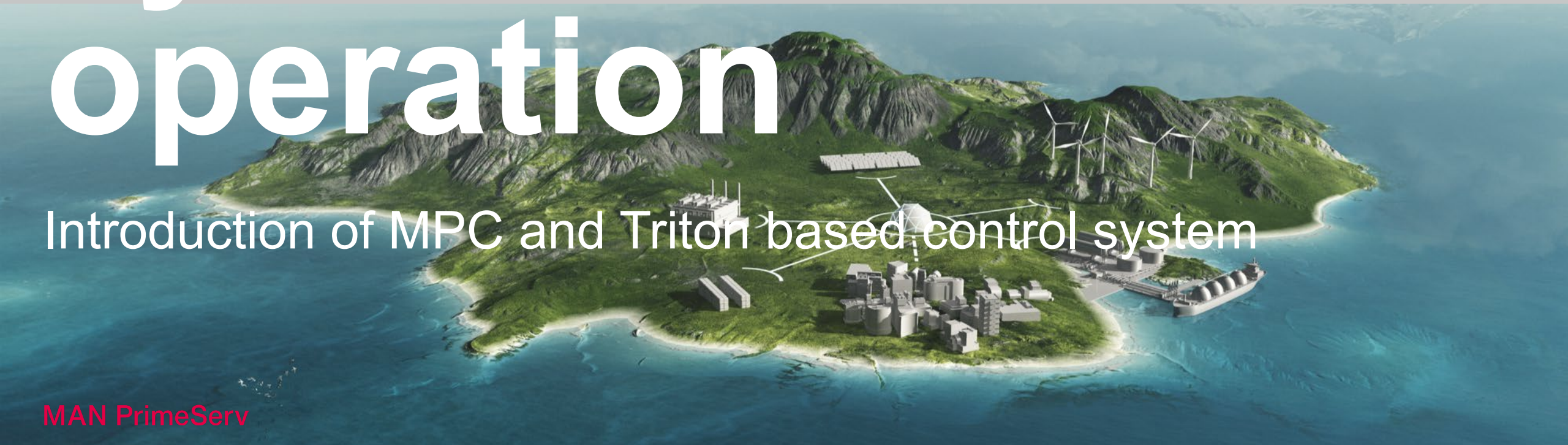
MAN Energy Solutions
Future in the making

ME-C control system standard operation

Introduction of MPC and Triton based control system



MAN PrimeServ

Learning objectives

Upon completion of this module you …

– will be able to recognize the various components in the systems.

– will be able to explain the build up of the control systems.

Agenda

ME-C control system standard operation

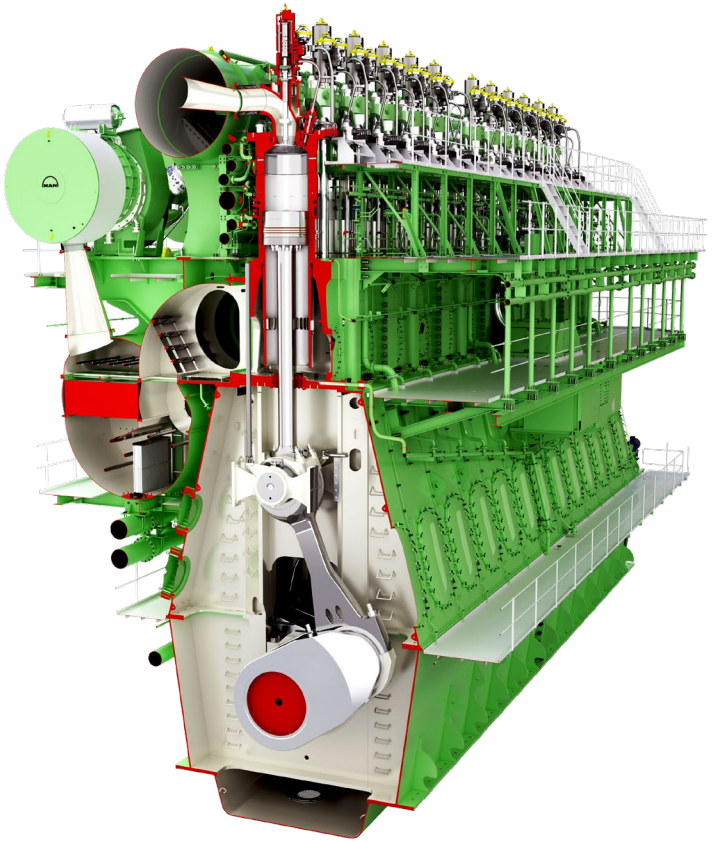
1 ME-C engine introduction

2 **Engine Control System (ECS)**

- Multi Purpose Controller (MPC)
- Pneumatic system
- Triton controller

ME-C engine introduction

Engine type designation



Engine type designation

5G70ME-C10.5-GI-EGRBP

- **Tier III technology**
  - (blank) Tier II only
  - EGRBP EGR with bypass matching
  - EGRTC EGR with TC cut-out matching
  - EcoEGR EGR in Tier II and Tier III mode
  - HPSCR High-pressure SCR
  - LPSCR Low-pressure SCR
  - W Water in methanol
- **Fuel injection concept**
  - (blank) Fuel oil only
  - GI/GA Gas injection/gas admission methane
  - GIE Gas injection ethane
  - LGIM Liquid gas injection methanol
  - LGIP Liquid gas injection LPG
- **Dot (.) number**
- **Mark number**
- **Engine concept**
  - ME-C Electronically controlled
  - ME-B Exhaust valve controlled by camshaft
- **Diameter of cylinder bore in cm**
- **Stroke/bore ratio**
  - G ‘Green’ ultra long stroke
  - S Super long stroke
- **Number of cylinders**

ME-C engine introduction

Main electronic and hydraulic components

Hydraulic Power Supply (HPS)

- Automatic backflush filter
- Electrical start up pumps
- Engine driven pumps

Hydraulic Cylinder Unit (HCU)

- Distribution block
- Double wall pipe (200 bar)
- FIVA / ELFI & ELVA and accumulator
- FOPB
- Exhaust valve actuator
- ME lubricator

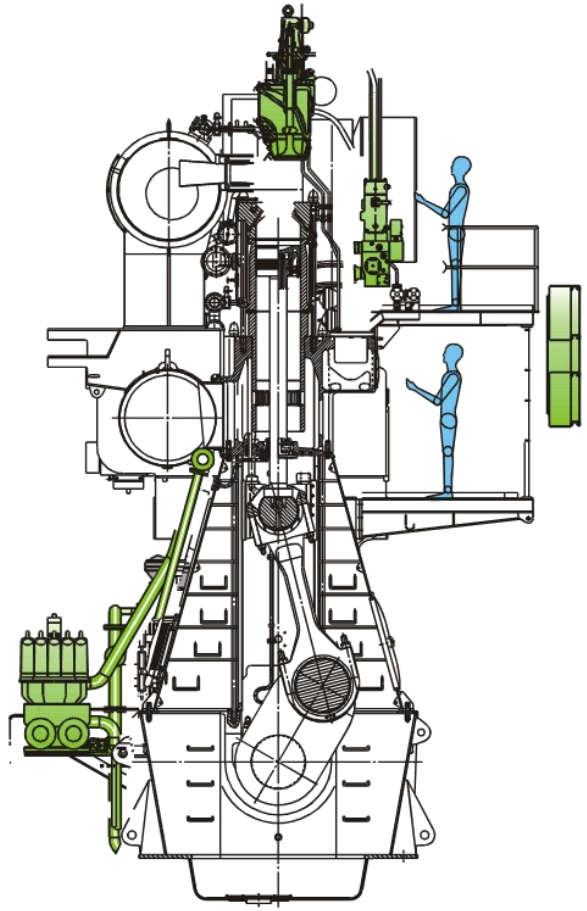
Engine Control System (ECS)

- MPCs and MOP´s

Crankshaft position sensing system (Tacho)

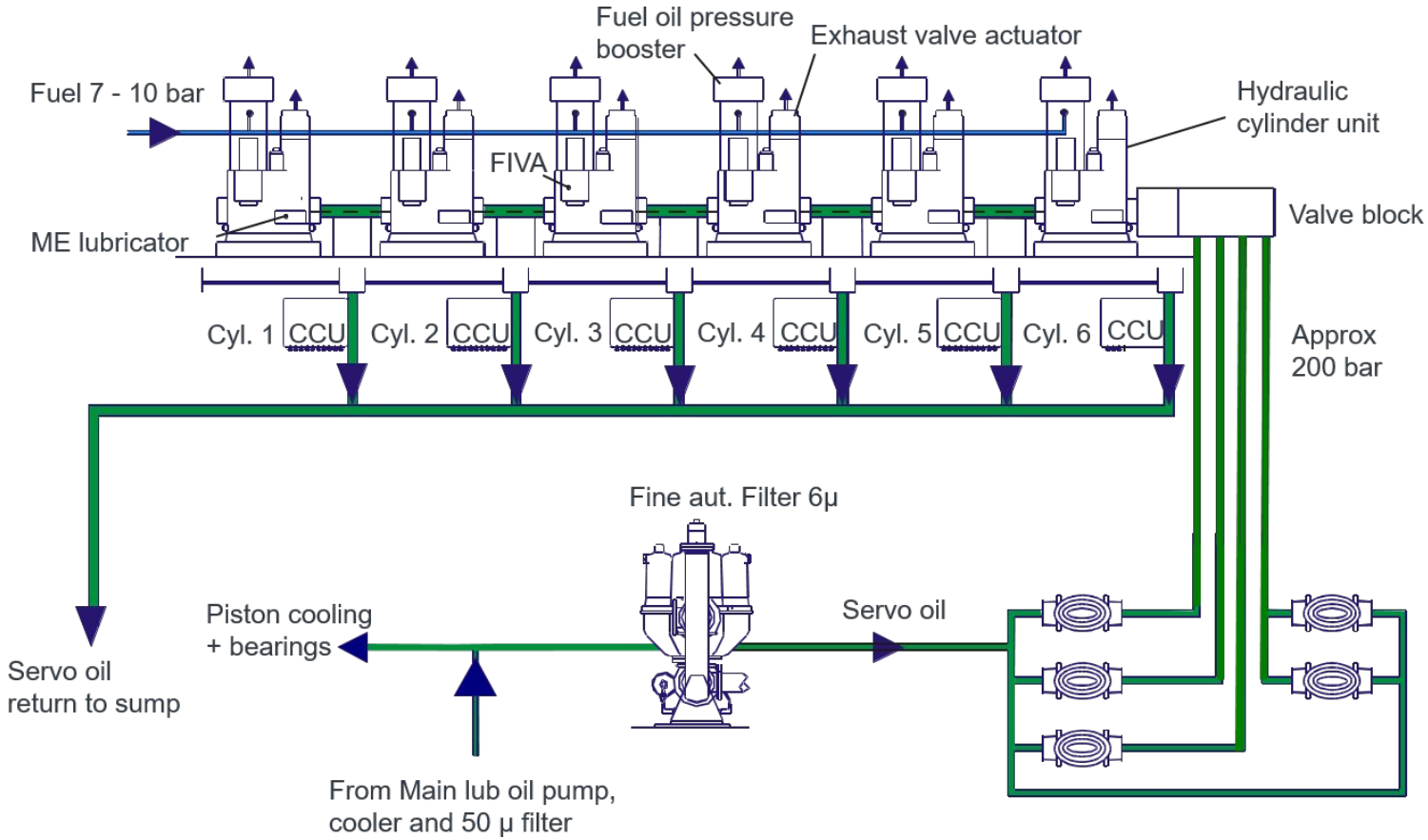
- Encoder A & B

Local Operation Panel (LOP)



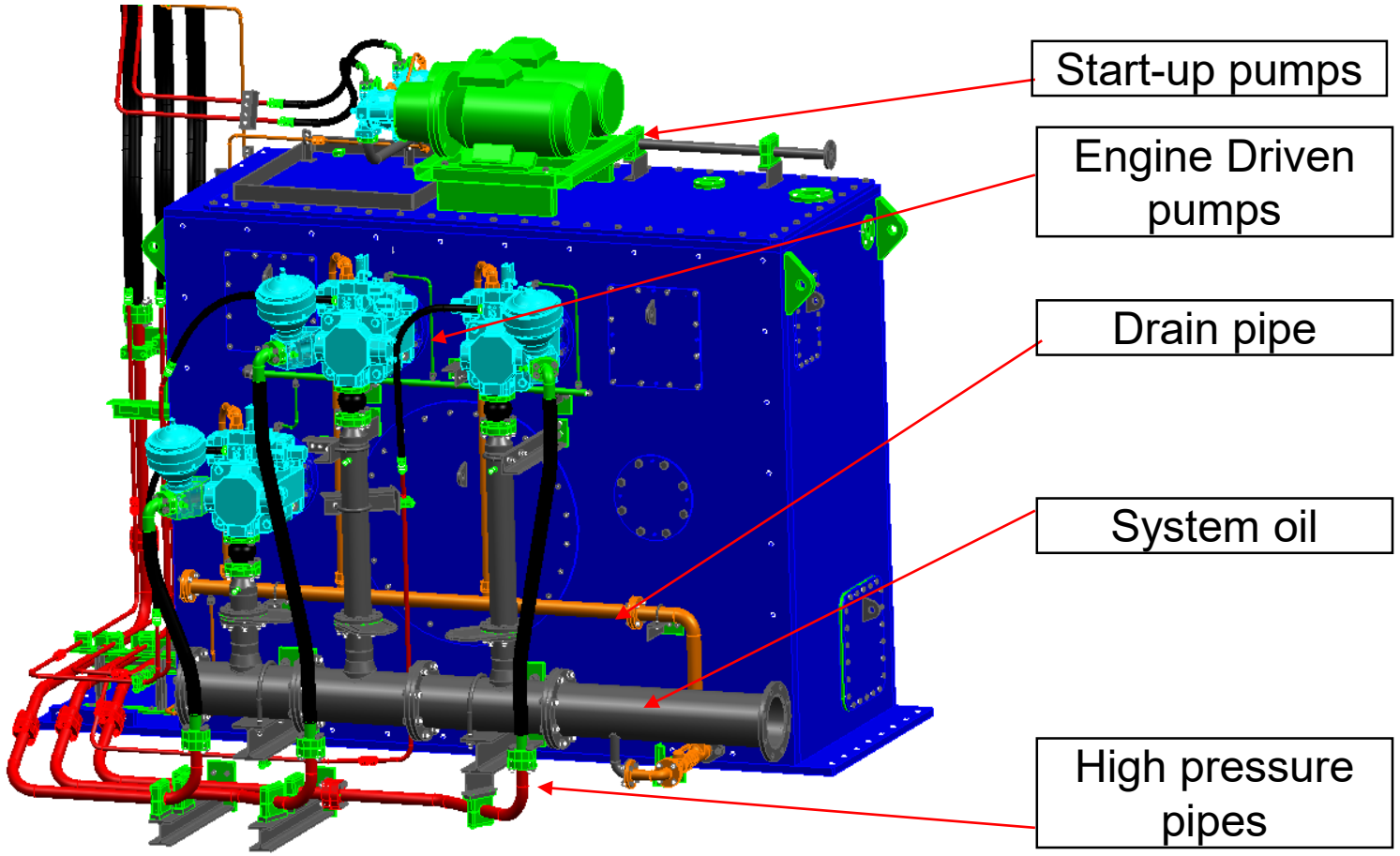
ME-C engine introduction

Hydraulic system



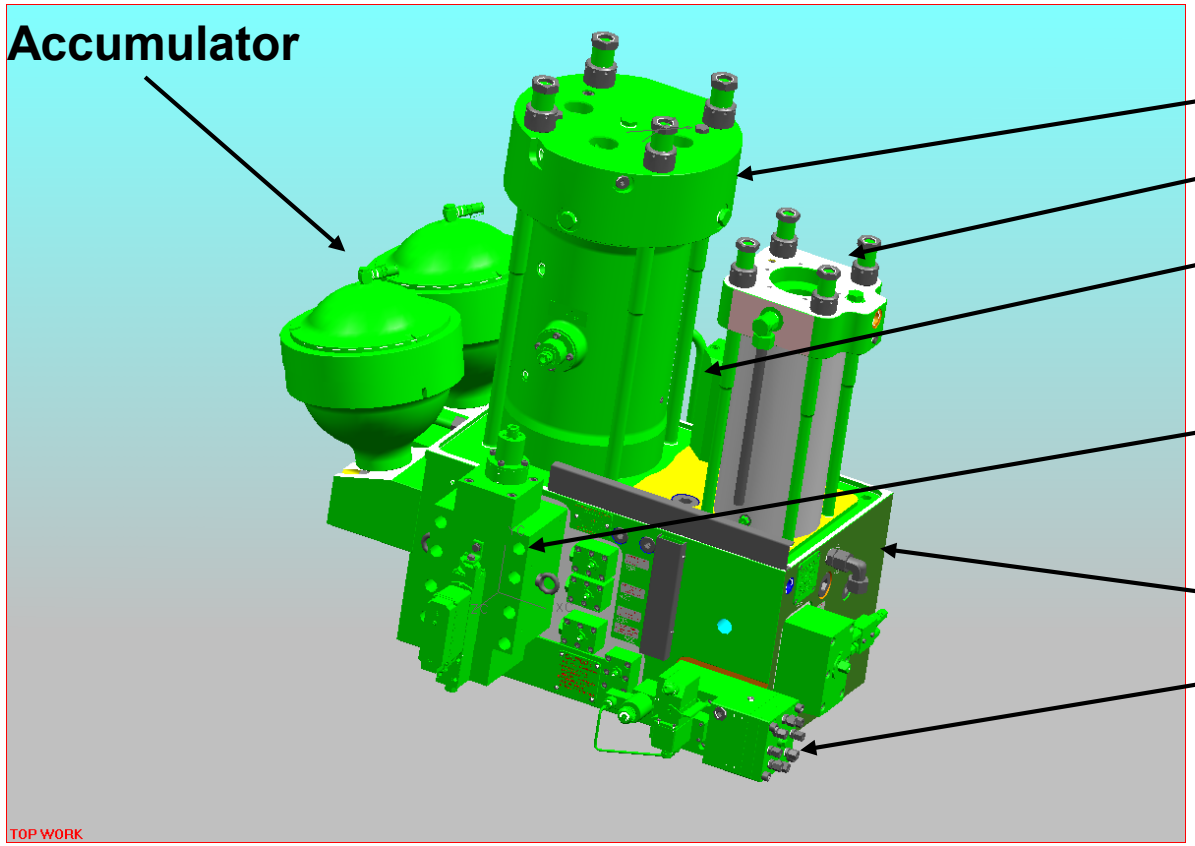
ME-C engine introduction

Hydraulic Power Supply (HPS)



ME-C engine introduction

Hydraulic Cylinder Unit (HCU)



Fuel oil pressure booster

Exhaust valve actuator

De-aeration unit

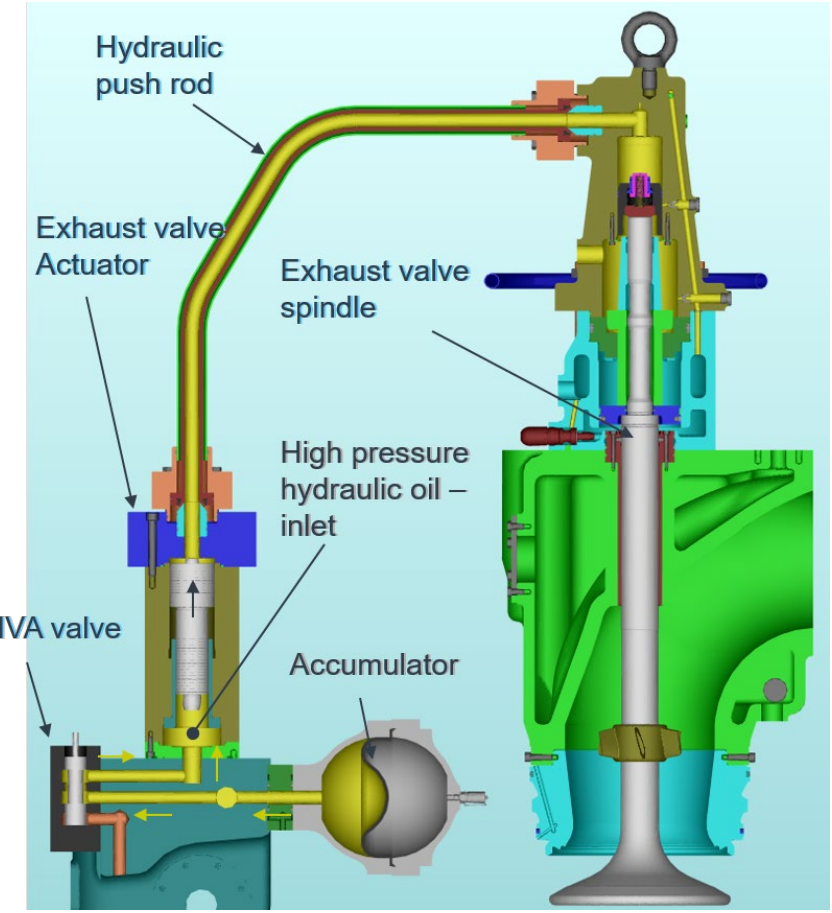
Fuel Injection and exhaust Valve Actuation (FIVA)

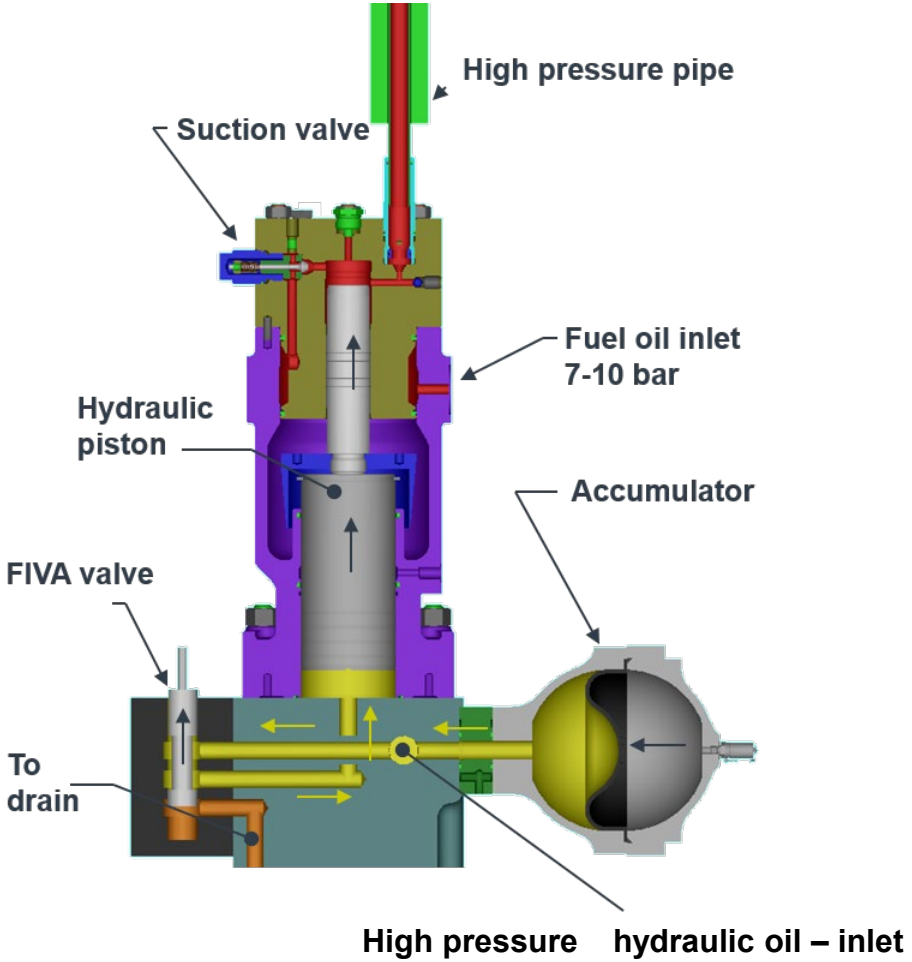
Distribution block

ME lubricator

ME-C engine introduction

Exhaust valve and fuel oil pressure booster





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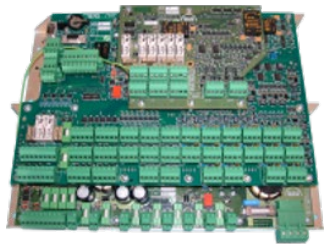
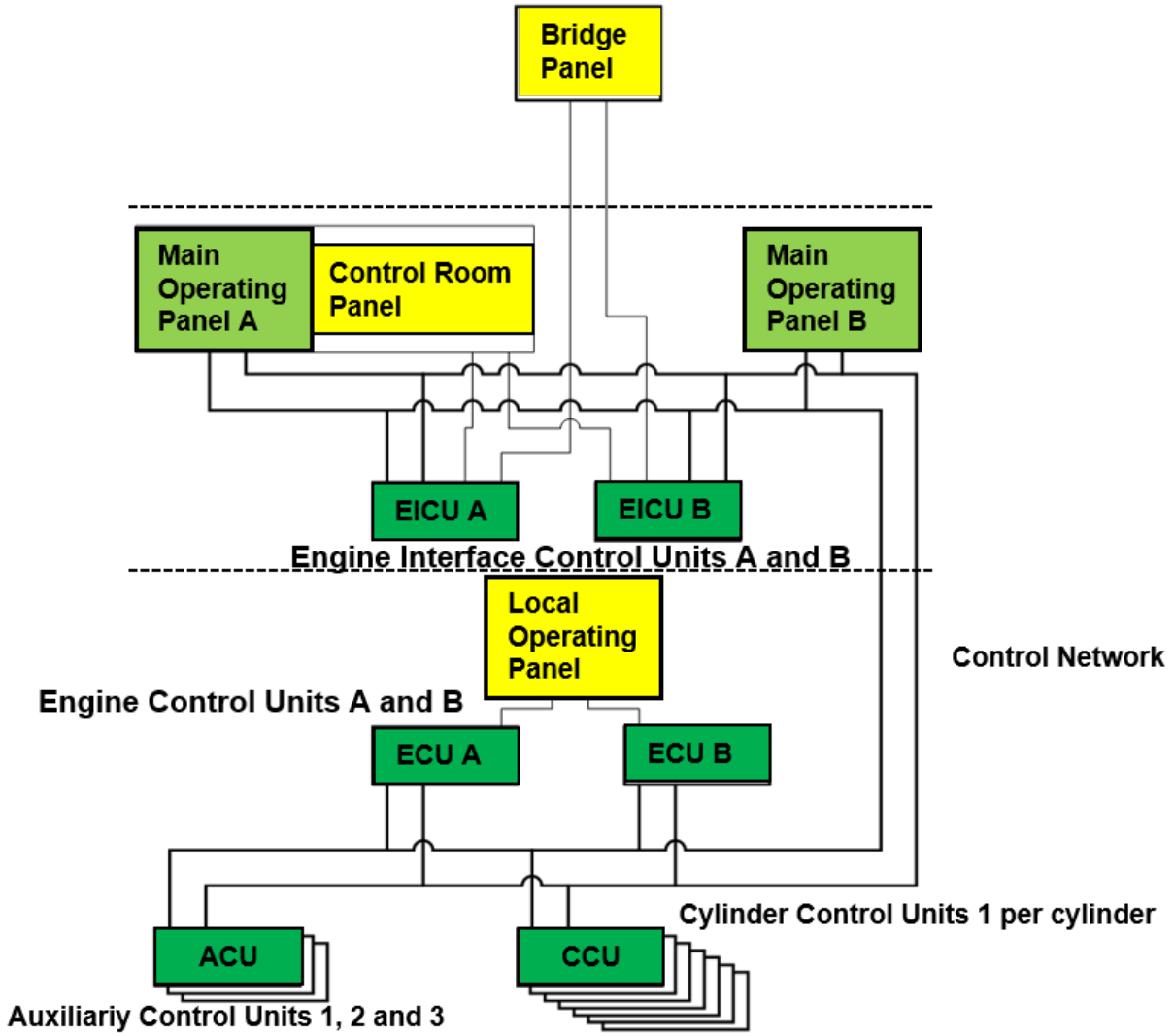
Engine Control System (ECS)

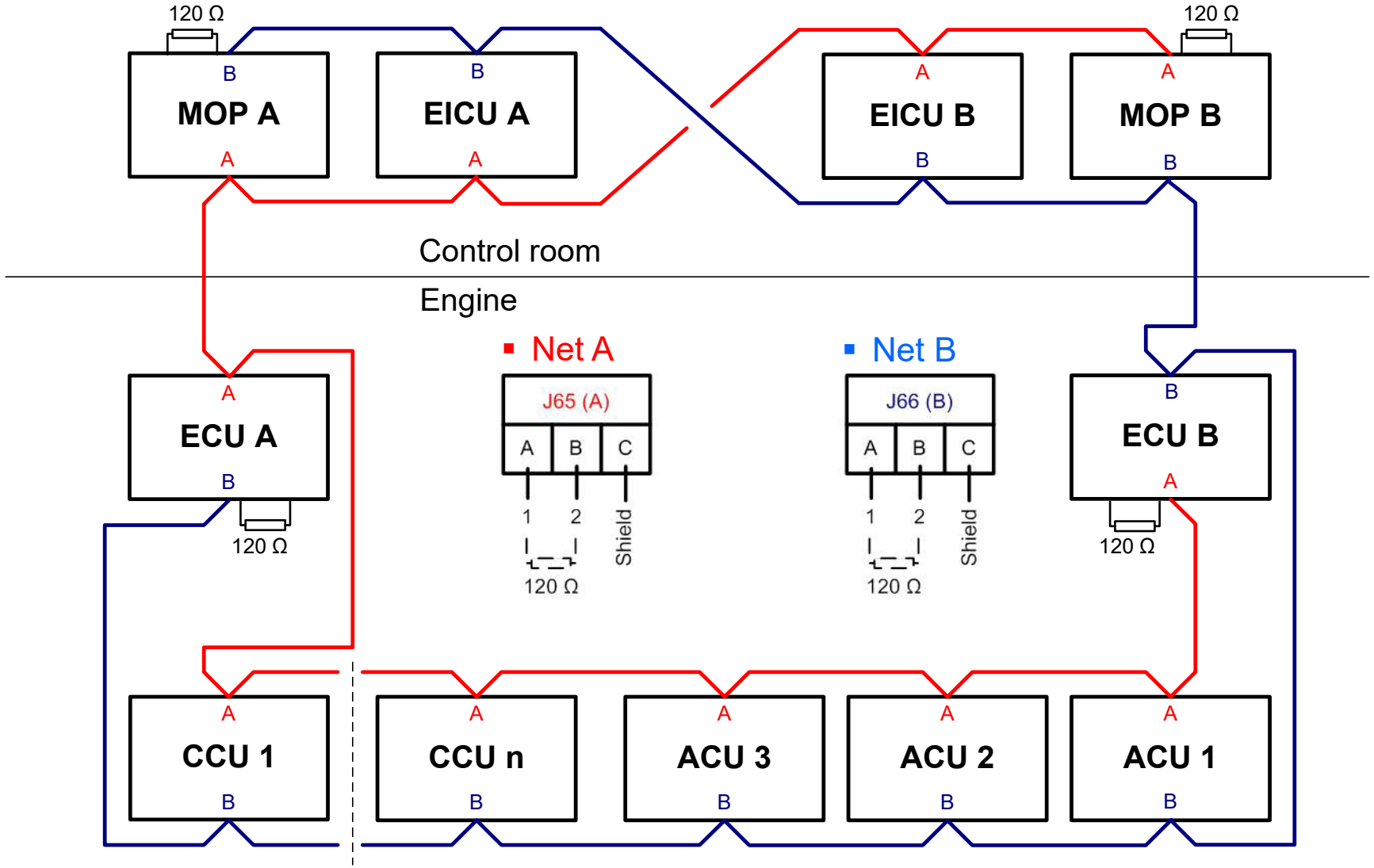
Control Network





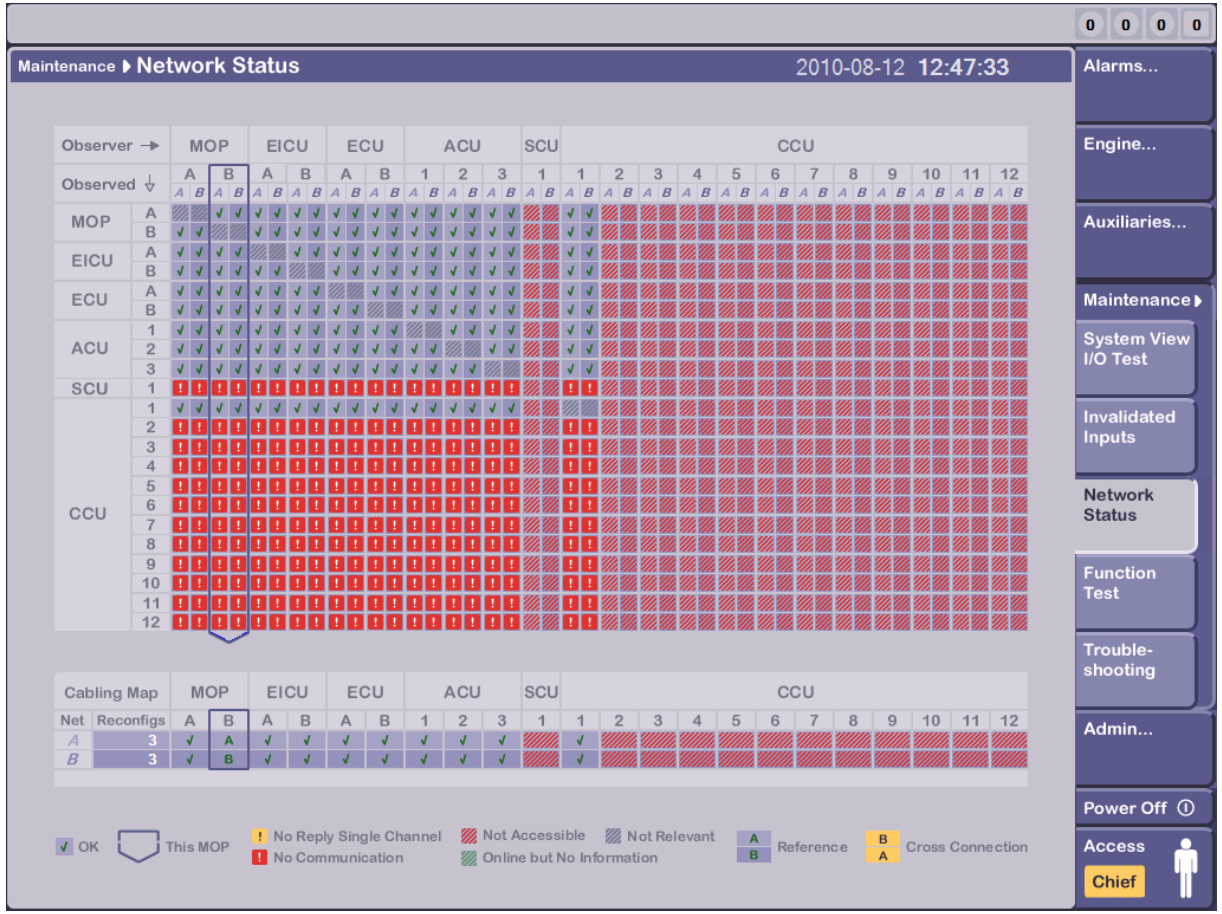
Engine Control System (ECS)

Control Network



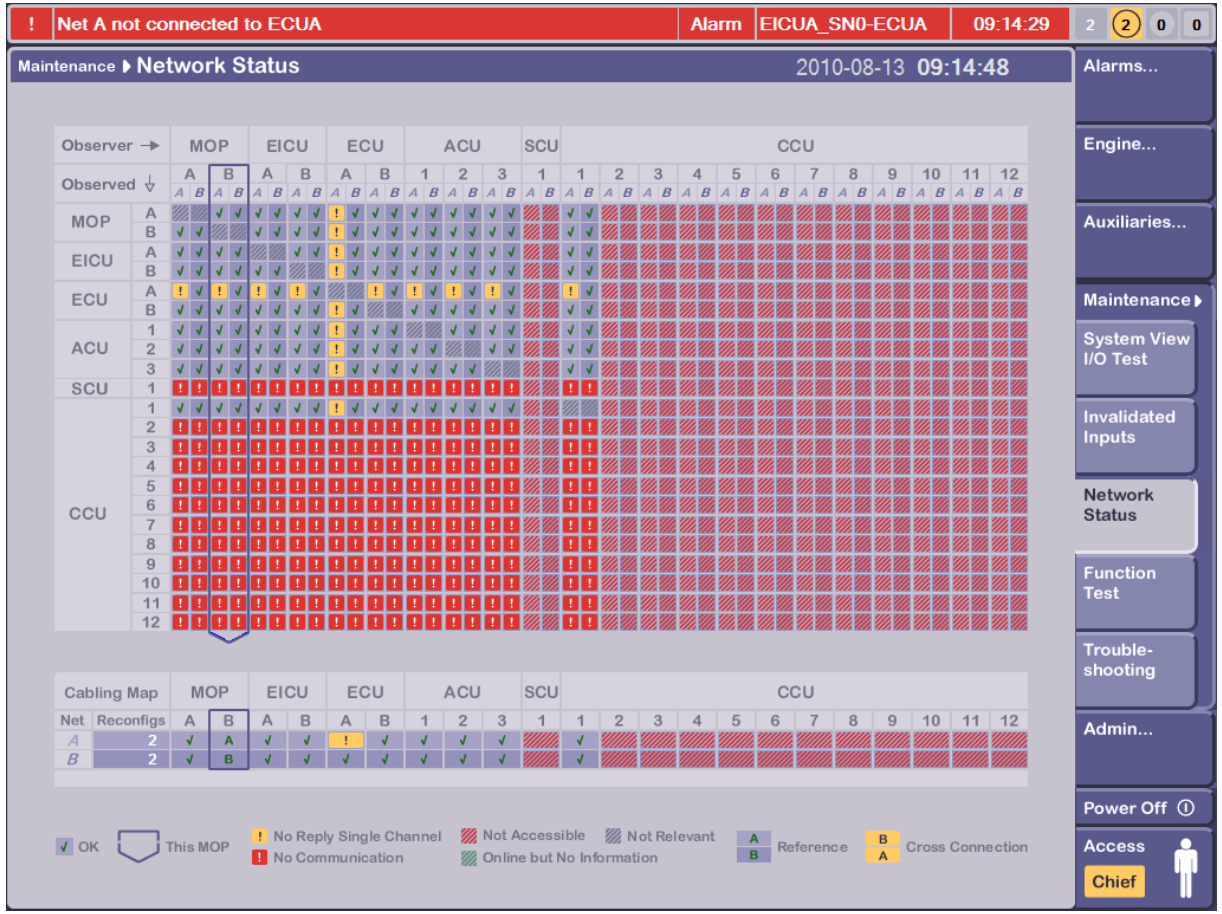
Engine Control System (ECS)

Network status



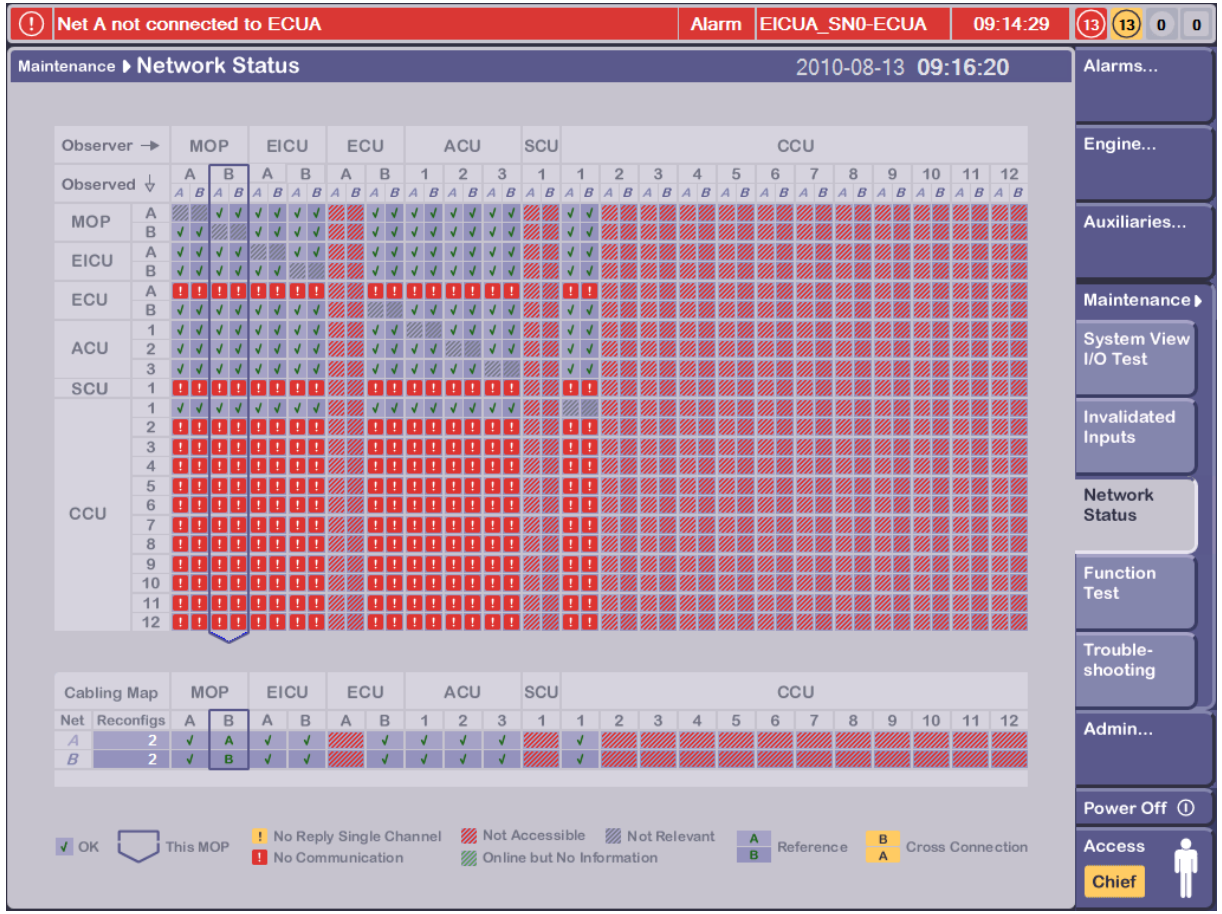
Engine Control System (ECS)

Network status



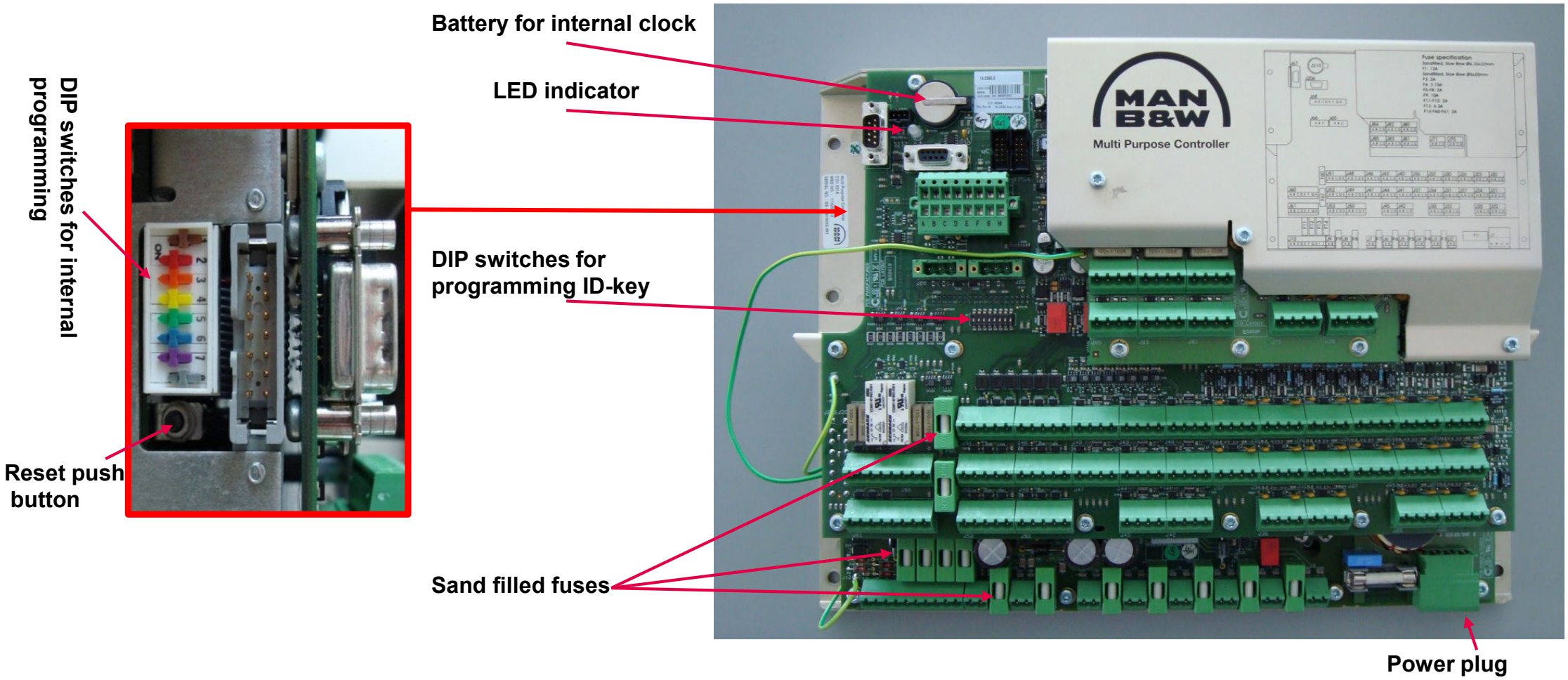
Engine Control System (ECS)

Network status



Engine Control System (ECS)

Multi Purpose Controller (MPC)



Engine Control System (ECS)

LED Information

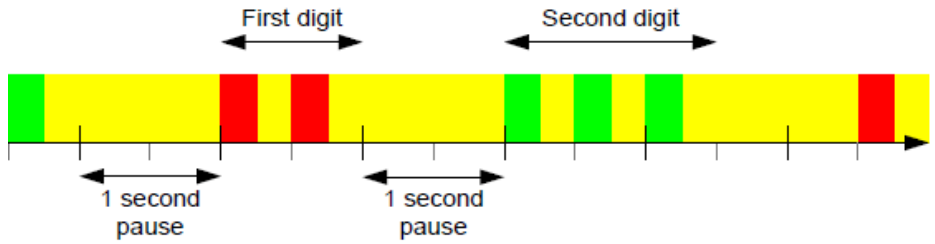
The LED gives information, either as a constant light or by flashing.

A flashing LED is a coded message from the controller. The code consists of 2 digits:

1. Digit is given by red flashes on yellow/orange background

2. Digit is given by green flashes on yellow/orange background

The 2 digits are separated by a 1 sec. yellow/orange pulse.



Constant

Colour	Short name	Short description
Red	ERROR	Either early initialization or fatal error
Orange	INIT	Initialization, no parameters available or non-normal node mode
Green	NORMAL	Application up and running

Flashing

Digits	Short name	Short description
(1,1)	CTRL_PRG	Onboard control programming in progress
(2,1)	APPLOAD_SCAN	Application download in progress – scanning for server
(2,2)	APPLOAD_DOWNLOAD	Application download in progress – downloading program
(2,3)	APPLOAD_DIP	Application download completed – reset yellow DIP switch set to ON
(3,1)	BOOTLOAD_SCAN	Boot loader download in progress – scanning for server
(3,2)	BOOTLOAD_DOWNLOAD	Boot loader download in progress – downloading program
(4,1)	DONGLE_VERIFY	Checking node ID dongle
(4,2)	DONGLE_ERROR	Dongle error – missing, broken or not programmed
(4,3)	DONGLE_DIP	Node ID DIP switch not correctly reset – reset it to 0x00
(4,4)	DONGLE_FORMAT	Waiting for confirmation to reformat the records in the Dongle with Start up and Persistent Data Area information.
(4,5)	DONGLE_DIP_CONFLICT	ID key not connected, no usable address supplied from DIP or Service Terminal.
(5,1)	DIP_ILLEGAL_RANGE	The selected address is outside the defined range 0xC0 – 0xFF (192 - 255).

Engine Control System (ECS)

Standard MPC compared with an MPC-10

MPC-10

Size: 310 x 135 x 98 mm
Weight: 2.5 kg

Cabinet: 380 x 300 x 210 mm
20 external connectors

Sheltered electronics

MPC

Size: 370 x 280 x 87 mm
Weight: 4.2 kg

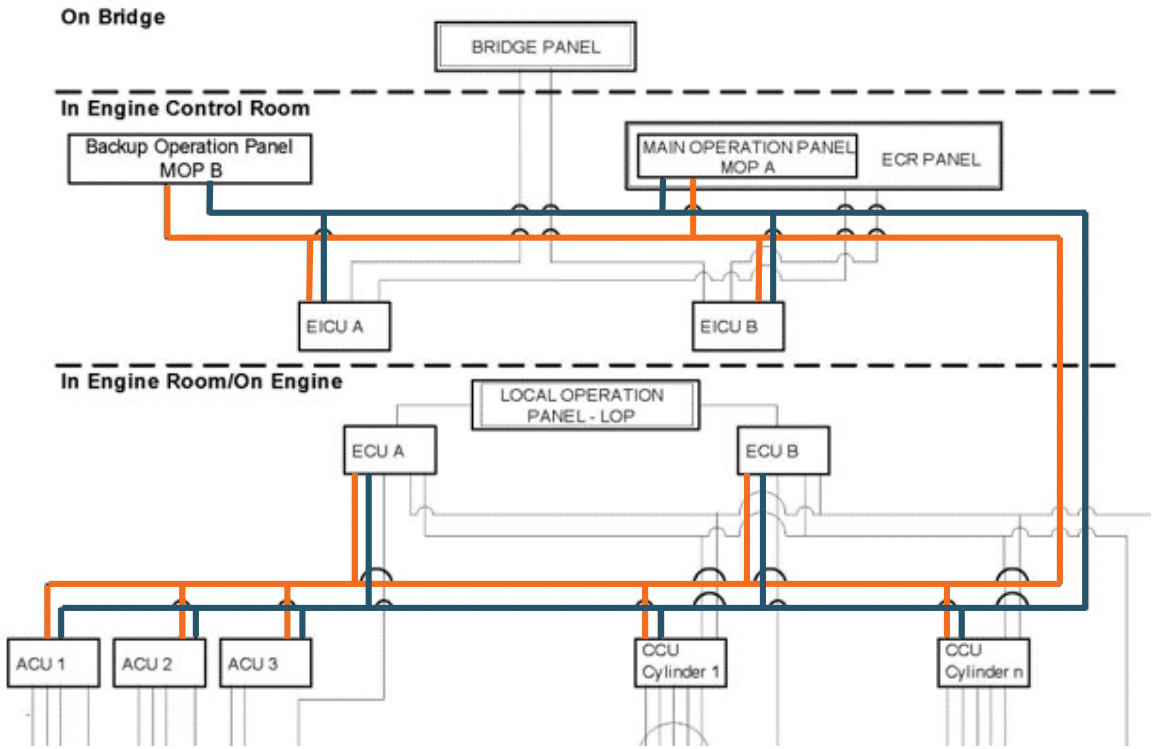
Cabinet: 500 x 400 x 210 mm

55 external connectors

Not sheltered electronics

Engine Control System (ECS)

MPC and control network summary



The Multi Purpose Controllers are identical hardware wise. They have different software configurations.

Two redundant control networks are connecting all Multi Purpose Controllers and both main operating panels computers.

A backup of the application- and setup- software is stored on both main operation panels.

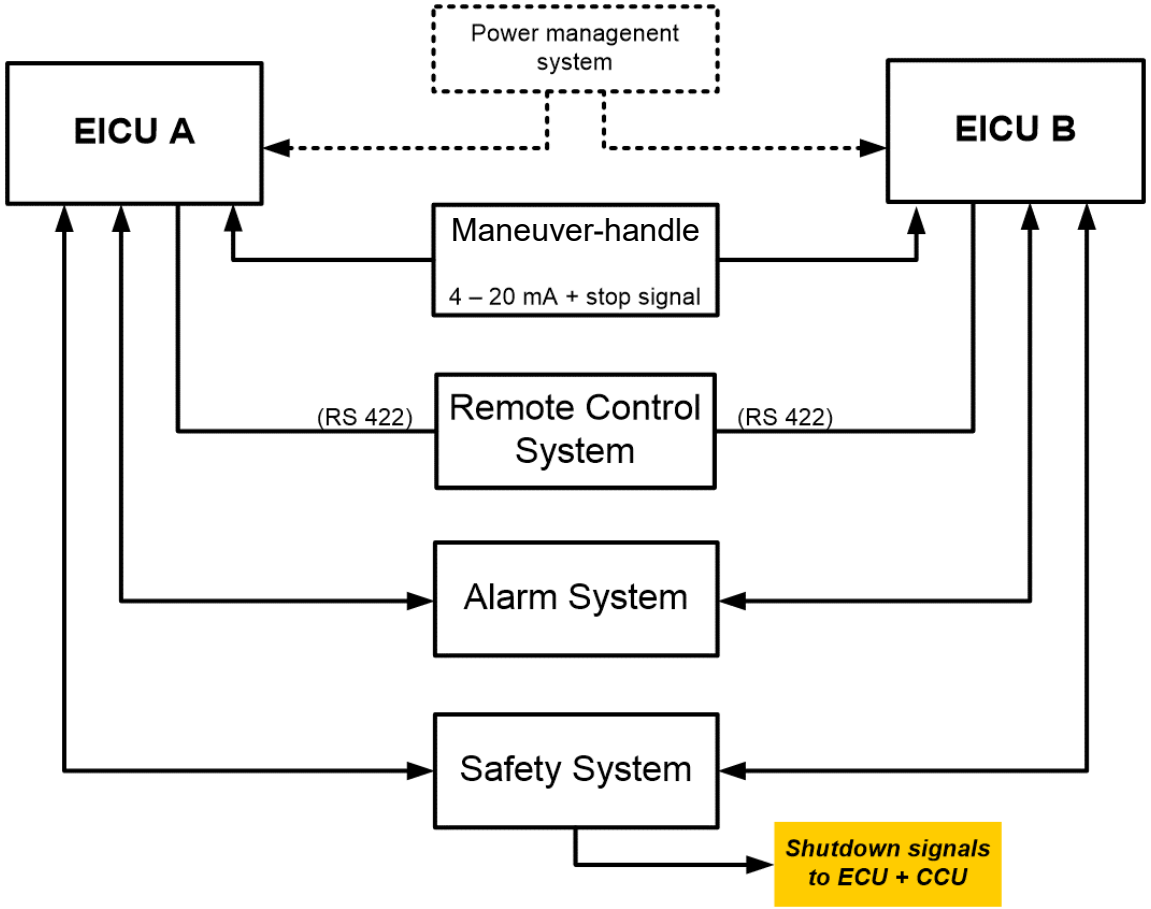
At replacement, the new controller is automatically configured with correct software via the control networks.

Bridge panel and engine control room panel are wired to EICU A & B.

Local operating panel is wired to ECU A & B.

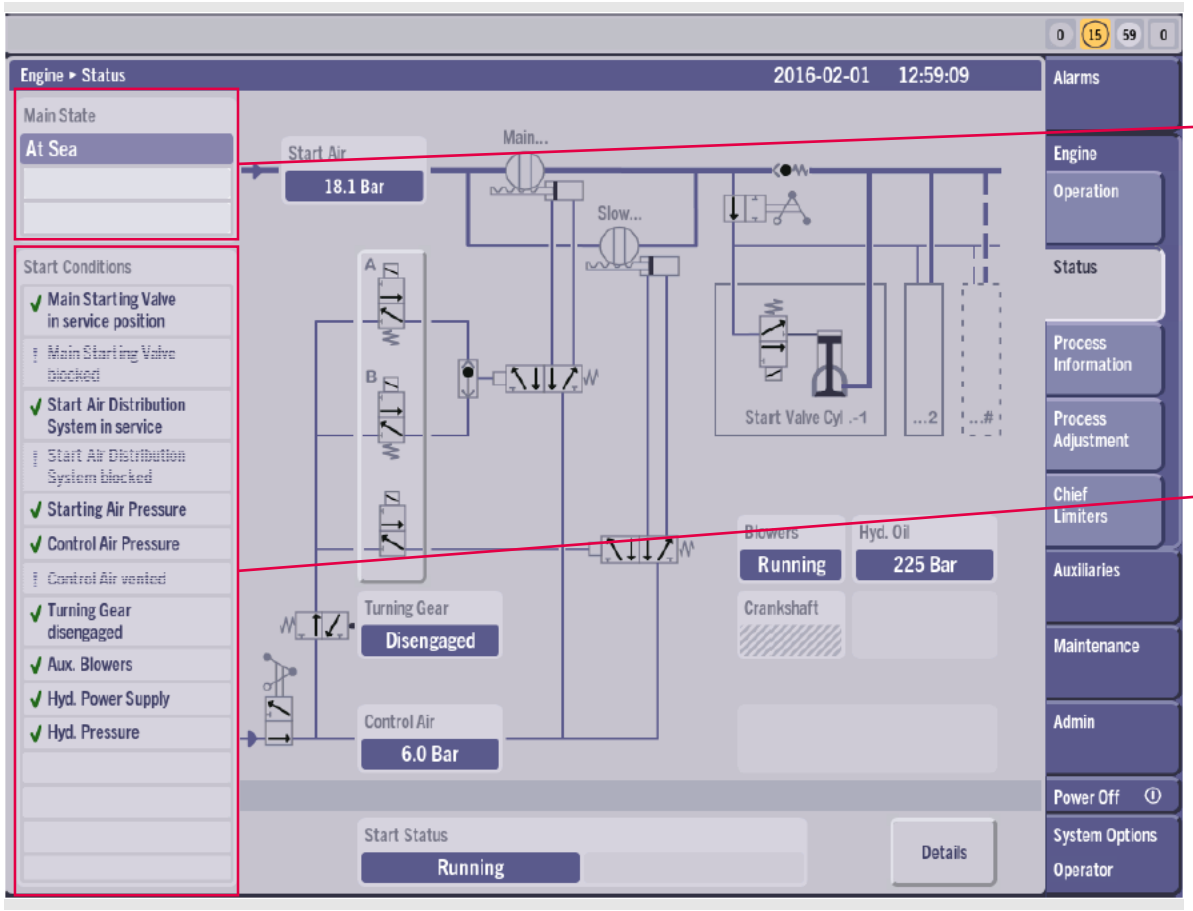
Engine Control System (ECS)

Engine Interface Control Unit (EICU)



ME engine introduction

Engine Control Unit (ECU) – Start block & checklist



Main State:

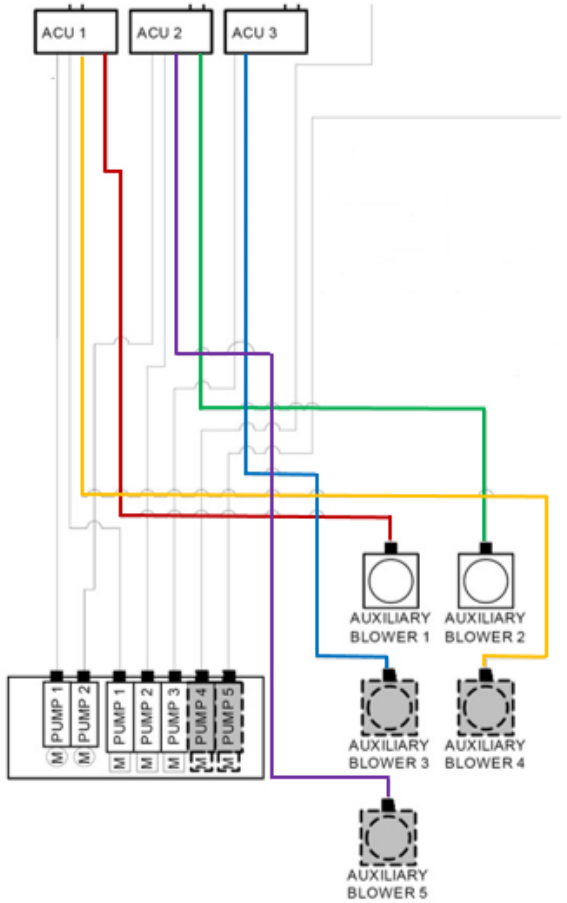
- Shows the main state of the engine FWE / Standby / At Sea
- Any warnings to the state and / or blockings will be shown here.

Start Conditions:

- Check list of conditions which must be met in order to have the engine in the corresponding state.
- One list for Finished With Engine (FWE) and one list for Standby

Engine Control System (ECS

Auxiliary Control Unit (ACU) – Blower control



The blowers are started one by one in order to prevent overload of the electrical system.

In AUTO mode:

The blowers are started at ‘Prepare Start’ button.

At engine running they are controlled by the scavenge air pressure.

- stop at 0,7 bar (time delay)
- start at 0,4 bar.

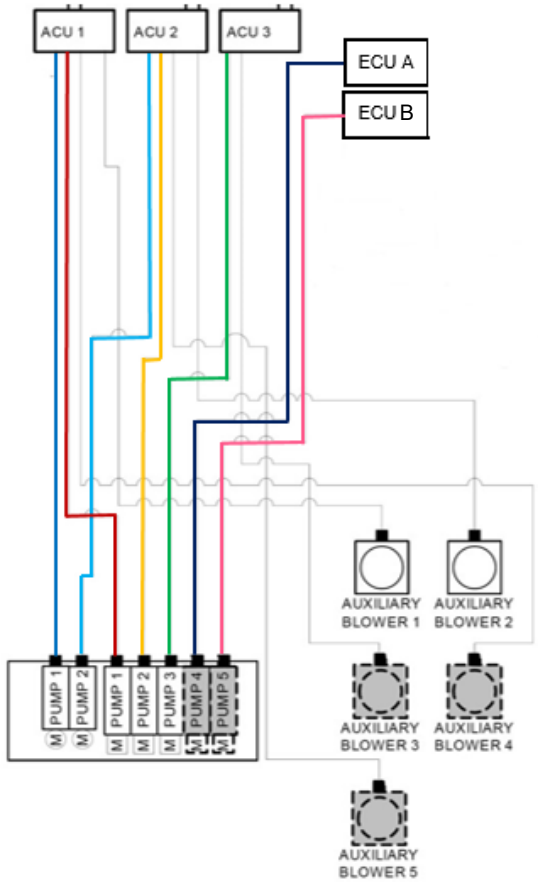
At engine stop they continue to run for a default 15-20 min.

In MANUAL mode:

Operation is controlled by the operator via the MOP.

Engine Control System (ECS

Auxiliary Control Unit (ACU) – Pump control



Electrically driven start-up pumps:

- start-up pump 1 controlled by ACU 1
- start-up pump 2 controlled by ACU 2

Engine driven pumps:

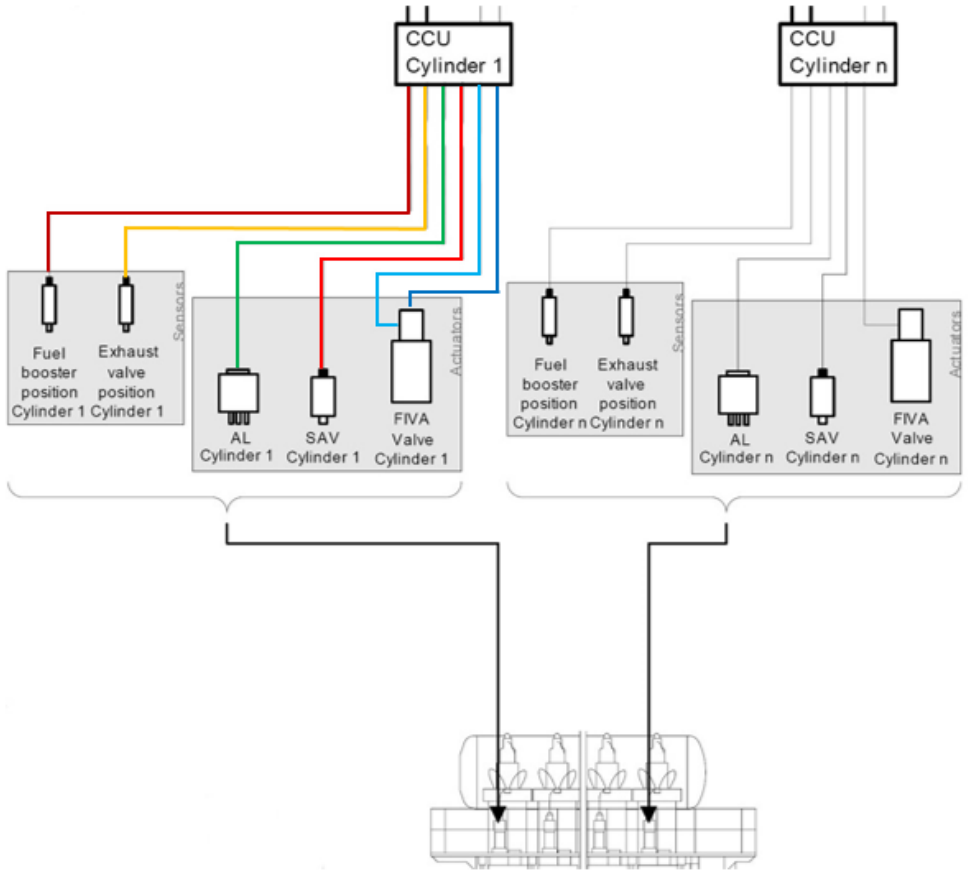
- pump 1 controlled by ACU 1
- pump 2 controlled by ACU 2
- pump 3 controlled by ACU 3
- The control is modulated, based on the pressure set point and the actual hydraulic pressure.

Engine driven pumps 4 and 5:

- same type as pump 1, 2 and 3, but they are controlled digitally by ECU's either max ahead or max astern.
- pump 4 controlled by ECU A
- pump 5 controlled by ECU B

Engine Control System (ECS

Cylinder Control Unit (CCU)



FIVA : Fuel Injection, Valve Actuation

– Proportional valve for fuel injection.

– On / Off for exhaust valve operation

Control of FIVA movement

Monitor feedback from FIVA

Control of Start Air Valve (SAV)

Control of ME lubricator

Monitor feedbacks from lubricator

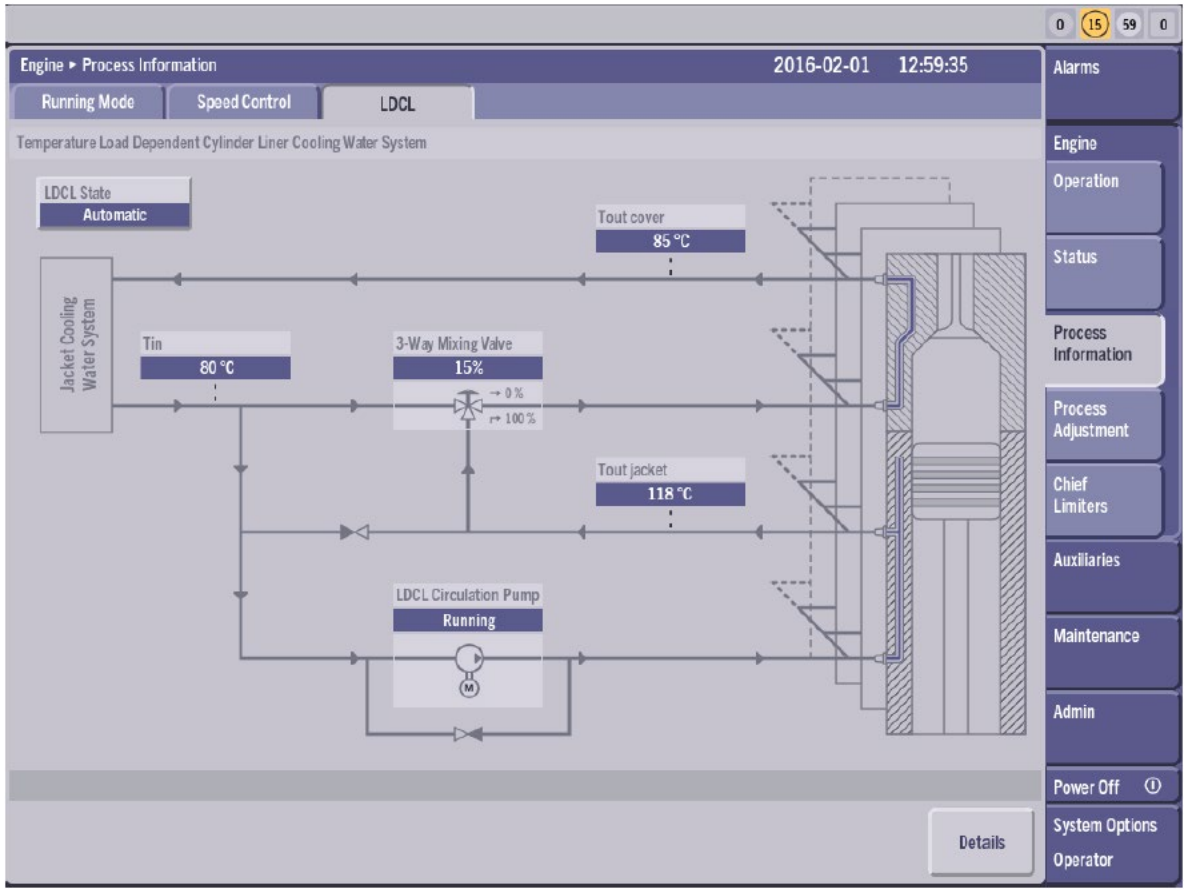
Monitor fuel oil booster feedback

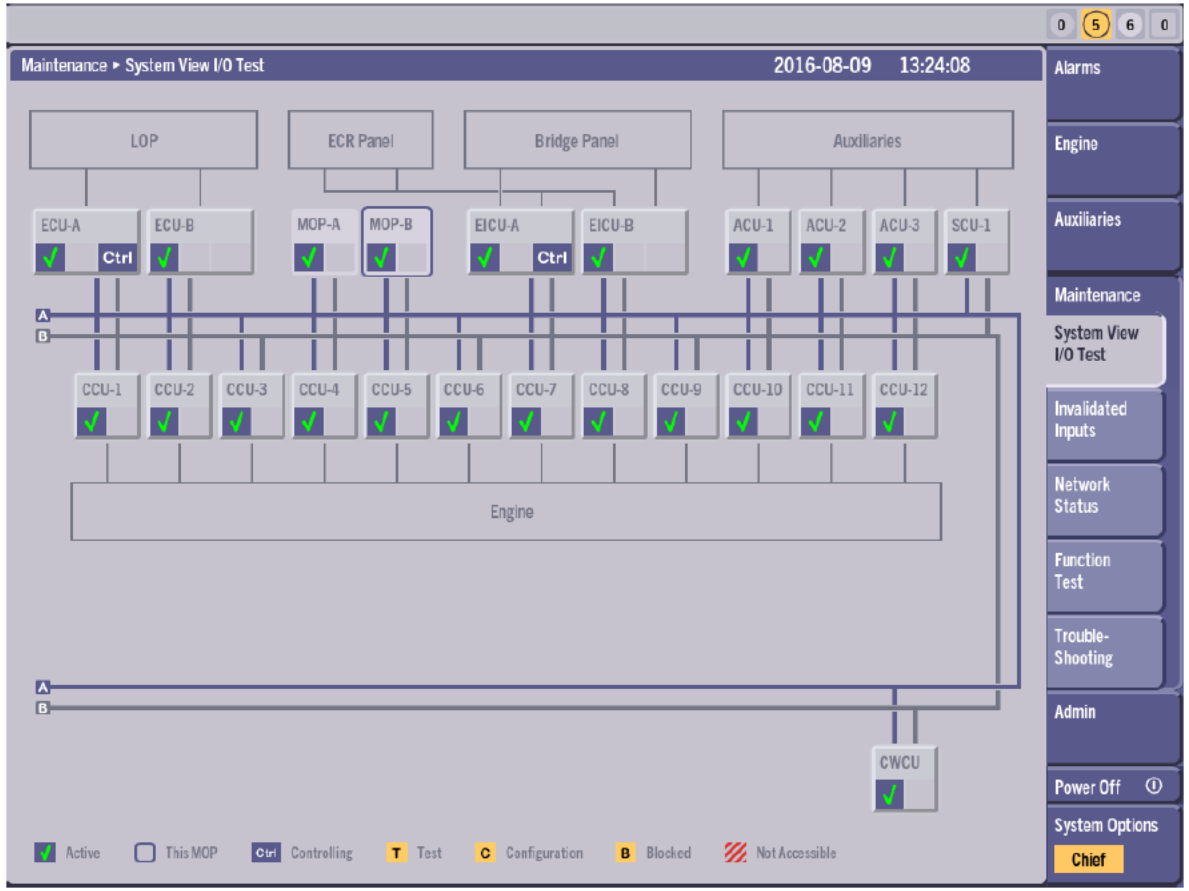
Monitor exhaust valve position feedback

One CCU per cylinder

Engine Control System (ECS

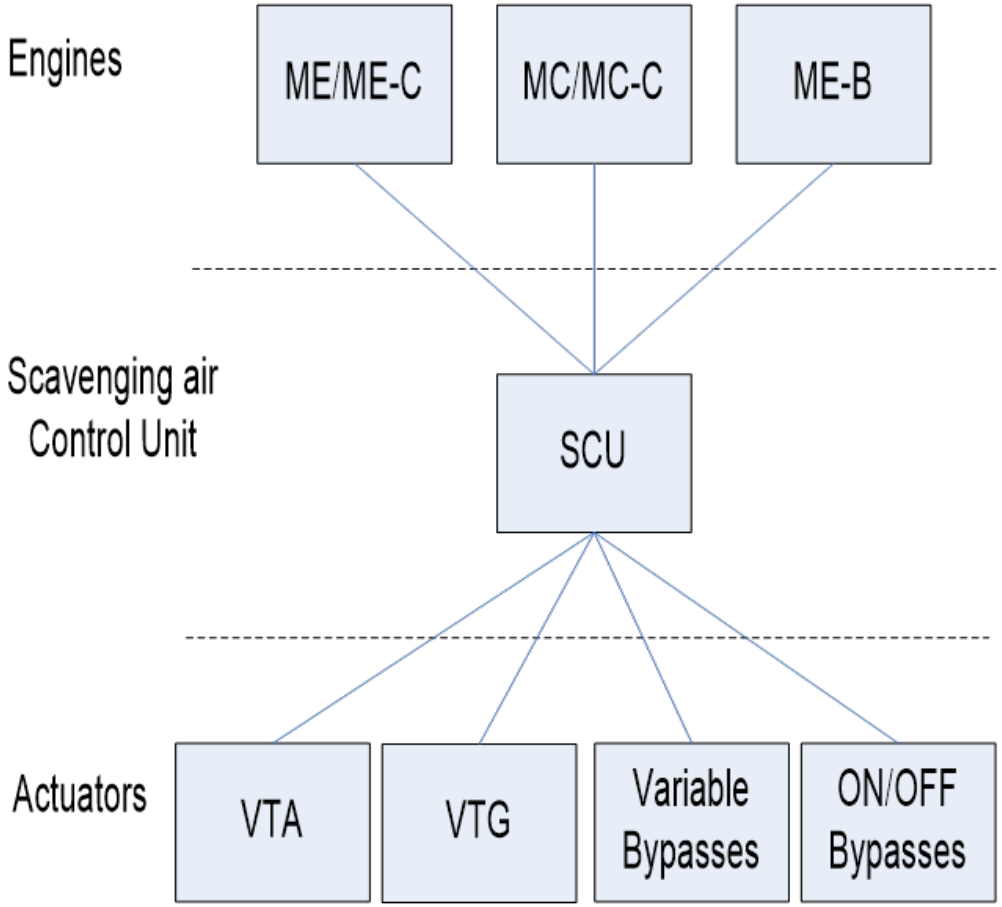
Cooling Water Control Unit (CWCU) – Temperature Load Dependent Cylinder Liner (LDCL)

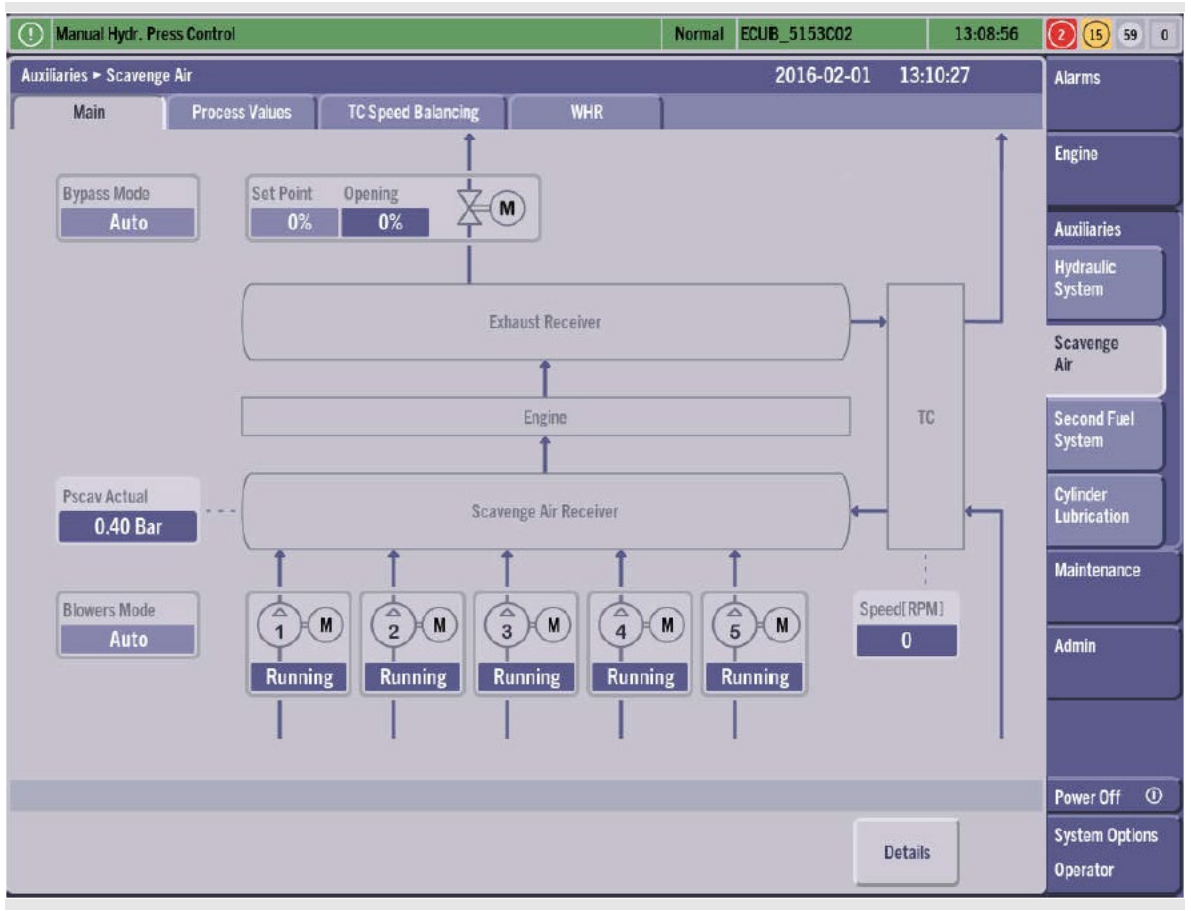




Engine Control System (ECS

Scavenge air Control Unit (SCU) – VTA, WHR, EGB





Engine Control System (ECS

Main Operating Panel (MOP)

Integrated PC

EC - MOP

MOP A:

- Touch screen
- Track ball
- Daily operation of engine

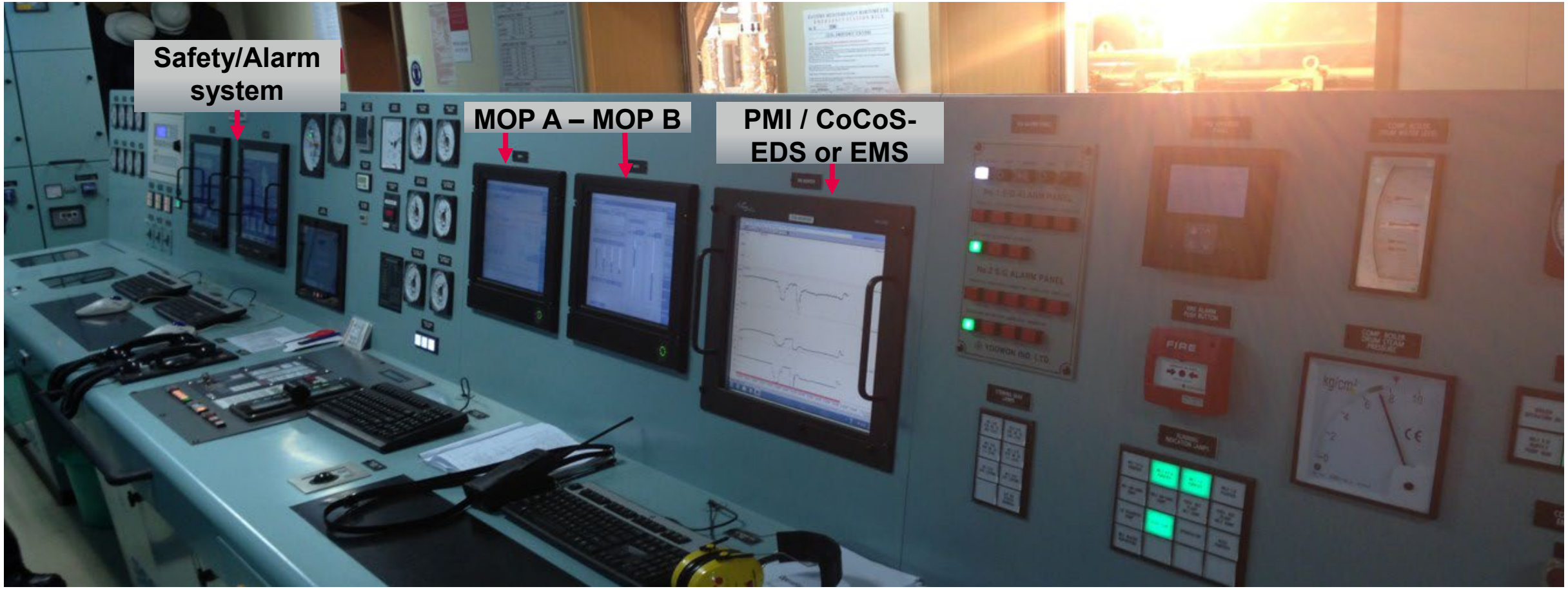
MOP B:

- Touch screen
- Keyboard with mouse
- Daily operation & trouble shooting of engine

Marine approved PC's with embedded Windows software.

Engine Control System (ECS

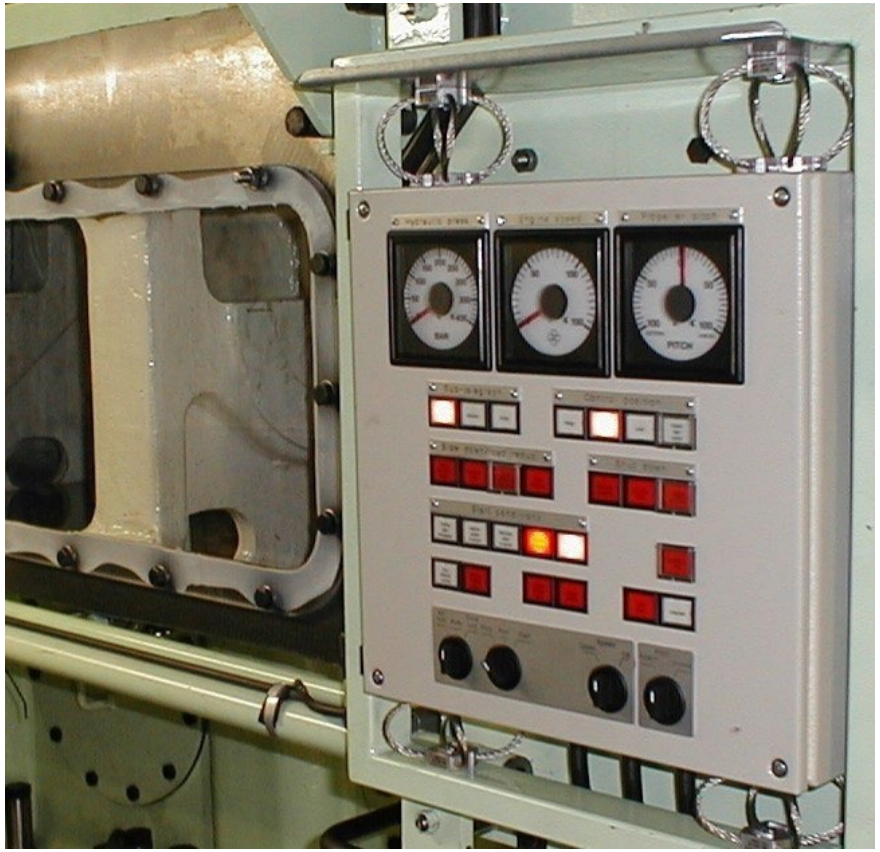
Main Operating Panel (MOP)



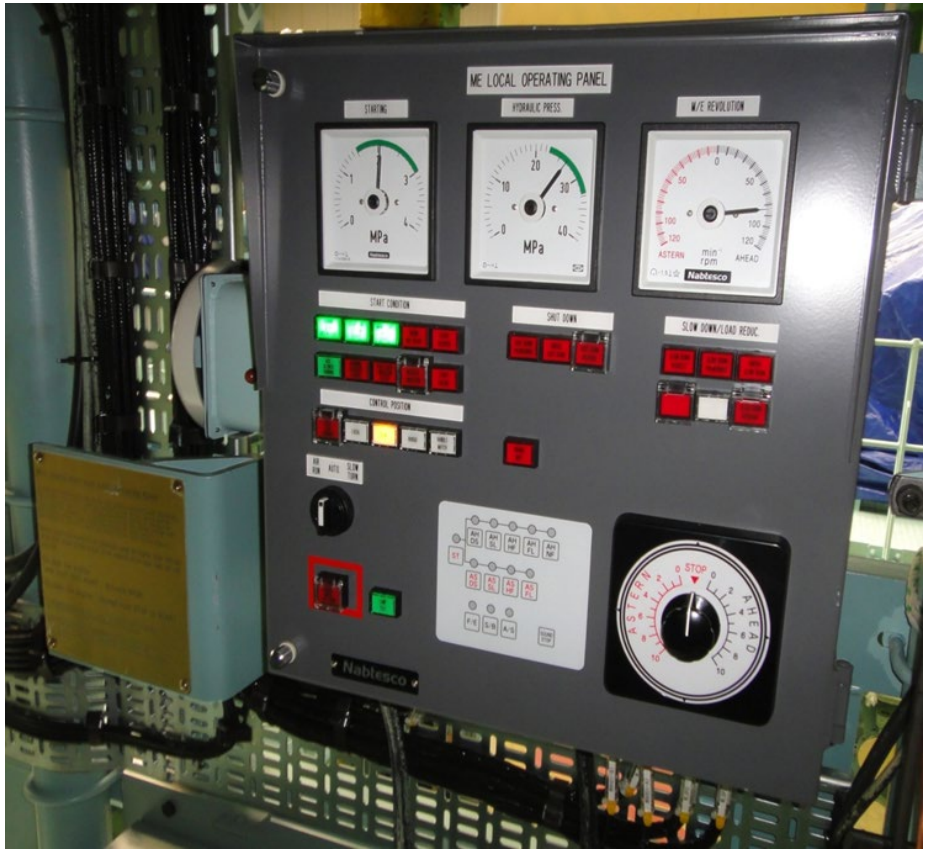
Engine Control System (ECS

Local Operating Panel (LOP)

MAN - ES supplied



Nabtesco supplied



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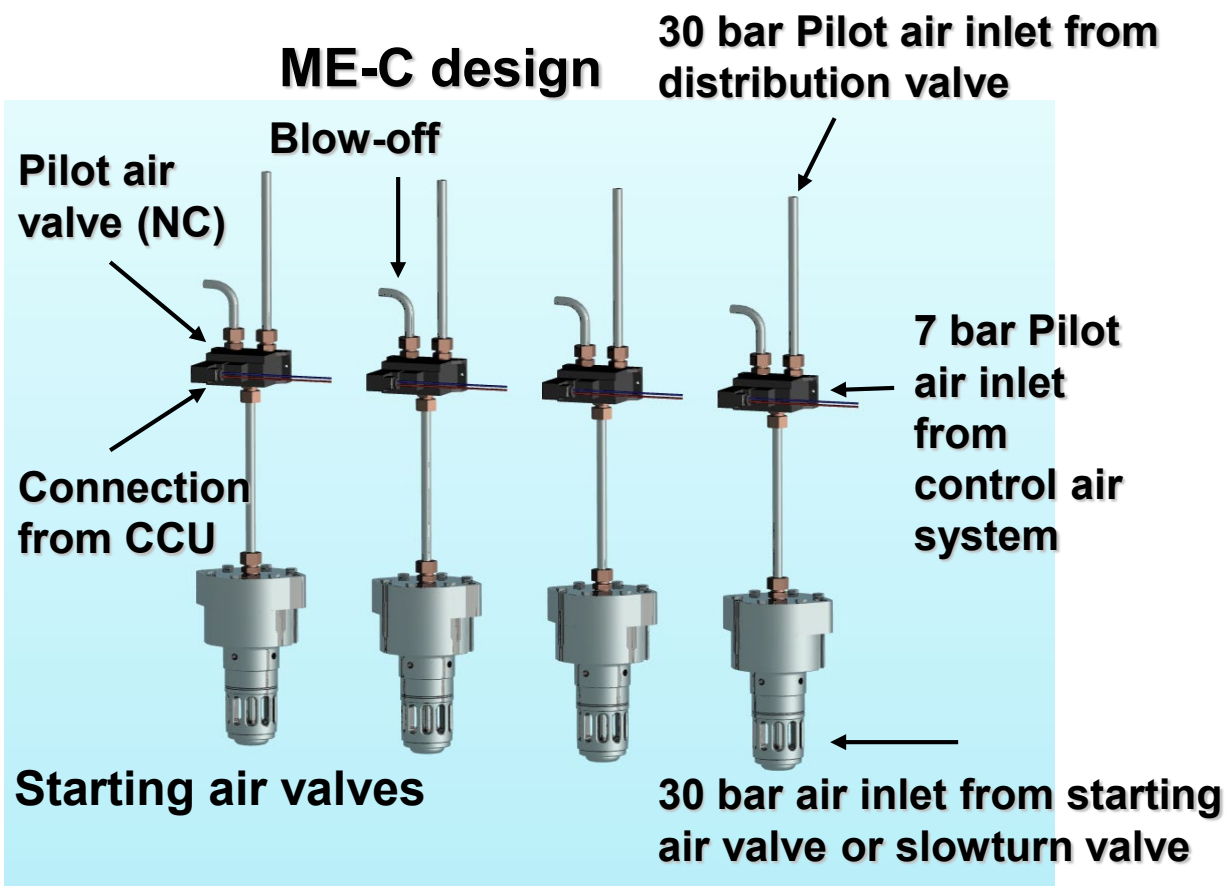
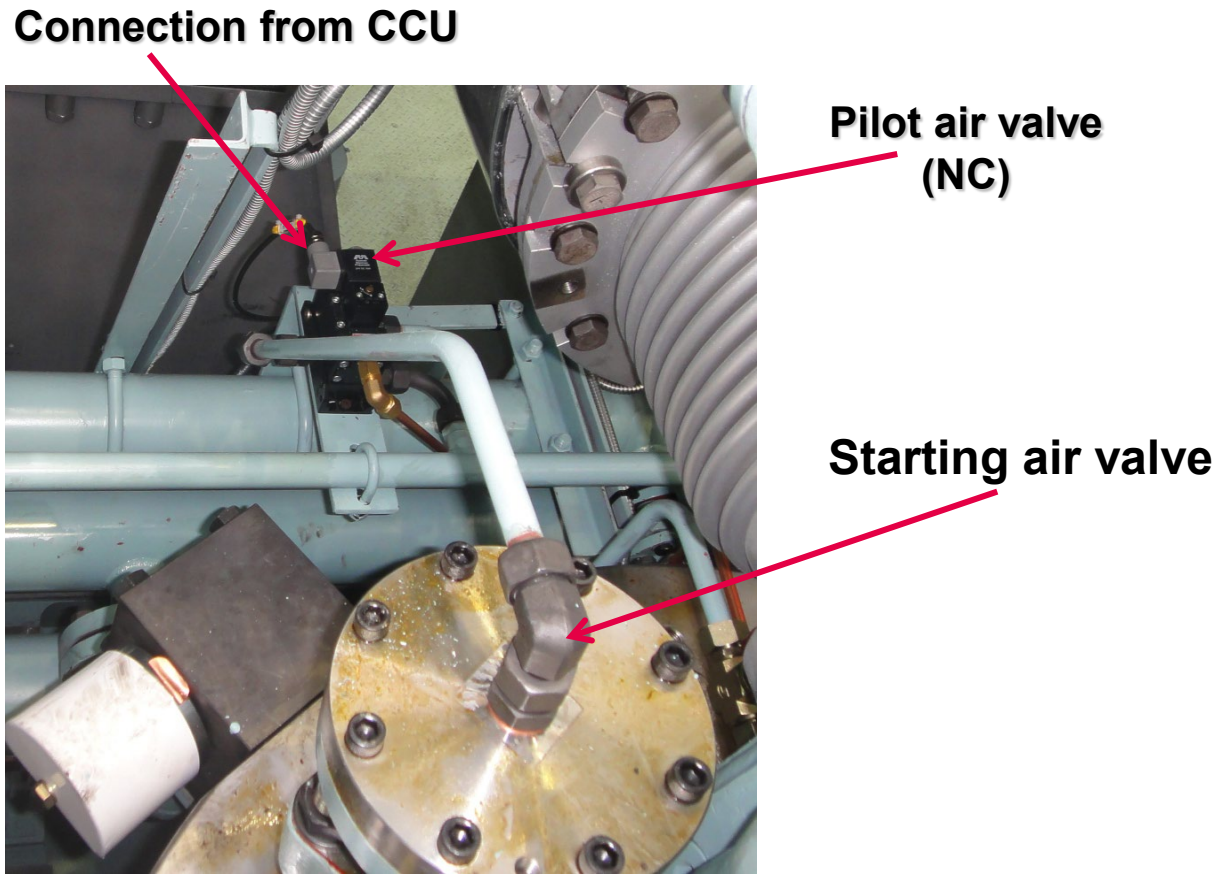
Engine Control System (ECS)

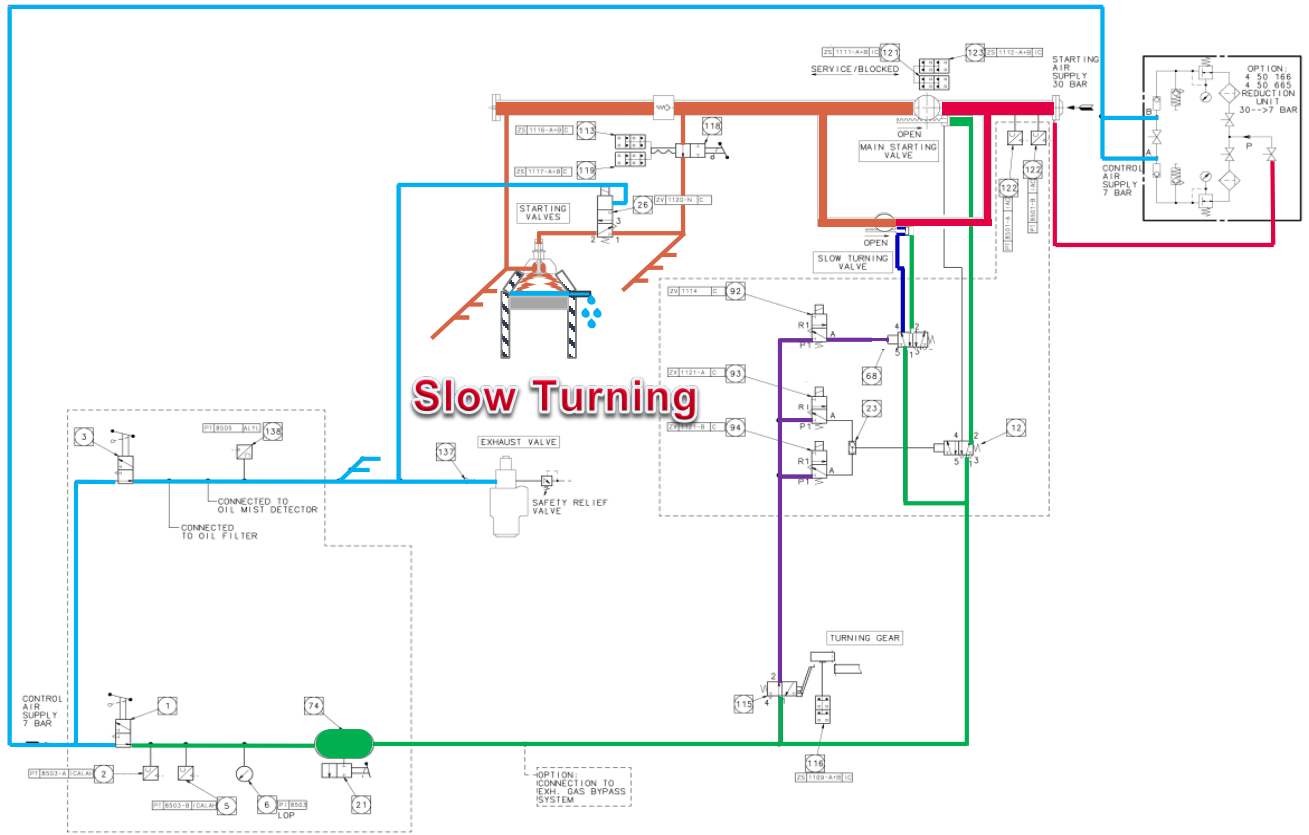
Pneumatic system for ME engine





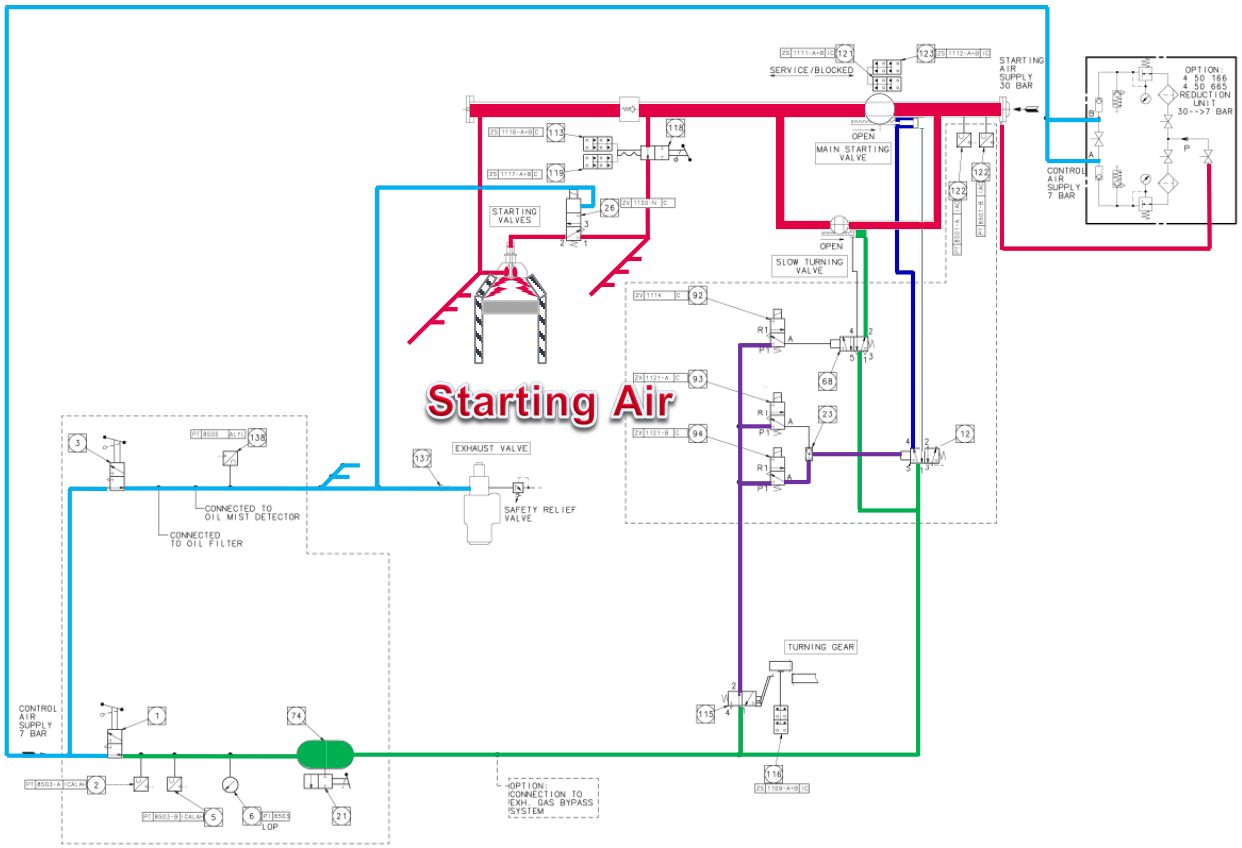
Engine Control System (ECS)

Starting and control air systems – Slowturning



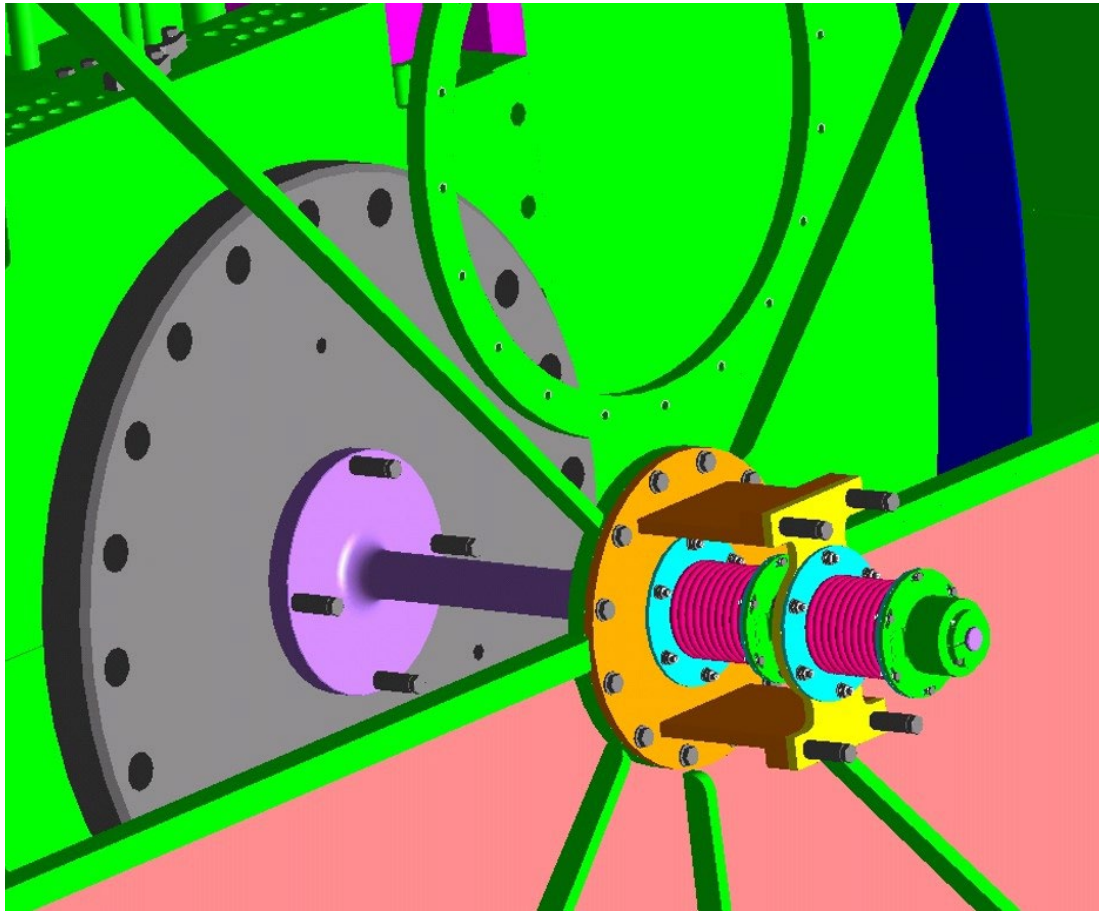
Engine Control System (ECS)

Starting and control air systems – Start/Air run



Engine Control System (ECS)

ME Tacho system



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Engine Control System (ECS)

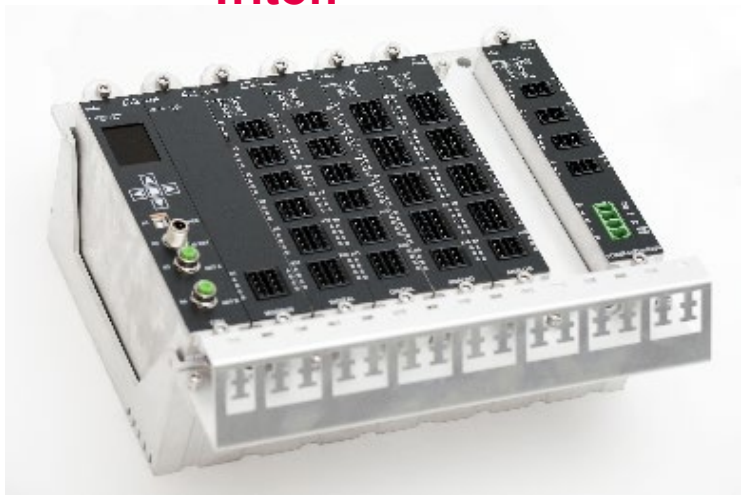
Triton controller

Future needs of flexibility and capacity

- MPC platform has been in production since 2002.
- Key components in current platform are becoming obsolete.
- Need for higher processing power and capacity – Tier III, Dual-fuel etc.

MPC

Triton



Engine Control System (ECS)

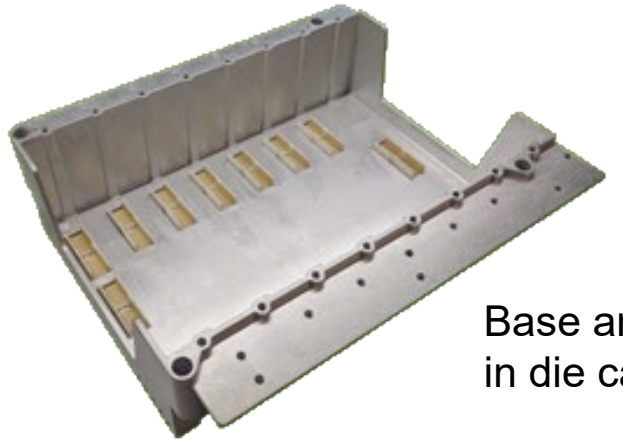
Triton controller

Comparison	MPC	Triton
Control Network	Arcnet 2Mbps shared	**Ethernet 100Mbps**
Microprocessor	Hard core	Soft core
Data sampling	2kHz	**200kHz**
Filtering	Analog	Digital
Display	None	Yes
Buttons	None	5
LED indicators	Yes, for some channels	**Yes, for all channels and fuses**
Service terminal	RS232	USB
Fuses	Time lag T, non-resettable	**Electronic, resettable**
IO configuration	Fixed	Modular
Tacho	Separate cabling	**uses Control network**
Spare part	Controller	**Module**
Insulation monitor	External	Internal
Cooling	Passive	Passive

Engine Control System (ECS)

Triton contoller

ID-KEY



Base and modules
in die casted aluminum

CPU

Digital
I/O

Analog
I/O

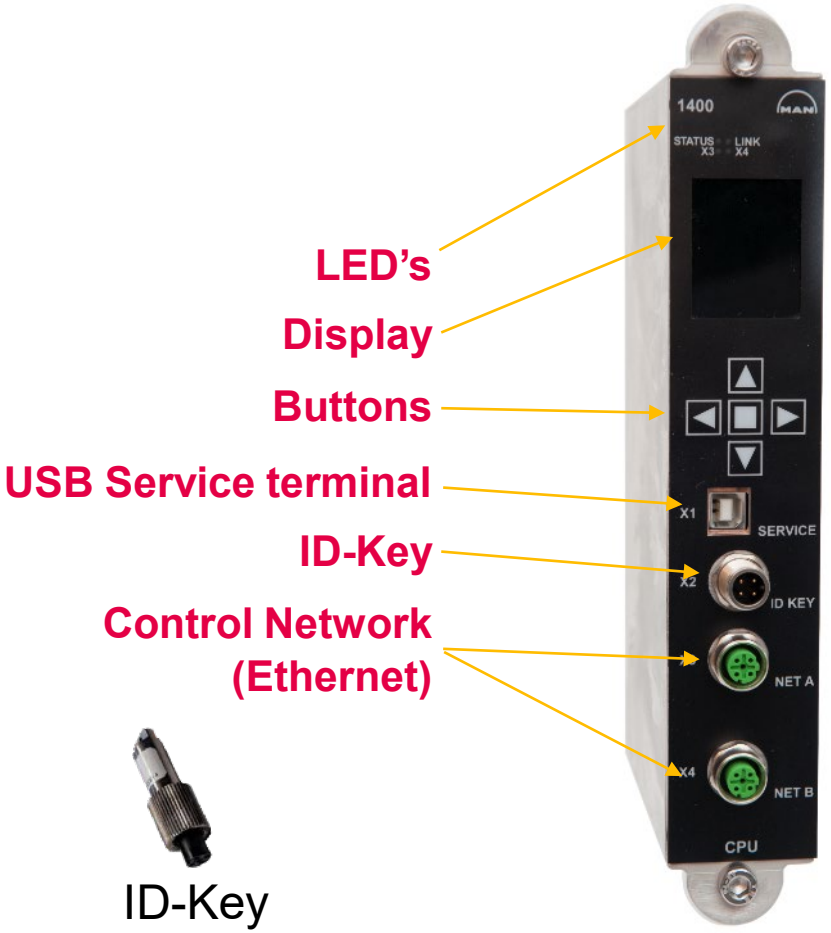
Modbus

Power supervision

Future
modules…

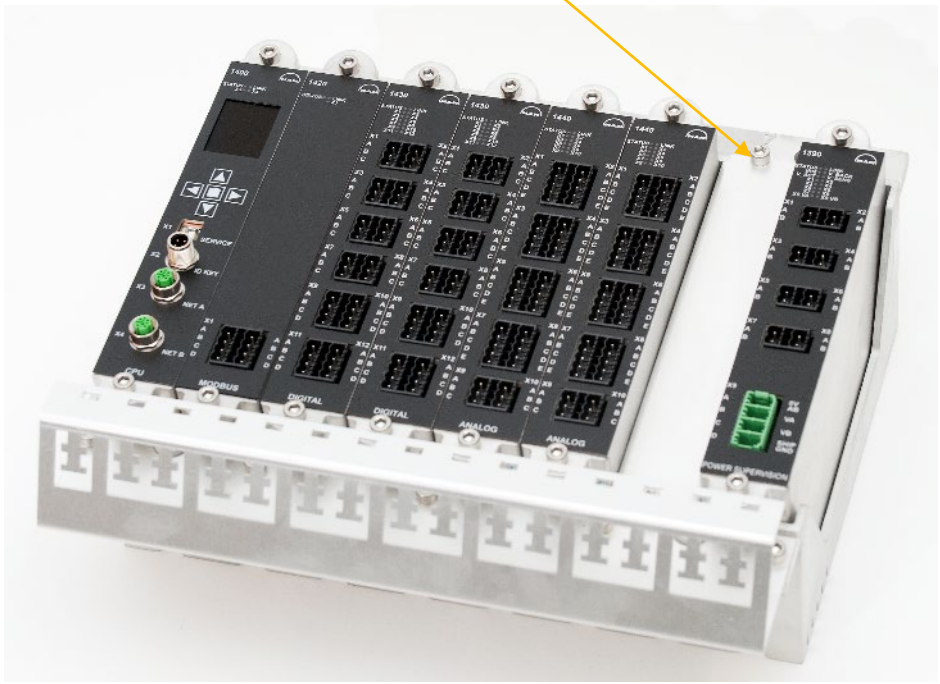
Engine Control System (ECS)

Triton contoller



ID-Key

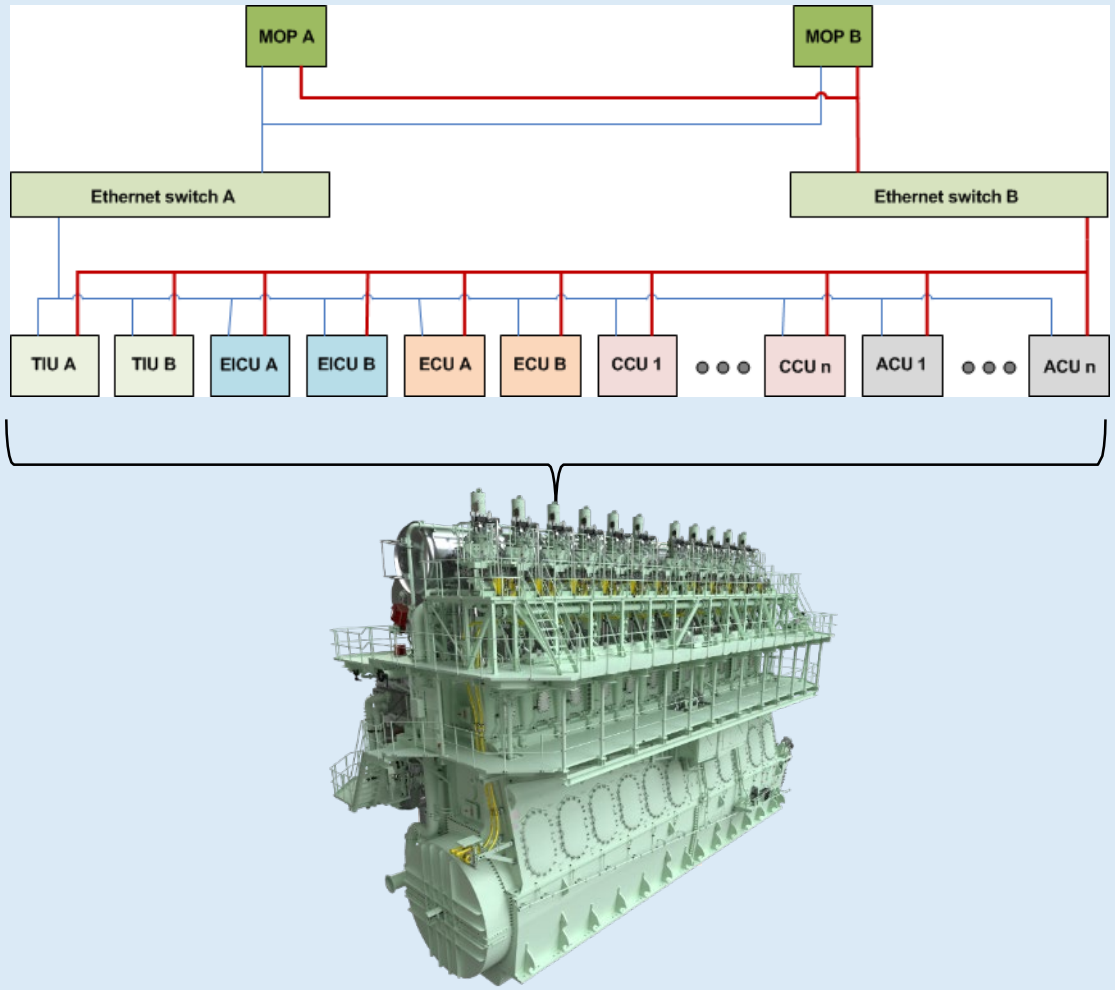
Free module slots



Future module(s)

Engine Control System (ECS)

Engine configuration based on Triton Controller platform



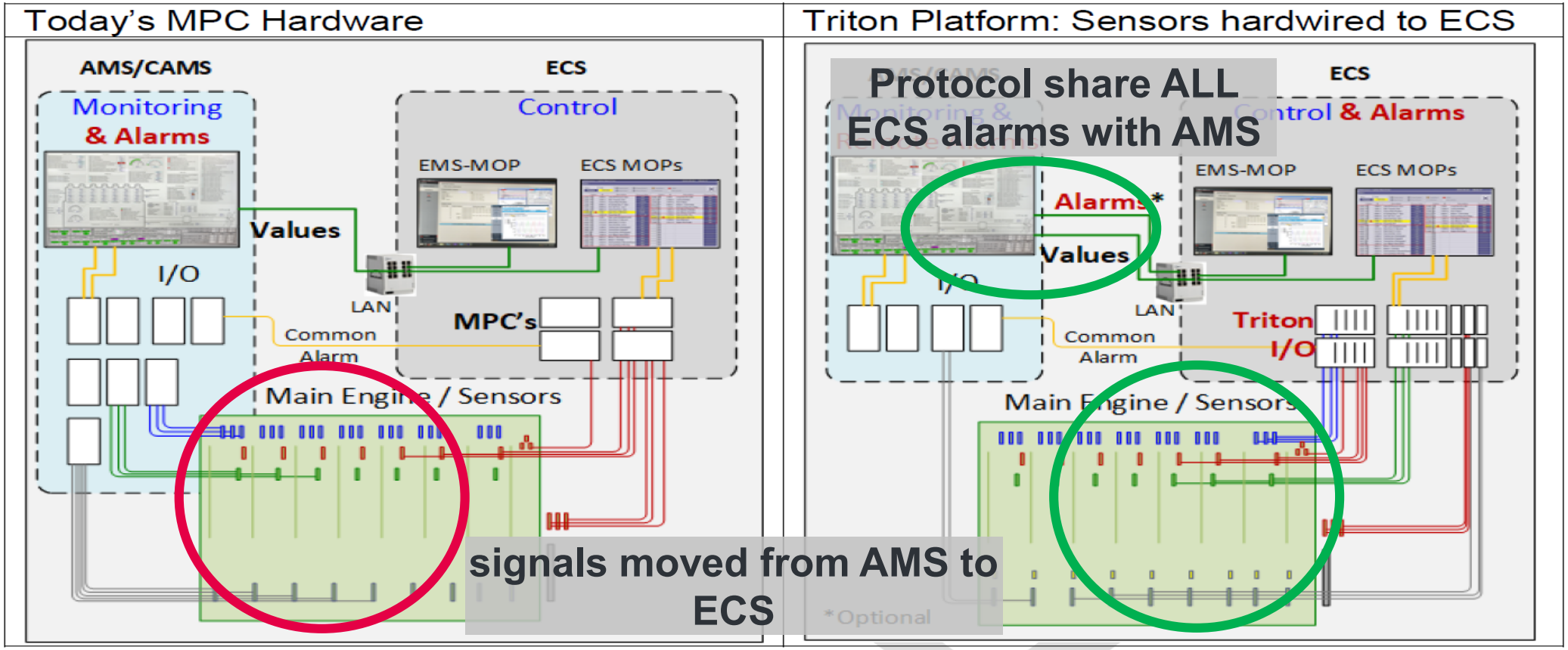
MOP (Main Operation Panel)

Control Network - Ethernet Switch

Triton Controller

Engine Control System (ECS)

Monitoring signals in Triton



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Thank you very much!

PrimeServ Academy Copenhagen

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