Improving Equipment Reliability and Availability through Real-time Data

Presented by **Nada Khalfan Al Meqbali**
Praveen Bangari

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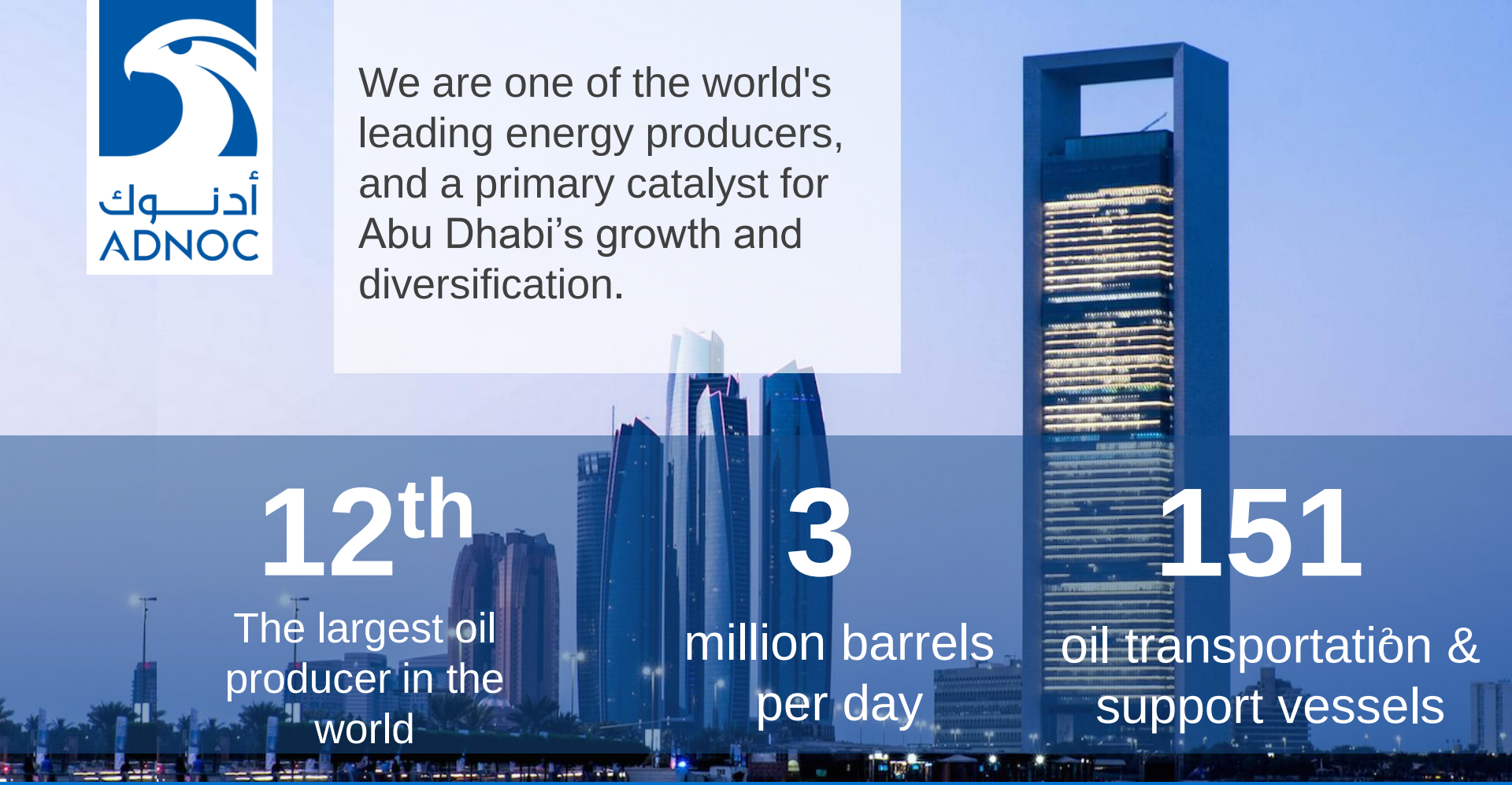

We are one of the world's leading energy producers, and a primary catalyst for Abu Dhabi's growth and diversification.

12th

The largest oil producer in the world

3

million barrels per day

151

oil transportation & support vessels

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ADNOC Business

Exploration & Production

We produce about 3 million barrels of oil per day, and over 9 billion standard cubic feet of gas per day, which places us among the largest energy producers

Processing & Refining

We positively impact the lives of millions of people throughout the world; generating the energy that is driving Abu Dhabi's development.

Marketing & Distribution

We are a trusted and reliable global energy provider. Our oil, gas, refined and petrochemical products are sold on six continents.

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ADNOC Business

Exploration & Production

We produce about 3 million barrels of oil per day, and over 9 billion standard cubic feet of gas per day, which places us among the largest energy producers.

3.0
million barrels of oil per day

9.8
billion cubic feet of raw gas per day

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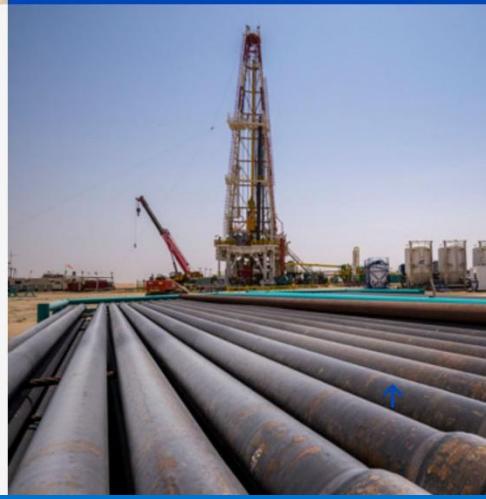
ADNOC Onshore

We are the leading onshore producer within ADNOC Group, producing 1.6 million barrels of oil and 5.6 billion cubic feet of gas per day.

Established in
1971

Oil & gas fields
11



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ADNOC Onshore

Fields and Terminals

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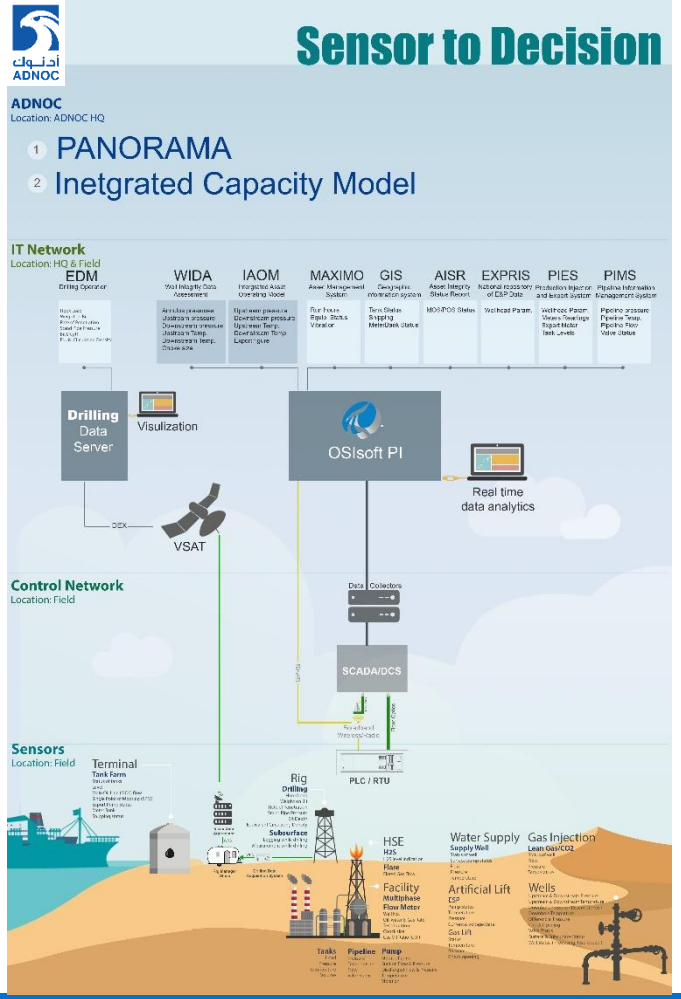
ADNOC Onshore

Digital Transformation

- Operations
- Production Optimization
- Maintenance & Integrity
- Terminal Operations
- Remote Monitoring
- HSE & Energy



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Business Case

Production

Sustainability

- Equipment Reliability
- Equipment Availability

Challenge

Manual data entry of equipment run hours & status and manual calculation of KPI's related to equipment reliability and availability.

No effective condition monitoring of equipment's

Solution

Automated the capturing of equipment run hours & status in Asset Management System and equipment's KPI's calculation

Developed an effective condition monitoring with smart notifications for equipment's

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OSIsoft PI - Maximo Integration

Overview

DCS/SCADA

- PROVIDES ACTUAL EQUIPMENT STATUS
- PROVIDES ACTUAL ASSET PARAMETERS

OSIsfot PI

- MONITORS EQUIPMENT
- PROVIDES INTERFACE TO ENTER EVENT REASONS
- CALCULATES EQUIPMENT KPIs
- PROVIDES VIEWS & REPORTS
- PROVIDES ALERTS WHEN EQUIPMENT HAS STOPPED
- INTERFACES TO MAXIMO

Asset Management System

- RECEIVES ACTUAL STOP REASON FROM OSI PI
- PERFORMANCE-BASED PM & WORK ORDERS

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OSIsoft PI - Maximo Integration

Architecture

PI Modular Database

PI ACE

Output in PI Process Book

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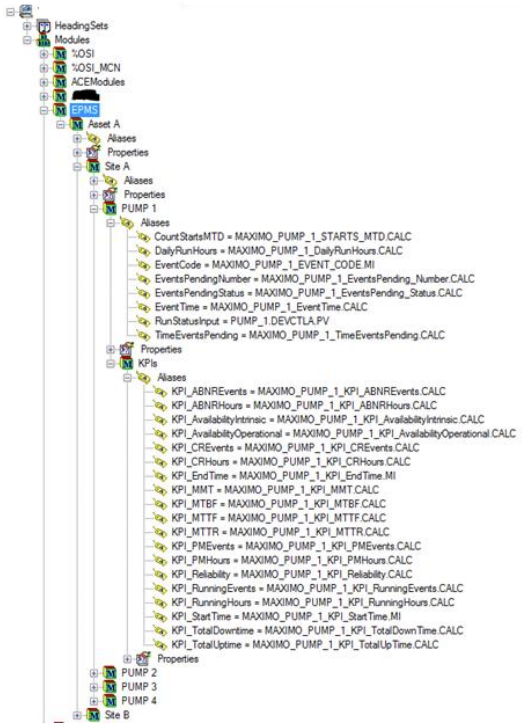
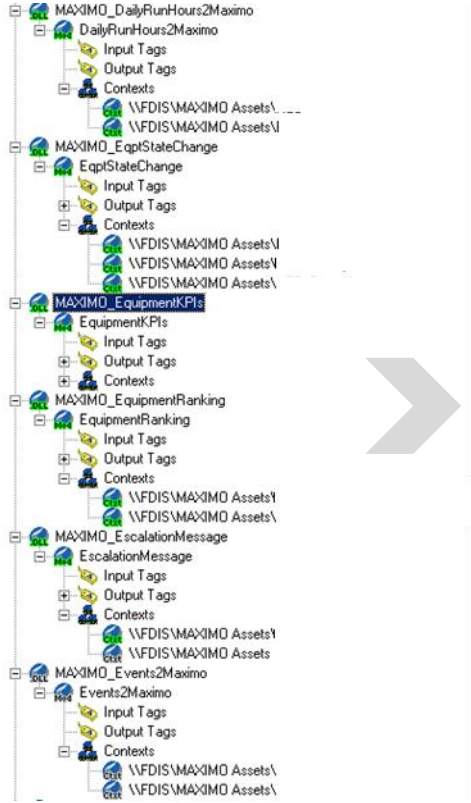
OSIsoft PI - Maximo Integration

Architecture





The calculations are based on the definitions provided in ISO-14224

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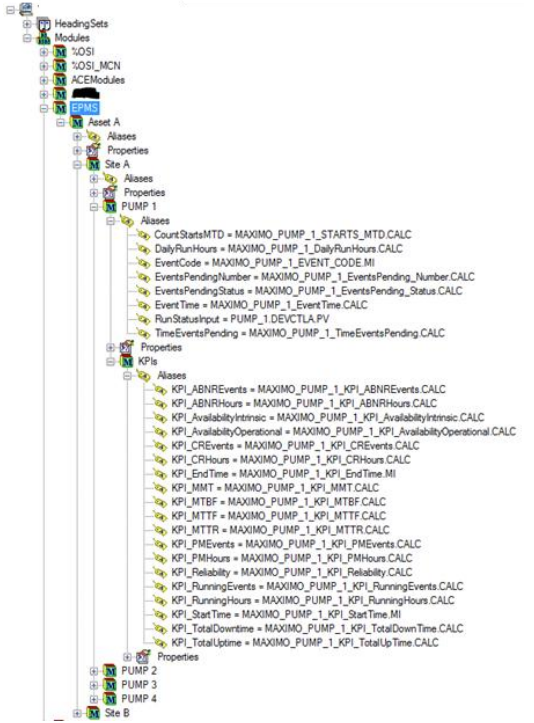
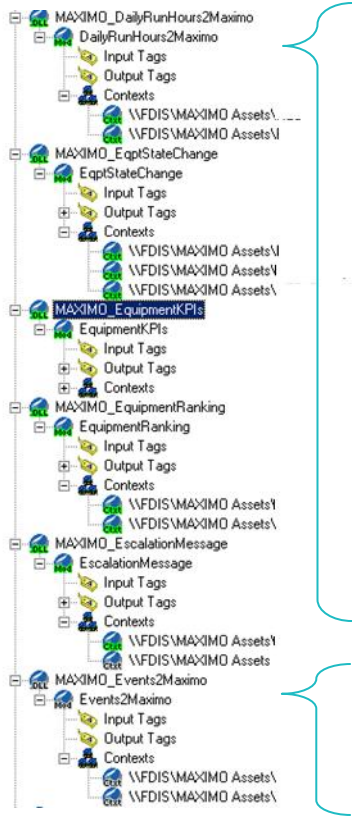
OSIsoft PI - Maximo Integration

Architecture





Maximo Meters

TSO-Meter	TSO-Meter

MAXIMO WebServices

getAssets: Provides a list of participating Maximo Assets, the Web Service will respond with a list of Asset

addMeterReading: Allows adding asset meter reading.

changeAssetStatus: Allows changing a specific asset status.

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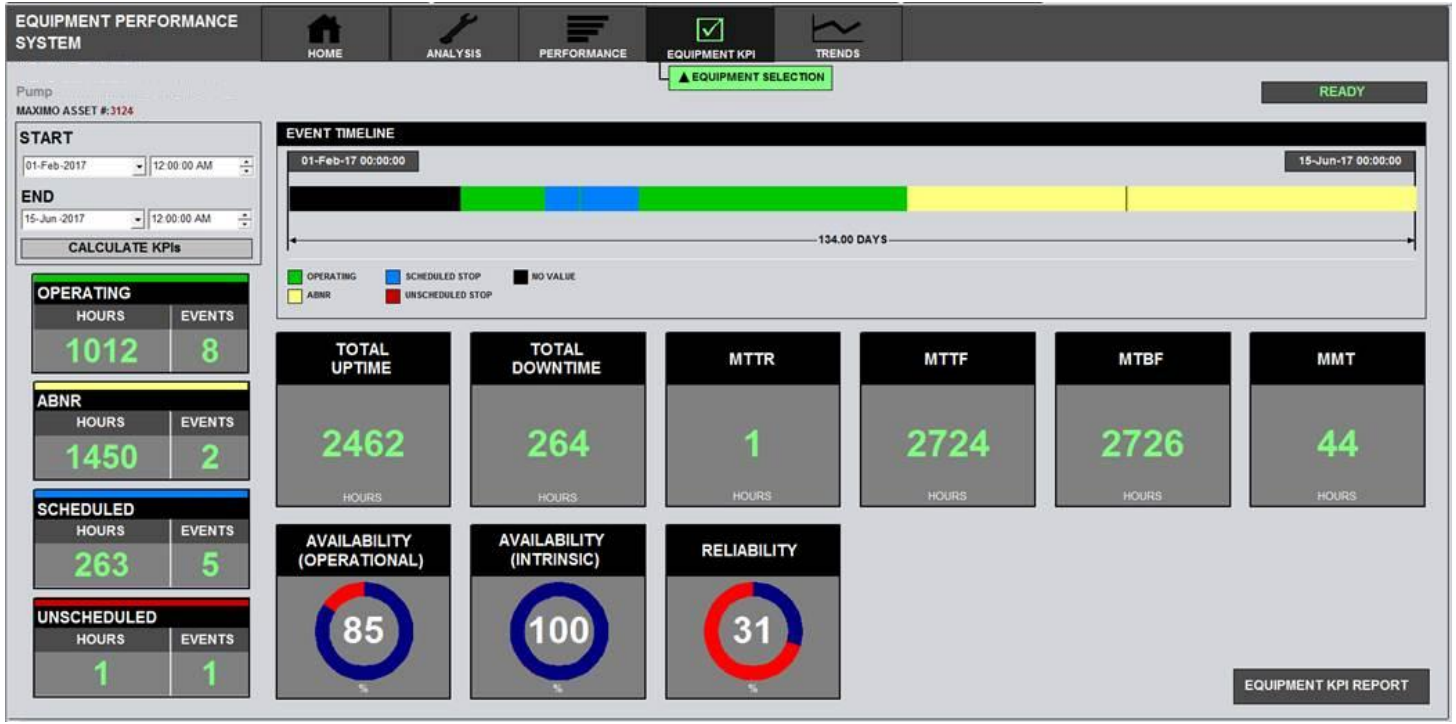
OSIsoft PI - Maximo Integration

Application



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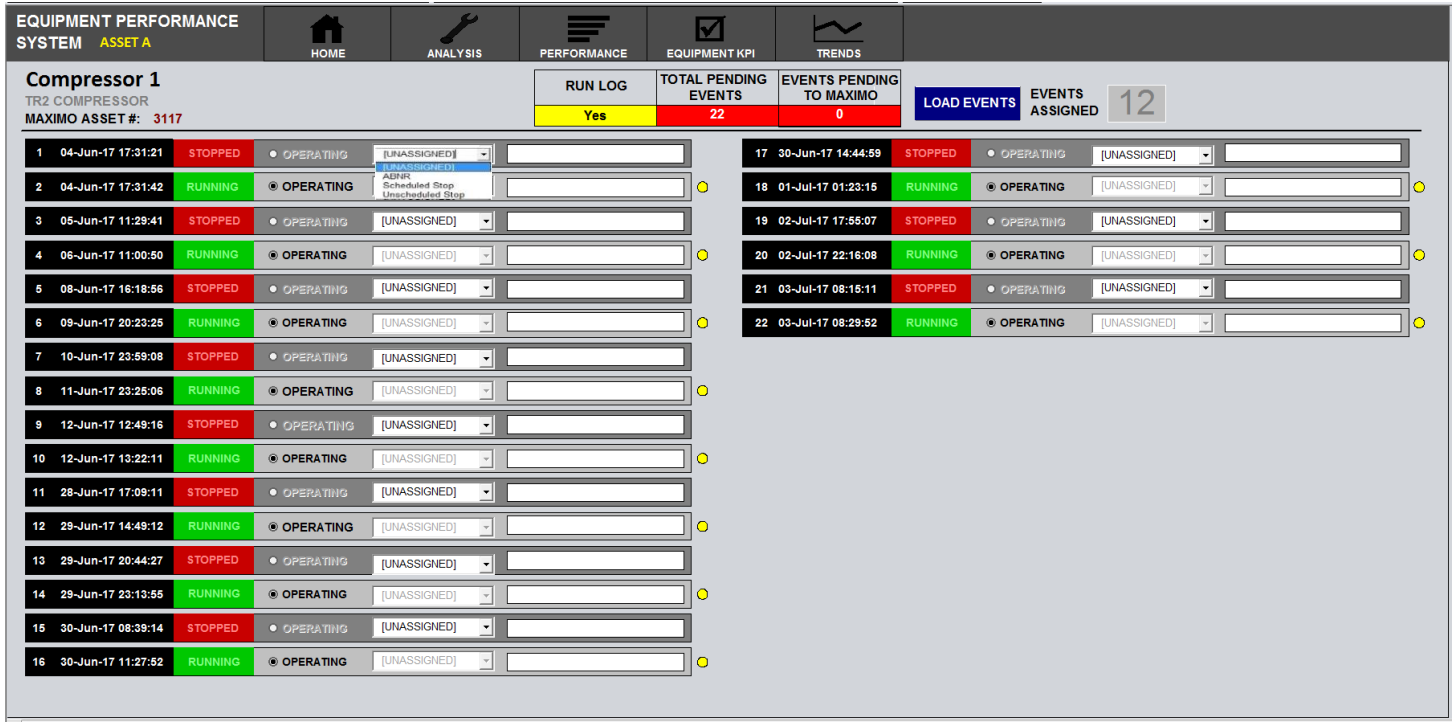
OSIsoft PI - Maximo Integration

Equipment Status Capturing



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OSIsoft PI - Maximo Integration

Notifications - Escalation Matrix

Operator

Level 1 Escalation
24 Hours

Engineer

Level 2 Escalation
48 Hours

Manager

Level 3 Escalation
72 Hours

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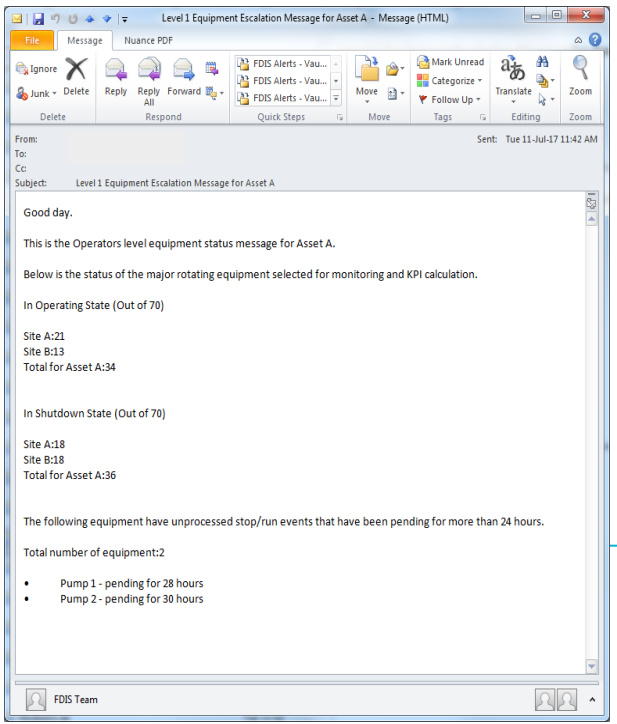
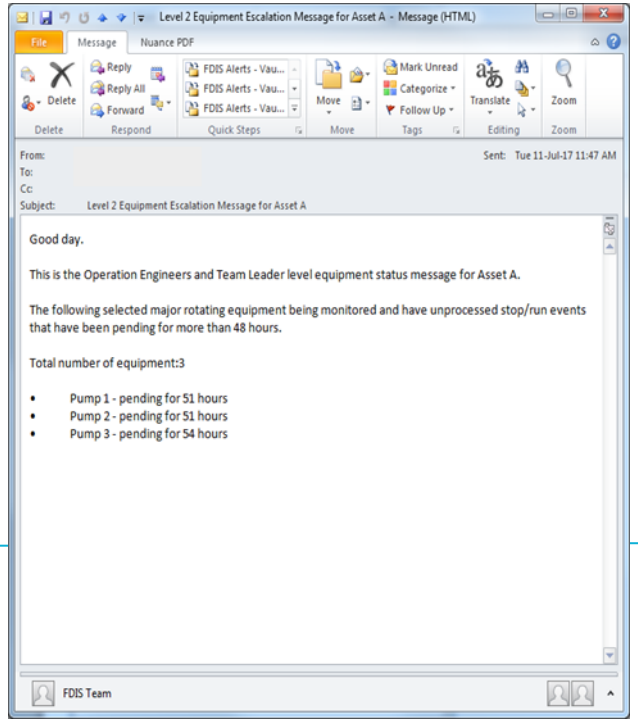
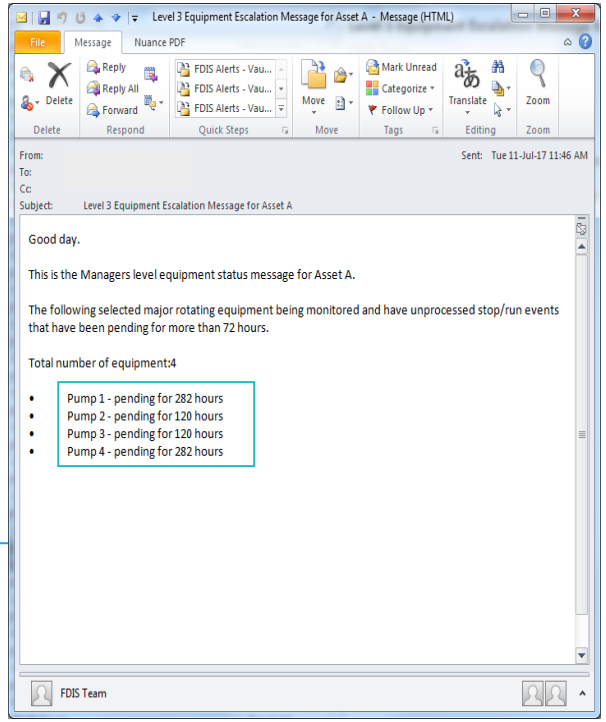
OSIsoft PI - Maximo Integration

Notifications - Escalation Matrix







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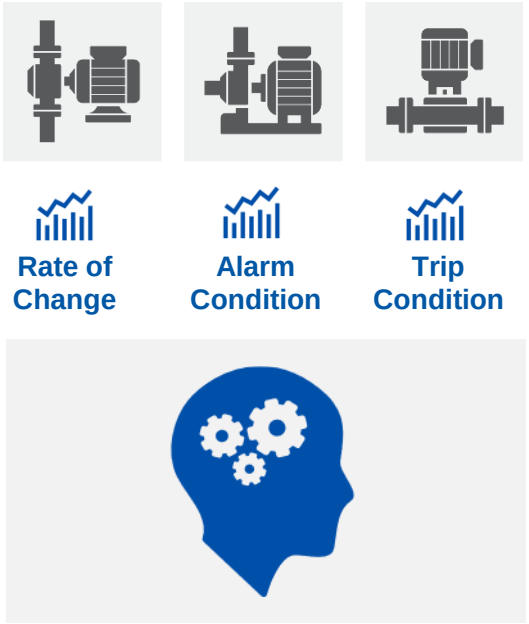
Condition Monitoring

Rotating Equipment



Real-time Data Analytics

Alert

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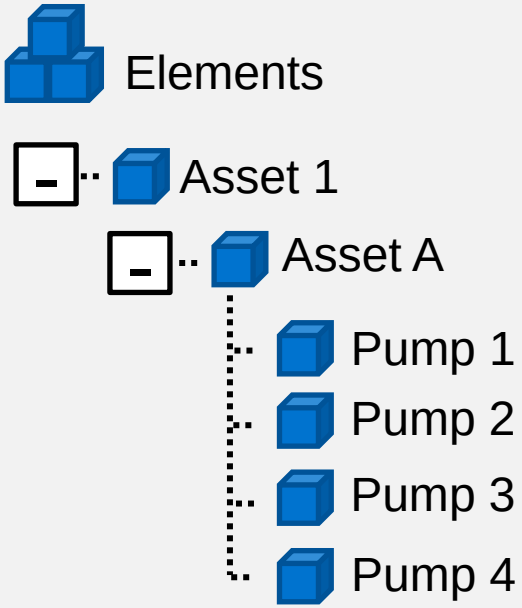
Real Time Data Analytics

Elements



Name	Expression	Value at Evaluation	Value at Last Trigger	Output Attribu
Runtime	TimeEq('SURFACE PMP STATUS','y','t',"RUNNING")/3600	24	24	Map
Stoptime	TimeEq('SURFACE PMP STATUS','y','t',"STOPPED")/3600	0	0	Map
DailyRunHours	IF Runtime = 0 OR Runtime = 24 THEN Runtime ELSE IF Runtime < 24 AND Runtime + Stoptime > 23.99 THEN Runtime ELSE IF Runtime < 24 AND Stoptime = 0 THEN 24 ELSE IF Runtime < 24 AND Runtime + Stoptime < 23.99 AND Stoptime > 0 THEN (24 - Stoptime) Else N	24	24	DailyRunHours

```
IF Runtime = 0 OR Runtime = 24 THEN Runtime ELSE
IF Runtime < 24 AND Runtime + Stoptime > 23.99 THEN Runtime ELSE
IF Runtime < 24 AND Stoptime = 0 THEN 24 ELSE
IF Runtime < 24 AND Runtime + Stoptime < 23.99 AND Stoptime > 0 THEN (24 - Stoptime) Else NoOutput()
```

Name	Expression	Value at E	Value at Last Tri	Output Attribute
SPDE_X_AXIS_VIBR	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF TagVal('SURFA(			SURFACE PMP DE X A
SPNDE_X_AXIS_VIBR	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF 'SURFACE PMP I			SURFACE PMP NDE X
SPDE_Y_AXIS_VIBR	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF 'SURFACE PMP I			SURFACE PMP DE Y A
SPNDE_Y_AXIS_VIBR	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF 'SURFACE PMP I			SURFACE PMP NDE Y
LUBEOIL_TANK_LEVEL	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF 'LUBE OIL TANI			LUBE OIL TANK LEVEL
SEALWATER_TANK_LEVEL	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF 'SEAL WATER TA			SEAL WATER TANK LE
LUBEOIL_TANK_TEMP	IF 'SURFACE PMP STATUS' = "RUNNING" THEN (IF 'LUBE OIL TANI			LUBE OIL TANK TEMPI

1500+ Analysis, 500+ Notifications

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Component Level Monitoring Alerts

Pump Component Level Monitoring

- Rotor Condition
- Bearing Condition
- Seal Condition
- Cooling Fan

Motor Component Level Monitoring

- Rotor Condition
- Stator Condition
- Bearing Condition
- Casing Condition

Seal Oil System Component Level Monitoring

- Seal Oil Pump
- Seal Oil Cooler
- Seal Oil Cooler Fan

Lube Oil System Component Level Monitoring

- Lube Oil Pump
- Lube Oil Cooler
- Lube Oil Cooler Fan

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Component Level Alerts Details

Asset Details

- Asset Name
- Asset ID
- Asset Tag & Asset Description (Static information coming from PI AF Elements/Equipment Attributes)

Process Parameters Status

- Real-time - Value, Condition/Status
- Alarm Set Point Value & Trip Set Point Value (Static: PI AF Elements/Equipment Attributes)

Probable Effects & Proposed Solutions

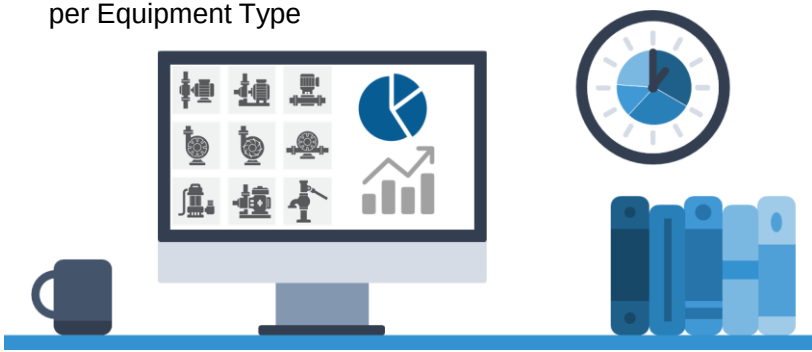
- Static Data Entered in the PI AF Template per Equipment Type

Dynamic Links

- PI Coresight & Maximo (Unique links are generated for every equipment)

Spare Parts

- Details - Name, Spare Part Code & Installed Quantity
- Data Source - Static Data Entered in the PI AF Template per Equipment Type



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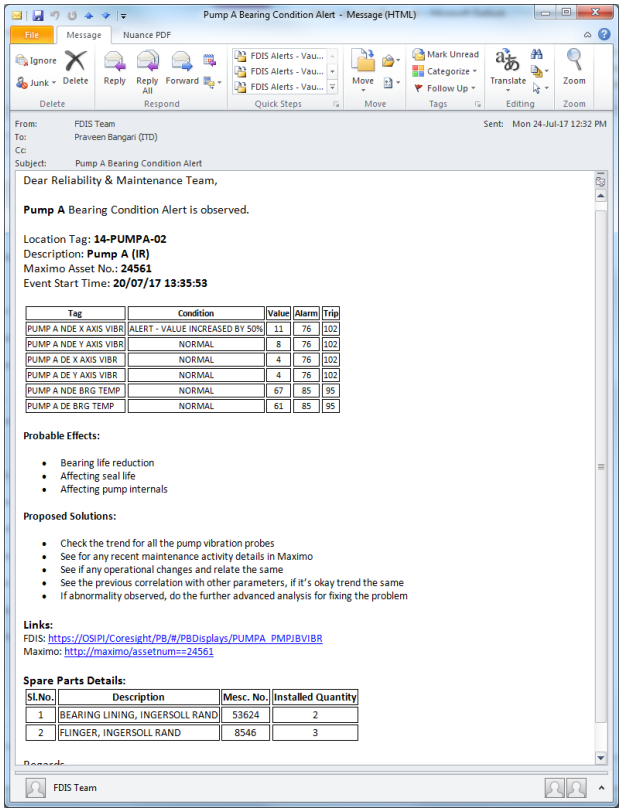
Component Level Monitoring Alerts



Pump A Bearing Condition Alert - Message (HTML)

From: FDIS Team
To: Praveen Bangari (ITD)
Cc:
Subject: Pump A Bearing Condition Alert
Sent: Mon 24-Jul-17 12:32 PM

Dear Reliability & Maintenance Team,

Pump A Bearing Condition Alert is observed.

Location Tag: **14-PUMPA-02**
Description: **Pump A (IR)**
Maximo Asset No.: **24561**
Event Start Time: **20/07/17 13:35:53**

Tag	Condition	Value	Alarm	Trip
PUMP A NDE X AXIS VIBR	ALERT - VALUE INCREASED BY 50%	11	76	102
PUMP A NDE Y AXIS VIBR	NORMAL	8	76	102
PUMP A DE X AXIS VIBR	NORMAL	4	76	102
PUMP A DE Y AXIS VIBR	NORMAL	4	76	102
PUMP A NDE BRG TEMP	NORMAL	67	85	95
PUMP A DE BRG TEMP	NORMAL	61	85	95

Probable Effects:

- Bearing life reduction
- Affecting seal life
- Affecting pump internals

Proposed Solutions:

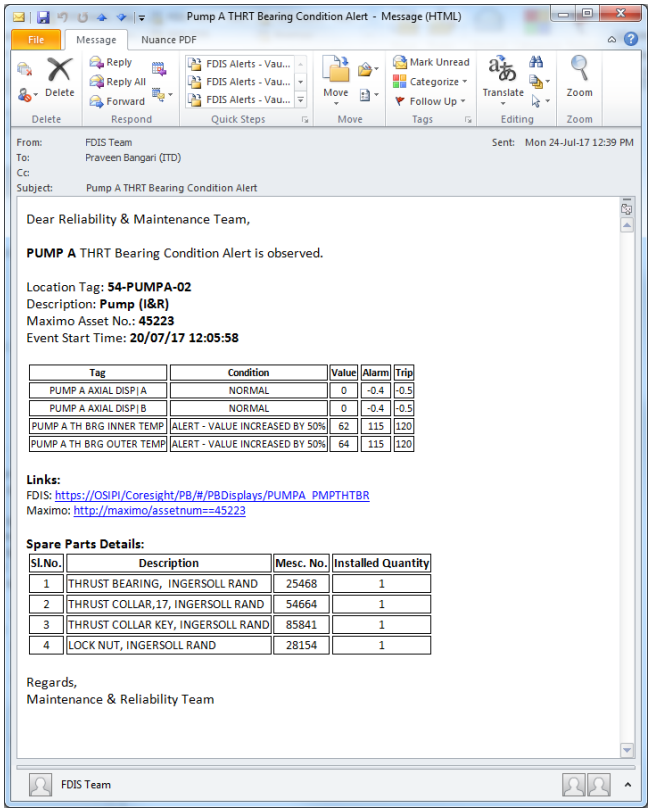
- Check the trend for all the pump vibration probes
- See for any recent maintenance activity details in Maximo
- See if any operational changes and relate the same
- See the previous correlation with other parameters, if it's okay trend the same
- If abnormality observed, do the further advanced analysis for fixing the problem

Links:
FDIS: https://OSIPI/Coresight/PB/#/PBDisplays/PUMPA_PMPJBVIBR
Maximo: http://maximo/assetnum==24561

Spare Parts Details:

Sl.No.	Description	Mesc. No.	Installed Quantity
1	BEARING LINING, INGERSOLL RAND	53624	2
2	FLINGER, INGERSOLL RAND	8546	3

FDIS Team



Pump A THRT Bearing Condition Alert - Message (HTML)

From: FDIS Team
To: Praveen Bangari (ITD)
Cc:
Subject: Pump A THRT Bearing Condition Alert
Sent: Mon 24-Jul-17 12:39 PM

Dear Reliability & Maintenance Team,

PUMP A THRT Bearing Condition Alert is observed.

Location Tag: **54-PUMPA-02**
Description: **Pump (I&R)**
Maximo Asset No.: **45223**
Event Start Time: **20/07/17 12:05:58**

Tag	Condition	Value	Alarm	Trip
PUMP A AXIAL DISP| A	NORMAL	0	-0.4	-0.5
PUMP A AXIAL DISP| B	NORMAL	0	-0.4	-0.5
PUMP A TH BRG INNER TEMP	ALERT - VALUE INCREASED BY 50%	62	115	120
PUMP A TH BRG OUTER TEMP	ALERT - VALUE INCREASED BY 50%	64	115	120

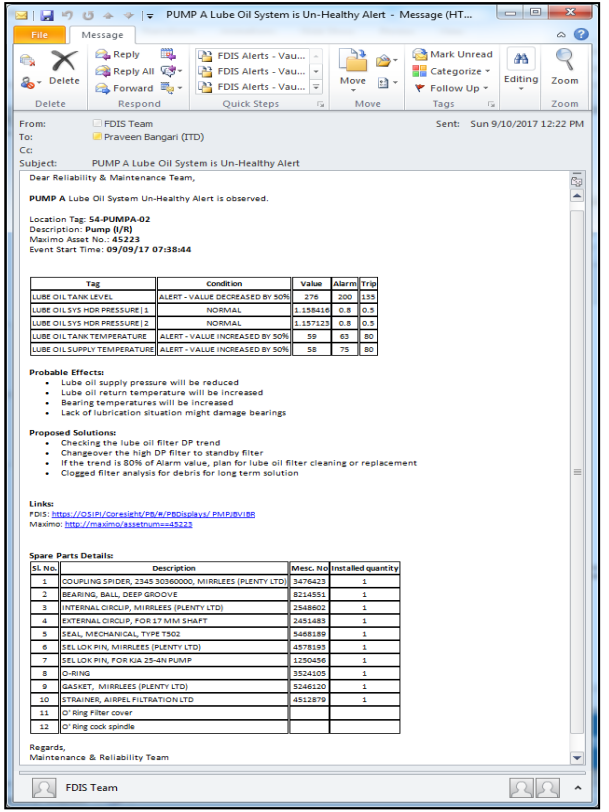
Links:
FDIS: https://OSIPI/Coresight/PB/#/PBDisplays/PUMPA_PMPTHTBR
Maximo: http://maximo/assetnum==45223

Spare Parts Details:

Sl.No.	Description	Mesc. No.	Installed Quantity
1	THRUST BEARING, INGERSOLL RAND	25468	1
2	THRUST COLLAR,17, INGERSOLL RAND	54664	1
3	THRUST COLLAR KEY, INGERSOLL RAND	85841	1
4	LOCK NUT, INGERSOLL RAND	28154	1

Regards,
Maintenance & Reliability Team

FDIS Team



PUMP A Lube Oil System is Un-Healthy Alert - Message (HT...

From: FDIS Team
To: Praveen Bangari (ITD)
Cc:
Subject: PUMP A Lube Oil System is Un-Healthy Alert
Sent: Sun 9/10/2017 12:22 PM

Dear Reliability & Maintenance Team,

PUMP A Lube Oil System Un-Healthy Alert is observed.

Location Tag: **54-PUMPA-02**
Description: **Pump (I/R)**
Maximo Asset No.: **45223**
Event Start Time: **09/09/17 07:38:44**

Tag	Condition	Value	Alarm	Trip
LUBE OIL TANK LEVEL	ALERT - VALUE DECREASED BY 50%	276	200	135
LUBE OIL SYS HDR PRESSURE | 1	NORMAL	1.158416	0.8	0.5
LUBE OIL SYS HDR PRESSURE | 2	NORMAL	1.157125	0.8	0.5
LUBE OIL TANK TEMPERATURE	ALERT - VALUE INCREASED BY 50%	59	63	80
LUBE OIL SUPPLY TEMPERATURE	ALERT - VALUE INCREASED BY 50%	58	75	80

Probable Effects:

- Lube oil supply pressure will be reduced
- Lube oil return temperature will be increased
- Bearing temperatures will be increased
- Lack of lubrication situation might damage bearings

Proposed Solutions:

- Checking the lube oil filter DP trend
- Changeover the high DP filter to standby filter
- If the trend is 80% of Alarm value, plan for lube oil filter cleaning or replacement
- Clogged filter analysis for debris for long term solution

Links:
FDIS: https://OSIPI/Coresight/PB/#/PBDisplays/ PMPJBVIBR
Maximo: http://maximo/assetnum==45223

Spare Parts Details:

Sl. No.	Description	Mesc. No	Installed quantity
1	COUPLING SPIDER, 2345 30360000, MIRRLEES (PLENTY LTD)	3476423	1
2	BEARING, BALL, DEEP GROOVE	8214551	1
3	INTERNAL CIRCLIP, MIRRLEES (PLENTY LTD)	2548602	1
4	EXTERNAL CIRCLIP, FOR 17 MM SHAFT	2451483	1
5	SEAL, MECHANICAL, TYPE T502	5468189	1
6	SEL LOK PIN, MIRRLEES (PLENTY LTD)	4578193	1
7	SEL LOK PIN, FOR KIA 25-4N PUMP	1250456	1
8	O-RING	3524105	1
9	GASKET, MIRRLEES (PLENTY LTD)	5246120	1
10	STRAINER, AIRPEL FILTRATION LTD	4512879	1
11	O' Ring Filter cover		
12	O' Ring cock spindle		

Regards,
Maintenance & Reliability Team

FDIS Team

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Smart Notification Benefits

Lube Oil System

Tank Level

Water Ingress (Level Increase)

Required Oil Quantity (Level Decrease)

Drop Rate/Day

Oil Leak Prediction (Design vs Actual)

Tank Level Prediction (Inventory Planning)

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Way Forward

Migration of OSIsoft PI – Maximo Integration to PI AF and PI Coresight

Extend the Smart Notifications to all the pump types

Implementation of Smart Notifications for monitoring the Performance of the Equipment (Energy Optimization)

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Team Leader IT Drilling Solutions

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Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

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감사합니다

Danke

谢谢

Merci

Gracias

Thank You

ありがとう

Спасибо

شكراً

Obrigado

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