Total Energies: Predictive Analytics from O&G to Renewables

Remote monitoring for equipment failure prediction

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Summary

1. The Genesis
2. An Integrated & Centralized Monitoring Center
3. Feedback & Benefits
4. What’s next …. 
Remote Assistance Intervention & Diagnosis
The Genesis
Genesis of the RAID - EP

From 2006 to 2010

- Growing fleet – more than 4.5 GW installed

- Increased number of mechanical failures across TotalEnergies

- E&P 2009 – Accident offshore with severe consequences

Analysis

71 GT Failures

- 31% Unpredictable failures
- 69% Predictable failures

34 Centrifugal Compressors failures

- 18% Unpredictable failures
- 82% Predictable failures

Among 105 breakdowns recorded, half of them could have been avoided with a proper remote monitoring and condition-based maintenance
Remote Assistance Intervention & Diagnosis
An Integrated and Centralized Monitoring Center
Principles

Remote Monitoring
- Does not request additional sensors
- Rely on PI data
- Processes PI data with softwares

Packages Instrumentation
- Turbocompressor: ~250 sensors
- Turbogenerator: ~200 sensors
- Critical Moto pump: ~100 sensors

PI Data retrieval
Datasets every 10 minutes (NOT a strict real time)
Mid term to long term support

• Anticipation of slow temporality phenomena vs. rapid events (High Cycle Fatigue)
• Detection ~50%
Remote Assistance Intervention & Diagnosis Towards Operation Excellence

Use of Predictive Analytics suite for anticipating critical machinery failures

Centralize the TotalEnergies’ Monitoring In House
- Analyze the entire process around each machine
- Correlate similar issues and experience through our extended fleet
- Capitalize on Internal Competences developed and Operational Data

Maintenance Philosophy
- Prefer condition-based maintenance vs. planned maintenance
- Extend gas turbine MTBO

Improve Operational Efficiency

RAID acts as an Advisor ➡ No Interference with daily Operation or Site Personnel
Deployment Status – TotalEnergies Operated Assets

**Downstream (PRISM)**
- Deployment started **2018**
- 7 LBUs
- **172** shaft line monitored ~10,000 alerts/y
- **210** catches/y (2022)

**Electrical Combined Cycle Power Plant (PRiSM/Other)**
- Deployment started **2022**
- 3 CCGT
- **19** shaft line monitored

**Upstream (Other)**
- Deployment started **2013**
- 10 Affiliates
- ~**320** shaft line monitored
- ~**36,000** alerts/y
- **429** catches/y (2022)

*catch: alert leading to corrective action*
Remote Assistance Intervention & Diagnosis

Feedback and Benefits
RAID Benefits after 10 years

Prevent failures brings Direct savings...
- Production shortfall avoided – half a day of yearly Upstream Production in 2022
- Potential Downtime saving (0.07% in RC in 2020)
- Avoid catastrophic failure (no more predictable one since) and plan for repairs

... and valorizing the operation data, Long term savings
- Optimize maintenance intervals
- Enhance asset management vs. OEM

Foster our internal capabilities to build tools
- Online Gas Turbine CO₂ Emission monitoring
- Centralized Centrifugal Compressor Performance monitoring
- Power Reserve monitoring tool

Focus on the most strategic and value-added topics
04.

Remote Assistance Intervention & Diagnosis

What’s next…
Our vision for TotalEnergies in 2050

2021 energy mix

- Oil: 44%
- LNG & Gas: 48%
- Renewables & Electricity: 7%
- New Molecules: 2%

2050 energy mix

- Oil: 50%
- LNG & Gas: 25%
- Renewables & Electricity: 25%
- New Molecules: 50–100 Mt CO₂e

To preserve the planet in the face of the climate challenge, we are moving forward, together, towards new energies.

OIL GAS ELECTRICITY HYDROGEN BIOMASS WIND SOLAR
Focus on Wind – RAID Roadmap

Wind turbine monitoring
- Customized & create templates
- Develop specific models
- Develop specific diagnostics

Wind farm monitoring
- Customized templates
- Develop specific models
- Develop specific diagnostics

Application to wind energy
- Balance of plant
- Farm production
- Global turbine availability
- Plant performance
- Yield model analysis
- Capitalize on data
- Weather History
- Climate change impact on yield
- Follow-up contractual aspects
- Support dialogue with OEM
- Be part of the world’s industrial leader in the Renewables

Upskilling competencies and Continuous Improvement Toward Operation excellence
Questions?
Please wait for the microphone.
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Backup
RAID
Feedback on Cases

• 2,462 Cases raised since January 2016

  • Half of the cases raised lead to a corrective action on site

Cases Breakdown:

- Equipment: 44%
- Performance: 13%
- Instrumentation: 40%
- Auxiliaries: 3%
PRiSM Catch Example – DGS primary seal failure

Issue
RAID operator observed pressure and flow from NDE primary seal gas gradually increased, which is a serious indication of primary seal wrong behaviour.

Potential
Serious indication of either an open primary seal or damaged seal.

Solution
Recommendation to check first sensor and then stop the machine until the issue is ruled out with a seal change.

Outcome
Primary seal found leaking (hang-up faces) and seal gas not 100% clean (process related). Not detected by site team as at the time, surge tuning on going on compression train.
PRiSM Catch Example – Oil cooler efficiency loss

**Issue**
RAID operator observed DE & NDE bearings temperature increase simultaneously with lube oil temperature too.

**Potential**
Miscalibrated sensors or lube oil cooler efficiency loss.

**Solution**
Recommendation to check first sensor and then verify lube oil cooler operation.

**Outcome**
Lube oil cooler found heavily clogged. Swapped to spare one and then later replaced. Avoid stop of vapo-cracker compressor and then of complete refinery train.
PRiSM Catch Example – Vibrations increase

Issue
After start-up, DE & NDE bearings vibrations found much higher, at same load, than before shutdown.

Potential
Faulty sensors, damaged shims on coupling, misalignment, unbalance, ....

Solution
First perform instrumentation check and if ok, perform vibration analysis to find root cause.

Outcome
Unbalance, due to compressor fouling.
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