

Turbocharger Seminar, Dubai 2012

Turbocharger service and Retrofit



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Disclaimer

All data provided on the following slides is for information purposes only, explicitly non-binding and subject to changes without further notice.



Agenda

1 PrimeServ Turbocharger

2 Technical Service

3 Turbocharger Academy

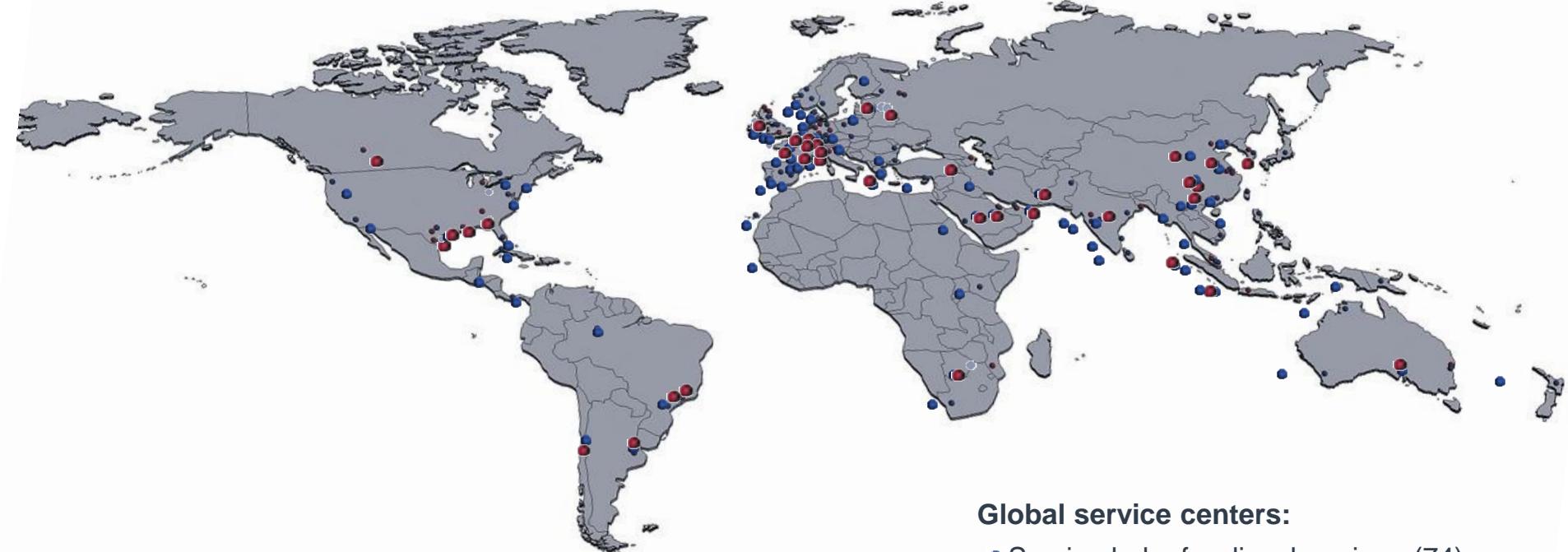
4 Turbocharger Retrofit



100 MAN | **PrimeServ** Hubs world wide
Sales gate to the customer

MAN | **PrimeServ** Turbocharger





Global service centers:

- Service hubs for diesel engines (74)
- Service hubs for turbomachinery (39)



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Repair and Reconditioning Solutions

OEM Repair

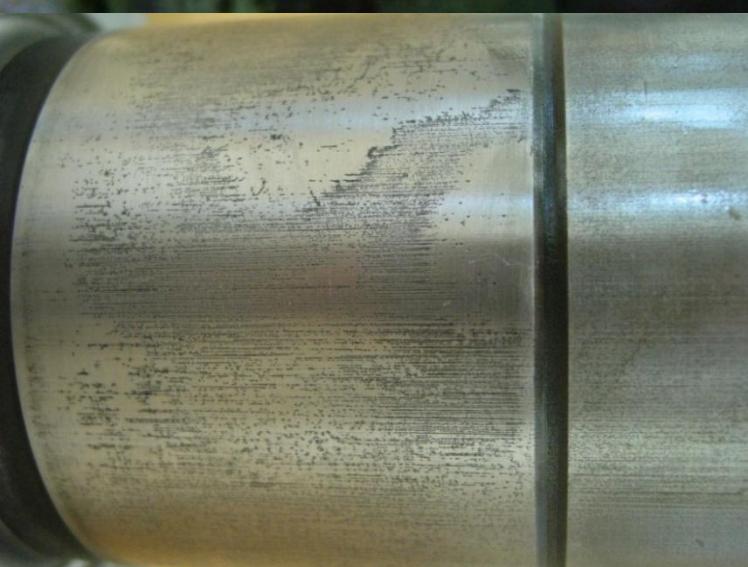
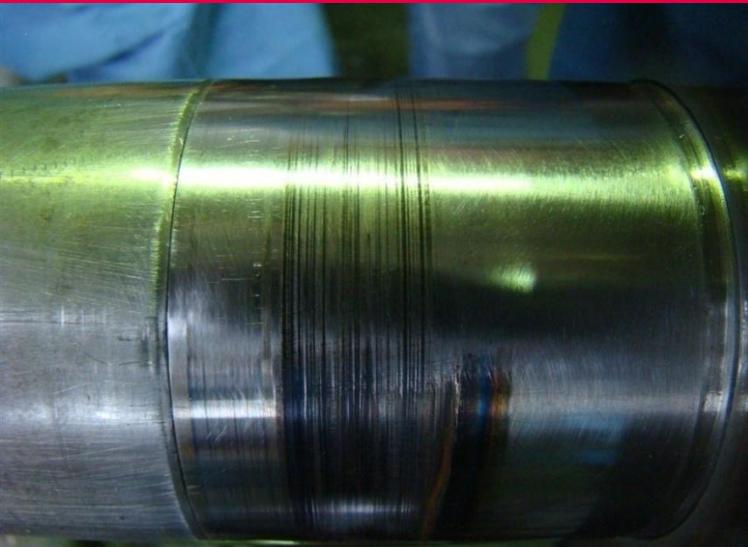


MAN Diesel and Turbo pledges
greatest attention developing new technical approaches
to provide our customers access to OEM reconditioning service:

**Fast, cost effective
and environmentally alternative to new parts**

Repair and recon solutions

Rotor shaft repair



Damages

- Score marks
- Overheating
- Pitting
- Bearing material smeared on
- Fretting corrosion
- Deflection

Repair and recon solutions

Rotor shaft repair

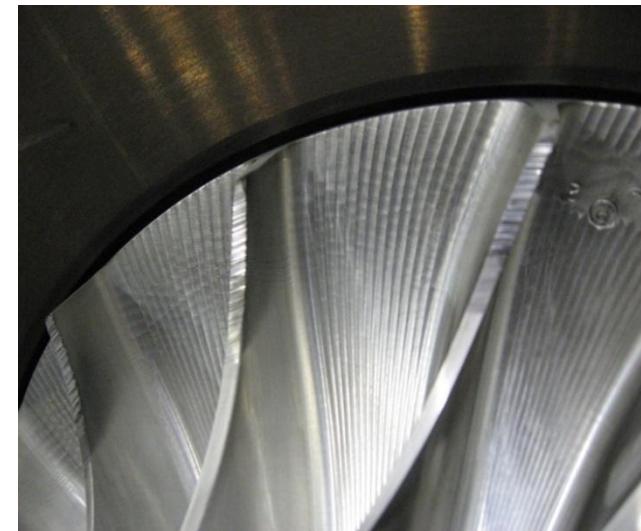


- Repair of bearing journals
- Repair of compressor wheel hub
- Repair of labyrinth and locating ring sections
- Alignment correction



Repair and recon solutions

Compressor wheel repair



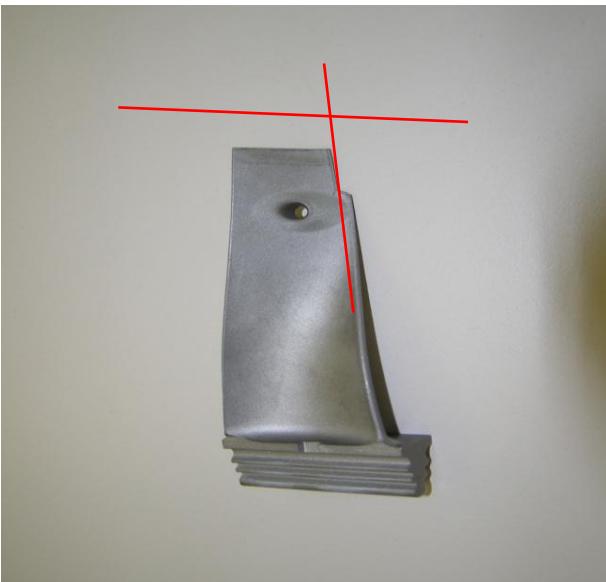
- Repair welding of compressor wheel vanes
- Re machining to OEM shape
- Honing of compressor wheel bore
- Anti corrosion coating
- Life time evaluation

Repair and recon solutions

Turbine blade repair



- Repair welding of turbine blade profile
- Tip circle machining to OEM shape
- Replicating aerodynamic performance
- High end quality test



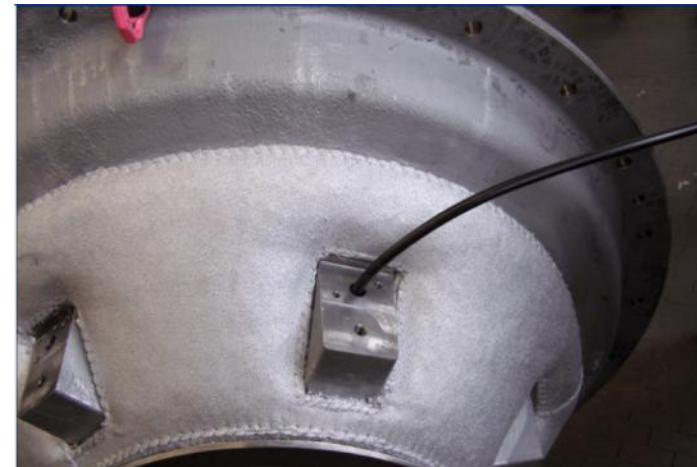


Non Destructive Testing



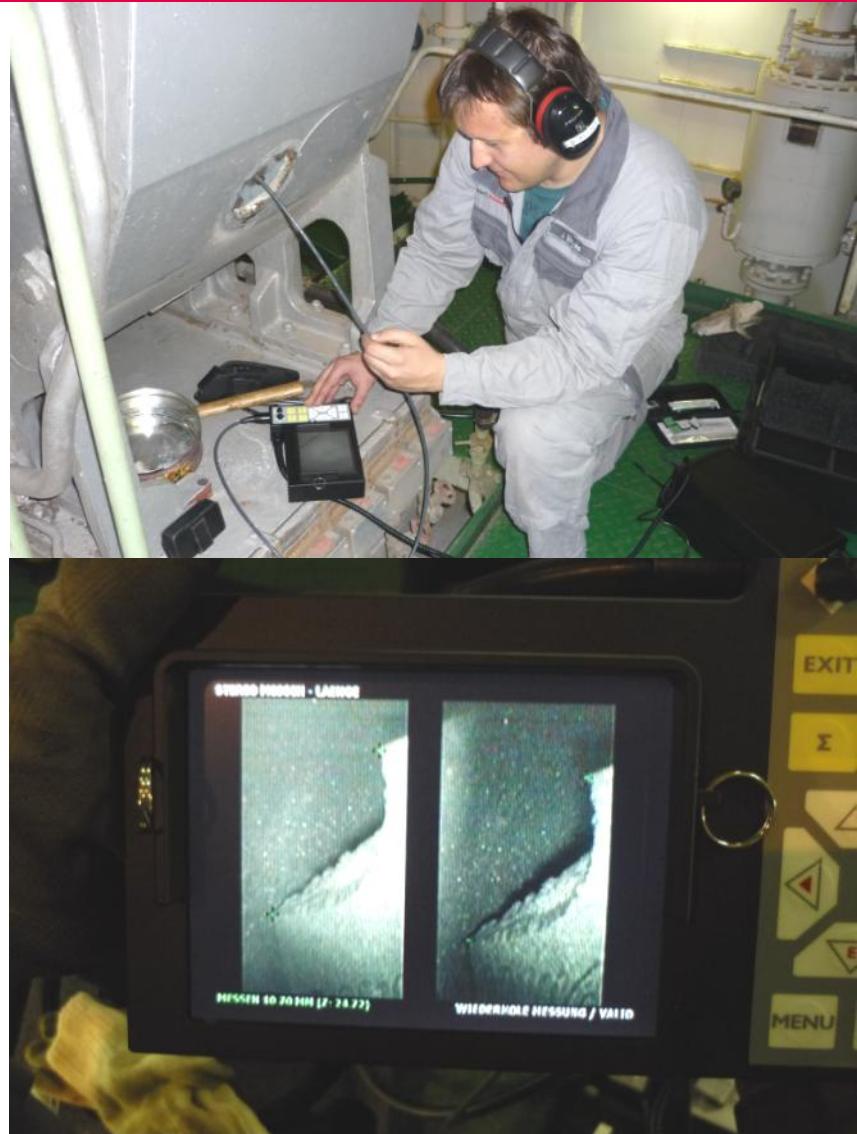
Boroscope

- Easy access to the rotating components
- No turbocharger dismantling necessary
- Fast access and reliable information



Field Test on 18V48/60B equipped with TCA 88:

2 hours for turbine rotor and
nozzle ring inspection !



Maintenance Contract



Maintenance Contract



"BASIC Package" consists of the following features:

- Timely spare parts planning enables higher price flexibility (see figure 1)
- Yearly based fixed price for turbocharger spare parts and maintenance kits
- One face to the customer through Key Account Management; single point of contact
- Regular update of product improvements and customer information letters

"ADVANCED Package" consists of the following features:

- BASIC package +
- Yearly based fixed price for turbocharger service
- MAN PrimeServ Turbocharger will coordinate and plan the complete upcoming scheduled maintenance within the PrimeServ network

"PREMIUM Package" consists of the following features:

- BASIC and ADVANCED package +
- MAN PrimeServ Turbocharger will monitor and administrate the upcoming maintenance intervals
- MAN PrimeServ Turbocharger will notify the customer 6 – 7 months prior to the upcoming service
- In time delivery of the required spare parts on site. Complete supply chain
- Constantly updated the turbocharger operational data including the complete maintenance history

Your demand:

- Reliable and save turbocharger operation
- No hidden costs
- Access to OEM know how
- High spare part availability
- Reduction of the yearly service cost

Maintenance Contract

Contract modules



| Contract Modules | Scheduled Manpower | Scheduled Spare Parts | Monitoring and Coordination | Operation |
|-------------------------------|--------------------|-----------------------|-----------------------------|-----------|
| Premium Maintenance Contract | ✓ | ✓ | ✓ | |
| Advanced Maintenance Contract | ✓ | ✓ | | |
| Basic Maintenance Contract | | ✓ | | |



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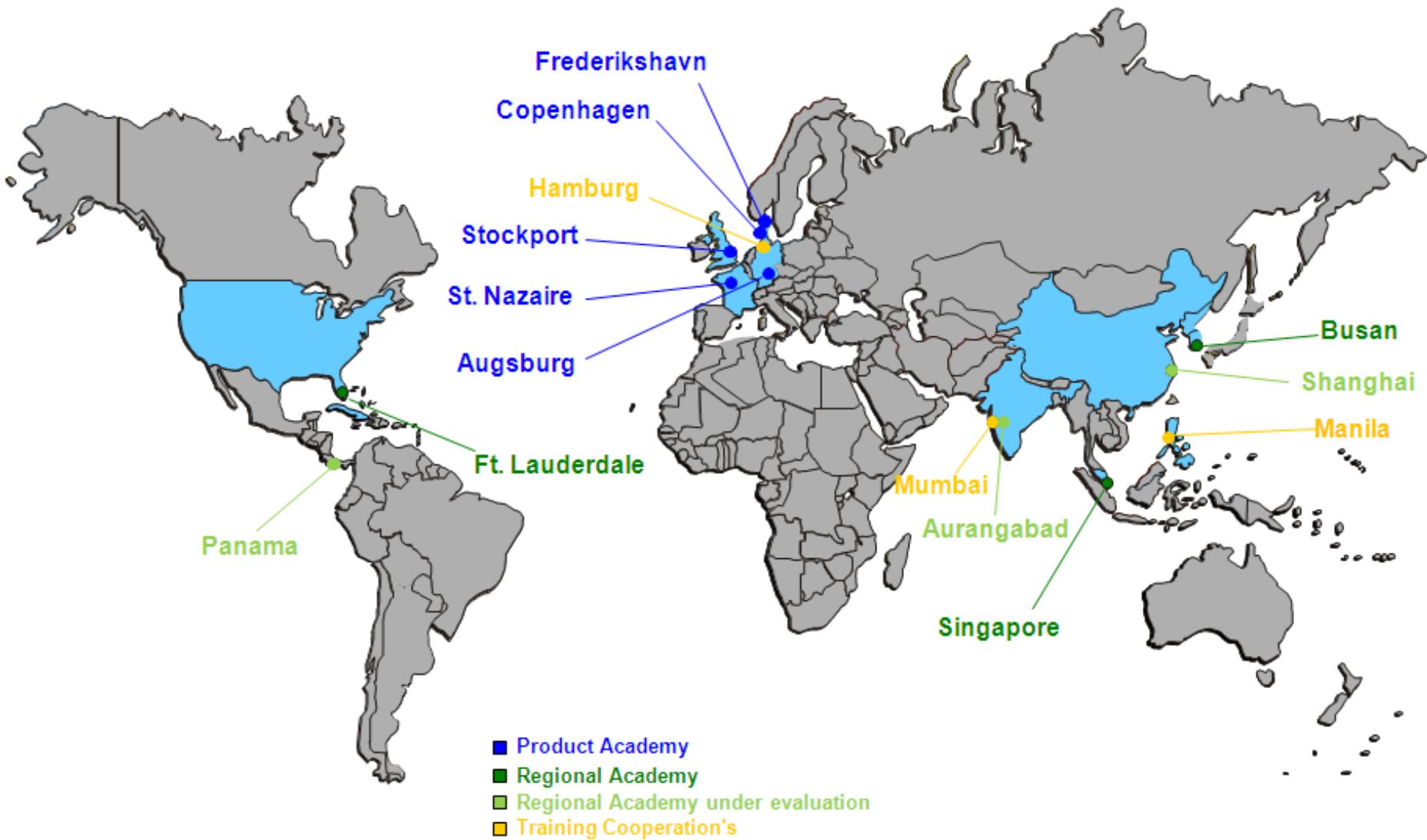
MAN | PrimeServ Academy

Turbocharger Service Qualification



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Turbocharger Service Qualification





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Turbocharger Retrofit

Definition



“Retrofitting means adding or substituting new parts or components to some device that were not previously available.”



Turbocharger Retrofit

What can we retrofit?



2-stroke



4-stroke



Traction



Turbocharger Retrofit

Services



**15 years of experience
in retrofitting turbochargers**



- Replacing of turbochargers
- Rematching of turbochargers
- Upgrading to VTA
- Engineering of connection parts
- Commissioning & matching

Turbocharger Retrofit

Why retrofitting?



- Poor availability of spare parts
- Increased prices
- Extended delivery times

- Faster spare part delivery
- Less downtime
- Cheaper spare parts
- Warranty
- Secured long term supply



Turbocharger Retrofit

Why retrofitting?



- Low charge air pressure
- High exhaust gas temperatures
- Poor engine response at load changes
- Surging



- High turbocharger efficiency
- Increased air-flow
- Engine response improvement
- Compressor surge margin enlargement



Turbocharger Retrofit

Retrofit projects



Power plant Pakistan

| | | | |
|-------------------|---|---------------------------------|--|
| Year of build | 1990 | | |
| Application | Power plant | | |
| Engine | 12 x | 18V38 | Wärtsilä |
| Bore/stroke [mm] | | 380/475 | |
| Speed MCR [1/min] | | 600 | |
| Power MCR [kW] | | 11.340 | |
| Original TC | 24 x | VTR454 | ABB |
| Retrofit TC | 24 x | TCA44 | MAN |
| Customer Benefits | <ol style="list-style-type: none">1. Fuel oil and spare part savings2. Exhaust gas temperature reduction3. Opportunity to maintain turbocharger by plant crew | | |
| | Δ Exhaust gas temp. after cylinder | Fuel oil consumption | Savings spare parts and HFO |
| Result | - 31°C | - 2,7g/kWh* | 190.000 € p.a. |

* based on customer information



Turbocharger Retrofit

Retrofit projects



Turbocharger Retrofit

Retrofit projects



Stena Line

Year of VTA installation: 2007

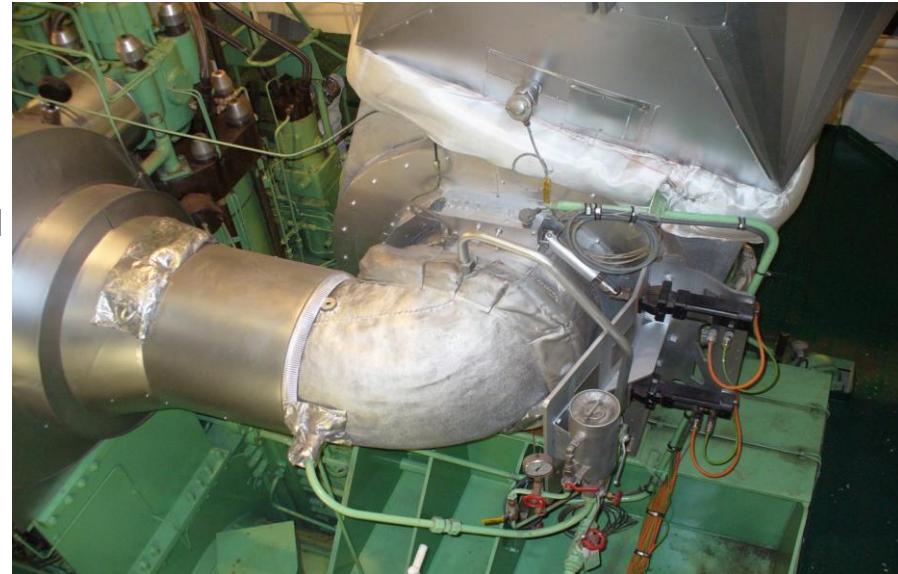
Engine: 2 x 6S46MC-C MAN

MCR: 7.860 kW

Turbocharger:

1x TCA55 with VTA

1x TCA55 without VTA as comparison



Fuel oil savings after Retrofit:

| | |
|----------|---------|
| Per kWh | 4,425 g |
| Per hour | 28 l |
| Per day | 672 l |
| Per year | 150 t |

Turbocharger Retrofit

Retrofit projects



Superstar Aquarius

| | | | |
|-------------------|--|-------------------------|-------------------------------------|
| Year of build | 1991 | | |
| Application | Marine | | |
| Engine | 2x | 6L40/54B | MAN |
| Bore/stroke [mm] | | 400/540 | |
| Speed MCR [1/min] | | 500 | |
| Power MCR [kW] | | 3960 | |
| | Retrofit | | |
| Original TC | 2x | NA34/T | MAN |
| Retrofit TC | 2x | NA34/SM | MAN |
| Customer Benefits | <ul style="list-style-type: none">1. Exhaust gas temperature reduction2. Fuel savings3. Better spare part availability | | |
| | Δ Exhaust gas temp. after cylinder | Fuel oil consumption | Saving spare parts and HFO |
| Result | - 80°C | | |



Turbocharger Retrofit

Retrofit projects



Cessa, El Salvador

| | | | |
|-------------------|---|-------------------------|-------------------------------------|
| Year of build | 1997 | | |
| Application | Power plant | | |
| Engine | 3x | 16V32/40 | MAN |
| Bore/stroke [mm] | | 320/400 | |
| Speed MCR [1/min] | | 720 | |
| Power MCR [kW] | | 6700 | |
| | Retrofit | | |
| Original TC | 6x | NA34/S018 | MAN |
| Retrofit TC | 6x | NA34/S062 | MAN |
| Customer Benefits | <ul style="list-style-type: none">1. Fuel oil savings2. Exhaust gas temperature reduction3. Performance increase to full load | | |
| | Δ Exhaust gas temp. after cylinder | Fuel oil consumption | Saving spare parts and HFO |
| Result | - 40°C | | |



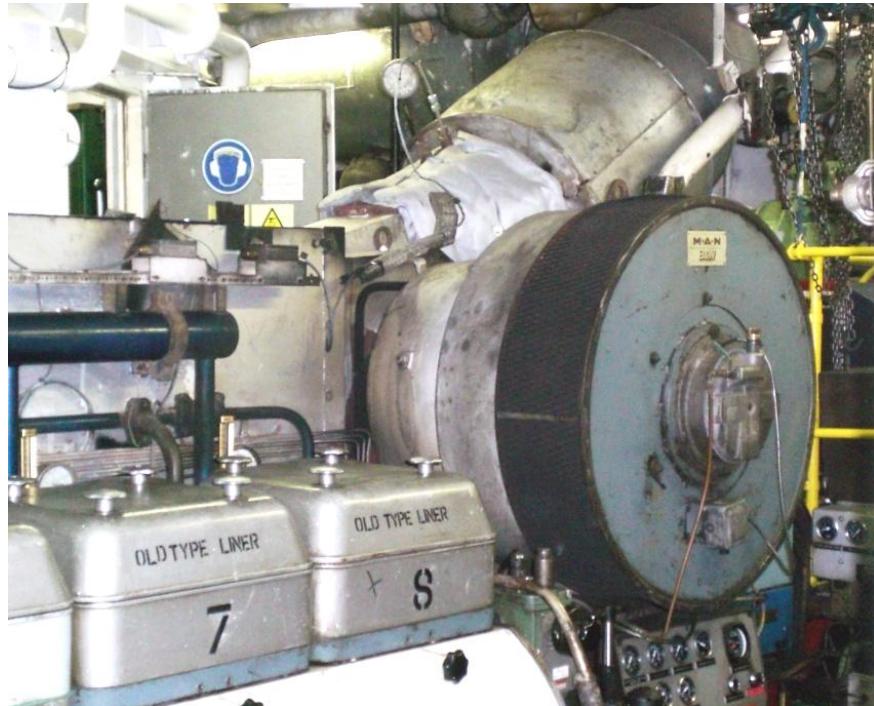
Turbocharger Retrofit

Current focus – NR26 Phase out



- NR26 on engines L28/32, L25/30, V25/30 (Alpha, Holeby)
- Retrofit option: TCR16 / 18 / 20

NR26 → TCR18 on 8L28/32



Turbocharger Retrofit

Current focus – 8-9L58/64

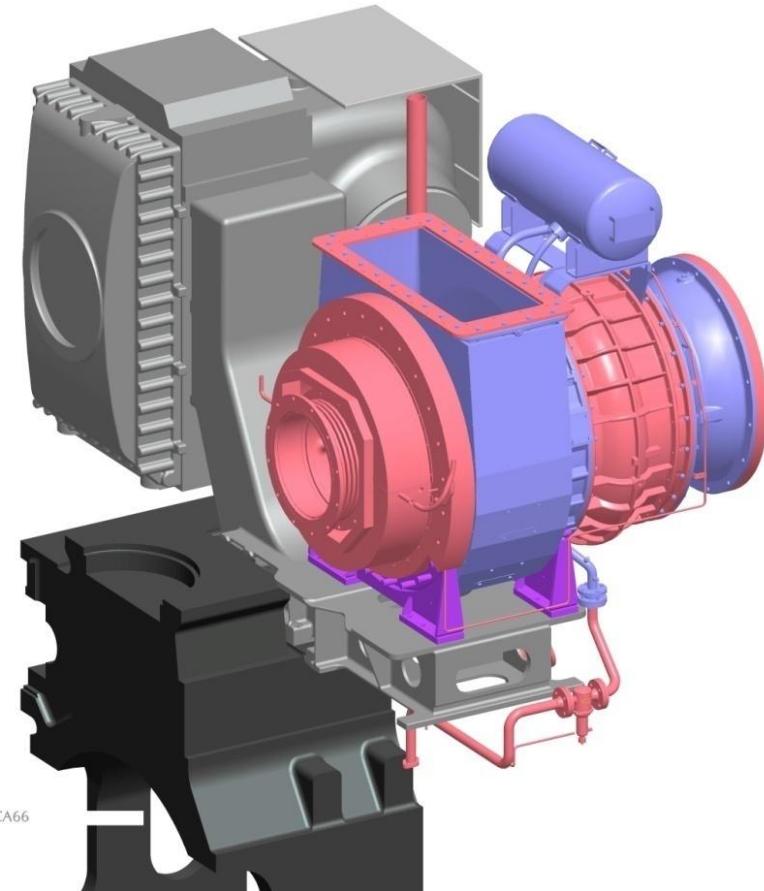


Problems of NA57 on 8-9L58/64

- High exhaust gas temperatures
- Operation at full load not possible
- Technical Problems: Overspeed, Vibrations
- Pirate parts
- Damages

Retrofit:

NA57 → TCA66



Vereinf Darst auf Anfrage:TCA66

Turbocharger Retrofit

Problem – solution - benefit



| Problem | Technical Solution | Environmental | Cost saving | Customer Benefit |
|----------------------------------|---|---------------|-------------|---|
| Black smoke | Jet Assist Waste Gate VTA New turbocharger | | | <ul style="list-style-type: none"> ➤ Less smoke ➤ Less wear on parts ➤ Less fuel consumption |
| Spare parts availability & costs | New turbocharger | | | <ul style="list-style-type: none"> ➤ Better availability ➤ Less downtime ➤ Cheaper part price ➤ Less life-cycle costs |
| Fuel Consumption | Turbocharger VTA Rematching with Nozzle ring Compressor wheel Diffuser | | | <ul style="list-style-type: none"> ➤ $-1,5 \text{ g/kWh} = 127.800,- \\* <p>* 6000 h/year * 20.000kW; 750,--\$ fuel oil price</p> |
| Maintenance interval | New turbocharger | | | <ul style="list-style-type: none"> ➤ Easy to maintain ➤ No special tools ➤ Customer training ➤ Less downtime ➤ Less life-cycle costs |
| Exhaust gas temp. | Turbocharger VTA Nozzle ring Compressor wheel Diffuser | | | <ul style="list-style-type: none"> ➤ Full engine power ➤ Less wear on combustion chamber parts ➤ Reduction of fuel consumption |

Turbocharger Retrofit

Benefits – Maintenance of MAN turbochargers



- Maintenance by plant crew
- Maintenance on site
- Trainings in one of the worldwide MAN academies



Turbocharger Retrofit

Benefits



- ✓ Customized solution
- ✓ Increased spare part availability
- ✓ Improved engine output
- ✓ Matching of engine performance to required operating profile



Turbocharger Retrofit

Benefits

- ✓ Maintenance freedom
- ✓ Spare part savings
- ✓ Fuel oil savings
- ✓ Short pay back time



Turbocharger Retrofit



Let's retrofit!



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