

# ME Fundamentals and Critical Principles

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



1<sup>st</sup> Classification Society Event 2017  
Friday 8 December 2017

2 0 1 7



1 9 6 7

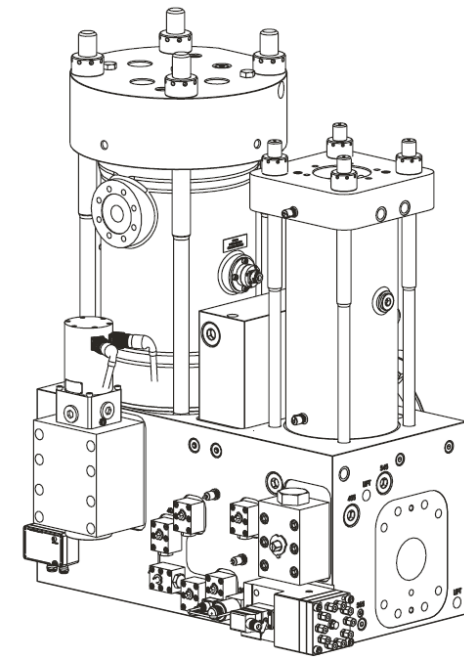
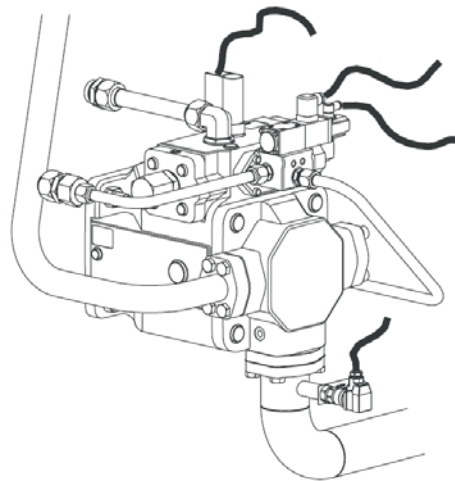
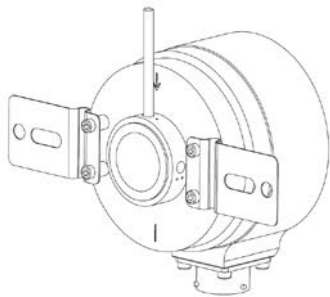
Vassilis Kois

Technical Instructor

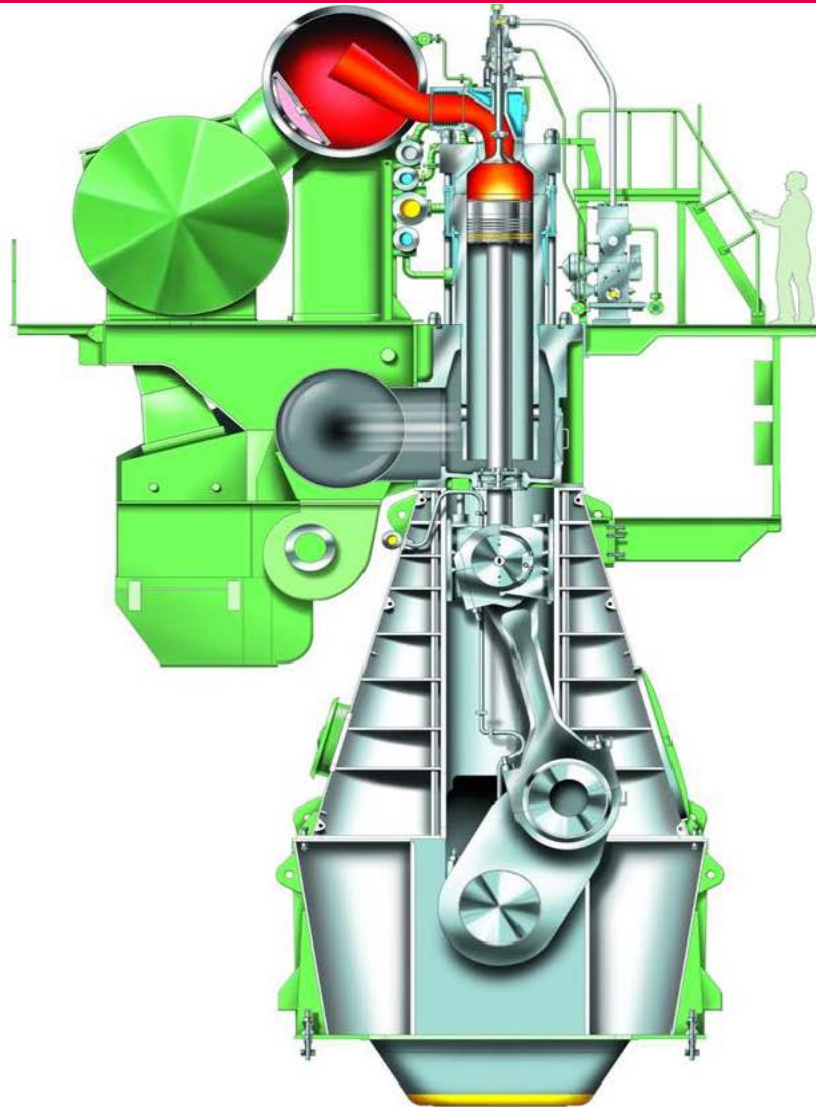
MAN PrimeServ Academy Piraeus

# Any new recommendations to machinery survey??

- Hydraulic AC Pumps – Pressure Build Up response time
- Hydraulic Engine Driven Pumps – Displacement for Ahead/Astern
- Accumulators of Hydraulic Power Supply System – Pressure check
- Accumulators of Hydraulic Cylinder Units System – Pressure check
- FIVA Operation – Testing of Cylinders
- Angle Encoders – Crank Angle reading accuracy



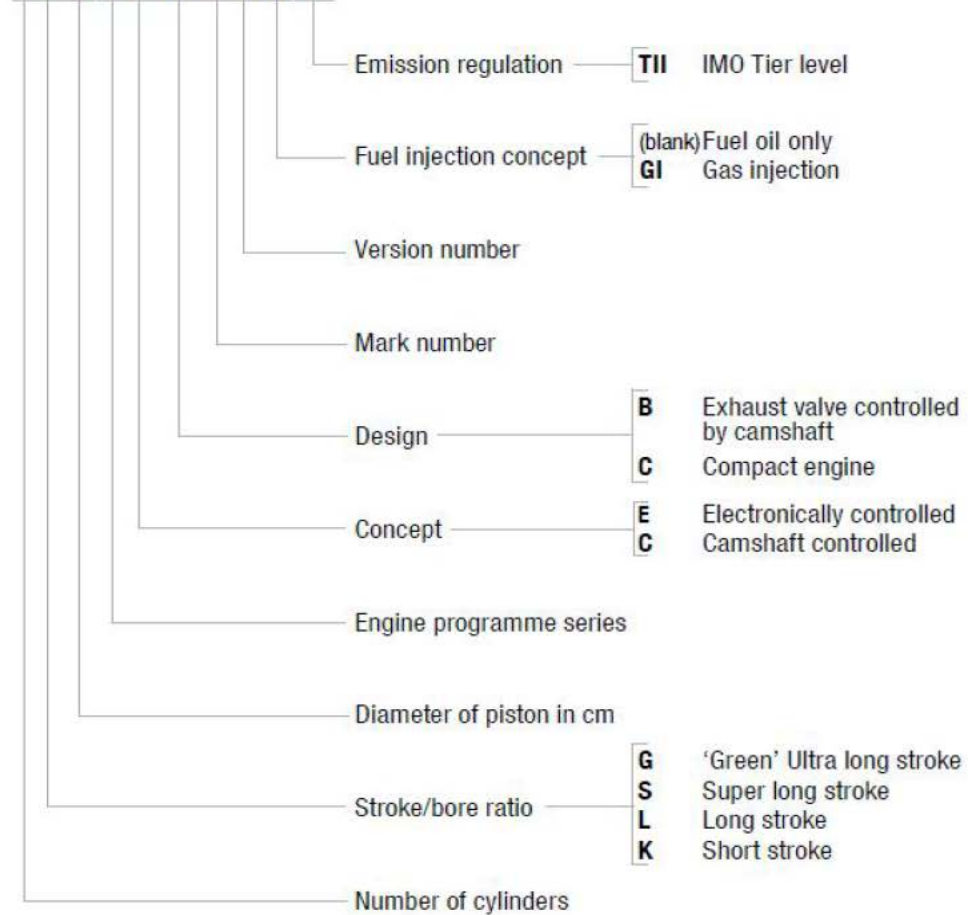
# What new to inspect on ME engines



## MAN B&W Low Speed Propulsion Engines

### Engine Type Designation

6 S 70 M E-B/C 7 .1 -GI-TII



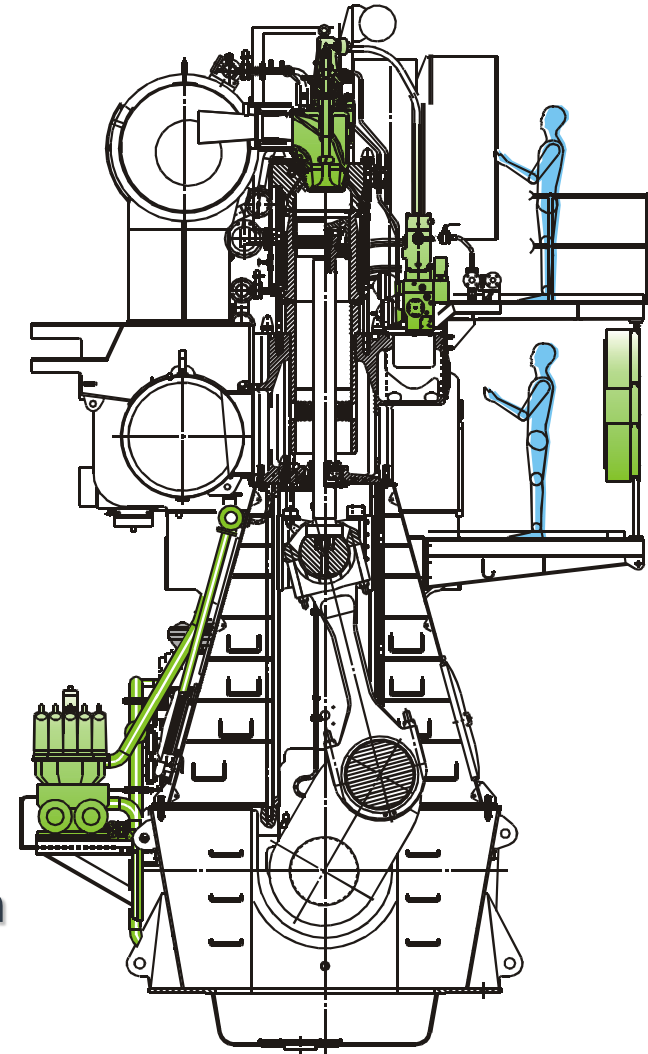
# New Components / Redesigned

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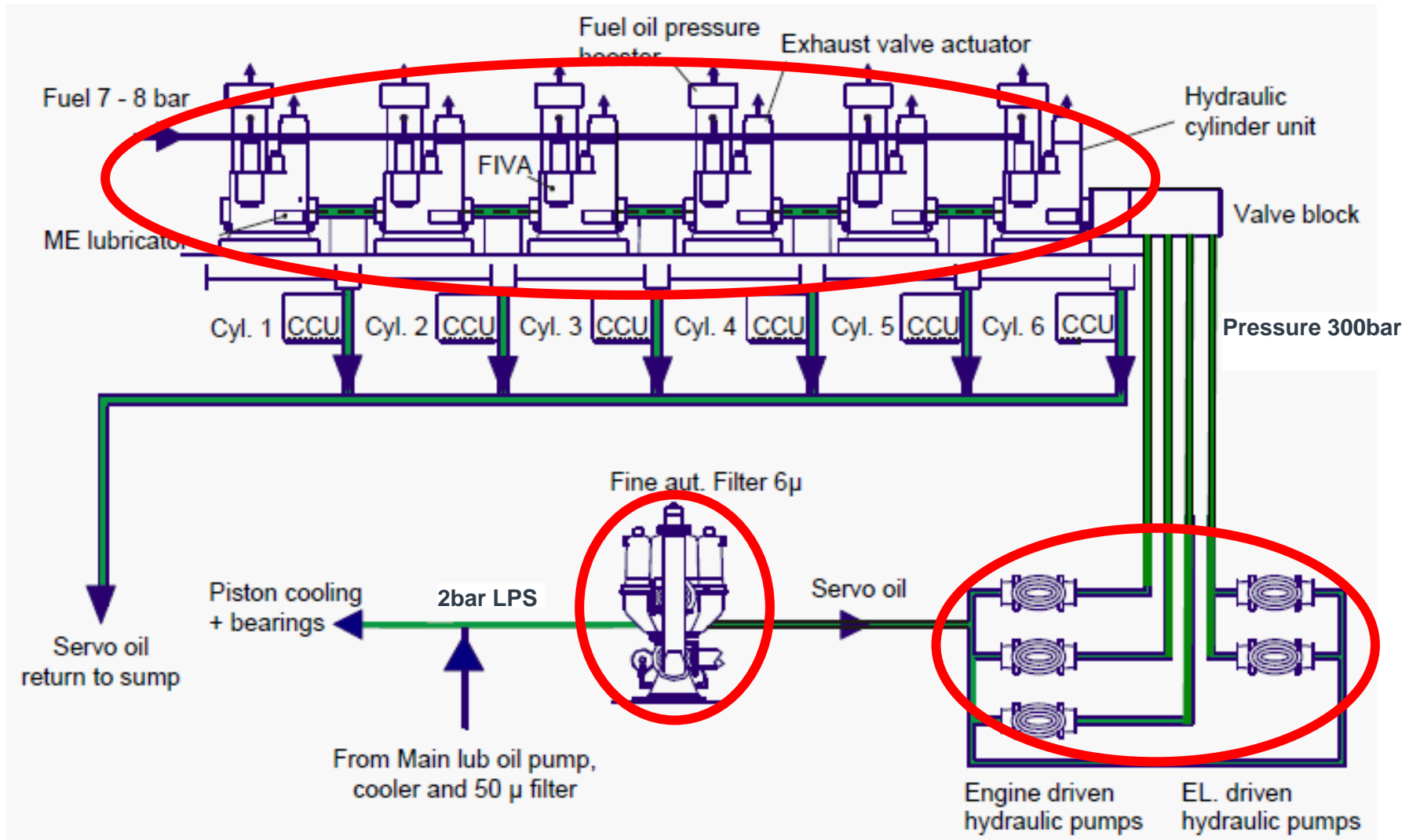


- **Hydraulic Power Supply (HPS)**
- **Hydraulic Cylinder Unit (HCU)**
- **Engine Control System (ECS)**
  - Starting air valves
  - Start and Reversing sequences
  - Governor function
  - Auxiliary blowers
  - Electronically Profiled Injection (EPIC)
  - Exhaust valve actuation
  - Cylinder lubrication (ACC)
- **Exhaust valve**
- **Crankshaft position sensing system**
- **Local Operation Panel (LOP)**

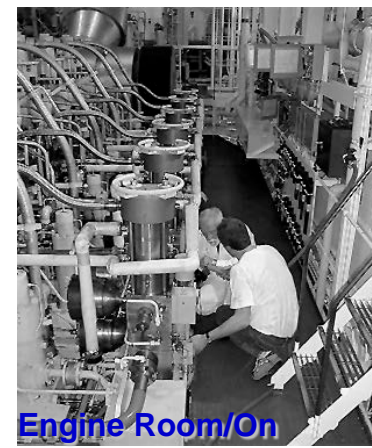
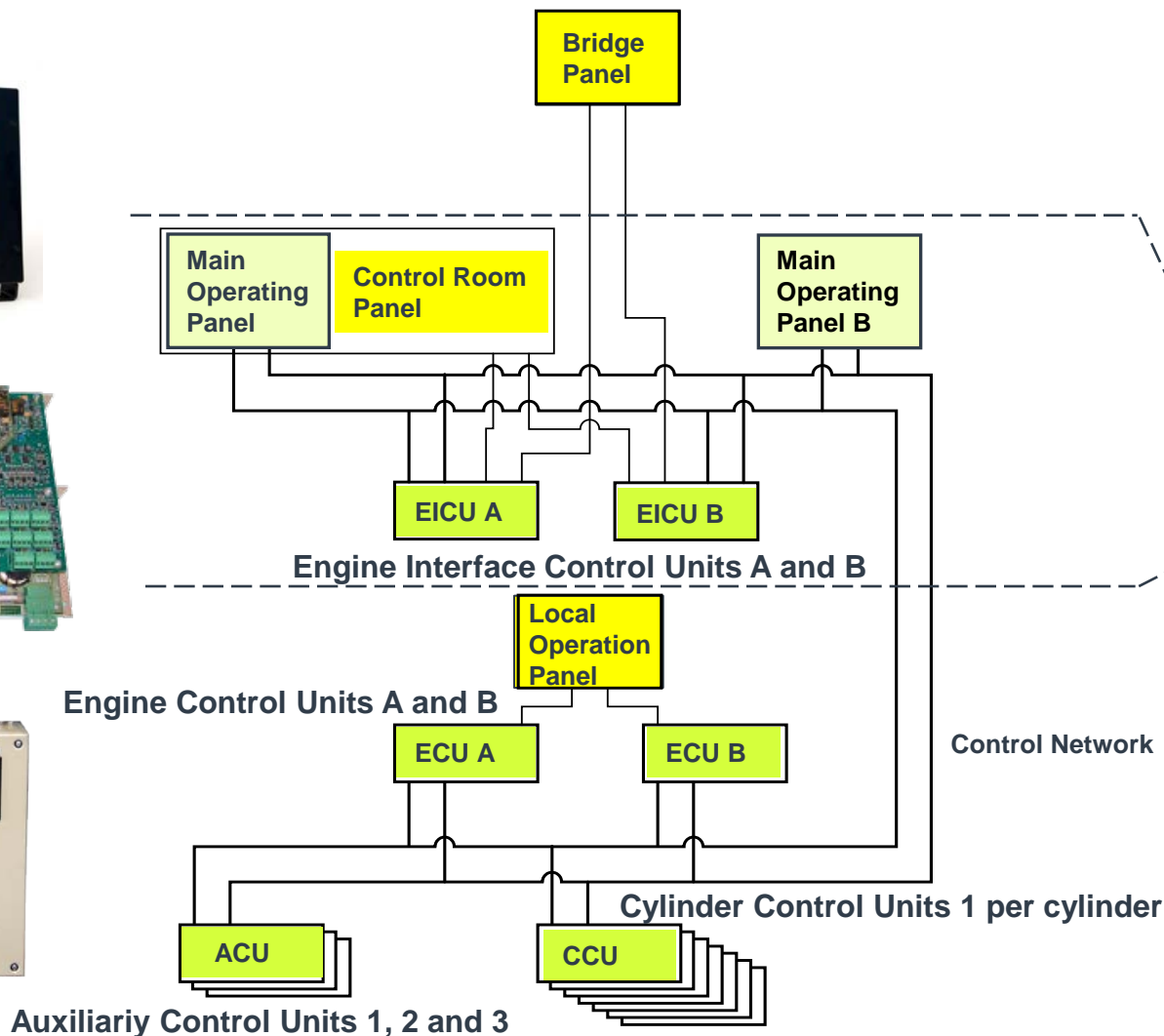


# Super Fine Filter

## ME engine - Hydraulic layout



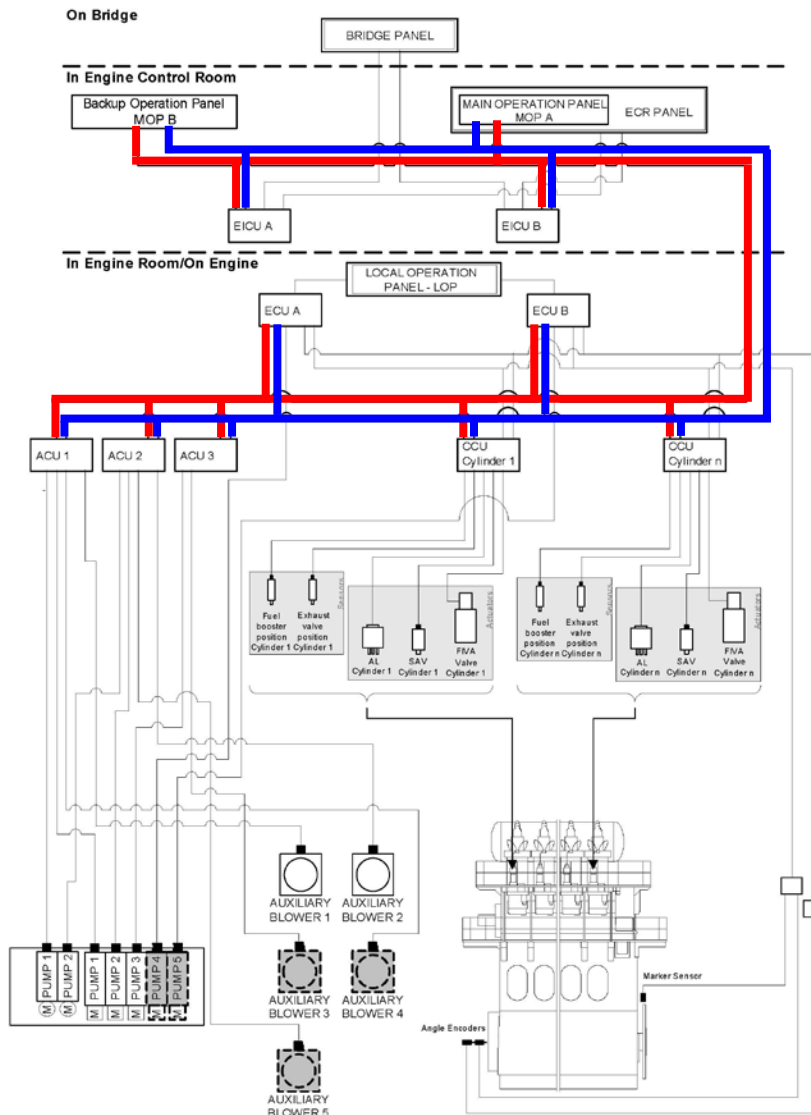
# ME Engine Control System



# Engine Control System MPC & Control Network

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- The Multi Purpose Controllers are identical hardware wise.
- They have different software configurations.
- 2 redundant control networks are connecting all Multi Purpose Controllers and both Main Operating Panels.
- A backup of the application- and setup- software is stored on both Main Operation Panels.
- At replacement, the new controller is automatically configured with correct software via the control networks.

# MPC Unique ID



0 0 0 0

Admin ▶ Version 2010-08-13 12:28:26

Product Name & Version  
**ME-ECS-SW-0905-6.16**

Engine Group No.  
**Simulator**

IMO No.  
**Sim 8**

Engine Builder  
**MD-CPH**

Eng. No.  
**8**

| Controller Unit |       |        | Parameters Check Sums |       |         |        |            |           |
|-----------------|-------|--------|-----------------------|-------|---------|--------|------------|-----------|
| ID              | Addr. | Type   | User                  | Chief | Service | Design | IMO Design | IMO Chief |
| ACU1            | 224   | ACU    | 0                     | 132   | 17757   | 3580   | 0          | 0         |
| ACU2            | 225   | ACU    | 0                     | 131   | 17757   | 3582   | 0          | 0         |
| ACU3            | 226   | ACU    | 0                     | 131   | 17690   | 3584   | 0          | 0         |
| AXU1            | 222   | AXU    | 0                     | 8     | 4400    | 0      | 0          | 0         |
| CCU1            | 240   | CCU    | 0                     | 2     | 27943   | 62776  | 16685      | 15472     |
| ECUA            | 208   | ECU    | 0                     | 7406  | 91064   | 53613  | 43433      | 19852     |
| ECUB            | 209   | ECU    | 0                     | 7408  | 91276   | 53613  | 43433      | 19852     |
| EICUA           | 192   | EICU   | 0                     | 387   | 93308   | 496    | 0          | 0         |
| EICUB           | 193   | EICU   | 0                     | 386   | 93365   | 496    | 0          | 0         |
| ESU             | 223   | EngSim | 0                     | 0     | 10508   | 0      | 0          | 0         |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |

Alarms...

Engine...

Auxiliaries...

Maintenance...

Admin ▶

Set Time

Version

Power Off ⓘ

Access

Chief

Refresh

Export...

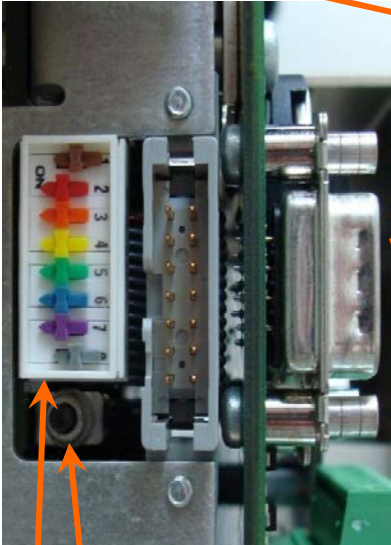
⏴

⏵



# Multi Purpose Controller, MPC

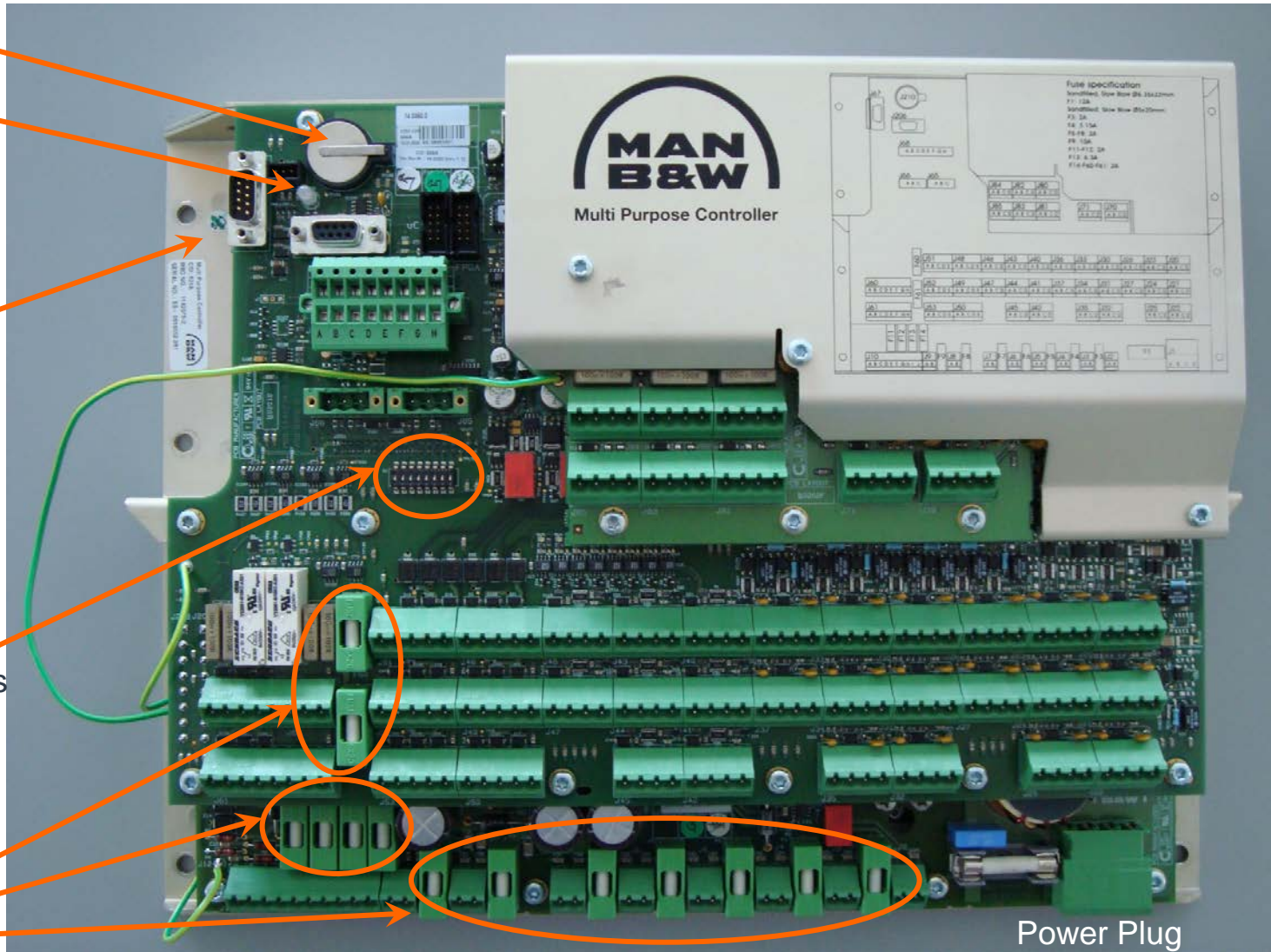
Battery for internal clock  
LED indicator



DIP Switches &  
Reset push button

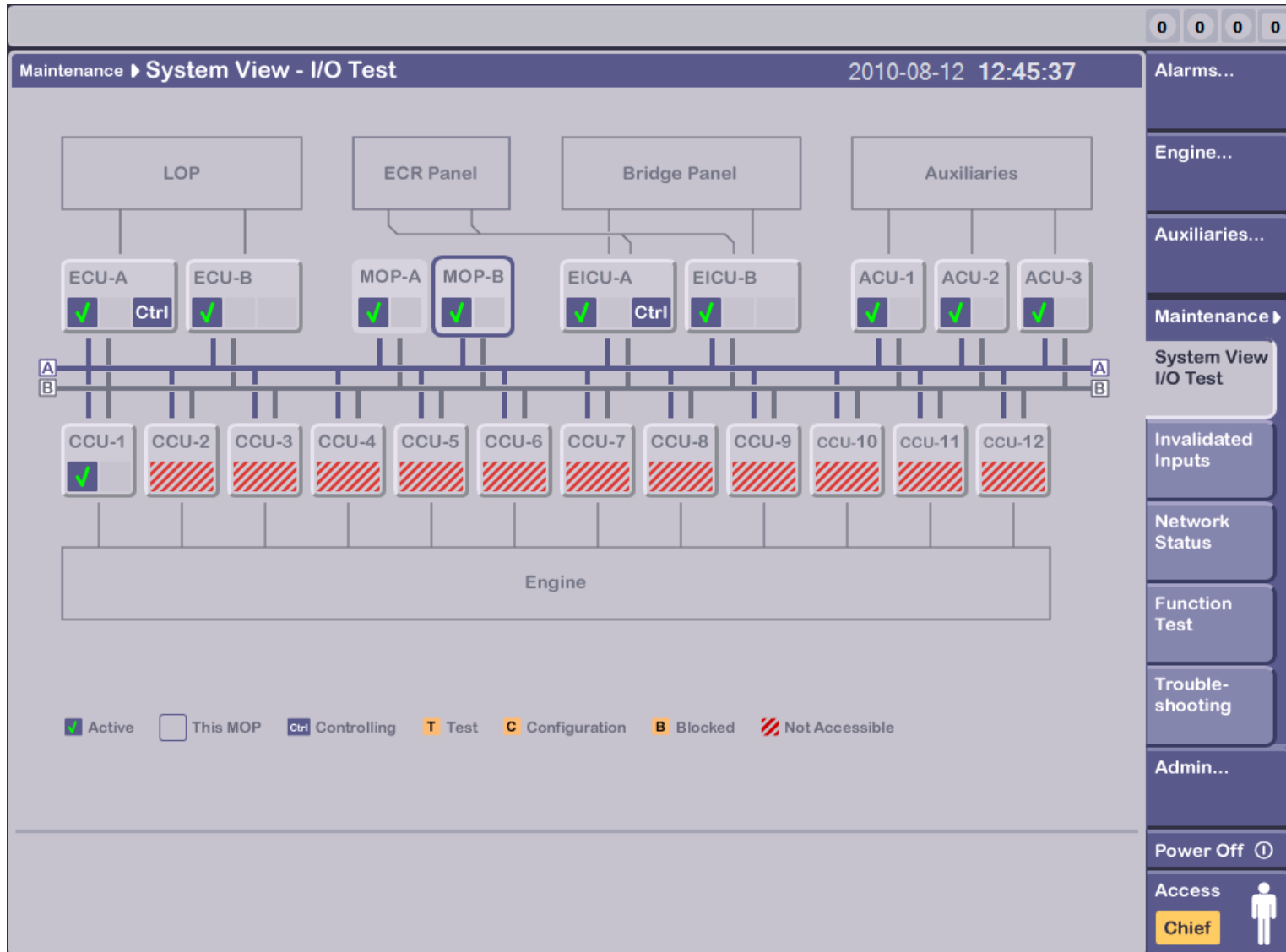
DIP Switches

Fuses



Power Plug

# Maintenance: System View, I/O Test



# Multi Purpose Controller, MPC Summary



The MPC's are software wise configured to 4 different controller functions:

## 1) Engine Interface Control Unit – EICU

- 2 completely redundant units
- Handles the interface to external systems & protects the engine by generating setpoint of speed

## 2) Engine Control Unit – ECU

- 2 completely redundant units (**except with more than 3 engine driven pumps**)
- Handles the engine specific control functions (the governor)

## 3) Cylinder Control Unit – CCU

- 1 for each cylinder unit. No redundancy.
- Handles the cylinder specific functions (fuel injection, exh. valve, cylinder lubrication and starting air valves)

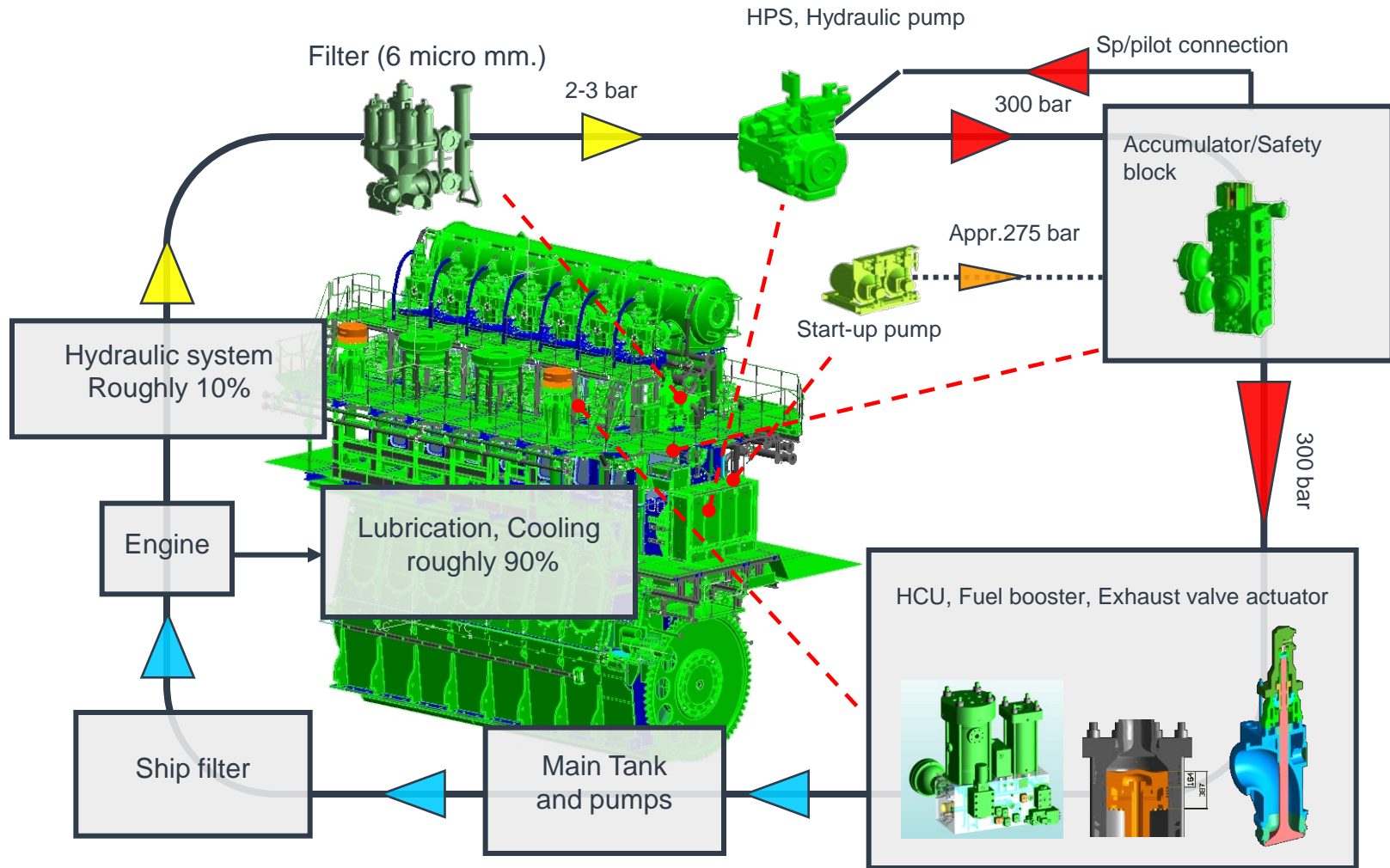
## 4) Auxilliary Control Unit – ACU

- 3 units. No redundancy
- Handles the auxilliary systems (hydraulic power supply, aux blowers)

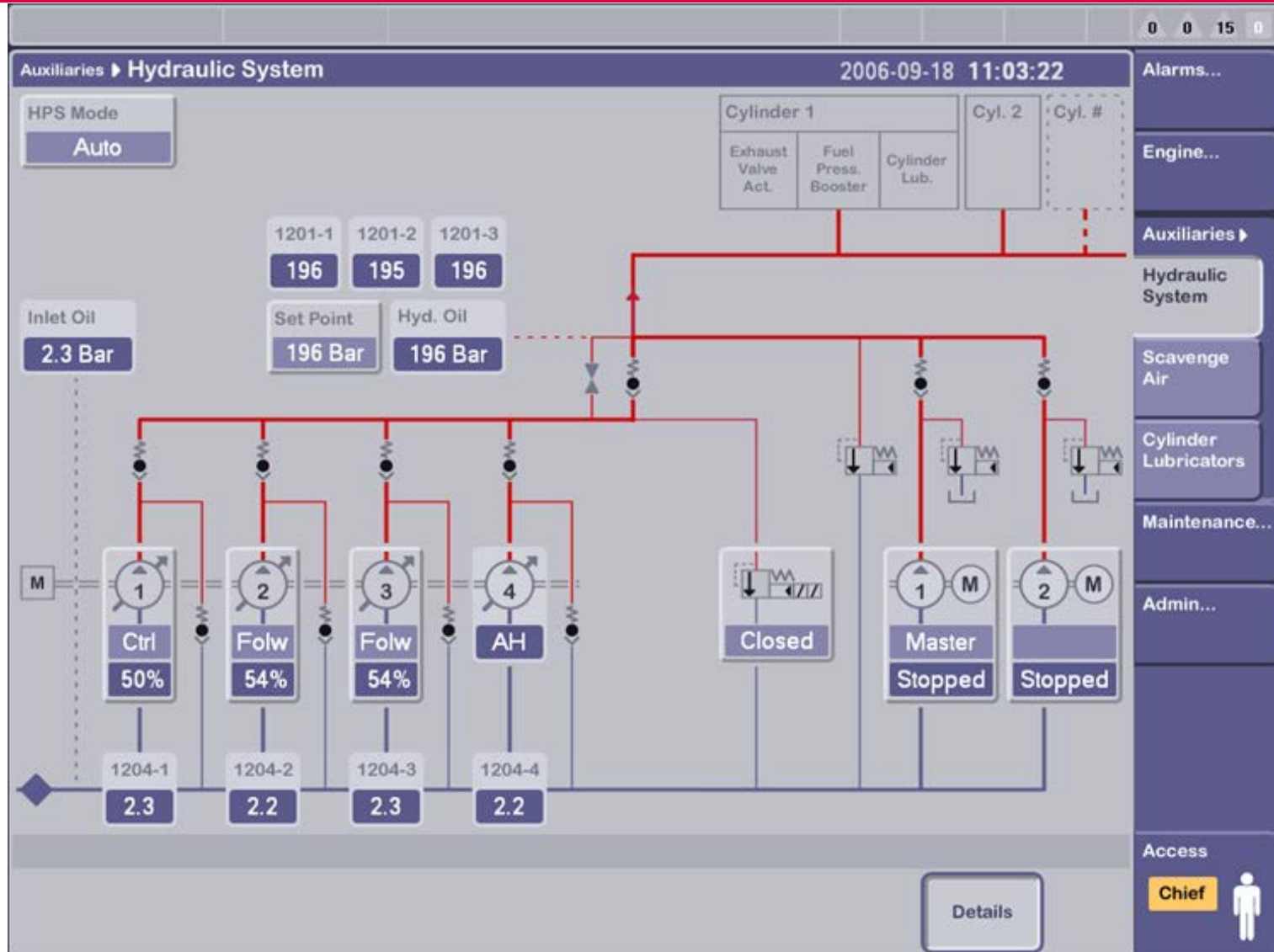
## 5) Scavenging Air Control Unit – SCU (Option)

- 1 Unit, no redundancy
- VTA, EGB, WHRS

# ME Engine Hydraulic Oil Loop



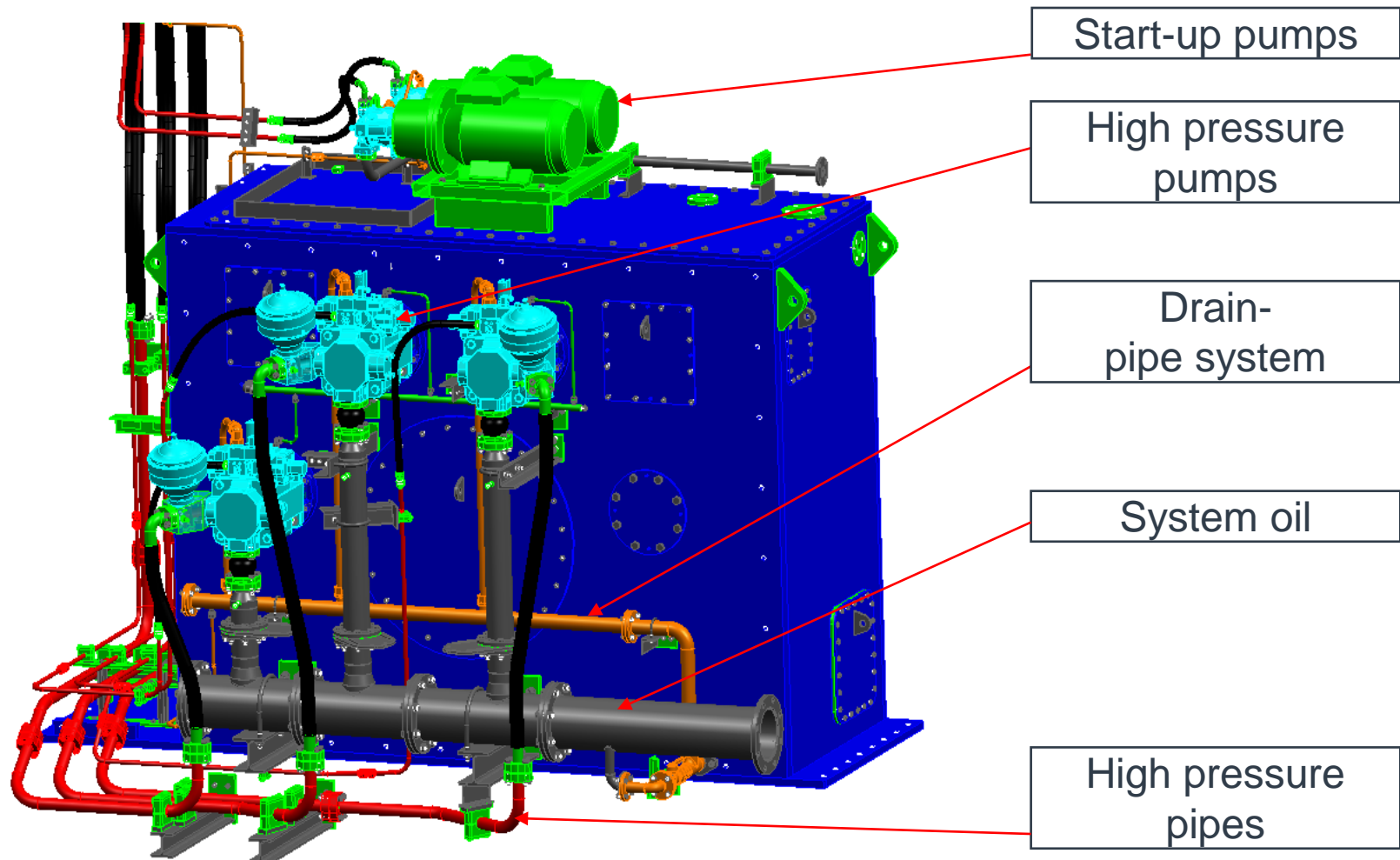
# Engine Driven Pumps



# Hydraulic Power Supply HPS

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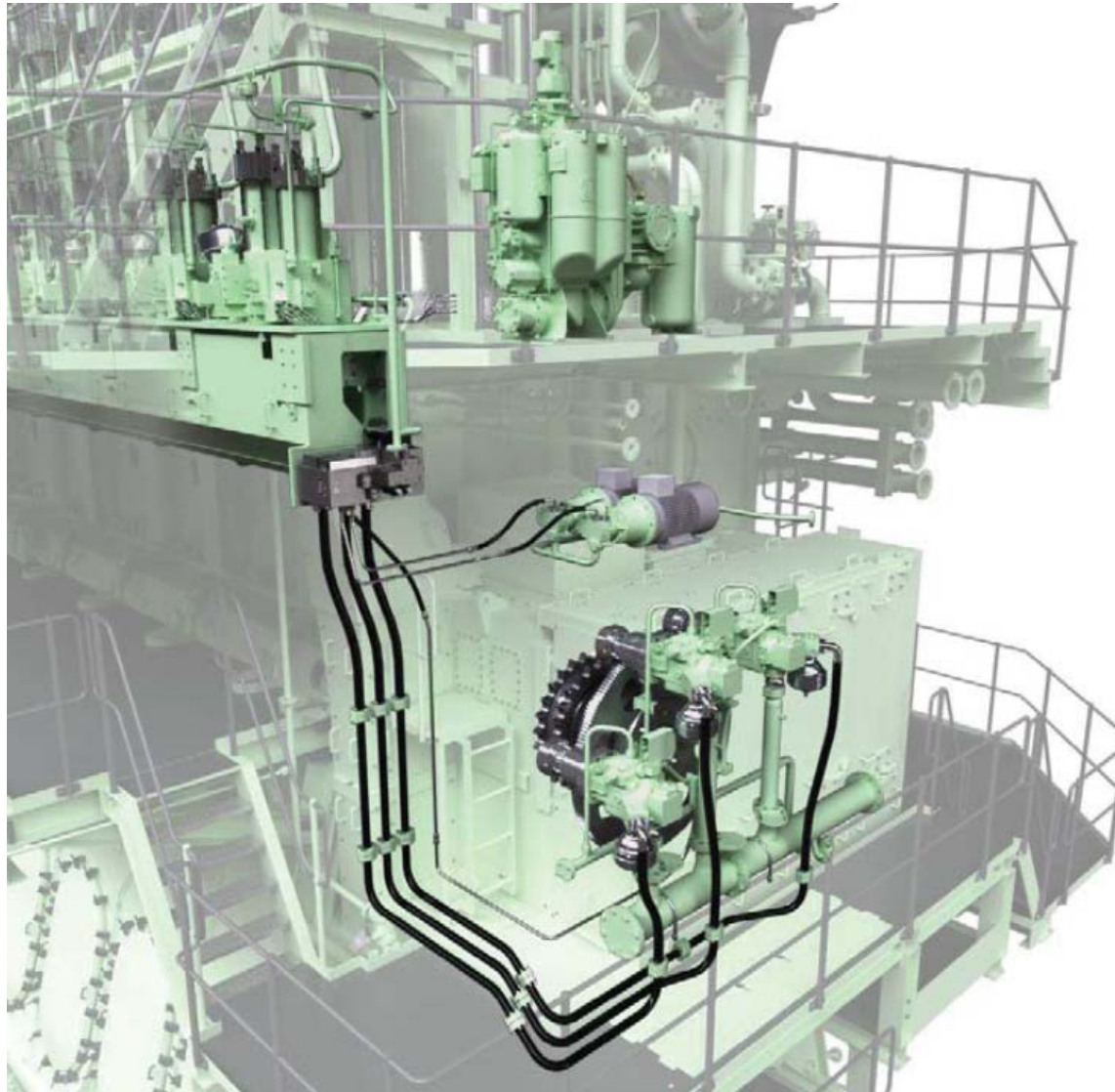
50 years  
Engine  
the MANkind



# Hydraulic Power Supply HPS in AFT of engine

MAN Diesel & Turbo Hellas

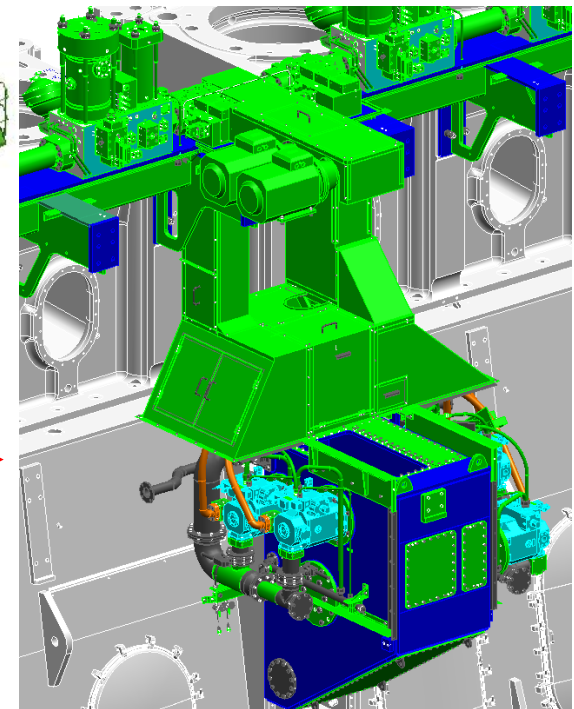
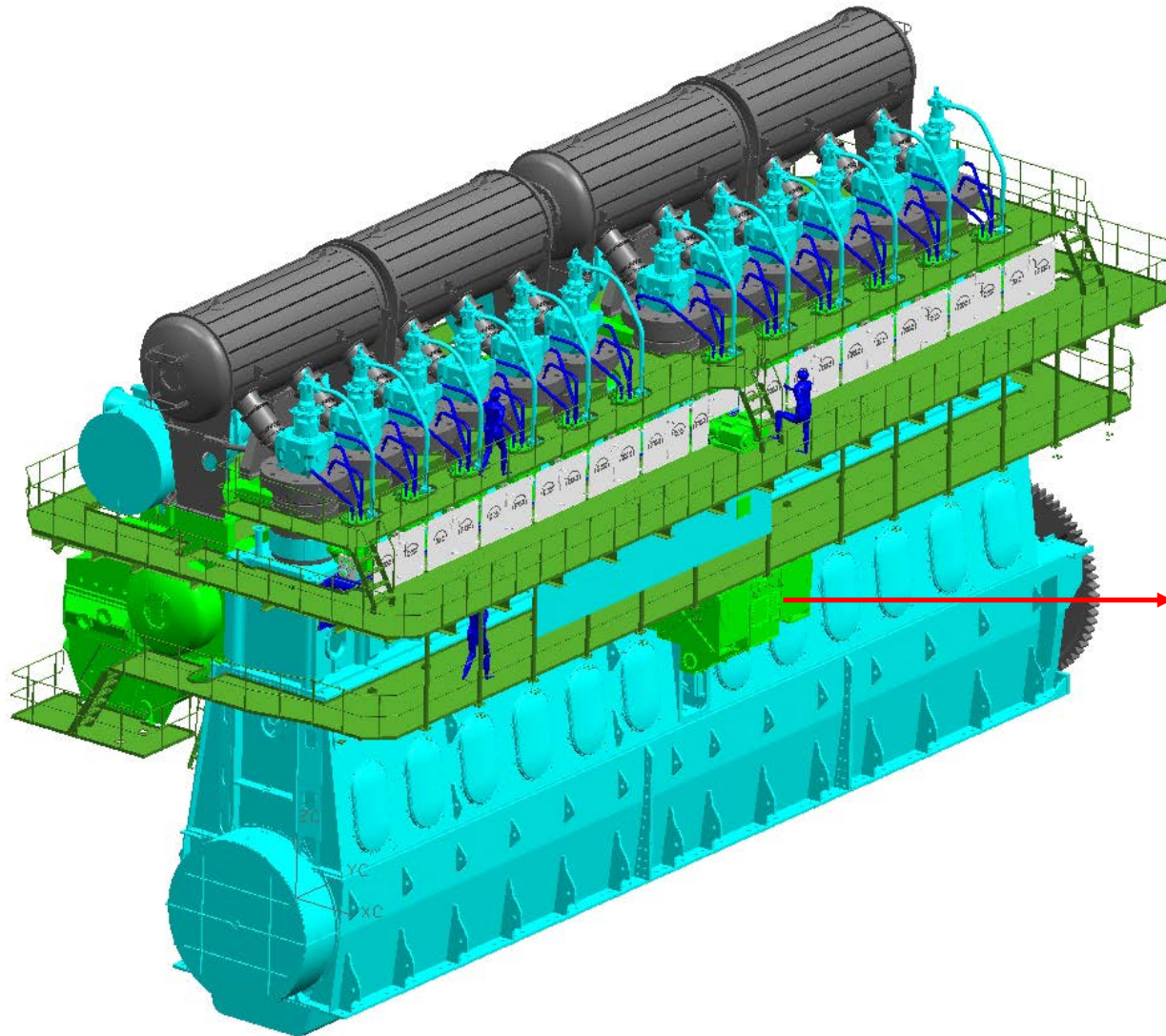
50 years  
Engine  
the MANkind



# Hydraulic Power Supply HPS in the middle of engine

MAN Diesel & Turbo Hellas

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Engine  
the MANkind



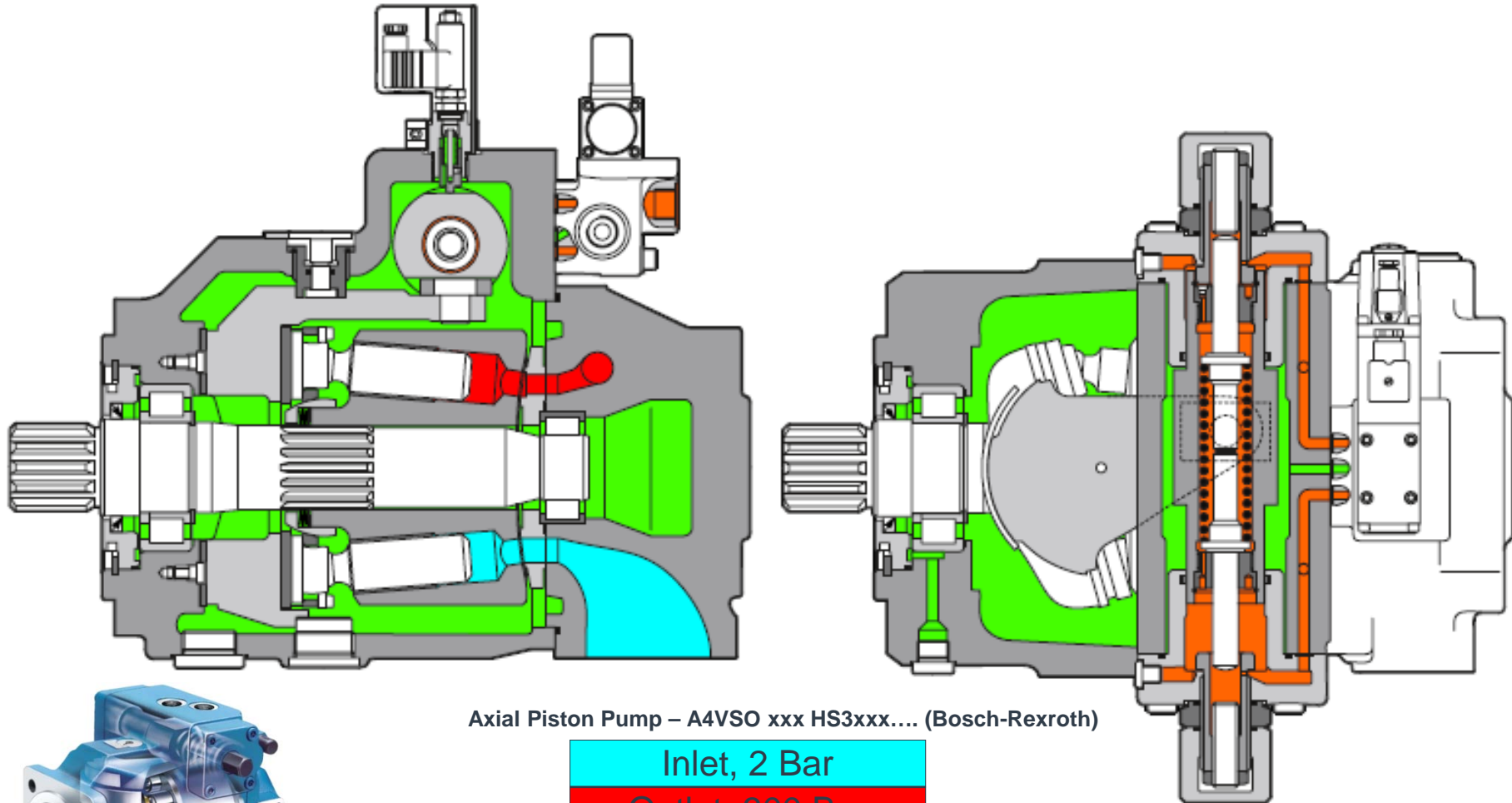


# Axial Piston Pump

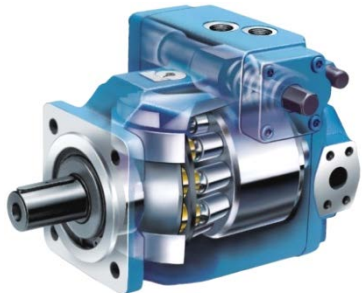
Bosch Rexroth

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



Axial Piston Pump – A4VSO xxx HS3xxx.... (Bosch-Rexroth)

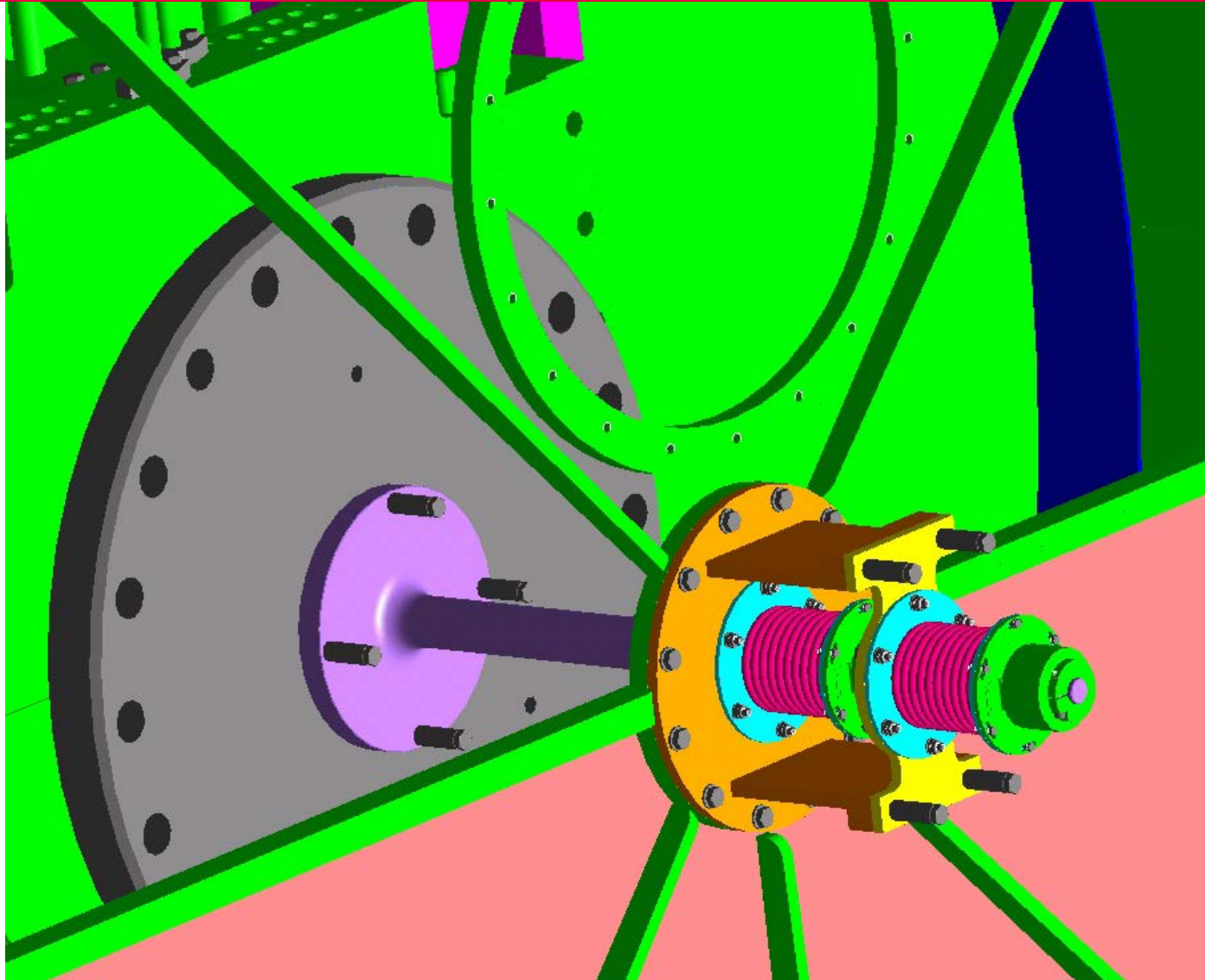


|                  |
|------------------|
| Inlet, 2 Bar     |
| Outlet, 300 Bar  |
| Control pressure |
| Case drain       |

# ME Tacho system

MAN Diesel & Turbo Hellas

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Engine  
the MANkind



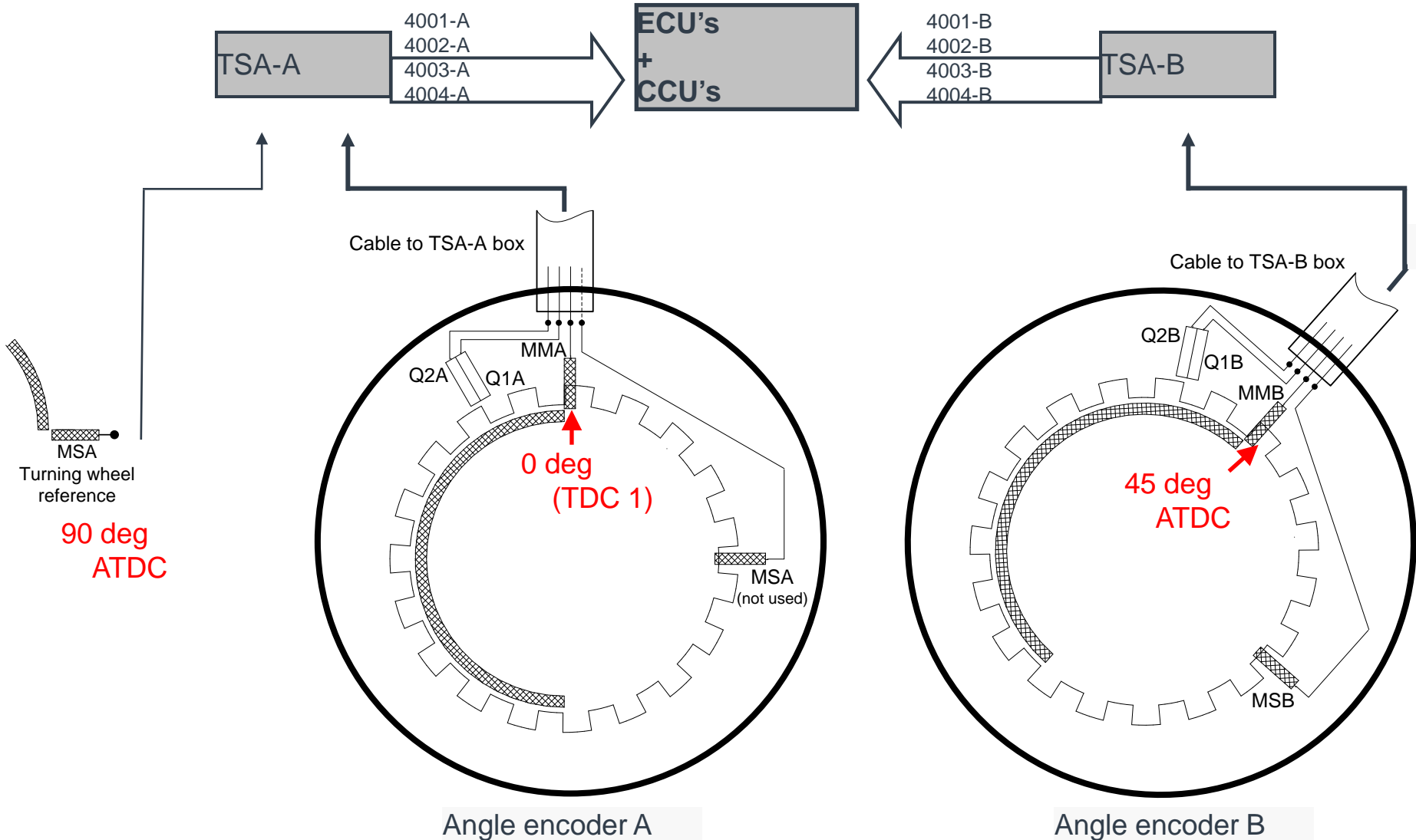
# Tacho System

MAN Diesel & Turbo Hellas

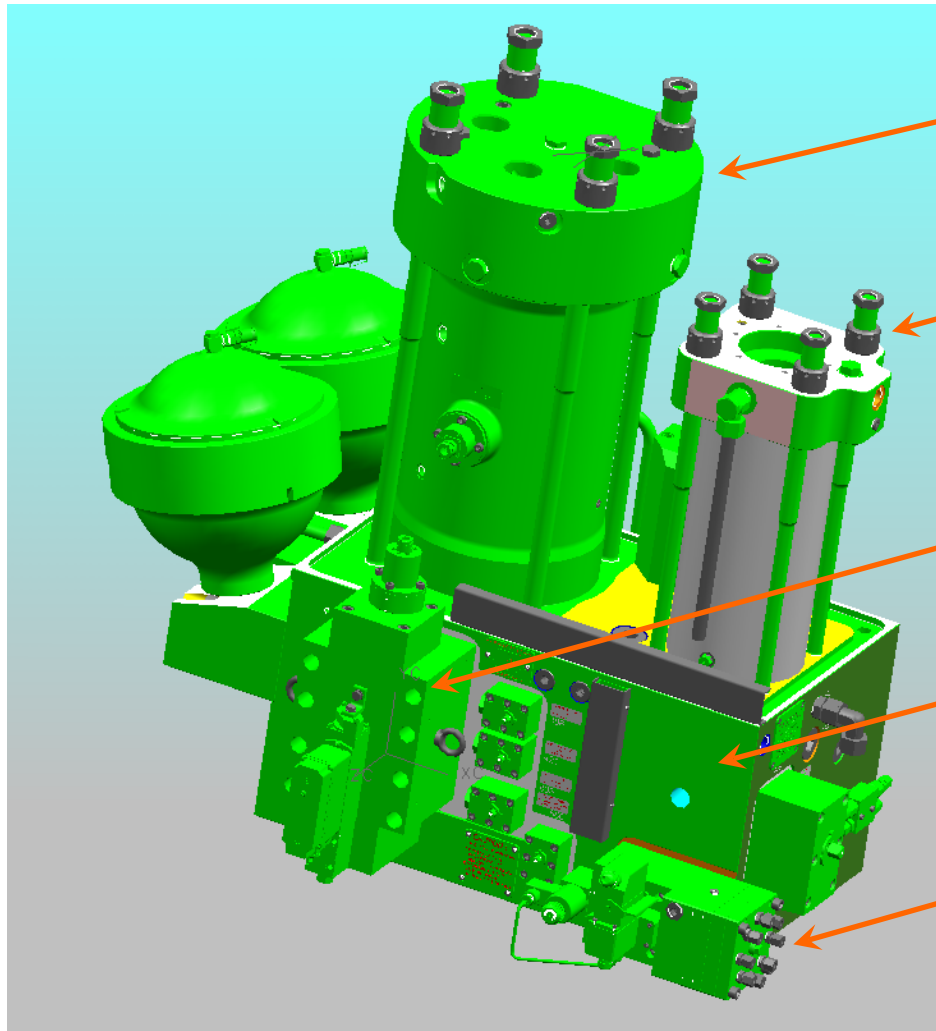
50 years  
Engine  
the MANkind



# Tacho System Angle Encoders



# Hydraulic Cylinder Unit – HCU 7K80ME-C9



Fuel Oil Pressure Booster

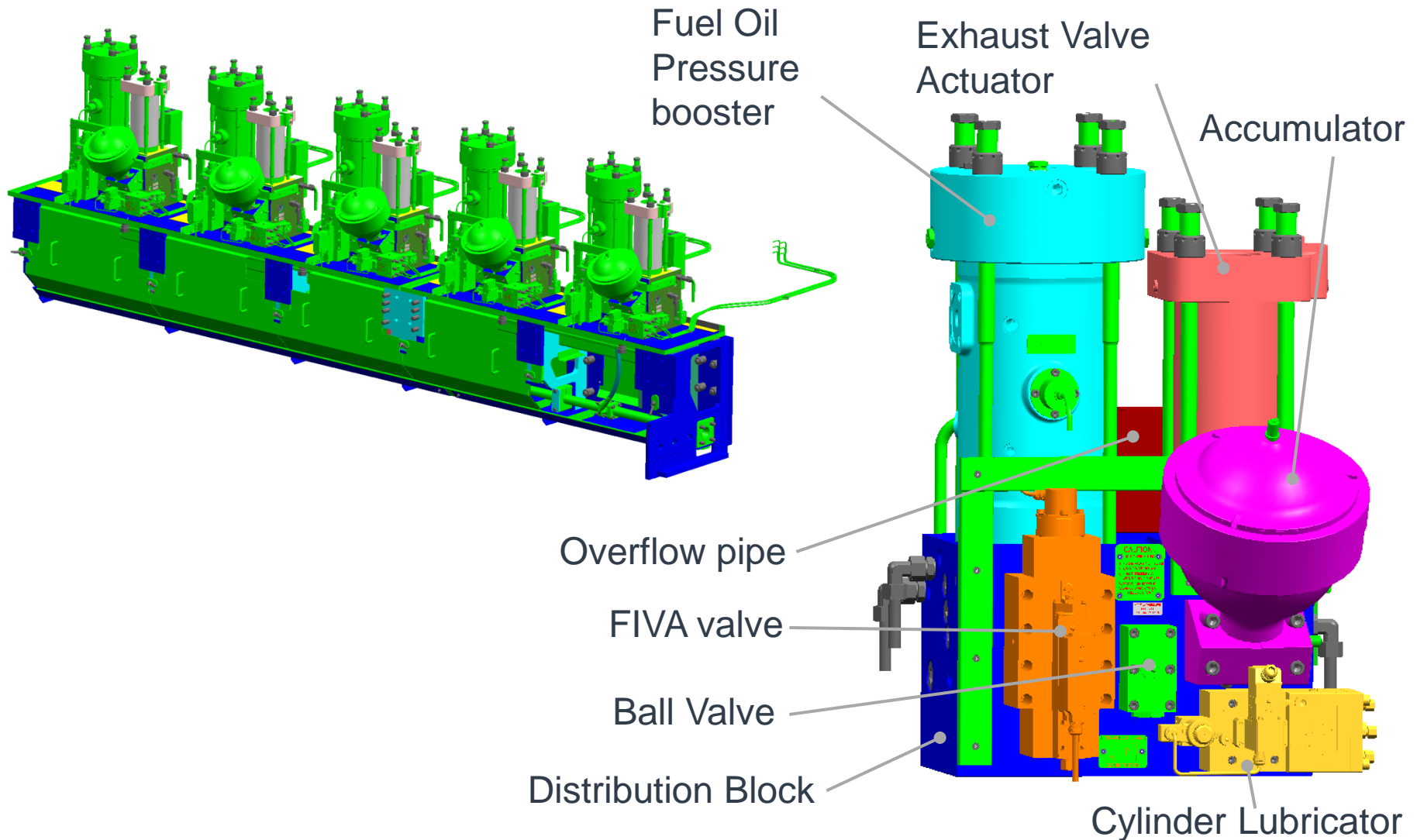
Exhaust Valve Actuator

FIVA & Proportional Valve

Distribution Block

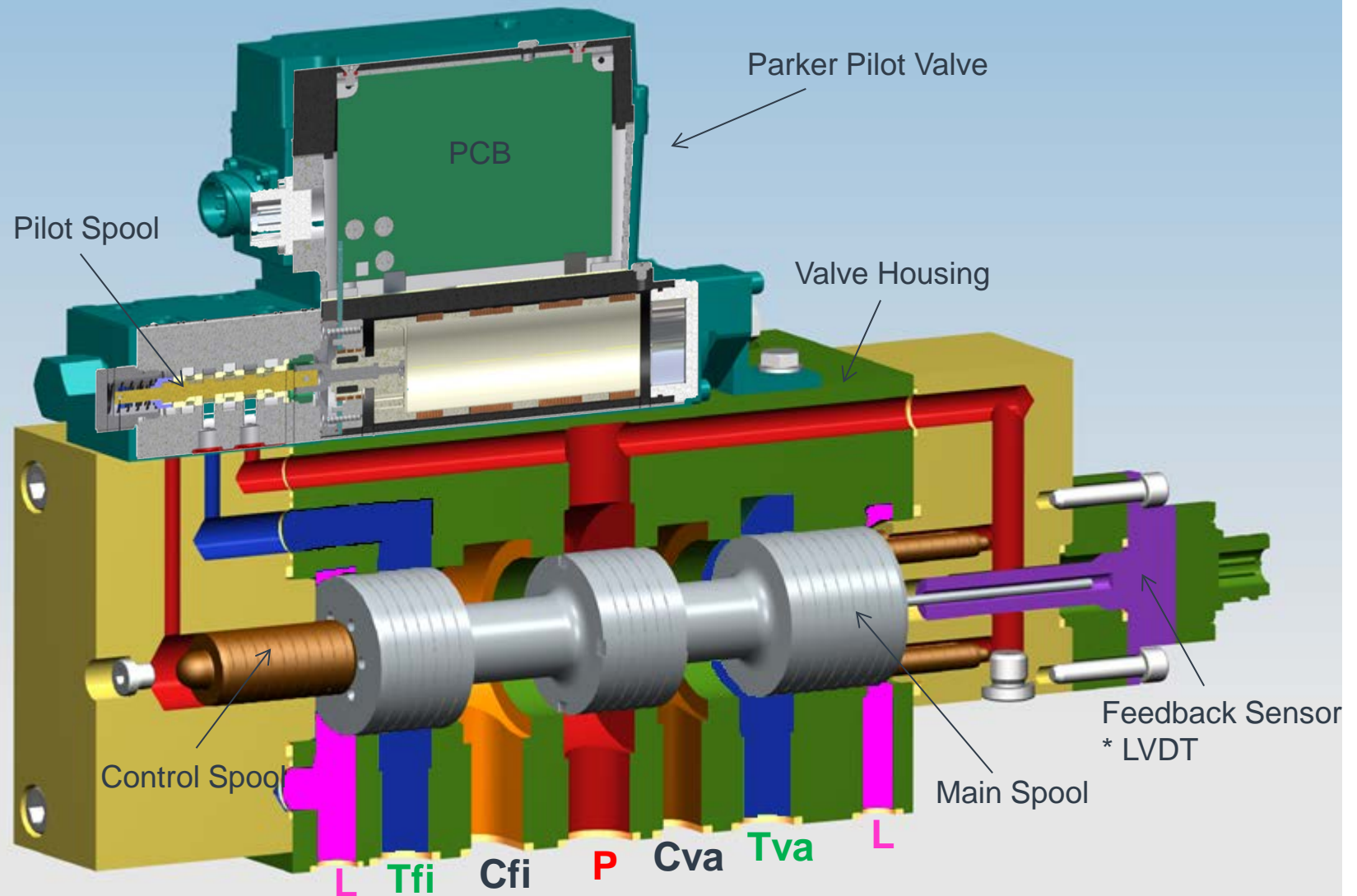
Cylinder Lubricator

# Hydraulic Cylinder Unit

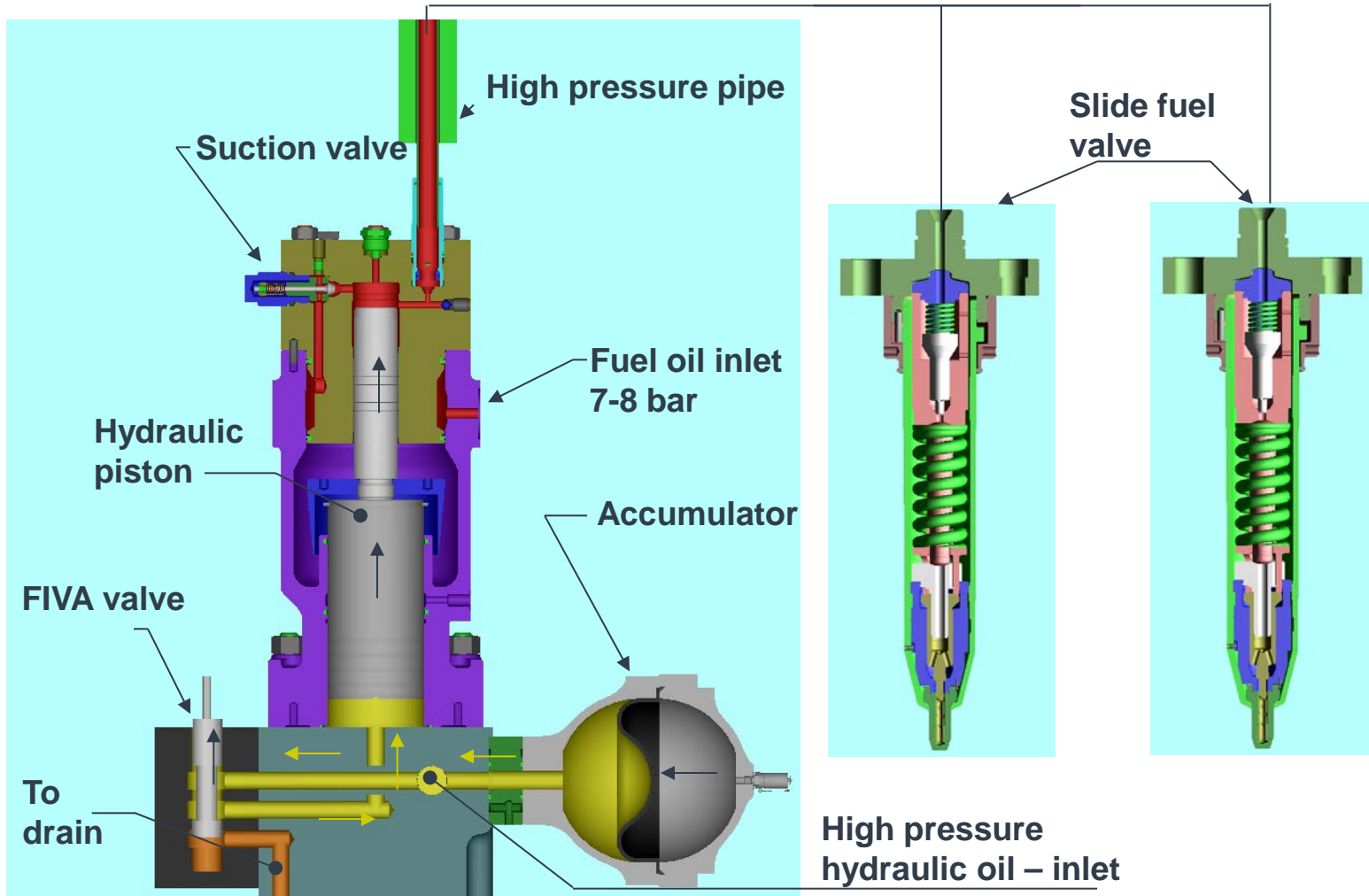


# FIVA valve

Two control port



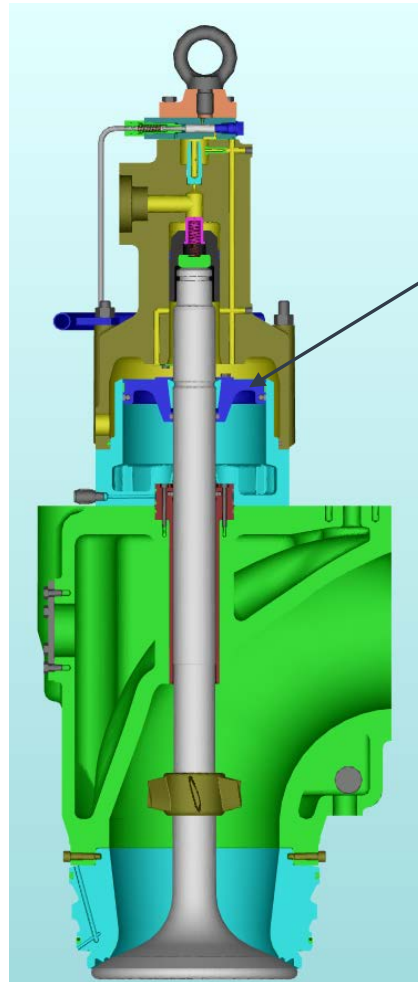
# Fuel Oil System



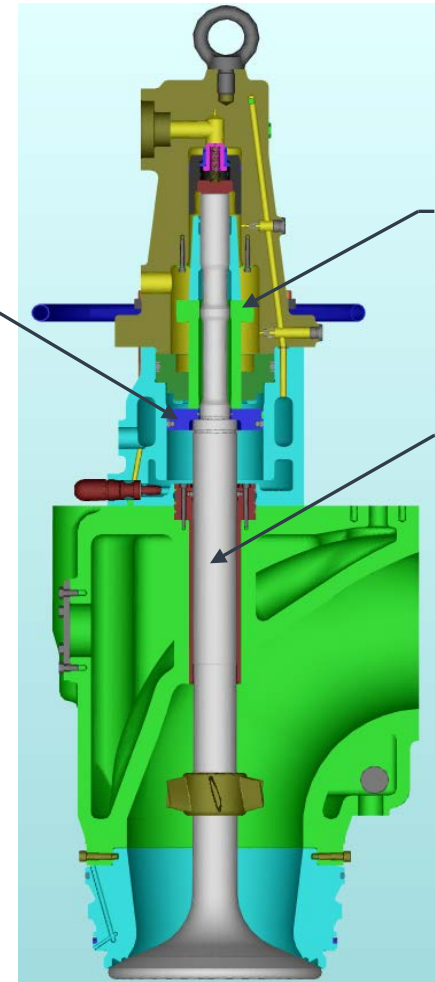


# Design Features, MC versus ME High force exh. valve

S50MC-C



S50ME-C

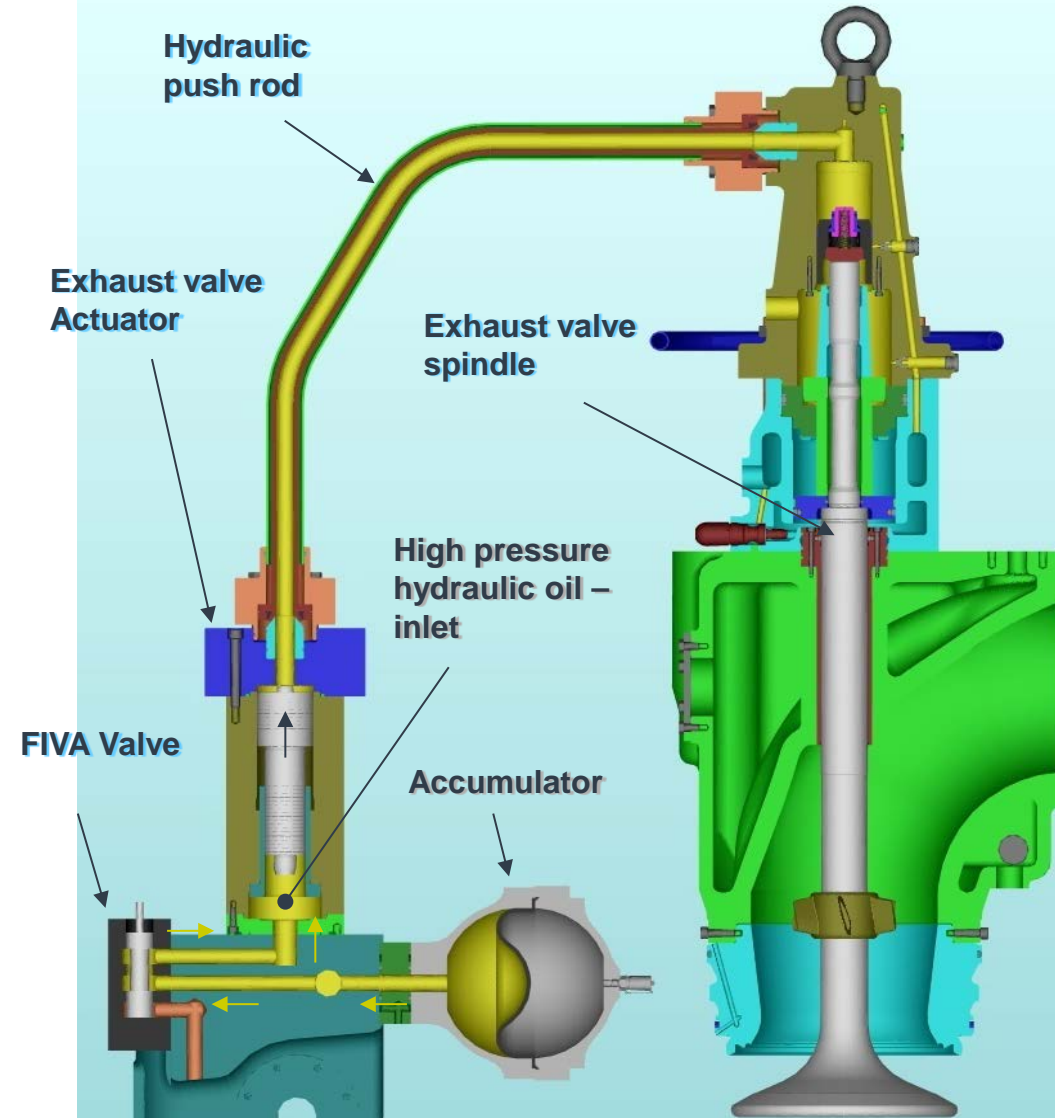
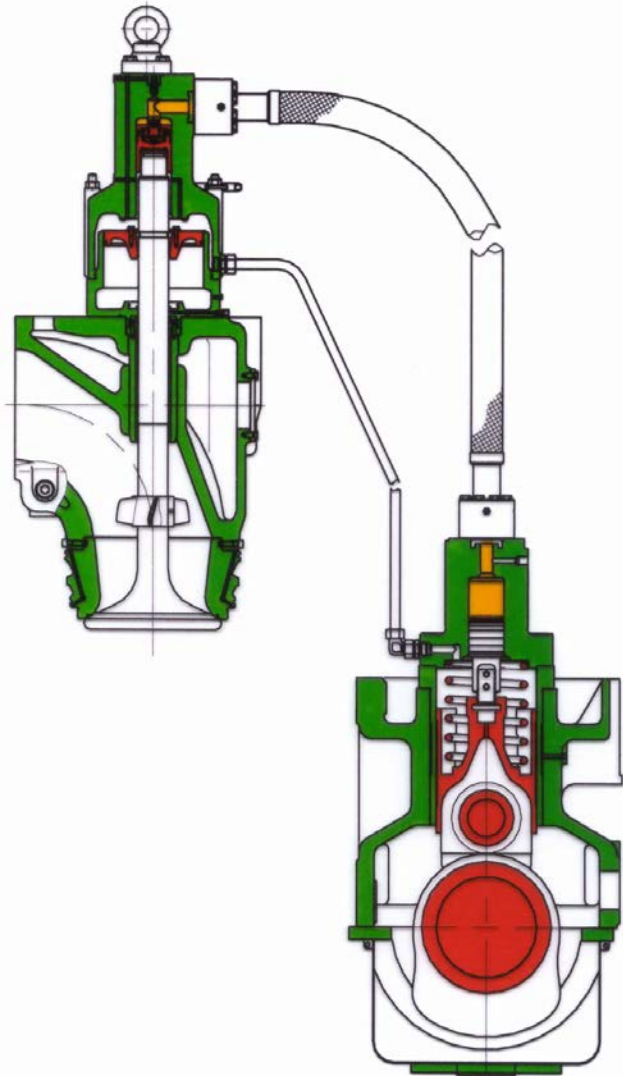


Air spring size for closing the exhaust valve reduced

Hydraulic damper for fixed valve stroke

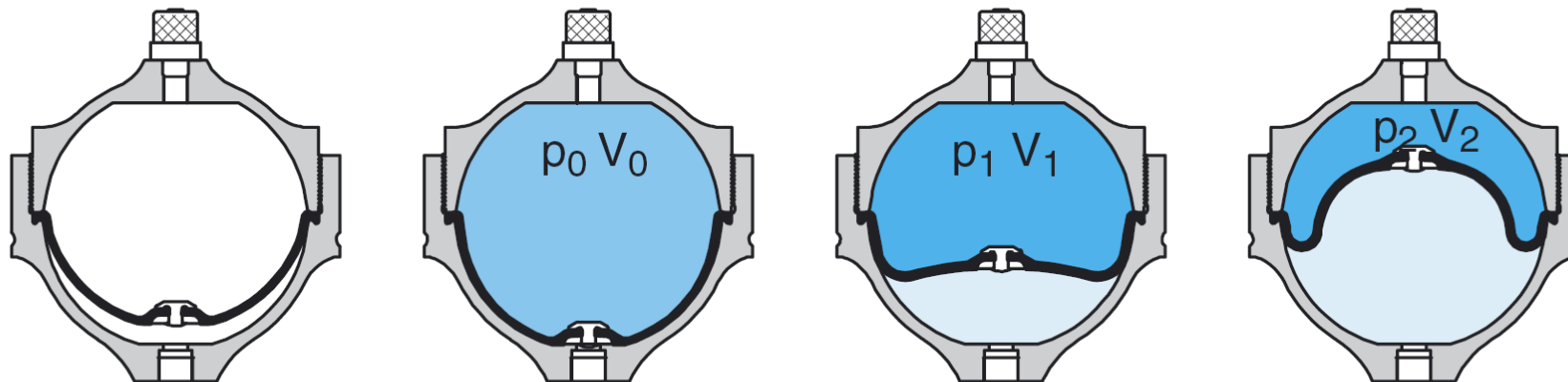
Different valve spindle design

# Exhaust Valve Actuation, MC versus ME.



# Accumulator

## Diaphragm, Working Principle



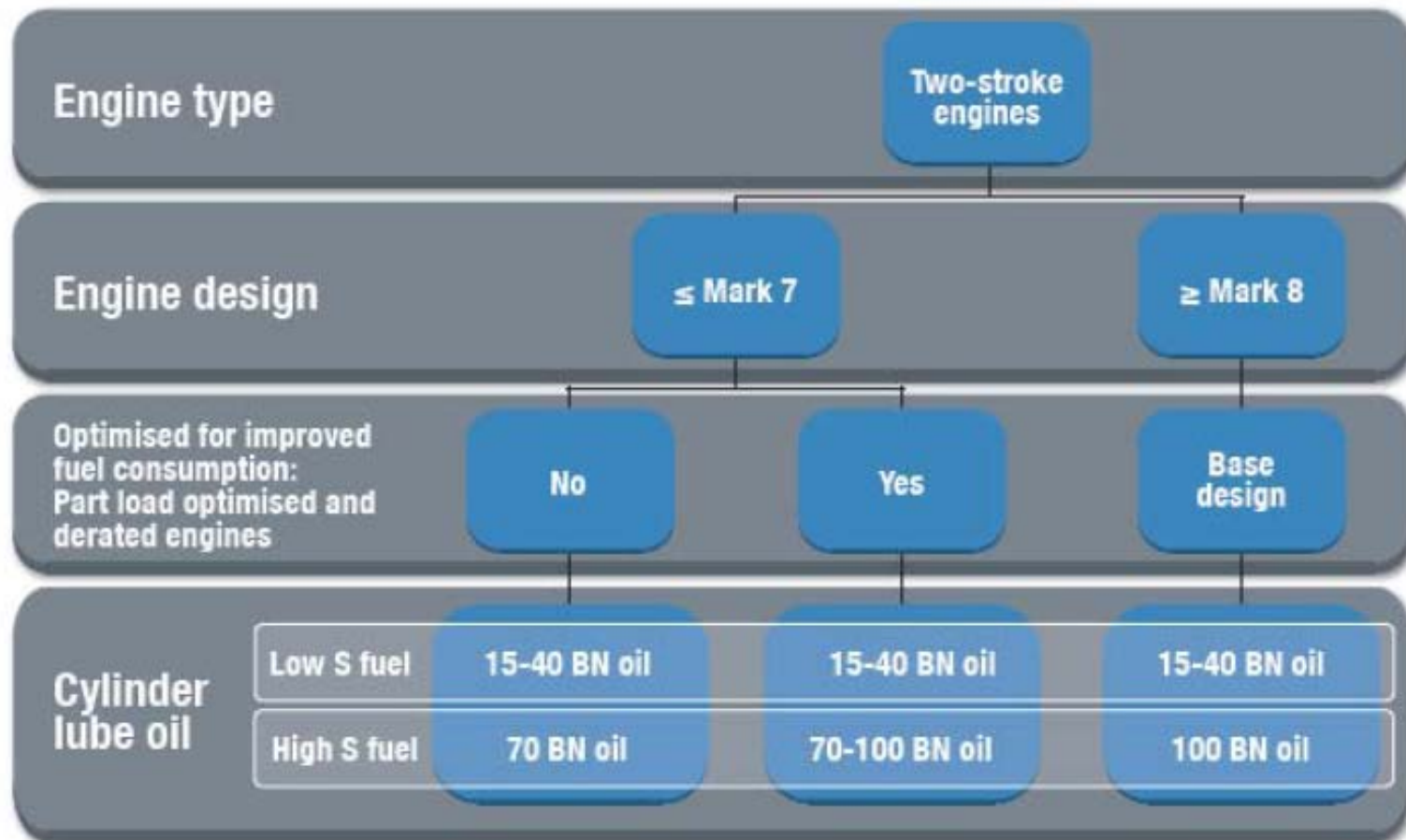
**WARNING**

To protect the accumulator from unnecessary stresses (fast acceleration of the membrane) and oil jets, the valve Pos. 420 must not be opened at pressurised oil system.

After check/overhaul or whatever situation where the valve Pos. 420 has been closed the opening procedure is:

- 1) The engine must be stopped (no oil pressure)
- 2) Open/Close all valves into normal running position.
- 3) Pressurise the system by starting the Start-up pumps.

# Total Base Number (TBN)



# Auxiliaries: Cylinder Lubricators

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Engine  
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Auxiliaries ▶ **Cylinder Lubrication** 2010-08-12 12:35:35

| Flow     | Total | Prelube | LCD | S%   | Feed Rate Factor | Basic Feed Rate | Min. Feed Rate |
|----------|-------|---------|-----|------|------------------|-----------------|----------------|
| 33.4 l/h | 228 l | Off     | Off | 3.20 | 0.20 g/kWhS%     | 0.64 g/kWh      | 0.60 g/kWh     |

|                          | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Actual Feed Rate [g/kWh] | 0.80 | 0.60 | 1.70 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Feed Rate Adjust Factor  | 1.25 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Running In [g/kWh]       | 0.00 | 0.00 | 1.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lubricator Test Sequence | Off  | ---  | ---  | ---  | ---  | ---  | ---  | ---  | ---  | ---  | ---  | ---  |

**Running In - Cyl. 3**

| Current | New  | ↓ | ▲ | ↔ | ↔ | ✕ |
|---------|------|---|---|---|---|---|
| 1.70    | 1.70 |   |   |   |   |   |

Apply to all    Apply to one    ✕

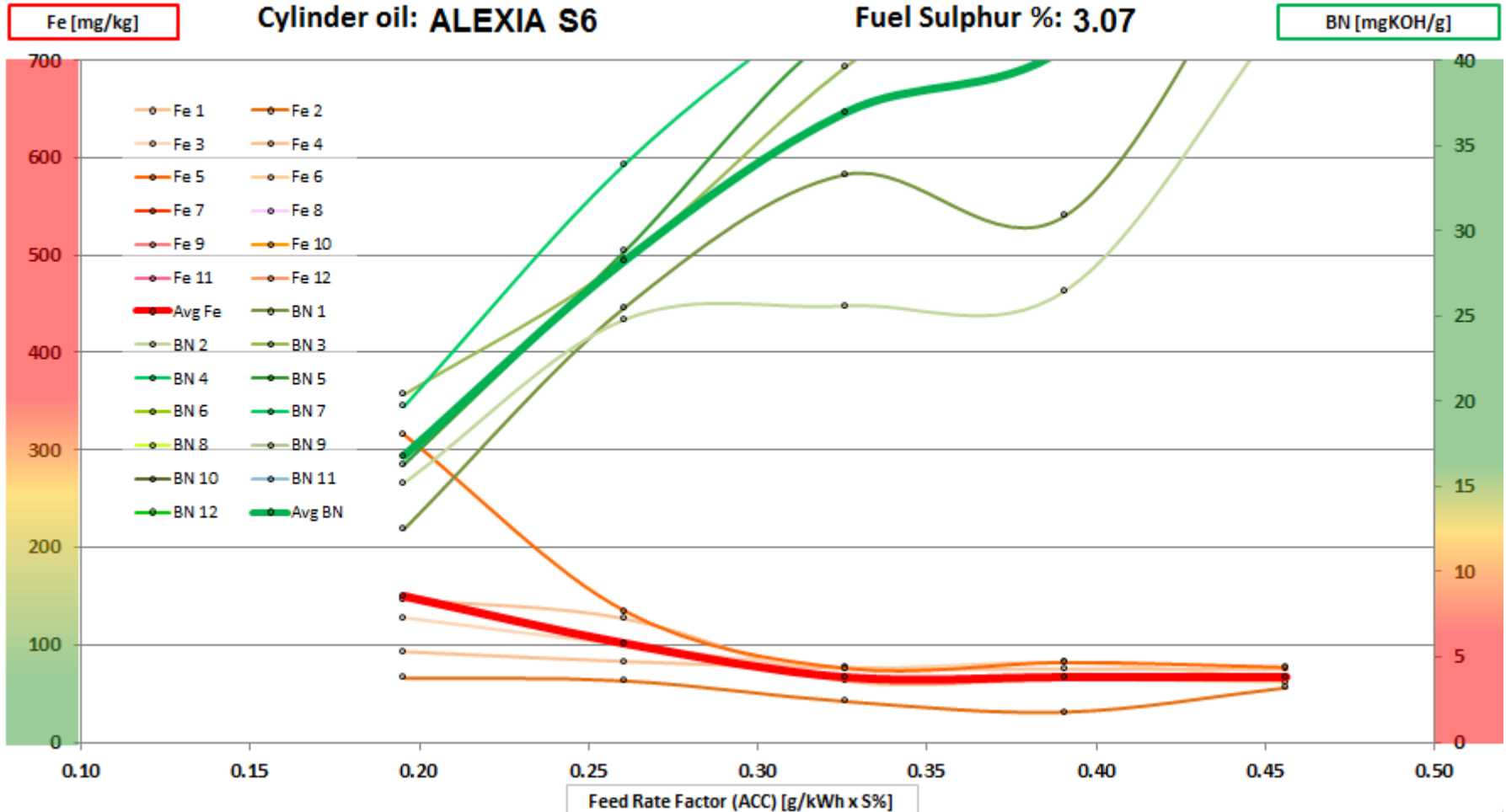
Alarms...  
Engine...  
Auxiliaries ▶  
Hydraulic System  
Scavenge Air  
Cylinder Lubrication  
Maintenance...  
Admin...  
Power Off ⓘ  
Access  
Chief

# Feed Rate Sweep

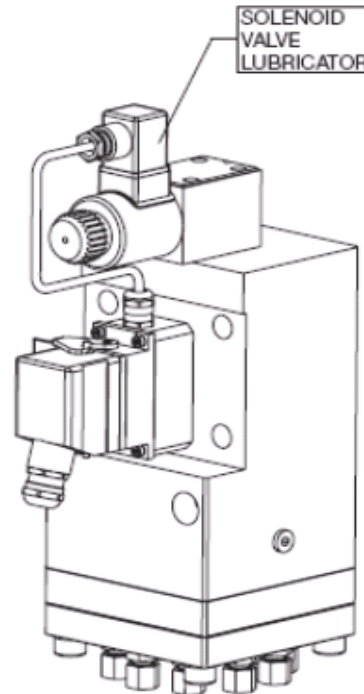
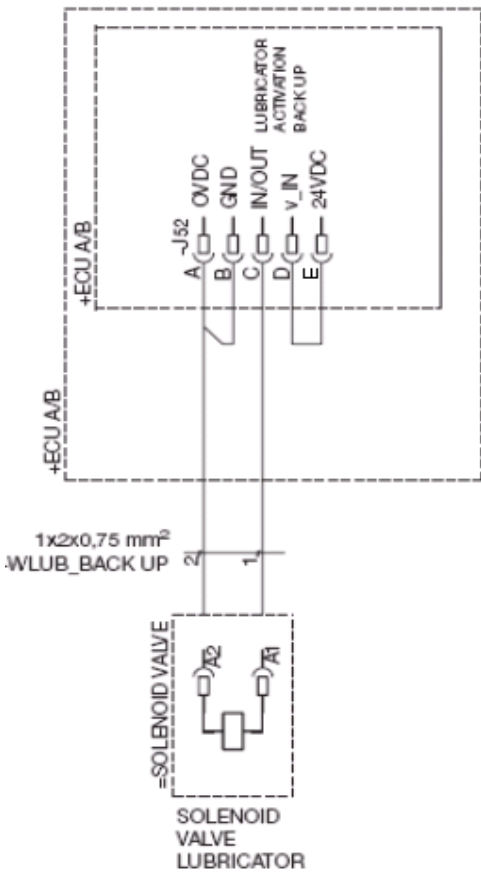


Vessel Name:  
Engine Load %: 50  
Cylinder oil: **ALEXIA S6**

Engine Type: **5S60ME-C8.1**  
New Oil BN: 100  
Fuel Sulphur %: 3.07



# Cylinder Lubrication Back up



- ✓ In case of CCU failure, where the CCU cannot be changed immediately, the cylinder lubrication can be achieved by a temporary cable from one of the ECU units, plug 52, to the solenoid valve on the lubricator on the unit in question.
- ✓ The lubrication will be with random timing.

# Engine: Operation

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50 years  
Engine  
the MANkind



0 0 0 0

Engine ▶ Operation 2010-08-10 13:40:57

**Main State**

Standby

**Command [RPM]**

ECR 110.0

LOP 0.0

**Speed [RPM]**

Speed Modifier

Chief Max Speed

| Set Point | Actual |
|-----------|--------|
| 67.0      | 66.7   |

**Fuel Index [%]**

Index limiter

Scav Air Pres

| Limiter | Actual |
|---------|--------|
| 61      | 41     |

**Start Air**

28.5 Bar

**Inlet Oil**

2.7 Bar

**Hyd. Oil**

186 Bar

**Scav. Air**

0.67 Bar

**HPS**

Auto

**Lubricator**

Running

**Auxiliary Blowers**

Auto

**PTO**

Off

**Engine Start**

Start Status: Running

Prepare Start    Slow Turn    Auto    Air Run

Alarms...

Engine ▶

Operation

Status

Process Information

Process Adjustment

Chief Limiters

Auxiliaries...

Maintenance...

Admin...

Power Off ⓘ

Access



# Engine: Status

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



0 0 15 0

Engine ▶ Status 2006-09-18 10:54:18

Alarms...

Engine ▶

Operation

Status

Process Information

Cylinder Load

Cylinder Pressure

Auxiliaries...

Maintenance...

Admin...

Access

Main State

Standby

Start Air 24.1 Bar

Main... Slow...

Start Valve Cyl.-1 ...2 ...#

Blowers Stopped Hyd. Oil 196 Bar

Crankshaft

Control Air 6.0 Bar

Turning Gear Disengaged

Start Status Running

Details

Start Conditions

- ✓ Main Starting Valve in service position
- ... Main Starting Valve blocked
- ✓ Start Air Distribution System in service
- ... Start Air Distribution System blocked
- ✓ Starting Air Pressure
- ✓ Control Air Pressure
- ... Control Air vented
- ✓ Turning Gear disengaged
- ✓ Aux. Blowers
- ✓ Hyd. Power Supply
- ✓ Hyd. Pressure

# Engine: Process Information Running Mode



0 0 15 0

Engine ▶ Process Information ▶ 2006-09-18 10:57:39

Running Mode Speed Control

|                        |                       |                    |
|------------------------|-----------------------|--------------------|
| Running Mode           | Speed Set Point [RPM] | Speed Actual [RPM] |
| Emission               | 92.6                  | 92.5               |
| Estimated Engine Load  | Fuel Index Set Point  |                    |
| 57 %                   | 71 %                  |                    |
| Maximum Pressure       | Hyd. Oil Set Point    | Hyd. Oil Actual    |
| 106 Bar                | 195 Bar               | 196 Bar            |
| Compression Pressure   |                       | Pscav Actual       |
| 95 Bar                 |                       | 1.57 Bar           |
| Pcomp/Pscav            |                       |                    |
| 37.4                   |                       |                    |
| Exh. Valve Open Timing |                       |                    |
| 114.8 °ATDC            |                       |                    |

Alarms...

Engine ▶

Operation

Status

Process Information

Cylinder Load

Cylinder Pressure

Auxiliaries...

Maintenance...

Admin...

Access

# Engine: Process Information Running Mode



0 0 41 0

Engine ▶ Process Adjustment 2013-05-28 09:32:49

Auto Tuning Cylinder Load Cylinder Press. **Fuel Quality**

|                                      | Reference shop test values | Enter actual values |
|--------------------------------------|----------------------------|---------------------|
| Lower Calorific value (MJ/kg)        | 40.00                      | 40.00               |
| Density @ 15 °C (kg/m <sup>3</sup> ) | 900.0                      | 850.0               |
| Fuel Temp. (°C)                      | 25                         | 110                 |

Calculation

Suggested Fuel Quality Offset  
**+14 %**

Applied Fuel Quality Offset  
**+13 %**

Alarms

Engine

Operation

Status

Process Information

Process Adjustment

Chief Limiters

Auxiliaries

Maintenance

Admin

Power Off ⓘ

**Chief** ⓘ

# Engine: Process Adjustment Pressures



0 0 0 0

Engine ▶ Process Adjustment 2010-08-11 12:51:11

Auto Tuning Cylinder Load **Cylinder Press.** Fuel Quality

All 1 2 3 4 5 6 7 8 9 10 11 12

Pmax Offset [Bar]

|     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0   | 0   | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| -20 | -20 | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |
| 0   | 0   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |
| -20 | -20 | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |

Pcomp/Pscav Offset [-]

|     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.0 | 0.0 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2   | 2   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |
| 0   | 0   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |
| -2  | -2  | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |

Exhaust Valve Open Timing Offset [DEG]

|     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.0 | 0.0 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0   | 0   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |
| -1  | -1  | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |
| -2  | -2  | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   |

Alarms...

Engine ▶

Operation

Status

Process Information

Process Adjustment

Chief Limiters

Auxiliaries...

Maintenance...

Admin...

Power Off ⓘ

Access

Chief

# Engine: Process Adjustment Pressures



0 0 0 0

Engine ▶ Process Adjustment 2010-08-11 12:48:47

Auto Tuning | **Cylinder Load** | Cylinder Press. | Fuel Quality

1 2 3 4 5 6 7 8 9 10 11 12

High Load Offset [%]

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Low Load Offset [%]

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Alarms...

Engine ▶

Operation

Status

Process Information

**Process Adjustment**

Chief Limiters

Auxiliaries...

Maintenance...

Admin...

Power Off ①

Access

# Engine: Chief Limiters

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



Engine ▶ Chief Limiters 2013-12-03 10:10:29

|                                     |                                      |                                |                                 |
|-------------------------------------|--------------------------------------|--------------------------------|---------------------------------|
| Chief Max Speed<br><b>200.0 RPM</b> | Engine Max Speed<br><b>200.0 RPM</b> | Chief Max Load<br><b>110 %</b> | Engine Max Load<br><b>110 %</b> |
|-------------------------------------|--------------------------------------|--------------------------------|---------------------------------|

All 1 2 3 4 5 6 7 8 9 10 11 12

Chief Index Limit [%]

|     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 | 110 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

Exhaust Valve operation

|         |         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

HCU status and reset

|        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Chief Index Limit - Cyl.1

|                       |                   |   |   |   |   |       |   |
|-----------------------|-------------------|---|---|---|---|-------|---|
| Current<br><b>110</b> | New<br><b>110</b> | ▼ | ▽ | ▲ | △ | Apply | ✕ |
|-----------------------|-------------------|---|---|---|---|-------|---|

Alarms  
Engine  
Operation  
Status  
Process Information  
Process Adjustment  
Chief Limiters  
Auxiliaries  
Maintenance  
Admin  
Power Off ⓘ  
Chief ⓘ

# Engine: Chief Limiters



Maintenance ▶ Troubleshooting 2010-07-29 13:04:52

HCU HPS HCU Events HPS Events

Cylinder: 1 2 3 4 5 6 7 8 9 10 11 12

MPC Mode

**Normal**

| Fuel Plunger Position |             |        |
|-----------------------|-------------|--------|
| CH-31                 | Max. - Min. | Stroke |
| ---                   | 0.0 mA      | 0.0 mm |

| Exhaust Valve Position |             |        |
|------------------------|-------------|--------|
| CH-34                  | Max. - Min. | Stroke |
| 3.8 mA                 |             |        |

| FIVA Position FB |        |
|------------------|--------|
| CH-30            | Value  |
|                  | 7.1 mA |

| FIVA Valve Control |       |
|--------------------|-------|
| CH-70              | Value |
|                    | N/A   |

Hyd. Oil

**194 Bar**

**ATTENTION:**  
Stopped Engine  
Only!

**INSTRUCTION:**  
Change CCU Mode  
to 'Test' to activate.

Fuel Plunger

Exhaust Valve

inject

Return

Open

Close

Cyclic Test

Alarms...

Engine...

Auxiliaries...

Maintenance ▶

System View  
I/O Test

Invalidated  
Inputs

Network  
Status

Function  
Test

Trouble-  
shooting

Admin...

Power Off ⓘ

Access

**Chief**

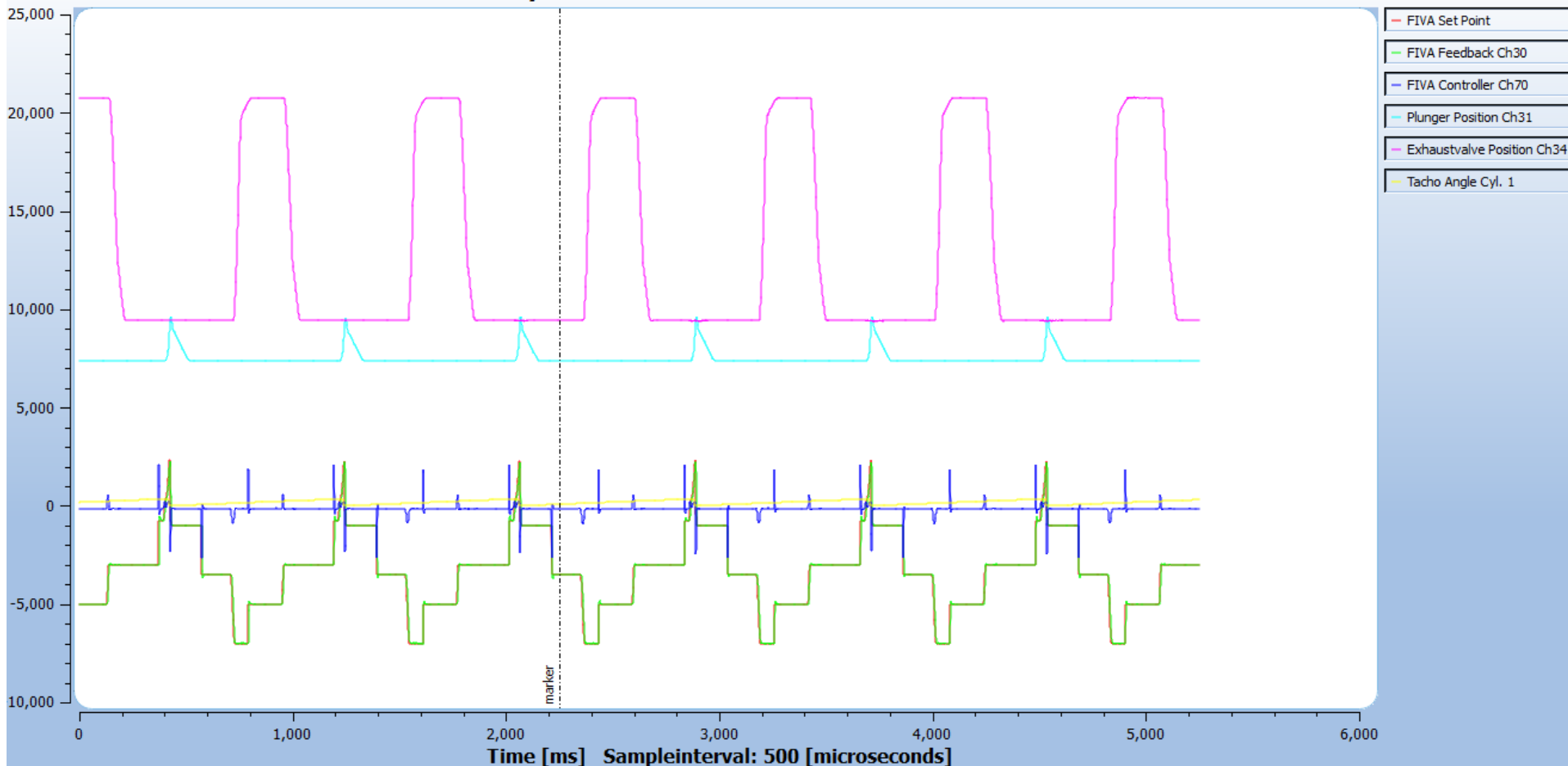
# Maintenance: Troubleshooting HCU Events

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



CCU1-0540#Manual Dump  
Tuesday December 01 2015 - 13:13:18.030 UTC





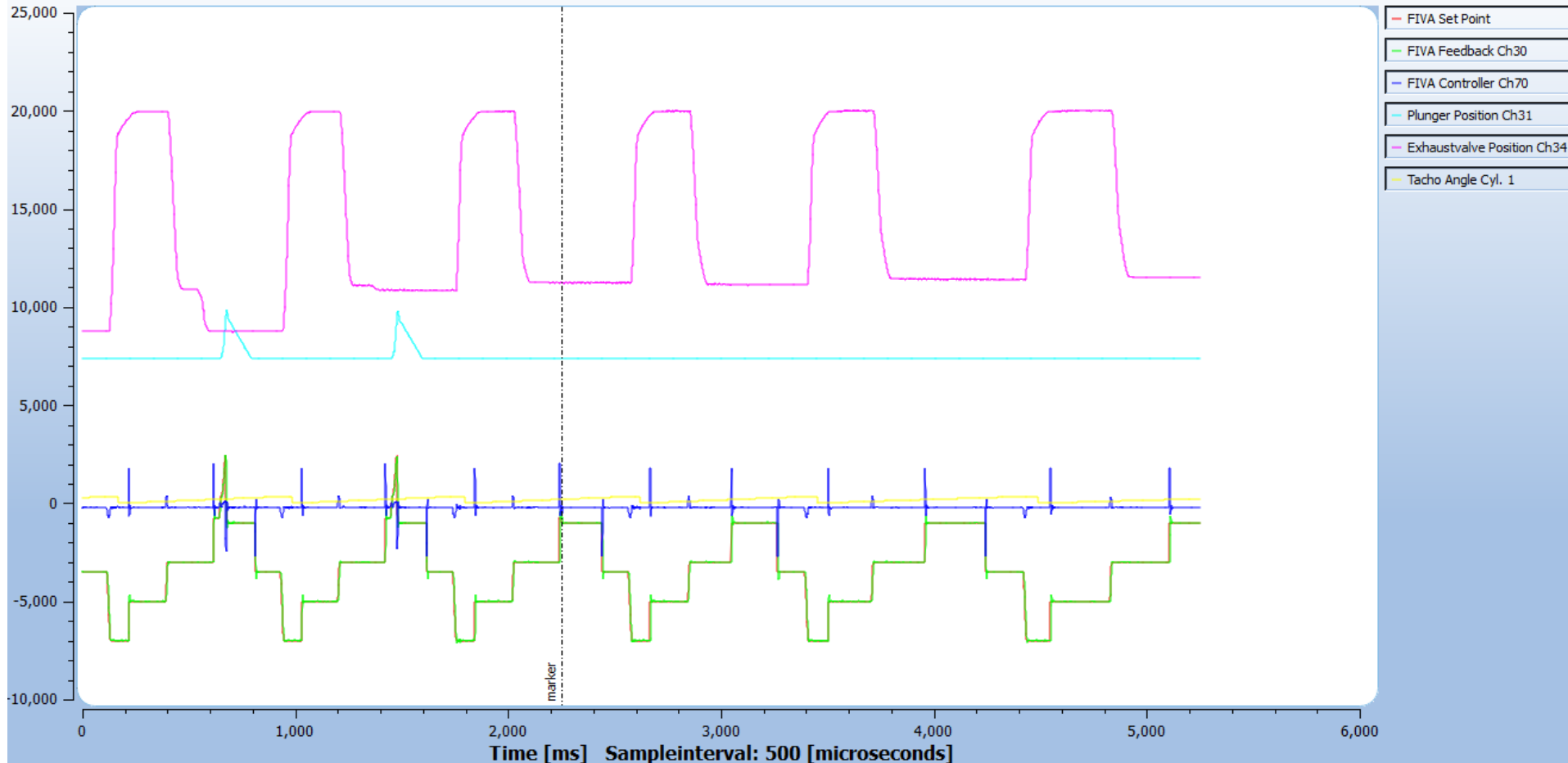
# Maintenance: Troubleshooting HCU Events

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



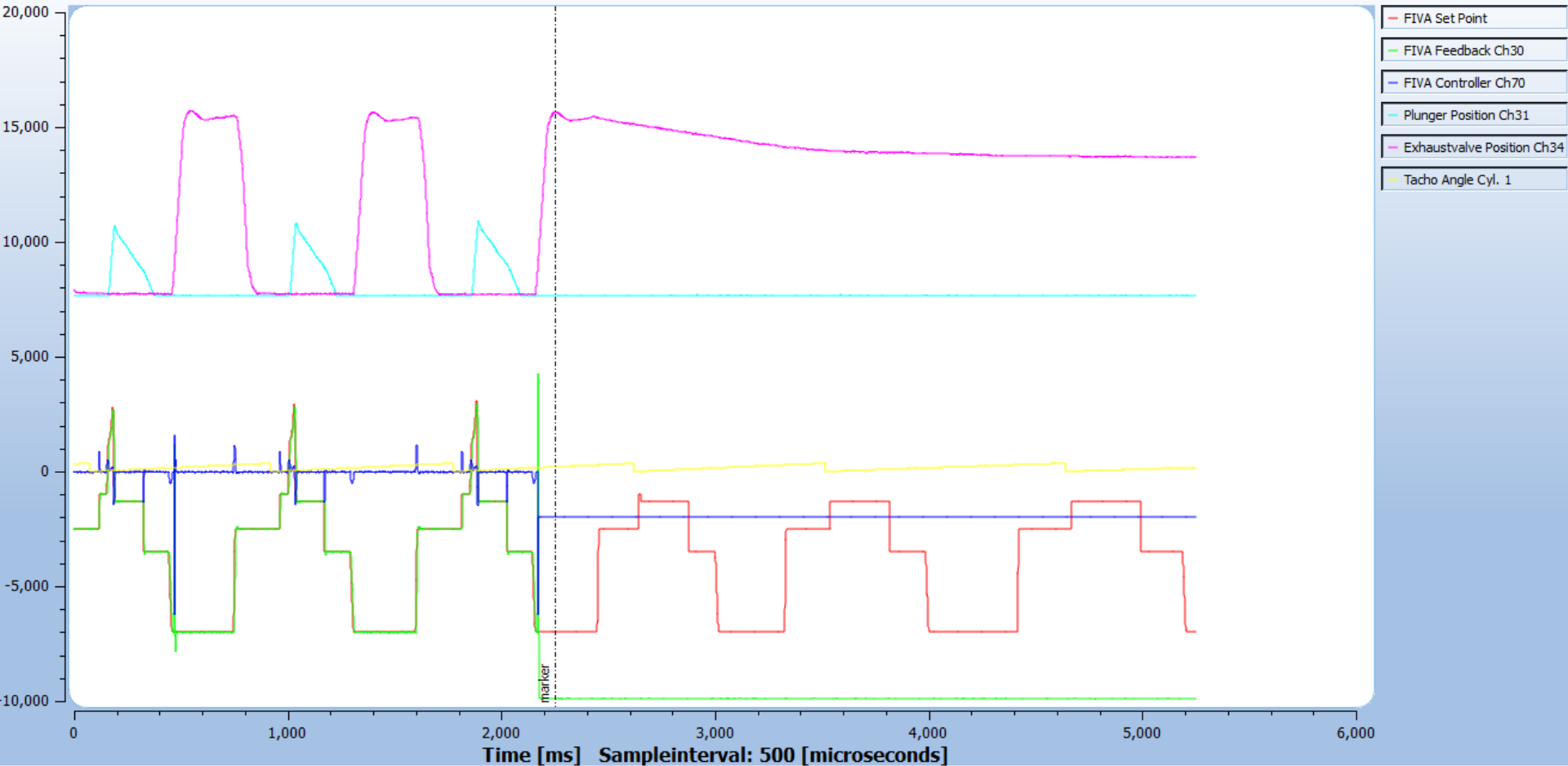
CCU2-03023210#Exh. Close Pos Changed (SlowDown)  
Tuesday November 24 2015 - 10:42:03.872 UTC



# Maintenance: Troubleshooting HCU Events



CCU6-030406#ELFI/FIVA Fdbck Sign. Fail.(Slw.Dw)  
Tuesday February 09 2016 - 03:54:37.768 UTC



# Admin.: Version

MAN Diesel & Turbo Hellas



0 0 0 0

**Admin ▸ Version** 2010-08-13 12:28:26

|                        |  |  |                  |  |         |  |                |  |          |  |
|------------------------|--|--|------------------|--|---------|--|----------------|--|----------|--|
| Product Name & Version |  |  | Engine Group No. |  | IMO No. |  | Engine Builder |  | Eng. No. |  |
| ME-ECS-SW-0905-6.16    |  |  | Simulator        |  | Sim 8   |  | MD-CPH         |  | 8        |  |

| Controller Unit |       |        | Parameters Check Sums |       |         |        |            |           |
|-----------------|-------|--------|-----------------------|-------|---------|--------|------------|-----------|
| ID              | Addr. | Type   | User                  | Chief | Service | Design | IMO Design | IMO Chief |
| ACU1            | 224   | ACU    | 0                     | 132   | 17757   | 3580   | 0          | 0         |
| ACU2            | 225   | ACU    | 0                     | 131   | 17757   | 3582   | 0          | 0         |
| ACU3            | 226   | ACU    | 0                     | 131   | 17690   | 3584   | 0          | 0         |
| AXU1            | 222   | AXU    | 0                     | 8     | 4400    | 0      | 0          | 0         |
| CCU1            | 240   | CCU    | 0                     | 2     | 27943   | 62776  | 16685      | 15472     |
| ECUA            | 208   | ECU    | 0                     | 7406  | 91064   | 53613  | 43433      | 19852     |
| ECUB            | 209   | ECU    | 0                     | 7408  | 91276   | 53613  | 43433      | 19852     |
| EICUA           | 192   | EICU   | 0                     | 387   | 93308   | 496    | 0          | 0         |
| EICUB           | 193   | EICU   | 0                     | 386   | 93365   | 496    | 0          | 0         |
| ESU             | 223   | EngSim | 0                     | 0     | 10508   | 0      | 0          | 0         |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |
|                 |       |        |                       |       |         |        |            |           |

Alarms...

Engine...

Auxiliaries...

Maintenance...

Admin ▸

Set Time

Version

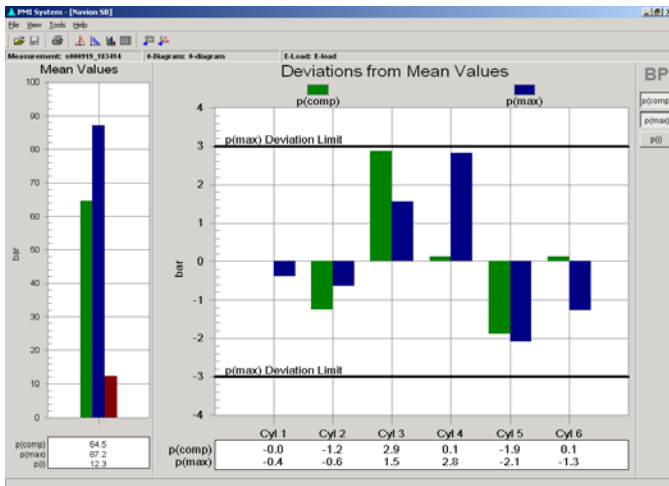
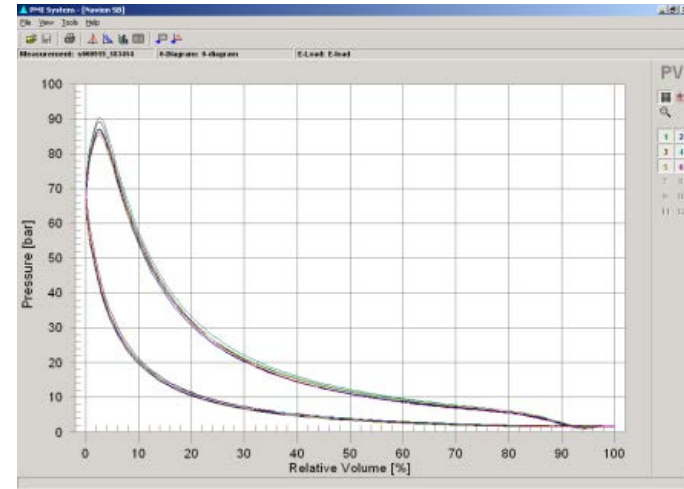
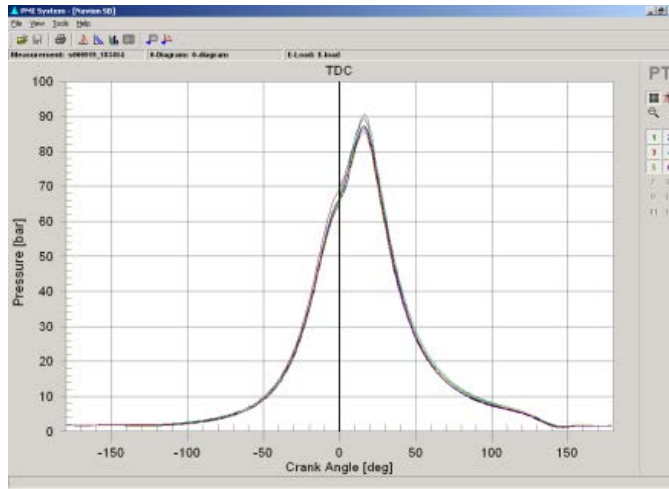
Power Off ⓘ

Access

Chief

Refresh Export...
⌵ ⌴

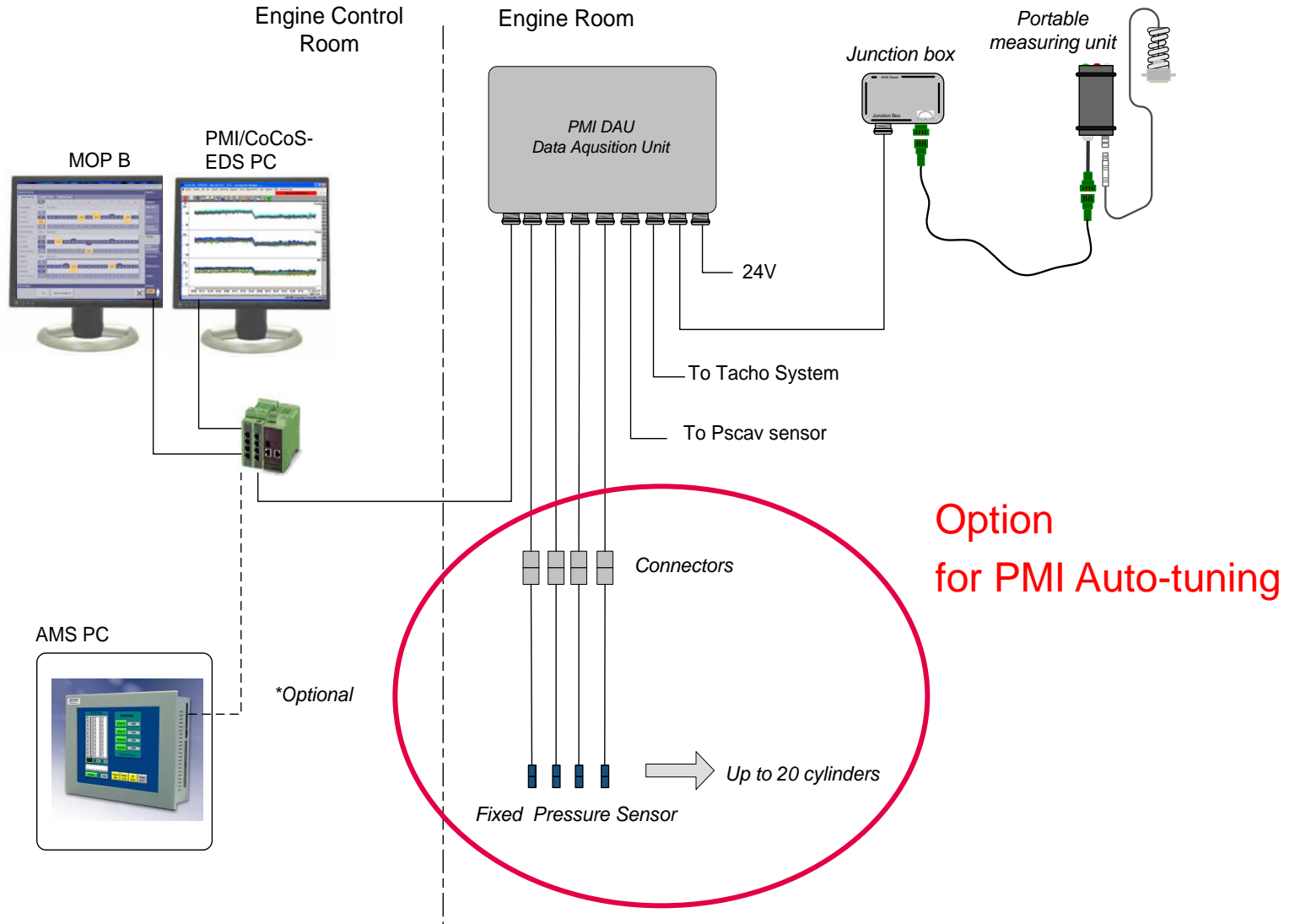
# PMI system



| Cylinder Number | p(i) [bar] | p(comp) [bar] | p(max) [bar] | Engine Speed [rpm] | Effective Power [kW] | Effective Power [Bhp] | gB Deviation [bar] | Index Adjust H | Rotation of Link H | p(max) Deviation [bar] | VIT Adjust H | Rotation of Link H |
|-----------------|------------|---------------|--------------|--------------------|----------------------|-----------------------|--------------------|----------------|--------------------|------------------------|--------------|--------------------|
| 1               | 12.15      | 64.5          | 86.0         | 141.0              | 963                  | 1174                  | 0.19               |                |                    | 0.4                    |              |                    |
| 2               | 12.12      | 63.2          | 86.5         | 143.4              | 971                  | 1184                  | -0.23              |                |                    | -0.6                   |              |                    |
| 3               | 11.86      | 67.3          | 88.7         | 143.8              | 963                  | 1180                  | 0.49               |                |                    | 1.5                    |              |                    |
| 4               | 13.18      | 64.8          | 90.0         | 143.0              | 960                  | 1200                  | 0.81               |                |                    | 2.8                    |              |                    |
| 5               | 12.62      | 62.6          | 85.1         | 142.8              | 922                  | 1253                  | 0.47               |                |                    | -2.1                   |              |                    |
| 6               | 11.80      | 64.8          | 85.9         | 141.5              | 949                  | 1156                  | -0.36              |                |                    | -1.3                   |              |                    |
| Mean            | 12.36      | 64.5          | 87.2         | 142.7              | 956                  | 1200                  |                    |                |                    |                        |              |                    |
| Total           |            |               |              |                    | 5300                 | 7218                  |                    |                |                    |                        |              |                    |

p(i)avg: 1.89 bar

# PMI system



# PMI Auto-tuning

## The new DAU 11 computer

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



### DAU:

General purpose Data Acquisition Unit  
based on FPGA technology

### PMI Auto-tuning application:

- Support for up to 20 cylinders
- Support for ABB & Kistler sensors
- Angle and time triggered data sampling
- Real time data logging & transfer
- On-unit status indication



# Disclaimer



All data provided in this document is non-binding.  
This data serves informational purposes only and is especially not guaranteed in any way. Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

# Thank You For Your Attention

MAN Diesel & Turbo Hellas

50 years  
Engine  
the MANkind



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