ME Fundamentals and Critical Principles

MAN Diesel & Turbo Hellas
50 years Engine the MANkind

1st Classification Society Event 2017
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Any new recommendations to machinery survey??

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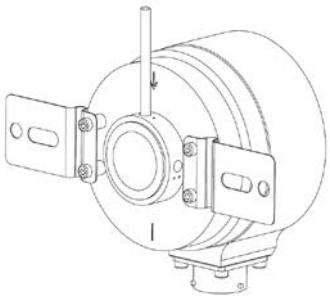
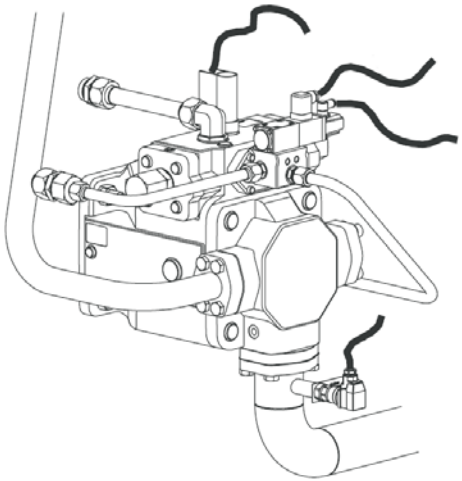
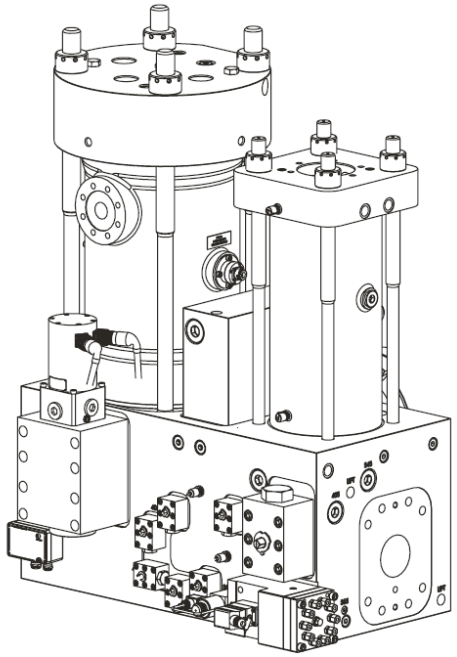
- Hydraulic AC Pumps – Pressure Build Up response time
- Hydraulic Engine Driven Pumps – Displacement for Ahead/Astern
- Accumulators of Hydraulic Power Supply System – Pressure check
- Accumulators of Hydraulic Cylinder Units System – Pressure check
- FIVA Operation – Testing of Cylinders
- Angle Encoders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







What new to inspect on ME engines

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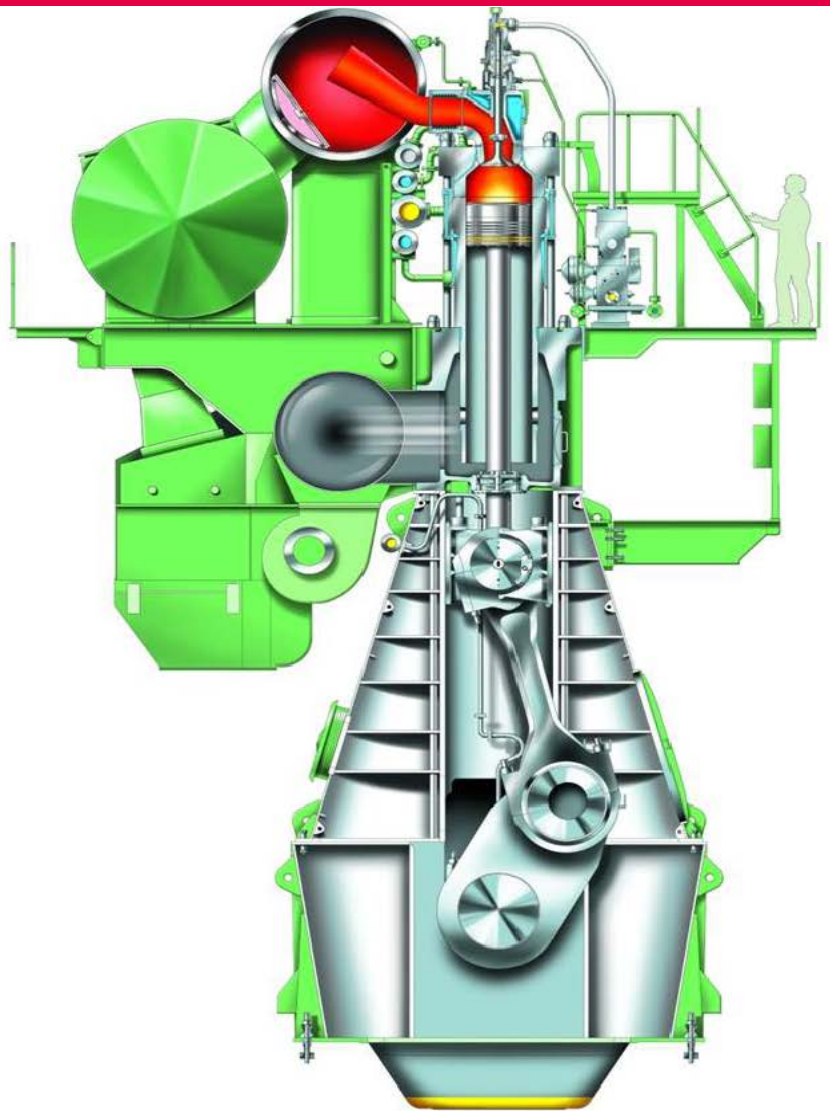

MAN B&W Low Speed Propulsion Engines

Engine Type Designation

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

- Emission regulation — TII: IMO Tier level
- Fuel injection concept — (blank): Fuel oil only; GI: Gas injection
- Version number
- Mark number
- Design — B: Exhaust valve controlled by camshaft; C: Compact engine
- Concept — E: Electronically controlled; C: Camshaft controlled
- Engine programme series
- Diameter of piston in cm
- Stroke/bore ratio — G: 'Green' Ultra long stroke; S: Super long stroke; L: Long stroke; K: Short stroke
- Number of cylinders

New Components / Redesigned

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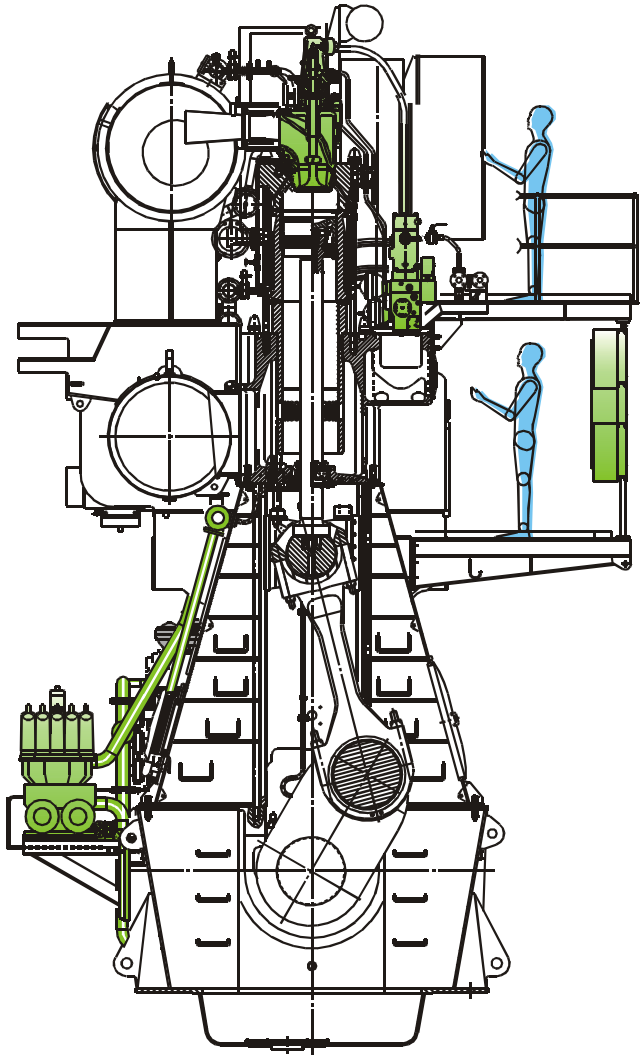
- **Hydraulic Power Supply (HPS)**
- **Hydraulic Cylinder Unit (HCU)**
- **Engine Control System (ECS)**
  - Starting air valves
  - Start and Reversing sequences
  - Governor function
  - Auxiliary blowers
  - Electronically Profiled Injection (EPIC)
  - Exhaust valve actuation
  - Cylinder lubrication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



Super Fine Filter

ME engine - Hydraulic layout

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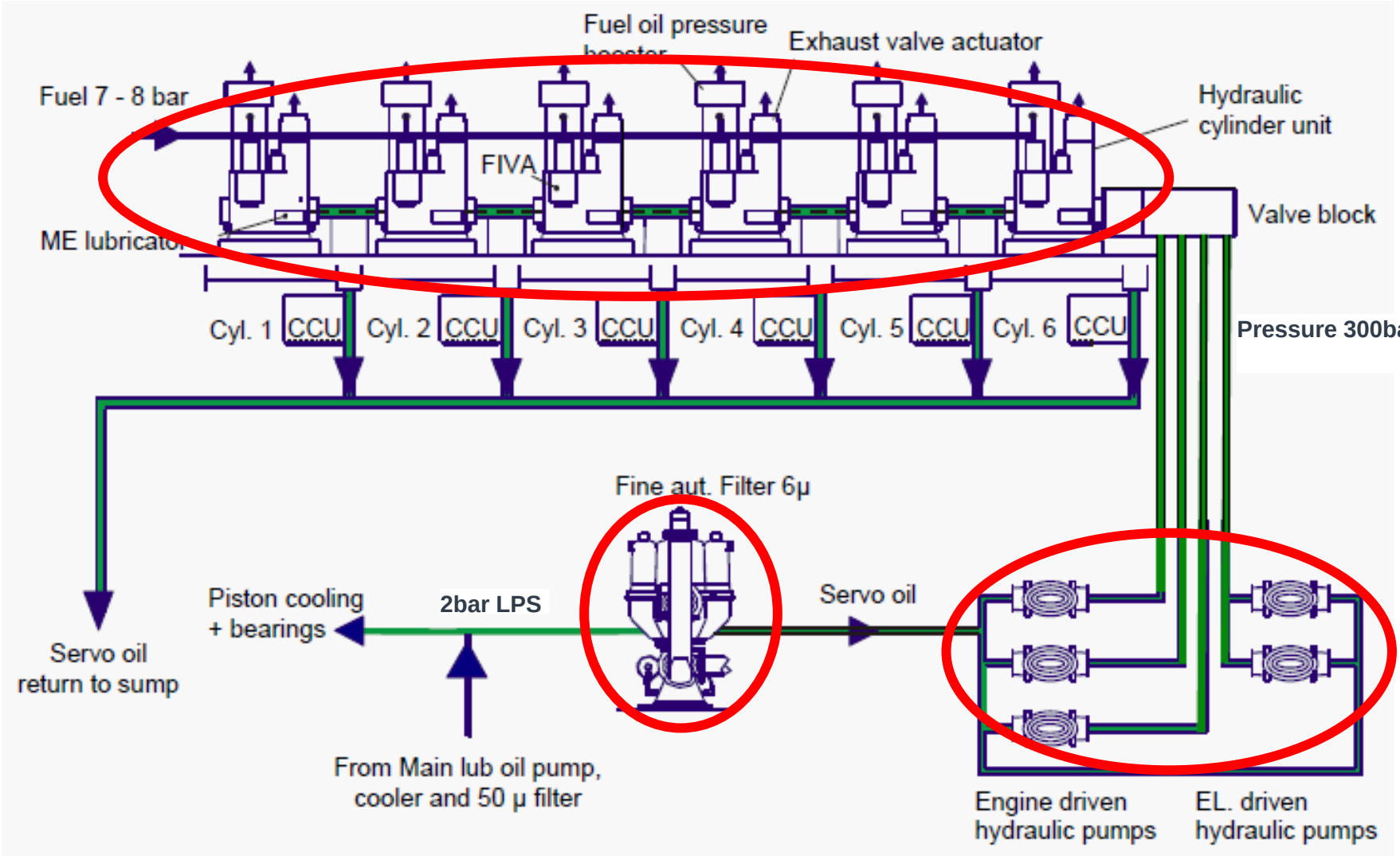
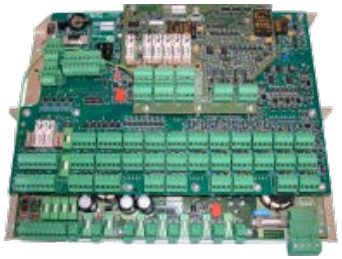


ME Engine Control System



Bridge Panel

Main Operating Panel

Control Room Panel

Main Operating Panel B

EICU A

EICU B

Engine Interface Control Units A and B

Local Operation Panel

Engine Control Units A and B

ECU A

ECU B

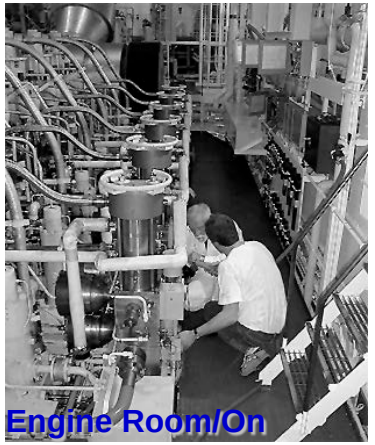
Control Network

Cylinder Control Units 1 per cylinder

ACU

CCU

Auxiliariy Control Units 1, 2 and 3



Engine Control System
MPC & Control Network

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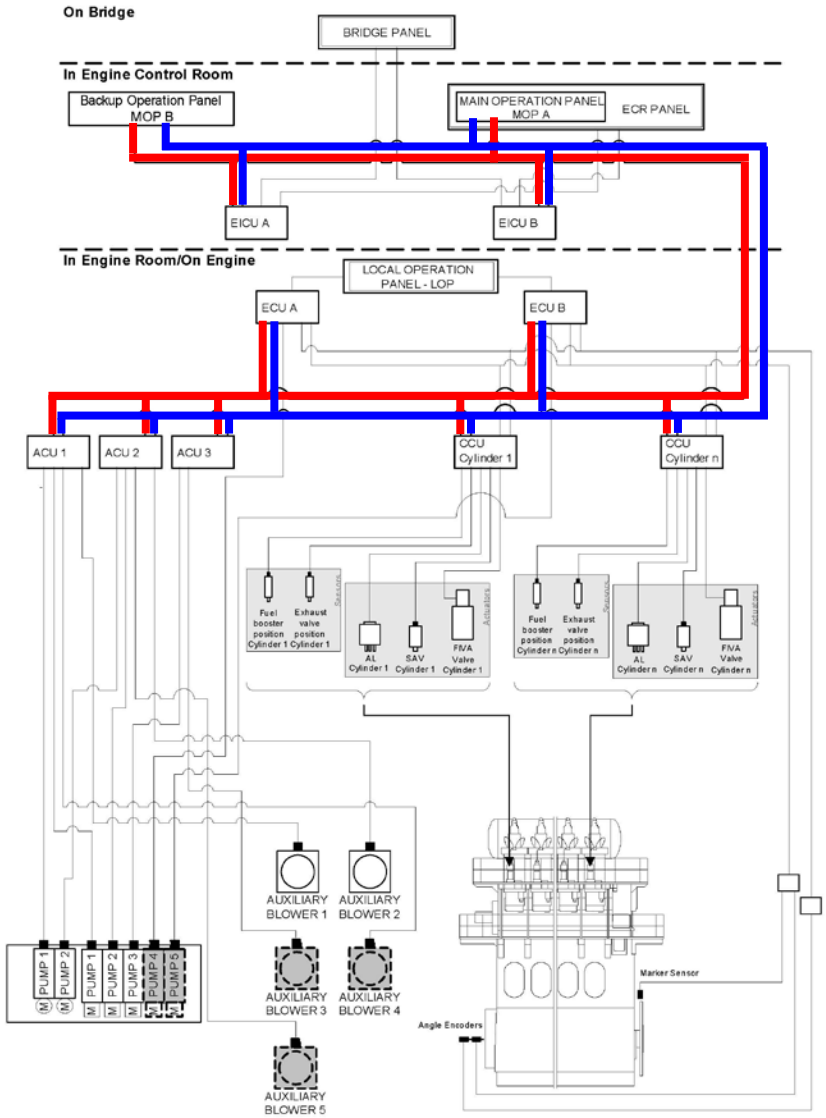
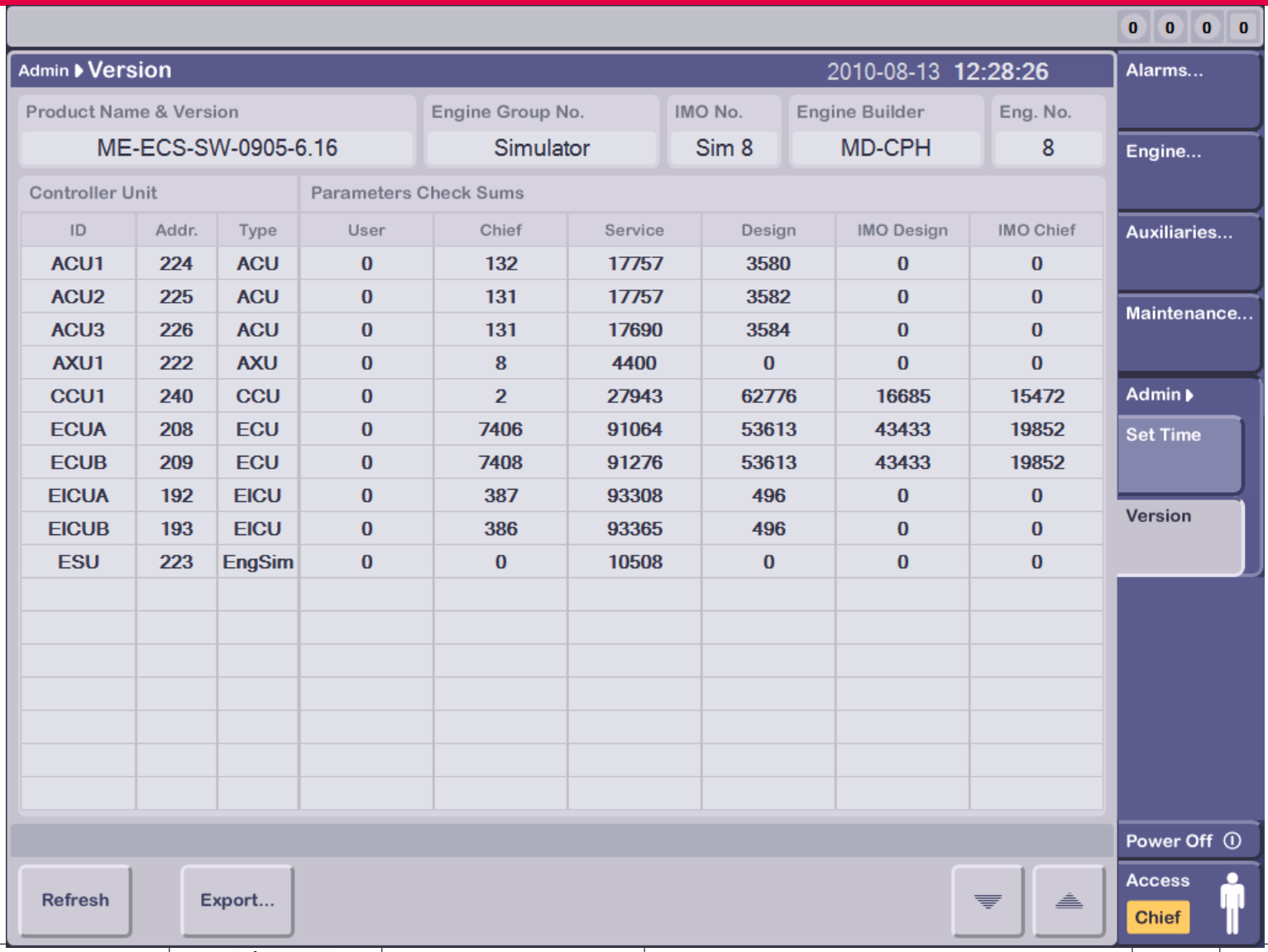


- The Multi Purpose Controllers are identical hardware wise.
- They have different software configurations.
- 2 redundant control networks are connecting all Multi Purpose Controllers and both Main Operating Panels.
- A backup of the application- and setup- software is stored on both Main Operation Panels.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

MPC Unique ID



Multi Purpose Controller, MPC

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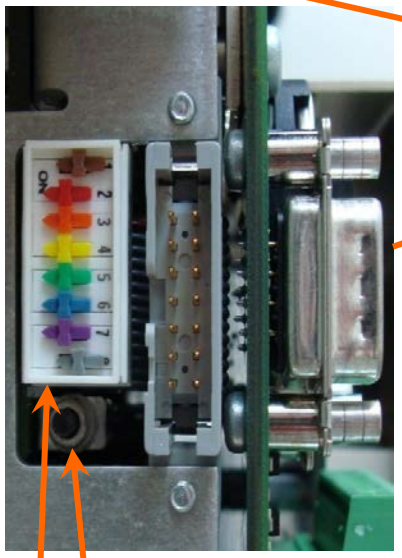

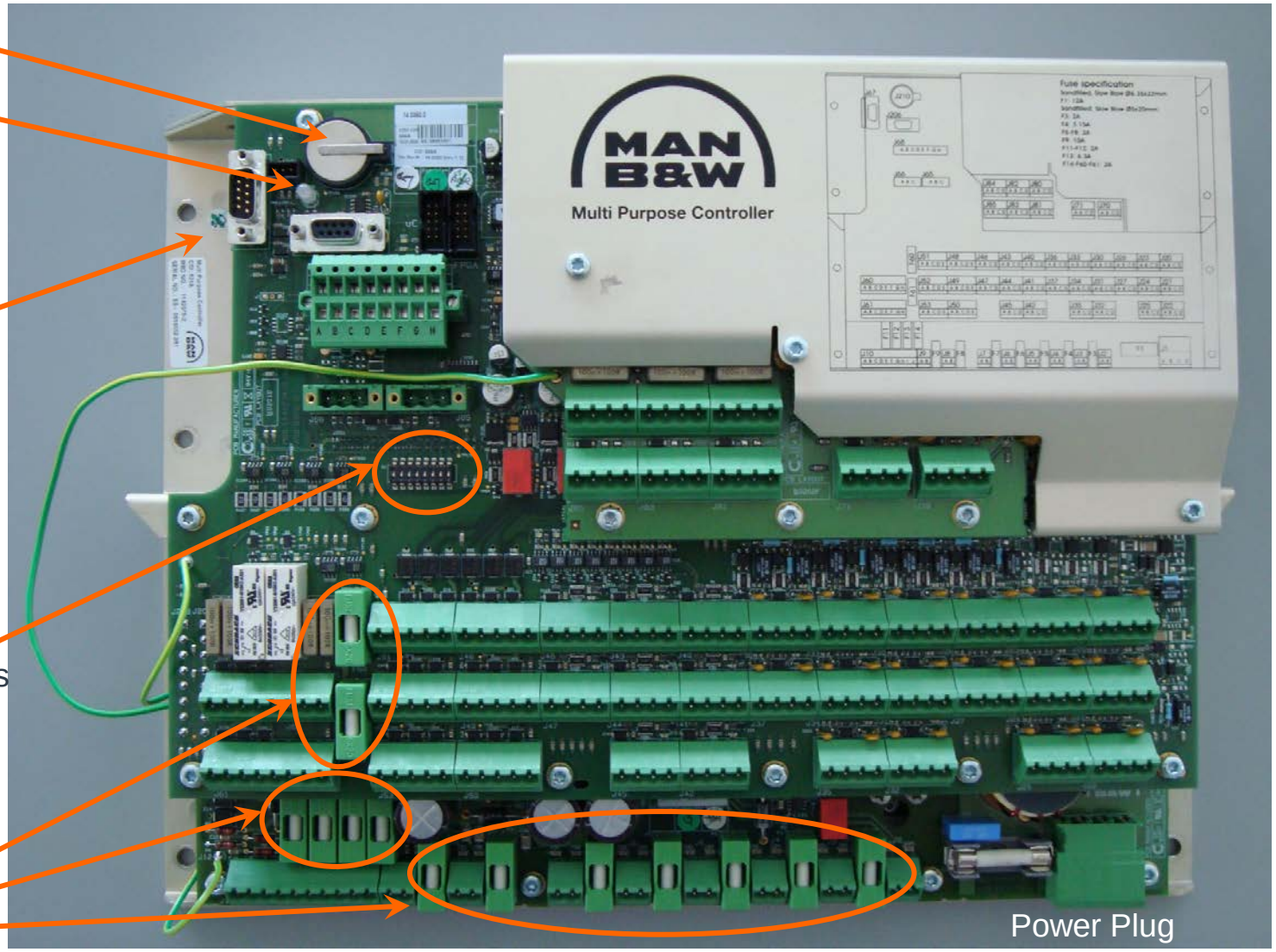

Maintenance: System View, I/O Test

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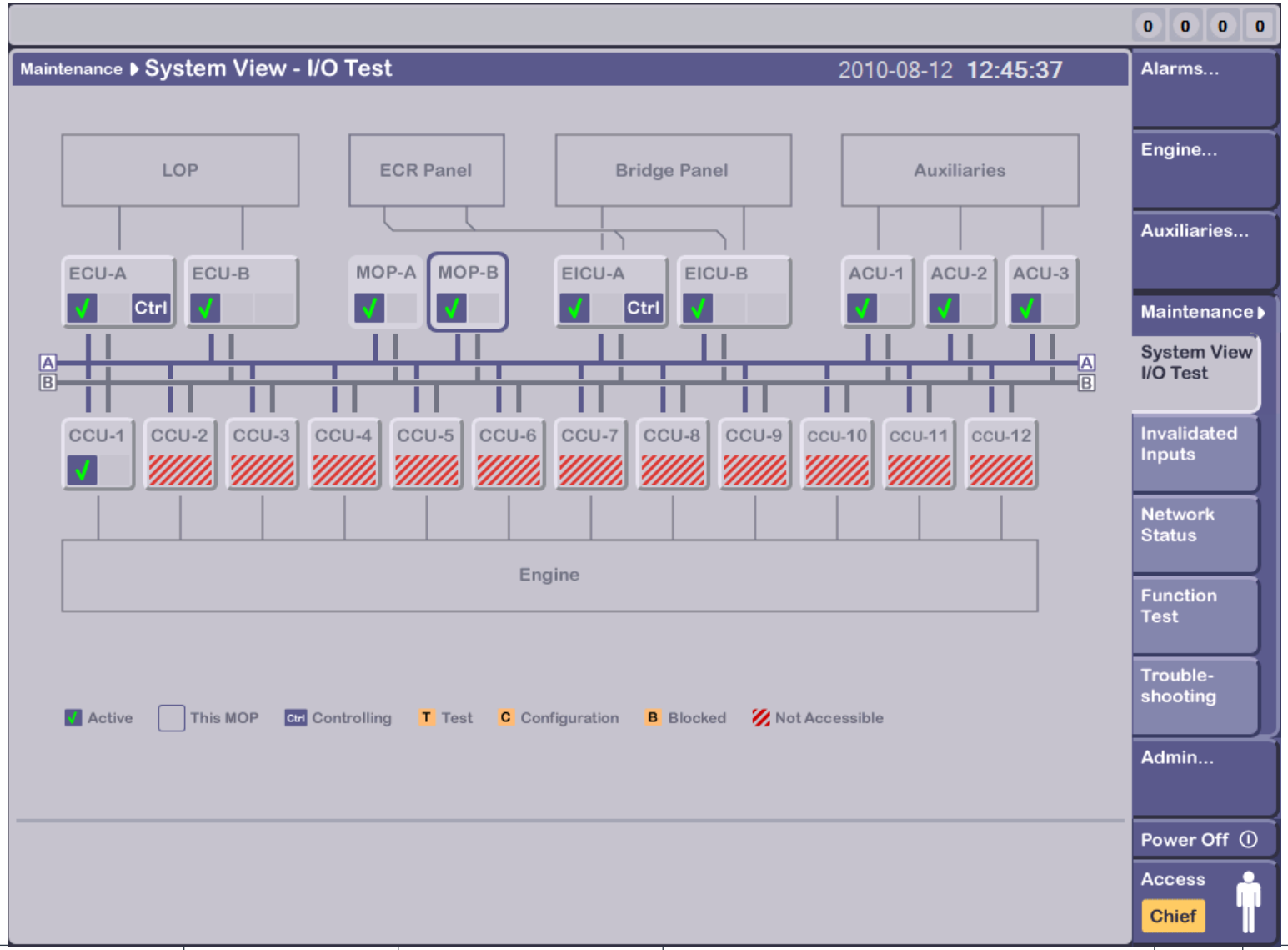

Multi Purpose Controller, MPC Summary

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

1) **Engine Interface Conrol Unit – EICU**
   - 2 completely redundant units
   - Handles the interface to external systems & protects the engine by generating setpoint of speed

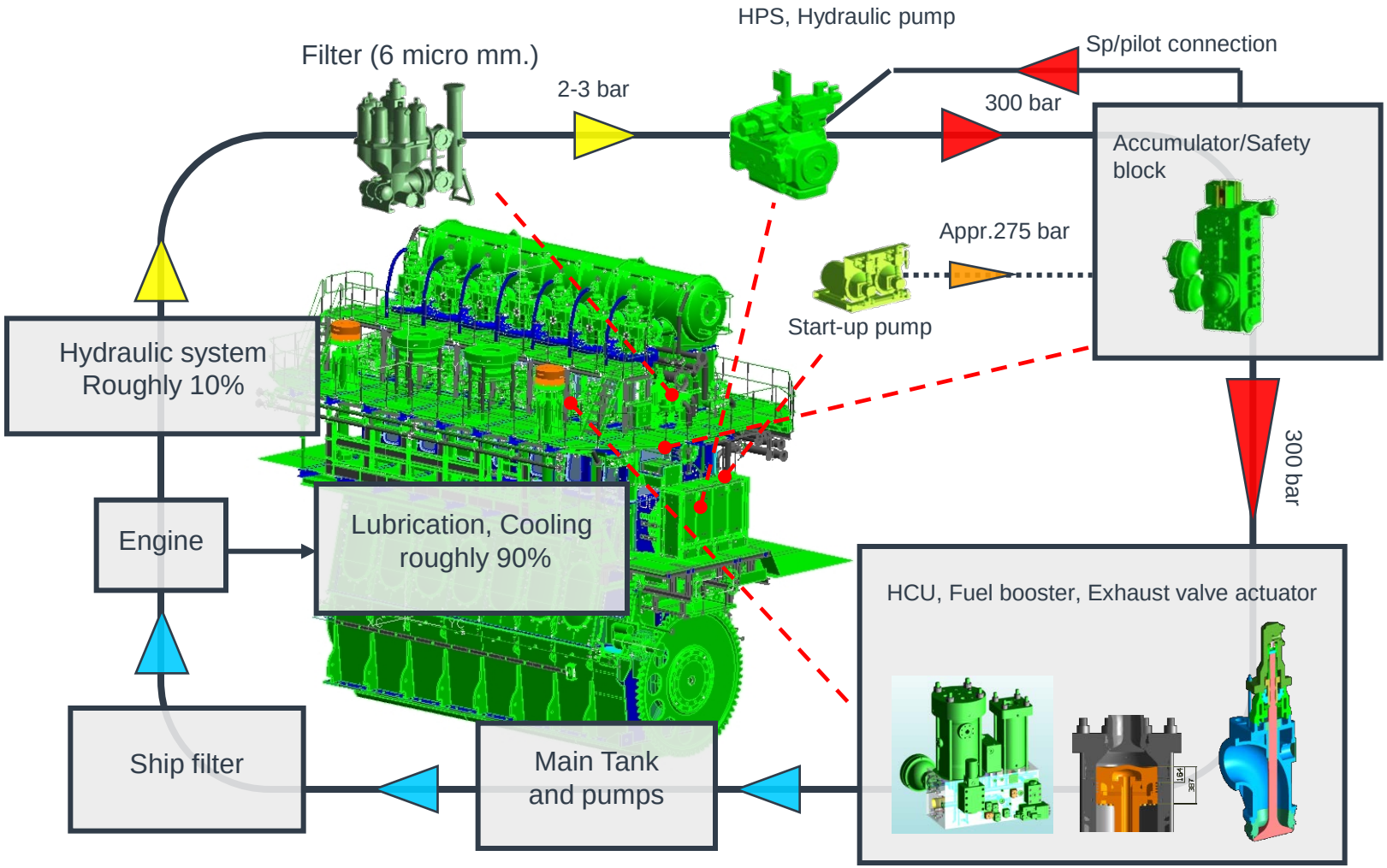
2) **Engine Control Unit – ECU**
   - 2 completely redundant units (except with more than 3 engine driven pumps)
   - Handles the engine specific control functions (the govenor)

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

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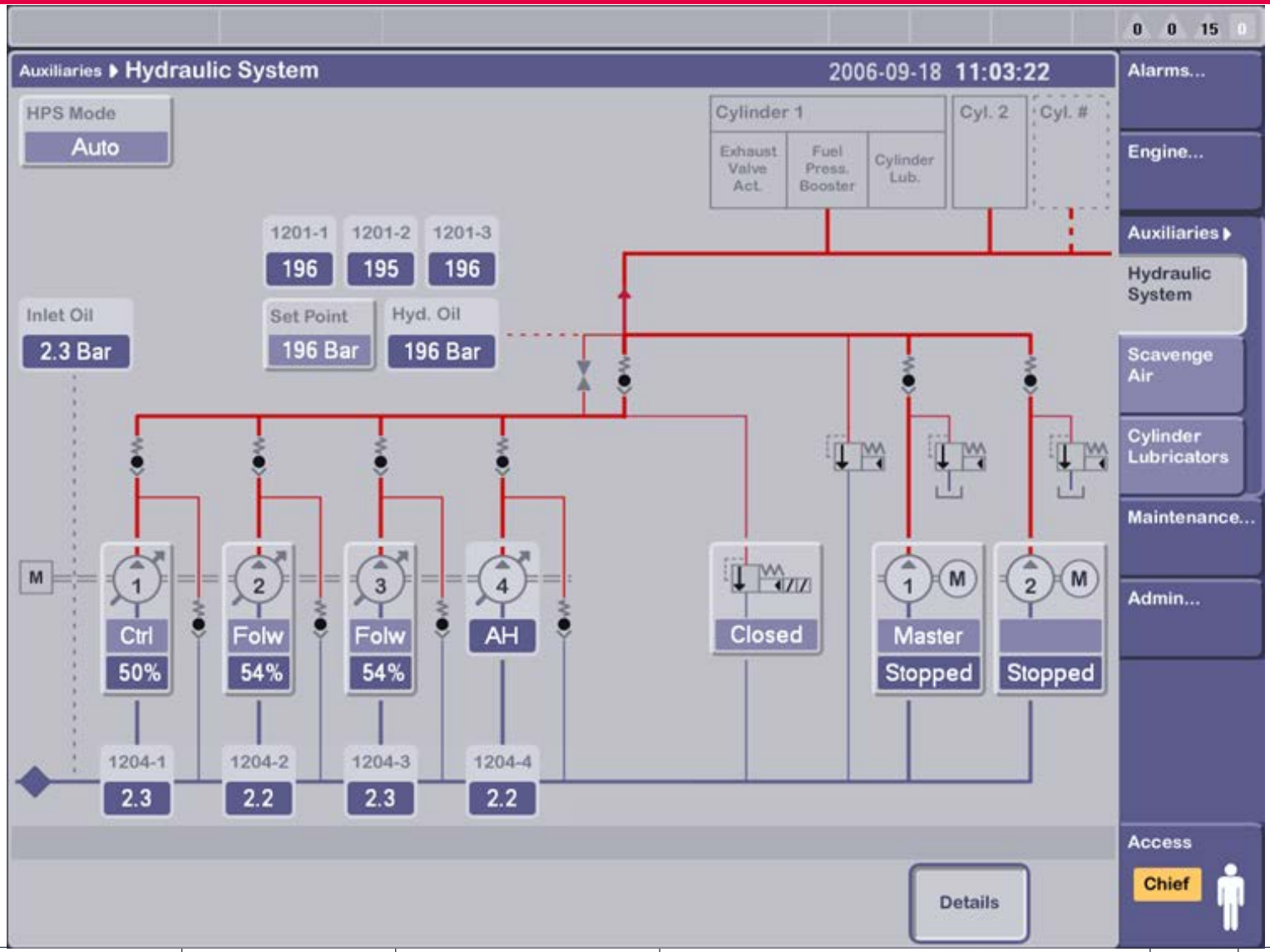
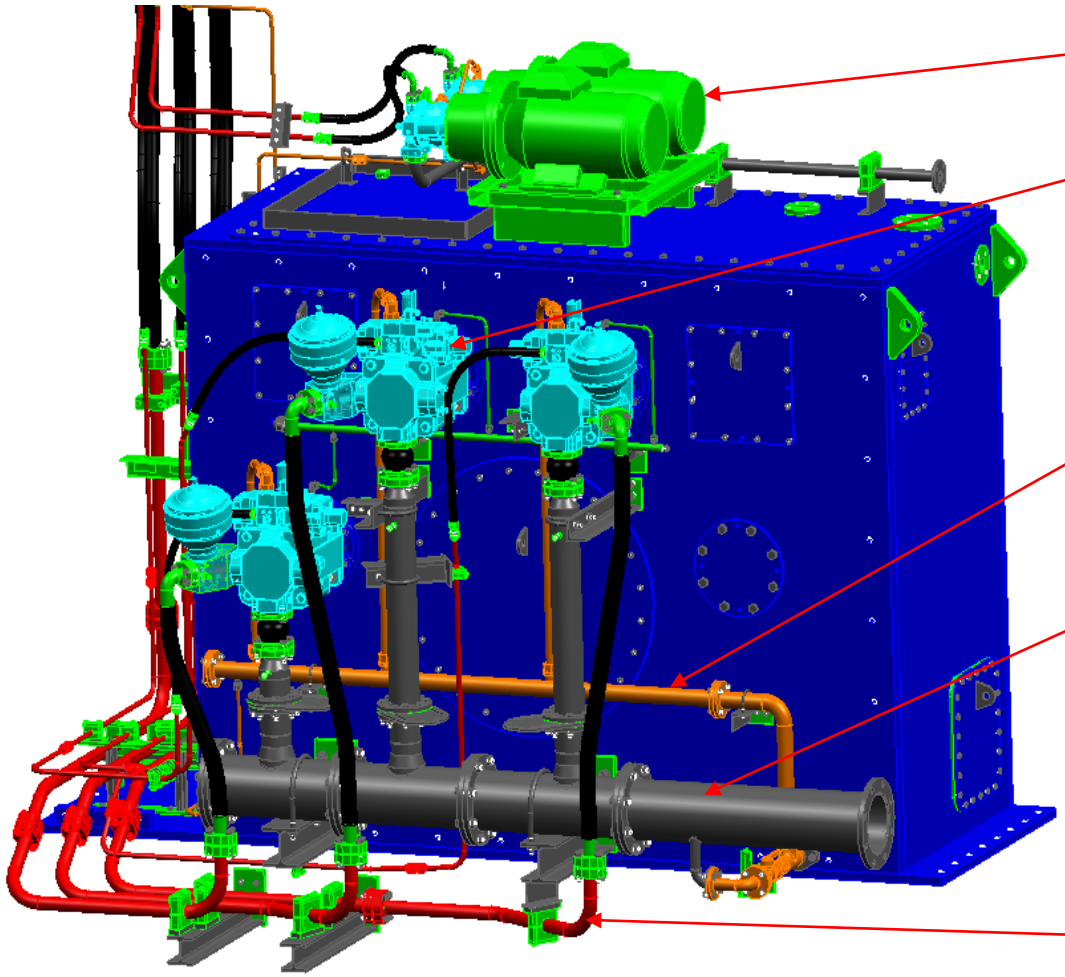


Hydraulic Power Supply HPS



Start-up pumps

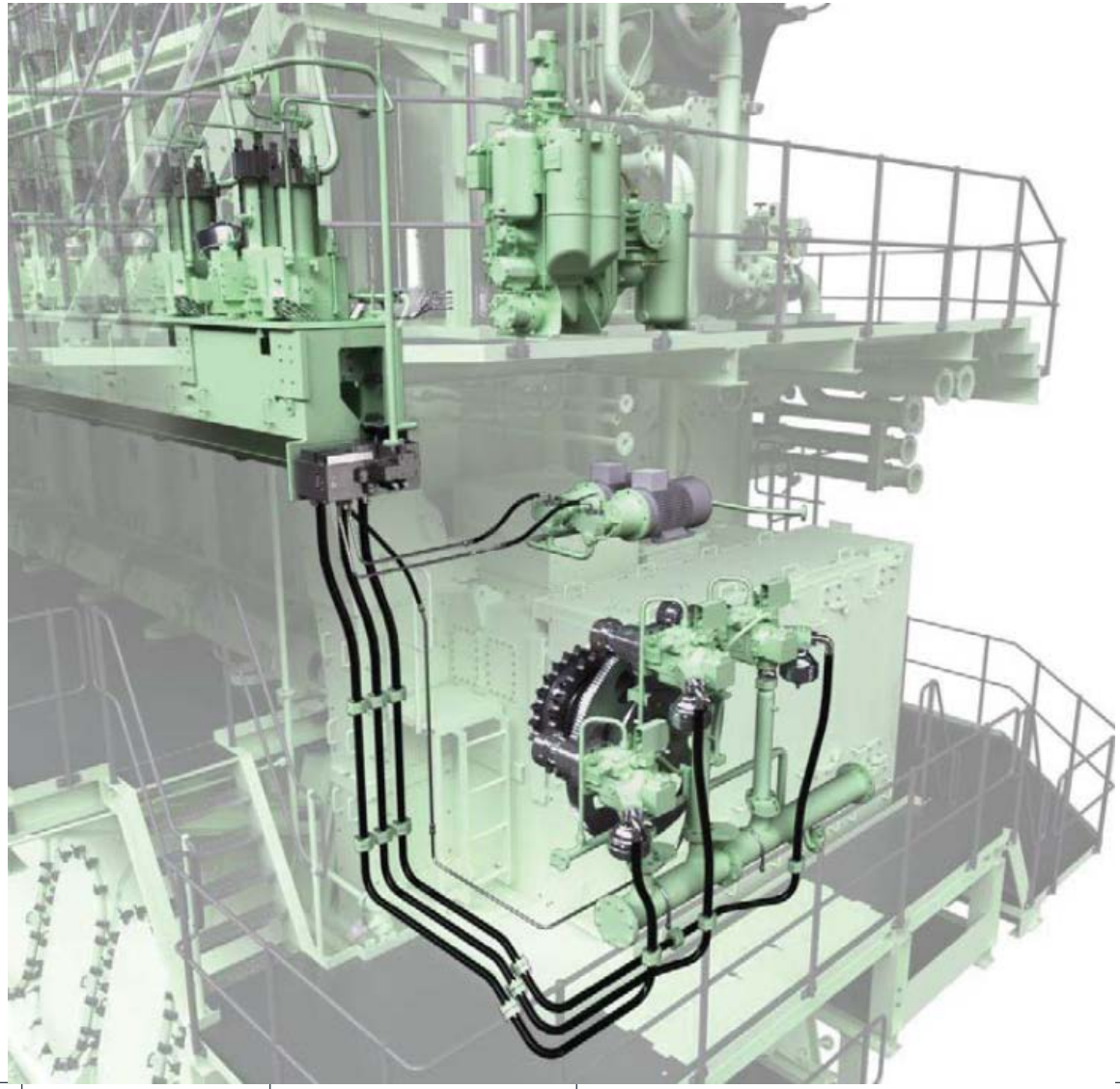
High pressure pumps

Drain-pipe system

System oil

High pressure pipes

Hydraulic Power Supply
HPS in AFT of engine



Hydraulic Power Supply
HPS in the middle of engine

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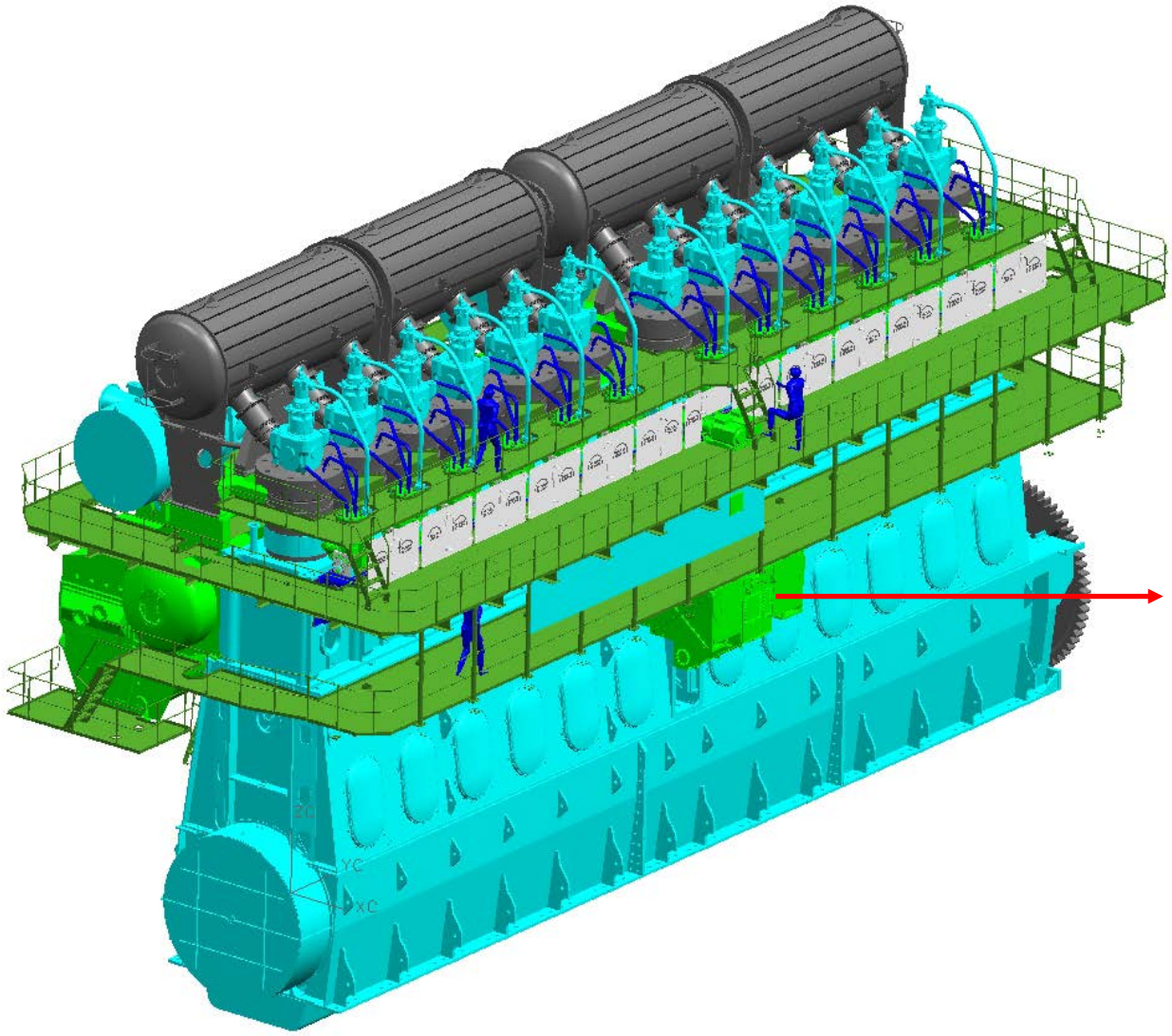

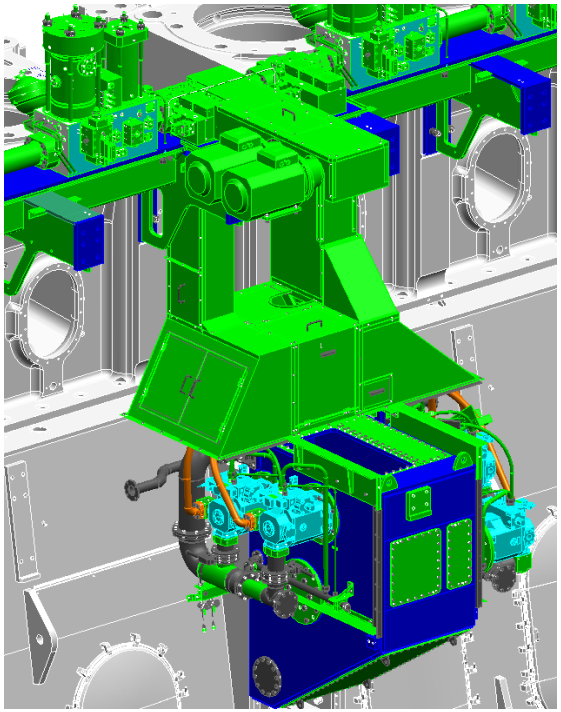

Axial Piston Pump

Bosch Rexroth

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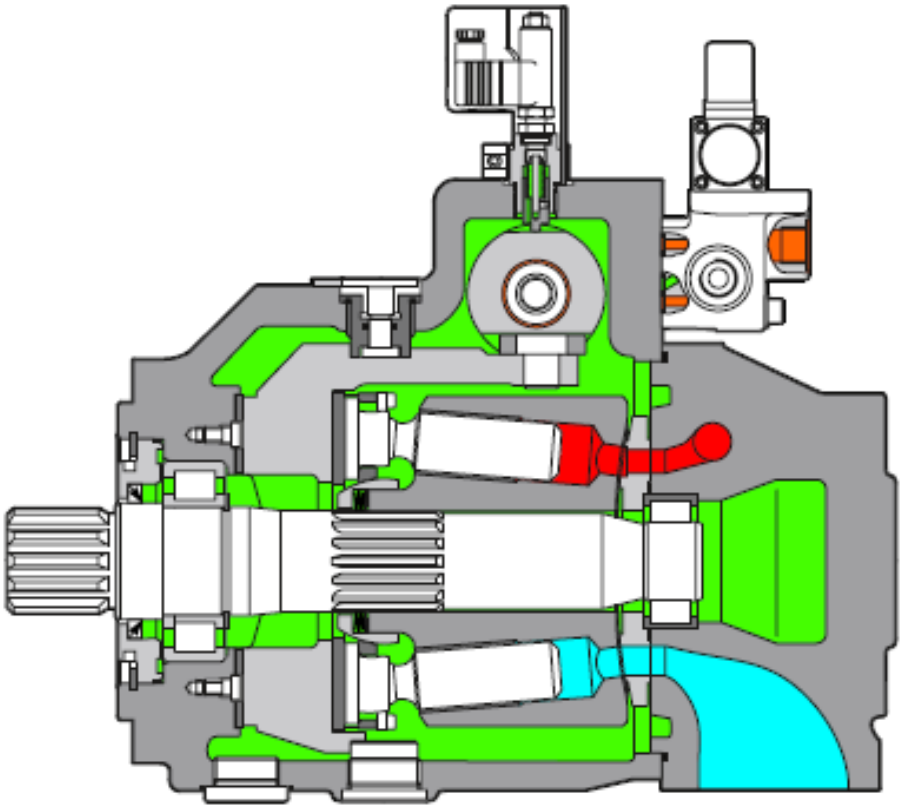
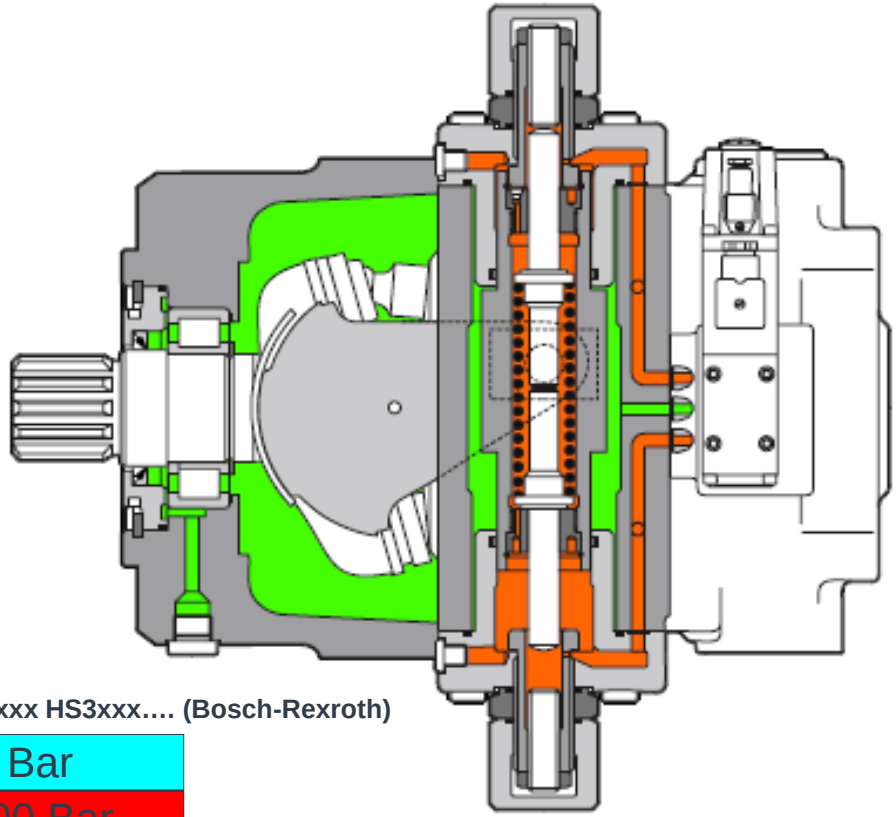
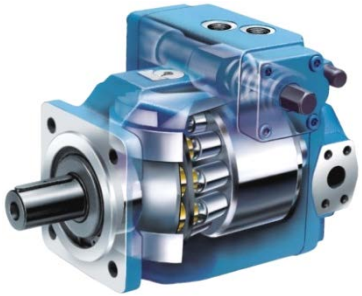


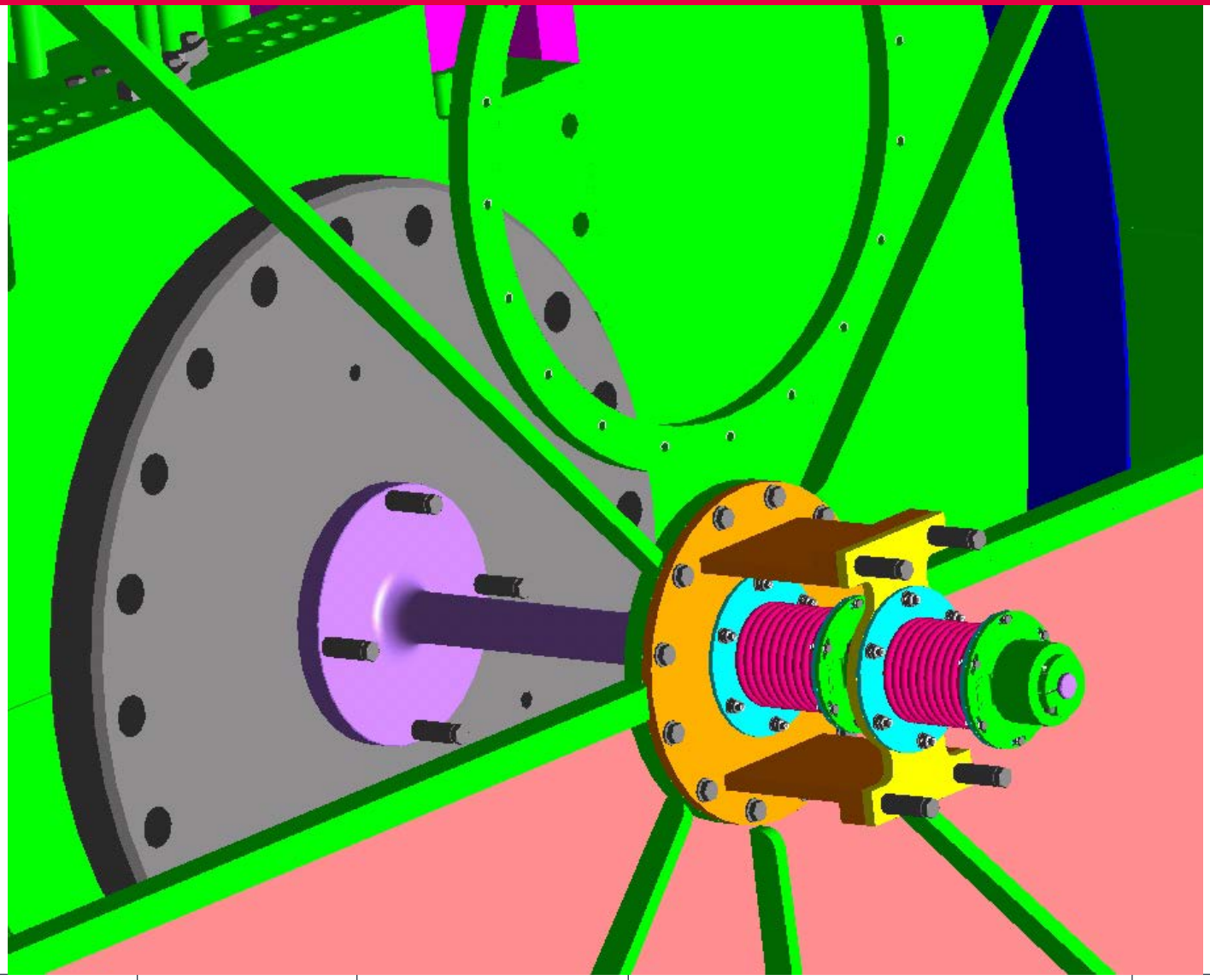




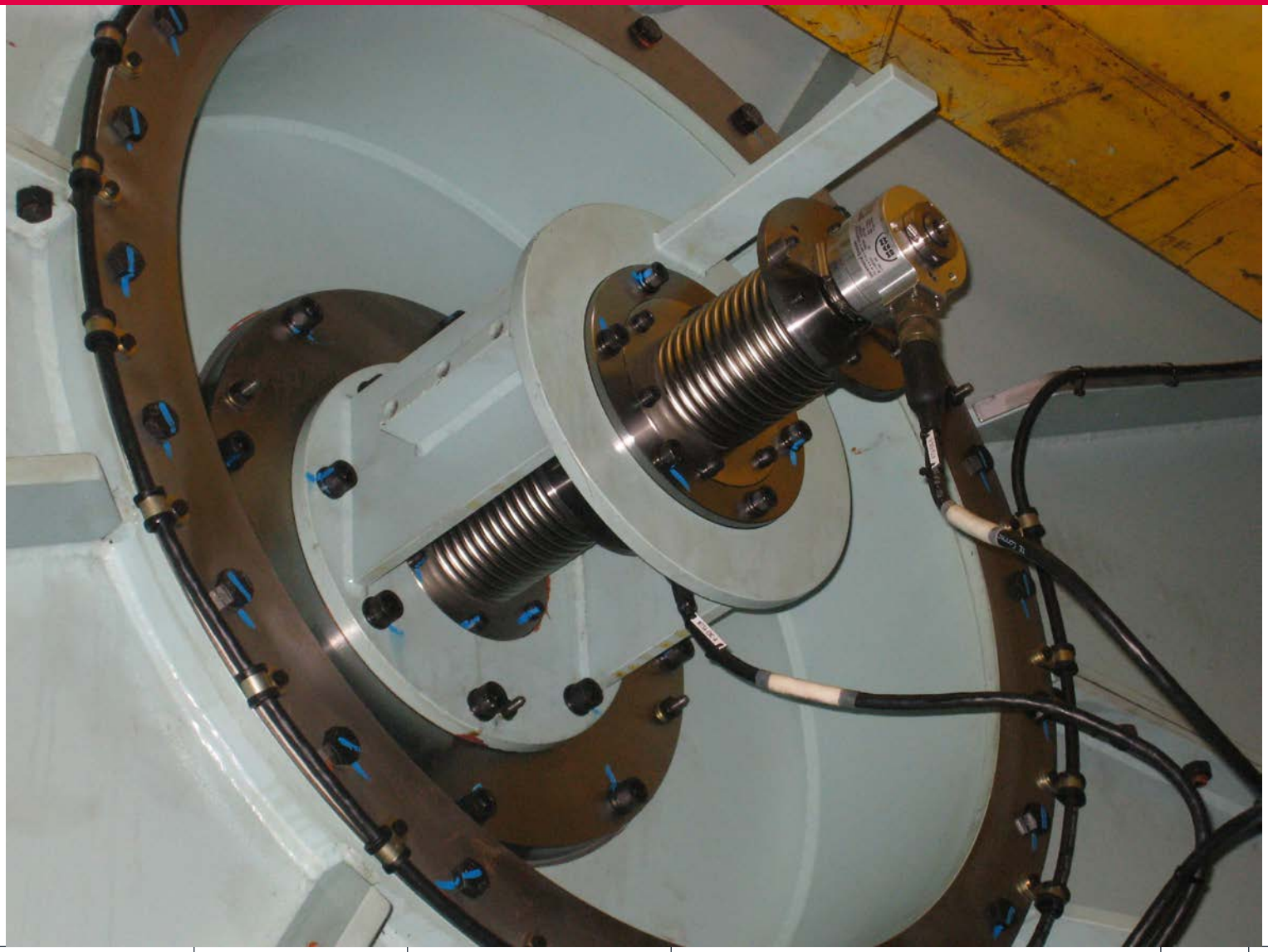
Axial Piston Pump – A4VSO xxx HS3xxx…. (Bosch-Rexroth)

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

ME Tacho system



Tacho System



Tacho System
Angle Encoders

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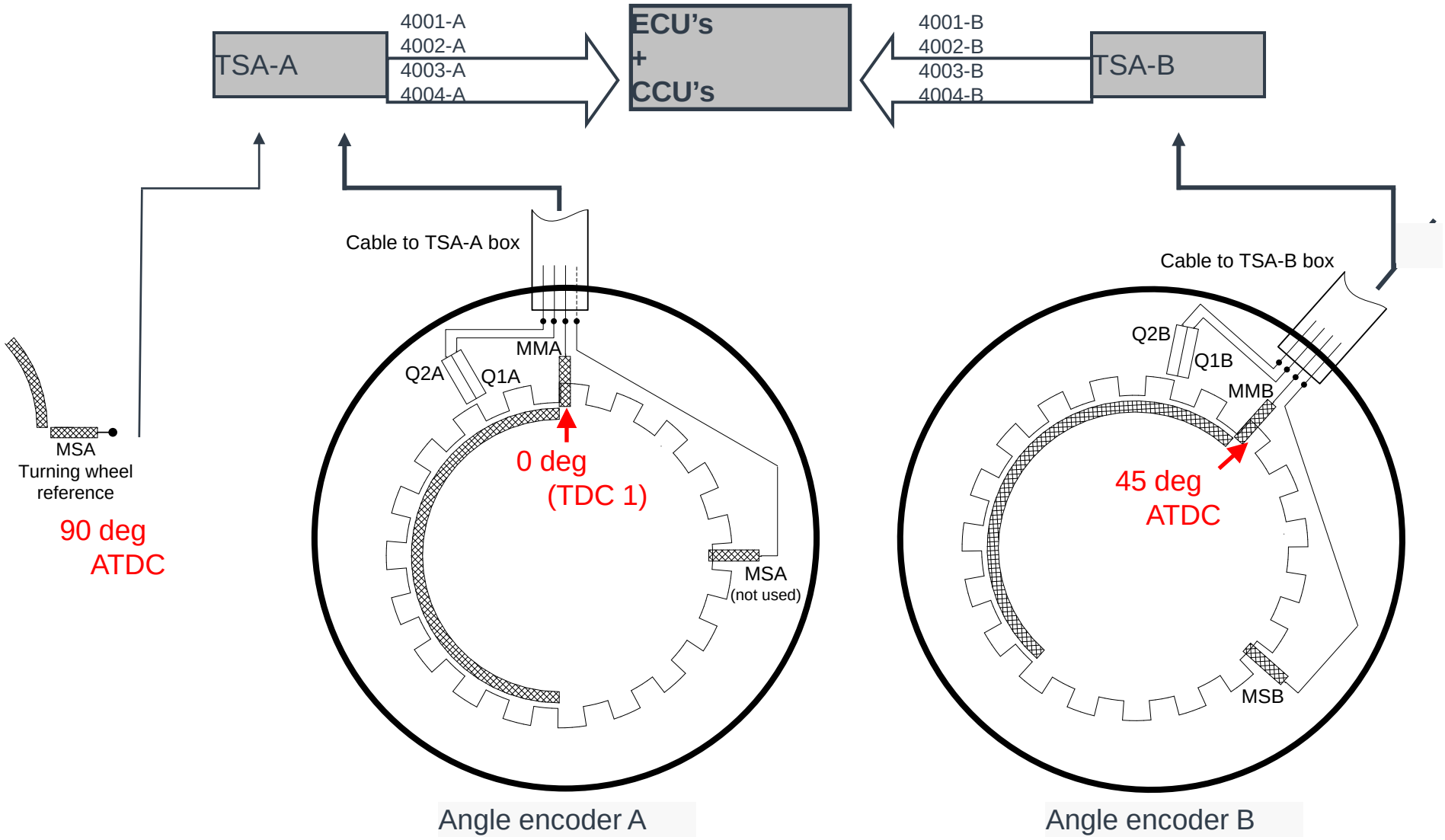

Angle encoder A

Angle encoder B

Hydraulic Cylinder Unit – HCU 7K80ME-C9

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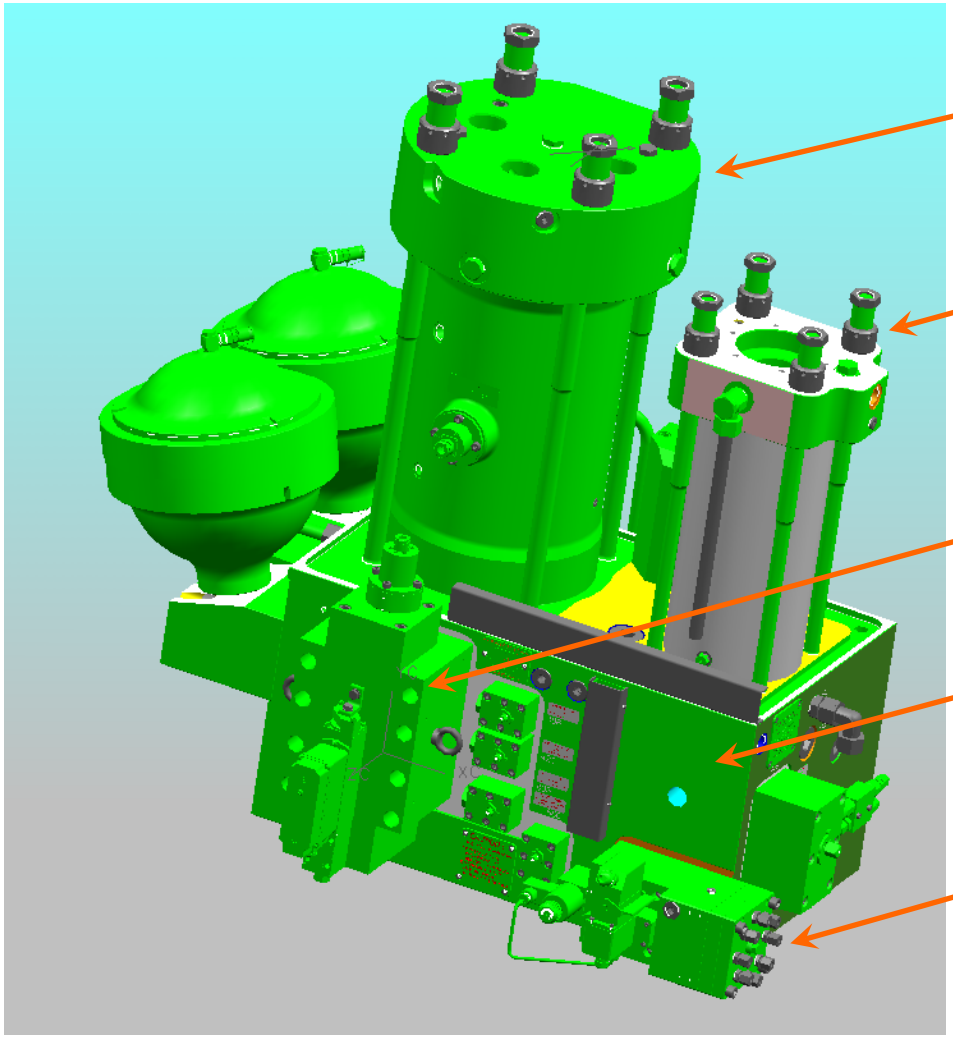
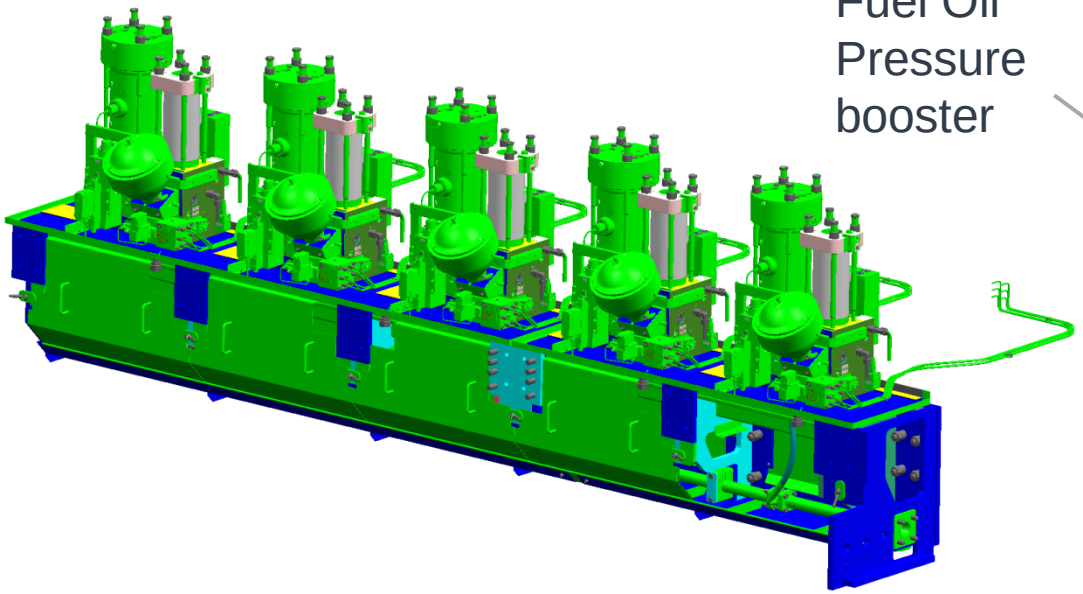
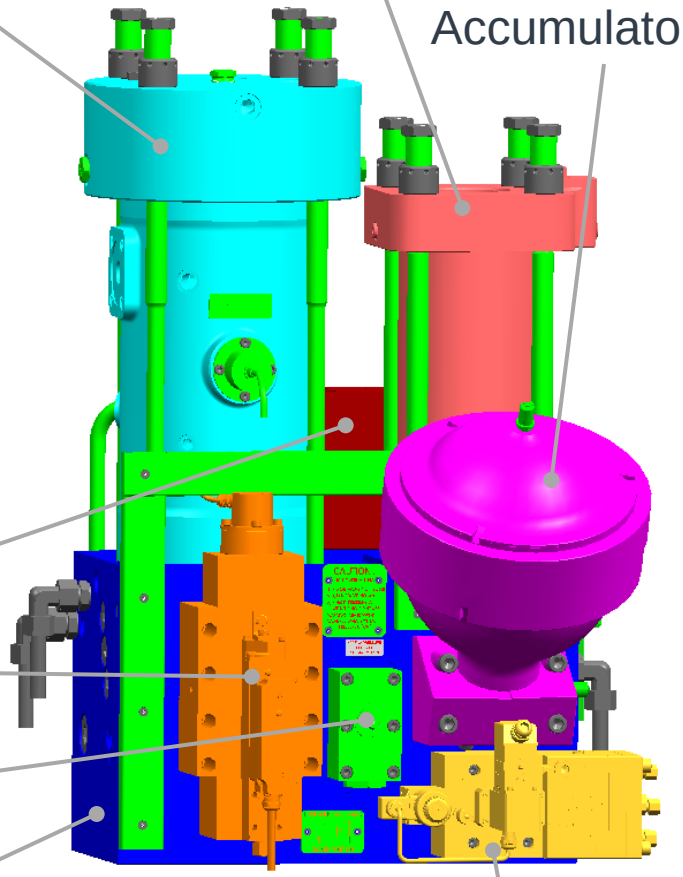


Hydraulic Cylinder Unit





FIVA valve

Two control port

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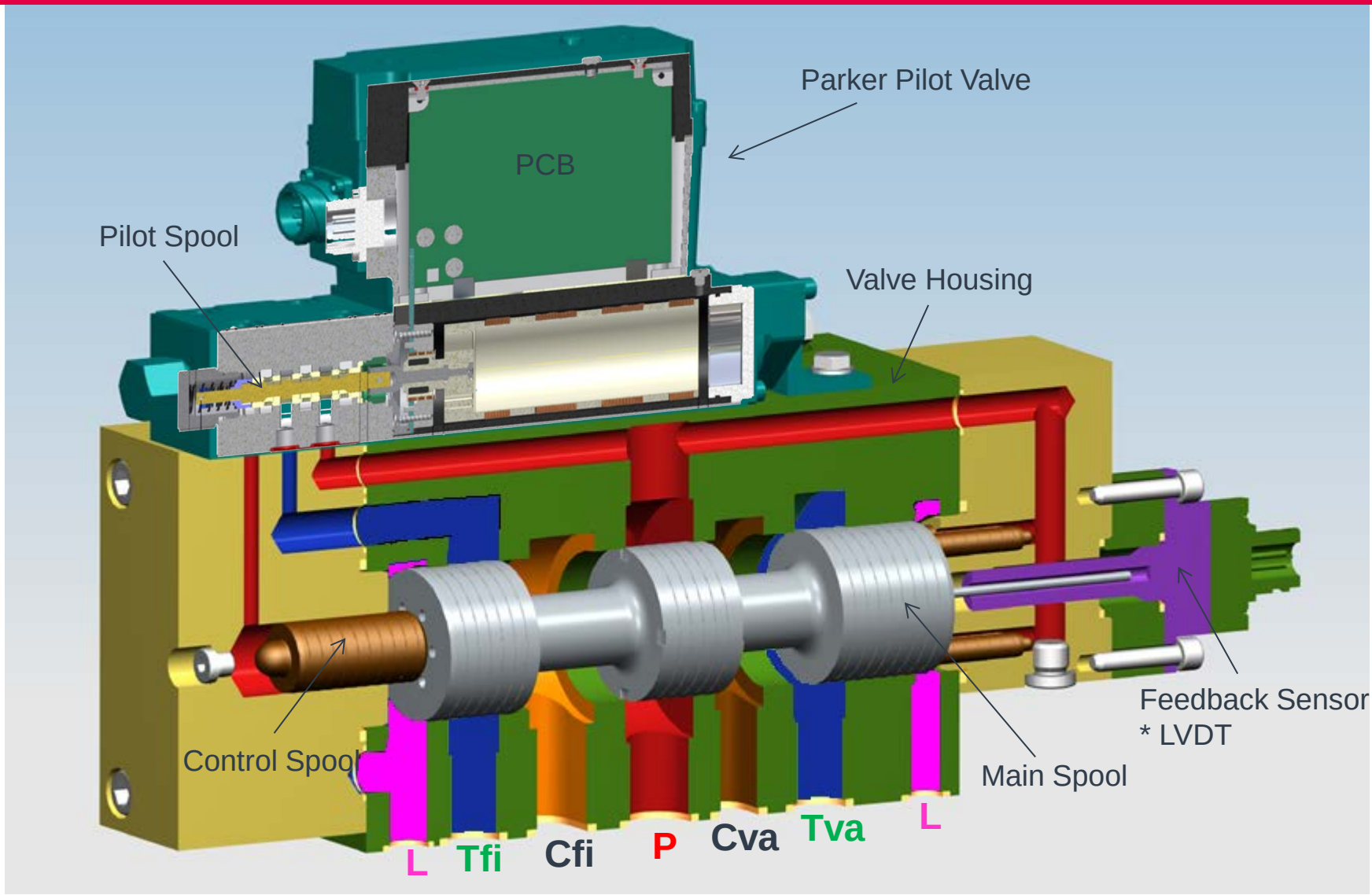
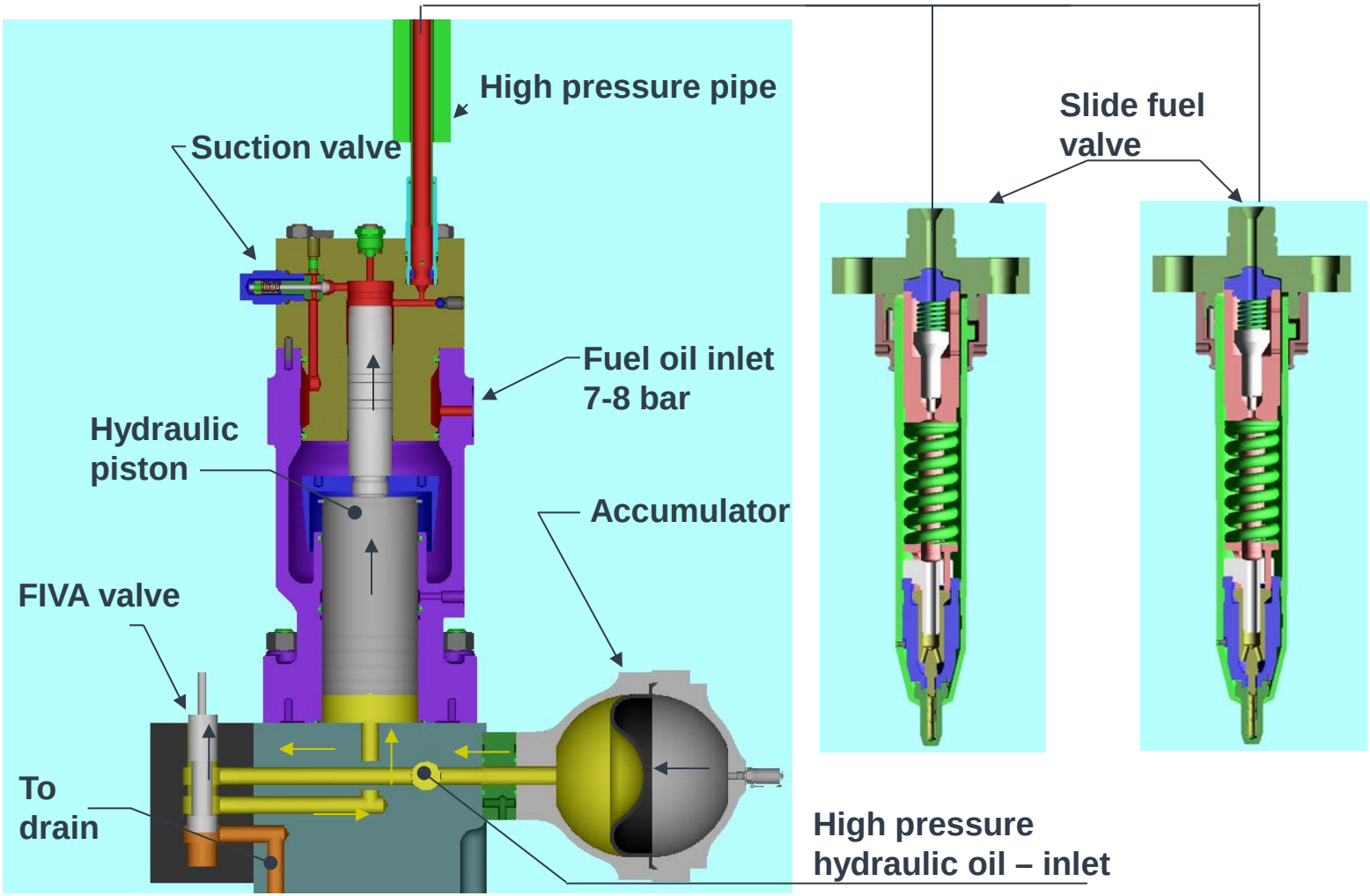


Fuel Oil System



Design Features,
MC versus ME High force exh. valve

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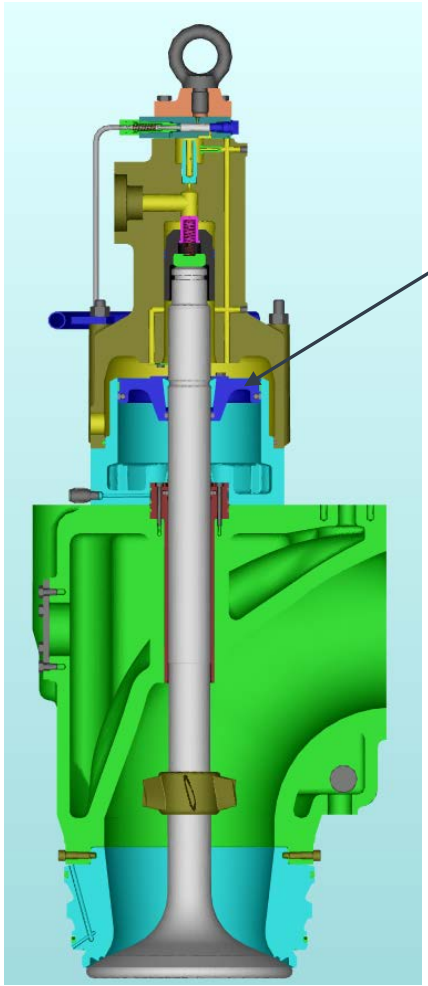
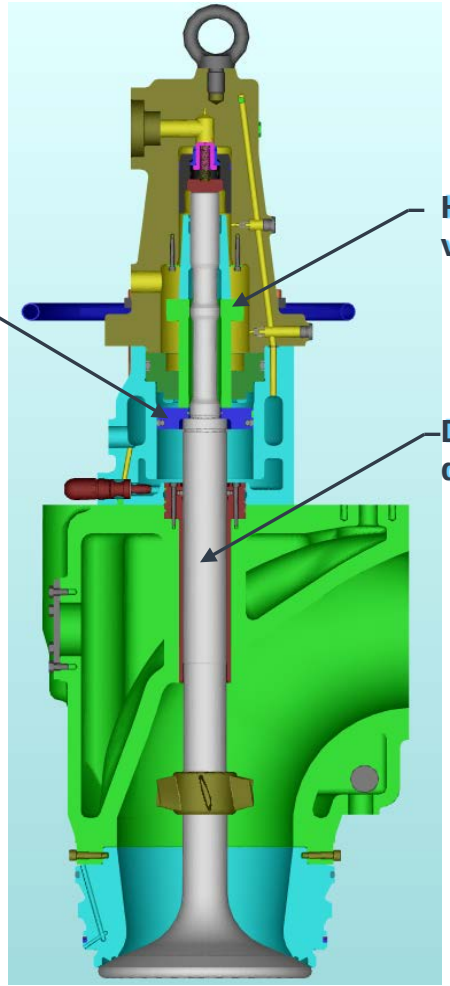
MAN

S50MC-C



Air spring size for closing the exhaust valve reduced

S50ME-C



Hydraulic damper for fixed valve stroke

Different valve spindle design

Exhaust Valve Actuation, MC versus ME.

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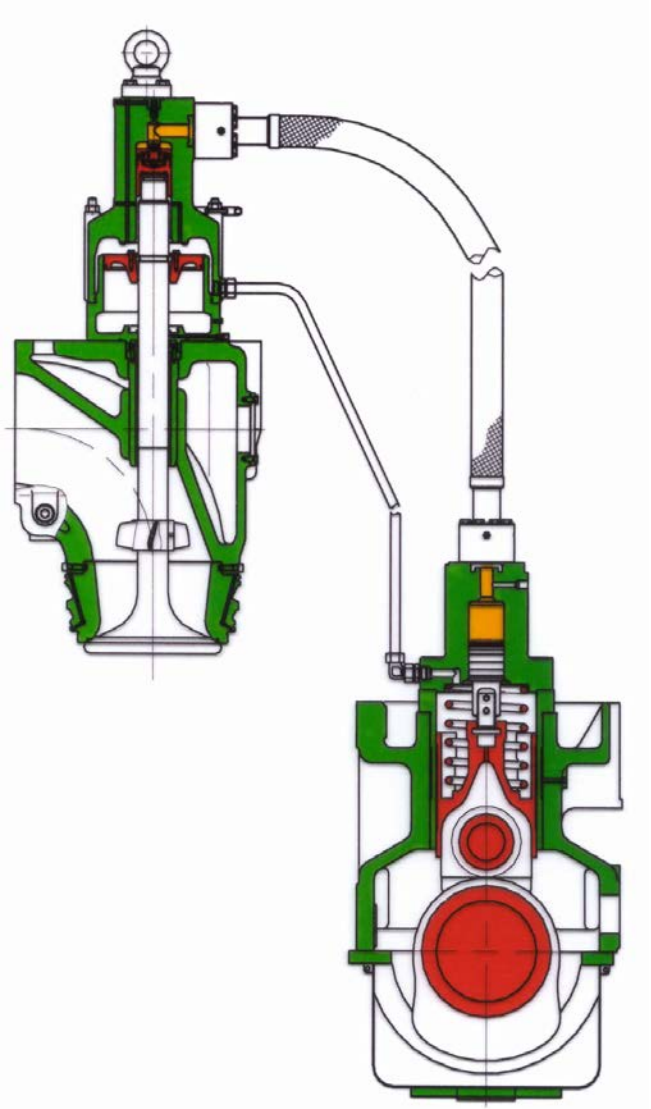
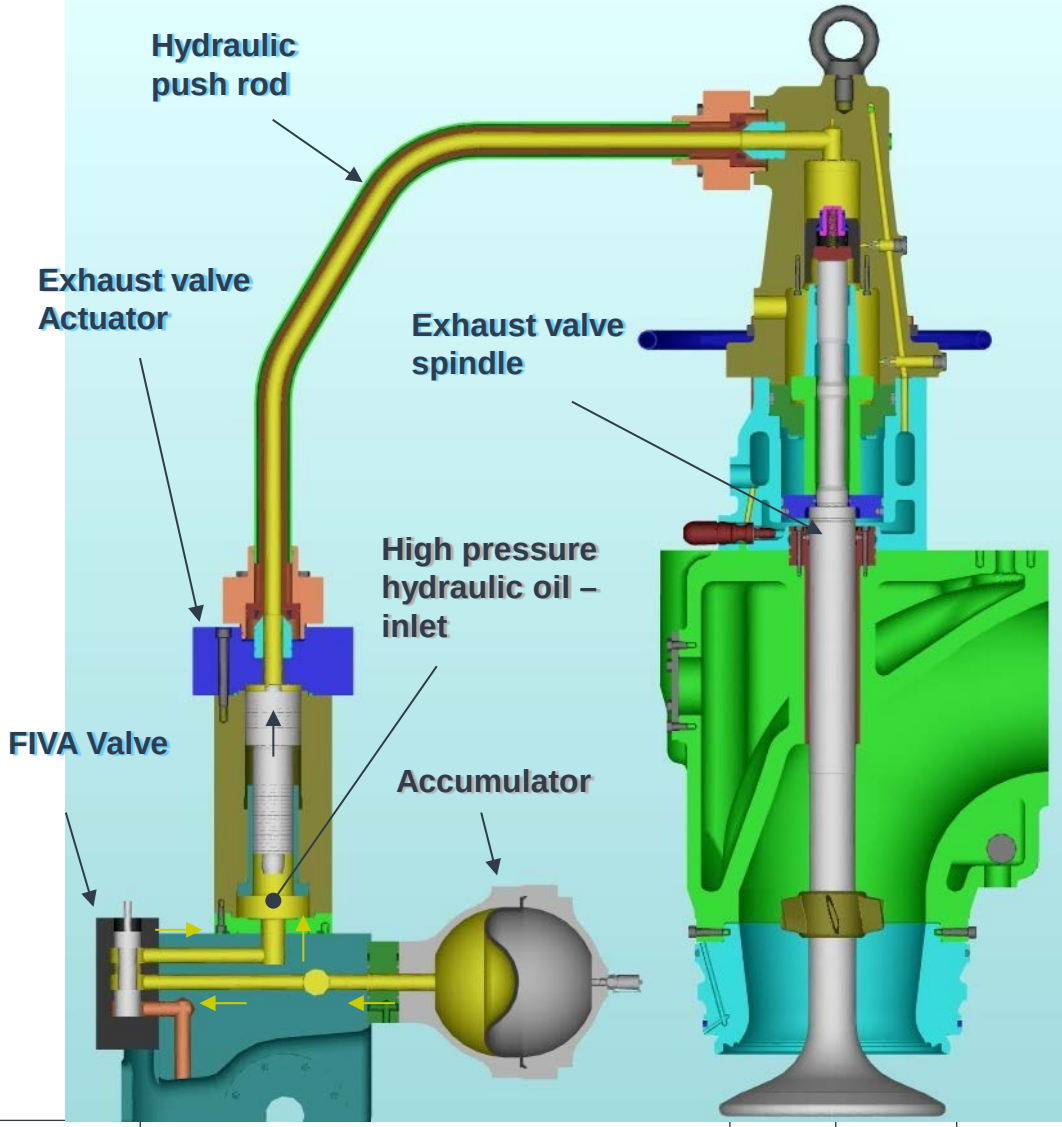
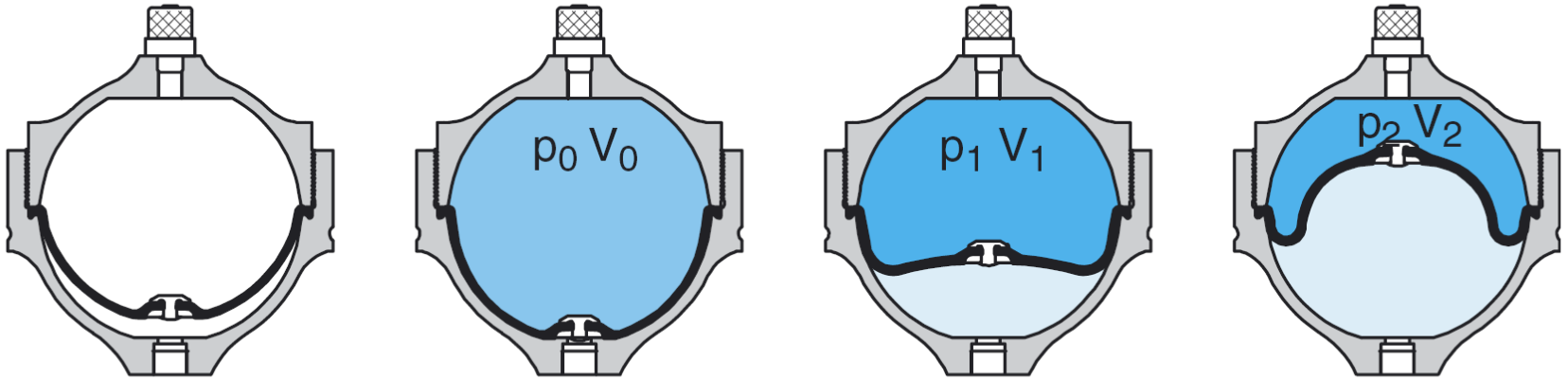




Accumulator

Diaphragm, Working Principle



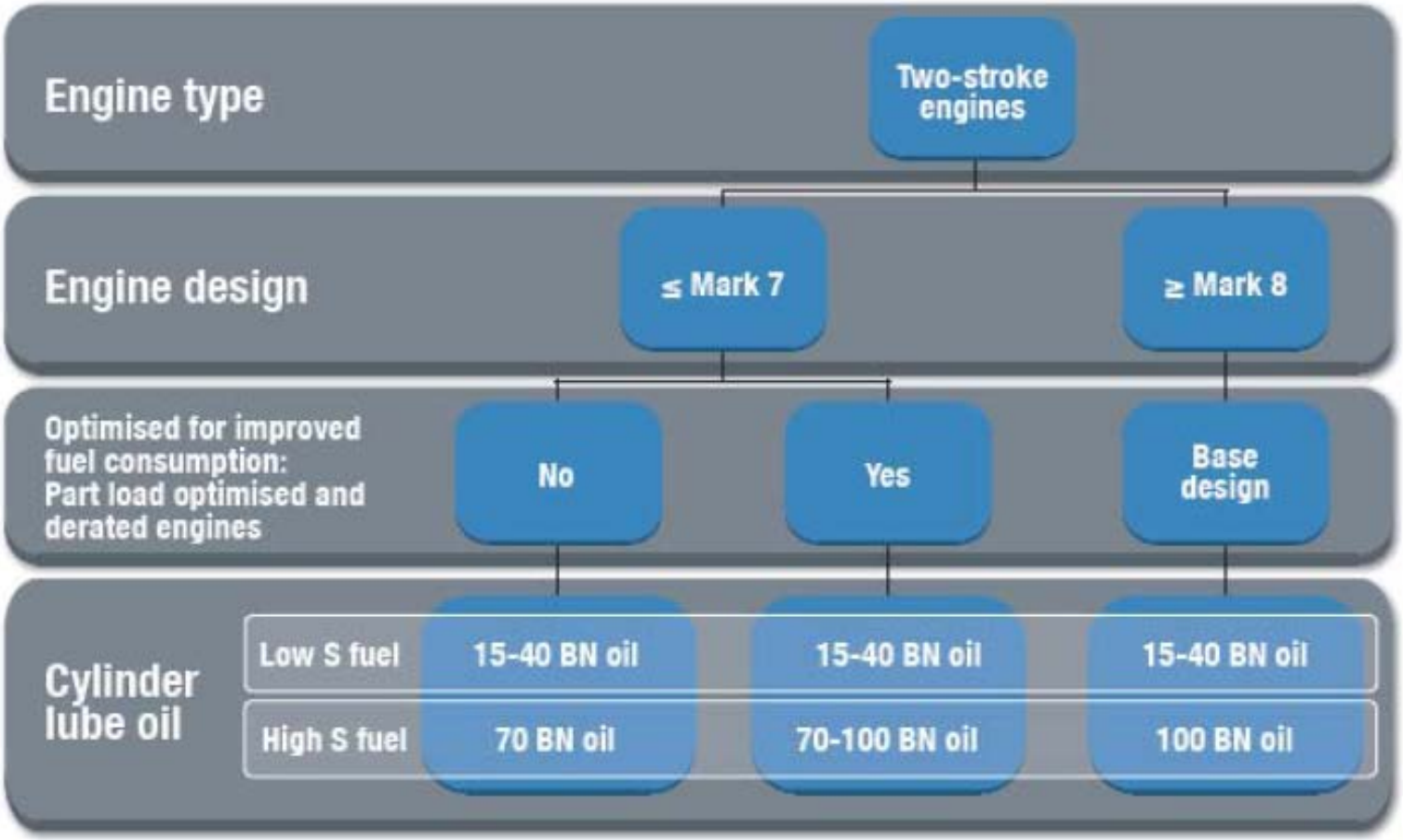
WARNING

To protect the accumulator from unnecessary stresses (fast accelleration 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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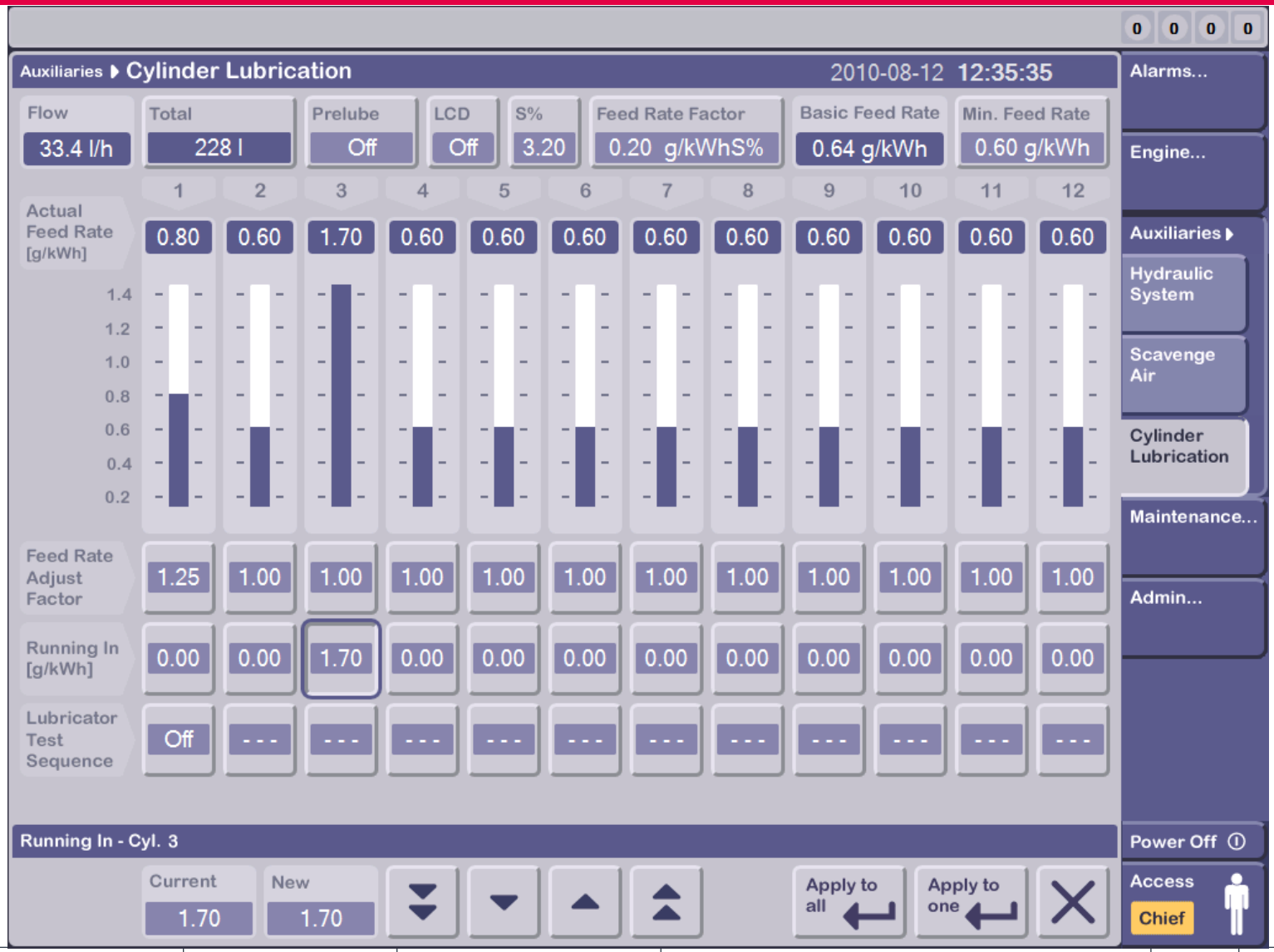

Feed Rate Sweep

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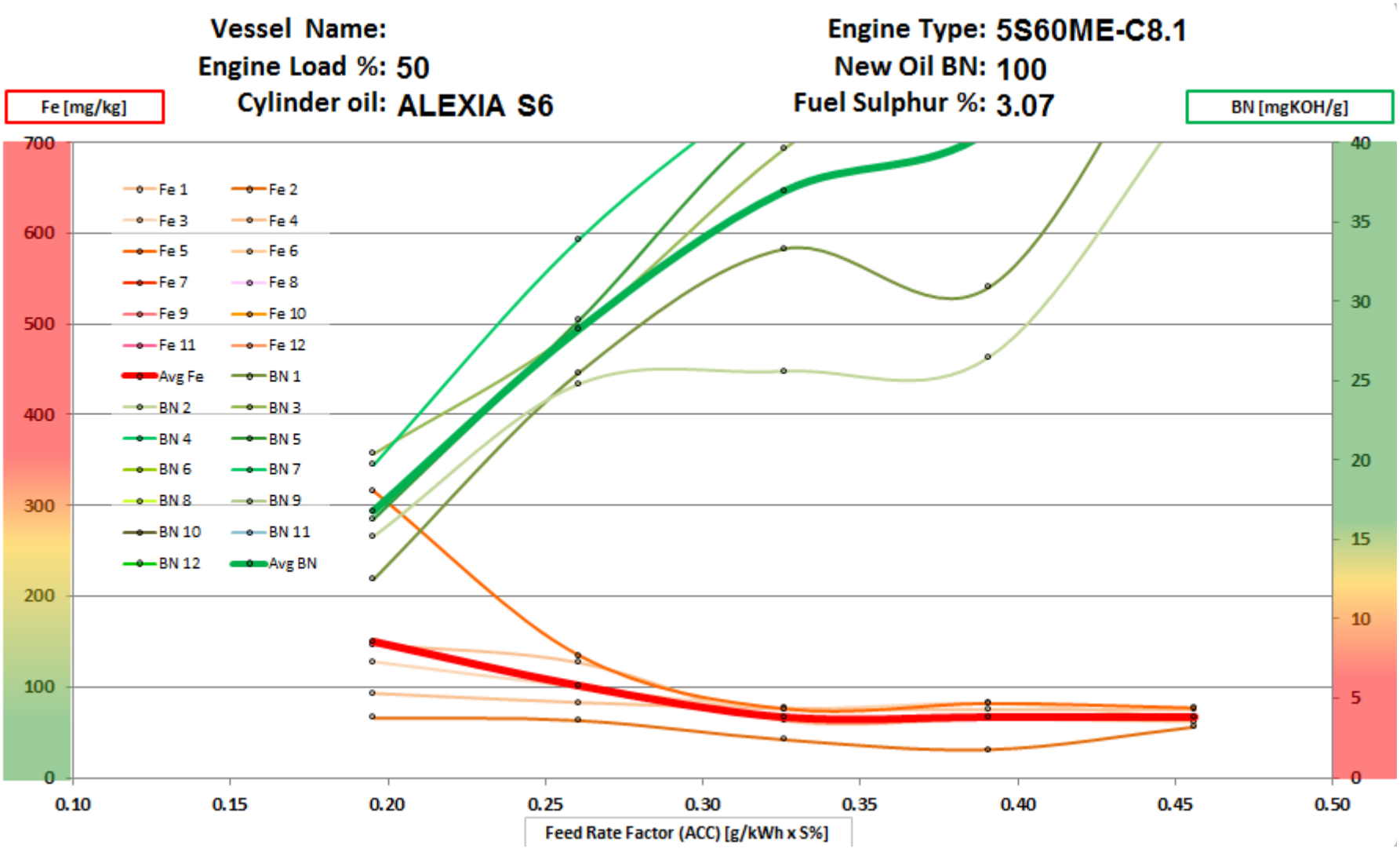
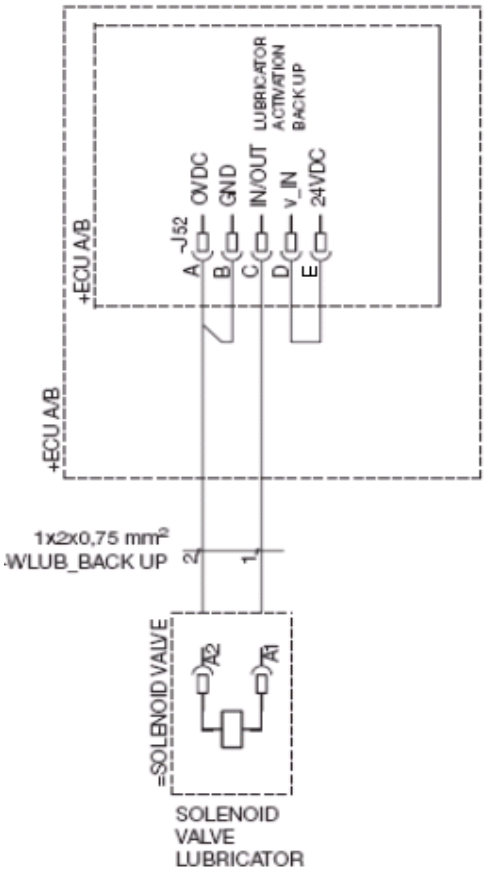
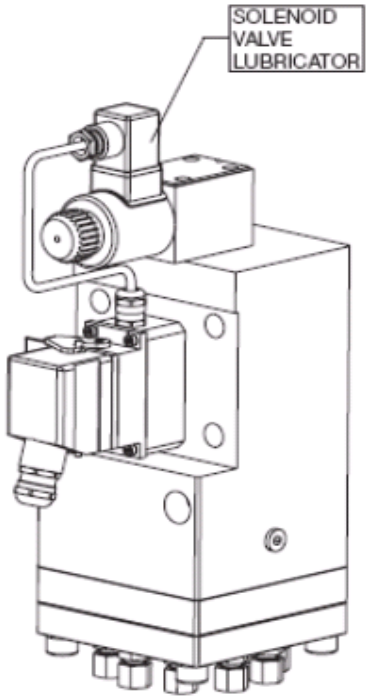


Cylinder Lubrication Back up





- ✓ 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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Engine: Status

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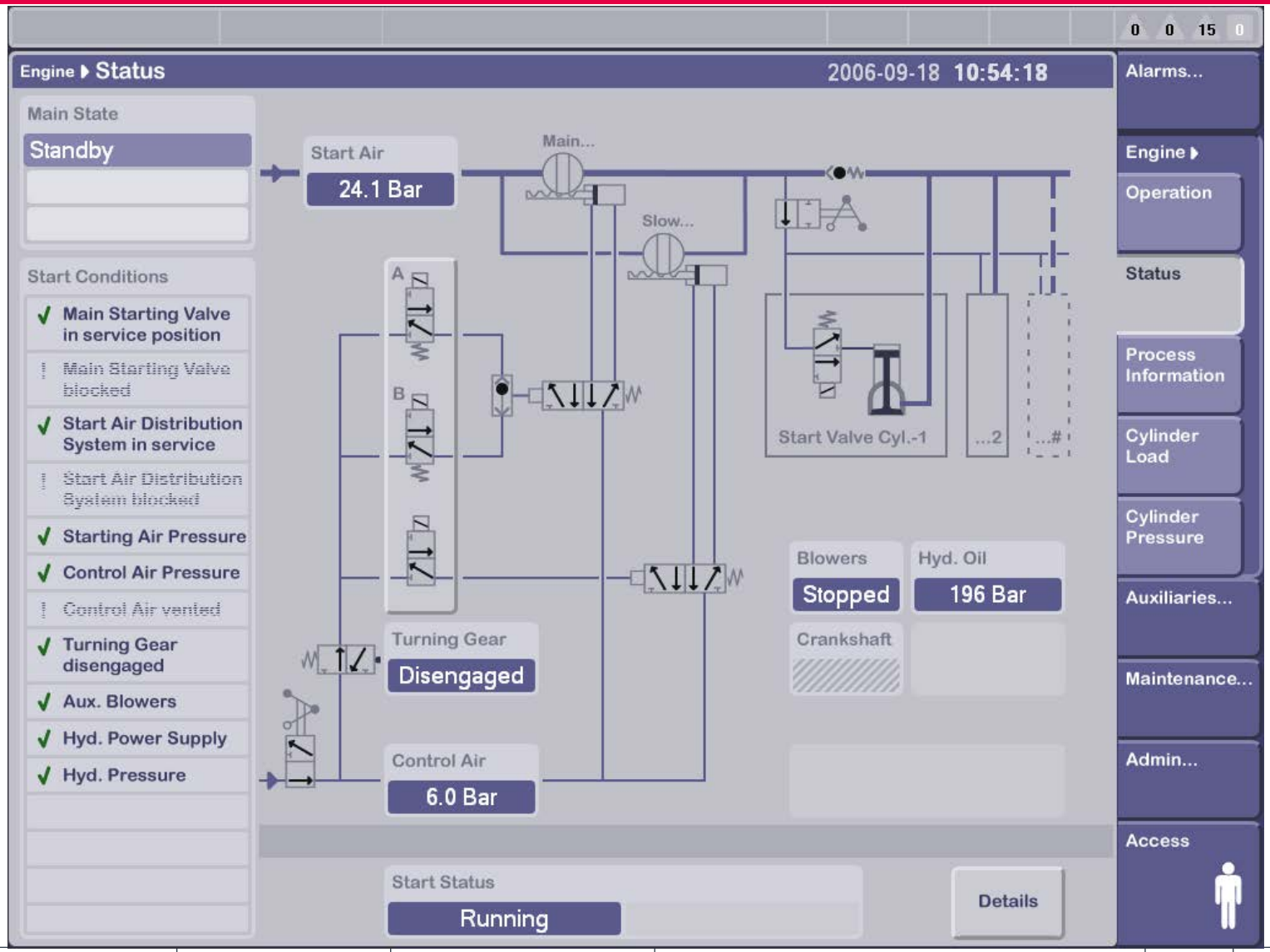

Engine: Process Information Running Mode

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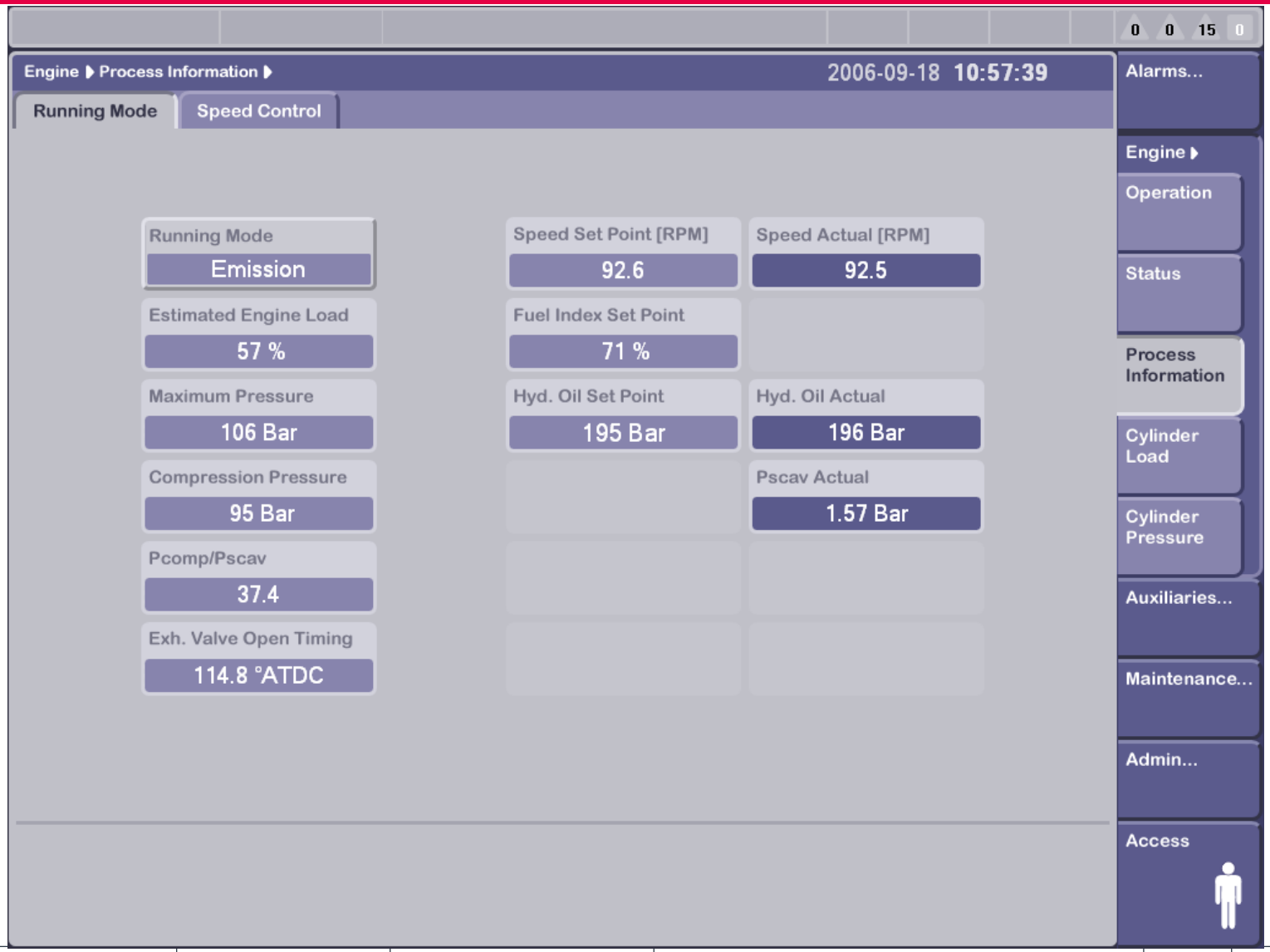

Engine: Process Information Running Mode

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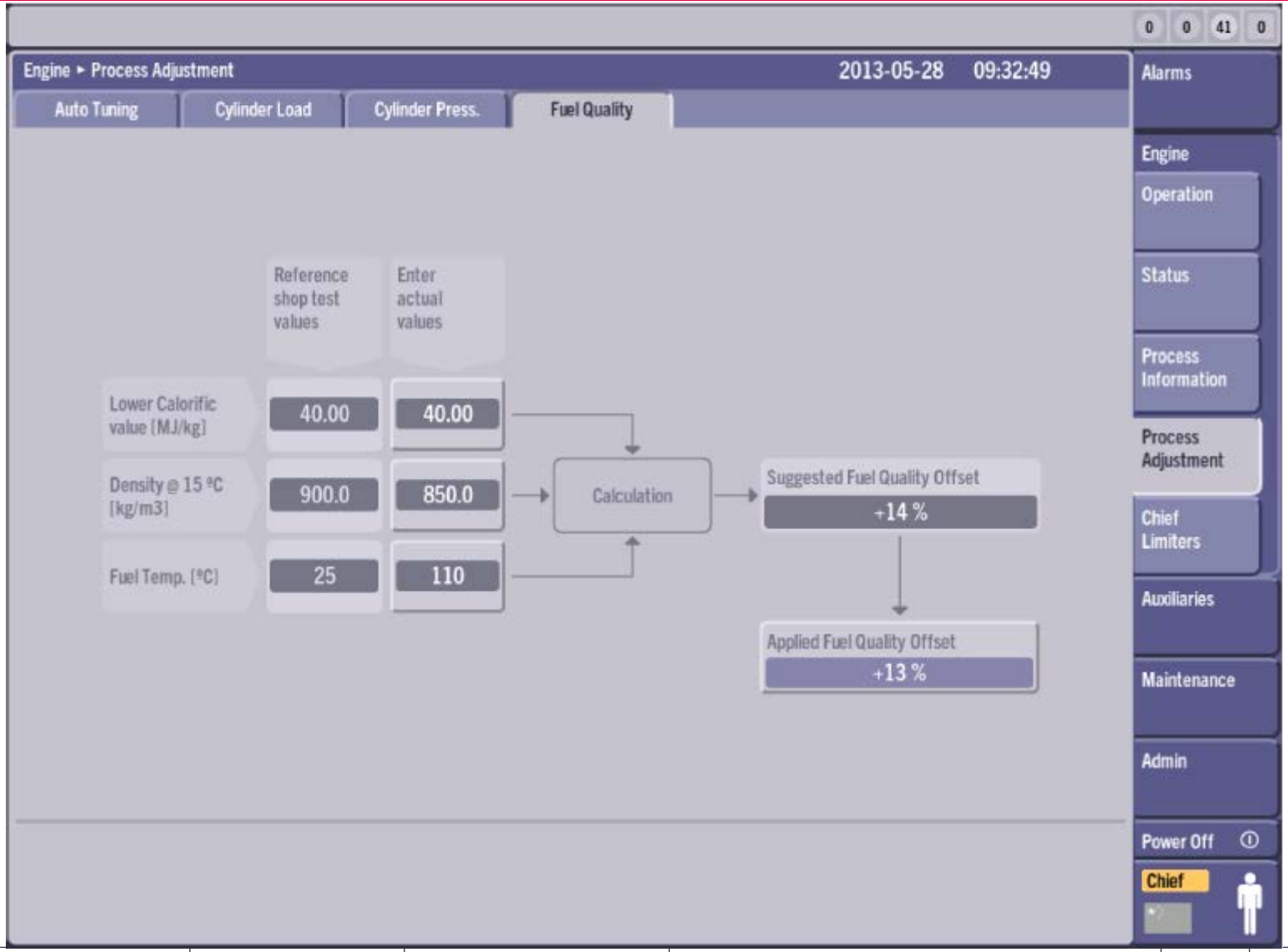

Engine: Process Adjustment Pressures

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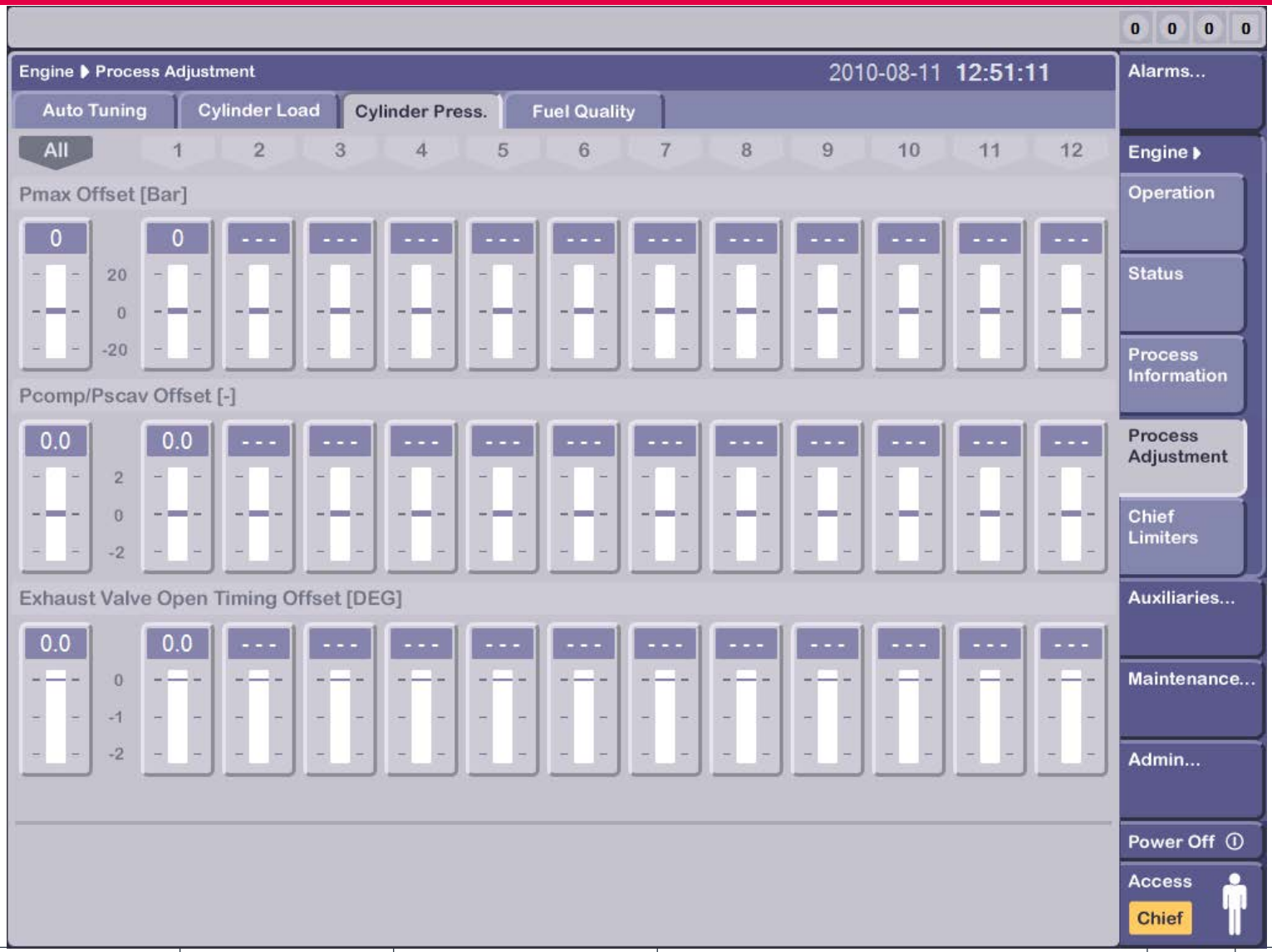

Engine: Process Adjustment Pressures

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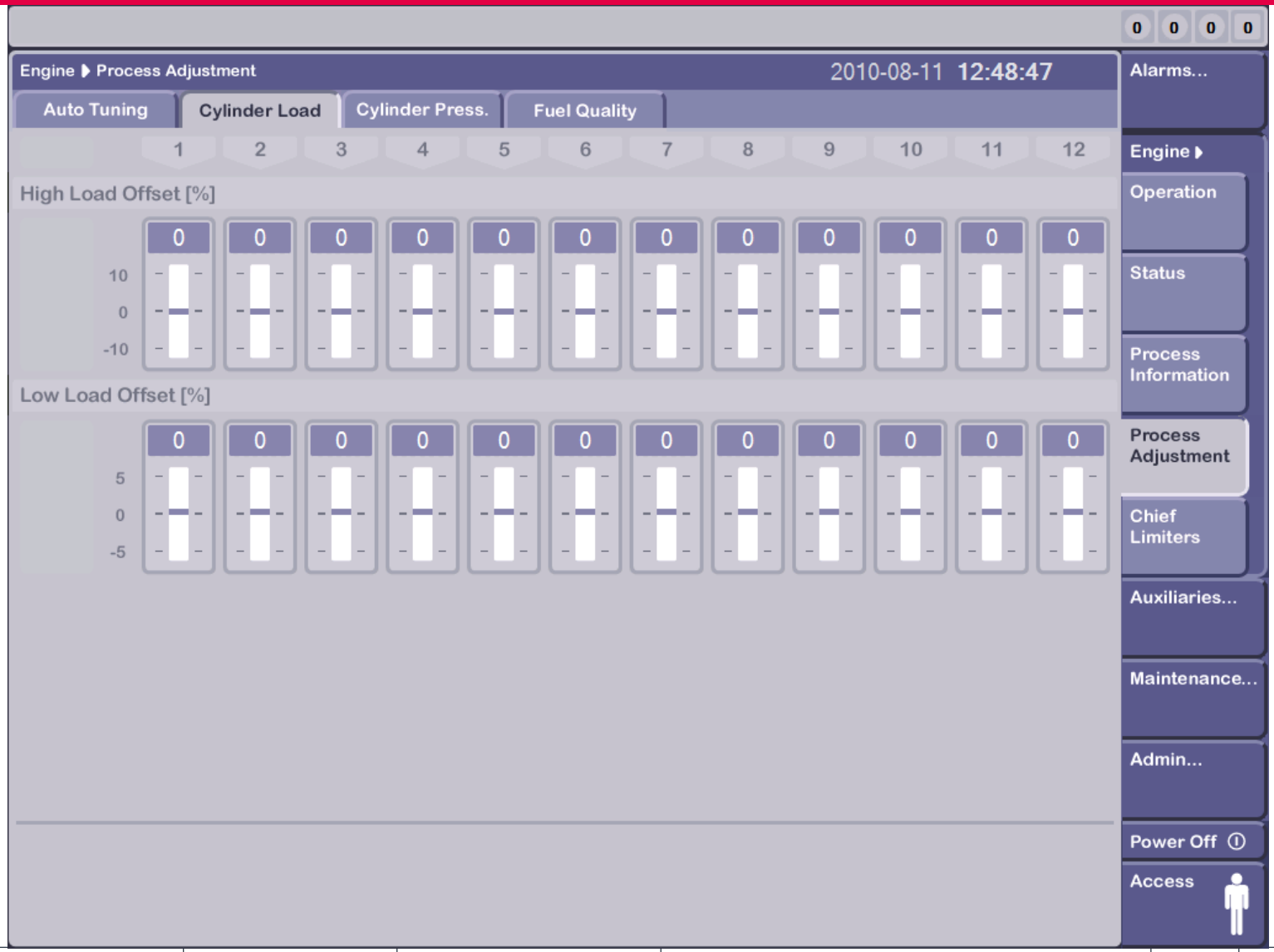

Engine:
Chief Limiters

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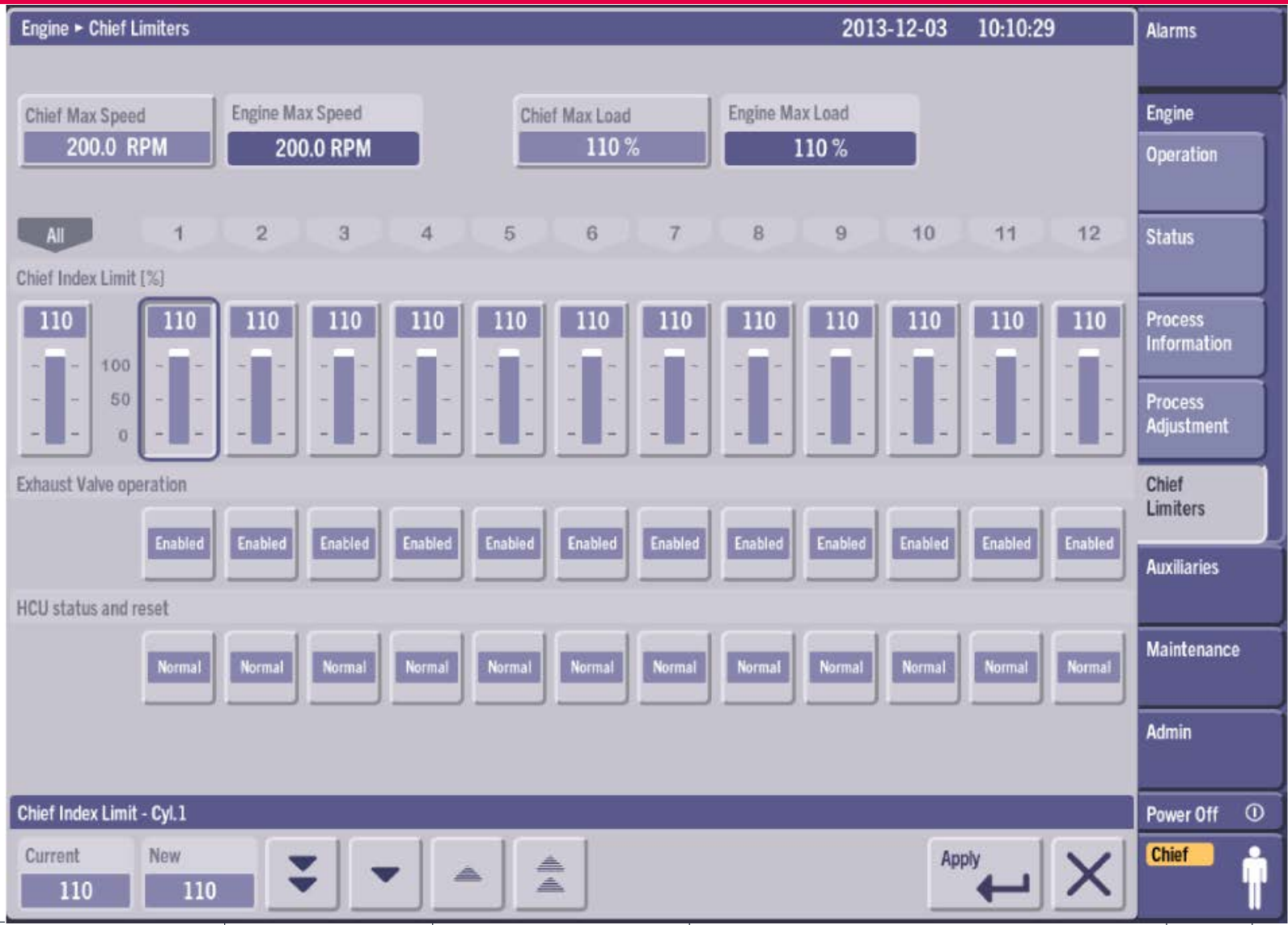

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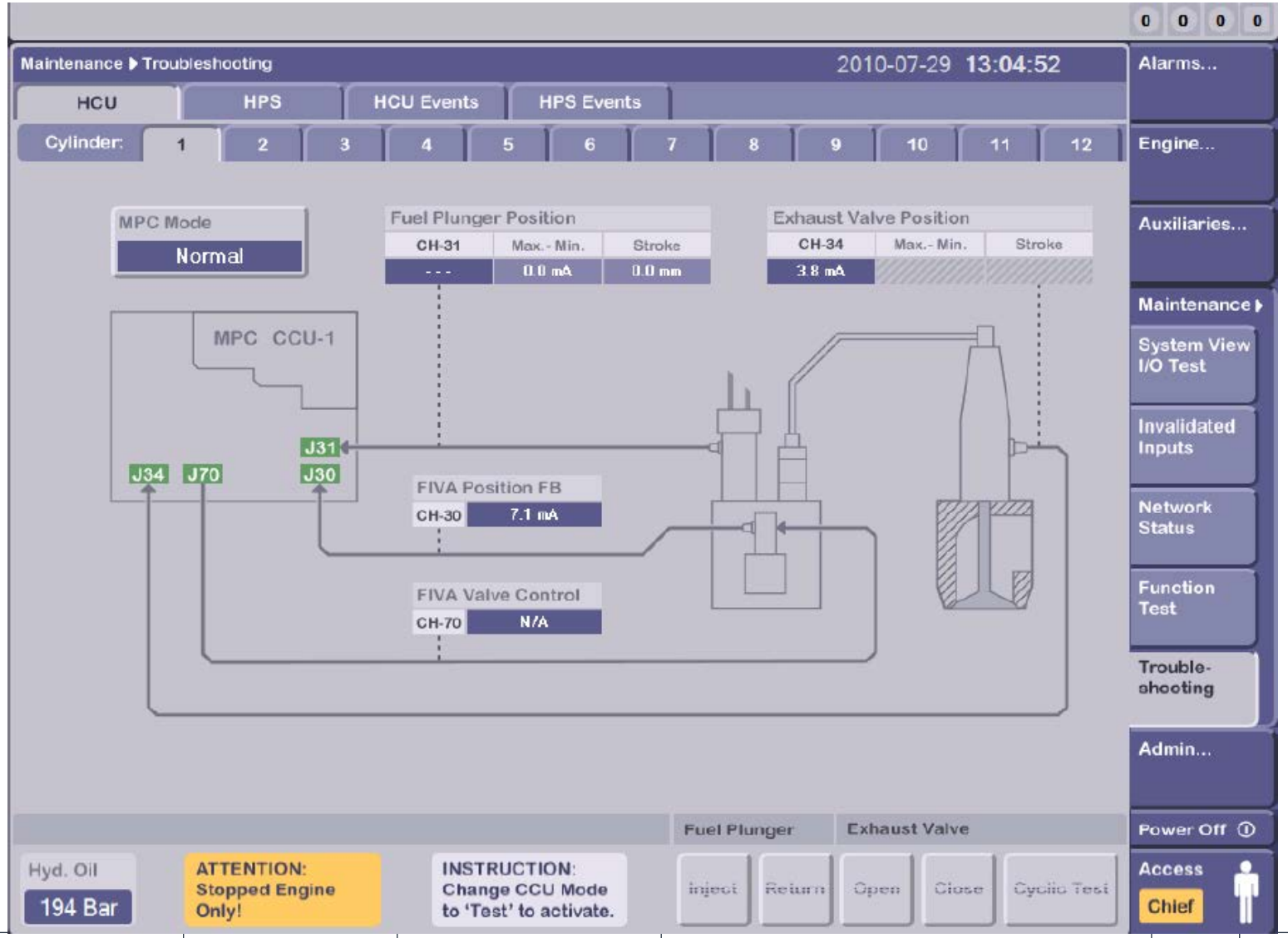
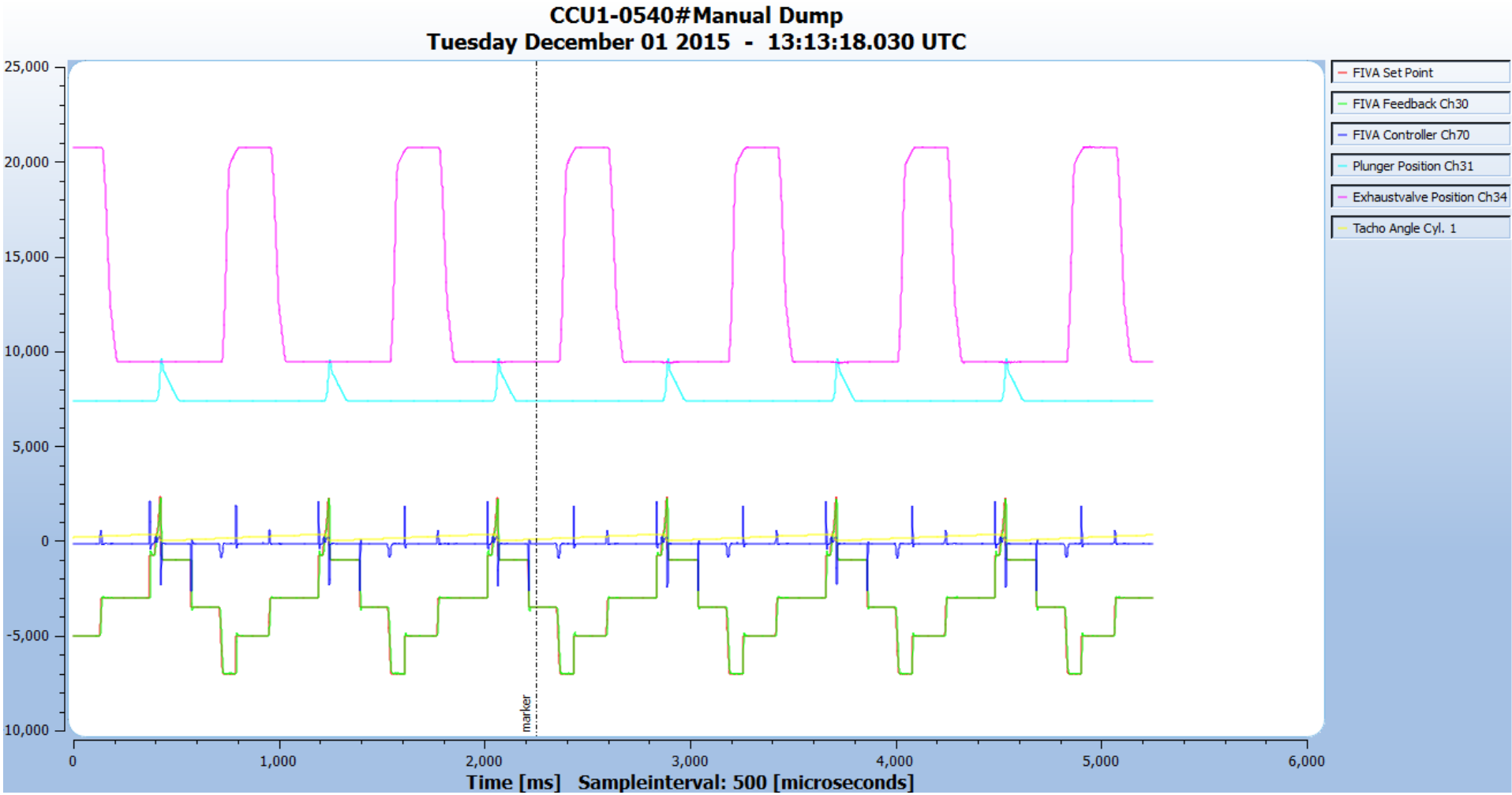


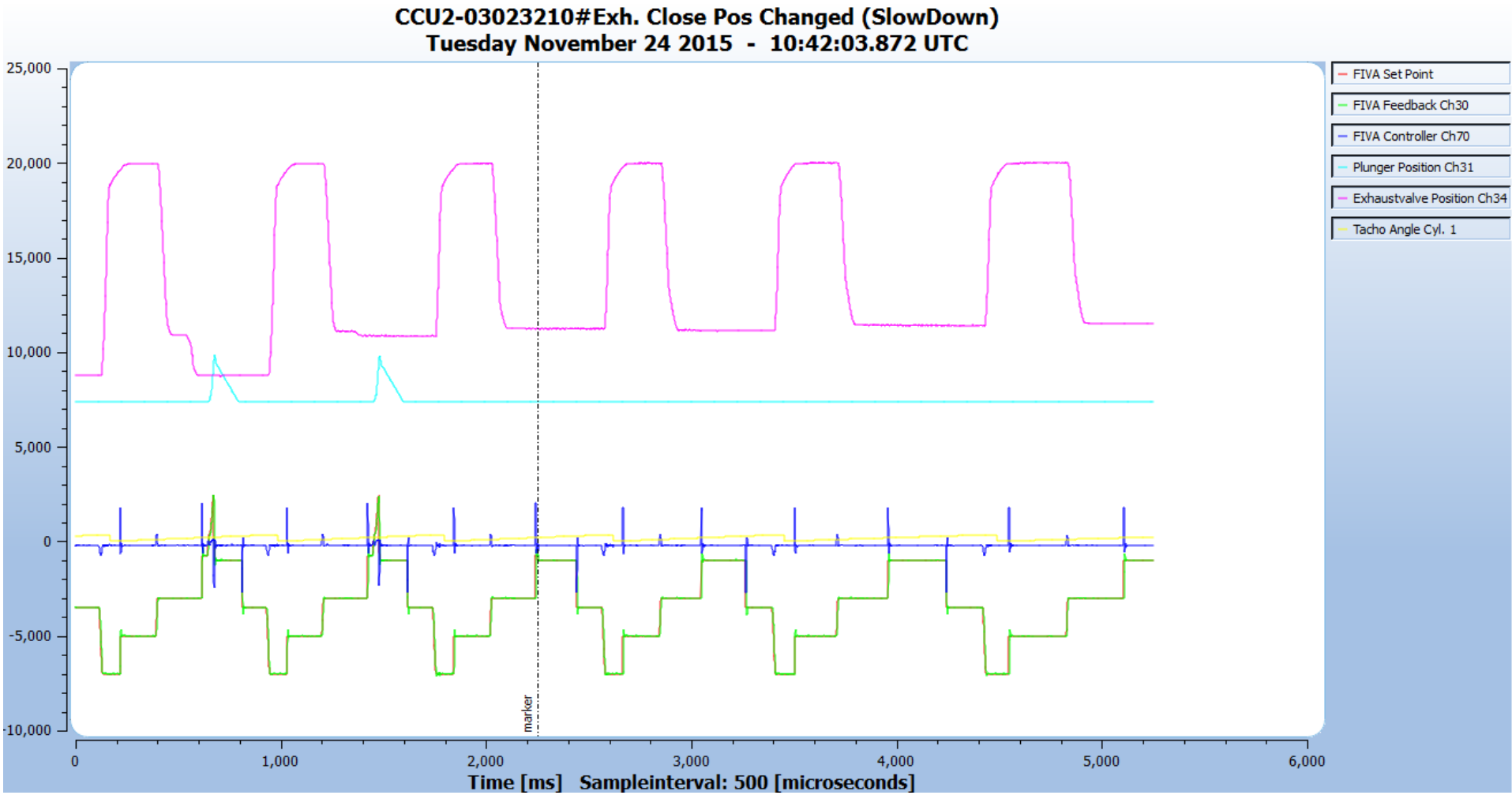
Maintenance: Troubleshooting HCU Events

MAN Diesel & Turbo Hellas
50 years Engine the MANkind



Maintenance: Troubleshooting HCU Events

MAN Diesel & Turbo Hellas
50 years Engine the MANkind



Maintenance:
Troubleshooting HCU Events

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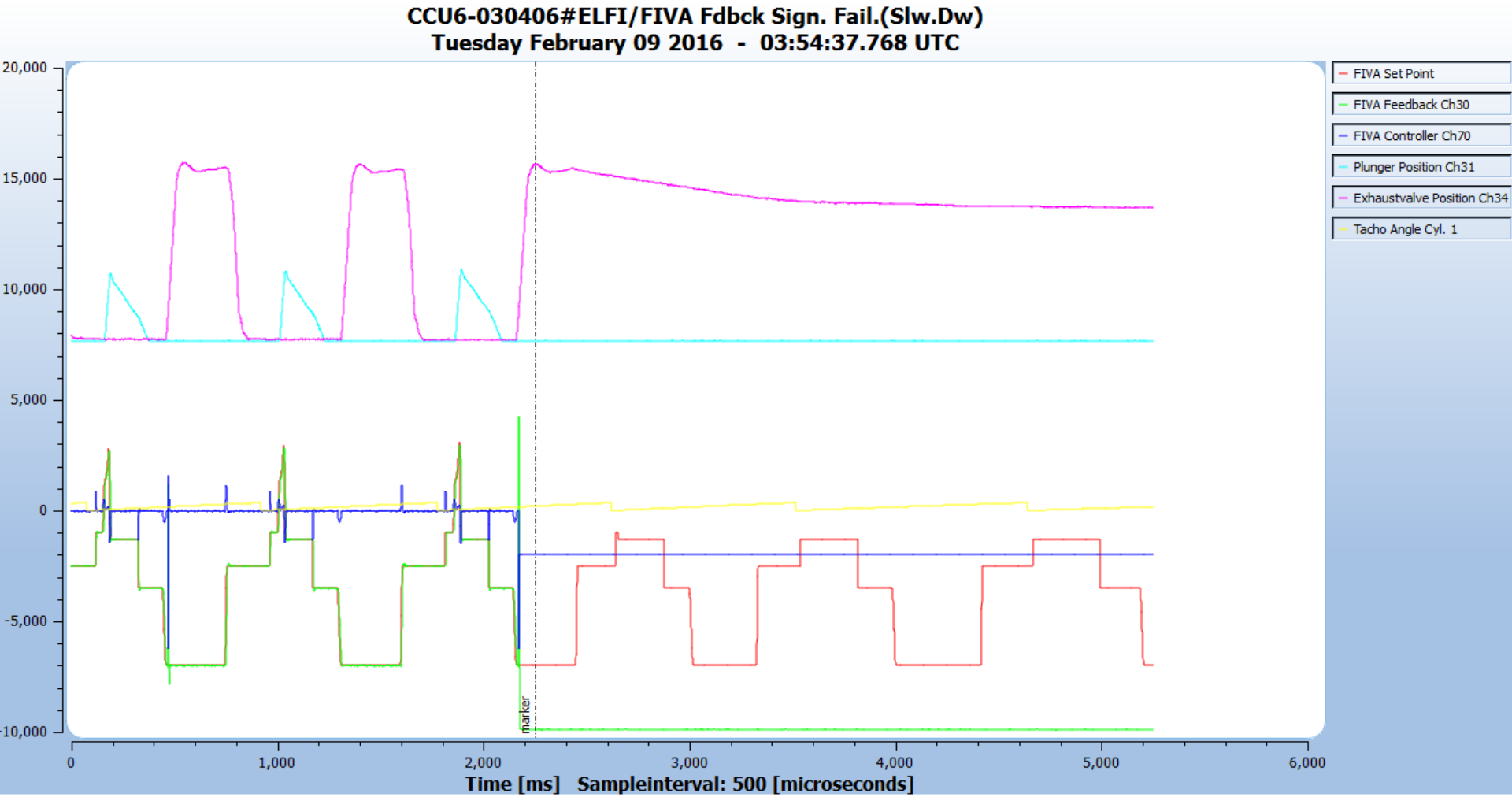

Admin.: Version

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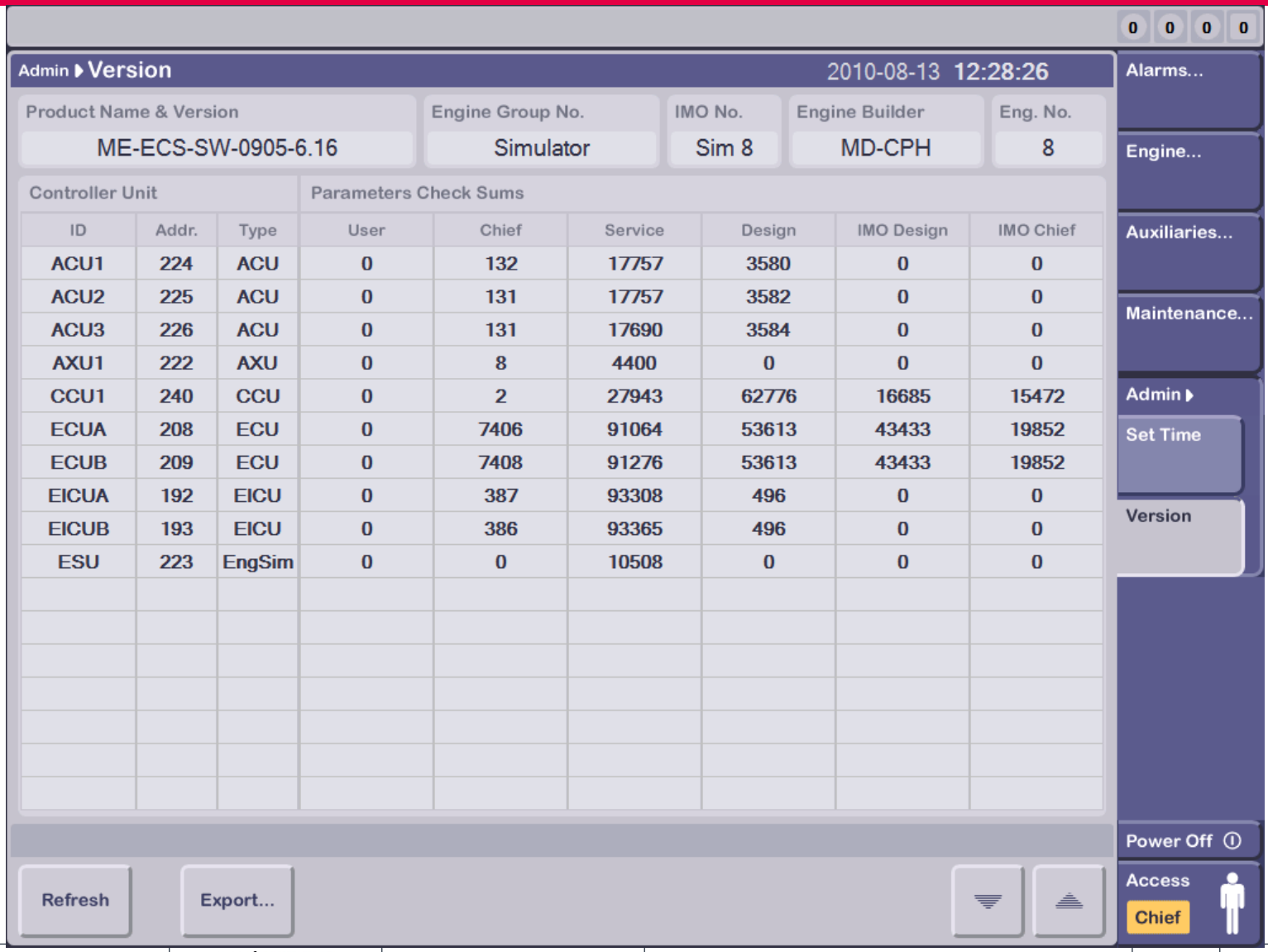
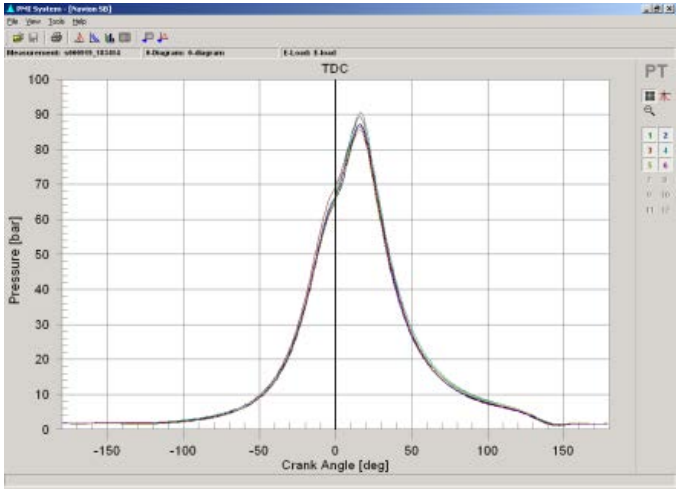
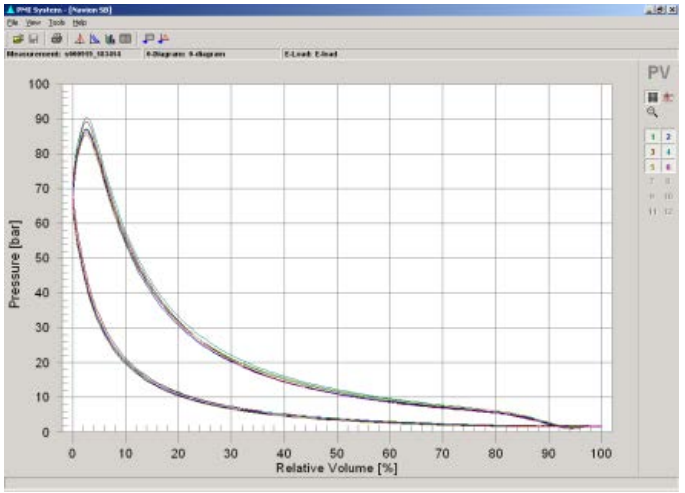


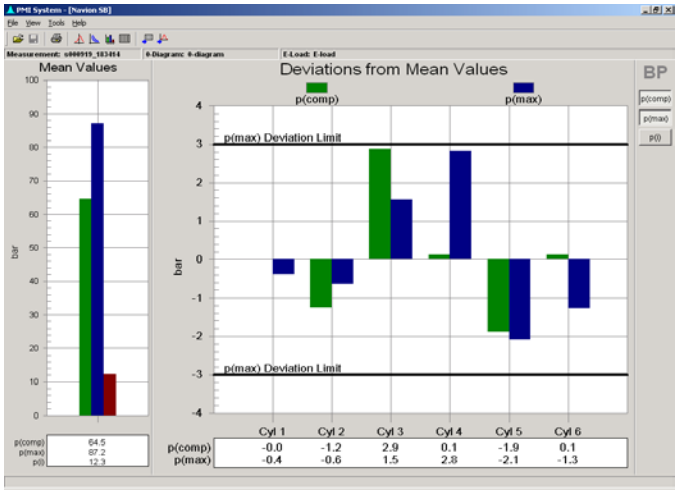
Product Name & Version	Engine Group No.	IMO No.	Engine Builder	Eng. No.
ME-ECS-SW-0905-6.16	Simulator	Sim 8	MD-CPH	8

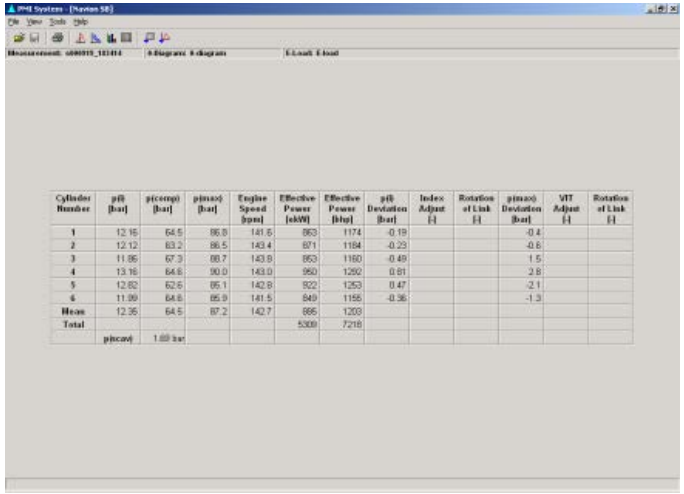
Controller Unit			Parameters Check Sums					
ID	Addr.	Type	User	Chief	Service	Design	IMO Design	IMO Chief
ACU1	224	ACU	0	132	17757	3580	0	0
ACU2	225	ACU	0	131	17757	3582	0	0
ACU3	226	ACU	0	131	17690	3584	0	0
AXU1	222	AXU	0	8	4400	0	0	0
CCU1	240	CCU	0	2	27943	62776	16685	15472
ECUA	208	ECU	0	7406	91064	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

PMI system



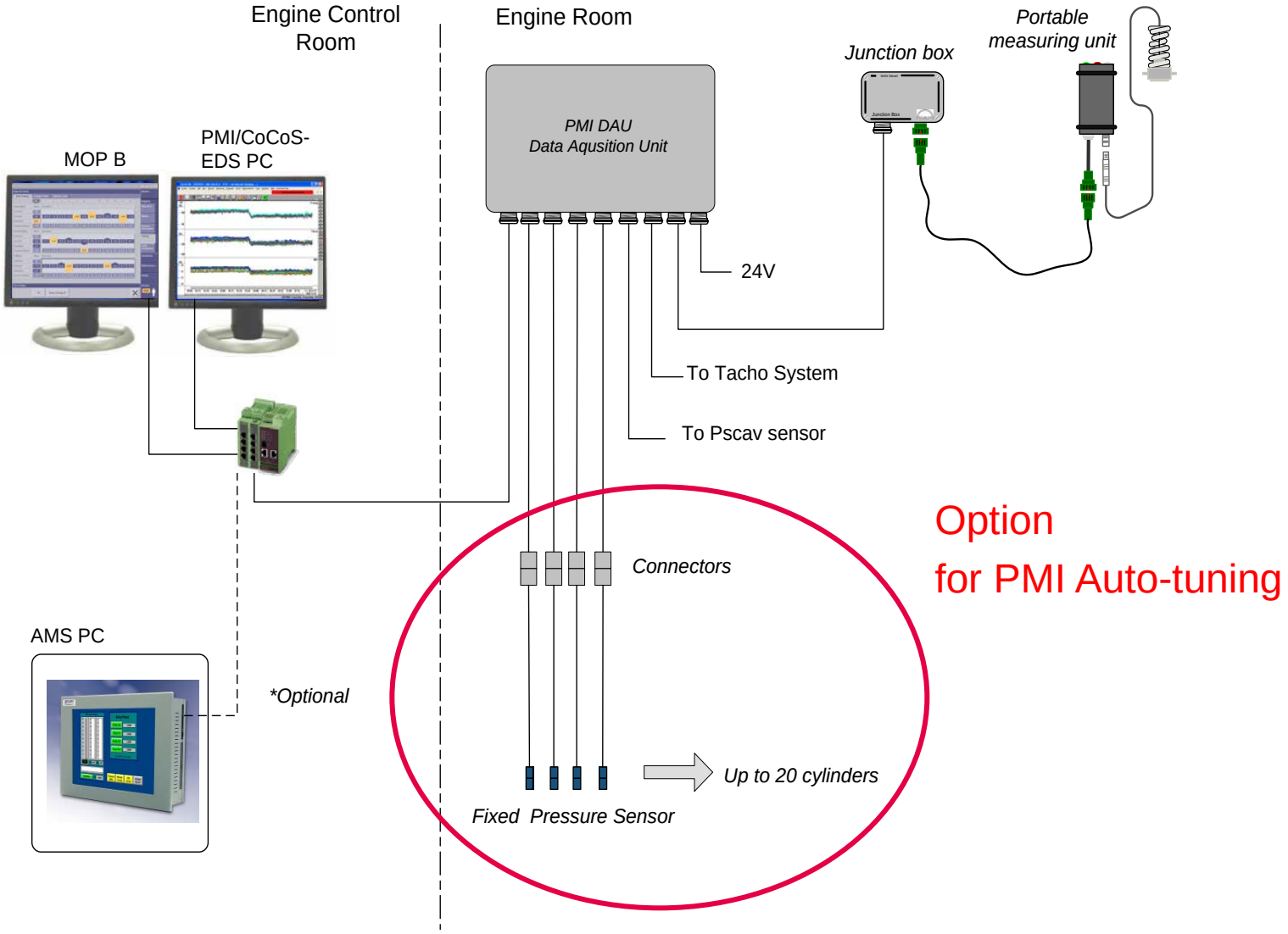






Cylinder Number	pfi [bar]	p(comp) [bar]	p(max) [bar]	Engine Speed [rpm]	Effective Power [kW]	Effective Power [bhp]	pfi Deviation [bar]	Index Adjust [-]	Rotation of Link [-]	p(max) Deviation [bar]	VIT Adjust [-]	Rotation of Link [-]
1	12.16	64.5	86.8	141.6	863	1174	-0.19			-0.4		
2	12.12	63.2	86.5	143.4	871	1184	-0.23			-0.6		
3	11.86	67.3	88.7	143.8	863	1160	-0.49			1.5		
4	13.16	64.8	90.0	143.0	950	1292	0.81			2.8		
5	12.82	62.6	85.1	142.8	922	1253	0.47			-2.1		
6	11.99	64.8	85.9	141.5	849	1155	-0.36			-1.3		
Mean	12.35	64.5	87.2	142.7	886	1203						
Total					5309	7218						
	pmcavi	1.69 bar										

PMI system


Engine Control Room
Engine Room
MOP B
PMI/CoCoS-EDS PC
PMI DAU
Data Aqusition Unit
Junction box
Portable measuring unit
24V
To Tacho System
To Pscav sensor
Connectors
AMS PC
*Optional
Up to 20 cylinders
Fixed Pressure Sensor
Option
for PMI Auto-tuning

PMI Auto-tuning
The new DAU 11 computer

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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

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