B.Grimm Power’s Maintenance Strategy Optimization by Data-Driven Approach

A Discussion plus Case Study

Michael T. Reed – Sr. Manager, AI Center of Excellence, AVEVA
Chih Hsing Tu – Maintenance Center, RdM Department Lead, Formosa Petrochemical Corporation
Wenting Zhu – Sustainability Program Manager, AVEVA
B.Grimm Power’s Maintenance Strategy Optimization by Data-Driven Approach
Tichaya Janngio
Senior Key Account Manager
• B.Grimm Technologies Company Limited
• tichaya.j@bgrimmgroup.com

Tanapat Techawuthikorn
Customer Success Manager
• Rayong Engineering and Plant Service Company Limited
• tanapatt@scg.com
145 YEARS OF B.GRIMM

Doing Business with Compassion for the Development of Civilisation in Harmony with Nature
B. Grimm Technologies Introduction

We provide innovative industrial systems solutions, together with sustainable energy and digital technologies.
B.Grimm Technologies Introduction

Solutions that pioneer change, through innovative processes and products for the world

Energy
- Energy Source (LNG, Clean Energy Source, CO₂ Emission Reduction)
  - B.Grimm Metalworks
  - B.Grimm Technologies
  - Chubb
  - KSB Pumps

Energy Generation (Cogeneration, Renewable, Hybrid Solution)
- Energy Technologies (Smart Grid, Transmission & Distribution, Energy & REC Trading, Solar Rooftop, Battery Storage)
  - B.Grimm Power PCL.

Industrial
- Building Materials
  - MBM Metalworks
  - B.Grimm Technologies
  - Chubb
  - KSB Pumps

Healthcare
- Medical Services
  - PrimoCare Medical
  - MSK

Digital
- Cyber Security
  - 22kN

Lifestyle
- Sport Club
  - Thai Polo & Equestrian

Investment
- Real Estate
  - B.Grimm Real Estate

- Investment
  - B.Grimm Capital Partners

- Education
  - Harbour, Space University

- Transportation
  - Panrail
  - PCM

- Medical Devices
  - Getinge
  - Zeiss

- Energy Equiments
  - B.Grimm Babcock Power
  - Hamon-B.Grimm

- Digital Solutions
  - Vault Dragon

- Financial Comparison Platform
  - Masil Group (Thailand)
  - Savings Asia

- Arts and Fashion Retail
  - Ma Maison
  - The MET Store Thailand
  - Nymphenburg

- Restaurant
  - Provence Restaurant

- Spa
  - Paris Spa
Digital Transformation in B.Grimm Corporate

B.Grimm Technologies Company collaborates with expert partners, REPCO NEX to develop and deliver innovative technologies to B.Grimm Corporate and Thai Industry.

Digital Technologies Increase Asset Competitiveness by Maximize Power Plant Uptime.

B.GRIMM Technologies

B.Grimm Technologies Company brings innovative technologies to B.Grimm Corporate.

REPCO NEX is practitioner who kill the pains with proven successes in applying digital technologies to maximize asset performance either in the aspect of reliability and lifetime.
Customer Success is our primary goal

Exceptional Customer Satisfaction is our service effort for sustaining long term relationship

Tangible impact products & services to empathize Customer’s Pain Points are professionally delivered with proven engineering facts and our 30 years’ practical expertise
REPCO NEX Digital Reliability Center
(Unified Operation Center for Asset Digital Twin)
Steam turbine major overhaul is scheduled at time-based interval of 6 years by OEM.

The thorough steam turbine inspection is usually conducted in major overhaul program leading to a big maintenance activity consuming large resources and long total plant outage duration.

The optimized strategy especially from extending major overhaul schedule can lead to huge benefits from:
- Shorter outage duration
- Reduced maintenance cost
- Lower risk of failures induced by unnecessary action

However, there is concern whether power plant can be safely and reliably run until next outage schedule.
Major Overhaul Extension Justification Approach

“To ensure that outstanding risk from major overhaul extension well known & controlled by RAGAGEP (Recognized And Generally Accepted Good Engineering Practices).”

1) PAST PERFORMANCE
2) CURRENT CONDITION REVIEW
3) FUTURE RISK MANAGEMENT
Past Performance Review and Current Condition Assessment

- All major troubles occurred in the past were prevented after RCA.
- No sign concerning turbine internal parts observed from the record.
- Machine was found in good condition from history trend.

STEAM TURBINE MAJOR TROUBLE CAUSE

- Control & Instrument Failure: 50%
- Mechanical Failure (External Part): 4%
- Contractor Workmanship: 31%
- Weak Design: 12%
- Human Error: 3%
Risk Assessment after Strategy Optimized

**Key Concern** if Strategy Optimized to Internally Inspect Steam Turbine based on Risk

- Age-Related **Degradation**
- Non Age-Related Failure **Detection Capability**
- How to **Locate The Failure** Detected

The Event of Steam Turbine Tripped by Axial Displacement Suddenly Increased
Age-Related Failure Concern Solved by Life prediction model showing ST life longer than next outage schedule

- **Key machine condition data**, such as vibration and bearing temperature, **were analyzed by life prediction model**.
- **No sign of degradation from all parameters**, but axial bearing temp prediction show potential risk.
- So it was decided to maintain that bearing inspection task in every 3 years with no major impact on plant outage duration.
Non Age-Related Failure Concern Solved by Anomaly Detection Model Capable of Early Detection 2 Months in Advance

If anomaly is notified, we can mitigate unplanned shutdown impact by:
- Extend remaining life from maintain load stable and gradually change load if needed
- Co-ordinate with Grid Operator to avoid fine on unplanned interruption
- Plan for manpower and spare part
**Example of Shaft Centerline Plot**

**Construction of Orbit Plot**

**Amplitude 0.20 ml / div X to Y (CCW)/ Rotation**

<table>
<thead>
<tr>
<th>PLOT</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall trend</td>
<td>Overall machine condition</td>
</tr>
<tr>
<td>2. Spectrum</td>
<td>Failure mode identified from frequency component in spectrum</td>
</tr>
<tr>
<td>3. Phase</td>
<td>Unbalance phase conditions of rotor indicating rotor mass conditions</td>
</tr>
<tr>
<td>4. Shaft centerline</td>
<td>Average shaft movement in bearing clearance by reference with bottom of bearing</td>
</tr>
<tr>
<td>5. Orbit plot</td>
<td>Dynamic shaft movement in bearing clearance related with rotor dynamic behavior</td>
</tr>
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</table>

**INSTRUCTION TASK**

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>VIBRATION ANALYSIS</th>
<th>BEARING TEMP.</th>
<th>LUBE OIL ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor unbalance</td>
<td>F G G G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor bending</td>
<td>F G G M G</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Coupling unbalance</td>
<td>F G G M G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotating unit damage</td>
<td>M G G F M F F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor crack</td>
<td>F M M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubbing</td>
<td>F M M G G M F F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misalignment</td>
<td>F M M G G</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Resonance</td>
<td>F G G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buried bearing defect</td>
<td>F F M M M F F F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotating stall</td>
<td>F M M</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Surging</td>
<td>F M M</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Oil whip</td>
<td>F G M G</td>
<td></td>
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<tr>
<td>Lube oil degradation</td>
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Optimized Strategy is Justified

- Justification is made from;
  - Steam turbine past performance review => OK
  - Current steam turbine condition assessment => OK
  - Future Risk Assessment => Risk mitigated by;
    - Improve condition monitoring program
      - Monitoring by Predictive Analytics
      - Turbomachinery Diagnosis
    - Keeping necessary spare parts

- Decision on opening turbine casing for internal part inspection/recondition can be made by condition based instead of time based fixed every 6 years.
During Predictive Analytics Model Implementation, Lesson Learnt and Solved by ONE Team ONE Goal

Unforeseen Issues

- Lack of Knowledge for Design Model
- Data Historian Capability Limitation
- Hardware Limitation
- Limited Data Export from OEM HMI
- Data Quality
- Standardized Data Export Practice
- Upgraded Data Historian
- Upgraded Hardware Spec
- Offline Monitor Manual until OEM Real-Time Data Completely Available
- AVEVA Expert Support

Solution
Highlight Catch and Finding After Model Go Live

Plant: Co-Gen Thermal Plant 130MW
Machine: GT12
Model: Mechanical
Event: Lube oil supply temperature was detected abnormally high than predicted value on 28 April 2022.
Action: Although the temperature was still lower than interlock setpoint recommended by OEM, running the machine at too high lube oil temperature could shorten bearing lifetime. Then O&M investigated related equipment condition and found that cooling water flow had been improperly adjusted. After cooling flow valve position was well set, lube oil temperature returned to normal value as predicted by the model.
Saving: This lube oil is supplied to 9 sets of bearings at gas turbine, gearbox and generator. Timely correction on abnormally high lube oil temperature has saved unnecessary bearing replacement at cost approx. 0.2MUSD.
Knowledge & Skill Transfer Under Long Term Partnership Program

Pilot Phase
REPCO NEX : BGP  
80 : 20

Scale-Up Phase
REPCO NEX : BGP  
20 : 80

REPCO NEX : Subscription Operating Model with OJT for BGP

REPCO NEX : Based line technical local support with robust back-up by global AVEVA team

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<th>BGP</th>
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Challenge
• Shorten plant outage duration by optimizing maintenance strategy without jeopardizing its reliability and performance
• Asset condition monitoring capability in-place insufficient
• O&M staffs inexperienced in big data analytics

Solution
• Deploy AVEVA™ Predictive Analytics™ to detect early sign of failures and conduct turbomachinery diagnosis to locate the defect under long term partnership program

Results
• Shorten outage duration 50% and reduced maintenance cost gaining >1MUSD
• Lower risk of failures induced by unnecessary action and more reliable operations until next outage schedule
• Enable O&M staffs maximize value from their own data and sustain the new digital tool
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.

Thank you!