Daleel Production Surveillance via Real-Time Well Models

Muneer Al Balushi & Gian Marco Gioria

دليل للنفط ش.م.م.
DALEEL PETROLEUM L.L.C.

Name: Muneer Al Balushi
Location: Oman

Beautiful , friendly , Safe

Daleel Petroleum

Role: RTO & Smart Fields Team Leader

"Local Oil and Gas exploration and production company"
"One of Leading Producers in Oman"
"50,000 BBL/D + Average"

دليـــــل للنفـــــط ش.م.م.
DALEEL PETROLEUM L.L.C.

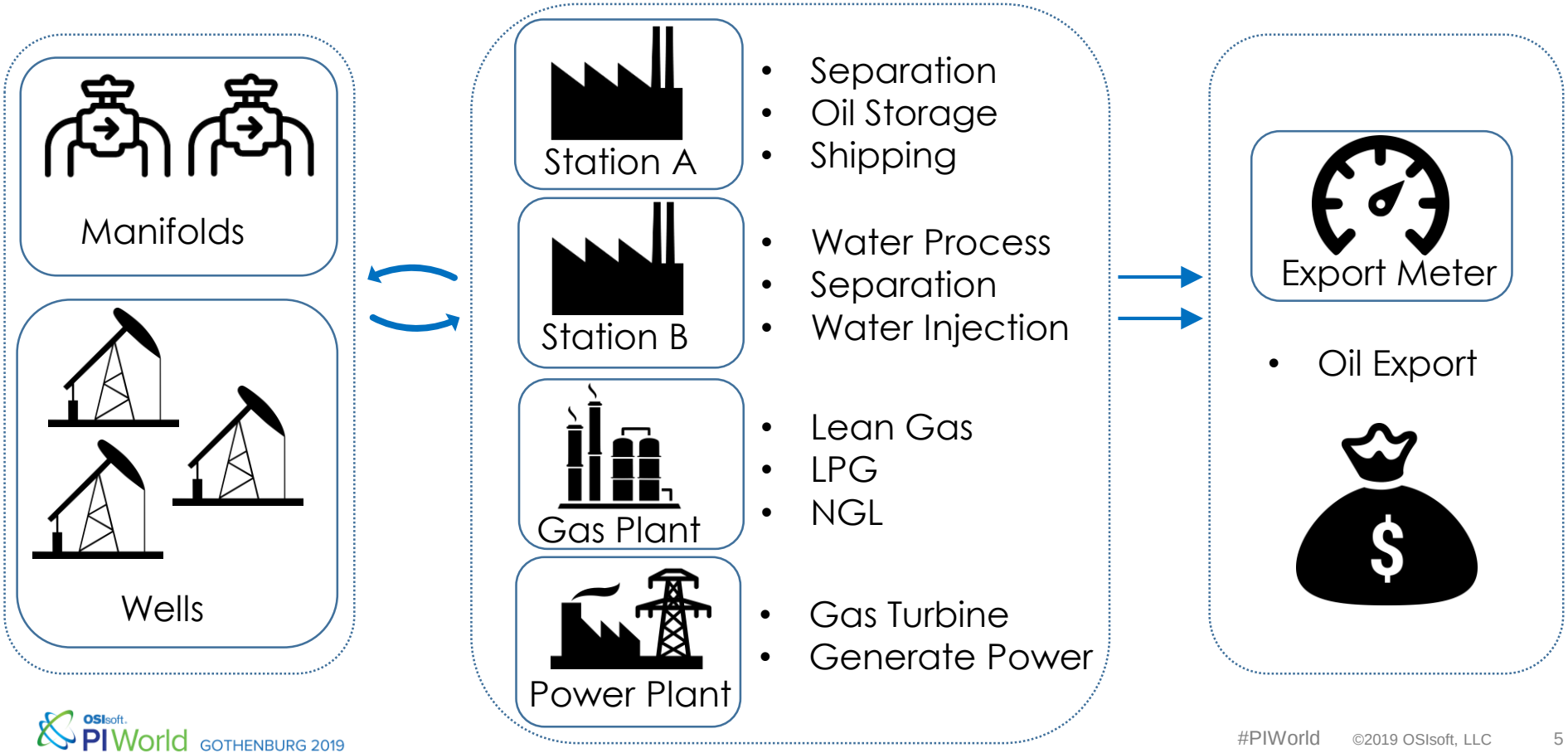
Real-Time & Smart Fields (Agenda)

- Daleel Real-Time Operation Journey (Daleel Portal)

  Overview, Integration , Filtration , Analysis

- Daleel Dashboard (Key Features)
  - Daleel Real-Time Production
  - Well Surveillance
  - Exception Based Surveillance (EBS)
  - Beam Pumps Dyna Cards
  - Well Production Real-Time Surveillance (Model Based)
  - Virtual Metering
  - KPI's
- Implementation Details
- Benefits / Conclusion

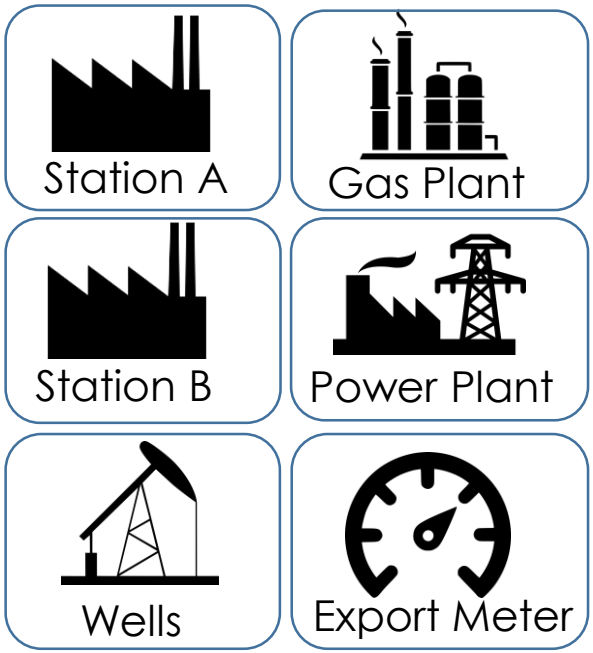
Daleel Petroleum (Overview)



Daleel Automation (Before)

Automation Systems

- Execution
- Maintenance



2.5 Mil/D
Real Time Data set

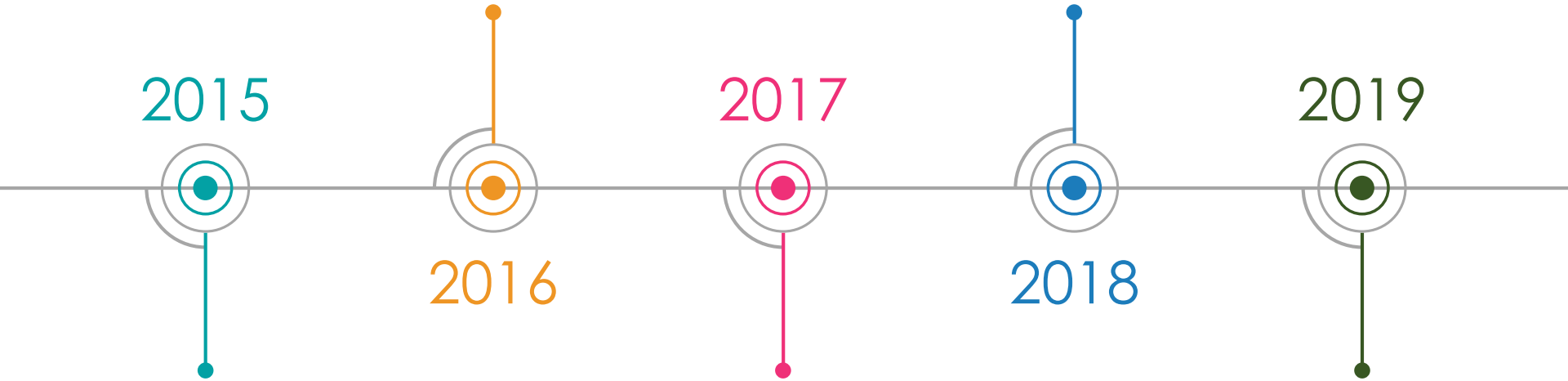
1k Data set / 5 hours

- Limited information
- Limited History
- Manual Entry
- Human Errors
- Transparency issues

Headquarter

- Analysis
- Development
- Decision Making

Daleel Real Time Operations (Plan)



Phase 1: Integration
Centralize real-time Data
(Data History & HQ accessibility)

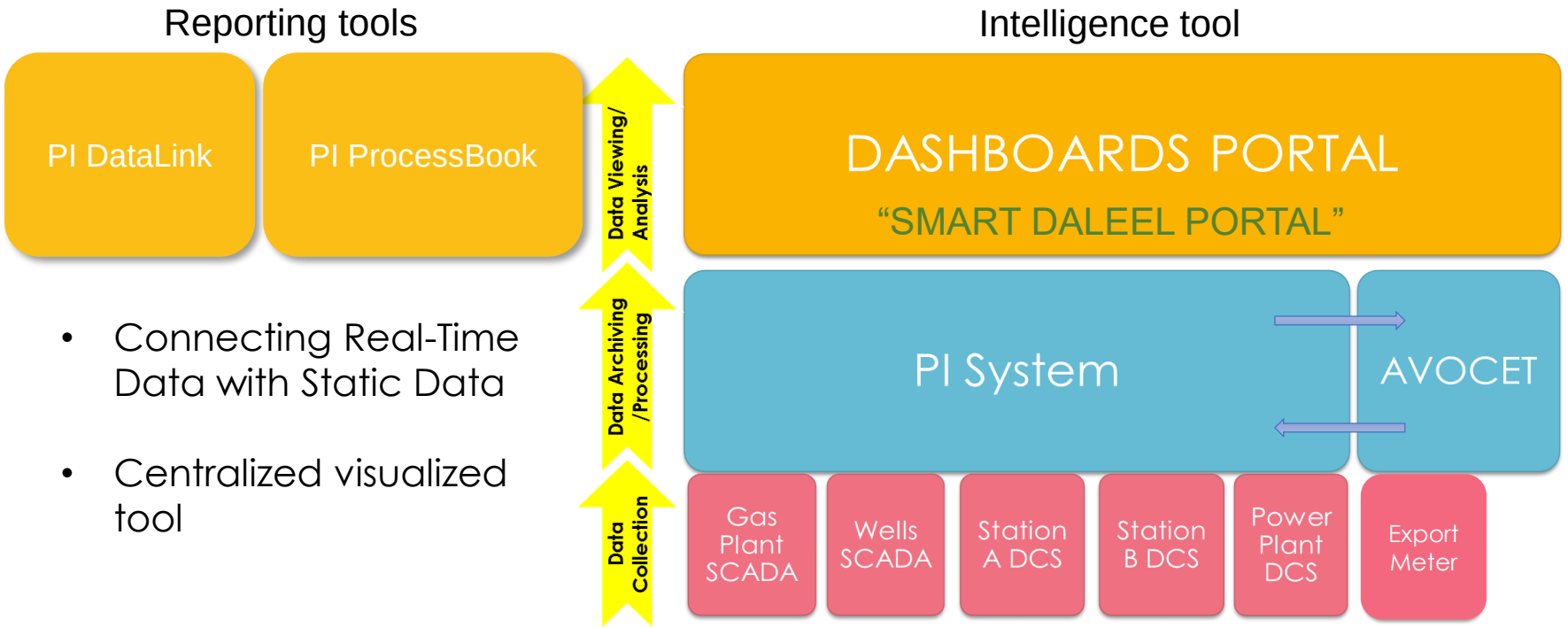
Phase 2: Filter & Alarm
Visualize Real-time + Static data
(Daleel Portal)

Phase 3.1: Analyze
Exception Base Surveillance (EBS)
(Upgraded Daleel Portal)

Phase 3.2: Analyze
Real-time Dyna Cards
Live Performance curve (wells/facility)
Live Well production (model based)

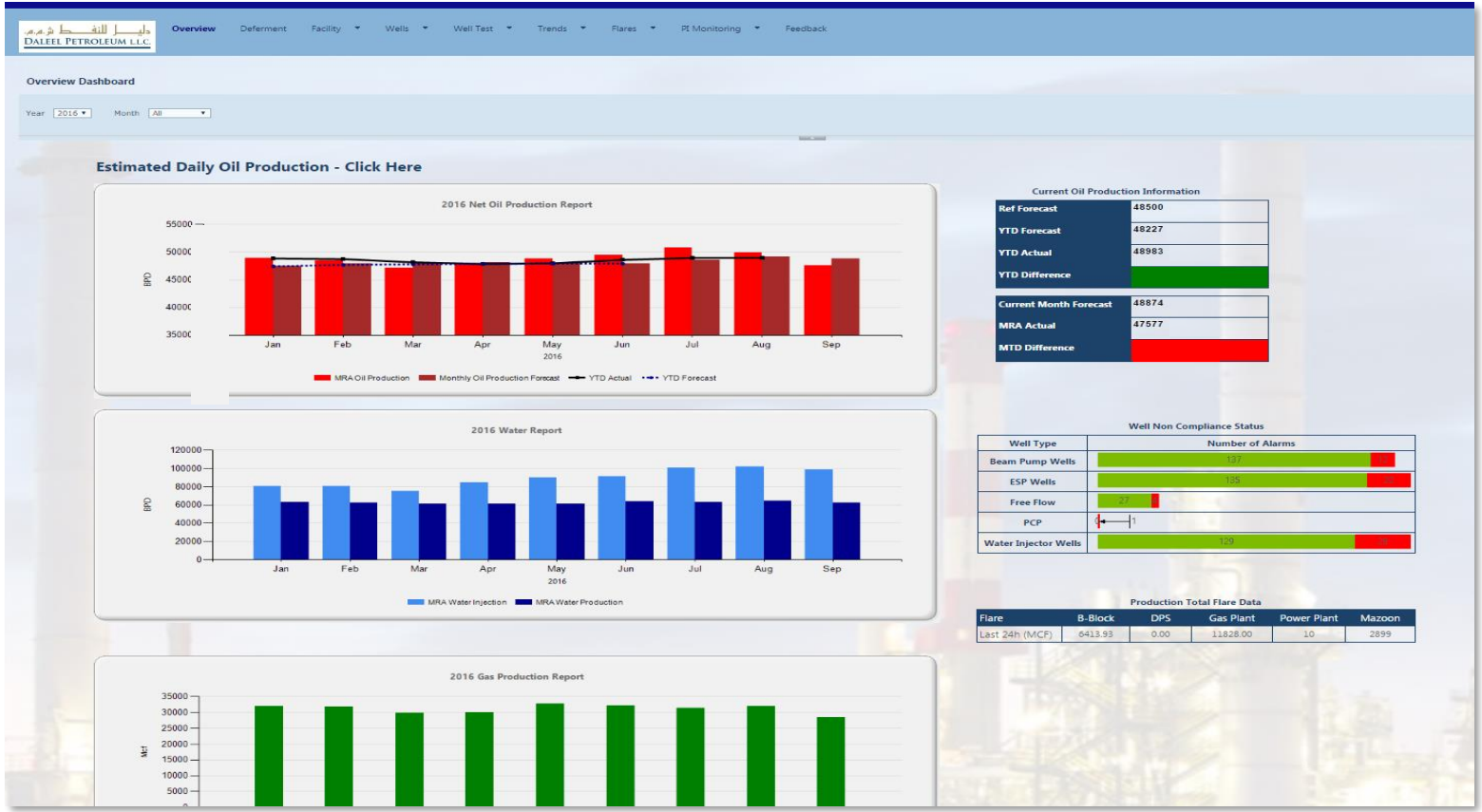
Phase 3.3: Analyze
Surface Models
E-Well Book
Drilling integration

Daleel Real Time Operations (Architecture) - 2015

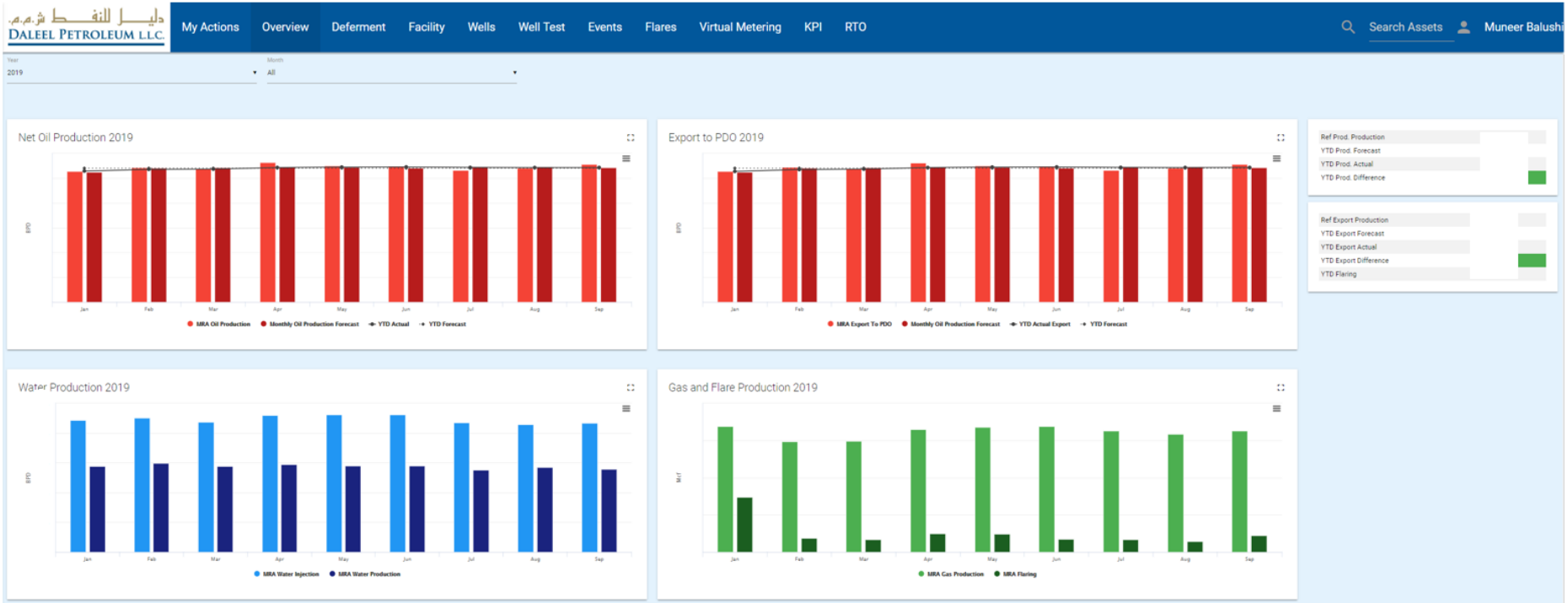


- Connecting Real-Time Data with Static Data
- Centralized visualized tool

Daleel Dashboard (Stage 1) - 2016



Daleel Dashboard (Stage 2) - 2017

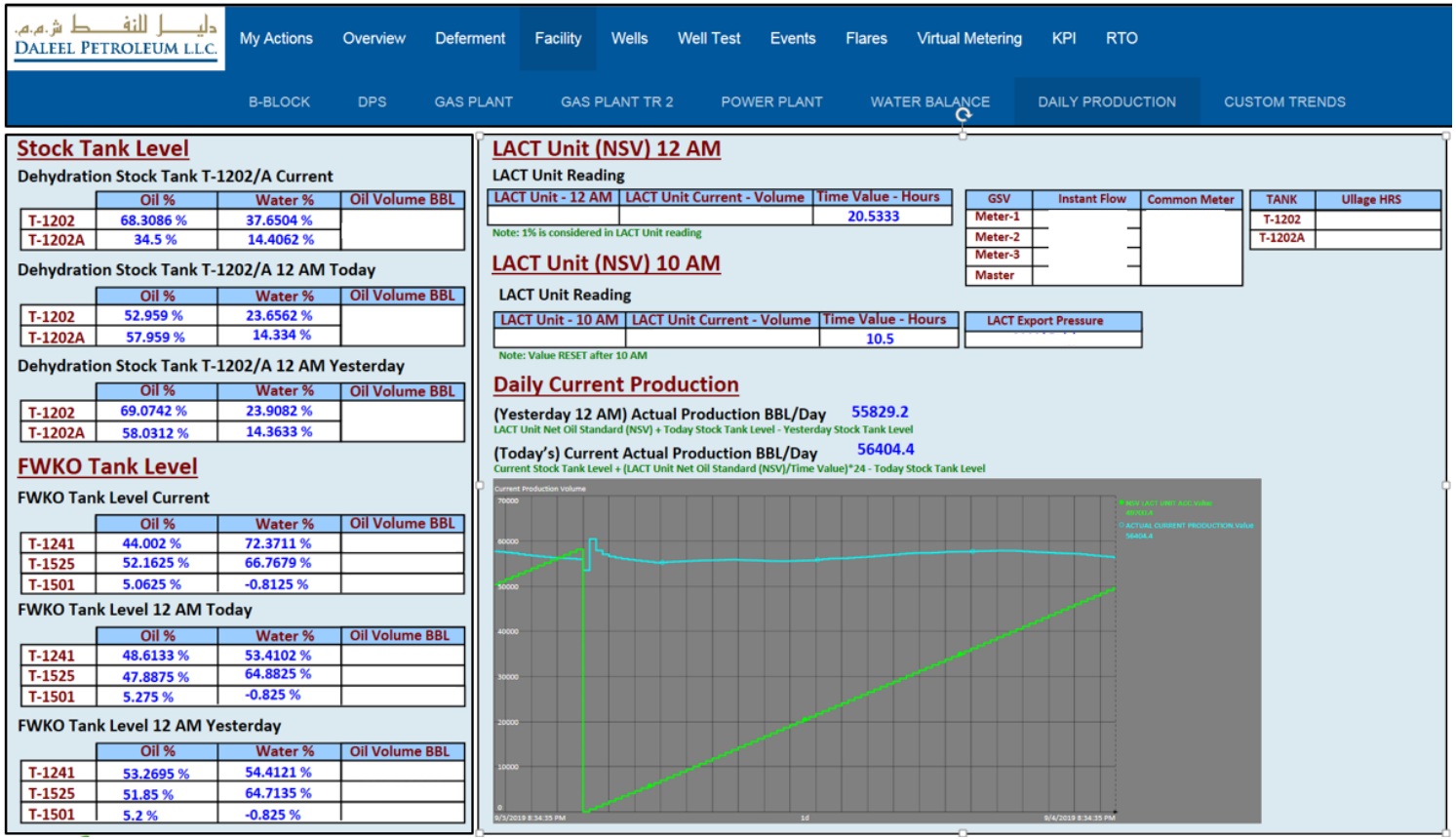


Daleel Dashboard (Stage 2) Key Features

- Field Real-Time Production
- Well Surveillance
- Exceptional Based Surveillance (EBS)
- Beam Pumps Dyna Cards
- Real Time Well Production (Based on a model)
- Virtual Metering

Field Real Time Production

Field Real Time Production

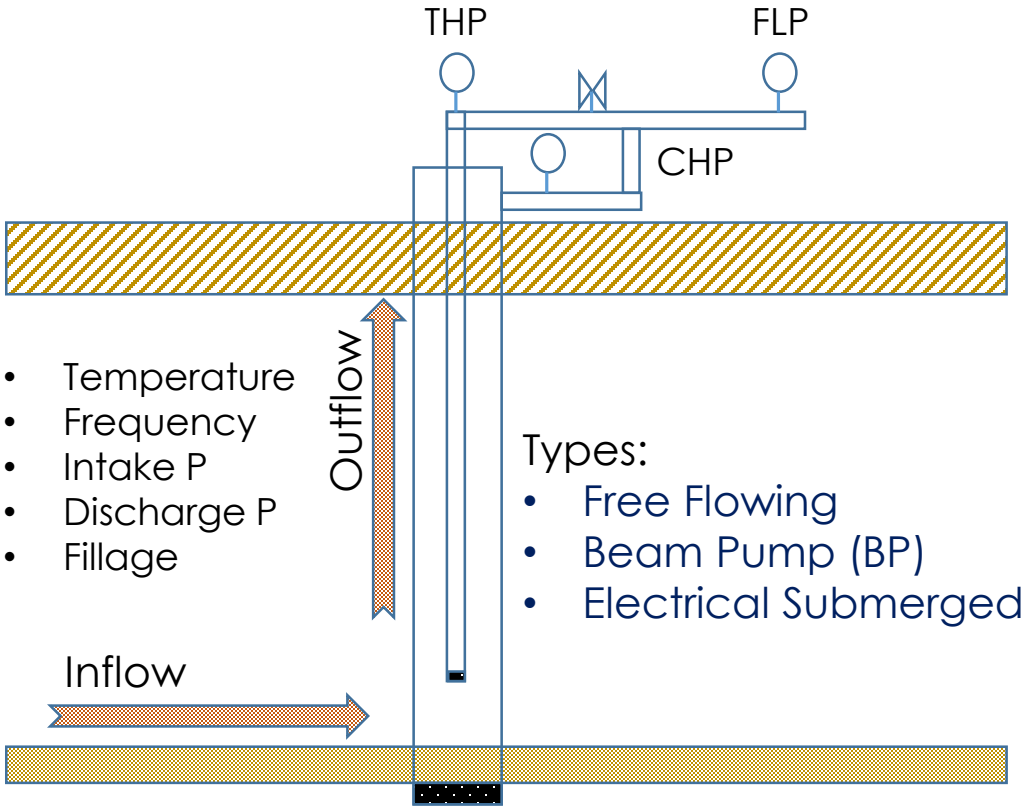


- Production Forecast
- Proactive Actions

Well Surveillance (Filter)

Well Surveillance

REAL TIME



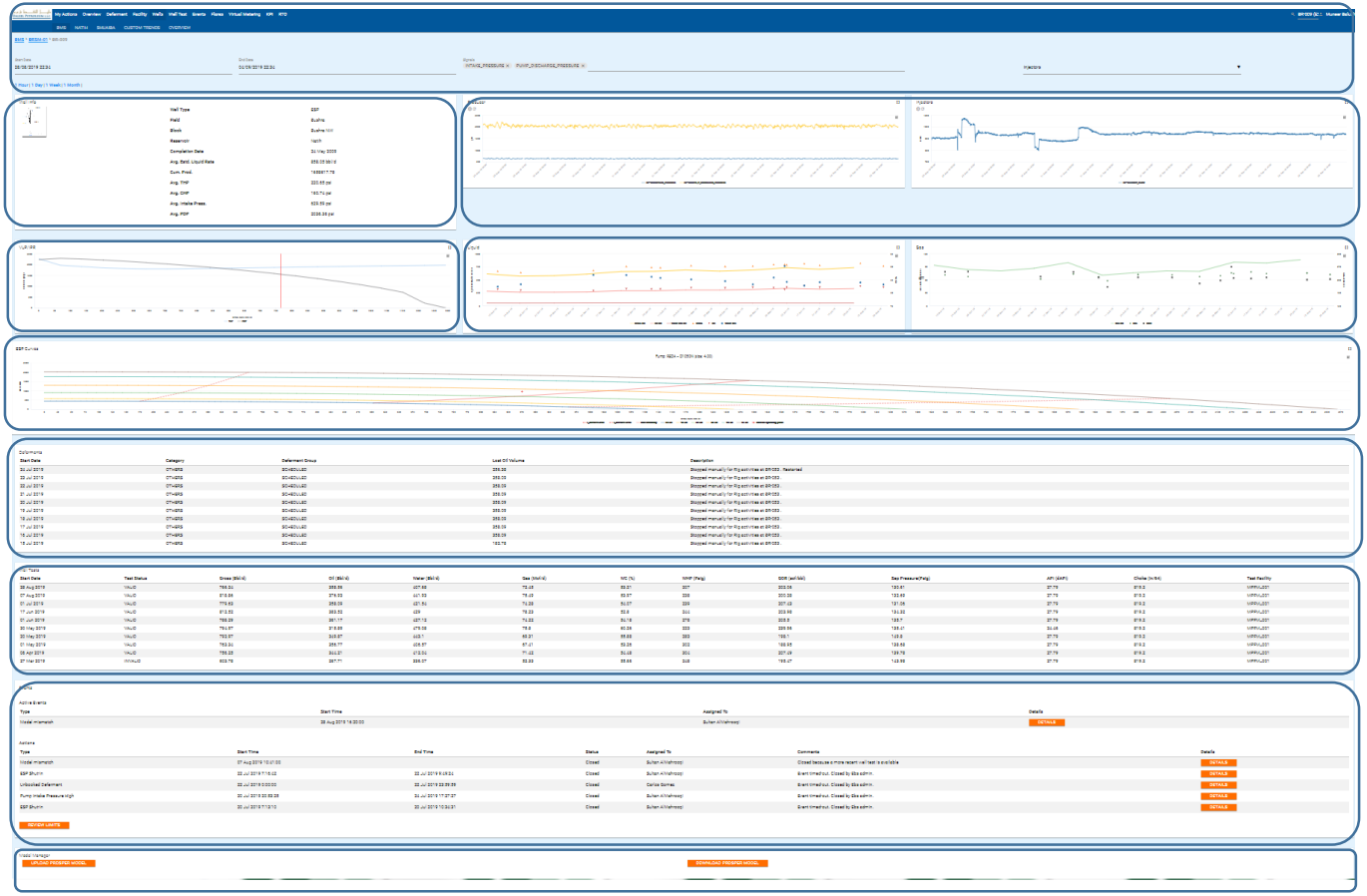
- Temperature
- Frequency
- Intake P
- Discharge P
- Fillage

Types:
- Free Flowing
- Beam Pump (BP)
- Electrical Submerged pump (ESP)

Aggregated

- Location
- Well Test
- Allocation
- Deferment
- Type
- Zone
- Lab Data
- Forecast

Well Surveillance (template)



Navigation

Well Info

Real-Time Data

Model Match

Well Test/
Allocation

Pump Curve

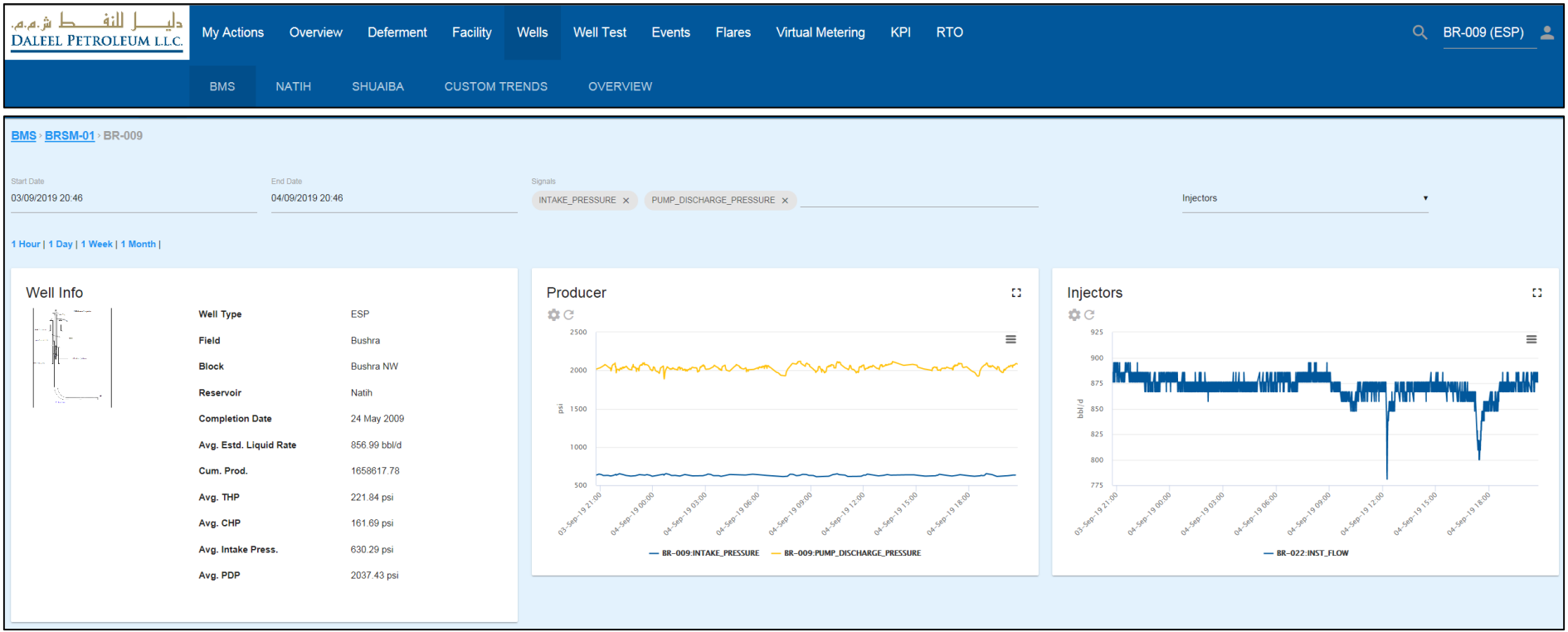
Well Test

Deferment

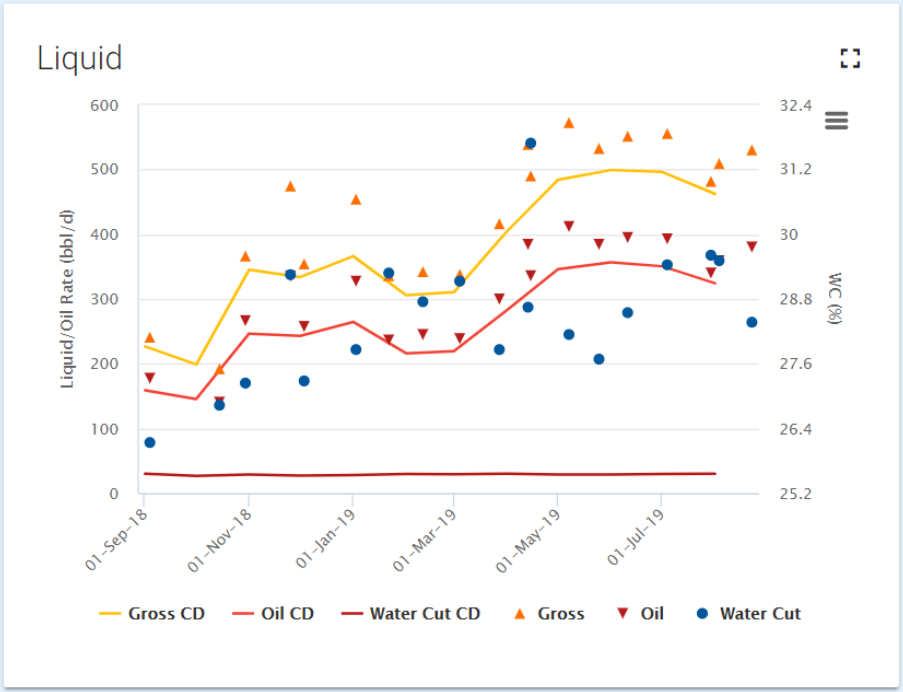
EBS Event
History

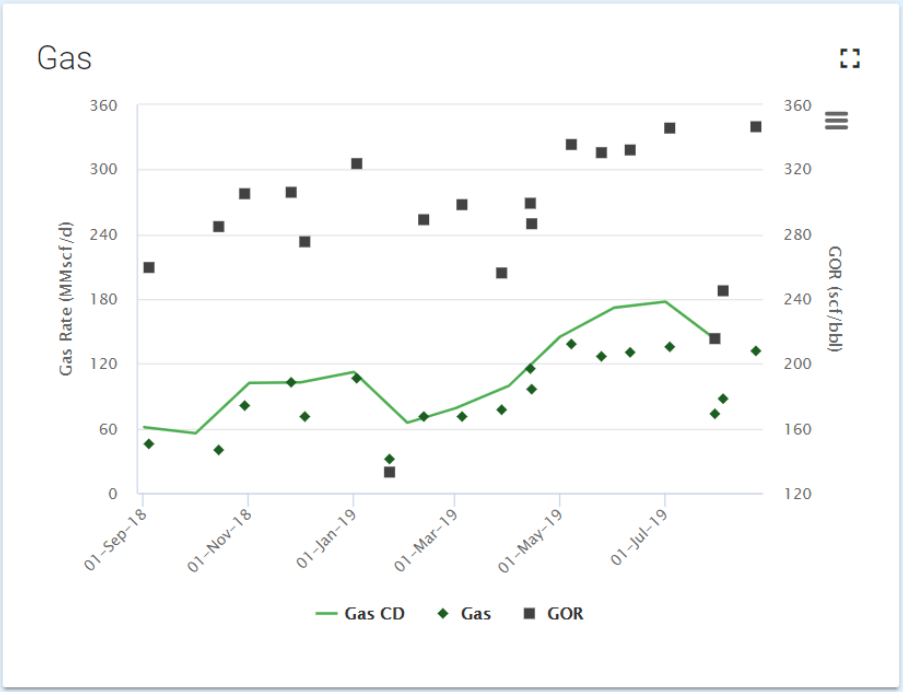
Model Manager

Well Surveillance



Well “Test” / Well “Allocation”





Well Test History (Detailed)

Well Tests

Start Date	Test Status	Gross (Bbl/d)	Oil (Bbl/d)	Water (Bbl/d)	Gas (Mcf/d)	WC (%)	WHP (Psig)	GOR (scf/bbl)	Sep Pressure(Psig)	API (dAPI)	Choke (in/64)	Test Facility
28 Aug 2019	VALID	1043.07	281.67	761.4	159.93	73	232	567.79	203.66	30.32	491.52	MPFM_007
24 Aug 2019	VALID	1043.62	283.71	759.91	162.11	72.81	212	571.39	204.59	30.32	491.52	MPFM_007

Deferment History (Tracking)

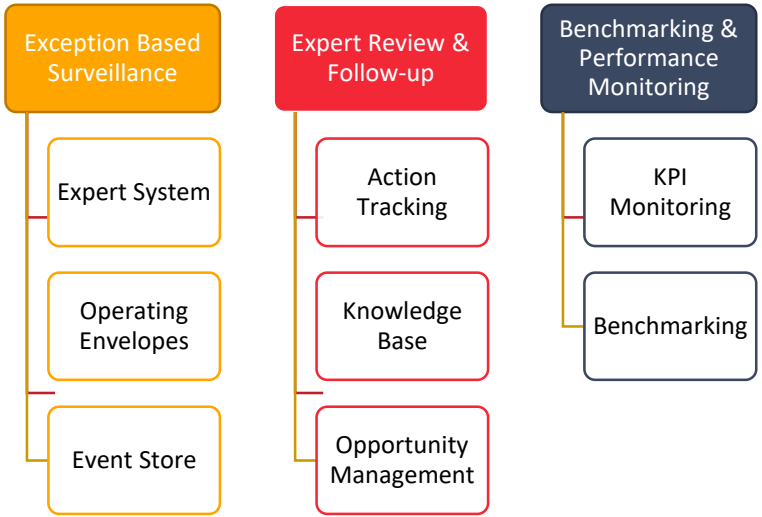
Deferments

Start Date	Category	Deferment Group	Lost Oil Volume	Description
13 Aug 2019	ESP RELATED	UNSCHEDULED	23.07	Tripped due to underload.
08 Aug 2019	WELL OPTIMISATION	SCHEDULED	11.1	Stopped manually for choke replacement.
07 Aug 2019	ESP RELATED	UNSCHEDULED	24.05	Tripped due to underload.
20 Jul 2019	OTHERS	UNSCHEDULED	65.07	Total field tripped due to adverse weather condition (due to Sandstorm ,Heavy Rain and lightning strike).
19 Jul 2019	OTHERS	UNSCHEDULED	24.05	Total field tripped due to adverse weather condition (due to heavy rain and lightning strike)
03 Jul 2019	ESP RELATED	UNSCHEDULED	123.39	Downhole Electrical failure. Restarted
02 Jul 2019	ESP RELATED	UNSCHEDULED	235.65	Downhole Electrical failure. Generator service
01 Jul 2019	ESP RELATED	UNSCHEDULED	235.65	Downhole Electrical failure.
30 Jun 2019	ESP RELATED	UNSCHEDULED	235.65	Downhole Electrical failure.
29 Jun 2019	ESP RELATED	UNSCHEDULED	235.65	Downhole Electrical failure.

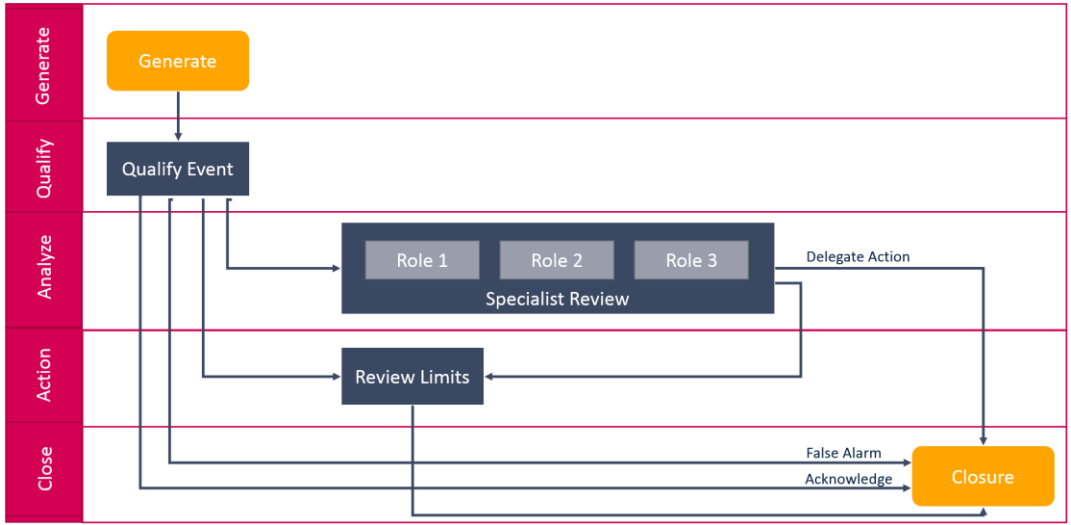
Exception Based Surveillance (EBS) (Analysis)

Exception Based Surveillance (EBS)

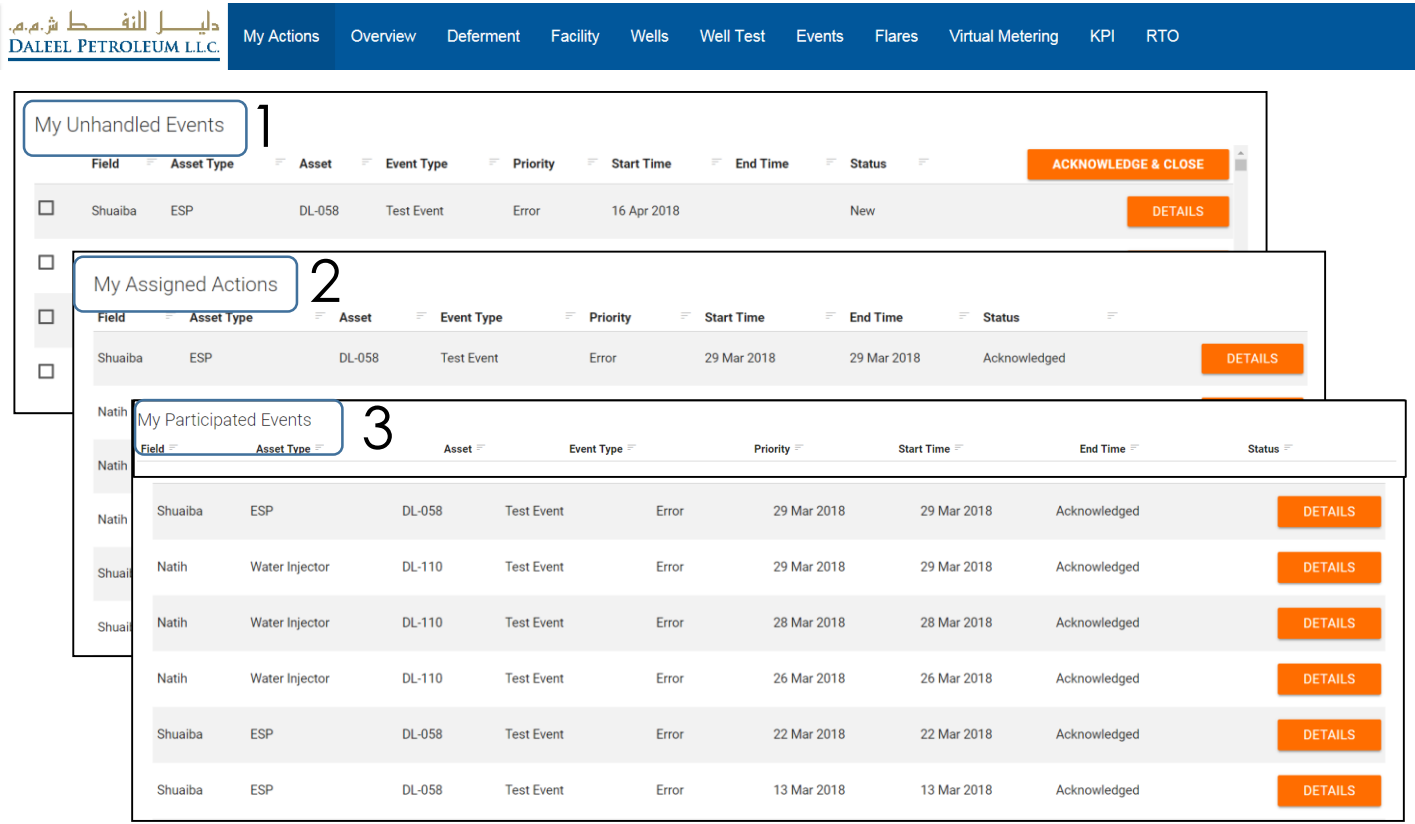
EBS Component



High Level Workflow

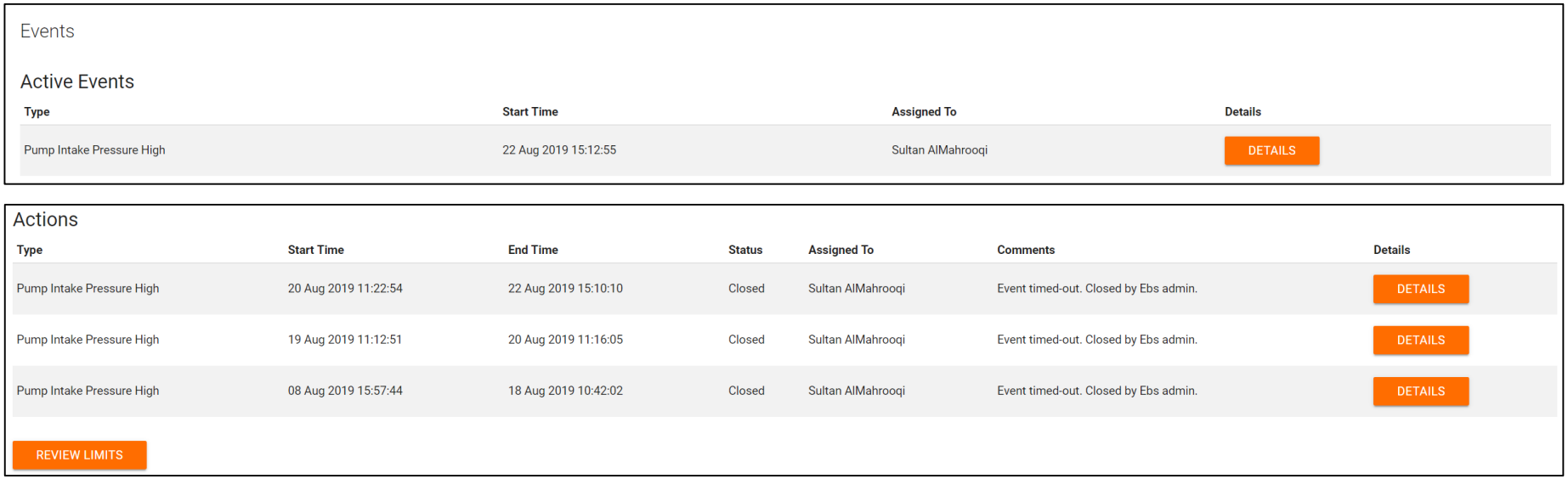


Exception Based Surveillance (EBS)



- Focused on Well Restoration
- Reduce Deferment
- Track actions taken

EBS Events History (Well Level)



Events

Active Events

Type	Start Time	Assigned To	Details
Pump Intake Pressure High	22 Aug 2019 15:12:55	Sultan AlMahrooqi	DETAILS

Actions

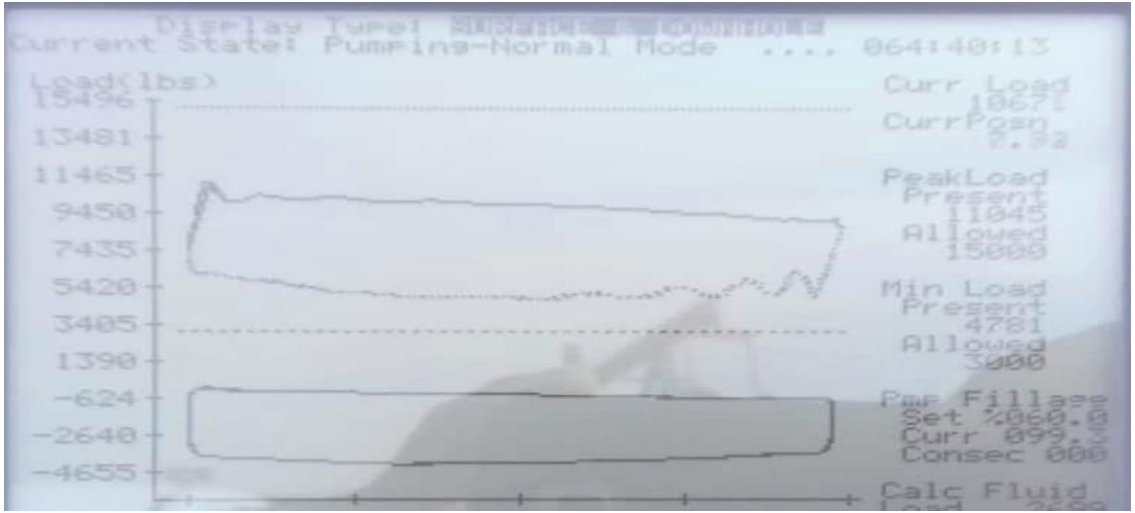
Type	Start Time	End Time	Status	Assigned To	Comments	Details
Pump Intake Pressure High	20 Aug 2019 11:22:54	22 Aug 2019 15:10:10	Closed	Sultan AlMahrooqi	Event timed-out. Closed by Ebs admin.	DETAILS
Pump Intake Pressure High	19 Aug 2019 11:12:51	20 Aug 2019 11:16:05	Closed	Sultan AlMahrooqi	Event timed-out. Closed by Ebs admin.	DETAILS
Pump Intake Pressure High	08 Aug 2019 15:57:44	18 Aug 2019 10:42:02	Closed	Sultan AlMahrooqi	Event timed-out. Closed by Ebs admin.	DETAILS

REVIEW LIMITS

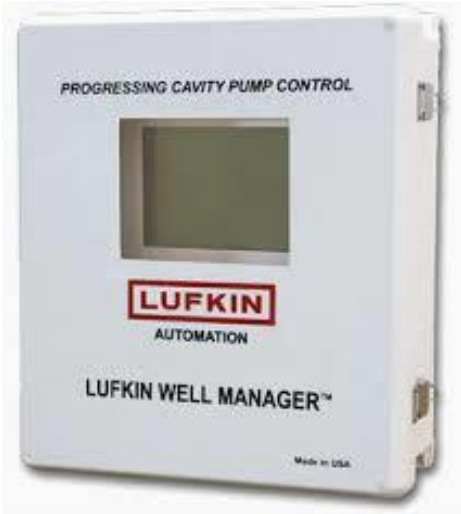
Beam Pump Dyna Cards

Well Production Surveillance (Beam Pump)

Engineers take Pictures Manually



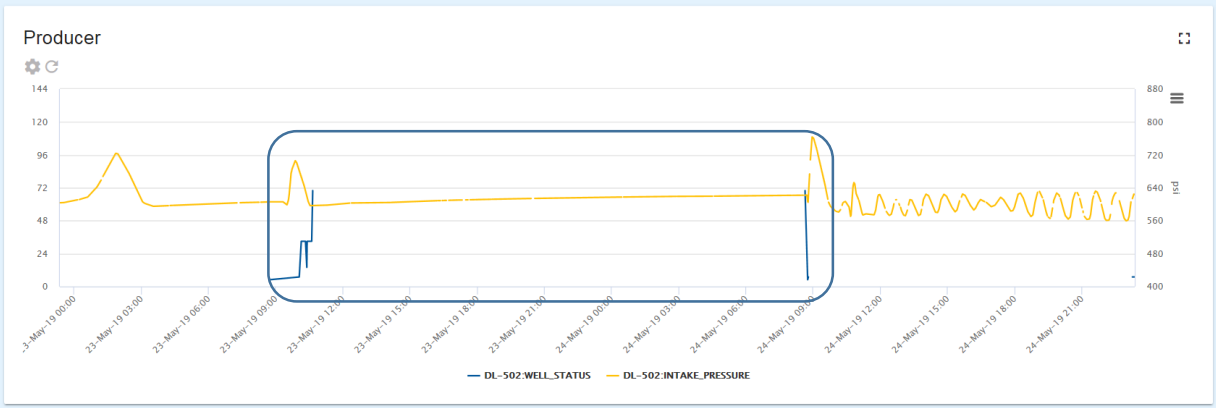
Beam Pump Panel



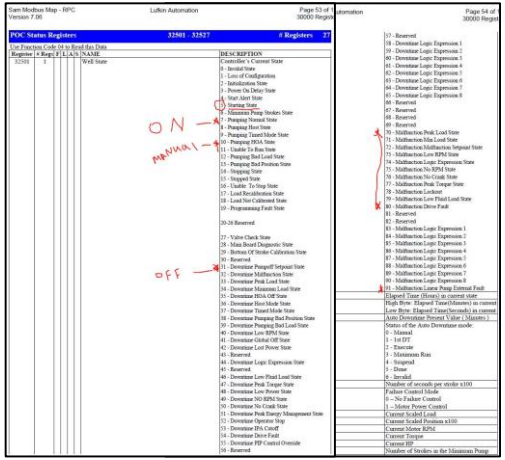
Well Production Surveillance (Beam Pump)

Stroke Length	117.01 inch
Net Stroke	111.82 inch
Max Load	9756 lbs
Min Load	6317 lbs
Load Limit	13000 lbs
Fluid Load	1377 lbs
Pump Fillage	95.56 %
Fillage Limit	0 %
SPM	4.27

Well Production Surveillance (Beam Pump)



- Introduced a new philosophy using Controller Well State codes

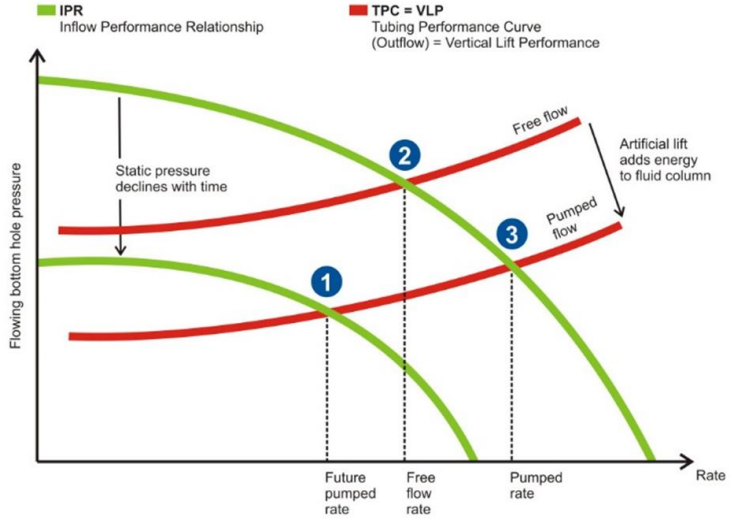


Real-Time Well Production
(Based on Model)
(Well Virtual Metering)

Real-Time Data

+

Well Model



Model Manager

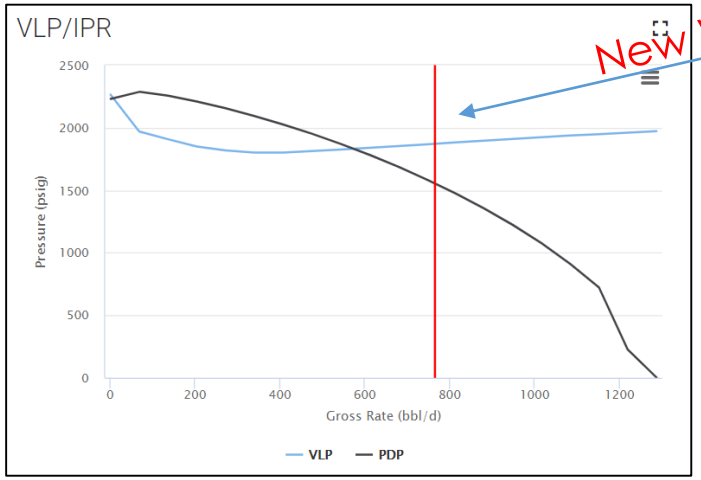
UPLOAD PROSPER MODEL

DOWNLOAD PROSPER MODEL

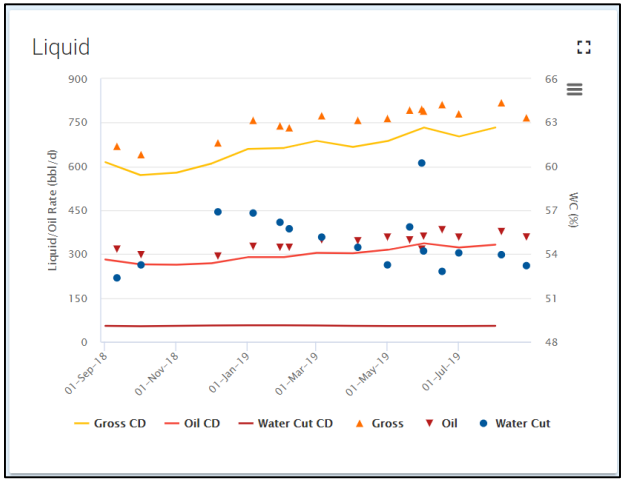
Model History

CreatedBy	UpdatedTime
Muneer Balushi	02 Jul 2019 8:43:02

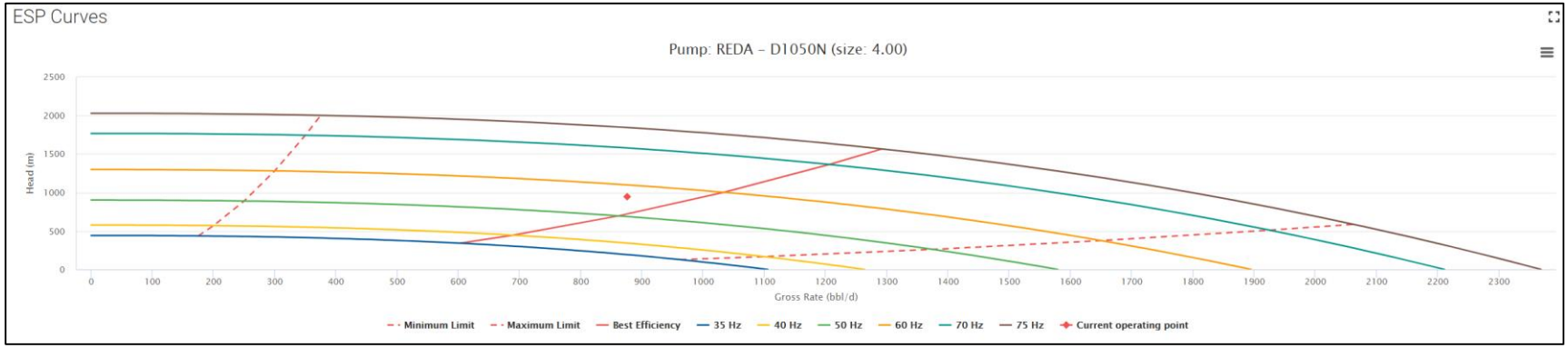
Well Mismatch



New Well Test



ESP Pump Curve / Operating Point



Well Model Quick Calibration

Well Test Info

Well	BRE-006
Test Date	02 Sep 2019
Oil Rate	109.94 Bbl/d
Gas Rate	8.13 Mscf/d
Water Rate	510.38 Bbl/d
Liquid Rate	620.32 Bbl/d
GOR	73.95 scf/bbl
WC	82.28 %
WHP	331 psig
Test Status	VALID

Model Info

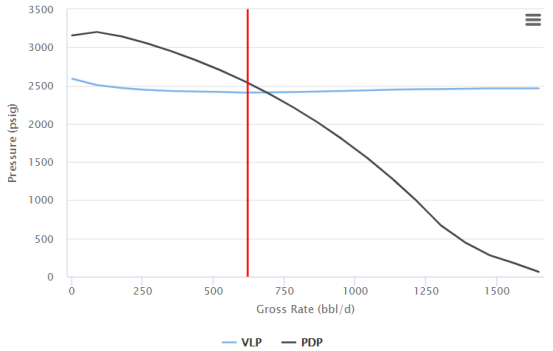
	Original Model	Altered Model
Calculated Liquid Rate (Bbl/d)	687.96	
Liquid Rate rel. Error (%)	10.9	
Reservoir Pressure (psig)	2000	
Productivity Index (bbl/day/psi)	1.19	
Watercut (%)	76	
Gas-oil ratio (scf/STB)	400	
Wear factor (1)	0	

RUN PROSPER

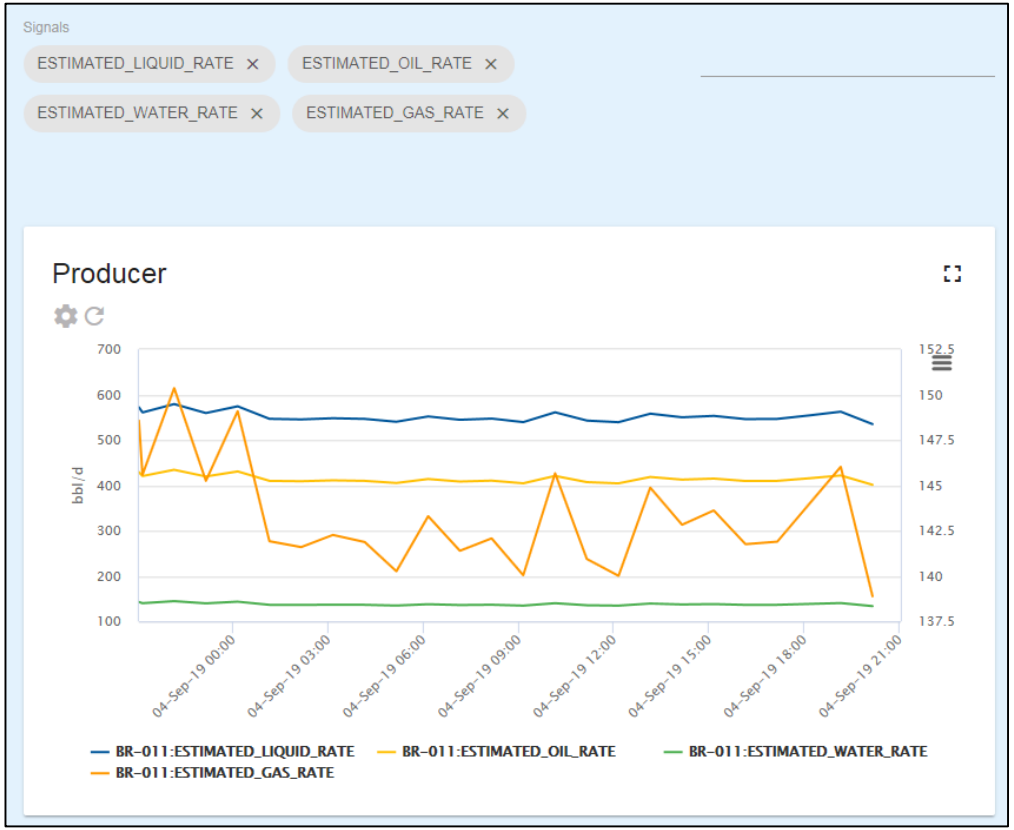
KEEP EXISTING MODEL

ACCEPT ALTERED MODEL

VLP/IPR



Production Estimate based on matched Well Model



ESP/Free Flowing Wells : Based on Prosper Model

Beam Pump Wells: Theoretical Formula

$$Q_{liq}(t) = \pi \left(\frac{Pump\ Diameter}{2}\right)^2 * Stroke\ Lenght * Stretch\ Factor * Fillage * SPM(t)$$

Virtual Metering

Virtual Metering

DALEEL PETROLEUM LLC.

My Actions | Overview | Deferment | Facility | Wells | Well Test | Events | Flares | Virtual Metering | KPI | RTO

Search Assets

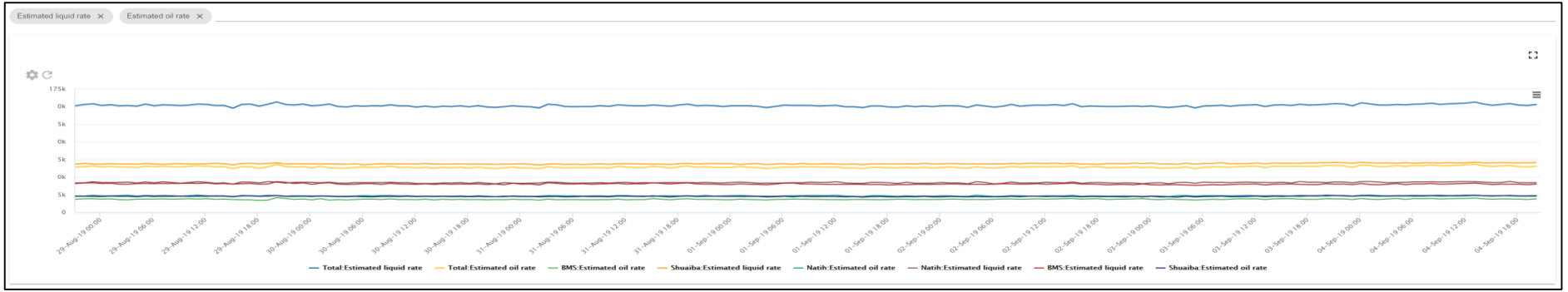
FIELD-BREAKDOWN | FACILITY-BREAKDOWN

Start Date: 28/08/2019 21:06

End Date: 04/09/2019 21:06

All areas

	Estimated liquid rate [bbl/d]	Estimated oil rate [bbl/d]	Estimated water rate [bbl/d]	Estimated gas rate [M scf/d]
Total				
BMS				
Shuaiba				
Natih	42109.58	22915.89	19193.69	3713.76



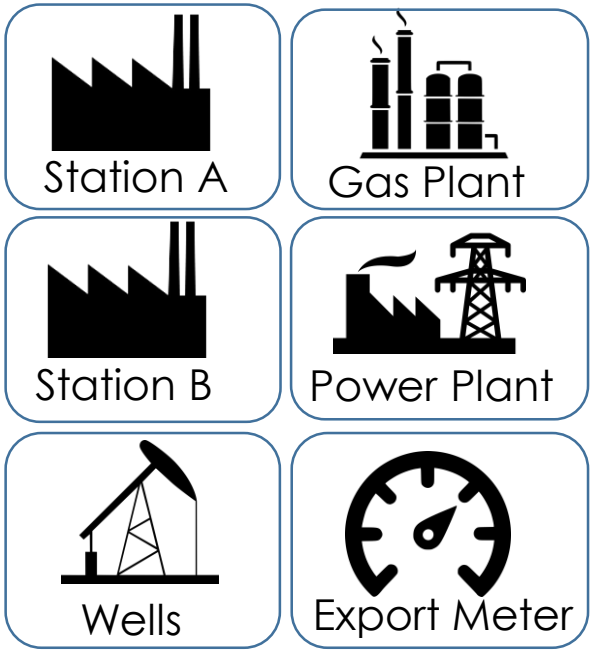
KPI's

- Event Analysis
- Portal Usage
- Model Coverage
- EBS Tracking Compliance

Daleel Automation (Now)

Automation Systems

- Execution
- Maintenance



Daleel's Real-Time Operational Infrastructure

- Production Forecasting
- Full History
- Automated Processes
- Exceptional Based Surveillance
- Production Virtual Metering
- Transparency

Headquarter

- Analysis
- Development
- Decision Making

IPCOS

Implementation Details

Key Design Principles

1. Maximize the use of off-the-shelf products
2. Give control to users
3. Use PI AF as foundation

Implementation Details

- Architecture
- Visualization
- Exception Based Surveillance
- Model Integration
- Beam Pump Surveillance

Implementation Details

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- Visualization
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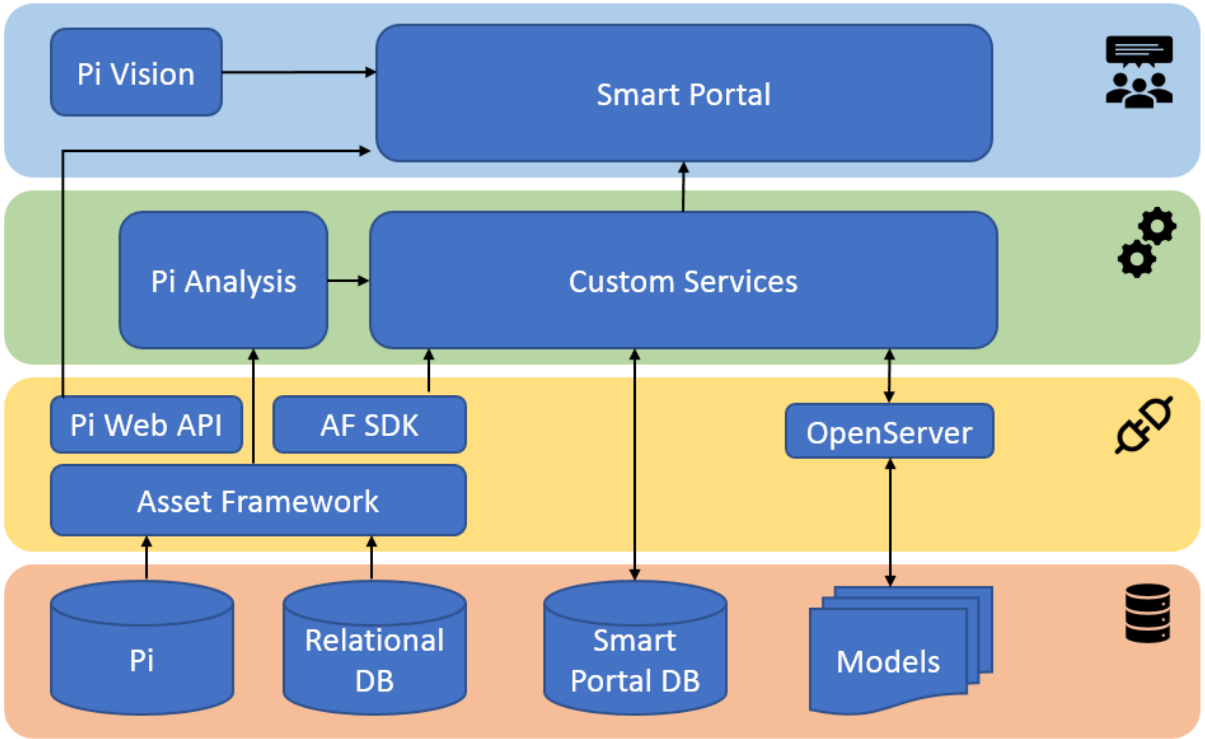
Architecture



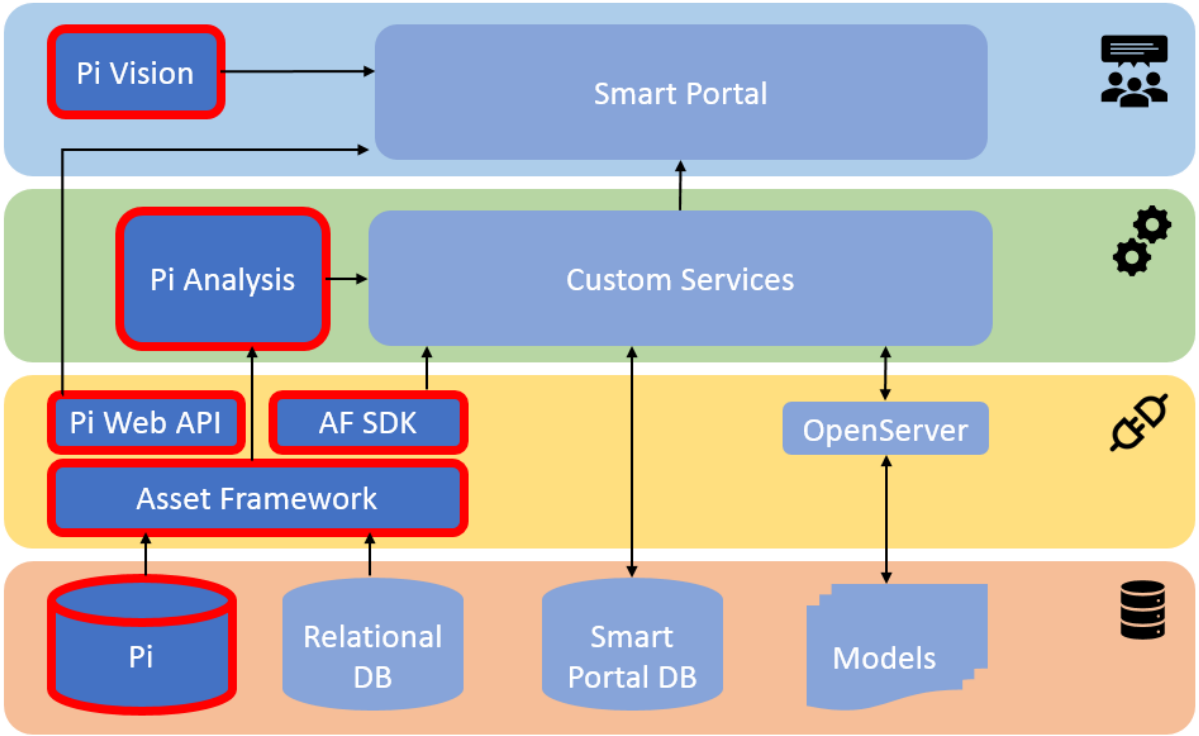
Visualization Layer

Logic Layer

Data Service Layer

Data Sources

Architecture – OSIsoft stack



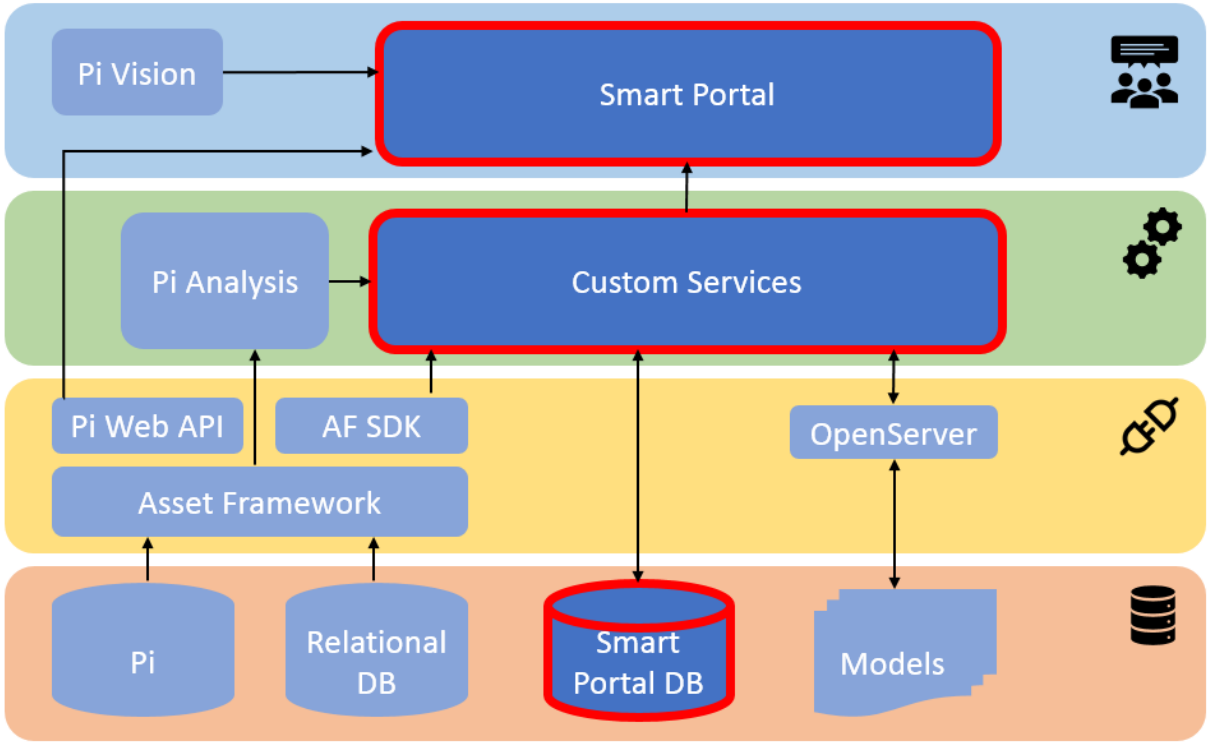
Visualization Layer

Logic Layer

Data Service Layer

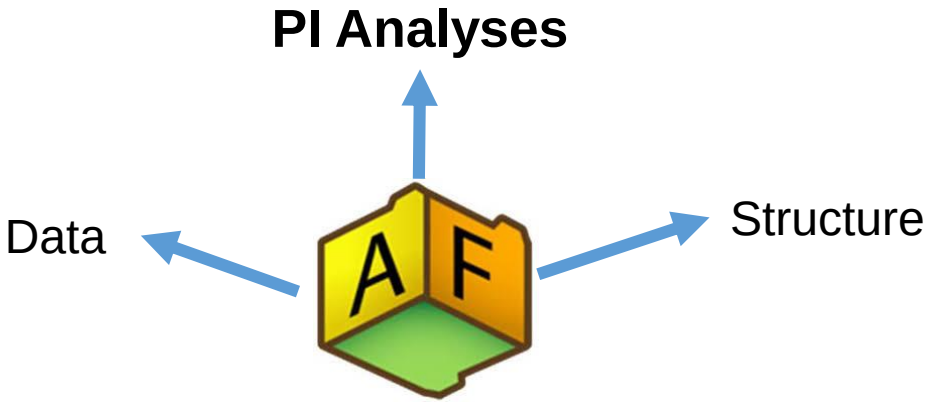
Data Sources

Architecture – Custom stack



PI Asset Framework (AF) as a foundation

Already available in Daleel

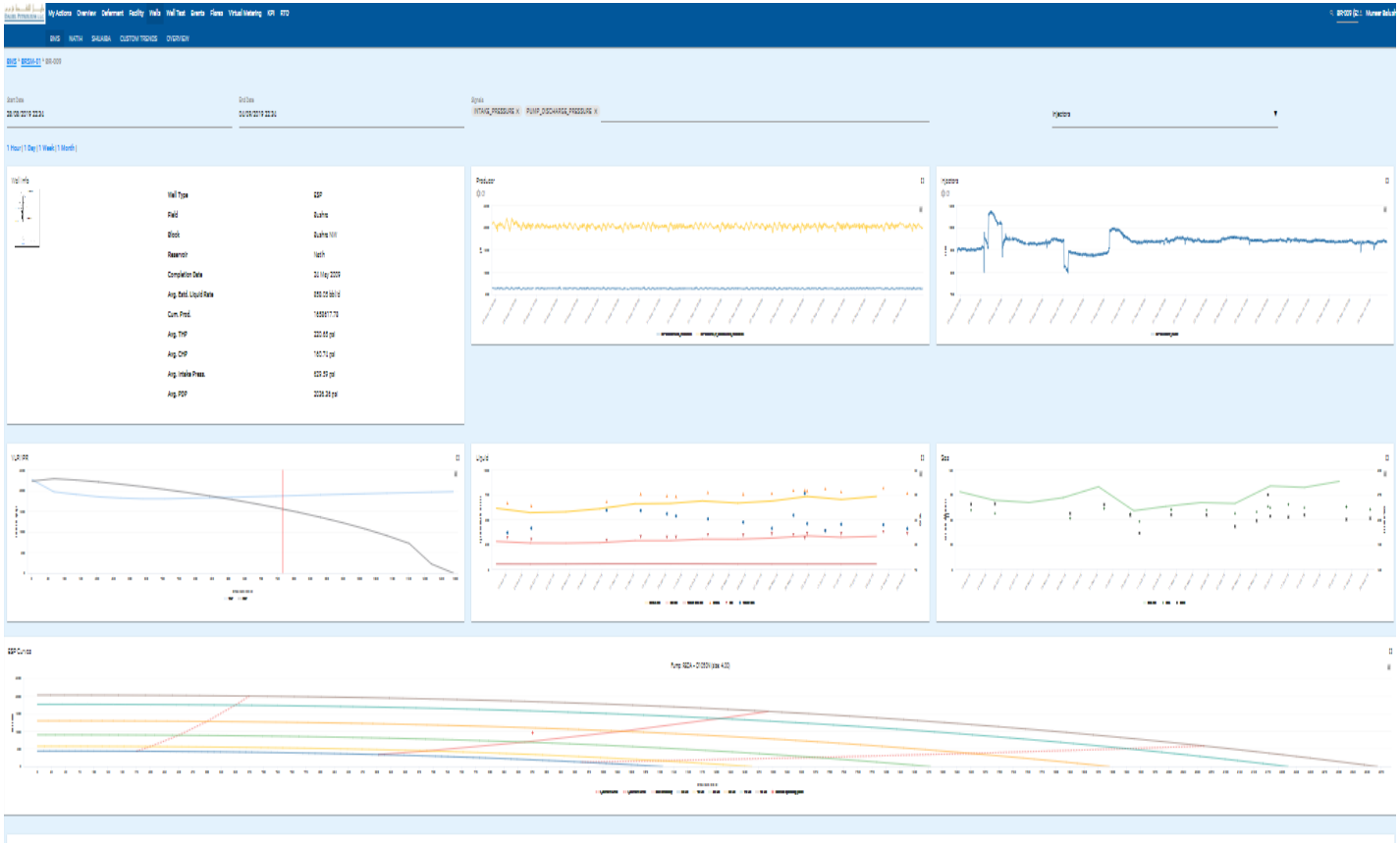


Not just data service, but logic layer

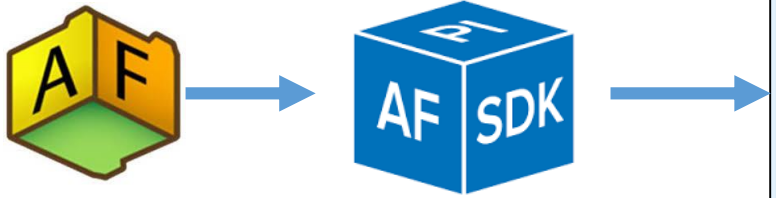
Implementation Details

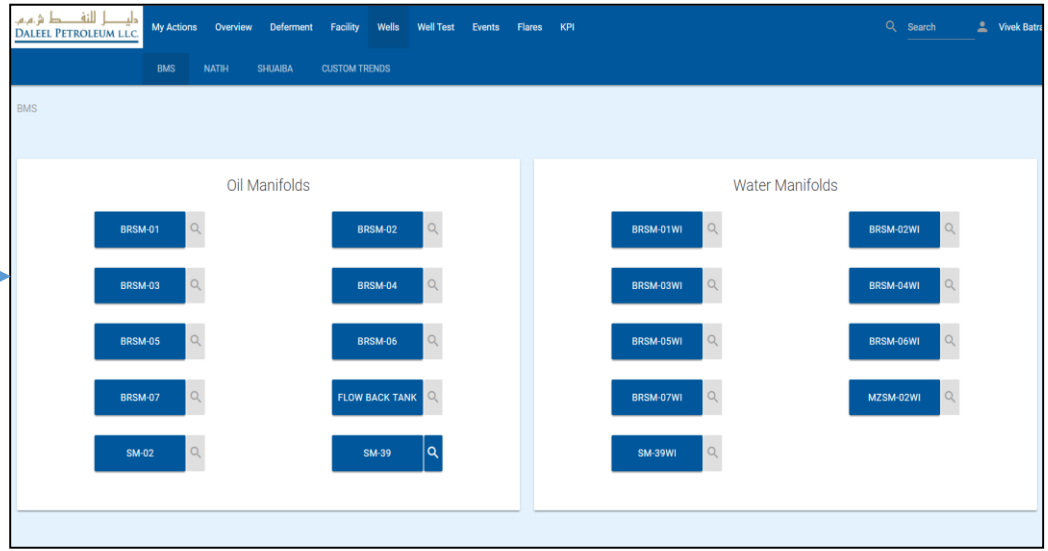
- Architecture
- Visualization
- Exception Based Surveillance
- Model Integration
- Beam Pump Surveillance

Visualization

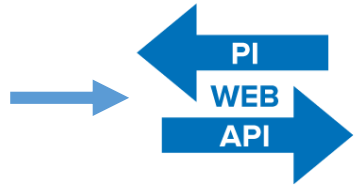


Visualization - Structure





Visualization - Plots

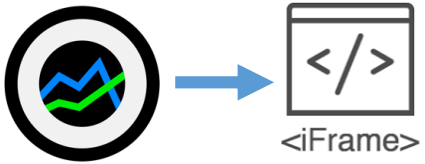


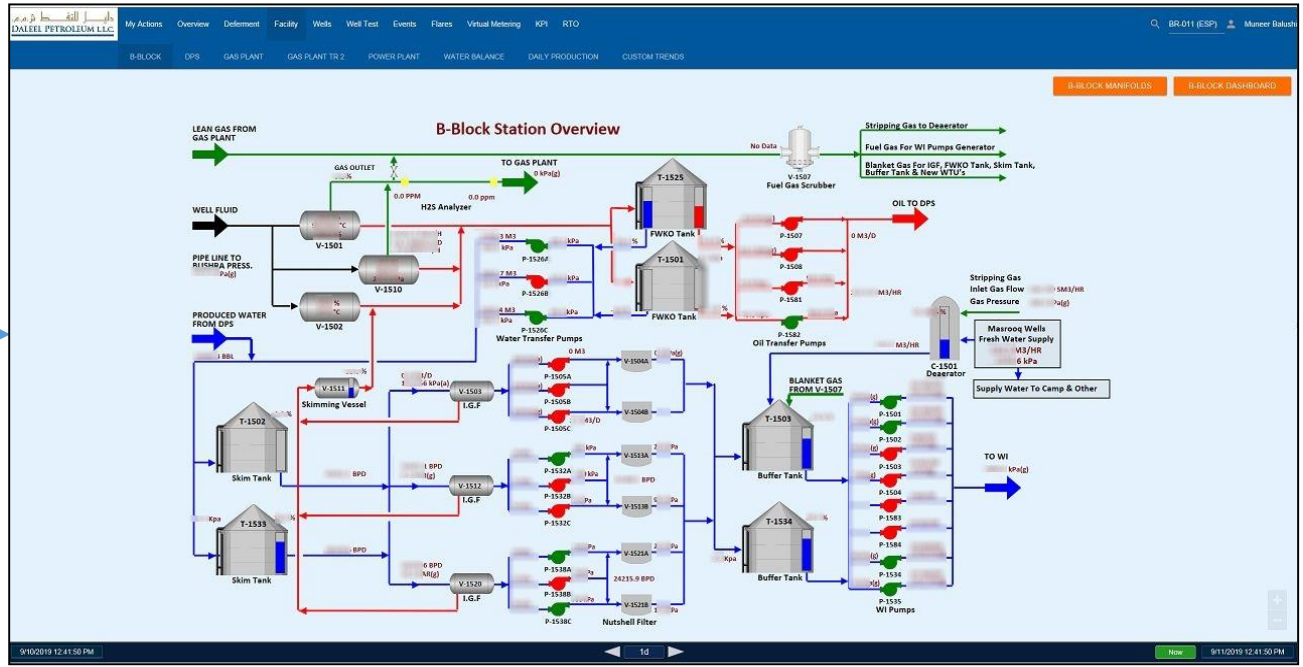
Data

Charts

Visualization – Process Schema

PI Vision





Implementation Details

- Architecture
- Visualization
- Exception Based Surveillance
- Model Integration
- Beam Pump Surveillance

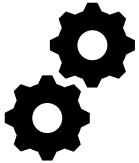
Exception Based Surveillance (EBS)

- Reactive surveillance
- Large well count and remote operations
- Capture events in real time
- Precise assignments to engineers

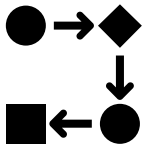
Exception Based Surveillance (EBS)

Real-Time Data

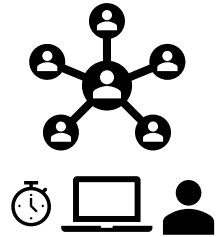
PI Analyses



Event Manager



Smart Portal



OSIsoft.

Custom developed

Exception Based Surveillance (EBS)

- PI Analyses
  - Out-of-the-box functionality
  - Perfect for real-time processing
  - Empowers the users

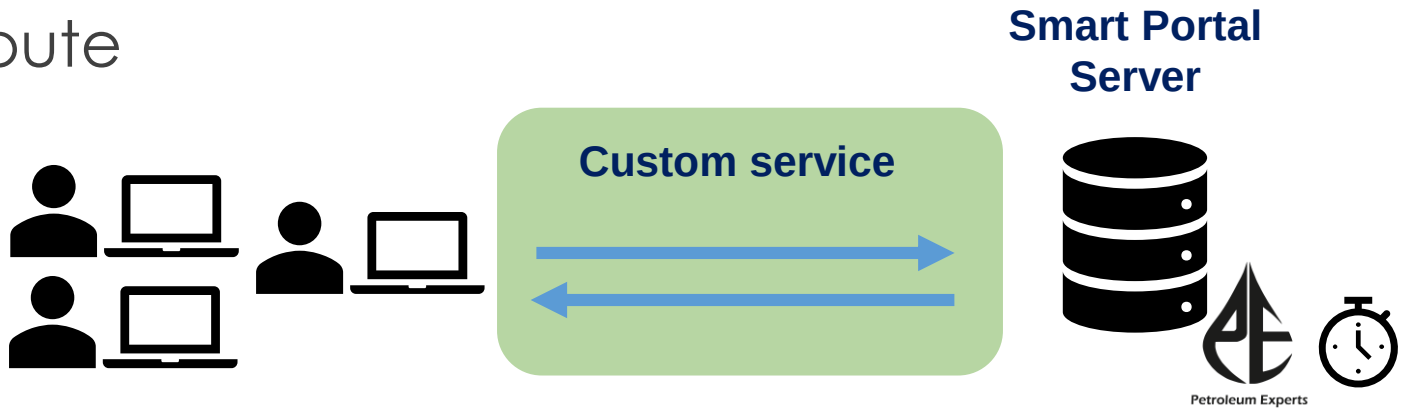
- Event Manager
  - Highly configurable
  - Ensures follow-up
  - Builds knowledge base

Implementation Details

- Architecture
- Visualization
- Exception Based Surveillance
- Model Integration
- Beam Pump Surveillance

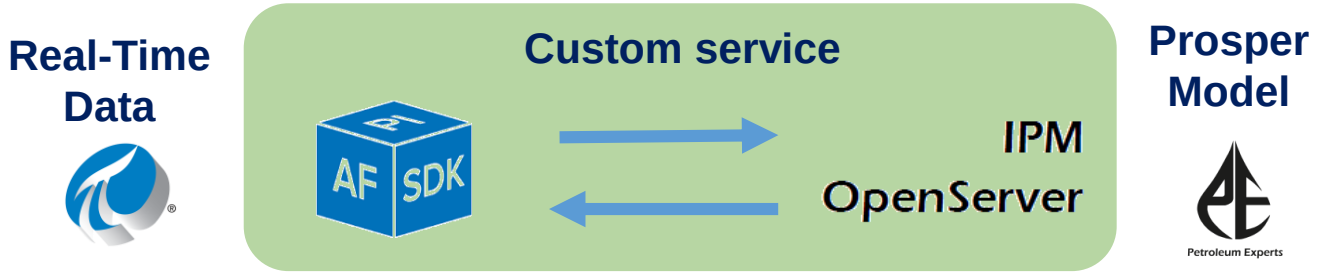
Model Integration

- Model Manager
  - Store models in the Smart Portal
  - Upload/download
  - Records history
  - Distribute



Model Integration

- Automated workflows
  - Connect real time data to models
  - Use existing API's
  - Run automatically
  - Store results in PI

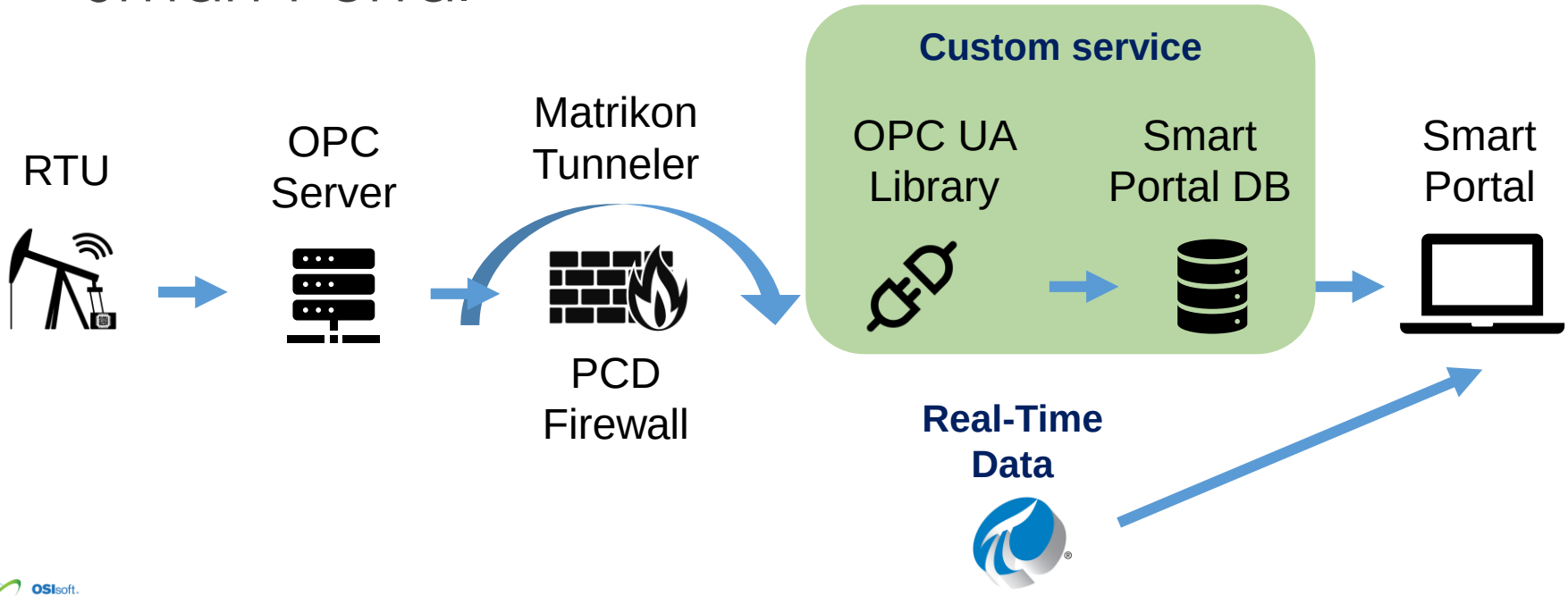


Implementation Details

- Architecture
- Visualization
- Exception Based Surveillance
- Model Integration
- Beam Pump Surveillance

Beam Pump Surveillance

- Streaming data from the controller to the Smart Portal



Benefits / Conclusions

Benefits

Direct Impact

- Reduced the average monthly Beam Pump wells deferment by 2,000 BBL (1.4 Mil $)
- Improved Deferment booking by 1% (Allocation from 0.90 to 0.91)

Expected Impact

- Increase the NFA (No Further Action) Wells Production by focused optimizations (Using EBS/Virtual metering/Dyna Cards)
- Increase Beam Pump wells production efficiency by 10% +

Conclusion

- OSIsoft provided the building blocks for Daleel "Real-Time infrastructure"
- Asset Framework (AF) can enable your Surveillance by Exception (EBS)
- PI Tools integration with well models can enable Virtual Metering

Presenters

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