Smart Factory Solution (Energy): Industry 4.0

Oil & Gas Well Plant Automation

Proposed Solutions

1. Oil/Gas Well Plants Automation

Oil and gas automation, also known as oilfield automation, in the oil and gas industry refers to a growing number of processes, many involving digital technologies, that can help energy producers better compete in global markets.

It reduce costs by both replacing some human labor and enhancing the safety and accuracy of existing human-driven tasks. Oil and gas automation cuts back on time, allows for more scalable processes, and reduces jobsite injury and death.
Upstream producers working in remote areas benefit from automation by using sensors/IOT devices, edge computing to help monitor inspection processes, equipment maintenance, ensure safety etc.
Also, automating internal IT processes helps all energy operations to simplify production and boost yields, reducing carbon footprints while increasing potential revenue.

Companies providing RIG plant automation related solution
Scadacore: IIOT solution & products (sensors)
Biz4intellia: IIOT solution & products (sensors)
Softengi: IIOT solution
Telit: IIOT solution
Amulet: IOT device wearables for IIOT
Ifsolutions: Pumping Hardwares used in Oil RIG

Upstream Oil & Gas

- Exploration
- Field Development
- Prodaction Operations

Midstream

- Transporation
- Processing
- Storage & Distribution

Downstream

- Manufacturing
- Refining & Petro-chemicals
- Wholesale & Marketing

UPSTREAM MIDSTREAM DOWNSTREAM

Production

Exploration

Gas

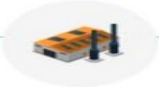
Processing

Transportation

Distribution

Oil

Transportation



Refining

Distribution

Oil/Gas Well Overview

Conventional natural gas and oil deposits are found in permeable rocks, trapped below impermeable rock. These deposits can be extracted by **drilling down through the impermeable rock into the permeable rock**. But gas and oil are also trapped in the spaces within impermeable shale rock.

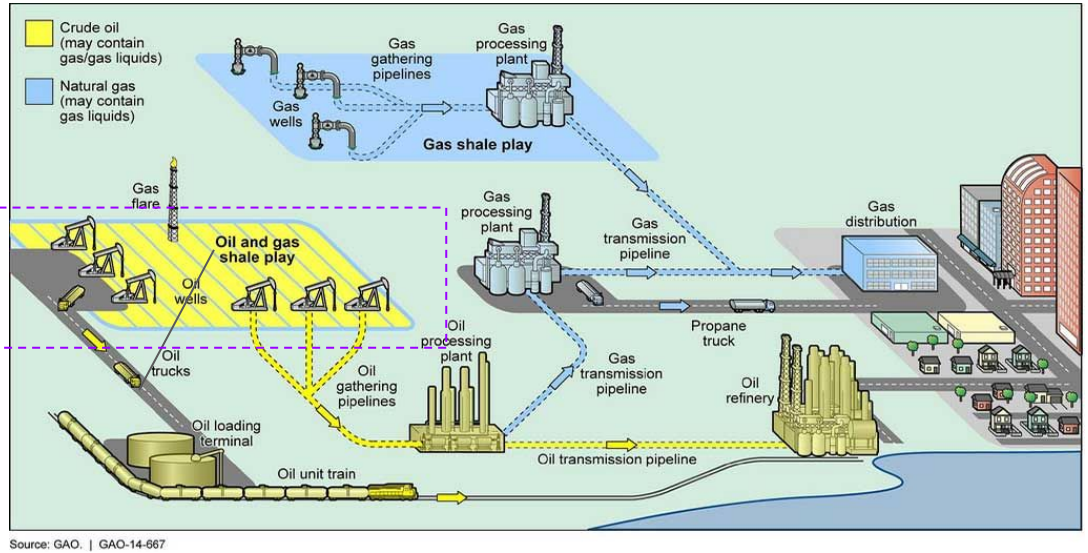
Industry under Consideration

The seven steps of oil and natural gas extraction

- STEP 1: Preparing the Rig Site.
- STEP 2: Drilling. ...
- STEP 3: Cementing and Testing.
- STEP 4: Well Completion. ...
- STEP 5: Fracking. ...
- **STEP 6: Production**
- STEP 7: Well Abandonment and Land Restoration.

https://www.cred.org/seven-steps-of-oil-and-natural-gas-extraction/

Oil/Gas Overall Process



Step 1 to 5 - Is one time manual step
Automation needed for this step 6

Deployment Option 1: Multiple Oil wells part of same field - All applications can be hosted in Edge Computing platform.
Deployment Option 2: Multiple Oil wells part of different field - Only latency sensitive application needs to be at Edge.

Summary

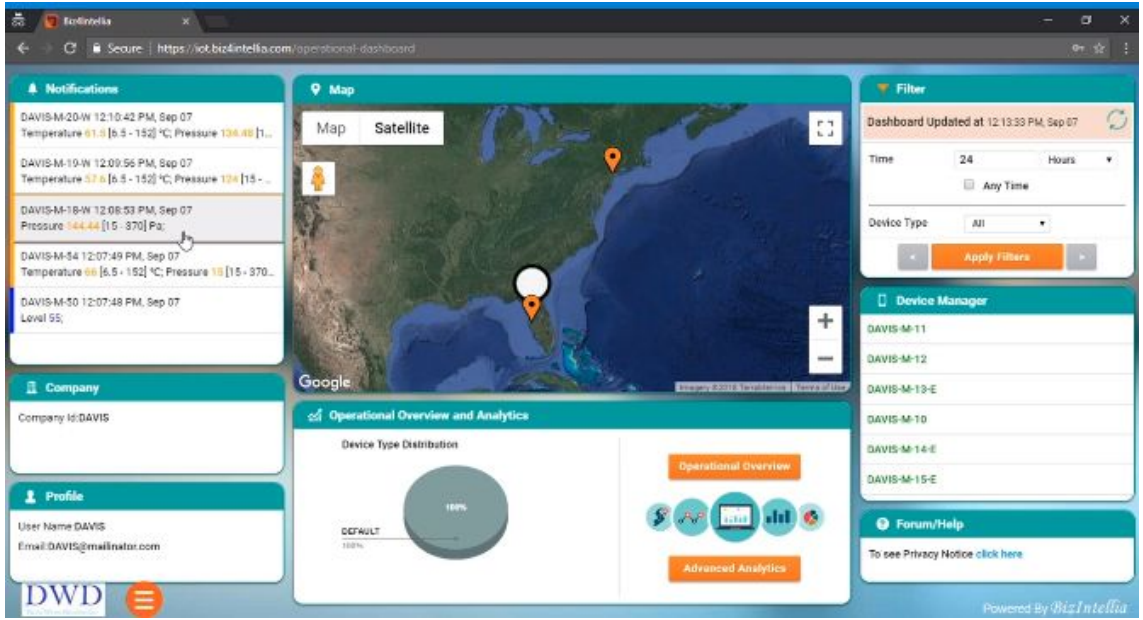
Feature	Sub-Feature	Type	Priority	Opensource	Remark
Human Resource Management	❑ Staff Information ❑ Staff Attendance ❑ Task Management ❑ Visitor information ❑ Employee health ❑ Training (Optional)	Generic		FE: New BE: nbPlus/HSL comm to be analyzed Reuse existing capabilities	
Well monitoring & management	❑ Plunger lift monitoring and control ❑ Well Performance/ Diagnostic ❑ Well Production Testing ❑ Surface casing vent pressure test monitoring	Specific		FE: New BE: New	
Well Production Inventory	❑ Production Inventory ❑ Tank level monitoring and alert	Specific		FE: New BE: New	
Equipment Maintenance	❑ Pumps ❑ Separator ❑ Storage Tank ❑ Pipeline ❑ Produced Water treatment	Specific		E: New BE: New	
Safety Management	❑ Safety gear management ❑ Zone management ❑ Environment monitoring ❑ Video surveillance ❑ Accidents/Incident summary	Partially Specific		FE: New BE: Partial re-use of some of the existing capabilities	

Possible Demo Story 1

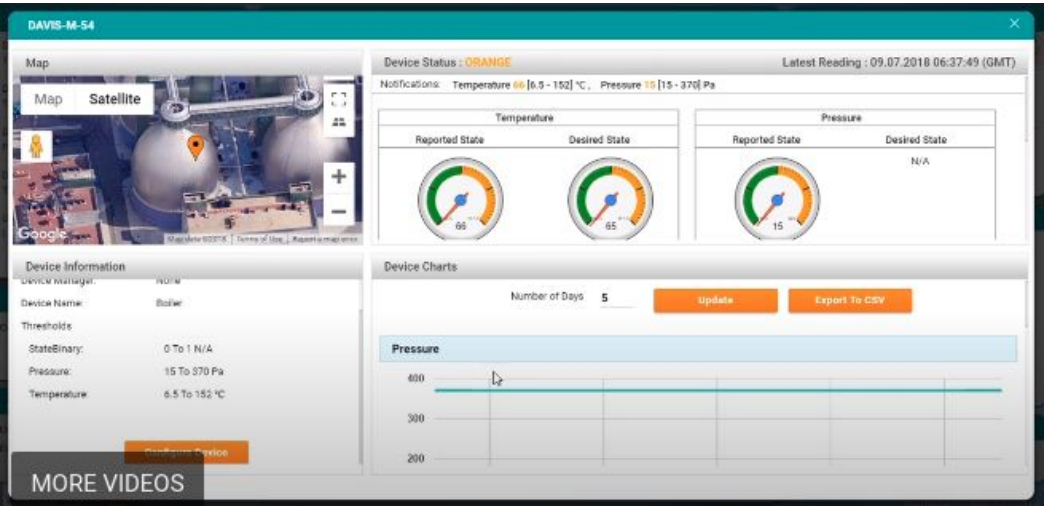
Wells Equipment Maintenance

- Monitoring
- Action
- Statistics

Summary Dashboard (Multiple Wells)



Device View

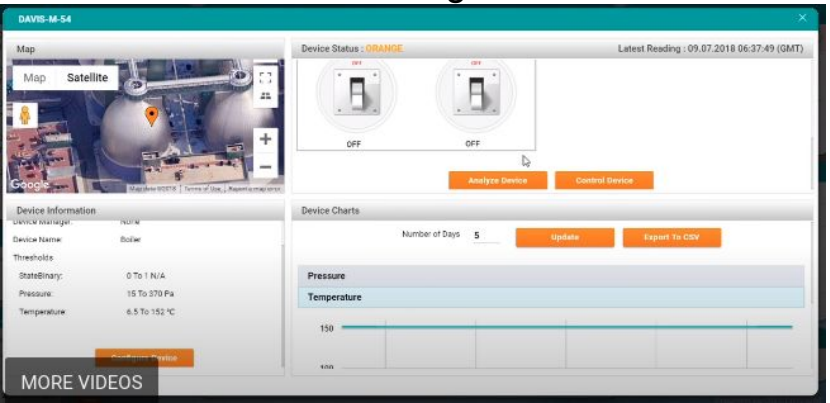


https://www.youtube.com/watch?time_continue=165&v=V8xKbueKdt4&feature=emb_logo

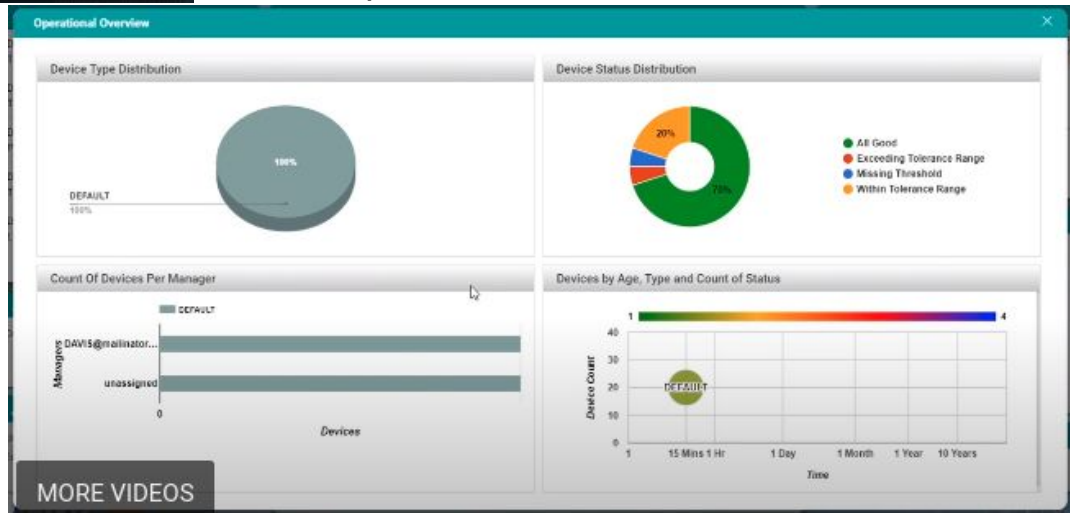
Summary Dashboard

Device State Change

Device view having Actions



Operational Overview Dashboard



Advanced Analytics

Modules needed

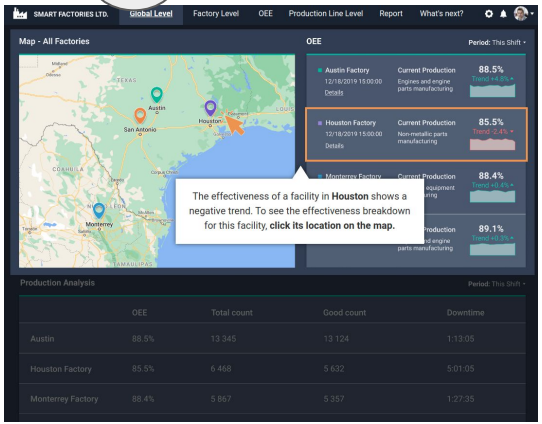
Equipment Maintenance	❑ Overall Dashboard ❑ Pumps ❑ Separator ❑ Storage Tank ❑ Pipeline ❑ Produced Water treatment	Specific		E: New BE: New	

Possible Demo Story 2

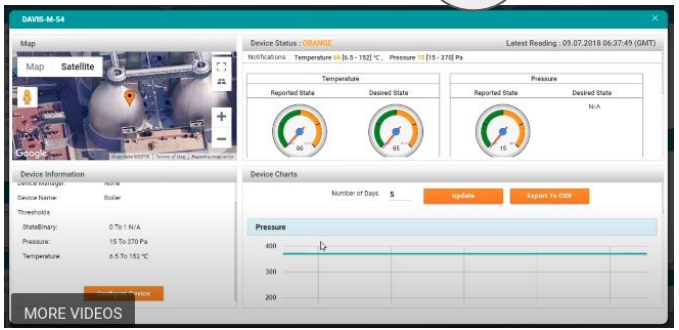
Production Monitoring with Equipment Maintenance

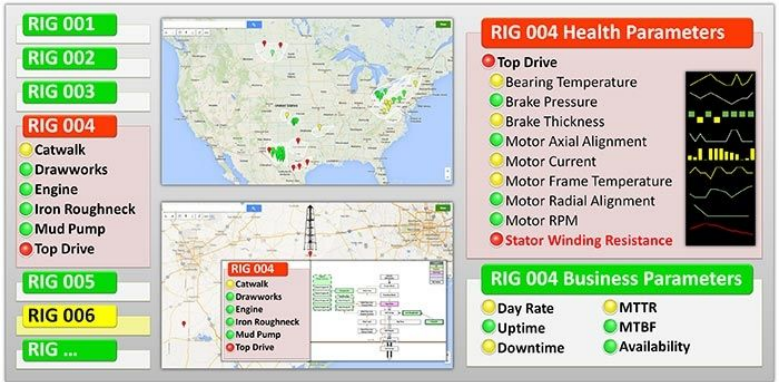
1. Observed production slippage in Production Oil RIGS Summary View.
2. Click on that Well summary page
   a. List equipments and output [w]
   b. Generic Test results [Dyno graph] [w]
   c. Well test result [w]
3. Follow Equipment Maintenance to find root cause of production reduction

1 Wells View



Device View 3





2

Well Overview with MAP (for Reference) Should show Production too

Modules Needed

Well Production Inventory	❑ Production Inventory ❑ Tank level monitoring and alert	Specific		FE: New BE: New	
Equipment Maintenance	❑ Pumps ❑ Separator ❑ Storage Tank ❑ Pipeline ❑ Produced Water treatment	Specific		E: New BE: New	

Other Possible Stories

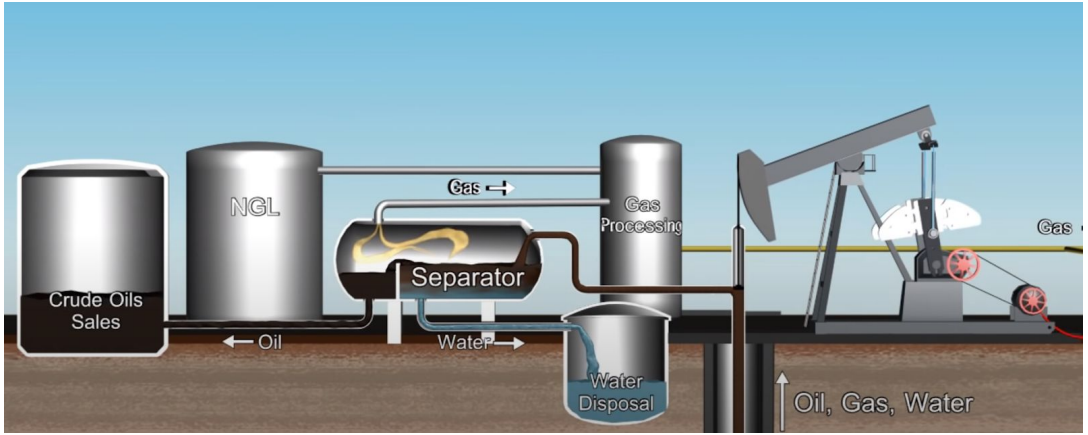
1. Predictive maintenance based dyno card plot
   Steps:
   a. Looking at the Graph Plot alert “Fluid pound ”.
      Predicting Problem: Pump jack failure after sometime
      Suggested solution
      i. Slowing down the pumping unit.
      ii. Shortening the stroke length.

Solution Details

Oil Well System

A well system consists of below units:

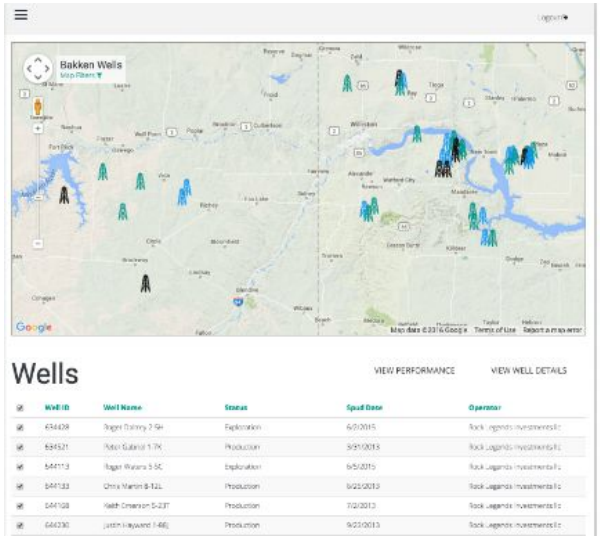
- Well
- Pump
- Pipeline connected to Processing unit
- Separator [Can be multi stage]
- Oil & Gas Storage
- Water Treatment



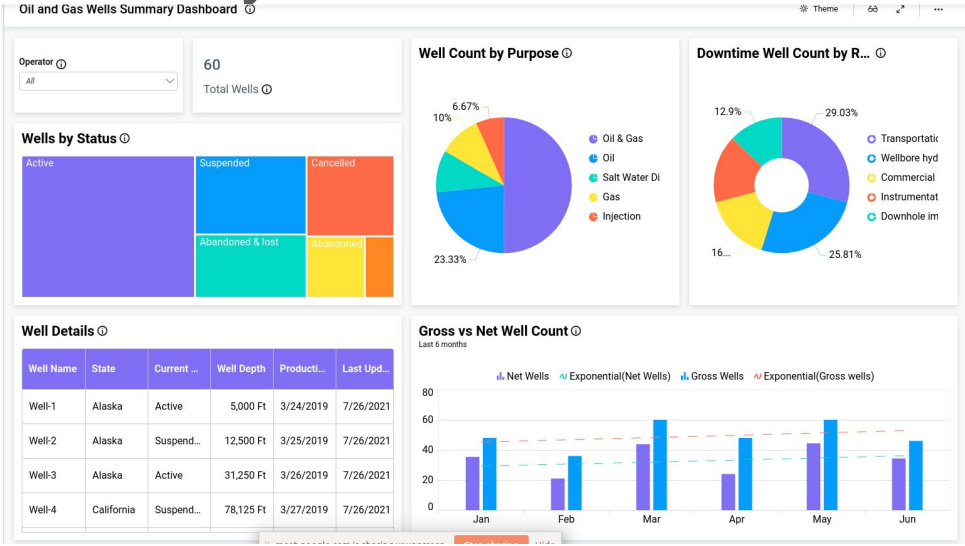
https://kimray.com/training/5-common-methods-artificial-lift

https://www.youtube.com/watch?v=WGFPb61qm9I

Oil Well Summary View

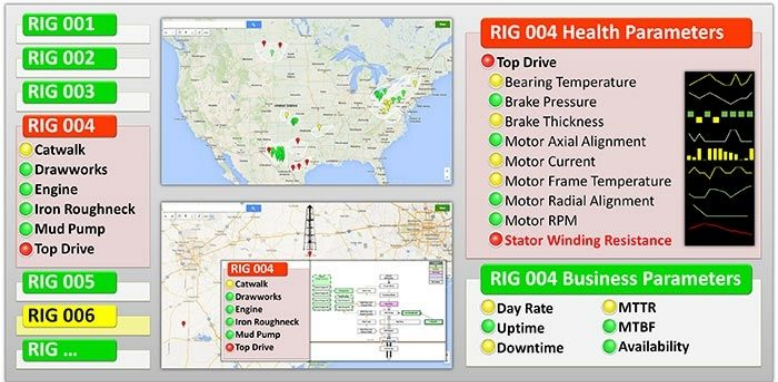


Well Overview with MAP



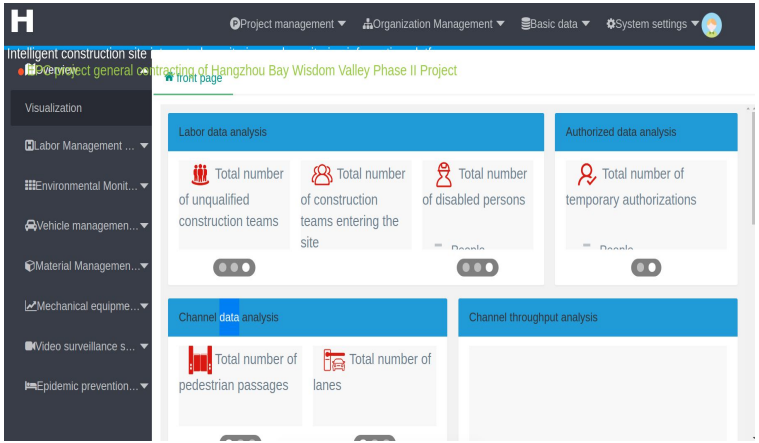
Well Overview

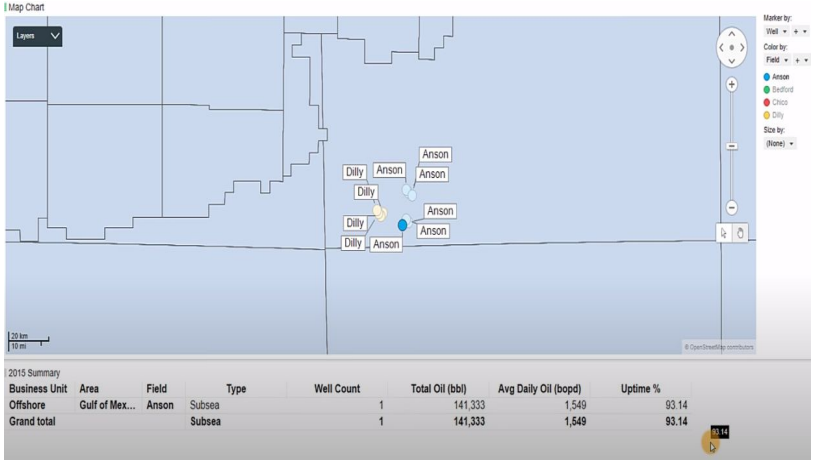
Select Well to go to specific one



Well Overview with MAP (for Reference) Should show Production too

Well Summary/Overview View





Source http://www.nbplus.link:8090/

https://www.youtube.com/watch?v=WotBSuQbnQs

WELL IDENTIFICATION	
Well Number or Name:	Should match the source_name in DHS records.
DHS Source Identification Number:	This should be the FRDS ID Number, which is used for federal reporting. The FRDS ID is the seven-digit system number followed by a dash and a three-digit number (example: 4910011-001). The FRDS ID is available from DHS. If you do not know the FRDS ID, the PS Code may be used (this is the identification number used by water systems and laboratories submitting water quality data). If a FRDS ID or PS CODE has not yet been assigned for this source leave the field blank.
State Well Number:	This number is issued by DWR, and by some local agencies. For some sources, the state well number is the same as the PS Code. If the state well number is known, enter it in this field. Otherwise DHS will be working with DWR later to identify state well numbers for all public water system wells.
Well Status:	Should match DHS records for active, standby or inactive.

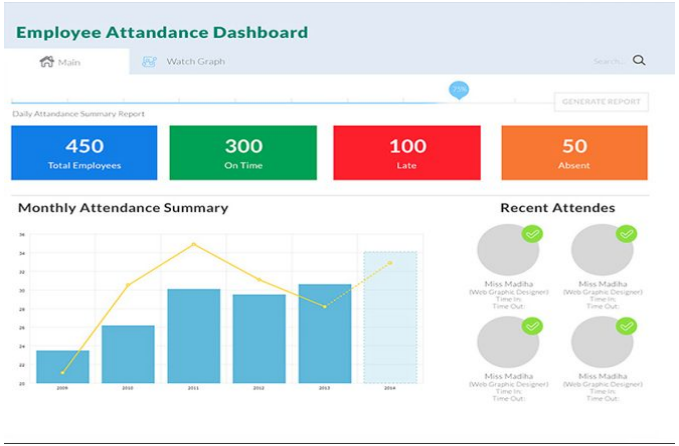
Heading 1: Human Resource Management

- ❏ Staff/Labor Information
- ❏ Staff/Labor Attendance
- ❏ Task Management
- ❏ Visitor information
- ❏ Employee health
- ❏ Training (Optional)

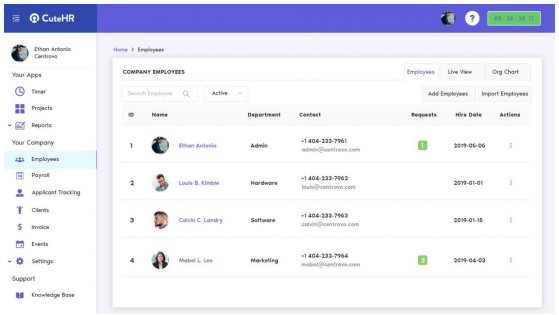
Human Resource Management

- Staff/Labor Information
  - Team information
  - Labor/Staff information
- Staff/Labor Attendance
  - Today's/History attendance
  - Attendance trend
  - Department wise attendance (Welding, Pump maintenance, Well maintenance, Engineers, Emergency)
- Department wise Task Management View (Welding, Pump maintenance, Well maintenance, Engineers, Emergency)
  - Different department list
    - Schedule/Task list
  - Performance

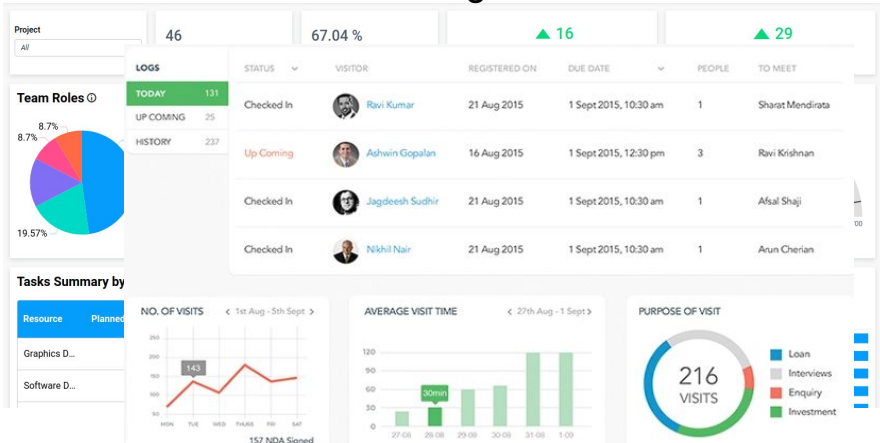
Employee Attendance



Staff/labor Information



Task Management

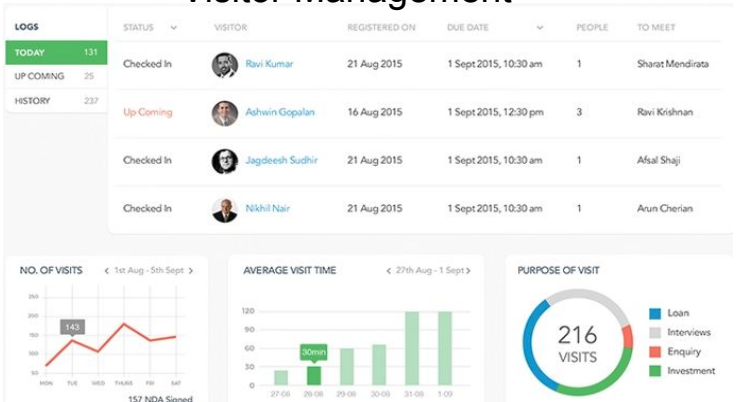


Human Resource Management

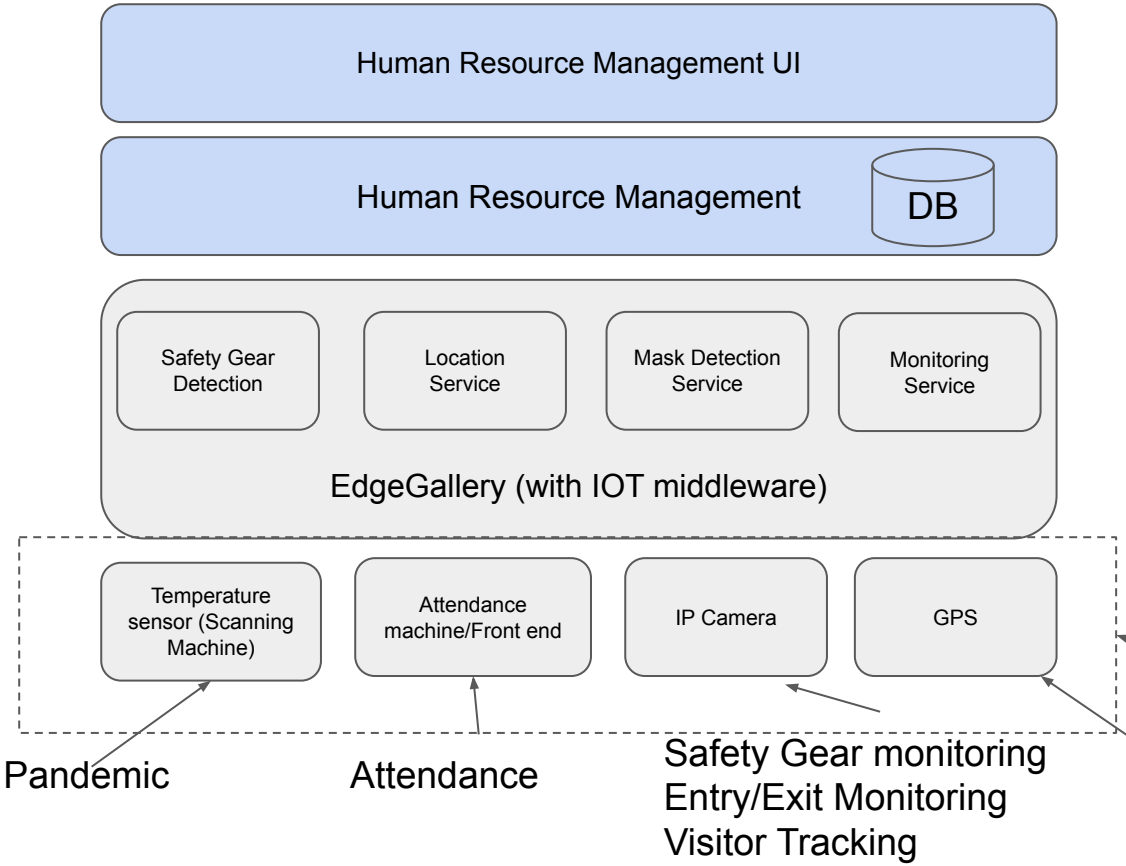
- Employee health/safety
  - Daily body Temperature check
  - Location tracking for Labor
  - PPE Gear checking
  - Mask Detection
- Visitor information
  - Visitor details, Entry/Exit details
  - Visitor location tracking
  - Mask Detection
- Training View (Optional)
  - No of Training tasks ongoing
  - No of ppl under training

Employee Health Monitoring

Visitor Management



How: Human Resource Management



FrontEnd (UI) - New Development
Backend - New development/Integration

Possible Open Source for backend
- Nbplus, HSL Communication

Note: Need code level analysis of these open sources to estimate if effort in integration is lesser than fresh development

Effort Estimation -

Heading 2: Well monitoring & management

- ❏ Plunger lift monitoring and control
- ❏ Well Performance/Diagnostic
- ❏ Well Production Testing
- ❏ Surface casing vent pressure test monitoring

Source : https://www.scadacore.com/applications/oil-and-gas-monitoring/plunger-lift-monitoring/

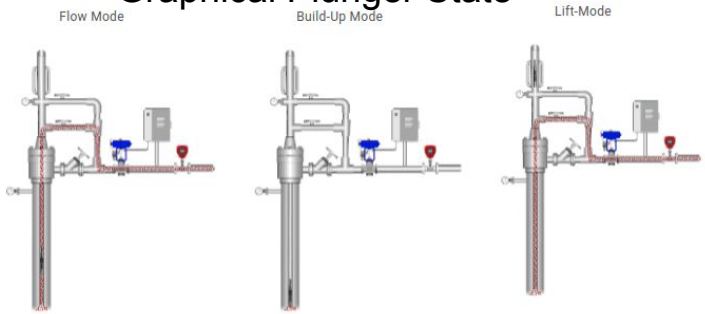
Plunger lift monitoring and control

What is Plunger lift: A plunger lift is an artificial list method of de-liquifying a natural gas well. A plunger is used to remove contaminants from productive natural gas wells, such as water, sand, oil, and wax.

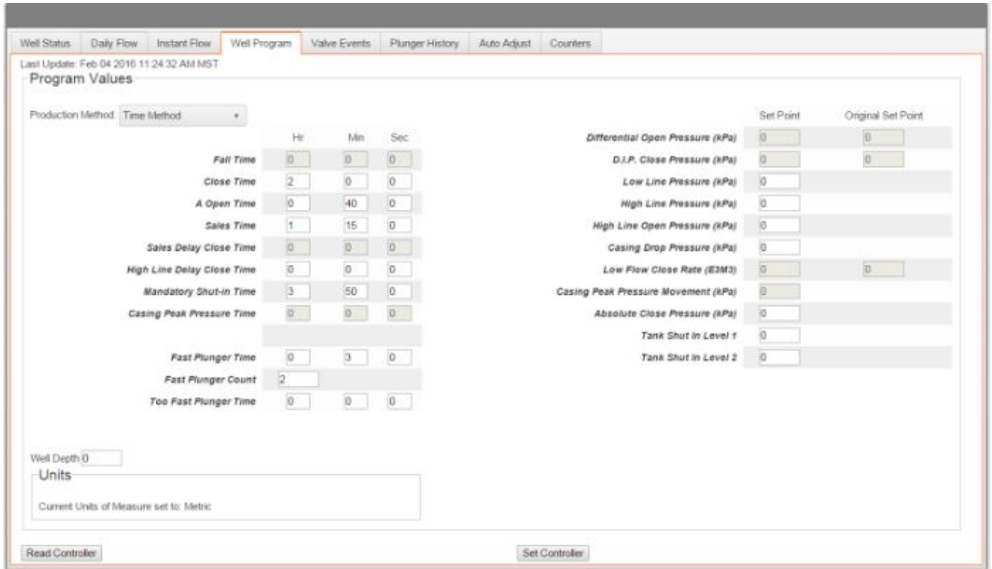
Plunger lift monitoring & Control Purpose: Full control and live view of the plunger enables technicians to remotely monitor and tune their plunger-lift systems without costly trips to the field. Custom reports allow technicians to plot plunger states along with pressures and flows to better tune and optimize you well.

How: Pressure/Flow sensors attach to plunger lift

Graphical Plunger State



Plunger Control Configuration



Plunger Charting

Well Performance/Diagnostic

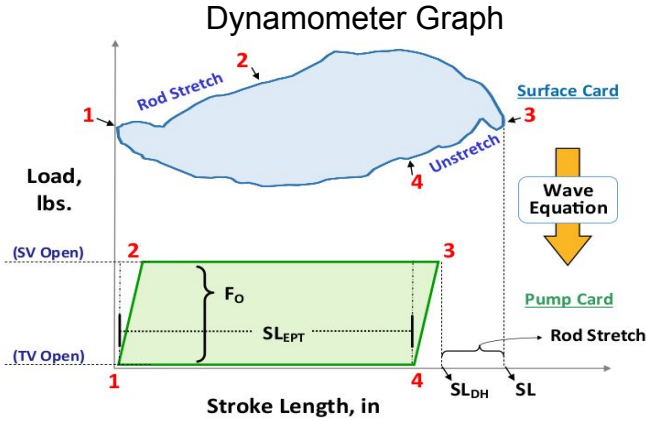
https://www.scadacore.com/applications/oil-and-gas-monitoring/pump-card-pump-controller-monitoring/
https://0aa73c5e-5e00-4b64-90ea-7763a66d9c30.filesusr.com/ugd/f8ee70_d4ba77a8b77e40d898037b28bebad23e.pdf
https://www.youtube.com/watch?v=4F581WnmE8U

Purpose: Dynamometer Graphs are noninvasive diagnostic tools that quantify the well's Producing Performance—in terms of the well's Production Potential (reservoir drawdown) & the Operational Lifting Efficiency of the rod pumping system (how efficiently the fluid is being lifted to surface). By interpreting the diagnostic data in context of the well, producing inefficiencies can be detected & corrected.

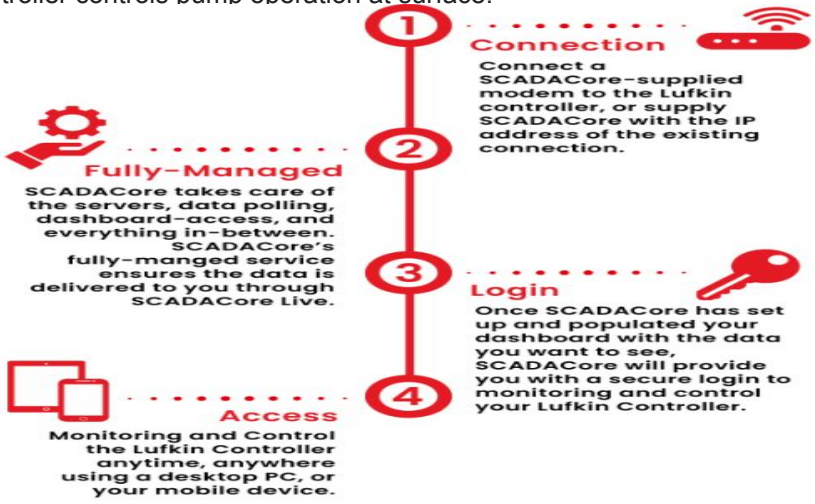
− **Surface Card:** displays the load on the Polished Rod (PR) over a pump cycle. The card shape is a function of everything (PPU geometry, SPMxSL, pump depth, rod string design and elasticity, fluid load on pump, etc).

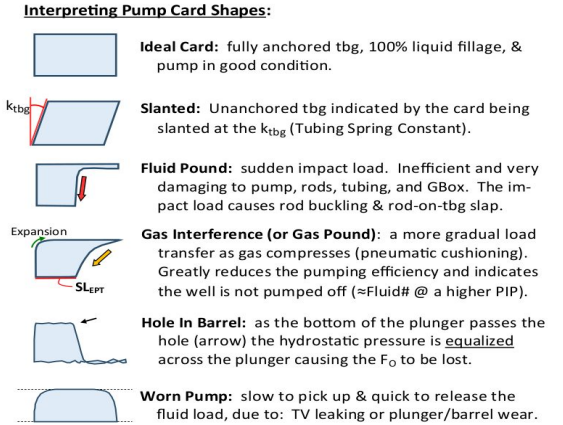
− **Pump Card:** displays the fluid load on the pump plunger (F O) over a pump cycle. The size and shape of the card indicate the operating conditions and performance of the pump.

- **Pump Controller:** Pump controller controls pump operation at surface.



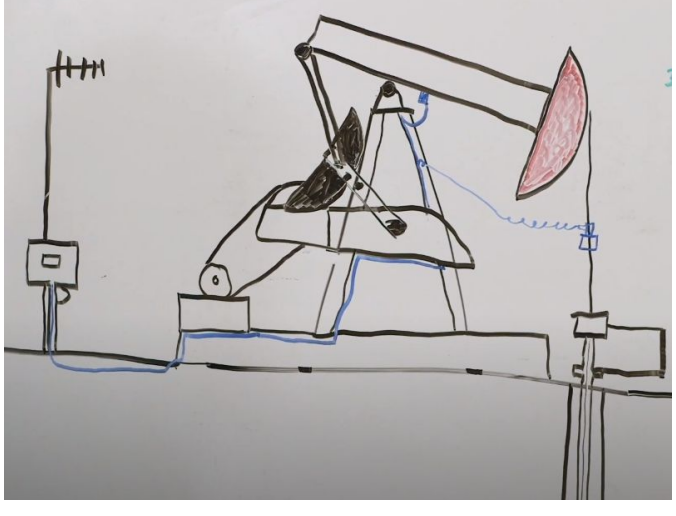
How: Integrate pump controller provided data and provide unified view to operation team





Well Performance/Diagnostic cont..

Pump controller + Polish Rod + Plunger



Pump Controllers Summary

Hourly Pumpoff

Poll	Status	Location	Report Date	Cycles (#)	Controller State	SPM (#)	Pump Fillage (%)	Last Stroke Peak Load (kin-lbs)	Last Stroke Min Load (kin-lbs)	Idle Time (hh:mm:ss)	Current State Time (hh:mm:ss)	Cycles (#)	Fluid Load (lb)	Production (m3)
		00-00-00-00W5	Apr 28 2020 08:35:03 MDT	0	Pumping Normal	2.45	90	15278	9126	00:00:00	642:35:55	0	0	0.03
		00-00-00-10W5	Apr 29 2020 10:36:35 MDT	1	Reserved	0	58	15211	9702	00:00:00	00:39:37	1	32.19	0.21
		00-00-00-11W5	Jun 16 2020 10:38:42 MDT	0	Pumping Normal	1.78	64	19234	9596	00:00:00	166:53:17	0	35.87	0.39
		00-00-00-12W5	Apr 29 2020 10:38:13 MDT	0	Pumping Normal	1.79	70	15616	9750	00:00:00	308:25:43	0	28.3	0.21
		00-00-00-13W5	Jun 16 2020 10:37:44 MDT	1	Downtime Timed Mode	0	44	16066	9572	00:00:00	00:47:33	1	0	0.09
		00-00-00-03W5	Jul 06 2019 09:34:01 MDT	0	Pumping Normal	2.48	87	14766	9738	14:15:38	88:36:44	0	23.08	0.01
		00-00-00-04W5	Jun 16 2020 10:35:40 MDT	0	Malfunction No RPM	0	72	17121	9605	00:00:00	74:03:13	0	46.5	0

Surface Pump Cards, Downhole Cards, and More

Daily | Instant | Surface Pump Card | Downhole Card | Audit

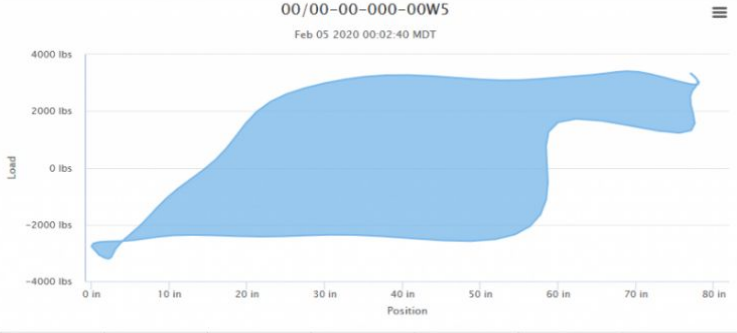
Read Device

Well Information

Well Name	00/00-00-000-00W5
Card Report Date	Feb 05 2020 00:02:40 MDT
UWI	
License Number	

Readings

Max Load (lbs)	3402
Min Load (lbs)	62333
Well State/Shutdown Event	0
Gross Stroke (in)	78.07
Net Stroke (in)	56.37
Pump Fillage (%)	72.24
Fluid Load (%)	48.36



View Card	Report Date	FluidLoad (%)	GrossStroke (in)	MaxLoad (lb)	MinLoad (lb)	NetStroke (in)	PumpFillage (%)	Sequence (#)	ShutdownEventID (#)
Card	Feb 05 2020 09:06:51 MDT	0	0	0	0	0	0	0	0
Card	Feb 05 2020 00:03:46 MDT	46.6	77.77	3427	62360	56.48	72.66	0	0

Well Production Test

https://www.scadacore.com/applications/oil-and-gas-monitoring/well-testing/

https://www.scadacore.com/applications/oil-and-gas-monitoring/well-testing/three-phase-well-testing/

Purpose:

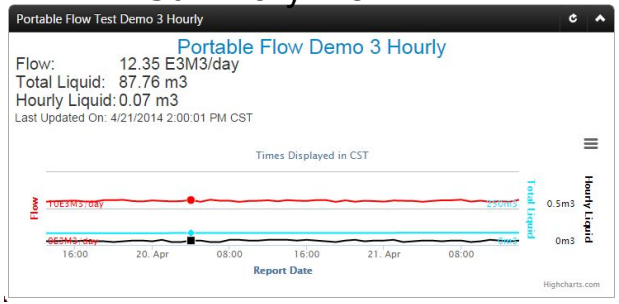
The test will also provide information about the state of the particular well used to collect data. The overall objective is identifying the reservoir capacity to produce hydrocarbons, such as oil, natural gas and condensate.

Data gathered during the test period includes volumetric flow rate and pressure observed in the selected well. Outcomes of a well test, for instance flow rate data and gas oil ratio data, may support the well allocation process for an ongoing production phase, while other data about the reservoir capabilities will support reservoir management.

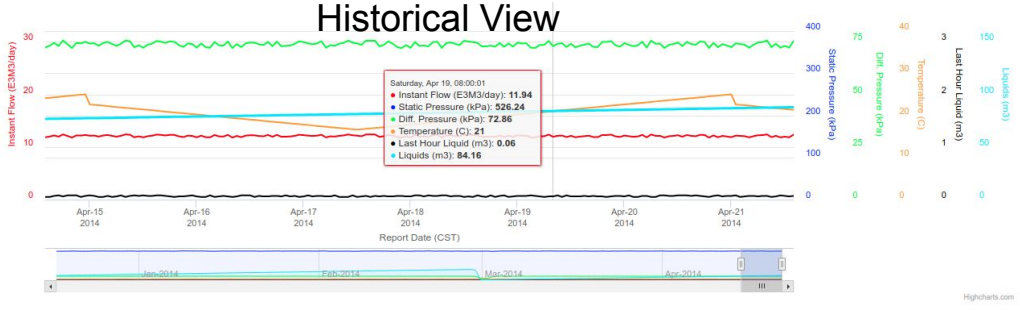
Can provide clients with running totals, hourly totals, daily totals, and monthly totals for gas and liquid flow.
Three phase monitoring will separate the condensate from the water giving a clear view of the wells production.

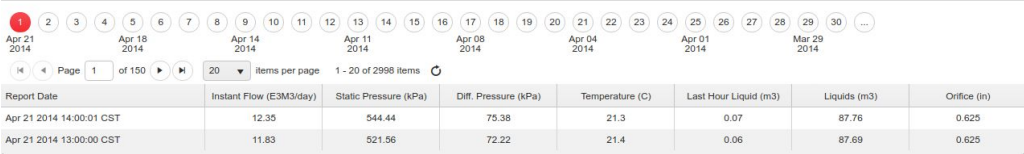
How: Meter/sensor readings from 3 Phase Separator - Test Separator machine.

Summary View

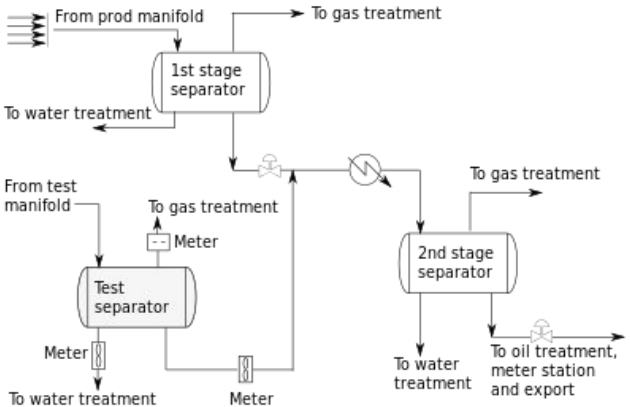


Historical View





Report Date	Instant Flow (E3M3/day)	Static Pressure (kPa)	Diff. Pressure (kPa)	Temperature (C)	Last Hour Liquid (m3)	Liquids (m3)	Orifice (in)
Apr 21 2014 14:00:01 CST	12.35	544.44	75.38	21.3	0.07	87.76	0.625
Apr 21 2014 13:00:00 CST	11.83	521.56	72.22	21.4	0.06	87.69	0.625



Surface casing vent pressure test monitoring

Why: As wells age the well casing deteriorates allowing the flow of gas and liquids through the walls of the casing. This has significant impact on the safety of the gas well as well as environmental effects caused by leaking liquids into the groundwater.

Surface Casing Vent Pressure Tests help to determine the integrity of the well casing and if any additional down-hole maintenance needs to be performed.

When pressure reaches threshold the backend generate alarm for maintenance.

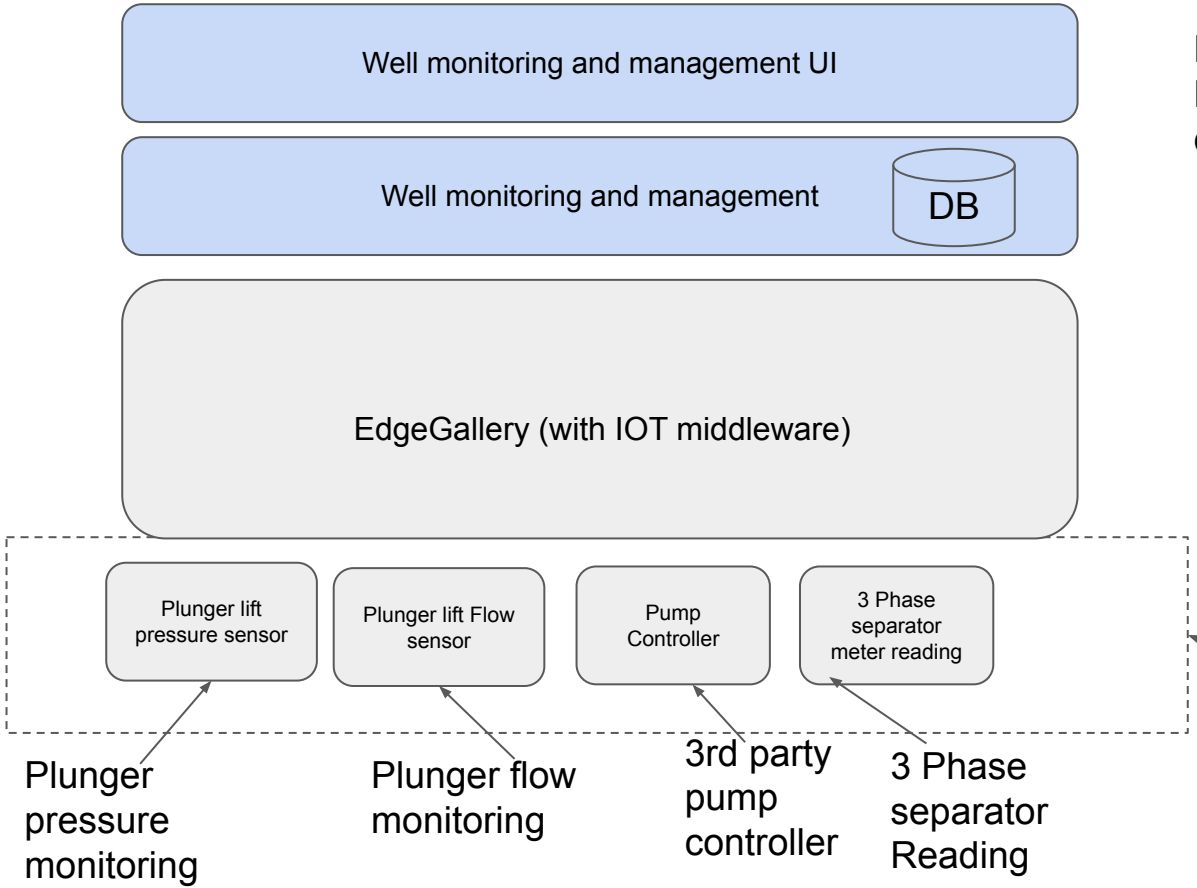
TEST details: A typical test will start with in the Flow State that will produce a base-line reading of the typical pressure and flow of the well. Following a flow reading the tester will remotely change modes putting the test unit into the Build-Up State which. The Build-Up state closes the flow valve allowing pressure to build up inside the well. Pressure will build up quickly at first and slowly level off. Following the Build-Up mode the tester will remotely change modes again to the Vent state, which bleeds off pressure from the casing in preparation to reset the test.

With the casing pressure removed the tester can return the test unit into a flow state to, once again, retrieve a base-line reading and begin the test over again.

https://www.scadacore.com/applications/oil-and-gas-monitoring/surface-casing-vent-pressure-testing/

https://demo.scadacore.com/

How: Well Monitoring and Management



FrontEnd (UI) - New Development
Backend - New development/Integration

Heading 3: Well Production Inventory

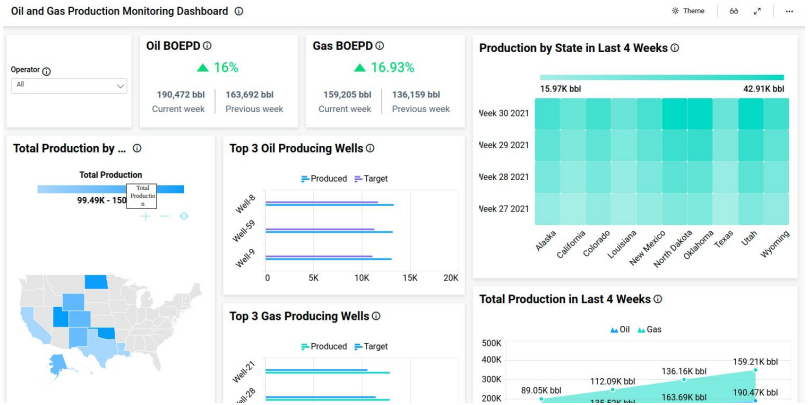
- ❏ Production Inventory
- ❏ Tank level monitoring and alert

Production Inventory

https://ifsolutions.com/metering-and-measurement-of-oil-and-gas-how-it-works/

Crude Oil measurement.
The first step toward accurate crude oil measurement is to remove any free water and sediment. This is done in one of several types of surface equipment such as a Free Water Knockout, a Gun Barrel Separator, or a Three Phase Separator. Following this step the oil is now isolated and can be measured.
After this oil will be measure from storage tank level, or using LACT unit.

Natural Gas Measurement
The majority of producing wells measure natural gas production with an orifice style meter.Differential pressure is measured and recorded as gas passes across an orifice plate, creating a pressure drop allowing for a calculation of the volume of gas passing through the pipe.



Production/Inventory
Oil Tank level Monitoring/Alerts

https://www.biz4intellia.com/iot-oil-fuel-theft-solutions/
https://www.biz4intellia.com/iot-in-oil-gas/
https://www.biz4intellia.com/level-monitoring-solution/
https://softengi.com/solutions/sensors-based-tank-monitoring/

Purpose:

1. Inventory Management

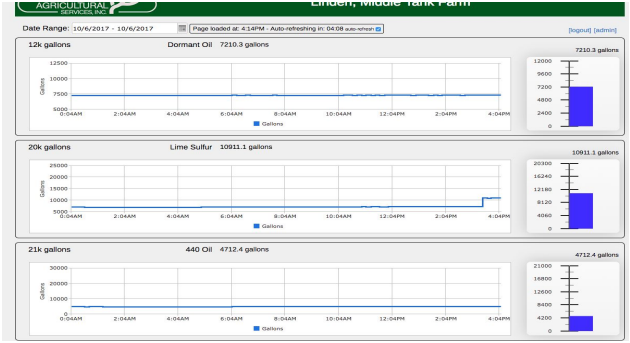
Additionally

2. Theft detection
3. Leak detection
4. Preventing Overfilling and production downtime

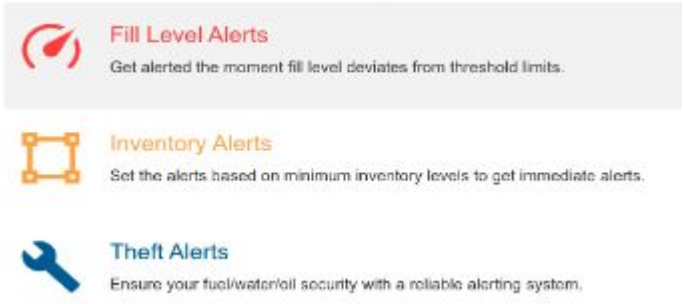
How:

1. Level monitoring sensor

Tank level summary



Alerts

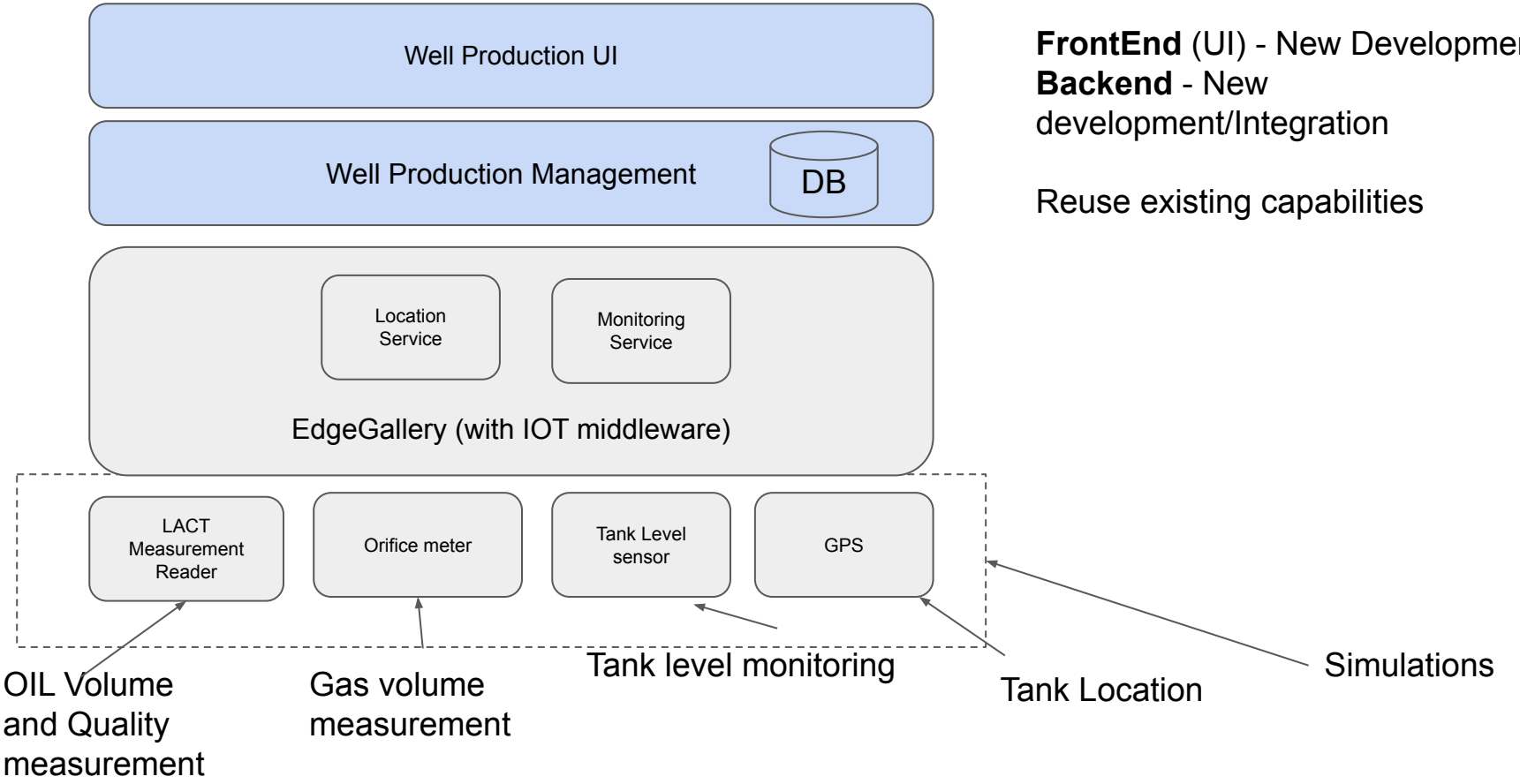


Real time Inventory

Real-time calculated volume based on liquid level data

Liquid Level supervision for each corresponding day

How: Well Production



FrontEnd (UI) - New Development
Backend - New development/Integration

Reuse existing capabilities

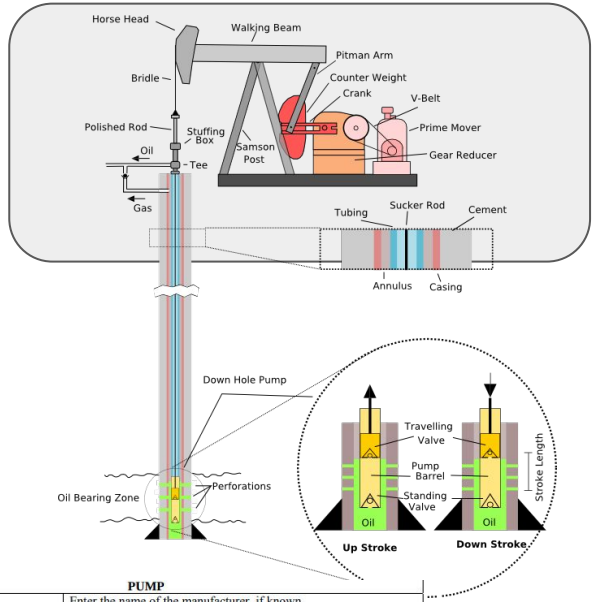
Heading 4: Equipement Maintenance

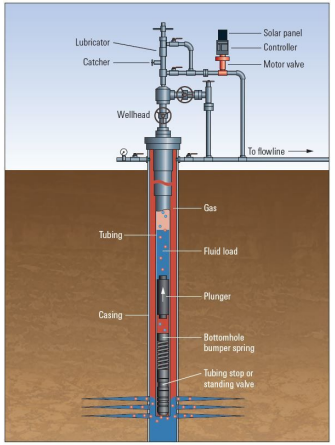
- ❏ Pumps
- ❏ Separator
- ❏ Storage Tank
- ❏ Pipeline
- ❏ Produced Water treatment

Pumps

There are multiple way oil/gas can be pumped out to surface. Initially because of pressure without pumping oil/gas may come to surface. If not then pump is required. There are different types of Pump.

1. PROGRESSIVE CAVITY PUMP (PCP)
2. Rod Lift via Pump jack(most common)
3. Plunger lift (common)
4. Gas lift
5. Hydraulic lift
6. electric submersible pumps





PUMP	
Make	Enter the name of the manufacturer, if known.
Type	Types of pump include: Centrifugal pumps (suction lift, vertical turbine, or submersible turbine); Jet pumps; Air-lift pumps.
Size	Enter in horsepower (hp). Enter only the value, not the units.
Capacity	The pumping capacity to be used is the maximum rate the well can be pumped, in gallons per minute. If the pumping capacity is not known it should be estimated based on historical records, local knowledge or by using the value for a system or source of similar size. However, if it is likely that the pumping rate is low (less than 15 to 20 gpm), it is not necessary to estimate the pumping capacity. If the pumping capacity is not known, the field can be left blank or enter "Unknown". See additional notes at the end of this guidance.
Depth to suction intake	Enter as feet below ground surface. This is the depth of the intake for the pump. This is not recorded on a well log, and is not always known by the water system unless the well was recently constructed.
Lubrication type	Is oil or water used as the lubricant for the pump?
Type of power	Type of power used to supply the pump on a regular basis (typically electric, but can be a diesel generator, or other power source).
Auxiliary power available?	Is a standby generator available, or some other type of backup power supply?
Operation controlled by:	What controls the pump to turn on and off? Typically automatic, not manual. The pump may be controlled by the level in a storage tank, or pressure within the distribution system or a pressure tank, or other system controls)
Pump to waste capability?	Can the water from the well be discharged without going into the water system?
Discharges to:	The well may directly discharge into a transmission line, a storage tank, the distribution system, or other part of the system.

Generic Pump information https://www.countyofkings.com/Home/ShowDocument?id=1240

Pumps: Pump Jack

Purpose: Pumps(rod lift) controller information gives use fare details about the problem happening in the pump.

Sensor Data Available

- Pump Controller Data including fluidLoad, Stoke information, pump fillage

Possible Action: On/Off

Pump Controllers Summary

Hourly Pumpoff

Poll	Status	Location	Report Date	Cycles (#)	Controller State	SPM (#)	Pump Fillage (%)	Last Stroke Peak Load (kin-lbs)	Last Stroke Min Load (kin-lbs)	Idle Time (hh:mm:ss)	Current State Time (hh:mm:ss)	Cycles (#)	Fluid Load (lb)	Production (m3)
		00-00-00-00W5	Apr 28 2020 08:35:03 MDT	0	Pumping Normal	2.45	90	15278	9126	00:00:00	642:35:55	0	0	0.03
		00-00-00-10W5	Apr 29 2020 10:36:35 MDT	1	Reserved	0	58	15211	9702	00:00:00	00:39:37	1	32.19	0.21
		00-00-00-11W5	Jun 16 2020 10:38:42 MDT	0	Pumping Normal	1.78	64	19234	9596	00:00:00	166:53:17	0	35.87	0.39
		00-00-00-12W5	Apr 29 2020 10:38:13 MDT	0	Pumping Normal	1.79	70	15616	9750	00:00:00	308:25:43	0	28.3	0.21
		00-00-00-13W5	Jun 16 2020 10:37:44 MDT	1	Downtime Timed Mode	0	44	16066	9572	00:00:00	00:47:33	1	0	0.09
		00-00-00-03W5	Jul 06 2019 09:34:01 MDT	0	Pumping Normal	2.48	87	14766	9738	14:15:38	88:36:44	0	23.08	0.01
		00-00-00-04W5	Jun 16 2020 10:35:40 MDT	0	Malfunction No RPM	0	72	17121	9605	00:00:00	74:03:13	0	46.5	0

Surface Pump Cards, Downhole Cards, and More

Daily | Instant | Surface Pump Card | Downhole Card | Audit

Read Device

00/00-00-000-00W5

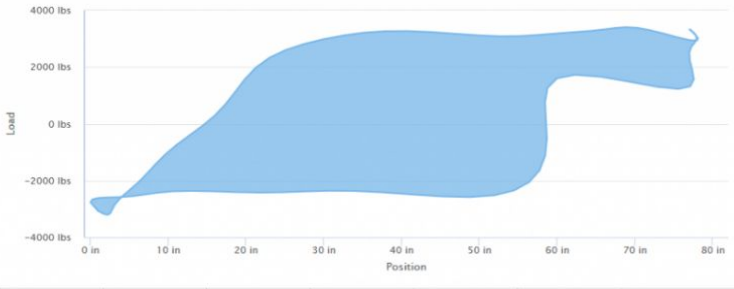
Feb 05 2020 00:02:40 MDT

Well Information

Well Name	00/00-00-000-00W5
Card Report Date	Feb 05 2020 00:02:40 MDT
UWI	
License Number	

Readings

Max Load (lbs)	3402
Min Load (lbs)	62333
Well State/Shutdown Event	0
Gross Stroke (in)	78.07
Net Stroke (in)	56.37
Pump Fillage (%)	72.24
Fluid Load (%)	48.36



View Card	Report Date	FluidLoad (%)	GrossStroke (in)	MaxLoad (lb)	MinLoad (lb)	NetStroke (in)	PumpFillage (%)	Sequence (#)	ShutdownEventID (#)
Card	Feb 05 2020 09:06:51 MDT	0	0	0	0	0	0	0	0
Card	Feb 05 2020 00:03:46 MDT	46.6	77.77	3427	62360	56.48	72.66	0	0

Pump: Plunger lift

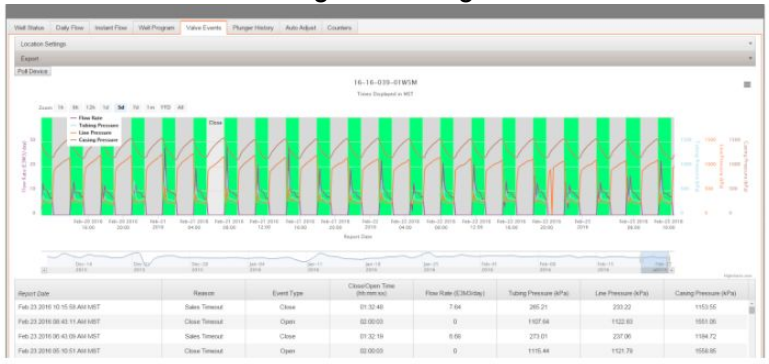
Source : https://www.scadacore.com/applications/oil-and-gas-monitoring/plunger-lift-monitoring/

What is Plunger lift: A plunger lift is an artificial list method of de-liquifying a natural gas well. A plunger is used to remove contaminants from productive natural gas wells, such as water, sand, oil, and wax.

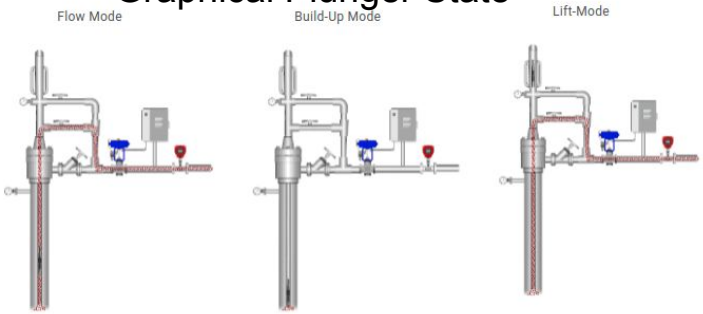
Plunger lift monitoring & Control Purpose: Full control and live view of the plunger enables technicians to remotely monitor and tune their plunger-lift systems without costly trips to the field. Custom reports allow technicians to plot plunger states along with pressures and flows to better tune and optimize your well.

Sensor Data Available: Pressure/Flow sensors attach to plunger lift
Possible Actions: On/Off

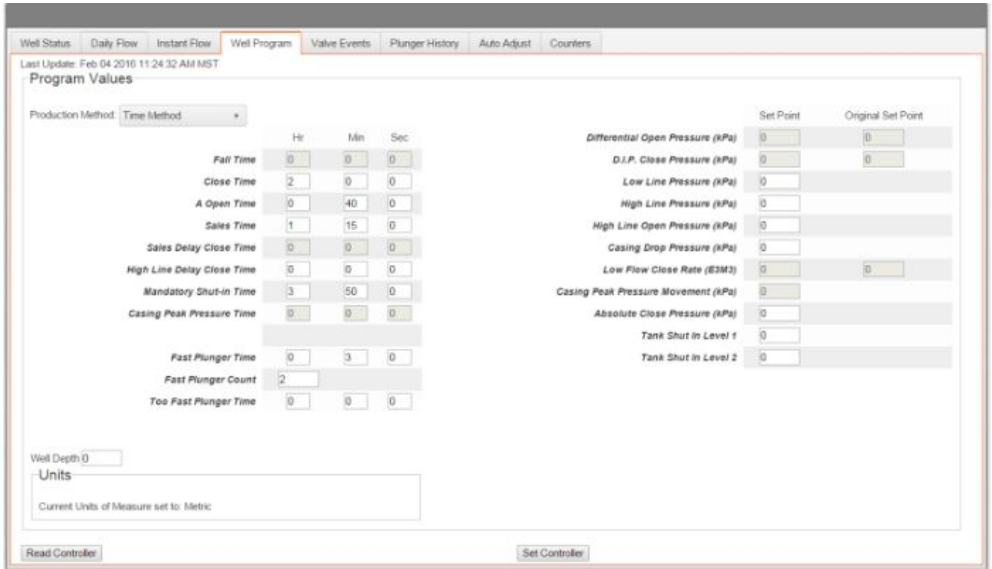
Plunger Charting



Graphical Plunger State



Plunger Control Configuration



Separator

The term separator in oilfield terminology designates a pressure vessel used for separating well fluids produced from oil and gas wells into gaseous and liquid components.
A separator requires strict pressure/temperature monitoring because of process operating and safety conditions. Temperature monitoring is always required to guarantee the right conditions for the separation process.

By detecting liquid carryover with the ultrasonic flowmeter described, we accomplish a few things:

1. Understand how efficient the mist eliminator is functioning in relation to gas flow rate
2. If a step change in the “moisture diagnostic variable” occurs it could indicate that the mist eliminator is damaged
3. Proper gas-liquid separation isn’t taking place and the separator performance should be evaluated. The control system can adjust dump cycle time and retention time, or adjust back pressure at the gas outlet.

Detecting liquid carryover can allow a producer to adjust the separation process.

The system must control incoming **flow**/**pressure** to ensure the gas and liquid flow rates are low enough so that gravity segregation and vapor-liquid equilibrium can occur.

The **temperature** also needs to be controlled, because if the temperature of pipeline walls or storage tanks decreases below the dew point of the water vapours present in the gas, the water starts to condense on those cold surfaces. If so, natural gas in combination with liquid water can form methane hydrate that may plug valves, fittings or even pipelines.

Sensor Data Available: Flow, Pressure & Temperature Sensor
Possible Actions: Inlet/Outlet Valve control, On/Off, Temperature

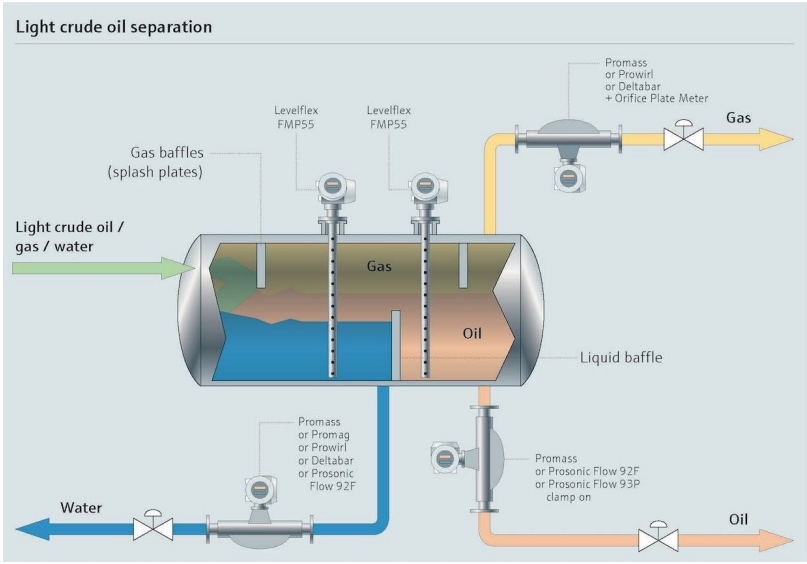


Figure 4: Endress+Hauser Prosonic Flow G 300/500 ultrasonic flowmeter measures flow, temperature, pressure, mass flow, methane content, and more. Courtesy: Endress & Hauser

A flow meter can monitor pressure, temperature and flow

https://www.oilandgaseng.com/articles/detecting-water-carryover-in-natural-gas/

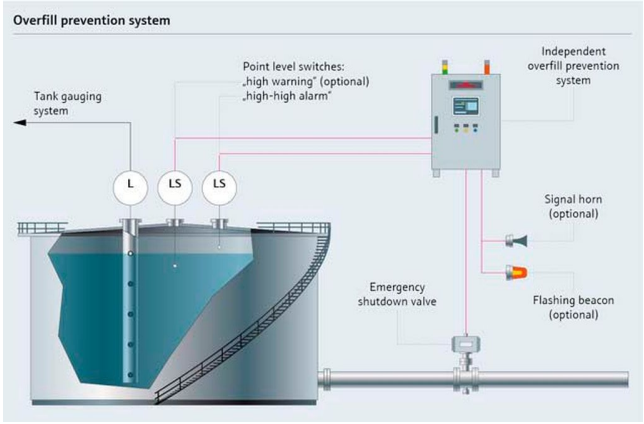
https://www.endress.com/en/solutions-lowering-costs/ims/inventory-monitoring/Storage-tank-safety

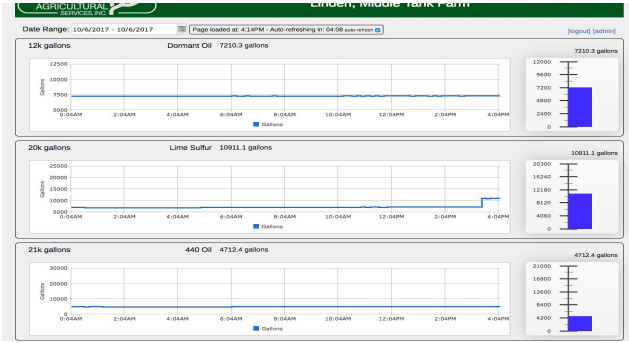
Storage Tanks

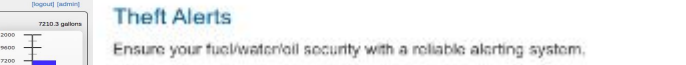
Petroleum storage tanks serve as large containers for powerful and volatile fluids, which if not monitored safely, have the potential to cause immense environmental damage. A faulty fuel gauge can fail to alert operators at a storage depot that a fuel storage tank is being filled to a dangerously high level. Eventually, large quantities of hazardous liquids will overflow from the tank, potentially causing a vapor cloud to form and ignite, followed by explosions and fire.

The dashboard will show realtime oil level and their levels

Sensor: Temperature, Level
Action: Control input/output valve



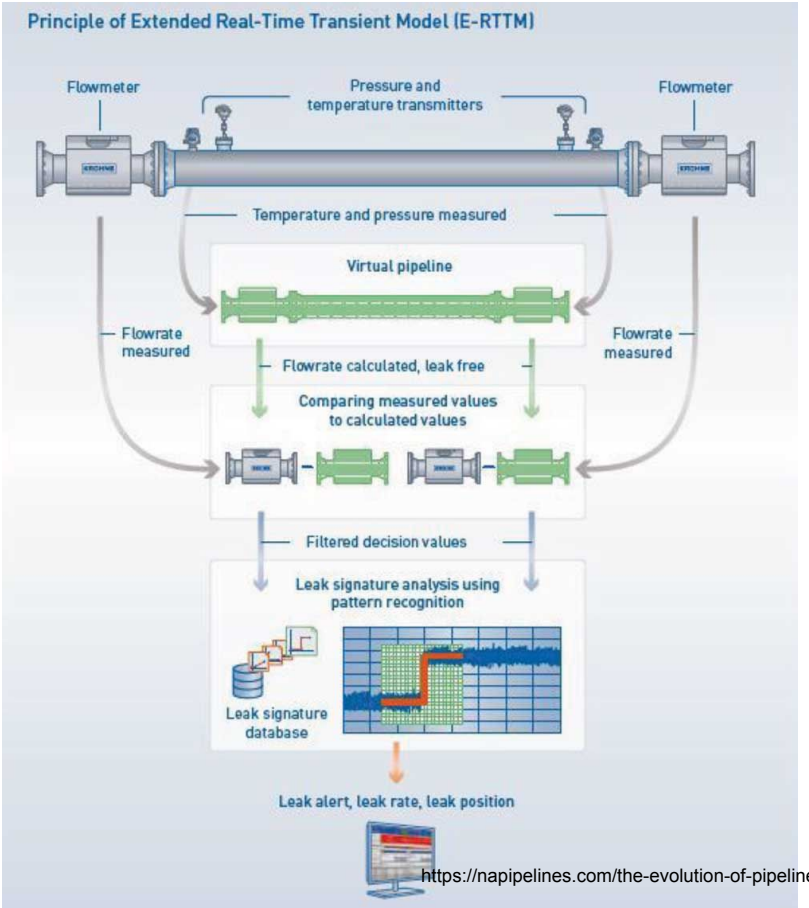




Pipeline

From unifying data silos to provide real-time operational insight, to improving leak detection, to ensuring accuracy measurement of gas flow, and to predictive maintenance, AVEVA facilitates more accurate and economic movement of hydrocarbon via pipelines, greatly improving pipeline throughput and safety.

Sensor: Leak detector (Eg. using Flow meter)
Action: Input/Output Valve

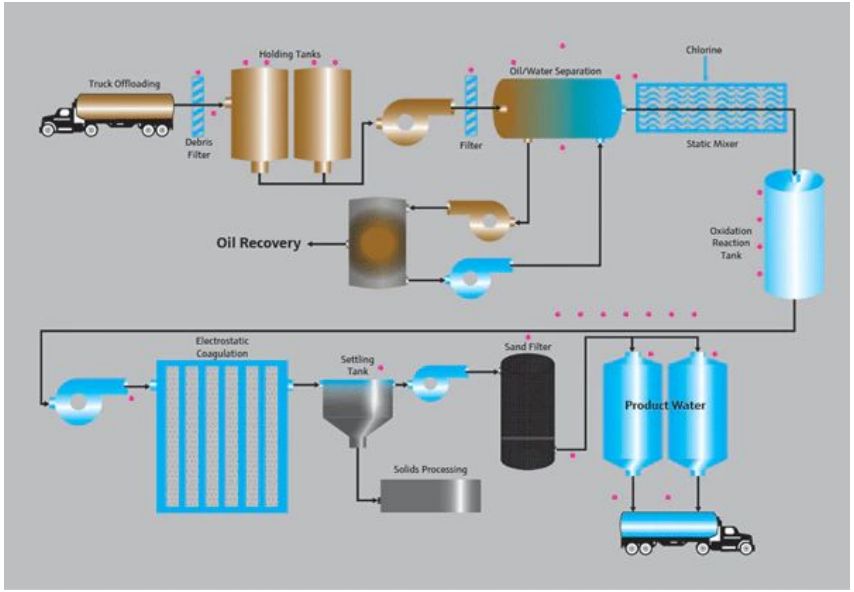


https://napipelines.com/the-evolution-of-pipeline-leak-detection/

Produced Water Treatment

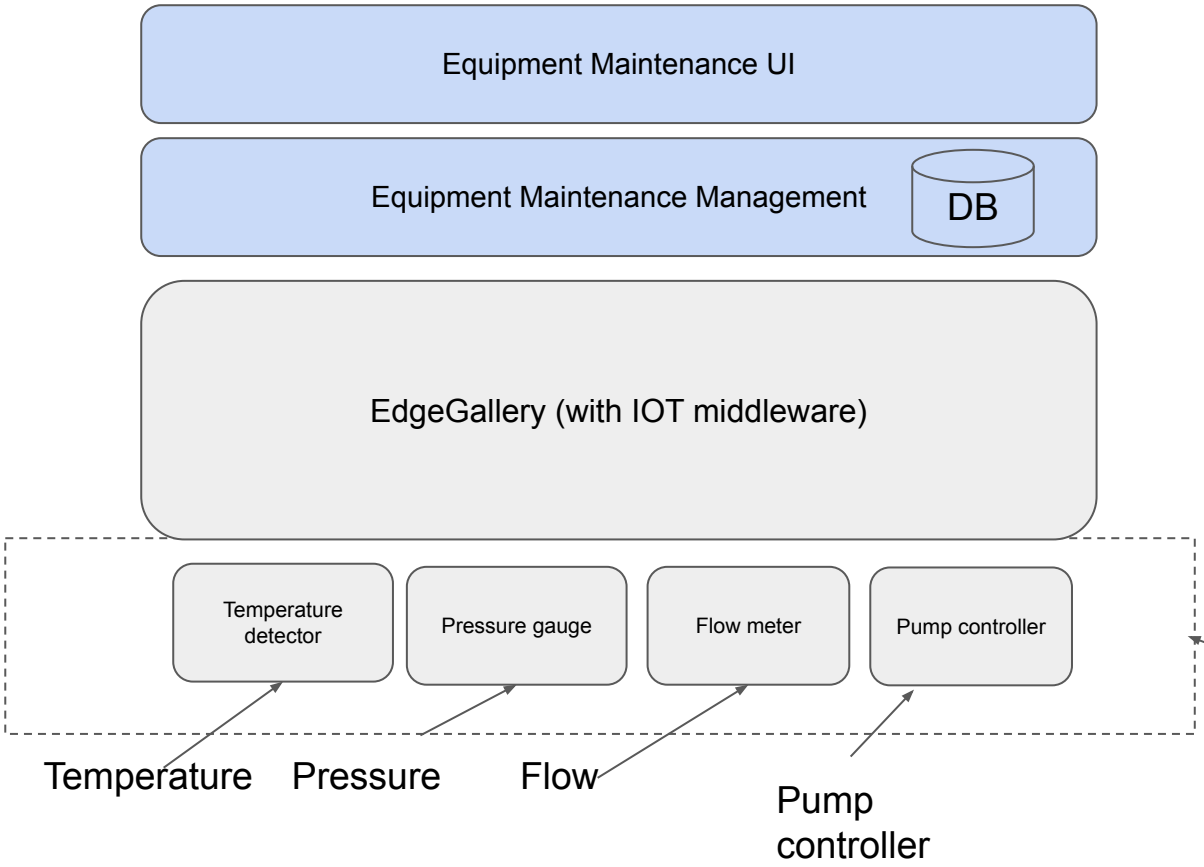
When crude oil and natural gas are extracted from the ground, undesirable constituents such as water, sand, and other contaminants are also extracted. These constituents are separated over several processes, and the water portion of the separation is known as produced water. Produced water will contain some level of hydrocarbons that must be further separated before it can be disposed of or used in subsequent operations. To conform to strict environmental standards and to improve produced water management, it is important to monitor the water quality at various points in the separation process

sensors can detect very low levels of oil using scattered light technology.



https://www.optek.com/en/petroleum/Oil-in-produced-water.asp

How: Equipement Maintenance



FrontEnd (UI) - New Development
Backend - New development/Integration

Reuse existing capabilities

Heading 5: Safety Management

- ❏ Safety gear management
- ❏ Zone management
- ❏ Environment monitoring
- ❏ Video surveillance
- ❏ Accidents/Incident summary

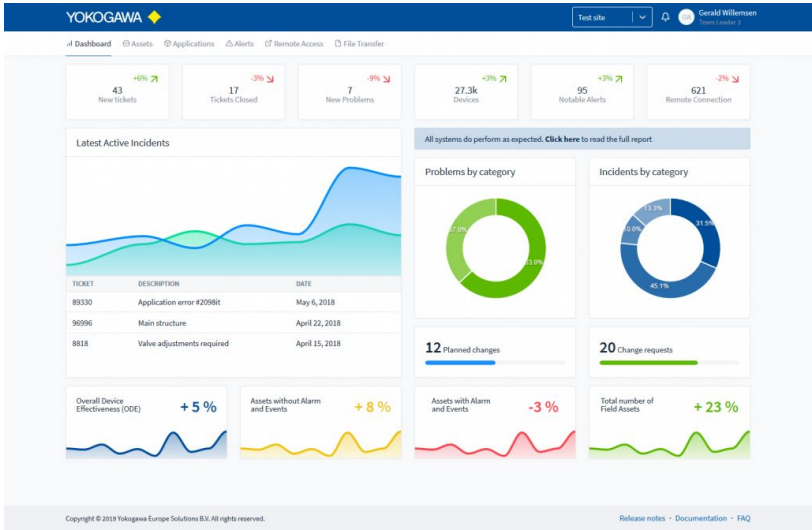
Safety gear management

Purpose: Oil and gas wells can expose workers to hydrogen sulfide gas. If your workplace uses sand for any process, such as hydraulic fracturing, workers may be exposed to crystalline silica. Crystalline silica is a known lung carcinogen, and can cause silicosis, which can be debilitating and even fatal. Oil-and-gas-related flash fires can reach up to 1900 degrees Fahrenheit and can last up to five seconds. Also incidents related to heavy machineries can result into physical damage.

How:

- So we must ensure workers are wearing proper safety gear (PPE) in the premises. The Safety-gear-detection Application will monitor the workers and will raise alarm if violation found.
- PPE kit with wearable sensors reports toxic gas, temperature, humidity around the worker.

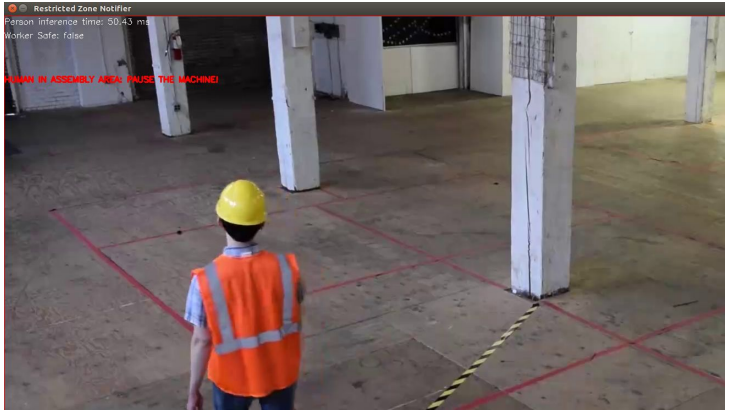
Accident/
Incident summary



Zone management

Purpose: To ensure security, not all person are allowed to visit accident/hazard prone zone, or some restricted site.

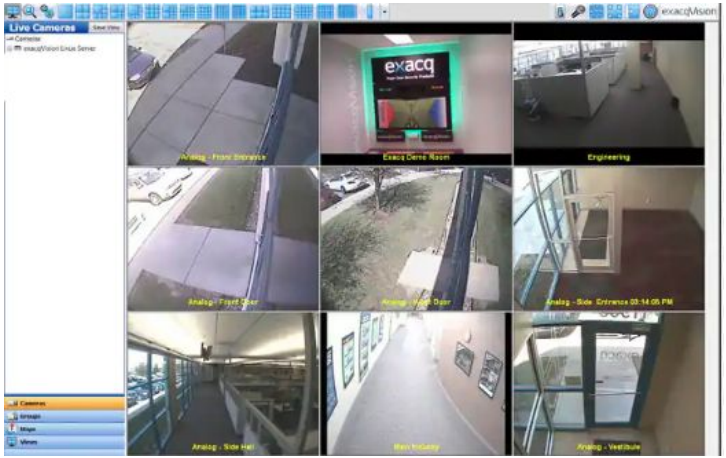
How: The ipcam based solution can detect people entering into restricted site and raise and alarm.



Video Surveillance

Purpose: Video surveillance is required to ensure safety of Assets, human resources etc.

How: The ipcam based solution can detect people, asset, vehicle movement into premises. Unusual event like unknown person, vehicle entering premises will raise an alarm.



Environment monitoring

Purpose: Oil and gas wells can release hydrogen sulfide and expose workers to hydrogen-sulfide gas. Diesel engines power a variety of machinery, vehicles, and equipment on a drilling site.

Also combustible Gas leak is a menace for fire hazard.

Workers might be exposed to harmful levels of diesel particulate matter during the operation of these engines.

NORM(naturally occur radioactive material) might be released from oil and gas formations. Workers at risk of exposure include those who handle pipes and equipment that might have been contaminated with NORM. Sludge, drilling mud, and pipe scales, for example, often contain elevated levels of NORM, and the radioactive materials might be moved from site to site as equipment and materials are reused. Disposal, reuse, and recycling of NORM might cause worker exposures.

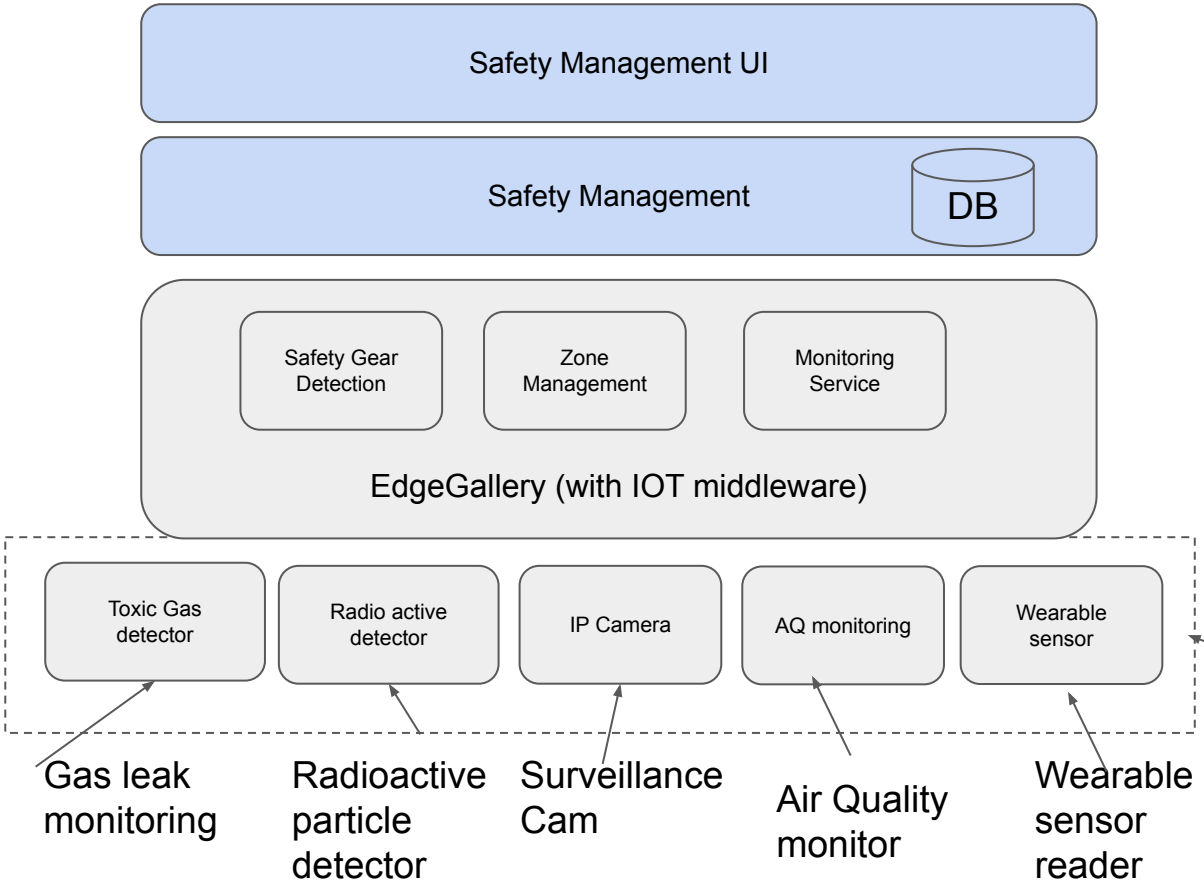
HOW:
Gas leak detector sensor can find out level of emission and raise alarm.
Air quality monitoring sensor can measure out the PPM level in air.
Radioactive detector can find the level of radioactivity into the system.

https://www.osha.gov/oil-and-gas-extraction/health-hazards#hazardous

https://www.biz4intellia.com/asset-monitoring-solution/

https://www.iotconnect.io/air-quality-monitoring-solution.html

How: Safety Management



FrontEnd (UI) - New Development
Backend - New development/Integration

Reuse existing capabilities

THANKS