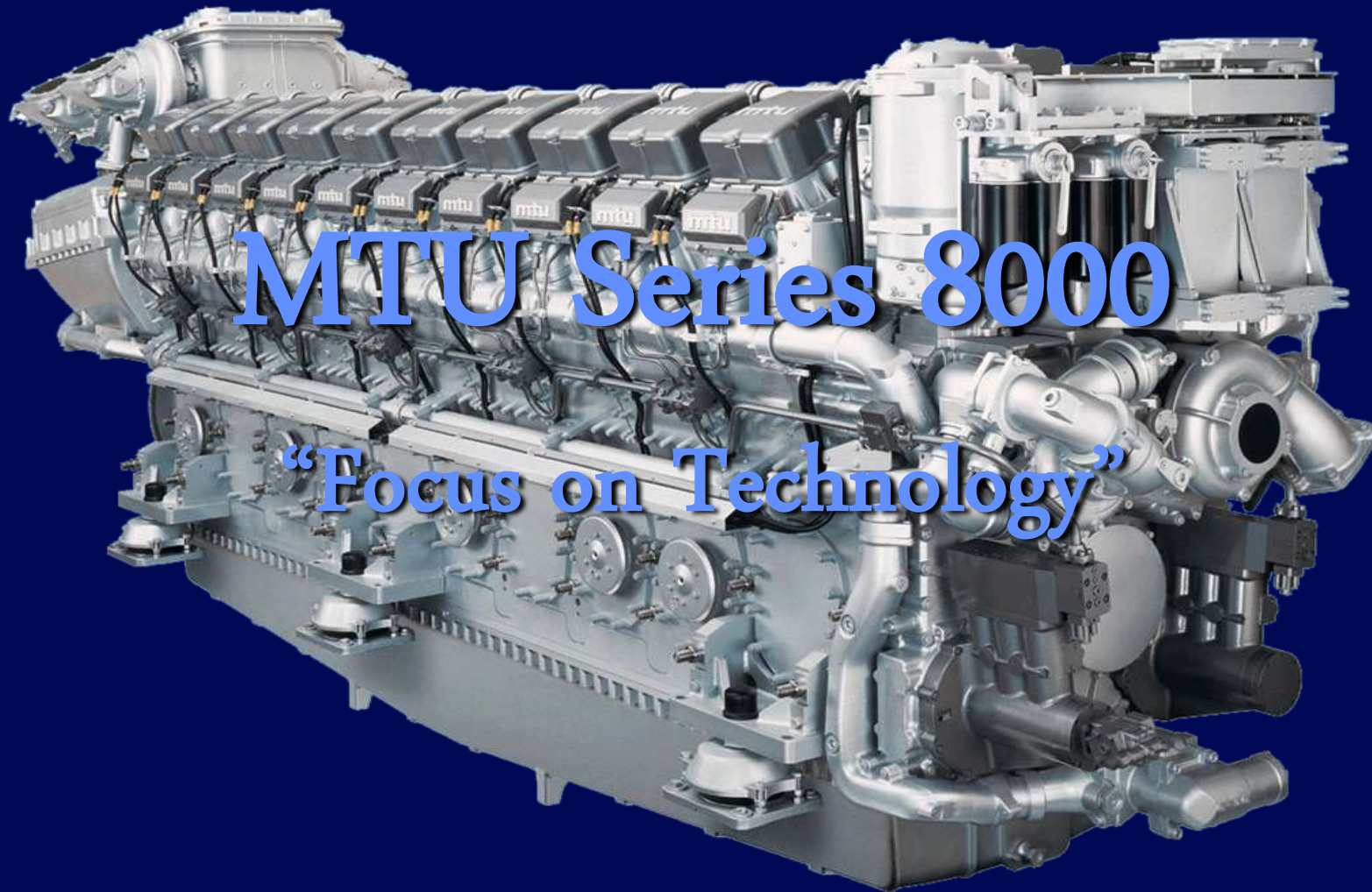




MTU Series 8000

“Focus on Technology”



Series 8000

Main Development Targets

- **Robust Design Specifically for Marine Applications**
- **Meet High Power Demand of Fast and High Payload Commercial Ships**
- **Meet Special Requirements of Military Ships**
- **Provide High Reliability and Availability With Good Maintainability**

Series 8000

Main Development Targets

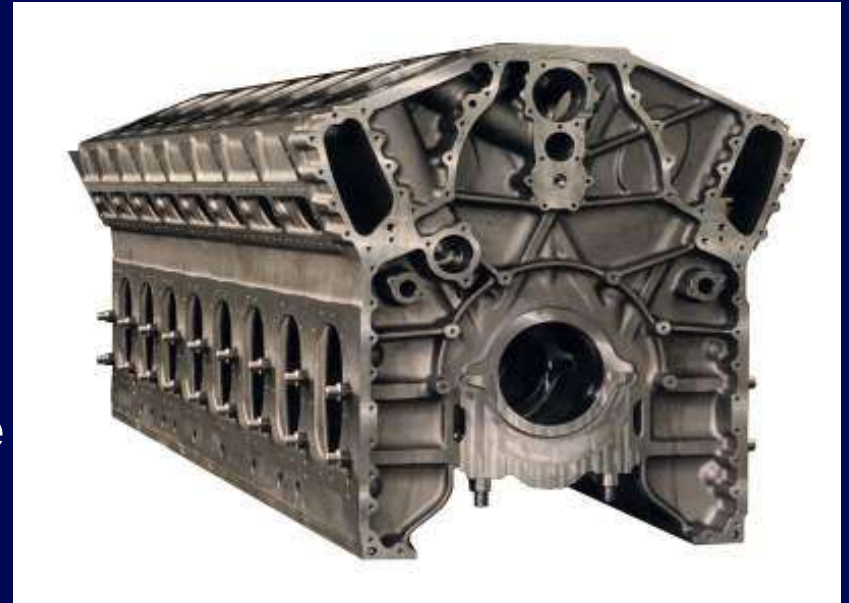
- **Low Life Cycle Costs, I.E. Low Fuel and Lube Oil Consumption**
- **Meet Current and Future Emission Requirements**
- **Designed to Fit Stringent Requirements of Catamarans**
- **Provide Complete Engine System With Minimal Interfaces**



Series 8000

Engine Design - Crankcase

- **Technical Features:**
 - Rigid Design, Nodular Cast Iron
 - Integrated Charge Air Ducting
 - Single Centrally Located Camshaft and Main Oil Channel
 - Hydraulically Tensioned Studs for Securing Main Bearing Caps
 - Large Crankcase Access Holes
- **Benefits:**
 - Extremely Stiff Crankcase
 - Strong Crankshaft Support
 - No Contact With Cooling Water
 - Main Bearings Replaceable on Site



Series 8000

Key Technologies for Diesel Engines

Injection



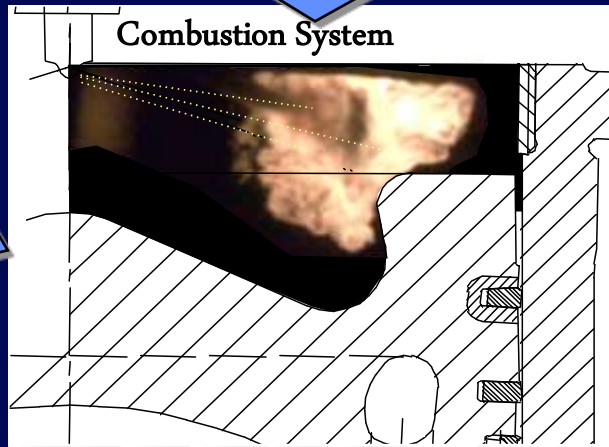
Turbocharging



Electronics



Combustion System



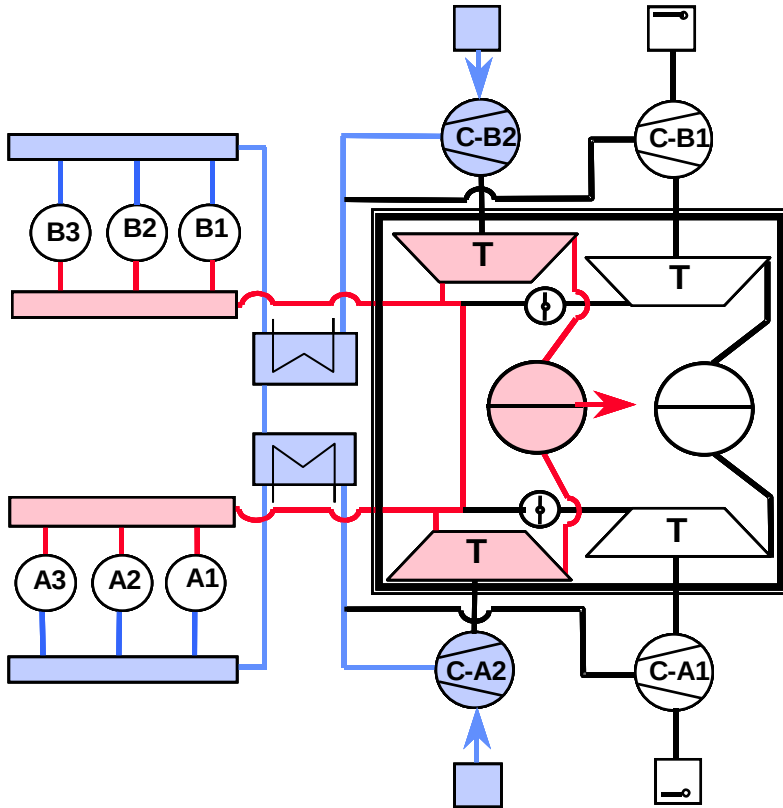
Series 8000

Key Technology – Air System

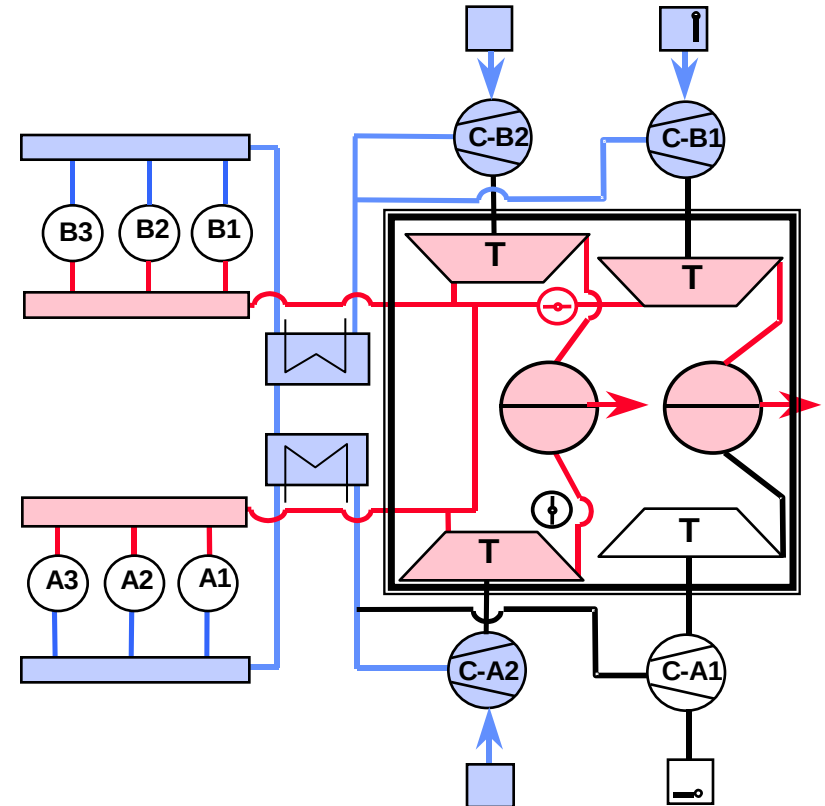
- **Four MTU Turbochargers**
 - Designed and Manufactured In-house
 - Small Chargers With Low Mass Inertia (Quick Response / Acceleration)
- **Single-stage With Charge-air Cooling**
- **Sequential Turbocharging**
 - Load-dependent Switching of Turbochargers
 - Two Base Charges and Two Switchable (Three-stage Switching)
 - Hydraulic Actuation of Compressor and Turbine Flaps



Series 8000 Sequential Turbocharging



Base charger in operation



Charger B1 switched into operation

Series 8000

Key Technology – Air System

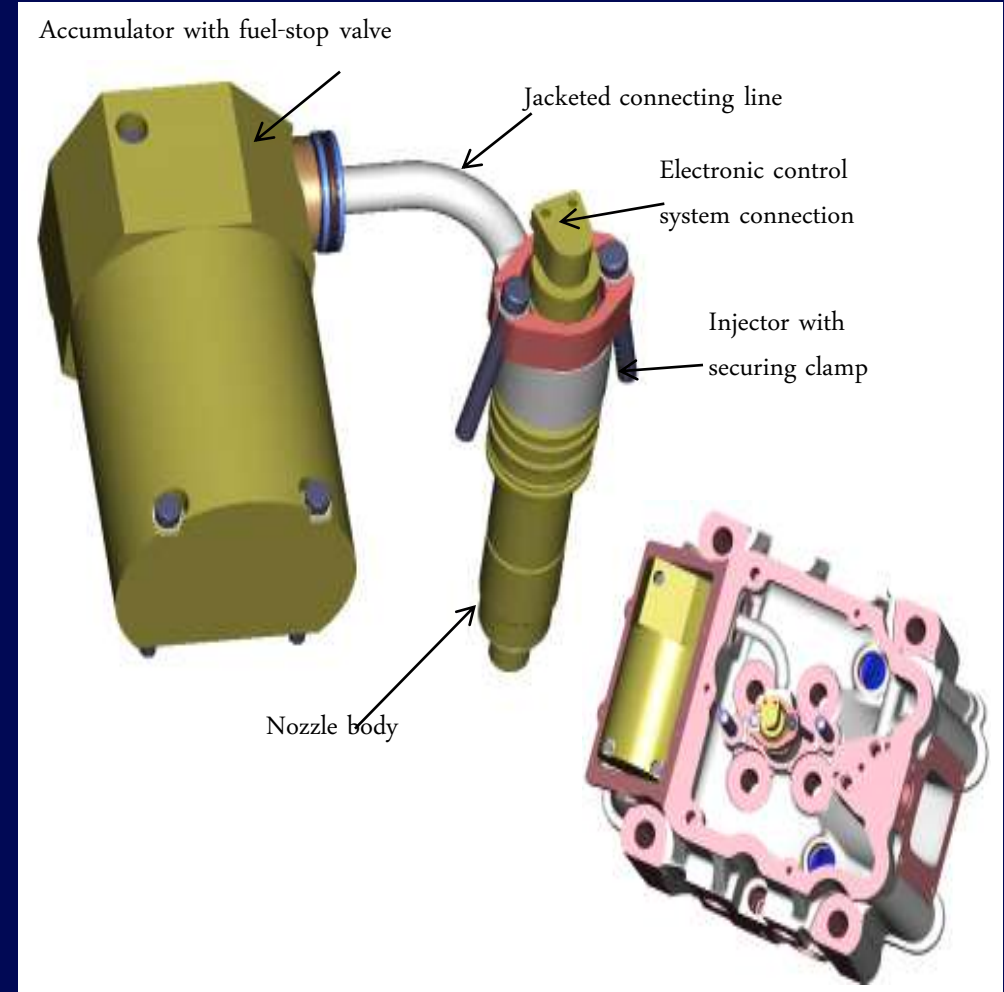
- **Benefits**
 - **System Optimized to Meet the Design Targets**
 - **Higher Torque Available Compared to Conventional System Allowing Quicker Acceleration and Maneuvering**
 - **Low Fuel Consumption Even at Part Load (Less Than 200 g/kW-h Down to 25% of Nominal Power)**
 - **Minimized Black and White Smoke Emissions at Part Load**
 - **Proven Technology**
 - **Service and Maintenance From One Source**



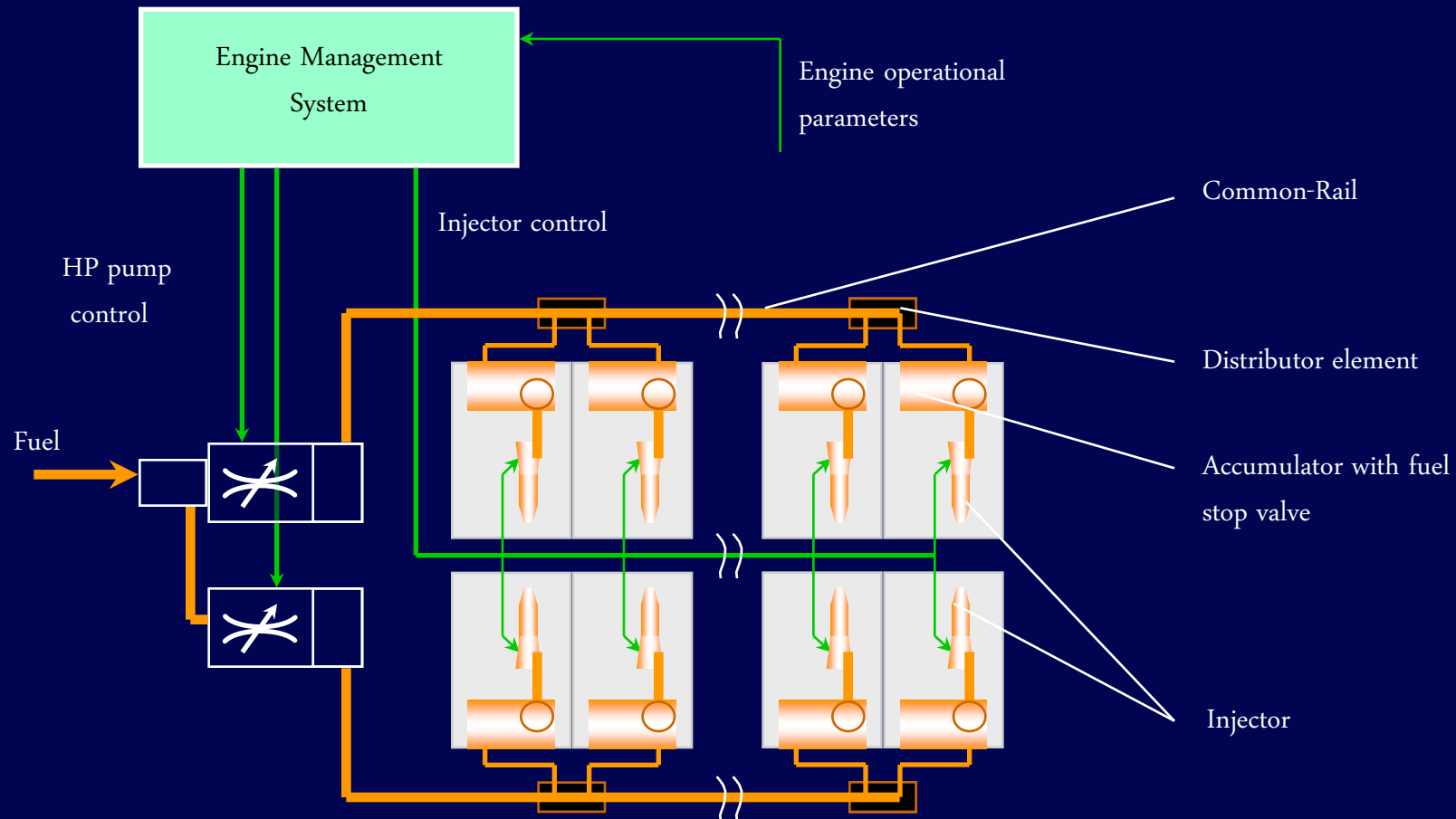
Series 8000

Key Technology – Fuel System

- **Common Rail Fuel System**
 - Designed and Manufactured In-house
 - New but Proven Technology
 - Continuously Optimized Injection Pressure and Flow Based on Load Demands
 - High Injection Pressure Over Full Operating Speed Range



Series 8000 Common Rail Fuel System



Series 8000

Key Technology – Fuel System

- **Benefits**
 - **System Optimized to Meet Design Targets**
 - **Low Fuel Consumption Over Entire Performance Range**
 - **Significant Reduction of Black Smoke Emissions at Low Engine Speeds**
 - **No Mechanical Adjustments Required**
 - **Provides Capability to Meet Emission Requirements Today and for the Future**
 - **Proven Technology**
 - **Service and Maintenance From One Source**



Series 8000

Key Technology - Electronics

- **Engine Fuel Management System**
 - Designed and Manufactured In-house
 - Regulates Engine Speed and Fuel
 - Controls Turbo Switching, Cylinder Cutout, and More
 - Monitors Critical Parameters for Engine Protection and Information Displays
 - Self Diagnostics



Series 8000

Key Technology - Electronics

- **Benefits**
 - **Optimized to Control and Monitor Other Key Technologies for Seamless Interfacing**
 - **Engine Mounted and Wired**
 - **Simple Diagnostic Tools**
 - **Proven Technology**
 - **Service and Maintenance From One Source**



Series 8000

Main Features



- Bore / Stroke 265 mm / 315 mm
- Bank-Configuration 48° V
- Swept volume 17.37 liter / cyl.
- Power range today up to 9 000 kW
- Speed range 380 - 1,150 rpm
- The engine is capable of running without operational restrictions at 9,000 kW
- At 45°C intake air and 32°C sea water, full power is available considering ISO standard tolerances.



- Power unit concept
- Common Rail fuel injection system
- Sequential turbo charging
- Split Circuit Cooling System
- Electronic engine management



Series 8000

Cross Section

Fresh water return line

Exhaust gas manifold

Fuel accumulator

Intermediate cooling
water housing

Charge air duct

Fresh water supply
manifold

Crankcase access
holes
Crankcase

Injector

Cylinder head

Cylinder liner

Composite piston

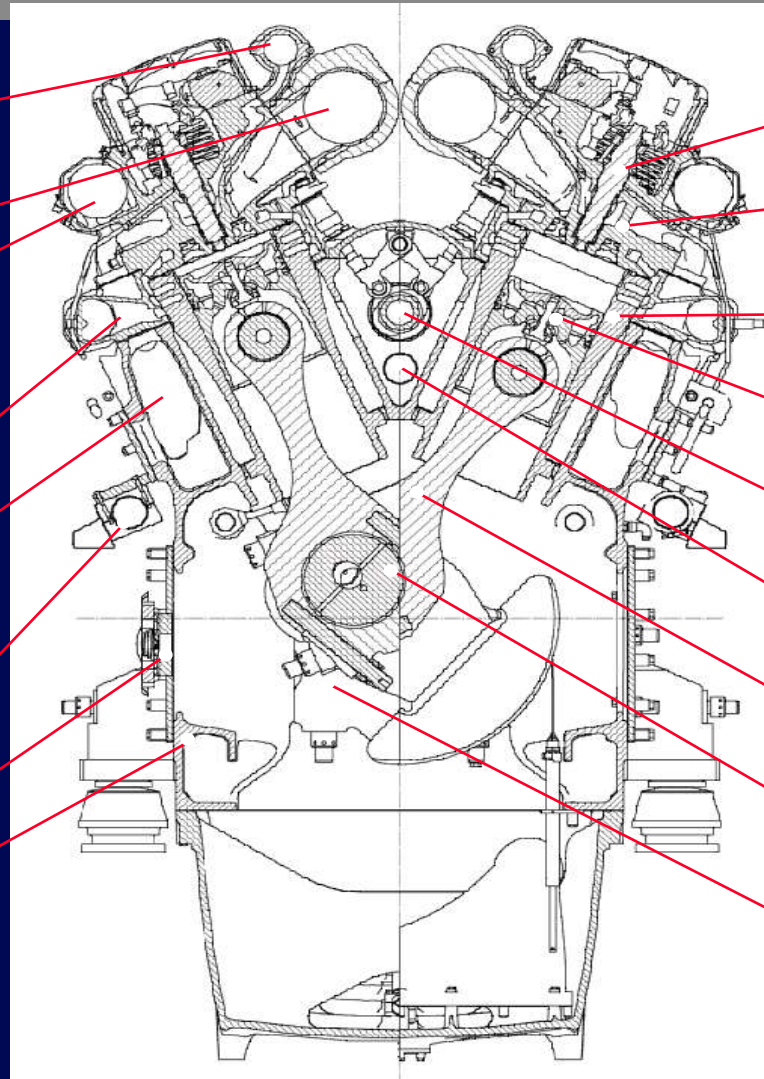
Central cam shaft

Main oil supply line

Connecting rod

Crankshaft

Main bearing cap



Series 8000

Performance and Fuel Consumption

Engine power

2500 kW / 3350 bhp

5000 kW / 6700 bhp

7500 kW / 10060 bhp

9000 kW / 12070 bhp

Fuel cons.

605 lit/h (160 gal/h)

1154 lit/h (305 gal/h)

1741 lit/h (460 gal/h)

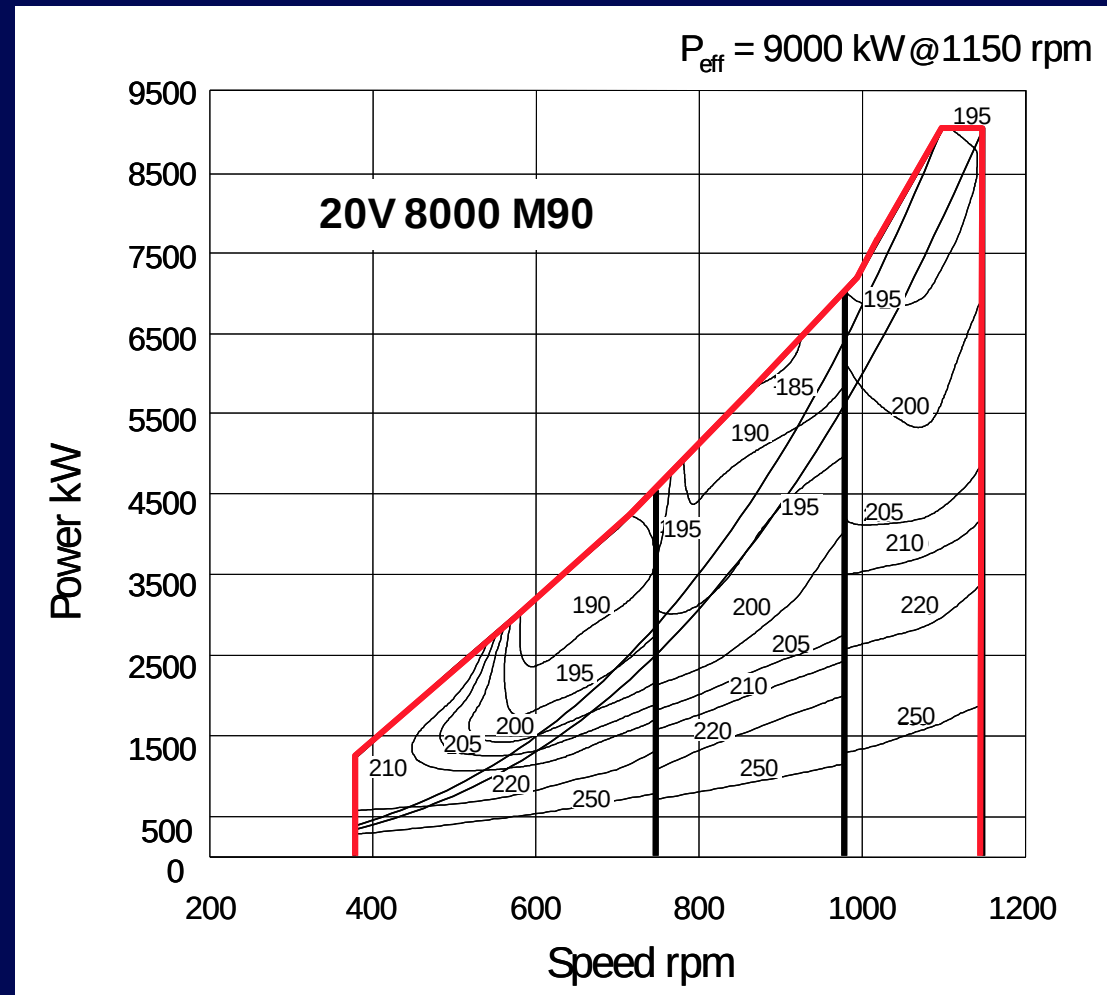
2119 lit/h (560 gal/h)

Reference conditions:

Intake air temperature 25 °C

Raw water temperature 25 °C

IMO-NO_x optimized



Series 8000

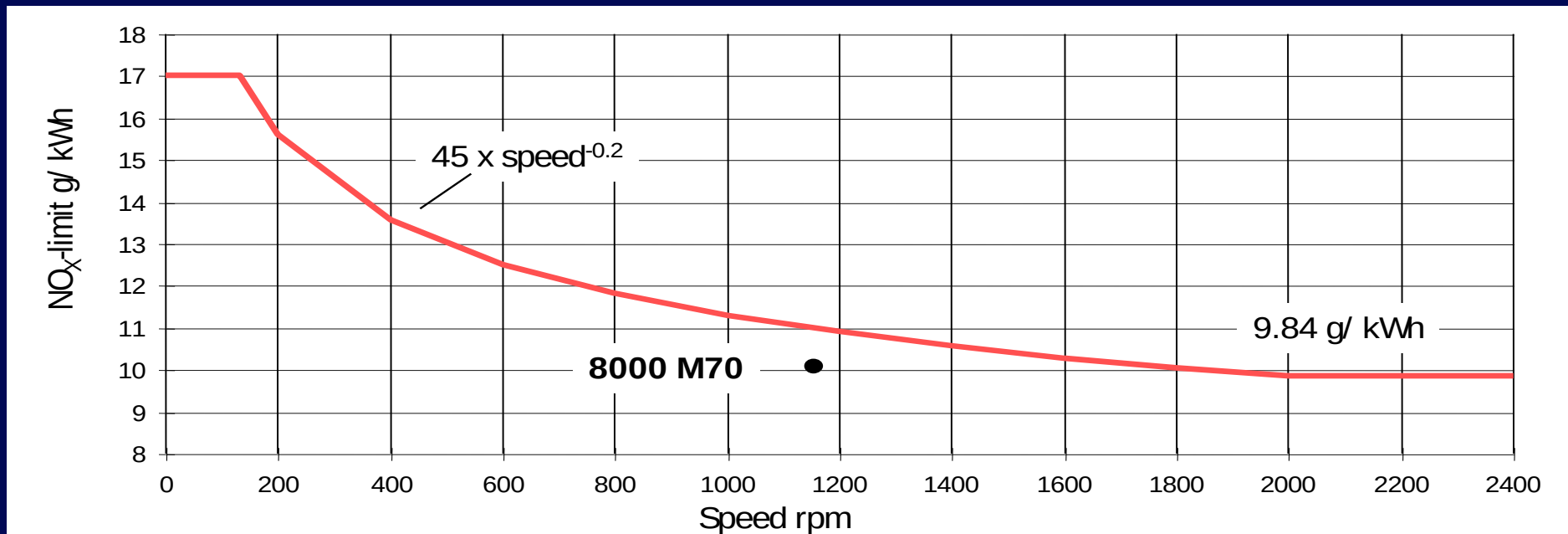
Fast Ferry Performance

- **9,000 kW Can Be Used for Unlimited and Uninterrupted Operation Without Thermal Overload for Yachts or Naval Vessels**
- **For Fast Ferry Power Is Limited 8,200 kW (90% of 9,000 kW)**
 - **Service Power Could Be Used for Unlimited and Uninterrupted Operation at 1080 to 1150 RPM**
 - **No Power Reduction up to 45 °C Air Inlet Temperature**



Series 8000 Emissions

- **NOx Regulation**
 - Marpol 73/78, Annex VI
 - Valid for Engines Above 130 kW Going in Service After January 2st, 2000
 - NOx Limit Curve, Test Cycle ISO 8178-4, E3

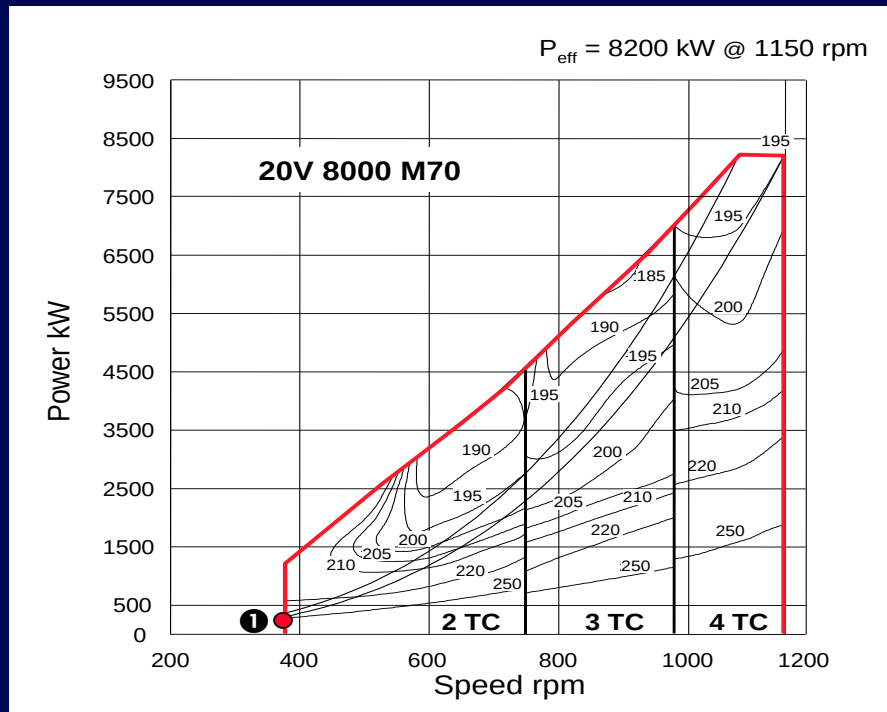


Series 8000 Emissions

Black Smoke Emission

20V 8000, M70 on test bed

- ① 22 kW / 380 rpm / 4 Turbochargers
SZ Bosch: 0.85

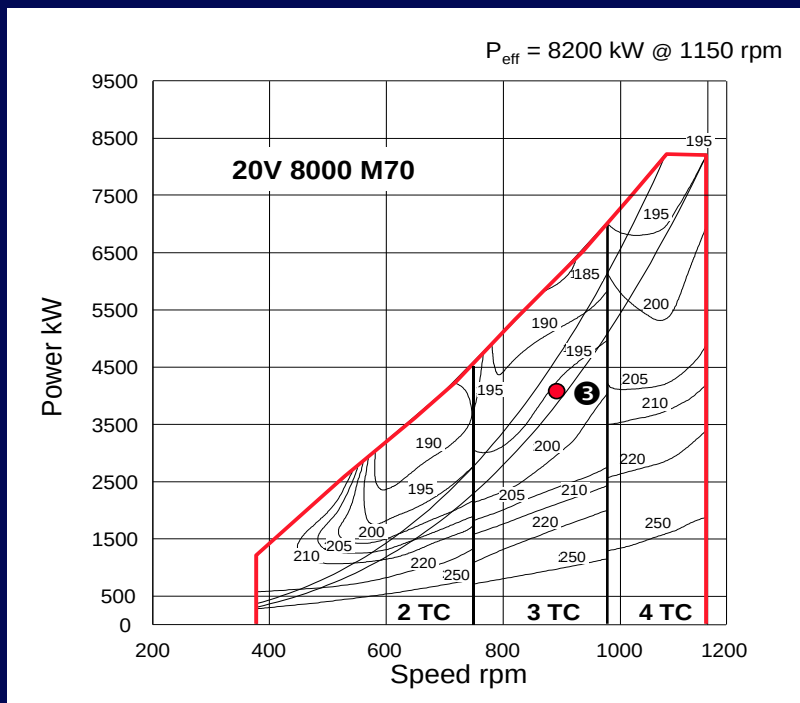


Series 8000 Emissions

Black Smoke Emission

20V 8000, M70 on test bed

- ③ 4100 kW / 915/min / 3 Turbochargers
SZ Bosch: 0.11

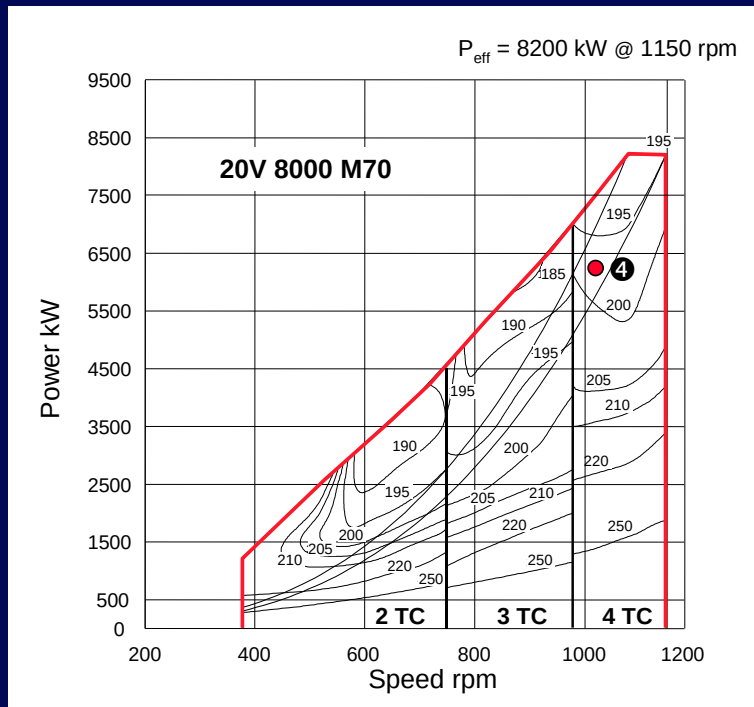


Series 8000 Emissions

Black Smoke Emission

20V 8000, M70 on test bed

④ 6150 kW / 1046/min / 3 4 TC switching
SZ Bosch: transient

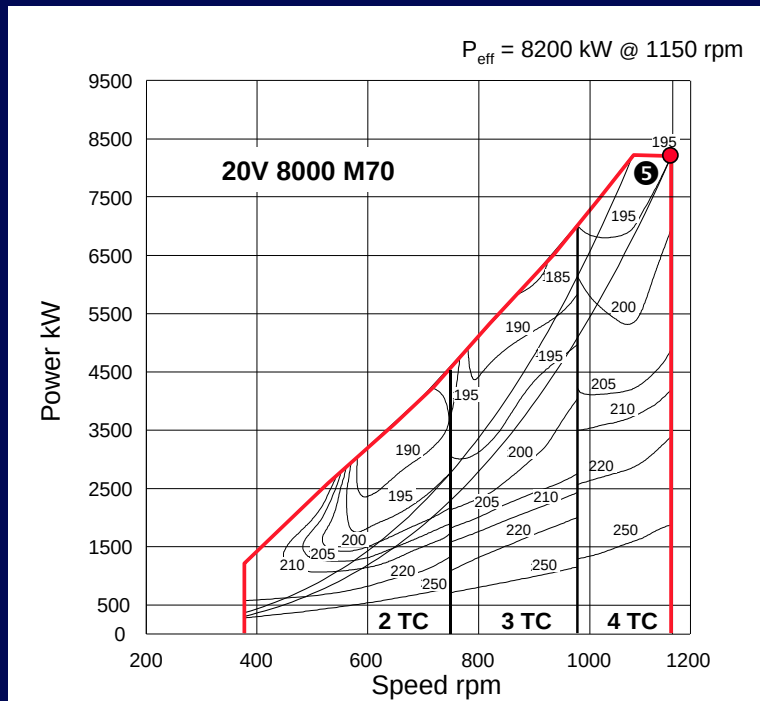


Series 8000 Emissions

Black Smoke Emission

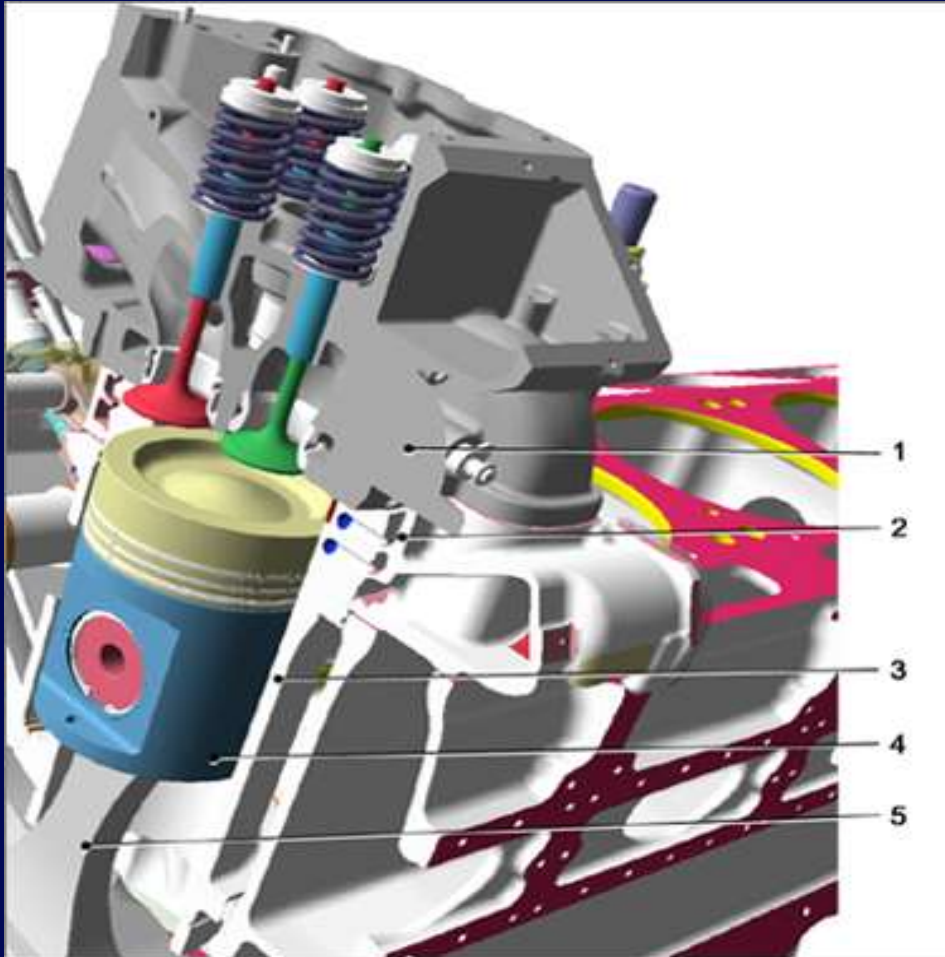
20V 8000, M70 on test bed

- ⑤ 8200 kW / 1150/min / 4 Turbochargers
SZ Bosch: 0.21



Series 8000

Serviceability - Power Unit



Power Unit Consists of

1. Cylinder Head
2. Intermediate Cooling Water Housing
3. Cylinder Liner With Anti- Polishing Ring
4. Piston
5. Connecting Rod

Series 8000

Serviceability – Power Unit

- **Power Unit Two Functions**
 - **Combustion and Cooling System**
 - » Liner With Intermediate Cooling Water Housing Bolted Onto Cylinder Head With 24 Bolts
 - » Optimizes Liner to Head Sealing
 - » Optimum Circularity of Liner
 - » Low Wear Piston Rings and Liner
 - **Retention System**
 - » Four Large Bolts Attaches Unit to Crankcase
 - » Easy Removal / Installation As Single Unit



Series 8000 Serviceability

- **All Main Accessories Are at Front of Engine**
 - Easy Servicing of Filters and Pumps
 - Well-accessible Interfaces for Fuel, Raw Water and Fresh Water
 - Minimized Interfaces to Ship Connections (Reduced Complexity of Shiplside Installations)

Engine control
and monitoring unit

Lub oil centrifugal
filter

Automatic lub
oil filter

Fuel filter

Lub oil coolers

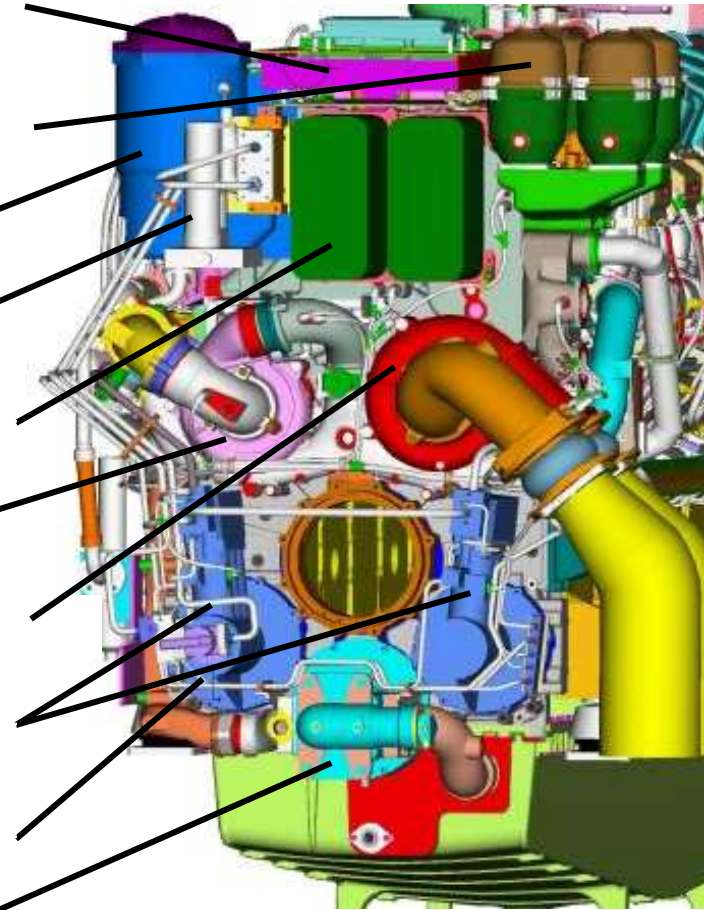
Fresh water
pump

Raw water pump

High-pressure
fuel pumps

Low-pressure
fuel supply pump

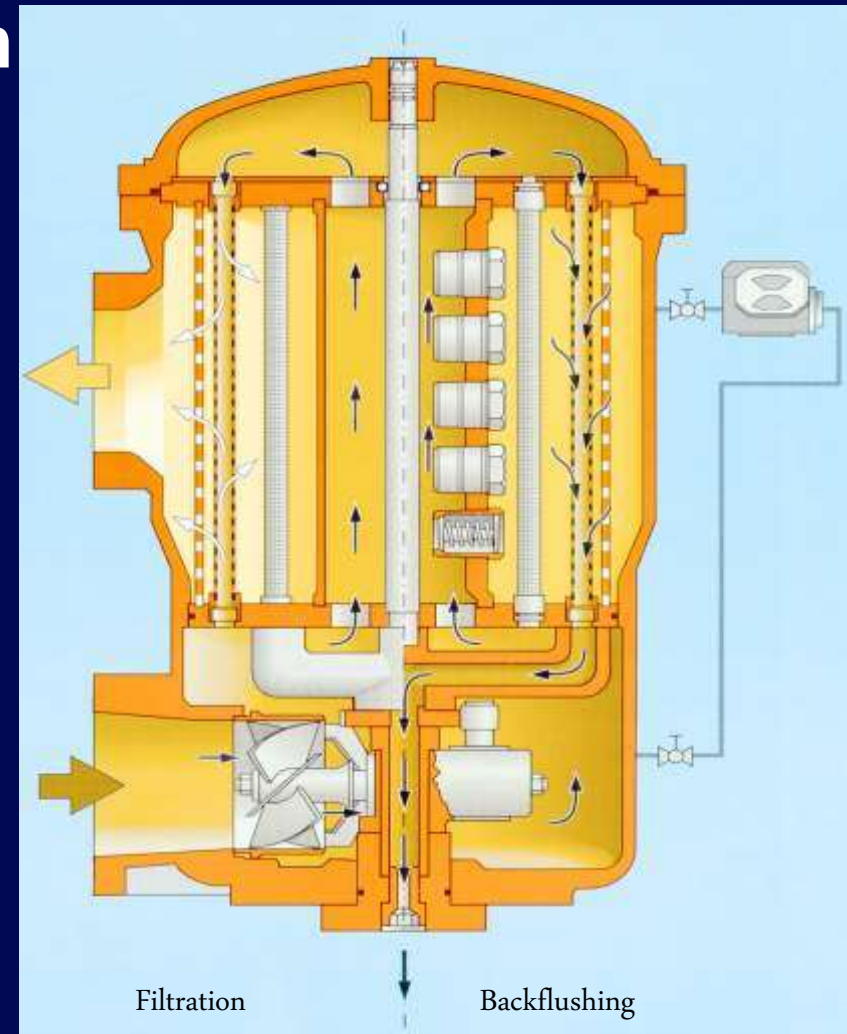
Oil pump



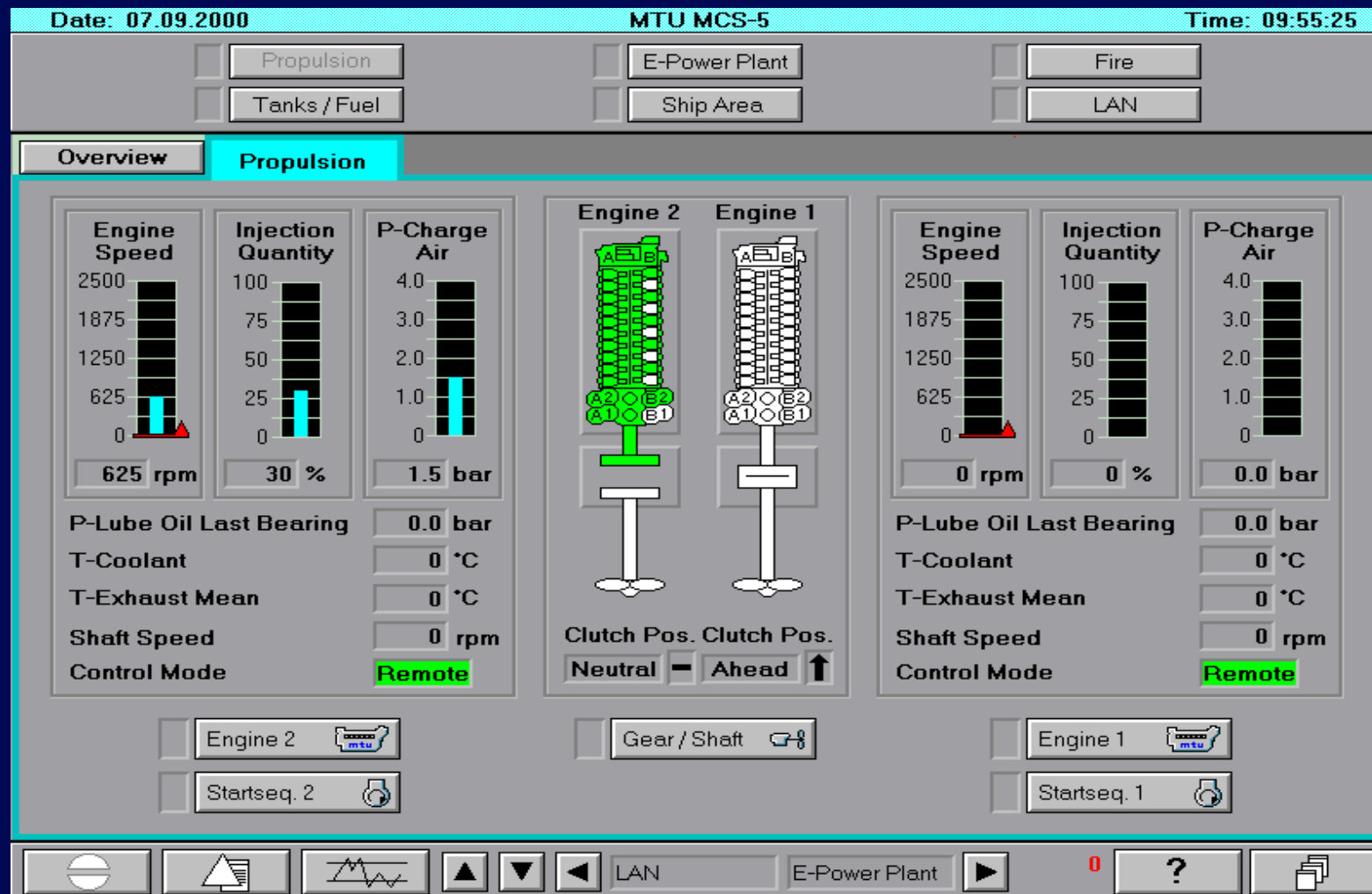
Series 8000

Serviceability - Automatic Lube Oil Filter

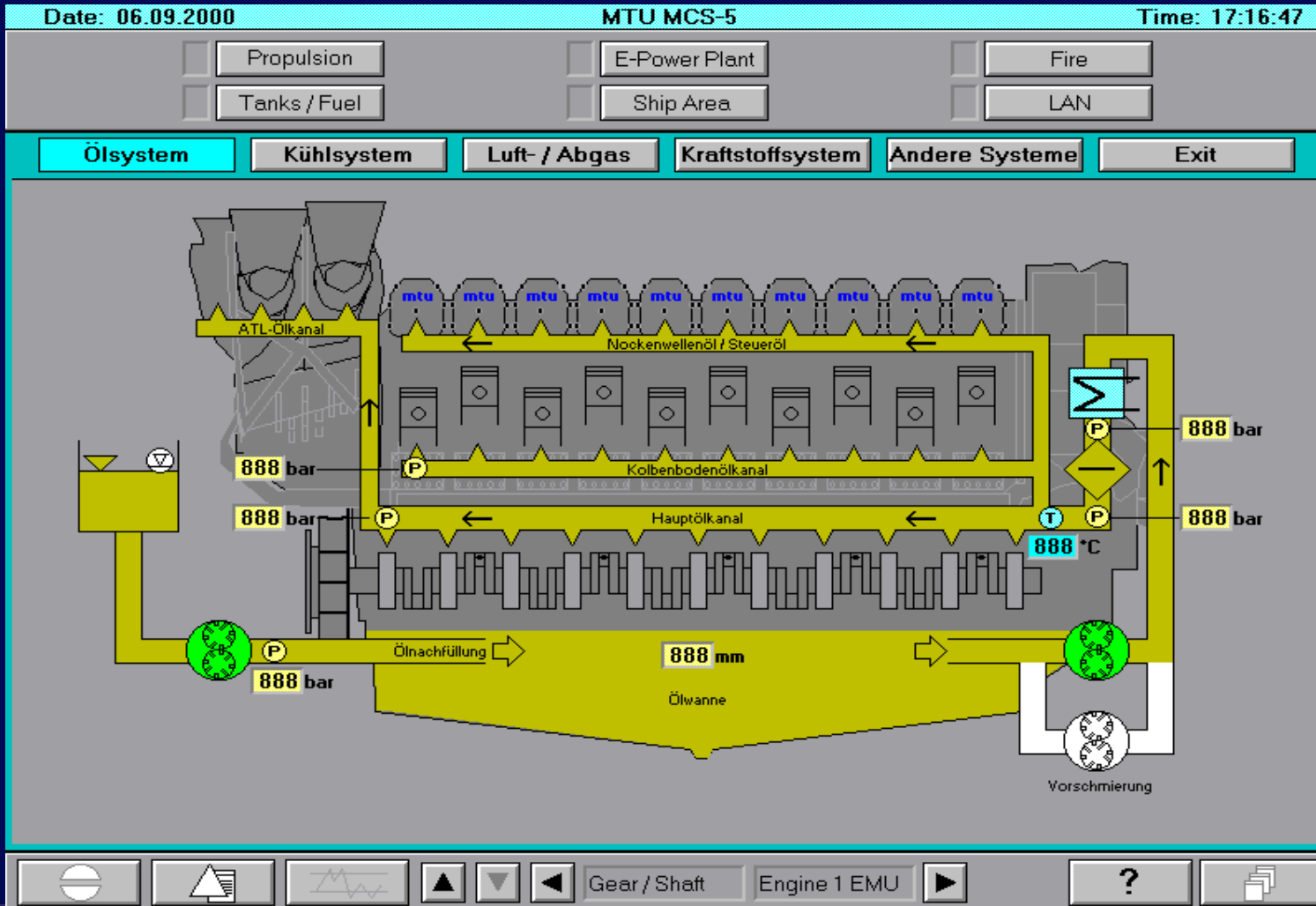
- **Full Flow Lube Oil Purification With Continuous Back-flushing**
- **By-pass Filtration Via Centrifugal Filters**
- **Benefits**
 - Defined Filter Fineness Maintained
 - Environmentally Friendly
 - Reduced Maintenance
 - Complete Lube Oil Treatment Integrated at Engine



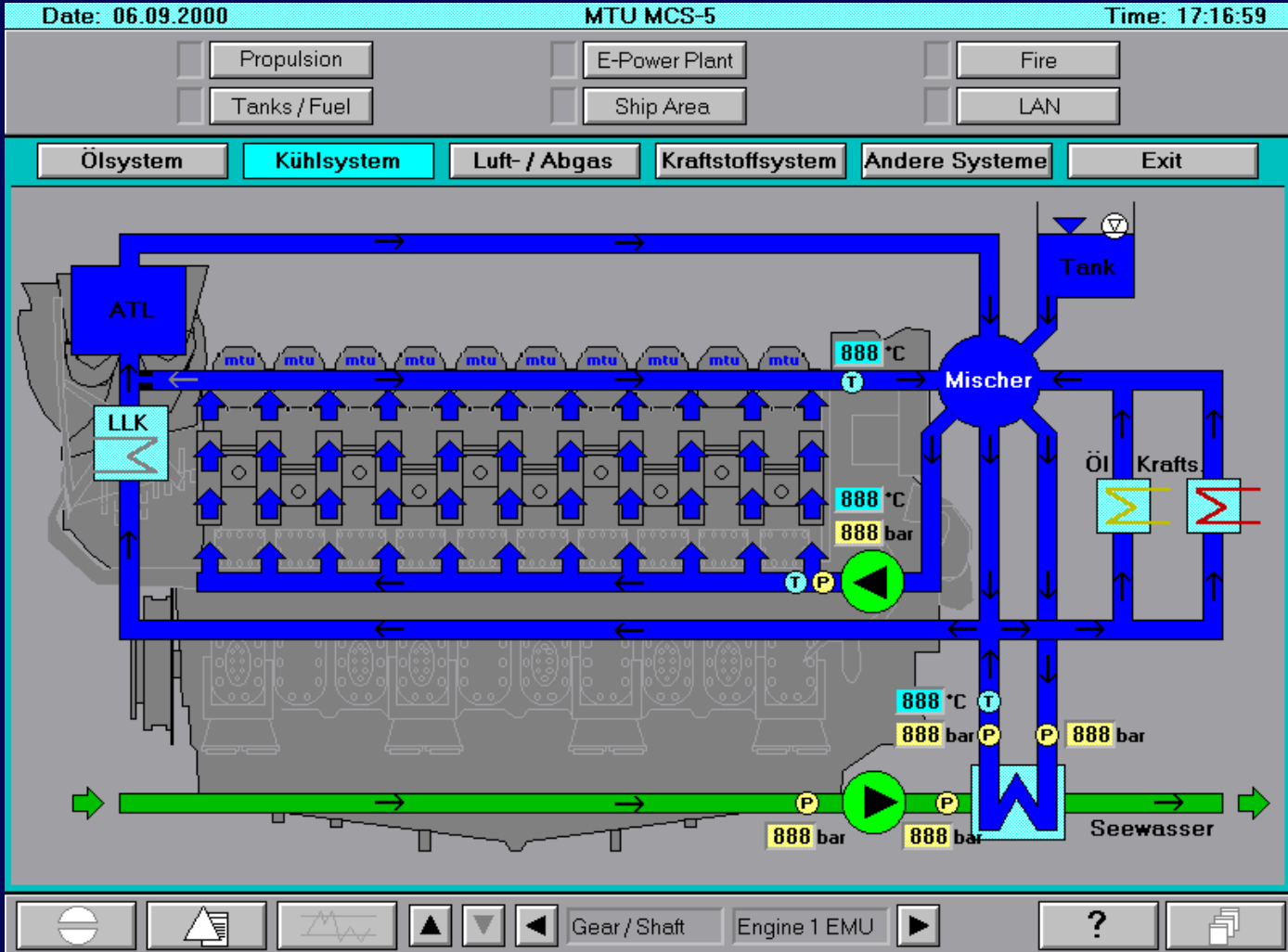
Series 8000 Monitoring and Control System



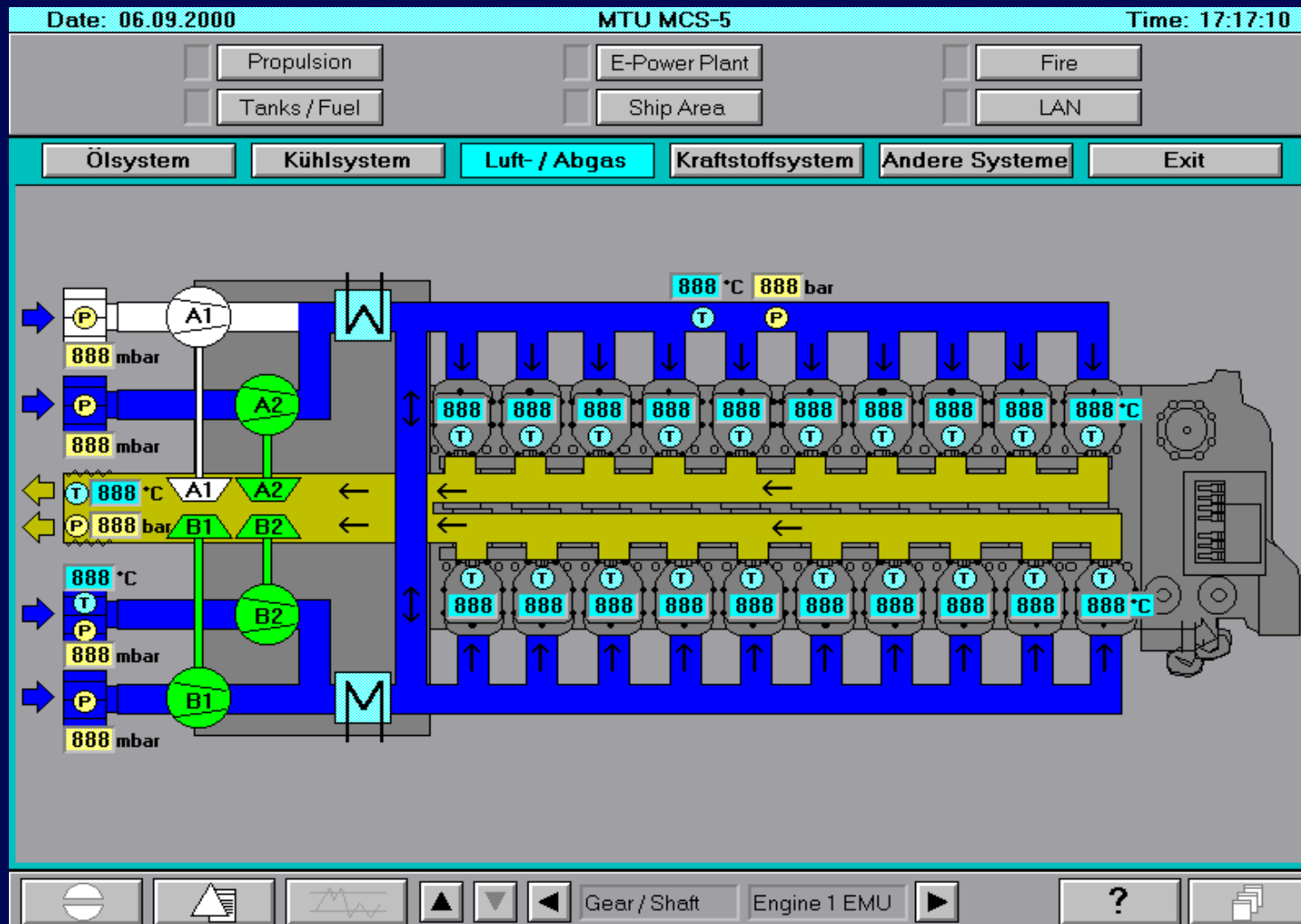
Monitoring and Control System



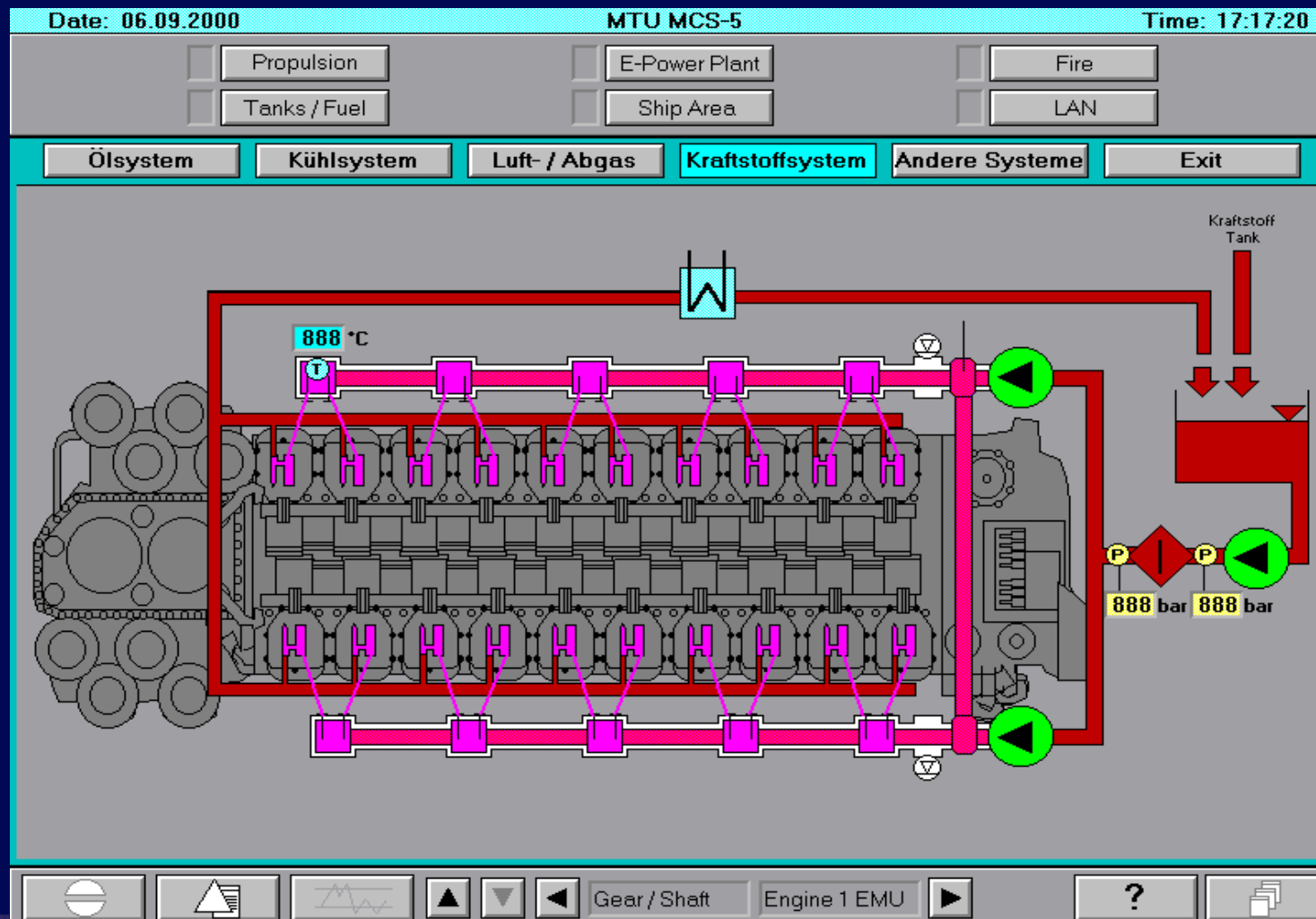
Monitoring and Control System



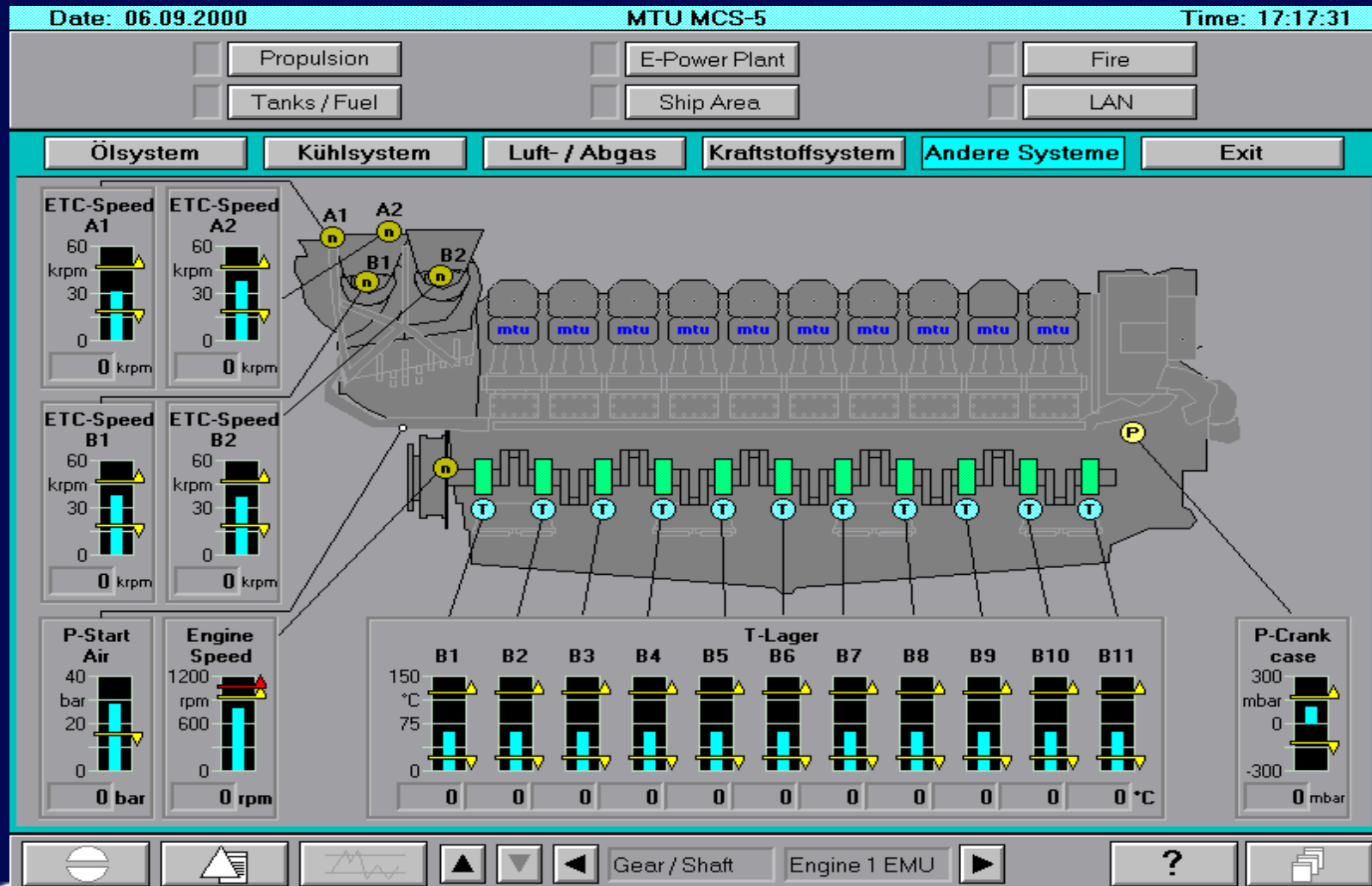
Monitoring and Control System



Series 8000 Monitoring and Control System



Series 8000 Monitoring and Control System



Series 8000

First Application in Fast Ferry

The World's most powerful diesel engine driven Catamaran



„Spit of Ontario“ 86 M, Passengers 774, Cars 238,
4 X MTU 20V 8000, 4 X 8200 Kw, 1150 Rpm, > 45 Knots

Series 8000

Summary of Benefits - Installation

- **Reduced Installation Time / Costs Due to Engine Installed Accessories:**
- **Complete and Fully Tested Diesel Engine System**
- **Compact Design Suitable for Vessels With Limited Machinery Space**
- **Several Gearbox Arrangements Are Available**



Series 8000

Summary of Benefits - Operation

- **Quick Acceleration Behavior With Minimal Black Smoke**
- **High Torque at Low Speed Provides Excellent Maneuverability**
- **Unlimited Operation at 9,000 kW for Yacht**
- **Unlimited Operation at 8,200 kW for Fast Ferry**
- **Low Emissions**
- **Minimal Smoke**

Series 8000

Summary of Benefits - Operation

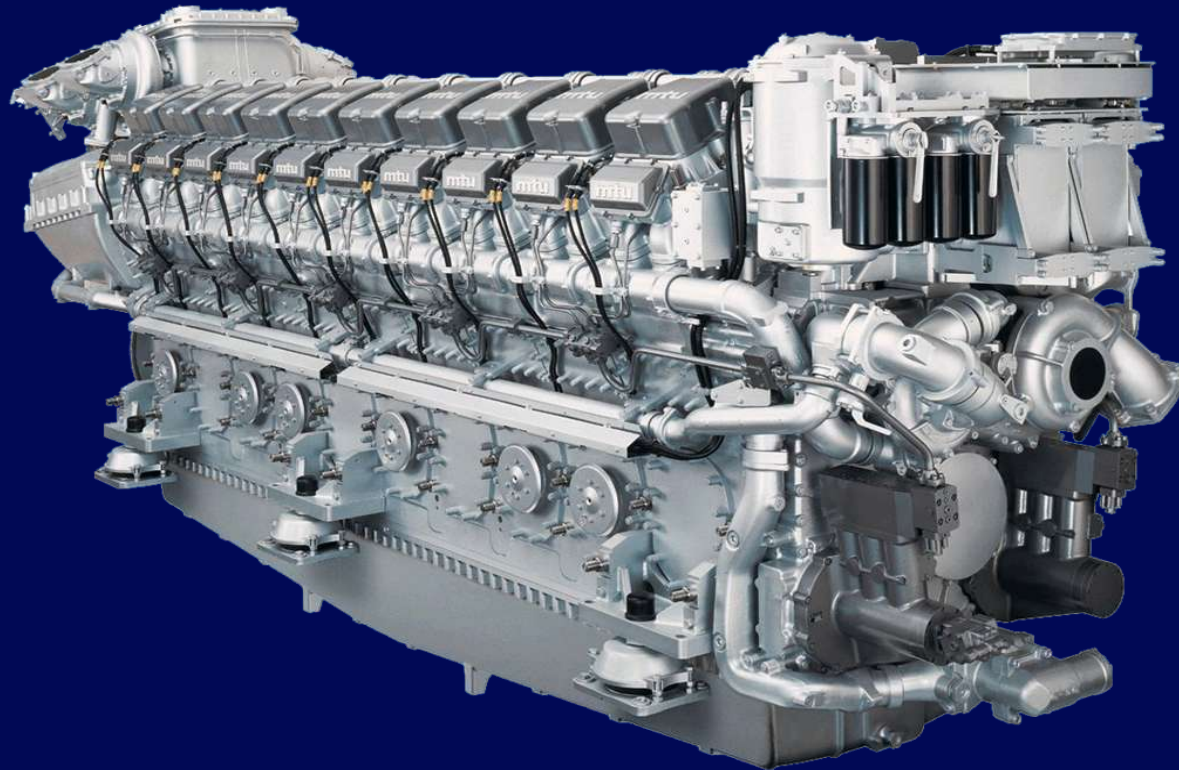
- **Low Fuel Consumption Over Entire Operating Range**
 - ≤ 195 G/kW-h at Maximum Power
 - ≤ 200 G/kW-h Down to 2,500 kW
- **Low Lube Oil Consumption**
 - Approximately 0.6 G/kW-h, 5 Lit/h
- **Reduced Maintenance Work With Long Maintenance Intervals**
- **Minimized Life Cycle Costs**



Series 8000 Conclusion

■ The Design Has Been Verified by Extensive Testing

■ New Proven Technologies Have Been Applied



■ All Targets Such As Performance, Consumption, Emissions Have Been Met

■ It Is A Robust New Generation Diesel Engine for Marine Applications

