsea Solutions September 2023 Present





Justin Crawford

- Graduated from Virginia Tech with a BS in Chemical Engineering in 2012.
- He worked as a process engineer before spending four years in China starting up a greenfield activated carbon plant.
- Expertise in the PI System and automation data historization.
- Specializes in delivering actionable data insights with tools like PI, IOTA, Asset Intellect, Power BI, PARCview, Excel, Python, dotnet, and MQTT.
- With Industrial Insight April 2024 present
- Fun facts:
 - Avid cyclist 🚵
 - Woodworker 📲
 - Beekeeper 🗰
 - Wannabe diesel mechanic for our farm equipment 🤣





Subsea Solutions



- •Founded in 1990 by Stan Bugara offered technical expertise, auditing, consulting services for upstream Oil and Gas Industry
- •Enhance Safety and Operational Excellence Safeguarding Environmental Impacts
- Provided over 4500 surveys in the past 35 years
- •Industry Leading Training Centers
- •Compliance with Regulatory Standards and Agencies American Petroleum Institute (API)
 - American Society of Mechanical Engineers (ASME)
 - National Association of Corrosion Engineers (NACE)
 - Code of Federal Regulations (CFR)
 - Bureau of Safety and Environmental Enforcement (BSEE)
 - Bureau of Ocean Energy Management (BOEM)
- •OEM-Cameron, NOV, GE







Industrial Insight

- Founded by Jim Gavigan in 2016 after his experiences at former OSIsoft as an account manager and his work at a Systems Integrator
- Deep with PI System from architecture/installation through custom solutions with PI System tools
- We cover almost all major industries: pulp and paper, oil and gas, chemicals, power generation, food and bev, mining, pharma
- We are deep skill-wise



- All of us have some type of field experience in engineering and/or IT
- We come from diverse industrial backgrounds
- We work exclusively with time-series databases/data historians with 95% plus of our work centering around the PI System

industrial

Data Optimization Experts

insight

- We also work with Business Intelligence tools like Power BI and Tableau
- We also are trained and versed with several advanced analytics/machine learning tools (Simca, Lityx, a little bit of Seeq)
- Several staff members are well-versed in writing custom code

Problem Statement

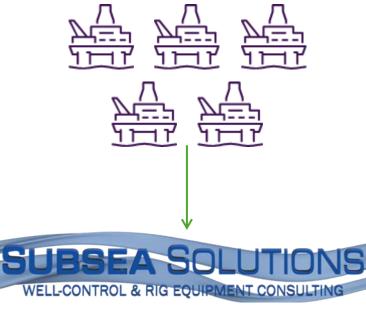
After the Deepwater Horizon oil spill in 2010, 30 CFR 250.724 & 737 regulations require an independent 3rd party to perform real-time monitoring of the blowout preventers on offshore drilling rigs in the Gulf of Mexico.

We need to provide the following:

- Real-time monitoring of the BOP using existing data pipelines off the rig
- Easy Scalability for new rigs onboarded to the platform
- Visualization of the current status and overall health of the blowout preventer
- Alarm visualization and contextualization
- Visualization of function sequencing
- System to compile information from the rig ie:
 - Failure tracking
 - Observation tracking
 - Test history, etc.

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- Custom analytics as market differentiators
- Ability for clients to view only their data in all solutions



RTM



Overview Page

BOP status, surface & subsea pressures, HPHT, EDS, DMAS and HPU pressure and consumption on PI Vision



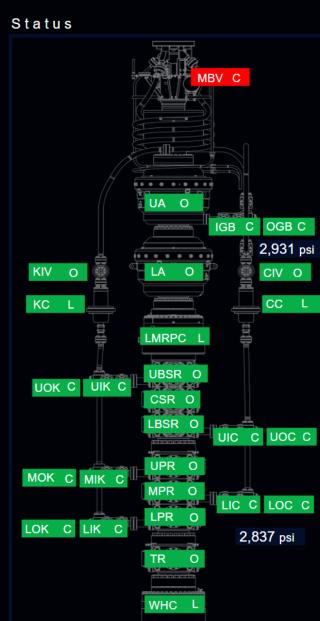
| ICON | | | |
|--|-----------|--------------|--|
| bsea Readbac | ks | | |
| BSEA (PSI) | (P) | (R) | |
| ifold Regulator | 1,677 | 1,500 | |
| er Annular Regulator | 1,538 | 1,484 | |
| er Annular Regulator | 1,495 | 1,398 | |
| lhead Connector | 1,524 | 1,402 | |
|) Pilot Pressure | | 3,107 | |
| D Regulated Supply Press | Ire | 2,934 | |
| POD Supply Pressure | | | |
| | | 5,082 | |
| ck Accum. Pressure | | 4,779 | |
| ace Flow (gal) | 4 | .6 | |
| POD Flow (gal) | 0 | 0.0 | |
| ow POD Flow (gal) | 0 | 0.0 | |
| | | | |
| ergency System Status S Mode EDS Hung | g Off Non | Shoar | |
| | | Shear | |
| A Riser Recoil Signal | | | |
| | | | |
| ta Updates | | | |
| t Tag Value Update | | 506 s | |
| | | | |

3/12/2025 2:05:39 PM

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SML Update Time

- O V E R V I E W -



the second s

-SUBSEA TRENDS-

-SURFACE TRENDS-

| Surface | Readbacks | (P S I) |
|---------|-----------|---------|
|---------|-----------|---------|

| Pump 1 (PP3-1) | Off |
|--------------------------------------|-------|
| Pump 2 (PP3-2) | Off |
| Pump 3 (PP3-3) | Off |
| HPU-Accumulator (PT1) | 4,969 |
| HPU-Manifold Pressure (PT2) | 4,949 |
| Diverter-Main Accumulator (PT1-1) | 5,15 |
| Diverter-Accumulation Supply (PT1-2) | 5,06 |
| Diverter-System Reg Supply (PT2-1) | 2,96 |
| TJ Bearing Pressure (PT2-3) | 84 |
| Lower SJ Regulator Pressure (PT3-1) | 392 |
| Diverter-Flowline Seals (PT3-2) | 260 |
| Lower Slip Joint Packer (PT3-3) | 19 |
| Diverter-Packer (PT4-2) | 1,374 |
| Diverter-Manifold (PT4-1) | 1,242 |
| Upper Slip Joint (PT5-1) | 114 |
| Upper Slip Joint Regulator (PT5-2) | 110 |
| Rig Air Supply (PT6) | 135 |
| | |

| POD | Statu |
|--------|-------|
| Active | e POD |

Blue SEM

Yellow SE

| UE | YEL |
|----|--------|
| ۱. | В |
| ۱. | В |
| | 4 4 |



Subsea and Surface Trends

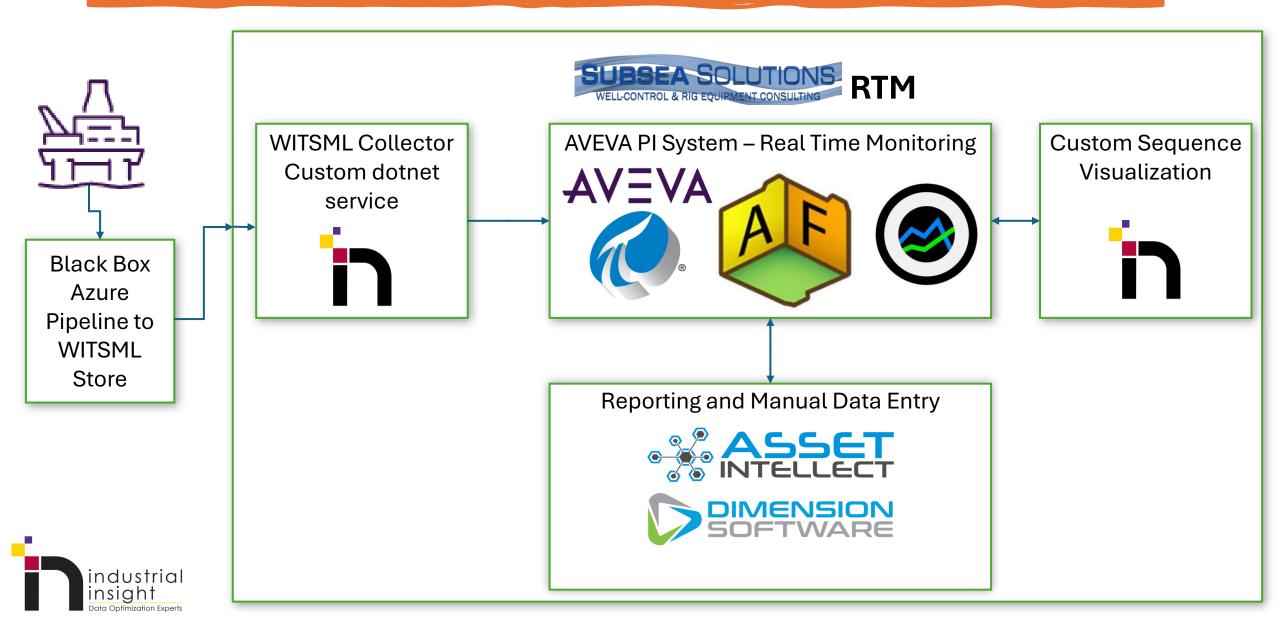
- Pilot and readback pressures each of the subsea circuits.
- All trends can be overlaid for drill down investigation







Solution Architecture – Subsea Solutions RTM



PI System Auto Tag Builder

All template-based build

| Mon Shear EDS \\%@\Subsea Solutions ~Configuration PI Server%\%@~Configuration Tag Prefix%. %@. Tag Config Tag Name%;ptdassname=dassic;pd | |
|--|--|
| Karring EDS Status | \\%@\Subsea Solutions ~Configuration PI Server%\%@~Configuration Tag Prefix%.%@. Tag Config Tag Name%;ptclassname=dassic;pointty |
| 르늘 Tag Config | |
| compressing | SELECT [%Attribute%] FROM [%Template%] WHERE [Attribute Name] = '% Attribute%' AND [Tag Prefix] = @[~Configuration Tag Prefix] |
| descriptor | SELECT [%Attribute%] FROM [%Template%] WHERE [Attribute Name] = '% Attribute%' AND [Tag Prefix] = @[~Configuration Tag Prefix] |
| 🖳 digitalset | SELECT [%Attribute%] FROM [%Template%] WHERE [Attribute Name] = '% Attribute%' AND [Tag Prefix] = @[~Configuration Tag Prefix] |
| 🔄 displaydigits | SELECT [%Attribute%] FROM [%Template%] WHERE [Attribute Name] = '% Attribute%' AND [Tag Prefix] = @[~Configuration Tag Prefix] |
| engunits | SELECT [%Attribute%] FROM [%Template%] WHERE [Attribute Name] = '% Attribute%' AND [Tag Prefix] = @[~Configuration Tag Prefix] |

Really long PI Point data reference template definition to generate all tags. \\%@\Subsea Solutions|~Configuration|PI Server%\%@~Configuration|Tag Prefix%.%@.|Tag Config|Tag Name%;ptclassname=classic;pointtype=%@.|Tag Config|pointtype%;...



Tables as Tag builders

| Name | Value Type |
|----------------|------------|
| Attribute Name | String |
| Tag Prefix | String |
| Tag Name | String |
| Tag ID | String |
| compressing | Int16 |
| descriptor | String |
| digitalset | String |
| displaydigits | Int16 |
| engunits | String |
| instrumenttag | String |
| location1 | String |



PI System Continued



- Active Pod Requirement
 - Need to have a single tag to look at current pod state
 - Problem is with redundant control systems each control system has its own set of tags.
 - Solution: Setup an "Active Pod" element that aggregates the currently active control system

| Name | Expression | | |
|-----------|--|--|--|
| ActivePod | If '\ Pod Select' = "Block/Vent" then Exit() else '\ Pod Select' | | |
| ActiveSEM | <pre>If ActivePod = "Blue Pod" Then '\Blue Pod Pod SEM Select' else If ActivePod = "Yellow Pod" Then '\Yellow Pod Pod SEM Select' else NoOutput()</pre> | | |
| SEM | Right(Left(String(ActiveSEM),5),1) | | |
| Target | <pre>IF ActivePod = "Yellow Pod" AND SEM = "A" THEN '\Yellow Pod\SEM-A\Solenoid Firing Status Choke Stabs' ELSE IF ActivePod = "Yellow Pod" AND SEM = "B" THEN '\Yellow Pod\SEM-B\Solenoid Firing Status Choke Stabs' ELSE IF ActivePod = "Blue Pod" AND SEM = "A" THEN '\Blue Pod\SEM-A\Solenoid Firing Status Choke Stabs' ELSE IF ActivePod = "Blue Pod" AND SEM = "B" THEN '\Blue Pod\SEM-B\Solenoid Firing Status Choke Stabs' ELSE IF ActivePod = "Blue Pod" AND SEM = "B"</pre> | | |

<u>-OVERVIEW-</u><u>-SUBSEA</u>

-SUBSEA TRENDS-

-SURFACE TRENDS-

Active POD

Yellow SEM

Blue SEM

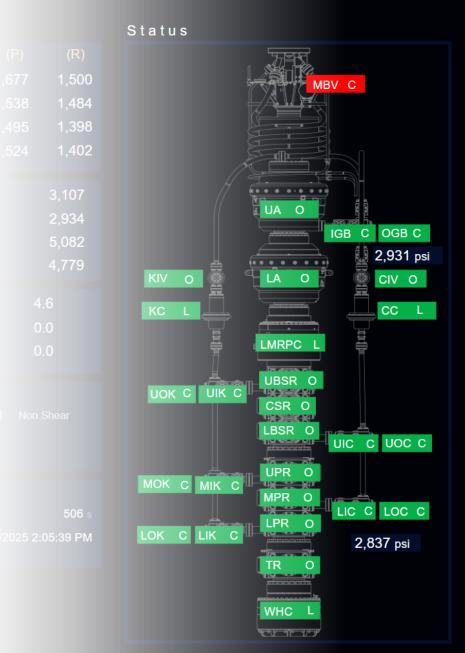
-TIMELINE PL

PI Vision

- Leverage AF for contextualization
- Status image with state overlays of all BOP function statuses.
- Easy navigation between pages

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 AF hierarchy has security to only allow a client to see their data.



Surface Readbacks (PSI)

| Pump 1 (PP3-1) | Off |
|--------------------------------------|-------|
| Pump 2 (PP3-2) | Off |
| Pump 3 (PP3-3) | Off |
| HPU-Accumulator (PT1) | 4,969 |
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| Upper Slip Joint (PT5-1) | 114 |
| Upper Slip Joint Regulator (PT5-2) | 110 |
| Rig Air Supply (PT6) | 135 |
| POD Status | |
| | |

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В

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|---|------|-----|
| С | hoke | HP |

2,8 Lower Sta

Pres.

6,000 5,500 5,000 4,500 4,000 3,500

3,500 3,000 2,500 2,000

Custom Sequence Visualization



- Easy visual and validation of cascading BOP functions.
- Visual is a custom dotnet website that queries the AFSDK for config and values and is embedded via iFrame into the display.

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Asset Intellect Solution

- COTS Software was a major reason for going with Dimension.
- Easy integration with Asset Framework and PI
- Combine AF with asset relative custom SQL database
- Filter your database queries based on your current path in Asset Intellect
- Security with Asset Framework and Asset Intellect combined allows each client to only see their data.
- Easy Manual Data Entry









BSSE Issue Tracking

- Failure, Observation, and other reports
- Easy Manual Data Entry
- Design SQL database backend and then define the form fields to fill it out.
- Manual Data Entry to:
 - SQL Database
 - AF Elements / Attributes
 - AF Event Frames / Attributes
 - PI Tags via AF Attributes
- Entry via Popup form, embedded form, and in grid.

| Edit selected item | | × |
|--------------------|------------------------------|---|
| Title | See if its fixed | |
| Client | | |
| Contractor | | |
| Rig | | |
| Well | Isabela 3 ST02 | • |
| Equipment | BOP-1 | • |
| Path | | 0 |
| Failure Type | IBWM Event | |
| Failure Date | 02/25/2025 | ä |
| Operations | Subsea | |
| Discovery Method | Visual Inspection (inc. ROV) | • |
| — Details ——— | | |
| Description | | |
| | | |
| | | |
| Indications | | |
| | | |
| | | |
| | | |
| | | |
| Impacted Functions | | |
| | Save X Cancel | |
| | | |





Slideouts

- Easy configuration of slideouts, popups, and links for more information.
- Ease of dynamic and asset relative design.

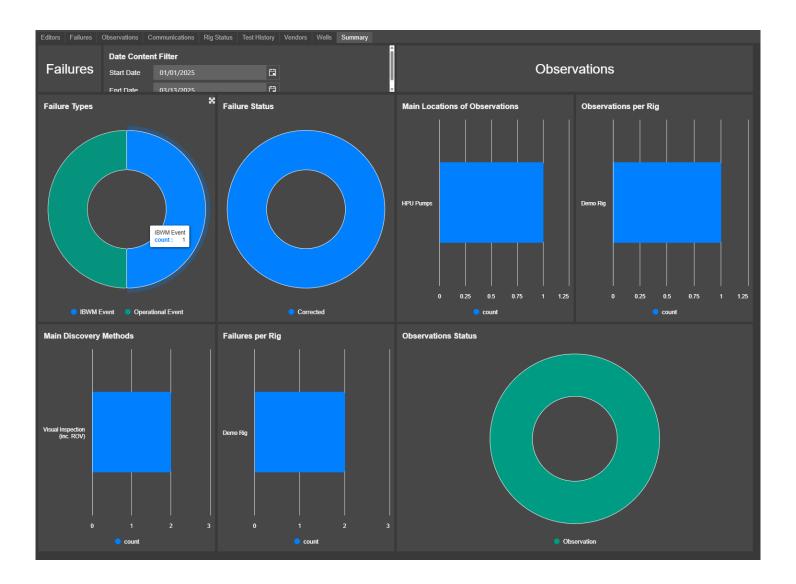
| ▼ Title ▼ Rig Title Test demo observaiion 21 Test demo observa Demo Rig Client Demo Operator contractor Demo Rig Contractor Demo Rig Well Isabela 3 ST02 equipment BOP-1 Path \SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Drentor\Demo Drillin Status Observation Deservation Date 12-Mar-2025 Seeking Set Pressure Sub Unit BOP Controls | | | ₹ Ⅲ |
|--|--------------------------------------|----------------|---|
| Title Rig Title Title Title 21 Title Title Title Title 21 Title Title Title Title 21 Title Title Title Demo Operator 21 Title Contractor Demo Operator contractor Demo Rig Demo Rig Veil Isabela 3 ST02 equipment BOP-1 Path \SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Operator\Demo Drillim Status Observation Date 12-Mar-2025 Type Seeking Set Pressure Description adf Observed Item HPU Pumps Component Pressure Indicators Component Pressure Indicators Component Fisiure Title Failure Title mdl Attachments Created 13-Mar-2025 Created_by jcrawford jcrawford jcrawford | | Observation SO | |
| 21 Test demo observa Demo Rig Client Demo Operator 21 Test demo observa Demo Rig Contractor Demo Rig ing Demo Rig Demo Rig Well Isabela 3 ST02 equipment BOP-1 BOP-1 BOP Path \SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Operato | Observations 🛛 + 🧪 📋 🤄 | ID | 21 |
| contractor ing ing ing ing ing ing ing ing | ▼ Title ▼ Rig | Title | Test demo observation |
| rig Demo Rig Well Sabela ST02 equipment BOP-1 YBR YBR Data SubSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo | 21 <u>Test demo observa</u> Demo Rig | client | Demo Operator |
| Well Babela ST02 equipment BOP-1 Path SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Operato | | contractor | Demo Drilliing Contractor |
| equipment BOP-1 Path \SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Dpmlon. Status Date Devation pstatus Top< 24Mar-2025 Sub Vini BOP Controls Solutions\Subsea Solutions\Lease Sub Vini BOP Controls Solution Observed Item HPU Pumps Observed Item Graipenti Component Indicators Solution Attachments Sub-2025 Solution Graipenti Component Indicators Solution Graipenti Component Indicators Solution Graipenti Component Indicators Solution Materia Solutions Solutions Status Indired Solutions | | rig | Demo Rig |
| Path \SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Drillion. Status Date Descration Type Seking Set Pressure Observed Item SOP Controls Sub Unit BOP Controls Observed Item HPU Pumps Omponent Faiure Title Faiure Title Outer Created ISMar-2025 Inder Status | | Well | Isabela 3 ST02 |
| Status Status Observation g Status Date 12-Mar-2025 Status Date Seking Set Pressure Sub Unit BOP Controls Sub Unit BOP Controls Observed Item HPU Pumps Component Component Failure Title null Attachments Status created IS-Mar-2025 Image: Status Status | | equipment | BOP-1 |
| Date 12-Mar-2025 Type Seeking Set Pressure pstatus Description Sub Unit SOP Controls Observed Item HPU Pumps Component nul Attachments Scatus created_by Johar-2025 modified J3-Mar-2025 | | Path | \\SUBSEA-AF01\Subsea Solutions\Subsea Solutions\Demo Operator\Demo Drilliin |
| Type Seeking Set Pressure Description asdf Sub Unit BOP Controls Observed Item HPU Pumps Omponent Inul Attachments Failure Title Created_by IS-Mar-2025 Inudified IS-Mar-2025 | | Status | Observation |
| Pescription asdf Status + • • • • • • • • Status > + • • • • • • • Status > + • • • • • • • Status > + • • • • • • • Status > + • • • • • • • Status > + • • • • • • • Status > + • • • • • • • Status > + • • • • • • • Status > + • • • • • • Status > + • • • • • • • Status > + • • • • • • • • • Status > + • • • • • • • • • • • • • • • • • • | | Date | 12-Mar-2025 |
| status + i) Rig Sub Unit BOP Controls Observed Item Component Failure Title Attachments created I 3-Mar-2025 I 3-Mar- | | Туре | Seeking Set Pressure |
| Status + Observed Item <p< th=""><th></th><th>Description</th><th>asdf</th></p<> | | Description | asdf |
| i T Rig Vell Observed Item HPU Pumps Component Pressure Indicators Failure Title null Attachments created created_by jcrawford modified 13-Mar-2025 | λig Status + 🖉 🛍 ėੈ ⊂ | Sub Unit | BOP Controls |
| Component Pressure Indicators Failure Title null Attachments | | Observed Item | HPU Pumps |
| Attachments created created_by modified 13-Mar-2025 | i i kig i vvei | Component | Pressure Indicators |
| created13-Mar-2025created_byjcrawfordmodified13-Mar-2025 | | Failure Title | null |
| created_by jcrawford modified 13-Mar-2025 | | Attachments | |
| modified 13-Mar-2025 | | created | 13-Mar-2025 |
| | | created_by | jcrawford |
| modified_by jcrawford | | modified | 13-Mar-2025 |
| | | modified_by | jcrawford |





Business Intelligence

- Can do BI style visuals and interactivity without the normal BI tools.
- Can use and embed PowerBI and similar if desired.
- Flexibility is the name of the game here.







Alarms & Analytics

Alarms

- Critical pressures points
 - LPA (HPU, subsea accum., Subsea regulators, pilot, air, diverter accum.)
- Loss of signal
- Emergency function activations
- Faults
- Differential pressure
- Operations/sequence alarms
- Tag availability



Analytics

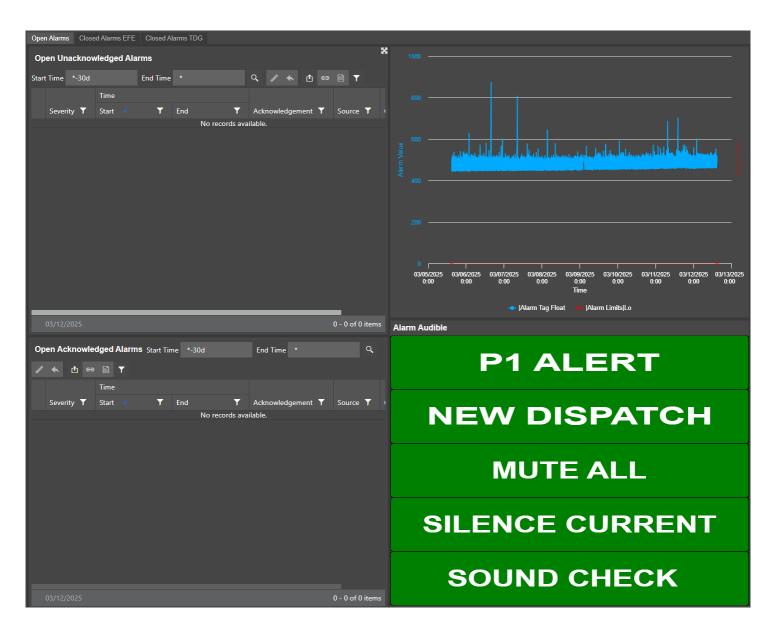
- Calculated consumption rates
- Health tools (development)
 - Annular (element/operator)
 - HPU (accumulators)
 - Packers (ram position)



Alarm Dashboard

- Ability to enunciate alarms without a SCADA system using images and injecting real time data into them.
- Dashboard to receive Event Frames as alarms and use AF acknowledgements to manage them.
- Click an alarm and see the trend for the time of interest in Asset Intellect or PI Vision

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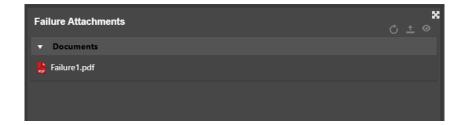




Other Benefits

- The wiki allows threaded comments unique to each SQL record, AF Event Frame, AF Element, etc.
- Ease of adding attachments that are related to each SQL record same as the wiki.
- We chose to go with Asset Intellect because the project is never fully scoped, so it provides us the freedom to build what we need now with the ability to build whatever is dreamt up in the future.

| Failu | ıre Wiki | |
|-------|--|--|
| ж | | |
| | | |
| JC | Justin Crawford Mar 12, 2025, 3:44:56 PM | |
| | Here is another demo comment. The wiki is super helpful. | |
| | ★ / ± | |
| Л | Justin Crawford Mar 12, 2025, 3:44:30 PM | |
| | Demo comment | |
| | ★ / # | |
| | | |
| | | |







Subsea Solutions rolls out an RTM Solution for BOPs

Challenge

- Real-time monitoring of the rig's blowout preventer using existing data pipelines off the rig
- Visualization of function sequencing
- Manual reporting processes led to mistakes.

Solution

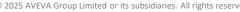
• Deployed AVEVA[™] PI System[™], Dimension Asset Intellect, and custom .NET solutions to streamline data collection, access, analysis, manual data entry, and reporting

Results

- Improving reliability and performance through visibility
- Ease of navigation for 3rd party users and clients
- Provided the ability to layer trends to assist with troubleshooting
- Avoided **\$7-10MM** of downtime due to unplanned stack pull









Questions???





https://www.industrialinsightinc.com/

Thank you

Justin Crawford jcrawford@industrialinsightinc.com Larry Landis llandis@subseasolutions.net



https://subseasolutions.net/