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

A Discussion plus Case Study

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B.GRIMM SINCE 1878

REPCO NEX INDUSTRIAL SOLUTIONS

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

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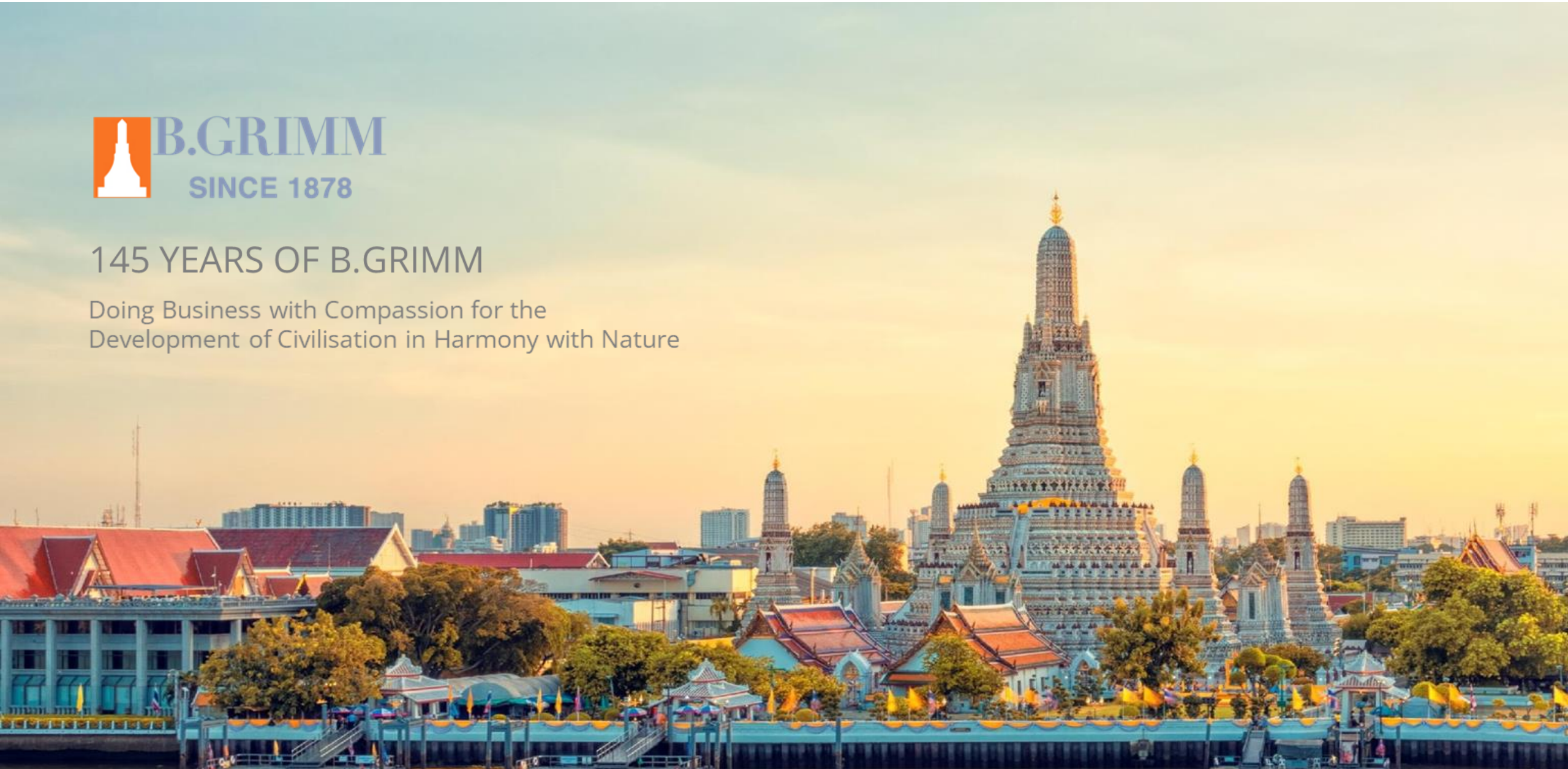
B.Grimm Technologies Introduction

REPCO NEX
INDUSTRIAL SOLUTIONS



B.Grimm Technologies Introduction

We provide innovative industrial systems solutions, together with sustainable energy and digital technologies

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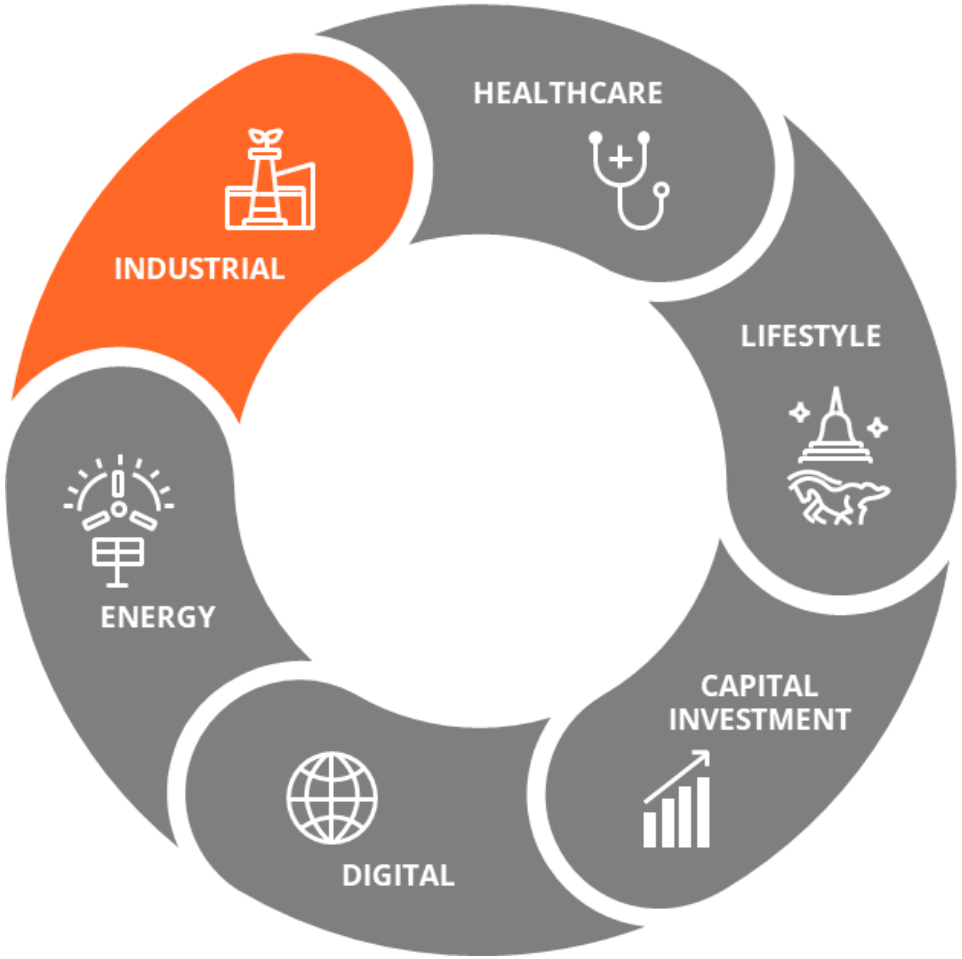
INDUSTRIAL SOLUTIONS



B.Grimm Technologies Introduction

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

REPCO NEX INDUSTRIAL SOLUTIONS

Energy

Energy Source
(LNG, Clean Energy Source, CO_2 Emission Reduction)

Energy Generation
(Cogeneration, Renewable, Hybrid Solution)

Energy Technology
(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

Cooling
- B.Grimm Carrier
- B.Grimm Airconditioning
- Beijer B.Grimm
- Carrier Thailand
- The Unisus Green Energy

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

Transportation
- Panrail
- PCM

Healthcare

Medical Services
- PrimoCare Medical
- MSK

Pharma
- Merck
- Biomonde
- ZenBio
- B.Green

Digital Solutions
- Vault Dragon

Medical Devices
- Getinge
- Zeiss

Digital

Cyber Security
- 22kN

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

Micro Financing
- Siam Digital Lending

Lifestyle

Sport Club
- Thai Polo & Equestrian

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

Restaurant
- Provence Restaurant

Spa
- Paris Spa

Investment

Real Estate
- B.Grimm Real Estate

Investment
- B.Grimm Capital Partners

Education
- Harbour.Space University

Digital Transformation in B.Grimm Corporate

B.Grimm Technogies 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 INDUSTRIAL SOLUTIONS

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.

REPCO NEX
INDUSTRIAL SOLUTIONS

ABOUT US

Since 2001

We are **THE INNOVATIVE INDUSTRIAL SOLUTIONS PROVIDER** offering **ONE STOP SERVICES** with more than **40 YEARS EXPERIENCES** for more than **20 PLANTS** with over **5,000 CRITICAL ASSETS.** As a solution practitioner in the petrochemicals industry, we bring our experiences and proven innovative solutions that will help you increase the utmost production efficiency and reliability.

10-30% Increase Productivity	50-90% Reduce Unexpected Downtime
30-50% Extend Asset Lifetime	30-50% Improve Safety & Compliance

"Your Trustworthy Industry Solutions Partner"

- **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

Digital Reliability Platform

HYDROCARBON PROCESSING 2021 AWARDS

BEST ASSET MONITORING TECHNOLOGY WINNER

SCG

AVEVA

REPCO NEX Digital Reliability Center

(Unified Operation Center for Asset Digital Twin)

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Original Steam Turbine Maintenance Strategy

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- **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

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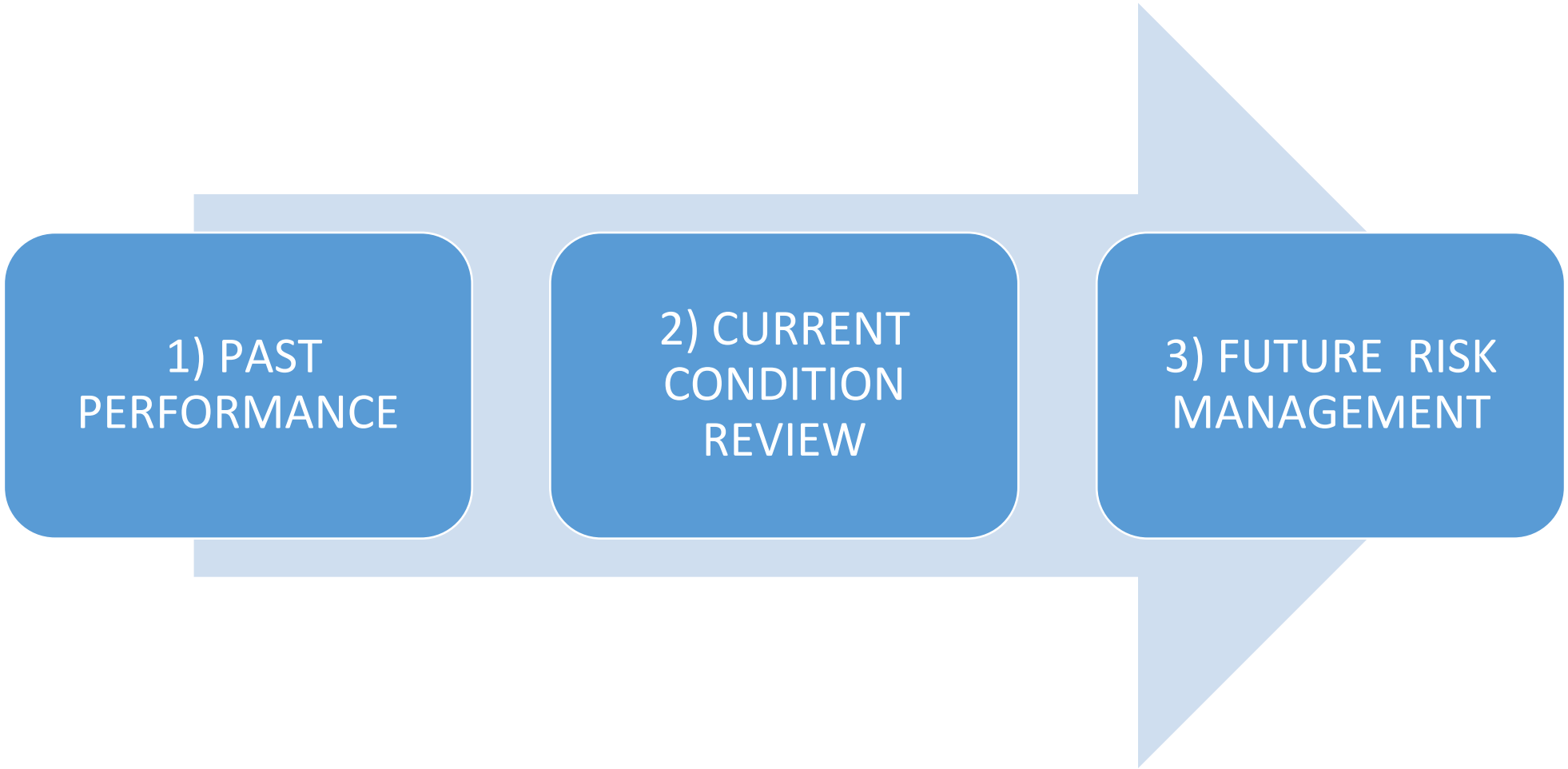
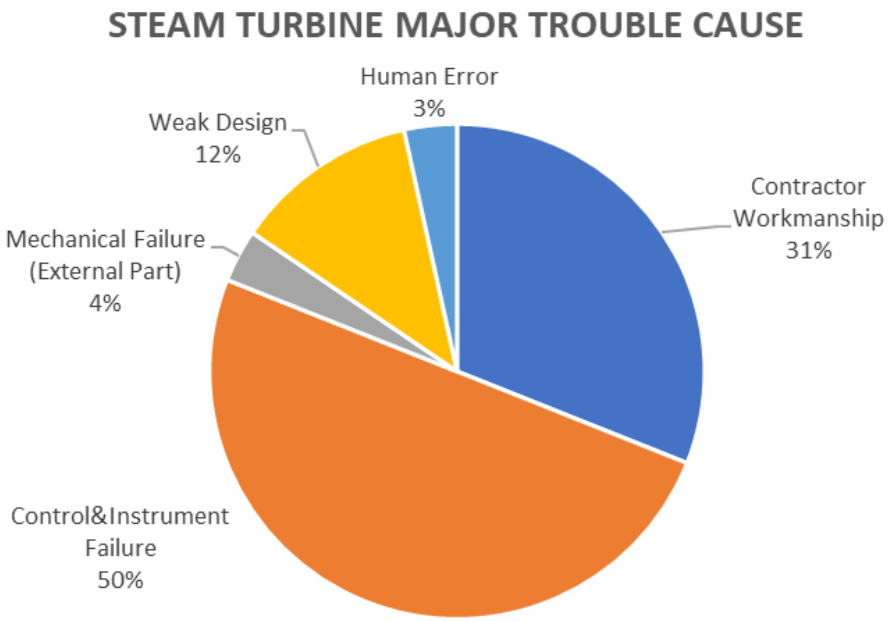
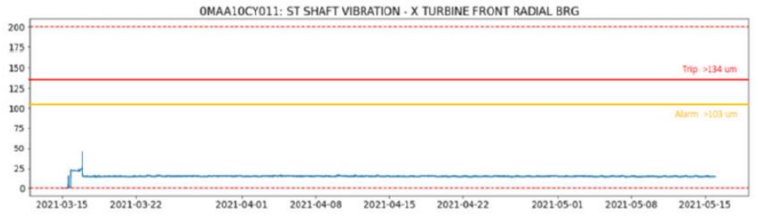
*"To ensure that **outstanding risk** from major overhaul extension **well known & controlled by RAGAGEP** (Recognized And Generally Accepted Good Engineering Practices)."*

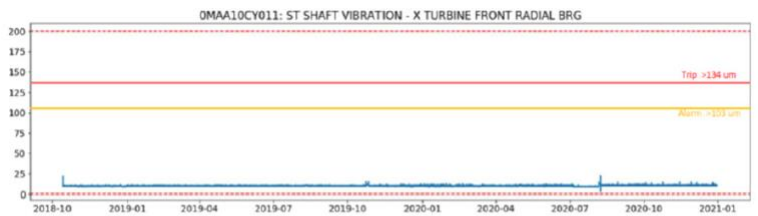


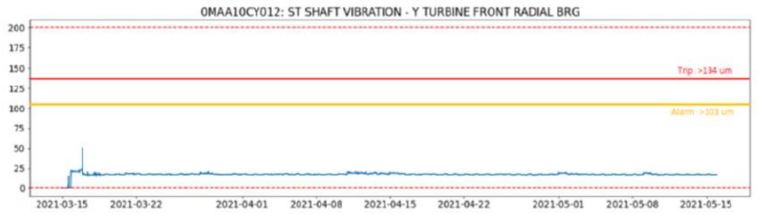
Past Performance Review and Current Condition Assessment

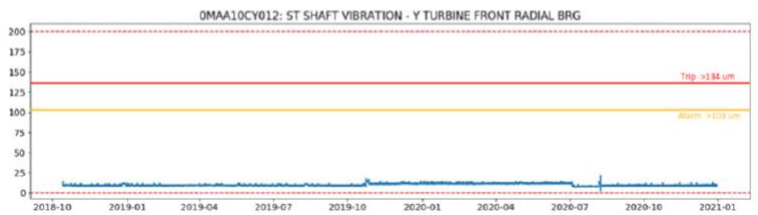
- **All major troubles occurred in the past were prevented** after RCA.
- **No sign concerning turbine internal parts observed** from the record.
- **Machine was found in good condition** from history trend.

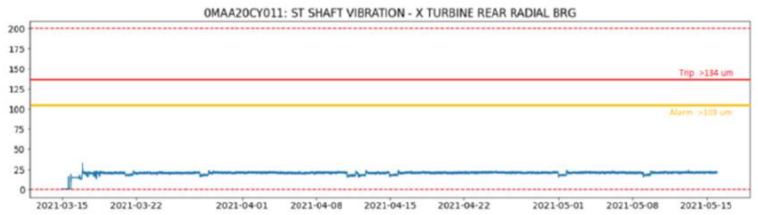


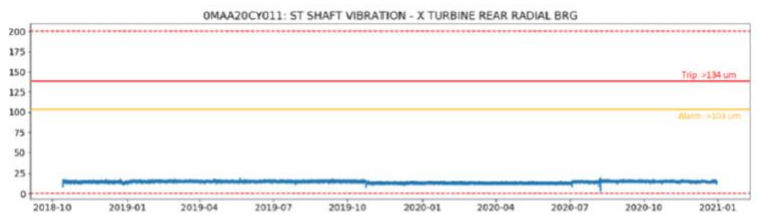


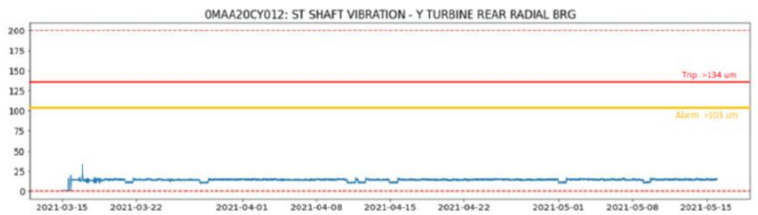


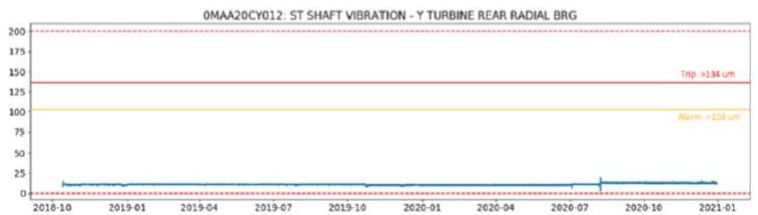










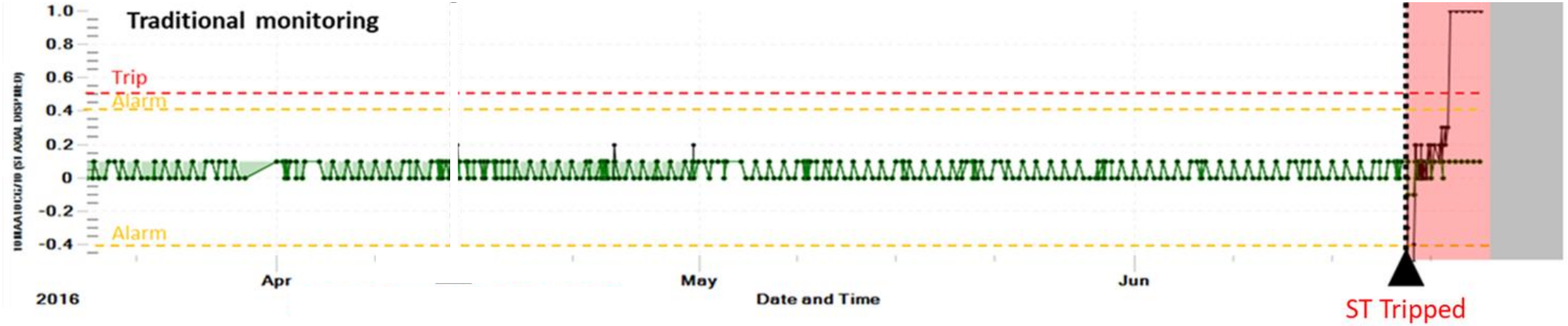


Risk Assessment after Strategy Optimized

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

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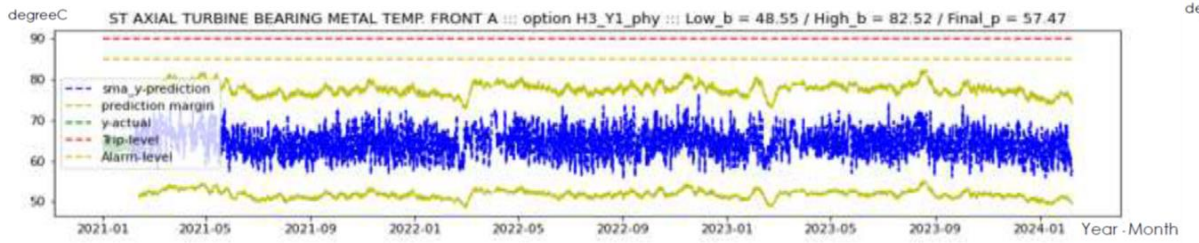
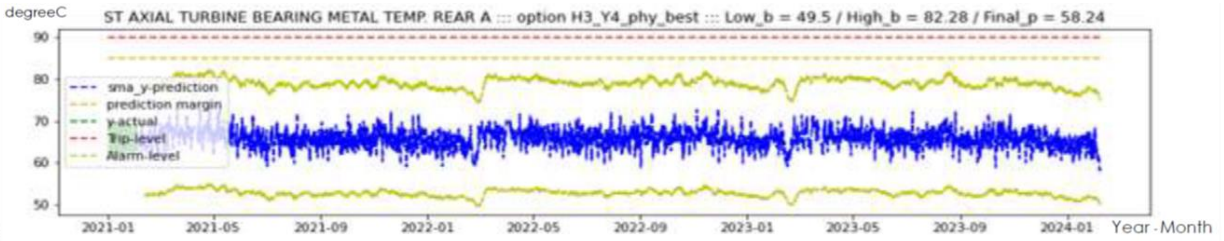
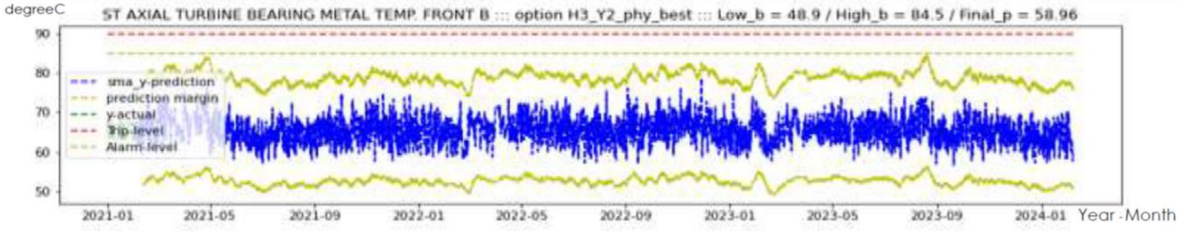
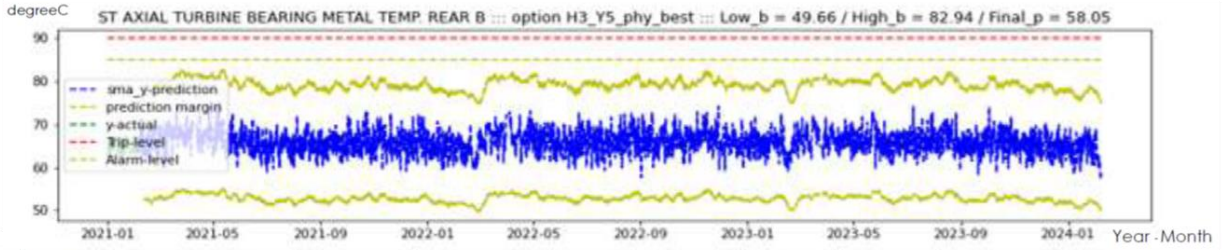
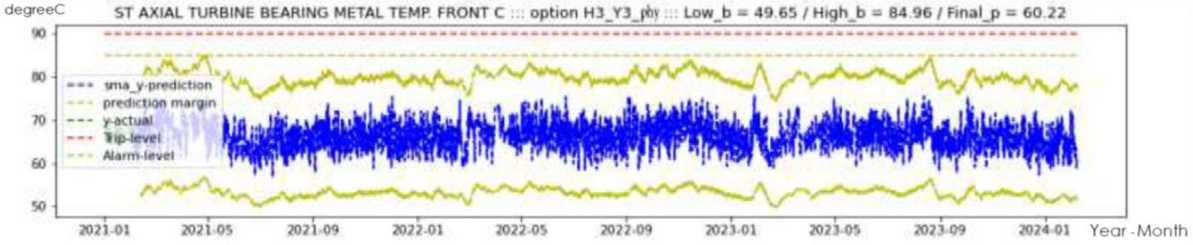
- **Key machine condition data**, such as vibration and bearing temperature, **were analyzed by life prediction model**.
- **No sign of degradation from all parameters,** but axial bearing temp prediction show potential risk.
- So it was decided to maintain that bearing inspection task in every 3 years with no major impact on plant outage duration.

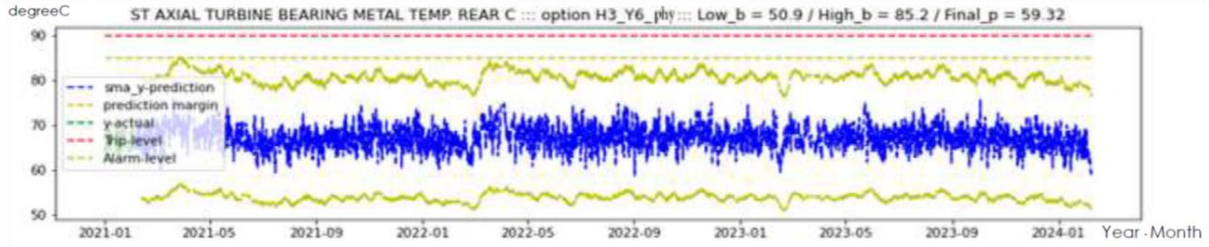












Non Age-Related Failure Concern Solved by Anomaly Detection Model Capable of Early Detection 2 Months in Advance

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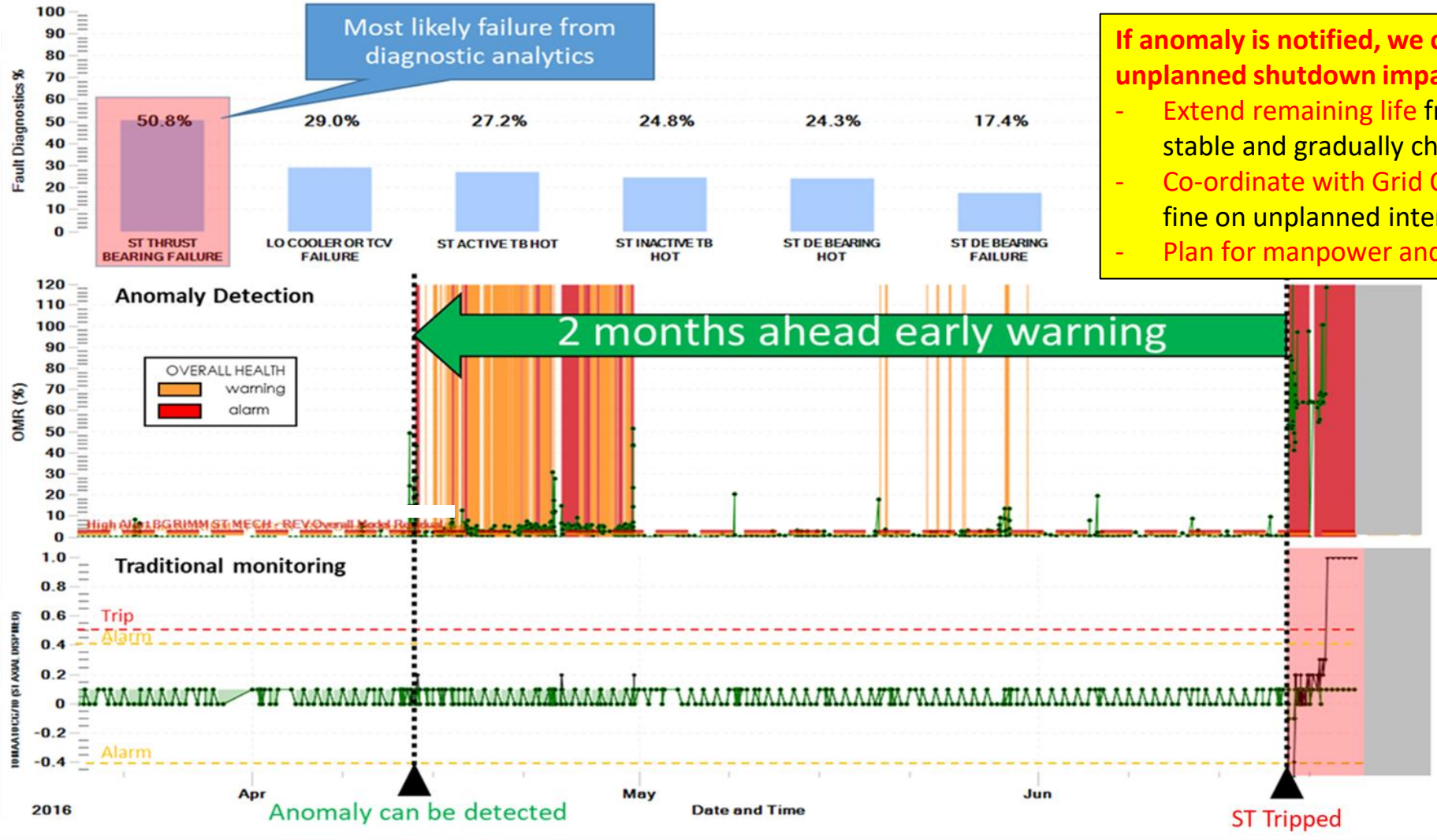

If anomaly is notified, we can mitigate unplanned shutdown impact by;

- 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

Early Detect and Locate Sign of Mech Failure by Turbomachinery Diagnosis

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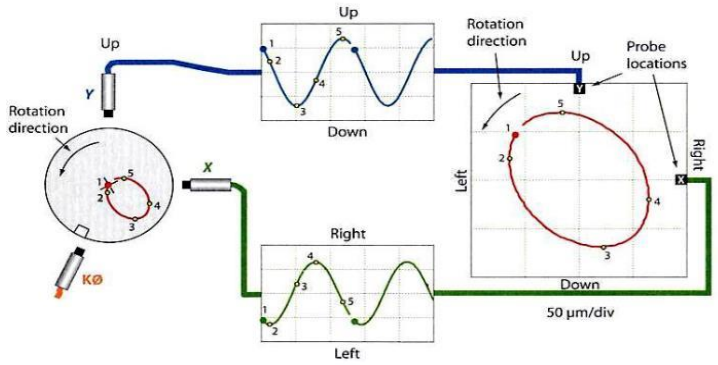
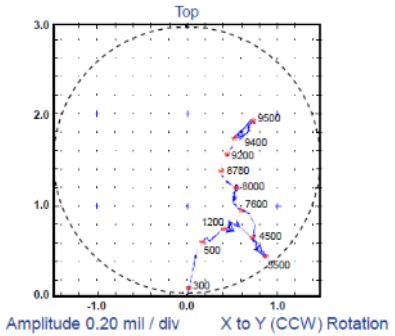
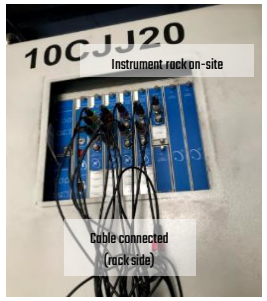


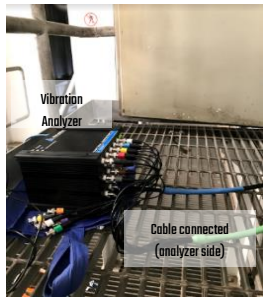
Construction of Orbit Plot



Example of Shaft Centerline Plot

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





G = good
M = Moderate
F = Fair

SYMPTOMS	INSPECTION TASK										
	VIBRATION ANALYSIS						BEARING TEMP.		LUBE OIL ANALYSIS		
	Trend Analysis	*Spectrum Analysis*	*Phase Analysis*	*Shaft Centerline Analysis*	*Orbit Analysis*	*Axial Position Monitoring*	*Journal Bearing Temperature*	*Thrust Bearing Temperature*	*Oil Properties*	*Wear Analysis*	*Contamination*
Rotor unbalance	F	G	G		G						
Rotor bending	F	G	G	M	G		F				
Coupling unbalance	F	G	G	M	G						
Rotating part damage	M	G	G		F	M	F	F			
Rotor crack*	F	M	M								
Rubbing	F	M	M	G	G	M	F	F			
Misalignment	F	M	M	G	G		F				
Resonance	F	G	G								
Journal bearing defect	F	F		M			M	M	F	F	F
Rotating stall	F	M				M	F				
Surging	F	M				M	F				
Oil whip/ Oil whirl	F	G		M	G						
Lude oil degradation							F	F	G	G	G

Optimized Strategy is Justified

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- 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

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Together Everyone Achieves More

Unforeseen Issues

- Lack of Knowledge for Design Model
- Data Historian Capability Limitation
- Hardware Limitation
- Data Quality
- Limited Data Export from OEM HMI

Solution

- Standardized Data Export Practice
- Offline Monitor Manual until OEM Real-Time Data Completely Available
- Upgraded Data Historian
- Upgraded Hardware Spec
- AVEVA Expert Support

Highlight Catch and Finding After Model Go Live

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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.

Before **After**

Knowledge & Skill Transfer Under Long Term Partnership Program

Pilot Phase

REPCO NEX : BGP
80 : 20

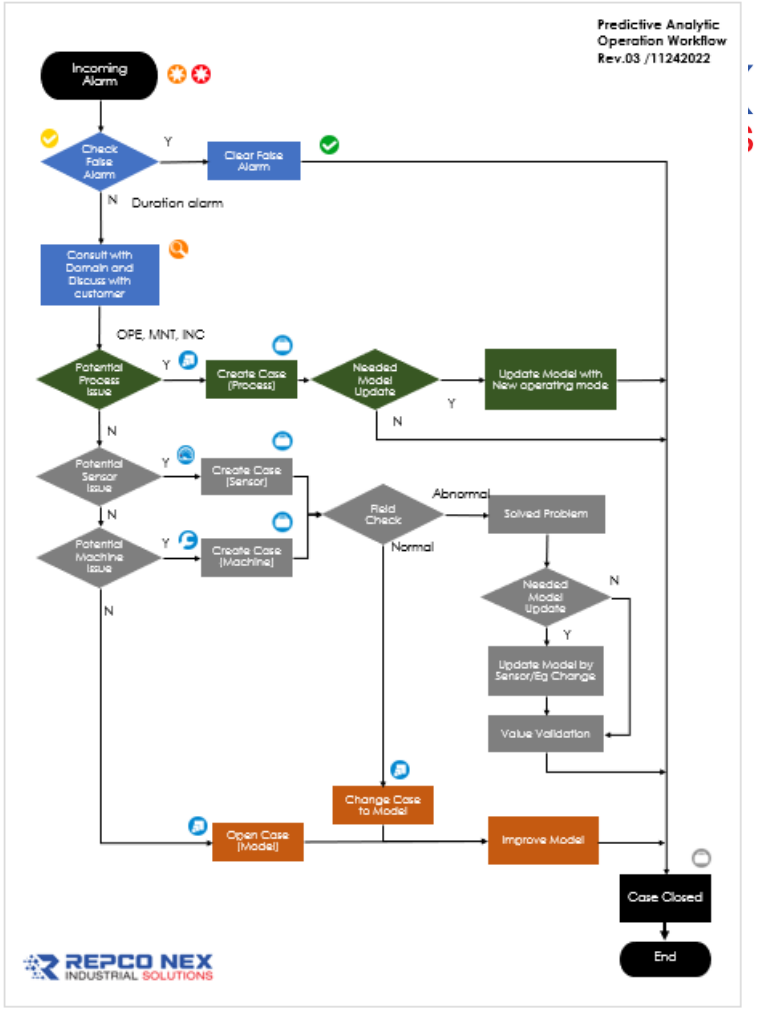
Scale-Up Phase

REPCO NEX : BGP
20 : 80

BGP : Built Up Capability & Capacity

REPCO NEX : Subscription Operating Model with OJT for BGP

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



Role in Pilot Phase	REPCO NEX	BGP
RMC (Remote Monitoring Center) Analysts	X	
SME (Subjected Matter Experts)	X (Rotating issue)	X (Other)
Site (relates O&M persons)		X

Role in Scale-Up Phase	REPCO NEX	BGP
RMC (Remote Monitoring Center) Analysts		X
SME (Subjected Matter Experts)	X (Rotating issue)	X (Other)
Site (relates O&M persons)		X

POWER | THAILAND

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

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!

AVEVA