

# PETRONAS Rotating Equipment Analytics Enhancement and Scale Up



# Presentation Outline



A horizontal progress bar at the top of the slide is divided into four segments: blue, orange, grey, and yellow. Below this bar, the first four items of the outline are listed. The numbers 01, 02, and 04 are in blue, 03 is in grey, and 05, 06, 07, and 08 are in orange. The corresponding titles are in the same color as their respective numbers.

**01**

MALAYSIA AT A GLANCE

**02**

ABOUT PETRONAS

**03**

WHAT IS PROTEAN

**04**

SOLUTION ARCHITECTURE



A second horizontal progress bar is located below the first row of items. It is divided into four segments: grey, yellow, orange, and blue. Below this bar, the last four items of the outline are listed. The numbers 05, 06, 07, and 08 are in orange, and 01, 02, 03, and 04 are in blue. The corresponding titles are in the same color as their respective numbers.

**05**

PROTEAN FEATURES

**06**

ACHIEVEMENTS

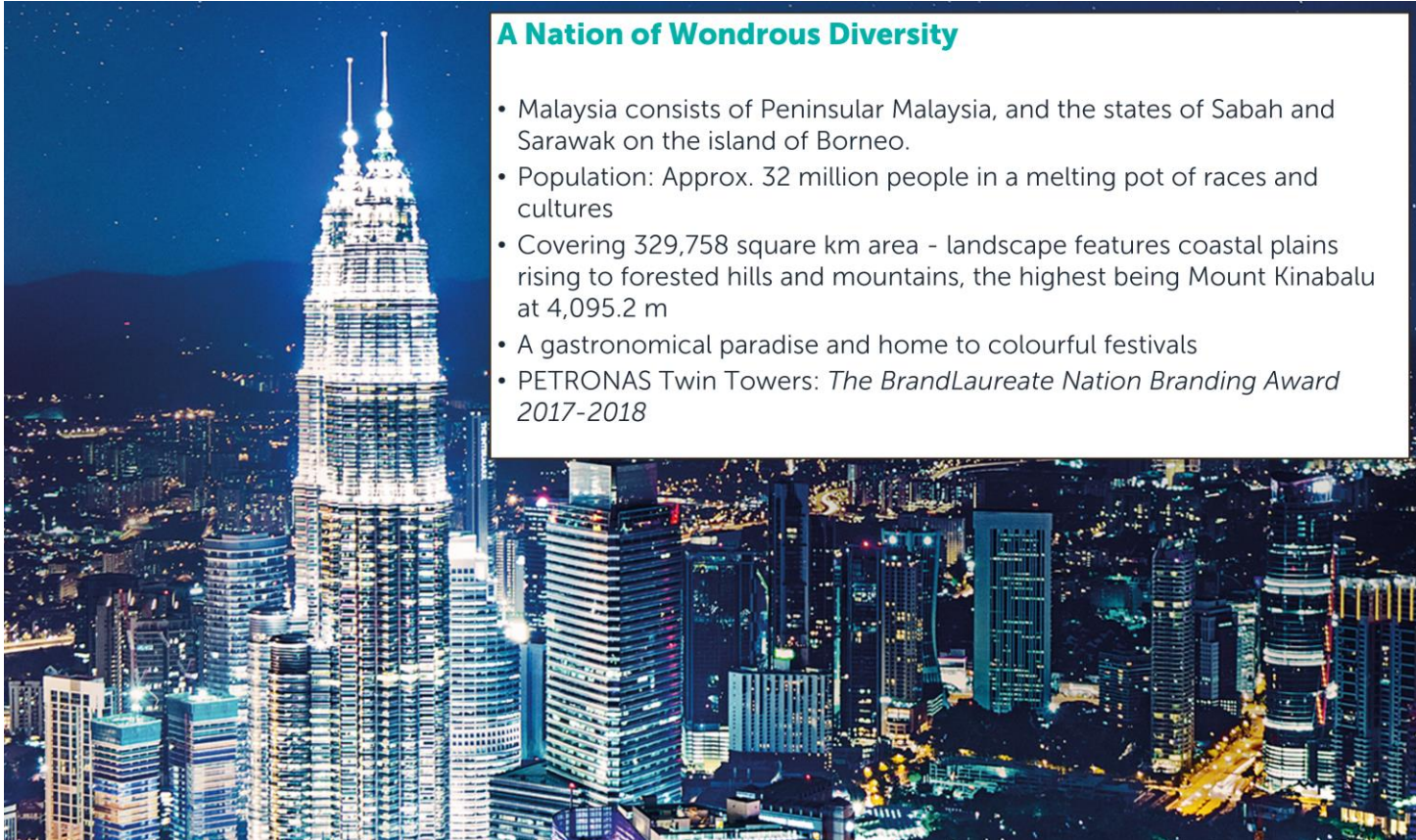
**07**

SUCCESS STORIES

**08**

QUESTION AND ANSWER

# Malaysia at a Glance



## A Nation of Wondrous Diversity

- Malaysia consists of Peninsular Malaysia, and the states of Sabah and Sarawak on the island of Borneo.
- Population: Approx. 32 million people in a melting pot of races and cultures
- Covering 329,758 square km area - landscape features coastal plains rising to forested hills and mountains, the highest being Mount Kinabalu at 4,095.2 m
- A gastronomical paradise and home to colourful festivals
- PETRONAS Twin Towers: *The BrandLaureate Nation Branding Award 2017-2018*

# About PETRONAS

## UPSTREAM



Total LNG sales volume of  
**28.94**  
million metric tonnes



**Over 390**  
BCE LNG loadable  
delivered from the  
PETRONAS LNG Complex  
in Bintulu, Sarawak



Average production  
**2,361** kboe/d

## DOWNSTREAM

Revenue of  
**RM128.0**  
billion

Sales volume at  
**25.2 billion**  
litres

Total of  
**265 million**  
man hours

### Launch of

**NEW**  
**PETRONAS**  
**PRIMAX 95**  
with Pro-Drive

**5-Time**  
Consecutive  
World  
Constructors'  
Champion  
in Formula One™

Roll-out of  
**Setel and ROVR**  
to drive new  
customer  
experience

### Reliability

**97.9%**

### Overall Equipment Effectiveness

**94.4%**

### Petrochemical Plant Utilisation

**91.9%**  
\*Nexant

### Pengerang Integrated Complex (December 2018)

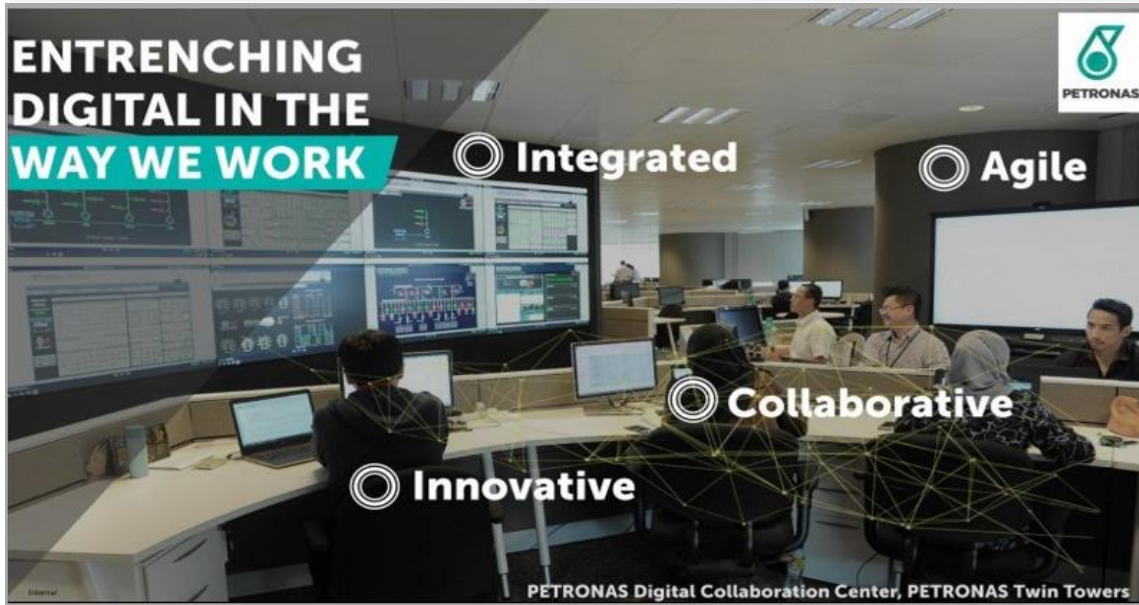
**97%**

\*Source: PETRONAS Annual Report 2018



# What is PROTEAN ?

An online remote monitoring system and predictive maintenance solution for rotating equipment



- Uses existing OSIsoft PI data from remote facilities.
- The data will be analyzed within PI AF software suite running various analytics.
- It detects anomaly at incipient stage and subsequently alert the user for any changes and potential threat to the machine.

# What is PROTEAN ?



PETRONAS UPSTREAM



MALAYSIA

SUMMARY

EQUIPMENT

PTEM

ANALYTIC

KG 2420

GE MS 7001 EA



KT 2420

GE NP NG 40/32



**PROTEAN**  
PETRONAS ROTATING EQUIPMENT ANALYTICS



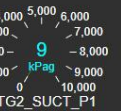
K2420

GE NP AN200



K2430

GE NP 2BCL 806



Driver Operating Summary






Driven Operating Summary



# What is PROTEAN ?

Analytic monitoring display enables monitoring of overall equipment health at glance and suggests focus area

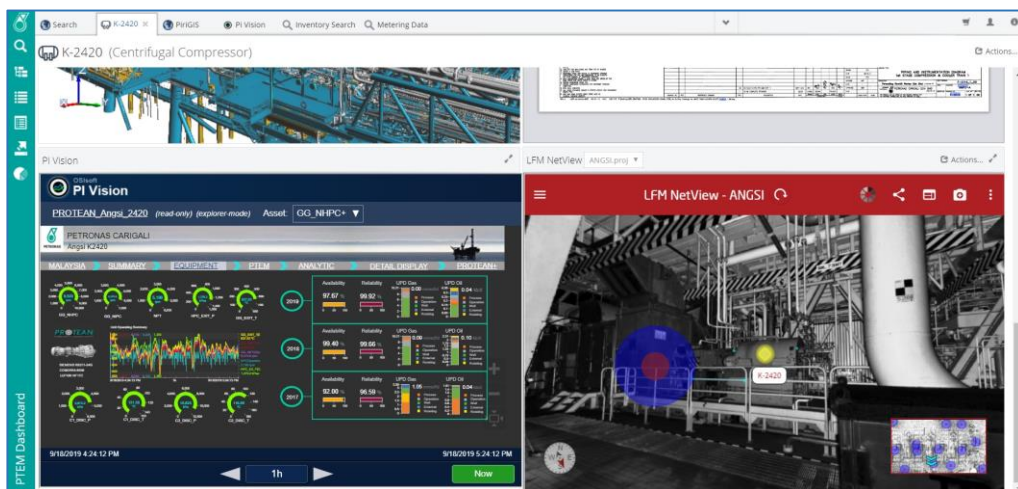
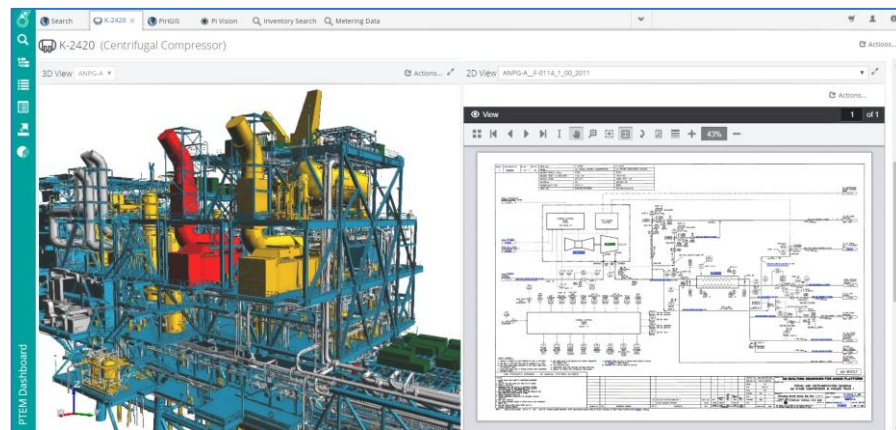
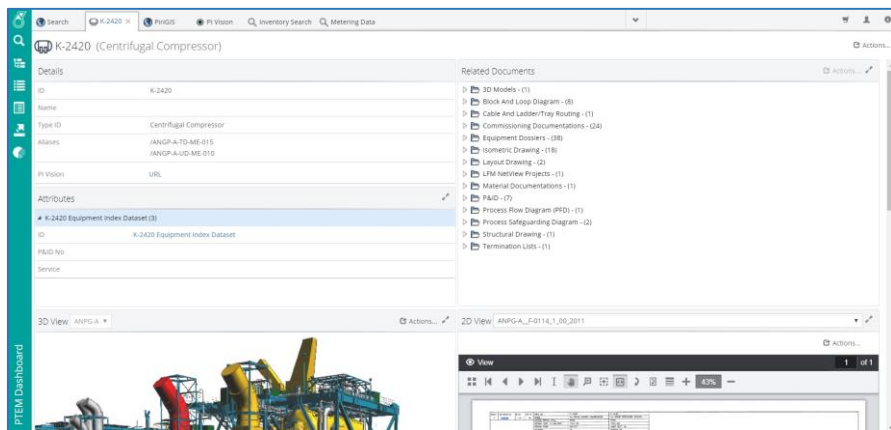
## Legend for Equipment Health

	No concern
	Concern
	Data Quality





# What is PROTEAN ?





# What is PROTEAN ?

## Email Alert Notification & Analytics Report

**Event:** C1 - Comp-C&M 2019-04-15 18:08:00:00  
**Name:** C1 - Comp-C&M  
**Server:** VCENPDTPAIFPS01  
**Database:** PROTEAN  
**Start Time:** 15-Apr-19 06:08:00 PM  
**Target:** SKO/BARAM/BAKP/Compressor/K7100/C1 - Comp-C&M  
**Severity:** None  
**Send Time:** 17-Apr-19 02:19:04 PM

Dear All,

Alert triggered for **Criticality 1 - C1 - Comp-C&M-Pressure Sensor** as below:

No	Name	Fault Code	Operating Value	Low Limit	High Limit
1.	C1_DISC_P1	Normal	7.228357	5.144	8.444
2.	C1_SUCT_P1	High Limit	2.169698	1.175	2
3.	C2_DISC_P1	Normal	11.52411	5.875157	12.17031
4.	C2_SUCT_P1	Normal	6.910936	5.051562	10.80156

Alert triggered for **Criticality 1 - C1 - Comp-C&M-Temp Sensor** as below:

No	Name	Fault Code	Operating Value	Low Limit	High Limit
1.	C1_DISC_T1	Normal	105.9989	76.68771	131.8907
2.	C3_SUCT_P	Normal	96.1365	65.4474	122.0313

Alert triggered for **Criticality 1 - C1 - Comp-C&M-Sensor** as below:

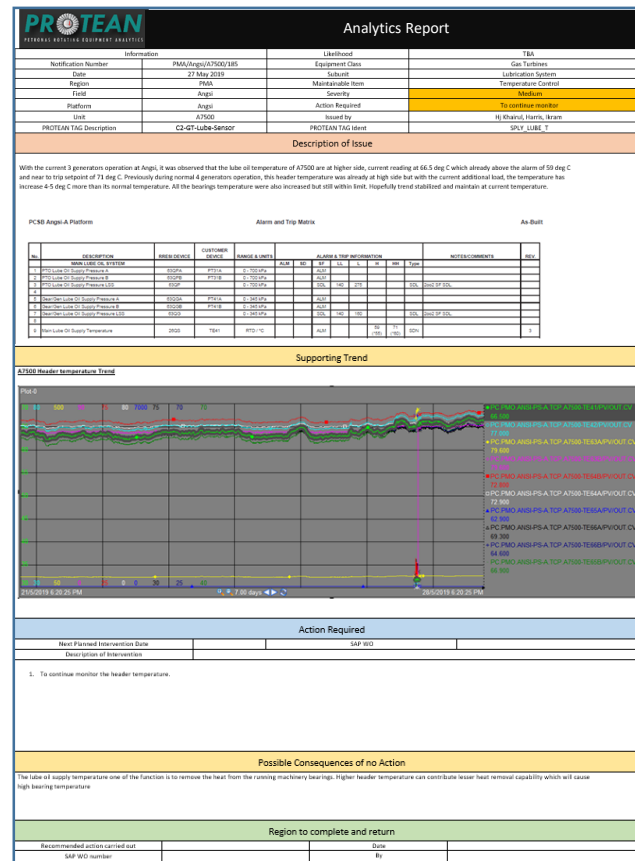
No	Name	Fault Code	Operating Value	Low Limit	High Limit
1.	C3_DISC_T	Normal	98.0059	57.59375	105.9187
2.	C3_DISC_P	Normal	24.92554	0.106876	25.326
3.	C3_SUCT_P	Normal	11.077	0.5204459	11.24899

Check for below hyperlink for details:

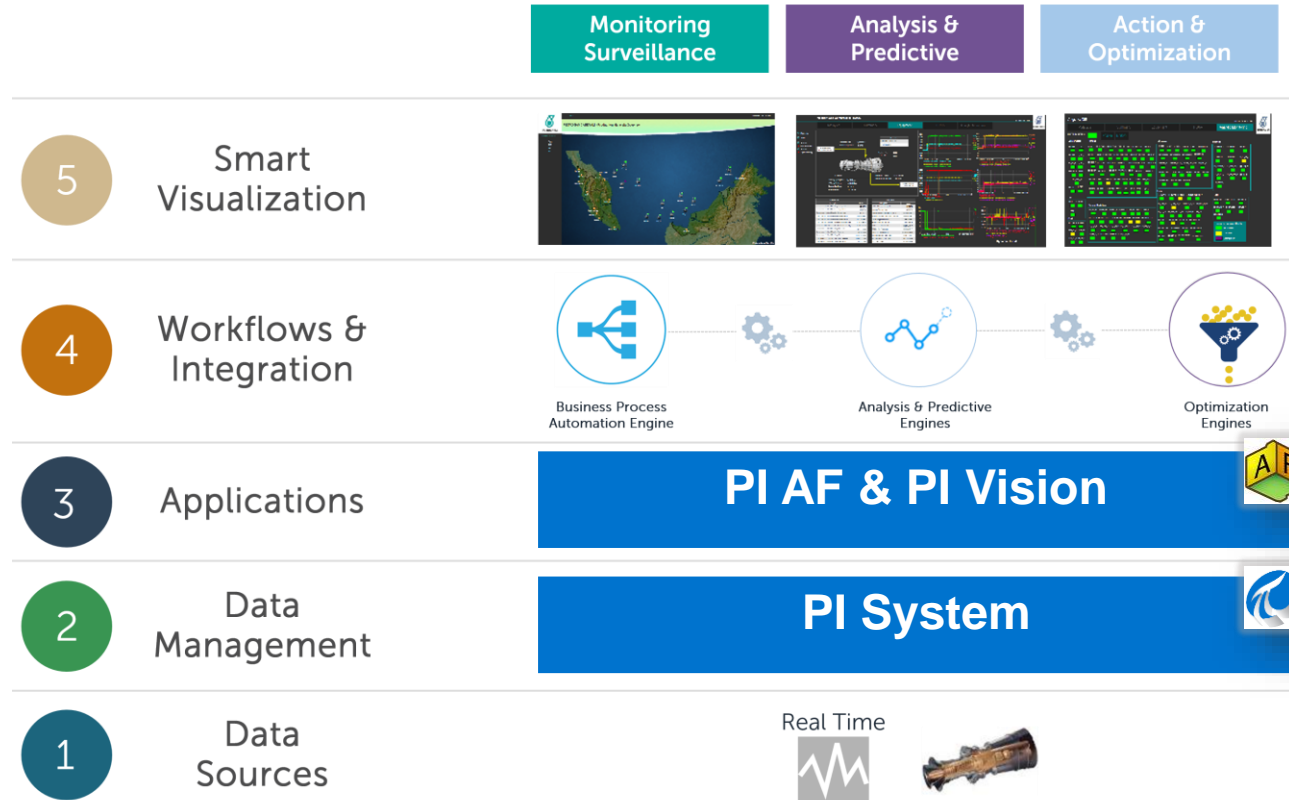
[Event Details Hyperlink](#)

Thank You & Best Regards,

**PI UPSTREAM SUPPORT**  
 Group Technical Data  
 Project Delivery & Technology  
**PETROMAS**



# PROTEAN Solution Architecture



# Protean Capability in 2017 (London)



Simple check  
mechanism



High/low limits on  
analog values



Follow simple  
abstraction



Automatic email  
notification

# Current Protean Capability & Features



Simple check  
mechanism



High/low limits on  
analog values



A distributed  
architecture maximizes  
staff availability



Ability to deal with  
large amount of data



Management of  
diagnostics



Follow simple  
abstraction



Automatic email  
notification



Reporting of alarm and  
machine status



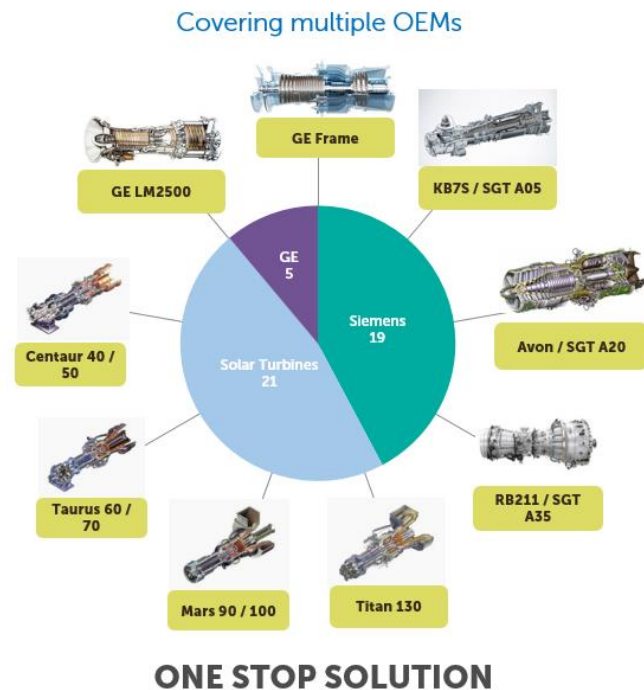
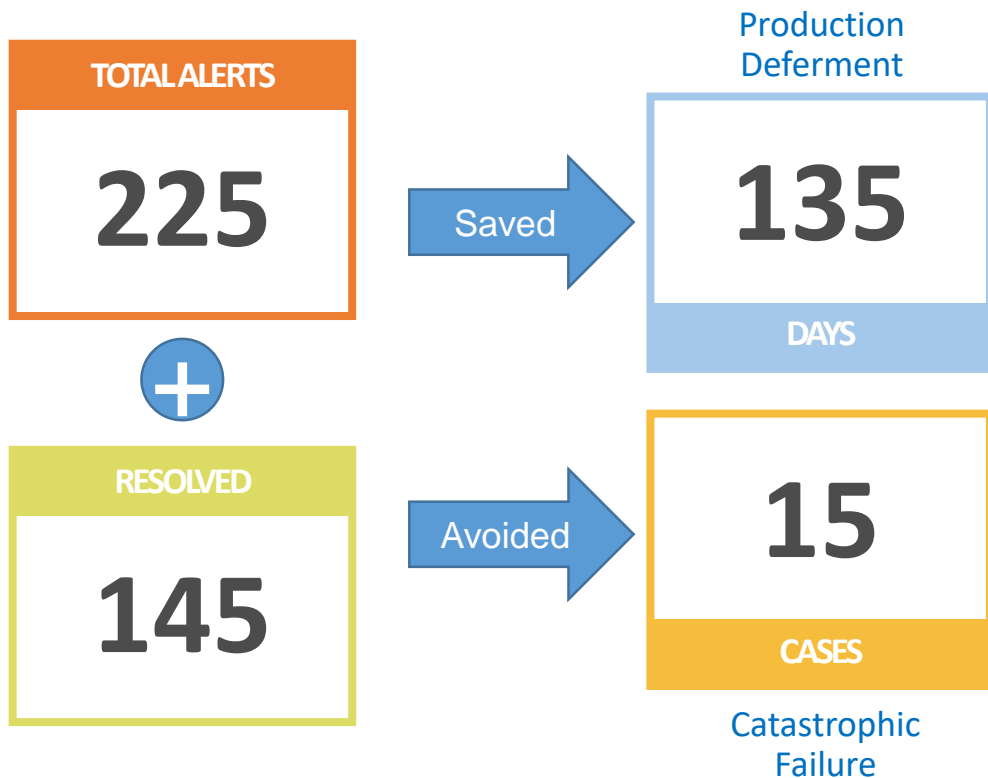
Gradient checker/  
Deviation



Additional support tools  
to identify faults



# What we have achieved so far .....



# Success Stories



**PETRONAS**

# Success Story #1: Safety – Eliminate Fire Hazard

## CHALLENGES

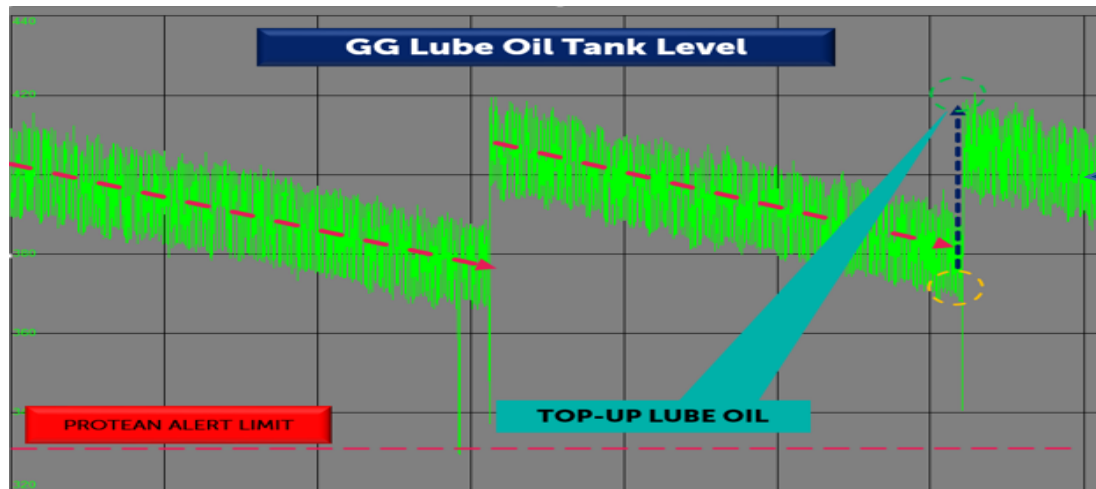
- Abnormal rate of lube consumption - Lube oil tank level drop triggered alert.
- Operator top-up the lube oil without investigating the cause of leak.

## SOLUTION

- Deviation limit triggered and PROTEAN alert notification issued.
- Inspection done and found lube oil leak.
- Unit shutdown and rectified.

## BENEFITS

- Lube oil leak may cause fire (hot surfaces of gas turbine engine and exhaust). Early detection of anomaly and timely intervention had prevented potential fire.
- Cost Avoidance: Equipment damage due to fire.



**Insight**  
Lube oil leak inside Gas  
Turbine Enclosure

# Success Story #2: Prevention of Platform Shutdown

## CHALLENGES

- Instrument air header pressure dropped significantly
- Operator did not notice as the reading was within DCS alarm limit

## SOLUTION

- Alert limit triggered.
- PROTEAN alert notification sent to site Operation team.
- Troubleshoot and resolved the issue.

## BENEFITS

- Early detection of anomaly and timely intervention had prevented total platform shutdown
- Cost Avoidance : 2 days of major production deferment and excessive value leakage (gas flaring)



Insight  
Severe leaking of  
instrument air supply



# Success Story #3: Prevention of Gas Turbine Catastrophic Failure

## CHALLENGES

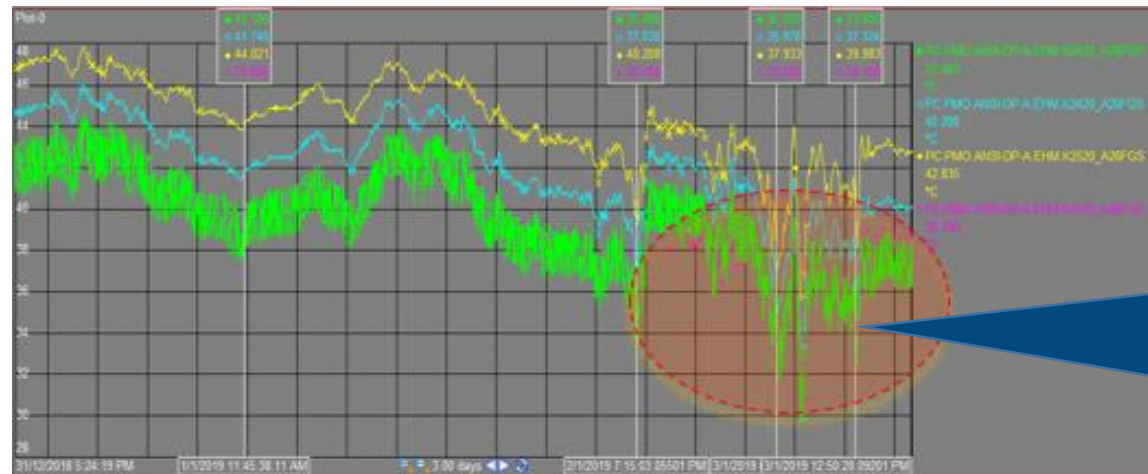
- Fuel gas temperature dropped below dew point during Storm **Pabuk** affecting two (2) gas turbine engines at an offshore platform in South China Sea

## SOLUTION

- Deviation limits triggered and PROTEAN alert notification sent to site Operation team.
- Adjustment made to the superheater firing set-point.

## BENEFITS

- Early detection of anomaly and timely intervention prevent permanent damage and catastrophic failure of the gas turbine combustor liner.
- Cost avoidance : Gas Turbine engine repair and 10 days of gas production curtailment



## Insight

Superheater performance degraded realized during low ambient temperature during storm

# Success Story #4: Prevention of Gas Compressor Prolonged Downtime

## CHALLENGES

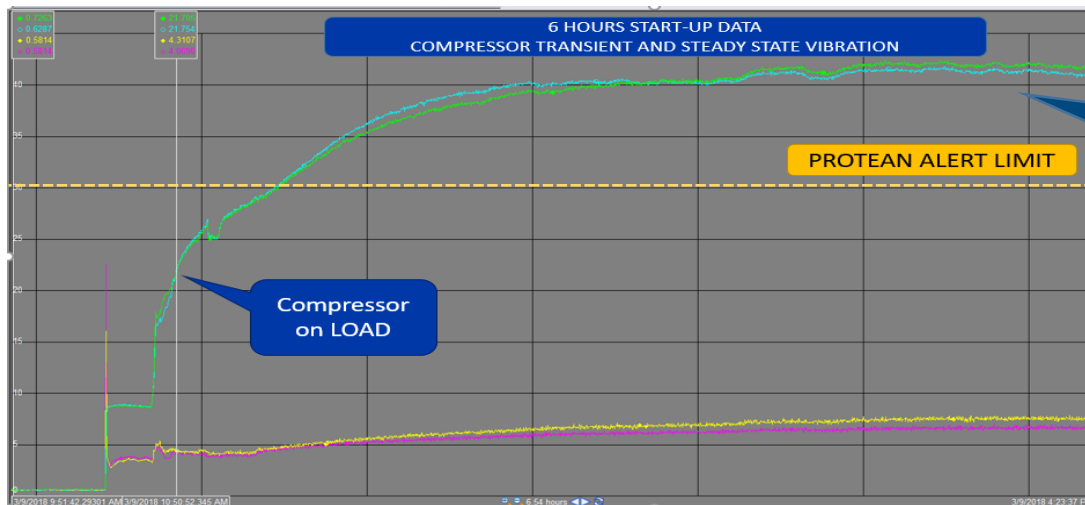
- Gas compressor running exceeded rated capacity during high gas demand
- Operating at higher compressor vibration levels exceeded OEM alarm

## SOLUTION

- Alert limit triggered and PROTEAN alert notification sent to site Operation team.
- Troubleshoot and resolved issue.

## BENEFITS

- Early detection of anomalies triggered detail vibration diagnostic requirement to understand the vibration behavior and its impact during high gas demand (flow). Requirement to run three (3) instead of two (2) trains.
- Cost avoidance : Compressor internal component damage and 14 days production deferment.



## Insight

Changes in Operating Philosophy is required during high gas demand

# Success Story #5: Detect Small & Fix Small – Lube Filter Clogged

## CHALLENGES

- Aero derivative Gas Turbine engine lube oil filters experienced frequent clogging.

## SOLUTION

- Alert limit triggered and PROTEAN alert notification sent to site Operation team.
- Switched to standby filter (duplex system) online without unit shutdown.

## BENEFITS

- Proved that frequent high filter dP was not normal. It indicates the lube was contaminated and prolong running will lead to component damage and catastrophic failure.
- Cost avoidance : 6 hours unplanned production deferment (unit trip) and potential prolonged downtime



Insight  
Contaminated Turbine  
Lube Oil

# Speakers

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# Questions?

Please wait for  
the **microphone**

State your  
**name & company**



# Please remember to...

## Complete Survey!

Navigate to this session in  
mobile agenda for survey

