Predictive Rotating Equipment Analytics (PROTEAN) X AVEVA™ Predictive Analytics

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PROTEAN Increase PETRONAS Upstream Turbomachinery Unit Reliability by up to 4%

**Challenge**
- OEM Solution based subscription becoming uneconomically challenge in high OPEX environment
- Digital solution applied on selective critical equipment instead of masses
- The needs of digitalization is increasing, and centralization effort would benefit the company in long run

**Solution**
- Predictive Rotating Equipment Analytics (PROTEAN) developed by PETRONAS, is a digital solution that enables remote monitoring of rotating equipment anytime, anywhere. Developed with in-house algorithm, PROTEAN is proven highly effective in detecting anomalies in rotating equipment.
- Utilizing PI AF and PI Vision, with AVEVA Predictive Analytics providing the multivariable analysis functions

**Results**
- Operational expenditure (OPEX) and unit maintenance cost (UMC) reduction
- Lower dependency on remote monitoring solutions subscription
- Higher unit reliability for rotating equipment (up to 4%)
- Capability building through digital retooling
• PROTEAN Anomalies Detection
   PROTEAN provides predictive alerts to user when the machine operates beyond its normal operating limit, indicating potential anomalies

• PROTEAN+ Centrifugal Compressor Performance Benchmark
   Using digital twin of compressor performance, PROTEAN provides the expected performance of the compressor and indicates potential deterioration – not applicable for PECL

• PROTEAN+ Gas Turbine Performance Benchmark
   Using data driven approach, PROTEAN provides the benchmark of gas turbine performance based on zero-hour unit

• PROTEAN+ Multivariable*
   PROTEAN provides the digital twin of the predicted value for critical equipment parameter and detects anomalies based on deviation between predicted and actual value under collaboration with AVEVA Predictive Analytics

• PROTEAN+ FMEA Prescriptive Library
   PROTEAN provides automatic prescriptions of potential failures based on in-house technical library

• PROTEAN+ Greenhouse Gas (GHG) Emission Monitoring
   PROTEAN monitors the equipment’s green house gas emission based on real time performance – subjected to availability of required parameters
PROTEAN Aspiration and Journey Ahead

2017

PROTEAN Pilot
@ Angsi
12 Alerts
1st Pilot under collaboration with PMA

2018

55 Trains
=147 Alerts
- Move to PDCC
- Collaboration with UTP and Texas A & M University

2019

129 Trains
=274 Alerts
- PFLNG1 selected PROTEAN
- IET Industry Award

2020

200 Trains
=502 Alerts
- PFLNG2 selected PROTEAN
- Successfully replace all OEM Remote Monitoring Solutions for Upstream

2021

255 Units
=744 Alerts
- PROTEAN Mobile Apps
- ATPS 2021
- TRL#7
- PETRONAS IP
- IEM Industry Award

2022

~300 Units
=1000 Alerts
- MLNG selected PROTEAN
- Commercialization
- ATPS 2022
- PROTEAN+ GHG Emission
- Expansion to Indonesia and Canada

2023 Onwards

Agile Solution
PROTEAN supporting MFT 50.30.0

50% Improvement on Operation Cashflow
Cost Avoidance via PROTEAN Predictive Alerts

Collaboration with AVEVA Predictive Analytics

GHG emission 2024
MA COB tCO₂e

PROTEAN GHG Emission monitoring and collaboration with CMD

Million for Yearly OPEX on Remote Monitoring under OEM

Millions for Yearly OPEX on Remote Monitoring under OEM
Protean Coverage And Equipment Population

550
Total Equipment

>225k
Total daily analysis

>200k
Monitored tag

1300
Total PROTEAN alerts

121
Gas Turbine

62
Generator

87
Electric Motor

10
Steam Turbine

132
Compressor

99
Pump

16
Turbo Expander

20
ICE

PROTEAN cover PMA | SKA | SBA | IA | PFLNG1 & 2 | MLNG 1,2,3 total of 550 numbers of major rotating equipment with total asset value of more than USD500 Mill

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PROTEAN Operationalization and Centralization Effort to make the tool sustainable

Establish One Monthly Forum with Assets Stakeholders
Point of discussions; Rotating Bad actors, UPDs

Identify Opportunities for Improvement
Continuous monitoring and engagement with Assets to monitor performance

Deep Dive on Operation Level
Historical events are available in PROTEAN page

Establish Core Team
Synergy between Rotating, Reliability Asset, and PDCC

Rotating Digital Solutions Operating Model

Deep Dive PROTEAN Availability Reliability Dashboard
Strategic and Tactical Approach
Identity historical trends
Focus on Bottom 10 lowest reliability

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Implementation selection criteria and consideration

- Asset Grading
- Equipment Criticality
- Historical Failure
- Equipment Function
- Data Connectivity / Readiness
- Solution Features

### Commercial Investment
- CAPEX
- OPEX
- ROI

### Operating Mode
- Asset Based Monitoring Centre
- Centralized Monitoring Centre

### Capability Building
- Internal
- Hybrid
- External / Outsource
PROTEAN has surpassed 1300 Predictive Alerts on 29th September 2023
2 Years Side by Side Monitoring for 4 PETRONAS Upstream Machines (BeC C586, DL CD563, BRM K2400 and BR K7130)

31 Genuine Alerts
6 Cases

SK BR KT-7130 GT MECH
- Alarm on bearing Cooling Air Temperature
- Increase of Axial Movement (sensor 1&2)

SK BR K-7130 MULTISTG CENT COMP STG1
- Primary seal DE & NDE are increasing trend

PM BEC C- C586
- HP Casing Seal DE & NDE Pressure

PM DL-B CD-563 COMP
- Casing vibration having step increase
- Lube oil header reading at lower pressure

PM BEC C- C586
- Lube oil header reading at lower pressure

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AVEVA Predictive Analytics for PROTEAN moving forward

Adding critical insights to improve the safety, reliability, and sustainability of your operation

Results from AVEVA Predictive Analytics

Forecast results
Predicting Asset Failures Before They Occur

- Leveraging and utilizing AI and machine learning to detect asset performance anomalies ahead of potential failures, without any coding.

- Visualizes sensor data from rotating equipment and correlates it with predictions from AVEVA Predictive Analytics.

- Provides monitoring, analysis, and predictive/prescriptive analytics that enhances diagnostic efficiency while providing better decision support.
AVEVA Predictive Analytics for PROTEAN

Utilizing AI and machine learning to detect asset performance anomalies ahead of potential failures, without any coding.
AVEVA Predictive Analytics for PROTEAN

Visualizes sensor data from rotating equipment and correlates it with results from AVEVA Predictive Analytics.
AVEVA Predictive Analytics for PROTEAN

Provides monitoring, analysis, and predictive/prescriptive analytics that enhances diagnostic efficiency while providing better decision support.
Questions?

Please wait for the microphone.
State your name and company.

Please remember to...

Navigate to this session in the mobile app to complete the survey.

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