Boost your efficiency

Webinar 07/05/2020

Manfred Manik
Engineering / Consulting MAN SEA
07/05/2020

MAN PrimeServ
Agenda

1. Your presenter
2. Company overview
3. Boost your efficiency
Introduction

Your presenter

Name
Manfred Manik

Function
Head of Engineering / Technical Consulting

Expertise
Dipl.-Ing. Mechanical
8 y commissiong engineer
16 y Consulting MAN headquarter Oberhausen
1,5 y Engineering / Consulting MAN Malaysia

Contact Details
MAN Energy Solutions
Jalan Sultan Ismail
Kuala Lumpur, Malaysia
Manfred.manik@man-es.com
MAN Energy Solutions

Company profile

**Marine systems**
- Two-stroke and four-stroke engines for marine applications
- Propellers and complete propulsion systems incl. fuel gas systems
- Turbocharger

**Power plants**
- Two-stroke and four-stroke engines for stationary applications
- Diesel and gas power plants

**Turbomachinery**
- Compressors, gas and steam turbines, and expanders
- Complex machine trains
- Chemical reactors
MAN Energy Solutions

Turbomachinery applications

**Upstream (production)**
Compressors, expanders, gas turbines

**Midstream (transportation)**
Compressors, gas turbines

**Downstream (processing)**
Compressors, expanders, steam turbines, gas turbines, reactors

**Industrial products**
Compressors, vacuum blowers, reactors

**Industrial gases**
Compressors, steam turbines, reactors

**Industrial power generation**
Steam turbines, gas turbines

**MAN PrimeServ**
Comprehensive service support
MAN Energy Solutions
PrimeServ Omnicare: your one-stop service

- Services for your entire fleet – including non OEM turbomachinery and equipment
- Strong network of multi-brand experts
- Regional Omnicare managers ensuring that global best practice is brought to you

Benefits
- Increased capacity, safety, reliability and availability
- Improved efficiency and cost-effective operation
- Same standards and quality as for OEM equipment
Aftersales MAN PrimeServ
Region APAC Structure – Functional reporting lines

AP – Region Head Turbo & PrimeServ
Dr. Marco Ernst

NE China – Ronnie Su
PS China – Stephen Zhou

North East Asia
Seung Suk Kim (Chris)

South East Asia
Ernst Geyer / Stefan Langhein

Indonesia
Ernst Geyer / Goetz Kassing

Pacific
Karl-Heinz Berdais

AP – BS Engineering
Matthias Daun

AP – Bids & Projects
Daniel Wyler

AP – Region Development
Chen Zhang

AP - Omnicare
Matthias Daun

12 Office locations
High motivated Service Engineering and Consulting team in KL

In general all members of this group are experienced and trained in consulting duties, site inspection, borescope, machine survey, root cause failure analysis, etc.
MAN PrimeServ
Strategic expertise

Availability
Meet rising performance expectations within increasingly complex and dynamic operating environment

Safety
Comply with contemporary safety standards and regulations to ensure safe operation

Efficiency
Improve the efficiency of your turbomachinery for more attractive margins

Capacity
Adjust the capacity of your equipment for optimum operation and to further develop your business

Sustainability
Adapt your equipment to increasingly stringed emission regulations and reduce your CO2 footprint
Your turbomachinery is a core element of your production process. Our upgrade solutions help you to improve the efficiency of your turbomachinery for more attractive margins:
Efficiency

Reduce energy costs

Avoidance of leakage losses
Replacement of obsolete sealing systems against contemporary solutions allowing for significantly smaller gaps

Reduction of energy consumption
Realization of energy savings by upgrade of auxiliary systems and reduction of parasitic power consumption

Improved efficiency
Implementation of latest design standards for increased machine efficiency

Engineering services
Assessment of existing unit design and condition to identify, validate, and propose upgrade solutions considering your specific operating conditions and business requirements
Efficiency

Improve reliability

**Modernization**
Replacement of old components and systems with increased risk of failure, outdated design, and limited spare parts availability by new-state-of-technology ones with higher MTTF

**Redundancy**
Upgrade of obsolete systems and control loops by replacing them against contemporary solutions with fully redundant design and 2003 voting

**New functionalities**
Implementation of new features as for example test routines for automatic online testing, monitoring, and evaluation of response and closing times of valves, fouling detection, or non-contact blade vibration monitoring

**Engineering services**
Assessment of existing unit design and condition to identify, validate, and propose upgrade solutions considering your specific operating conditions and business requirements
Efficiency
Reduce maintenance costs

Design improvements
Implementation of latest developments of technology allowing for extension of maintenance intervals of components or systems

Remote Monitoring Support
Use of PrimeServ Assist with near real-time data transmission and evaluation for detection of anomalies, condition assessment, and maintenance optimization

Service concepts
Development of tailor-made service concepts adjusted to your specific equipment, operating conditions, and operation requirements
New Efficiency Development
Flagship MAX 1
New Efficiency Development

MAX 1

Steam Turbine:
⇒ Through MAX1 (speed 1/3 higher):
  ➢ 1 frame size smaller
  ➢ ≈ 1 point higher efficiency

Handling, transportation, support structure etc.:
⇒ Through lighter machines:
  ➢ Cost reduction

Main Air Compressor:
⇒ Through MAX1 (speed 1/3 higher):
  ➢ ≈ 25% lighter
  ➢ ≈ 28% shorter
  ➢ ≈ 25% smaller impeller-∅

⇒ Whole Train:
A significant improvement [CAPEX+OPEX] compared to conventional compressor trains can be exploited.

+ higher efficiency!
**Efficiency**

New development implementation to process situation

Installation today state of the art vapor compressor to safe energy

Chemical exothermal process condition

Taking energy instead of wasting

Boosting up admission steam to increase efficiency steam turbine
New Machine Part Improvement

As-is Situation

Conventional aluminum seals require relatively large clearances to avoid possible contact between impeller and seal:

- Generally very robust and long lifetime

but

- Relatively high leakage losses
- Possible damage of seal during transient states, due to vibration or axial rotor displacement
- Contact of impeller and stationary parts may increase gap or even destroy the seal
- Irreversible deformations of labyrinths result in increased gaps, increased leakages and thus reduced efficiency and increased power consumption
New Machine Part Improvement

Service Solution

Installation of improved impeller labyrinth seal:

- Radial labyrinths made of Arlon®
- **Efficiency increase** of 0.4 to 2.7 percentage points per stage
- Permissible temporary contacts of impeller and seal during transient states
- Installation within planned overhaul or field service operation with less than 1 day additional downtime
- Approx. 2 years average amortization time

**Arlon® Material Properties**

- High-temperature thermoplastic material
- High elasticity and softer than impeller material and aluminum
- High temperature resistance from -120 to +160°C
- High pressure resistance
- Corrosion resistance against most media
- No brittleness
- Excellent rubbing behavior in case of possible failure
Efficiency

Improve reliability as a point of view “plant efficiency” by:

New equipment / instrumentation

**Fully redundant positioning system for hydraulic control valves:**

**Speed sensor online changeable:**
Efficiency

Modernization reliability: RIK development and revamp

First RIKT for Maanshan Steel delivered in 2003
    Thus, development of RIK ended

Further development  RIKT 2\textsuperscript{nd} Generation

Many improvements in RIKT:
    Time for RIK upgrade!

Restarted development of RIK for existing fleet in 2017
Energy Saving Solution
RIK revamp: General scope and savings

General scope*:
- Shaft
- Newly developed stage 1 impeller
- State of the art stage 2, 3, 4, … impellers
- Diffusors, Channel walls, Intermediate walls
- Impeller seals
- Shaft seals
- Coupling
- High Performance Coolers

* subject to change upon detailed engineering

up to 3% efficiency gain
## Efficiency
First implementation of new 1st stage impeller – RIK Revamp in China

**RIK100-4 from 1995**

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Wet air</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Condition</strong></td>
<td>Design Max TD 70%</td>
</tr>
<tr>
<td><strong>DElivered Flow</strong></td>
<td></td>
</tr>
<tr>
<td>- Flowrate (dry)</td>
<td>Nm³/h</td>
</tr>
<tr>
<td></td>
<td>174,600</td>
</tr>
<tr>
<td><strong>INlet data</strong></td>
<td></td>
</tr>
<tr>
<td>- Pressure bar a</td>
<td>1.005</td>
</tr>
<tr>
<td>- Temperature °C</td>
<td>35.0</td>
</tr>
<tr>
<td>- Relative humidity %</td>
<td>80</td>
</tr>
<tr>
<td><strong>Discharge data</strong></td>
<td></td>
</tr>
<tr>
<td>- Pressure bar a</td>
<td>6.07</td>
</tr>
<tr>
<td>- Temperature °C</td>
<td></td>
</tr>
<tr>
<td><strong>Performance data</strong></td>
<td></td>
</tr>
<tr>
<td>- Power at motor coupling kW</td>
<td>14,085</td>
</tr>
<tr>
<td>rpm</td>
<td>5,793</td>
</tr>
<tr>
<td>- Power at motor coupling kW</td>
<td>13,999</td>
</tr>
<tr>
<td>rpm</td>
<td>5,793</td>
</tr>
<tr>
<td>- Power saving kW</td>
<td>126</td>
</tr>
<tr>
<td>- Power saving %</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

- **Power saving kW**
- **Revamp 2018**

**Estimate:**
- 98.5% operation hours per year
- 0.70 CNY/kWh

**Savings: ~ € 95.130 per year (energy recovery on design point)**

\[
= 0.985 \times 365 \times 24 \times 126 \text{ kW} \times 0.70 \text{ CNY/kWh} = 761'042.52 \text{ CNY}
\]

- Installation and commissioning to take place in October 2019

---

**MAN Energy Solutions**

**MAN PrimeServ**

**Public**
Efficiency
First implementation of new 1st stage impeller – RIK Revamp in China

RIK100-4 from 1995: Condition of the compressor in 2015

Performance Improvement

- Replacement of fouled and eroded parts
- New stage 1 impeller
- Energy recovery

aerodynamic

energy recovery
Diffusor retrofits are available for better aerodynamic behavior in existing centrifugal and gear type compressors enabling increase in efficiency.

There are two measures aiming at further reducing flow disturbances in the diffusor.

1. **Diffusor width adaption for high flow open impeller configurations (pinch)**

For gear type compressors processing high volume flows utilizing high flow open impellers an adaption of the diffusor channel width can considerably reduce flow disturbances in the flow path. Resulting in more uniform flow distribution in the diffusor and a better transition into the stage volute overall peak stage efficiency can be increased of up to 1.5% per stage.
1. Diffusor width adaption for high flow open impeller configurations (pinch)
Upgrades and Retrofits
Reduce energy costs: Feature Upgrades in Diffusors

2. Diffusor flow stabilization with additional guide vanes
Additional guide vanes in non-vaned diffusors in a centrifugal or gear type compressor further increase stabilization of the flow and reduce flow disturbances. Depending on the number of flow stabilizing guide vanes (solidity) in the diffusor peak efficiency can be increased of up to 1.5% per stage.

Diffusor retrofits and upgrades affect static parts only and do not require further modifications or in-depth mechanical analysis of the critical rotating parts. Diffusor parts are interchangeable and can be pre-fabricated to keep machine down time at a minimum.
Upgrades and Retrofits
Reduce energy costs: Feature Upgrades in Diffusors

2. Diffusor flow stabilization with additional guide vanes

![Diffusor non-vaned](image1)
![Diffusor with new LSD / HSD](image2)
Upgrades and Retrofits
Reduce energy costs: Feature Upgrades in outlet compressor

Shifting efficiency to higher level
Upgrades and Retrofits

Reduce energy costs: by downsizing machine new process condition

The compressor could be modified to new process condition and requirements.
Smaller compressor stages could lift up the previous partial load with low efficiency to a higher efficiency level.

e.g. barrel compressor for gas transportation offshore in case of emptying oil field.

MAN can design a new barrel including rotor which is interchangeable with the existing casing.
Nearly 41% of ST problems are related to water-steam cycle chemistry.

Significant efficiency loss finally leads to a machine / plant shutdown.
In particular in the different sections of the steam turbine steam impurities result in:

- Development of deposits from silicates, iron oxides and copper oxides (performance loss)
- Pitting and crevice corrosion by salts and acids
- Intercrystalline and trans-crystalline stress corrosion cracking
- Corrosion fatigue cracking
  (Low Cycle Fatigue and High Cycle Fatigue)
**Upgrades and Retrofits**

**MAN instrumentation**

These instruments record the condition continuously to provide alarms, to be used in control system and to enable the operator to act prompt and appropriate.

- Cooler
- Online measuring device "direct / specific conductivity"
- Online measuring device "cation conductivity"
- Online measuring device "degassed cation conductivity"
- Cation exchanger
- Throttle valve
- Sampling drain upstream of cation exchanger

Online measurement for main parameters
Can be checked by MAN expert in headquarter
Upgrades and Retrofits
Fast cooling, trend without and with
Upgrades and Retrofits

Fast cooling

- MDT experience an analytical cooling curve will be calculated showing the limits of the counter flow cooling.
- Execution first time together with client
- Fully observation during cooling sequence
Efficiency

Reduce maintenance costs: PrimeServ Assist / Eye Tech

Advanced remote monitoring and optimization of machine condition and performance:

**Features**

− Near real-time data analytics
− Algorithm based anomaly detection and reporting
− Instant technical support
− Maintenance and performance optimization advice

**Benefits**

− Optimization of maintenance intervals
− Ad-hoc notifications for maximum safety and availability
− 24/7 “follow the sun” technical support
Efficiency
Main revamps steps and milestones, Basically «need Information»

- Define and fix new operating points -> Fill out empty datasheet
- Thermodynamic calculation
- Check mechanical feasibility and additional requirements
- Define and fix scope of revamp
Efficiency

Thank you!

Survey
Please stay in the webinar for a moment to give us your feedback on today’s webinar and topics you are specially interested in

Further information
For further information on future webinars and our upgrade solutions follow us on facebook, Twitter, and LinkedIn, or visit our website

Contact
For any questions or further information, don’t hesitate to speak to your local contact or contact me directly
Thank you very much!