ERS 5000 TechSim

MAN B&W 6S60MC-C Diesel Engine – Tanker LCC (Aframax)

Trainee Manual

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TRANSAS

MAN B&W 6S60MC-C Diesel Engine – Tanker LCC. Trainee Manual

Contents

Introduction

Introduction contains the general description of the simulator architecture and prototype vessel.

Introduction

This Chapter contains:

1. Printing House Conventions

Sample of notation	Usage comments
`Router.exe`	To highlight messages, commands, files and other Windows OS information
New	To highlight menu items
Button	To highlight buttons
Log	To highlight path to a file, folder
Exit	To highlight names of windows, pages, interface elements, etc.
Refer to	To highlight references and links.
<Enter>	To highlight keyboard key names

2. Abbreviations

ACB	Air Circuit Breaker
AHU	Air Handling Unit
AOP	Additional Operator Panel
BMCS	Boiler Monitoring & Control System
BW	Bilge Well
C.F.W. (CFW)	Cooling Fresh Water
C.S.W. (CSW)	Cooling Sea Water
C/R	Control Room
CB	Circuit Breaker
CCC	Cargo Control Console
CCR	Cargo Control Room
CMS	Control Monitoring System
C.O.P.T. (COPT)	Cargo Oil Pump Turbine
DGU	DEIF Generator Unit
DU	Display Unit
E/G (EG) (EmG)	Emergency Generator
E/R (ER)	Engine Room
E/S	Engine Side
ECC	Engine Control Console
ECR	Engine Control Room
EMCY (EM'CY)	Emergency
ESB	Emergency Switch Board
EXH	Exhaust
F.O. (FO)	Fuel Oil
F.W. (FW)	Fresh Water
F/E	Finishing with Engine
FF	Fire Fighting
FP	Feeder Panel
FPP	Fixed Pitch Propeller
G/E (GE)	Generator Engine
GB	Generator Breaker
GPBP	Group Push Button Panel
GSP	Group Starter Panel
H.F.O. (HFO)	Heavy Fuel Oil
H.T. (HT)	High Temperature
HPP	Hydraulic Power Pack
HPU	Hydraulic Power Unit
I.G.G. (IGG)	Inert Gas Generator
J.W. (JW)	Jacket Water
L.O. (LO)	Lube Oil
L.P. (LP)	Low Pressure
L.S. (LS)	Low Sulfur
L.S.H.F.O. (LSHFO)	Low Sulfur Heavy Fuel Oil
L.S.M.D.O. (LSMDO)	Low Sulfur Marine Diesel Oil
L/T (LT, L.T.)	Low Temperature
LAH	Level Alarm High
LAL	Level Alarm Low
LCC	Large Crude (oil) Carrier
LCP	Local Control Panel
LGSP	Local Group Starter Panel
LIAH	Temperature Indicator Level High
LOP	Local Operating Panel
M.D.O. (MDO)	Marine Diesel Oil
M.G.O. (MGO)	Marine Gas Oil
M.G.P.S.	Marine Growth Prevention System
M/E (ME)	Main Engine
MCD	Main Circuit Diagram
MSB (MSBD, MSWB)	Main Switch Board
O.W.S. (OWS)	Oily Water Separator
P.C.O. (PCO)	Piston Cooling Oil
P/P (PP)	Pump(s)
PAH	Pressure Alarm High
PAL	Pressure Alarm Low
PB	Push Button
PD DB (PDB)	Power Distribution Board
PMS	Power Management System
R/U	Ready For Use
RCS	Remote Control System
S.W. (SW)	Sea Water
S/B	Stand-By
S/G (SG)	Steering Gear / Shaft Generator
ShG	Shaft Generator
S/T	Stern Tube
SC	Sea Chest
SH.	Shut
SL.	Slow
STP	Sewage Treatment Plant
T/C (TC)	Turbo compressor
TAH	Temperature Alarm High
TAL	Temperature Alarm Low
T/G (TG	Turbo Generator
TI	Temperature Indication
TIAH	Temperature Indicator Alarm High
TK	Tank
VIT	Variable Injection Timing
W	Water
W.B.P.T. (WBPT)	Water Ballast Pump Turbine

3. The Ship

The simulator is modeling the Propulsion Plant, Electric Power Plant, Control Monitoring System (CMS), auxiliary systems, equipment, units and mechanisms of a general Tanker LCC (Large Crude Oil Carrier). The prototype for development is Aframax Tanker 115,000 DWT.

Ship general characteristics:

Max. continuous rating (MCR)	13 736 kW at 105 RPM
Normal continuous rating (85% of MCR	12 364 kW at 101.4 RPM
Length overall	248.92 meters
Breadth, moulded	43.8 meters
Designed draft, moulded	14.925 meters
Service speed	15.5 knots

Tanker LCC general view

4. Simulator Architecture

The Tanker LCC simulator model has the Propulsion console and Virtual Hardware console comprising all displays to control and monitor the ship's systems, units and mechanisms.

The bottom bar of the simulator screen contains buttons with page names. Pages consist of displays. Click a button to open the page submenu. The list of displays of a selected page opens in the drop-down (actually, pull-up) menu. Figures shows the simulator Propulsion and Virtual Hardware consoles button bars, and an example page menu.

4.1. Consoles Button Bars

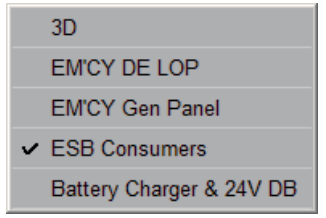
The pages (buttons on the button bar) of the Propulsion console are described in brief below:

- Displays of the page **BCC** model the Bridge control console panels;
- Displays of the page **ECR** model the Engine Control Room control console panels;
- Displays of the page **MSB** model the Electrical Power Plant Main Switchboard control panels;
- Displays of the page **CMS** model Control Monitoring System remote control displays on the ECR desk;
- Displays of the page **BMCS** model Boiler Monitoring & Control System remote control displays on the ECR desk;
- Displays of the page **Diag** model the diagnostic Cylinder Indicator Diagrams of the Main propulsion and Diesel engines of the generators, and combustion process;
- Displays of the page **SYS** contain mimics of the ship's systems. They model manual remote and local control of the respective units and mechanisms.
- The following pages model equipment control in the ship engine rooms:
  - **SG** – Steering Gear room page;
  - **ER1** – Engine Room 1 page;
  - **ER2** – Engine Room 2 (Deck 2) page;
  - **ER3** – Engine Room 3 (Upper Deck) page;
  - **ER4** – Engine Room 4 (Deck A) page;
  - **FFR** – Fire Fighting Room page.
  - **EmG** – Emergency Generator room page;
  - **CCR** – Cargo Control Room page.

The displays of a page menu contain mimics of the Local Operating Panels (LOPs) of the units and mechanisms, switchboards (SWBDs), power distribution boards (PDBs), group starter panels (GSP), etc. and the 3-D pictures of the engine rooms where applicable.

The pages of the Virtual Hardware console are:

- **GSP1** – No. 1 Group Starter Panels;
- **GSP2** – No. 2 Group Starter Panels;
- **CCP** – Cargo Control Panel;
- **EG** – EM'CY Generator Engine panel;
- **ESB** – Emergency Switchboard and Shore connection panels;
- **G1** – Generator 1 upper and lower panels;
- **G2** – Generator 2 upper and lower panels;
- **FP1** – MSB No. 1 Feeder AC440V upper and lower panels;
- **FP2** – MSB No. 2 Feeder AC440V upper and lower panels;
- **BUS** – Bus Tie panel;
- **ShG** – MSB Shaft Generator upper and lower panels;
- **Syn** – MSB Synchro upper and lower panels;
- **TG** – MSB Turbo Generator upper and lower panels;
- **ECR** – Engine Control Room panels;
- **220v** – MSB Feeder AC220V upper and lower panels;
- **Full** – unified system diagram (as video wall).



Example menu (EmG page)

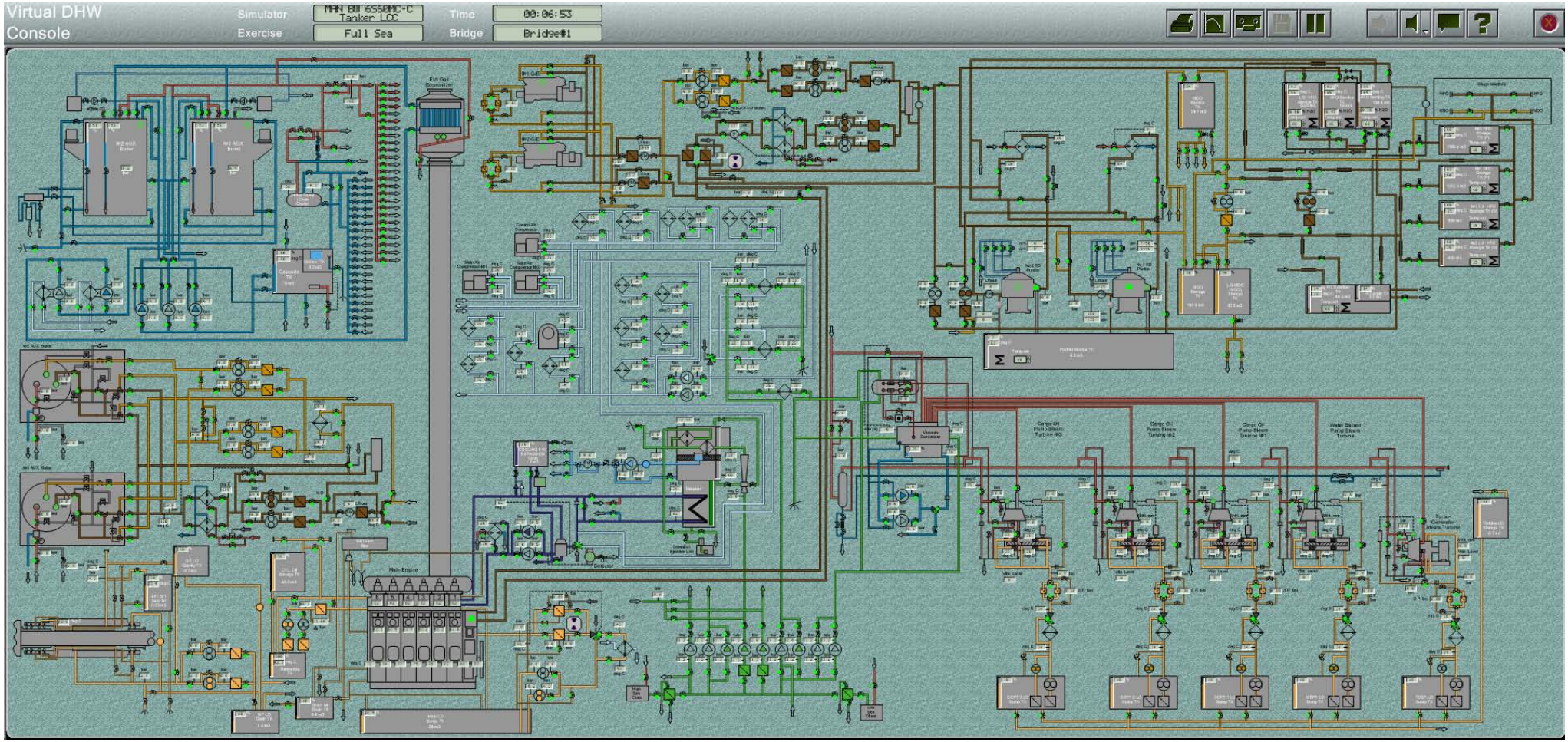
Bottom bar of the Propulsion console

Bottom bar of the Virtual Hardware console

4.2. Unified System Diagram

The unified system diagram is designed to control the ship systems and demonstrate their interaction and interconnections. It is implemented as a video wall comprising four “vertical” monitors (touch screen feature is supported) at resolution of 1920x1080 each.

Click on the menu item **Full** on the virtual **DHW** console bottom bar to open the diagram.



4.3. LCS Software

The Loading Control System (LCS) software kit `LCS 7957 LCC Tanker – 'Initial'` is designed for calculating and controlling the vessel's loading, trim and stability in the course of its operation, as well as for:

- Calculating the vessel loading by entering data on the ship's provisions, liquid cargoes, water ballast and cargoes carried; saving the input loading data in the computer memory; LCS help system allows the trainee to familiarize with the system and its options;
- Estimating an intact vessel trim, stability and longitudinal strength data, comparing it with the allowed values.

Note: **The LCS and the task `model` would always both run on the same computer.**

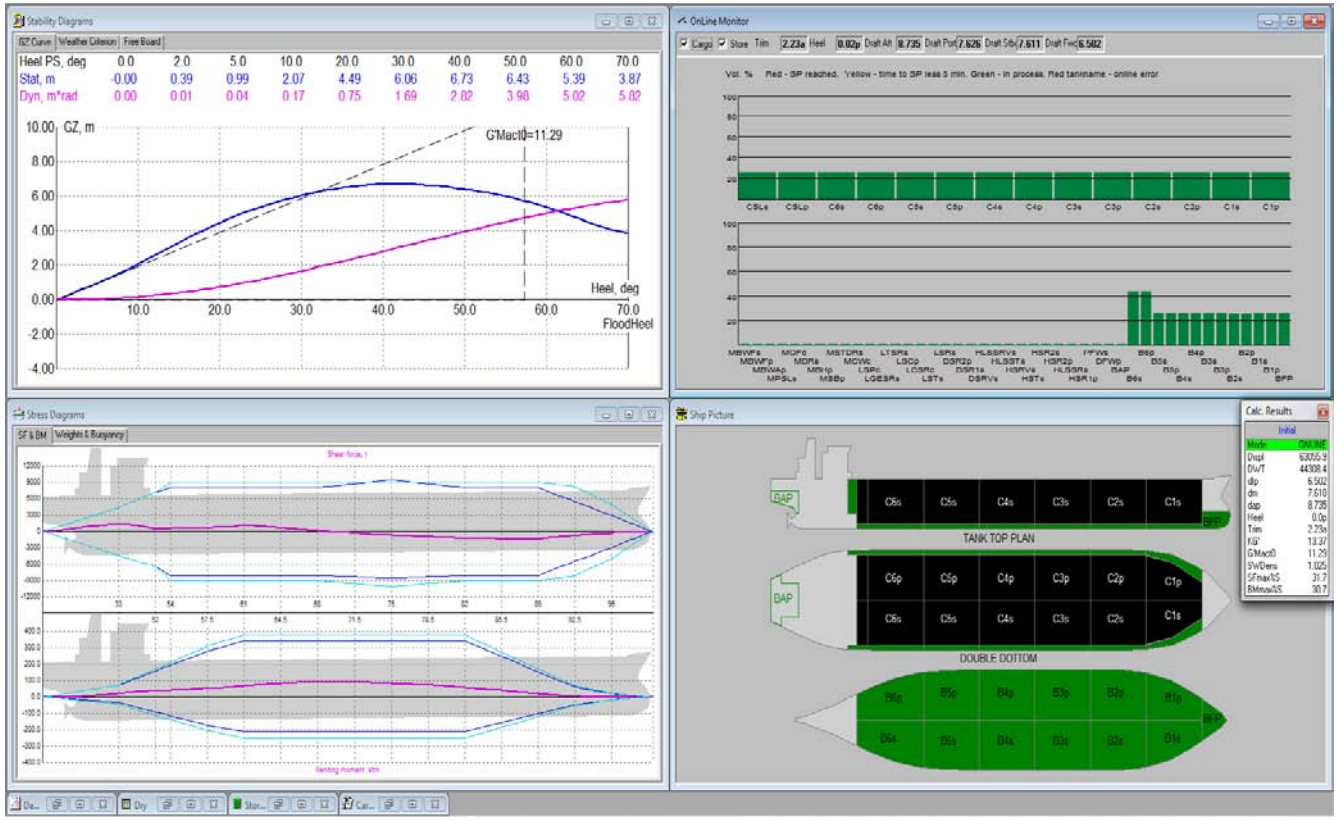
During the execution of an exercise the simulator model communicates with the LCS and sends the information about the volumes and density of the liquids in cargo and ballast tanks. Using this data the LCS calculates the vessel loading, trim and stability parameters. These values are displayed in the LCS dedicated windows and are also displayed on the CMS panels of the simulator.

LCS can be switched between Online and Standard modes.

- In Online mode, LCS constantly receives the actual values of Volume, Density and Temperature for cargo tanks.
- In Standard mode the parameters of cargo tanks and store tanks can be edited manually.

Note : **When the simulator is running, the LCS must be in Online Mode. Switch to Standard mode only when the exercise is paused.**

Note : **In Online mode, make sure, that the Product column in the Cargo Tanks window is empty for each of cargo tanks. This is required for correct displaying of actual values.**



To change the density of outside water during an exercise:

1. Set the simulator to Pause.
2. Switch LCS to Standard mode.
3. Edit the parameter **Water density** in the **Utilities/Voyage condition** window.
4. Switch back to Online mode and continue the exercise.

4.3.1. LCS Loading

During ERS–LCHS joint operation LCS starts automatically at simulators start. When ERS model runs standalone LCS software loading can be disabled in the **`Configuration Editor`** application. For both **Model** tasks, in the tab **Technological Simulator 5000**, select the **MAN BW 6S60MC-C Tanker LCC** item from the drop down list, and put the tick into the check box. Refer to the ***Installation & Configuration manual*** for detalied description of the **`Configuration Editor`**.

4.4. 3D Visualization

Photographic pictures of the Bridge, Engine Control Room, MSB Room, and Emergency Generator Room are displayed for the background of respective pages to provide realistic view.

Engine room pages contain **3D** simulation displays of the respective location. The **3D** displays are implemented for:

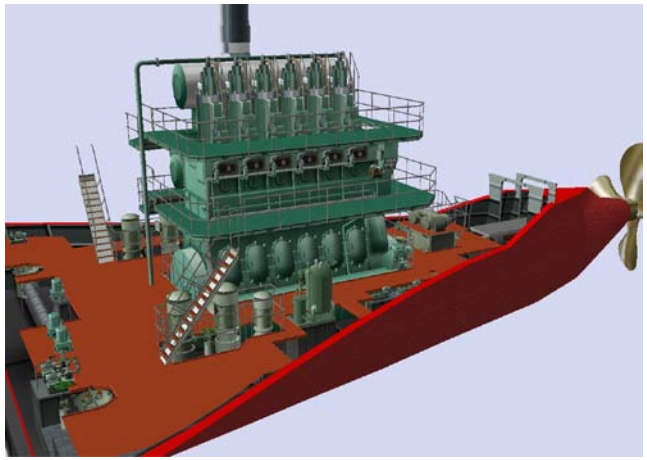
- Engine room 1 (**ER1** page);
- Engine room Deck 2 (**ER2** page);
- Engine room Upper Deck (**ER3** page);
- Engine room Deck A (**ER4** page);
- Steering Gear room (**SG** page).

Examples are presented on the figures below.

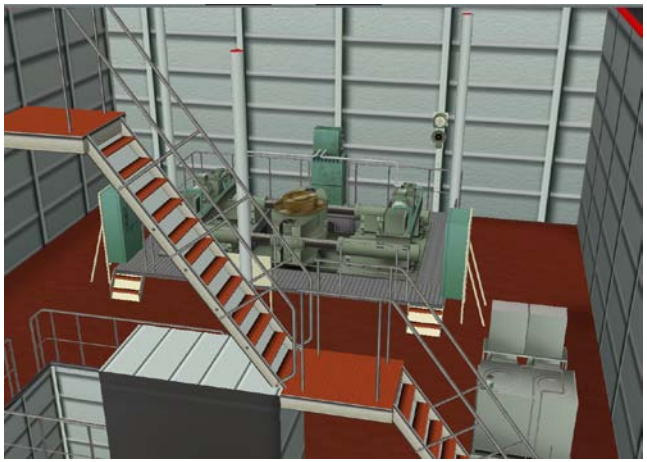
To give a look-over of the room click and hold the right mouse button while moving it around: the 3D scene will rotate. Zoom in and out the scene using the mouse wheel. Click and hold the left mouse button to move the scene around the display.

To open a local control panel or push button box (e.g. to control a pump) double-click on the mechanism's image. These panels are also called from the menu items of respective **ER** pages. An example is presented on the figure.

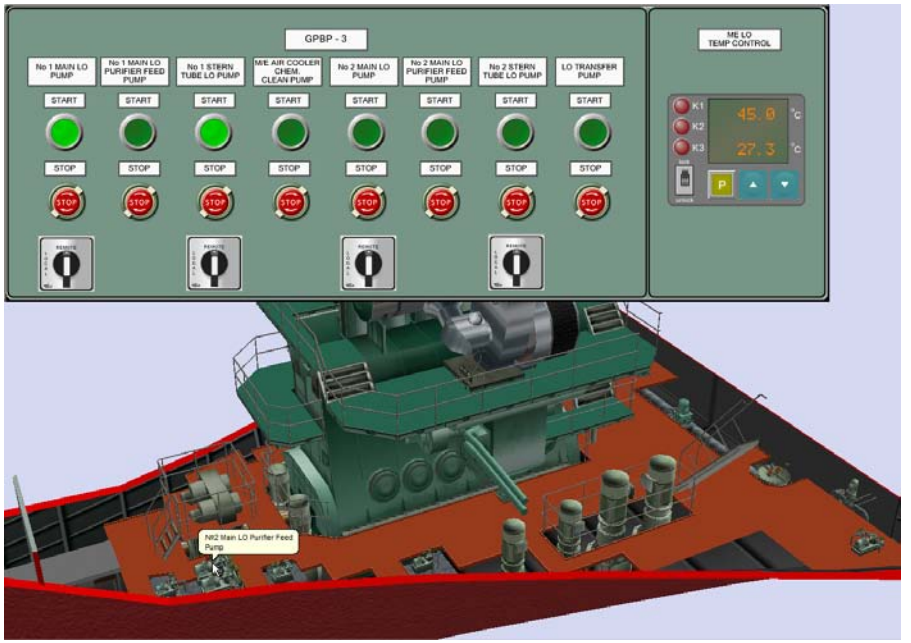
Direct control from **3D** displays is implemented for Main Engine manual control (see ***Chapter 1*** for detailed description) and emergency steering control (see ***Chapter 4*** for detailed description).



3D display of ER1 page



3D display of SG page



Example: Push Button Box GPBP - 3 for control of №2 Main LO Purifier Feed Pump

5. General Controls in the Simulator

Pumps can be manually controlled from the starter panels located on the switchboards, and from the push button boxes located on the pump itself.

5.1. Push Button Box

Push button (PB) boxes are used for local operating of pumps, compressors, etc., comprising:

- Mechanism nameplate;
- **START** push button;
- **STOP** button with a blocking ring. Click on the button center (red) to simply stop the mechanism. Click (or turn) on the button border (gray) to stop the mechanism and block its start; the button stays in pressed state. To unblock, click on the border; the button depresses;

- Two-position control mode selector switch (optional):
  - **LOCAL** – control is possible only from this box;
  - **REMOTE** – control is possible from group starter panel (GSP) and/or from CMS display.

5.2. Group Starter Panels

Group Starter Panels (GSP) on simulator displays vary slightly for different types of mechanisms. The figures present standard contents of such panels.

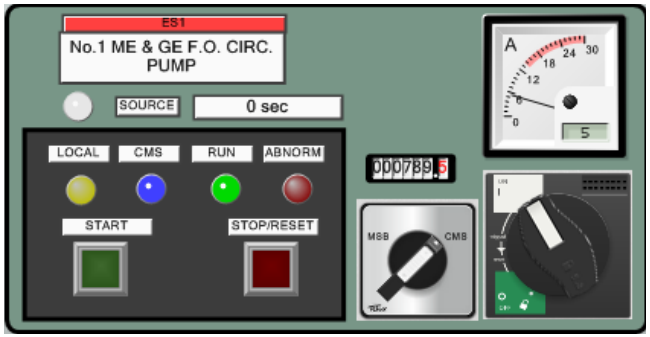
The MSB GSP contains:

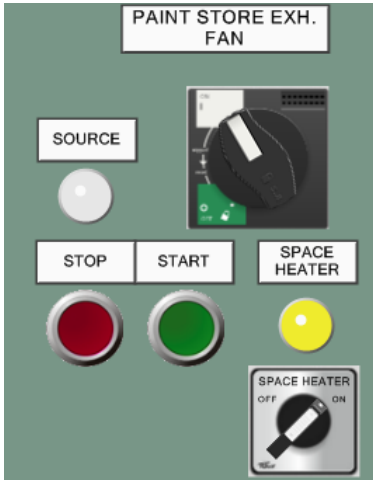
- Label with the name of mechanism;
- Color labels with the description of trip type (e.g. ES2), and white labels with restart sequence delay time;
- Power switch – automatic circuit breaker;
- Ammeter;
- Run hours counter;
- **SOURCE** indicator lamp to illuminate when power in On;
- **LOCAL** indicator lamp to illuminate when the mechanism is set to LOCAL control mode on the push button box panel; control from this GSP is disabled;
- Two-position control mode selector switch:
  - **MSB** – control is possible from this panel; on CMS display the mechanism is marked by MSB label;
  - **CMS** – control is possible from CMS display; on CMS display the mechanism is marked by CMS label. **CMS** blue indicator lamp illuminates.
- **RUN** indicator lamp;
- **ABNORM** indicator lamp to illuminate when mechanism fault/breakage occurs;
- **START** and **STOP/RESET** push buttons to operate from this panel (the mechanism should be set to REMOTE control state on the push button box panel);

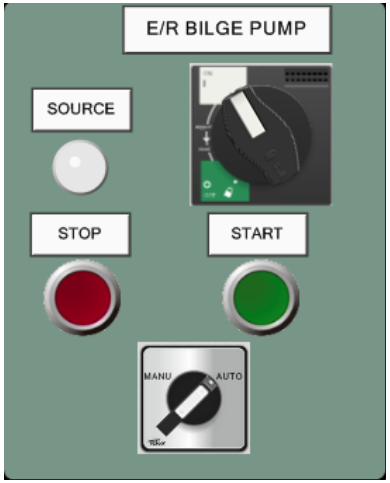
In most cases CMS control is provided for the pumps, which operate in duty/standby configuration.

On the MSB starter panels of the mechanisms, which are not subject to CMS control, there are no selector switch and respective lamps (e.g. fan panels).

Local GSPs will contain the main controls, such as power switch and operation buttons, and also can provide AUTO/MANUAL mode selector switch and heater unit controls..



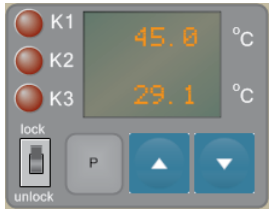




5.3. Thermocontroller

Thermocontrollers are used to setpoint the temperature values for various systems' automatics and to monitor the current temperatures.

The controller display outputs the Set Point in the upper line and the Current value in the lower line.



Controller LED Indicators

- The **K1** indicator illuminates when the output Temperature alarm occurs.
- The **K2** indicator illuminates when the Power failure alarm occurs.
- The **K3** indicator illuminates when the control valve triggers.

Controller can operate in the following three modes:

Mode #1 "Job Controller"

- The switch **lock–unlock** is in position **lock**.
- The upper line displays the task regulator.
- The lower line displays the current value of the adjustable parameter.

Mode #2 "Set Value"

Press the **P** button to enable the **more** and **less** buttons.

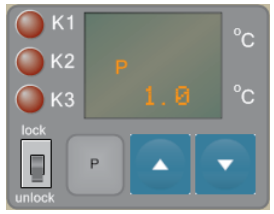
- The switch **lock–unlock** is in position **lock**.
- Use the **more** and **less** buttons to set the required value in the upper line.

Press the **P** button to confirm the setting and return to Mode # 1.

Mode #3 "Control Setting"

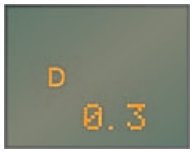
Turn the switch **lock–unlock** into position **unlock** set the Mode #3. The **more** and **less** buttons are enabled. The **P** button is used to switch the screen into modes "P", "I" and "D" in a round robin way and change their parameters.

- Press the **P** button. The screen changes the form to:



- Set the "P" proportional coefficient value in the lower line using the **more** and **less** buttons. Press the **P** button to confirm the setting and change the screen to the form:

- Set the "I" integral coefficient value in the lower line using the **more** and **less** buttons. Press the **P** button to confirm the setting and change the screen to the form:



- Set the "D" coefficient value in the lower line using the **more** and **less** buttons. Press the **P** button to confirm the setting and return the screen to the form with the "P" parameter.

Turn the switch **lock–unlock** into position **lock** to turn the controller into Mode #1.

5.4. SET-DIFF Controllers

Controllers can set temperature, pressure.

- **Heater** Controller contains:
  - The display **°C** to show the actual temperature;
  - The **DIFF** regulator to set the value controlling the heater automatic stop – when the temperature is below the **RANGE-DIFF** value;
  - The **SET T** illuminated latched button; press the button to operate the **RANGE** regulator; the button illuminates, the display shows the set value; press the button again to lock the values; the button lights down;
  - The **RANGE** knob to set the temperature value upon reaching which the heater will stop.
- **Boiler** Controller contains:
  - The display **BAR** to show the actual temperature;
  - The **DIFF** regulator to set the value controlling the boiler automatic stop – when the pressure is below the **RANGE-DIFF** value;
  - The **SET P** illuminated latched button; press the button to operate the **RANGE** regulator; the button illuminates, the display shows the set value; press the button again to lock the values; the button lights down;
  - The **RANGE** knob to set the pressure value upon reaching which the boiler will stop.

Chapter 1. Propulsion Plant

This chapter contains the description of the simulator tools for training the watch personnel of the vessel in skills of correct operating the Tanker LCC Propulsion Plant.

Chapter 1. Propulsion Plant

This chapter contains:

1. Introduction

The propulsion system is designed to provide reliable, efficient and economical motive power for the Ship in automatic, semi-automatic or manual propulsion modes to meet the ship's demands in motion and manoeuvring under standard and emergency conditions.

The simulator models the Propulsion Plant of the Tanker LCC prototype ship.

The Propulsion Plant is MAN B&W 6S60MC-C, two strokes, slow speed, turbocharged, reversible main diesel engine, MCR 18,420 BHP at 105 RPM and Fixed Pitch Propeller (NCR, 85% MCR – 16,580 BHP at 101,4 RPM).

The Ship Propulsion Plant simulation is designed for training the engine room watch personnel in skills required for the proper operation of the Propulsion Plant, including:

- Preparation of equipment/systems for operation, startup and shutdown;
- Operating the PP when manoeuvring the ship;
- Monitoring of operation using variable parameters;
- Trouble shooting.

In addition to training in practical skills, the simulator allows the user to learn the basic principles of the arrangement, functions and interaction of PP components and systems.

The parameters and features of simulated mechanisms and systems correspond to the real life as the simulator models all main PP processes (heat, mechanical, gas- and hydrodynamic, and electrical) in their interconnection.

1.1. Propulsion Plant Remote Control System

The main engine Remote Control System (RCS) provides the following performance of the main engine with a micro-processor from the bridge by operating a single telegraph transmitter: reversing, starting, and stopping electrically-pneumatically; speed setting electrically.

And in case of control room control, main engine is controlled by means of telegraph receiver for reversing, and by means of manoeuvring handle for starting, stopping and speed setting.

An engine side control system is provided on the main engine for the case of the emergency in failure of the remote control system or the governor, etc.

In addition, there is provided a safety system, which automatically slows down or automatically shuts down the main engine under electric-pneumatic control at emergency such as abnormal condition of the main engine.

A manually emergency shut down device is provided to be able to shut down the main engine under electric-pneumatic control for emergency such as failure of the RCS.

Furthermore, in case of control room and engine side control, telegraph transmitter on the bridge is used as normal engine telegraph.

Manoeuvring Method

	Manoeuvring method	**Speed control method**	**Safety system**
Bridge	Automatic control by means of telegraph transmitter (Micro-computer-pneumatic control)	Governor control by electric signal from telegraph transmitter	Manual emergency shut down Automatic emergency shut down Automatic emergency slow down
Control room	Manual control by means of telegraph receiver and manoeuvring handle (Electric-pneumatic control)	Governor control by electric signal from manoeuvring handle	Manual emergency shut down Automatic emergency shut down
Engine side	Manual control by means of fuel regulating wheel, reversing lever and push button (Mechanical, pneumatic control)	Fuel regulation shaft control by fuel regulation wheel	Manual emergency shut down Automatic emergency shut down

2. PP Remote Control from the Bridge

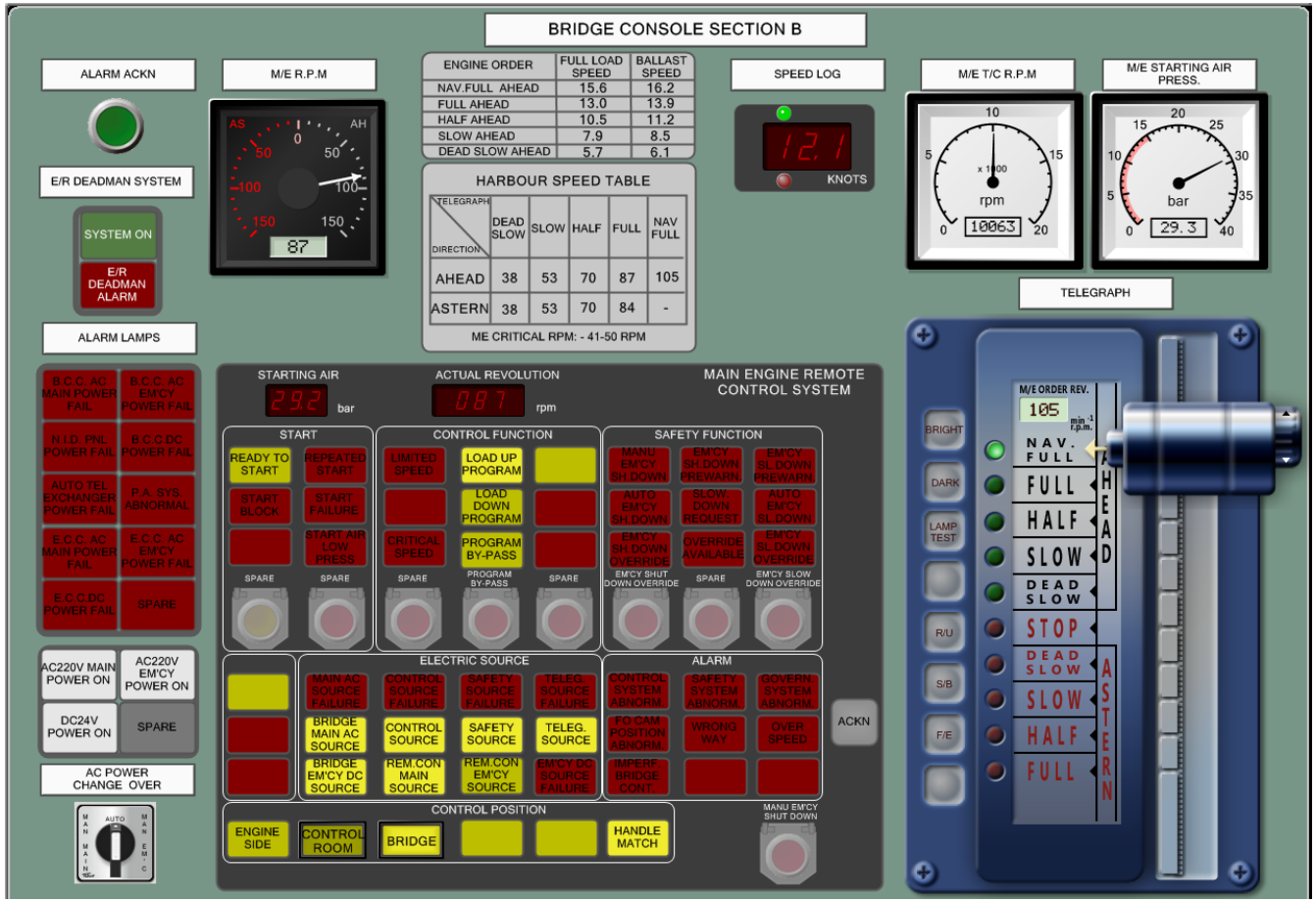
Displays of the page BCC contain the Bridge control consoles section A (SG and Fire pumps control), and section B (alarm, ME remote control system, safety system and governor control unit) simulation. Fire station and emergency control and monitoring is also available from the Bridge, as well as Inert Gas Generator monitoring. Propulsion plant control is executed from BCC console B.

2.1. Bridge Control Console Section B

Click the menu item **BCC B** of the page **BCC** to open the display **BRIDGE CONSOLE SECTION B.**

The display contains:

- **ALARM ACKN** button to acknowledge alarms indicated by the **ALARM LAMPS** below;
- **M/E R.P.M.** gauge;
- **E/R DEADMAN SYSTEM** indicators, which highlight to signal SYSTEM ON or E/R DEADMAN ALARM (see ***Chapter 4***);
- **ENGINE ORDER** table and **HARBOUR SPEED TABLE**;
- **SPEED LOG** gauge comprising: digital speed indicator, green lamp, which illuminates when moving ahead (speed positive), and red lamp, which illuminates when moving astern (speed negative);
- **M/E T/C R.P.M.** gauge;
- **M/E STARTING AIR PRESS.** gauge;
- **ALARM LAMPS** on the panel illuminate to indicate the following power failure alarm conditions:
  - **B.C.C. AC MAIN POWER FAIL**;
  - **B.C.C. AC EM'CY POWER FAIL**;
  - N.I.D. PNL POWER FAIL – not modeled;



- **B.C.C. DC POWER FAIL**;
- **AUTO TEL EXCHANGER POWER FAIL**;
- **P.A. SYS ABNORMAL**;
- **E.C.C. AC MAIN POWER FAIL**;
- **E.C.C. AC EM'CY POWER FAIL**;
- **E.C.C. DC POWER FAIL**.

- **AC220V MAIN POWER ON** indicator lamp, which illuminates when 220V AC power supply is available from MSB;
- **AC220V EM'CY POWER ON** indicator lamp, which illuminates when 220V AC power supply is available from ESB;
- **DC24V POWER ON** indicator lamp, which illuminates when 24V DC power supply is available;

- **AC POWER CHANGE OVER** switch to select power source manually between: MAN MAIN / MAN EM'CY; or set AUTO selection by RCS;
- **MAIN ENGINE REMOTE CONTROL SYSTEM** panel (see the description below);
- **TELEGRAPH** transmitter (see the description below).

The **MAIN ENGINE REMOTE CONTROL SYSTEM** panel contains:

- **STARTING AIR;** and **ACTUAL REVOLUTION** indicators;
- **START** panel lamps, which illuminate to indicate:
  - **READY TO START**;
  - **REPEATED START** repeater start procedures, see indication on the diagram of ECC C Top panel (***the paragraph 3.2 on page 22***);
  - **START BLOCK** at starting , when ready to start is off;
  - **START FAILURE**;
  - **START AIR LOW PRESS**.
- **CONTROL FUNCTION** panel lamps, which illuminate to indicate:
  - **LIMITED SPEED** attempt to exceed the speed limit set in Safety system, see ***the paragraph 3.2 on page 22***;
  - **LOAD UP PROGRAM / LOAD DOWN PROGRAM** at ahead remote speed control in the range of 80~MAX rpm ;
  - **CRITICAL SPEED** speed is in the range 41~50 rpm for > 5 sec.;
  - **PROGRAM BY-PASS** – LOAD UP / LOAD DOWN programs are switched off by **PROGRAM BY-PASS** button;
  - **PROGRAM BY-PASS** button with protection cover.
- **SAFETY FUNCTION** panel lamps, which illuminate to indicate:
  - **MANU EM'CY SH.DOWN** manual ME EM'CY stop executed;
  - **EM'CY SH.DOWN PREWARN** shut down condition exists, and timer is ON;
  - **EM'CY SL.DOWN PREWARN** slow down condition exists, and timer is ON;
  - **AUTO EM'CY SH.DOWN** shut down is ON;
  - **SLOW DOWN REQUEST** slow down override is set, or ME is under local control, or slow down has been reset but the conditions were not cleared;
  - **AUTO EM'CY SL.DOWN** slow down is ON;
  - **EM'CY SH.DOWN OVERRIDE** button **EM'CY SHUT DOWN OVERRIDE** was pressed – emergency run function is ON;
  - **OVERRIDE AVAILABLE** the slow down or shut down pre-warning, or condition can be by-passed;
  - **EM'CY SL.DOWN OVERRIDE** button **EM'CY SLOW DOWN OVERRIDE** was pressed – emergency run function is ON;
  - **EM'CY SHUT DOWN OVERRIDE** and **EM'CY SLOW DOWN OVERRIDE** buttons with protection cover.
- **ELECTRIC SOURCE** panel lamps, which illuminate to indicate the following power source state and failure alarm conditions:
  - **MAIN AC SOURCE FAILURE** ;
  - **BRIDGE MAIN AC SOURCE** ;
  - **BRIDGE EM'CY DC SOURCE** ;
  - **CONTROL SOURCE FAILURE** ;
  - **CONTROL SOURCE** ;
  - **REM.CON MAIN SOURCE** ;
  - **SAFETY SOURCE FAILURE** ;
  - **SAFETY SOURCE** ;
  - **REM.CON EM'CY SOURCE** ;
  - **TELEG. SOURCE FAILURE** ;
  - **TELEG. SOURCE** ;
  - **MAN/EM'CY SOURCE FAILURE** .
- **ALARM** panel lamps, which illuminate to indicate the following alarm conditions:
  - **CONTROL SYSTEM ABNORMAL / SAFETY SYSTEM ABNORMAL / GOVERN. SYSTEM ABNORMAL** alarm in the respective system (see ECC C in ***the paragraph 3.2 on page 22***);
  - **F.O. CAM POSITION ABNORMAL** see indication on the local panel in ***the paragraph 4.2 on page 30***;
  - **WRONG WAY** sailing direction on the Bridge and ECR (or local panel) do not coincide;
  - **OVER SPEED**;
  - **IMPERF. BRIDGE CONT.** control from the Bridge is impossible: any power source alarm of the bridge consoles, or turning gear is engaged, or no starting air is available;
- **ACKN** button to acknowledge RCS alarms;
- **CONTROL POSITION** panel to indicate control position, request and accept control change over (see the description below);
- **MANU EM'CY SHUT DOWN** button with protection cover. Click once to open the cover; click second time to push the button and shut down the ME.

2.1.1. Control Position Change Over from Bridge

Change over is performed on control consoles **BCC B** (see ***the paragraph 2.1 on page 17***) and **ECC C Bottom** (see ***the paragraph 3.3 on page 26***).

1. Control is at the Bridge:

   On **BCC B** console **BRIDGE** button is illuminated on **CONTROL POSITION** panel;
   On **ECC C Bottom** console **BRIDGE** lamp is illuminated on **M/E INDICATOR PANEL**.

› To request control change over from Bridge to ECR, click the **CONTROL ROOM** button on **BCC B** console. The button light and **CONTROL ROOM** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** start flashing.

› To accept control position change over on **ECC C Bottom** console, set the **M/E CONTROL POSITION CHANGE OVER** switch to ECR.

CONTROL ROOM button on **BCC B** console, and **CONTROL ROOM** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** turn to steady light to indicate the change over.

2. Control is at the ECR:

On **BCC B** console **CONTROL ROOM** button is illuminated on **CONTROL POSITION** panel;
On **ECC C Bottom** console, lamp **CONTROL ROOM** is illuminated on **M/E INDICATOR PANEL**.

› To request take control from Bridge, click the **BRIDGE** button on **BCC B** console. The button light and **BRIDGE** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** start flashing.

› To accept control position change over on **ECC C Bottom** console, set the **M/E CONTROL POSITION CHANGE OVER** switch to BRIDGE.

BRIDGE button on **BCC B** console, and **BRIDGE** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** turn to steady light to indicate the change over.

ENGINE SIDE indicator illuminates when control is executed from the engine side LOP.

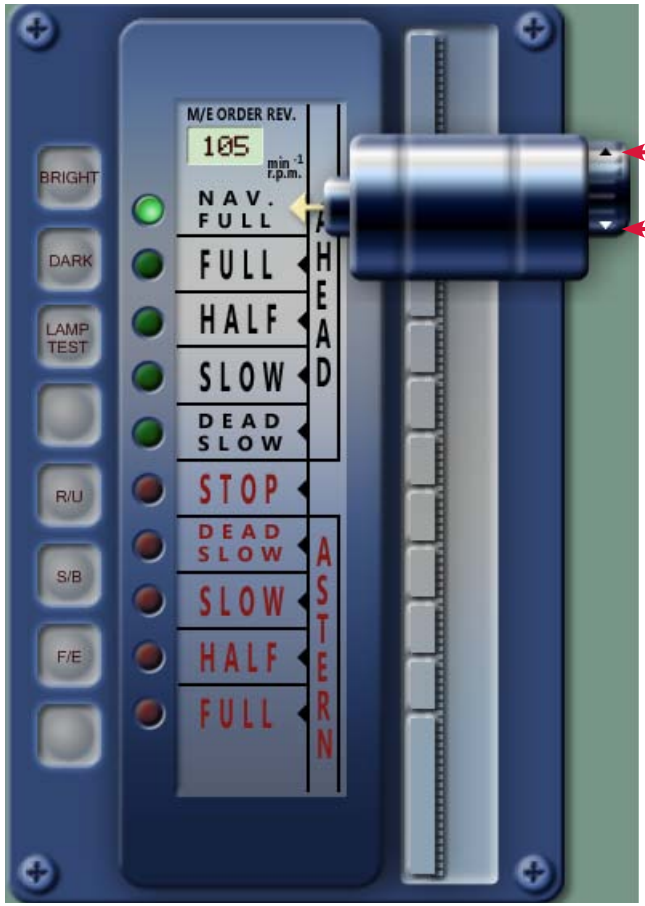
HANDLE MATCH indicator illuminates when telegraph positions at the Bridge and ECR match.

2.1.2. Telegraph Transmitter Operation

Telegraph transmitter on the Bridge console is used for ordering the ME speed.

TELEGRAPH transmitter contains:

- Buttons:
  - **BRIGHT** – press and hold to increase brightness of the telegraph sectors;



  - **DARK** – press and hold to decrease brightness of the telegraph sectors;
  - **LAMPTEST** – press to illuminate all indicator lamps on the scale for testing;
  - **R/U** – Ready For Use;
  - **S/B** – Stand-By;
  - **F/E** – Finishing with Engine.
- **M/E ORDER REV.** digital indicator of the ordered ME speed in min^{-1} r.p.m.;
- Speed scale comprising following sectors & lamps:
  - **NAV. FULL AHEAD** – 105/108 (central/max pos.) rpm; overspeed – 110 rpm;
  - **FULL AHEAD** – 87/95 rpm;
  - **HALF AHEAD** – 75/80 rpm;
  - **SLOW AHEAD** – 53/67 rpm;
  - **DEAD SLOW AHEAD** – 38/48 rpm;
  - **STOP** – 0 rpm;
  - **DEAD SLOW ASTERN** – -38 rpm;
  - **SLOW ASTERN** – -53 rpm;
  - **HALF ASTERN** – -75 rpm;
  - **FULL ASTERN** – -84 rpm (-86 max).
- Telegraph handle; drag the handle to required position using the mouse.

The handle always sets to central position of a sector. Click the small up or down arrows on the handle to adjust the order by 1 rpm; actual value is displayed in the **M/E ORDER REV.** box.

3. PP Remote Control from the ECR

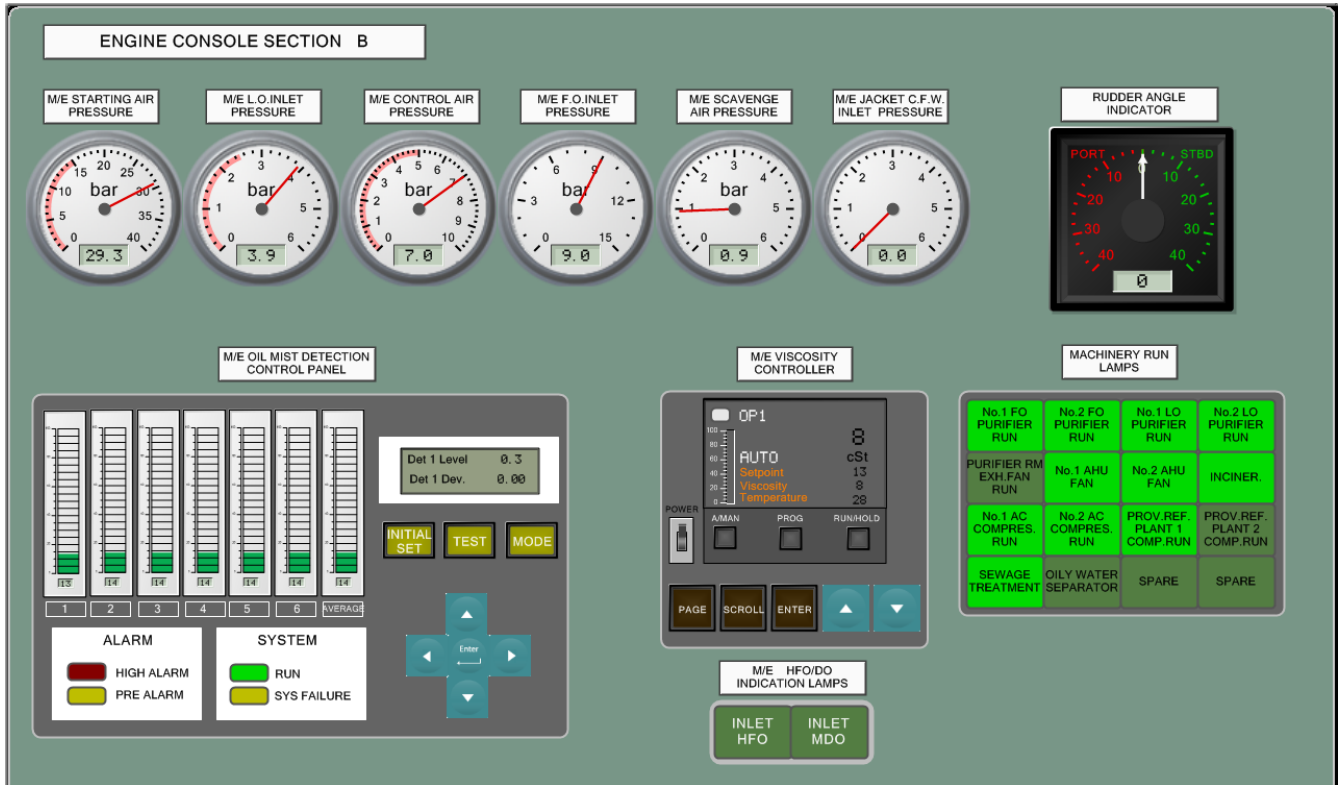
Displays of the page **ECR** contain simulation of the Engine Room Control Console (ECC) panels **A**, **B**, **C Top**, and **C Bottom**. Fire and emergency control and monitoring is also available from the Bridge, as well as Inert Gas Generator monitoring. Propulsion plant control is executed from ECC panels B and C.

3.1. ECR Control Console Section B

Click the menu item **ECC B** of the page **ECR** to open the display.

The console contains:

- **M/E STARTING AIR PRESSURE**, **M/E L.O. INLET PRESSURE**, **M/E CONTROL AIR PRESSURE**, **M/E F.O. INLET PRESSURE**, **M/E SCAVENGE AIR PRESSURE**, **M/E JACKET C.F.W. INLET PRESSURE** gauges;
- **RUDDER ANGLE INDICATOR** gauge; green – STBD, red – PORT;
- **M/E OIL MIST DETECTION CONTROL PANEL** comprising:
  - Scales and digital indicators of oil mist content in each ME cylinder, and **AVERAGE** value;
  - **ALARM** indicators for **HIGH ALARM** (value > 1.5 – slow down condition) and **PRE ALARM** (deviation > 0.4, or value > 1.5) on any of the detectors);
  - **SYSTEM** indicator for **RUN** indication; SYS FAILURE indicator is not modeled;
  - LCD screen with indication of the **Level** and **Deviation** values in oil mist detectors;
  - INITIAL SET, TEST, MODE and right and left arrow buttons are not modeled;
  - Arrow **UP** and Arrow **DOWN** buttons to browse the list of detectors on LCD screen.



- **M/E VISCOSITY CONTROLLER** panel (see description in *the paragraph 3.1.1 on page 21*);
- **M/E HFO/DO INDICATOR LAMPS** to show the actual M/E FO supply: **INLET HFO**, **INLET MDO**;
- **MACHINERY RUN LAMPS** to illuminate when respective systems are running:
  - **No.1 FO PURIFIER RUN**; **No.2 FO PURIFIER RUN**;
  - **No.1 LO PURIFIER RUN**; **No.2 LO PURIFIER RUN**;
  - **PURIFIER RM EXH.FAN RUN**;
  - **No.1 AHU FAN**; **No.2 AHU FAN**;
  - **INCINER.**;
  - **No.1 AC COMPRES. RUN**; **No.2 AC COMPRES. RUN**;
  - **PROV.REF. PLANT 1 COMP. RUN**; **PROV.REF. PLANT 2 COMP. RUN**;
  - **SEWAGE TREATMENT**;
  - **OILY WATER SEPARATOR**.

3.1.1. Operating ME Viscosity Controller

Controller contains:

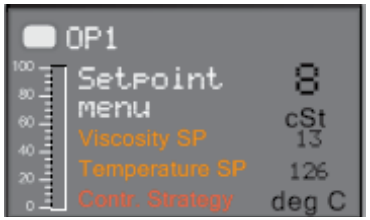
- **POWER** switch to turn power on/off;
- **OP 1** indicator, which flashes in white when power is on;
- Bar graph to indicate the open state of the Viscosity system inlet valve, which is controlled by the viscosity system;
- Screen indicators of the mode and parameters values; the buttons A/MAIN, PROG, RUN/HOLD are not modeled;
- **PAGE** button to switch between screens;
- **SCROLL** button to select parameters;
- **ENTER** button to confirm the setting;
- **Up** and **Down** arrows to increase/decrease the chosen value.

In the simulator only the AUTO (Heating) mode of the viscosity controlled is modeled.

The first (main) screen displays:

- Actual value and units of the parameter in large font (in the figure above control strategy is set by viscosity, the actual value equals 8 cSt);
- Lower lines display the current set point values of the system in smaller font.

Click the **PAGE** button to switch to second screen where parameters can be modified:



› Use the **SCROLL** button to select the **Contr. Strategy** line.

› Use any arrow button to change the units (**cSt/deg C**). Click **ENTER** button to confirm.

› Use the **SCROLL** button to select the respective SP (Viscosity SP/Temperature SP).

› Use **Up** and **Down** arrow buttons to modify the value as required. Click **ENTER** button to confirm.

Click the **PAGE** button to return to main screen. The set point unit should change.

When the controlled parameter value falls out of range the **OP 1** indicator turns into red **ALM**.

Switch to the **Alarm Settings** screen by the **PAGE** button. The screen displays actual and limit values of the viscosity system current strategy:

The viscosity controller is powered 220V AC from the Engine Control console by **ENGINE CONTROL CONSOLE** circuit breakers on: **AC220V FEEDER PANEL** (use menu item **MSB 220V Feeder** of the page **MSB**) or **EM'CY AC220V FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**).

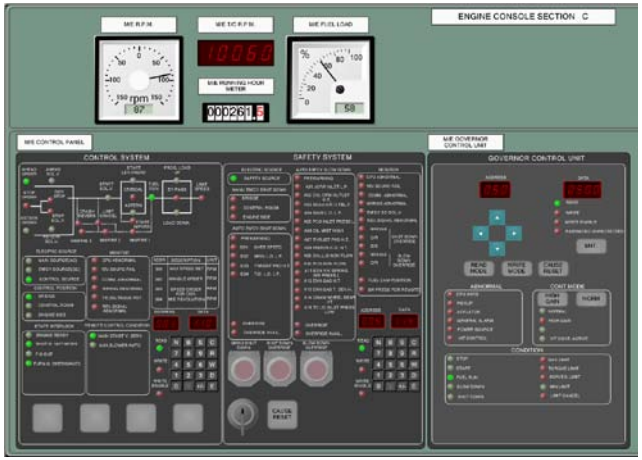
3.2. ECR Control Console Section C Top Panel

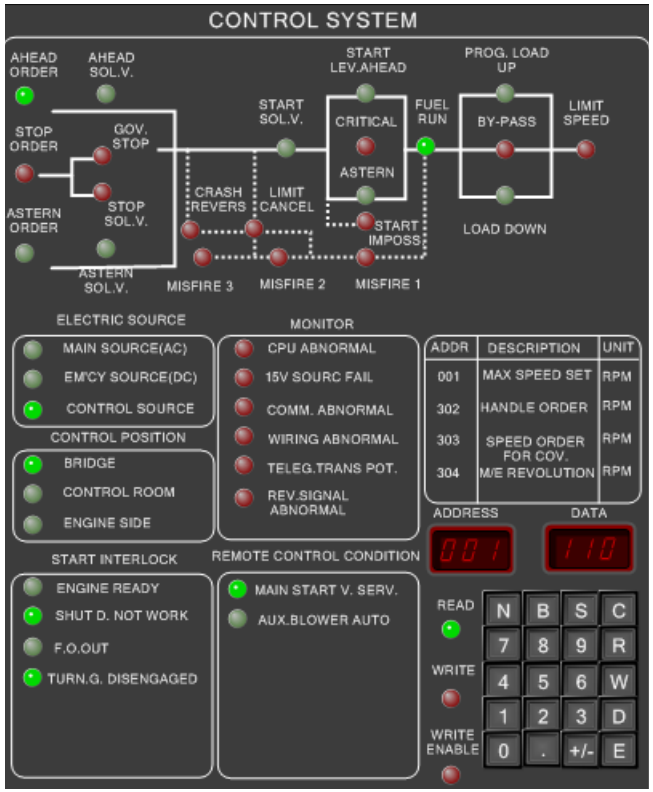
Click the menu item **ECC C Top Panel** of the page **ECR** to open the display of the main engine Remote Control System (RCS).

The console contains:

- **M/E R.P.M.** gauge;
- **M/E T/C R.P.M.** digital gauge;
- **M/E RUNNING HOUR METER**;
- **M/E FUEL LOAD** gauge;
- **M/E CONTROL PANEL** of the RCS comprising **CONTROL SYSTEM** and **SAFETY SYSTEM** panels (described below);
- **M/E GOVERNOR CONTROL UNIT** panel (described below).

In further descriptions not modeled controls are omitted.





3.2.1. Remote Control System Panel

The **CONTROL SYSTEM** panel contains:

- System diagram with indicator lamps;
- **ELECTRIC SOURCE** lamps illuminate when power is available:
  - **MAIN SOURCE (AC)** ;
  - **EM'CY SOURCE (DC)** ;
  - **CONTROL SOURCE** .
- **CONTROL POSITION** indicator lamps: **BRIDGE**; **CONTROL ROOM**; **ENGINE SIDE**;
- **MONITOR** alarm lamps:
  - **CPU ABNORMAL** / **15V SOURCE FAIL** / **TELEG. TRANS POT** – faults by the instructor;
  - **WIRING ABNORMAL** any of the above alarms; on the BCC B the alarm lamp **CONTROL SYSTEM ABNORMAL** illuminates.
- **START BLOCK CONDITION** lamps illuminate to indicate start block conditions:
  - **ENGINE READY**;
  - **SHUT D. NOT WORK** ;
  - **F.O. OUT** ;
  - **START AIR P NOR** .
- **ENGINE READY CONDITION** lamps illuminate to indicate ready to start conditions:
  - **MAIN START V. SERV.** ;
  - **TURN. G. DISENGAGED** ;
  - **START DIST.V. OPEN** .
- **ADDR | DESCRIPTION | UNIT** table and TEN-KEY board (see the description in ***the paragraph 3.2.4 on page 25*** below).

Addresses of RCS TEN-KEY board implemented in the simulator

ADDRESS	DESCRIPTION
001	Max speed set
302	Handle order
303	Speed order for governor
304	M/E revolution

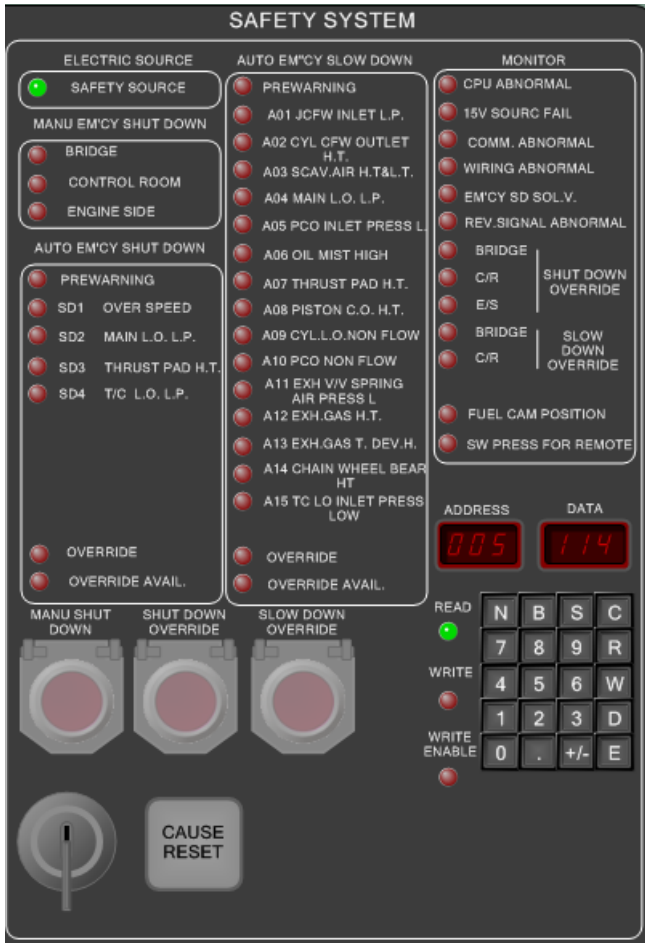
Note: **Click the button to start the movie, which demonstrates the sensitivity of the Main engine Control system (part one) and Safety system (part two) to setpoint variations.**

Demonstration

3.2.2. Safety System Panel

The **SAFETY SYSTEM** panel contains:

- **ELECTRIC SOURCE** indicator lamp SAFETY SOURCE – system power ON;
- **MANU EM'CY SHUT DOWN** indicator lamps to indicate the actual PP control place:
  - **BRIDGE** / **CONTROL ROOM** / **ENGINE SIDE**.
- **AUTO EM'CY SHUT DOWN** indicator lamps:
  - **PREWARNING** flashes during timer set; lights steadily when shut down occurred;
  - **SD1 OVERSPEED** – speed > 114.5 rpm;
  - **SD2 MAIN L.O. L.P.** – ME LO inlet pressure < 1.0 bar;
  - **SD3 THRUST PAD H.T.** – temperature > 90 °C;
  - **SD4 T/C L.O. L.P.** – TC LO inlet pressure < 0.7 bar;
  - **OVERRIDE** emergency run condition;
  - **OVERRIDE AVAIL.** is available for SD2, SD3.
- **AUTO EM'CY SLOW DOWN** indicator lamps:
  - **PREWARNING** flashes during;
  - **A01 JACKET CFW L.P.** – inlet pressure < 2.0 bar;
  - **A02 JACKET CFW H.T.** – outlet temp. > 95 °C;
  - **A03 SCAV.AIR H.T.&L.T.** – temp. < 15 °C & temp. > 120 °C;
  - **A04 MAIN L.O. L.P.** – ME LO inlet pressure < 1.2 bar;
  - **A05 PCO INLET PRESS LOW** – pressure < 1.2 bar;
  - **A06 OIL MIST HIGH** – crankcase oil mist high;
  - **A07 THRUST PAD H.T.** – temperature > 80 °C;
  - **A08 PISTON C.O. H.T.** – cooling oil temp. > 75 °C;
  - **A09 CYL.L.O. NON FLOW** – cylinder LO non flow;
  - **A10 PCO NON FLOW** – piston cool. oil non flow;
  - **A11 EXH V/V SPRING AIR PRESS. L** – exhaust valve spring air pressure < 4.5 bar;



- **A12 EXH.GAS H.T.** – outlet temperature > 450 °C;
- **A13 EXH.GAS T. DEV. H.** – temperature deviation > 70 °C;
- **A14 CAM.BEAR.L.O. H.T.** – temperature > 75 °C:
- **A15 TC LO INLET PRESS LOW** – press.ure < 1.2 bar;
- **OVERRIDE** emergency run condition;
- **OVERRIDE AVAIL.** is available when any of slow down conditions occur except A06, A07.

- **MONITOR** alarm lamps:
  - **SHUT DOWN OVERRIDE** on: **BRIDGE**; **C/R**; **E/S** – the override button pressed at respective control place;
  - **SLOW DOWN OVERRIDE** on: **BRIDGE**; **C/R** – the override button pressed at respective control place;
  - **FUEL CAM POSITION** – is illuminated if any cylinder reverse operation failed (introduced fault by instructor).
- Buttons with protection cover (click once to open the cover, click second time to push the button):
  - **MANU SHUT DOWN**;
  - **SHUT DOWN OVERRIDE**;
  - **SLOW DOWN OVERRIDE**.
- TEN-KEY board (see the description in ***the paragraph 3.2.4 on page 25***);
- CAUSE RESET button – not modeled.

Addresses of SS TEN-KEY board implemented in the simulator

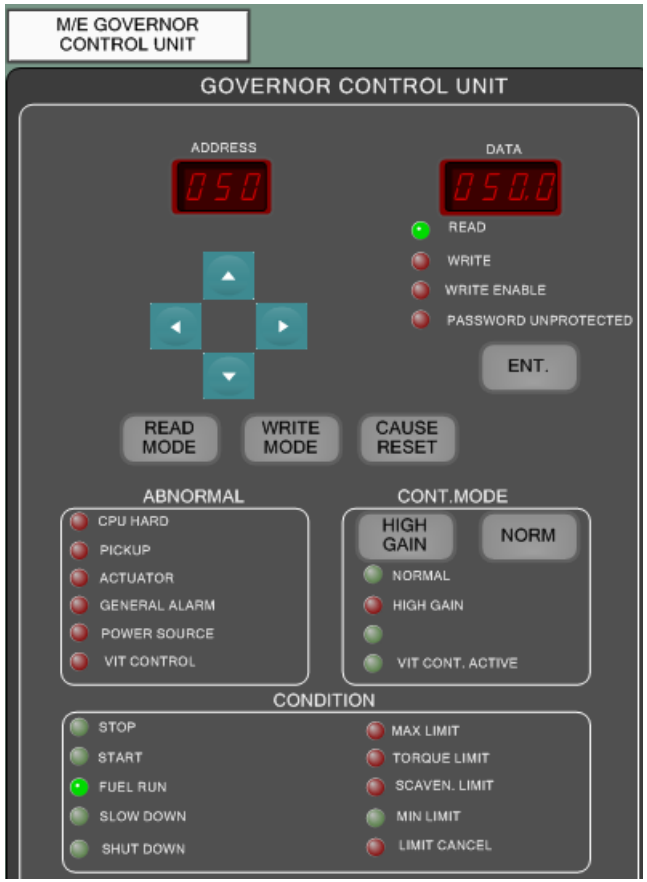
Read "SH" for shut down; "SL" for slow down. Time delay is set in seconds, other values' units are RPM.

ADDR	DESCRIPTION
005	Over speed detect
010	Piston C.O. non-flow slow down cancel
011	Cyl. L.O. non-flow slow down cancel
012	Exh. Gas H.T. slow down cancel
075	SH-1 Overspeed time delay

076	SH-2 ME LO inlet pressure low time delay
077	SH-3 Thrust pad temperature high time delay
078	SH-4 TC LO inlet pressure low time delay
081	SL-1 Jacket C.F.W. low pressure time delay
082	SL-2 Jacket C.F.W. high temperature time delay
083	SL-3 Scavenging air high & low temperature time delay
084	SL-4 Main L.O. low pressure time delay
085	SL-5 PCO inlet pressure low time delay
086	SL-6 Crankcase oil mist high time delay
087	SL-7 Thrust pad high temperature time delay
088	SL-8 Piston C.O. high temperature time delay
089	SL-9 Cylinder L.O. non flow time delay
090	SL-10 Piston C.O. non flow time delay
091	SL-11 Exhaust v/v spring air pressure low time delay
092	SL-12 Exh. gas high temperature time delay
093	SL-13 Exh. gas temp. deviation high time delay
094	SL-14 Camshaft bearing L.O. high temp. time delay
095	SL-15 TC L.O. inlet pressure low time delay
301	Revolution signal

Note: Click the button to start the movie, which demonstrates the sensitivity of the Main engine Control system (part one) and Safety system (part two) to setpoint variations.

Demonstration



3.2.3. Governor Control Unit Panel

The **GOVERNOR CONTROL UNIT** panel contains:

- TEN-KEY board (see description in ***the paragraph 3.2.4 on page 25***);
- **ABNORMAL** alarm lamp: **ACTUATOR** – instructor fault;
- **CONDITION** indicator lamps:
  - **STOP** ;
  - **START** ;
  - **FUEL RUN** ;
  - **SLOW DOWN** ;
  - **SHUT DOWN** ;
  - **MAX LIMIT** when speed limit alarm is activated;
  - **TORQUE LIMIT**;
  - **LIMIT CANCEL** – **LIMIT CANCEL** button is pressed on ECC C Bottom panel (see ***the paragraph 3.3.2 on page 26***).

Addresses of GCU TEN-KEY board implemented in the simulator

ADDR	DESCRIPTION
050	Actuator START set point (low level) in %, mm
112	PID-F.G. proportional gain
117	PID-F.G. integral time (timing)
122	PID-F.G. differential time

Note: Click the button to start the movie, which demonstrates the sensitivity of the Main engine Governor Control unit to setpoint variations.

Demonstration

3.2.4. TEN-KEY Board

TEN-KEY boards are present on Remote Control System (RCS), Safety System (SS) and Governor Control Unit (GCU) panels. The boards are used to setpoint ME control values in WRITE mode, and to examine the current parameters values in READ mode.

In the simulator parameters input is implemented for quite a few addresses. Most of the functionality allows to read data, e.g. when a slow/shut down occurs, it may be useful to review the critical value.

On RCS and SS panels the boards are similar, on GCU panel it has slightly different arrangement.

The RCS and SS boards contain:

- **ADDRESS** digital indicator to display the address, which is listed in respective table, of parameter data;
- **DATA** digital indicator to display the actual value; in WRITE mode the border flashes when input is enabled (**WRITE ENABLE** indicator is illuminated);
- **READ**, **WRITE** LED indicators to show the operating mode;
- **WRITE ENABLE** LED indicator to show that input is allowed;
- Alpha-numeric pad comprising the buttons:
  - **0** – **9** digits – to enter the value; buttons "**.**", and "**+/-**" are not modeled;
  - **N** (next) – go to next address number (addresses are taken from the respective table);
  - **B** (back) – go to previous address number;
  - **C** (clear) – clear the value from **DATA** box before input;
  - **R** (read) – set READ mode; **READ** indicator illuminates;
  - **W** (write) – set WRITE mode; **WRITE** indicator illuminates;
  - **D** (data) – data input command; this operation declares that the input figures are memorized data;
  - **E** (enter) – key to memorize input data.

The GCU board contains the following buttons:

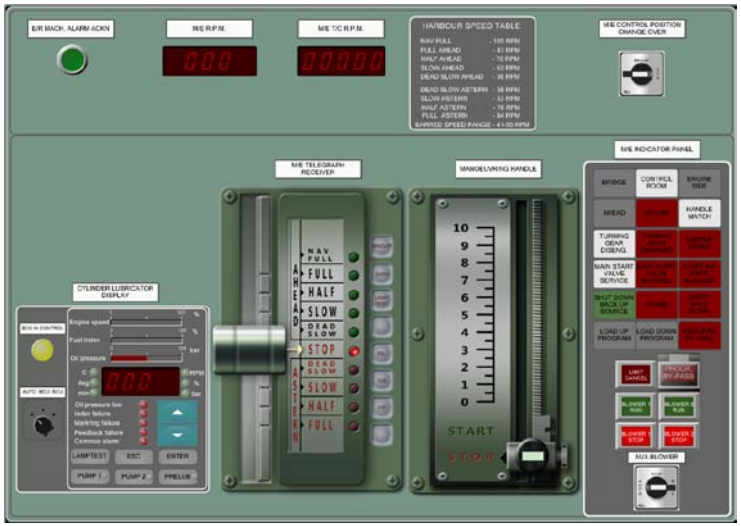
- Arrow **Up** – go to next address number;
- Arrow **Down** – go to previous address number;
- Arrow **Left** – cancel;
- Arrow **Right** – data input command;
- **READ MODE**, **WRITE MODE** – to set mode;
- **ENT.** – key to memorize input data.

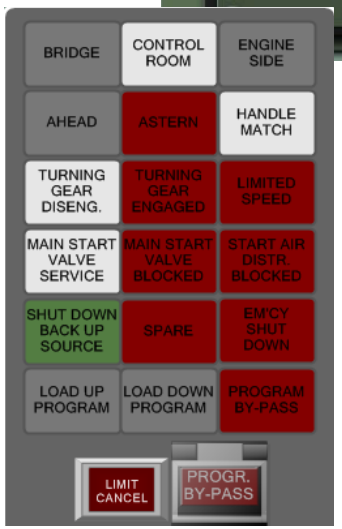
3.3. ECR Control Console Section C Bottom Panel

Click the menu item **ECC C Bottom Panel** of the page **ECR** to open the display.

The console contains:

- **E/R MACH. ALARM ACKN** button;
- **HARBOUR SPEED TABLE** for reference;
- **M/E CONTROL POSITION CHANGE OVER** switch to set control place **BRIDGE** or **ECR**; change over instructions are given in *the paragraph 3.3.4 on page 28*;
- **CYLINDER LUBRUCATOR DISPLAY** (see the description below);
- **M/E TELEGRAPH RECEIVER**; functions and operation are similar to telegraph transmitter on the Bridge console **BCC B** (see *the paragraph 2.1.2 on page 19*); it is used to set the sailing direction when control is at ECR, and accept the Bridge orders when control is at the Bridge;
- **MANOEUVRING HANDLE**; see the description below;
- **M/E INDICATOR PANEL**; see the description below.





3.3.1. Operating Manoeuvring Handle

Drag and drop the handle (slider) by the mouse to set it to required position on the scale. **0** on the scale corresponds to minimal stable rpm. **10** – max rpm for the sailing mode.

The actual value is displayed in the box on top of the handle.

Use the small up and down arrows on the handle to adjust the revolution speed by 1 rpm.

Two fixed positions are used:

- **START** – to activate the ME start program;
- **STOP** – to activate the ME stop program.

3.3.2. ME Indicators

The **M/E INDICATOR PANEL** contains the lamps, which illuminate to indicate:

- **BRIDGE**; **CONTROL ROOM**; **ENGINE SIDE** – ME control place;
- **AHEAD**; **ASTERN** – sailing directions; when direction of the telegraphs on Bridge and ECR do not match, the WRONG WAY alarm lamp on the Bridge illuminates;
- **HANDLE MATCH** – the telegraph receiver at ECR (or engine side LOP) and telegraph transmitter at the Bridge handles' positions match;
- **TURNING GEAR DISENG.**; **TURNING GEAR ENGAGED**;
- **LIMITED SPEED** – speed limit is ON;
- **MAIN START VALVE SERVICE** – control air available;
- **MAIN START VALVE BLOCKED** – no control air available;
- **START AIR DISTR. BLOCKED** – no control air available;
- **EM'CY SHUT DOWN** – any EMCY shut down occurred;
- **LOAD UP PROGRAM**; **LOAD DOWN PROGRAM**; **PROGRAM BY-PASS** – respective program is operating.

Use **LIMIT CANCEL** button to cancel all limitations.

Use **PROGR. BY-PASS** button with protection cover to activate the by-pass mode; click twice to open the cover and push the button.

3.3.3. Cylinder Lubricator System Display

Lubricator is a complex system for reduction of the oil pressure from the Pump station and oil supply to each ME cylinder. The system consists of the Oil Tank (47 m3) with QCV; Pump Station comprising two pumps operating in duty/standby configuration; control unit in ECR and local control panel.

The Lubricator System display contains:

- **BCU IN CONTROL** indicator lamp; it illuminates when Back-up Control Unit (BCU) mode is selected;
- Three-position mode selector switch to choose between:
  - **AUTO** – in this mode the duty pump starts automatically and pre-lubricators start 12 cycles of oil supply to cylinders; this activity occurs before ME start during Blowers start; if ME failed to start, then after 12 cycles (about 1 minute) of pre-lubrication the duty pump stops;
  - **MCU** – Master Control Unit (MCU) to control lubricators operation by the buttons on this panel;
  - **BCU** – Backup Control Unit (BCU) to control lubricators operation; oil consumptions is set to maximum for each lubricator; **BCU IN CONTROL** lamp illuminates; BCU mode is switched to automatically when any alarm condition occurs.

Note: **To reset BCU mode after an alarm condition, set the switch to MCU position first and then set to AUTO position.**

- **Engine speed** (%) bar graph;
- **Index** (%) bar graph – fuel rack position;
- **Oil pressure** (bar) bar graph – pump station discharge pressure (about 45 bar normally);
- LED indicators and LC display; indicators illuminate when the respective parameter reading is selected on the display by the **up** and **down** arrow buttons:
  - **C** – oil temperature in Hydropack;

  - **RPM** – ME speed;
  - **%** – effective pressure;
  - **bar** – pump station discharge pressure;
  - deg, min – not modeled.
- LED alarm indicators, which illuminate when:
  - **Oil pressure low** – pressure < 35 bar;
  - **Index failure** – no signal from fuel index sensor (fault from instructor);
  - **Mark/trig failure** – not modeled;
  - **Feedback failure** – no signal from speed sensor (fault from instructor);
  - **Common alarm** – any sensor alarm condition.
- UP and DOWN arrows buttons – use to switch readings on the LC display;
- LAMPTEST, ESC, ENTER – buttons are not modeled;
- **PUMP 1** button with LED indicator, which illuminates when Pump 1 is duty; in AUTO mode Pump 1 is set to duty;
- **PUMP 2** button with LED indicator, which illuminates when Pump 2 is duty; click the button to set Pump 2 duty;
- **PRELUB** button – can only be activated when engine is stopped; click to activate prelubrication sequence; the lubricators will be activated continuously from Lubricator 1A, ... 6A; the cycles will be repeated a pre-programmed number of times (normally 12).

3.3.3.1. Filter Replacement

When pressure on the system Discharge filter raises > 7 bar it is required to change the filter.

To replace the filter in the simulator do the following:

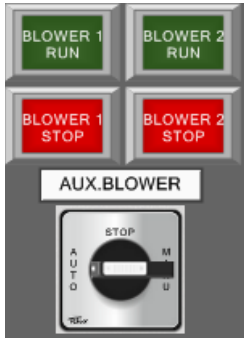
1. Switch the filter off.
2. Enable by-pass line.
3. Then switch the filter on again.

3.3.5. ME Aux Blowers Remote Control

The remote control of the Aux blowers is available on **M/E INDICATOR PANEL** of the ECC C Bottom panel: use menu item **ECC C Bottom Panel** of the page **ECR**. The panel contains:

- Buttons:
  - **BLOWER 1 RUN**; **BLOWER 2 RUN** – to start respective M/E blower in MANU mode; the button highlights when the blower is running;
  - **BLOWER 1 STOP**; **BLOWER 2 STOP** – to stop respective blower in MANU mode; the button highlights when the blower is stopped.
- **AUX. BLOWER** three-position switch to select between:
  - **AUTO** – automatic operation regulated according to charge air pressure;
  - **STOP** – remote control is blocked;
  - **MANU** – control by the buttons on this panel, for the blower, which is set to REMOTE mode on the LOP.

Blowers can be locally controlled from the LOP (use the menu item **Aux Blowers 1, 2 LOP** of the page **ER3**), see *the paragraph 4.4 on page 32*.



3.3.4. Control Position Change Over

Change over is performed on control consoles **BCC B** (see *the paragraph 2.1 on page 17*) and **ECC C Bottom** (see *the paragraph 3.3 on page 26*).

1. Control is at the ECR:

On **ECC C Bottom** console **CONTROL ROOM** lamp is illuminated on **M/E INDICATOR PANEL**.
On **BCC B** console **CONTROL ROOM** button is illuminated on the **CONTROL POSITION** panel.

› To request control position change over from ECR to Bridge, set **M/E CONTROL POSITION CHANGE OVER** switch to BRIDGE position on **ECC C Bottom** console. The **BRIDGE** button on **BCC B** console, and **BRIDGE** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** start flashing.

To accept control position change over on **BCC B** console, click the **BRIDGE** button.

2. Control is at the Bridge:

On **ECC C Bottom** console **BRIDGE** lamp is illuminated on **M/E INDICATOR PANEL**.
On **BCC B** console **BRIDGE** button is illuminated on the **CONTROL POSITION** panel.

› To request control change over from Bridge to ECR click **CONTROL ROOM** button on **BCC B** console **CONTROL POSITION** panel. The button light and **CONTROL ROOM** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** start flashing.

To accept control position change over on **ECC C Bottom**, set the **M/E CONTROL POSITION CHANGE OVER** switch to ECR.

› **CONTROL ROOM** button on **BCC B** console, and **CONTROL ROOM** lamp on **ECC C Bottom** console **M/E INDICATOR PANEL** turn to steady light to indicate the change over.

4. Main Diesel Engine

4.1. General Description

Main Engine (ME) – Doosan-MAN B&W model 6S60 MC-C: two stroke, slow speed, reversible, crosshead type marine diesel engine with constant pressure turbocharging.

Type	MAN B&W model 6S60 MC-C
Number of cylinders	6
Cylinder bore	600 mm
Length of stroke	2 400 mm
Nominal MCR	18 420 BHP at 105 RPM

Fuel pumps

The engine is provided with one Fuel Pump for each cylinder. The pump is activated by the fuel cam, and the volume injected is controlled by turning the plunger by means of a toothed rack connected to the regulating mechanism. The Fuel Pumps incorporate Variable Injection Timing (VIT) for optimized fuel economy at part load. The VIT principle uses the fuel regulating shaft position as the controlling parameter.

Exhaust Gas Turbocharger

The engine is fitted with one turbocharger. The Turbocharger is provided with equipment for washing of the compressor side and turbine side.

Scavenge Air Cooler

The engine is fitted with an air cooler for a fresh water cooling system. The cooler is provided with equipment for cleaning of air side – standard showering system. Cleaning is to be carried out only when engine is stopped.

Cylinder Lubricators

The engine is fitted with a complex Lubricators system for reduction of the oil pressure and oil supply to each ME cylinder.

Governor

The engine is provided with an electronic governor. The electronic governor consists of the following parts: Actuator, Electronic panel (located in ECR control console) and sensors. The actuator is connected to the fuel regulating shaft by means of a mechanical linkage.

Manoeuvring System

The engine is provided with a pneumatic/electric manoeuvring and fuel oil regulating system. The system makes it possible to start, stop and reverse the engine and to control the engine speed. The speed control handle gives a speed-setting signal to the governor, dependent on the desired number of revolutions. At a shut down function, the fuel injection is stopped by activating the puncture valves in the fuel pumps, independent of the speed control handle's position. Reversing is effected by moving the telegraph handle from "Ahead| to "Astern" position and the speed control handle from "Stop" to "Start" position. Control air then moves the starting air distributor and, through an air cylinder, the displaceable roller in the driving mechanism for fuel pump, to the "Astern" position.

Auxiliary Blower

The engine is provided with two electrically-driven blowers. The Aux. blowers will start operating before the engine is started and will ensure sufficient scavenge air pressure to obtain a safe start. During operation of the engine, the Aux. Blowers will start automatically each time the engine load is reduced to about 30-40% and they will continue operating until the load again exceeds approx.. 40-50%.

Turning Gear

The turning gear is driven by an electric motor. The turning gear is equipped with a blocking device that prevents the main engine from starting when the turning gear is engaged.

Engine Safety Shut-Down system (independent safety system)

In case of the following conditions the engine shall be stopped by this device:

- Over speed;
- Main Bearing LO inlet pressure low;
- Thrust Pad temperature high;
- Turbocharger LO inlet pressure low.

Engine Safety Slow-Down system

Automatic slow down shall be carried out by means of the Bridge Remote manoeuvring system.

Function of Automatic emergency slow down is available in both ahead and astern modes. In case under anyone of the listed condition for a preset time, the ME is slowed down automatically to a preset speed (SLOW):

- Jacket C.F.W. low pressure
- Jacket C.F.W. high temperature
- Scavenging air high temperature & low temperature Main L.O. low pressure
- Main L.O. high temperature
- Crankcase oil mist high
- Thrust pad high temperature
- Piston C.O. high temperature
- Cylinder L.O. non flow
- Piston C.O. non flow
- Axial vibration high
- Exh. gas high temperature
- Exh. gas temp. deviation high
- Camshaft bearing L.O. high temperature (fore)
- Camshaft bearing L.O. high temperature (aft)
- Inter shaft bearing high temperature

4.2. ME Local Control Panel

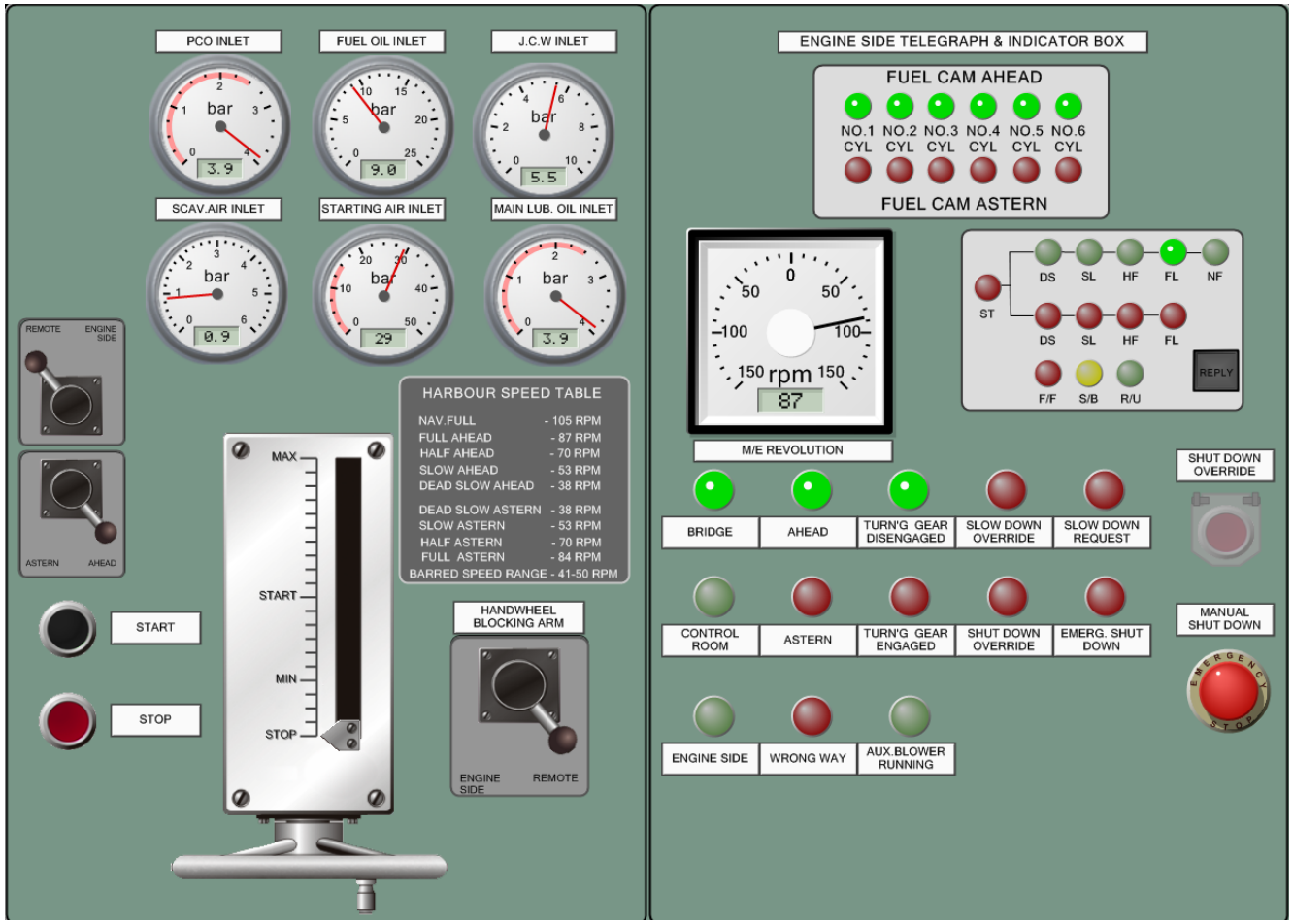
Click on the menu item **ME LOP** of the page **ER1** to open the display with engine side control panels. These panels can be accessed also from the 3D display of the page ER1 (see ***the paragraph 5.4 on page 39***).

The left panel contains:

- Gauges to monitor the ME state:
  - **PCO INLET** (Piston Cooling Oil) pressure;
  - **FUEL OIL INLET** pressure;
  - **J.C.W. INLET** (jacket Cooling Water) pressure;
  - **SCAV. AIR INLET** pressure;
  - **STARTING AIR INLET** pressure;
  - **MAIN LUB. OIL INLET** pressure.
- **REMOTE – ENGINE SIDE** switch to set the control mode;
- **ASTERN – AHEAD** switch to set the sailing direction in ENGINE SIDE control mode;
- **START** / **STOP** buttons to operate the ME in ENGINE SIDE control mode;
- Manoeuvring handle; drag&drop the slider to required position in ENGINE SIDE control mode;
- **HARBOUR SPEED TABLE**;
- **HANDWHEEL** switch ENGINE SIDE/REMOTE; to enable Manoeuvring handle operation at the LOP both switches should be set to ENGINE SIDE position.

The right panel **ENGINE SIDE TELEGRAPH & INDICATOR BOX** contains:

- **FUEL CAM AHEAD** / **FUEL CAM ASTERN** set of lamps; green lamp(s) illuminate to indicate the cylinder operation according to ordered direction; red lamp(s) illuminate to indicate the alarm state condition (incorrect reversing of a cylinder) – in the simulator it is invoked by the instructor fault "ME Cyl.1 Fuel Cam. Fault";



- **ME REVOLUTION** speed gauge;
- Telegraph repeater; indicators on the repeater illuminate according to the position of the main telegraph handle at the Bridge; click the **REPLY** button to confirm the order when operating at engine side;

- Indicator and alarm lamps:
  - **BRIDGE**, **CONTROL ROOM**, **ENGINE SIDE** – indicate the control place;
  - **AHEAD**, **ASTERN** – indicate sailing direction;
  - **WRONG WAY** – illuminates when telegraph position or the position of the sailing direction handles do not coincide with those at the Bridge; **ME start is blocked**;
  - **TURNING GEAR DISENGAGED/ENGAGED**;
  - **SLOW DOWN OVERRIDE**, **SHUT DOWN OVERRIDE** – to indicate the override mode;
  - **SLOW DOWN REQUEST** – to indicate the slow down request;
  - **EMERG. SHUT DOWN** – to indicate emergency shut down condition.
- **SHUT DOWN OVERRIDE** button with protection cover; click once to open the cover, click second time to set shut down override mode;
- **MANUAL SHUT DOWN** emergency button.

4.3. ME Turning Gear Panel

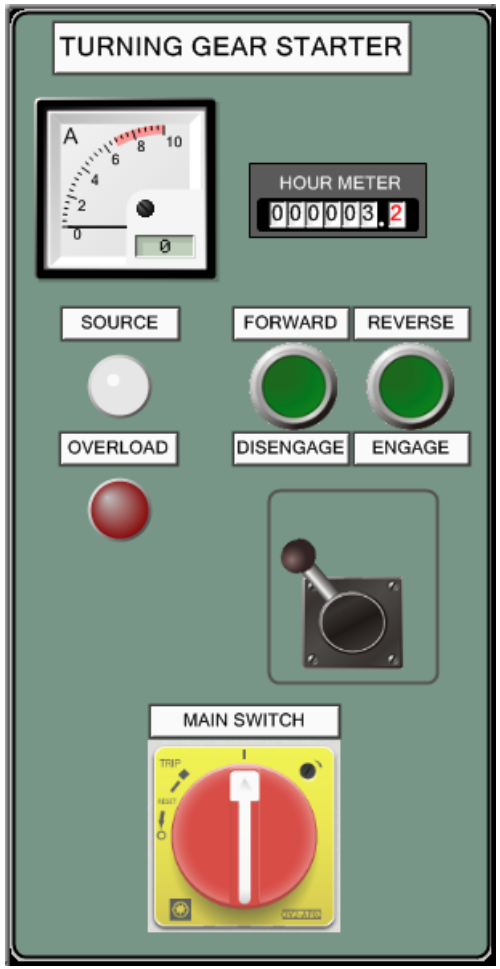
Click on the menu item **Turning Gear LOP** of the page **ER1** to open the panel for local control of the Turning Gear.

The panel **TURNING GEAR STARTER** contains:

- The ammeter to monitor the turning gear load;
- **HOUR METER** indicator;
- **SOURCE** indicator lamp, which illuminates when the turning gear unit is powered and ready for use;
- **FORWARD** and **REVERSE** buttons; click to set the turning direction; the active button illuminates;
- **OVERLOAD** alarm lamp;
- **DISENGAGE–ENGAGE** two-position switch handle to operate the gear; set the required position of the handle using the mouse;
- **MAIN SWITCH** circuit breaker to turn power off/on.

Switch the power supply 440 V for **TURNING GEAR STARTER** on the **No. 7 GROUP STARTER PANEL** (use menu item **GSP 7** of the page **ER1**) by the **M/E TURNING GEAR** circuit breaker.

Switch the power supply 440 V for the **No. 7 GROUP STARTER PANEL** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No 7 LOCAL GROUP STARTER PANEL** circuit breaker.



4.4. ME Aux Blowers LOP

Click on the menu item **Aux Blowers LOP** of the page **ER3** to open the display with identical **AUX. BLOWER NO 1 STARTER** and **AUX. BLOWER NO 2 STARTER** panels.

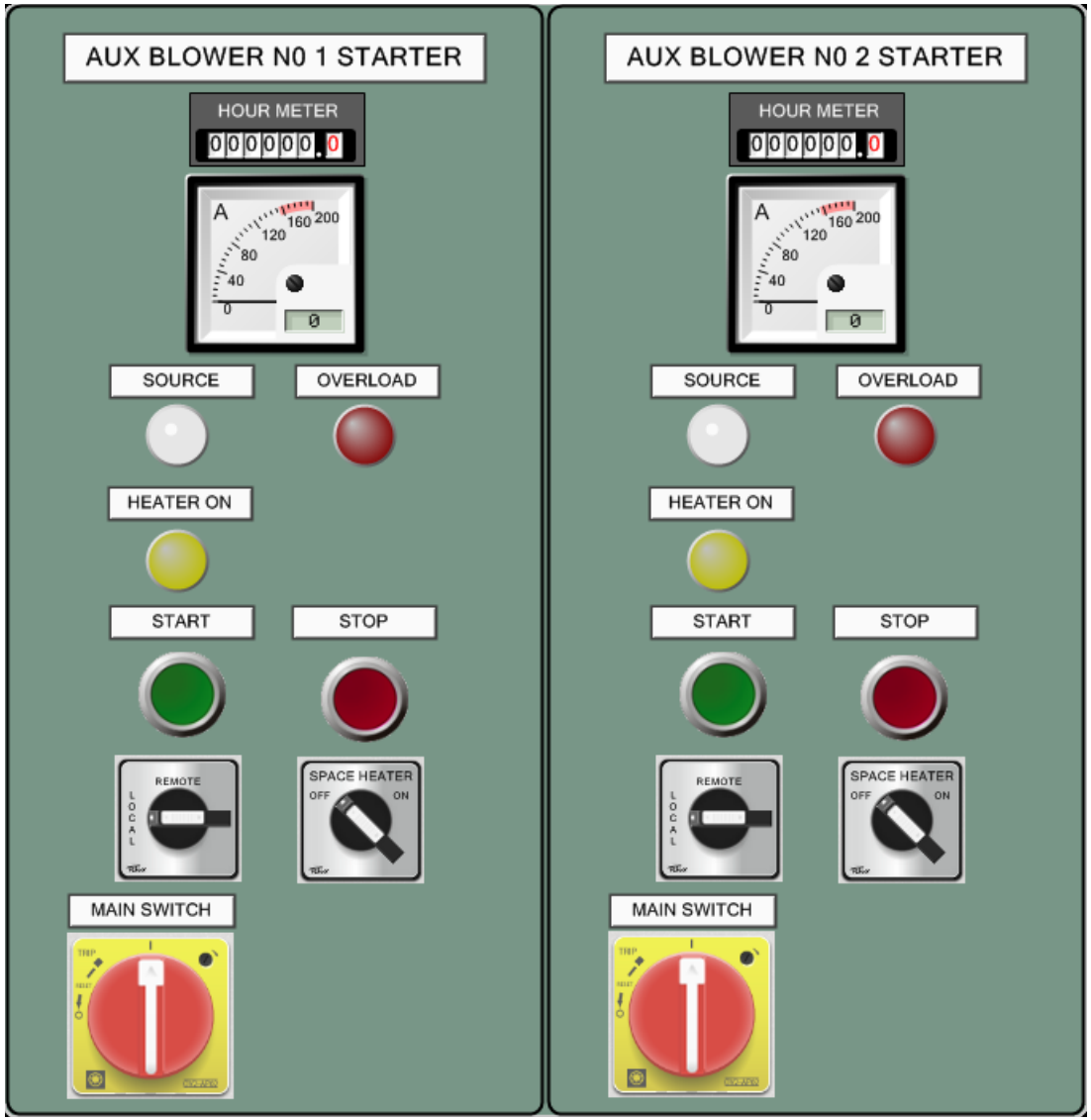
The description given below is for **AUX. BLOWER NO 1 STARTER** panel. The **AUX. BLOWER NO 2 STARTER** panel is similar to 1.

The panel **AUX. BLOWER NO 1 STARTER** contains:

- **HOUR METER**;
- Ammeter;
- **MAIN SWITCH** power switch;
- **SOURCE** indicator lamp;
- **START/RUN**, **STOP** buttons to operate the blower in LOCAL mode;
- **OVERLOAD** alarm lamp;
- **HEATER ON** indicator lamp;
- **LOCAL–REMOTE** two-position mode selector switch; in REMOTE mode the blowers are controlled from the ECR console **ECC C Bottom** (see ***the paragraph 3.3.5 on page 28***);
- **HEATER** two-position switch to turn heater OFF/ON;

Switch the power supply 440 V for:

- **AUX. BLOWER NO 1 STARTER** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No. 1 AUX.BLOWER** circuit breaker;
- **AUX. BLOWER NO 2 STARTER** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No. 2 AUX.BLOWER** circuit breaker.



5. Operating ME from 3-D Pages

Manual control of the Main Engine is simulated on the 3-D pages of the Engine Rooms (displays **3D** of the pages **ER1**, **ER2**, **ER3**, **ER4**).

On 3-D diagrams the following actions are available:

- Zoom in/out – by the mouse wheel;
- Pan – drag&drop by left mouse button;
- Rotate – drag&drop by right mouse button;
- Left double-click a controlled object – open the LOP (open the same panels as from the page menu);
- Directly operate a controlled object on 3-D display – only for ME regulation and cleaning mechanisms, as described in this section below.

Controlled objects (e.g. wheel, handle, screw) on the display are animated to simulate the action:

- Left-click to open a valve (unscrew);
- Right-click to close a valve (put the screw on).

Controlled gauges are animated to simulate performance and present actual measured values.

5.1. ME Manual Control and Adjustment

5.1.1. Indicator Valve

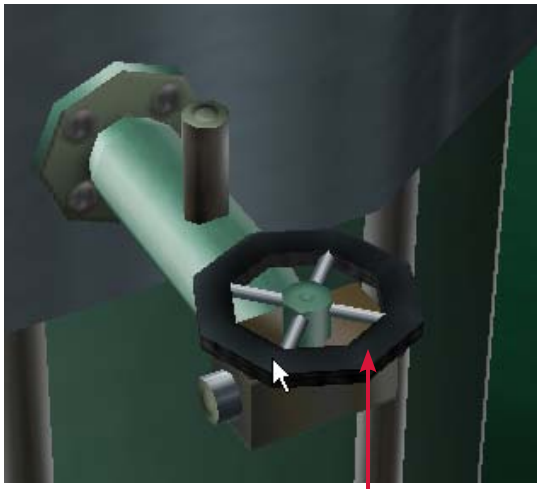
Indicator valve is used when ME is started manually. Cylinder indicator diagrams are obtained by **Indicator valve**.

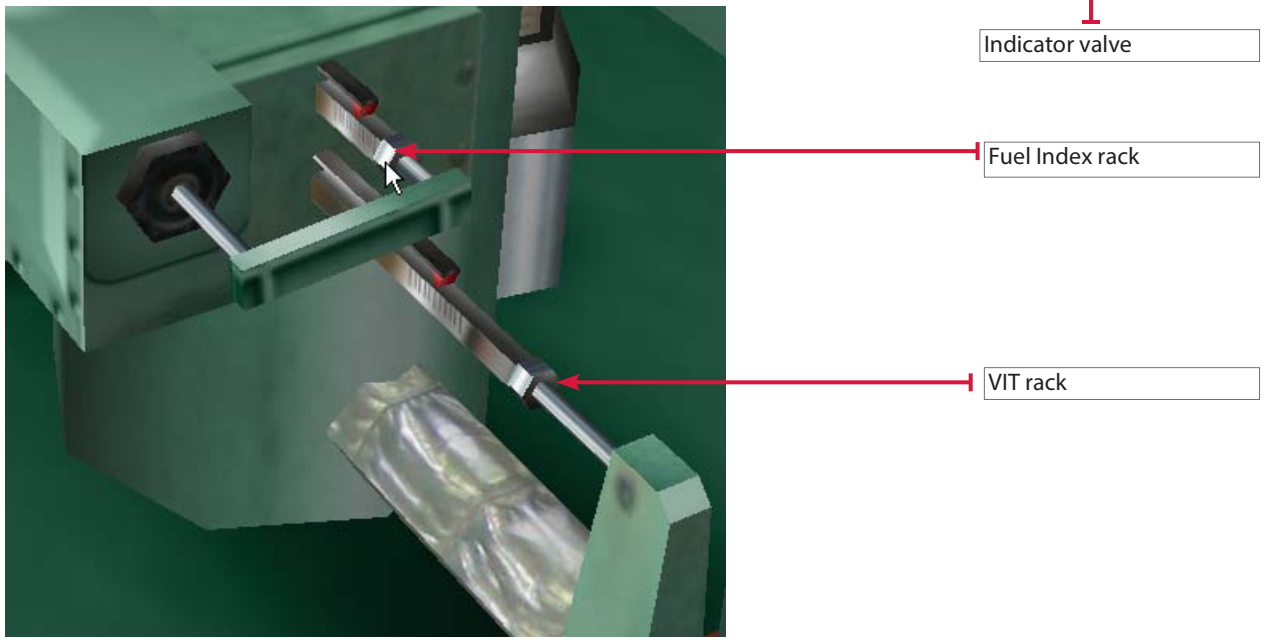
5.1.2. FO Pump Adjustment Screws

Two **FO Pump Adjustment** screws are to control the position of:

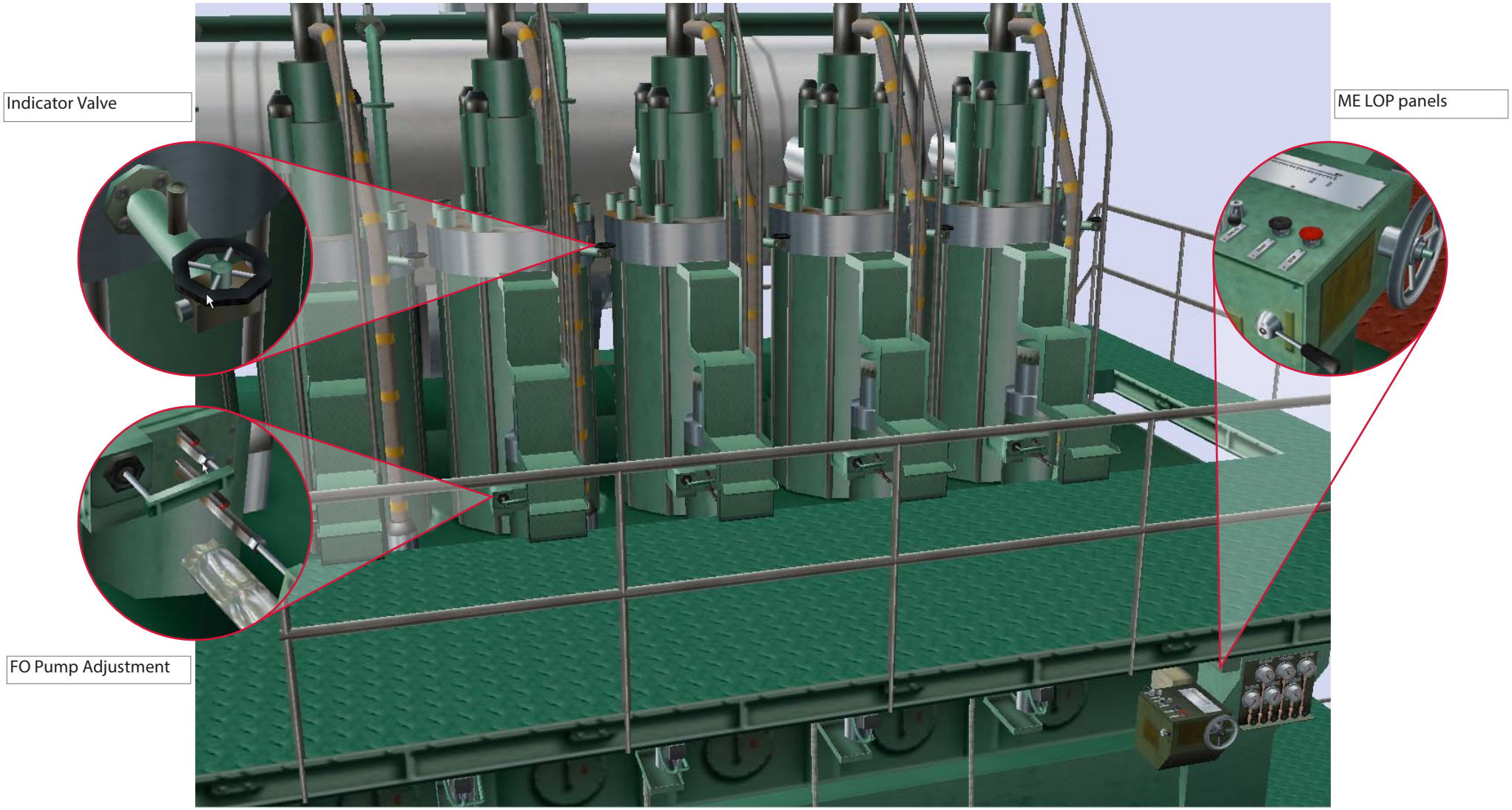
- Variable Injection Timing (VIT) rack;
- Fuel Index Rack.

The screws and valves are operational on all six cylinders of the ME and available on the 3-D displays of the pages **ER1** (see *the figure ER1 cylinders side 3-D view on page 34*), **ER2** (see *the figure ER2 cylinders side 3-D view on page 35*) **ER3** and **ER4**.

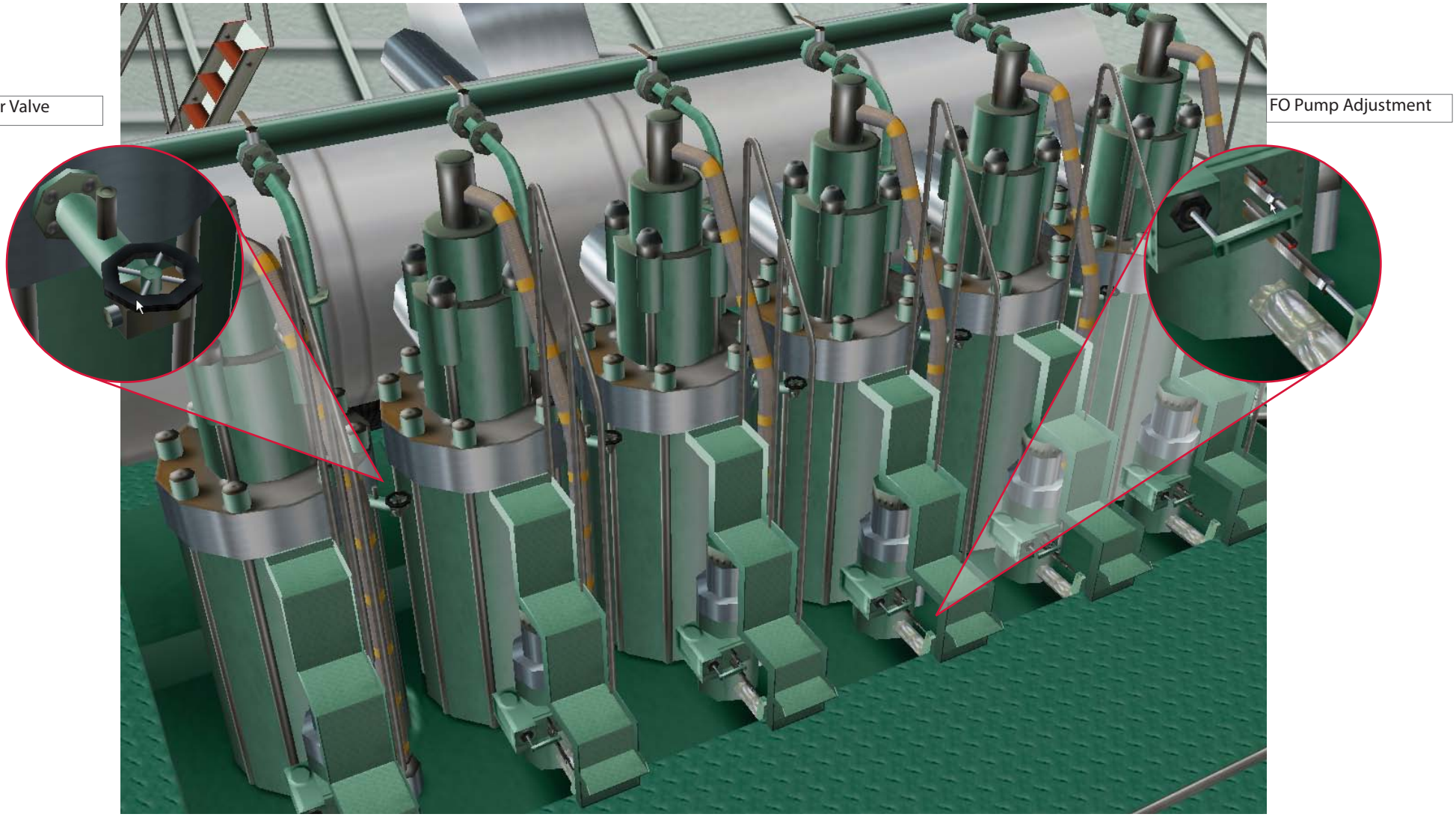




ER1 cylinders side 3-D view



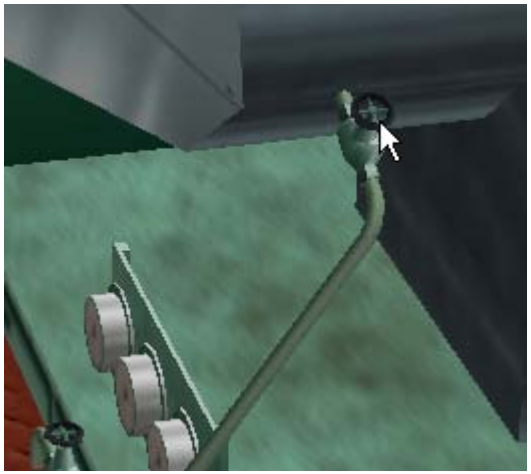
ER2 cylinders side 3-D view



5.2. TC Cleaning Valves

5.2.1. TC Turbine Cleaning

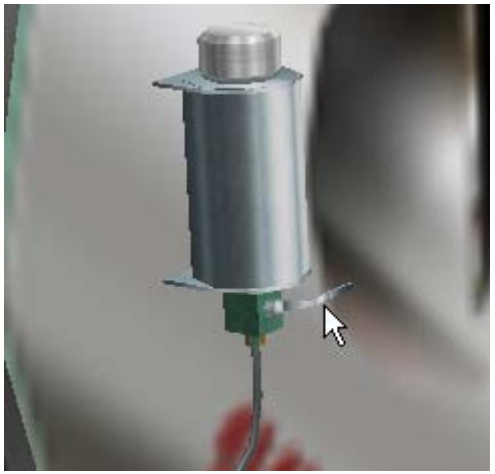
When any of the faults "ME Turbine Blades Fouling" or "ME Turbine Nozzle Fouling " is introduced by the instructor, the ME speed drop occurs, ME exhaust gas temperature grows (watch on the display **EXHAUST GASES** of the page **CMS**). To clean the blades and nozzle, the **TC Turbine Cleaning Valve** should be unscrewed, and then put on again on **3D** display of the page **ER1** (see ***the figure ER1 turbine side 3-D view on page 38***).



TC Turbine Cleaning Valve

5.2.2. TC Compressor Cleaning

When the fault "ME Compressor Blades Fouling" is introduced by the instructor, the ME speed drop occurs, ME exhaust gas temperature grows (watch on the display **EXHAUST GASES** of the page **CMS**). To clean the blades, the **TC Compressor Cleaning Valve** should be unscrewed, and then put on again on **3D** display of the page **ER1** (see ***the figure ER1 turbine side 3-D view on page 38***).



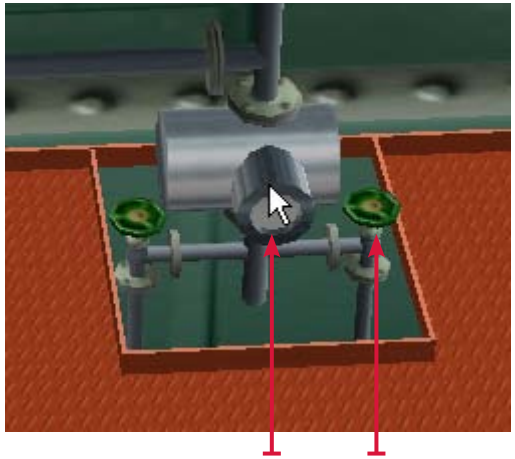
TC Compressor Cleaning Valve & Container

5.3. Air Cooler Cleaning

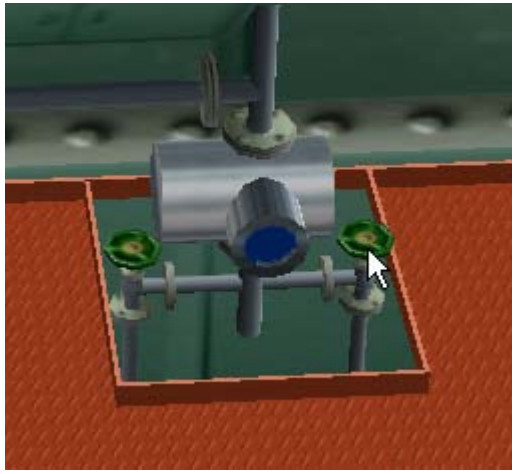
When the fault "ME TC SA cooler Fouling (air side)" is introduced by the instructor, the Scavenge Air pressure and temperature rise (watch on the display **EXHAUST GASES** of the page **CMS** and the **Air Cooler Diff. Press.** gauge on **3D** display of the page **ER1**: see ***the figure ER1 turbine side 3-D view on page 38***). On the **3D** display of the page **ER1** the **Air Cooler Cleaning sight glass** water flow color changes to brown.

To clean the cooler do the following:

1. Open one of the discharge valves to drain dirty water on **3D** display of the page **ER1** (see ***the figure ER1 turbine side 3-D view on page 38***).
2. Start the **ME AIR COOLER CHEM. CLEANING PUMP** from the push button box (use menu item **LOP GPBP-3** of the page **ER1**).
3. Wait till the water flow in the sight glass turns to blue color.
4. Stop the pump and close the discharge valve.



Air Cooler Cleaning sight glass & discharge valves

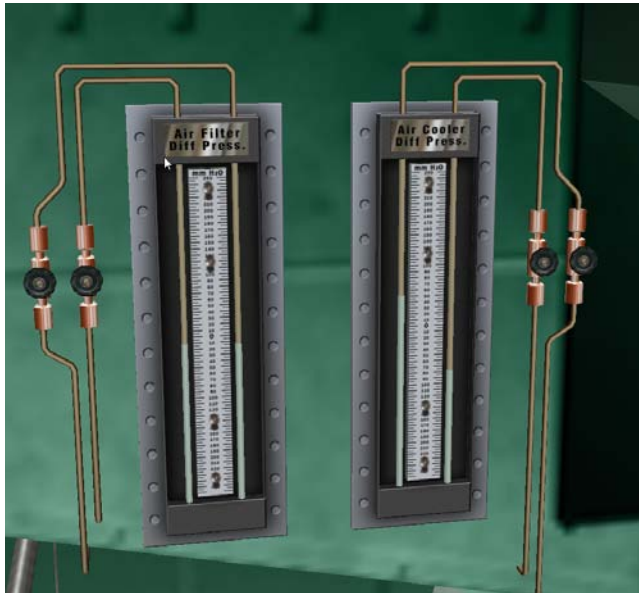


5.3.1. Differential Pressure Gauges

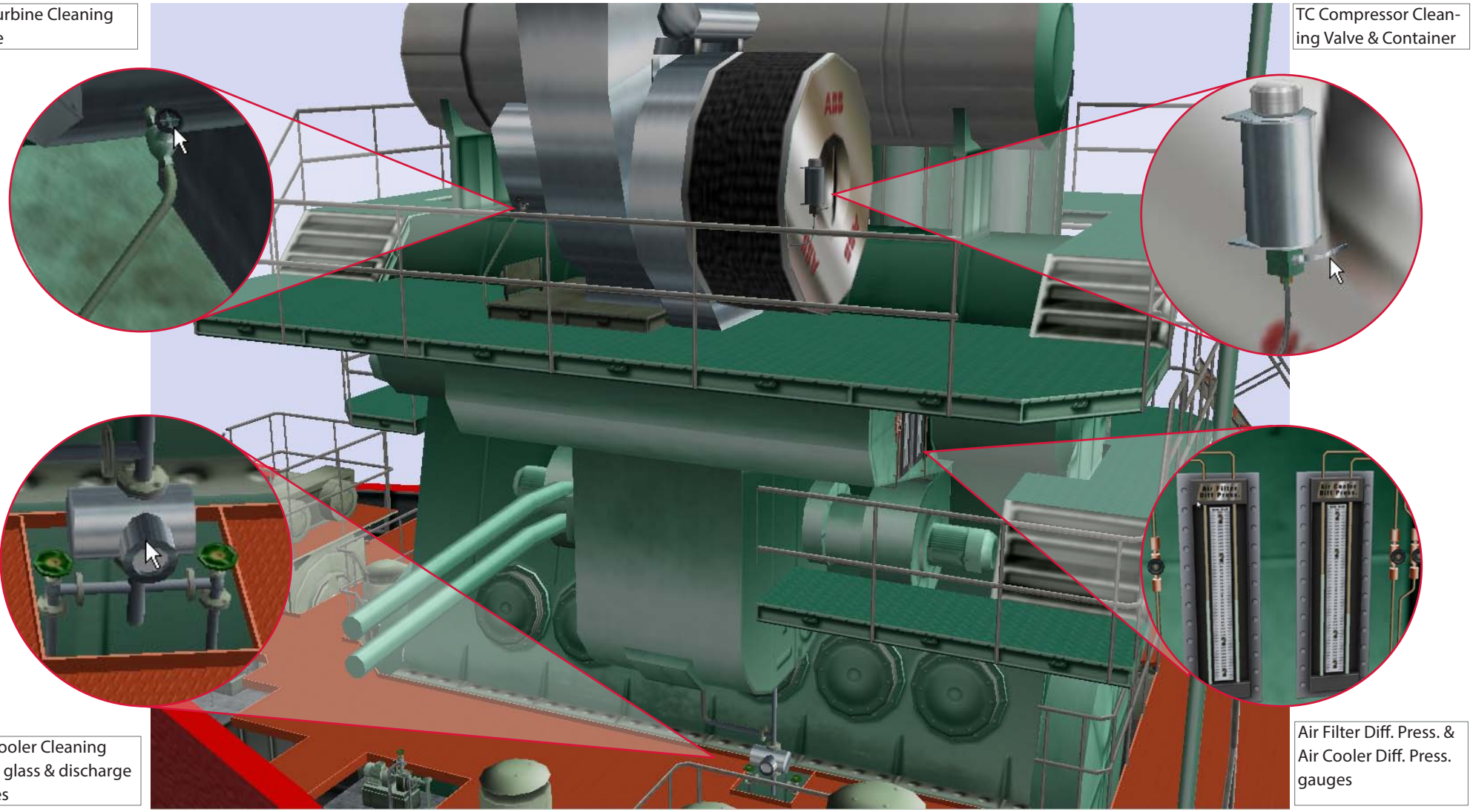
Air Filter Diff. Press. and **Air Cooler Diff. Press.** gauges can be monitored from the **3D** display of the page **ER1** (see ***the figure ER1 turbine side 3-D view on page 38***).

The **Air Filter Diff. Press.** gauge indicates the differential pressure on the TC filter.

The **Air Cooler Diff. Press.** gauge indicates the differential pressure on the air cooler filter.



ER1 turbine side 3-D view



5.4. ME Local Control Panel on 3D

Engine side control is implemented on the **3D** display of the page **ER1** (see ***the figure ER1 cylinders side 3-D view on page 34***). Three LOP panels duplicate the ME Local Control Panel opened by the menu item **ME LOP** of the page **ER1** (see the description in ***the paragraph 4.2 on page 30***).

All gauges and indicator lamps are functional on all three panels of the LOP.

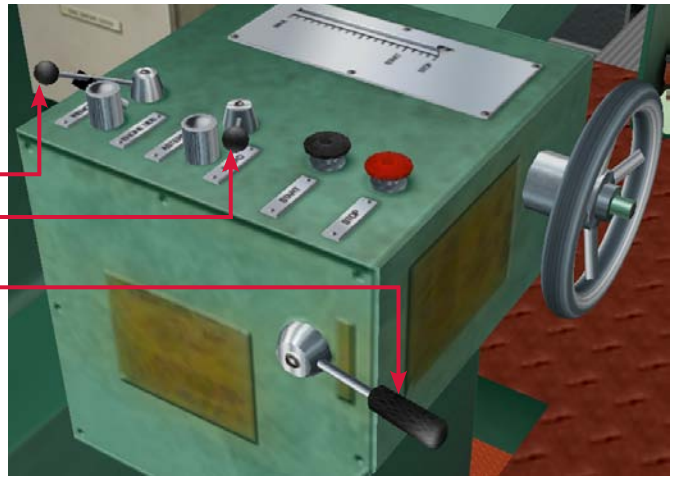
The buttons **REPLY**, **SHUT DOWN OVERRIDE** and **MANUAL SHUT DOWN** can be operated by double-click on the top part of the LOP **ENGINE SIDE TELEGRAPH & INDICATOR BOX**.

On the bottom part of the LOP the buttons **START** and **STOP** can be operated by double-click.

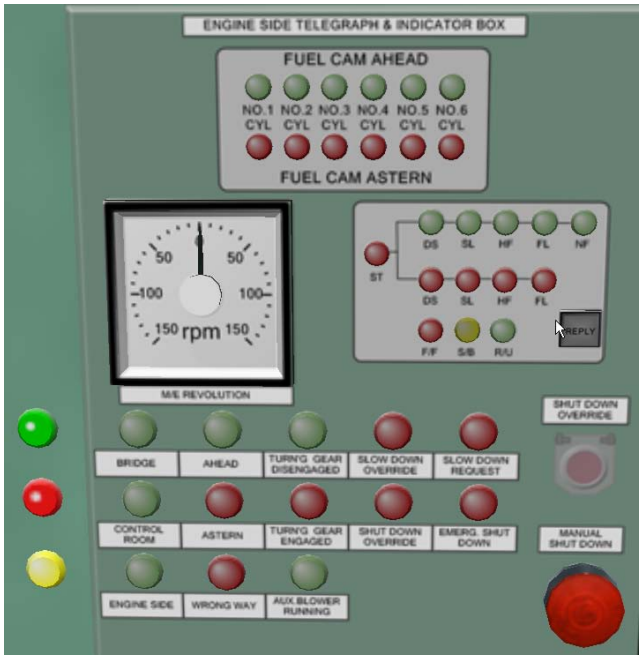
Left-click to rotate the handles counterclockwise, and right-click to rotate clockwise:

- **REMOTE–ENGINE SIDE** switch;
- **ASTERN–AHEAD** switch;
- **HANDWHEEL BLOCKING ARM** switch: **REMOTE** – upper position; **ENGINE SIDE** – lower position.

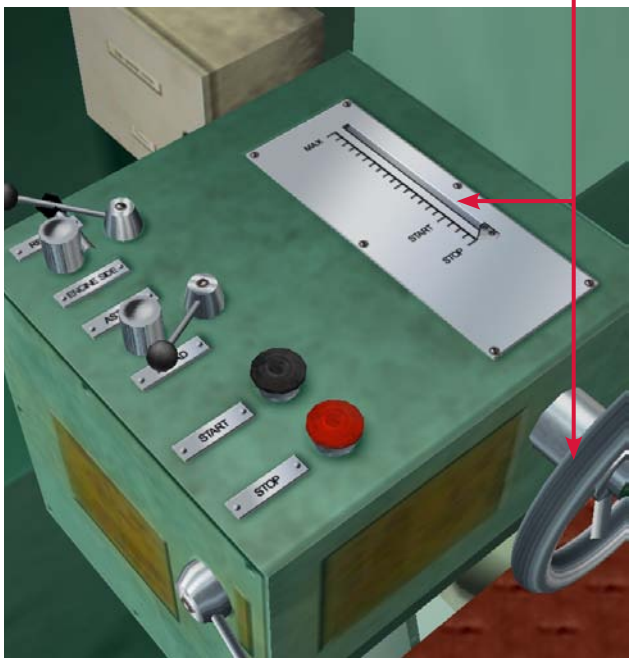
Operate the **MANOEUVRING HANDLE** by the wheel: left-click click to raise the speed, right-click to lower the speed; watch the slider on the scale for actual value.



Bottom panel (side view



Top panel



Bottom panel (top view)

Gauges (side panel)

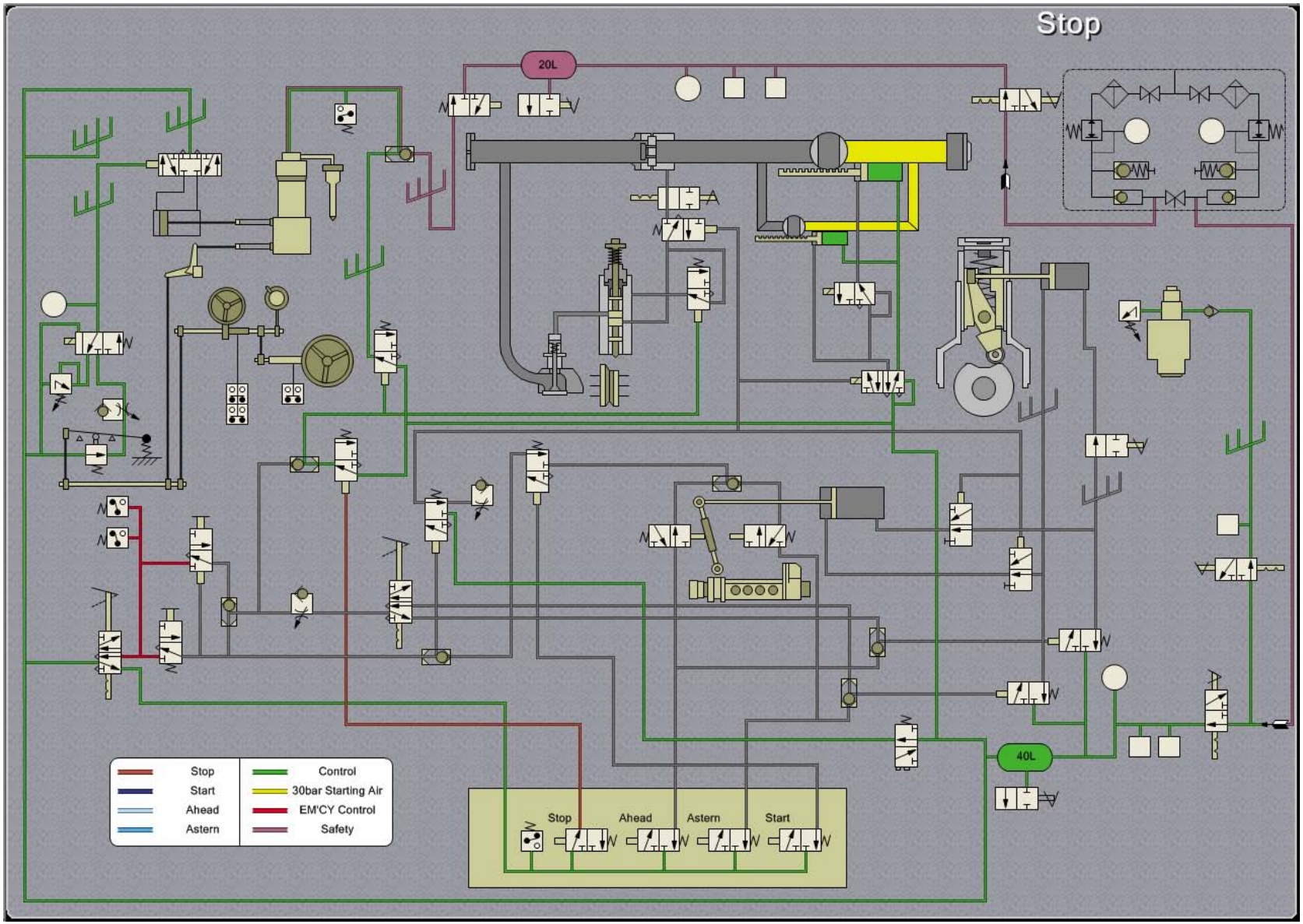
6. ME Manoeuvring System Diagrams

The diagrams show the most important signals in the manoeuvring system during start, stop, reversing, etc.

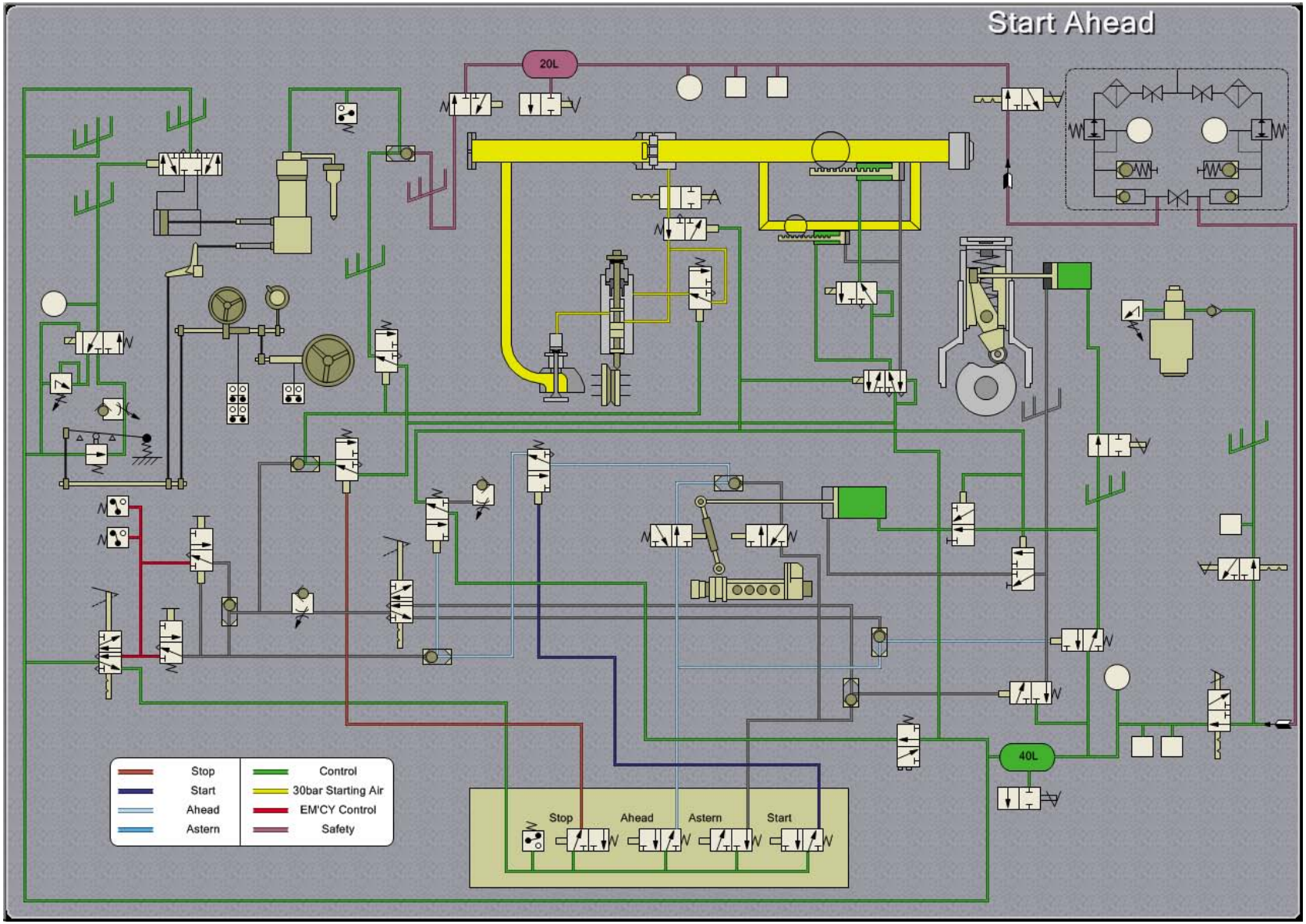
The symbols consist of one or more square fields. The number of fields corresponds to the number of valve positions. The connecting lines are connected to the field which represents the valve position at a given moment of the process.

Manoeuvring diagrams in the simulator are stationary figures. However active parts, pipelines, connections are highlighted according to the actual systems state and manoeuvring handle position. Objects on the diagrams are provided with descriptive hints (the **Hints Off/On** button should be pressed on the top toolbar), which explain the object behavior.

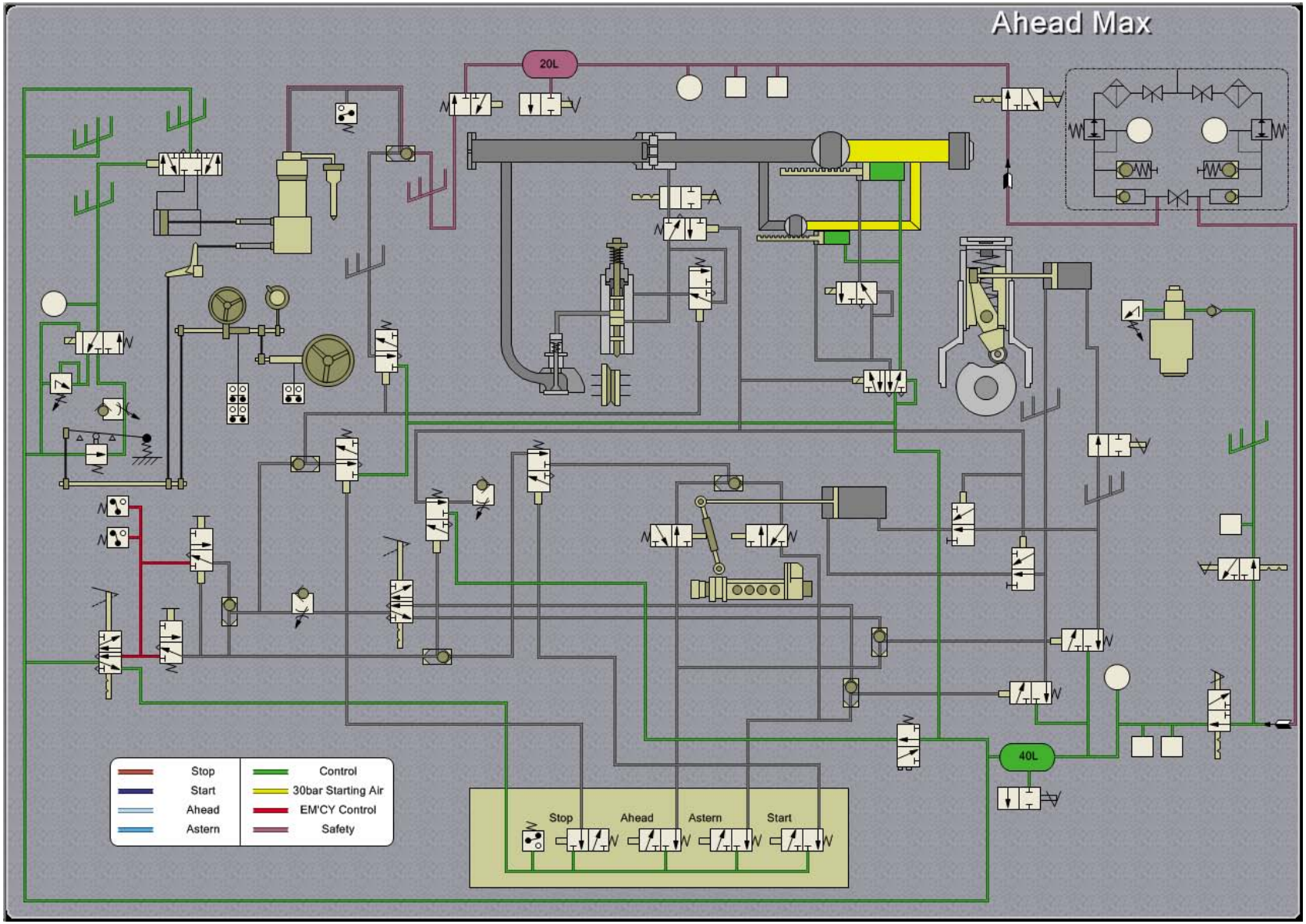
Stop Diagram



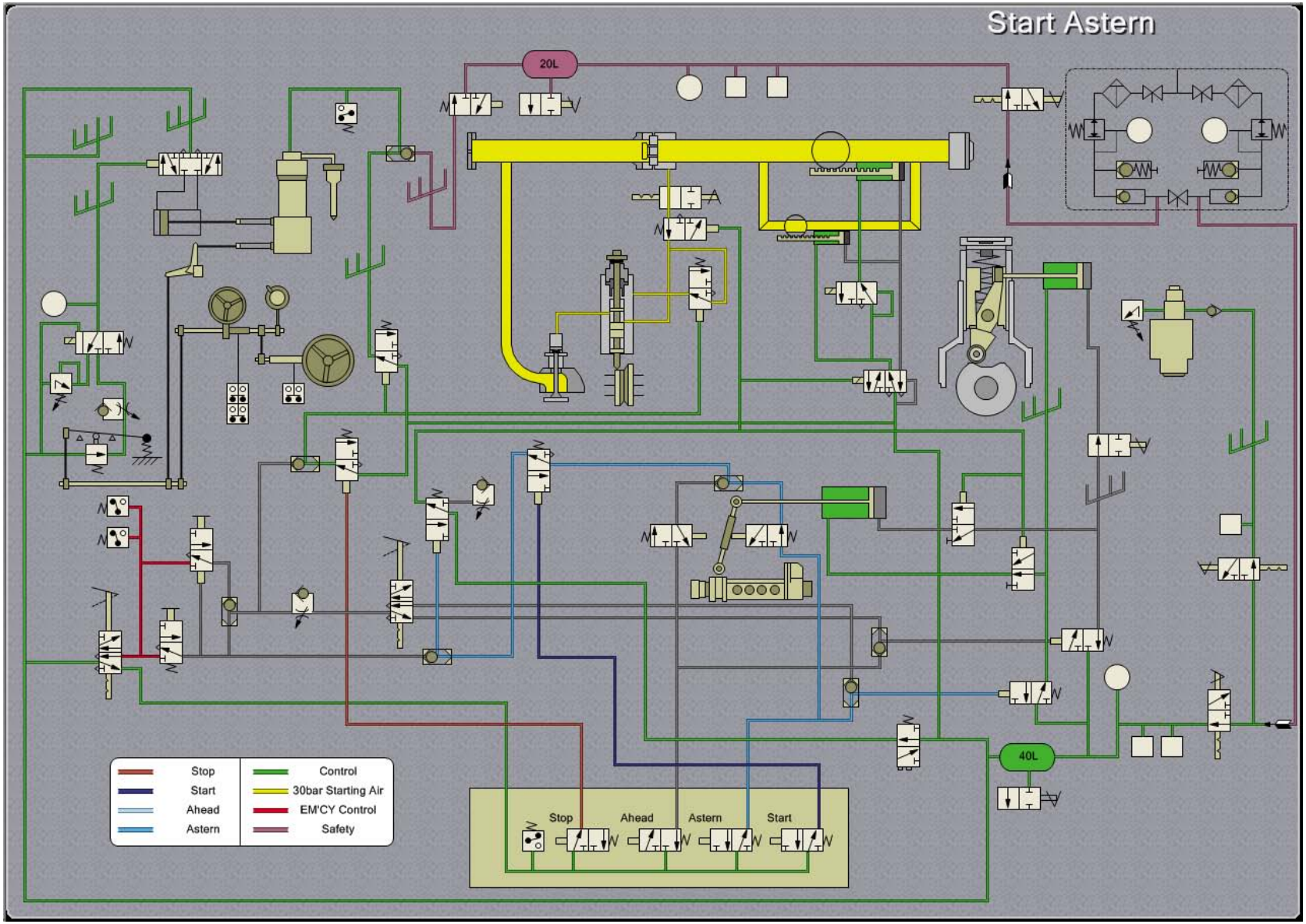
Start Ahead Diagram



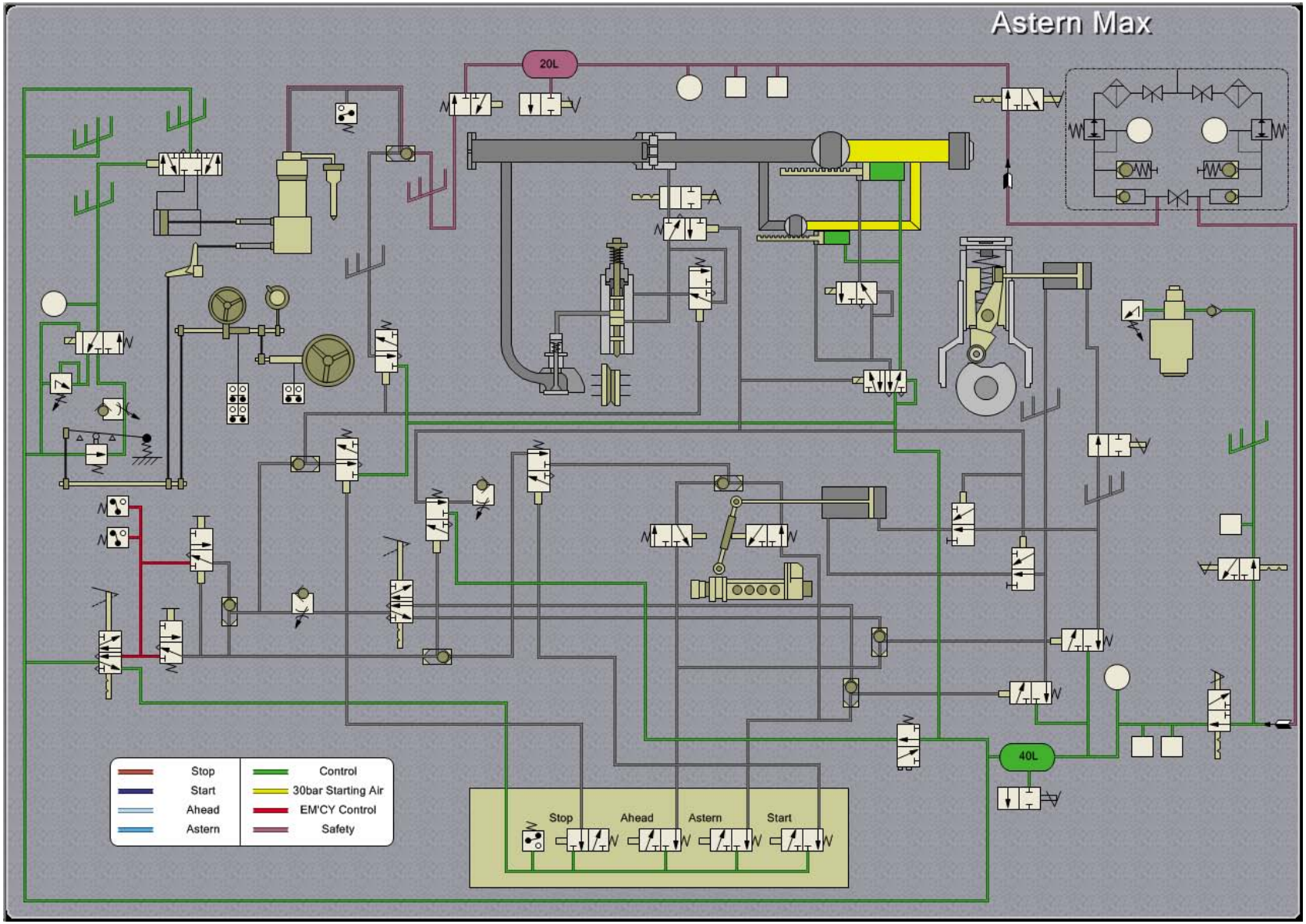
Ahead Max Diagram



Start Astern Diagram



Astern Max Diagram



7. Diagnostic System

7.1. Cylinder Indicator Diagrams for ME & GEs

Analyzing comprises:

- Hand Unit for recording of pressure in each engine cylinder (Indicator Diagram) – step by step;
- Data transfer to main unit for next analyzing and comparison.

Comparison comprises:

- Stationary device;
- Simultaneous analyzing and comparison of recorded indicator diagrams of different engine cylinders;
- "P–φ" type and "P-V" type Indicator diagrams.

7.1.1. Analyzing

Click on the menu item **Analyzing** of the page **CID** to open the display for measurement of the cylinders' pressure.

The display contains:

- The hand measuring device simulation;
- **Injection** handle to set in ON/OFF position;
- The cylinder selection box; click on the down arrow sign to open the drop-down list of cylinders and choose the required one for measurement.

Screen Content

The following parameters are displayed:

- Pi – mean effective pressure;
- Pz – maximum combustion pressure;
- Pc – compression pressure;
- φpz – timing angle;
- φign – angle of combustion start;
- Slide # – the measurement slide number;
- Total – total slides in the sequence.

The diagram horizontal axis is the cylinder crankshaft angle, vertical axis is pressure.

Three curves are output for each cylinder:

- Indicator diagram curve;
- Injector needle value lift curve;
- Combustion rate curve;
- Dynamics of fuel injection.

Injection ON/OFF handle in the simulator is used to imitate raising of the booster pump roller over the drive cam to prevent fuel injection into selected cylinder at the pressure measurement time. When the handle is in **OFF** position, the resulting diagram presents the cylinder pressure curve as function of piston stroke without fuel injection and, respectively, without combustion.

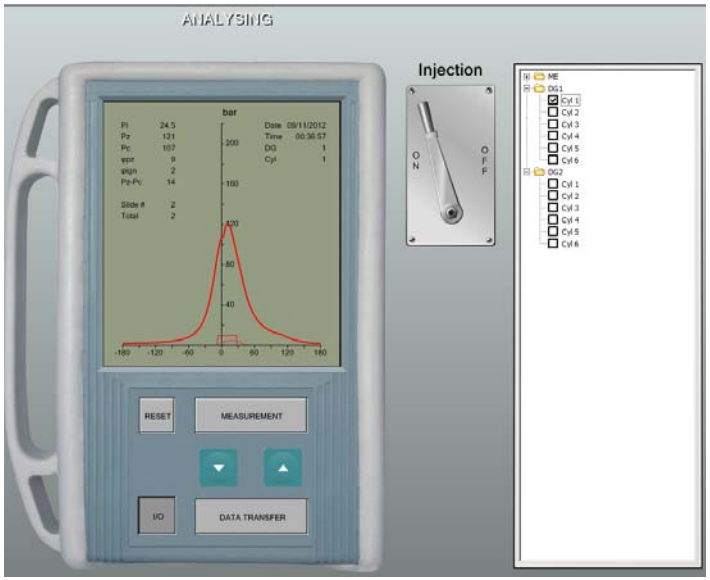
See the figures for diagrams difference.

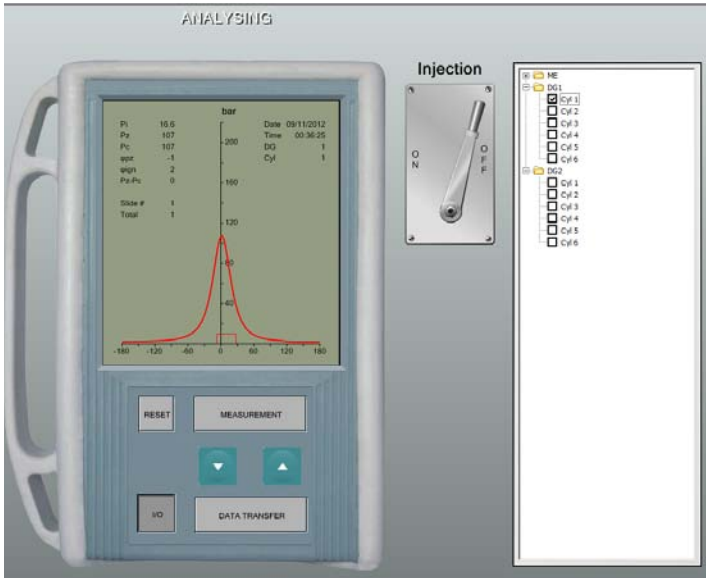
How it Works

1. Click the **I/O** button to switch the measuring device on.
2. In the cylinder selection box choose the required cylinder.
3. Click the **MEASUREMENT** button to start measuring. The parameters of the cylinder will appear on the device screen.
4. Repeat the procedure for all required cylinders.

   Use the **UP** and **DOWN** arrowed buttons to browse through the measurement slides sequence on the device screen.

   Use the **DATA TRANSFER** button to send all collected data to the Comparison unit (refer to ***the paragraph 7.1.2 on page 46***). After the data has been transferred it is excluded from the slide sequence.
5. Click the **I/O** button to switch the measuring device off.





7.1.2. Comparison

Click on the menu item **Comparison** of the page **CID** to open the display for comparison of parameters in different cylinders.

The display contains:

- The Chart area with the legend on top of it;
- The Cylinders Selection panel;
- The Table area;
- The panel to set the diagram's scaling and presentation.

How it Works

Provided you have measured the cylinders' parameters and transferred the data (refer to *the paragraph 7.1.1 on page 45*).

Open the cylinder trees in the selection panel on the right and check the required measurement data for comparison. The diagrams will be painted in the chart area using different colors for convenience.

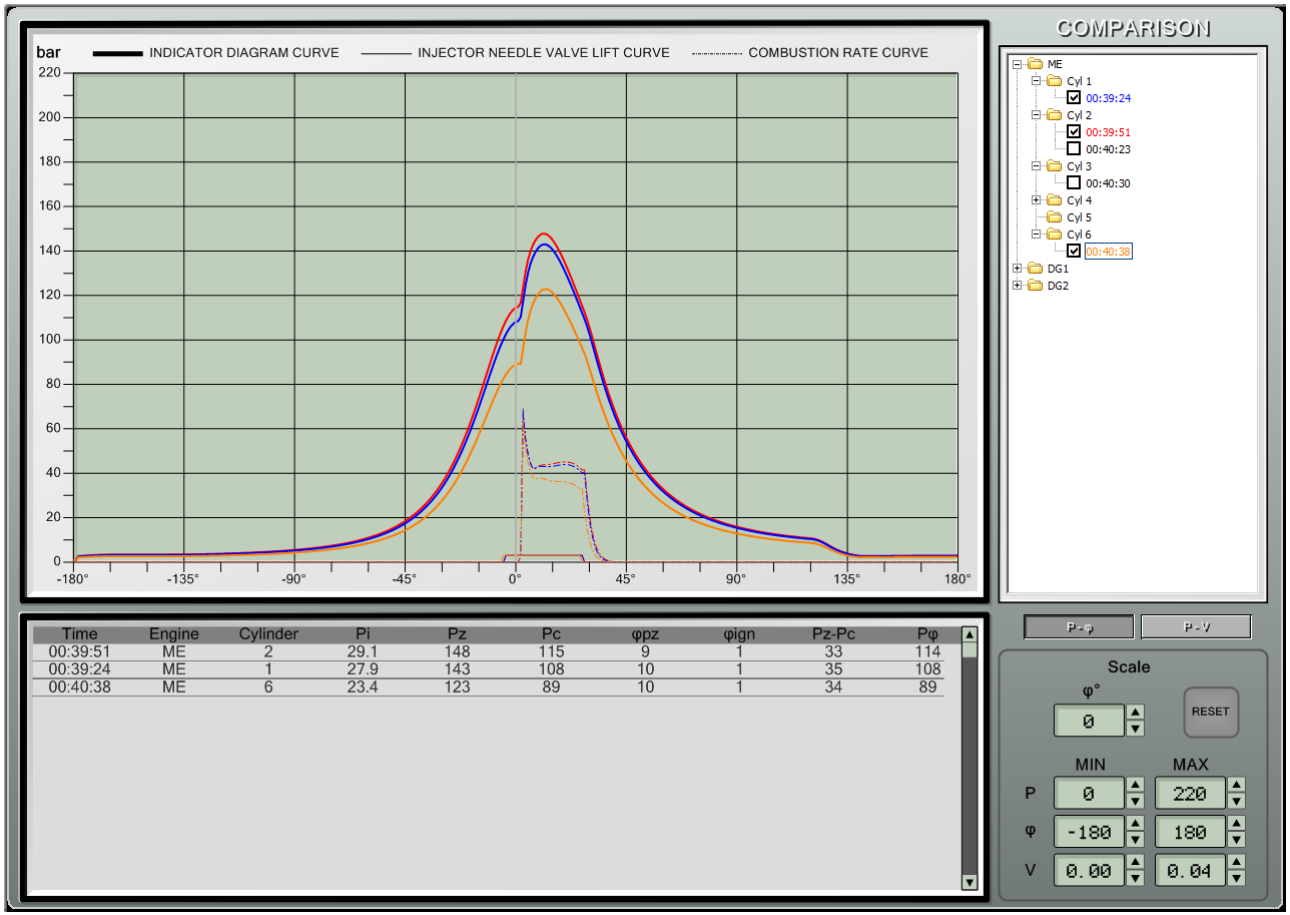
For each cylinder the three diagrams are output on the **P–φ** chart using different line style as explained in the legend at the top of the chart area. The **P–V** chart contains one diagram for each of the selected cylinders.

The table area displays the selected cylinder parameters:

- Pz – maximum combustion pressure;
- Pc – compression pressure;
- Pi – mean effective pressure;
- Phi pz – timing angle;
- Phi ign – angle of combustion start.

Use the **P–φ** button to compare the diagrams, where the horizontal axis is the cylinder crankshaft angle and the vertical axis is pressure.

Use the **P–V** button to compare the diagrams, where the horizontal axis is the cylinder volume and the vertical axis is the cylinder volume and the vertical axis is pressure.



The **Scale** panel contains:

- The **φ°** field to move the vertical hairline pointer along the horizontal axis with the up and down arrows to increase/decrease the value; the pointer is handy to find the exact angle of a curve inflexion point, etc.;
- The **RESET** button to clear the scale adjustment settings to default;
- The **φ** fields to set the **MIN** and **MAX** values of the angle parameter (horizontal axis);
- The **P** fields to set the **MIN** and **MAX** values of the pressure parameter (vertical axis).

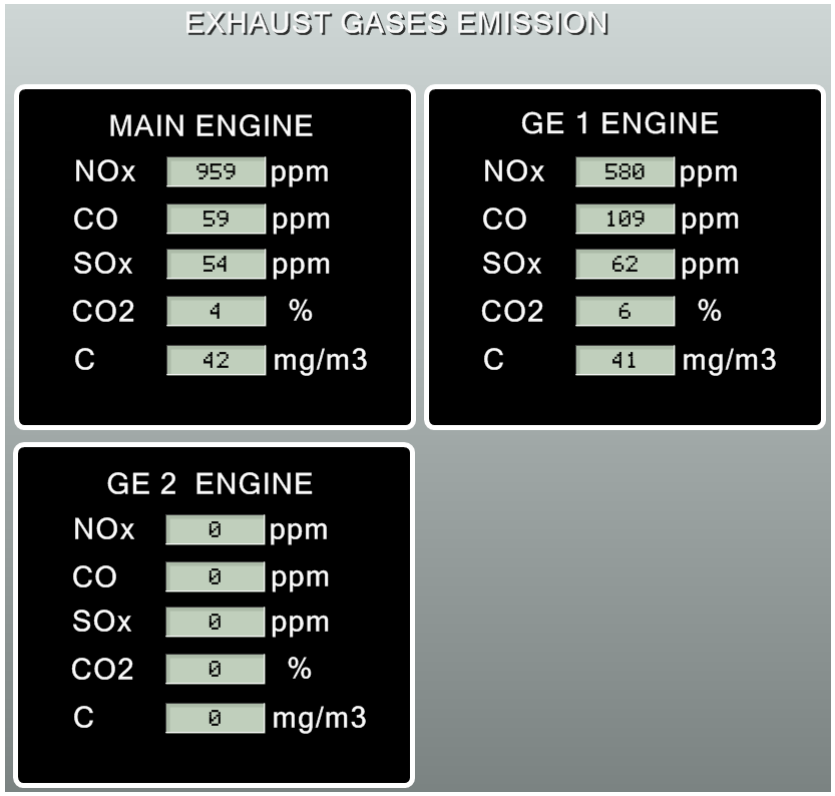
The scale panel is not used for the **P–V** chart presentation.

7.2. Exhaust Gases Emission Panel

Click on the menu item **Exhaust Gases Emission** of the page **CID** to open the display, which contains four panels with information on current exhaust gases emission of:

- **MAIN ENGINE**;
- **GE 1 ENGINE**;
- **GE 2 ENGINE**.

The exhaust gases scrubber system is used for exhaust gas stream cleaning according to IMO Resolution MEPC.170(57), see Chapter 4, ***the section 7.14 on page 222***.

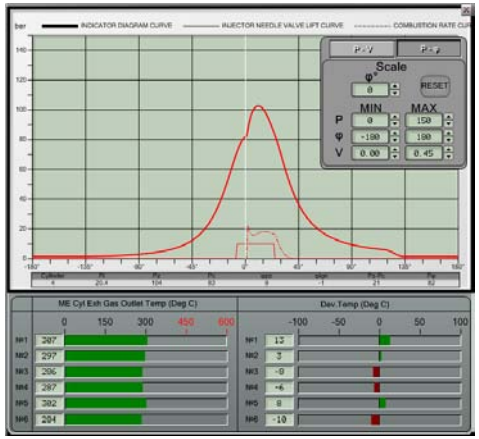


7.3. Cylinder Combustion Diagnosis Panel

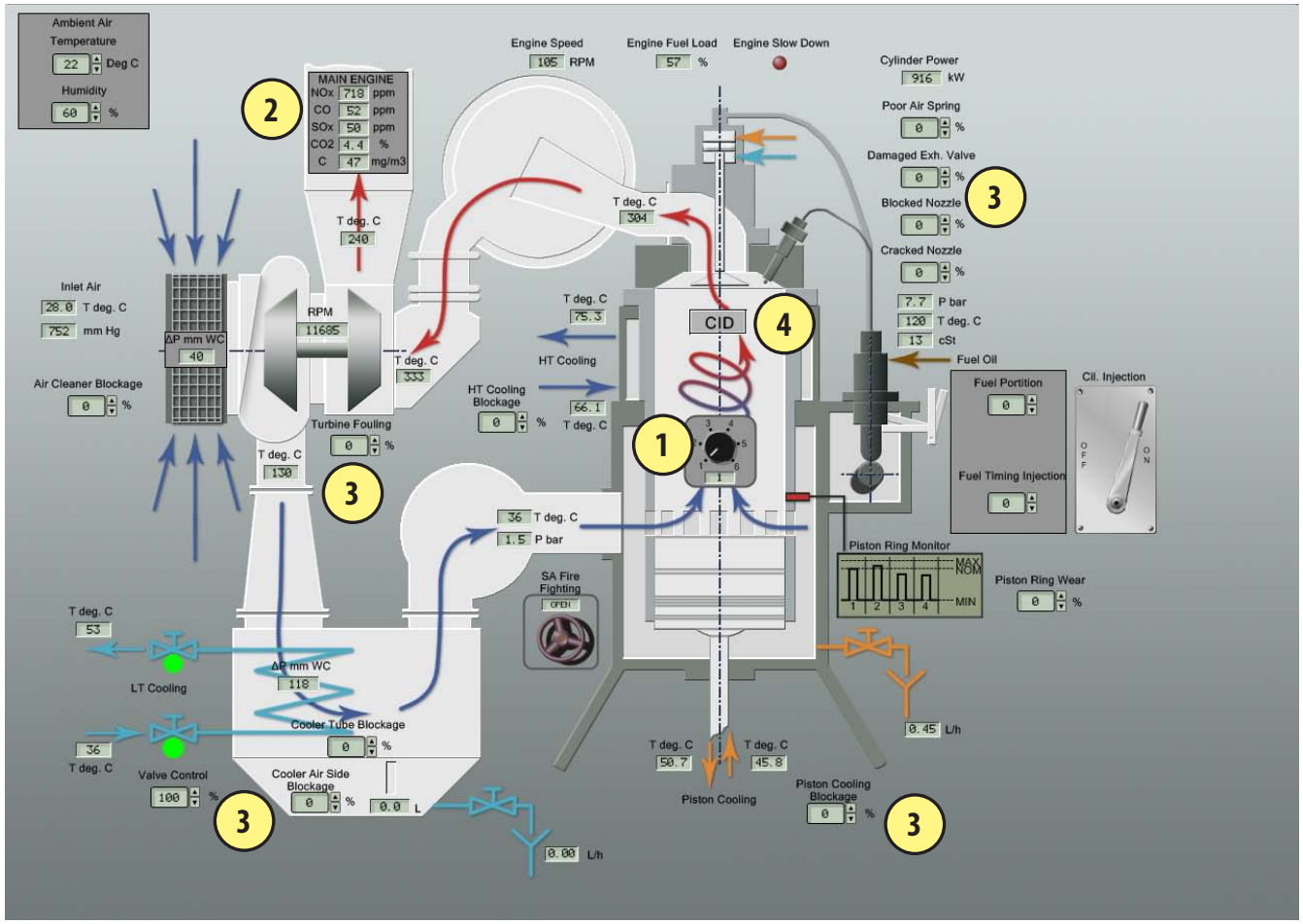
Click on the menu item **Cylinder Combustion process** of the page **Diag** to open the interactive diagram of the main engine, which allows to observe the effects of various combustion faults. It is also possible to influence the combustion process by making online adjustments or introducing faults directly.

The diagram contains:

- (1) six-position selector switch – to choose the required cylinder;
- (2) **MAIN ENGINE** – ME exhaust gases indicators;
- (3) spin controls (sliders) – to set the specified parameter values for introducing faults;
- Digital indicators to display the actual response of the ME system parameters;
- (4) **CID** button – to open the indicator diagrams in the floating window over the display (the diagrams are described in *the paragraph 7.1.1 on page 45*).



Cylinder Indicator Diagrams (CID) panel



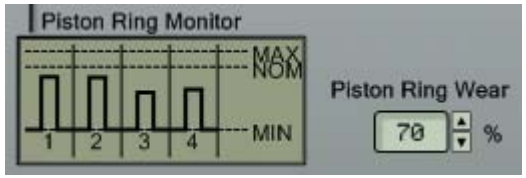
7.3.1. Modeling Faults

All faults modeled on the display can be also introduced from the instructor workplace.

7.3.1.1. Piston Ring Wear

Damaged or worn piston rings are difficult to diagnose in 2-stroke engines. Damage may not be apparent until it is severe.

The variable inductance transducer located in the cylinder liner above the scavenge-air port generates the electrical signal directly proportional to the piston ring gap. The signal is displayed on the LED screen oscillogram. For a new ring the gap is minimal, and the peak on the oscillogram reaches MAX value.



Adjustment:

Ring wear can be set for all rings simultaneously by the **Piston Ring Wear** spin control in the range 0–100%.

Indication:

- Low compression with injection switched off, CID (see cylinder indicator diagram);
- Increase in piston cooling oil return temperature;
- Improper indication of an increase of cylinder pressure at the bottom of the piston stroke indicated in the P–V CID diagram;
- Increase in cylinder lubricating oil flow or combustion gas at the trunk drain.

7.3.1.2. Air Cleaner Blockage

This is one of the most common faults associated with marine diesel engines. It should be the first item to check when an engine is under performing. The effect is to reduce the amount of combustion air entering the cylinder thus causing poor combustion.

Adjustment

The amount of blockage can be set by the **Air Cleaner Blockage** spin control in the range 0–100%.

Indications

- Reduction in scavenge air pressure;
- Loss of power, reduction in RPM;
- Increased exhaust temperature on all cylinders;
- Increase in exhaust gas emissions;
- Increased filter ΔP;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram);
- Stopped engine or engine will not start at high levels of blockage.

7.3.1.3. Turbo Charger Exhaust Turbine Fouling

Increase of exhaust products building up on the exhaust turbine blades. This will decrease the turbo charger RPM. Scavenge air pressure will reduce causing a reduction of combustion air entering the cylinders.

Adjustment

The amount of fouling can be set by the **Turbine Fouling** spin control in the range 0–100%.

Indications

- Reduction in turbo charger RPM;
- Loss of power, reduction in RPM;
- Increased exhaust temperature on all cylinders;
- Increase in exhaust gas emissions;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram).

7.3.1.4. Air Side Scavenge Air Cooler Fouling

A blockage of the scavenge air cooler (air side) will reduce the amount of combustion air entering the cylinders leading to poor combustion. The reduced cooling effect of the cooler will also affect the sea water cooling outlet temperature.

To repair, wash the Air Cooler on the air side.

Adjustment

The amount of fouling can be set by the **Cooler Air Side Blockage** spin control in the range 0–100%.

Indications

- Increased cooler ΔP;
- Loss of power, reduction in RPM;
- Reduction in scavenge air pressure;
- Increased exhaust temperature on all cylinders;
- Increase in exhaust gas emissions;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram);
- Decreased sea water cooling Δt;
- Increased NOx emission.

7.3.1.5. Scavenge Air Cooler Sea Water Flow

A reduction of scavenge air flow will reduce the cooling effect of the air cooler and increase the temperature and decrease density of the air entering the cylinder. This will cause poor combustion. An increased sea water flow will cause the over cooling of the scavenge air.

Adjustment

The cooling flow rate can be adjusted by closing the sea water cooling supply valve by the **Cooler Tube Blockage** spin control (tube fouling) and/or the **Valve Control** spin control (water flow) in the ranges 0–100%.

Indications Decreased flow

- Increase of scavenge air temperature;
- Increase of scavenge air pressure;
- Loss of power, reduction in RPM;
- Increased exhaust temperature on all cylinders;
- Increase in exhaust gas emissions;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram).

Indications Increased Flow

- Reduction of scavenge air temperature;
- Increase of condensate water flow at the scavenge air cooler drain.;
- Increase in combustion pressure, CID (see cylinder indicator diagram);
- Increase of engine power;
- Increase of exhaust temperatures

7.3.1.6. Scavenge Space Fire

A scavenge space fire is caused by the leakage of lubricating oil, or unburned fuel oil which accumulates in the scavenge space. It is ignited by a spark or flame passing the piston rings into the scavenge space. The accumulation of these combustible materials can be caused by worn or damaged piston rings, poor fuel injection, low compression and a partially choked exhaust valve. The fire can start at any speed or load.

In the simulator the fire conditions are modeled using the fault introduced by instructor "Clogging of Injection valve nozzle" or by a set of: Piston Ring Wear > 20% & RPM > 90 (ME running). After a certain delay time the fire starts.

Indications

- Loss of power;
- Irregular running of the engine;
- Surging turbocharger;
- Increased exhaust temperature in the effected units;
- Sparks and smoke emitted from the scavenge space drains;
- High temperature of the scavenge trunk.

To start extinguishing fire rotate the **SA Fire Fighting** wheel handle to position **OPEN**.

7.3.1.7. Engine Room Air Temperature

An increase of engine room air temperature will reduce the density of the air entering the engine.
This will lead to poor combustion if the scavenge air cooler flow is not increased to compensate.

Adjustment

Impact the engine room temperature by adjusting the ambient air temperature with the **Ambient Air Temperature** spin control. Engine room temperature depends also on the selection and quantity of the running fans, and the power of running machinery.

7.3.1.8. Engine Room Humidity

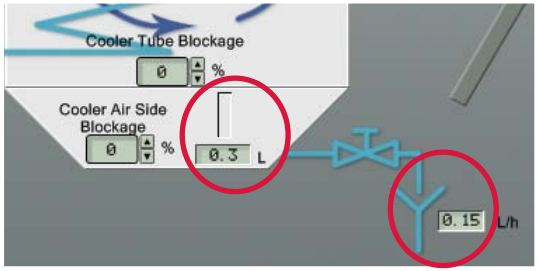
The amount of humidity entering the engine will cause some slight changes to the combustion process. The major effect of an increase of humidity is an increase of condensate water from the scavenge air cooler drain, and slight (2–3%) decrease of power due to lack of air.

Adjustment

Adjust the engine room air humidity using the **Ambient Air Humidity** spin control in the range 0–100%. and **Ambient Air Temperature** spin control (-20 – +38 deg.C).

Indications

- Increased condensate water flow from the scavenge air cooler drain;



In the field conditions ambient air humidity varies significantly. When cylinders are charged with humid air, portion of dry air and Oxygen in the cylinders decreases. If the FO supply governors stay in constant position the air fuel ratio decreases directly proportional to the humid volume difference in the air. As a result, the engine power decreases. Exhaust gases temperature increases, which may cause engine overload.

7.3.1.9. Poor Exhaust Valve Air Spring

Compressed air is used to shut the exhaust valve. Should the air pressure be low or the piston damaged the valve may not close properly or quickly. This will reduce compression as air escapes through the valve during the compression stroke. If the valve stays permanently open the cylinder will not fire.

Adjustment

Adjust the exhaust valve air spring force using the **Poor Air Spring** spin control in the range 0–100%. The valve stays fully open at 100% value.

Indications

- The cylinder power decreases;
- Increased exhaust gases temperature;
- Modification of right end on the P-V diagram (see ***the figure Poor Exh. v. Air Spring CID P-V diagrams on page 51***):

7.3.1.10. Damaged Exhaust Valve

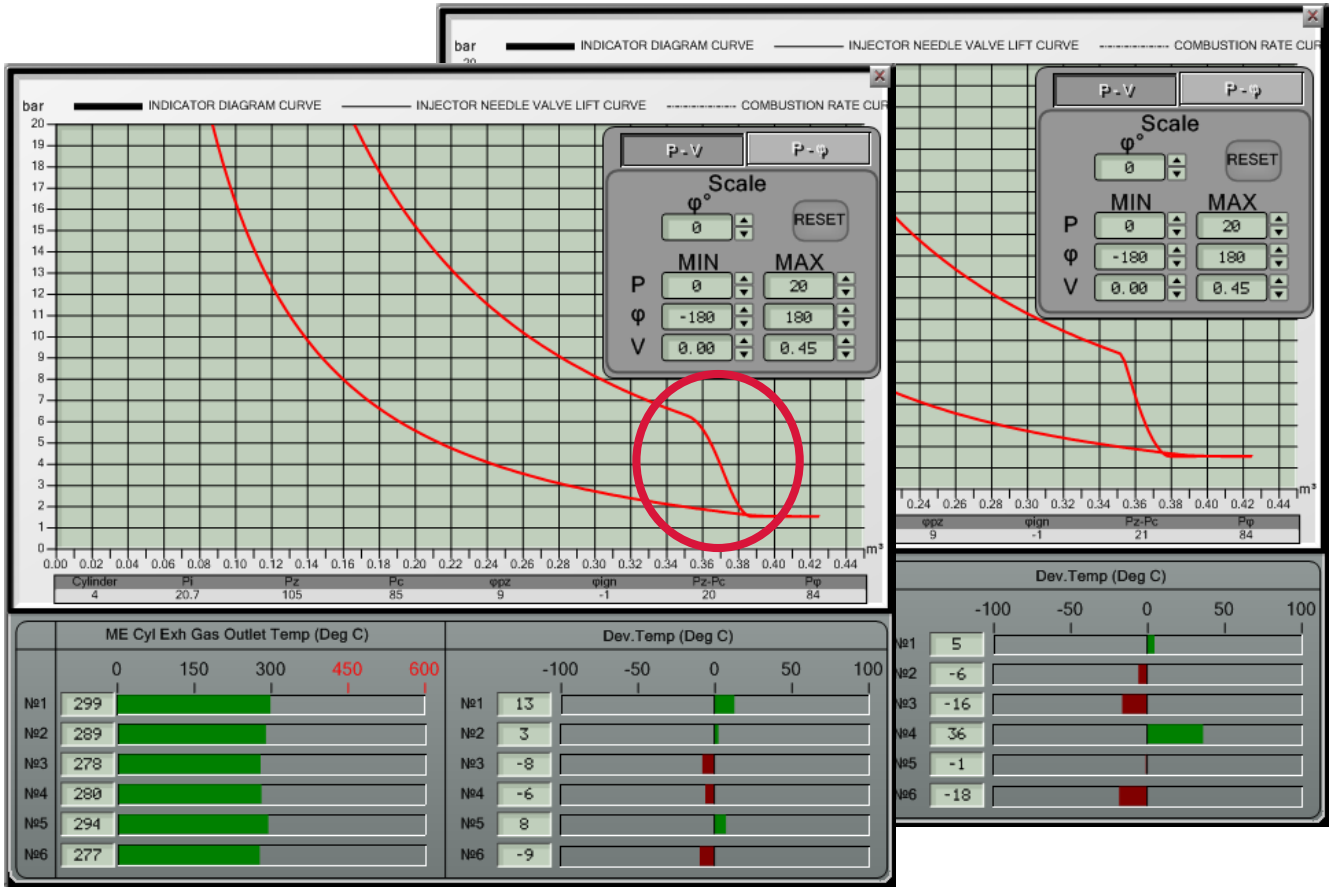
Damage to the exhaust valve will cause a loss of power due to escaping combustion gases and poor compression.

Adjustment

Adjust the exhaust valve air spring force using the **Damaged Exh. Valve** spin control in the range 0–100%.

Indications

- Low compression indication in the, CID (see cylinder indicator diagram) with injection off;
- Poor combustion due to lower compression;
- Increase in exhaust cylinder temperature.



Poor Exh. v. Air Spring CID P-V diagrams

7.3.1.11. Reaction on HT Cooling Supply and Return

The cylinder HT return temperature should increase and decrease in relation to engine power and performance.

Adjustment

Adjust the HT return temperature using the **HT Cooling Blockage** spin control in the range 0–100%.

Indications

- Increased return HT temperature.

7.3.1.12. Late or Early Injection Timing

Injection timing may change due to poor adjustments or wear in the fuel pump operating mechanisms. Early and late injection have different indications and effects on engine performance. The handle **Cyl. Injection** position **Off** closes FO supply to the cylinder.

Adjustment;

Adjust the injection timing using the **Fuel Timing Injection** spin control in the range -5 – +5. When the slider is in the central position the point of injection is correct.

Controls to adjust FO supply to cylinders are available also on the 3-D displays (see ***the paragraph 5.1.2 on page 33***).

Indication Early Injection

- Early injection pump lift indication, CID (see cylinder indicator diagram);
- Early change in cylinder pressure at point of injection;
- Poor combustion as the fuel is not vaporized sufficiently due to low compression temperature;
- Loss of power, reduction in RPM;
- Increased exhaust temperature on affected cylinder;
- Increase in exhaust gas emissions;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram);
- Increased NOx emission.

Indication Late Injection

- Late injection pump lift indication, CID (see cylinder indicator diagram);
- Late change in cylinder pressure at point of injection.;
- Poor combustion as the fuel is not vaporised sufficiently due to low compression temperature. ;
- Loss of power, reduction in RPM;
- Increased exhaust temperature on affected cylinder;
- Increase in exhaust gas emissions;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram)
- Decreased NOx emission.

7.3.1.13. Fuel Delivery Rate Adjustment

The fuel delivery “Fuel Rack” position has a direct correlation with cylinder power.

Adjustment;

Adjust the fuel injection using the **Fuel Portion** spin control in the range 0–100%.

Controls to adjust FO supply to cylinders are available also on the 3-D displays (see ***the paragraph 5.1.2 on page 33***).

7.3.1.14. Blocked Injector Nozzle

Blocked spray holes in an injection nozzle will reduce cylinder power. When totally blocked the cylinder will not fire.

Adjustment

Adjust the blockage amount using the **Blocked Nozzle** spin control in the range 0–100%.

Indications

- Loss of power;
- Decreased combustion pressure;
- Reduced exhaust temperature;
- Knocking noise (not modeled in the simulator) emanating from the fuel injection pump. Noise increases with the amount of blockage.

7.3.1.15. Cracked Injection Nozzle

Cracked injector nozzles cause poor atomization of the fuel injected into the cylinder. Combustion is incomplete and fuel is still burning as it leaves the cylinder. Over time the hosing of the liquid fuel onto the cylinder liner will wash the lubricating oil from the liner causing increased cylinder wear.

Adjustment

Adjust the severity of damage using the **Cracked Nozzle** spin control in the range 0–100%.

Indications

- Loss of power, reduction in RPM;
- Increased exhaust temperature on affected cylinder;
- Increase in exhaust gas emissions CO and CH;
- Black smoke from the exhaust;
- Reduced combustion peak pressure, CID (see cylinder indicator diagram);
- Reduced combustion indication, CID (see cylinder indicator diagram);
- At high levels of damage fuel may pass the piston rings. There may be an increase of waste oil flow in the trunk drain.

Chapter 2. Remote Supervision Systems

This chapter contains the description of the remote automatic control systems for training the watch personnel of the ship in skills of correct operating the Ship Control Monitoring System and Boiler Monitoring Control System.

Chapter 2. Remote Supervision Systems

This chapter contains:

1. Control and Monitoring System

1.1. CMS Description and Functions

The displays of the Control and Monitoring System (CMS) in the simulator are designed for remote supervision of the vessel systems from the Bridge and ECR. The simulator CMS is not full replica of LCC tanker on board system, however it simulates all functionality of real systems and allows the trainee to familiarize oneself with the general features and use.

In the simulator the change of state of units and mechanisms in various vessel systems is displayed simultaneously on the **CMS** page and **SYS** page displays, and on the displays of appropriate LOPs. When referring to the **SYS** displays in this Chapter, refer to the detailed description of the respective displays in ***Chapter 4***.

An alarm is generated when a failure occurs in equipment monitored by the **CMS** system. The alarms, which have to be acknowledged by ECR Desk operators to inhibit audible (tone) and visual (flashing) indicators, are automatically added to the **List of Alarms** and to the **Event Log**. When a failure is rectified the alarm is removed from the list of alarms but not from the Event log. Operators can view the log at any time.

The CMS includes the following type of screens:

- Process Displays, e.g. a system diagram or overview screen;
- Trend Curve Displays;
- Alarms & Events Displays.

The CMS displays include:

- Main Engine Overview;
- Generator Engines Overview;
- Fuel Oil Service system for ME & GE;
- Fuel Oil Filling & Transfer system;
- Fuel Oil Purifying system;
- Lube Oil Service system for Main Engine & Stern Tube;
- Lube Oil Transfer & Purifying system and LO Service for Generator Engines;
- Sea Water Cooling & Service system;
- Exhaust Gases system;
- Low Temperature Cooling Fresh Water system;
- Bilge & Fire General Service system;
- Compressed Air system;
- Aux. Boiler and Feed Water system;
- Electric Plant;
- Alarms and Events.

1.2. Operating the CMS Displays

Operating the CMS displays requires the general knowledge of the layout and graphical representation of the information on screen including the objects' construction and color. The guidelines are described in the sections below.

1.2.1. Layout

The layout of the display areas is applicable for all CMS displays. Three independent areas, described below are available.

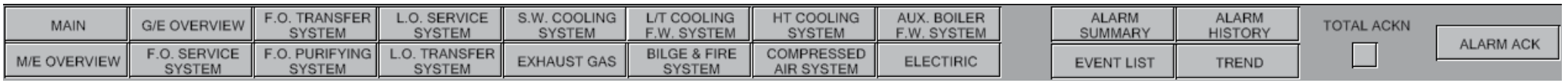
The top part of each display of the CMS page contains the panel, where information is displayed: The panel contains:

- **Time** indicator – the actual time of exercise execution;
- The output box, where the latest current alarm is displayed; the box occupies most part of the panel;
- **TOTAL UNACK** – digital indicator displaying the total number of unacknowledged alarms in the system;
- **Date** indicator – displays the actual date of the exercise execution;
- **ME CONTROL** – indicator of the control location;
- **DEADMAN** – indicator of the Deadman system state.

The bottom part of the displays is occupied by the two-row bottom panel with the CMS menu and functional buttons:

- **MAIN**– button to jump to the display with the ship image;
- Buttons with the names of the systems controlled by CMS; click a button to open the respective mimic;
- **ALARM SUMMARY**, **ALARM HISTORY**, **EVENT LIST**, **TREND** – buttons to jump to the displays **Alarm List**, **Alarm History List**, **Event List**, and **Trend**;
- **TOTAL ACK** button; when the button is pressed, click the **ALARM ACK** button to acknowledge all CMS alarms at once; otherwise it acknowledges only last alarm, which is displayed in the output box of the top panel;
- **ALARM ACK** button.

Top panel of the CMS display



Bottom panel of the CMS display

The central part of the display is occupied by the application area, which contains the selected process display or list. The process displays have been constructed using:

- Static background picture;
- Static and dynamic primitives and figures;
- Numeric and alpha-numeric indicators;
- Bar graphs.

Each primitive or figure can use dynamic attributes allocated for the presentation of process, such as figure name, color, and flashing. As an example a bar from a bar graph will change its height in response to measured value changes. For other figures the change can be displayed by means of the figure color.

The set of possible statuses is presented on each display in the form of the **LEGEND**. An example is presented on the figure:

The pipelines and figures of pumps, compressors, etc. are displayed with the color respective to the flowing matter. The state of electrical chains and equipment is designated by color too. The following colors are used:

- Light blue color for the fresh water pipes;
- Green color for the sea water pipes;
- Orange color for the hydraulic and thermal oil pipes;
- Light brown color for the MDO pipes;
- Dark brown color for the HFO pipes;
- Grey color for compressed air system;
- Green color for electrical chains free of load;
- Magenta color for electrical chains under load.

1.2.2. Indication of Alarms on Mimic

Digital indicators flash in red when parameter value falls out of the range. When alarm is acknowledged but the alarm condition has not been cleared, the indicator lights in continuous red.

Fault indicators highlight in red when a fault occurs. When acknowledged it changes color to magenta, and lights down when fault condition has been cleared.

1.2.3. Remote Valves Control

Remote valves are operated by double-click. When the mouse hovers over a controlled valve the cursor changes its shape: from “arrow” to “hand”:

The valve open state is displayed by the color of flowing matter. Closed valve is colored by background color.

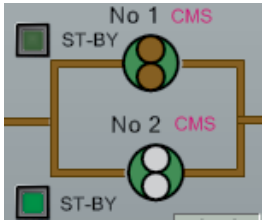
1.2.4. Standby Pairs and Auto Control

In the arrangement of duty/standby pair of pumps, fans, compressors, the operating logic is set as follows.

On the Group Starter Panel (GSP) at MSB start one of the mechanisms and set both to CMS control by the **MSB–CMS** switch. On the respective CMS display then click **ST-BY** latched button (it highlights) for the second mechanism.

Another option would be to set both mechanisms to CMS control on GSP and then from the CMS display double-click to start one of them for duty operation, and click **ST-BY** button for the second mechanism.

Units under CMS control are marked by **CMS** labels; units under remote control from MSB GSP are marked by MSB labels.



Similar logic is applied to set automatic operation by **AUTO** buttons on CMS displays when a mechanism is under CMS control.

If the motor of the duty mechanism is overloaded for some cause (e.g. fault from instructor), the motor is stopped and an alarm red color indicator **ABNORM** is illuminated.

At this time the standby mechanism is started immediately. Overloading mechanism is placed in a ST-BY mode automatically when it is recovered from the overload.

1.3. CMS Displays in Simulator

1.3.1. Main Engine Overview

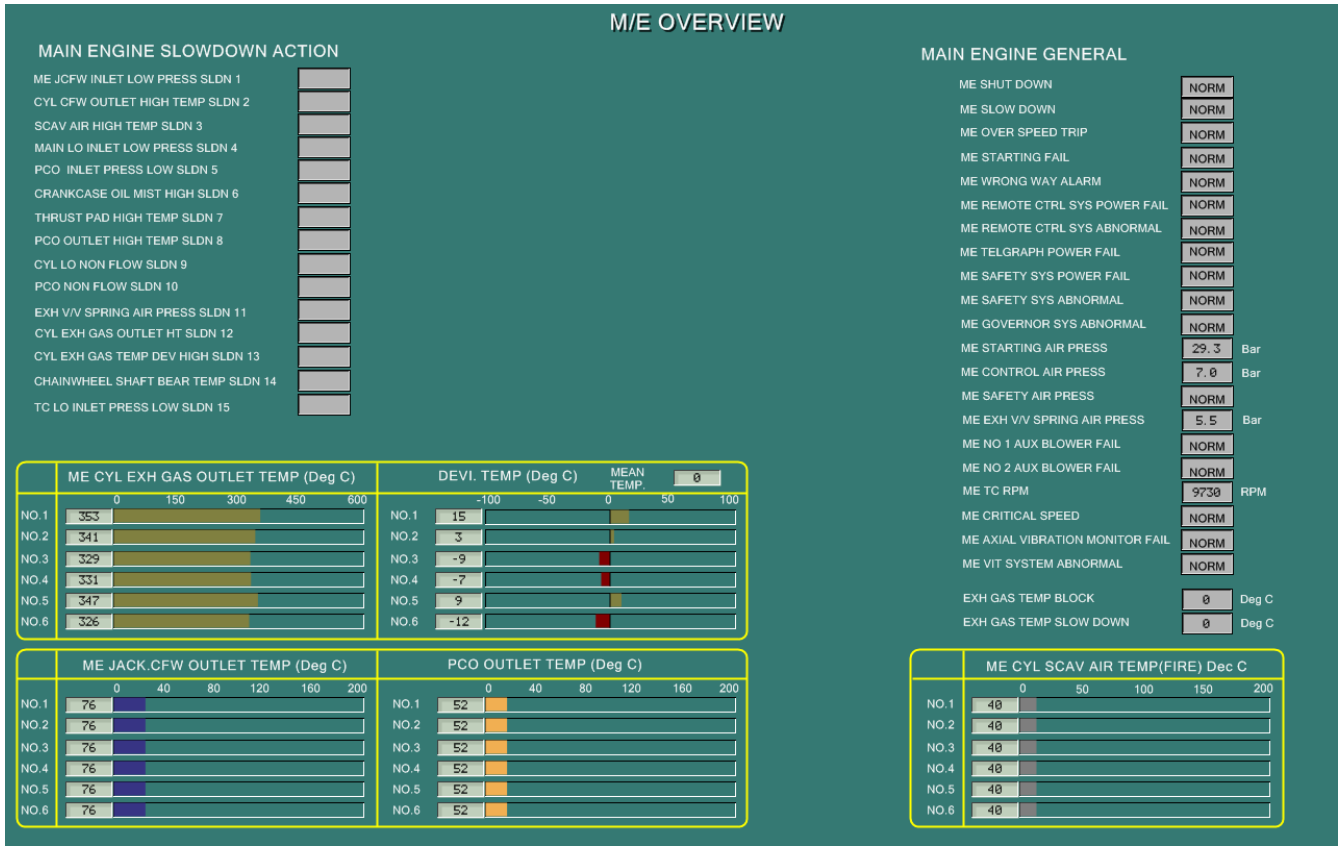
Click on the **M/E OVERVIEW** button in the **CMS** bottom menu to open the display **MAIN ENGINE OVERVIEW**.

The mimic contains:

- **MAIN ENGINE SLOWDOWN ACTION** table of ME system parameters actual values, which cause ME slowdown;
- **MAIN ENGINE GENERAL** table of ME system parameters actual values and **NORM** indicator labels, which turn to **ABNORM** red when an alarm condition occurs;
- Tables of ME cylinder parameters actual values digital indicators and bar graphs:
  - **M/E CYL. EXH. GAS OUTLET TEMP (Deg C)**;
  - **DEVI. TEMP (Deg C)**; and **MEAN TEMP**;
  - **M/E JACK. C.F.W. OUTLET TEMP (Deg C)**;
  - **P.C.O. OUTLET TEMP (Deg C)**;
  - **M/E CYL. SCAV. AIR TEMP (FIRE) Deg C**.

Abnormal conditions can occur to a unit (system, mechanism) breakage, failure, alarm or a fault introduced by the instructor. Then **NORM** indicator label turns to **ABNORM** red, or alarmed parameter box highlights in red.

Parameters of ME and supply systems are described in Chapter 1 and Chapter 4 respective sections.



1.3.2. Generator Engines Overview

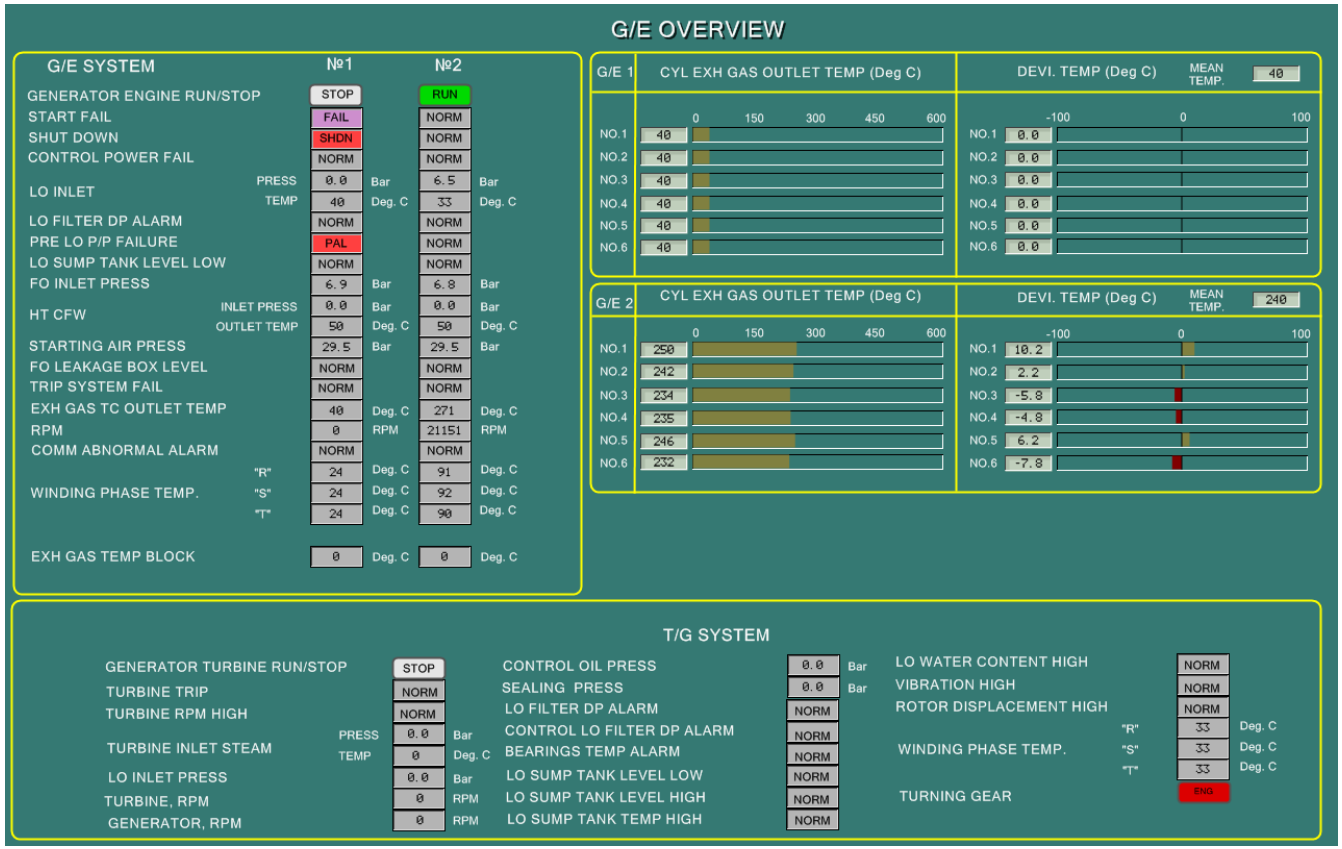
Click on the **G/E OVERVIEW** button in the **CMS** bottom menu to open the display **GENERATOR ENGINE OVERVIEW**.

The mimic contains:

- **G/E SYSTEM** table of parameters, **RUN/STOP** indicator, and safety system indicators for each of the generator engines **№1, №2**.
- **G/E 1** and **G/E 2** tables of cylinder parameters actual values digital indicators and bar graphs:
  - **CYL. EXH. GAS OUTLET TEMP (Deg C)**;
  - **DEVI. TEMP (Deg C)**; and **MEAN TEMP**;
- **T/G SYSTEM** table of parameters, **RUN/STOP** indicator; **TURNING GEAR** state indicators; safety system indicators.

Abnormal conditions can occur to a unit (system, mechanism) breakage, failure, alarm or a fault introduced by the instructor. Then **NORM** indicator label turns to **ABNORM** red, or alarmed parameter box highlights in red.

Parameters of GEs and supply systems are described in Chapter 3 and Chapter 4 respective sections.



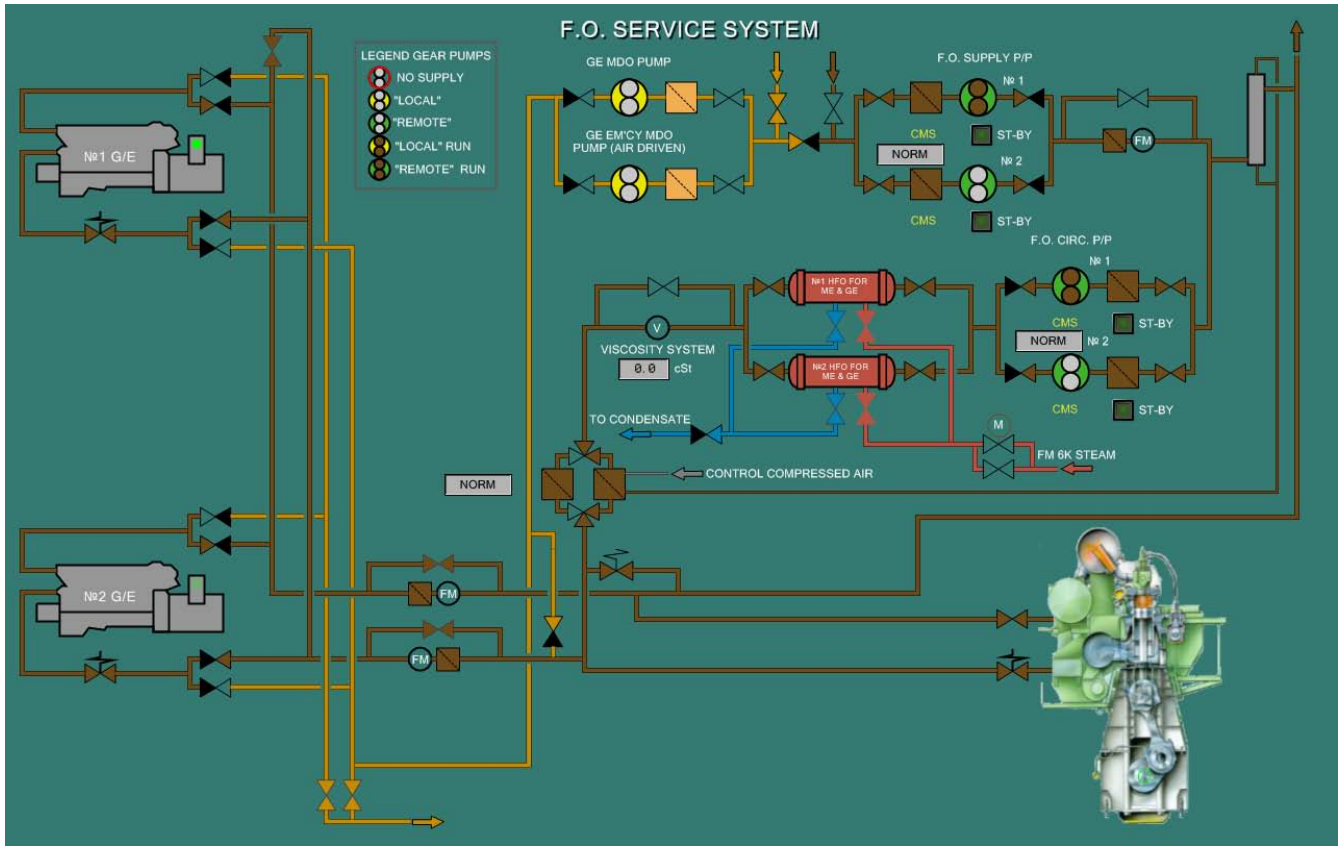
1.3.3. Fuel Oil Service System for ME & GE

Click on the **F.O. SERVICE** button in the **CMS** bottom menu to open the display **F.O. SERVICE SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- **№1 G/E, №2 G/E,** ME cross-section with run indicators;
- **GE MDO PUMP** control;
- **GE EM'CY MDO PUMP (AIR DRIVEN)** control;
- **F.O. SUPPLY P/P №1, №2** controls and **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **F.O. CIRC. P/P №1, №2** controls and **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **№1, №2 HFO FOR ME & GE** heater units;
- **VISCOSITY SYSTEM** unit;
- The pipelines with controlled valves (EM – electric-mechanical, M – mechanical), measuring gauges (FM – flow meter), and connections to ship systems.



1.3.4. Fuel Oil Filling & Transfer System

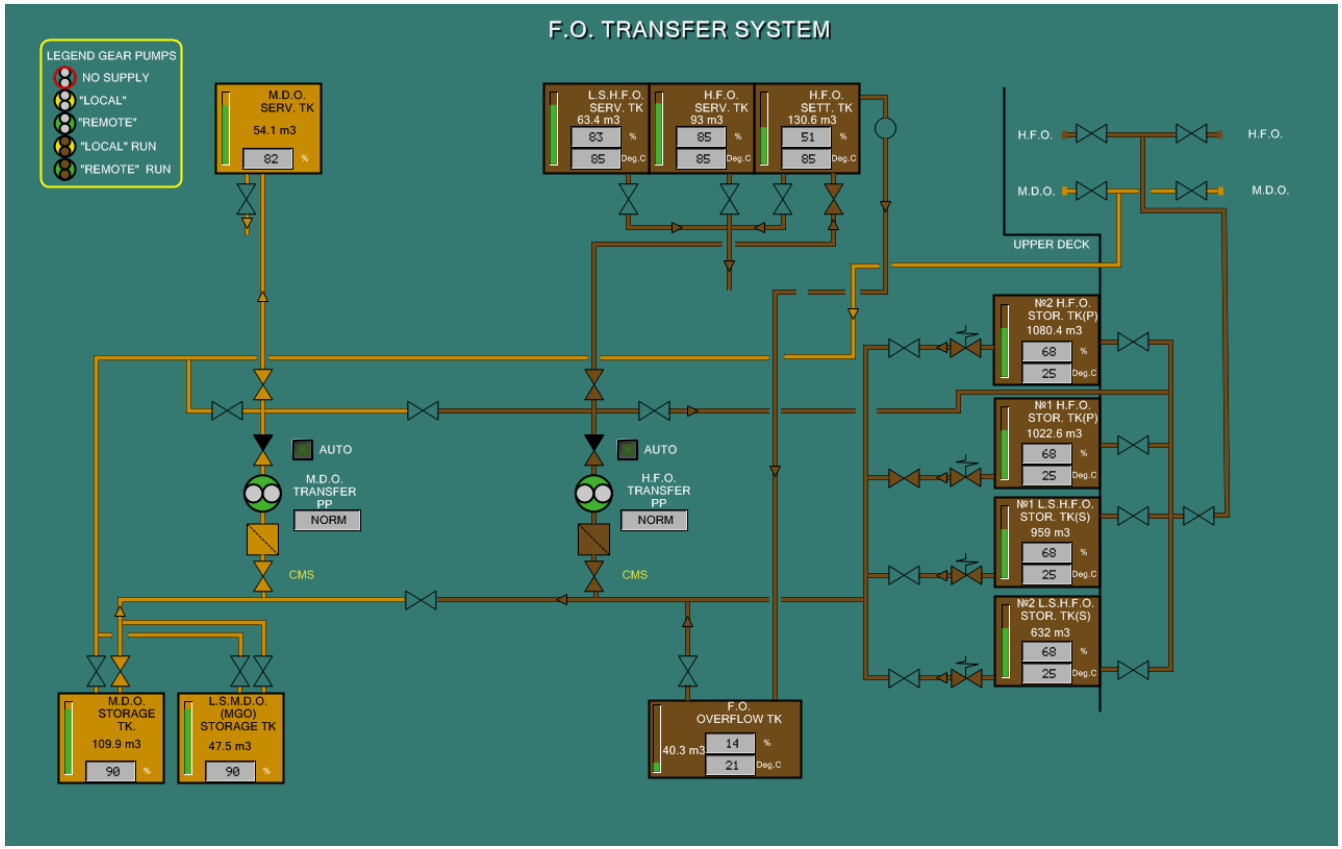
Click the **F.O. TRANSFER SYSTEM** button on the bottom bar of any **CMS** page to open the display **F.O. FILLING & TRANSFER SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- Tanks:
  - **M.D.O. SERV. TK 54.1 m3;**
    M.D.O. STORAGE TK 109.9 m3;
    L.S.M.D.O. (MGO) STORAGE TK 47.5 m3;
  - **L.S.H.F.O. SERV. TK 63.4 m3;**
    H.F.O. SERV. TK 93 m3;
    H.F.O. SETT. TK 130.6 m3;
  - **№2 H.F.O. STOR. TK (P) 1080.4 m3;**
    №1 H.F.O. STOR. TK (P) 1022.6 m3;
    №1 L.S.H.F.O. STOR. TK (S) 959 m3;
    №2 L.S.H.F.O. STOR. TK (S) 632 m3;
  - **F.O. OVERFLOW TK 40.3 m3.**
- **H.F.O.** and **M.D.O.** bunker stations on **UPPER DECK;**
- **M.D.O. TRANSFER PP** control and **AUTO** button (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **H.F.O. TRANSFER PP** control and **AUTO** button (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage or filter fouling occurs;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

Each tank is fitted with the tank level bar graph and digital indicator. Each H.F.O. tank is fitted with fuel temperature digital indicator. Each storage tank is fitted with controlled QCV.



The pumps can be controlled from the starter panels and push button boxes (see Chapter 4, *the paragraph 3.1.4.2 on page 130*).

1.3.5. Fuel Oil Purifying System

Click the **F.O. PURIFYING SYSTEM** button on the bottom bar of any **CMS** page to open the display **F.O. PURIFYING SYSTEM**.

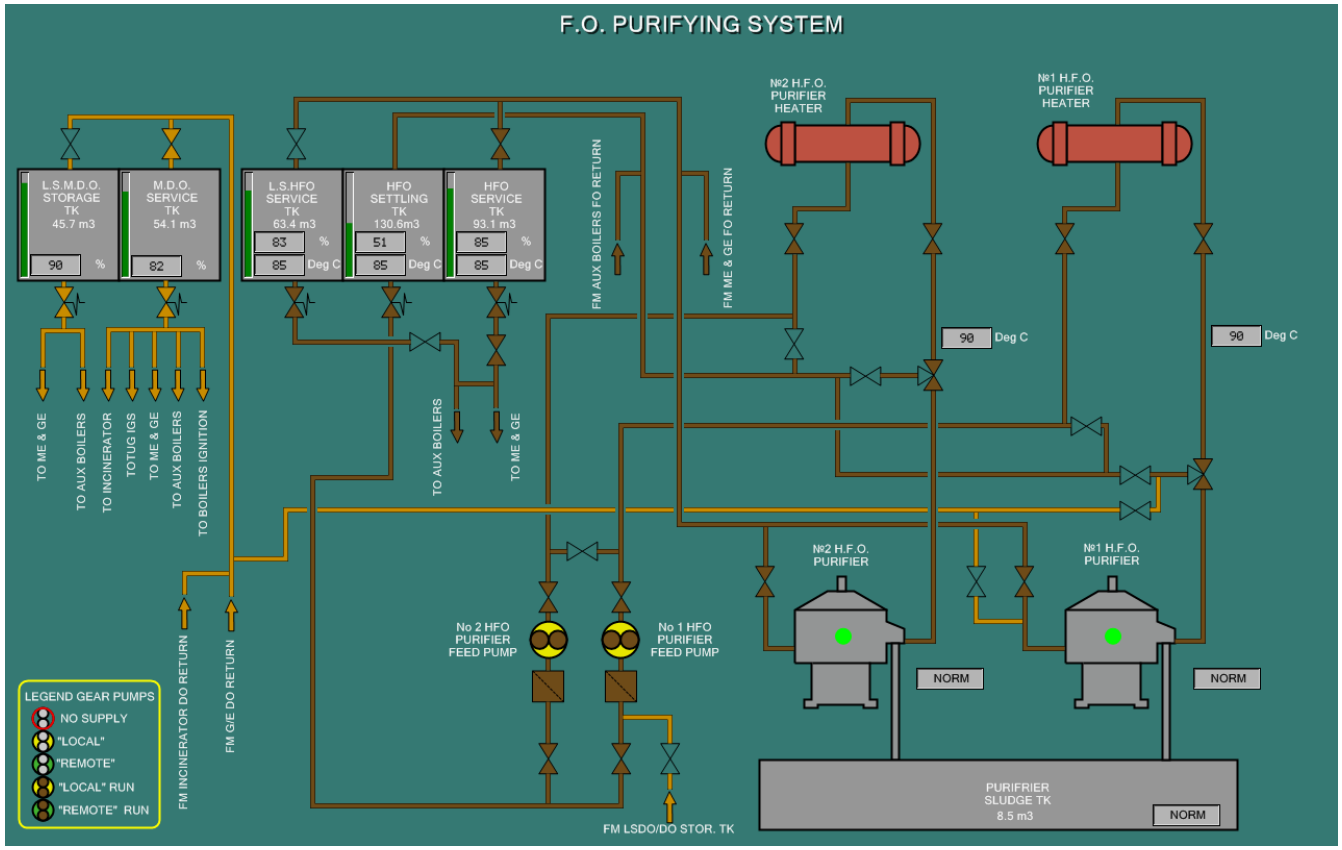
Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- Tanks:
  - **L.S.M.D.O. STORAGE TK 47.5 m3**; **M.D.O. SERVICE TK 54.1 m3**;
  - **L.S.H.F.O. SERVICE TK 63.4 m3**; **H.F.O. SETTLING TK 130.6 m3**; **H.F.O. SERVICE TK 93.1 m3**.
- **№ 2 H.F.O. PURIFIER** and **№ 1 H.F.O. PURIFIER** units with run indicators; digital indicators of FO temperature; **NORM** indicator label, which turns to **ABNORM** red when a purifier breakage occurs;
- **№ 2 HFO PURIFIER FEED PUMP** and **№ 1 HFO PURIFIER FEED PUMP** controls;
- **№ 2 H.F.O. PURIFIER HEATER** and **№ 1 H.F.O. PURIFIER HEATER** units;
- **PURIFIER SLUDGE TK 8.5 m3** with **NORM** indicator label, which turns to **ABNORM** red when tank level alarm occurs;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

Each tank is fitted with the tank level bar graph and digital indicator. Each H.F.O. tank is fitted with fuel temperature digital indicator. Each storage tank is fitted with controlled QCV.

Purifiers and purifier feed pumps are operated from their LOPs (see Chapter 4, *the paragraph 3.2.4.2 on page 132*).



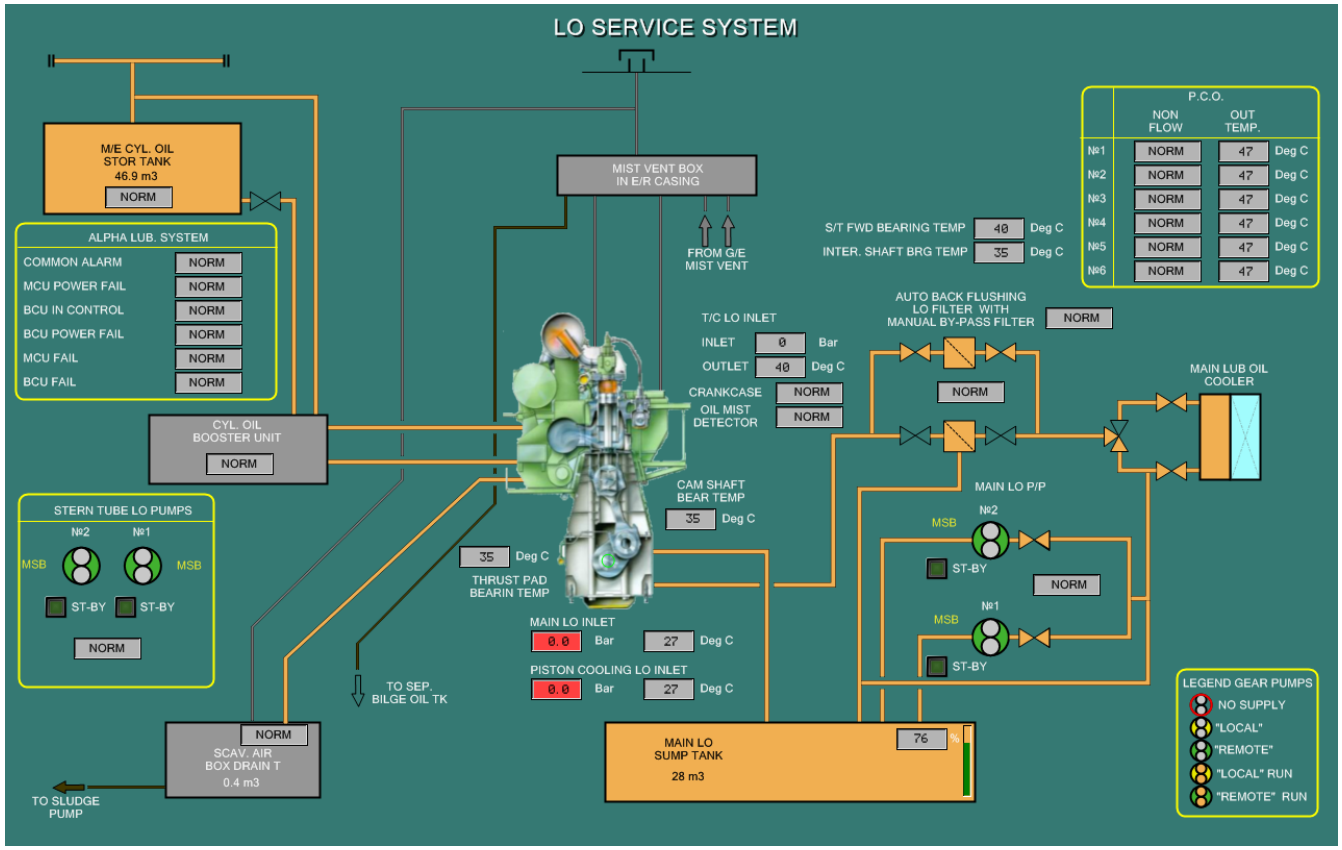
1.3.6. Lube Oil Service System

Click on the **L.O. SERVICE SYSTEM** button in the **CMS** bottom menu to open the display **LO SERVICE SYSTEM** for ME and S/T.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- ME cross-section and digital indicators of the engine lubricating parameters actual values;
- Tanks:
  - **ME CYL. OIL STOR TK 46.9 m3**;
  - **SCAV. AIR BOX DRAIN TK 0.4 m3**;
  - **MAIN LO SUMP TANK 28 m3**.
- **ALPHA LUB. SYSTEM** table with alarm and control location; **NORM** indicator labels turn to **ABNORM** red in a column when the respective alarm occurs;
- **STERN TUBE LO PUMPS №2, №1** controls and **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **CYL. OIL BOOSTER UNIT** with **NORM** indicator label turn to **ABNORM** red in a column when the respective alarm occurs;
- **P.C.O.** table of ME cylinders' lubrication and temperature; **NORM** indicator labels turn to **ABNORM** red in a column when the respective alarm occurs;
  - **NON-FLOW** – when fouling of LO pipes causes rise of bearings temperature;
  - **OUT TEMP.**
- **MAIN LO P/P №2, №1** controls and **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;



- **AUTO BACKFLUSHING LO FILTER WITH MANUAL BY-PASS FILTER** with **NORM** indicator label, which turns to **ABNORM** red when filter fouling occurs;
- **MAIN LUB OIL COOLER**;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

Tanks are provided with controlled QCVs; **NORM** alarm indicators, which turn to **ABNORM** red when the level alarm occurs.

1.3.7. Lube Oil Transfer System

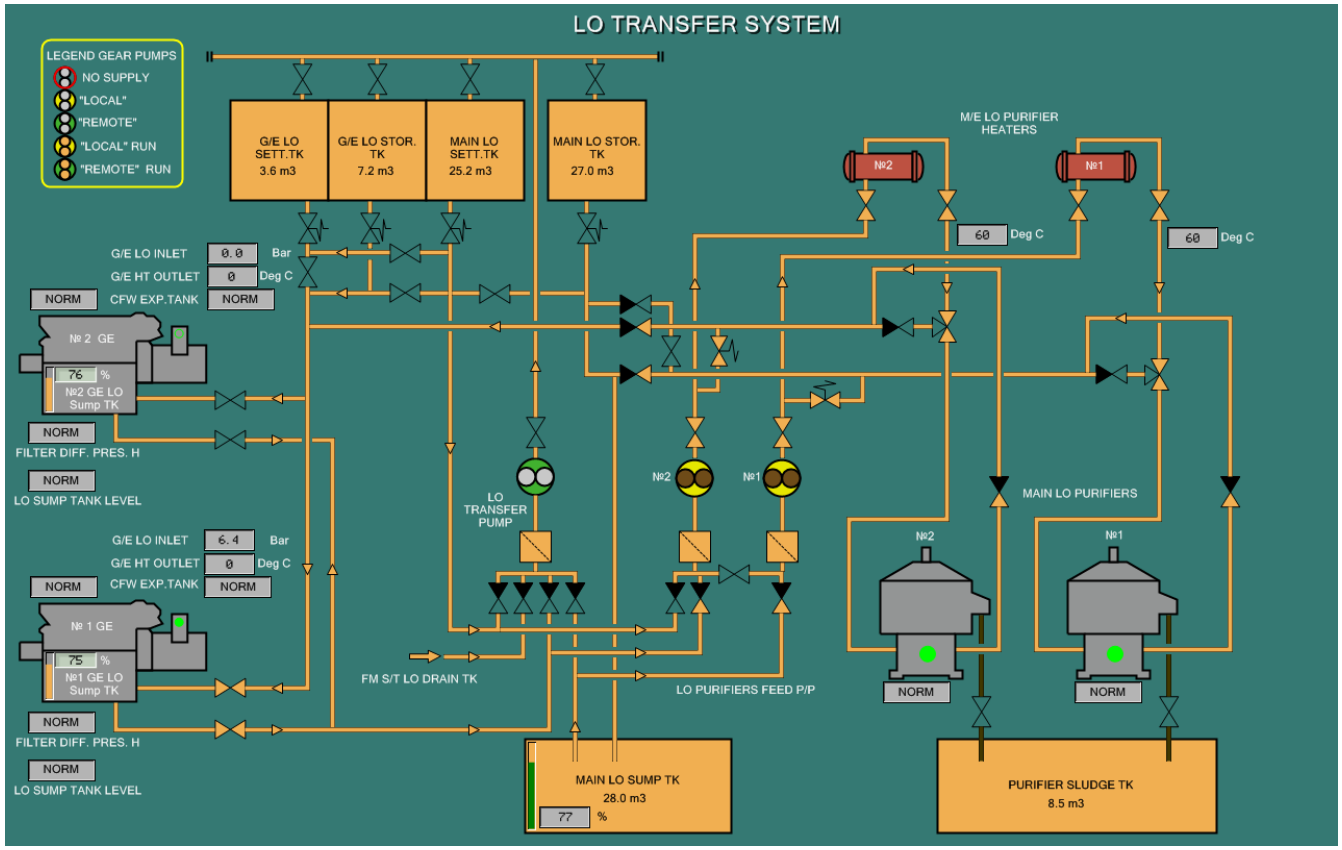
Click on the **L.O. TRANSFER SYSTEM** button in the **CMS** bottom menu to open the display **LO TRANSFER SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- Tanks:
  - **G/E LO SETT. TK 3.6 m3**;
    G/E LO STOR. TK 7.2 m3;
    MAIN LO SETT. TK 25.2 m3;
    MAIN LO STOR. TK 27.0 m3;
  - **MAIN LO SUMP TK 28.0 m3**;
  - **PURIFIER SLUDGE TK 8.5 m3**.
- **№2, №1 GE** units; each unit comprises:
  - Run indicator; digital indicators of pressure and temperature;
  - **GE LO Sump TK** level bar graph and indicator;
  - **LO SUMP TANK LEVEL**, **CFW EXP. TANK NORM** indicator labels, which turn to **ABNORM** red when level alarm occurs;
  - **FILTER DIFF. PRESS. H** indicator label, which turns to **ABNORM** red when differential pressure > 0.9 bar.
- **№1, №2 L.O. PURIFIER**; each with run indicator, and **NORM** indicator label, which turns to **ABNORM** red when a purifier breakage occurs;
- **L.O. TRANSFER PUMP** control and filter
- **LO PURIFIER FEED P/P №2, №1** controls;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

Tanks are provided with controlled QCV.



The pumps can be controlled from the starter panels and push button boxes (see Chapter 4, ***the paragraph 4.1.4.3 on page 146***).

The purifiers are controlled from the LOPs (see Chapter 4, ***the paragraph 4.1.4.4 on page 147***).

1.3.8. Sea Water Cooling & Service System

Click on the **S.W. COOLING SYSTEM** button in the **CMS** bottom menu to open the display **S.W. COOLING & SERVICE SYSTEM**.

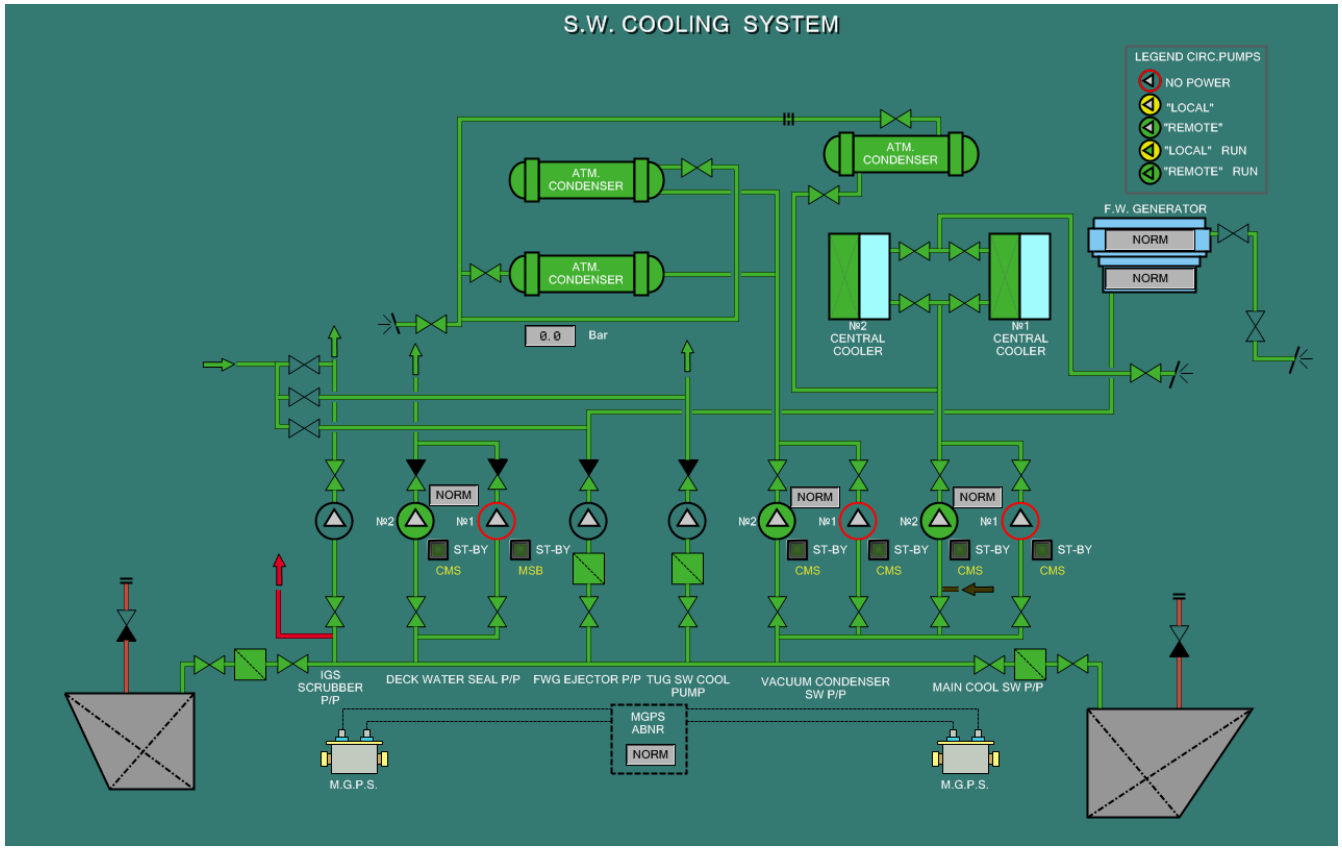
Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- **F.W. GENERATOR**; top **NORM** alarm indicator, which turns to **ABNORM** red when salinity high alarm is indicated; bottom **NORM** alarm indicator, which turns to **ABNORM** red when any of 3 alarms occurs on FWG panel;
- **ATM. CONDENSER** unit;
- **№2, №1 CENTRAL COOLER** units;
- Pumps:
  - **I.G.S. SCRUBBER P/P**;
  - **DECK WATER SEAL P/P №2, №1**;
  - **FWG EJECTOR P/P**;
  - **TUG SW COOL PUMP**;
  - **VACUUM CONDENSER SW P/P №2, №1**;
  - **MAIN COOL SW P/P №2, №1**.
- 2 x Sea Chests with M.G.P.S. units each; **MGPS ABNR** indicator label **NORM** turns to **ABNORM** red when fouling occurs;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

The pumps pairs (№2, №1) with **ST-BY** buttons operate in duty/stand-by mode (control logic is described in *the paragraph 1.2.4 on page 56*); indicator label **NORM** turns to **ABNORM** red when a pump breakage occurs.

The pumps can be controlled from the starter panels and push button boxes; M.G.P.S. anti-fouling panels are opened from **ER1** page menu (see Chapter 4, *the paragraph 2.1.4.6 on page 122*).



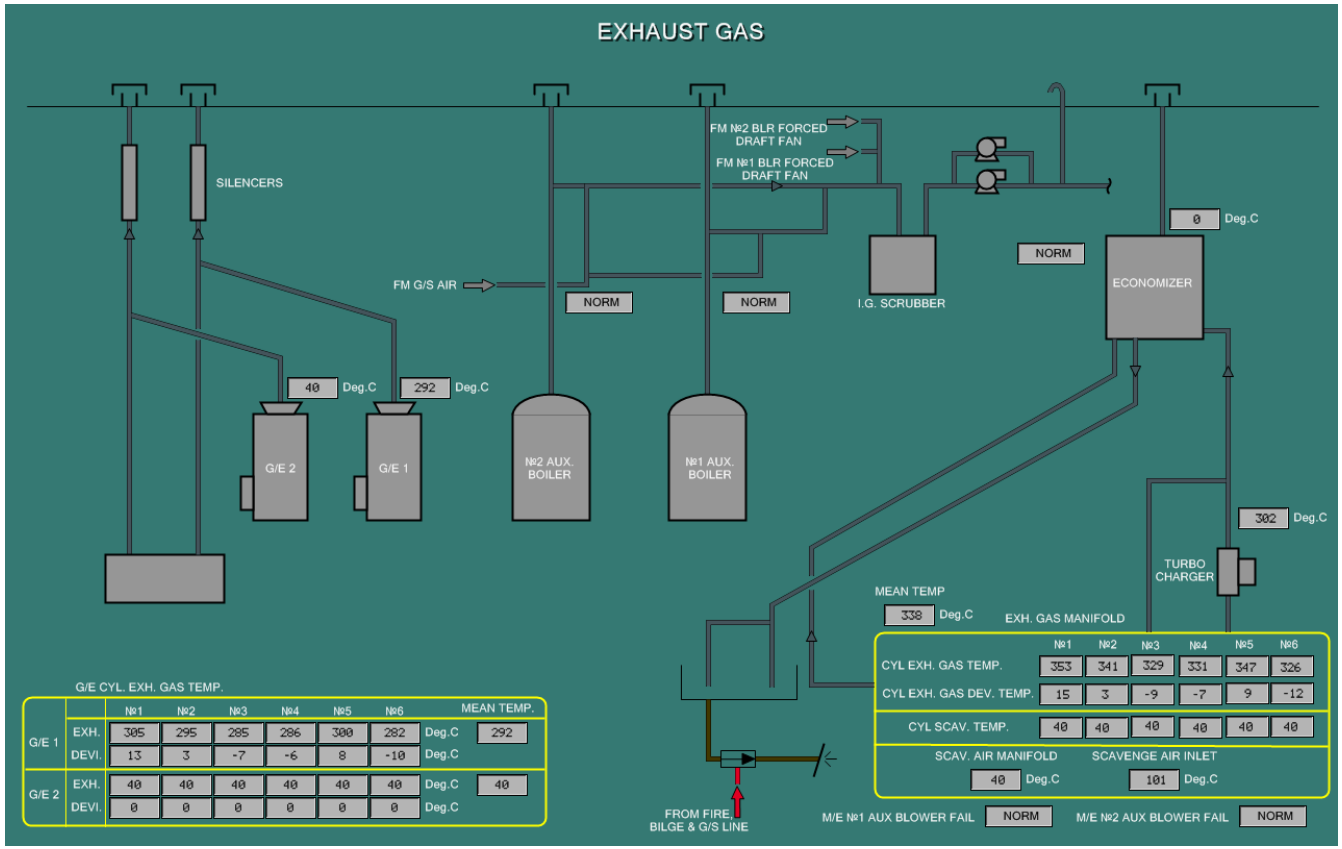
1.3.9. Exhaust Gases System

Click on the **EXHAUST GAS** button in the **CMS** bottom menu to open the display **EXHAUST GASES SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- **G/E 2, G/E 1** with exhaust gases temperature indicators; each engine is connected to **SILENCERS**;
- **№2, №1 AUX. BOILER** with **NORM** indicator label, which turns to **ABNORM** red when boiler exhaust gas temperature > 430 °C;
- **I.G.S SCRUBBER** with fans; **NORM** indicator label, which turns to **ABNORM** red when scrubber exhaust gas temperature > 430 °C;
- **ECONOMIZER** with temperature digital indicator;
- **TURBO CHARGER** with temperature digital indicator;
- **G/E CYL. EXH. GAS TEMP.** table with digital indicators of gas temperature and temperature deviations in cylinders;
- **EXH. GAS MANIFOLD** table with digital indicators of ME parameters in cylinders:
  - **CYL EXH. GAS TEMP.**;
  - **CYL EXH. GAS DEV. TEMP.**;
  - **CYL SCAV. TEMP.** ;
- **SCAV. AIR MANIFOLD** and **SCAVENGE AIR INLET** temperature digital indicators;
- **M/E №1 AUX BLOWER FAIL** and **M/E №2 AUX BLOWER FAIL** indicator labels **NORM**, which turn to **ABNORM** red when any blower breakage occurs.



1.3.10. LT Fresh Water Cooling System

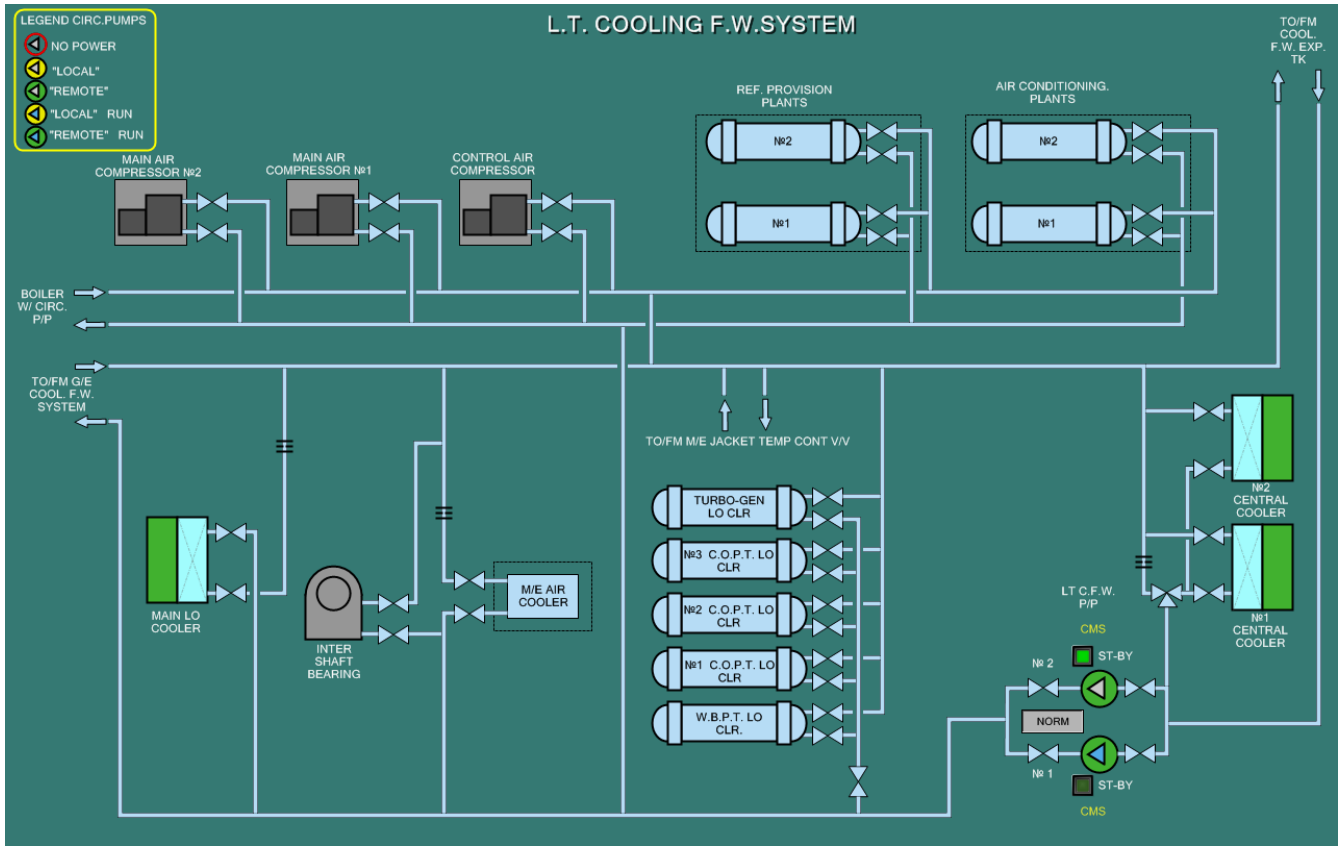
Click on the **L/T COOLING F.W. SYSTEM** button in the **CMS** bottom menu to open the display **L.T. COOLING F.W. SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- **MAIN AIR COMPRESSOR №2** and **№1**; **CONTROL AIR COMPRESSOR** units;
- **REF. PROV. PLANTS №2** and **№1**; **AIR CONDITIONING PLANTS №2** and **№1** cooling units;
- **MAIN LO COOLER** unit;
- **INTER SHAFT BEARING** unit;
- **M/E AIR COOLER** unit;
- Cooling units:
  - **TURBO-GEN LO CLR**;
  - **W.B.P.T. LO CLR**;
  - **№3, №2** and **№1 C.O.P.T. LO CLR**.
- **LT C. F.W. P/P №2** and **№1** pumps controls; **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **№2** and **№1 CENTRAL COOLER** units;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

The pumps can be controlled from the starter panels and push button boxes (see Chapter 4, *the paragraph 2.4.4.1 on page 127*).



1.3.11. Bilge & Fire General Service System

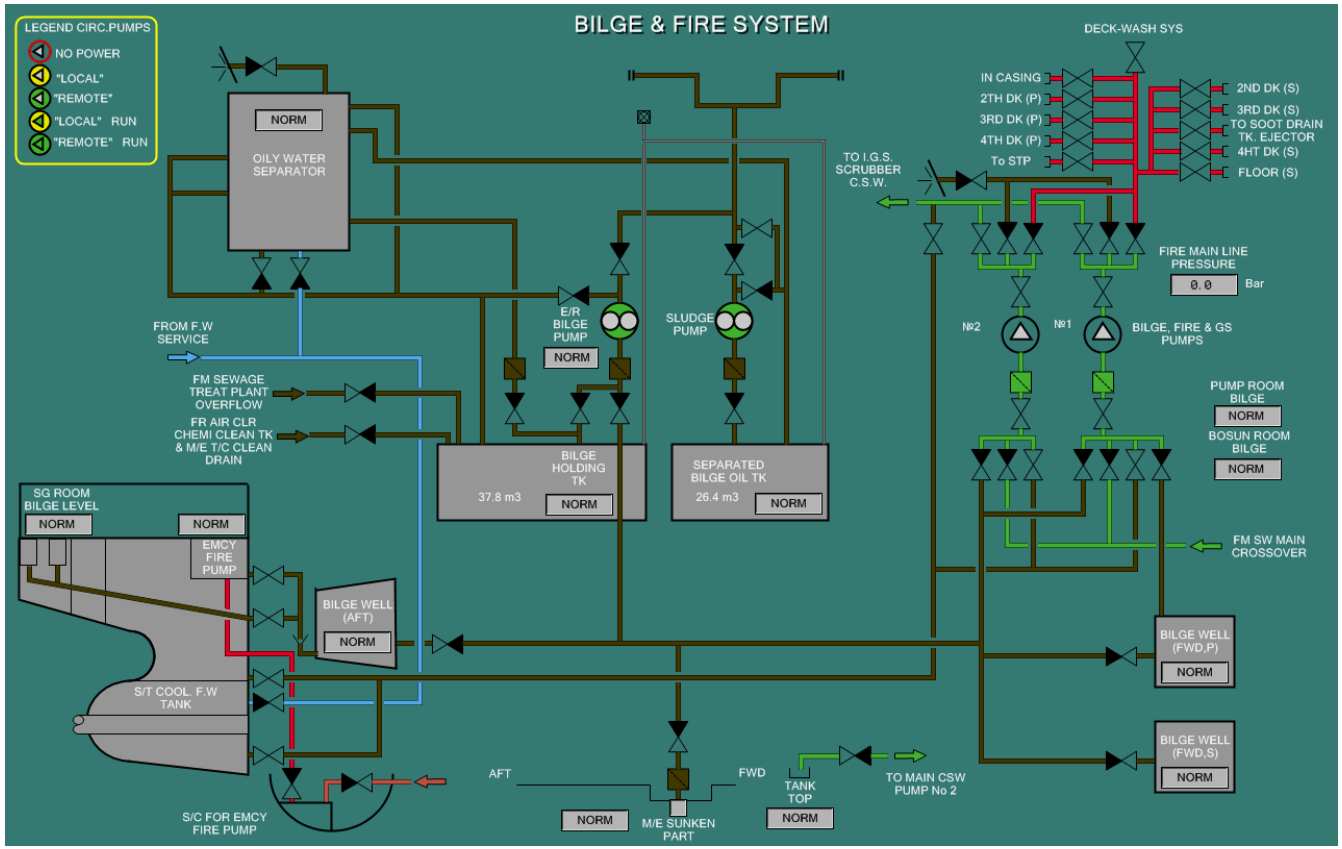
Click on the **BILGE & FIRE SYSTEM** button in the **CMS** bottom menu to open the display **BILGE & FIRE SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- **OILY WATER SEPARATOR** with indicator label **NORM**, which turns to **ABNORM** red when separator breakage occurs;
- **E/R BILGE PUMP** control and **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **SLUDGE PUMP** control;
- **BILGE, FIRE & G/S PUMPS №2, №1** controls;
- **BILGE HOLDING TK 37.8 m3** with **NORM** indicator label, which turns to **ABNORM** red when level alarm occurs;
- **SEPARATED BILGE OIL TK 26.4 m3** with **NORM** indicator label, which turns to **ABNORM** red when level alarm occurs;
- Bilge wells: **BILGE WELL (AFT)**, **SG ROOM BILGE WELL**, **BILGE WELL (FWD P)**, **BILGE WELL (FWD S)**, **BOSUN ROOM BILGE**, **PUMP ROOM BILGE**, and tanks; each with **NORM** indicator labels, which turn to **ABNORM** red when well level > 90%;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

The pumps can be controlled from the starter panels and push button boxes (see Chapter 4, ***the paragraph 7.11.4.2 on page 216***).



1.3.12. HT Cooling System

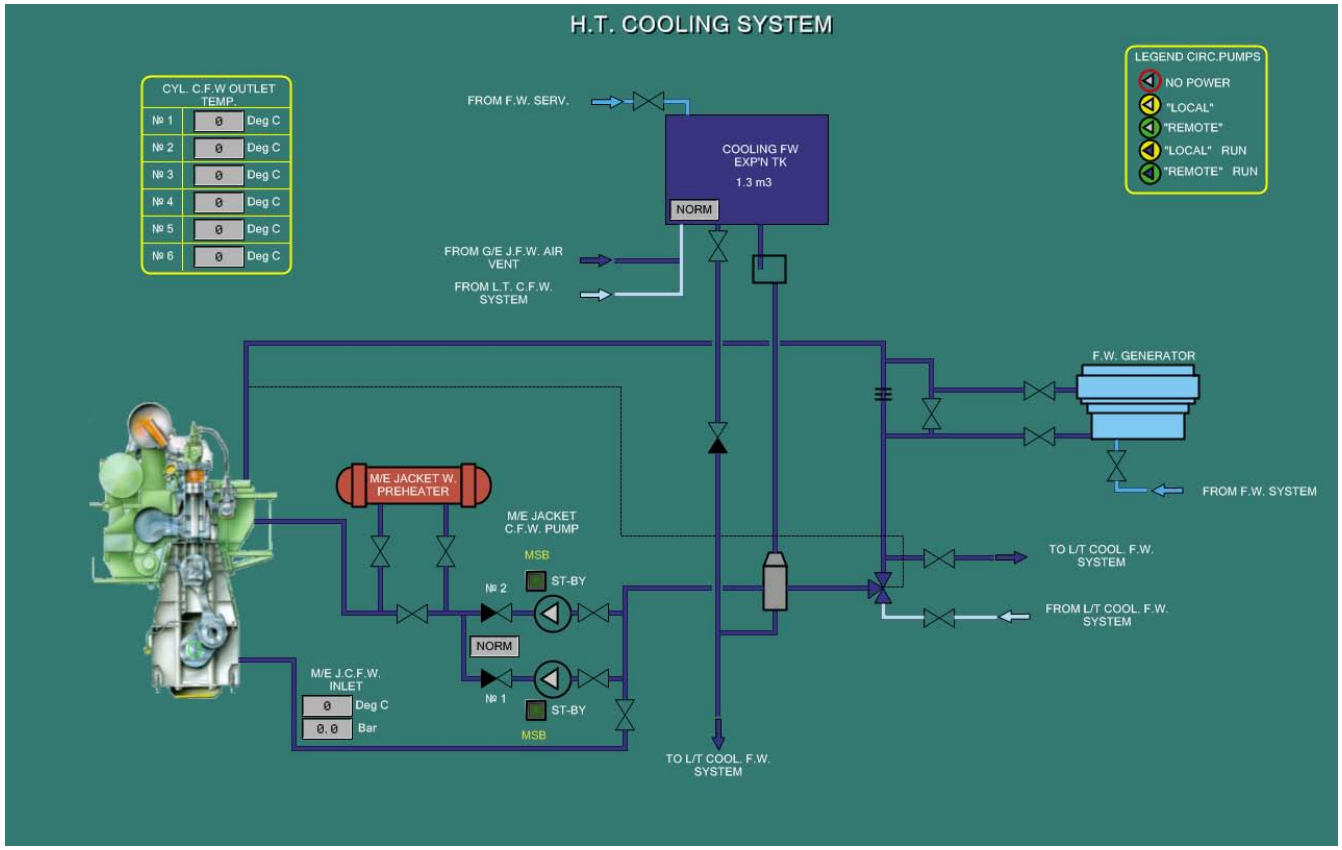
Click on the **HT COOLING SYSTEM** button in the **CMS** bottom menu to open the display **H.T. COOLING SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- Main engine cross-section with run indicator and digital indicators of **M/E J.C.W. INLET** temperature and pressure;
- **M/E JACKET W. PREHEATER** unit;
- **M/E JACKET C.F.W. PUMP №2, №1** controls; **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- **CYL. C.F.W. OUTLET TEMP** table with actual temperature for each cylinder;
- **COOLING FW EXPN TK 1.3 m3**; indicator label **NORM**, which turns to **ABNORM** red when level alarm occurs;
- **F.W. GENERATOR**;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

The pumps can be controlled from the starter panels and push button boxes (see Chapter 4, *the paragraph 2.2.4.1 on page 124*).



1.3.13. Compressed Air System

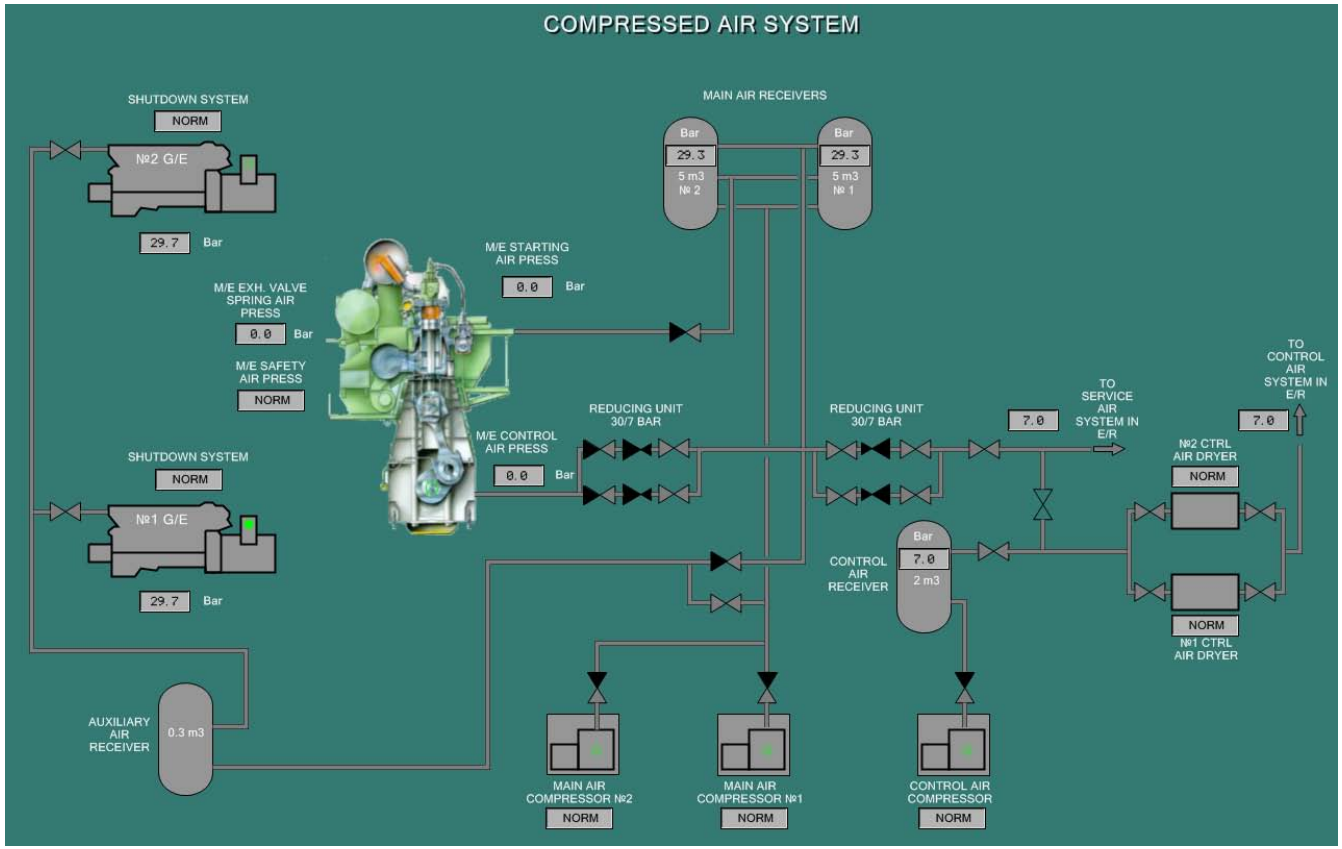
Click on the **COMPRESSED AIR SYSTEM** button in the **CMS** bottom menu to open the display **COMPRESSED AIR SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- Main engine cross-section with run indicator and digital indicators of actual **M/E EXH. VALVE SPRING AIR PRESS**, **M/E SAFETY AIR PRESSURE**, **M/E STARTING AIR PRESS**, **M/E CONTROL AIR PRESS**;
- **№2, №1 G/E** with run indicators and Starting Air pressure digital indicators; **NORM** indicator labels turn to **ABNORM** red when generator is stopped by **SHUTDOWN SYSTEM**;
- **MAIN AIR RECEIVERS №2, №1 5 m3** with pressure indicators;
- **AUXILIARY AIR AIR RECEIVER 0.3 m3** with pressure indicator,
- **CONTROL AIR AIR RECEIVER 2 m3** with pressure indicator,
- **MAIN AIR COMPRESSOR №2, №1** and **CONTROL AIR COMPRESSOR** with run indicators; **NORM** indicator labels turn to **ABNORM** red when compressor breakage occurs;
- **REDUCING UNIT 30/7 BAR**;
- **№2, №1 CTRL AIR DRYER**; **NORM** indicator labels turn to **ABNORM** red when dryer breakage occurs;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.

The compressors are controlled from the starter panels and push button boxes (see Chapter 4, ***the paragraph 7.2.4.2 on page 184***).



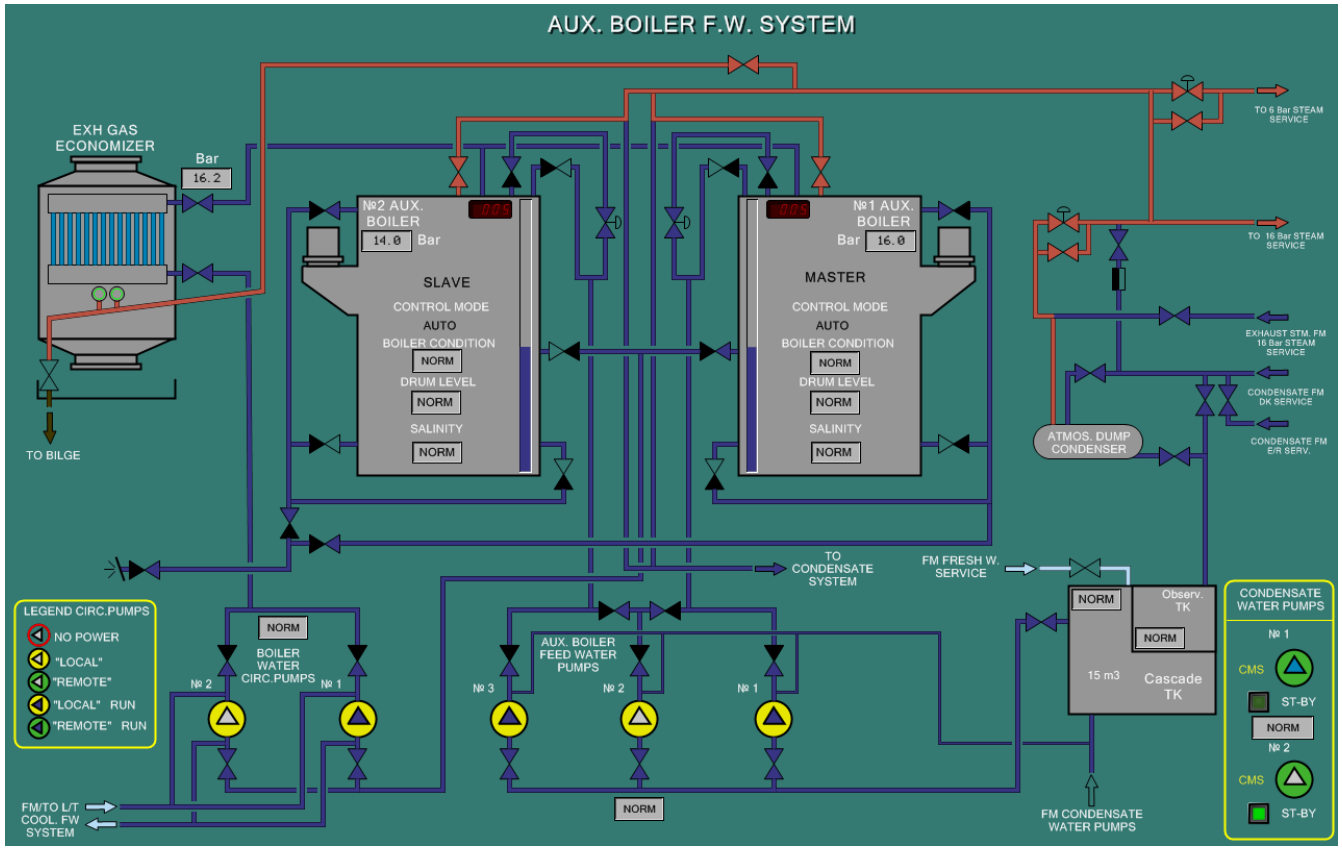
1.3.14. AUX Boiler Feed Water System

Click on the **AUX BOILER F.W. SYSTEM** button in the **CMS** bottom menu to open the display **AUX BOILER FEED WATER SYSTEM**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- **№2, №1 AUX BOILER** with digital indicators of actual pressure and temperature; water level bar graph; indicator label **CONTROL MODE** (MASTER/SLAVE); indicator labels **NORM** turn to **ABNORM** red when **BOILER CONDITION**, **DRUM LEVEL** or **SALINITY** alarms occur;
- **EXH. GAS ECONOMIZER** with run indicators and digital indicators of actual feed water pressure;
- **BOILER WATER CIRC. PUMPS №2, №1** indicators; indicator label **NORM** turn to **ABNORM** red when a pump breakage occurs;
- **AUX BOILER FEED WATER PUMPS FOR №3, №2, №1** pumps indicators; **NORM** indicator label turn to **ABNORM** red when a pump breakage occurs;
- **Observ. TK**; **NORM** indicator label turns to **ABNORM** red when level alarm occurs;
- **Cascade TK 15 m3**; top indicator label **NORM** turn to **ABNORM** red when level > 90%; bottom indicator label **NORM** turn to **ABNORM** red when level < 15%;
- **CONDENSATE WATER PUMPS №2, №1** controls; **ST-BY** buttons (control logic is described in *the paragraph 1.2.4 on page 56*); **NORM** indicator label, which turns to **ABNORM** red when a pump breakage occurs;
- The pipelines with controlled valves, measuring gauges and connections to ship systems.



The boilers are controlled from the local panels, and condensate pumps are controlled from the starter panels and push button boxes (see Chapter 4, *the paragraph 5.5 on page 63*).

Remote control of the pumps is provided from the Boiler Monitoring & Control System (see *the paragraph 2.2.4 on page 63)*.

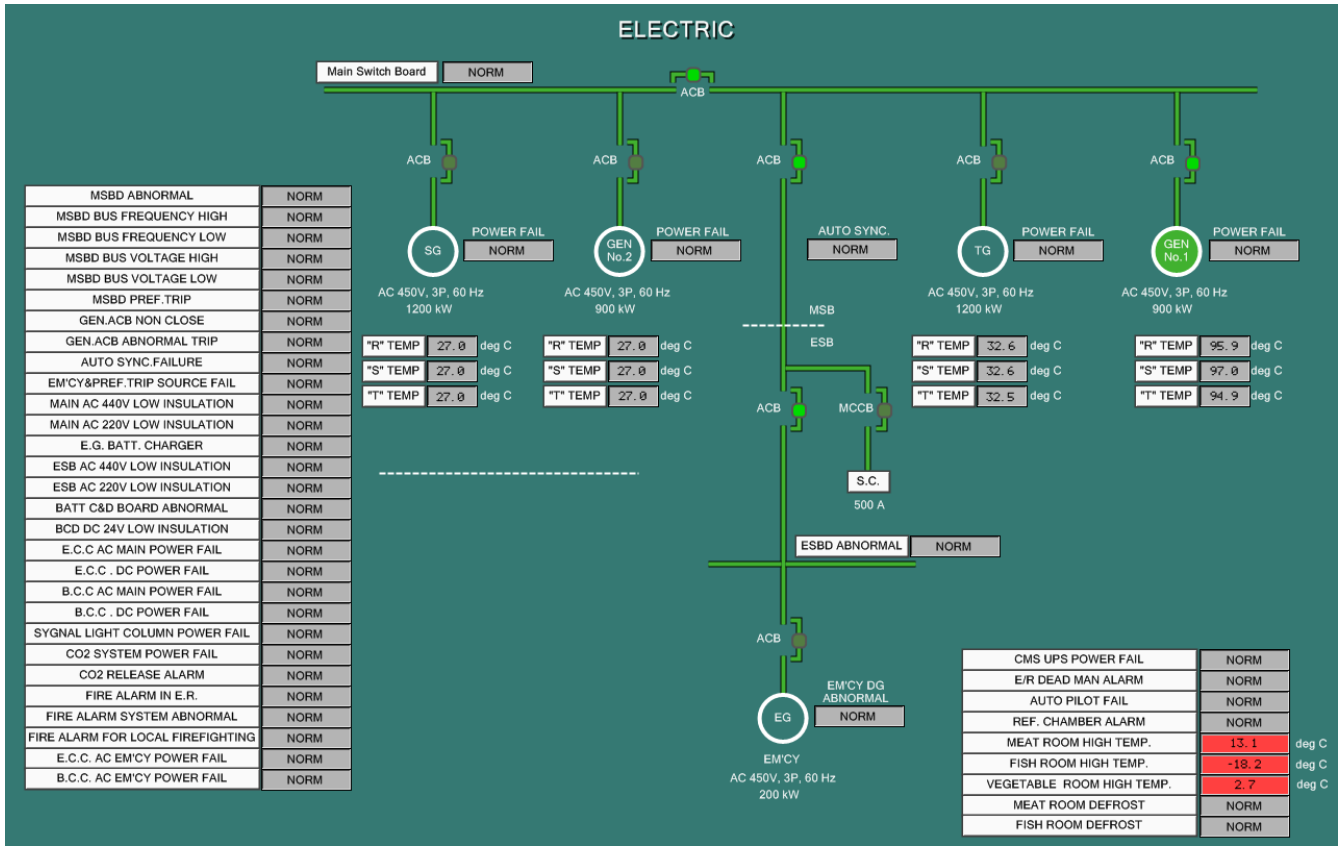
1.3.15. Electric System

Click on the **ELECTRIC** button in the **CMS** bottom menu to open the display **ELECTRIC**.

Abnormal conditions can occur to a unit breakage, failure, alarm or a fault introduced by the instructor.

The mimic contains:

- System diagram;
- **Main Switch Board** alarm **NORM** indicator label, which turns to **ABNORM** red when frequency or voltage < 95% or > 105% of rating value;
- **SG** (AC 450V, 3P, 60 Hz, 1200 kW),
  GEN No.2 (AC 450V, 3P, 60 Hz, 900 kW),
  TG (AC 450V, 3P, 60 Hz, 1200 kW),
  GEN No.1 (AC 450V, 3P, 60 Hz, 900 kW) indicators – each with:
  - **POWER FAIL** indicator label **NORM**, which turns to **ABNORM** red if generator ACB trip occurs;
  - **"R" TEMP**, **"S" TEMP**, **"T" TEMP** digital indicators of actual stator temperatures.
- **AUTO SYNC.** indicator label **NORM** turns to **ABNORM** red if synchronization is not performed in 1 min.;
- A list of electric system alarms for generators; **NORM** indicator labels, which turn to **ABNORM** red when a parameter is out of range, or trip condition occurs;
- **SC** (500 A) – shore connection indicator;
- **ESBD ABNORMAL** alarm **NORM** indicator label, which turns to **ABNORM** red when frequency or voltage < 95% or > 105% of rating value;
- **EG** (EM'CY AC 450V, 3P, 60 Hz, 200 kW) indicator and **EM'CY DG ABNORMAL** alarm **NORM** indicator label, which turns to **ABNORM** red when frequency, current or voltage is out of range;
- Lists of system alarms and digital indicators.



1.3.16. Alarm Summary

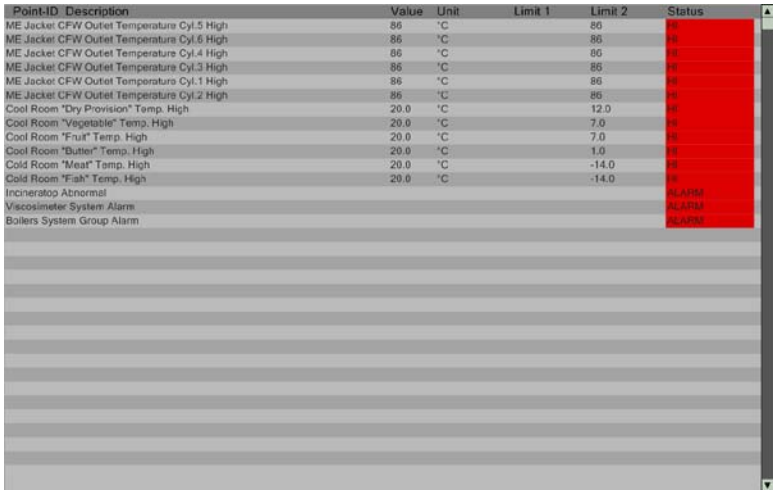
Click the **ALARM SUMMARY** button on the bottom bar of any **CMS** page to open the display.

The mimic contains the list of current alarms in the ship's systems with their corresponding attributes:

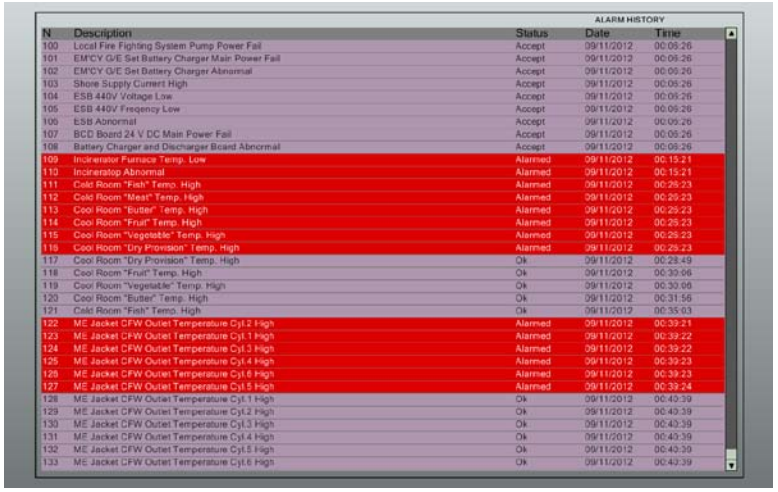
Each table row displays:

- **Point-ID Description** – the ID and brief description of alarm;
- **Value** – parameter value that caused alarm state;
- **Unit** – parameter units;
- **Limit 1** and **Limit 2** – parameter range;
- **Status** – alarm state of types:
  - LOW – parameter fell out of the range by Limit 1;
  - HIGH – parameter fell out of the range by Limit 2;
  - ALARM – any failure of normal operation of a parameter that is not measured.

Status of an unacknowledged alarm flashes, status of an acknowledged alarm is on colored in red. When the alarm cause has been removed the alarm line is deleted from the list.



Point-ID Description	Value	Unit	Limit 1	Limit 2	Status
ME Jacket CFW Outlet Temperature Cyl.5 High	86	°C		86	HI
ME Jacket CFW Outlet Temperature Cyl.6 High	86	°C		86	HI
ME Jacket CFW Outlet Temperature Cyl.4 High	86	°C		86	HI
ME Jacket CFW Outlet Temperature Cyl.3 High	86	°C		86	HI
ME Jacket CFW Outlet Temperature Cyl.1 High	86	°C		86	HI
ME Jacket CFW Outlet Temperature Cyl.2 High	86	°C		86	HI
Cool Room "Dry Provision" Temp. High	20.0	°C		12.0	HI
Cool Room "Vegetable" Temp. High	20.0	°C		7.0	HI
Cool Room "Fruit" Temp. High	20.0	°C		7.0	HI
Cool Room "Butter" Temp. High	20.0	°C		1.0	HI
Cold Room "Meat" Temp. High	20.0	°C		-14.0	HI
Cold Room "Fish" Temp. High	20.0	°C		-14.0	HI
Incineratop Abnormal					ALARM
Viscosimeter System Alarm					ALARM
Boilers System Group Alarm					ALARM



ALARM HISTORY

N	Description	Status	Date	Time
100	Local Fire Fighting System Pump Power Fail	Accept	09/11/2012	00:05:26
101	EM'CY G/E Set Battery Charger Main Power Fail	Accept	09/11/2012	00:05:26
102	EM'CY G/E Set Battery Charger Abnormal	Accept	09/11/2012	00:05:26
103	Shore Supply Current High	Accept	09/11/2012	00:05:26
104	ESB 440V Voltage Low	Accept	09/11/2012	00:05:26
105	ESB 440V Frequency Low	Accept	09/11/2012	00:05:26
106	ESB Abnormal	Accept	09/11/2012	00:05:26
107	BCD Board 24 V DC Main Power Fail	Accept	09/11/2012	00:05:26
108	Battery Charger and Discharger Board Abnormal	Accept	09/11/2012	00:05:26
109	Incinerator Furnace Temp. Low	Alarmed	09/11/2012	00:15:21
110	Incineratop Abnormal	Alarmed	09/11/2012	00:15:21
111	Cold Room "Fish" Temp. High	Alarmed	09/11/2012	00:29:23
112	Cold Room "Meat" Temp. High	Alarmed	09/11/2012	00:29:23
113	Cool Room "Butter" Temp. High	Alarmed	09/11/2012	00:29:23
114	Cool Room "Fruit" Temp. High	Alarmed	09/11/2012	00:29:23
115	Cool Room "Vegetable" Temp. High	Alarmed	09/11/2012	00:29:23
116	Cool Room "Dry Provision" Temp. High	Alarmed	09/11/2012	00:29:23
117	Cool Room "Dry Provision" Temp. High	Ok	09/11/2012	00:28:49
118	Cool Room "Fruit" Temp. High	Ok	09/11/2012	00:30:06
119	Cool Room "Vegetable" Temp. High	Ok	09/11/2012	00:30:06
120	Cool Room "Butter" Temp. High	Ok	09/11/2012	00:31:56
121	Cold Room "Fish" Temp. High	Ok	09/11/2012	00:35:03
122	ME Jacket CFW Outlet Temperature Cyl.2 High	Alarmed	09/11/2012	00:39:21
123	ME Jacket CFW Outlet Temperature Cyl.1 High	Alarmed	09/11/2012	00:39:22
124	ME Jacket CFW Outlet Temperature Cyl.3 High	Alarmed	09/11/2012	00:39:22
125	ME Jacket CFW Outlet Temperature Cyl.4 High	Alarmed	09/11/2012	00:39:23
126	ME Jacket CFW Outlet Temperature Cyl.6 High	Alarmed	09/11/2012	00:39:23
127	ME Jacket CFW Outlet Temperature Cyl.5 High	Alarmed	09/11/2012	00:39:24
128	ME Jacket CFW Outlet Temperature Cyl.1 High	Ok	09/11/2012	00:40:39
129	ME Jacket CFW Outlet Temperature Cyl.2 High	Ok	09/11/2012	00:40:39
130	ME Jacket CFW Outlet Temperature Cyl.3 High	Ok	09/11/2012	00:40:39
131	ME Jacket CFW Outlet Temperature Cyl.4 High	Ok	09/11/2012	00:40:39
132	ME Jacket CFW Outlet Temperature Cyl.5 High	Ok	09/11/2012	00:40:39
133	ME Jacket CFW Outlet Temperature Cyl.6 High	Ok	09/11/2012	00:40:39

1.3.17. Alarm History

Click the **ALARM HISTORY** button on the bottom bar of any **CMS** page to open the display **ALARM HISTORY.**

The mimic contains the list of all alarms in the ship's systems with their corresponding attributes:

- **N** – the number of an alarm;
- **Description** – the ID and brief description of alarm;
- **Status** – the alarm state;
- **Date** – the date of alarm;
- **Time** – the time of alarm (starting from the exercise start).

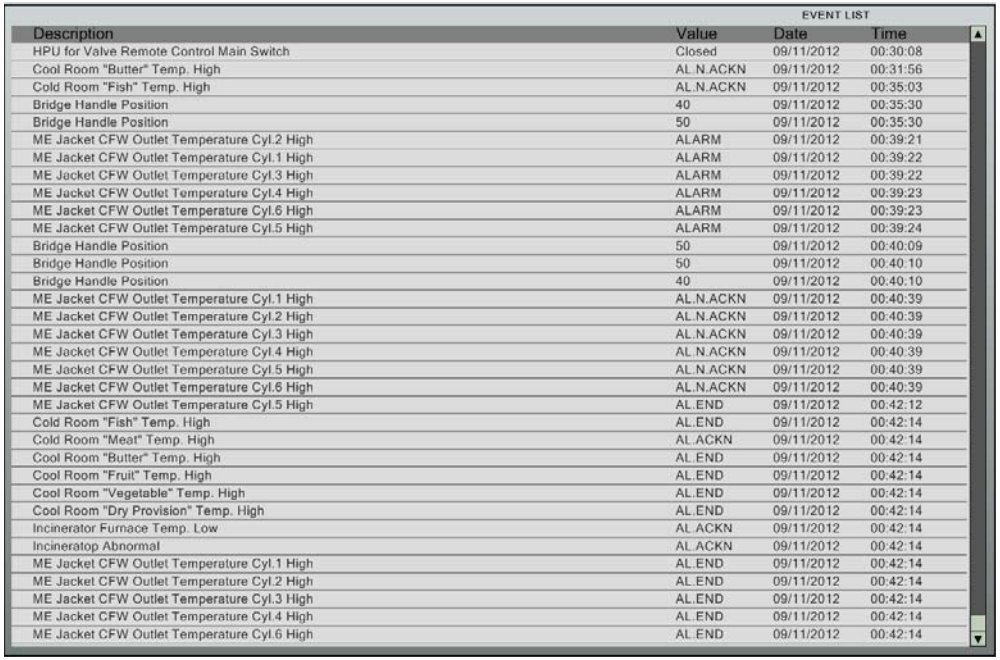
Alarm records are colored according to the alarm status: unacknowledged alarms are red; acknowledged but not cleared alarms are light magenta; acknowledged and cleared alarms are gray.

1.3.18. Event List

Click the **EVENT LIST** button on the bottom bar of any **CMS** page to open the display **EVENT LIST**.

The mimic contains the list of all events in the ship's systems with their corresponding attributes:

- **Description** – the ID and brief description of event;
- **Value** – the state of appropriate parameter;
- **Date** – the date of event;
- **Time** – the time of event (starting from the exercise start).



EVENT LIST

Description	Value	Date	Time
HPU for Valve Remote Control Main Switch	Closed	09/11/2012	00:30:08
Cool Room "Butter" Temp. High	AL.N.ACKN	09/11/2012	00:31:56
Cold Room "Fish" Temp. High	AL.N.ACKN	09/11/2012	00:35:03
Bridge Handle Position	40	09/11/2012	00:35:30
Bridge Handle Position	50	09/11/2012	00:35:30
ME Jacket CFW Outlet Temperature Cyl.2 High	ALARM	09/11/2012	00:39:21
ME Jacket CFW Outlet Temperature Cyl.1 High	ALARM	09/11/2012	00:39:22
ME Jacket CFW Outlet Temperature Cyl.3 High	ALARM	09/11/2012	00:39:22
ME Jacket CFW Outlet Temperature Cyl.4 High	ALARM	09/11/2012	00:39:23
ME Jacket CFW Outlet Temperature Cyl.6 High	ALARM	09/11/2012	00:39:23
ME Jacket CFW Outlet Temperature Cyl.5 High	ALARM	09/11/2012	00:39:24
Bridge Handle Position	50	09/11/2012	00:40:09
Bridge Handle Position	50	09/11/2012	00:40:10
Bridge Handle Position	40	09/11/2012	00:40:10
ME Jacket CFW Outlet Temperature Cyl.1 High	AL.N.ACKN	09/11/2012	00:40:39
ME Jacket CFW Outlet Temperature Cyl.2 High	AL.N.ACKN	09/11/2012	00:40:39
ME Jacket CFW Outlet Temperature Cyl.3 High	AL.N.ACKN	09/11/2012	00:40:39
ME Jacket CFW Outlet Temperature Cyl.4 High	AL.N.ACKN	09/11/2012	00:40:39
ME Jacket CFW Outlet Temperature Cyl.5 High	AL.N.ACKN	09/11/2012	00:40:39
ME Jacket CFW Outlet Temperature Cyl.6 High	AL.N.ACKN	09/11/2012	00:40:39
ME Jacket CFW Outlet Temperature Cyl.5 High	AL.END	09/11/2012	00:42:12
Cold Room "Fish" Temp. High	AL.END	09/11/2012	00:42:14
Cold Room "Meat" Temp. High	AL.ACKN	09/11/2012	00:42:14
Cool Room "Butter" Temp. High	AL.END	09/11/2012	00:42:14
Cool Room "Fruit" Temp. High	AL.END	09/11/2012	00:42:14
Cool Room "Vegetable" Temp. High	AL.END	09/11/2012	00:42:14
Cool Room "Dry Provision" Temp. High	AL.END	09/11/2012	00:42:14
Incinerator Furnace Temp. Low	AL.ACKN	09/11/2012	00:42:14
Incineratop Abnormal	AL.ACKN	09/11/2012	00:42:14
ME Jacket CFW Outlet Temperature Cyl.1 High	AL.END	09/11/2012	00:42:14
ME Jacket CFW Outlet Temperature Cyl.2 High	AL.END	09/11/2012	00:42:14
ME Jacket CFW Outlet Temperature Cyl.3 High	AL.END	09/11/2012	00:42:14
ME Jacket CFW Outlet Temperature Cyl.4 High	AL.END	09/11/2012	00:42:14
ME Jacket CFW Outlet Temperature Cyl.6 High	AL.END	09/11/2012	00:42:14

1.3.19. Trend

Click the **TREND** button on the bottom bar of any **CMS** page to open the display **TREND**.

The Trend application allows outputting time curves of working parameter changes for devices and mechanisms of the ship systems. With this application Trainee is able to select parameters for monitoring, adjust required setting to display the curves on screen, review the current state of certain aggregates and mechanisms, and forecast changes in order to take appropriate actions.

Description of the available options and functionality is given in the section ***Application 'Trends'*** of the manual ***TechSim/ERS-5000_General_Trainee_Manual.pdf***.

2. Boiler Monitoring & Control System

2.1. BMCS General Description

The Boiler Monitoring & Control System (BMCS) is the integrated PC-based system for remote supervision of the ship's Aux Boiler and related systems.

Layout of each display is similar to the layout of CMS displays (see ***the paragraph 1.2.1 on page 55***). In the simulator only **Boiler System** menu function of the BMCS is modeled.

Top panel contains:

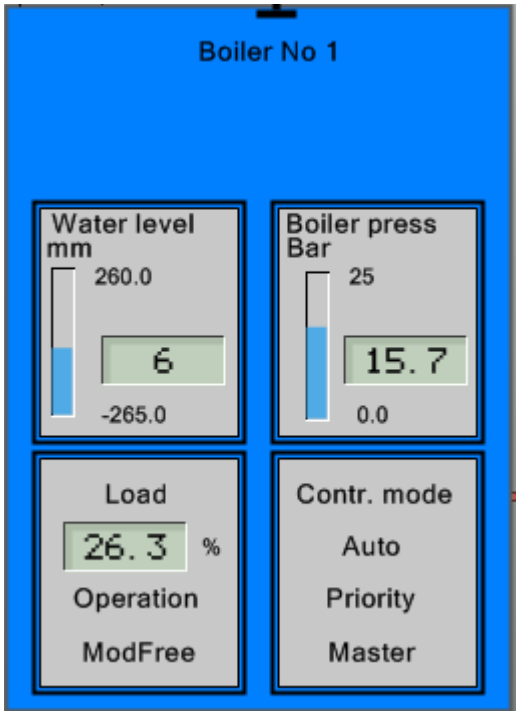
- **BURNER OVERVIEW**, **FEED WATER OVERVIEW**, **STEAM OVERVIEW**, **PUMP OVERVIEW** buttons to switch between the displays;
- **ALARMS** box to present the number of unacknowledged alarms in the Boiler system;
- **DATE, TIME** indicators of actual date and time;
- OVERVIEW PICTURE and USER fields are not modeled.

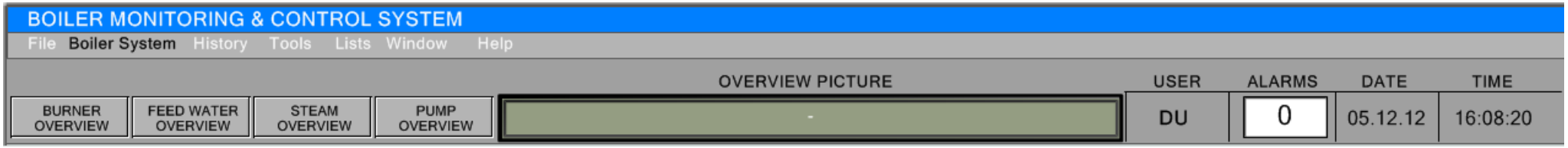
Bottom panel contains:

- Text box to output the last unacknowledged alarm in the Boiler system;
- **SINGLE/ALL ACK SWITCH** button;
- **ALARM ACKN** button; when the **SINGLE/ALL ACK SWITCH** button is pressed click the **ALARM ACKN** button to acknowledge only one last alarm; otherwise it acknowledges all Boiler system alarms at once;
- **EVENT LIST**, **ALARM LIST** to switch to respective displays, where alarms and events of the Boiler system are listed.

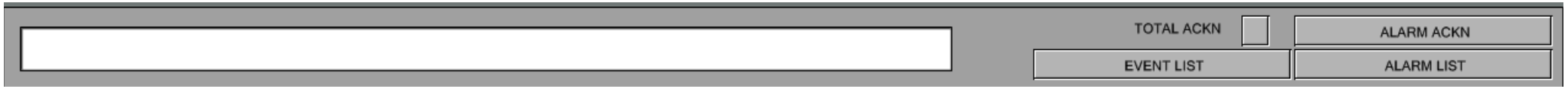
OVERVIEW displays of BMCS contain the **Boiler No 1** and **Boiler No 2** state information boxes with the following information:

- **Water level mm** bar graph provided with max and min values, and level digital indicator; red color of the bar indicates alarm condition;
- **Boiler press Bar** bar graph provided with max and min values, and pressure digital indicator; red color of the bar indicates alarm condition;
- **Load %** digital indicator;
- **Operation** text indicator of the Boiler system state: **Ready**; **Shut-down**; **Stopped**; **Purge** (the burner is purged with air); **Ignition**; **Low Firing** (low FO supply at low steam pressure); **Rising** (the steam pressure); **Mod. Free** (mode of constant steam pressure);
- **Control mode** text indicator: **Auto**/**Manual**/**Stopped**; in Stopped mode (control mode Stopped selected) the boiler cannot be started.





Top panel of the BMCS display



Bottom panel of the BMCS display

2.1.1. Boilers Automatic Operating Modes

The control system automatically starts, stops, and regulates the burners in normal operation depending on the steam demand.

In modulation free mode, the control system attempts to maintain the steam pressure at the desired set point by regulation of the burners load from minimum firing load to full load.

When high pressure mode is selected the boiler pressure rises until the modulating set point is reached. At this point control system attempts to maintain the steam pressure at the desired set point by regulation of the burner load.

Operation in low pressure mode is similar to operation in high pressure mode. The difference is that it is possible to reduce the maximum load of the burner in low pressure mode by settings in the control system.

The boilers can be operated in a master/slave principle. In this control mode one boiler is chosen as the master boiler and the other as the slave boiler (the selection is optional). **Note:** Both boilers must operate in the same pressure mode (low/high pressure mode).

If the steam pressure in the common steam line drops below the set point for operation the master boiler will start. After start-up the burner begins to modulate until the pressure is equal to the chosen set point. Start-up of the slave boiler will only take place if the load of the master boiler exceeds and remains above a predetermined value for a certain period of time. The set point for start-up is normally set to approximately 75% load.

When the slave boiler has been started the burner remains in minimum firing position until the differential pressure between the slave boiler and the main steam line is within the limit for which the slave boiler is released to go into rising mode. In rising mode the burner load will ramp-up until the oil now is higher than the master boiler oil now. At this point the slave boiler is allowed to go into modulation free mode and the load will be equally shared between the two boilers. Stop of the slave boiler will be initiated when the load on the master burner reaches a predetermined stop load which is normally set to approximately 25%.

If both boilers are in automatic mode and the master boiler receives a shutdown signal the slave boiler automatically becomes the master boiler. This is valid in all operation states.

When the slave boiler has not been started for a long period of time e.g. if the steam demand is low, the pressure of the slave boiler will drop. The control system starts the burner automatically and keeps it in minimum firing position by means of the signal from the pressure transmitter of the boiler. When the pressure of the slave boiler has been raised the control system stops the burner again. This temporary operation of the slave boiler, also called slave maintenance operation, is carried out to avoid a too long start time of a cold slave.

2.2. BMCS Displays in Simulator

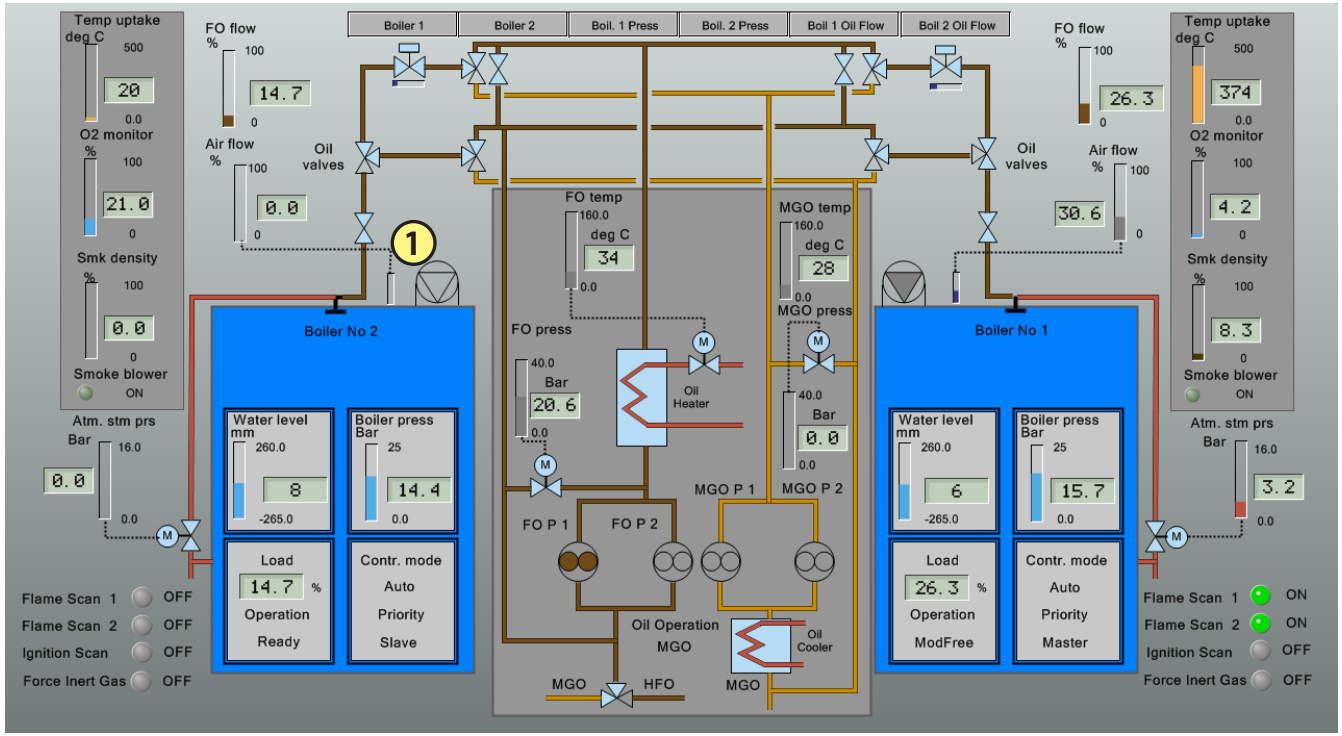
2.2.1. Burner Overview

Click the **BURNER OVERVIEW** button on the top menu bar of any **BMCS** page to open the display with the burner diagram.

The mimic contains:

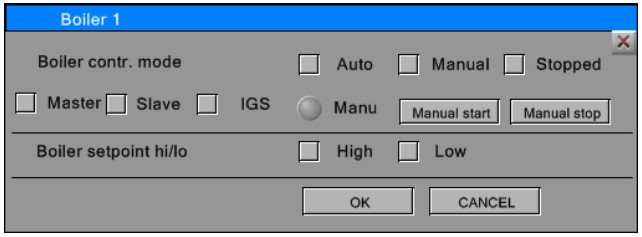
- **Boiler 1**, **Boil. 1 Press**, **Boil. 1 Oil Flow**, **Boiler 2**, **Boil. 2 Press**, **Boil. 2 Oil Flow** buttons to open the control panels for remote operation (see the description below);
- Data of **Boiler No 1** and **Boiler No 2** burner systems; the description given below is for **Boiler No 1**; **Boiler No 2** system is similar to **Boiler No 1**; the system comprises:
  - **Temp uptake**, **O2 monitor**, **Smk density**, **Atm. stm prs**, **FO flow**, **Air flow** digital indicators and bar graphs;
  - **Smoke blower ON**, **Flame Scan 1 OFF**, **Flame Scan 2 OFF**, **Ignition Scan OFF** indicator lamps;
  - **Boiler No 1** state information box (see *the paragraph 2.1 on page 74*);
  - ① Boiler Combustion Air Fan run indicator and Air Damper bar graph showing the damper open state;
- Boiler FO system diagram comprising:
  - **FO temp**, **FO press** digital indicators and bar graphs;
  - **GO temp**, **GO press** digital indicators and bar graphs;
  - **Oil Heater** unit for HFO;
  - **FO P 1**, **FO P 2** run and state indicators;
  - **GO P 1**, **GO P 2** run and state indicators;

    Pumps are controlled from the **PUMP OVERVIEW** display (see *the paragraph 2.2.4 on page 80*) and/or Boiler Control and Boiler Power panels (see Chapter 4, *the section 5.4 on page 160*);
  - **Oil Cooler** unit for GO;
  - Three-way valve to switch MGO/HFO supply.



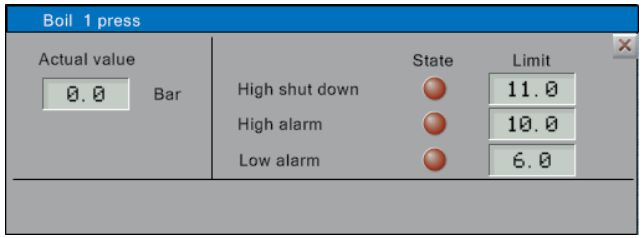
On the control panels described below click on required buttons (button is then "pressed") to select an action. Click **OK** to confirm the selected actions, or **CANCEL** to cancel selections (depress buttons); then close the panel.

Click on the **Boiler 1** (**Boiler 2**) button to open the panel comprising:



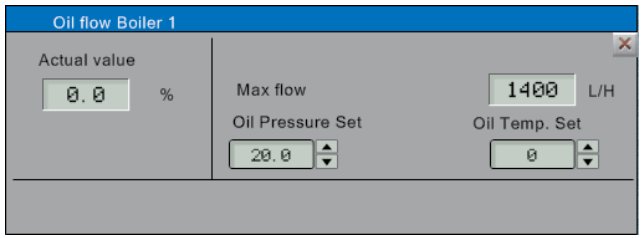
- **Boiler contr. mode** buttons:
  - **Master** and **Slave** – to set the boiler status;
  - **IGS** – to run the boiler to produce inert gas (CO2);
  - In **Auto** mode the Boiler is controlled by BMCS;
  - In **Manual** mode the Boiler is controlled from this panel; the **Manu** indicator highlights;
  - In **Stopped** mode the Boiler is stopped and blocked;
  - **Manual start** and **Manual stop** buttons are used to operate the Boiler in **Manu** mode.
- **Boiler setpoint hi/lo** buttons:
  - **High** – FO valve open state is not limited;
  - **Low** – to limit FO valve open state.

Click on the **Boil. 1 Press** (**Boil. 2 Press**) button to open the panel to monitor pressure conditions, comprising:



- **Actual value** pressure indicator;
- **High shut down**, **High alarm**, **Low alarm** indicator lamps **State** and digital indicators **Limit**.

Click on the **Boil. 1 Oil Flow** (**Boil. 2 Oil Flow**) button to open the panel to modify set points, comprising:



- **Actual value** flow % indicator;
- **Max flow** digital indicator;
- **Oil Pressure Set** spin control to set the FO inlet pressure;
- **Oil Temp Set** spin control to set the FO inlet temperature.

2.2.2. Feed Water Overview

Click the **FEED WATER OVERVIEW** button on the top menu bar of any **BMCS** page to open the feed water system diagram.

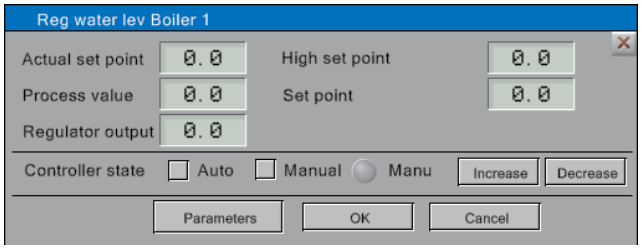
The description given below is for **Boiler No 1**. The panel and functions of **Boiler No 2** are similar to **Boiler No 1**,

The **Boiler No 1** mimic part contains:

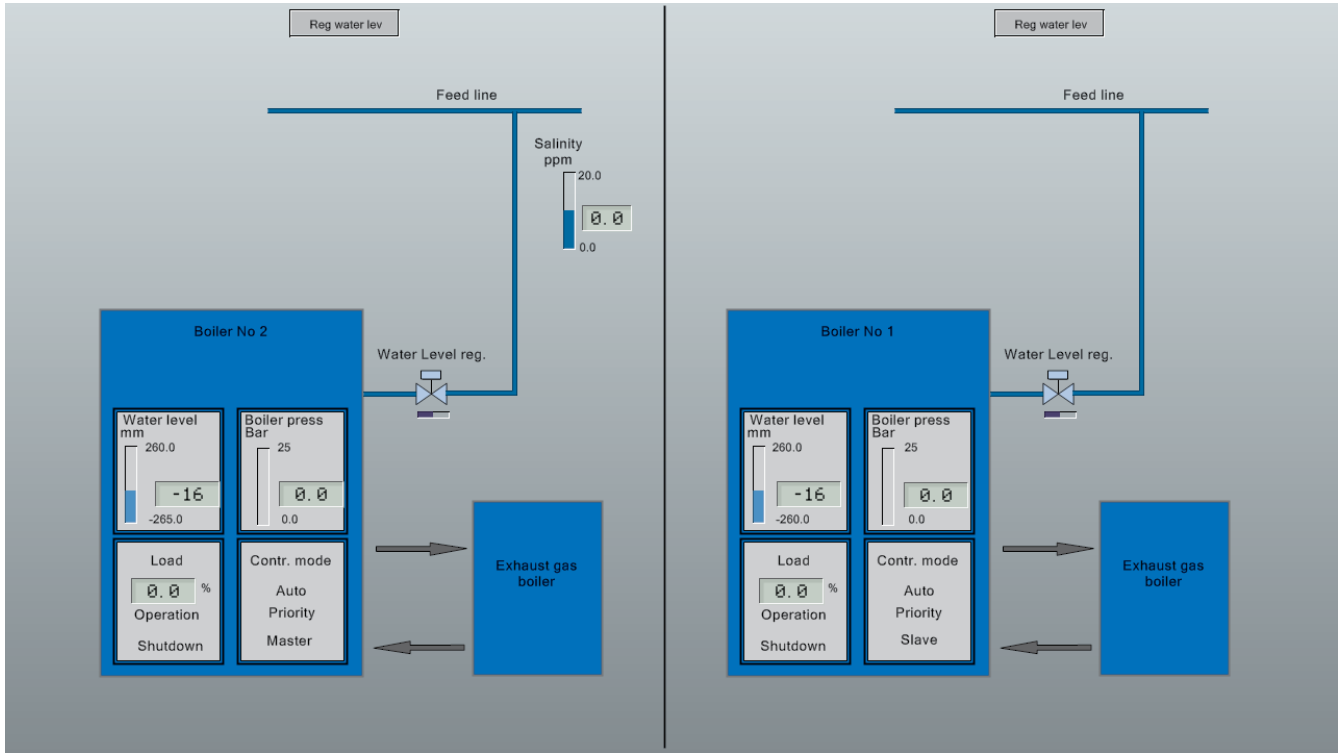
- **Reg water lev** button to control the system;
- **Salinity mScm** digital indicator and bar graph;
- **Water Level reg.** valve with open state bar graph;
- **Boiler** state information box (see *the paragraph 2.1 on page 74*);
- **Exhaust gas boiler** connections.

On the control panels described below click on required buttons (button is then "pressed") to select an action. Click **OK** to confirm the selected actions, or **CANCEL** to cancel selections (depress buttons); then close the panel.

Click on the **Reg water lev** button to open the panel comprising:

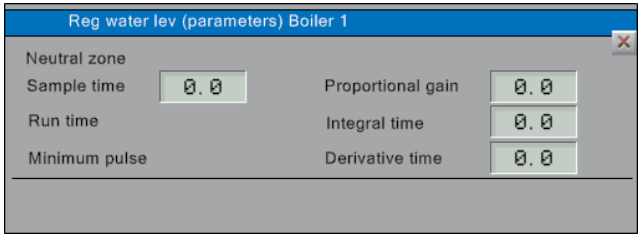


- Digital indicators:
  - **Actual set point** – water level in the boiler;
  - **High set point** – water level in the boiler;
  - **Process value** – actual water level;



- **Set point** – water level in the boiler;
- **Regulator output** – position of the water supply PID regulator, which controllers the water supply valve in Automatic mode.

- Controller state buttons:
  - In **Auto** mode the water supply valve is controlled by the regulator;
  - In **Manual** mode the water supply valve is controlled by **Increase** and **Decrease** buttons; the **Manu** indicator highlights;
  - **Increase** and **Decrease** buttons to adjust the open state of the water supply valve.
- **Parameters** button to open the **Reg water lev (parameters)** window:



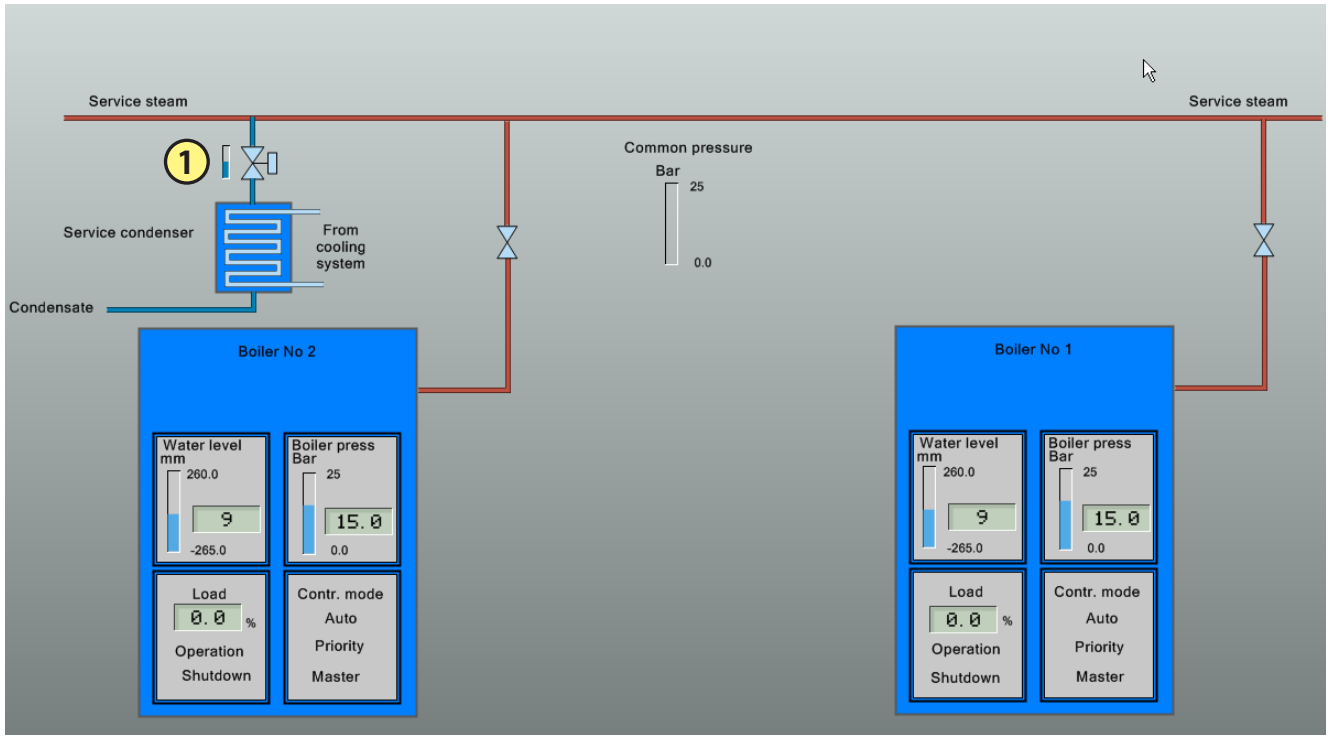
Digital indicators correspond to PID regulator parameters (see the description of the regulators in ***Introduction***). The parameters are set by the Instructor.

2.2.3. Steam Overview

Click the **STEAM OVERVIEW** button on the top menu bar of any **BMCS** page to open the service steam system diagram.

The mimic contains:

- (1) Dump valve open state bar graph;
- **Service condenser** and connections **From cooling system**;
- **Common pressure** bar graph;
- **Boiler No 2, Boiler No 1** state information boxes (see ***the paragraph 2.1 on page 74***).



2.2.4. Pumps Remote Control

Click the **PUMP OVERVIEW** button on the top menu bar of any **BMCS** page to open the display with panels for remote control of the pumps: **Chemical pump 1**, **Circulation pump 1**, **Circulation pump 2**, **Fuel oil pump 1**, **Fuel oil pump 2**, **MGO pump 1**, **MGO pump 2**, **Feed water pump 1**, **Feed water pump 2**, **Feed water pump 3**.

Each panel contains:

- The button to open the pump control panel;
- The pump state indicator, which highlights when the pump is running;
- The pump **Mode** text indicator OFF/ON.

Remote control of **Chemical pump** and **Fuel oil pump 1, 2** is enabled only if both – the **AUTO MANUAL** switches on the **BOILER LOCAL CONTROL PANEL** and **BOILER POWER PANEL** are set to AUTO position. If any of the switches is in MANUAL position the remote control is disabled.

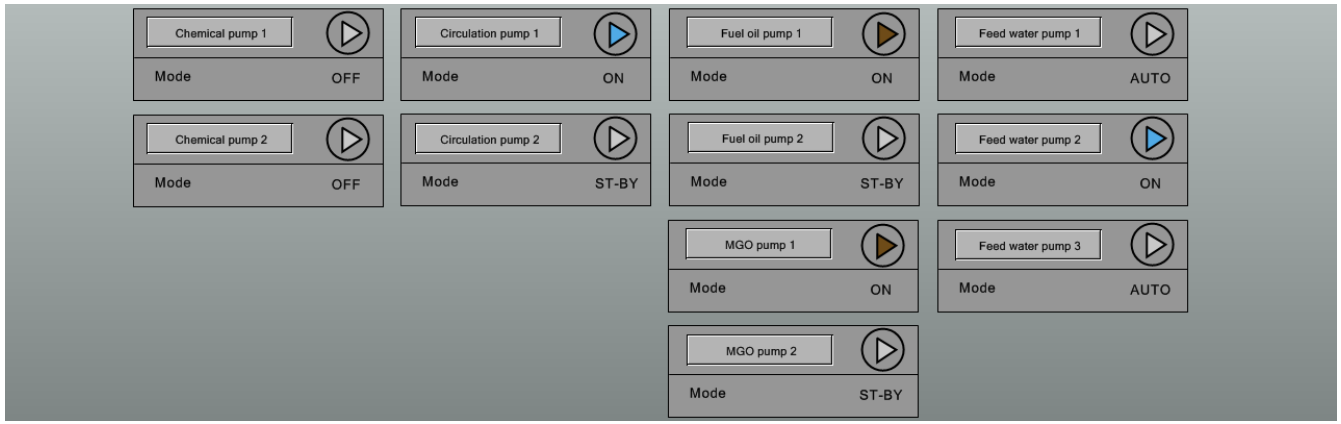
On the control panels described below click on required buttons (button is then "pressed") to select an action. Click **OK** to confirm the selected actions, or **CANCEL** to cancel selections (depress buttons); then close the panel.

Alarm lamps illuminate to indicate the pump **Overload** alarm and **No feedback** alarm circumstances.

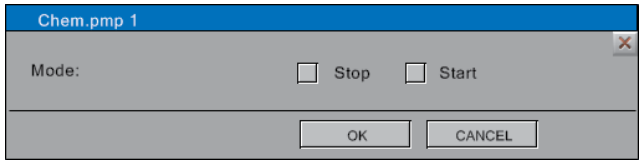
Remote Stopped, Remote Started lamps on control panels are not modeled.

Use **St-By** button to set a pump operation in Stand-by mode (for Circulation pumps, FO pumps duty/standby pairs and Feed water pump 2).

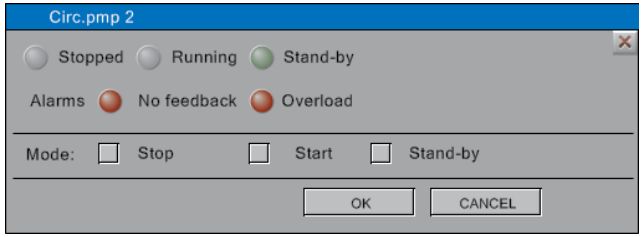
The **Feed water pump 1** supplies water to Boiler 1. The **Feed water pump 3** supplies water to Boiler 2. The **Feed water pump 2** supplies water to any Boiler as required.



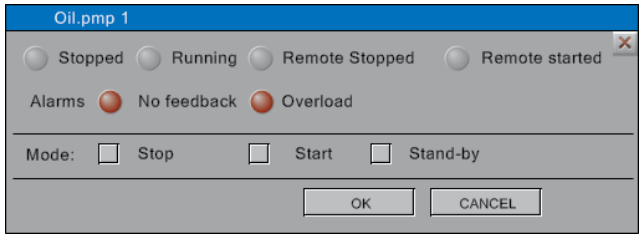
Chemical Pump Control Panel



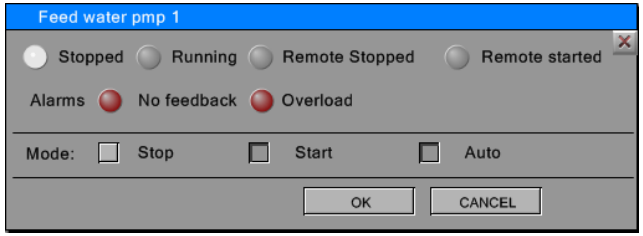
Circulation Pump Control Panel



Fuel Oil & MGO Pump Control Panel



Feed Water Pump Control Panel



Use **Auto** button to set the pump automatic operation controlled by the water level sensor in the respective Boiler (for Feed water pump 1 and 3).

Chapter 3. Electrical Power Plant

This chapter contains the description of the simulator module for training the watch personnel of the tanker in skills of correct operating the Ship Electrical Power Plant.

Chapter 3. Electrical Power Plant

This chapter contains:

1. Introduction

The Ship Electrical Power System is designed to meet the vessel's electrical power demands in standard and emergency conditions.

The Ship Electrical Power System simulator module is designed for training the Engine Room watch personnel of the tanker in skills of correct operating the vessel's Electrical Power Plant (EPP), including:

- Preparation of equipment/systems for their operation, start-up, and shutdown;
- Monitoring of operation using variable parameters;
- Troubleshooting.

In addition to training in practical skills, the simulator allows the Trainee to learn the basic principles of the structure, functions, and interaction of EPP components and systems.

Electrical Power system consists of the ship electrical power plant (EPP), ship electrical network and power consumers. The ship electrical network in turn consists of switchboards (MSB, ESB) and electric cables (feeders).

The simulator composition corresponds to EPP standard setup, parameters and performance of the simulated mechanisms and systems, corresponds to the systems onboard ship.

The simulator module architecture comprises a set a displays for monitoring of the EPP only. There are two displays in CMS (described in ***Chapter 2***): G/E OVERVIEW and ELECTRIC. A set of displays of the pages **MSB**, **EmG** and in ER pages simulate the Switchboard panels, Group Starter panels and Local Operating Panels of the generator engines/turbines..

The displays described in this chapter are opened from the bottom menu page **MSB, EmG** and some of the **ER** pages of the simulator Propulsion Console.

Virtual Hardware console duplicates the EPP displays, which can be distributed on a set of screens to provide realistic performance.

1.1. Plant Specification

The EPP includes: one Shaft generator (SG), one Turbo generator (TG), 2 diesel generators (DG), emergency diesel generator (EMG), main switchboard (MSB), emergency switchboard (ESB), Shore connection Box, and four power transformers.

The ship's EPP comprises:

- Shaft Generator with clutch – 440 V, 1200 kW, 60 Hz, 600 RPM, converter controlled, with synchronous condenser 150 kW.
- 2 x Diesel-Generators, YANMAR 6N21AL-EN 970 kW at 900 RPM, Generator 1125 kVA/900 kW, 450V AC, 60Hz;
- Steam Turbine Driven Generator 1200 kW, 450V AC, 60Hz;
- Emergency Diesel-Generator 1800 RPM, Generator 200 kW (250 kVA), 450 V AC, 60 Hz;
- Main Switch Board (MSB): Two sections of 440V Bus bar with Bus-Tie Circuit Breaker (CB), Bus bar 230 V;
- Emergency Switch Board (ESB): Bus bar 440 V, Bus bar 230 V;
- Transformers: 2 x 440V/230V; EM'CY 2 x 440V/230V;
- 24V DC Batteries and Charger: 230V AC – 24V DC:
  - for EM'CY Generator engine starter
  - for supply Charging and Discharging distribution board 24 V DC-BCD;
- Power Distribution: sections 440V, 230V, 24V DC Customers with CB and starters;
- Local panels and starters in engine rooms.

The main diesel generators can be operated in parallel with each other without time limitation.

The Turbo- Generator shall be operated in parallel with Diesel-generators and SG.

The Shaft Generator shall be operated in parallel with Diesel-generators and TG.

Parallel operation "Turbo-Generator – Shaft Generator" is modeled.

The emergency generator is not capable of running in parallel with the main diesel generators and is not capable of feeding to main switchboard with its source. The emergency diesel generator shall be automatically started by battery starting device and one additional hydraulic starting device in the event of failure of main power and fed to emergency switchboard, and shall be stopped automatically.

2. Power Generation

2.1. General Description

The main bus of the main switchboard is served by generators, driven by their respective diesel engines. When the ship is at sea one generator is usually in single operation. When the ship is during the loading/unloading operation, or entering/leaving port, one or two of the diesel generators (DG) will be paralleled to cover the increased power demand.

The DGs may be set as stand-by to automatically start in emergency case. Shaft generator (ShG) and turbo generator (TG) can't be set to stand-by mode.

2.2. Major Components

The ship's main power generation equipment comprises:

- Shaft Generator – PTO SMG/CFE type, installed on the propeller shaft without any clutches – 440 V, 1200 kW, 60 Hz, converter controlled, with synchronous condenser 150 kW.
- 2 x Diesel-Generators, YANMAR 6N21AL-EN 970 kW at 900 RPM, Generator 1125 kVA/900 kW, 450V AC, 60Hz;
- Steam Turbine Driven Generator 1200 kW, 450V AC, 60Hz;

The two sets of YANMAR diesel engines, as drive of electric generators, are modeled in the simulator. YANMAR 6N21AL-EN diesel engine: four stroke, medium speed, turbocharged, non-reversible DE, 970 kW at 900 RPM, with air starting system.

Generator Engines are designed for HFO and MDO, Low Sulfur MDO and Low Sulfur HFO.

One turbo-generator is modelled as high speed steam turbines with all vital subsystems such as: RPM governor; Cooling water; Lubrication oil; Steam system with condenser.

The Shaft Generator – PTO SMG/CFE type, installed on the propeller shaft without any clutches. (PTO: Power Take Off. SMG: Shaft Mounted Generator. CFE: Constant Frequency Electrical).

The PTO/CFE incorporates frequency control system, which makes it possible to produce electric power with constant electrical frequency at varying engine speed. The ShG with Synchronous Condenser is modeled.

The SMG/CFE is normally able to operate in parallel with the gensets at the full rated electric power, when the speed of the main engine is between 75% and 100% of the engine speed at specified MCR. Between 40% and 75% of the SMCR speed, the electric output of the PTO/CFE is reduced proportionately to the engine speed.

Voltage and frequency readings of the Generator bus bar are available on the panel. Together with speed adjustment, the operator is allowed to connect the generator with verification of synchronizing to the main bus bar.

Automatic voltage regulator (AVR) is used to control generator voltage. The AVR type, includes all basic features necessary for automatic control of the generator voltage:

- Voltage regulation;
- Reactive load compensation (voltage drop) for operation in parallel with other generators or utility network.

The circuit breakers have a gear motor spring operating mechanism, powered at 110 V DC. The closing springs are automatically charged by gear motor immediately following the closing command; in case of emergency, they can be charged manually using the lever.

Shore power rating: 440 V, 60 Hz, 500 A.

The main diesel generators shall be served as follows:

Service condition	DG in use
Normal sea going	One (1)
• With tank cleaning	Two (2)
• With I.G.S	Two (2)
Maneuvering	Two (2)
Cargo handling	Two (2)
Harbour	One (1)

2.3. Load Sharing

Normally, as soon as two DGs are put on line, the automatic load sharing control function starts to control their governor motors, so that each generator will be loaded to the same percentage in reference to their rated kW output values and that the bus frequency will be maintained at the rated value.

Manual load sharing can include ShG and TG.

3. Power Generation Control in the Simulator

3.1. Generator Engines LOP

Click on the menu item **GE 1-2 LOP** of the page **ER3** to open the display with two identical LOPs of the diesel engines.

The description given is for the **LOP GE 1**; LOP GE 2 is similar to LOP GE 1.

The top part of the LOP contains the gauges to control:

- **FO BOOST PRESSURE**;
- **RPM**;
- **LO PRESSURE**;
- **HT CW PRESSURE**;
- **FO INLET TEMPERATURE**;
- **HT CW PRESSURE**.

The bottom part of the LOP contains:

- **CONTROL KNOB** potentiometer to manually regulate the engine rpm;
- **START** button to start the engine in ENGINE mode; if the handle is set to **RUN** position the engine starts; if the handle is set to **STOP** position the engine turns on air;
- Two-position switch to select the control mode between ENGINE / REMOTE;
- Handle to **STOP** and **RUN** the engine; in STOP position start is blocked.

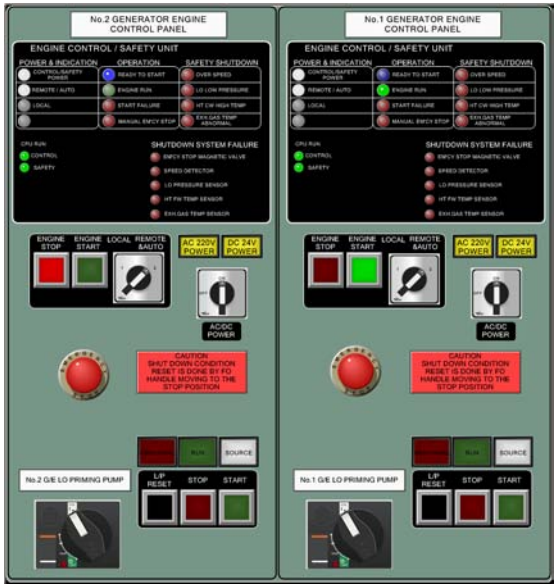
3.2. Generator Engine Control Panels

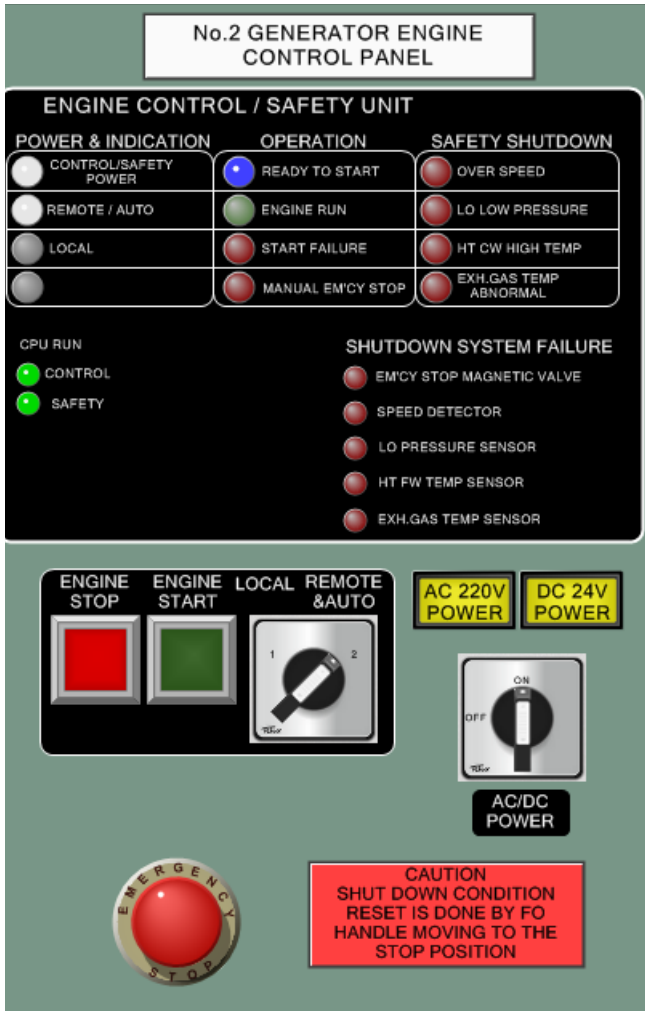
Click on the menu item **GE 1-2 Control Panel** of the page **ER3** to open the display with two identical panels of generator engines.

The description given is for the **No.2 GENERATOR ENGINE CONTROL PANEL**; Generator Engine No. 1 control panel is similar to No. 2 GE control panel.

The **ENGINE CONTROL / SAFETY UNIT** contains groups of indicator lamps for information of the generator set state. The lamps illuminate under the following conditions:

- **POWER & INDICATION**:
  - **CONTROL/SAFETY POWER** – power is available;
  - **REMOTE/AUTO** – when both switches: **ENGINE–REMOTE** on the engine LOP and **LOCAL – REMOTE&AUTO** on this panel are in remote/auto position;





  - **LOCAL** – when switches **ENGINE–REMOTE** on the engine LOP is in REMOTE position, and **LOCAL – REMOTE&AUTO** on this panel is in LOCAL position.
- **OPERATION**:
  - **READY TO START** – when control & safety power exists, and no active shut down conditions exist;
  - **ENGINE RUN** – when engine is running;
  - **START FAILURE** – when required rpm has not been reached during a set starting time;
  - **MANUAL EMCY STOP** – if the **EMERGENCY STOP** button has been pressed.
- **SAFETY** SHUTDOWN;
  - **OVER SPEED** – speed > 1035 rpm;
  - **LO LOW PRESSURE** – pressure < 3 bar;
  - **HT CW HIGH TEMP** – temp. > 99 °C;
  - **EXH.GAS TEMP ABNORMAL** – temp. > 750 °C.
- **CPU RUN**:
  - **CONTROL** and **SAFETY** – when CONTROL & SAFETY POWER supply in ON.
- **SHUTDOWN SYSTEM FAILURE** alarm lamps – illuminate when fault is introduced by instructor: the sensor is broken and DE shutdown does not occur, as the result DE breaks.

The central part of the panel contains:

- **ENGINE STOP, ENGINE START** buttons to operate in **LOCAL** mode;;
- **LOCAL–REMOTE&AUTO** switch to set control mode;
- **AC 220V POWER**, **DC 24V POWER** indicators of the panel power source, which is provided from ECR console and from BCD = 24 V DC;
- **AC/DC POWER** two-position switch to turn CONTROL & SAFETY POWER supply OFF/ON ;
- **EMERGENCY STOP** button.

Cylinder indicator diagrams of the generator engines and the exhaust gases content can be obtained using the page CID of the simulator (see ***Chapter 1***).

3.2.1. G/E LO Priming Pump

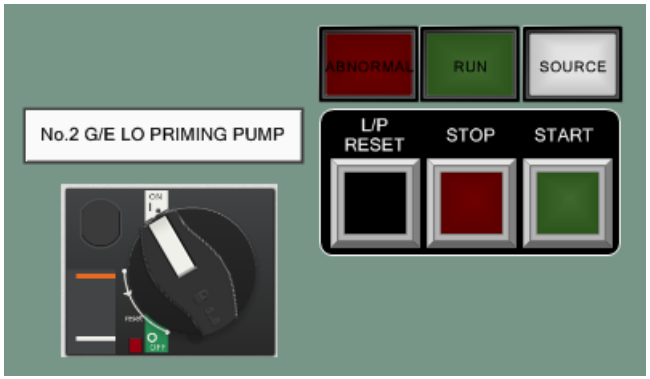
The lower part of the **GENERATOR ENGINE CONTROL PANEL** contains controls for the GE LO Priming Pump:

- **No. 1 G/E LO PRIMING PUMP** circuit breaker;
- **ABNORMAL** alarm indicator – illuminates when the pump breakage/failure occurs;
- **RUN**, **SOURCE** indicators to display the pump state and power supply;
- **L/P RESET** button to reset the pump after trip condition;
- **STOP**, **START** buttons to operate the pump in LOCAL mode.

Automatic operation

For automatic operation of the Priming pump, both switches: **ENGINE–REMOTE** on the engine LOP and **LOCAL – REMOTE&AUTO** on this panel should be set to remote/auto position.

The pump will start automatically at engine start The pump will automatically stop when engine LO driven pump starts. If the engine is in standby mode the pump operates in intervals to keep the engine in ready to start condition.



Local control

Local operation by **STOP**, **START** buttons is possible when **LOCAL–REMOTE&AUTO** switch is set to LOCAL position.

Start the pump before engine start. Stop the pump manually after having started the engine.

Power supply

Switch power supply 440 V for:

- **No. 1 G/E LO PRIMING PUMP** on **No.1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No 1 G/E LO PRIMING PUMP** circuit breaker;
- **No. 2 G/E LO PRIMING PUMP** on **No.2 AC440V FEEDER PANEL** (use menu item **MSB No 1,, No 2 440V Feeder** of the page **MSB**) by the **No 2 G/E LO PRIMING PUMP** circuit breaker.

3.3. Turbo Generator LOP

Click on the menu item **Turbogenerator LOP** of the page **ER3** to open the **STEAM TURBOGENERATOR CONTROL PANEL**.

The panel contains:

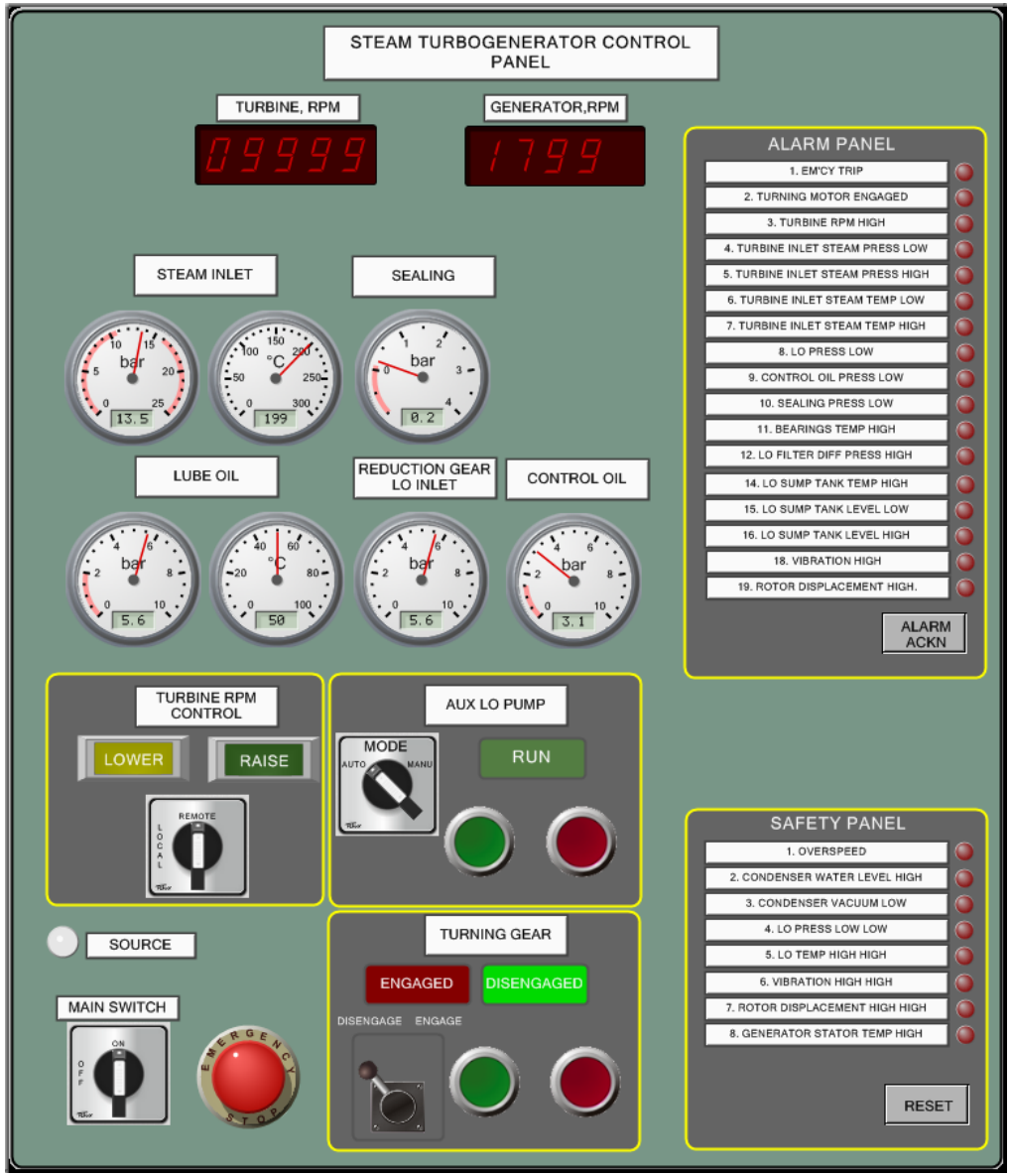
- **TURBINE, RPM** ; **GENERATOR, RPM** – digital indicators;
- **STEAM INLET** – pressure and temperature gauges;
- **SEALING** – pressure gauge;
- **LUBE OIL** – – pressure and temperature gauges;
- **REDUCTION GEAR LO INLET** – pressure gauge;
- **CONTROL OIL** – pressure gauge.
- **TURBINE RPM CONTROL** box comprising:
  - **LOWER** and **RAISE** buttons to adjust speed in LOCAL mode;
  - Two-position mode selector switch:

    LOCAL – RPM control by **LOWER** and **RAISE** buttons;

    REMOTE – to control from MSB Synchro panel (use menu item **MSB Synchro Panel** of the page **MSB**) by **GOVERNOR CONTROL** impulse handle.
- **AUX LO PUMP** push button box comprising:
  - **MODE** two-position selector switch:

    AUTO – the pump is set to automatic operation;

    MANU – operate the pump by the panel buttons.
    Note: Start the pump for pre-warming of the turbine and then set in to AUTO operation.
  - **RUN** indicator lamp;
  - Buttons to start and stop the pump manually.
- **SOURCE** indicator lamp; illuminates when power is ON;
- **MAIN SWITCH** – to turn power OFF/ON for the panel and turning gear motor;
- **EMERGENCY STOP** button;



- **TURNING GEAR** box comprising:
  - **ENGAGE** and **DISENGAGE** indicator lamps;
  - **ENGAGE** / **DISENGAGE** handle switch to turn the turbine by electrical motor before starting;
  - Buttons to engage (green) and disengage (red) the gear.
- **ALARM PANEL** LED indicators, which illuminate when:
  - 1. EM'CY TRIP – clicked **EMERGENCY STOP** button;
  - 2..TURNING MOTOR ENGAGED;
  - 3. TURBINE RPM HIGH – speed > 7200 RPM;
  - 4. TURBINE INLET STREAM PRESS LOW – pressure < 7 bar;
  - 5. TURBINE INLET STREAM PRESS HIGH – press. > 17 bar;
  - 6. TURBINE INLET STREAM TEMP LOW – temp. < 150 °C;
  - 7. TURBINE INLET STREAM TEMP HIGH – temp. > 270 °C;
  - 8. LO PRESS LOW – pressure < 2.0 bar;
  - 9. CONTROL OIL PRESS LOW – pressure < 1.5 bar;
  - 10. SEALING PRESS LOW – pressure < 0.1 bar;
  - 11. BEARINGS TEMP HIGH – ;
  - 12. LO FILTER DIFF PRESS HIGH – press. > 1.5 bar;
  - 14. LO SUMP TANK TEMP HIGH – temp. > 55 °C;;
  - 15. LO SUMP TANK LEVEL LOW – level < 30%;
  - 16. LO SUMP TANK LEVEL HIGH – level > 90%;
  - 18. VIBRATION HIGH – vibration level > 110 micron;
  - 19. ROTOR DISPLACEMENT HIGH – shift > 0.5 mm.
- **SAFETY PANEL** LED indicators, which illuminate when the following trip conditions occur:
  - 1. OVERSPEED – ≥ 7400 rpm;
  - 2. CONDENSER WATER LEVEL HIGH – level > 90%;
  - 3. CONDENSER VACUUM LOW – pressure < 0.2 bar;
  - 4. LO PRESS LOW LOW – pressure < 0.5 bar;
  - 5. LO TEMP HIGH HIGH – temperature > 85 °C;
  - 6. VIBRATION HIGH HIGH – vibration level > 130 micron;
  - 7. ROTOR DISPLACEMENT HIGH HIGH – shift > 1 mm;
  - 8. GENERATOR STATOR TEMP HIGH – temp. > 170 °C.

Switch power 440V supply for the panel and gear motor on any of the **No. 1 AC440V FEEDER PANEL** and **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440v Feeder** of the page **MSB**) by **SHAFT GEN AUX POWER** circuit breakers.

3.4. Turbo Generator & Shaft Generator Panels at MSB

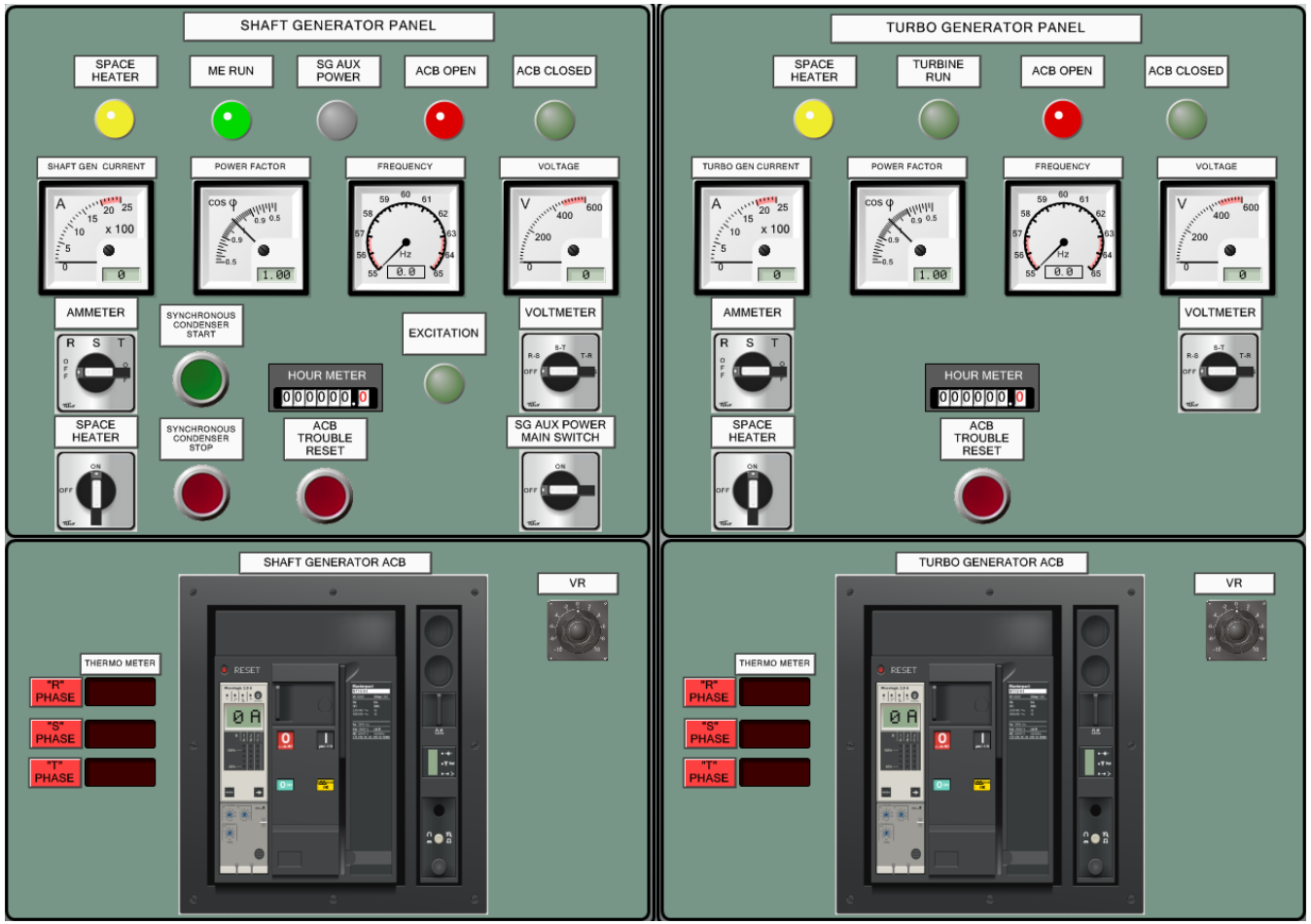
Control of the Shaft generator (ShG) is provided from the MSB panel. Click on the menu item **MSB TG, SG Panel** of the page **MSB** to open the **TURBO GENERATOR PANEL** and **SHAFT GENERATOR PANEL**.

Both panels have similar controls comprising:

- **SPACE HEATER**, **ACB OPEN**, **ACB CLOSED** – indicator lamps, which illuminate when the respective condition is active;
- **GEN CURRENT**, **POWER FACTOR**, **FREQUENCY**, **VOLTAGE** – gauges to monitor the generator parameters;
- **AMMETER** – four-position switch to select the measurement on phases **R**, **S**, **T**, or switch **OFF**;
- **SPACE HEATER** – switch to turn heating OFF/ON;
- **VOLTMETER** – four-position switch to select the measurement between phases **R-S**, **S-T**, **T-R**, or switch **OFF**;
- **HOURS METER** counter;
- **ACB TROUBLE RESET** – button to reset ACB after trip condition;
- **THERMO METER** – digital indicators of the “R” PHASE, “S” PHASE and “T” PHASE temperatures;
- **VR %** – voltage regulator; turn the knob to manually adjust generator voltage value according to the bus voltage value (watch on the voltmeter);
- **GENERATOR ACB** – see the operating description in *the paragraph 4.2.2 on page 91*.

The **SHAFT GENERATOR PANEL** additionally contains:

- **ME RUN** – indicator lamp;
- **SG AUX POWER** – indicator lamp, which illuminates when power is available for **SYNCHRONOUS CONDENSER** operation by start and stop buttons on this panel;
- **EXCITATION** – indicator lamp, which illuminates when the **SG AUX POWER** is present and **SYNCHRONOUS CONDENSER START** and **SYNCHRONOUS CONDENSER STOP** buttons can be used to operate the condenser;
- **SG AUX POWER MAIN SWITCH** – to turn **OFF/ON** power; one of **SHAFT GEN AUX POWER** circuit breakers on the MSB 440V Feeder 1 or 2 panels (use menu item **MSB No 1, No 2 440v Feeder** of the page **MSB**) should be closed.



The **TURBO GENERATOR PANEL** additionally contains:

- **TURBINE RUN** – indicator lamp, which illuminates when the generator steam turbine is running. **Note:** Wait for required frequency and voltage readings on the gauges before connecting the generator to MSB.

TG local control is described in *the paragraph 3.3 on page 88*.

4. Power Distribution

4.1. General Description

The ship electrical network is designed for delivering electrical power from the ship EPP to the consumers. The ship electrical network supplies consumers with 3-phase, 440V, 60 Hz generated by the generators.

4.2. Major Components

The ship's power distribution system comprises:

- Main Switch Board (MSB) consists of:
  - 2 x Group Starter Panel 1, 2 – 440 V;
  - 2 x Feeder Panel 1, 2 – 440 V;
  - Feeder Panel 230 V;
  - Bus bar with Bus-Tie Circuit Breaker.
- Emergency Switch Board (ESB) consists of:
  - EM'CY Group Starter Panel 440 V;
  - Feeder panel 440 V;
  - Feeder panel 220 V.
- Power Distribution boards: 440V, 230V, 24V DC Consumers with CBs and starter panels;
- Local panels and starter panels in engine rooms.

4.2.1. Air Circuit Breakers (ACB) Components

The air circuit breaker consists of:

- Electric motor module to automatically change the spring. When the ACB opens, the geared motor recharges the stored energy system allowing for a closing/opening operation so that by charging the closing spring, sufficient energy is stored to ensure that the opening spring is also charged.
- Electromagnetic tripping device operating at overcurrent, over/under voltage and overload;
- Springs to open/close the ACB;
- **I** pushbutton to manually close the ACB; it is active only when the spring is changed;
- Signalling device mechanically connected to the spring (below the **I** pushbutton). The condition of the stored energy mechanism is indicated by a tag which displays either a white "discharged" or yellow "charged" indicator;
- **0** pushbutton to manually open the ACB;

- Signalling device mechanically connected to the spring (below the **0** pushbutton). The condition of the ACB is indicated by a tag which displays either a white **I** closed ACB, or light blue **0** opened ACB indicator;
- **RESET** pushbutton to reset ACB after tripping and re-enable the protection mechanism; the pushbutton is pulled out when ACB trips;
- The lever to manually charge the spring. In electrical fault circumstances such as a blackout condition, the motor mechanism will be unable to recharge the stored energy system for any ACB's that tripped, subsequently these ACB's will require resetting and recharging using the manual charging lever. In the simulator the lever needs to be dragged one time down and up using the mouse to achieve the yellow "charged" indicator being displayed to confirm successful charging.

The left-most control panel located on the ACB front below the **RESET** pushbutton, if present, is used to change the inputs.

ACB controls are located on the appropriate SWBD panels.

4.2.2. ACB Principle of Operation

The ACB will not close unless the closing spring is fully charged. In automatic operation (including under/over voltage tripping, where used) the closing/opening springs are charged automatically by the motor mechanism. When the ACB opens, the geared motor recharges the stored energy system allowing for a closing/opening operation so that by charging the closing spring, sufficient energy is stored to ensure that the opening spring is also charged. In electrical fault circumstances such as a blackout condition, the motor mechanism will be unable to recharge the stored energy system for any ACB(s) that tripped, subsequently these ACB(s) will require resetting and recharging using the manual charging lever.

ACB can be opened either by remote tripping mechanism or manually. To open the ACB manually it is sufficient to click the button **0**. Spring energy is not required for opening.

To close the ACB manually the operator needs to ensure that springs are charged. The **RESET** pushbutton on the front panel or **ACB TROUBLE RESET** button should be clicked. To close the ACB it is sufficient to click the **I** button. At that the spring closes the ACB. If the motor mechanism module is powered, then the motor re-charges the spring, and in 4 sec. it is again in charged state. The spring state is indicated by the tag indicator.

4.2.3. Consumers' CB Principle of Operation

Circuit Breakers of the consumers are three-position automatic power switches having the following positions:

- **0** – power is switched off;
- **TRIP** – CB is tripped; the CB opens and the operating lever rotates to the tripped position; to reset the CB the operator needs to manually switch the lever into 0 position, and only after that CB can be closed manually;
- **1** – power from the bus is supplied to the consumer.

CBs have inbuilt short circuit and thermal protection.

Switching a CB in the simulator is done by the double-click, or by dragging the lever into desired position with the mouse.

Closing of a CB (the lever in position 1) means that the power is supplied to the specified consumer(s). For operation the consumer(s) need to be switched on either remotely or on their local panels.

The automatic CBs located on the local panels and starters.

The automatic CBs located on the distribution boards and switchboard panels. Associated consumers' names are displayed on the nameplates above the switch:

CB is closed

CB is tripped

CB is open

4.2.4. ACB Protection

ACBs are installed on the main and EM'CY Generators; bus tie connection.

ACB trips after delay time or instantaneously.

4.2.4.1. Generator ACB Protection

A GCB protection has the following characteristics:

- Time delayed generator overcurrent trip. Delay time depends on the current value: at $I = 1.21\ I_R$ GCB trips after 30 sec.;
- Instantaneous short circuit trip: $I = 3\ I_R$;
- Time delayed under voltage trip: $U_0 = 0.9\ U_R$, 3 sec.;
- Time delayed reverse power trip: $P < -0.1\ P_R$, 5 sec.;

After the preferential tripping (as described in 4.2.5 below), when the generator is further overloaded. Long Time Delay TRIP (LTD) function among the functions of overcurrent tripping device of ACB operates to trip ACB of generator to prevent damage in the generator.

4.2.4.2. Main Bus Tie ACB Protection

A BTCB protection has the following characteristics:

- Instantaneous short circuit trip: $I = 3\ I_R$.

4.2.5. Preferential Tripping

4.2.5.1. Purpose

When the generators on line are overloaded, relatively non-essential load is tripped from the system by the preferential tripping system, to reduce the load.

Thus the operation of generator continues and the feeding to essential load circuits continues.

The preferential tripping system of this ship has two kinds of "Tripping", namely, one by overload of the generator, and the other by abnormal ACB trip of the generator during parallel operation of generators.

For the consumers' CB designated for non-essential load, a thin black plate with the label PT is inserted above its nameplate specifying its application purposes. This indicates the preferential breaking designation.

4.2.5.2. Operation

Separation of non-essential load due to overload **PT**.

If the current or power of generator on line:
> 100% during 10 seconds, or
> 110% during 5 seconds, or
> 120 % during 1 second,

PREFERENTIAL TRIP function operates to trip the CBs for non-essential consumers.

4.3. Auto Synchro & Power Control

Purpose

The system is designed for control and protection of parallel running generators and can also carry out engine control and protection. The application software consists of two main software units:

- Generator control software unit;
- Power Management System (PMS) software unit

Generator control software unit

The generator set control software unit controls and supervises all local operations of the generator set. The received PMS commands may initiate e.g. start and stop of the generator set, but the generator set control software unit carries out the actual control, protection and supervision of the generator set.

PMS software unit

The PMS interface forms a bidirectional communication link between the PMS software unit and the generator set control software units. The PMS software unit transmits e.g. PMS start/stop commands and selected plant mode via the PMS interface. The generator set control software unit(s) transmits signals such as the operational status of the generator sets (e.g. running or stand-by), relevant measured and calculated values and status of the selected AUTO or MANUAL control mode.

Load-dependent start/stop function

The load-dependent start/stop function is active, when the AUTO plant mode is selected and the shore connection is not closed. The start/stop function transmits PMS start and stop commands, which are based on a calculation of how many generator sets are needed in order to meet the actual power demand at the busbar. The PMS start/stop commands cause the individual generator sets to carry out start and stop respectively according to the programmed start/stop priority.

Predicted available power

Calculation of the predicted available power is based on a summation of the available power at each running generator set. The result of the summation is the total measured available power at the busbar.

The predicted available power is subsequently calculated with consideration to the following events:

- The nominal load of a running generator set which is about to be stopped due to a safety stop alarm sequence (expected stop);
- Conditional connection of heavy consumers.

Programming the load-dependent stop limit

The PMS stop command is generated by comparing the programmed stop limit value with the result of the following calculation: The predicted available power deducted from the nominal load of the generator set designated with the highest stop priority.

The programmable stop limit represents the desired remaining available power at the busbar, after the load-dependent PMS stop of the generator set has been carried out.

Transfer of the PMS start command

A PMS start command is automatically transmitted to the stand-by generator set, if any of the below-mentioned alarm sequences become active at a running generator set:

- The “SAFETY STOP” alarm sequences;
- The “TRIP OF GB” alarm sequences;
- The “SHUTDOWN” alarm sequence.

Automatic starting of diesel generators

The diesel generators (G1 and G2) can be set as stand-by when one of the generators is in service.

If a bus trouble is detected when one generator is in service, then the stand-by D/G will be automatically started and one generator in service will be replaced by this generator to restore the bus conditions to normal.

The stand-by generator will also be automatically started when generator in service is overloaded, in which case the started stand-by is automatically paralleled to service generator.

Automatic start sequence

The automatic start sequence starts the corresponding engine and detects, if the start is completed successfully. A successfully completed start sequence initiates the GB ON sequence.

The automatic start sequence is carried out on the PMS start command. The PMS start command may be generated e.g. by the load depending start/stop or by the blackout function.

The automatic start sequence is considered to be normally completed, if both below-mentioned conditions are fulfilled:

- An active **RUNNING** status signal at the generator set;
- Normal generator voltage is measured;
- **RUN** LED turning green.

Deloading

The automatic GB OFF deloads the generator set before allowing the generator breaker to be opened. When the measured generator load (real power) goes below the programmable limit, the generator breaker is opened.

Automatic stop sequence

The automatic stop sequence includes:

- Programmable cooling down time
- “STOP” output with programmable extended ON time.

5. Power Distribution Control in the Simulator

5.1. Main Circuit Diagram

Click the menu item **MCD** of the page **MSB** to open the **MAIN CIRCUIT DIAGRAM** (MCD) display.

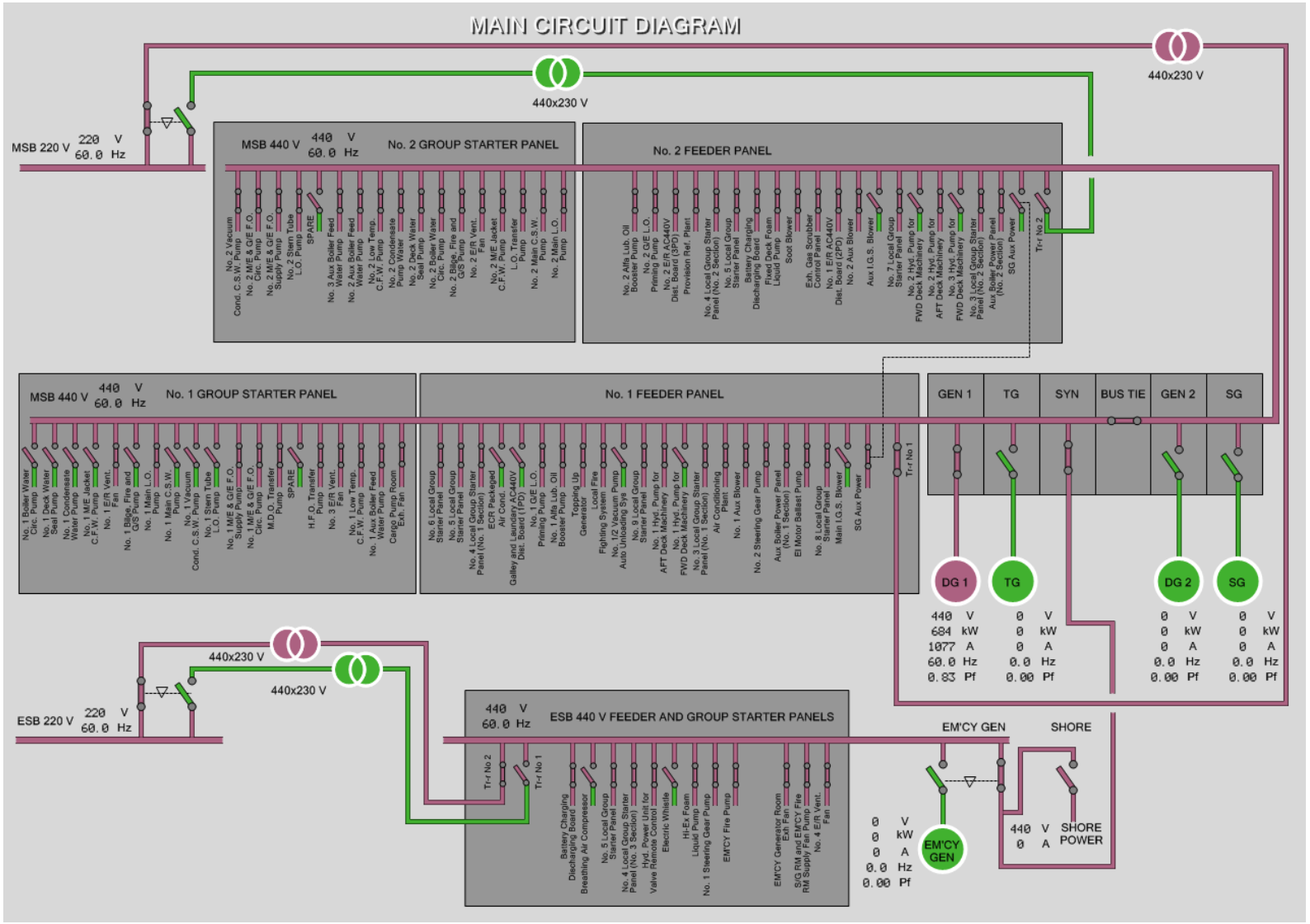
Active (powered) elements of the diagram, such as generators, buses, transformers, closed CBs are painted in magenta. Digital indicators display the actual values of appropriate electrical parameters: voltage, current, power, frequency.

Non-active (not powered) elements are painted on the diagram in green.

Tripped CBs are painted in red.

Circuit breakers can be operated from this diagram except Generator ACBs. Double-click a required CB to open/close it on the MCD display. In the event when a CB is blocked by the bus or generator automatics, then operation is not possible. It should be carried out from the local panel or respective switchboard section.

Zoom in/out MCD display using the mouse wheel to read consumers names on the switch boards.



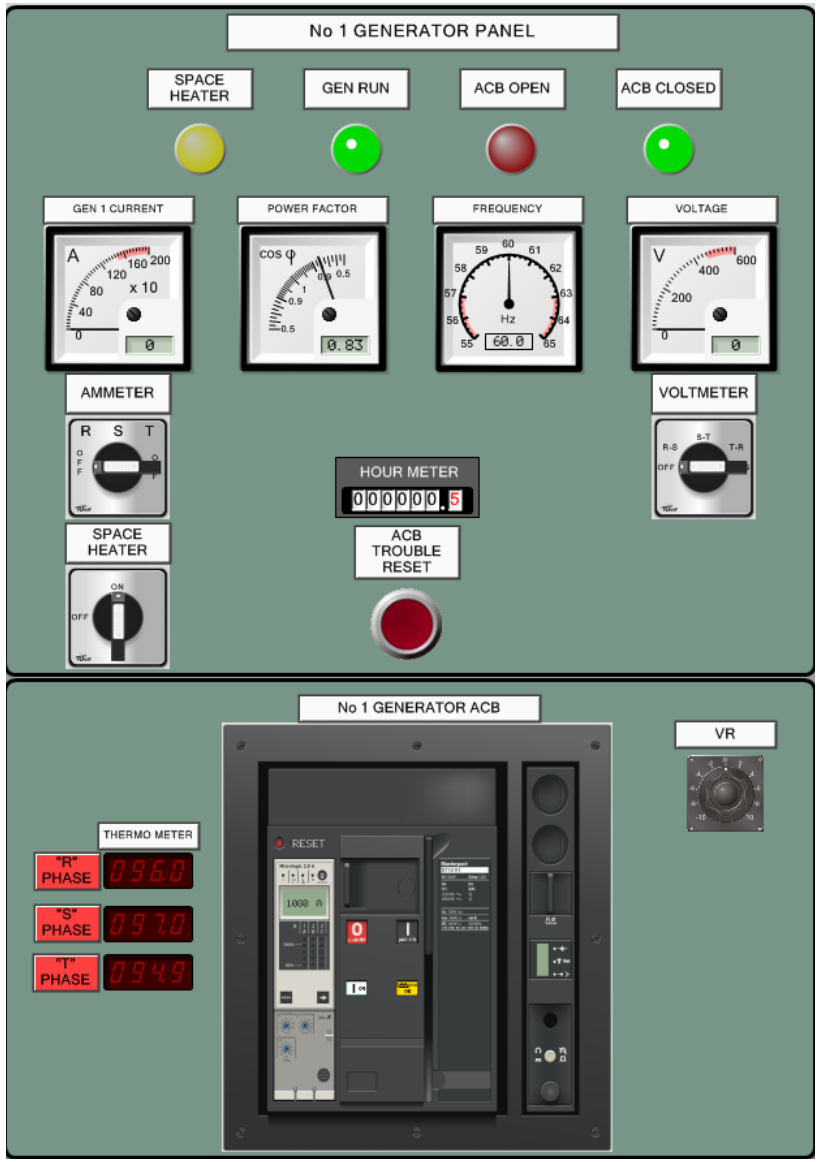
5.2. Generator 1, 2 Panels

Click the menu item **MSB Gen 1, 2 Panel** of the page **MSB** to open the display with two generator panels.

The description given is for generator 1. Generator 2 panel is similar to generator 1 panel.

The **No 1 GENERATOR PANEL** contains:

- **SPACE HEATER**, **GEN RUN**, **ACB OPEN**, **ACB CLOSED** – indicator lamps, which illuminate when the respective condition is active;
- **GEN1 CURRENT**, **POWER FACTOR**, **FREQUENCY**, **VOLTAGE** – gauges to monitor the generator parameters;
- **AMMETER** – four-position switch to select the measurement on phases **R**, **S**, **T**, or switch **OFF**;
- **SPACE HEATER** – switch to turn heating OFF/ON;
- **VOLTMETER** – four-position switch to select the measurement between phases **R-S**, **S-T**, **T-R**, or switch **OFF**;
- **HOURS METER** counter;
- **ACB TROUBLE RESET** – button to reset ACB after trip condition;
- **THERMO METER** – digital indicators of the “R” PHASE, “S” PHASE and “T” PHASE temperatures;
- **VR %** – voltage regulator; turn the knob to manually adjust generator voltage value according to the bus voltage value (watch on the voltmeter);
- **No1 GENERATOR ACB** – see the operating description in ***the paragraph 4.2.2 on page 91***.

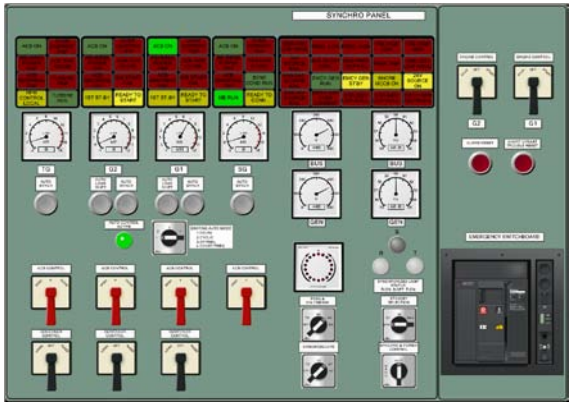


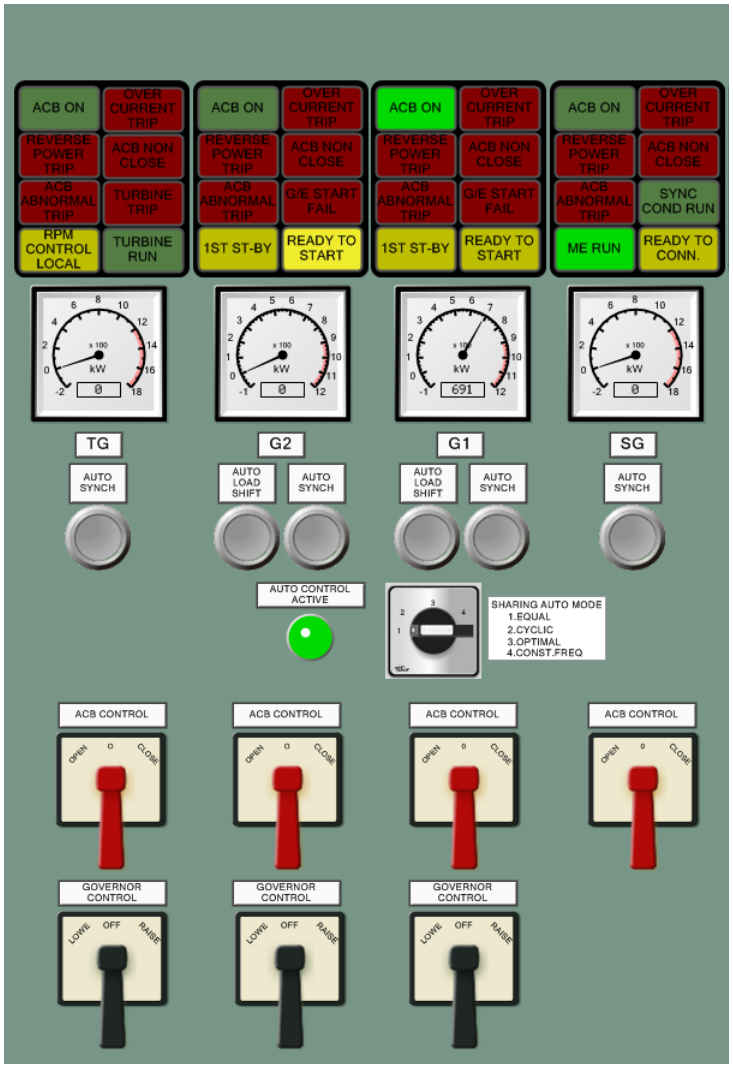
5.3. Synchronization Panel

Click the menu item **MSB Synchro panel** of the page **MSB** to open the display with two panels.

Left part of **SYNCHRO PANEL** contains:

- **TG, G2, G1, SG** – four similar indicator lamps panels to display the state of generators and alarm conditions; each set comprises:
  - **ACB ON**; **OVERCURRENT TRIP**;
  - **REVERSE POWER TRIP**; **ACB NON CLOSE**;
  - **ACB ABNORMAL TRIP.**
- **TG** indicator lamps also contain:
  - **TURBINE TRIP**;
  - **RPM CONTROL LOCAL**; **TURBINE RUN.**
- **G2** and **G1** indicator lamps also contain:
  - **G/E START FAIL**;
  - **1ST ST-BY**; **READY TO START.**
- **SG** indicator lamps also contain:
  - **SYNC COND RUN**;
  - **ME RUN**; **READY TO CONN.**





- **TG, G2, G1, SG** – gauges to display generators power; and buttons **AUTO SYNCH**: click to synchronize generator with the bus, if **AUTO CONTROL ACTIVE** lamp is illuminated;
- **AUTO LOAD SHIFT** – buttons for diesel-generators **G2, G1**: click to gradually lower the generator power to 0 and to open generator ACB, if **AUTO CONTROL ACTIVE** lamp is illuminated;
- **AUTO CONTROL ACTIVE** lamp – illuminates when generators can be synchronized and unloaded automatically; if TG or SG is online the lamp lights down, and automatic operation of GEs is disabled;
- **SHARING AUTO MODE** – four-position switch to select automatic load sharing mode:

  1. EQUAL – equal load on running generators;

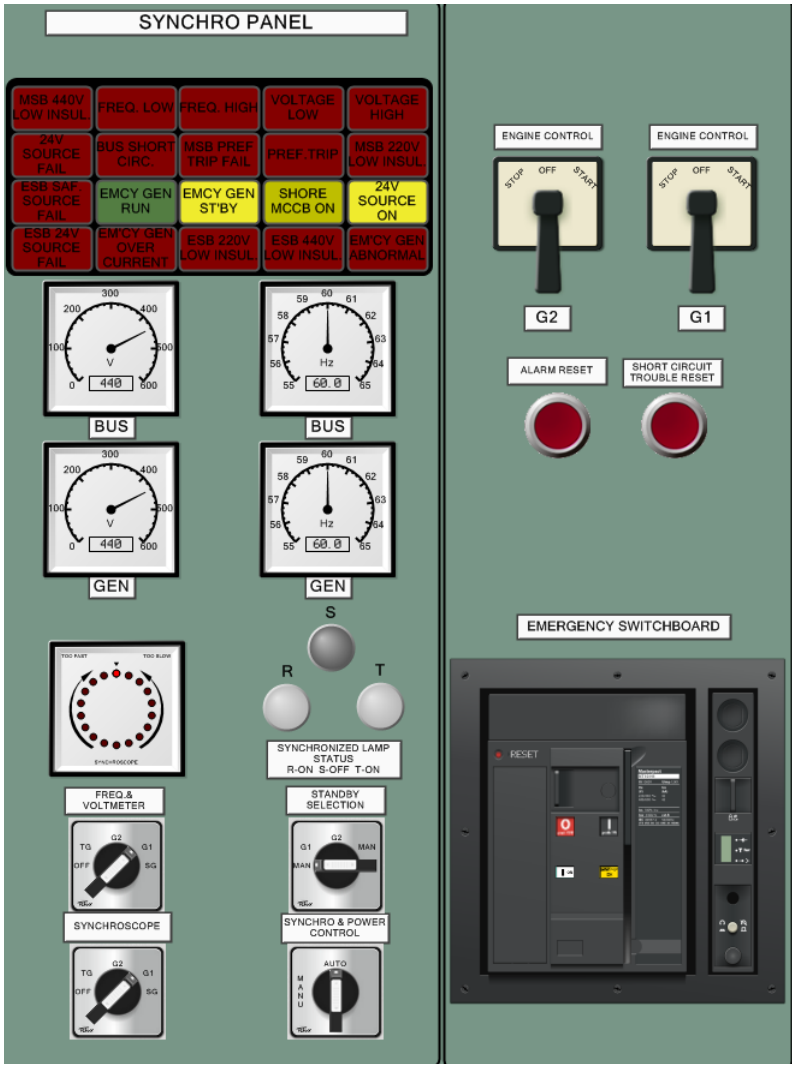
  2. CYCLIC – the generators are loaded just like they are in the OPTIMAL mode, the generator priority, however, changes cyclically according to the set time period;

  3. OPTIMAL – the higher-priority generator is loaded more than the other one; this is the best DG operating mode;

  4. CONST. FREQ – the load is divided between the DCs in equal parts with a more accurate stabilization of the current frequency within 49-50 Hz limits. In this mode the RPM governor of the higher-priority DG ensures the frequency stabilization, whilst the RPM governor of the other DG ensures the load distribution.
- **ACB CONTROL** impulse handles to **OPEN** or **CLOSE** the respective generator ACB manually: turn and hold for operation;
- **GOVERNOR CONTROL** impulse handles to **LOWER** or **RAISE** the voltage for **TG, G2** and **G1** generators; the handles are enabled when **STANDBY SELECTION** switch is set to position MAN.

Right part of **SYNCHRO PANEL** contains:

- Indicator lamps panel to display the EPP state and alarm condition:
  - **MSB 440V LOW INSUL.**;
  - **FREQ. LOW** – frequency < 95% during 5 sec.;
  - **FREQ. HIGH**– frequency > 105% during 5 sec.;
  - **VOLTAGE LOW** – voltage < 95% during 5 sec.;
  - **VOLTAGE HIGH** – voltage > 105% during 5 sec.;
  - **24V SOURCE FAIL**;
  - **BUS SHORT CIRC.**;
  - **MSB PREF. TRIP FAIL**;
  - **PREF. TRIP**;
  - **MSB 220V LOW INSUL.**;
  - **ESB SAF. SOURCE FAIL**;
  - **EM'CY GEN RUN**;
  - **EM'CY GEN ST'BY**;
  - **SHORE MCCB ON**;
  - **24V SOURCE ON**;
  - **ESB 24V SOURCE FAIL**;
  - **EM'CY GEN OVERCURRENT**;
  - **ESB 220V LOW INSUL.**;
  - **ESB 440V LOW INSUL.**;
  - **EM'CY GEN ABNORMAL**.
- **BUS** and **GEN** – voltage and frequency gauges to monitor synchronization process;
- Synchroscope (see the description in ***the paragraph 5.3.1 on page 98***);
- **S**, **R**, **T** – light synchroscope lamps; operation is described in ***the paragraph 5.3.2 on page 98***; **Note:** Synchronized lamp status is **R** on, **S** off, **T** on;
- **FREQ.&VOLTMETER** – five-position switch to select the generator set for measurement between OFF/TG/G2/G1/SG;



- **STANDBY SELECTION** – four-position switch:
  - MAN – operate by **GOVERNOR CONTROL**, **ENGINE CONTROL** and **ACB CONTROL** handles;
  - **G1**, **G2** – operate in fully automatic mode if **SYNCHRO & POWER CONTROL** switch is set to position **AUTO**.
- **FREQ. & VOLTMETER** – five-position switch to select the generator set for measurement between OFF/TG/G2/G1/SG;
- **SYNCHROSCOPE** – five-position switch to select the generator set for synchronization: OFF/TG/G2/G1/SG;
- **SYNCHRO & POWER CONTROL** – switch to select the control mode:
  - **MANU** – by **GOVERNOR CONTROL**, **ENGINE CONTROL** handles and synchroscope;
  - **AUTO** – can synchronize by **GOVERNOR CONTROL** handles, or use **AUTO SYNC** buttons.

The right panel on the display contains:

- **ENGINE CONTROL** impulse handles for **G2** and **G1** to operate the diesel engine: **STOP**, **OFF**, **START** – only when **SYNCHRO & POWER CONTROL** switch is in MANU position and **STANDBY SELECTION** switch is in MAN position;
- **ALARM RESET** button to reset active alarms on **SYNCHRO PANEL**;
- **SHORT CIRCUIT TROUBLE RESET** – button to reset trip condition of the **EMERGENCY SWITCHBOARD** ACB;
- **EMERGENCY SWITCHBOARD** – to operate MSB-ESB ACB.

5.3.1. Synchroscope Operation

The "rotation" of the red LED circle indicates the frequency difference. The circle can rotate clockwise and counterclockwise.

If the generator is synchronized with the bus (it is safe to connect the generator to the bus), then only the upper LED indicator is illuminated (12 o'clock position).

If the generator frequency is less than the bus frequency the circle rotates counterclockwise (TOO SLOW). If generator frequency is greater than the bus frequency the circle rotates clockwise (TOO FAST).

Exact frequency values should be checked using the voltage and frequency gauges. Frequency adjustment is done using the potentiometer of the appropriate generator.

5.3.2. Light Synchroscope Operation

The lamps **S**, **R**, **T** – light synchroscope, illuminate in round robin way:

- The sequence **S** -> **R** -> **T** indicates that the generator frequency is greater than the bus frequency;
- The sequence **T** -> **R** -> **S** indicates that the generator frequency is less than the bus frequency.

Synchronized generator and bus are indicated by the lamp state: **R** on, **S** off, **T** on. Then the generator ACB can be closed.

5.3.3. Synchronizing in AUTO & MANUAL Modes

Note 1: Automatic synchronization of diesel generators is possible only when TG and SG are out of operation.

Note 2: One generator should be running and connected to the bus.

SYNCHRO & POWER CONTROL switch is set to **AUTO** control mode. Both automatic and manual synchronization is allowed.

1. Automatic synchronization of diesel generator:
   - › Set **STANDBY SELECTION** switch to **G1** or **G2** position.
   - › Set **SHARING AUTO MODE** switch to **OPTIMAL** position.

   The selected diesel generator automatically starts, synchronizes and connects to the bus. Load sharing is automatically done.
2. Automatic synchronization of TG and ShG:
   - › Use respective **AUTO SYNCH** button to synchronize and connect the generator to the bus. When connected the lamp **AUTO CONTROL ACTIVE** lights down, and all control is manual. Load sharing for TG, G1, G2 is manually done using **GOVERNOR CONTROL** impulse handle, and watching the frequency reading ~ 60 Hz.

   ShG load sharing is controlled by load controller through the static converter by timing rectifying thyristors.
3. Manual synchronization:
   - › Set **STANDBY SELECTION** switch to **MAN** position.
   - › Start the diesel of the generator number that needs to be connected in parallel (using **ENGINE CONTROL** impulse handle, or manually from the LOP).
     Or
     Start TG on the LOP or ShG on the MSB panel.
   - › Set **FREQ.&VOLTMETER** switch to the generator number.
   - › Synchronize manually (using **GOVERNOR CONTROL** impulse handle).
   - › Close generator ACB manually (using **ACB CONTROL** impulse handle).

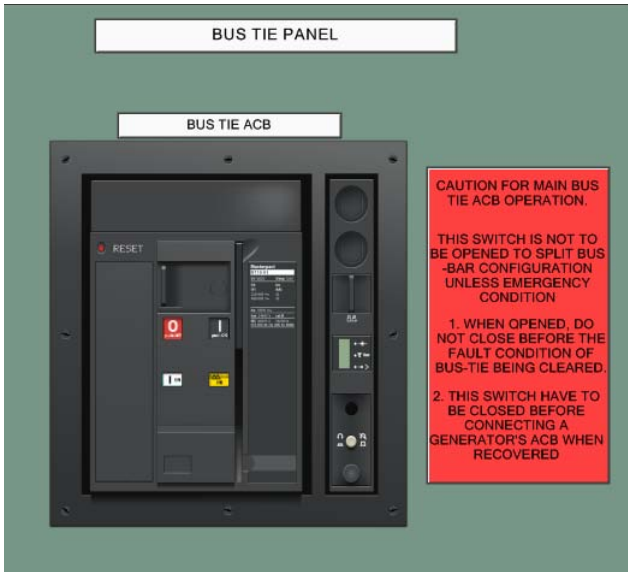
SYNCHRO & POWER CONTROL switch is set to **MANU** control mode. Manually start, synchronize, connect generators as described above in item 3.

5.4. Bus Tie Panel

Click the menu item **MSB Bus Tie Panel** of the page **MSB** to open the display.

The **BUS TIE PANEL** contains:

- **BUS TIE ACB** – see the operating description in *the paragraph 4.2.2 on page 91*;
- Caution label.



5.5. Group Starter Panel No 1

Starter panels for the mechanisms are described in their respective paragraphs.

Thin red and yellow labels on top of the CBs nameplates designate their EMCY stop group (see the designation legend on the 440V feeder panel – use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**).

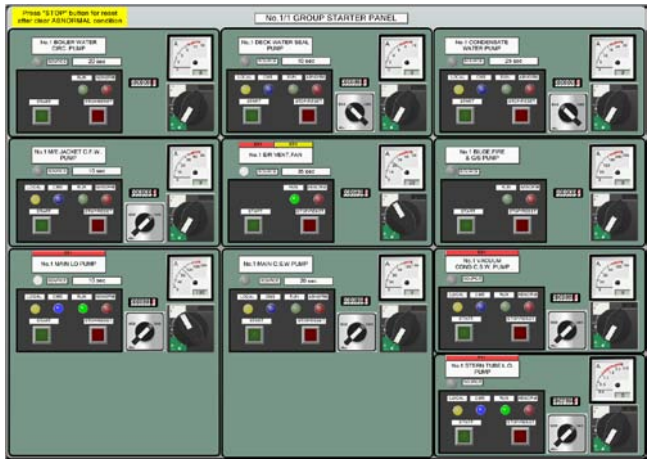
White labels (**SEQ**. **START**) indicate the mechanism starting time delay after blackout.

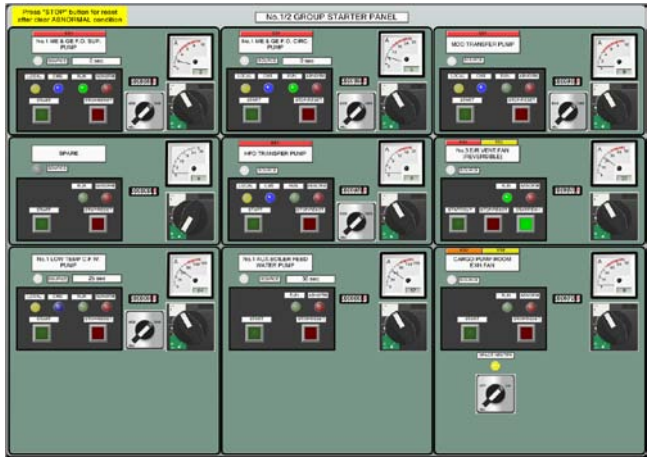
5.5.1. Section 1

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display **No.1/1 GROUP STARTER PANEL**.

Starter panels:

- No. 1 BOILER WATER CIRC. PUMP
- No. 1 DECK WATER SEAL PUMP
- No. 1 CONDENSATE WATER PUMP
- No. 1 M/E JACKET C.F.W. PUMP
- No. 1 E/R VENT FAN
- No. 1 BILGE, FIRE & G/S PUMP
- No. 1 MAIN LO PUMP
- No. 1 MAIN C.S.W. PUMP
- No. 1 VACUUM COND. C.S.W. PUMP
- No. 1 STERN TUBE L.O. PUMP





5.5.2. Section 2

Click the menu item **MSB No 1/2 GSP** of the page **MSB** to open the display **No.1/2 GROUP STARTER PANEL**.

Starter panels:

- No. 1 ME & GE F.O. SUP. PUMP
- No. 1 ME & GE F.O. CIRC. PUMP
- MDO TRANSFER PUMP
- HFO TRANSFER PUMP
- No. 3 E/R VENT FAN (REVERSIBLE)
- No. 1 LOW TEMP C.F.W. PUMP
- No. 1 AUX.BOILER FEED WATER PUMP
- CARGO PUMP ROOM EXH. FAN

5.6. Group Starter Panel No 2

Starter panels for the mechanisms are described in their respective paragraphs.

Thin red and yellow labels on top of the CBs nameplates designate their EMCY stop group (see the designation legend on the 440V feeder panel – use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**).

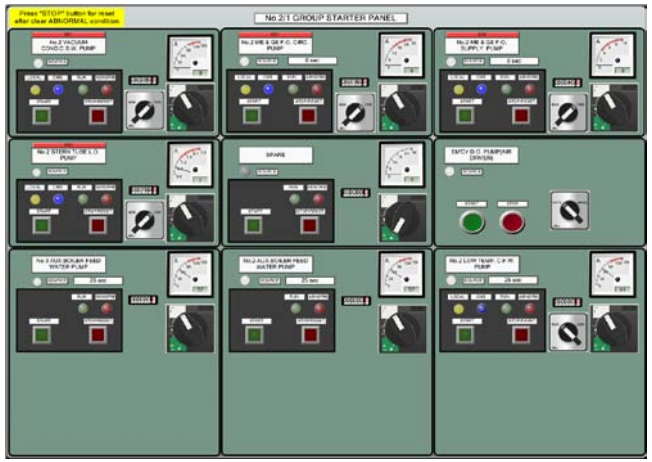
White labels (**SEQ**. **START**) indicate the mechanism starting time delay after blackout.

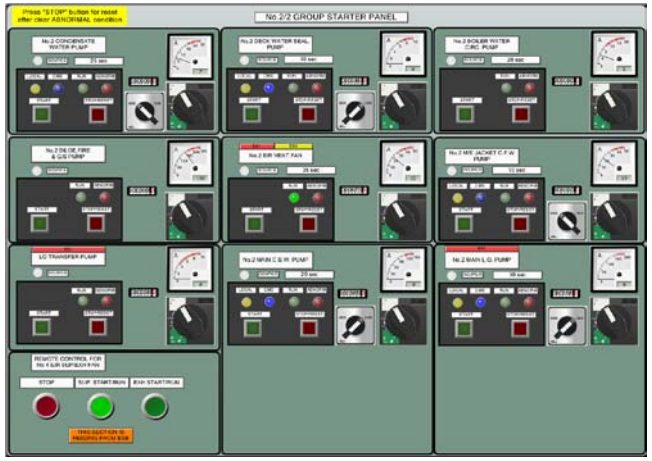
5.6.1. Section 1

Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display **No.2/1 GROUP STARTER PANEL**.

Starter panels:

- No. 2 VACUUM COND. C.S.W. PUMP
- No. 2 ME & GE F.O. CIRC. PUMP
- No. 2 ME & GE F.O. SUP. PUMP
- No. 2 STERN TUBE L.O. PUMP
- EM'CY D.O. PUMP (AIR DRIVEN)
- No. 3 BOILER WATER FEED WATER PUMP
- No. 2 BOILER WATER FEED WATER PUMP
- No. 2 LOW TEMP C.F.W. PUMP





5.6.2. Section 2

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display **No.2/2 GROUP STARTER PANEL**.

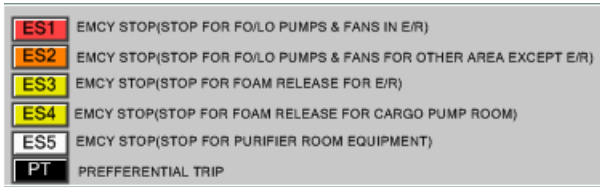
Starter panels:

- No. 2 CONDENSATE WATER PUMP
- No. 2 DECK WATER SEAL PUMP
- No. 2 BOILER WATER CIRC. PUMP
- No. 2 BILGE, FIRE & G/S PUMP
- No. 2 E/R VENT FAN
- No. 2 M/E JACKET C.F.W. PUMP
- LO TRANSFER PUMP
- No. 1 MAIN C.S.W. PUMP
- No. 2 MAIN L.O. PUMP
- REMOTE CONTROL FOR No. 4 E/R SUP/EXH FAN

5.7. MSB Feeder Panels 440 V

Click the menu item **MSB No 1, NO 2 440V Feeder** of the page **MSB** to open the display with the circuit breakers of the MSB feeder panels 440 V consumers.

Preferential and ESD tripping of non-essential consumers legend is provided on No. 2 panel. Black, orange, yellow and white labels on top of the nameplates designate the tripping conditions.

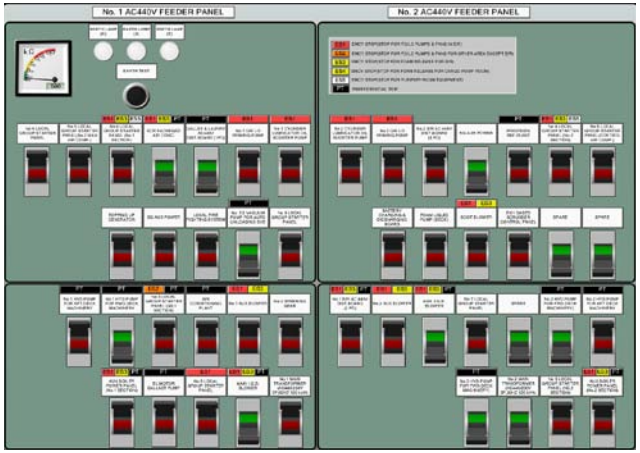


No. 1 AC440V FEEDER PANEL contains:

- Insulation monitor;
- **EARTH LAMP (R), EARTH LAMP (S), EARTH LAMP (T)** lamps; normally the lamps are illuminated; in the circumstances, when insulation is low on a phase/phases, the respective lamp light fades, or lights down; insulation monitor then points to the yellow or red sector on the scale;
- **EARTH TEST** button for testing if **R**, **S**, **T** lamps are burned out; click the button, all lamps should illuminate;
- A set of circuit breakers to power 440 V consumers.

5.7.1. No. 1 AC 440V Feeder Panel Consumers

- No 6 LOCAL GROUP STARTER PANEL
- No 5 LOCAL GROUP STARTER PANEL (No.2 MAIN AIR COMPRESSOR)
- No 4 LOCAL GROUP STARTER PANEL (No.1 SECTION)
- ECR PACKEGED AIR COND.
- GALLEY & LAUNDRY AC440V DIST.BOARD (1 PD)
- No 1 G/E L.O. PRIMING PUMP



- No 1 CYLINDER LUBRICATOR OIL BOOSTER PUMP
- TOPPING UP GENERATOR
- SG AUX POWER
- LOCAL FIRE FIGHTING SYSTEM
- No 1/2 VACUUM PUMP FOR AUTO UNLOADING SYS
- No 9 LOCAL GROUP STARTER PANEL
- No 1 HYD. PUMP FOR AFT. DECK MACHINERY
- No 1 HYD. PUMP FOR FWD. DECK MACHINERY
- No 3 LOCAL GROUP STARTER PANEL (No.1 SECTION)
- AIR CONDITIONING PLANT
- No.1 AUX. BLOWER
- No.2 STEERING GEAR
- AUX BOILER POWER PANEL (No.1 SECTION)
- EL. MOTOR BALLAST PUMP
- No 8 LOCAL GROUP STARTER PANEL
- MAIN I.G.S. BLOWER
- No. 1 MAIN TRANSFORMER (AC440/230V 3P, 60HZ, 120 kVA)

5.7.2. No. 2 AC 440V Feeder Panel Consumers

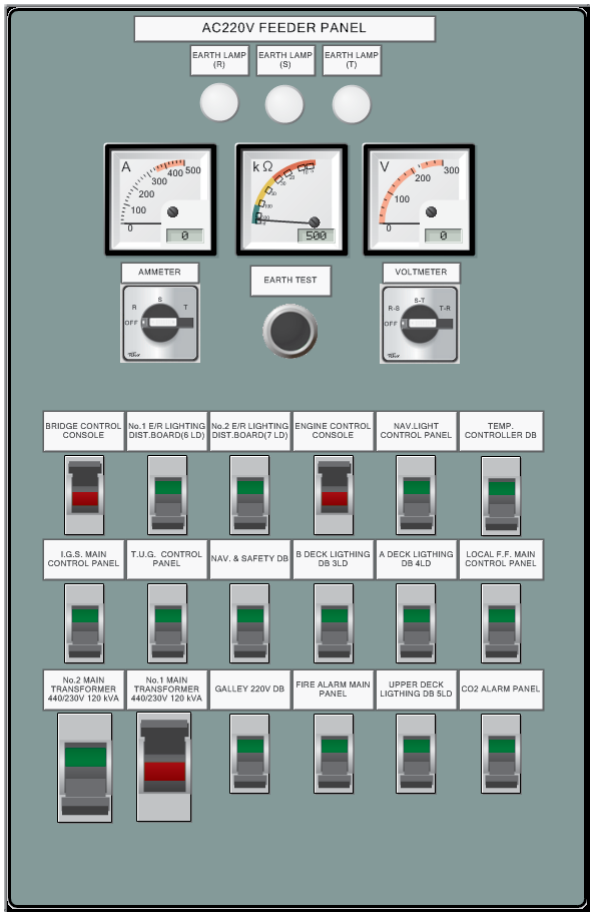
- No 2 CYLINDER LUBRICATOR OIL BOOSTER PUMP
- No 2 G/E L.O. PRIMING PUMP
- No.2 E/R AC440V DIST.BOARD (3 PD)
- SG AUX POWER
- PROVISION REF. PLANT
- No 4 LOCAL GROUP STARTER PANEL (No.2 SECTION)
- BATTERY CHARGING & DISCHARGING BOARD
- FOAM LIQUID PUMP (DECK)
- SOOT BLOWER
- HPU FOR VALVE REMOTE CONTROL SYS
- No.1 E/R AC440V DIST.BOARD (2 PD)
- No.2 AUX. BLOWER
- AUX. I.G.S. BLOWER
- No 7 LOCAL GROUP STARTER PANEL
- No 2 HYD. PUMP FOR FWD. DECK MACHINERY
- No 2 HYD. PUMP FOR AFT. DECK MACHINERY
- No 3 HYD. PUMP FOR FWD. DECK MACHINERY
- No. 2 MAIN TRANSFORMER (AC440/230V 3P, 60HZ, 120 kVA)
- No 3 LOCAL GROUP STARTER PANEL (No.2 SECTION)
- AUX BOILER POWER PANEL (No.2 SECTION)

5.8. MSB Feeder Panel 220 V

Click the menu item **MSB 220v Feeder** of the page **MSB** to open the **AC220v FEEDER PANEL** with the circuit breakers of the MSB 220 V consumers.

The panel contains:

- **EARTH LAMP (R)**, **EARTH LAMP (S)**, **EARTH LAMP (T)** lamps; normally the lamps are illuminated; in the circumstances, when insulation is low on a phase/phases, the respective lamp light fades, or lights down; insulation monitor then points to the yellow or red sector on the scale;
- Ammeter gauge and four-position switch to select the measurement phase between OFF/R/S/T;
- Insulation monitor;
- Voltmeter gauge and four-position switch to select the measurement phase between OFF/R-S/S-T/T-R;
- **EARTH TEST** button for testing if **R**, **S**, **T** lamps are burned out; click the button, all lamps should illuminate;
- A set of circuit breakers to power 220 V consumers.



5.8.1. MSB 220V Feeder Panel Consumers

- BRIDGE CONTROL CONSOLE
- No. 1 E/R LIGHTING DIST. BOARD (6 LD)
- No. 2 E/R LIGHTING DIST. BOARD (7 LD)
- ENGINE CONTROL CONSOLE
- NAV. LIGHT CONTROL PANEL
- TEMP. CONTROLLER DB
- I.G.S. MAIN CONTROL PANEL
- T.U.G. CONTROL PANEL
- NAV. & SAFETY DB
- B DECK LIGHTING DB 3LD
- A DECK LIGHTING DB 4LD
- LOCAL F.F. MAIN CONTROL PANEL
- No. 2 MAIN TRANSFORMER (AC440/230V 120 kVA)
- No. 1 MAIN TRANSFORMER (AC440/230V 120 kVA)
- GALLEY 220V DB
- FIRE ALARM MAIN PANEL
- UPPER DECK LIGHTING DB 5LD
- CO2 ALARM PANEL

5.9. Local Group Starter Panels

In the simulator the following LGSPs are modeled:

- No. 3 LGSP – menu item **GSP 3** of the page **ER4**;
- No. 4 LGSP – menu item **GSP 4** of the page **ER3**;
- No. 5 LGSP – menu item **GSP 5** of the page **ER4**;
- No. 6 LGSP – menu item **GSP 6** of the page **ER3**;
- No. 7 LGSP – menu item **GSP 7** of the page **ER1**;
- No. 8 LGSP – menu item **GSP 8** of the page **ER1**;
- No. 9 LGSP – menu item **GSP 9** of the page **ER4**.

5.9.1. GSP 3

No. 3 GROUP STARTER PANEL contains panels:

- Section 1:
  - PROVISION REF. FAN
  - GALLEY PACKED AIR COND.
  - GALLEY SUPPLY FAN
  - DRY PROVISION STORE EXH. FAN
  - GARBAGE STORE EXH. FAN
  - GALLEY & PANTRY EXH. FAN
  - SANITARY SPACE EXH. FAN
  - PAINT STORE EXH. FAN
  - No. 1/2 AIR HANDL. UNIT FAN
- Section 2:
  - LIFE/RESCUE BOAT DAVIT & WINCH
  - PROVISION CRANE
  - HOSE HANDLING CRANE

Switch power 440V for **No. 3 GROUP STARTER PANEL**:

- on **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 3 LOCAL GROUP STARTER PANEL (No.1 SECTION)** circuit breaker;
- on **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 3 LOCAL GROUP STARTER PANEL (No.2 SECTION)** circuit breaker.

5.9.2. GSP 4

No. 4 GROUP STARTER PANEL contains panels:

- Section 1:
  - No. 1 H.F.O. PURIFIER
  - No. 1 H.F.O. PURIFIER FEED PUMP
  - No. 1 MAIN LO PURIFIER
  - No. 1 MAIN LO PURIFIER FEED PUMP
  - G/E F.O. AUTO FILTER
  - M/E F.O. AUTO FILTER
- Section 2:
  - No. 2 H.F.O. PURIFIER
  - No. 2 H.F.O. PURIFIER FEED PUMP
  - No. 2 MAIN L.O. PURIFIER
  - No. 2 MAIN LO PURIFIER FEED PUMP
  - PURIFIER ROOM EXH. FAN
- Section 3:
  - G/E D.O. PUMP
  - M/E L.O. AUTO FILTER

Switch power 440V for **No.4 GROUP STARTER PANEL:**

- on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL (No.1 SECTION)** circuit breaker;
- on **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL (No.2 SECTION)** circuit breaker;
- on **EM'CY AC440v FEEDER PANEL** of ESB (use menu item **ESB Consumers** of the page **EmG**) by **No. 4 LGSP (GE MDO PUMP)** circuit breaker.

5.9.3. GSP 5

No. 5 GROUP STARTER PANEL contains panels:

- No.1 MAIN AIR COMPRESSOR
- No.2 MAIN AIR COMPRESSOR
- CONTROL AIR COMPRESSOR

Switch power 440 V for **No.5 GROUP STARTER PANEL**:

- on **EM'CY AC440v FEEDER PANEL** of ESB (use menu item **ESB Consumers** of the page **EmG**) by **No. 5 LGSP (No 1 MAIN AIR COMPRESSOR)** circuit breaker;
- on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 5 LOCAL GROUP STARTER PANEL (No 2 MAIN AIR COMP.)** circuit breaker;
- on **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 5 LOCAL GROUP STARTER PANEL (CONTROL AIR COMP.)** circuit breaker.

5.9.4. GSP 6

No. 6 GROUP STARTER PANEL contains panels:

- CALORIFIER
- DRINK F.W. HYD. PUMP
- No. 1 HOT WATER CIRC. PUMP
- No. 2 HOT WATER CIRC. PUMP
- No. 1 FRESH WATER CIRC. PUMP
- No. 2 FRESH WATER CIRC. PUMP

Switch power 440V for the **GSP 6** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 6 LOCAL GROUP STARTER PANEL** circuit breaker.

5.9.5. GSP 7

No. 7 GROUP STARTER PANEL contains panels:

- OILY WATER SEPARATOR
- M/E TURNING GEAR
- IGS SCRUBBER C.S.W. PUMP
- E/R BILGE PUMP
- SLUDGE PUMP

Switch the power supply 440 V for the **No. 7 GROUP STARTER PANEL** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No 7 LOCAL GROUP STARTER PANEL** circuit breaker.

5.9.6. GSP 8

No. 8 GROUP STARTER PANEL contains panels:

- F.W.G. DISTILLATE PUMP
- M/E AIR COOLER CHEM. CLEAN PUMP
- F.W.G. EJECTOR PUMP

Switch power 440V for the **No. 8 GROUP STARTER PANEL** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 8 LOCAL GROUP STARTER PANEL** circuit breaker.

5.9.7. GSP 9

No. 9 GROUP STARTER PANEL contains panels:

- FWD ICCP POWER UNIT
- BOSUN STORE SUPPLY FAN
- FWD TRANSFORMER

Switch power 440V for the **No. 9 GROUP STARTER PANEL** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 9 LOCAL GROUP STARTER PANEL** circuit breaker.

5.10. Power Distribution Boards 440V

In the simulator the following PDBs are modeled:

- No. 2 PDB – menu item **PD DB 2** of the page **ER2**;
- No. 3 PDB – menu item **PD DB 3** of the page **ER4**.

2 PD E/R 440V DIST. BOARD consumers:

- DRILLING MACHINE
- GRINDING MACHINE
- AFT ICCP POWER SUPPLY UNIT
- ELECTRIC ARC WELDER
- LATHE
- WORKSHOP PACKAGED AIR COND.
- WELDING SPACE EXH. FAN
- TURBOGEN CONTROL PANEL
- No 1 C.O.P.T. CONTROL PANEL
- No 2 C.O.P.T. CONTROL PANEL
- No 3 C.O.P.T. CONTROL PANEL
- W.B.P.T. CONTROL PANEL

Switch power 440V for the **2 PD E/R 440V DIST. BOARD** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 1 E/R AC 440V DIST.BOARD (2 PD)** circuit breaker.

3 PD E/R 440V DIST. BOARD consumers:

- INCINERATOR
- WASTE OIL CONTROL PANEL
- SEWAGE TREATMENT PLANT
- O.D.M.S. PUMP
- ENGINE ROOM CRANE
- VACUUM TOILET UNIT

Switch power 440V for the **3 PD E/R 440V DIST. BOARD** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 2 E/R AC 440V DIST.BOARD (3 PD)** circuit breaker.

6. Emergency Power Supply

6.1. General Description

During normal operation a bus tie connects the ESB with the MSB, power from the MSB is fed through the ESB to supply essential services (refer to Main Circuit Diagram). The bus tie is fitted with two ACB: EMERGENCY SWITCHBOARD manual control from the MSB side (this ACB is normally closed), and BUS TIE TO MSB control from the ESB side. BUS TIE TO MSB breaker closes automatically when MSB is powered and EMERGENCY SWITCHBOARD is closed. The EMERGENCY SWITCHBOARD breaker trips when ACB EMCY GEN is closed.

In the event of a power failure from the MSB, the ESB is disconnected from the MSB. In Automatic control mode the Emergency DG starts under automated control, runs the EMCY GEN up to a state ready to be loaded, and then closes the ACB EMCY GEN to instigate the source changeover to continue supplying the essential services. The ESB is also configured to provide the ability for this process to be performed manually if necessary.

Emergency DG is switched off automatically when/if the MSB is powered, taking the following steps:

- Opening ACB EMCY GEN.
- Closing the EMERGENCY SWITCHBOARD breaker.
- Stopping the Emergency DG.

The BUS TIE TO MSB breaker protection is identical to the protection of the MSB–ESB BUS TIE breaker.

The ACB EMCY GEN protection is identical to the protection of the main generator CB (refer to GCB Protection).

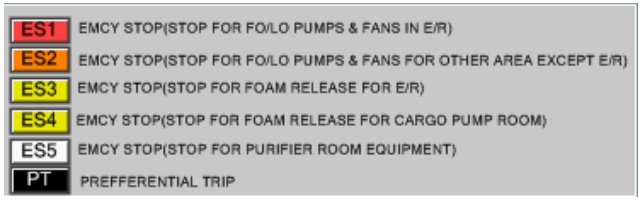
The controls of ACB EMCY GEN are located on the ESB panel (refer to Emergency Switchboard).

The emergency generator is, normally, intended for fully automatic operation. Manual operations described in this section are therefore primarily for inspection and maintenance purposes as well as giving general idea what can be done in the event of an automatic control circuit failure.

6.2. EMCY and Preferential Tripping Legend

Tripping of non-essential consumers is done according to the stages presented on the figure.

Circuit breakers on PDBs and Feeder panels that are marked by tripping labels will be tripped in the reverse order of the given table: i.e. **PT2** will be the first and **ES1** will be the last to trip.



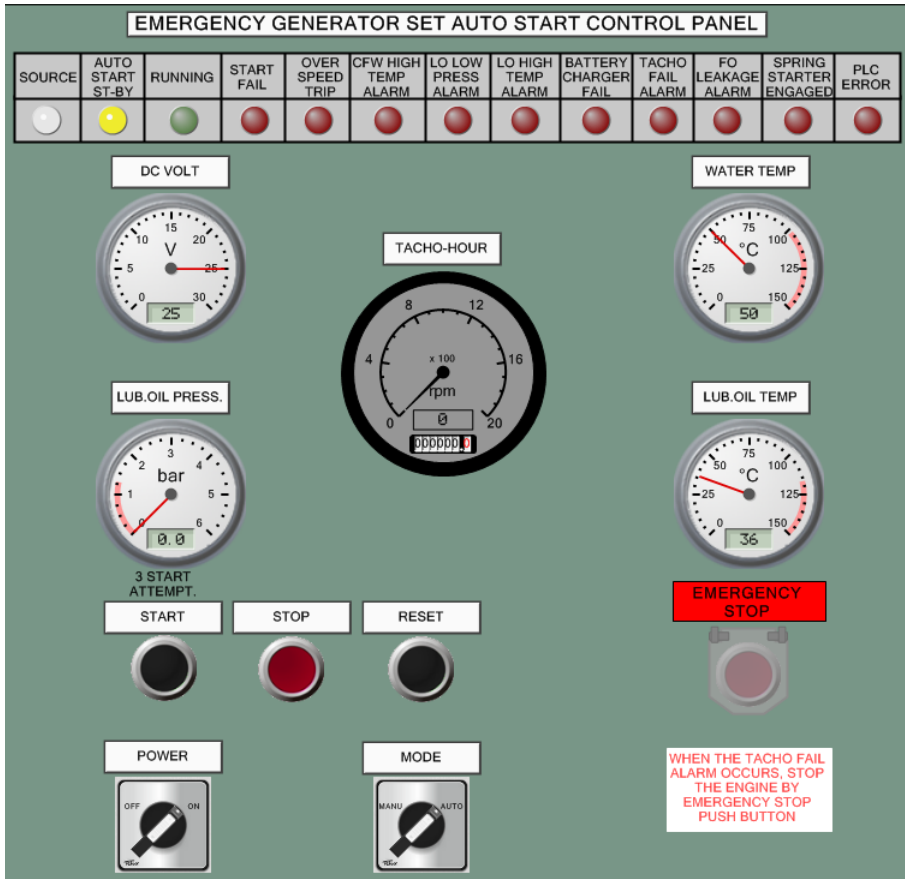
7. EMCY Power Supply Control in the Simulator

7.1. EMCY Generator Engine LOP

Click on the menu item **EM'CY GE LOP** of the page **EmG** to open the display with two panels.

The **EMERGENCY GENERATOR SET AUTO START CONTROL PANEL** contains:

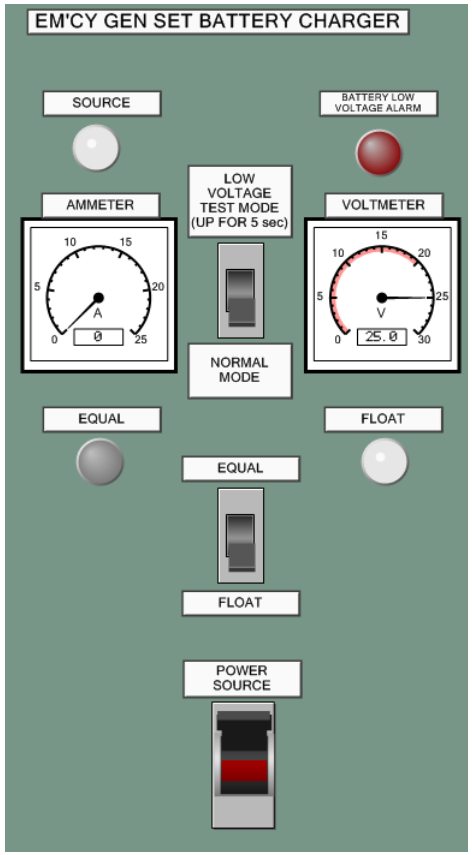
- State and alarm indicator lamps, which illuminate when:
  - **SOURCE** – power supply from **EMCY GEN SET BATTERY CHARGER** exists, and **POWER** switch is ON;
  - **AUTO START ST-BY** – generator engine;
  - **RUNNING** – generator engine is running;
  - **START FAIL** – generator engine has not started;
  - **OVER SPEED TRIP** – engine speed > 2160 rpm;
  - **CFW HIGH TEMP ALARM** – temperature > 102 °C;
  - **LO LOW PRESSURE ALARM** – pressure < 1.27 bar;
  - **LO HIGH TEMP ALARM** – temperature > 117 °C;
  - **BATTERY CHARGER FAIL** – power 220 V supply failure of **EMCY GEN SET BATTERY CHARGER**;
  - **TACHO FAIL ALARM** – fault from instructor;
  - **FO LEAKAGE ALARM** – fault from instructor;
  - **SPRING STARTER ENGAGED** – ACB;
  - **PLC ERROR** – controller error.
- **DC VOLT** – battery voltage meter;
- **TACHO-HOUR** – combined gauge;
- **WATER TEMP** – cooling fresh water temperature;
- **LUB. OIL PRESS**, **LUB. OIL TEMP** – gauges to monitor the LO pressure and temperature;



- **START**, **STOP**, **RESET** buttons to operate the EMCY engine in MANU mode;
- **EMERGENCY STOP** button with a protection cover; click the button once to open the cover; click the opened button to immediately stop the engine; the attention label below contains the instructions;
- **POWER** – two-position switch to switch power **OFF/ON**;
- **MODE** – two-position switch to select the **MANU** (manual) or **AUTO** control mode.

The **EM'CY GEN SET BATTERY CHARGER** panel contains:

- **SOURCE** – indicator, which illuminates when the charger is powered;
- **BATTERY LOW VOLTAGE ALARM** – indicator, which illuminates when voltage < 20 V;
- **AMMETER** – gauge to monitor the charging current;
- LOW VOLTAGE TEST MODE (UP FOR 5 sec.) / NORMAL MODE – switch is not modeled;
- **VOLTMETER** – gauge to monitor the battery voltage;
- **EQUAL, FLOAT** – indicators which illuminate when the respective charger mode is in operation;
- **EQUAL / FLOAT** – switch to select charging mode (see the description in ***the paragraph 7.4 on page 112***);
- **POWER SOURCE** – switch; power is ON when the switch is in up position.

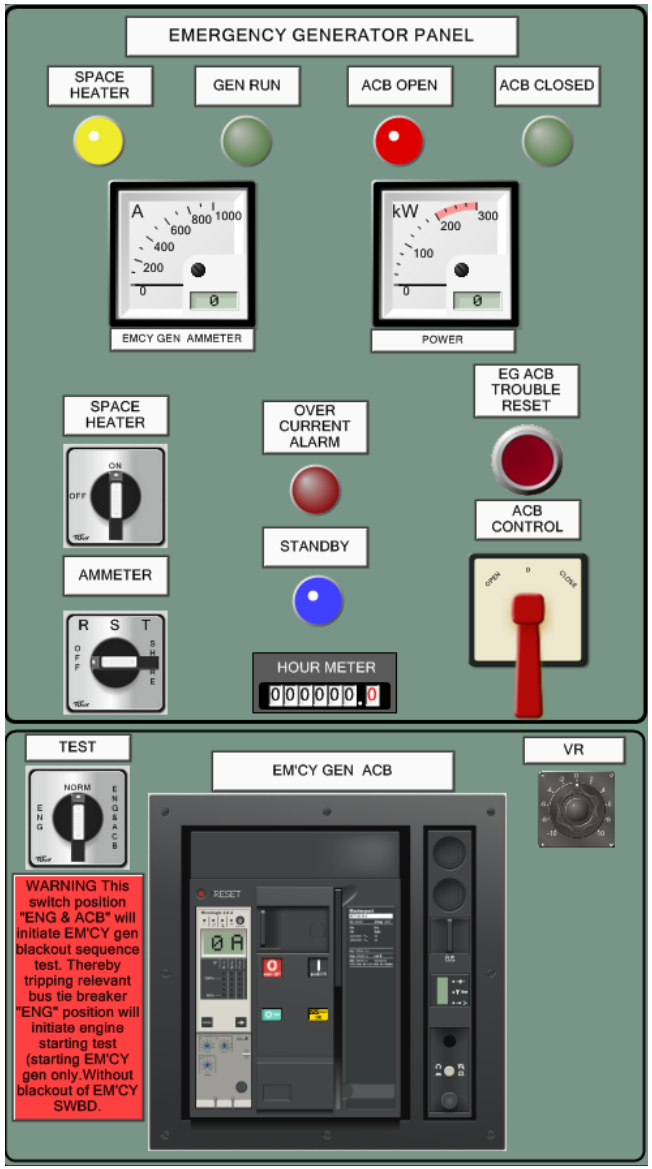


7.2. EMCY Generator & Shore Connection Panels

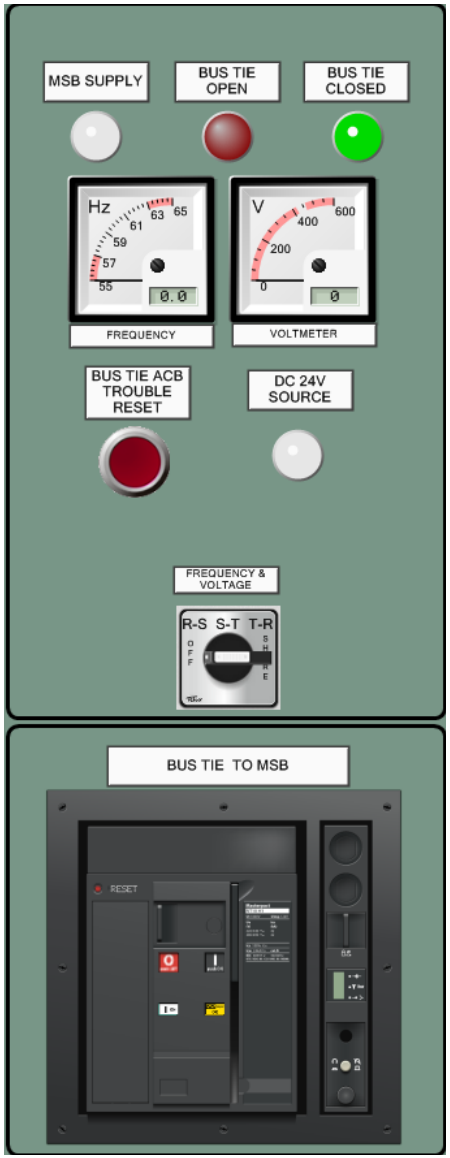
Click on the menu item **ESB Generator & Shore Panels** of the page **EmG** to open the display with three panels.

The left panel of the **EMERGENCY GENERATOR PANEL** contains:

- **SPACE HEATER** – indicator lamp, which illuminates when the heater is on to keep the set in ready state;
- **GEN RUN**, **ACB OPEN**, **ACB CLOSED** – indicator lamps, which illuminate when the respective condition is active;
- **EM'CY GEN AMMETER** gauge;
- **POWER** gauge;
- **SPACE HEATER** – switch to switch the heater OFF/ON;
- **AMMETER** – five-position switch to select between:
  - **OFF** – gauge is off;
  - **R / S / T** – generator phases current;
  - **SHORE** – shore supply current.
- **OVERCURRENT ALARM** – indicator lamp;
- **STANDBY** – indicator lamp, which illuminates when the generator is in stand-by mode;
- **HOUR METER**;;
- **EG ACB TROUBLE RESET** – button;
- **ACB CONTROL** – switch handle to manually **OPEN** or **CLOSE** the generator ACB;



- **TEST** – switch to select the test mode between:
  - **ENG** – to initiate the engine starting test: starting EMCY gen only without blackout of EMCY SWBD);
  - **NORM** – normal EMG start after blackout;
  - **ENG & ACB** – to initiate the EMCY Gen blackout sequence with ESB–MSB disconnection.
- **EM'CY GEN ACB** – generator ACB; see the operating description in *the paragraph 4.2.2 on page 100*.
- **VR %** – voltage regulator; turn the knob to manually adjust generator voltage.



The right panel of the **EMERGENCY GENERATOR PANEL** contains:

- **MSB SUPPLY, BUS TIE OPEN, BUS TIE CLOSED, DC 24V SOURCE** – indicator lamps, which illuminate when the respective condition is active;
- **FREQUENCY** and **VOLTMETER** – gauges;
- **FREQUENCY & VOLTAGE** – five-position mode selector switch to select between:
  - **OFF** – gauges are off;
  - **R-S / S-T / T-R** – gauges display generator parameters;
  - **SHORE** – gauges display shore supply parameters.
- **BUS TIE ACB TROUBLE RESET** button;

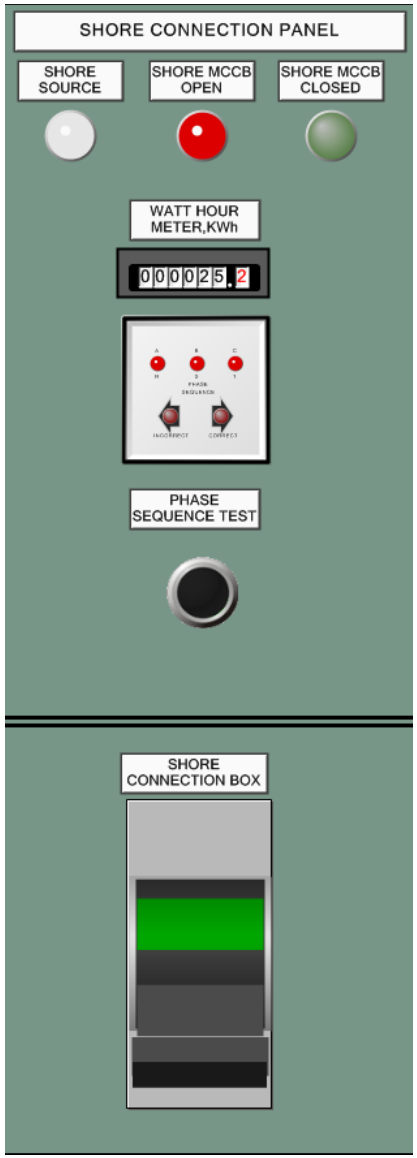
The **SHORE CONNECTION PANEL** contains:

- **SHORE SOURCE, SHORE MCCB OPEN, SHORE MCCB CLOSED** – indicator lamps, which illuminate when the respective condition is active;
- **WATT HOURS METER, KWh** gauge;
- The gauge to control the shore connection phase sequence:
  - **PHASE SEQUENCE** LED indicators of shore supply voltage on three phases; indicators are illuminated if power is available;
  - **INCORRECT** LED indicator is illuminated if phase sequence is incorrect;
  - **CORRECT** LED indicator is illuminated if phase sequence is correct.

Note: Indicators are illuminated when Instructor introduces the faults: 'Shore Supply Wrong Phase Sequence', 'Shore Supply Phase Break'.

- **PHASE SEQUENCE TEST** – button; click the button to operate the phase sequence gauge;
- **SHORE CONNECTION BOX** – automatic power switch 500 A.

Attention! Generator ACBs closing is blocked when shore supply is ON.



7.3. ESB Consumers & EM'CY GSP

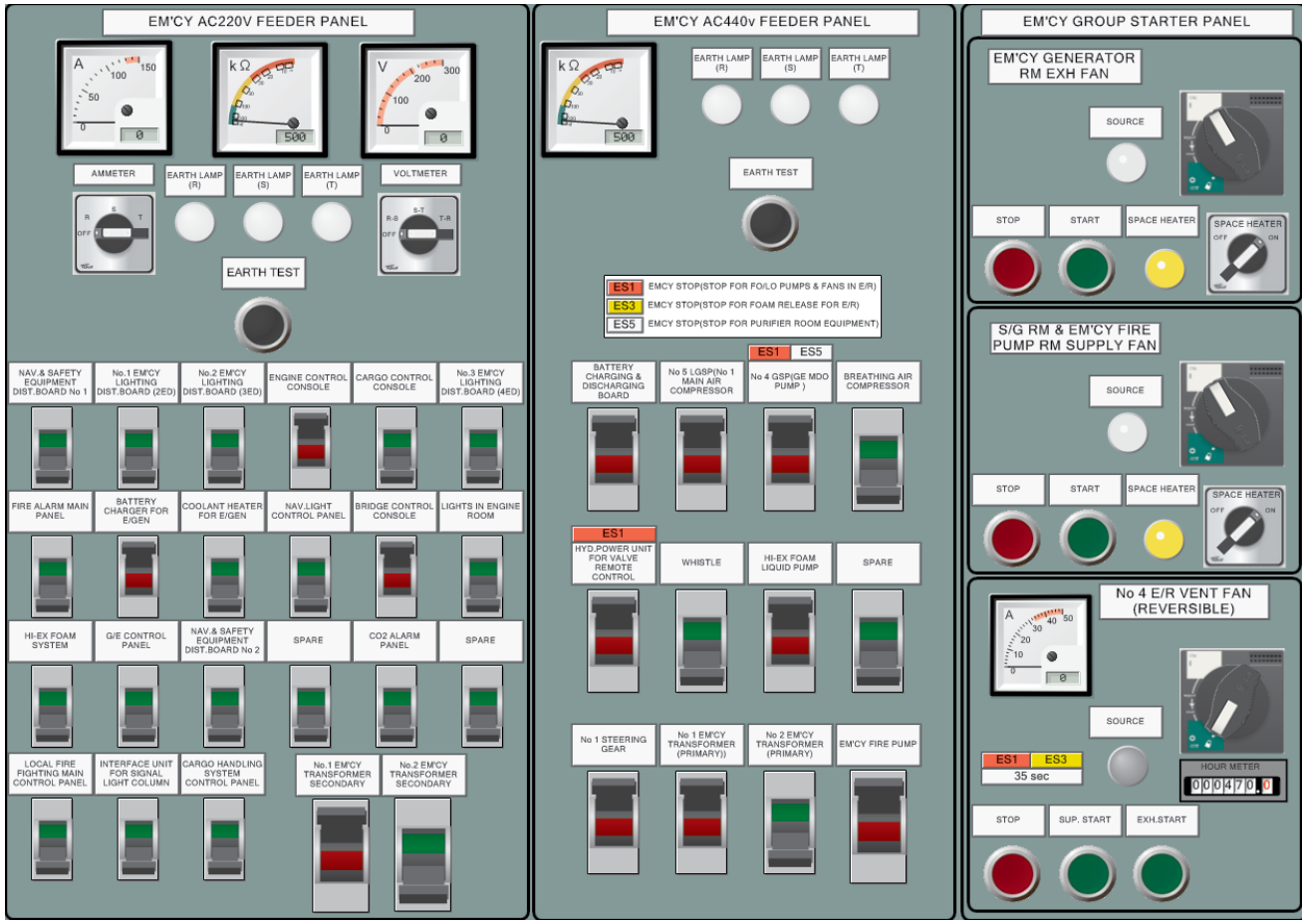
Click on the menu item **ESB consumers** of the page **EmG** to open the display with three panels.

The **AC220V FEEDER PANEL** contains:

- **AMMETER** gauge and four-position switch to select the measurement phase between OFF/R/S/T;
- Insulation monitor;
- **EARTH LAMP (R), EARTH LAMP (S), EARTH LAMP (T)** lamps; normally the lamps are illuminated; in the circumstances, when insulation is low on a phase/phases, the respective lamp light fades, or lights down; insulation monitor then points to the yellow or red sector on the scale;
- **VOLTMETER** gauge and four-position switch to select the measurement phase between OFF/R-S/S-T/T-R;
- **No.1 EM'CY TRANSFORMER** and **No.2 EM'CY TRANSFORMER** circuit breakers **225 A** to power transformers;
- **EARTH TEST** button for testing if **EARTH LAMP(s)** are burned out; click the button, all lamps should illuminate;
- A set of circuit breakers to power 220 V consumers.

The **AC440V FEEDER PANEL** contains:

- Insulation monitor;
- **EARTH LAMP (R), EARTH LAMP (S), EARTH LAMP (T)** lamps; normally the lamps are illuminated; in the circumstances, when insulation is low on a phase/phases, the respective lamp light fades, or lights down; insulation monitor then points to the yellow or red sector on the scale;
- **EARTH TEST** button for testing if **EARTH LAMP(s)** are burned out; press the button, all lamps should illuminate;
- Emergency stop legend;
- A set of circuit breakers to power 440 V consumers.



The **EM'CY GROUP STARTER PANEL** contains panels for:

- **EM'CY GENERATOR RM EXH. FAN** – starts automatically when EMG starts;
- **S/G RM & EM'CY FIRE PUMP RM SUPPLY FAN**;
- **No 4 E/R VENT FAN (REVERSIBLE)**; the buttons:
  - **SUP. START** is used to operate supply fan;
  - **EXH. START** is used to operate exhaust fan.

Starter panels description is given in Introduction, *the section 5 on page 102*.

7.3.1. ESB 440V Feeder Panel Consumers

- BATTERY CHARGING & DISCHARGING BOARD
- No 5 LGSP (No 1 MAIN AIR COMPRESSOR)
- No 4 GSP (GE MDO PUMP)
- BREATHING AIR COMPRESSOR
- HYD. POWER UNIT FOR VALVE REMOTE CONTROL
- WHISTLE
- HI-EX FOAM LIQUID PUMP
- No 1 STEERING GEAR
- No 1 EM'CY TRANSFORMER (PRIMARY)
- No 2 EM'CY TRANSFORMER (PRIMARY)
- EM'CY FIRE PUMP

7.3.2. ESB 220V Feeder Panel Consumers

- NAV. & SAFETY EQUIPMENT DIST. BOARD No 1
- No.1 EM'CY LIGHTING DIST. BOARD (2ED)
- No.2 EM'CY LIGHTING DIST. BOARD (3ED)
- ENGINE CONTROL CONSOLE
- CARGO CONTROL CONSOLE
- No.3 EM'CY LIGHTING DIST. BOARD (4ED)
- FIRE ALARM MAIN PANEL
- BATTERY CHARGER FOR E/GEN
- COOLANT HEATER FOR E/GEN
- NAV. LIGHT CONTROL PANEL
- BRIDGE CONTROL CONSOLE
- LIGHTS IN ENGINE ROOM
- HI-EX FOAM SYSTEM
- G/E CONTROL PANEL
- NAV. & SAFETY EQUIPMENT DIST. BOARD No 2
- CO2 ALARM PANEL
- LOCAL FIRE FIGHTING MAIN CONTROL PANEL
- INTERFACE UNIT FOR SIGNAL LIGHT COLUMN
- CARGO HANDLING SYSTEM CONTROL PANEL
- No.1 EM'CY TRANSFORMER SECONDARY
- No.2 EM'CY TRANSFORMER SECONDARY

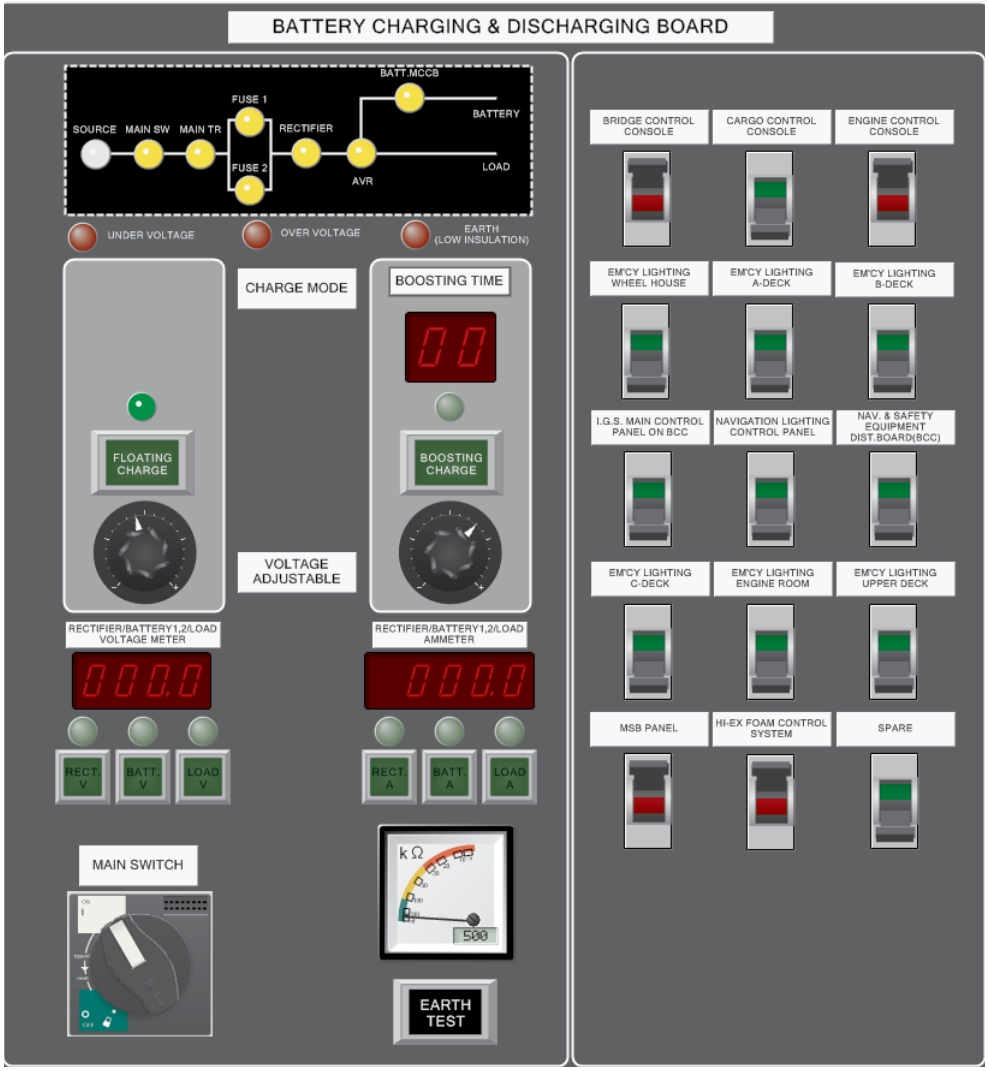
7.4. Battery Charging & Discharging Board

Click on the menu item **Battery Charger & 24v DB** of the page **EmG** to open the display with two panels.

The left panel contains:

- The diagram of the charging/discharging process with the indicator lamps, which illuminate corresponding to the current circuit;
- **UNDER VOLTAGE**, **OVER VOLTAGE**, **EARTH (LOW INSULATION)** – alarm indicator lamps, which illuminate when respective condition occurs;
- **CHARGE MODE** – two groups of controls to operate in floating or boosting modes:
  - **FLOATING CHARGE** – button and lamp; click to start charging in floating mode; use the potentiometer to adjust the battery charger voltage;
  - **BOOSTING TIME** – the value displays the boosting mode time countdown; when time =0 charging is automatically continued in floating mode;
  - **BOOSTING CHARGE** – button and lamp; click to start charging in boosting mode; use the potentiometer to adjust the battery charger voltage;

  In each of the charge modes the following controls are used:
  - **VOLTAGE ADJUSTABLE** – potentiometer;
  - **RECTIFIER/BATTERY 1,2/LOAD VOLTAGE METER** and **RECTIFIER/BATTERY 1,2/LOAD AMMETER** – digital indicators;
  - **RECT. V**, **BATT. V**, **LOAD V** – button and lamp; click a button to measure respective voltage and read the voltmeter;
- **MAIN SWITCH** – circuit breaker to power this board; in **ON** position the rectifier is powering consumers;
- Insulation monitor;
- **EARTH TEST** – button to start the earth test; insulation monitor then indicates 500 kOm.



7.4.1. EMCY 24V DC Consumers

- BRIDGE CONTROL CONSOLE
- CARGO CONTROL CONSOLE
- ENGINE CONTROL CONSOLE
- EM'CY LIGHTING WHEEL HOUSE
- EM'CY LIGHTING A-DECK
- EM'CY LIGHTING B-DECK
- I.G.S. MAIN CONTROL PANEL ON BCC
- NAVIGATION LIGHTING CONTROL PANEL
- NAV & SAFETY EQUIPMENT DIST.BOARD (BCC)
- EM'CY LIGHTING C-DECK
- EM'CY LIGHTING ENGINE ROOM
- EM'CY LIGHTING UPPER DECK
- MSB PANEL
- HI-EX FOAM CONTROL SYSTEM

Chapter 4. Systems and Mechanisms

This chapter contains the description of the simulator tools for training the watch personnel of a tanker ship in skills of correct operating the Tanker LCC Systems and Mechanisms.

Chapter 4. Systems and Mechanisms

This chapter contains:

1. Systems General

1.1. How to Select a Mimic or a Local Operating Panel

The page **SYS** corresponding to the button **SYS** in the bottom bar of the simulator Propulsion console contains a set of displays listed in its drop-down menu. The set of **SYS** displays is designed to provide general information about the systems on the mimic and to simulate local manual control of the systems' elements, such as valves, pumps, etc.

Along with the page **SYS**, more pages are implemented in the simulator, which contain displays modelling local operating (control) panels located in appropriate ship rooms. These pages are accessed by clicking the bottom bar buttons:

- **ER1** (Engine Room 1), **ER2** (Deck 2), **ER3** (Upper Deck), **ER4** (Deck A) – Engine rooms pages;
- **FFR** – Fire fighting room page;
- **SG** – Steering gear room page.

When ME revolution speed reaches critical value, the hull shaking is modeled in the simulator by shaking the ER panels, ECR and BCC consoles.

1.2. Operating SYS Displays

Operating the **SYS** displays requires the general knowledge of the layout and graphical representation of the information on screen including the objects' construction and color. The guidelines are described below.

To zoom in/out he mimic of **SYS** displays in the simulator use the mouse wheel; the mouse cursor should point to the centre of a zoomed area. Press and hold the mouse wheel to drag a zoomed-in mimic for navigation to a required area.

The change of state of units and mechanisms is displayed simultaneously on the **SYS** and **CMS** displays.

Some of the pumps, fans and compressors can be remotely controlled from CMS displays. Local control panels (LOP) can be used for local control of the mechanisms. The valves can be controlled locally from the displays of the **SYS** page.

Digital and color indication is used to display the following parameters on the pipelines of the **SYS** page displays: flows, temperature and pressure.

When the units and mechanisms run, their state (run) indicator body is highlighted by color; otherwise, only the indicator border is highlighted.

Press the **Hints ON /OFF** button on the simulator toolbar to enable the simulator mode, in which a balloon hint appears on the display when the mouse hovers an object:

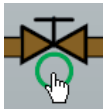
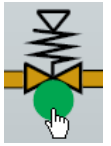
The flow indicators are presented by sight glasses and by arrows; an arrow body is filled by the substance color when the flow is present; no flow is indicated by an empty arrow.

The mouse pointer changes its form from the "arrow" to the "hand" for the objects that are controlled from a **SYS** display.

On the mimics of the page SYS the manually controlled 0–1 valves can be switched by double-click.

The open valves' body is filled in green color; closed valves have a green border only.

The following valves are used on the mimics:

• Locally controlled closed valve	
• Locally controlled open valve	
• Locally controlled 3-way valve	
• Locally and remotely controlled valve (motorized)	
• Locally and remotely controlled quick closing valve; the QCV is remotely closed from the Fire Fighting Room, and opened locally when required	
• Remotely controlled valve (hydraulic), with emergency control by the pump	
• Remotely controlled safety valve	
• Remotely controlled thermostatic valve	
• Thermoregulator 3-way valve	

2. Water Cooling Systems

Water cooling systems include:

- Sea water cooling and service system;
- HT Cooling of the Main Engine,
- LT Cooling system;
- LT & HT Cooling of the Generator Engines.

Water Quality

Only treated fresh water containing approved corrosion inhibitors may be circulated through the engines. The fresh water in the cooling water system of the engine must fulfil the following requirements:

- pH min. 6.5;
- Hardness max. 10 °dH;
- Chlorides max. 80 mg/l;
- Sulfates max. 150 mg/l.

2.1. Sea Water Cooling System

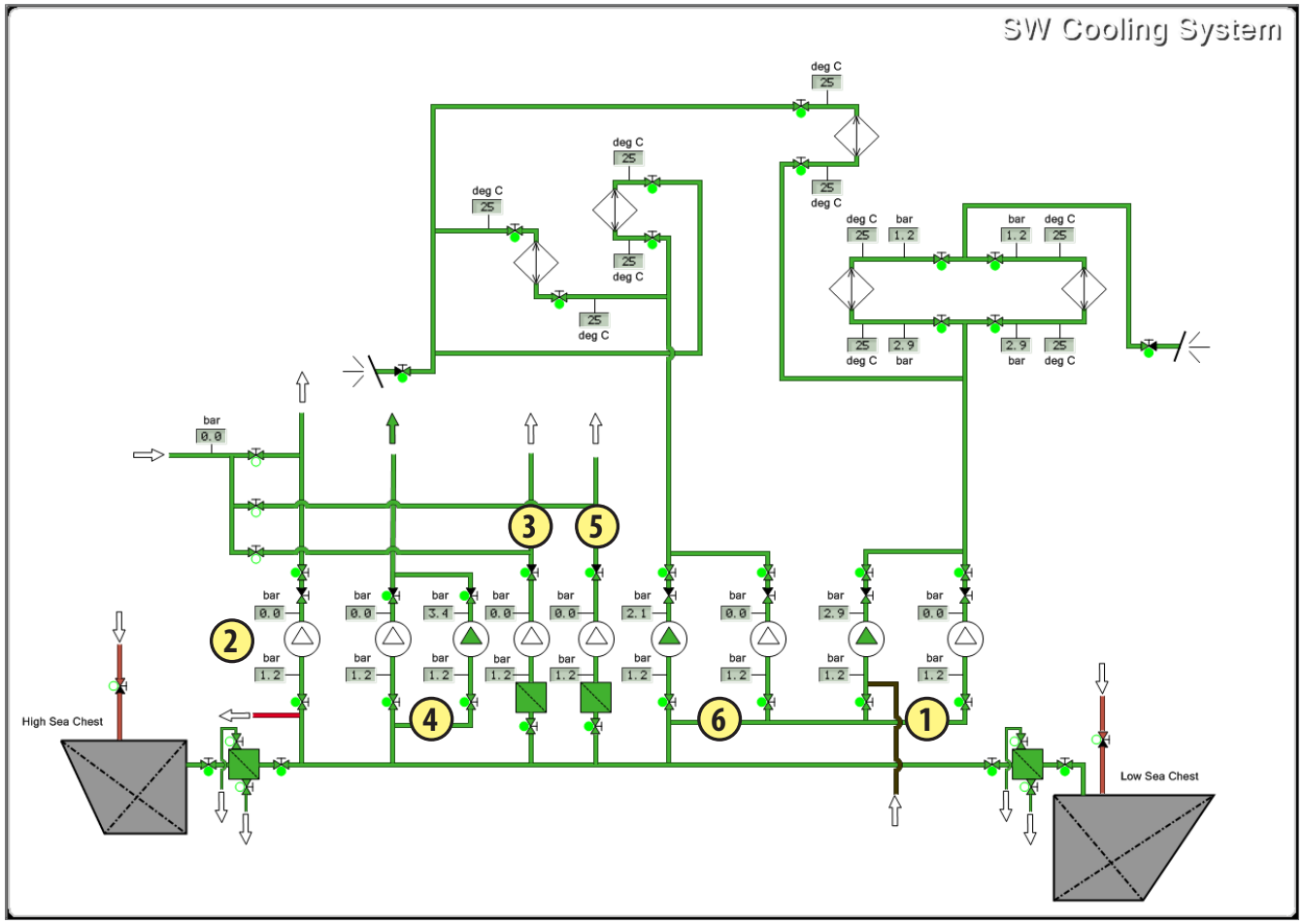
2.1.1. General

The system is designed for suction and transfer of sea water for cooling of the fresh water coolers.

Click on the menu item **SW Cooling System** of the page **SYS** to open the system diagram.

2.1.2. Content

- Pumps:
  - (1) **Main C.S.W. Pump №1 (2)** – 730 m3/h x 1.8 kg/cm2;
  - (2) **IGS Scrubber Cool. W. P/P** – 204 m3/h x 4 kg/cm2;
  - (3) **FW Generator S.W. Ejector Pump** – 61 m3/h x 5kg/cm2;
  - (4) **Deck W. Seal Cool W P/P №1 (2)** – 2.4 m3/h x 4kg/cm2;
  - (5) **TUG SW Cool P/P**;
  - (6) **Vacuum Condenser Cool S.W. P/P №1 (2)** – 1240 m3/h x 1 kg/cm2.
- **High** and **Low Sea Chests** with Marine Growth Protection System (M.G.P.S.) each;
- **Vacuum Condenser** cooling circuit;
- **Steam Drive Air Ejector Condenser** cooling circuit;
- **Atmos. Drain/Dump Condenser** cooling circuit;
- **Central Cooler 1** (2) circuits;
- Pipelines with valves, filters, measuring gauges.



2.1.3. Connections

- From/To Fire, G/S P/P
- To Inert Gas System Scrubber
- Steam Supply
- To IGS Deck Water Seal
- To Fresh Water Generator
- To Topping Up Generator
- EMCY Bilge Suction
- Steam Supply

Note: Click the button to start the movie, which demonstrates the impact of the failure in the SW cooling system circulation on the Main engine operation.

Demonstration

2.1.4. Control

The general description of a starter panel and a push button box controls is given in Introduction ***the section 5 on page 12***.

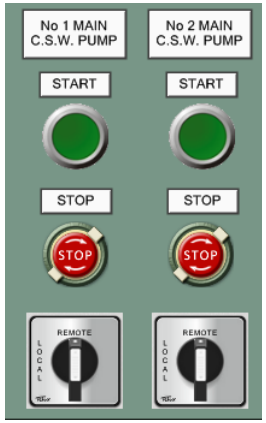
2.1.4.1. Main Cooling SW Pumps

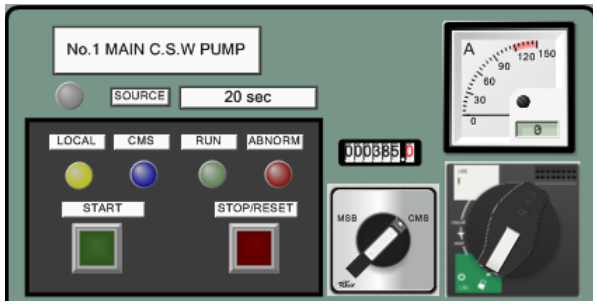
Click the menu item **GBPB-1** of the page **ER1** to open the **No 1 MAIN C.S.W. PUMP** and **No 2 MAIN C.S.W. PUMP** push button boxes.

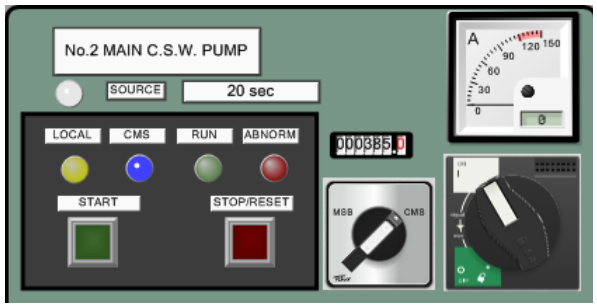
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No. 1 MAIN C.S.W. PUMP** starter panel.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No. 2 MAIN C.S.W. PUMP** starter panel.







2.1.4.2. Topping Up Generator (TUG) SW Pump

Click the menu item **GBPB-1** of the page **ER1** to open the **TOPPING UP GEN. C.S.W. PUMP** push button box.

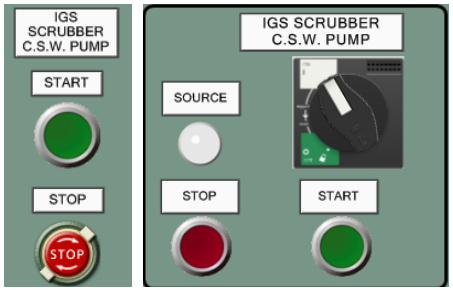
Switch power supply 440V for the TUG pump on **No.1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **TOPPING UP GENERATOR** circuit breaker.

2.1.4.3. IGS Scrubber CSW Pump

Click the menu item **GBPB-2** of the page **ER1** to open the **IGS SCRUBBER C.S.W. PUMP** push button box.

Control is also possible from the **IGS SCRUBBER C.S.W. PUMP** starter panel (to open use menu item **GSP 7** of the page **ER1**).

Switch the power supply 440 V for the **No. 7 GROUP STARTER PANEL** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No 7 LOCAL GROUP STARTER PANEL** circuit breaker.



2.1.4.4. Vacuum Condenser SW Pumps

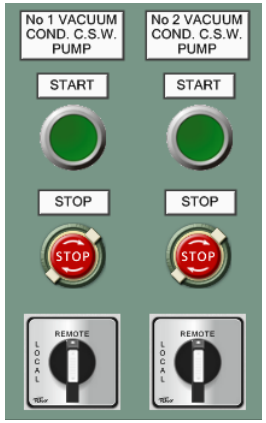
The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

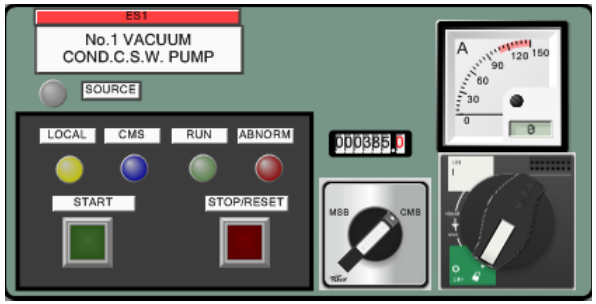
Click the menu item **GBPB-1** of the page **ER1** to open the **No 1 VACUUM COND. C.S.W. PUMP** and **No 2 VACUUM COND. C.S.W. PUMP** push button boxes.

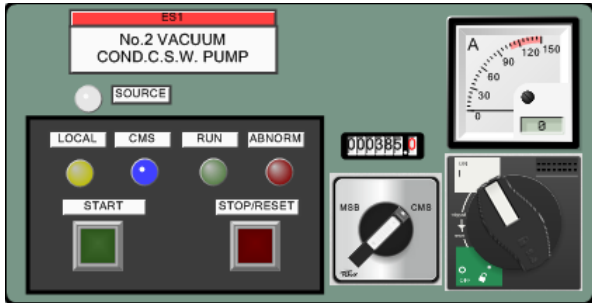
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No. 1 VACUUM COND. C.S.W. PUMP** starter panel.

Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display with the **No 2 VACUUM COND. C.S.W. PUMP** starter panel.







2.1.4.5. Deck Water Seal & Condensate Pumps

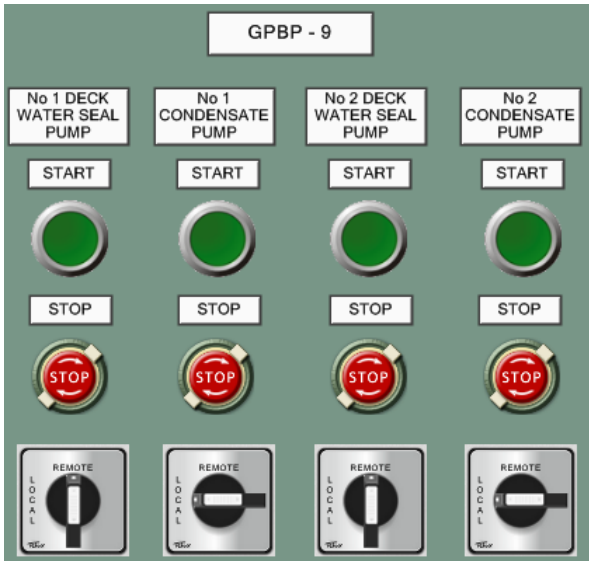
The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

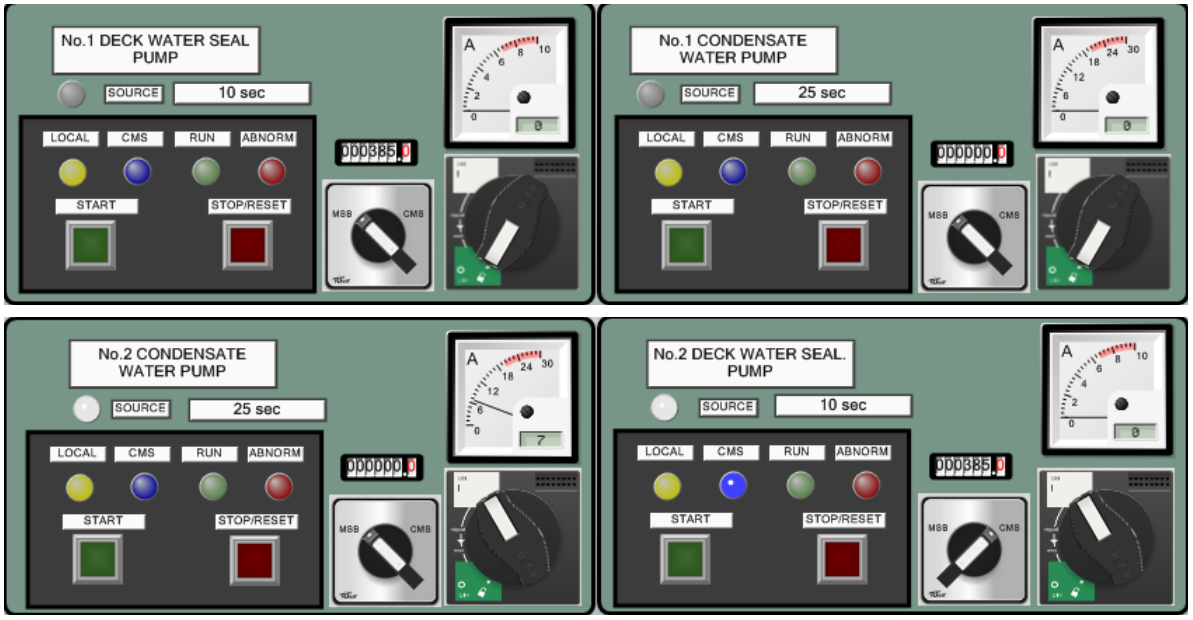
Click the menu item **GBPB-1** of the page **ER1** to open the pumps push button box.

Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with:
No. 1 DECK WATER SEAL PUMP
No. 1 CONDENSATE WATER PUMP starter panels.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with:
No. 2 DECK WATER SEAL PUMP
No. 2 CONDENSATE WATER PUMP starter panels.





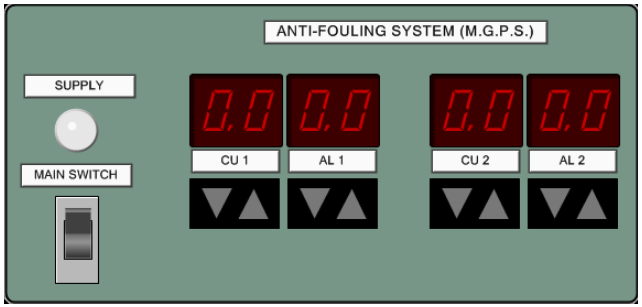
2.1.4.6. Anti-Fouling System

Click the menu item **MGPS LOP** of the page **ER1** to open the panel **ANTI-FOULING SYSTEM (M.G.P.S.)**.

Marine Growth Prevention System **(M.G.P.S.)** panel contains:

- **SUPPLY** indicator lamp;
- **MAIN SWITCH** power circuit breaker;
- Two sets of digital indicators for Sea chest 1 and 2; each set comprises:
  - **CU** – electric current of anode (Cuprum);
  - **AL** – electric current of cathode (Aluminium).

Indicators always display default values (system operation is not modeled). Arrow buttons are not modeled.



2.1.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.12 on page 273*, and in other respective paragraphs.

2.2. ME HT Cooling System

2.2.1. General

The system is designed for cooling cylinder jackets, cylinder heads and the 1st stage of the charge air cooler of the ME.

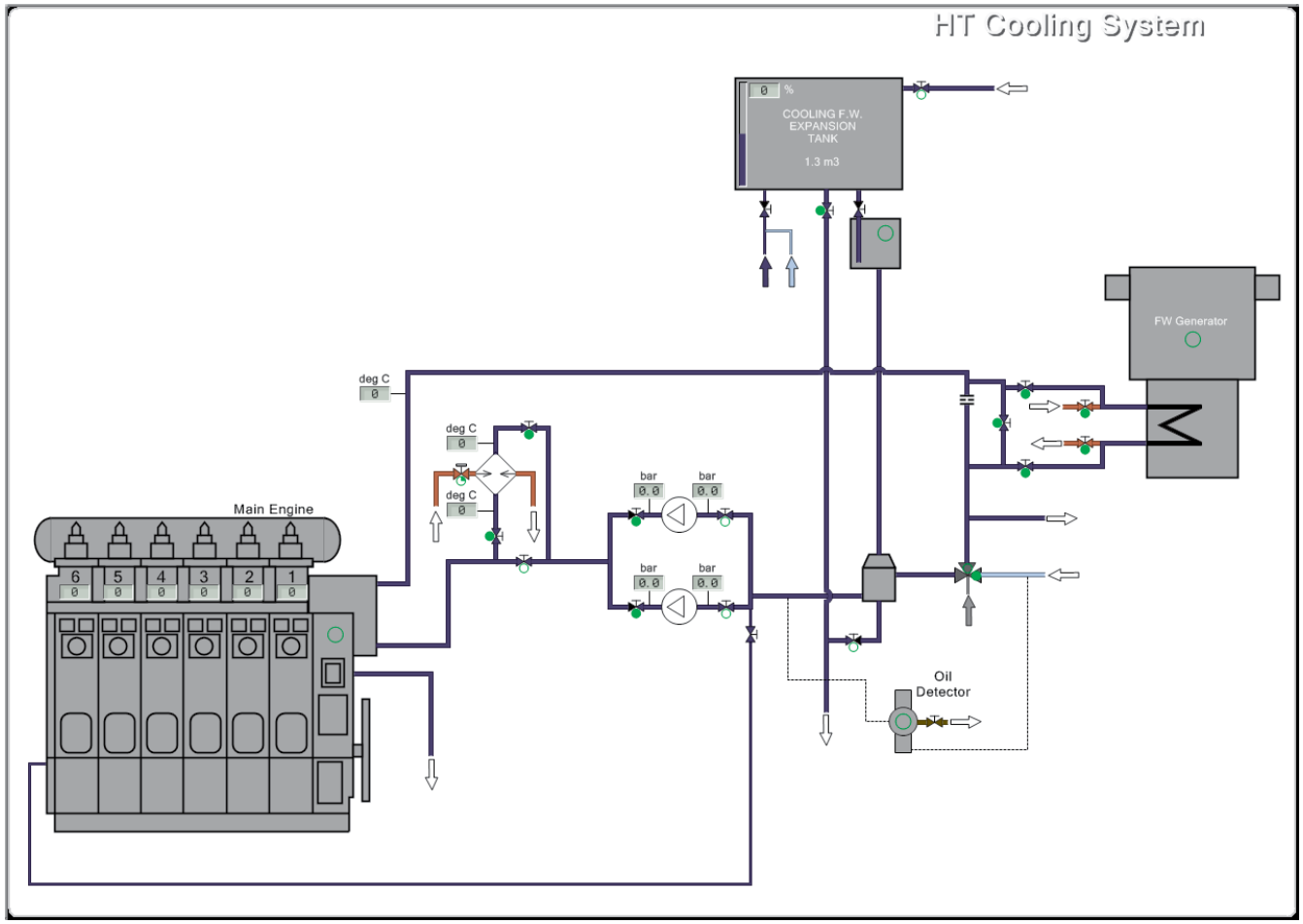
Click on the menu item **HT Cooling System** of the page **SYS** to open the system diagram.

2.2.2. Content

- **Main Engine** with run indicator and digital indicators of temperature on the cylinders' outlet;
- **ME HT JW Pump 1** (**2**) – 115 m3/h x 2.9 kg/cm2;
- **COOLING FW EXPANSION TANK** – 1.3 m3; with **Alarm Device For Air Detector**;
- **ME HT JW Preheater** unit;
- **Oil Detector** unit;
- **FW Generator** with run indicator;
- Pipelines with valves, filters, measuring gauges.

2.2.3. Connections

- From FW Service Sys
- From LT CFW System
- From G/E JFW Air vent
- To/From Steam Service
- To/From LT Cooling System
- To Condensate System
- Compressed Control Air
- To Bilge Well
- Water Drain To Bilge Hold TK



2.2.4. Control

The FW generator is controlled from the panel (see *the paragraph 2.4.4.1 on page 115*).

2.2.4.1. HT Fresh Water Pumps

The general description of a starter panel and a push button box controls is given in Introduction ***the section 5 on page 12***.

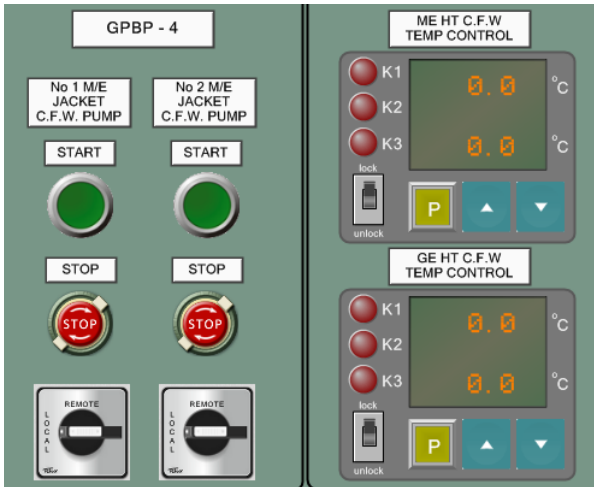
Click the menu item **GPBP-4** of the page **ER3** to open the **No 1 M/E JACKET C.F.W. PUMP** and **No 2 M/E JACKET C.F.W. PUMP** push button boxes, and temperature controllers.

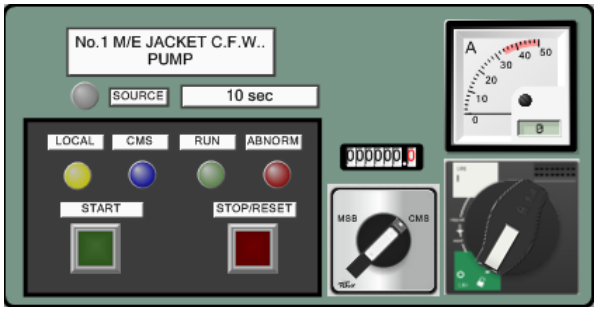
Use **ME HT C.F.W. TEMP CONTROL** and **GE HT C.F.W. TEMP CONTROL** thermocontrollers to set operation of the 3-way HT Thermoregulation Valves in the main engine HT cooling system (see ***the paragraph 2.2.2 on page 123***) and generator engines' cooling system (see ***the paragraph 2.3.2 on page 125***). Thermocontroller operation is described in Introduction, ***the paragraph 5.3 on page 13***.

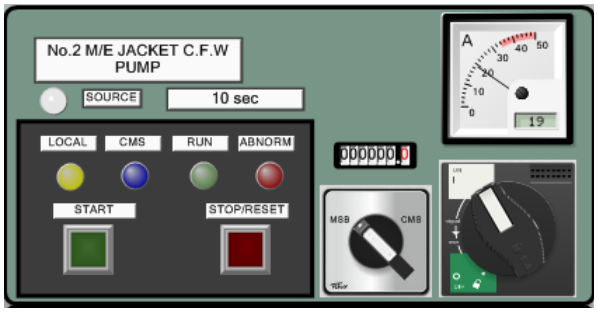
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No. 1 M/E JACKET C.F.W. PUMP** starter panel.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No. 2 M/E JACKET C.F.W. PUMP** starter panel.







2.2.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.14 on page 273***, and in other respective paragraphs.

2.3. GE HT & LT Cooling Systems

2.3.1. General

The system is designed for HT cooling of cylinder jackets, cylinder heads, and the LT cooling of the charge air and lube oil of the Generator Engines.

Click on the menu item **GE Cooling System** of the page **SYS** to open the system diagram.

2.3.2. Content

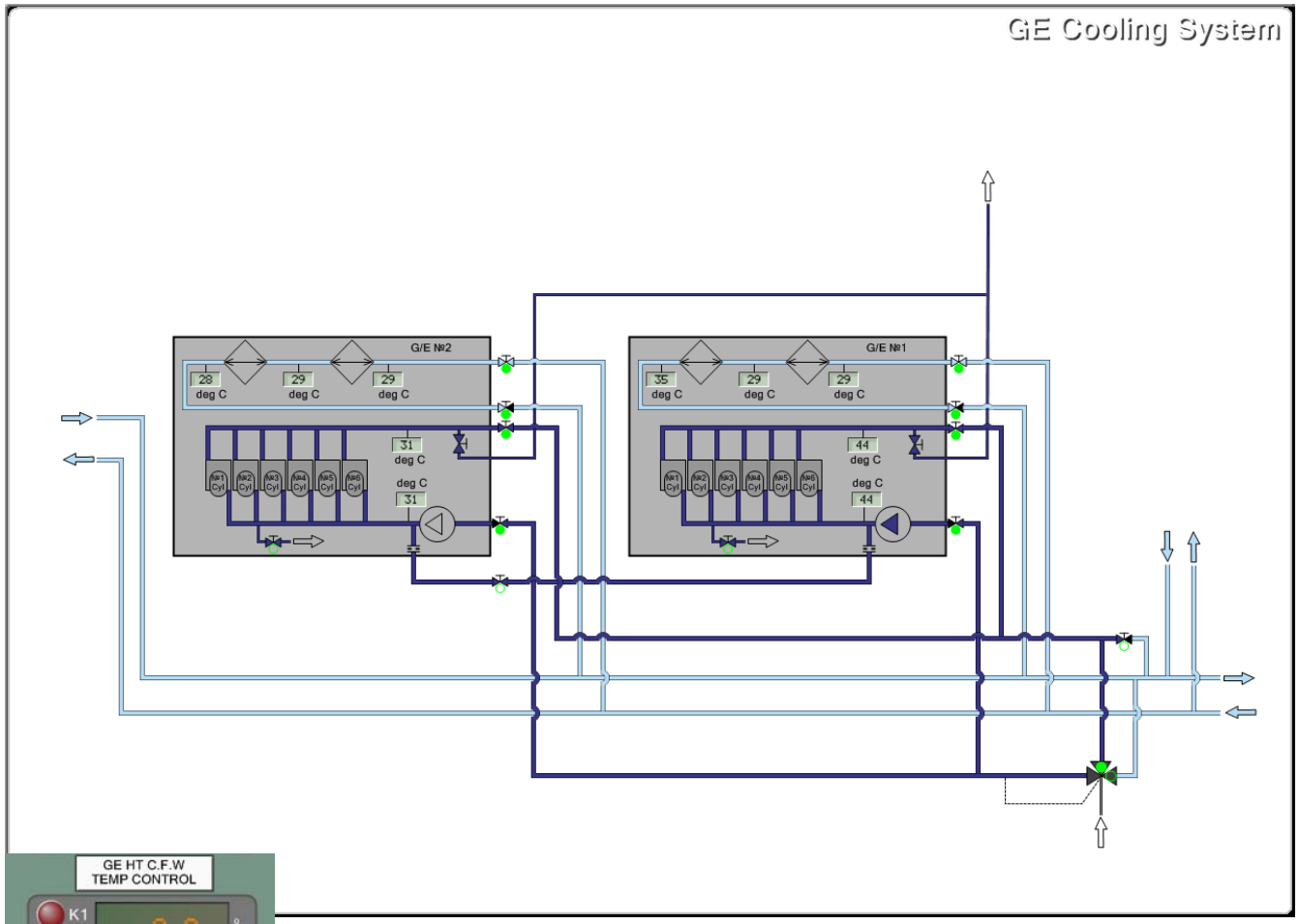
- **G/E № 1** and **G/E № 2** ; each with:
  - **Cooling Driven Pump** (HT) – 16 m3/h x 2.2 kg/cm2;
  - **Air Cooler** (LT);
  - **Lub. Oil Cooler** (LT);
  - Digital indicators of the inlet and outlet of the HT circuit.

2.3.3. Connections

- To CFW EXPN TK
- To/From AC Coolers
- To/From LT FW System
- Control Air
- To/From Oil Cooler For DK. Mach. Hyd. Power Pack
- Drain

2.3.4. Control

Click the menu item **GPBP-4** of the page **ER3** to open the panel with **GE HT C.F.W. TEMP CONTROL** thermocontroller to set operation of the 3-way HT Thermoregulation Valve. Thermocontroller operation is described in Introduction, ***the paragraph 5.3 on page 13***



2.3.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.16 on page 273***, and in other respective paragraphs.

2.4. LT Cooling Fresh Water System

2.4.1. General

The system is designed for LT cooling of: ME Air, Turbines LO, Generator Engines, coolers of Provision Ref. plant, etc.

Click on the menu item **LT Cooling System** of the page **SYS** to open the system diagram.

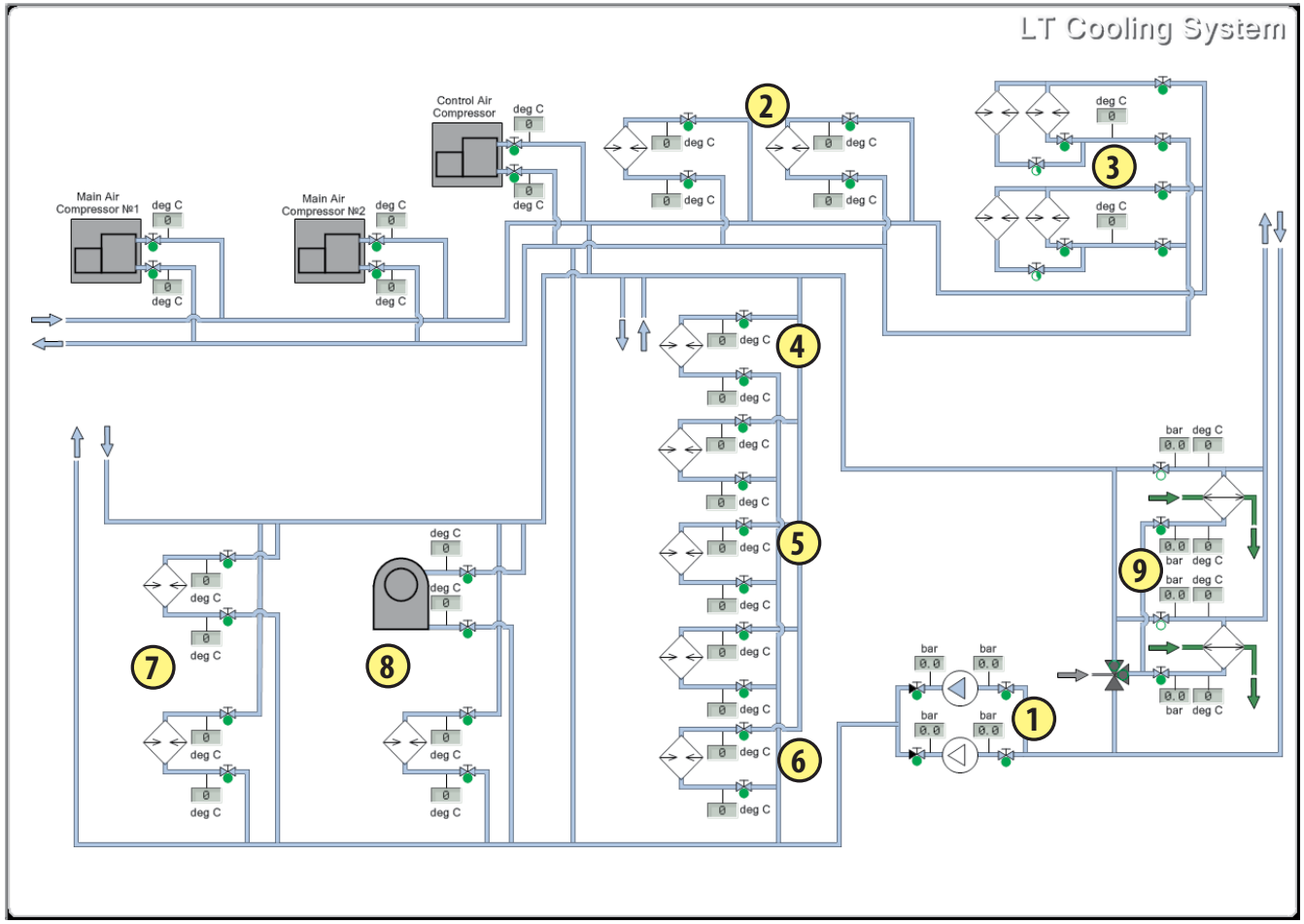
LT water lines are light blue, SW water lines are green color.

2.4.2. Content

- (1) **№1 (№2) LT Cooling Fresh Water P/P** – 560 m3/h x 2.3 kg/cm2;
- **Main Air Compressor №1 (№2)** with cooling inlet and outlet valves and digital temperature indicators;
- (2) **№1 (№2) Ref. Prov. Plant** cooling units;
- (3) **№1 (№2) AC System Condenser** and **Compressor** cooling units;
- (4) **Turbo generator LO** cooler;
- (5) **№3 (№2, №1) C.O.P.T. LO Cooler**;
- (6) **W.B.P.T. LO Cooler**;
- (7) **2 x Cooler for Hyd. Power Pack** cooling unit;
- (8) **Intermediate Shaft bearing**; **M/E Air Cooler** units;
- (9) **№1 (№2) LT Fresh Water Cooler** units;
- Pipelines with valves, filters, measuring gauges.

2.4.3. Connections

- To/From CFW Expn. TK
- To/From SW Cooling System
- To/From G/E Cooling System
- To/From Boiler W Circ P/P
- To/From M/E Jacket Temp Cont. V/V



2.4.4. Control

2.4.4.1. LT Cooling FW Pumps Control

The general description of a starter panel and a push button box controls is given in Introduction ***the section 5 on page 12***.

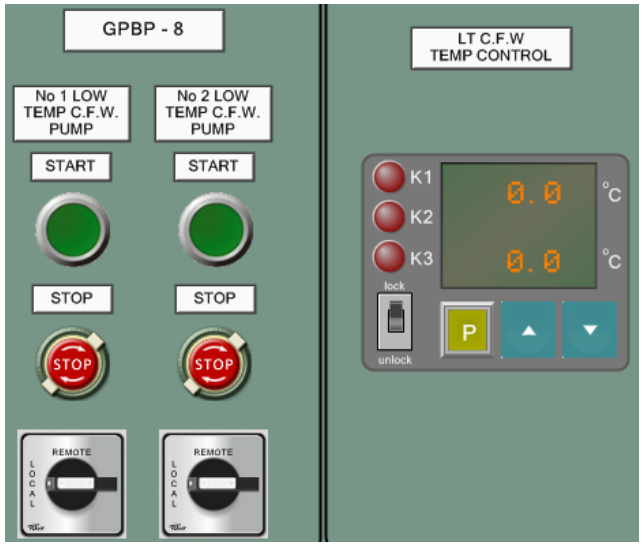
Click the menu item **GPBP-8** of the page **ER2** to open the **No 1 LOW TEMP C.F.W. PUMP** and **No 2 LOW TEMP C.F.W. PUMP** push button boxes.

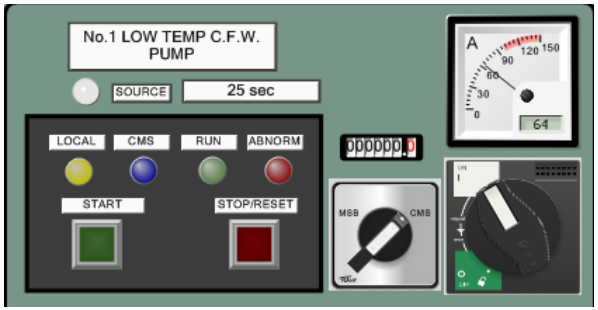
Use **LT C.F.W. TEMP CONTROL** thermocontroller to setup automatic operation of 3-way Thermoregulation Valve of LT Fresh Water Cooler unit. Thermocontroller operation is described in Introduction, ***the paragraph 5.3 on page 13***.

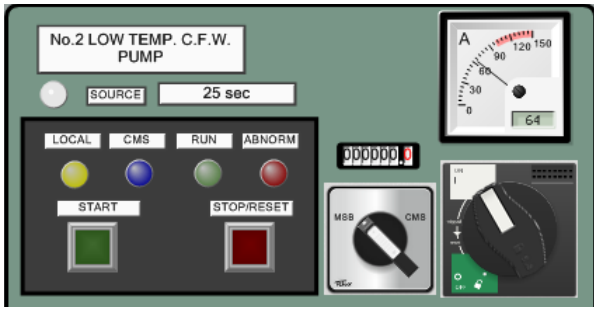
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/2 GSP** of the page **MSB** to open the display with the **No. 1 LOW TEMP C.F.W. PUMP** starter panel.

Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display with the **No. 2 LOW TEMP C.F.W. PUMP** starter panel.







2.4.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.15 on page 273***, and in other respective paragraphs.

3. Fuel Oil Systems

The FO systems include:

- Fuel Oil Filling & Transfer system
- Fuel Oil Purifying system;
- Fuel Oil Service for ME & GE system;
- Fuel Oil Service for Aux. Boiler system;
- Fuel Oil Service for Incinerator and EGE system.

3.1. FO Filling & Transfer System

3.1.1. General

The system is designed for fuel bunkering from the shore, fuel storage and transfer to FO service systems. Low Sulfur HFO and MDO are also modeled.

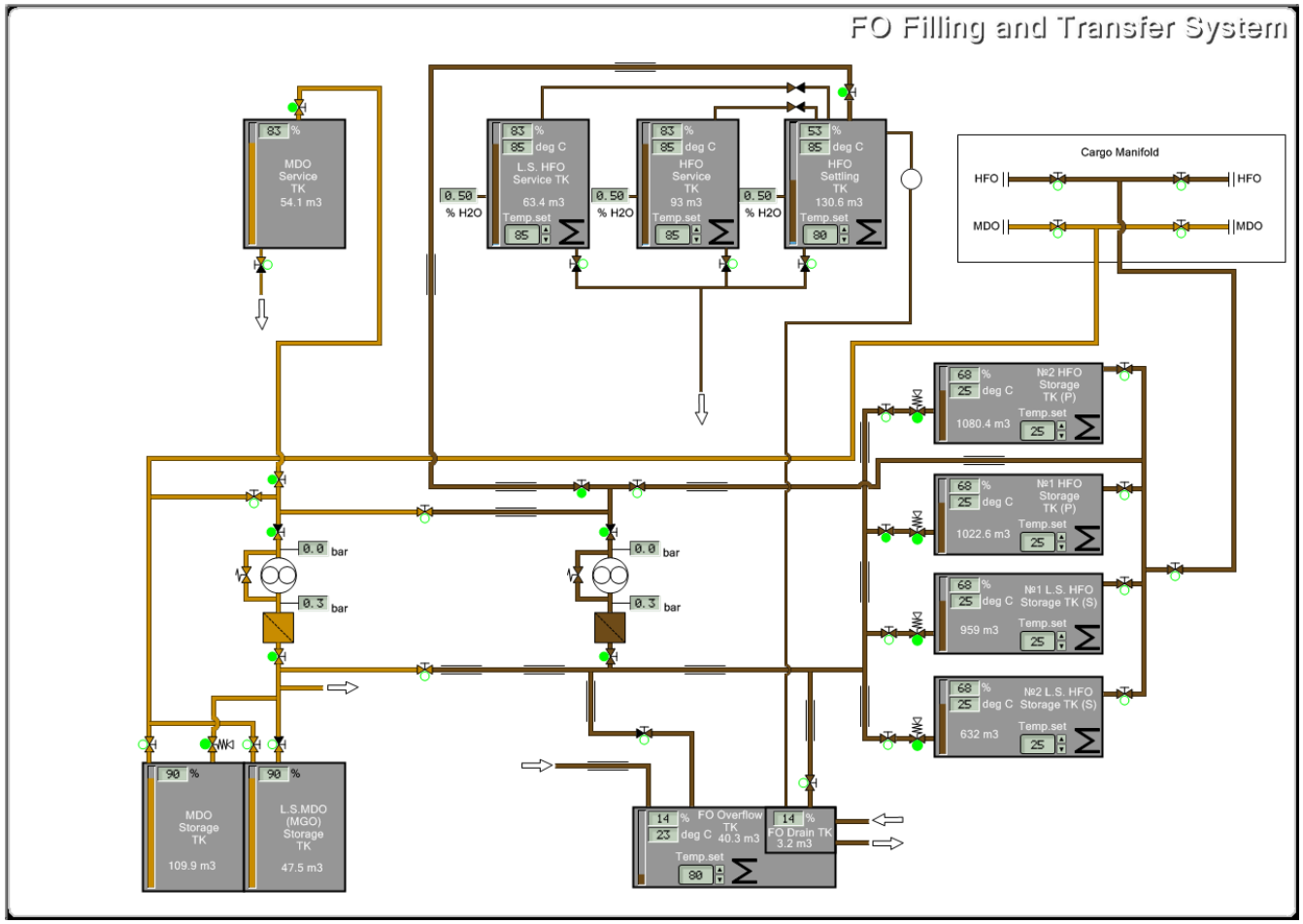
Click on the menu item **FO Filling and Transfer System** of the page **SYS** to open the system diagram.

3.1.2. Content

- **Cargo Manifold HFO** and **MDO** bunker stations;

Tank	Volume m³
№1 HFO Storage Tank (P)	1022.6
№2 HFO Storage Tank (P)	1080.4
№1 L.S.HFO Storage Tank (S)	959.0
№2 L.S.HFO Storage Tank S	632.0
HFO Settling Tank	130.6
L.S.HFO Service Tank	63.4
HFO Service Tank	93.0
MDO Storage Tank	109.9
L.S.MDO Storage Tank	47.5
MDO Service Tank	54.1
FO Overflow Tank	40.3
FO Drain Tank	3.2

- **HFO Transfer Pump** – 10 m3/h x 3 kg/cm2;
- **MDO Transfer Pump** – 10 m3/h x 3 kg/cm2;
- Pipelines with valves, filters, measuring gauges.



3.1.3. Connections

- To L.S.MDO(MGO) Storage Tank
- To Separated Bilge Oil Tank
- To HFO Purifier Feed Pump
- From FO ME & GE Auto Filter
- From ME Leakage
- To Sludge Pump

3.1.4. Control

3.1.4.1. Controls on Diagram

Some of the tanks are fitted with **Temp Set** spin box to set temperature for the FO heater. Click on the spin box up/down arrows to adjust the setpoint value.

Storage tanks are equipped with QCVs to cut off FO supply in emergency.

3.1.4.2. FO Transfer Pumps

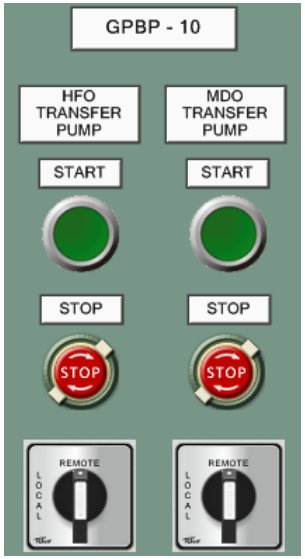
The general description of a starter panel and a push button box controls is given in Introduction, ***the section 5 on page 12***.

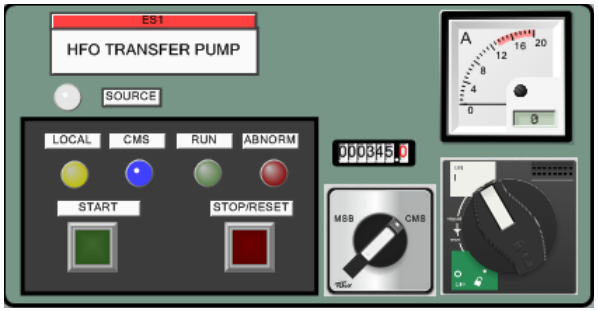
Click the menu item **GPBP-10** of the page **ER1** to open the **MDO TRANSFER PUMP** and **HFO TRANSFER PUMP** push button boxes:

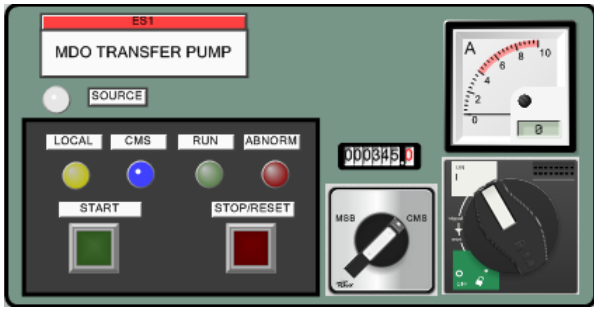
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/2 GSP** of the page **MSB** to open the display with starter panels:

- **HFO TRANSFER PUMP**;
- **MDO TRANSFER PUMP**.







3.1.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.6 on page 272***, and in other respective paragraphs.

3.2. FO Purifying System

3.2.1. General

The system is designed for purifying of HFO and MDO.

Purifier No.1 is used to process HFO (LSHFO) or MDO. Purifier No.2 is used to process HFO (LSHFO). Fuel can be processed from Settling (or Service) to Service tanks. Operate Supply Unit and Filling valves to set required flow direction.

Two SELFJECTOR Mineral Oil Separators are installed in the HFO FOT system. Separator data: capacity: 3 300 litres/h; motor: 440 V, 18.5 kW at 3 600 rpm; bowl speed: 8 200 rpm.

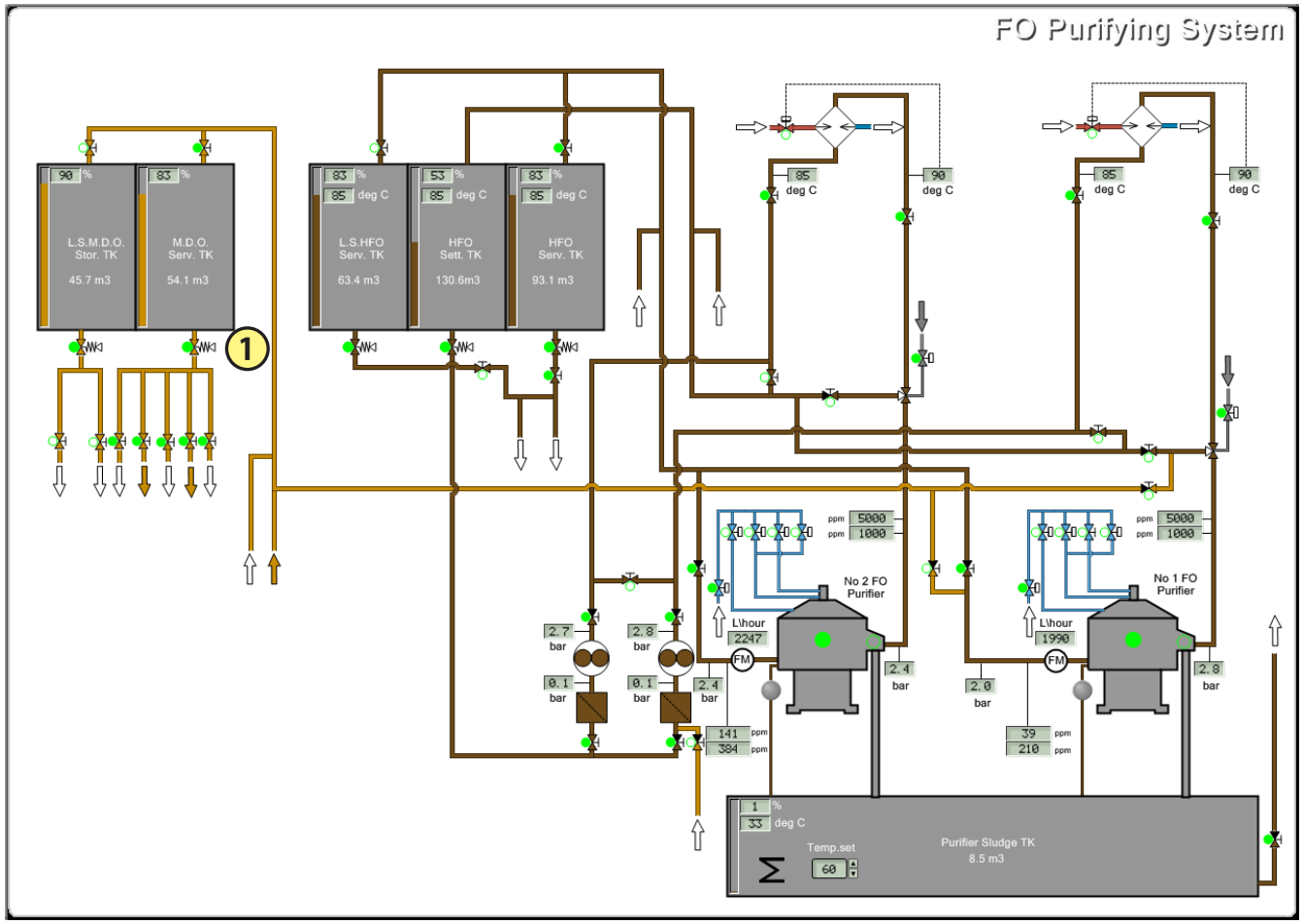
Click on the menu item **FO Purifying System** of the page **SYS** to open the system diagram.

3.2.2. Content

- **No 2 (No 1) HFO Purifier** units; each unit comprises:
  - Purifier run indicator and purifier open indicator;
  - **HFO Purifier Feed Pump** – 3 m3/h x 2.5 kg/cm2;
  - **HFO Purifier Heater**;
  - **HFO Purifier Suction Filter**.
- Tanks:

Tank	Volume m³
HFO Settling Tank	130.6
L.S.HFO Service Tank	63.4
HFO Service Tank	130.6
L.S.MDO Storage Tank	45.7
MDO Service Tank	54.1
Purifier Sludge Tank	8.5

- Digital indicators of water and impurity content in HFO;
- Pipelines with valves, filters, measuring gauges.



3.2.3. Connections

- To ME & GE
- To Aux Boilers
- To TUG IG
- To Incinerator
- From ME & GE MDO Return
- From Incinerator DO Return
- From ME & GE FO Return
- From MDO, LS MDO Storage TKs
- To Condensate System
- From Fresh Water Service To Purifier 2
- From Fresh Water Service To Purifier 1
- To Sludge Pump
- Compressed Control Air
- From Steam Service System

3.2.4. Control

3.2.4.1. Controls on Diagram

Temp Set spin box in **Sludge Tank** is used to set temperature for the FO heater.

① **Quick-closing Valves** of FO Storage, Service, Settling tanks are used for manual FO supply shut-off in case of emergency.

Check the open state of automatic **FO Purifier Control Water Solenoid Valve**. Open the HFO Discharge valve to open the separator line; at that the green open indicator illuminates. Purifier run indicator and pump run indicator illuminate when purifier is operating.

3.2.4.2. FO Purifiers Control Panel

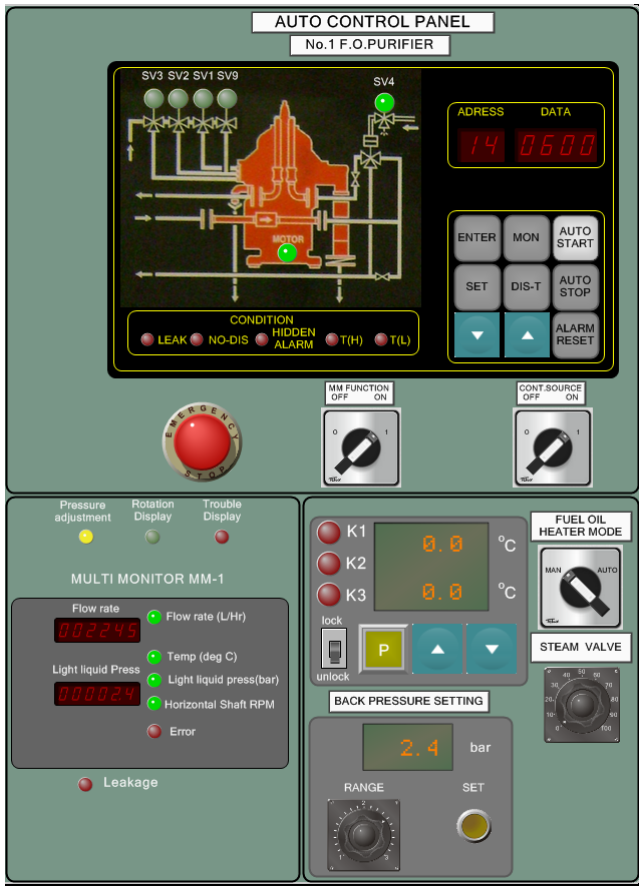
Purifiers and purifier FO supply driven pumps are controlled from their **AUTO CONTROL PANEL**(s).

Click the menu item **FO Purifiers 1,2 LOP** of the page **ER3** to open the display with two identical panels **No. 2 (No.1) F.O. PURIFIER AUTO CONTROL PANEL**.

Description given is for Purifier No.1 panel. The panel No.2 is similar to No.1.

The top panel of the purifier LOP contains:

- The purifier **AUTO CONTROL PANEL** (see the description below);
- The **SEPARATOR MOTOR** and **FEED PUMP** groups of two buttons each comprising:
- **EMERGENCY STOP** button to stop the purifier directly;
- **MM FUNCTION OFF – ON** two-position switch to control the feeding signal output from the control panel of the Multi-Monitor; when the switch is in OFF position the signal is not outputted even if the SELFJECTOR is on feeding;
- **CONT. SOURCE OFF–ON** two-position switch to power the auto control panel.



The bottom panel of the purifier LOP contains:

- **MULTI-MONITOR MM-1** unit comprising:
  - **Pressure adjustment** LED indicator; flashes when adjustment is in process;
  - Information screen, which displays the current values of the parameters:

    Flow rate (L/Hr) in the upper box;

    Temp (deg C), Light liquid press (bar), RPM exchanging in the lower box with 5 sec. period.

  Green LED indicators illuminate when parameters are within the operating range;
  - **Horizontal Shaft RPM** LED indicator; flashes when purifier motor and driven pump are starting; when is lights steadily, then the **AUTO START** button can be pressed to start the purification process;
  - **Error** and **Leakage** alarm LED indicators.
- PID controller to operate the heater unit in AUTO mode (see the controller description in ***Chapter 1***);
- **FUEL OIL HEATER MODE** two-position selector switch to choose between **MAN–AUTO** control;
- **STEAM VALVE** regulator to open the heater thermal oil valve 0–100 in MAN mode;
- **BACK PRESSURE SETTING** panel comprising:
  - Display to present the actual pressure or set point value;
  - **SET** button; click to start modify pressure set point; the button highlights; click again to confirm the setting;
  - **RANGE** potentiometer knob to set the pressure value.

Switch power supply 440 V for purifiers and purifiers feed pumps on the **No. 4 GROUP STARTER PANEL** (use menu item **GSP 4** of the page **ER3**) on the starter panels **No. 2 H.F.O. PURIFIER**, **No. 1 H.F.O. PURIFIER** and **No. 2 H.F.O. PURIFIER FEED PUMP**, **No. 1 H.F.O. PURIFIER FEED PUMP** (see ***the paragraph 3.2.5.1 on page 134***).

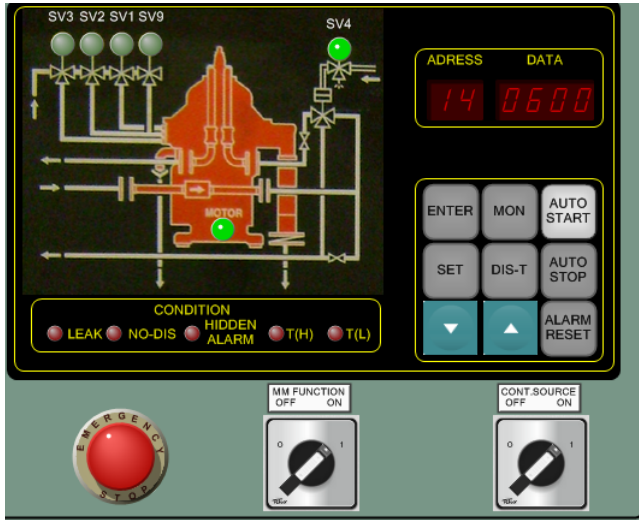
Auto Control Panel

The panel contains:

- Purifier diagram with **MOTOR** run indicator;
- LED indicators of the valves state:
  - **SV3** Regulating replacement water;
  - **SV2** For closing bowl;
  - **SV1** For opening bowl – total;
  - **SV9** For opening bowl – partial;
  - **SV4** Control water solenoid.
- **CONDITION** LED alarm indicators modeled:
  - **LEAK**;
  - **T(H), T(L)** – high/low temperature

Buttons modeled in the simulator are used to:

- **MON** to monitor the proceeding condition of functions in the **ADDRESS** and **DATA** digital indicators, which display the timer setting times of the automatic system (see the table below); **Note:** no changes can be done to factory settings in the simulator;
- Up and down arrows to browse the list of addresses of required timer or counter;
- **DIS-T** to partially discharge purified oil;
- **AUTO START** to start automatic purifying; the lamp is on while automatic purifying is operating;
- **AUTO STOP** to pause automatic purifying and stop the purifier after discharging sludge completely;
- **ALARM RESET** to reset common alarms; the lamp is on when an alarm condition has occurred, and off when reset.



Timer setting times

Default values are set by service engineers. In the simulator the values cannot be changed. Use the following table as reference.

Addr	Description	Time that can be set
01	Bowl opening time (total discharge)	0.0~999.9 s
02	Replacement water supply time (total discharge)	0.0~999.9 s
03	Sealing water (regulating water) supply time (total discharge)	0.0~999.9 s
04	Bowl washing water supply time	0.0~999.9 s
11	Bowl opening time (partial discharge)	0.0~999.9 s
12	Replacement water supply time (partial discharge)	0.0~999.9 s
14	Intermittent bowl closing water supply intervals	1~9999 min
15	Sludge discharge intervals	1~9999 min
16	Operating water supply for closing bowl	0.0~999.9 s
23	Bowl washing counter	1~100 times

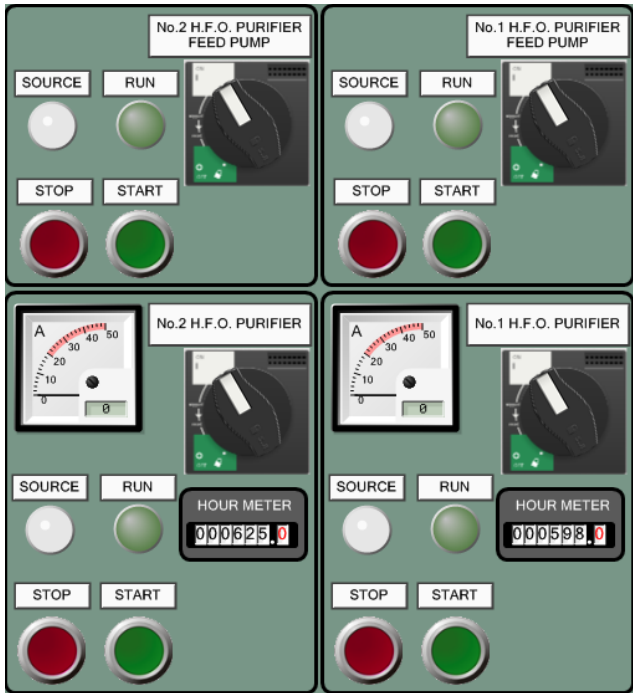
3.2.5.1. FO Purifiers Feed Pumps

Click the menu item **GSP 4** of the page **ER3** to open the display with the **No. 2 H.F.O. PURIFIER**, **No. 1 H.F.O. PURIFIER** and **No. 2 H.F.O. PURIFIER FEED PUMP**, **No. 1 H.F.O. PURIFIER FEED PUMP** starter panels.

The general description of a starter panel is given in Introduction *the section 5 on page 12*.

Switch power 440V for **No.4 GROUP STARTER PANEL:**

- on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL** (**No.1 SECTION**) circuit breaker;
- on **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL** (**No.2 SECTION**) circuit breaker;
- on **EM'CY AC440v FEEDER PANEL** of ESB (use menu item **ESB Consumers** of the page **EmG**) by **No. 4 LGSP (GE MDO PUMP)** circuit breaker.



3.2.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.11 on page 273*, and *the paragraph 2.11.3 on page 275*.

3.3. Fuel Oil Service Systems General Description

The FO supply system allows the changeover processes from HFO to LSHFO and back, and from HFO to MDO and back.

The FO service system comprises subsystems:

- FO Service for Main Engine & Generator Engines;
- FO Service for Aux Boilers System;
- FO Service for Incinerator & EM'CY Generator Engine Systems.

3.3.1. FOS Tanks Volumes

Tank	Volume m³
№1 HFO Storage Tank (P)	1022.6
№2 HFO Storage Tank (P)	1080.4
№1 L.S.HFO Storage Tank (S)	959.0
№2 L.S.HFO Storage Tank S	632.0
HFO Settling Tank	130.6
L.S.HFO Service Tank	63.4
HFO Service Tank	93.0
MDO Storage Tank	109.9
L.S.MDO Storage Tank	47.5
MDO Service Tank	54.1
FO Overflow Tank	40.3
FO Drain Tank	3.2
Purifier Sludge Tank	8.5

3.4. FO ME & GE Service System

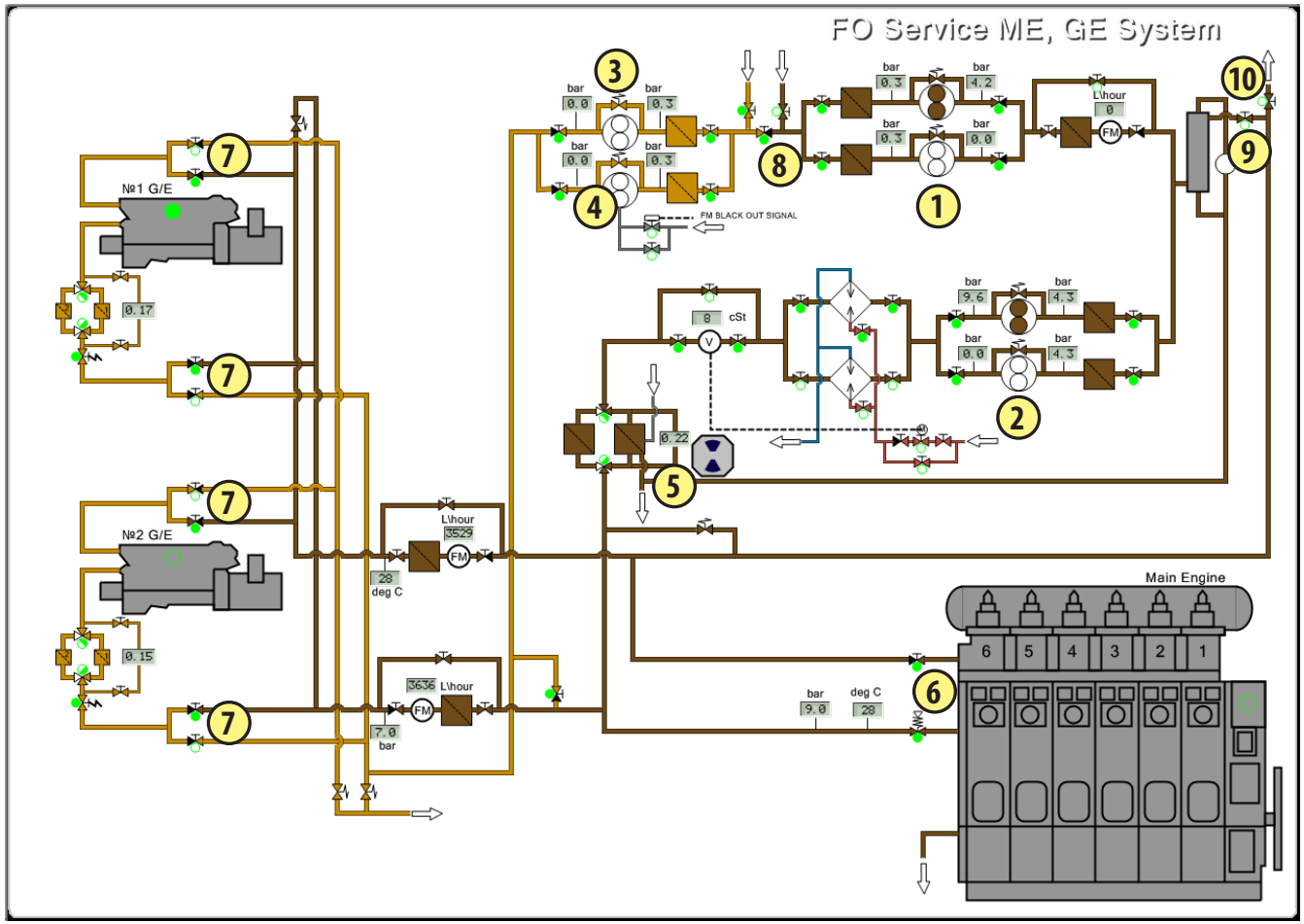
3.4.1. General

The system is designed for supplying the Main and Generators diesel engines (DE) with purified fuel from HFO or MDO Service Tanks. The engines can normally run on HFO including the start/stop sequences and continuous work. The MDO will be used only in ports with high ecological requirements, or in the case of emergency (e.g. blackout), or to start the DEs when the steam plant is not yet operational.

Click on the menu item **FO ME, GE Service System** of the page **SYS** to open the system diagram.

3.4.2. Content

- **Main Engine** and **№1 G/E, №2 G/E** with run indicators;
- (1) **FO Supply Pump 1 (2)** – 3.2 m3/h x 4 kg/cm2;
- (2) **FO Circ. Pump 1 (2)** – 7.4 m3/h x 6 kg/cm2;
- (3) **GE MDO Pump** – 1.3 m3/h x 7 kg/cm2;
- (4) **GE EM'CY MDO Pump (Air driven)** – 0.2 m3/h x 5 kg/cm2;
- **G/E 1 (2) FO Filter** units, each with controlled 3-way **Change Over** valves and **EM'CY Shut-off Valve**;
- **ME/GE HFO Heater 1 (2)**;
- (5) **FO Automatic Filter**;
- (9) **Fuel Oil Venting Box Inlet Valve**;
- (10) **HFO Return Valve N.C.**;
- **Viscosity System** valves and gauge;
- Pipelines with valves, filters, measuring gauges.



3.4.3. Connections

- To MDO Service or LSMDO Stor.Tank
- ME FO Leakage To Drain Tank
- FO Auto Filter Drain To FO Overflow Tank
- Compressed Control Air
- From Service Air System
- From MDO Service Tank
- From HFO Service Tanks
- To HFO Service TK Return
- To Condensate System
- From Steam System

3.4.4. Control

3.4.4.1. Controls on Diagram

(8) **From MDO To FO Unit Valve, HFO From Service Tanks Valve** and **MDO From Service Tank Valve** are used to select either HFO or MDO supply for Main Engine.

(6) **ME FO Inlet Valve** and **ME FO Return Valve** are used for Main Engine FO supply.

(7) **G/E №1 (№2) MDO (HFO) Inlet Valve** and **G/E №1 (№2) MDO (HFO) Return Valve** are used to supply respective generator engine with FO.

(9) **Fuel Oil Venting Box Inlet Valve** is used to open flow to ventilation box.

(10) **HFO Return Valve N.C.** is used to control HFO recirculation.

Filter clogging in (5) **FO Automatic Filter** is displayed by the image with two blue sectors. Sectors turn to red to indicate clogging. Clogging condition is set by the Instructor fault.

Switch the power supply 440 V for the auto filters on **No. 4 GROUP STARTER PANEL** (use menu item **GSP 4** of the page **ER3**) by **G/E F.O. AUTO FILTER** and **M/E F.O. AUTO FILTER** circuit breakers.

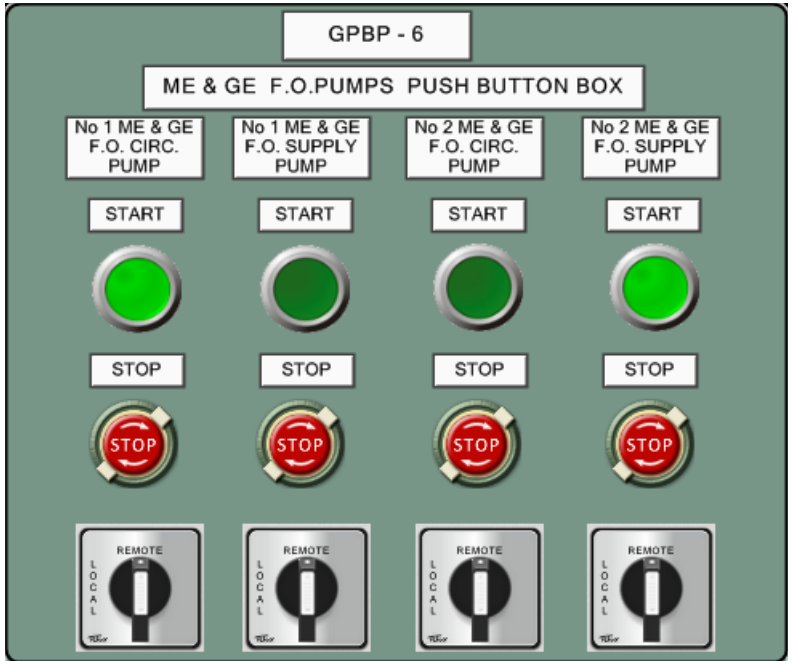
Switch power supply 440 V of **No. 4 GROUP STARTER PANEL** for the auto filters on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL** (**No.1 SECTION**) circuit breaker.

3.4.4.2. FO Supply & Circulating Pumps

The general description of a push button box and a starter panel controls is given in Introduction *the section 5 on page 12*.

Click on the menu item **GPBP-6** of the page **ER3** to open the panel with push button boxes of **No 1 ME & GE F.O. SUPPLY PUMP, No 2 ME & GE F.O. SUPPLY PUMP, No 1 ME & GE F.O. CIRC. PUMP, No. 2 ME & GE F.O. CIRC. PUMP.**

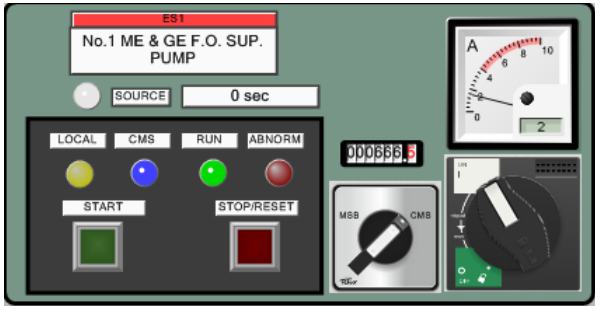
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

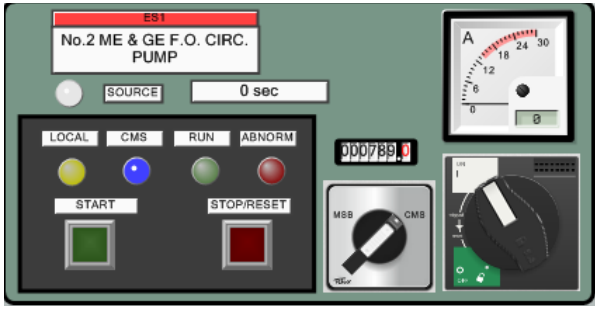


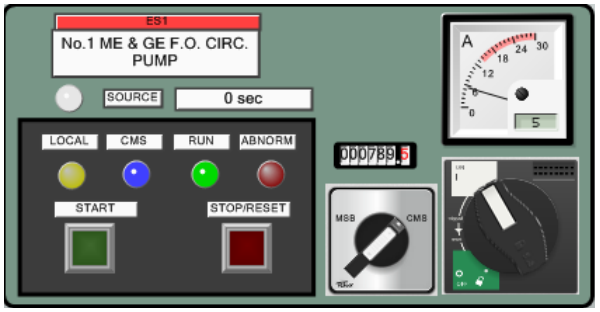
Click the menu item **MSB No 1/2 GSP** of the page **MSB** to open the display with the **No. 1 M/E & G/E F.O. SUP. PUMP** and **No. 1 M/E & G/E F.O. CIRC. PUMP** starter panels.

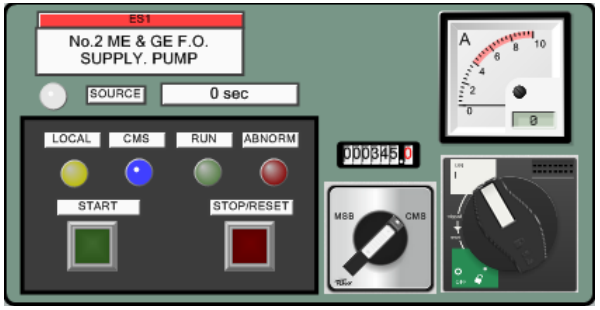
Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display with the **No 2 M/E & G/E F.O. SUP. PUMP** and **No 2 M/E & G/E F.O. CIRC. PUMP** starter panels.

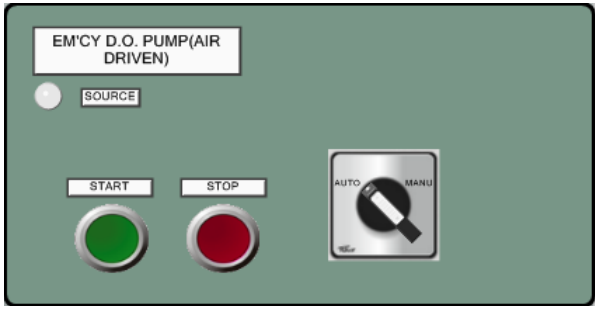
The supply and circulating pumps are operating in duty/ standby configuration.











3.4.4.3. MDO Pumps

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

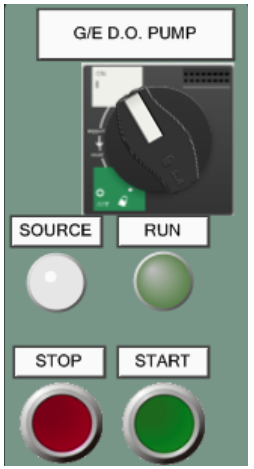
Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display with the **EM'CY D.O. PUMP (AIR DRIVEN)** starter panel.

Use the two-position mode selector switch to set:

- **MANUAL** mode for operating the pump from this panel;
- **AUTO** mode for the pump to start automatically after EPP blackout.

Click the menu item **GSP 4** of the page **ER3** to open the starter panel **G/E D.O. PUMP** of the **GE MDO Pump**.

Switch power supply 440 V of the **No. 4 GROUP STARTER PANEL** for the pump on the **EM'CY AC440v FEEDER PANEL** of the ESB (use menu item **ESB Consumers** of the page **EmG**) by the **No.4 GSP (GE MDO PUMP)** circuit breaker.



3.4.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.7 on page 272*, and in other respective paragraphs.

3.5. FO AUX Boilers Service System

3.5.1. General

The system is designed for supplying the Aux. Boilers with purified fuel.

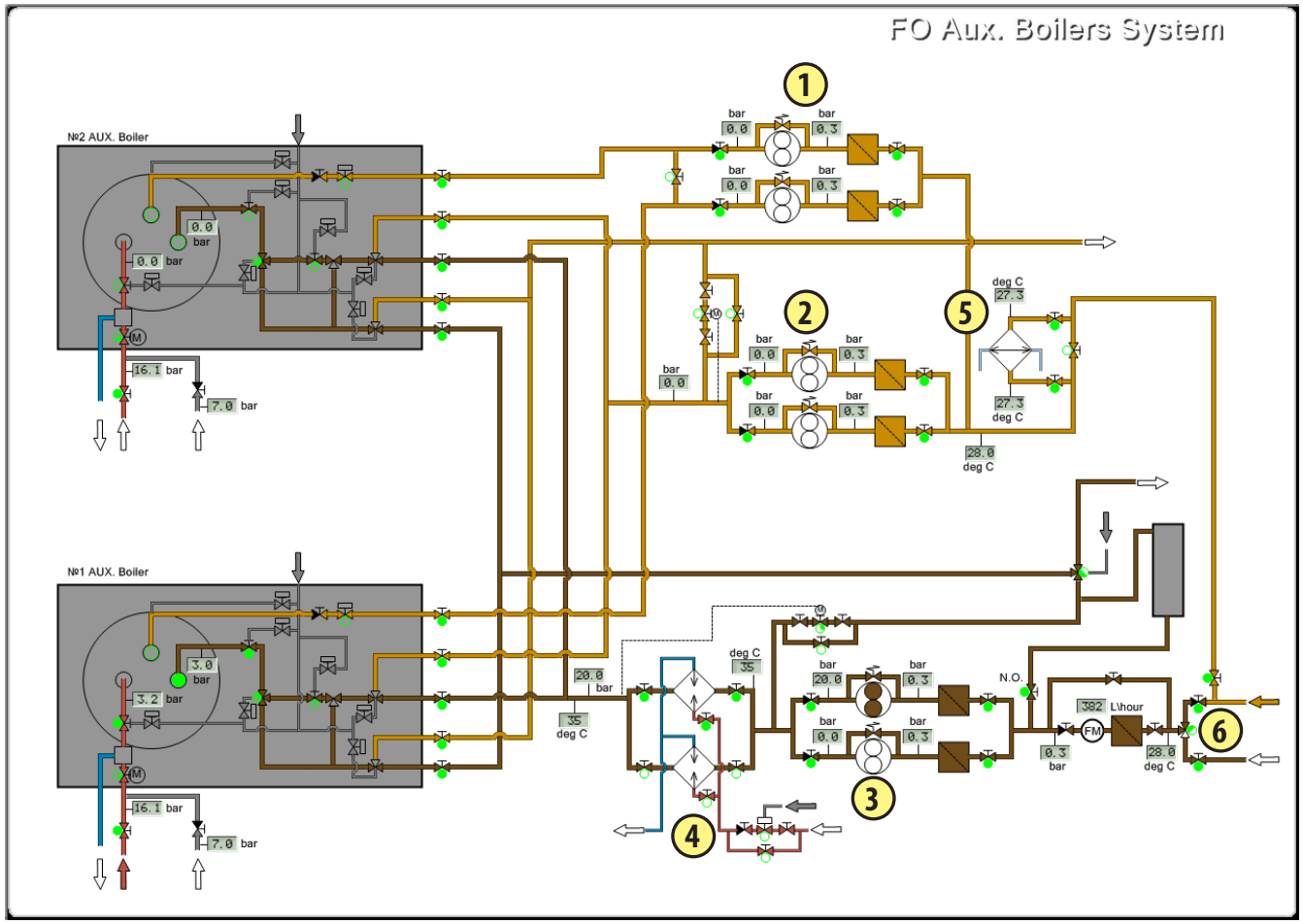
The boiler normally would run on the HFO heated in Boiler FO Heater. MDO supply would be used in an emergency, if HFO could not be supplied to the boilers, or if it was considered necessary to flush the boiler burner system and supply the system with MDO prior to maintenance. The boiler Igniter runs on MDO, which is fed by the Ignition MDO Pump.

In normal operation, steam atomization is used for the HFO and MDO, but if no steam supply is available, atomizing air at a pressure of 7 bar is employed.

Click on the menu item **FO Aux Boilers System** of the page **SYS** to open the system diagram.

3.5.2. Content

- **№ 2 (№1) AUX. Boiler** unit, each comprising:
  - Fuel Oil Inlet/Return Valve(s);
  - Atomizing Steam Inlet Valve;
  - Ignition and Burner run indicators.
- (1) **AUX Boiler MDO Ignition Pump 1 (2)** – 50 L/h x 10 bar; the pumps start automatically when ignition is started on the Boiler LCP;
- (2) **AUX Boiler MGO Pump 1 (2)** – 7.5 m3/h x 25 bar;
- (3) **FO Supply Pump 1 (2)** – 7.5 m3/h x 25 bar;
- (4) **Boilers HFO Heater 1 (2)**;
- (5) **MGO Cooler**;
- Pipelines with valves, filters, measuring gauges.



3.5.3. Connections

- To Condensate System
- To Steam Service Line For Atomizing
- From Steam System
- Compressed Service Air For Atomizing
- MGO Return To LS MDO Tank
- To Service Tanks
- From Compressed Air Sys
- From MDO Service Tank or LS MDO Storage Tank
- From HFO Service Tanks.

3.5.4. Control

3.5.4.1. Controls on Diagram

Use (6) **3-way Fuel Oil Selection Valve** to change FO supply.

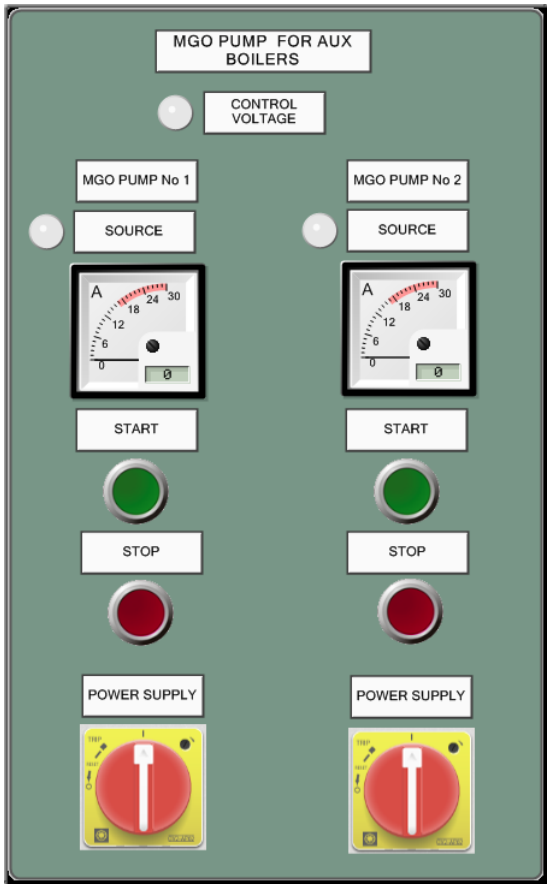
3.5.4.2. AUX Boiler MGO Pumps

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

Click on the menu item **Boilers MGO Pumps LOP** of the page **ER4** to open the **MGO PUMP No 1** and **MGO PUMP No 2** starter panels.

Switch power 440V for:

- **MGO PUMP No 1** on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **AUX BOILER POWER PANEL (No.1 SECTION)** breaker;
- **MGO PUMP No 2** on **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **AUX BOILER POWER PANEL (No.2 SECTION)** breaker.



3.5.4.3. FO for AUX Boiler Pumps

The AUX Boilers, FO pumps, combustion air fans and oil regulating valves are controlled from the Boiler Control Panel(s) (see *the paragraph 5.4.1 on page 161*), and/or Boiler Power panel (see *the paragraph 5.4.2 on page 164*).

3.5.5. Faults Introduced by Instructor

The faults for MGO pumps are introduced in Chapter 7, *the section 2.12.13 on page 278*.

3.6. FO Incinerator & EGE Service System

3.6.1. General

The FO Service for Incinerator system is designed for disposal of the oil product and solids by burning, in accordance with MARPOL requirements. The EM'CY G/E system is designed for supplying the diesel engine with fuel oil.

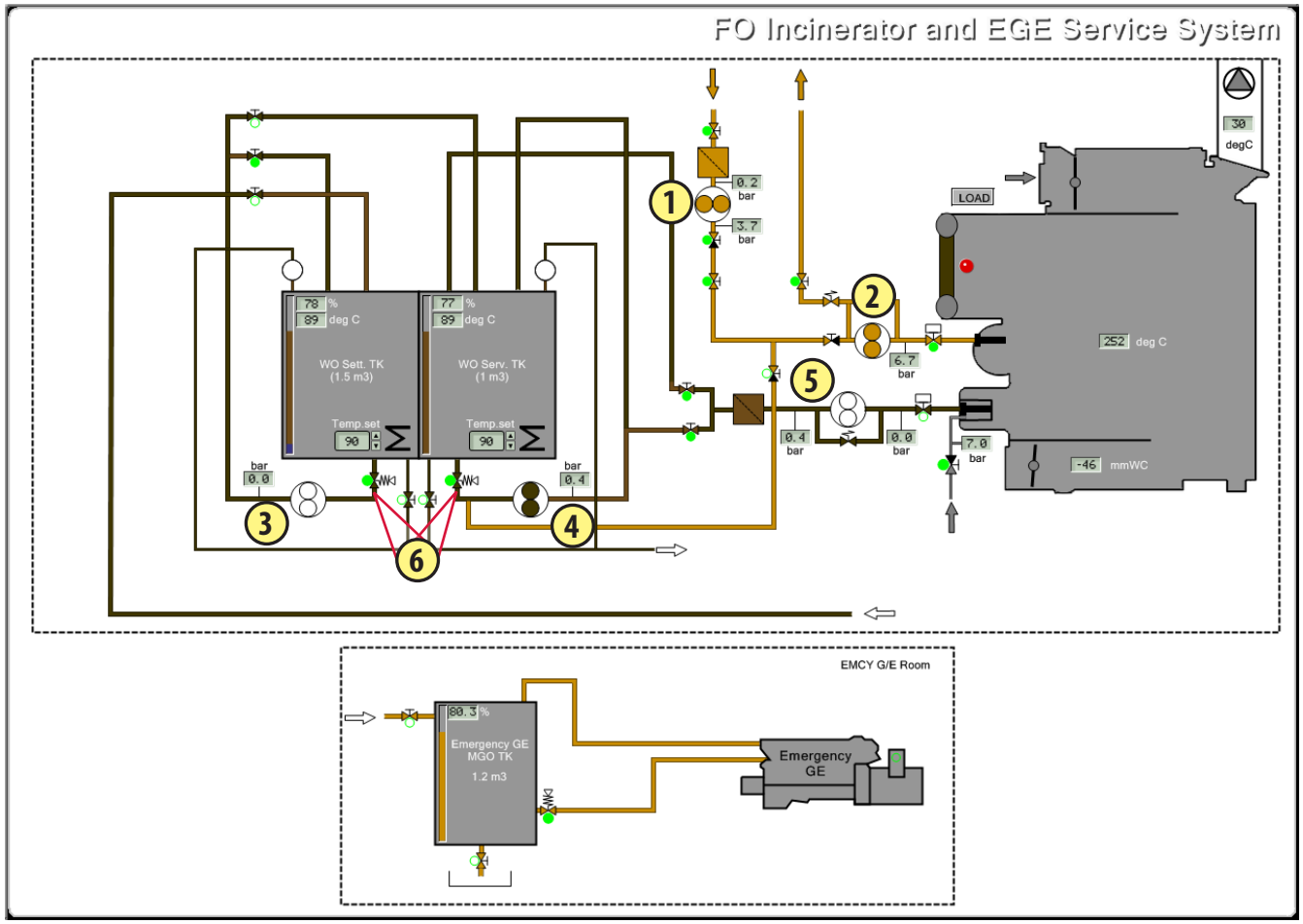
To provide for combustion process, the Incinerator furnace has:

- Electrical ignition burner using MDO only;
- Main Rotary cup type burner using both the MDO and the oil product sludge.

The unit is fed from MDO service tank. The incinerator's own feed fuel oil pump takes suction from the MDO service tank and supplies MDO under pressure to the burner unit. The waste oil (WO) burner employs compressed air atomizing with compressed air being supplied from the general service air system. WO is supplied from the waste oil tanks by means of milling pumps, and a waste oil dosing pump is then used to supply the waste oil to the burner. The milling pumps supply oil to the incinerator, the excess returning to the waste oil tank.

WO tanks for the incinerator collect the waste oil from the various tanks around the ER and supply the incinerator waste oil burner. The sludge pump supplies the incinerator WO tank. The pump also discharges to the shore connections.

Click on the menu item **FO Incinerator and EGE Service System** of the page **SYS** to open the system diagram:



3.6.2. Content

Incinerator FO service system contains:

- **Incinerator** Main burner integrated with **Air Supply Fan**;
- **WO Sett. TK** – 1.5 m3;
- **WO Serv. TK** – 1.0 m3:
- (1) **MDO Supply Pump** – 0.05 m3/h x 3.0 kg/cm2;
- (2) **Incin. MDO Feed Pump** – 2 m3/h x 3.5 kg/cm2;
- (3) **WO Sett. Mill Pump** – 26 m3/h x 0.5 kg/cm2;
- (4) **WO Serv. Mill Pump** – 26 m3/h x 0.5 kg/cm2;
- (5) **Waste Dosing Pump** – 0.3 m3/h x 2.0 kg/cm2;
- **Shore Discharge** station;
- Pipelines with valves, filters, measuring gauges.

EM'CY G/E Room FO system contains:

- **Emergency GE MGO TK** – 1.2 m3 with QCV;
- **Emergency GE** with run indicator.

3.6.3. Connections

- From/To MDO Service TK
- To Separated Bilge Oil TK
- From Sludge Pump
- Compressed Service Air
- Make Up.

3.6.4. Control

3.6.4.1. Controls on Diagram

⑥ **WO Suction Valve Sett.TK Mill. Pump(QCV)** and **WO Suction Valve Serv.TK Mill. Pump(QCV)** are used to cut off FO supply in the case of emergency.

Temp set controllers are used to setpoint WO heater temperature of the **WO Sett. TK** and **WO Serv. TK**. Use the spin box arrows to set WO temperature.

Drain valve is used for draining water to sludge tank.

WO return valve is used to direct part of fuel back to the WO Settling tank or back to the WO pump inlet.

Incinerator operation and overheat protection is described in *the paragraph 7.13.4.3 on page 221*.

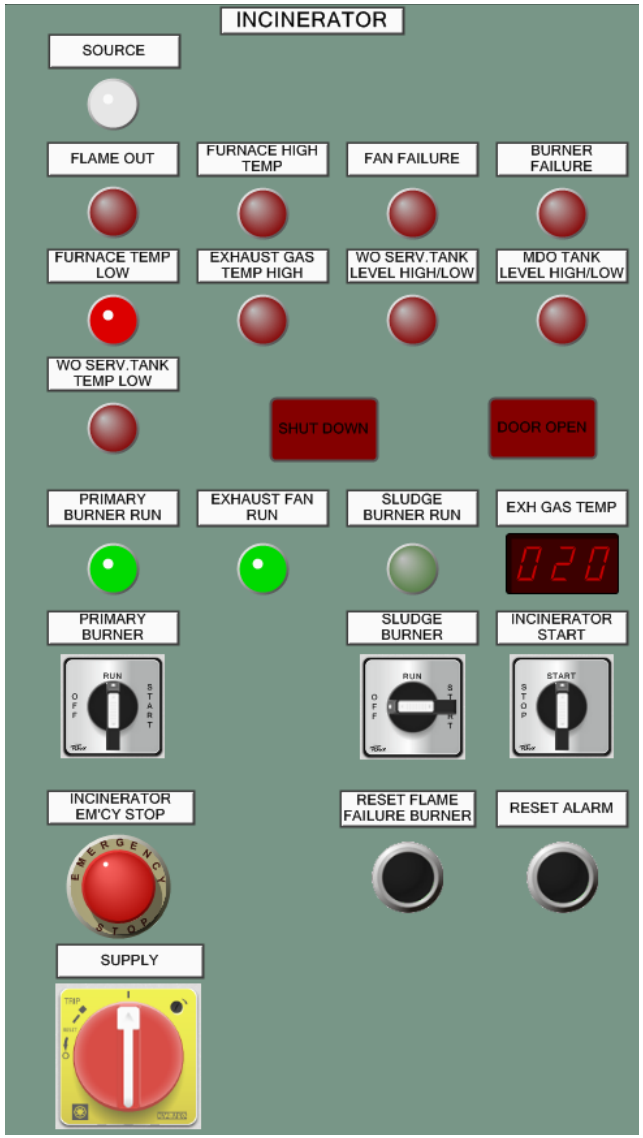
The Emergency Generator is controlled from the LOP or ESB panel (see Chapter 3, *the paragraph 7.1 on page 106* or *the paragraph 7.2 on page 108*).

3.6.4.2. Incinerator & Waste Oil Tank Control Panels

Click on the menu item **Incinerator LOP** of the page **ER3** to open the panel for incinerator and W.O. TK local control.

The **INCINERATOR** panel contains:

- **SOURCE** indicator, which illuminates when power is ON;
- A set of alarm indicators:
  - **FLAME OUT** – fire extinction in the furnace;
  - **FURNACE HIGH TEMP** – temperature > 1200° C;



  - **FAN FAILURE** – exhaust gas fan is overheated;
  - **BURNER FAILURE** – main burner failure;
  - **FURNACE TEMP LOW** – temperature < 800° C;
  - **EXHAUST GAS TEMP HIGH** – temperature > 350° C;
  - **WO SERV TANK LEVEL HIGH/LOW** – level of oil product sludge in the Waste Oil service tank is high or low;
  - **MDO TANK LEVEL HIGH/LOW** – level is high or low;
  - **WO SERV. TANK TEMP LOW** – temperature < 80° C.
- **SHUT DOOR** indicator display; it highlights when the door is closed;
- **DOOR OPEN** display; it highlights when the door is open;
- **PRIMARY BURNER RUN** indicator; it illuminates when the primary burner is running;
- **EXHAUST FAN RUN** indicator; it illuminates when the fan is running;
- **SLUDGE BURNER RUN** indicator; it illuminates when the main burner is running;
- **EXHAUST GAS TEMP** digital indicator;
- **PRIMARY BURNER** three-position switch;
  - **OFF** position turns the ignition burner off;
  - **RUN** position enables the burner to start and run;
  - **START** position is used to actually start the burner; on successful start the switch jumps back to the RUN position and the **PRIMARY BURNER RUN** indicator illuminates.
- **SLUDGE BURNER** three-position switch;
  - **OFF** position turns the main burner off;
  - **RUN** position enables the burner to start and run;
  - **START** position is used to actually start the burner; on successful start the switch jumps back to the RUN position and the **SLUDGE BURNER RUN** indicator illuminates.
- **INCINERATOR START** two-position **STOP–START** switch to power the system; the Exhaust gas fan starts automatically;

Attention! The correct starting sequence would be to:

a). Start the incinerator;

b). Start the primary burner;

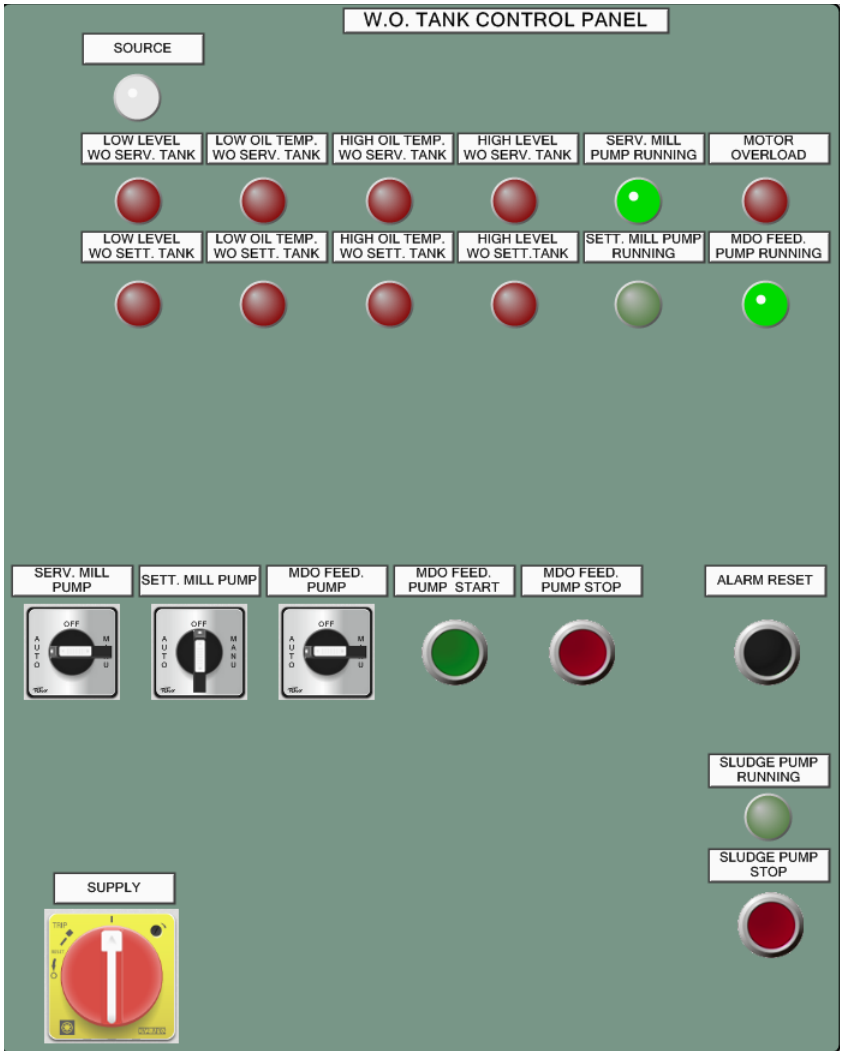
c). Start the sludge burner when the furnace temperature > 800 °C.

- **INCINERATOR STOP** emergency button;
- **RESET FLAME FAILURE BURNER** button; press the button to reset the incinerator system after the flame failure;
- **RESET ALARM** button; press the button to reset the incinerator system after the alarm condition when the cause of alarm has been removed;
- **SUPPLY** automatic CB.

Switch 440 V power supply for **INCINERATOR** from the **3 PD E/R 440 V DIST. BOARD** (use menu item **PD DB 3** of the page **ER4**) by **INCINERATOR** circuit breaker.

The **W.O. TANK CONTROL PANEL** contains:

- **SOURCE** indicator; it illuminates when panel power is ON;
- A set of alarm and state indicators:
  - **LOW LEVEL WO SERV. TANK** – level < 30%;
  - **LOW OIL TEMP. WO SERV. TANK** – temperature < 60 °C;
  - **HIGH OIL TEMP. WO SERV. TANK** – temperature > 110 °C;
  - **HIGH LEVEL WO SERV. TANK** – level > 90%;
  - **SERV. MILL PUMP RUNNING**;
  - **MOTOR OVERLOAD** – of any pump;
  - **LOW LEVEL WO SETT. TANK** – level < 30%;
  - **LOW OIL TEMP. WO SETT. TANK** – temperature < 60 °C;
  - **HIGH OIL TEMP. WO SETT. TANK** – temperature > 110 °C;
  - **HIGH LEVEL WO SETT. TANK** – level > 90%.
  - **SETT. MILL PUMP RUNNING**;
  - **MDO FEED PUMP RUNNING**. – MDO pump for incinerator.



- **SERV. MILL PUMP, SETT. MILL PUMP, MDO FEED PUMP** three-position switches to select pump control mode:
  - **OFF** position turns the pump off;
  - **AUTO** position sets the pump to start automatically, when incinerator starts;
  - **MANU** position sets the pump to manual control from this panel; MILL pumps are stared when the panel power is on; MDO feed pump is operated by the buttons;
- **MDO FEED PUMP START**; M**DO FEED PUMP STOP** buttons – to actually start/stop the pump in MANU mode; on successful start the **MDO FEED PUMP RUNNING** indicator illuminates;
- **ALARM RESET** button; click the button to reset the WO tanks system after the alarm condition when the cause of alarm has been removed;
- **SLUDGE PUMP RUNNING** indicator;
- **SLUDGE PUMP STOP** button duplicating the stop buttons on the pump starter panel (see *the paragraph 7.11.4.3 on page 216*);
- **SUPPLY** automatic CB.

Switch the power supply 440 V for the pumps and **W.O. TANK CONTROL PANEL** on the **3 PD E/R 440 V DIST. BOARD** (use menu item **PD DB 3** of the page **ER4**) by the **WASTE OIL CONTROL PANEL** circuit breaker.

3.6.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.12.9 on page 277*, and in other respective paragraphs.

4. Lube Oil Systems

The Lubricating system is designed for the oil storage, transfer, purification and supply to ME, DG engines with clean lube oil.

- The system comprises the subsystem:
- LO Transfer & Purifying System and LO Service for GEs;
- LO Service System for ME;
- Stern Tube LO Service System;
- LO Service for Steam Turbines System.
- Lube Oil Tanks Volumes

Tank	**Volume m³**
Main LO Storage Tank	27.0
Main LO Settling Tank	25.2
G/E LO Storage Tank	7.2
G/E LO Settling Tank	3.6
Main LO Sump Tank	28.0
Scav. Air LO Drain Tank	0.4
2 x G/E LO Sump Tank	1.0
Purifier Sludge Tank	8.5
Cylinder Oil Storage Tank	46.9
Turbine LO Storage Tank	6.7

4.1. LO Transfer & Purifying System

4.1.1. General

The system is designed for bunkering lube oil from shore, storage and transfer to LO service systems, and serving generator engines. All of the storage tanks are filled from connections on the bunker stations of the upper deck.

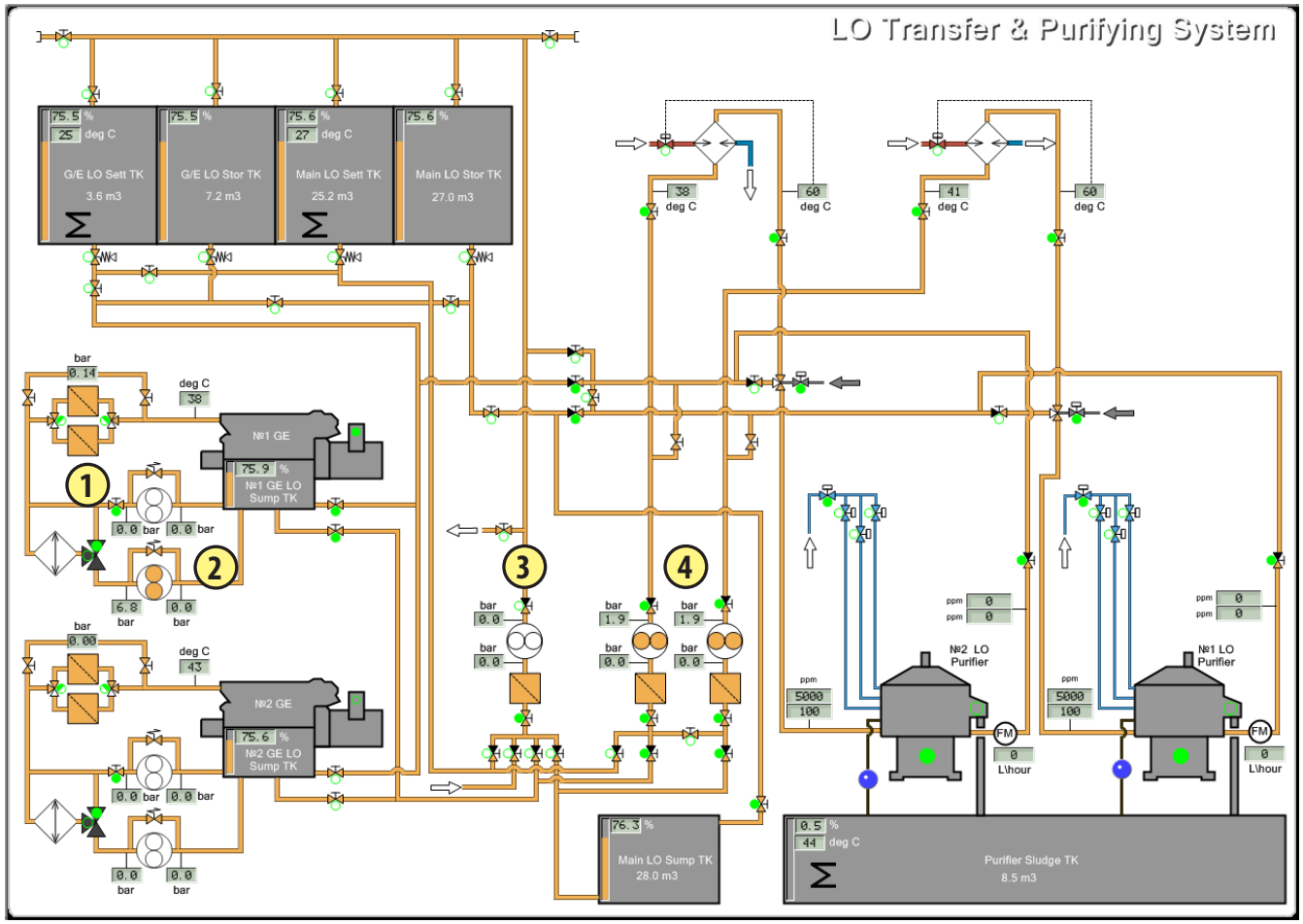
Click on the menu item **LO Transfer & Purifying System** of the page **SYS** to open the system diagram.

4.1.2. Content

- **№1 (№2, №3) GE** units; each unit comprises: engine run indicator; pumps; **GE LO Filters**; **GE LO Cooler**;

Tank	Volume m³
Main LO Storage Tank	27.0
Main LO Settling Tank	25.2
G/E LO Storage Tank	7.2
G/E LO Settling Tank	3.6
Main LO Sump Tank	28.0
2 x GE LO Sump Tank	1.0
Purifier Sludge Tank	8.5

- (1) **№1 (№2) GE LO Pre-lub Pump** – 2.6 m3/h x 1.5 kg/cm2;
- (2) **№1 (№2)GE LO Driving Pump** – 17.2 m3/h x 7.8 kg/cm2;
- (3) **LO Transfer Pump** – 5 m3/h x 3 kg/cm2;
- **№1 (№2) Purifier** units, each with purifier open indicator and run indicator;
- (4) **№1 (№2) Purifier Feed Pump** – 2 m3/h x 3 kg/cm2;
- **№1 (№2) Purifier Heater** units;
- Pipelines with valves, filters, measuring gauges.



4.1.3. Connections

- From/To Steam Distribution System
- To/From S/T LO Drain TK
- Compressed Control Air
- Control Water To Purifier.

4.1.4. Control

4.1.4.1. Controls on Diagram

Quick Closing Valves of LO Storage and Settling tanks are used to cut off LO supply in the case of emergency.

Attention! When starting LO purifiers open Inlet/Outlet valves on required tanks to establish the oil flow to the purifier.

4.1.4.2. GE LO Priming Pumps

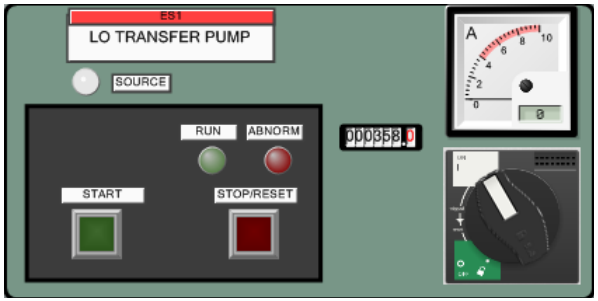
LO Pre-lub (priming) pumps are powered and started from:

- **№1 GE LO Pre-lub Pump – No.1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No1 G/E LO PRIMING PUMP STARTER** circuit breaker;
- **№2 GE LO Pre-lub Pump – No.2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No2 G/E LO PRIMING PUMP STARTER** circuit breaker.

4.1.4.3. LO Transfer Pump

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **L.O. TRANSFER PUMP** starter panel.



4.1.4.4. LO Purifiers Control Panel

Click the menu item **LO Purifiers 1, 2 LOP** of the page **ER2** to open the display with two identical **No.2 (No.1) L.O. PURIFIER** panels.

LO Purifiers panels are similar to HFO Purifiers panels. Description is given in *the paragraph 3.2.4.2 on page 132*. The general description of a starter panel is given in Introduction *the section 5 on page 12*.

Switch power supply 440 V for LO Purifiers on the **No. 4 GROUP STARTER PANEL** (use menu item **GSP 4** of the page **ER3**) on the starter panels **No. 2 MAIN LO PURIFIER** and **No. 1 MAIN LO PURIFIER**.

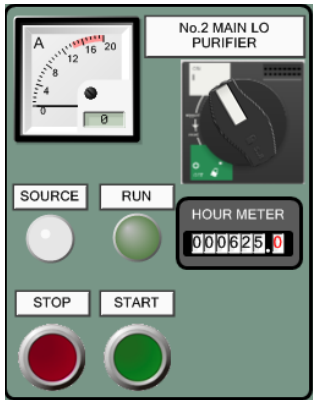
Switch power 440V for **No.4 GROUP STARTER PANEL:**

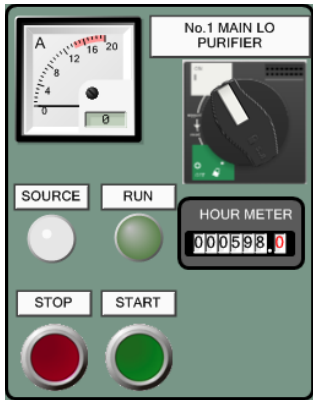
- on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL** (**No.1 SECTION**) circuit breaker;
- on **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 4 LOCAL GROUP STARTER PANEL** (**No.2 SECTION**) circuit breaker.

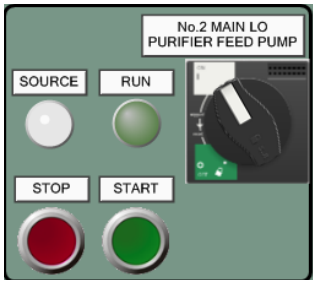
4.1.4.5. LO Purifiers Feed Pumps

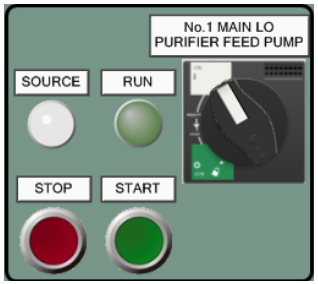
The general description of a starter panel controls is given in Introduction *the section 5 on page 12*.

Click the menu item **GSP 4** of the page **ER3** to open the display with the **No.2 MAIN LO PURIFIER FEED PUMP** and **No.1 MAIN LO PURIFIER FEED PUMP** starter panels.









4.1.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.13 on page 273*, and *the paragraph 2.11.6 on page 275*.

4.2. ME LO Service System

4.2.1. General

The system is designed for lubrication of the ME. The main engine has two separate lubricating oil systems:

- Main bearing lubricating oil system;
- Cylinder oil system

The main or crankcase lubrication system is supplied by one of two pumps. The pumps will be operating automatically in duty/standby configuration. Lubrication of the pistons and cylinders is performed by a separate cylinder lubrication system (mechanical lubricators).

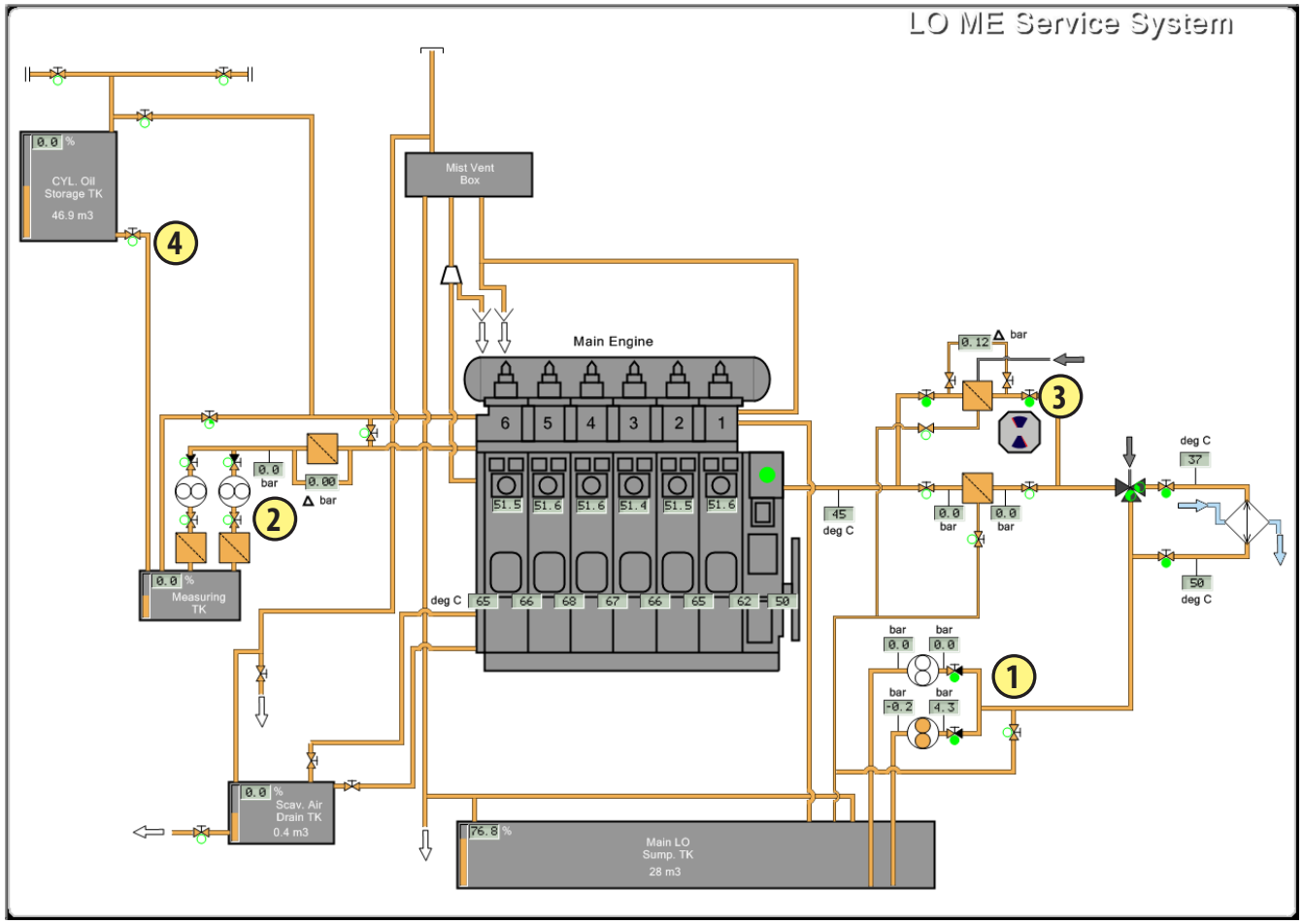
Click on the menu item **LO ME Service System** of the page **SYS** to open the system diagram.

4.2.2. Content

- Main Engine unit comprising:
  - Engine run indicator;
  - Digital indicators of the oil temperature in Cylinders, Main Bearings and Thrust Bearing.

Tank	Volume m³
Main LO Sump Tank	28.0
ME Scavenge Air Drain Tank	0.4
Cylinder Oil Storage Tank	46.9
Measuring Tank	0.028

- (1) **№1 (№2) ME LO Pump** – 295 m3/h x 4,3 kg/cm2;
- (2) **Cyl. Oil Booster Pump №1 (№2)** – 0.8 m3/h x 50 kg/cm2;
- **ME LO Cooler** unit;
- (3) **ME LO Automatic Filter** – operating pressure 4.3 bar;
- **ME LO By-Pass Filter**;
- Cylinder Oil Bunkering Station (Port and Stbd);
- Pipelines with valves, filters, measuring gauges.



4.2.3. Connections

- To Sep. Bilge Oil TK
- To Sludge Pump
- Control Air To ME LO Automatic Filter
- Compressed Control Air
- FROM/To LT Cooling System

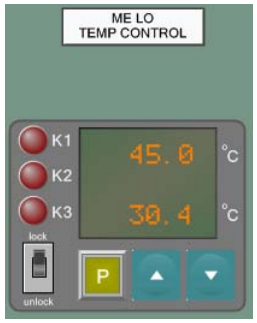
4.2.4. Control

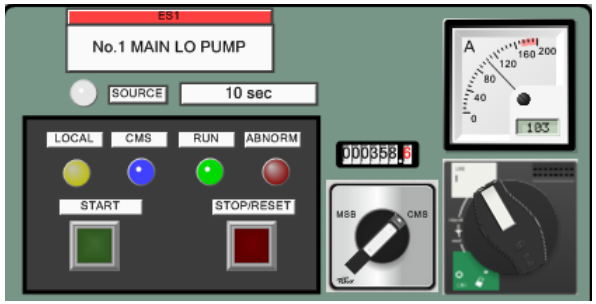
4.2.4.1. Controls on Diagram

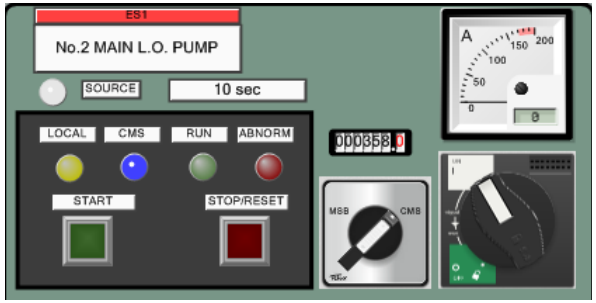
④ **CYL Oil Storage TK Outlet** valve is used for cylinder lubrication oil supply.

Filter clogging in ③ **ME LO Automatic Filter** is displayed by the image with two blue sectors. Sectors turn to red to indicate clogging. Clogging condition is set by the Instructor fault.

Switch the power supply 440 V for the LO auto filters on the **No. 4 GROUP STARTER PANEL** (use menu item **GSP 4** of the page **ER3**) by **M/E L.O. AUTO FILTER** circuit breaker.







4.2.4.2. ME LO Pumps

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

Click the menu item **GPBP-3** of the page **ER1** to open the display with panels:

- **No 1 MAIN LO PUMP**;
- **No 2 MAIN LO PUMP**;
- **ME LO TEMP CONTROL** gauge to automatically operate 3-way LO Cooler valve; controller description is given in Introduction, *the paragraph 5.3 on page 13*.

Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No 1 MAIN LO PUMP** starter panel.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No 2 MAIN LO PUMP** starter panel.

The Main LO pumps operate in duty/standby configuration.

4.2.4.3. ME Cylinder Lubricator Pumps

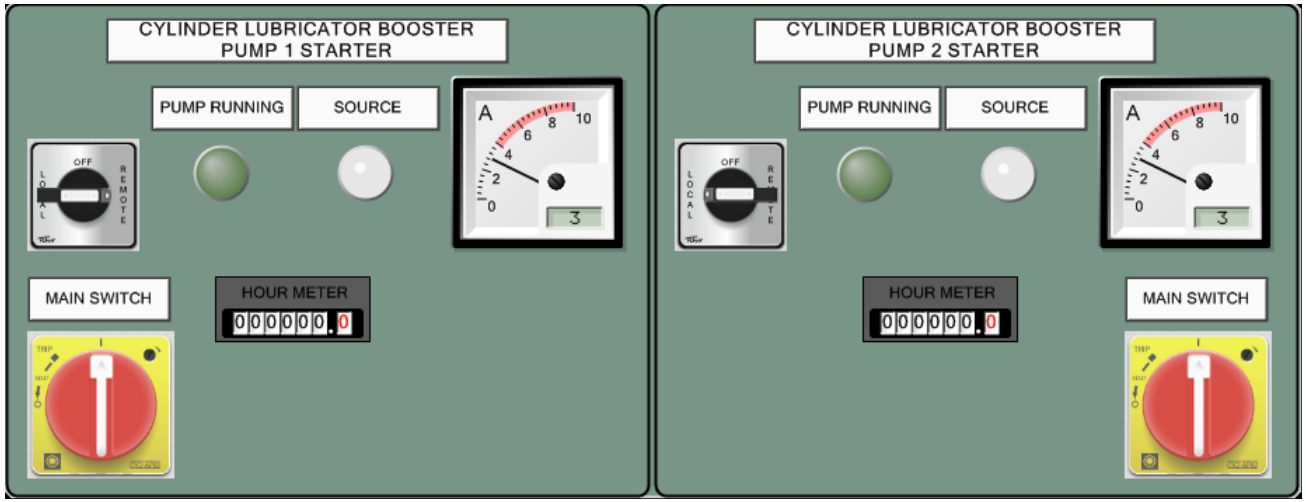
Click the menu item **Cyl. Lubricator Pumps LOP** of the page **ER2** to open the display with **CYLINDER LUBRICATOR BOOSTER PUMP STARTER 1** and **CYLINDER LUBRICATOR BOOSTER PUMP START-ER 2** identical panels:

Each panel contains:

- **MAIN SWITCH** automatic circuit breaker;
- Three-position mode selector switch:
  - **LOCAL** – to start the pump by MAIN SWITCH close;
  - **OFF** – to turn the pump off;
  - **REMOTE** – control from the **CYLINDER LUBRICATOR DIS-PLAY** on the ECR console ECC C Bottom (use menu item **ECC C Bottom** of the page **ECR**).
- **PUMP RUNNING**; **SOURCE** indicator lamps;
- Ammeter;
- **HOUR METER**.

Switch power 440V for:

- **ALPHA LUB. BOOSTER PUMP 1** on **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 1 CYLINDER LUBRICATOR OIL BOOSTER PUMP** circuit breaker;
- **ALPHA LUB. BOOSTER PUMP 2** on **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 2 CYLINDER LUBRICATOR OIL BOOSTER PUMP** circuit breaker.



Remote control on ECC C Bottom console

4.2.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.9 on page 272*, and *the paragraph 2.10.7 on page 275*.

4.3. LO Stern Tube System

4.3.1. General

The system is designed for lubrication of the Stern Tube.

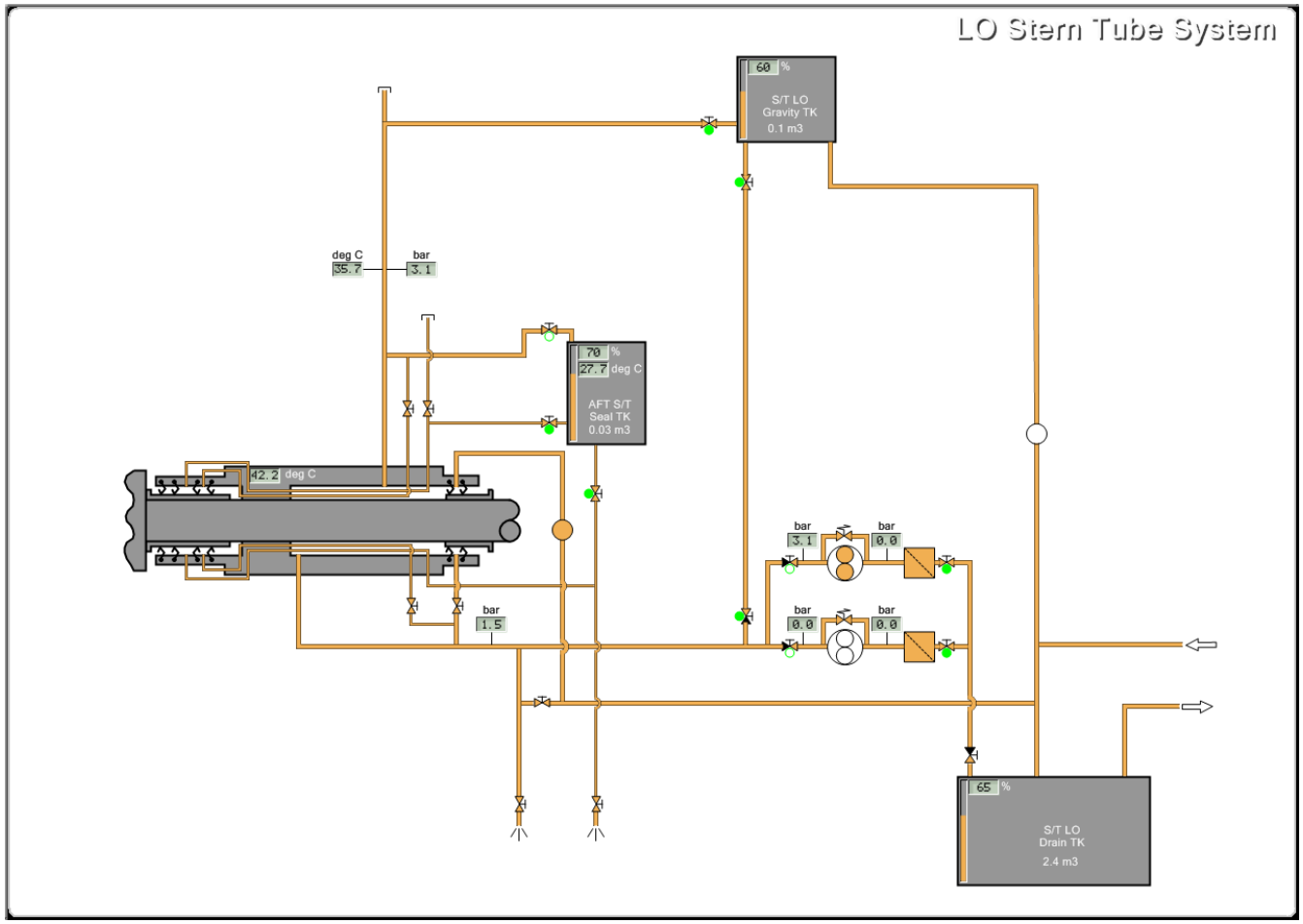
Click on the menu item **LO Stern Tube System** of the page **SYS** to open the system diagram.

4.3.2. Content

- **Stern Tube** unit with **Aft Bearing Temp** digital indicator;
- **AFT S/T Seal TK** – 0.03 m^3;
- **S/T LO Gravity TK** – 0.1 m^3;
- **S/T Drain TK** – 2.4 m^3;
- **Stern Tube LO Pump 1 (2)** – 1 m3/h x 2.5 kg/cm2.

4.3.3. Connections

- From/To LO Trans. Pump



4.3.4. Control

Controlled valves on the diagram.

4.3.4.1. S/T LO Pumps

The general description of a starter panel and a push button box controls is given in Introduction, ***the paragraph 5.1 on page 12***.

Click the menu item **GPBP-3** of the page **ER1** to open the display with push button boxes:

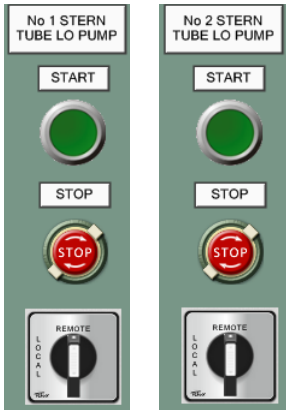
- **No 1 STERN TUBE LO PUMP**;
- **No 2 STERN TUBE LO PUMP**.

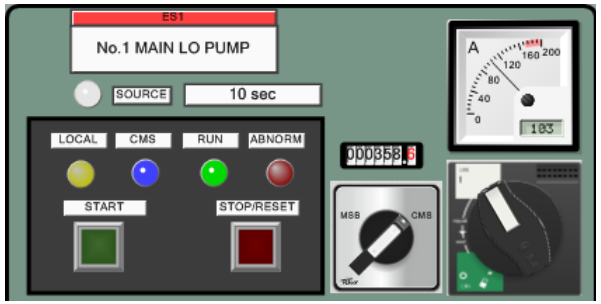
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

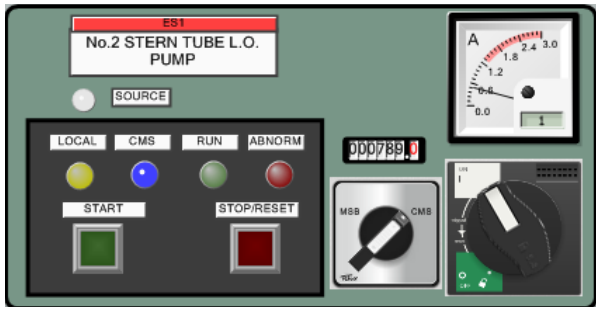
Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No 1 STERN TUBE L.O. PUMP** starter panel.

Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display with the **No 2 STERN TUBE L.O. PUMP** starter panel.

The S/T LO pumps operate in duty/standby configuration.







4.3.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.3 on page 272***, and in other respective paragraphs.

4.4. Steam Turbines LO System

4.4.1. General

The Steam Turbines LO system is designed for lubricating and control of the turbines.

Control oil is used for control of the manoeuvring valve during the turbine operating mode change.

Click on the menu item **LO Steam Turbines System** of the page **SYS** to open the system diagram.

4.4.2. Content

- **Cargo Oil Pump Steam Turbine №3 (№2, №1), Water Ballast Pump Steam Turbine, Turbo-Generator Steam Turbine** similar units; each unit comprising:
  - **LO Sump TK** with **Main LO Pump** and **Strainer**;
  - **Aux Oil Pump** – 4 m3 x 3 bar;
  - Driven LO Pump – 12 m3 x 6 bar;
  - **LO Cooler** and duplex **Filter 1, 2**.
- **Turbine LO Storage TK** – 6.7 m^3;
- Pipelines with valves, filters, measuring gauges.

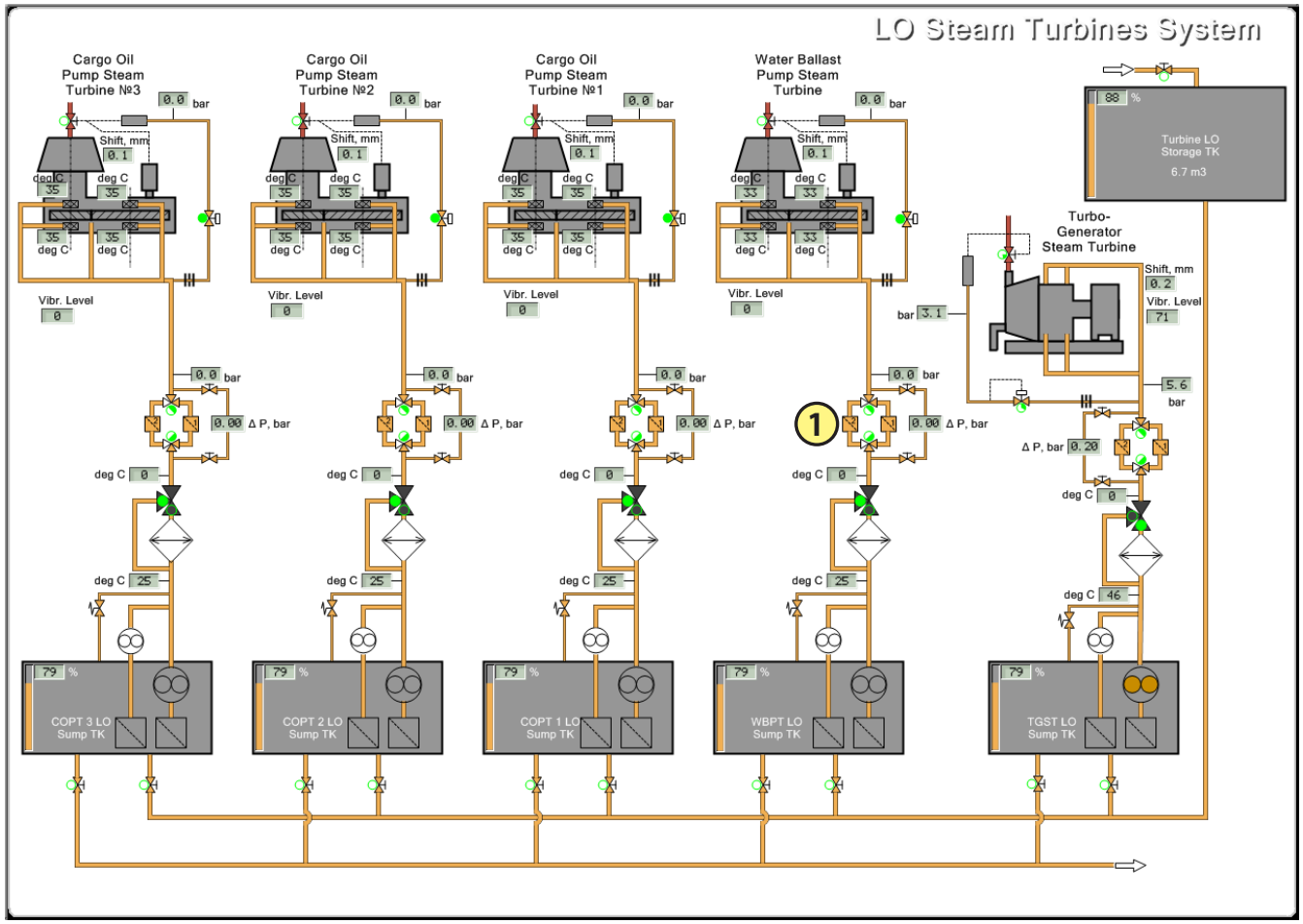
4.4.3. Connections

- To Separated Bilge Oil Tank
- Make Up

4.4.4. Control

① Duplex **Filter** fouling is modeled by introducing instructor fault, and indicated on the pressure difference gauge **Δ P bar**.

To clean/replace the filter switch (double-click) any one of the 3-way **Change Over Filter Valve**.



4.4.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.4 on page 272*, and in other respective paragraphs.

5. Steam Plant

5.1. General Description

The Steam Plant is designed for steam production and distribution to consumers. The boilers operates as a back-up system for the exhaust gas economizer and will only start when the steam pressure falls below the set point. This is the normal arrangement for the boiler plant which must always be kept in a state of readiness.

The Boilers Monitoring & Control System (BMCS) is supervising the boilers operation is automatic mode (see the description in Chapter 2, ***the section 2.2 on page 76***).

The Plant includes the following systems:

- Aux. Boiler 1 and 2 Feed Water System;
- Aux. Boiler Steam Service System;
- Aux. Boiler Condensate System;
- Economizer;
- FO Service for Aux. Boiler System (see the description in ***the paragraph 3.5 on page 146***).

The Plant operation mode depends on the requirements of the steam consumption and can run economizer only, economizers and boiler(s), or boiler(s) only.

Boiler – prototype is Aalborg model CPH-10 with steam atomizing burner, cylindrical combined water and fire tube.

Boiler capacity: 30 000 kg/h at 16 bar.

Economizer prototype is Aalborg, model AV-6N; type Finned tube.

Economizer capacity: 1 200 kg/h at 7 bar; working pressure: 7 bar (18 bar Max); working temperature: 170 °C. Economizer circulation pump capacity: 8 400 kg/h.

Manual control of the Steam Plant is possible using the local control panels and local power panel.

5.2. Boilers Feed Water & Condensate System

5.2.1. General

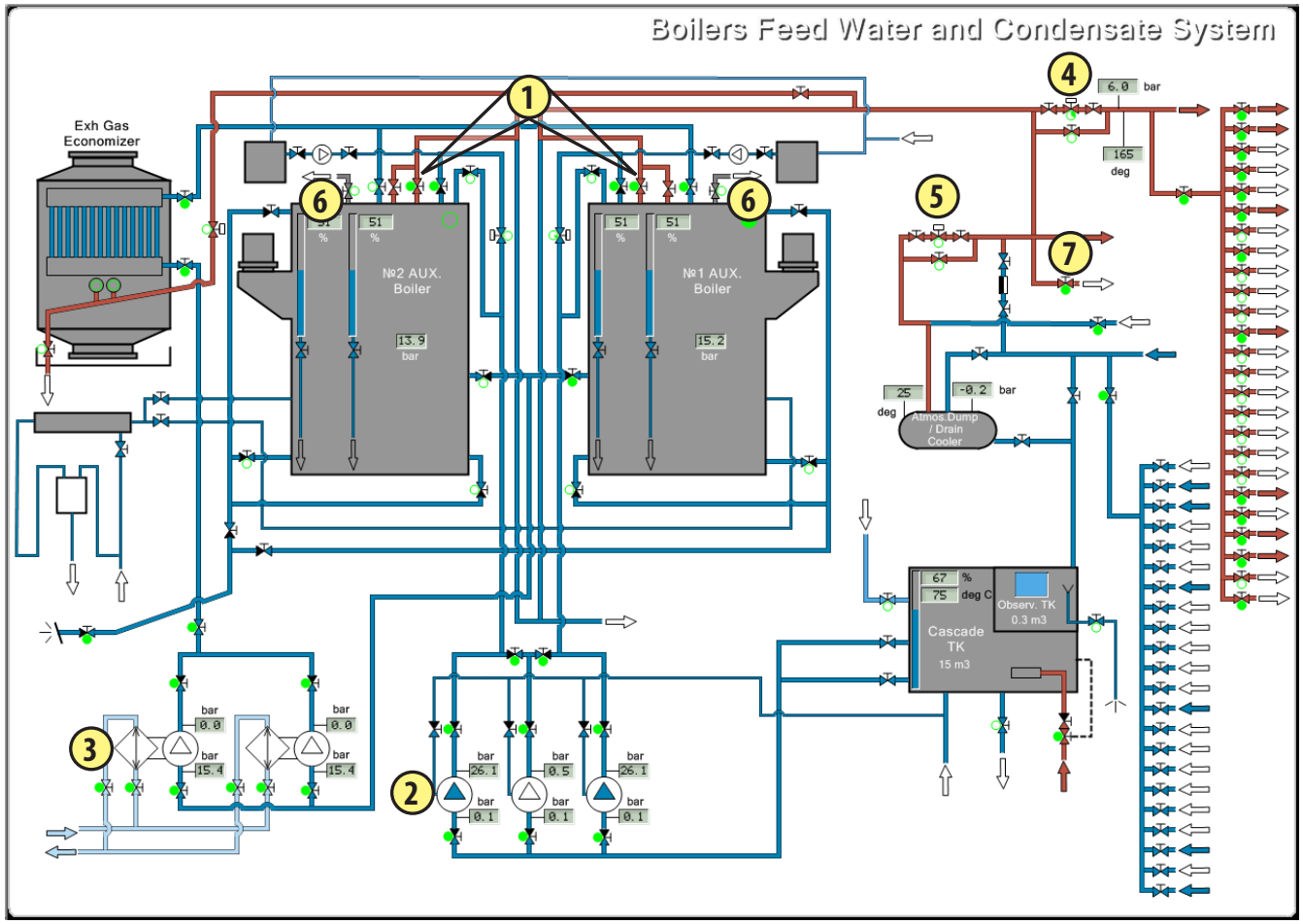
The oil fired boilers are supplied with feed water from the hot well by one of the three boiler feed water pumps (operating in duty/standby configuration).

The exhaust gas economizer, when in service, is circulated with water taken from the oil fired boiler by two circulation pumps. The feed water pumps will automatically fill and maintain the boilers at the correct level.

The main condensate system, as part of the steam generating cycle, is the section concerned with the collection of condensed steam and its discharge to the hot well. To obtain the maximum benefit from steam as a heating medium, it condenses in the heating coils as it recovers the latent heat of evaporation in the steam. Drain traps are fitted at the outlets from such heating coils, so that only water is allowed to pass.

This is the condensate which is returned to the hot well. Depending upon the heating application, the returning condensate can be very close to boiling temperature. This high temperature can cause the water in the hot well to be of too high a temperature for the feed pumps to handle, without the risk of 'gassing-up'. Drain coolers are used to reduce the temperature of the condensate returning to the hot well.

Click on the menu item **Boilers Feed Water and Condensate System** of the page **SYS** to open the system diagram.



5.2.2. Content

- **№2 (№1) Aux. Boiler**;
- (1) **BLR (1, 2) Steam Outlet Main Valve** on **Steam Service** line;
- (2) **Aux Boiler Feed Pump 1, 2, 3** – 33 m3/h x 22 kg/cm2;

- **Exhaust Gas Economizer** with run indicators of two **Soot Blowers**; indicators illuminate when blowers are operating;
- (3) **№2 (№1) Circ. Water Pump For Economizer** – 10 m3/h x 2 kg/cm2;
- **BLR (1, 2) Chemical Dosing Pump** – 0.06 m3/h x 16 bar ;
- **Obser. TK** – 0.3 m3
- **Cascade TK** – 15.0 m3;
- **Sampling Cooler**;
- **Atmos. Dump/Drain Cooler**;
- (4) **Steam 6k Regulating Valve** and by-pass valve;
- (5) **Steam 16k Regulating Valve** and by-pass valve;
- (7) **To Stripping Pump Valve**;
- A set of tanks and units that are heated by steam from the Steam Plant;
- A set of tanks and units, from which steam condensate is returned;
- Pipelines with valves, filters, measuring gauges.

5.2.3. Connections

- To/From LT CFW Sys
- From FW Service Sys
- To Bilge
- To Scupper
- To Drain
- To Condensate Sys
- From Condensate Water P/P
- To Separated Bilge TK
- From Main Steam
- To Deck Service
- To Aux BLR FO Heaters
- To ME/GE FO Heaters
- To Main LO Purifiers Heaters
- To HFO Purifiers Heaters
- To FWG Heater
- To GE LO Sett.TK Heating
- To ME LO Sett.TK Heating
- To Incin.Waste TKs Heating
- To Purifier Sludge TK Heating
- To Separated Bilge Oil TK Heating
- To FO Overflow/Drain TK Heating
- To ME Jacket FW Preheater
- To LS HFO Service TK Heating
- To HFO Service TK Heating
- To HFO Settling TK Heating
- To No 2 HFO Storage TK(P) Heating
- To No 1 HFO Storage TK(P) Heating
- To No 1 LS HFO Storage TK(S) Heating
- To No 2 LS HFO Storage TK(S) Heating
- To Calorifier Heating
- To Sea Chest Heating
- To Cascade TK Heating
- To Steam Tracing
- To Bilge Hold TK Heating
- To Cargo Oil Turbine P/P
- To Cargo Oil Stripping P/P
- Condensate From Cargo Oil Turbine P/P
- Condensate From Aux BLR FO Heaters
- Condensate From ME/GE FO Heaters
- Condensate From Main LO Purifiers
- Condensate From HFO Purifiers Heaters
- Condensate From FWG Heater
- Condensate From GE LO Sett.TK Heating
- Condensate From ME LO Sett.TK Heating
- Condensate From Incin.Waste TKs Heating
- Condensate From Purifier Sludge TK Heating
- Condensate From Separated Bilge Oil TK Heating
- Condensate From FO Overflow/Drain TK Heating
- Condensate From ME Jacket FW Preheater
- Condensate From LS HFO Service TK Heating
- Condensate From HFO Service TK Heating
- Condensate From HFO Settling TK Heating
- Condensate From No 2 HFO Storage TK(P) Heating
- Condensate From No 1 LS HFO Storage TK(S) Heating
- Condensate From No 2 LS HFO Storage TK(S) Heating
- Condensate From Calorifier Heating
- Condensate From Bilge Hold TK Heating
- Condensate From Cargo Stripping P/P
- Condensate From Deck Service

5.2.4. Control

(1) **BLR (1, 2) Steam Outlet Main Valve** – for use to supply steam to consumers.

(6) **Oil Fired Boiler 1 (2) Vent Valve** – for use in emergency.

Boilers control is described in ***the section 5.4 on page 160***.

(7) **To Stripping Pump Valve** – for use to supply steam for driving the stripping pump during joint operation with LCHS.

5.2.5. Faults Introduced by Instructor

No faults are introduced.

5.3. Steam Turbines Service System

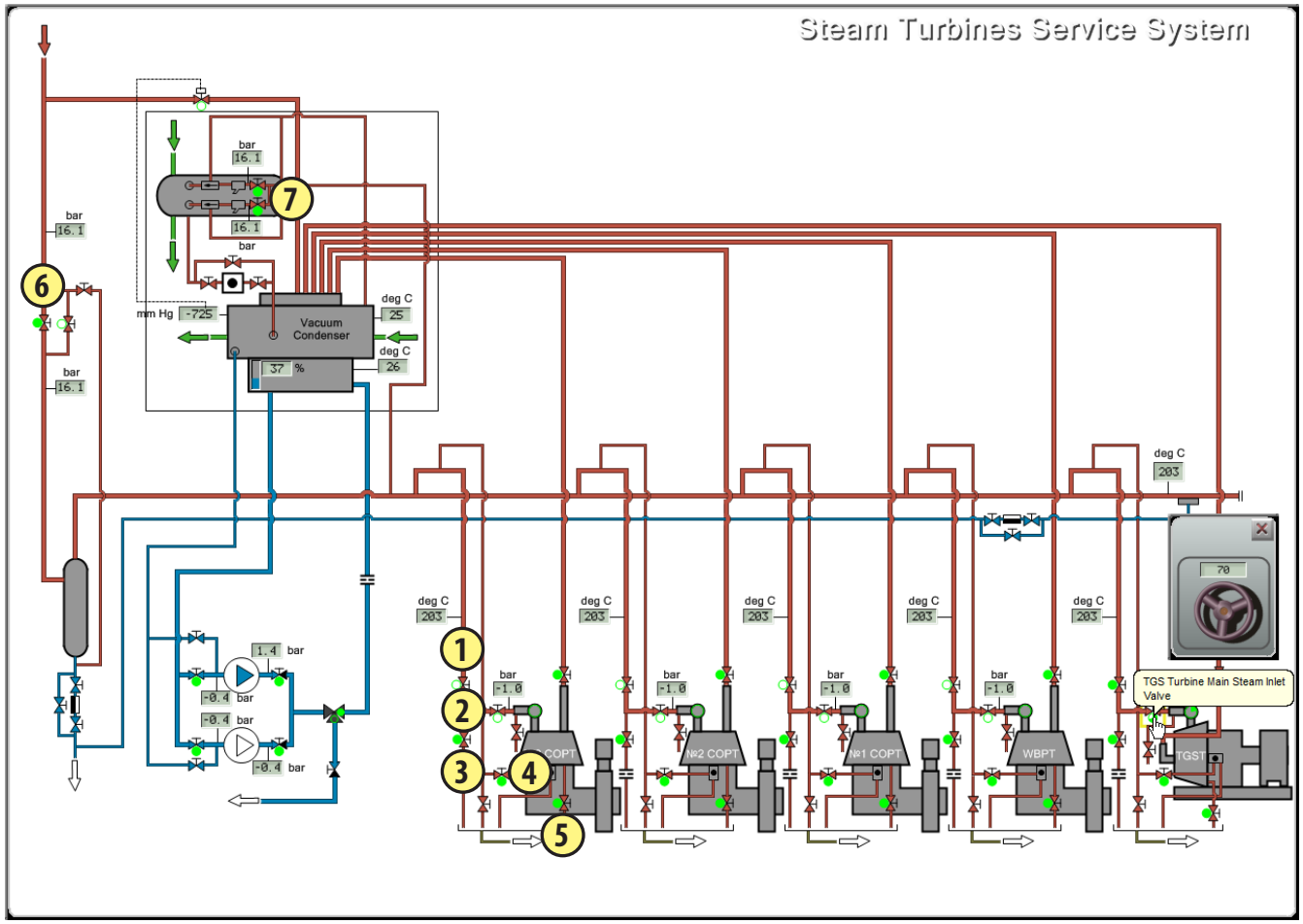
5.3.1. General

Saturated steam is supplied by the boilers. There is no provision for superheating steam. Steam supply is reduced to working pressure of 14.5 bar (max 16 bar) by each turbine Main steam inlet (safety) valve. Drainage is provided for the turbine and casing to condensate line.

Click on the menu item **Steam Turbines Service System** of the page **SYS** to open the system diagram.

5.3.2. Content

- **COPT №1, COPT №2, COPT №3; WBPT** and **TGST** units; each turbine unit comprises:
  - (1) **Main Steam Shut-Off Valve**;
  - (2) **Main Steam Inlet Valve** – 0–100 open position is controlled by local panel with the wheel handle; inlet steam pressure gauge;
  - (3) **Inlet Steam Pipe Drain Valve**;
  - (4) **Steam Gland Inlet Valve**;
  - (5) **Casing Drain Valve**.
- (6) **Main Steam Shut-off valve** and **Warm-up Valve** on the 16 bar steam service line;
- (7) **Steam Ejector Valve 1 (2)**;
- **Condensate Water Pump 1 (2)** – 50 m3/h x 2 kg/cm2;
- **Vacuum Condenser** with pressure and temperature gauges;
- Pipelines with valves, filters, measuring gauges.



5.3.3. Connections

- From 16 K Steam Service
- To Condensate Line
- To Cascade Tank
- To SW Cooling System
- From SW Cooling System
- To Bilge Well

5.3.4. Control

The turbines are started manually using the control valves on the system diagram and respective local panels.

5.3.4.1. Local Control Panels

Cargo Oil Pump Turbine 1, 2, 3 LOPs are described in ***the paragraph 7.7.2.1 on page 203***. Water ballast turbine LOP is described in ***the paragraph 7.7.2.2 on page 205***.

Turbo Generator turbine LOP is described in Chapter 3, ***the paragraph 3.3 on page 88***.

5.3.4.2. Condensate Water Pumps

The general description of a starter panel and a push button box controls is given in Introduction, ***the paragraph 5.1 on page 12***.

Click the menu item **GPBP-9** of the page **ER1** to open the display with push button boxes:

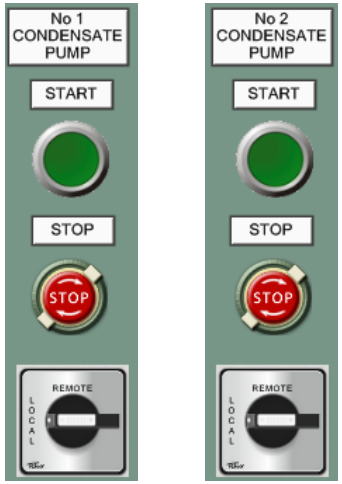
- **No 1 CONDENSATE PUMP**;
- **No 2 CONDENSATE PUMP**.

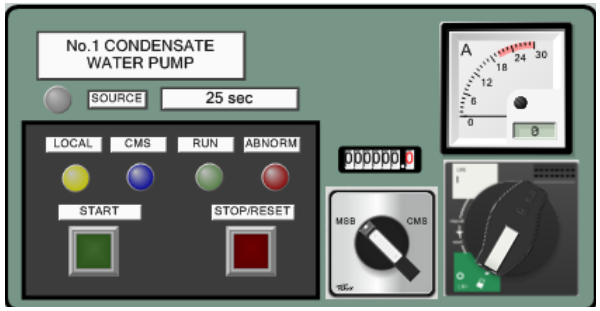
Set the two-position mode selector switch to position **REMOTE** to enable pump remote control from MSB or CMS.

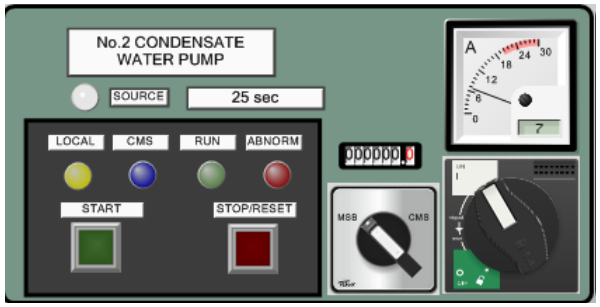
Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No. 1 CONDENSATE WATER PUMP** starter panel.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No. 2 CONDENSATE WATER PUMP** starter panel.

The pumps operate in duty/standby configuration.







5.3.5.1. Starting Turbine

Ensure that one of the boilers is running or ready to start automatically; the **BLR Steam Outlet Main Valve** should be open (see ***the paragraph 5.2.2 on page 155***).

Start one of the **CONDENSATE WATER** pumps (see ***the paragraph 5.3.4.2 on page 158***).

Start one of the **VACUUM CONDENSER S.W.** pumps to establish water flow through the Condenser (see ***the paragraph 2.1.4.4 on page 121***).

1. On the required turbine LOP:
   - › Click **AUX LO PUMP** start button to run the turbine pre-lubricating pump;
   - › For the turbo generator turbine, additionally:
     - Set the handle to **ENGAGE** position to turn the turbine manually; **ENGAGED** label illuminates;
     - Click the green button, and watch the rotation speed reading, on the turbine **RPM** indicator.
     - Click the red button to stop the turbine;
     - Set the handle to **DISENGAGE** position.
   - › Set **MODE** switch to position AUTO.
2. On the **Steam Turbines Service System** diagram:
   - › Open (6) **Warm-up Valve** on the 16 bar steam service line to warm the turbine lines if it is the first turbine to start, otherwise this step can be omitted.
   - › Open (7) **Steam Ejector Valve 1** and **2**.
   - › Open (6) **Main Steam Shut-off valve** and close **Warm-up Valve** to set steam to main line when temperature rises more than 100 °C.
   - › Check out the sufficient vacuum value and sea water flow in the Condenser. Thus the system pipelines are drained and purged, to prevent from turbine safety system activation by shift or temperature.
3. On the **Steam Turbines Service System** diagram for required turbine:
   - › Check/open (3) **Inlet Steam Pipe Drain Valve**.
   - › Open (4) **Steam Gland Inlet Valve**.
   - › Open (1) **Main Steam Shut-Off Valve**.
   - › Click (2) **Main Steam Inlet Valve** to open its control panel. Rotate the wheel to position 15-20% open to slowly start warming up the turbine.
4. On the **LO Steam Turbines System** diagram (see ***the paragraph 4.4.2 on page 153***) monitor the respective turbine parameters: **Shift, mm** (should be in the range 0~0.5) and **Vibr. Level**. Also control alarms and trip conditions on the turbine LOP.
5. If the turbine state is stable continue to slowly open (2) **Main Steam Inlet Valve** and watch the parameters (item 4) until the turbine runs to speed.
6. On the **Steam Turbines Service System** diagram for required turbine running at full speed (for saving steam purposes):
   - › Close (3) **Inlet Steam Pipe Drain Valve**.
   - › Close (5) **Casing Drain Valve**.

5.3.5.2. Stopping Turbine

To stop the turbine normally, slowly close (2) **Main Steam Inlet Valve** and open drain valves. All start steps can be implemented in reverse order. To stop turbine in emergency use the button with protection cover on the LOP.

5.3.5. Faults Introduced by Instructor

No faults are introduced.

5.4. Steam Plant Control

There are two boilers in the ship steam plant.

Boiler Control (local and remote) is available from:

- Boiler 1 (Boiler 2) Control Panel;
- Boilers Power Panel;
- Boiler PC-based Control system (BMCS).

The boilers monitoring & control system (BMCS) is designed to operate the burner, load control alarms and ancillary systems. The system can be operated in automatic mode from the ECR via the PC control panel of BMCS. The complete plant or parts of the plant can be operated manually should the need arise.

Local operation (from ER4) selects the control panel at the boiler unit for each component group and the groups can then be operated locally on automatic or switched to manual operation.

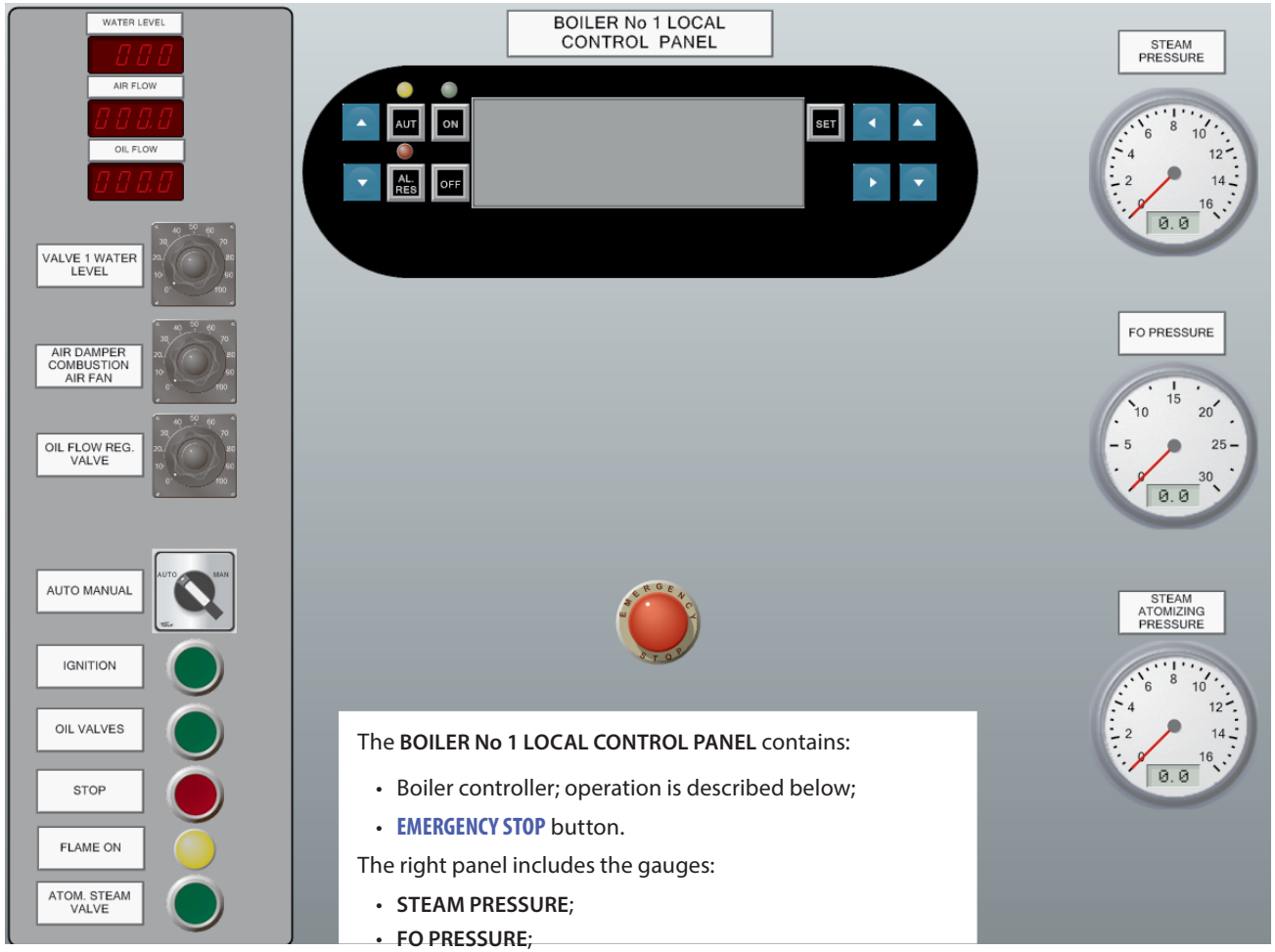
5.4.1. Boiler 1 (2) Control Panel

Click on the menu item **Boiler 1 Control Panel** of the page **ER4** to open the display with three panels. Click on the menu item **Boiler 2 Control Panel** of the page **ER4** to open the similar control panel of the Boiler No.2.

The left panel includes:

- Digital indicators of **WATER LEVEL**; **AIR FLOW**; **OIL FLOW**;
- Potentiometers to control in **MAN** mode:
  - **VALVE 1 WATER LEVEL** – set the open state of the **Feed Water Regulating Valve** (see **Boilers Feed Water and Condensate System** in *the paragraph 5.2.2 on page 155*);
  - **AIR DAMPER COMBUSTION AIR FAN** – set the damper open state (observe on the **BURNER OVERVIEW** display of the page **BMCS**, see Chapter 2, *the paragraph 2.2.1 on page 76*);
  - **OIL FLOW REG. VALVE** – set the open state of the **Fuel Oil Control Valve** (see **FO Aux Boilers System** in *the paragraph 3.5.2 on page 139*).
- **AUTO MANUAL** switch to select the control mode:
  - In **MAN** mode the control is provided from this panel;
  - in **AUTO** mode operation is provided by the Boiler controller (see the description below).

    Note: The **AUTO MANUAL** switch on the **BOILER POWER PANEL** should be also set to AUTO.
- Buttons to operate in **MAN** mode:
  - **IGNITION** – to switch ignition and DO Ignition pump on;
  - **OIL VALVES** – to open BLR 3-Way Fuel Oil Control Valve and Fuel Oil Inlet Valve (see **FO Aux Boilers System** in *the paragraph 3.5.2 on page 139*);
  - **STOP** – to close FO valves and Steam Atomizing Shut-Off Valve;
  - **ATOM. STEAM VALVE** – to open Steam Atomizing Shut-Off Valve.
- **FLAME ON** lamp – illuminates to indicate burner flame.



The **BOILER No 1 LOCAL CONTROL PANEL** contains:

- Boiler controller; operation is described below;
- **EMERGENCY STOP** button.

The right panel includes the gauges:

- **STEAM PRESSURE**;
- **FO PRESSURE**;
- **STEAM ATOMIZING PRESSURE**.

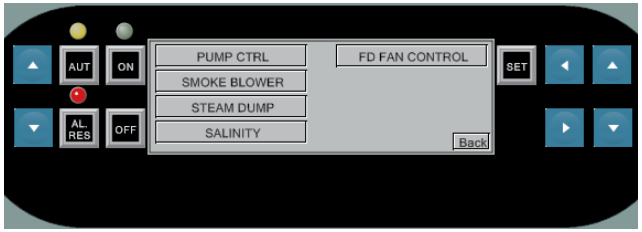
Switch the power supply 440 V for the **BOILER LOCAL CONTROL PANEL** on the **BOILER POWER PANEL** (use menu item **Boiler Power Panel** of the page **ER4**) by the right **SUPPLY FROM MSB No 1/No 2 FEEDER PANEL** circuit breaker (see *the paragraph 5.4.2 on page 164*).

5.4.1.1. Boiler Controller Operation

The controller left part contains the buttons and LED indicators:

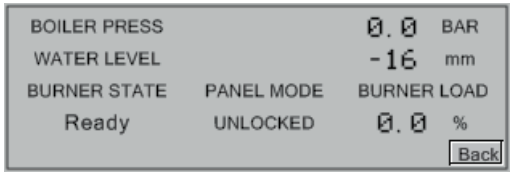
- **AUT** – to switch AUTO/MAN mode; the yellow LED indicator illuminates in **MAN** mode; in **AUTO** mode the lamp is not illuminated;
- **ON** – to start the Boiler in **MAN** mode; the green LED indicator illuminates;
- **OFF** – to stop the Boiler in **MAN** mode; the green LED indicator is not illuminated;
- Red LED indicator blinks when there are any alarms in the Boiler system;
- **AL. RES** – to reset all Boiler alarms and system automatics after the trip condition has been cleared;
- **UP** / **DOWN** – to raise / lower the Burner load by changing the FO Control Valve open state in **MAN** mode.

The buttons in the right part are not modeled.



The controller central part contains the screen where information and controls are presented according to the mode, selected by clicking the buttons. Use small **Back** button in the right bottom corner of any screen to return to previous view.

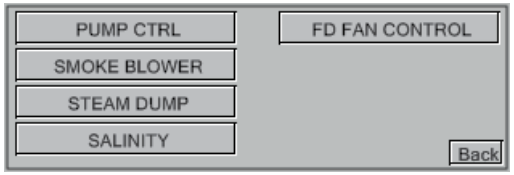
1. Click the **Boiler** button to open the information screen:



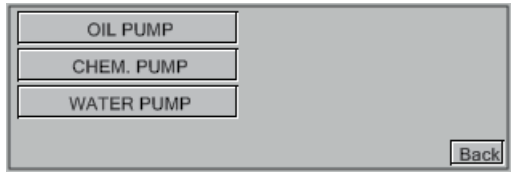
2. Click the **Boiler FO** button to open the information screen:

3. Click the **Combust** button to open the information screen:

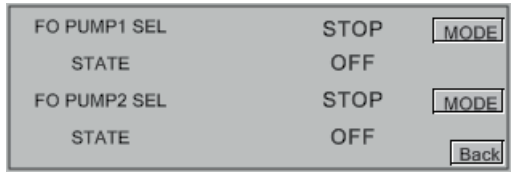
4. Click the **CMN CTRL** button to open the screen with buttons:



4.1. Click the **PUMP CTRL** button to open the screen with buttons to control pumps:

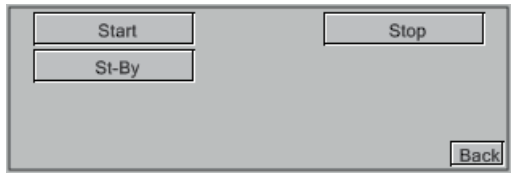


4.1.1. Click the **OIL PUMP** button to open the screen with buttons to control FO pumps:



A FO pump is controlled from this panel if **AUTO** mode is set on both, the **BOILER LOCAL CONTROL PANEL** and the **BOILER POWER PANEL** (use menu item **Boiler Power Panel** of the page **ER4**), see *the paragraph 5.4.2 on page 164*.

Click one of the **MODE** buttons to open the screen with buttons to control selected pump:



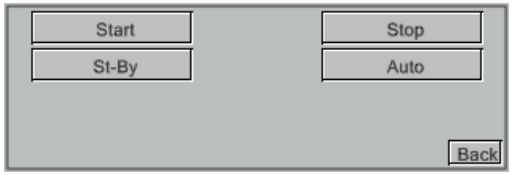
4.1.2. Click the **CHEM PUMP** button to open the screen with **Start\Stop** button to control Chemical pump:

4.1.3. Click the **WATER PUMP** button to open the screen with buttons to control Water pumps:

A **FEED** or **CIRC WATER** pump is operated from this panel if **AUTO** mode is set on the pump starter panel (Chapter 2, *the paragraph 2.2.4 on page 80)*; otherwise control on this panel is disabled.

4.1.3.1. Click the **FEED PUMP** button to open the screen with buttons to control FW pumps:

Click one of the **MODE** buttons to open the screen with buttons to control selected pump:

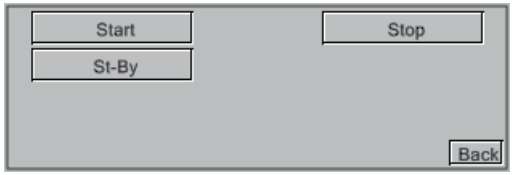


Use **St-By** button to set the pump operation in Stand-by mode.

Use **Auto** button to set the pump automatic operation controlled by the water level sensor in the Boiler.

4.1.3.2. Click the **CIRC. PUMP** button to open the screen with buttons to control water circulating pumps:

Click one of the **MODE** buttons to open the screen with buttons to control selected pump:



4.2. Click the **SMOKE BLOWER** button to open the screen with **START/STOP** button to control the blower:

4.3. Click the **STEAM DUMP** button to open the information screen:

4.4. Click the **SALINITY** button to open the information screen:

4.5. Click the **FD FAN CONTROL** button to open the information screen with the Forced Draft Fan run indicator:

5. Click the **SETUP** button to open the information screen:

BURNER CTRL MODE can be set by the **AUTO MANUAL** switches on the Local Control panel and Power panel; and changed by the **AUT** button of either controller.

SETPOINT SELECT parameter is set in BMCS **Boiler** pop-up panel of the page **BURNER OVERVIEW** (see Chapter 2, *the paragraph 2.2.1 on page 76*). The values denote:

- **LOW** – FO valve open state is limited;
- **HIGH** – FO valve open state is not limited.

5.4.2. Boilers Power Panel

Click on the menu item **Boilers Power Panel** of the page **ER4** to open the display with three panels.

The **BOILER POWER PANEL** contains:

- **COMBUSTION AIR FAN No 2**, **COMBUSTION AIR FAN No 1** ammeters;
- **HOURS METER**(s) of the fans;
- **CONTROL VOLTAGE ON** indicator lamp;
- **EMERGENCY STOP** button.

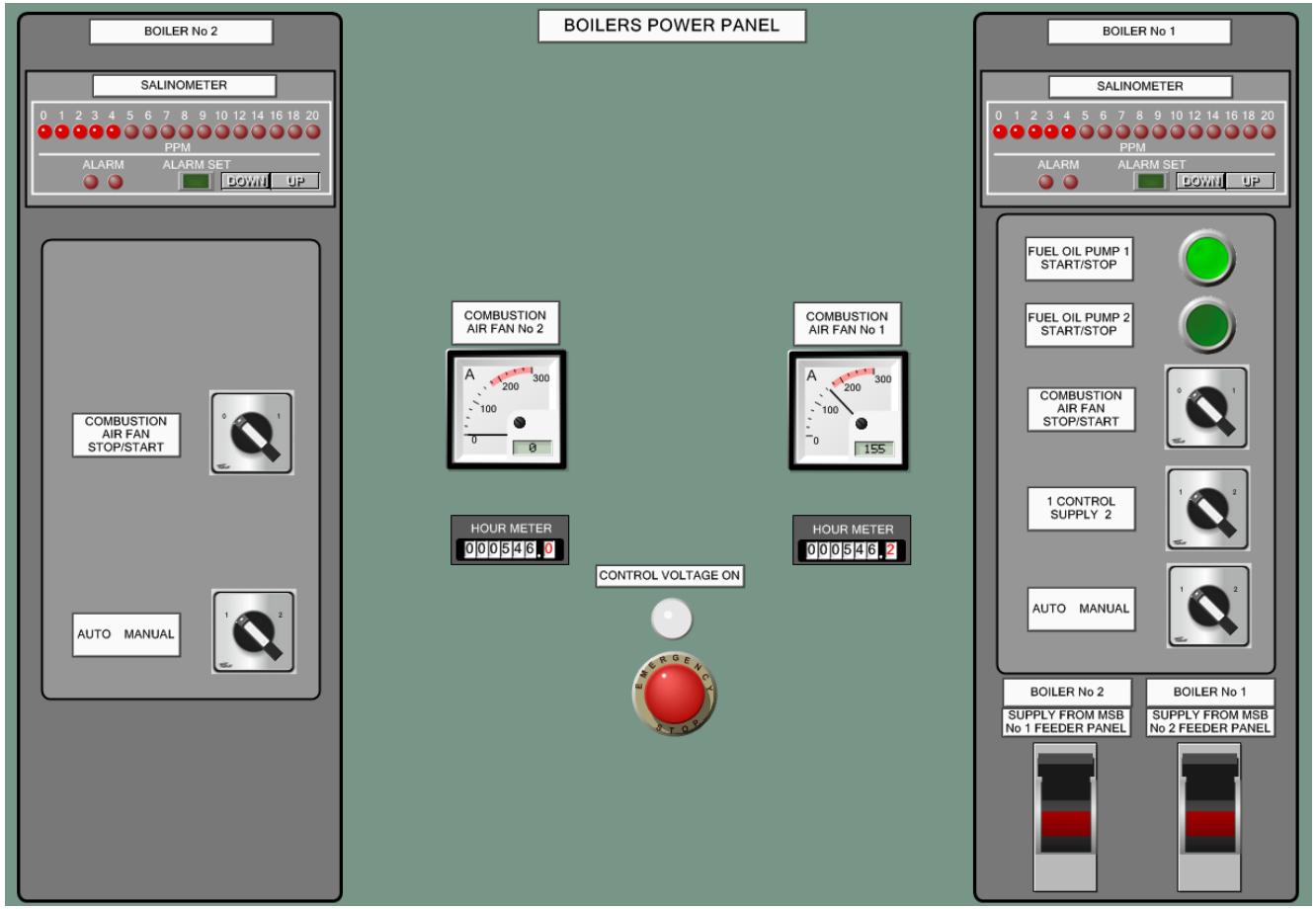
The **BOILER No 2** and **BOILER No 1** panels contain each:

- **SALINOMETER** panel; operation is described below;
- **COMBUSTION AIR FAN STOP/START** two-position switch to stop (**0**) / start (**1**) the fan;
- **AUTO MANUAL** two-position switch to set the control mode for the pumps and fan of respective boiler:
  - In **AUTO** mode the pumps are operated from the **BOILER CONTROL PANEL** controller (see *the paragraph 5.4.1.1 on page 162*);

    Note: The **AUTO MANUAL** switch on the respective **BOILER CONTROL PANEL** should be also set to AUTO.
  - In **MANUAL** mode the pumps and combustion fan are operated from this panel.

The **BOILER No 1** panel additionally contains:

- **FUEL OIL PUMP 1 START/STOP** and **FUEL OIL PUMP 2 START/STOP** buttons to use in **MANUAL** control mode;
- 1 CONTROL SUPPLY 2 switch (not modeled);
- **SUPPLY FROM MSB No 1 FEEDER PANEL** and **SUPPLY FROM MSB No 1 FEEDER PANEL 200 A** circuit breakers to set power supply source for the **BOILER No 2** and **BOILER No 1** control panels, DO Ignition pump, Combustion Air fan and Fuel Oil Pumps 1, 2.



5.4.2.1. Boiler Salinometer Operation

Boiler water quality is continuously checked using a salinometer with an electrode unit fitted on the feed water pump delivery side. If the salinity of the feed water exceeds the chosen maximum value, the alarm Salinity High is activated in BMCS. When salinity > 12 ppm the Boiler is shutdown.

SALINOMETER unit contains:

- **0~20** LED indicators, which highlight to show the **PPM**;
- **ALARM** double indicator, which illuminates when salinity is higher than the set point;
- **ALARM SET** button; click to set point the max ppm; use **DOWN** and **UP** to modify the alarm value; click **ALARM SET** to confirm the setting and return to display mode.

5.4.3. Boiler Water Pumps

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

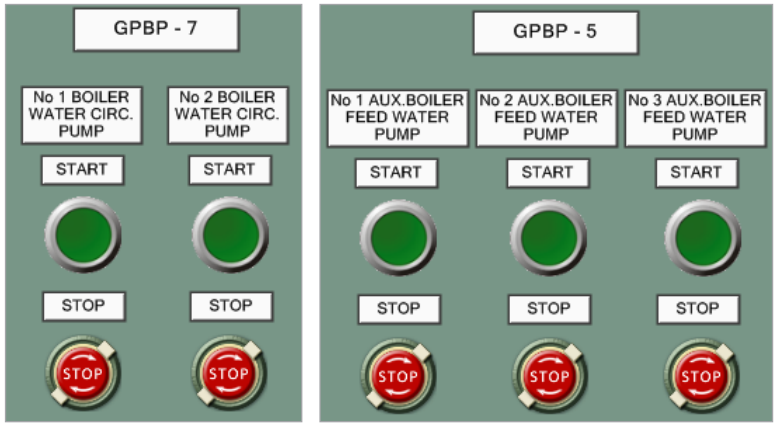
Click on the menu item **GPBP-7** of the page **ER4** to open the display with push button boxes **No 1 BOILER WATER CIRC. PUMP**, and **No 2 AUX BOILER WATER CIRC. PUMP**.

Click on the menu item **GPBP-5** of the page **ER2** to open the display with push button boxes: **No 1 AUX BOILER FEED WATER PUMP, No 2 AUX BOILER FEED WATER PUMP, No 3 AUX BOILER FEED WATER PUMP.**

Set the two-position mode selector switch to position **REMOTE** to enable pump control from MSB.

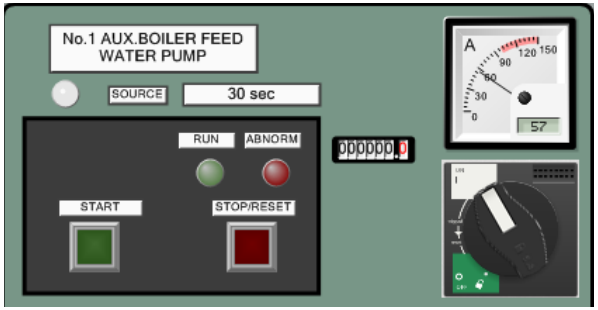
Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No. 1 BOILER WATER CIRC. PUMP** starter panel.

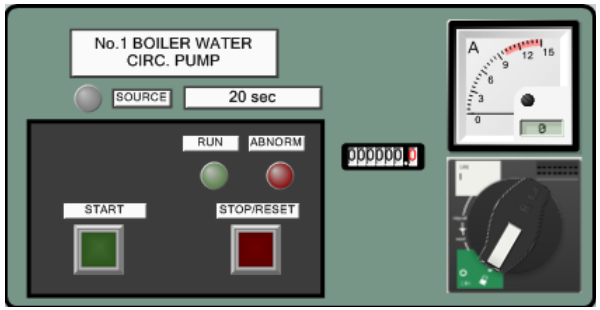
Click the menu item **MSB No 1/2 GSP** of the page **MSB** to open the display with the **No. 1 AUX BOILER FEED WATER PUMP** starter panel.

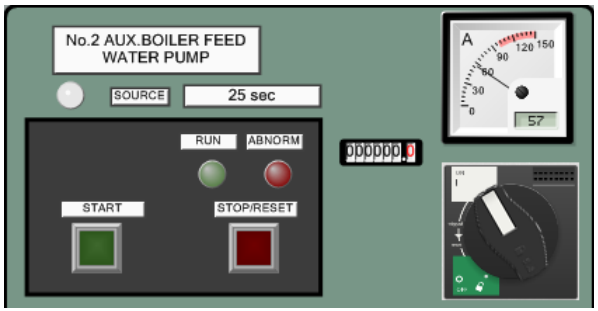


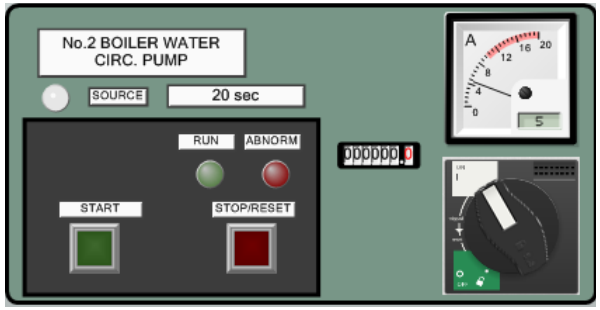
Click the menu item **MSB No 2/1 GSP** of the page **MSB** to open the display with the **No. 3 AUX BOILER FEED WATER PUMP** and **No. 2 AUX BOILER FEED WATER PUMP** starter panels.

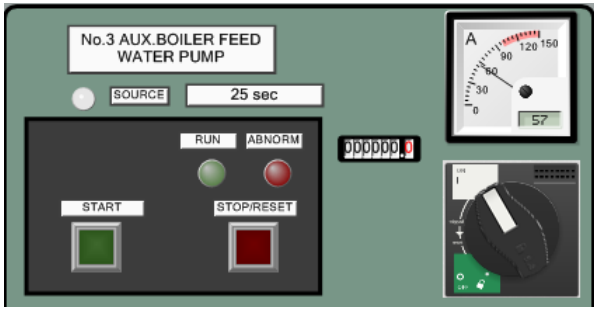
Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No 2 BOILER WATER CIRC. PUMP** starter panel.









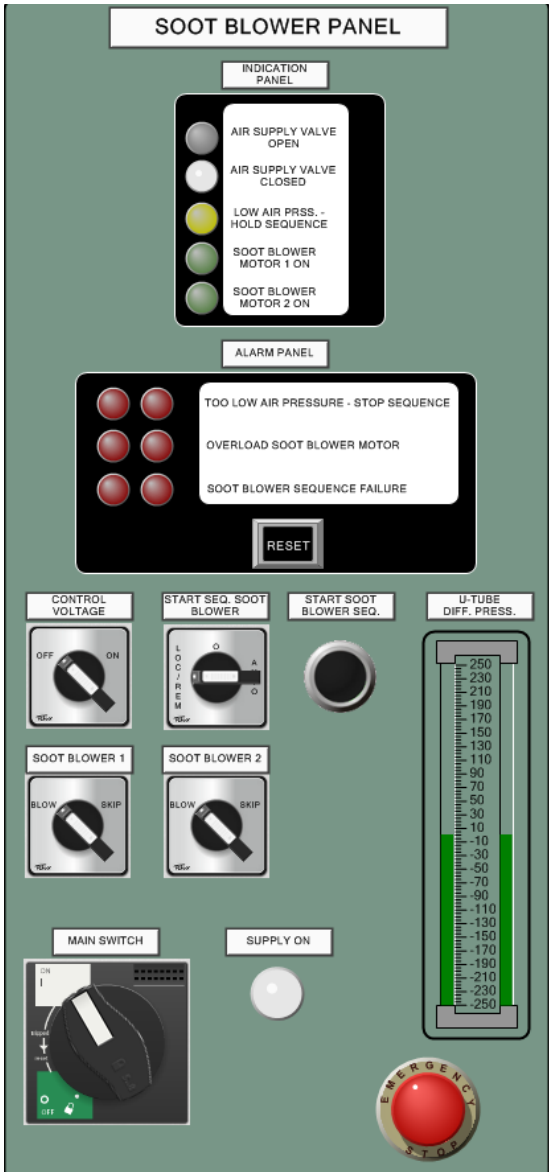


5.4.4. Economizer Soot Blower LOP

Click on the menu item **Economizer Soot Blower LOP** of the page **ER4** to open the **SOOT BLOWER PANEL**. Soot Blower is fitted with the Economizer (see the diagram **Boilers Feed Water & Condensate System** in *the paragraph 5.2.2 on page 155*).

The panel contains:

- **INDICATION PANEL** with the lamps, which illuminate:
  - **AIR SUPPLY VALVE OPEN** and **AIR SUPPLY VALVE CLOSED** to indicate the position of Air Supply Solenoid valve on the diagram **Aux. Boiler Feed Water System**;
  - **LOW AIR PRSS. – HOLD SEQUENCE**;
  - **SOOT BLOWER MOTOR 1 ON**; **SOOT BLOWER MOTOR 2 ON**.
- **ALARM PANEL** with the lamps, which illuminate to indicate emergency trip conditions:
  - **TOO LOW AIR PRESSURE – STOP SEQUENCE**;
  - **OVERLOAD SOOT BLOWER MOTOR** ;
  - **SOOT BLOWER SEQUENCE FAILURE**.
- **RESET** button to reset the system after trip condition has been cleared;
- **CONTROL VOLTAGE** two-position switch to turn OFF–ON control power supply of the panel and valves;
- **START SEQ. SOOT BLOWER** three-position switch to select mode between:
  - **LOC/REM** – control from either this panel or push button box at ECR (see *the paragraph 5.4.5 on page 167*);
  - **O** – blowers are off;
  - **AUTO** – automatic operation according to the defined operating sequence.



- **START SOOT BLOWER SEQ.** button to start the blowers operating sequence in **LOC/REM** mode;
- **U-TUBE DIFF. PRESS.** gauge – to indicate the differential pressure on the economizer exhaust gases;
- **SOOT BLOWER 1** and **SOOT BLOWER 2** two-position switches to set the respective blower operating mode:
  - **BLOW** – run in sequence;
  - **SKIP** – skip blowing (this blower is stopped).
- **MAIN SWITCH** circuit breaker to power the blowers;
- **SUPPLY ON** indicator lamp;
- **EMERGENCY STOP** button.

Switch power supply 440 V for the **SOOT BLOWER PANEL** from the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **SOOT BLOWER** circuit breaker.

Note: Click the button to start the movie, which demonstrates the fires in the Economizer burning up as a result of the soot fouling.

Demonstration

5.4.5. Soot Blower Push Button Box at ECR

Click on the menu item **ECC A** of the page **ECR** to open the ECC with the push button box **SOOT BLOWER**.

Use the buttons **START/RUN** and **STOP** to operate both blowers from the ECR console. Operation is allowed when **START SEQ.** **SOOT BLOWER** switch is in position **LOC/REM** on the local **SOOT BLOWER PANEL** (see *the paragraph 5.4.4 on page 166*).

5.4.6. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.12.6 on page 276*, *the paragraph 2.12.7 on page 277*, *the paragraph 2.12.12 on page 277*.

6. Fire Fighting & ESD Systems

Fire detection and Fire fighting systems are modeled in the simulator by sub-systems:

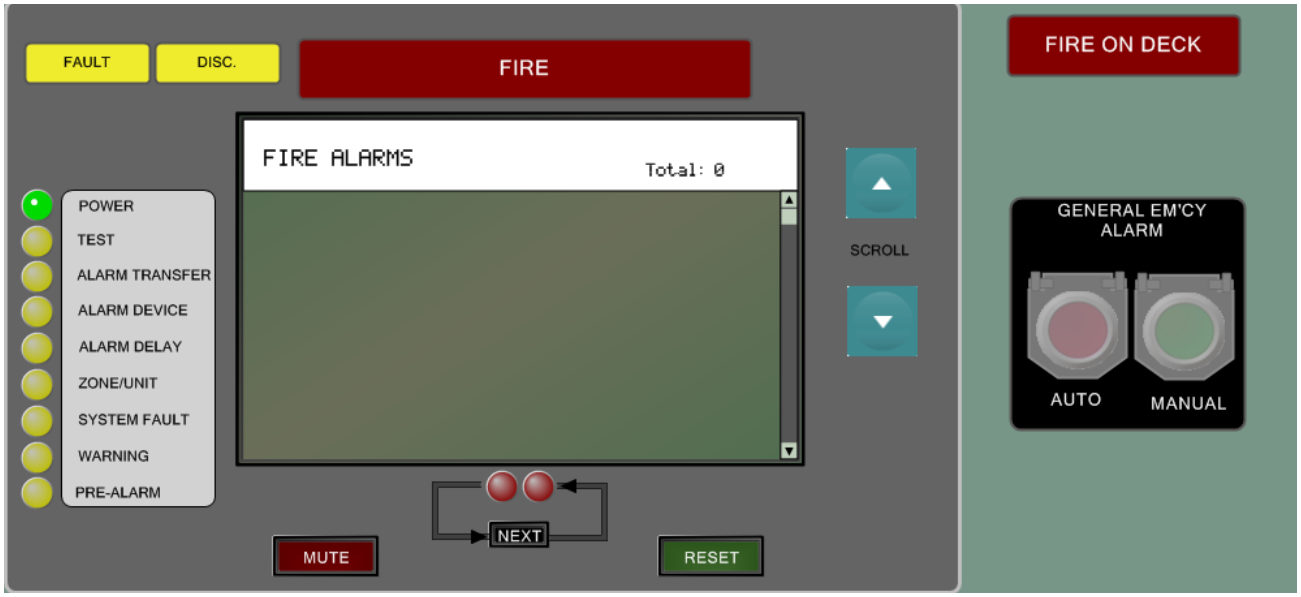
- Fire Detection and Alarm System;
- Quick Closing & Emergency Shutdown System (ESD);
- Fire, Wash Deck & Foam System;
- CO2 System.

6.1. Fire Detection and Emergency Shutdown Panel at the Bridge

Click on the menu item **BCC C** of the page **BCC** to open the display of the Fire Detection Station and emergency shutdown (ES) of the mechanisms remote control panels.

The top part of the display contains:

- Fire Detection Station panel;
- **FIRE ON DECK** indicator having the following states:
  - Not active – no fire is detected;
  - Flashing red – there is an unacknowledged fire alarm;
  - Continuous red – alarm acknowledged by **MUTE** button.



- **GENERAL EM'CY ALARM** panel comprising two buttons with protection cover; click once to open the cover; click second time to select the system control mode:
  - **AUTO** – General Alarm is actuated automatically from Fire Detection Station;
  - **MANUAL** – General Alarm is actuated by clicking this button.

The Fire Detection Station panel includes (description is given for modeled controls only):

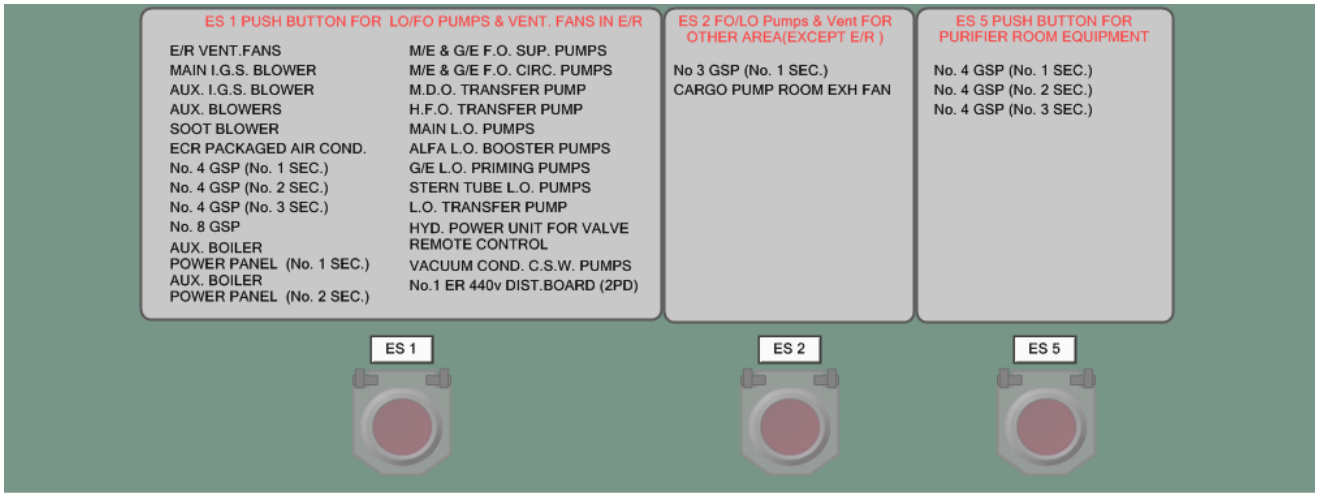
- LED indicating lamps:
  - **POWER** illuminates when the system is powered;
  - Other lamps are not modeled;
- **FIRE** indicator of the fire; flashes with red light when there is an unacknowledged fire alarm at least of one sensor; it turns into steady light when all fire alarms of all sensors have been acknowledged by **MUTE** button;
- **FIRE ALARMS** LCD screen to display the list of fire alarms and **Total:** fires count;
- **MUTE** button is used to mute and silence alarms;
- **RESET** button is used to reset the system;
- **NEXT** and arrow buttons are not modeled.

Power 220 V is supplied from **EM'CY AC220V FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**) by **FIRE ALARM MAIN PANEL** circuit breaker; or from **AC220V FEEDER PANEL** (use menu item **MSB 220V Feeder** of the page **MSB**) by **FIRE ALARM MAIN PANEL** circuit breaker.

The bottom part of the display contains emergency stop switch box with **ES 1**, **ES 2**, and **ES 5** buttons with protection covers. Click once to open the cover. Click second time to activate the respective shutdown function for all mechanisms listed on the label above the button.

ES 1 PUSH BUTTON FOR LO/FO PUMPS & VENT. FANS IN E/R list includes:

- E/R VENT. FANS
- MAIN I.G.S. BLOWER
- AUX I.G.S. BLOWER
- AUX BLOWERS
- SOOT BLOWER
- ECR PACKAGED AIR-COND.
- No.4 GSP (No. 1 SEC)
- No.4 GSP (No. 2 SEC)
- No.4 GSP (No. 3 SEC)
- No. 8 GSP
- AUX. BOILER POWER PANEL (No.1 SEC)
- AUX. BOILER POWER PANEL (No.2 SEC)
- M/E & G/E F.O. SUP. PUMPS
- M/E & G/E F.O. CIRC. PUMPS
- M.D.O. TRANSFER PUMP
- H.F.O. TRANSFER PUMP
- MAIN L.O. PUMPS
- ALPHA L.O. BOOSTER PUMPS
- G/E L.O. PRIMING PUMPS
- STERN TUBE L.O. PUMPS
- L.O. TRANSFER PUMP
- HYD. POWER UNIT FOR VALVE REMOTE CONTROL
- VACUUM COND. C.S.W. PUMPS
- No.1 ER 440v DIST. BOARD (2PD)



ES 2 FO/LO Pumps & Vent FOR OTHER AREA (EXCEPT ER) list includes:

- No.3 GSP (No 1 SEC)
- CARGO PUMP ROOM EXH FAN

ES 5 PUSH BUTTON FOR PURIFIER ROOM list includes:

- No.4 GSP (No. 1 SEC)
- No.4 GSP (No. 2 SEC)
- No.4 GSP (No. 3 SEC)

The **FIRE ALARM REPEATER PANEL** is located in ECR console **ECC Left Panel** (see ***the paragraph 6.4 on page 172***).

The functions of shutdown buttons are duplicated on the extended **EMERGENCY STOP SWITCH BOX**, which is located in Fire Fighting room (see ***the paragraph 6.2 on page 170***).

6.1.1. Faults Introduced by Instructor

Introduced faults are related to initiating the imitation of fires, listed in Chapter 7, ***the paragraph 2.2.3 on page 269***.

6.2. EM'CY Stop Switch Box at Fire Fighting Room

Click on the menu item **EM'CY Stop Switch Box** of the page **FFR** to open the display **EMERGENCY STOP SWITCH BOX**.

The central part of the display contains **ES 1**, **ES 2**, **ES 3**, **ES 4**, and **ES 5** buttons with protection cover; click once to open the cover; click second time to activate the respective shutdown function for all mechanisms listed on the label above the button.

The buttons **ES 1**, **ES 2**, **ES 5** duplicate the functions of the similar buttons on the Fire Alarm and Emergency Shutdown console at the Bridge. The mechanisms on the labels of these buttons are listed in *the paragraph 6.1 on page 168*.

Additionally **ES 3**, **ES 4** buttons provide shutdown functions for the following mechanisms.

ES 3 PUSH BUTTON FOR FOAM RELEASE FOR ER list includes:

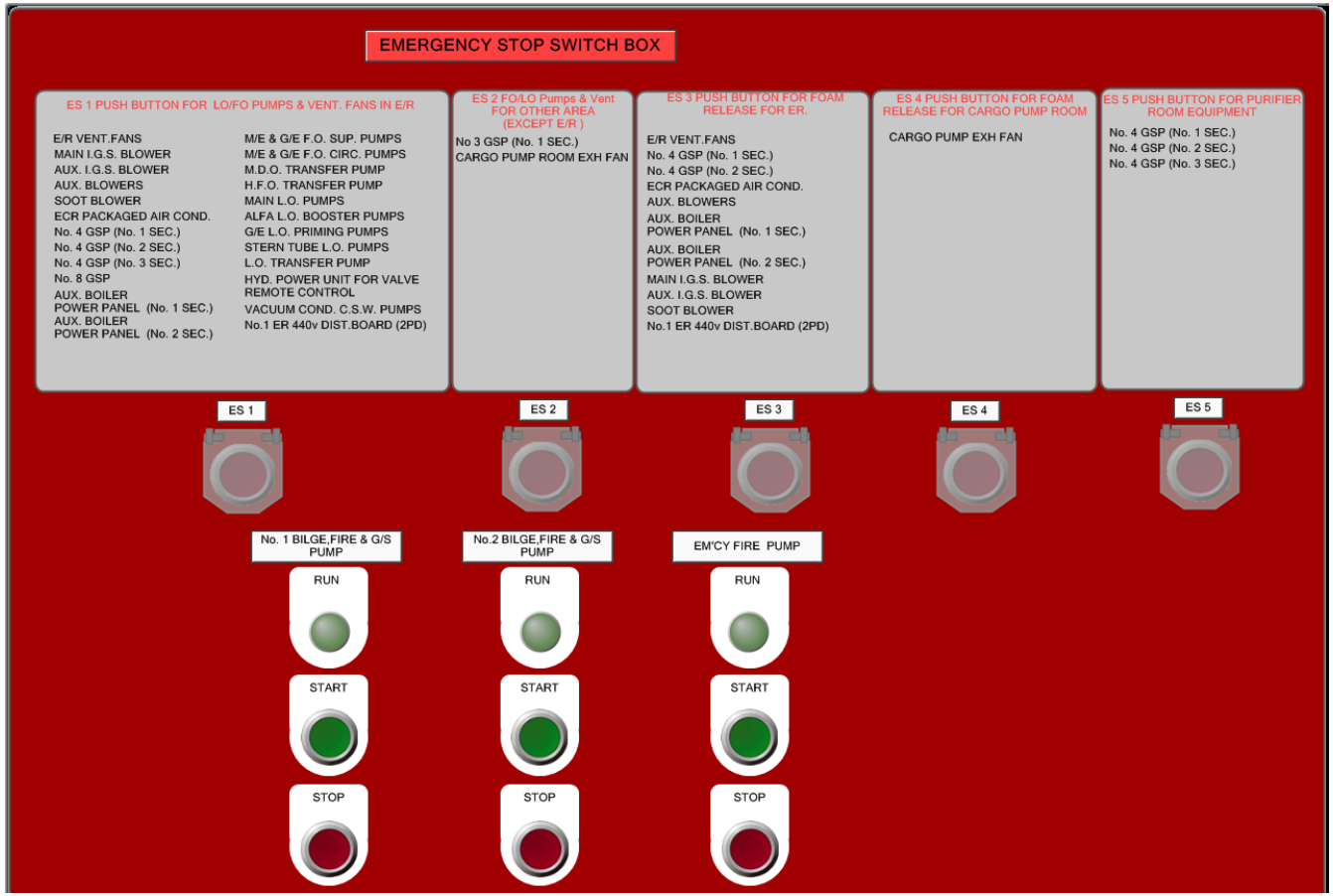
E/R VENT. FANS
No. 4 GSP (No 1 SEC)
No. 4 GSP (No 2 SEC)
ECR PACKAGED AIR-COND.
AUX. BLOWERS
AUX. BOILER POWER PANEL (No. 1 SEC)
AUX. BOILER POWER PANEL (No. 2 SEC)
MAIN I.G.S. BLOWER
AUX. I.G.S. BLOWER
SOOT BLOWER
No.1 ER 440v DIST. BOARD (2PD)

ES 4 PUSH BUTTON FOR FOAM RELEASE FOR CARGO PUMP ROOM list includes:

CARGO PUMP EXH. FAN.

The bottom part of the display contains push button boxes of the pumps:

- **No. 1 BILGE, FIRE & G/S PUMP**;



- **No. 2 BILGE, FIRE & BILGE PUMP**;
- **EM'CY FIRE PUMP**.

The general description of push button box controls is given in Introduction *the section 5 on page 12*.

The **No.1 BILGE, FIRE & G/S PUMP** and **No.2 BILGE, FIRE & G/S PUMP** are shared with the Bilge and Fire G/S system. Pumps' starter panels are described in *the paragraph 7.11.4.2 on page 216*. The **EM'CY FIRE PUMP** LOP is described in *the paragraph 6.7.4.1 on page 175*.

The **BILGE, FIRE & G/S PUMPs** and **EM'CY FIRE PUMP** push button boxes are available on the Bridge Console Section A (use menu item **BCC A** of the page **BCC**).:

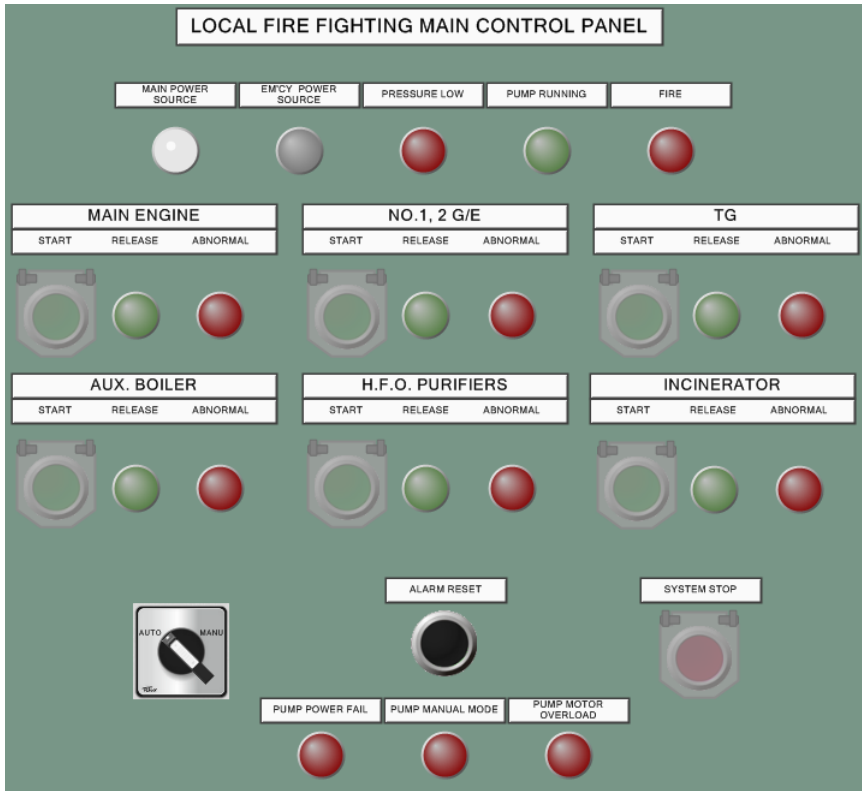
6.3. Local FF Main Control Panel at FFR

Click on the menu item **Local FF Main Control Panel** of the page **FFR** to open the panel.

The panel contains:

- Indicators:
  - **MAIN POWER SOURCE** – power from MSB;
  - **EM'CY POWER SOURCE** – power from ESB;
  - **PRESSURE LOW** – alarm: FF pump pressure < 4 bar;
  - **PUMP RUNNING** – FF pump is running;
  - **FIRE** – alarm from Fire Detection Station.
- Sets of controls for **MAIN ENGINE**, **NO.1, 2 G/E**, **TG**, **AUX. BOILER**, **H.F.O. PURIFIERS**, **INCINERATOR**; each set contains:
  - **START** button with protection cover; click once to open the cover; click second time to start Fire extinguishing in MANU mode;
  - **RELEASE** lamp – illuminates to indicate remote valve for fire extinguishing open;
  - **ABNORMAL** alarm lamp – illuminates to indicate remote valve fire extinguishing doesn't open.
- Two-position switch to select control mode:
  - **AUTO** – automatic opening of the fire extinguishing remote valves in the fire location;
  - **MANU** – manual opening of the fire extinguishing remote valves in the fire location; requires manual starting of the local FF system in compartment by respective protected **START** button.

    In both modes the **Local Fire Extinguishing Pump** is started, if it is set to AUTO on the LOP (see *the paragraph 6.7.4.2 on page 175*), otherwise it should be started from the LOP.
- **ALARM RESET** button to reset the alarms on this panel;



- **SYSTEM STOP** button with protection cover; click once to open the cover; click second time to stop fire extinguishing – remote valves are closed;
- Alarm indicators for the FF pump operation:
  - **PUMP POWER FAIL** – no power supply on FF pump Starter;
  - **PUMP MANUAL MODE** – FF Pump mode select switch is set to position **2** (MANUAL) on **LOCAL FIRE FIGHTING PUMP STARTER PANEL** (see *the paragraph 6.7.4.2 on page 175*);
  - **PUMP MOTOR OVERLOAD** – electric motor is stopped by overload protection.

Power 220 V is supplied:
from **EM'CY AC220V FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**) by **LOCAL FIRE FIGHTING MAIN CONTROL PANEL** circuit breaker;
or from **AC220V FEEDER PANEL** (use menu item **MSB 220V Feeder** of the page **MSB**) by **LOCAL F.F. MAIN CONTROL PANEL** circuit breaker.

The **LOCAL FIRE FIGHTING REPEAT PANEL** is located at the Bridge (see *the paragraph 6.5 on page 172*).

6.4. Fire Alarm Repeater Panel at ECR

Click on the menu item **ECC A** of the page **ECR** to open the display with the **FIRE ALARM REPEATER PANEL.**

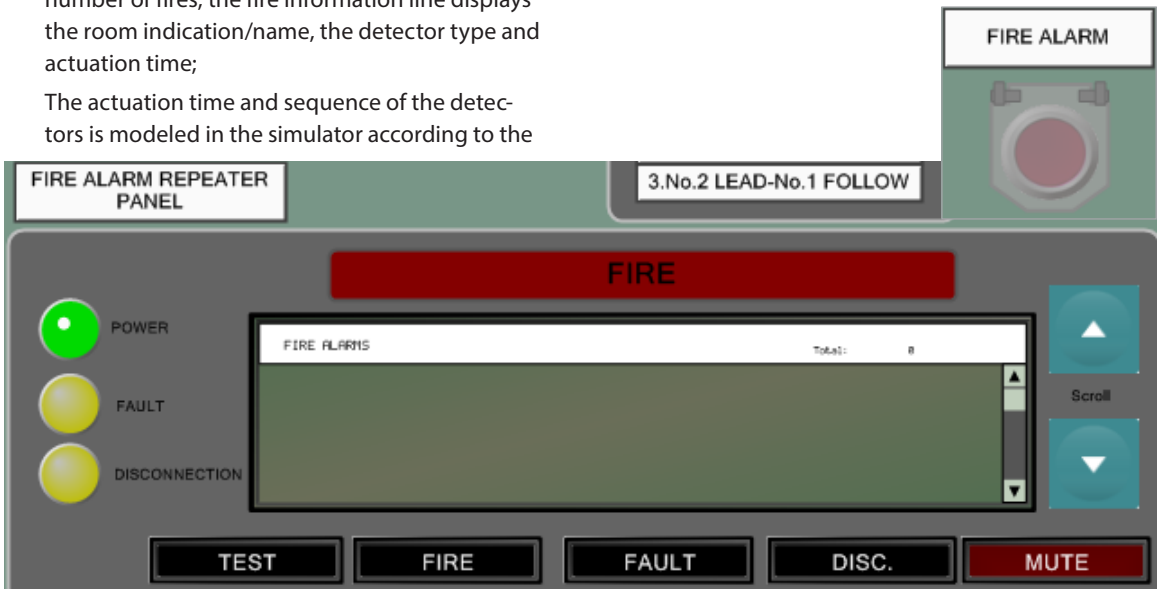
The panel includes:

- **FIRE** indicator of the fire having the following states:
  - Not active – no fire is detected, no sensors were actuated;
  - Flashing red – there is an unacknowledged fire alarm at least of one sensor;
  - Continuous red – all alarms of all sensors were acknowledged by **MUTE** button.
- **FIRE ALARMS** text LC display, where information about the fire is listed. The **Total:** value outputs the number of fires; the fire information line displays the room indication/name, the detector type and actuation time;

  The actuation time and sequence of the detectors is modeled in the simulator according to the dynamics of the fire spread, actuation of fire dampers, and running of fans.
- The indicating lamps:
  - **POWER** illuminates when the detection system is powered;
  - FAULT; DISCONNECTION indicators and arrow buttons are not modeled.
- **MUTE** button is used to mute and silence alarms.

The Main Fire alarm panel is located at the Bridge console **BCC C** (see *the paragraph 6.1 on page 168*).

FIRE ALARM button with protection cover on **ECC SECTION A** console is used to manually activate the fire system audible signal. Click once to open the cover; click second time to activate the signal.



6.5. Local Fire Fighting Repeat Panel at the Bridge

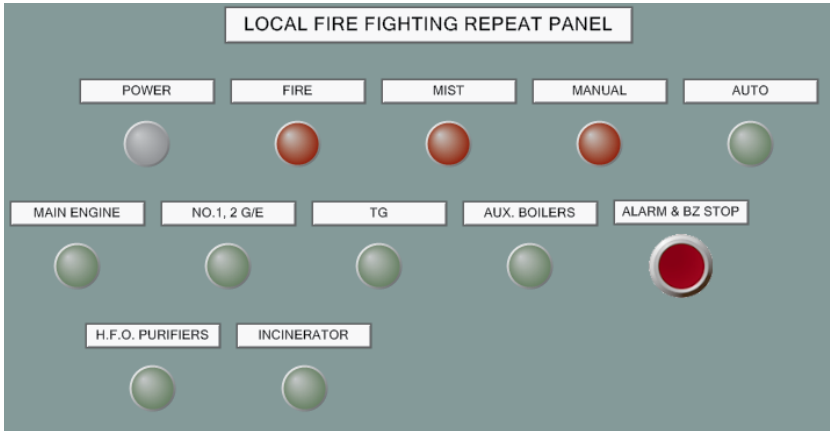
Click on the menu item **Local FF Repeat Panel** of the page **BCC** to open the **LOCAL FIRE FIGHTING REPEAT PANEL.**

The panel contains indicators, which illuminate when:

- **POWER** – power in ON;
- **FIRE** – alarm from Fire Detection Station;
- **MIST** – any pump is started (auto or manual) on **LOCAL FIRE FIGHTING MAIN CONTROL PANEL;**
- **MANUAL** – manual fire extinguishing;
- **AUTO** – automatic fire extinguishing;
- **MAIN ENGINE, NO.1, 2 G/E, NO.3 G/E, AUX. BOILER, H.F.O.PURIFIERS, I.G.G., INCINERATOR** – each indicate the fire extinguishing room.

ALARM & BZ STOP button is used to acknowledge: the **FIRE** indicator stops flashing and continuously illuminates, the audio alarm switches off.

The **LOCAL FIRE FIGHTING MAIN CONTROL PANEL** is located in the Fire Fighting room (see *the paragraph 6.3 on page 171*).



6.6. EM'CY Shut Off Valves Panel at FFR

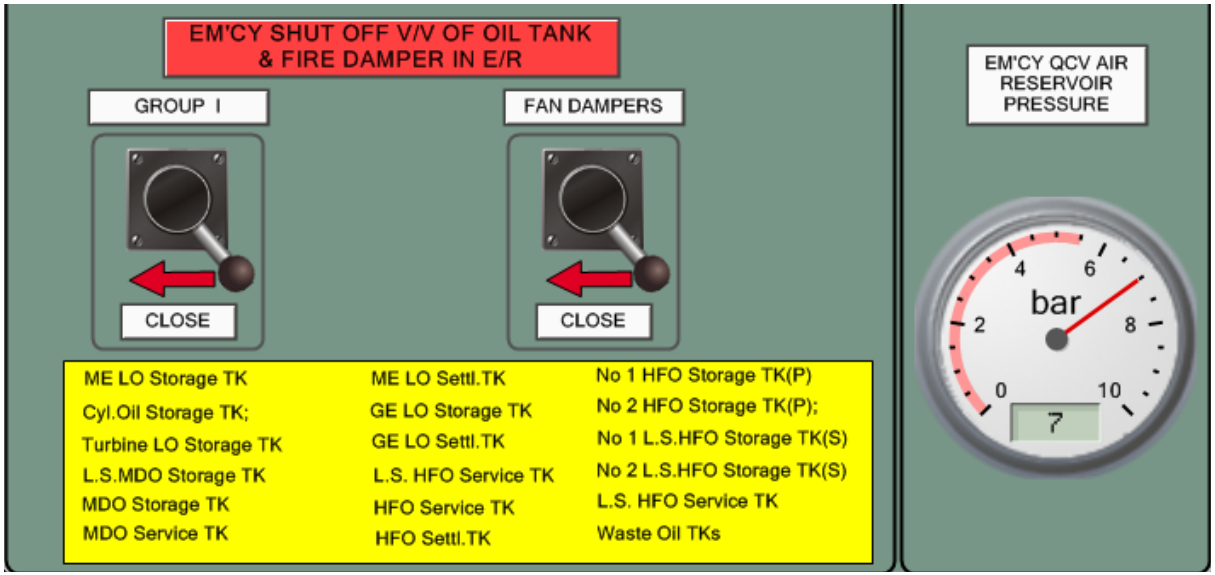
Click on the menu item **EM'CY Shut Off Valves Panel** of the page **FFR** to open the panel **EM'CY SHUT OFF V/V OF OIL TANK & FIRE DAMPER IN E/R**.

The left panel contains two handles to manually close the QCVs and fan dampers. To close QCVs and dampers drag the handle to the left position.

The handles operate on the following groups:

- **GROUP I** comprising:
  - ME LO Storage TK
  - Cyl. Oil Storage TK
  - Turbine LO Storage TK
  - L.S MDO Storage TK
  - MDO Storage TK
  - MDO Service TK
  - ME LO Settl. TK
  - GE LO Storage TK
  - GE LO Settl. TK
  - L.S HFO Service TK
  - HFO Service TK
  - HFO Settl. TK
  - No 1 HFO Storage TK (P)
  - No 2 HFO Storage TK (P)
  - No 1 L.S. HFO Storage TK (S)
  - No 2 L.S. HFO Storage TK (S)
  - L.S. HFO Service TK
  - Waste Oil TK
- **FAN DAMPERS**.

The right panel contains the **EM'CY QCV AIR RESERVOIR PRESSURE** gauge.



6.7. Local Fire & Foam Systems

6.7.1. General

The system is designed for local fire fighting by means of the foam and wash deck water systems.

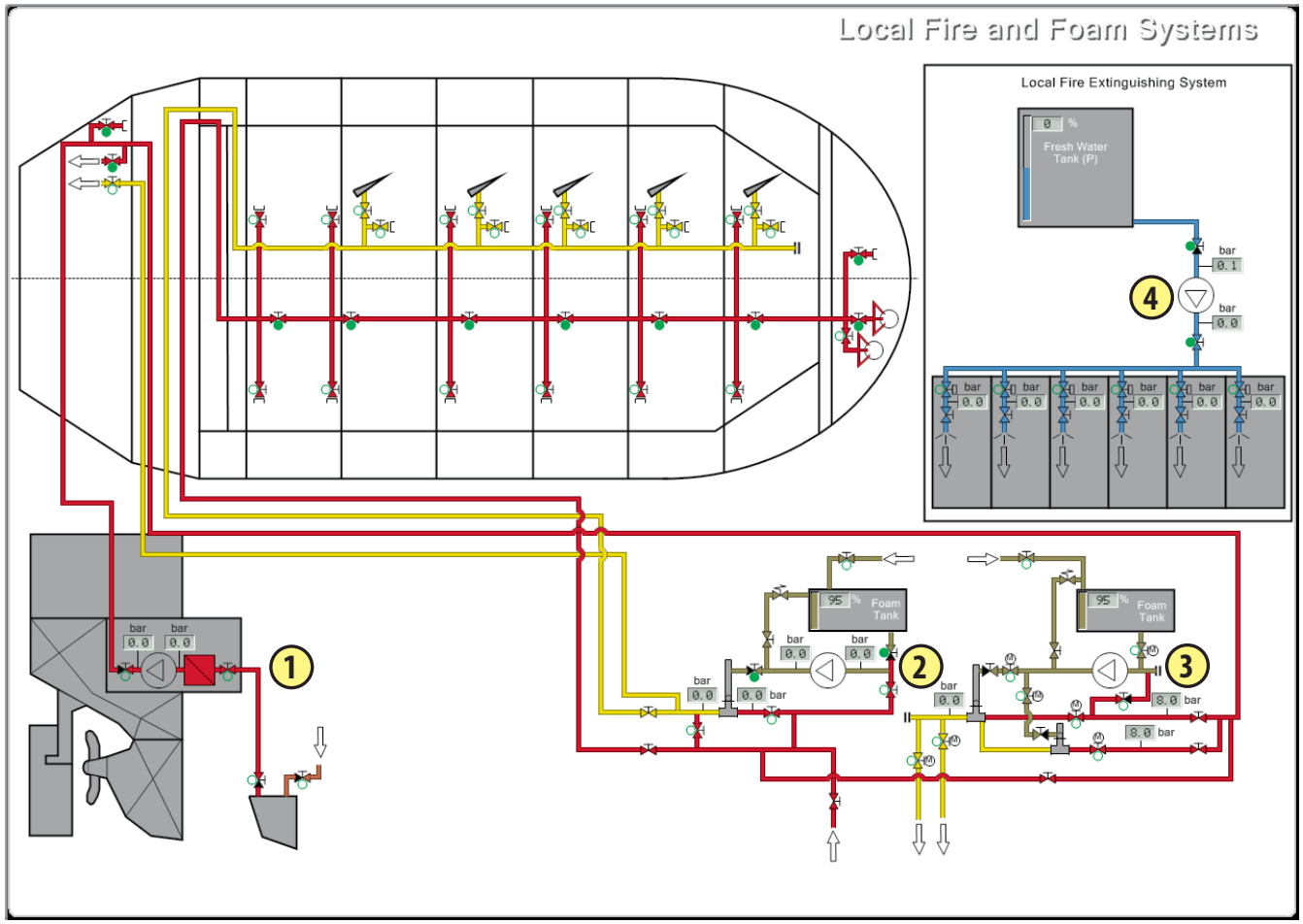
Click on the menu item **Local Fire and Foam System** of the page **SYS** to open the **Wash Deck, Foam & Local Fire Extinguishing System** diagram.

The foam pipelines are painted in yellow, wash deck pipelines are painted in red. Sea water is supplied from the sea chest or from the Bilge & Fire G/S System.

6.7.2. Content

- The ship stern cross section and upper deck diagrams with the fire main and foam manifolds fitted with controlled valves and supply hydrants;
- (1) **EMCY Fire Pump** – 280 m3/h x 80 mwc; suction from Sea Chest;
- 2 x **Foam Tank** – 5 m3;
- (2) **Foam Liquid Pump For Deck Foam System** – 4.2 m3/h x 10 kg/cm2;
- (3) **HI-EX Foam Liquid Pump** – 4.2 m3/h x 10 kg/cm2;
- **Local Fire Extinguishing System** comprising:
  - **Fresh Water Tank (P)** – 8 m3;
  - (4) **Local Fire Extinguishing Pump** – 8 m3/h x 7.9 kg/cm2;
  - Water supply lines through **Solenoid** valves to Main Engine; DG 1,2; AUX Boiler; Turbo generator; HFO Purifiers; Incinerator.
- Pipelines with valves, filters, measuring gauges.

Note: The panel similar to the deck area of the diagram is available in LCHS model during ERS–LCHS joint operation.



6.7.3. Connections

- Fresh Water To Incinerator
- Fresh Water To H.F.O. Purifiers
- Fresh Water To Aux Boiler
- Fresh Water To Turbo Gen.
- Fresh Water To No. 1, 2 G/E
- Fresh Water To Main Engine
- Make Up (foam agent)
- Foam To Engine Room
- Foam To Pump Room
- From Bilge/Fire & GS Pumps
- Steam Supply
- Sea Water To Accommodation
- Foam Branch To A Deck

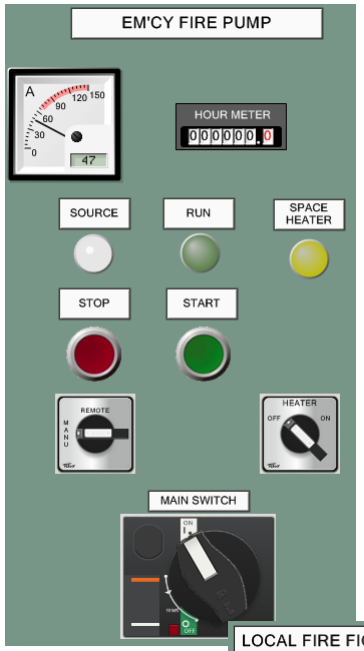
6.7.4. Control

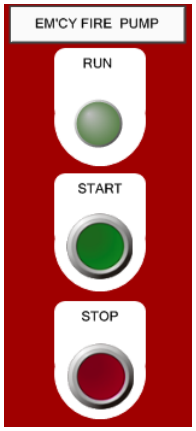
6.7.4.1. EM'CY Fire Pump

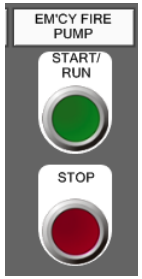
Click on the menu item **EM'CY Fire Pump LOP** of the page **SG** to open the **EM'CY FIRE PUMP** starter panel, which contains:

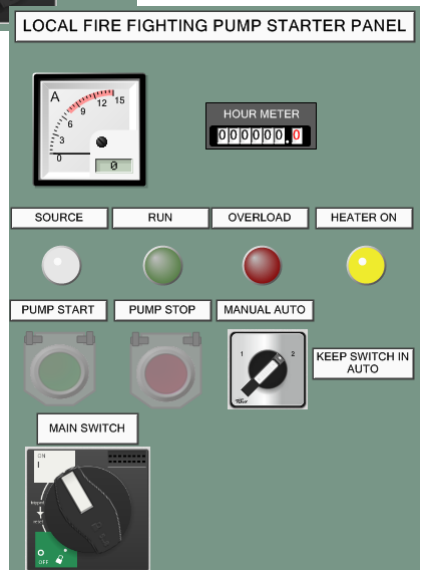
- **MAIN SWITCH** automatic CB;
- Ammeter;
- **HOUR METER**;
- **SOURCE**, **RUN**, **SPACE HEATER** indicator lamps;
- **MANU/REMOTE** mode selector switch; operation:
  - **MANU** mode – using **STOP** and **START** buttons on this starter panel;
  - **REMOTE** mode – using push button boxes on the **Bridge Console Section A** (use menu item **BCC A** of the page **BCC**) and on **Emergency Stop Switch Box** (use menu item **EM'CY Stop Panel** of the page **FFR**)
- **HEATER** two-position switch to turn heating OFF/ON in order to keep the pump ready for use in all environment circumstances; indicator lamp is illuminated when heating is ON.

Switch power supply 440 V for the **EM'CY FIRE PUMP** on **EM'CY AC440v FEEDER PANEL** of the ESB (use menu item **ESB Consumers** of the page **EmG**) by **EM'CY FIRE PUMP** circuit breaker.









6.7.4.2. Local Firefighting Pump

Click on the menu item **Local FF Pump Starter** of the page **ER3** to open **LOCAL FIRE FIGHTING PUMP STARTER PANEL**, which contains:

- **MAIN SWITCH** automatic CB;
- Ammeter;
- **HOUR METER**;
- **SOURCE**, **RUN**, **SPACE HEATER** indicator lamps;
- **OVERLOAD** alarm lamp; it illuminates when the pump motor is overloaded;
- **AUTO/MANUAL** mode selector switch; it is strictly recommended to **KEEP SWITCH IN AUTO** (position **1**); operation:
  - **MANUAL** mode (position **2**) – use **STOP** and **START** buttons with protection covers; click once to open the cover; click second time to operate the button;
  - **AUTO** mode – the pump starts automatically by the signal from the **LOCAL FIRE FIGHTING MAIN CONTROL PANEL** (see *the paragraph 6.3 on page 171*).

Switch power supply 440 V for the pump on **No.1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **LOCAL FIRE FIGHTING SYSTEM** circuit breaker.

6.7.4.3. Foam Pumps

Click on the menu item **Foam Pumps LOP** of the page **FFR** to open the **HI-EX FOAM LIQUID PUMP** and **FOAM LIQUID PUMP (DECK)** starter panels.

Each panel contains:

- Power switch;
- Ammeter;
- **HOUR METER**;
- **SOURCE**, **RUN** indicator lamps;
- **STOP** and **START** buttons to manually operate the pump.

The **HI-EX FOAM LIQUID PUMP** panel additionally contains:

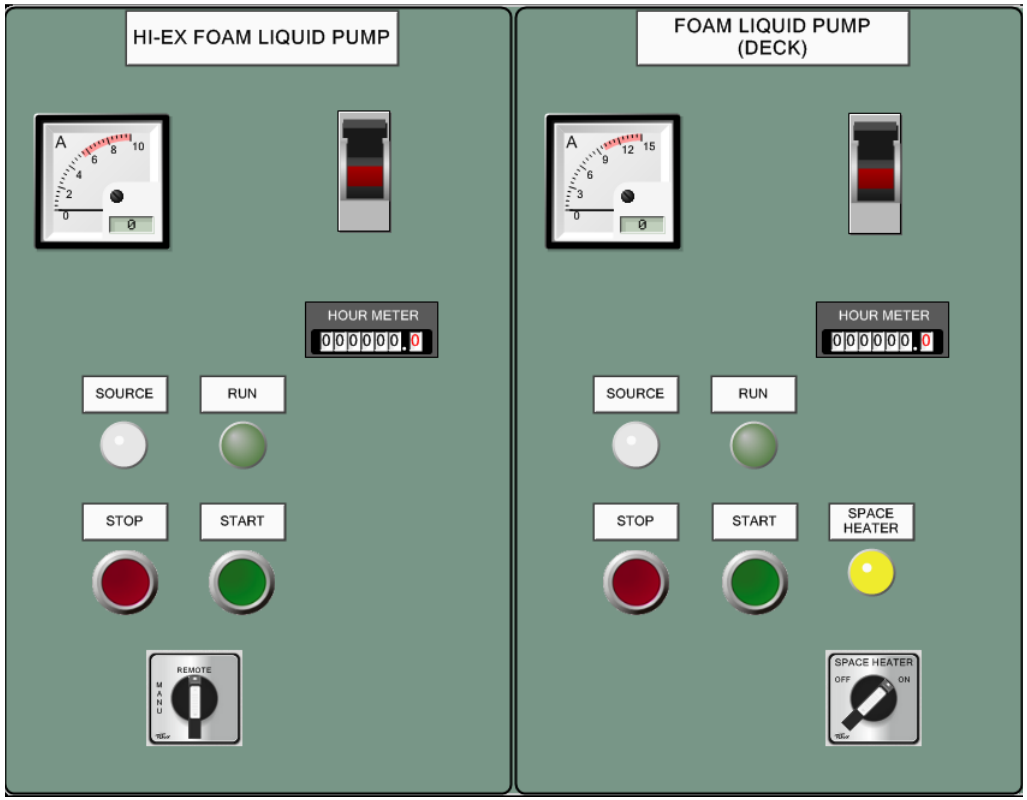
- **MANU/REMOTE** mode selector switch; operation:
  - **MANU** mode – using **STOP** and **START** buttons on this starter panel;
  - **REMOTE** mode – the pump automatically starts when **FOAM DISCHARGE** button is clicked in either of the **ENGINE ROOM** or **PUMP ROOM** sections on the **MAIN CONTROL PANEL FOR HIGH EXPANSION FOAM FIRE EXTINGUISHING SYSTEM** (see ***the paragraph 6.8 on page 178***).

The **FOAM LIQUID PUMP (DECK)** panel additionally contains:

- **SPACE HEATER** two-position switch to turn heating OFF/ON in order to keep the pump ready for use in all environment circumstances; indicator lamp **SPACE HEATER** is illuminated when heating is ON.

Switch power supply 440 V for the **HI-EX FOAM LIQUID PUMP** on the **EM'CY AC440v FEEDER PANEL** of the ESB (use menu item **ESB Consumers** of the page **EmG**) by **HI-EX FOAM LIQUID PUMP** circuit breaker.

Switch power supply 440 V for the **FOAM LIQUID PUMP (DECK)** on the **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **FOAM LIQUID PUMP (DECK)** circuit breaker.



6.7.4.4. Local Fire Fighting System Controls in ER

The local fire fighting system push button boxes are installed in **ER2** (Deck 2) and **ER4** (Upper Deck) compartments, and the panels in the simulator are respectively located.

Click on the menu item **Local FF PB** of the page **ER2** to open the panels:

- **LOCAL FIRE FIGHTING SYSTEM MAIN ENGINE**;
- **LOCAL FIRE FIGHTING SYSTEM NO.1,2 G/E**;
- **LOCAL FIRE FIGHTING SYSTEM TG**;
- **LOCAL FIRE FIGHTING SYSTEM HFO PURIFIERS**.

Click on the menu item **Local FF PB** of the page **ER4** to open the panels:

- **LOCAL FIRE FIGHTING SYSTEM AUX BOILER**;
- **LOCAL FIRE FIGHTING SYSTEM INCINERATOR**.

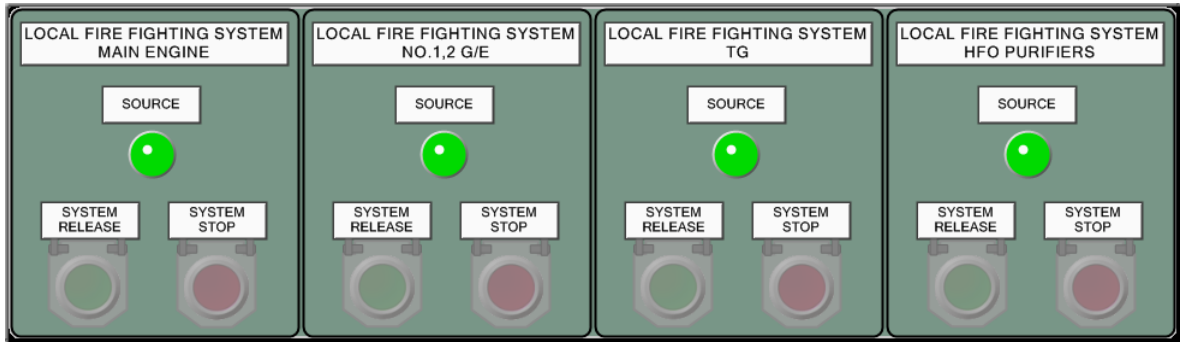
Each panel contains:

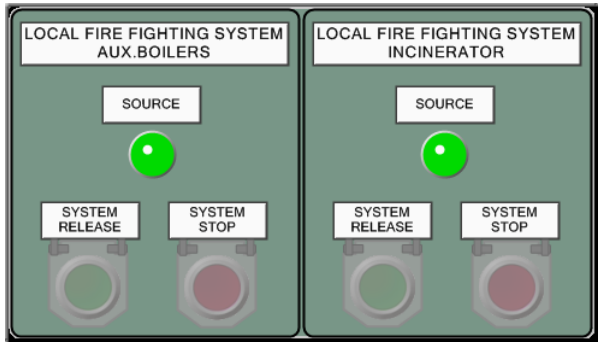
- **SOURCE** indicator lamp;
- Buttons with protection cover **SYSTEM RELEASE** to manually start local fire extinguishing in the room, and **SYSTEM STOP** to manually stop the system.

The **LOCAL FIRE FIGHTING MAIN CONTROL PANEL** is located in the Fire Fighting room (see *the paragraph 6.3 on page 171*).

The **LOCAL FIRE FIGHTING REPEAT PANEL** is located at the Bridge (see *the paragraph 6.5 on page 172*).

Power supply for the boxes is provided from Local Fire Fighting Main Control Panel.





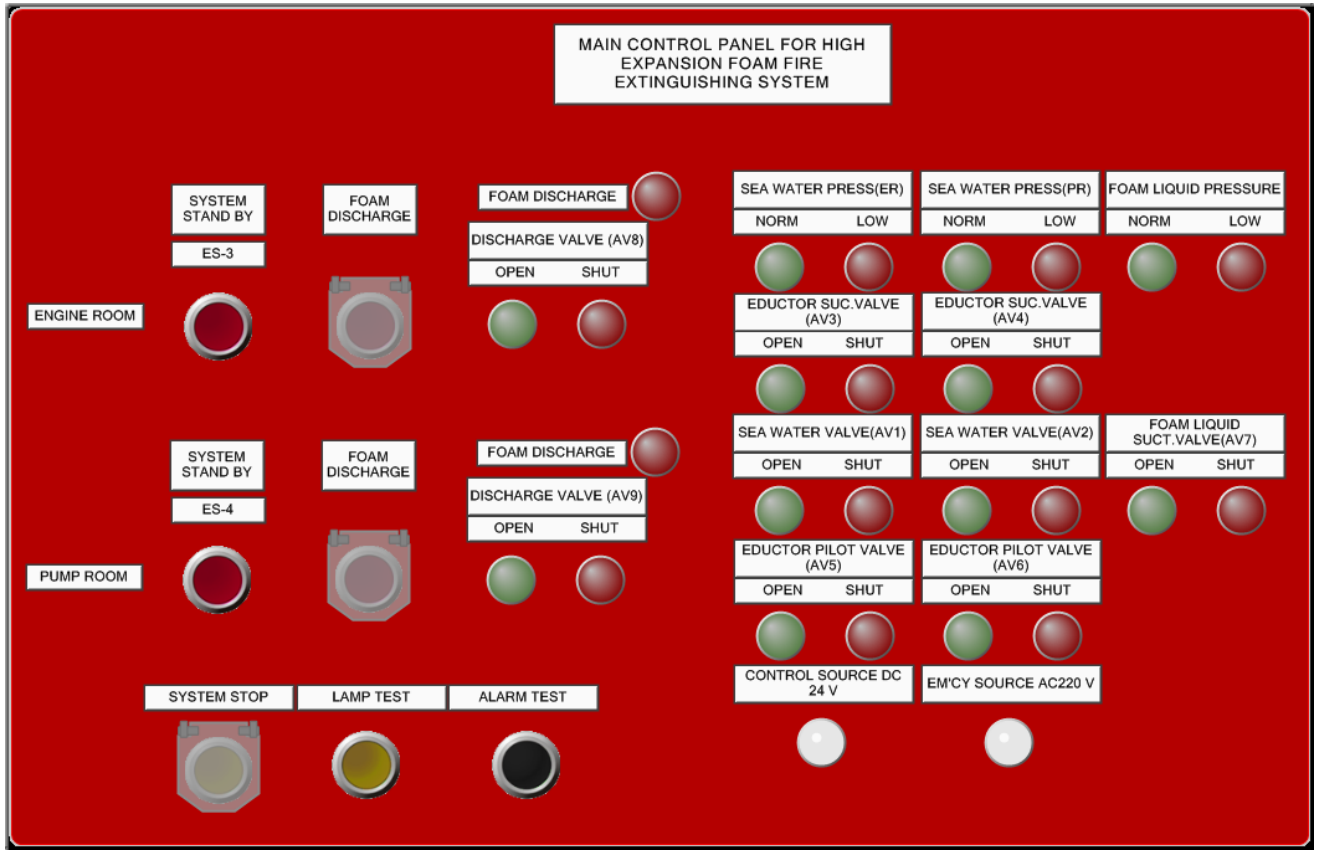
6.7.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.10 on page 273*, *the paragraph 2.11.8 on page 276* and *the paragraph 2.13.1 on page 278*.

6.8. High Expansion Foam Fire Extinguishing System Main Panel at FFR

Click on the menu item **High Expansion Foam FF System Panel** of the page **FFR** to open the panel, which contains:

- ENGINE ROOM and PUMP ROOM similar sections of controls; each section comprising:
  - **SYSTEM STAND BY** button to ;
  - **FOAM DISCHARGE** button with protection cover to start the **HI-EX FOAM LIQUID PUMP**, and open required valves; click once to open the cover; click second time to operate the button; indicator lamp **FOAM DISCHARGE** and respective valves' **OPEN** lamps illuminate when the system is in operation; the valves' **SHUT** lamps illuminate in case of low pressure or other failure in the system;
  - **DISCHARGE VALVE** indicator lamps, which illuminate to show the respective valve **OPEN** and **SHUT** position.
- **SYSTEM STOP** button with protection cover to stop the hi-ex foam system and pump; click once to open the cover; click second time to operate the button;
- LAMP TEST and ALARM TEST buttons – not modeled;
- **SEA WATER PRESS (ER)** indicator lamps **NORM** and **LOW** – illuminates if pressure < 5 bar for > 15 sec.;
- **SEA WATER PRESS (PR)** indicator lamps **NORM** and **LOW** – illuminates if pressure < 5 bar for > 15 sec.;
- **FOAM LIQUID PRESSURE** indicator lamps **NORM** and **LOW** – illuminates if pressure < 5 bar for > 15 sec.;
- Sets of indicators **OPEN** and **SHUT** for the valves state:
  - **EDUCTOR SUC. VALVE (AV3)**; **EDUCTOR SUC. VALVE (AV4)**;
  - **SEA WATER VALVE (AV1)**; **SEA WATER VALVE (AV2)**;
  - **FOAM LIQUID SUCT. VALVE (AV7)**;
  - **EDUCTOR PILOT VALVE (AV5)**; **EDUCTOR PILOT VALVE (AV6)**;



- **CONTROL SOURCE DC 24 V** and **EM'CY SOURCE AC220 V** indicator lamps – illuminate when power is available.

Switch power supply 220 V for the system on the **EM'CY AC220V FEEDER PANEL** of the ESB (use menu item **ESB Consumers** of the page **EmG**) by **HI-EX FOAM SYSTEM** circuit breaker.

6.9. Fixed CO2 Fire Fighting System

6.9.1. General

The carbon dioxide (CO2) high-pressure system is designed for protection of Engine and auxiliary rooms.

CO2 is supplied to the **Engine Room** from **CO2 Room** bottles actuated by either of **CO2 Control Cylinders Box**; to the **Emergency Generator Room** from **CO2 Package Unit**.

Click on the menu item **CO2 FF System** of the page **SYS** to open the **CO2 FF System** diagram.

The main CO2 supply pipelines are painted in blue, control CO2 supply pipelines are painted in red.

6.9.2. Content

- **Engine Room** and **Emergency Generator Room** with engine run indicators and CO2 nozzles;
- **CO2 Room** with ten sets of CO2 bottles, digital pressure indicator, **Safety Valve** and **CO2 Distribution Valves**;
- **CO2 Control Cylinders Box**(es) and **CO2 Package Unit**.

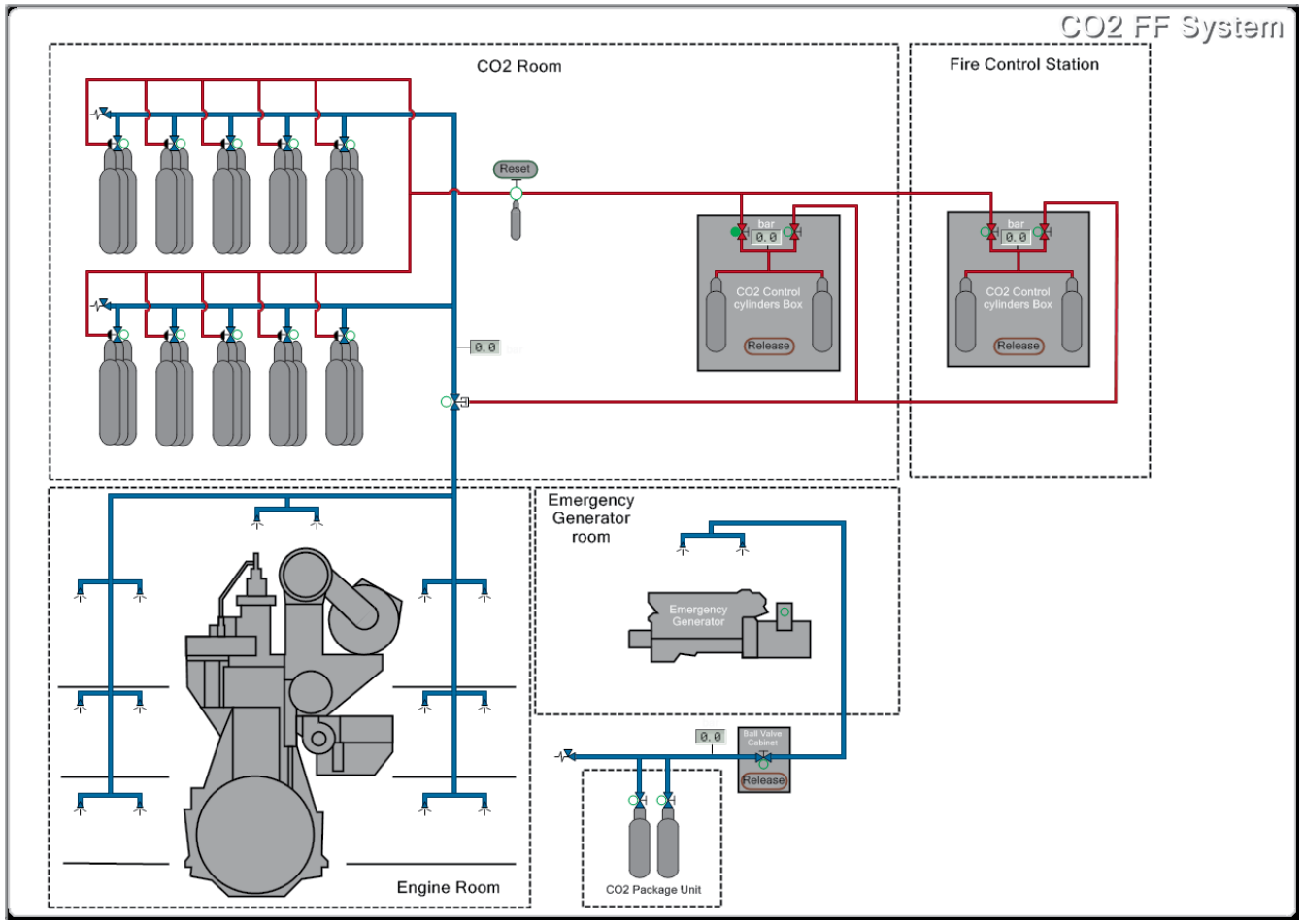
The CO2 system includes the identical units for fighting fires in the designated rooms. Each unit contains:

- Cylinders Group with the active indicator;
- **CO2 Control Cylinders Box**;
- Time delay units – empty bottles, which are filled with control CO2 for a specified time (30 sec.), so that the crew could leave the room: The **Reset** button modeling a mechanical discharge device of the bottle;
- The light-audible announcers in rooms.

It is sufficient to open one of the valves on the **CO2 Control Cylinders** to start control CO2 supply to the system.

6.9.3. Connections

The system has no connections to other ship systems.



6.9.4. Control

Release latched button in **CO2 Control Cylinders Box** models opening the Control Box door in a selected room. At that the engine in this room stops; all fans in this room stop, fire dampers should be closed manually on **EM'CY SHUT OFF V/V OF OIL TANK & FIRE DAMPER IN E/R** panel (see *the paragraph 6.6 on page 173*).

Manually operated valves control distribution valves of the main cylinders through time delay units; right-hand side valve supplies control CO2 pressure to time delay unit; left-hand-side valve opens the pneumatic valve on the CO2 duct of the room where fire is found; one of the valves on **CO2 Control Cylinders** should be opened first to start control CO2 supply.

7. Auxiliary Systems

The following Auxiliary systems are modeled in the simulator:

- Deadman system;
- Compressed Air system;
- Inert Gas system;
- Ballast system;
- Fresh Water Service system;
- Fresh Water Generator system;
- Steam Turbines;
- Hydraulic Systems;
- Air Conditioning system;
- Ventilation system;
- Bilge & Fire G/S system;
- Sewage Treatment system;
- Incinerator;
- Provision Cooling system;
- Steering Gears system.

7.1. Deadman System at ECR and ER Operation

The working algorithm of the system is as follows.

When there is no personnel in the Engine Room the two-position **SYSTEM START** indicator lamp is not illuminated.

The engineers should push the button **SYSTEM START** on either the ER3 (page **ER3**) panel or at the ECR (console **ECC Left**) when they enter the ER thus turning the system on. The system is tuned to start the pre-alarm signal (the lamps start flashing, light column and audible signal are activated) after a defined time period.

During operation in the ER the engineer should click the **DEADMAN RESET** button in any of engine rooms, or click the PRE ALARM **RESET** button on **DEAD MAN MAIN PANEL**, when pre-alarm signal is activated. The time counter then resets.

If the activated pre-alarm **RESET** button is not pressed within the given time frame the **DEAD MAN ALARM** indicator lamp starts flashing and the audible alarm signal starts. Alarm is also indicated on CMS and BCC B. The officer on watch in the ECR should address the alarm condition in the Engine Room(s).

To reset the system after alarm, do the following:

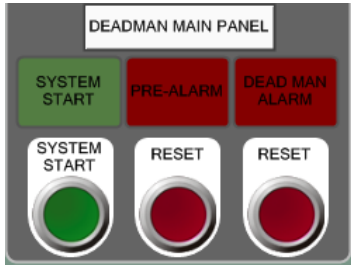
› Click the PRE ALARM **RESET** button.
› Click the DEAD MAN ALARM **RESET** button.

Note: The time periods limit for alarm and pre-alarm signals may be set by the instructor in the instructor screen.

Switch the system off on the **DEAD MAN START PANEL** of the page **ER3**, when nobody is operating in ER.

7.1.4.1. Dead Man System Panel at ECR

Click the menu item **ECC A** of the page **ECR** to open the display with **DEADMAN MAIN PANEL**.

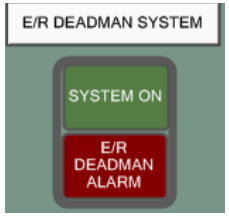


The panel contains:

- **SYSTEM START** button and indicator label, which is illuminated when the system is in operation;
- **PRE-ALARM** indicator label and **RESET** button to reset the system after pre-alarm has been acknowledged;
- **DEAD MAN ALARM** indicator label and **RESET** button to reset the system after dead man alarm has been cleared in engine room.

7.1.4.2. Dead Man System Panel on Bridge

Click the menu item **BCC B** of the page **BCC** to open the **BRIDGE CONSOLE SECTION B** with **E/R DEADMAN SYSTEM** panel.

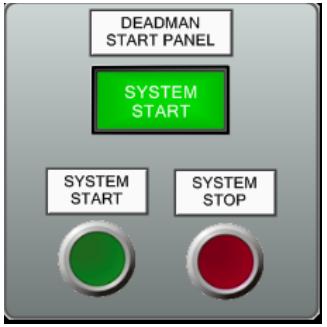


The panel contains lamps to indicate the system state:

- **SYSTEM ON** – is illuminated when the system is activated;
- **E/R DEADMAN ALARM** – starts flashing and the audible alarm signal starts when an alarm condition occurs.

7.1.4.3. Dead Man System Start Panel at ER3

Click the menu item **Deadman Start Panel** of the page **ER3** to open the **DEAD MAN START PANEL**.



The panel duplicates the ECR **ECC Left** console. It contains:

- **SYSTEM START** button and indicator label, which is illuminated when the system is in operation;
- **SYSTEM STOP** button to stop the system when nobody is operating in ERs; **SYSTEM START** indicator lamp goes off.

7.1.4.4. Dead Man System Reset Panels at Engine Rooms

Each engine room is equipped with Deadman Reset panel to confirm presence in the ER.

Click the menu item **Deadman Reset** of the respective page **ER1/ ER2/ER3/ER4/SG** to open the **DEAD MAN PANEL**.

7.2. Compressed Air System

7.2.1. General

The Compressed Air system is designed to generate and supply compressed air for ship systems by:

- Compressed Starting & Service Air System.
- Control Air System.

To ensure the functionality of the components in the compressed air system, the compressed air has to be dry and clean from solid particles and oil.

7.2.1.1. Starting Air System

The Starting Air System produces and supplies compressed air for starting ME and DEs. All engines are started by means of compressed air with a nominal pressure of 3 MPa (30 bar). The start is performed by direct injection of air into the cylinders through the starting air valves in the cylinder heads. The master starting valve is built on the engine and can be operated both manually and electrically.

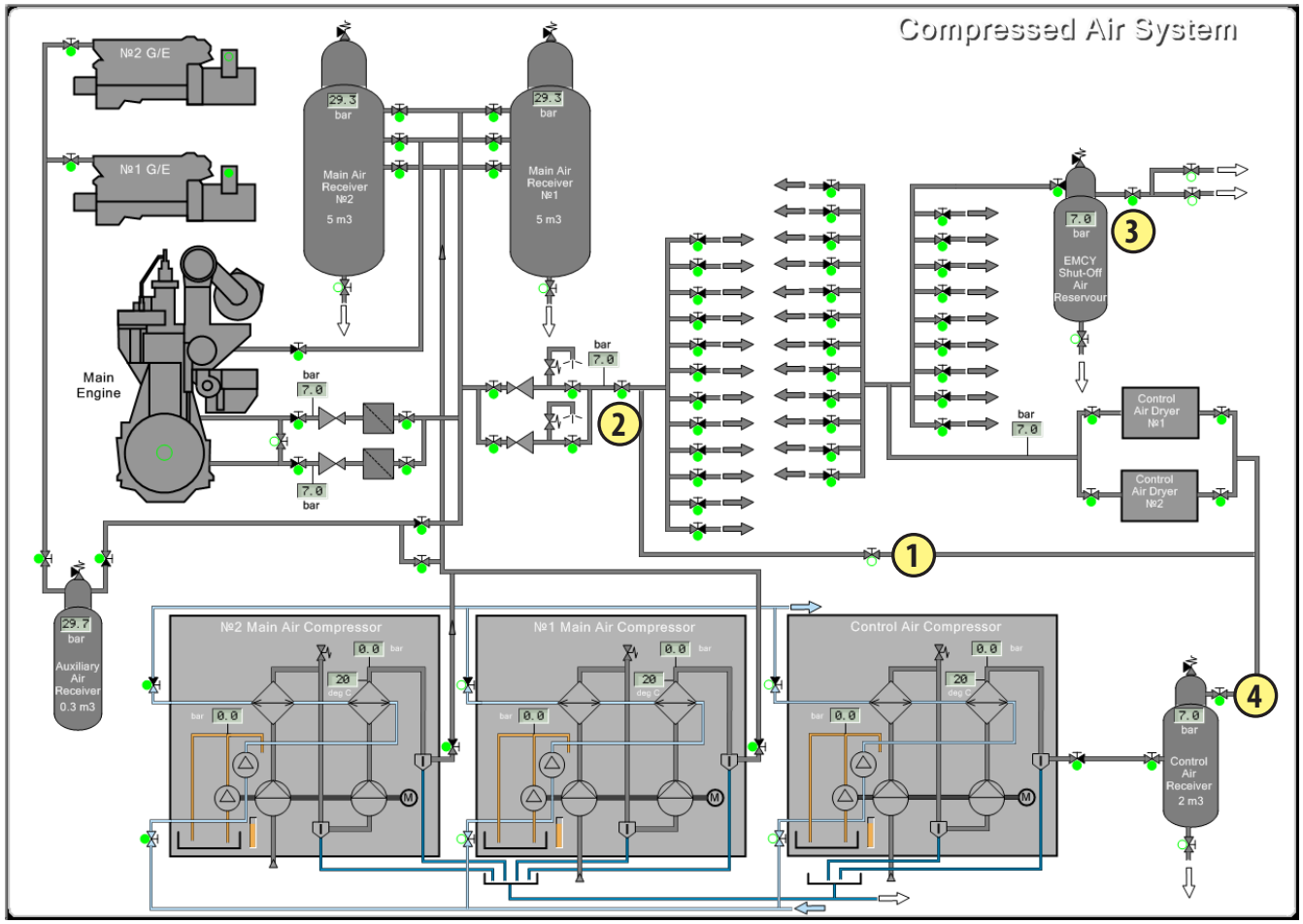
In automatic operating mode, the Main Start Air Compressors are switched on by the pressure control at low pressure 28 bar (LEAD)and 26 bar (FOLLOW), respectively switched off at max pressure 30 bar (FOLLOW) and 30 bar (LEAD).

The compressors can be also operated manually from the LOP.

7.2.1.2. Control Air & Service Air System

The Control Air & Service Air System produces and supplies compressed air for pneumatic mechanisms (e.g. valves, pumps) and safety and control devices.

In automatic operating mode, when the pressure in the Air receiver drops <7.5 bar the compressor automatically starts. The compressor can be also operated manually from the push button box.



Click on the menu item **Compressed Air System** of the page **SYS** to open the system diagram.

7.2.2. Content

- **№1 G/E**, **№2 G/E**, engines, and **Main Engine** with run indicators and compressed air supply lines;
- **Main Air Receiver №1 (№2)** – 5 m^3; with pressure switches for auto mode (installed on inlet pipe between air reservoirs), safety, drainage, inlet and outlet valves;

- **№1 (№2) Main Air Compressor** units in duty/stand-by configuration – 180 m3/h x 30 bar, LT CFW-cooled, safety valve 31.5 bar; and **Control Air Compressor** unit – 200 m3/h x 7 bar, safety valve 9 bar; each unit comprising:
  - **First Stage Air Compressor** and **Air Cooler**;
  - **Second Stage Air Compressor** and **Air Cooler**;
  - **LO Driven Pump**, **LT Cooling Pump**,bar graph of the compressor **LO level, %**, digital indicator of oil pressure;
  - Digital indicators of the air temperature and pressure.
- **Control Air Receiver** – 2 m3;
- **Auxiliary Air Receiver** – 300 L, with digital pressure indicator, Oily Water Separator to supply generators set;
- **Control Air Dryer №1 (№2)** units;
- 2 x **Reduction station** – 30 bar to 7 bar; with Oily Water Separators;
- **EM'CY Shut-Off Air Reservoir** – ;
- **EM'CY Shut-Off V/V LOP** box with controlled supply valves to **Fire Dampers**, **Group 1**, **Group 2**, **Group 3** valves;
- Pipelines with valves, filters, measuring gauges.

7.2.3. Connections

- To Scupper System
- From/To LT CFW System
- Drain
- Service Air To Decks
- To Local FF Sys
- To No 1 Main CSW P/P Priming Unit
- To Foam Room
- To Incinerator Atom. Air
- To GE EM'CY MDO Pump(Air Driven)
- To D.W. Hyd. Unit
- To M.E. T/C Cleaning
- Bilge Fire G.S. P/P Air Ejector
- For IG Uptake V/V Cleaning
- For Boiler No 1 (No 2) Atomizer
- IG Instrument Air Supply
- For Boiler No 1 (No 2) Burner Unit
- HPU Valve Control
- Oily Water Separator
- Economizer Soot Blower
- ME LO Temp Cont.V.
- ME LO Auto Filter
- ME FO Auto Filter
- FO Purifiers Heater Temp Cont V/V
- FO Purifiers Solenoid V/V
- LO Purifiers Heater Temp Cont V/V
- LO Purifiers Heater
- LT CFW Temp V/V
- Aux Boilers Heater Temp Cont V/V
- Fire Alarm Air Horns
- Foam Alarm Air Horns
- GE JCFW Temp.Cont V/V
- Steam Dumping V/V
- To Fire Dampers
- To QCV/V

7.2.4. Control

7.2.4.1. Controls on Diagram

The following valves are operated:

- ① **Service Air To CNTRL Air Sys Valve;**
- ② **Service Air Outlet Valve**;
- ③ **EMCY Shut-Off Air Reservoir Outlet Valve** – to supply air for Quick Closing Valves operation;
- ④ **Control Air Receiver Outlet Valve** – to supply control air for the valves' control.

7.2.4.2. Compressors Starter Panels

Click the menu item **GSP 5** of the page **ER4** to open the display with the **No. 1 MAIN AIR COMPRESSOR, No. 2 MAIN AIR COMPRESSOR** and **CONTROL AIR COMPRESSOR** starter panels.

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

Alarm indicator lamps illuminate when any of the following conditions occurs:

- **OVER CURRENT TRIP;**
- **AIR HIGH TEMP TRIP** – > 80 °C;
- **LO LOW PRESS TRIP** – < 0.8 kg/cm2;
- **AIR HIGH TEMP ALARM** – > 75 °C;
- **LO LOW PRESS ALARM** – < 1.0 kg/cm2.

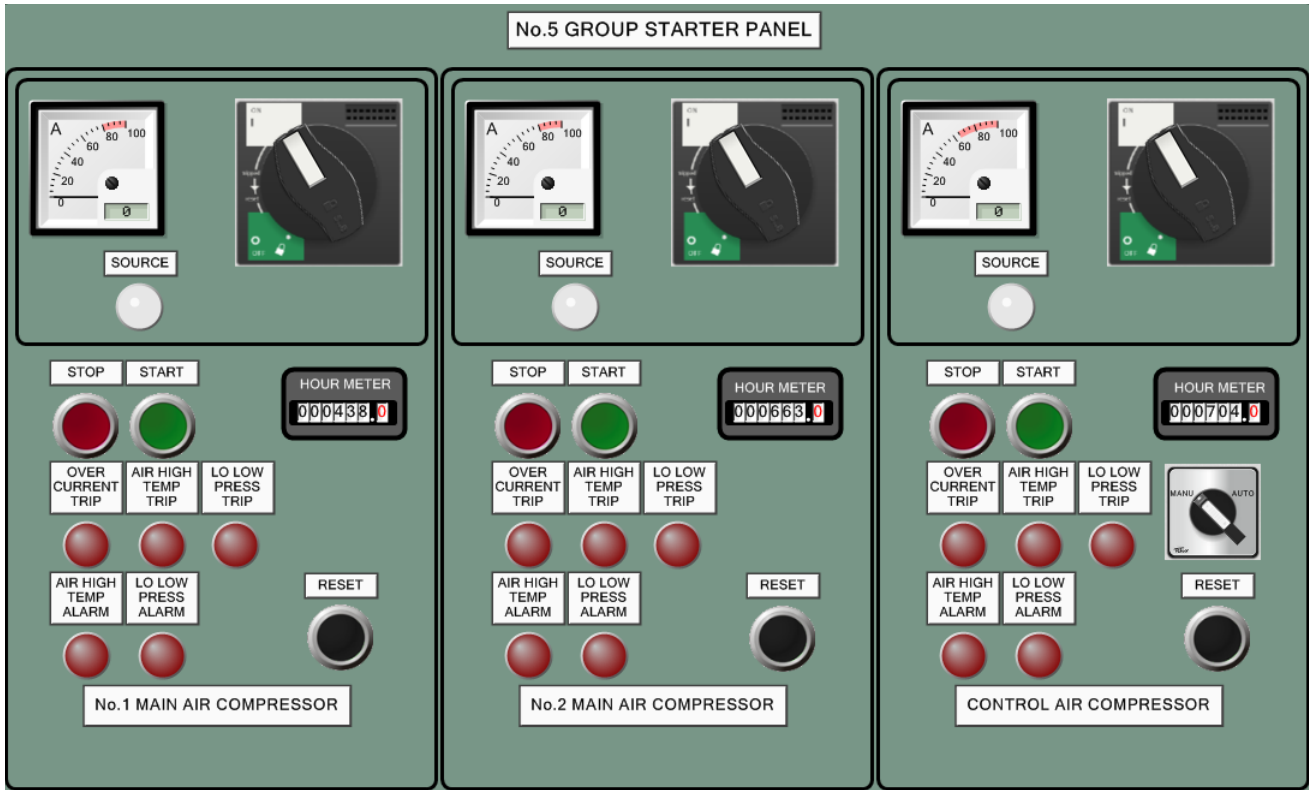
Use **RESET** button to reset the compressors automatics after a trip condition has be cleared.

The **CONTROL AIR COMPRESSOR** panel contains also the two-position mode selector switch to set:

- **MANU** mode – control by the buttons on the starter panel;
- **AUTO** mode – compressor starts at 6 bar and stops at 7 bar.

Switch power 440 V for **No.5 GROUP STARTER PANEL**:

- on **EM'CY AC440v FEEDER PANEL** of ESB (use menu item **ESB Consumers** of the page **EmG**) by **No. 5 LGSP (No 1 MAIN AIR COMPRESSOR)** circuit breaker;
- on the **No. 1 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 5 LOCAL GROUP STARTER PANEL** (**No 2 MAIN AIR COMP.**) circuit breaker
- on the **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 5 LOCAL GROUP STARTER PANEL** (**CONTROL AIR COMP.**) circuit breaker.



7.2.4.3. Main Compressors Push Button Boxes

Click the menu item **ECC A** of the page **ECR** to open the console display, with **MAIN AIR COMPRESSOR No 1 No 2** panel.

The general description of a starter panel and a push button box controls is given in Introduction *the section 5 on page 12*.

Three-position **No 1/2 COMPRESSOR LEAD/FOLLOW** switch sets compressors control mode:

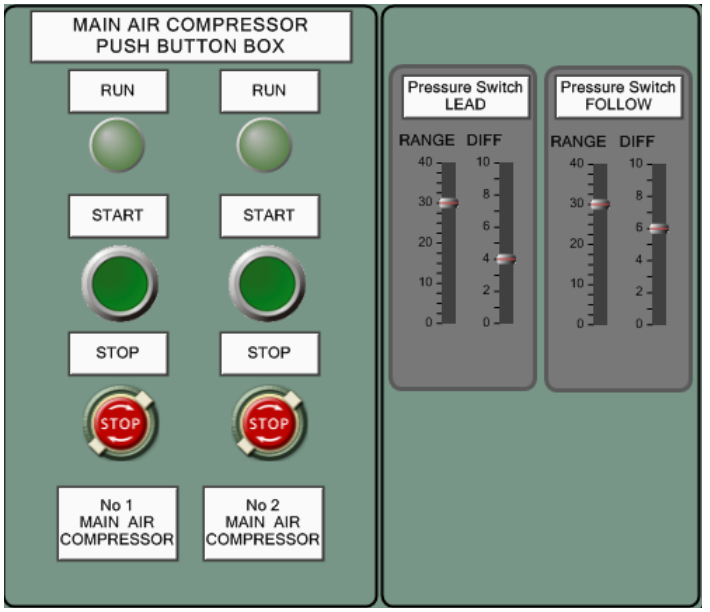
- **1. No.1 LEAD - No.2 FOLLOW** – auto mode;
- **2. MANUAL** – compressors are controlled from their starter panels and/or any of the push button boxes;
- **3. No.2 LEAD - No.1 FOLLOW** – auto mode.

In automatic mode compressors are operating according to the settings of the pressure switches in **MAIN AIR COMPRESSOR PUSH BUTTON BOX**.

Click the menu item **Main Compressors LOP** of the page **ER4** to open the **MAIN AIR COMPRESSOR PUSH BUTTON BOX**.

Pressure Switch LEAD and **Pressure Switch FOLLOW** on the right panel are used to setpoint the automatic starting (pressure ≤ **RANGE-DIFF** value) and stopping (pressure ≥ **RANGE** value) the compressors. LEAD and FOLLOW compressors are set on the ECR panel (ECC Left).

Switch power supply 440 V for the compressors on their starter panels No 5 GSP of the MSB and ESB (see *the paragraph 7.2.4.2 on page 184*).



7.2.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.1 on page 272*, and in other respective paragraphs.

7.3. Inert Gas System

7.3.1. General

The inert gas system consists of a main inert gas plant, using boiler flue gas, and an independent topping up inert gas plant generator, to provide a gas explosion protection system for the cargo oil tanks and slop tanks. This is achieved by maintaining a slight over-pressure in the tanks at all times.

Whilst discharging the cargo, liquid pumped out of the tanks is replaced by inert gas. Pressure of the inert gas in the tanks is maintained at all times slightly above atmospheric pressure. The inert gas used on this vessel is produced by a conventional flue gas plant, which cools and cleans gas from the boiler uptake, and an independent generator system, which burns fuel oil at a very low excess air setting. The resulting exhaust gas is cooled and cleaned before being fed into the cargo tanks.

The main inert gas plant consists of a scrubber and demister, two inert gas fans, a pressure vacuum breaker and a deck water seal unit and Topping Up SW Cooling Water Pump.

7.3.1.1. Main Inert Gas System

The Main IGG system capacity:
each Blower supplies 10 500 m3/h.

The flue gas from the boiler uptake is led into the plant, then cooled and cleaned. The gas is then distributed by the fans to the cargo oil and slop tanks via a deck water seal and distribution piping. The system is used to purge the ullage spaces in the cargo oil tanks of hydrocarbon gases and replace them with an inert gas, keeping the oxygen content below 5% by volume.

Scrubber

The scrubber is of the tower type and consists of inlet water seal tanks, tower elements and spray nozzles.

An independent cooling sea water supply pump supplies the scrubber. Emergency cooling water can be provided from either Bilge, Fire and G.S. pumps. The water leaving the scrubber is discharged overboard.

Inert Gas Fans

Two electrically driven inert gas fans are supplied. Each is capable of supplying the full rated inert gas capacity (10 500 m3/h). They draw the gas from the boiler uptake, through the scrubber, and deliver to the deck distribution pipe system with sufficient over-pressure to form a high velocity gas jet at the inlet to the cargo tanks.

Deck Water Seal

The deck water seal is of the displacement type. The water inside the seal is displaced into a reservoir during operation, and immediately falls back and closes the seal in case of loss of positive gas pressure, preventing any backflow of cargo gases.

Two sea water supply pumps (one as a standby) supply water to the deck water seal. This water is discharged overboard.

7.3.1.2. Inert Gas Top-Up Generator (TUG)

Type: Topping Up; Capacity: 500 Nm3/h; Fuel oil: approximately 40kg/h.

The function of this inert gas generator is to enable the inert gas inside the tanks to be topped up to the normal working range without having to put the main system on line. Changes in the climatic conditions and the areas the ship is passing through can radically change the pressure inside the tanks.

The unit comprises of an oil burner and combustion chamber, a scrubber, a blower and a fuel oil pump unit. This unit operates automatically and can be set to start and stop at given pressures set on the control panel. An independent cooling sea water supply pump supplies the topping-up generator cooling system. Emergency cooling water can be provided from either of the bilge, fire and GS pumps. The water leaving the unit is discharged overboard.

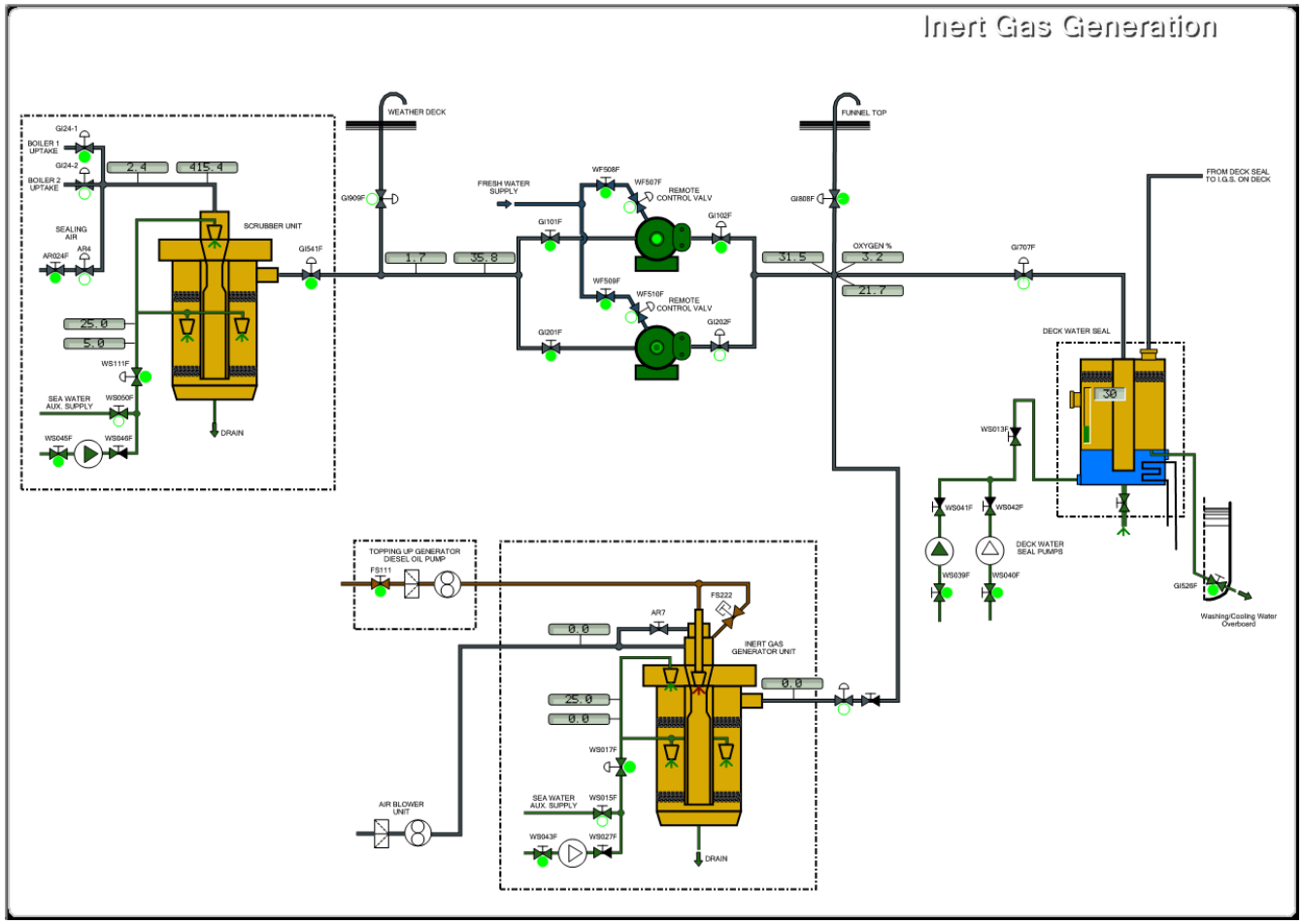
Fuel oil is burned in the combustion chamber. The exhaust gas is then led through the cooling tower where the gas is cleaned and cooled. The inert gas is then delivered to the inert gas main through a flow control valve.

7.3.2. Inert Gas System Diagram

Click on the menu item **Inert Gas System** of the page **SYS** to open the system diagram, which contains:

- **SCRUBBER UNIT** – comprising scrubber pump indicator, gauges and controlled valves;
- **INERT GAS GENERATOR UNIT** – comprising gauges, pump and blower indicators and controlled valves; IGG is controlled from **CCR** (use menu item **Inert Gas Generator Control Panel**, see *the paragraph 7.3.3 on page 188*);
- **TOPPING UP GENERATOR DIESEL OIL PUMP** unit – comprising pump indicator and controlled valve; TUG is controlled from **CCR** (use menu item **Topping Up Generator Control Panel**, see *the paragraph 7.3.6 on page 191*);
- **DECK WATER SEAL** unit – comprising gauges, pumps indicators and controlled valves; the pumps are controlled from **CCR** (use menu item **Inert Gas Generator Control Panel**, see *the paragraph 7.3.3 on page 188*);
- Pipelines with gauges and controlled valves; click on a valve to open the control panel (see).

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.



7.3.3. Inert Gas System Control Panel

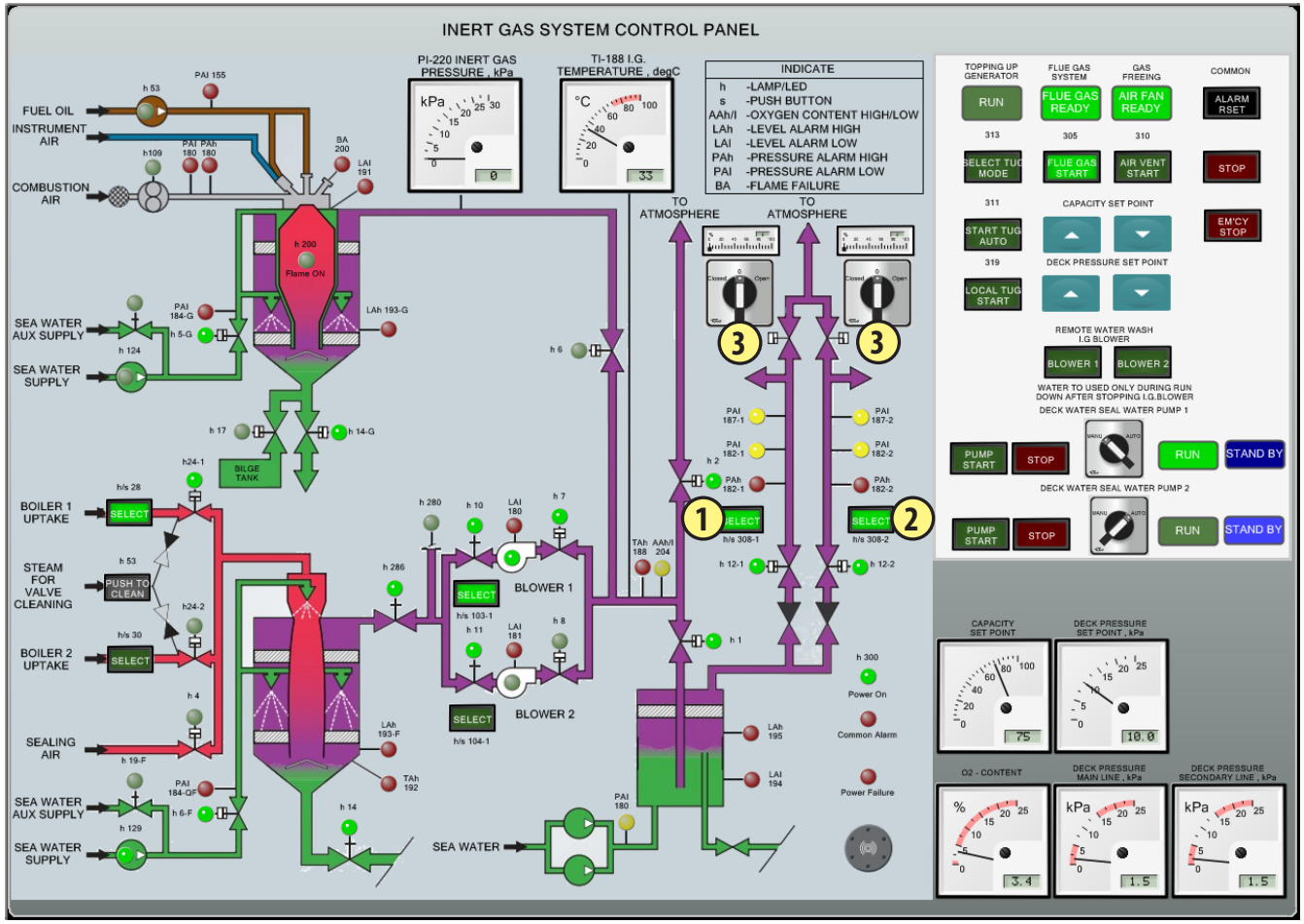
Click on the menu item **Inert Gas System Control Panel** of the page **CCR** to open the system diagram and control panel.

The display contains:

- The TUG diagram (see detailed description in *the paragraph 7.3.6 on page 191*);
- The Main IGG system diagram comprising the scrubber, blowers and deck water seal; **Note:** TUG and Main gas generator system cannot run simultaneously;
- Gas distribution system diagram;
- Panel with control buttons, lamps and gauges.

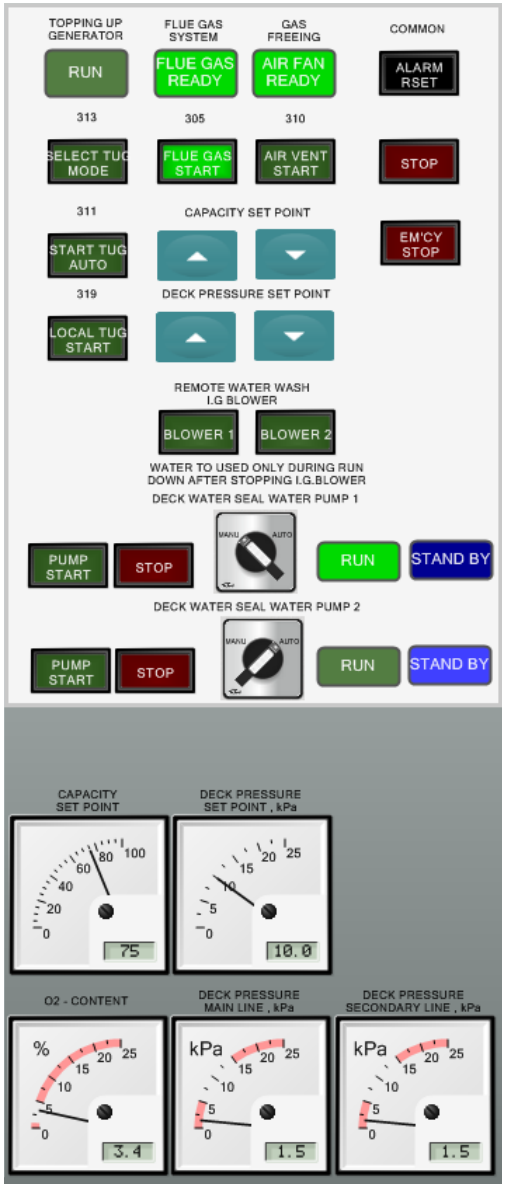
IGG diagram in the left and central part of the display contains:

- **SELECT** buttons to choose between:
  - **BOILER 1 UPTAKE/BOILER 2 UPTAKE** – click to select exhaust gas supply from respective boiler;
  - **BLOWER 1/BLOWER 2** – click to select the blower for gas supply into the system;
  - (1) button – click to supply gas to MAIN LINE;
  - (2) button – click to supply gas to SECONDARY LINE.
- **PUSH TO CLEAN** button – click to clean soot from the uptake valves;
- (3) Three-position control switches – to open the MAIN or SECONDARY line valves for blowing gas **TO ATMOSPHERE**; the gauges above indicate the valve open state %;
- Indicator lamps to reflect the alarm and normal state conditions of the gas flow;
- **PI-220 INERT GAS PRESSURE, kPa; TI-188 I.G. TEMPERATURE, deg C** – measuring gauges;
- **INDICATE** legend.



The right panel of the display contains:

- **TOPPING UP GENERATOR** controls comprising:
  - **RUN** indicator lamp;
  - **SELECT TUG MODE** and **START TUG AUTO** buttons to select and automatically start the TUG for IG supply;
  - **LOCAL TUG START** button to indicate that TUG should be started manually (see *the paragraph 7.3.6.1 on page 192*).
- **FLUE GAS SYSTEM** controls comprising:
  - **FLUE GAS READY** indicator lamp;
  - **FLUE GAS START** button to start the main gas generation system; the button flashes during start sequence, and lights steadily when the system is running.
- **GAS FREEING** controls comprising:
  - **AIR FAN READY** indicator lamp;
  - **AIR VENT START** button to blow atmospheric air through the system (valve **h 286** closes and valve **h 280** opens).
- **COMMON** controls comprising:
  - **ALARM RESET** button;
  - **STOP** button to stop the main IGG system normally;
  - **EM'CY STOP** button to stop the IGG system in emergency.
- **CAPACITY SET POINT** buttons to raise or lower the IGG capacity; the **CAPACITY SET POINT** gauge at the bottom of the panel displays the set value;
- **DECK PRESSURE SET POINT** buttons to raise or lower the gas deck pressure; the **DECK PRESSURE SET POINT** gauge at the bottom of the panel displays the set value;
- **REMOTE WATER WASH I.G. BLOWER** buttons to select **BLOWER 1** and **BLOWER 2** – click the button to wash respective blower from soot during the stopping sequence time, while the **STOP** button is flashing;



- **DECK WATER SEAL WATER PUMP 1** controls comprising:
  - **PUMP START** and **STOP** buttons to operate the pump from this panel in MANU mode;
  - Two-position control mode selector switch:

    MANU – operate the pump by panel buttons;

    AUTO – to start the respective pump automatically controlled by the SW pressure drop after the pump.
  - **RUN** and **STAND BY** indicator lamps.

  Note: When operating in MANU mode one of the pumps should be started and the second set to AUTO mode.
- **DECK WATER SEAL WATER PUMP 2** controls – similar to controls of pump 1;
- **O2 CONTENT**; **DECK PRESSURE MAIN LINE kPa**; **DECK PRESSURE SECONDARY LINE kPa** measuring gauges.

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.

7.3.4. Connections

- Steam service system
- FO service system
- Compressed air system
- SW system
- FW service system

7.3.5. Control

The system can supply IG through the main line using the Steam Service system Boilers' exhaust gases (high capacity) or Topping Up Generator system (see ***the paragraph 7.3.6 on page 191***) for maintaining IG pressure.

7.3.5.1. Starting Main IGG System

1. Ensure that one of the boilers is running or ready to start automatically; the **BLR Steam Outlet Main Valve** should be open (see ***the paragraph 5.2.2 on page 155***).
2. Start **VACUUM COND. C.S.W.** pumps in duty/standby configuration (see ***the paragraph 2.1.4.4 on page 121***).
3. Start **CONDENSATE WATER** pumps in duty/standby configuration (see ***the paragraph 5.3.4.2 on page 158***).
4. On the **Steam Turbines Service System** diagram (use menu item **Steam Turbines Service System** of the page **SYS**, see ***the paragraph 5.3.2 on page 157***):
   - › Open one of **Steam Ejector Valve**.
   - › Check sea water flow in condenser and vacuum pressure.
5. On the **BURNER OVERVIEW** display of the page **BMCS** (see ***Chapter 2, the paragraph 2.2.1***):
   - › Click one of the **Boiler 1** or **Boiler 2** buttons to open the control panel.
   - › On the panel set the boiler to **IGS** mode; click **OK**.
6. On **INERT GAS SYSTEM CONTROL PANEL** display of the page **CCR** (see ***the paragraph 7.3.3 on page 188***):
   - › Click **SELECT** button to set the required **BOILER UPTAKE**.
   - › Click **SELECT** button to set the **BLOWER** for operation.
7. Switch ON power for **IGS SCRUBBER C.S.W.** pump on **GSP 7** panel in **ER1** (see ***the paragraph 2.1.4.3 on page 120***).
8. Start **DECK WATER SEAL** pumps in duty/standby configuration (see ***the paragraph 2.1.4.5 on page 122***).
9. On **INERT GAS SYSTEM CONTROL PANEL** click (1) and/or (2) button(s) to set the required gas supply line(s).
10. On **INERT GAS SYSTEM CONTROL PANEL** display click **FLUE GAS START** button.
    - Automatic start program launches for 10 sec.;
    - **IGS SCRUBBER C.S.W. PUMP** starts; valve **h 6-F** opens;
    - Selected Blower runs for 17 sec.; its inlet valve opens;
    - Selected Boiler valve opens;
    - Gas is purged to atmosphere for about 50 sec.;
    - Gas is supplied to selected deck lines according to **CAPACITY SET POINT** and **DECK PRESSURE SET POINT** values.

7.3.5.2. Stopping Main IGG System

Use the button **STOP** on **INERT GAS SYSTEM CONTROL PANEL** display to stop the system according to the stop sequence.

Use **EM'CY STOP** button to stop the IGG system in emergency.

7.3.6. Topping Up Generator Control Panel

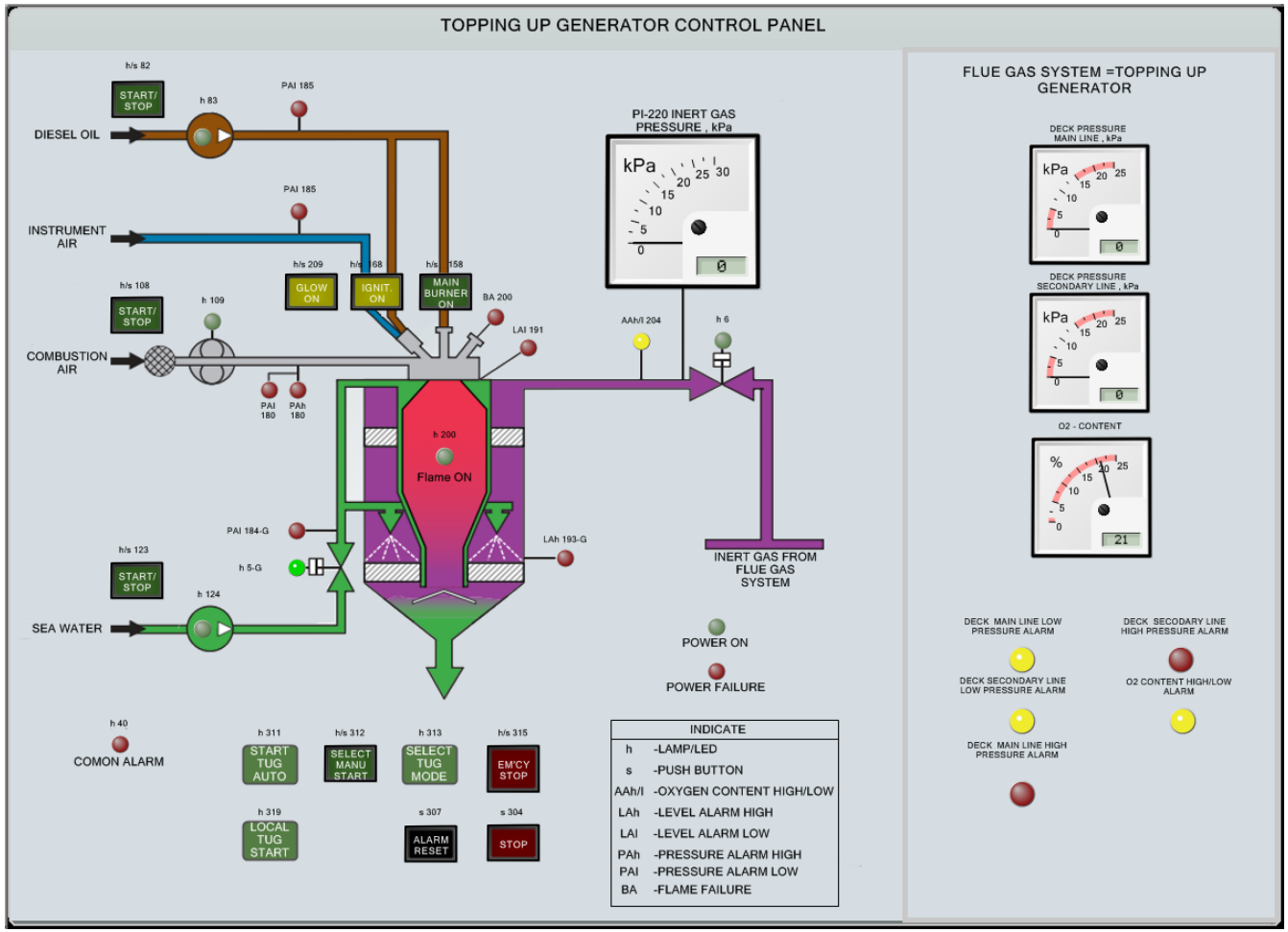
Click on the menu item **Topping Up Generator Control Panel** of the page **CCR** to open the system diagram and control panel.

The TUG system diagram in the left and central part of the display contains:

- **START/STOP** buttons to operate in manual mode:
  - **DIESEL OIL** pump;
  - **COMBUSTION AIR** fan;
  - **SEA WATER** pump.
- **GLOW ON**; **IGNIT. ON**; **MAIN BURNER ON**; **SELECT MANU START** buttons; see operation description in *the paragraph 7.3.6.1 on page 192*
- **PI-220 INERT GAS PRESSURE** – measuring gauge;
- **SELECT TUG MODE**; **START TUG AUTO**; **LOCAL TUG START** indicator lamps – reflect the selection on **INERT GAS SYSTEM CONTROL PANEL** (see *the paragraph 7.3.3 on page 188*);
- **ALARM RESET** button;
- **STOP** button to manually stop the TUG;
- **EM'CY STOP** button to stop the TUG in emergency;
- **INDICATE** legend.

The **FLUE GAS SYSTEM = TOPPING UP GENERATOR** panel contains:

- **DECK PRESSURE MAIN LINE kPa**; **DECK PRESSURE SECONDARY LINE kPa**; **O2 CONTENT** measuring gauges;
- Lamps, which illuminate to indicate:
  - **DECK MAIN LINE LOW PRESSURE ALARM** – press. < 5 kPa;
  - **DECK SECONDARY LINE HIGH PRESSURE ALARM** – pressure > 15 kPa;
  - **DECK SECONDARY LINE LOW PRESSURE ALARM** – pressure < 5 kPa;



- **DECK MAIN LINE HIGH PRESSURE ALARM** – pressure > 15 kPa;
- **O2 CONTENT HIGH/LOW ALARM** – 5% / 1%.

Switch power supply 440V for the TUG on **No.1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **TOPPING UP GENERATOR** circuit breaker.

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.

7.3.6.1. TUG Manual Start

On **INERT GAS SYSTEM CONTROL PANEL** display of the page **CCR** (see *the paragraph 7.3.3 on page 188*) click **SELECT TUG MODE** button to supply gas by the topping up generator. Starting of the generator is done from the TUG control panel.

1. On the **SW Cooling System** display (use menu item **SW Cooling System** of the page **SYS**) open the TUG sea water supply pump suction and discharge valves. If the pump is unavailable, either of the bilge, fire and GS pumps can be utilized to supply the TUG.
2. Click the **SELECT MANU START** button.
3. Click **START/STOP** button to start the TUG **SEA WATER** supply pump.
4. Click **START/STOP** button to start **COMBUSTION AIR** fan.
5. Click **START/STOP** button to start the **DIESEL OIL** pump, and energize the ignition glow plug with the **GLOW ON** button.
6. Admit air and fuel to the ignition burner with the **IGNIT. ON** button.
7. Supply fuel to the main burner by operating the **MAIN BURNER ON** button.
8. When the flame is established and indicated by the **Flame ON** lamp, allow 5 seconds for the flame to establish, then stop the ignition burner by cancelling the **IGNIT. ON** and **GLOW ON** buttons.

After the purging period it will be possible to direct the inert gas to the deck, if the oxygen level is below 5% (read **O2 CONTENT** gauge): click the main and/or secondary **SELECT** button on the **INERT GAS SYSTEM CONTROL PANEL** display (use menu item **Inert Gas System Control Panel** of the page **CCR**).

7.3.6.2. TUG Manual Stop

Click the **STOP** button on the TUG control panel. The system will shut down and reset to the purge mode. The sea water system and the blower will continue to run for a cooling down period.

7.3.6.3. TUG Automatic Start

1. On the **SW Cooling System** display (use menu item **SW Cooling System** of the page **SYS**) open the TUG sea water supply pump suction and discharge valves. If the pump is unavailable, either of the bilge, fire and GS pumps can be utilized to supply the TUG.
2. On **INERT GAS SYSTEM CONTROL PANEL** display of the page **CCR** (see *the paragraph 7.3.3 on page 188*):
   - › Click **SELECT TUG MODE** button.
   - › Click **START TUG AUTO** button.

   The sea water pump then starts and the sea water inlet valve to the cooling tower opens. After a few seconds the blower will start. After receiving a running signal from the blower, the IG capacity control valve will begin regulation. After a few seconds the fuel oil pump will start and the ignition plug is activated.

   After activation of the main burner, the gas will purge through the vent valve for about a minute. The sequence is the same as manual operation.
3. After the purging time period it will be possible to direct the inert gas to the deck, if the oxygen level is below 5% (read **O2 CONTENT** gauge): click the main and/or secondary **SELECT** button on the **INERT GAS SYSTEM CONTROL PANEL** display (use menu item **Inert Gas System Control Panel** of the page **CCR**).

The start sequence is indicated with lamps on the mimic diagram.

7.3.6.4. TUG Automatic Stop

The generator stops when activated by the high-pressure signal from the inert gas main. The system will revert to the purge mode and shut down. The sea water system and the blower will continue to run for a cooling down period.

7.3.6.5. Topping Up Generator C.S.W. Pump

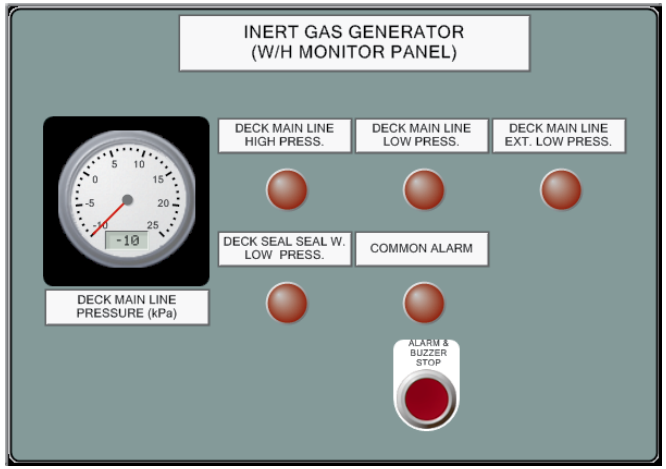
The pump description is given in *the paragraph 2.1.4.2 on page 120*.

7.3.7. IGG Monitoring Panels at Wheel House & ECR

Click on the menu item **BCC IGG Monitor** of the page **BCC** to open the panel **INERT GAS GENERATOR (W/H MONITOR PANEL)**.

The panels contains:

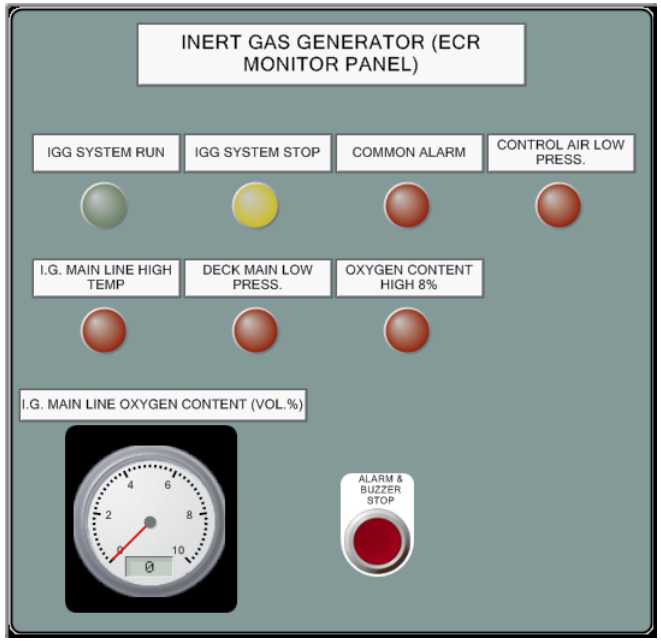
- **DECK MAIN LINE PRESSURE (kPa)** pressure gauge;
- Alarm indicator lamps:
  - **DECK MAIN LINE HIGH PRESS.** – pressure > 14 kPa;
  - **DECK MAIN LINE LOW PRESS.** – pressure < 2 kPa;
  - **DECK MAIN LINE EXT. LOW PRESS.** – pressure < 1 kPa;
  - **DECK SEAL SEAL W. LOW PRESS.** – low flow;
  - **COMMON ALARM** – any alarm.
- **ALARM & BUZZER STOP** button.



Click on the menu item **ECC IGG Monitor** of the page **ECR** to open the panel **INERT GAS GENERATOR (ECR MONITOR PANEL)**.

The panels contains:

- Alarm and state indicator lamps:
  - **IGG SYSTEM RUN**;
  - **IGG SYSTEM STOP**;
  - **COMMON ALARM** – any alarm;
  - **CONTROL AIR LOW PRESS.** – pressure < 0.4 MPa;
  - **OXYGEN CONTENT HIGH (8%)**;
  - **I.G. MAIN LINE HIGH TEMP.** – temperature > 85 °C;
  - **DECK MAIN LINE LOW PRESS.** – pressure < 2 kPa;
  - **FLAME ESTABLISH**;
  - **ELECTRIC SOURCE FAIL**.
- **I.G. MAIN LINE OXYGEN CONTENT (VOL.%)** gauge;
- **ALARM & BUZZER STOP** button.



7.3.8. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.15.1 on page 279* and *the paragraph 2.15.2 on page 279*.

7.4. Ballast System

7.4.1. General

The vessel complies with MARPOL Protocol 73/78 as a segregated ballast tanker. Segregated ballast is carried in the AFT ballast tanks, FORE PEAK tank and in pairs of wing tanks arranged along the entire length of the cargo tank area.

The vessel is designed with sufficient heavy weather ballast capacity to meet any weather condition without having to load additional ballast in the cargo tanks.

Click on the menu item **Ballast System** of the page **SYS** to open the system diagram

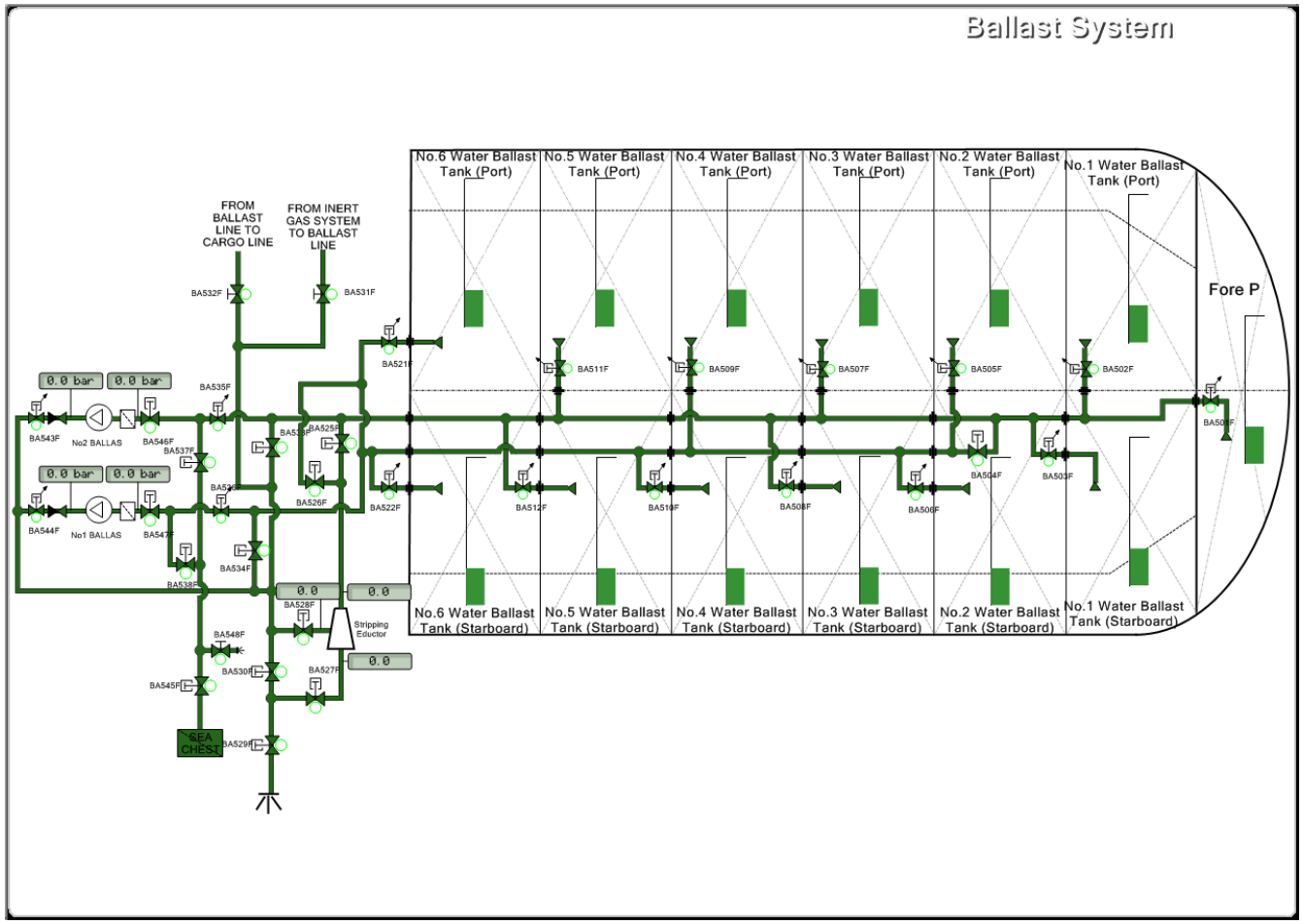
7.4.2. Content

- A set of ballast water tanks; each tank is fitted with hydraulic **Suction/Discharge Valve**;
- **No 1 (No 2) Ballast Pump** – 750 m3/h x 25 mwc;
- Sea Water Crossovers and Sea Chest;
- Pipelines with valves, filters, measuring gauges.

7.4.3. Connections

- To Cargo Line;
- From Inert Gas System.

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.



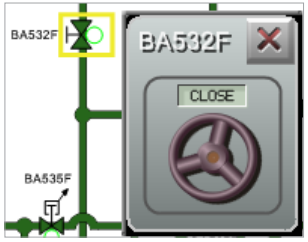
7.4.4. Control

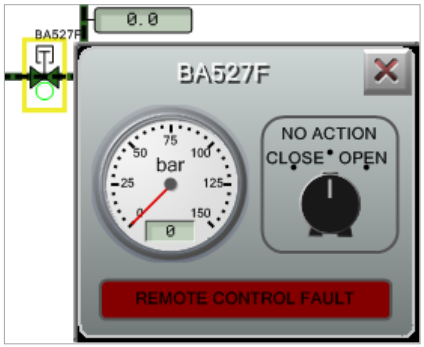
7.4.4.1. Valve Control Panels

Pop-up control panels are used to operate modulating 0-100 mechanical manual valves and remote hydraulic valves in the case of valve fault (see panels operating description in *the paragraph 8.3 on page 237*).

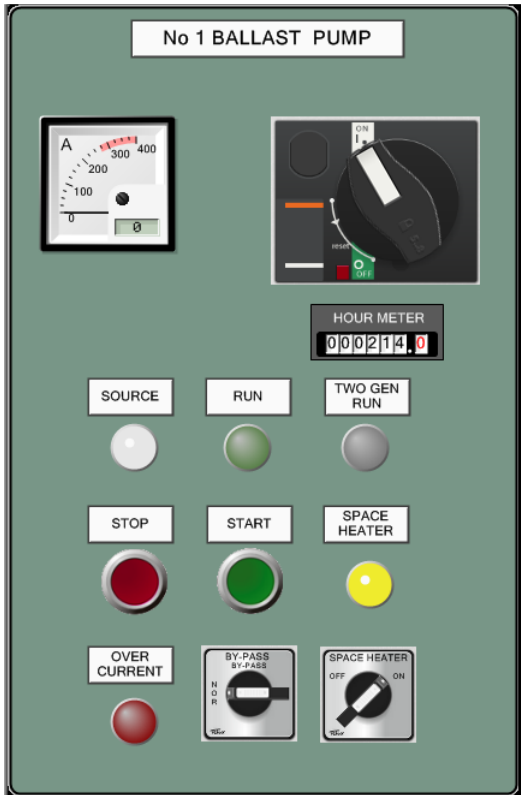
Click a valve to open its control panel.

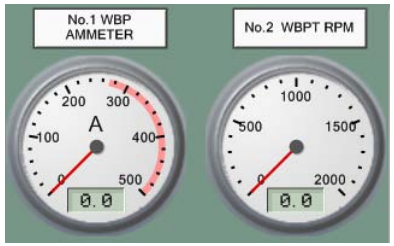
The valve color reflects the open (filled), or filling percentage, or closed (only border) state. Filling time reflects the actual valve operation time.





The remote hydraulic valves are normally controlled from the ballast mimic console (use menu item **Ballast System Mimic** of the page **CCR**, see *the paragraph 8.4 on page 238*).





7.4.4.2. Ballast Pumps

Click on the menu item **Ballast Pump 1 LOP** of the page **ER2** to open the **No 1 BALLAST PUMP** control panel. Pump 1 has electrical drive motor.

The panel contains:

- Power switch automatic circuit breaker;
- Ammeter, HOUR METER;
- **SOURCE**, **RUN** indicator lamps;
- **TWO GEN** indicator lamp: illuminates when both Gens run;
- **STOP** and **START** buttons to operate the pump;
- **OVER CURRENT** alarm lamp;
- **BY-PASS** two-position motor start mode selector switch:
  - **NOR** – set for normal water flow;
  - **BY-PASS** – thyristor motor start.
- **SPACE HEATER** two-position switch OFF/ON and lamp.

Note: Ballast pump pressure is limited to 150 bar.

Control of the Water Ballast Pump 2 turbine drive (use menu item **WBPT LOP** of the page **ER2**) is described in *the paragraph 7.7.2.2 on page 205*.

In ECR on ECC Section A (use menu item **ECC A Panel** of the page **ECR**) there are presented the running state indicator lamps and gauges to read parameters of the ballast water pumps.

The pumps remote control is also provided from the panel of the CCR page (use menu item **Ballast Pumps Panel** of the page **CCR**, see *the paragraph 8.4.2 on page 239*).

7.4.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.8 on page 272* and in other respective paragraphs.

7.5. Fresh Water Service System

7.5.1. General

The system is designed for generating, storing and distribution of fresh water for different ship purposes (different salinity).

Click on the menu item **Fresh Water Service System** of the page **SYS** to open the display.

7.5.2. Content

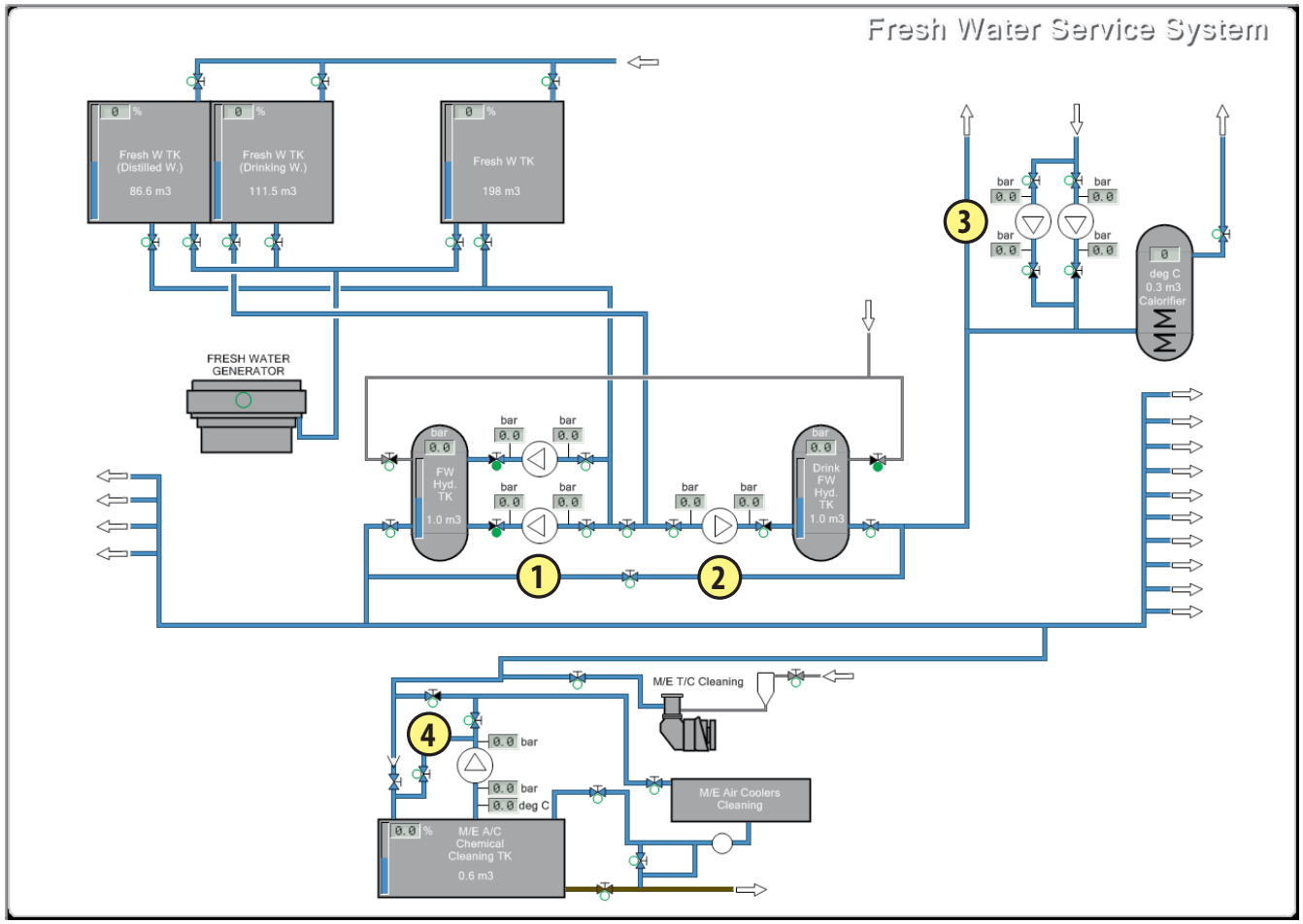
- Tanks

Tank	Volume m³
Fresh W TK (Distilled W.)	86.6
Fresh W TK (Drinking W.)	111.5
Fresh W TK	198.0
FW Hyd. TK	1.0
Drink FW Hyd. TK	1.0
M/E A/C Chemical Cleaning TK	0.6

- **FRESH WATER GENERATOR** with run indicator;
- (1) **Fresh Water Pump №1 (2)** – 5 m3/h x 6 kg/cm2;
- (2) **Drink Fresh Water Pump** – 5 m3/h x 6 kg/cm2;
- (3) **Hot Water Circ. Water Pump №1 (2)** – 2 m3/h x 1 kg/cm2;
- (4) **M/E A/C Chemical Cleaning Pump** – 2 m3/h x 3 kg/cm2.
- **Calorifier** 0.3 m3 – with heating coils;
- Chemical cleaning unit for M/E T/C, Air coolers, A/C systems FW service;
- Pipelines with valves, filters, measuring gauges.

7.5.3. Connections

- From Shore
- To Economizer Washing



- To Sewage Treatment Plant For Dilution & Service
- To Boiler Chem. Dosing Unit
- To Boiler Water Sampling Cooler
- Air For Soft Blast Cleaning
- To Bilge Hold TK
- From Compressed Air Supply
- To/From Accommodation
- To IGS Main Blower Washing
- To IGS Aux Blower Washing
- To CFW Exp. TK
- To Cascade TK
- To Oily W. Separator
- To M/E Soot Collecting TK
- To №2 (№1) Main LO Purifier
- To №2 (№1) HFO Purifier

7.5.4. Control

7.5.4.1. Fresh Water Pumps

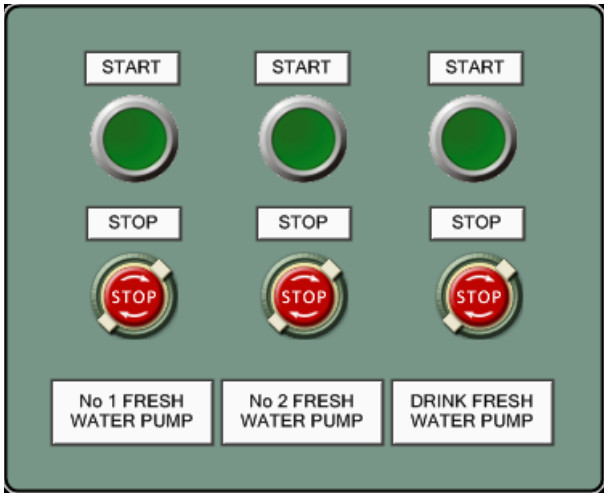
The general description of a starter panel and a push button box is given in Introduction ***the section 5 on page 12***.

Click on the menu item **Service FW Pumps GPBP** of the page **ER3** to open the **No 1 FRESH WATER PUMP, No 2 FRESH WATER PUMP, DRINK FRESH WATER PUMP** push button boxes.

Remote control of the FW pumps and power supply is provided from the **No.6 GROUP STARTER PANEL**.

Click on the menu item **GSP 6** of the page **ER3** to open the **No.6 GROUP STARTER PANEL** with starter panels of:

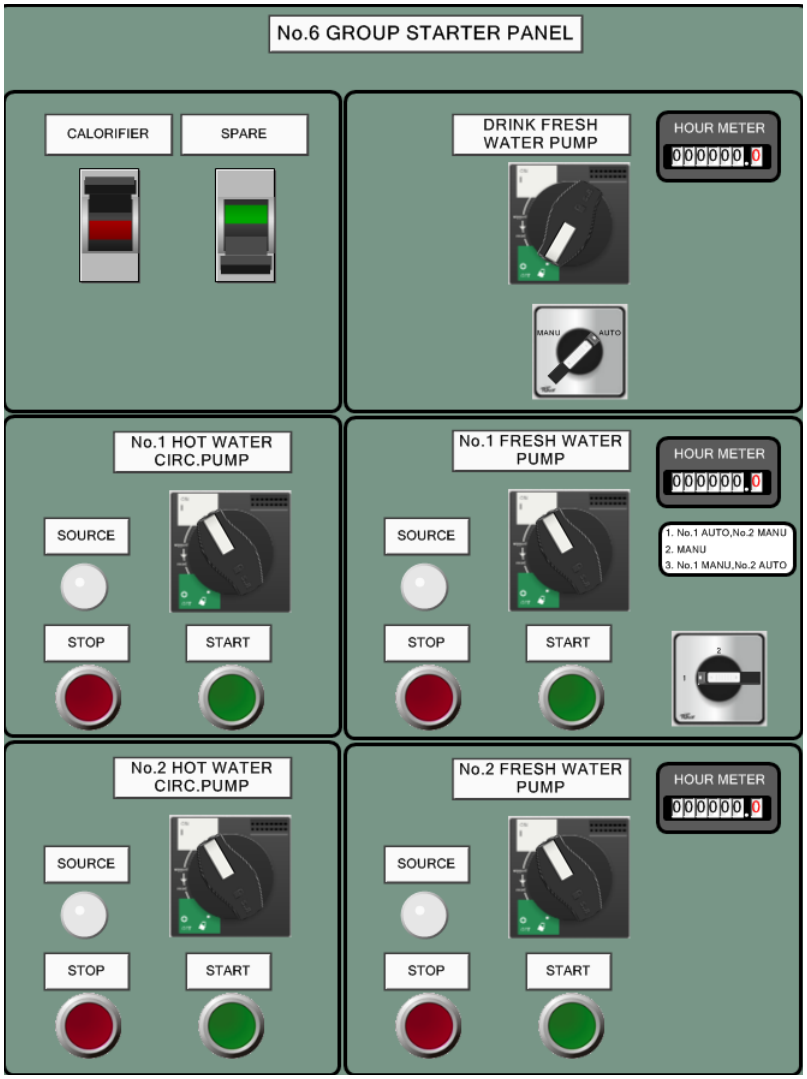
- **No.1 FRESH WATER CIRC. PUMP** – the three-position mode selector switch is used to select operating mode of the No 1 and No 2 pumps as follows:
  - **1. No 1 AUTO, No 2 MANU** – pump 1 automatic starts when FW Hydrophore tank pressure ≤ 5 bar, and stops when pressure ≥ 6 bar; pump 2 is controlled manually from **GSP 6** or push button box;



  - **2. MANU** – both pumps are controlled from either GSP 6 or push button box;
  - **3. No 1 MANU, No 2 AUTO** – pump 2 automatically starts when FW Hydrophore tank pressure ≤ 5 bar, and stops when pressure ≥ 6 bar; pump 1 is controlled manually from **GSP 6** or push button box.
- **No.2 FRESH WATER CIRC. PUMP**;
- **No.1 (No.2) HOT WATER CIRC. PUMP**;
- **DRINK WATER HYD. PUMP** – the two-position mode selector switch is used to select:
  - **MANU** – operate on the push button box;
  - **AUTO** – automatic starts on Drink Hydrophore tank pressure drop ≤ 5 bar, and stops when pressure ≥ 6 bar.

Switch the power supply for the **No.6 GROUP STARTER PANEL** on the **No.1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 6 LOCAL GROUP STARTER PANEL** circuit breaker.

Switch power 440V for the **GSP 6** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 6 LOCAL GROUP STARTER PANEL** circuit breaker.



7.5.4.2. Calorifier Control Panel

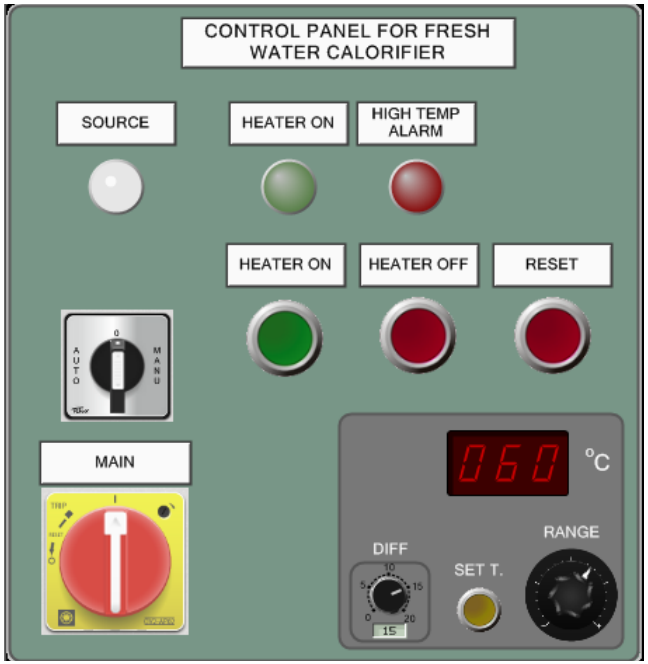
Click on the menu item **FW Calorifier LOP** of the page **ER3** to open the **CONTROL PANEL FOR CALORIFIER**.

The panel contains controls to operate the electrical calorifier:

- **MAIN** power automatic CB;
- **SOURCE** lamp; it illuminates when power is on;
- **HEATER ON** lamp; it illuminates when heater is on;
- **HIGH TEMP ALARM** lamp; it illuminates when temp. > 80 °C; high temperature trip = 90 °C.
- **AUTO OFF MAN** mode selector switch to set the mode:
  - **AUTO** – the heater is controlled automatically according to the temperature set point (see below)
  - **OFF** – heater is off;
  - **MAN** – operate the heater by the buttons on the panel.
- **HEATER ON** and **HEATER OFF** buttons to operate the heater in MAN mode;
- **RESET** button;
- Temperature controller to set point automatic operation of the electrical calorifier. Controller operation is described in Introduction, *the paragraph 5.3 on page 13*.

Switch the poser supply for the CALORIFIER panel on the **No.6 GROUP STARTER PANEL** (use menu item **GSP 6** of the page **ER3)** by **CALORIFIER** circuit breaker.

Switch the power supply for the **No.6 GROUP STARTER PANEL** on the **No.1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 6 LOCAL GROUP STARTER PANEL** circuit breaker.



Calorifier comprises the second heater, which automatically maintains the temperature of 75 °C using the steam from the Boilers Feed Water & Condensate system (use menu item **Boilers Feed Water & Condensate System** of the page **SYS**, see *the paragraph 5.2.2 on page 155*. Open the **To Calorifier Heating Valve** to supply steam.

Note: The Temperature controller set point impacts only the electrical part of the calorifier.

7.5.4.3. ME Air Cooler Chemical Cleaning Pump

Switch power 440V for the pump on the **No.8 GROUP STARTER PANEL** (use menu item **GSP 8** of the page **ER1**) by **M/E AIR COOLER CHEM. CLEAN PUMP** circuit breaker.

7.5.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.7.17 on page 273* and in other respective paragraphs.

7.6. Fresh Water Generator System

7.6.1. General

The system is designed for generating of fresh water for different ship purposes (different salinity).

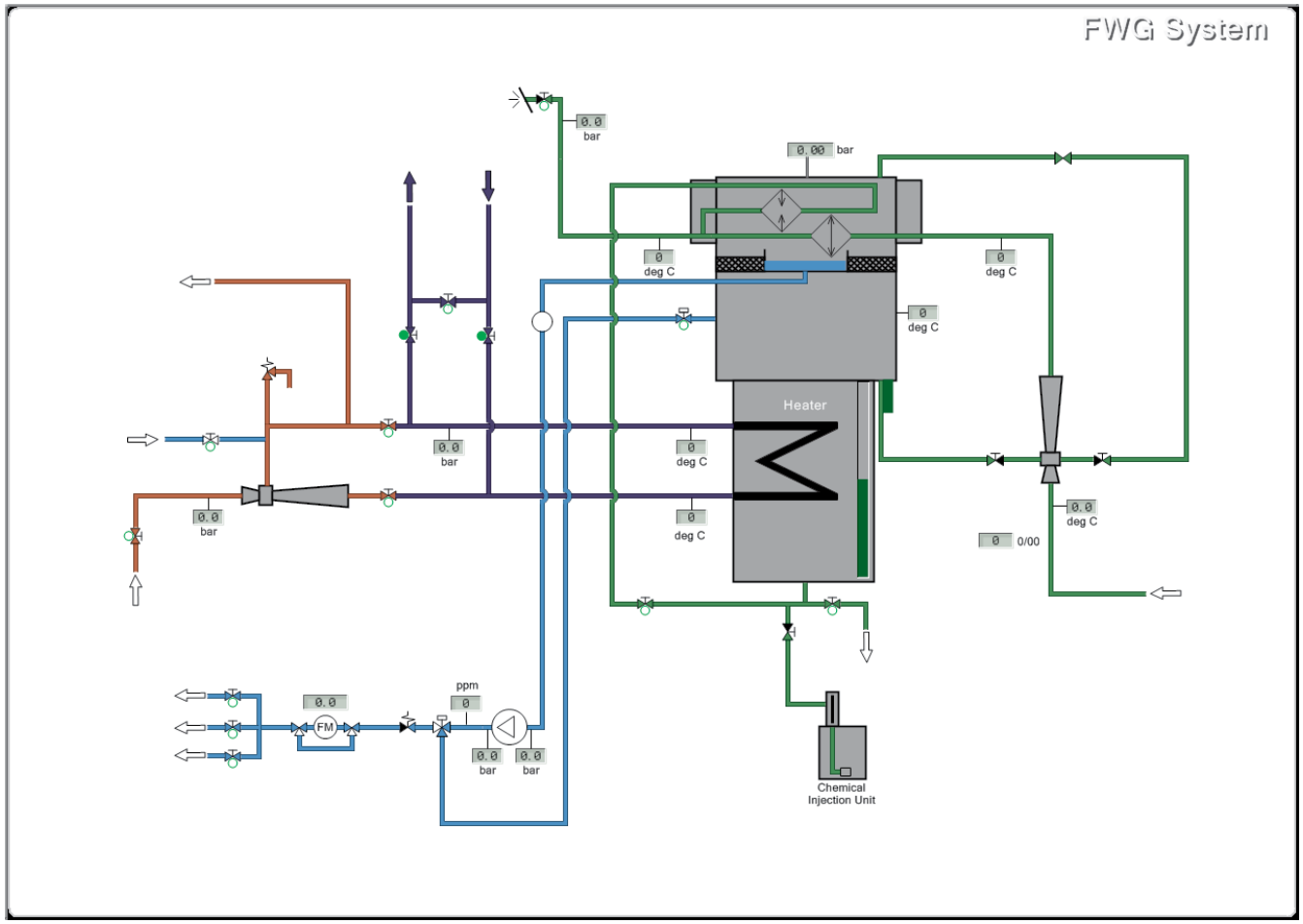
Click on the menu item **FWG System** of the page **SYS** to open the display.

7.6.2. Content

- **Fresh Water Generator** with Cooler and Heater;
- **Heater**;
- **Distillate Pump** – 1.2 m3/h x 3 bar;
- **Water Ejector**;
- **Steam Injector**;
- **Chemical Injection Unit**;
- Pipelines with valves, filters, measuring gauges.

7.6.3. Connections

- To/From HT Cooling System
- Steam Drain Outlet
- Priming Water
- From Steam Line
- To Fresh Water TK (Distilled W.)
- To Fresh Water TK (Drinking W.)
- To Feed Water TK
- Drain To Bilge
- From SW Ejector Pump



7.6.4. Control

7.6.4.1. Fresh Water Generator Panel

Click on the menu item **FWG LOP** of the page **ER3** to open the **FRESH WATER GENERATOR PANEL**.

The panel includes:

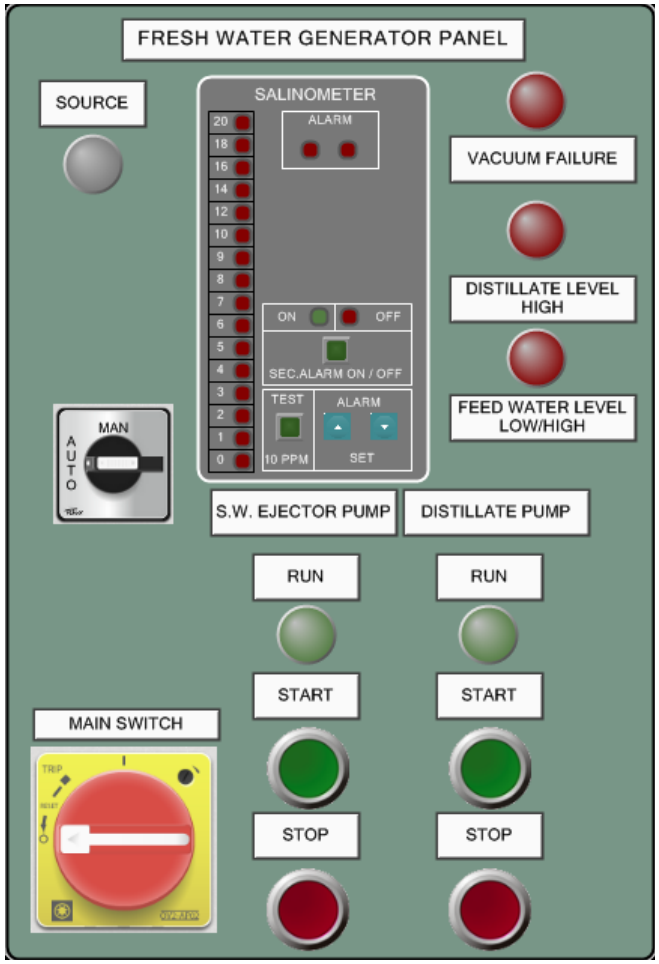
- **SOURCE** indicator lamp;
- **SALINOMETER** panel;
- Alarm indicator lamps:
  - **VACUUM FAILURE**
  - **DISTILLATE LEVEL HIGH**
  - **FEED WATER LEVEL LOW/HIGH**
- **AUTO–MAN** two-position switch to set the FWG control mode;
- **MAIN SWITCH** circuit breaker to turn power for the pumps;
- **S.W. EJECTOR PUMP** push button box to operate the pump in MAN mode;
- **DISTILLATE PUMP** push button box to operate the pump in MAN mode.

The general description of a push button box controls is given in Introduction *the section 5 on page 12*.

Switch power 440V for the pumps on the **No.8 GROUP STARTER PANEL** (use menu item **GSP 8** of the page **ER1**) by:

- **F..W.G. EJECTOR PUMP** starter panel;
- **F.W.G. DISTILLATE PUMP** circuit breaker.

Switch power 440V for the **GSP 8** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 8 LOCAL GROUP STARTER PANEL** circuit breaker.



FWG Salinometer Operation

Fresh water quality is continuously checked using a salinometer with an electrode unit fitted on the freshwater pump delivery side. If the salinity of the fresh water produced exceeds the chosen maximum value, the dump valve and alarm are activated to automatically dump the fresh water overboard.

The **SALINOMETER** unit contains:

- **20~0** LED indicators, which highlight to show the ppm;
- **ALARM** double indicator, which illuminates when salinity is higher than the set point;
- **ON** and **OFF** indicator lamps;
- **SEC. ALARM ON/OFF** button to switch on/off alarm;
- **TEST 10 PPM** button to test the device; when the button is pressed the LED indicators should show 10 ppm;
- **ALARM SET** buttons **Up** and **Down** to setpoint the salinometer alarm value.

7.6.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.11.7 on page 276* and in other respective paragraphs.

7.7. Steam Turbines

7.7.1. General

Three steam turbines are modeled in the simulator as drives of cargo oil pumps (COPT): HYUNDAI HEAVY IND., ENK120G; output 1205 kW, speed turbine/gear 7998/1510 RPM, inlet steam pressure 14.5 kg/cm2, saturated steam.

One steam turbine is modeled as drive of water ballast pump No.2 (WBPT): HYUNDAI HEAVY IND., ENK112G; output 130 kW, speed turbine/gear 9934/1190 RPM, inlet steam pressure 14.5 kg/cm2, saturated steam.

Turbines are similar vertical construction: with reduction gear, simple impulse type, consisting of one velocity-compounded stage with two rows of rotating blades and one row of stationary blades. This rotor is mounted on pinion shaft end of reduction gear, therefore the turbine is most simplicity and compact. Turbine with manual start and Woodward speed governor.

High speed and suitable nozzles for the steam conditions fitted on all circumference of rotor realize high efficiency and large power for small simple impulse turbine.

Trip System

When the turbine is stopped by safety devices (overspeed trip, low oil pressure trip, bearing oil temperature high trip or excess back pressure trip), the emergency stop and governor valve shut the steam flow immediately and it protects the turbine safety.

7.7.1.1. Construction

Turbine Blades

The turbinblading consists of one row of stationary blade, and two rows of rotating blades.

The rotating blades are mounted on rotor with T-root, and their tops are cramped each other with several shrouds.

The stationary blades are mounted on retainer with dovetail.

Turbine Casing

Turbine casing consists of a casing rear, and a casing front bolted together at the vertical joint.

Turbine Rotor

The rotor disc is shrunk and keyed on the pinion shaft which overhung from two pinion bearings. After the blades are installed, the entire rotating assembly is dynamically balanced.

Nozzle and Stationary Blade Retainer

The nozzle is distributed to all circumference of the rotor in order to get large power.

The nozzle ring is bolted up the steam chest firmly. The stationary blade retainer is fitted to casing by sliding.

Steam Chest

Steam chest is one ring and is bolted together with nozzle ring to the turbine casings.

Turbine Gland

The parts of the turbine casing where the turbine shaft goes through are sealed with gland having Brass labyrinth divided in two. The labyrinth prevents the leakage of steam through the parts penetrated by the shaft.

Emergency Stop Valve

The emergency stop valve is situated upper position and the governor valve is situated down position.

The emergency stop valve has two distinct purposes.

First, to control throttling of steam when starting and bring the turbine up to speed: second, to act as quick-closing valve when tripped by hand or remote-trip, and as an emergency stop valve when tripped automatically by safety device such as overspeed trip, back pressure trip, low oil pressure trip.

Governor Valve

The governor valve position is determined by movement of the governor and the governor valve controls the flow of steam to the steam chest.

Governor Link

The governor shaft of the governor and the governor valve stem are connected with the governor link.

Reduction Gear

This reduction gear is designed high reduction ratio and the pinion shaft end fits a turbine rotor in order to obtain high efficiency and economy of space

Lubrication System

Lube oil is sucked up from the oil reservoir by the main oil pump or aux. oil pump and supplied to the pinion bearing, gear bearing and gear teeth surfaces through the strainer and oil cooler, and then it returns to the oil reservoir.

The bearing oil pressure is regulated by oil relief valve, and excess oil returns to the oil reservoir.

Speed Governor

The rotational speed of this turbine is controlled by the Woodward governor. This governor is driven by the drive gear mounted on the front end of the main oil pump shaft.

It ensures an excellent speed controlling, enabling to keep always constant the rotational speed of the turbine regardless of variation off-load and steam conditions.

The speed setting point can be significantly changed by turning the speed setting dial with hand or the remote control motor.

Main Oil Pump and Governor Drive Gear

The main oil pump is driven at properly reduced or increased speed by the drive gear (drive) mounted on the upper end of the gear shaft and the driven gear (follow) fitted to the pump gear (drive).

Auxiliary Oil Pump

This turbine is equipped with auxiliary oil pump to furnish bearing lubrication during starting and shut down periods.

The unit has one motor-operated pump which provides auto-start and stop by means of a pressure switch (Start : 0.4 kg/cm2 or under 700 rpm. Stop: 1.2 kg/cm2 and over 700 rpm)

Oil Relief Valve

The oil relief valve is mounted on main oil pump discharge line. Usually, it serves to keep constant the bearing oil pressure and gear spray oil pressure.

7.7.1.2. Trip Conditions

Over Speed Trip

The turbine is equipped with an overspeed trip which prevents overspeed of the turbine by tripping the emergency stop valve and shutting off the supply of the steam to the turbine.

If the turbine speed increases by abnormal condition as much as predetermined value (about 113% rated speed), the overspeed trip operates and shuts the emergency stop valve through the emergency mechanism linkage by means of dual electric overspeed sensor and trip solenoid valve. The over-speed is detected with a groove on the upper end of the wheel shaft and dual electric sensors.

Excess Back Pressure Trip

The turbine is provided with an excess back pressure trip de-vice to prevent trouble due to excessive back pressure rise.

When the turbine back pressure rises, the steam sentinel valve begins to emit steam.

When if rises further up to the operating pressure, the pressure switch de-energizes the trip solenoid valve.

And closes the emergency stop valve to shut off steam inflow.

Lub. Oil Pressure• Low Trip

The turbine is provided with a lub. Oil pressure low trip device, to prevent trouble due to failure of bearing oil pressure.

Same as excess back pressure trip, when the specified opera-tion pressure is reached, the pressure switch de-energizes the trip solenoid valve and trips the turbine.

Trip Solenoid Valve

In order to trip the turbine, the trip solenoid valve in the oil line of the trip cylinder of the emergency stop valve is de-energized.

Manual Trip Valve

In order to trip the turbine at turbine side, trip line. Resetting the trip system has to close this valve.

7.7.2. Control

7.7.2.1. Cargo Oil Pump Turbine 1, 2, 3 LOPs

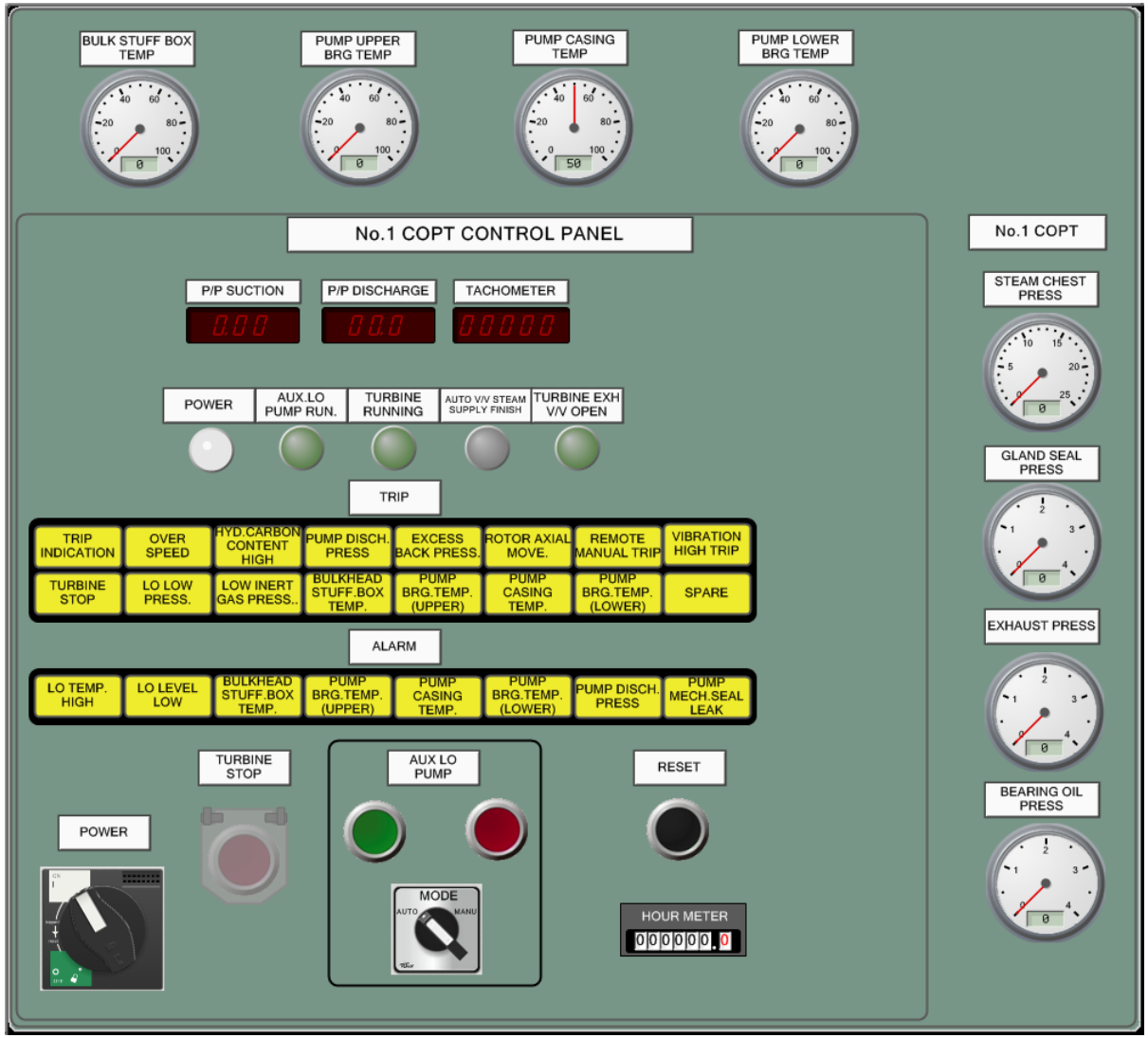
Click on the menu item **COPT 1 LOP** of the page **ER2** to open the turbine control panel. Click on the menu item **COPT 2 LOP** of the page **ER2** to open the turbine control panel. Click on the menu item **COPT 3 LOP** of the page **ER2** to open the turbine control panel. The description given is for the **COPT 1 LOP**. **COPT 2** and **COPT 3** LOPs and similar to **1**.

The display contains:

- Gauges to control parameters: **BULK STUFF BOX TEMP.**; **PUMP UPPER BRG TEMP**; **PUMP CASING TEMP**; **PUMP LOWER BRG TEMP**;
- **No. 1 C.O.P.T.** gauges: **STEAM CHEST**; **GLAND SEAL**; **EXHAUST**; **BEARING OIL**;
- **No. 1 C.O.P.T. CONTROL PANEL**.

The **No. 1 C.O.P.T. CONTROL PANEL** contains:

- Digital indicators of:
  - **P/P SUCTION**;
  - **P/P DISCH.**;
  - **TACHOMETER**.
- Indicator lamps:
  - **POWER**;
  - **AUX. LO PUMP RUN.**;
  - **TURBINE RUNNING**;
  - **AUTO V/V STEAM SUPPLY FINISH**;
  - **TURBINE EXH V/V OPEN**.



- **TRIP** condition indicator lamps illuminate when:
  - **TRIP INDICATION**;
  - **OVER SPEED** – speed > 113% RPM Nom;
  - **HYD. CARBON CONTENT HIGH** – ;
  - **PUMP DISCH. PRESS** – ;
  - **EXCESS BACK PRESS** – pressure > 0.7 bar;
  - **ROTOR AXIAL MOVE.** – move > 9 mm;
  - **REMOTE MANUAL TRIP** – EM'CY **TURBINE STOP** clicked;
  - **VIBRATION HIGH TRIP** – vibration > 0.8;
  - **TURBINE STOP**;
  - **LO LOW PRESS** – pressure < 0.5 bar;
  - **LOW INERT GAS PRESS.** – ;
  - **BULKHEAD STUFF. BOX TEMP.** – temperature > 90 °C;
  - **PUMP BRG. TEMP. (UPPER)** – temperature > 90 °C;
  - **PUMP CASING TEMP.** – temperature > 80 °C;
  - **PUMP BRG. TEMP. (LOWER)** – temperature > 90 °C.
- **ALARM** condition indicator lamps:
  - **LO TEMP. HIGH** – temperature > 52 °C;
  - **LO LEVEL LOW** – level < 30%;
  - **BULKHEAD STUFF. BOX TEMP.** – temperature > 85 °C;
  - **PUMP BRG. TEMP. (UPPER)** – temperature > 85 °C;
  - **PUMP CASING TEMP.** – temperature > 75 °C ;
  - **PUMP BRG. TEMP. (LOWER)** – temperature > 85 °C;
  - **PUMP DISCH. PRESS** – pressure > 15 bar;
  - **PUMP MECH. SEAL LEAK** – .
- **POWER** automatic circuit breaker to switch power for the panel;
- **TURBINE STOP** button with protection cover; click once to open the cover; click second time to stop the turbine;
- **AUX LO PUMP** operating buttons for MANU control mode; click the green button to start the pump; click the red button to stop the pump;
- **MODE** two-position selector switch to set the AUX LO PUMP control mode:
  - **AUTO** – the pump automatically starts when LO pressure drops in the pipeline;
  - **MANU** – control the pump by the buttons on this panel.
- **RESET** button to reset alarms and trip conditions;
- **HOUR METER** gauge.

Switch power 440V supply on the **2 PD E/R 440 V DIST. BOARD** (use menu item **PD DB 2** of the page **ER2**) for:

- No. 1 C.O.P.T. control panel by **No 1 C.O.P.T. CONTROL PANEL** circuit breaker;
- No. 2 C.O.P.T. control panel by **No 2 C.O.P.T. CONTROL PANEL** circuit breaker;
- No. 3 C.O.P.T. control panel by **No 3 C.O.P.T. CONTROL PANEL** circuit breaker.

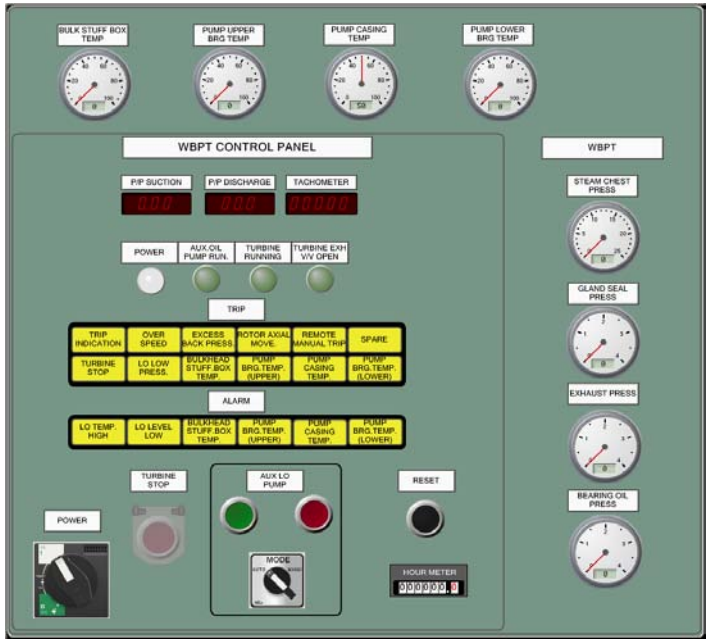
Switch power 440V for the **2 PD E/R 440V DIST. BOARD** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 1 E/R AC 440V DIST.BOARD (2 PD)** circuit breaker.

7.7.2.2. Water Ballast Pump Turbine LOP

Click on the menu item **WBPT LOP** of the page **ER2** to open the turbine control panel. The turbine is similar to Cargo Oil Pump Turbine, see the description in *the paragraph 7.7.2.1 on page 203*; (some of trip and alarm conditions are omitted).

Switch power 440V supply on the **2 PD E/R 440 V DIST. BOARD** (use menu item **PD DB 2** of the page **ER2**) for W.B.P.T. control panel by **No 2 W.B.P.T. CONTROL PANEL** circuit breaker.

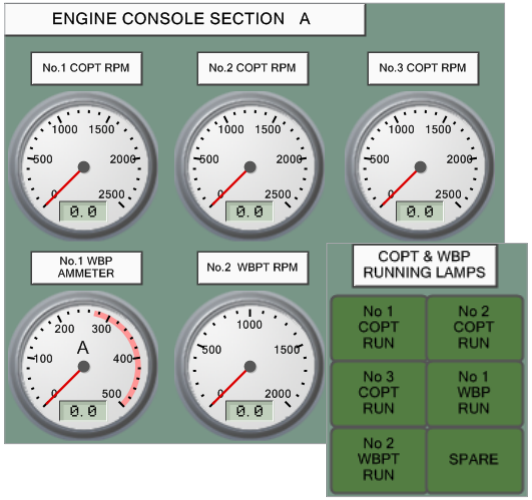
Switch power 440V for the **2 PD E/R 440V DIST. BOARD** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 1 E/R AC 440V DIST.BOARD (2 PD)** circuit breaker.



7.7.2.3. Steam Turbines Supervision at ECR

Click on the menu item **ECC A** of the page **ECR** to open the **ENGINE CONSOLE SECTION A** display, which contains:

- **COPT & WBP RUNNING LAMPS** panel; note that **No 2 WBPT** lamp indicates the state of the turbine driven pump, and **No 1 WBP** lamp indicates the electrical water ballast pump state;
- **No. 1 (No. 2, No.3) COPT RPM** and **No 2 WBPT RPM** gauges.



7.7.3. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.10.3 on page 274*, *2.10.4*, *2.10.5* and *2.10.6*.

7.8. Hydraulic Systems

7.8.1. General

Hydraulic power packs in after peak are modeled for mooring operations; fore peak HPUs are not modeled in the simulator.

The separate closed hydraulic system for operating the valves of ballast system is described in *the paragraph 8.3 on page 237*.

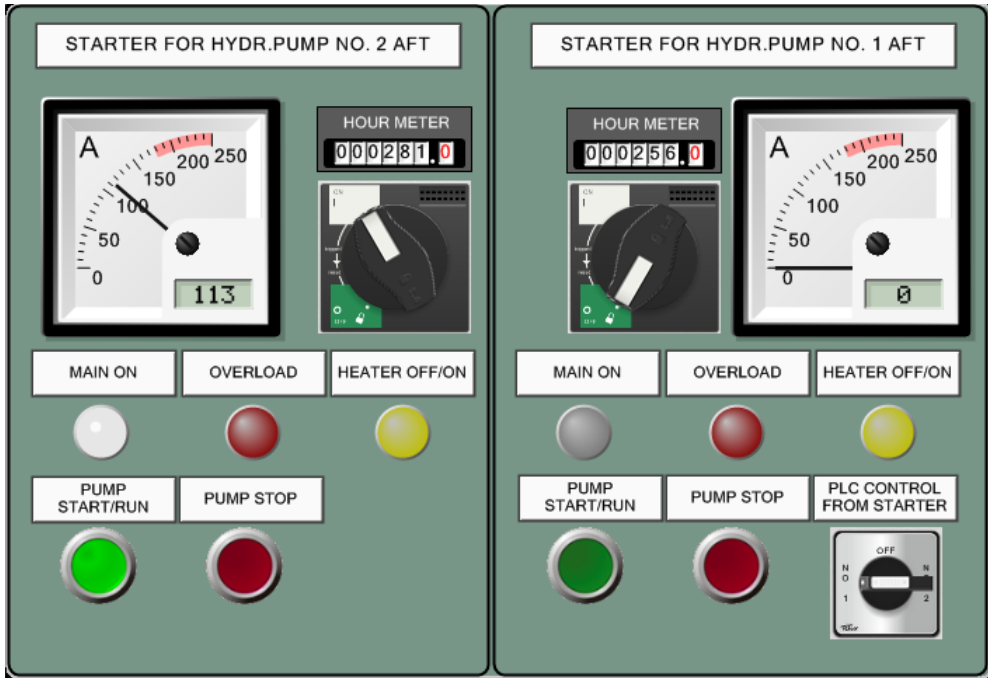
7.8.2. Control

7.8.2.1. Aft Deck HPU Pumps LOP

Click on the menu item **Aft Deck HPU LOP** of the page **SG** to open the display with **STARTER FOR HYDR. PUMP NO.2 AFT** and **STARTER FOR HYDR. PUMP NO.1 AFT** panels.

Each panel contains:

- Power automatic circuit breaker;
- Ammeter; **HOUR METER** gauges;
- **MAIN ON** power indicator lamp;
- **OVERLOAD** alarm indicator lamp;
- **HEATER ON/OFF** indicator lamp;
- **PUMP START/RUN** and **PUMP STOP** operation buttons.
- PLC CONTROL FROM STARTER three-position selector switch is not modeled.



Switch power 440V for:

- **STARTER FOR HYDR. PUMP NO.1 AFT** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 1 HYD. PUMP FOR AFT. DECK MACHINERY** circuit breaker;
- **STARTER FOR HYDR. PUMP NO.2 AFT** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 2 HYD. PUMP FOR AFT. DECK MACHINERY** circuit breaker;

7.8.3. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.8.3 on page 274*.

7.9. Air Conditioning System

7.9.1. General

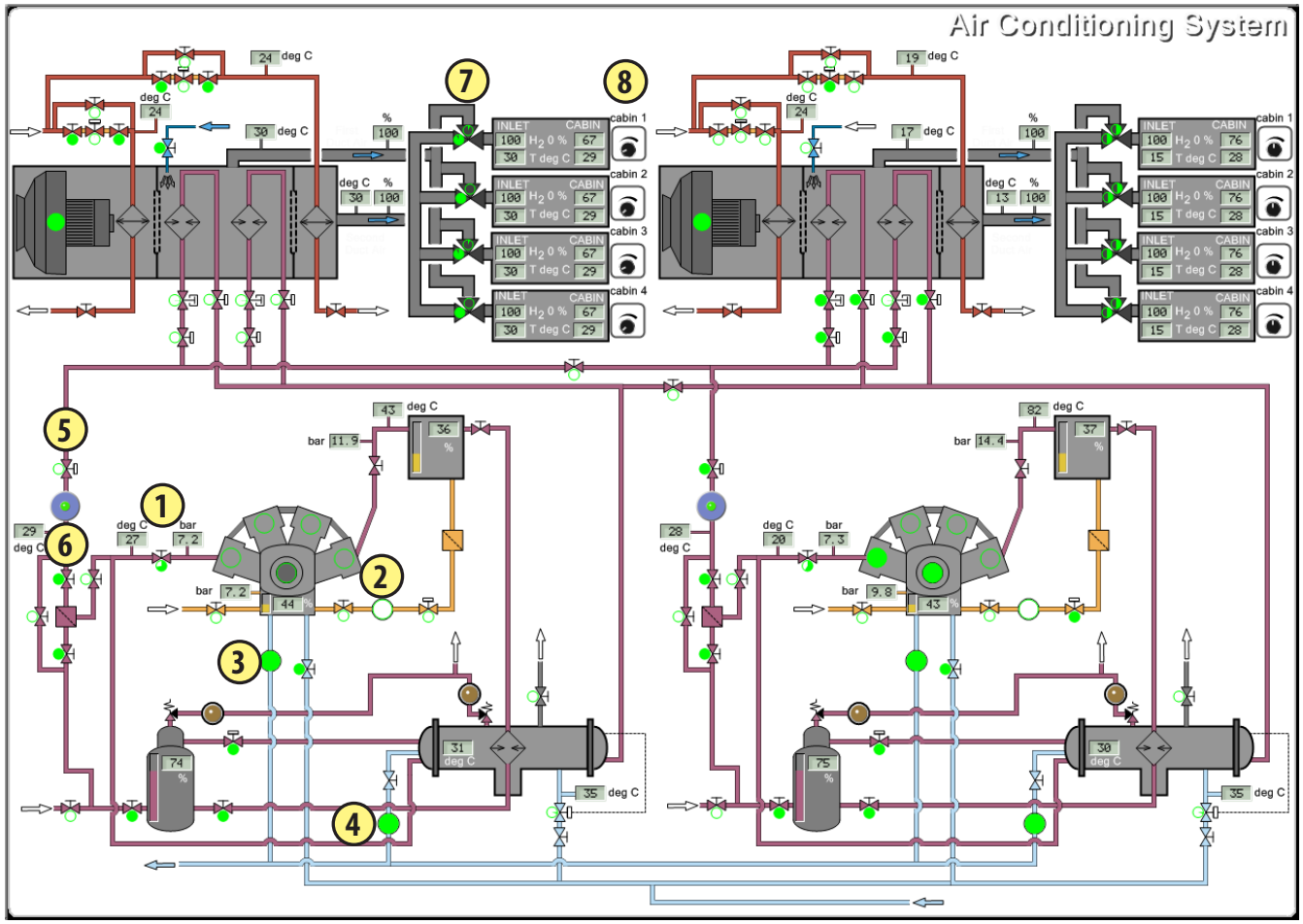
The air conditioning system is designed for the year-round moisture and temperature treatment of the air in the accommodation spaces, mess room and other rooms on the ship.

Click on the menu item **Air Conditioning System** of the page **SYS** to open the display.

7.9.2. Content

Two identical AC sets are modeled; each set contains:

- Eight-cylinder piston **Compressor**;
- **Receiver** with safety release valve and safety oil glass;
- **Condenser Cooler** with safety release valve and oil glass;
- (5) **Master Solenoid Valve**;
- (6) Moisture and flow indicator and Refrigerant filters unit;
- **AC Unit Air Blower** with an electric motor and air filter;
- In the Blower unit: two thermal oil air heaters of the first and second stage; two air coolers of the first and second stage; regenerative Coolant heat exchanger;
- (7), (8) Ship compartments (**Cabin 1 (2, 3, 4) Temperature Control Valve**) serviced by the conditioner with digital indicators of inlet air temperature and humidity;
- Pipelines with valves (see description below), filters, measuring gauges.



7.9.3. Connections

- Inlet Steam
- Outlet Steam
- Domestic Water Inlet
- Oil Make Up
- Make Up
- To/From LT Cooling F.W. System
- Emergency Discharge
- Ventilation

7.9.4. Control

7.9.4.1. Controls on Diagram

Compressor run indicators: indicator in the center illuminates, when compressor is running; indicators on the cylinders show operation of cylinder pairs.

① **AC Compressor Suction Valve** is used for slow increase of compressor load during start procedure.

② **Return Oil Sight Glass** is used for indication and control of normal circulation of oil in compressor.

③ **AC Compressor LT Outlet Sight Glass** and ④ **Condenser LT Outlet Sight Glass** are used for indication and control of the cooling water flow in compressor and condenser.

⑤ **Master Solenoid Valve** can be operated from the diagram or from the AC Plant LOP (see ***the paragraph 7.6.4.3 on page 187***).

Safety oil glass of a safety valve bursts out when the valve operates.

⑥ Moisture and flow indicator. Indicator body flashes when the flow is low, and colors gray when no flow is detected in the line; indicator center colors in yellow when there is water or air detected in the system.

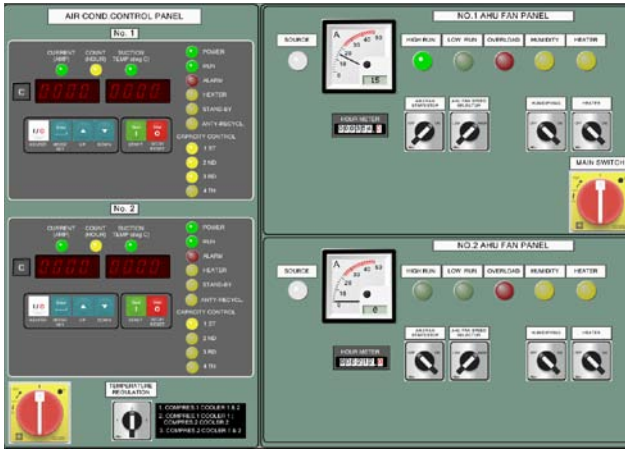
Control air parameters in ship compartments using a cabin air distribution switch ⑧ set in the room. Turn the knob by the mouse clockwise to open and counterclockwise to close the ⑦ **Cabin Temperature Control Valve**.

7.9.4.2. AC Plant & AHU Control Panels

Click on the menu item **AC Control Panel** of the page **ER4** to open the display, which contains:

- **AIR COND. CONTROL PANEL No.1**;
- **AIR COND. CONTROL PANEL No.2**;
- Circuit breaker to power both compressors;
- **TEMPERATURE REGULATION** three-position switch **1/2/3** to set the plant operating mode as outlined on the label:
  1. COMPRES. 1 COOLER 1 & 2
  2. COMPRES. 1 COOLER 1;
     COMPRES. 2 COOLER 2
  3. COMPRES. 2 COOLER 1 & 2
- **NO.1 AHU FAN PANEL**; **NO.2 AHU FAN PANEL** (see the description below).

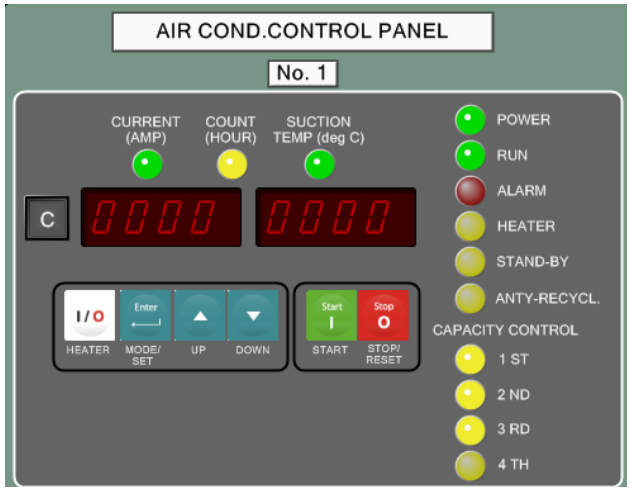
Note: **The TEMPERATURE REGULATION switch should be set to position 2 for starting the compressors.**



The description given below is for **AIR COND. CONTROL PANEL No.1**. The **AIR COND. CONTROL PANEL No.2** is similar to panel 1.

The **AIR COND. CONTROL PANEL No.1** contains:

- **CURRENT (AMP)** indicator lamp, which illuminates when the digital indicator is in operation;
- **COUNT (HOUR)** indicator lamp, which illuminates when the **HOUR METER** is in operation on the AHU FAN LOP;
- **SUCTION TEMP (deg C)** indicator lamp, which illuminates when the digital indicator is in operation;
- Digital indicators of CURRENT and SUCTION TEMP;
- Sensor buttons:
  - **HEATER I/O**, **MODE / SET**, **UP, DOWN** – not modeled;
  - **START Start I** – to start the compressor;
  - **STOP / RESET Stop 0** – to stop the compressor or reset the alarm condition (reset can also be done from the LOP).

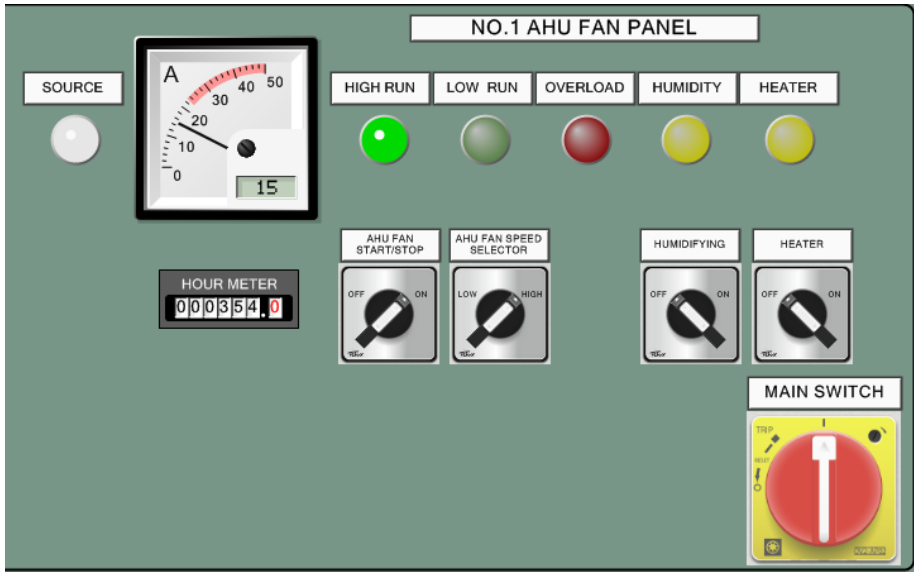


- Indicator lamps, which illuminate to indicate respective state of the AC unit:
  - **POWER**;
  - **RUN**;
  - **ALARM** – any alarm condition occurred;
  - **HEATER**;
  - **STAND-BY**;
  - **ANTY-RECYCL.** – compressor start is blocked (e.g. when the heater is ON).
  - **CAPACITY CONTROL** indicator lamps, which illuminate to indicate the compressor cylinders in operation.

The description given below is for **NO.1 AHU FAN PANEL**. The **NO.2 AHU FAN PANEL** is similar to panel 1.

The **NO.1 AHU FAN PANEL** contains:

- **SOURCE** lamp, which illuminates when the fan is powered;
- Ammeter;
- **HOUR METER** indicator;
- Indicator lamps, which illuminate to indicate respective state of the AHU Fan:
  - **HIGH RUN**; **LOW RUN** – to indicate the fan rotation speed;
  - **OVERLOAD** – alarm indicator is not modeled;
  - **HUMIDITY** – humidifier is ON;
  - **HEATER** – heater is ON.
- **AHU FAN START/STOP** two-position OFF/ON switch to start/stop the fan;
- **AHU FAN SPEED SELECTOR** two-position switch to select LOW/HIGH fan rotation speed;
- **HUMIDIFYING** two-position switch to turn humidifier OFF/ON;
- **HEATER** two-position switch to turn the heater OFF/ON;
- **MAIN SWITCH** circuit breaker to power both fan units.



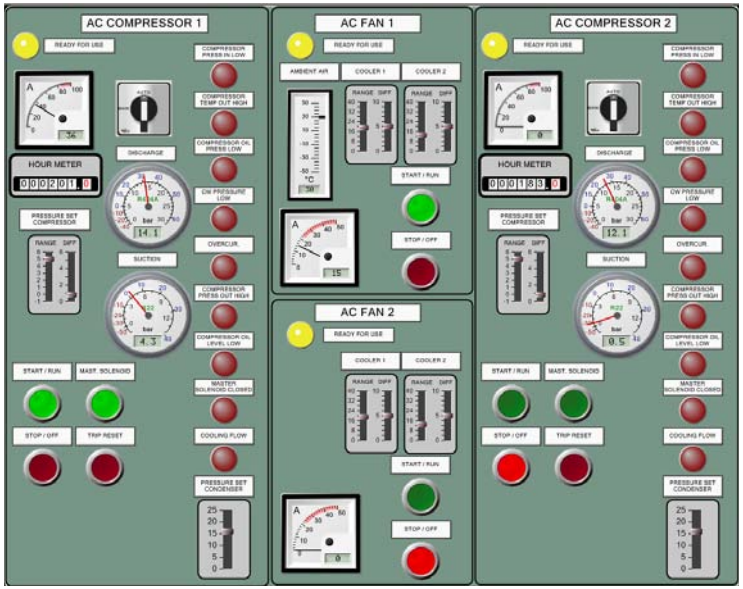
Switch power supply 440 V for the **AC Compressors** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **AIR CONDITIONING PLANT** circuit breaker:

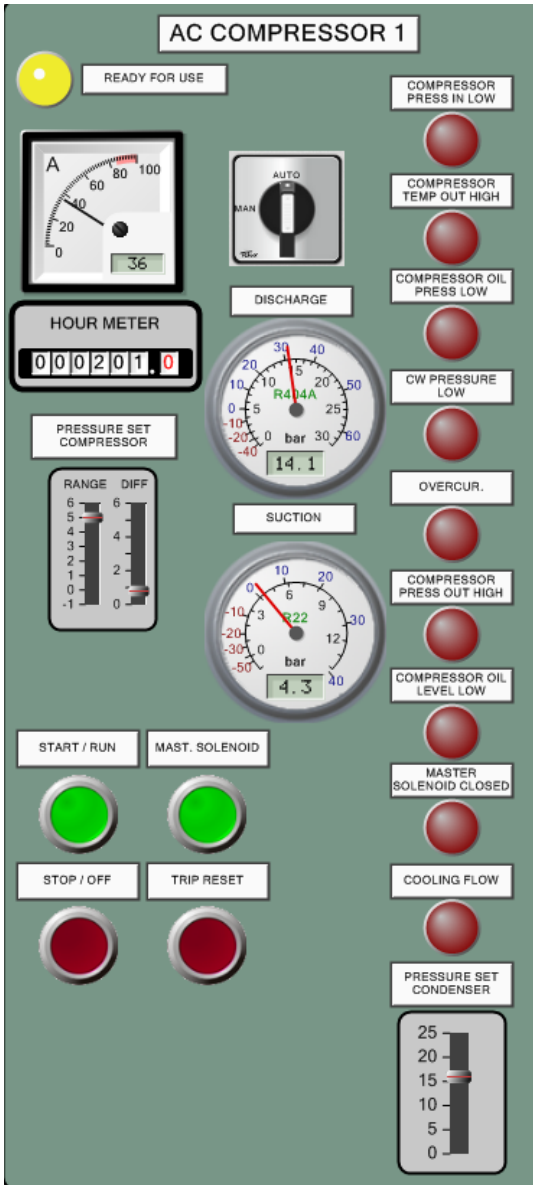
Switch power supply 440V for the **AHU fans** on the **No.3 GROUP STARTER PANEL** (use menu item **GSP 3** of the page **ER4**) by **No. 1/2 AIR HANDL. UNIT FAN** circuit breaker.

Switch power 440V for the **GSP 3** on the **No. 1 AC440V FEEDER PANEL** and **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No 3 LOCAL GROUP STARTER PANEL (No.1 SECTION)** and **No 3 LOCAL GROUP STARTER PANEL (No.2 SECTION)** circuit breakers.

7.9.4.3. Air Conditioning LOP

Click on the menu item **AC LOP** of the page **ER4** to open the display with the **AC COMPRESSOR 1 (2)**, **AC FAN 1 (2)** local control panels.





The description given below is for **AC COMPRESSOR 1** panel. The **AC COMPRESSOR 2** panel is similar to panel 1.

The **AC COMPRESSOR 1** panel contains:

- **READY FOR USE** indicator lamp, which illuminates when the compressor is powered;
- The ammeter and the **HOUR METER** counter;
- **MAN–AUTO** – two-position switch to select the compressor control mode; in **AUTO** mode the compressor motor and solenoid valves are controlled automatically;
- Nine alarm indicator lamps, which illuminate when respective alarm condition occurs;
- **DISCHARGE** – refrigerant pressure gauge;
- **SUCTION** – refrigerant pressure gauge;
- **PRESSURE SET COMPRESSOR** pressostat (see the operation description in *the paragraph 7.9.4.4 on page 211*);
- **START / RUN** button to start the compressor in **MAN** mode; the button highlights when the pump is running;
- **STOP / OFF** button to stop the compressor in **MAN** mode; the button illuminates when the compressor is stopped;
- **MAST. SOLENOID** button to open the master solenoid valve in MAN control mode; the button highlights when the valve is open; the valve state is reflected on the display **Air Conditioning System** (see *the paragraph 7.9 on page 207*);
- **TRIP RESET** button to reset the trip condition after the cause has been removed.

Note: **In the MAN control mode it is required to open the master solenoid valve by clicking the MAST. SOLENOID button and open SW cooling valves before starting the compressor.**

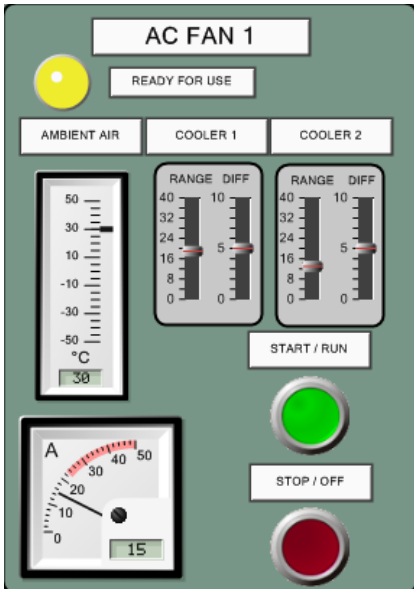
The description given below is for **AC FAN 1** panel. The **AC FAN 2** panel is similar to panel 1.

The **AC FAN 1** panel contains:

- **READY FOR USE** indicator lamp, which illuminates when the fan is powered;
- **AMBIENT AIR** thermometer;
- **COOLER 1** and **COOLER 2** pressostats (see the operation description in ***the paragraph 7.9.4.4 on page 211***);
- The ammeter;
- **START / RUN** button to start the fan; the button highlights when the fan is running;
- **STOP / OFF** button to stop the fan.

Switch the power supply 440 V for compressors and fans on the AC Plant and AHU Control panels (see ***the paragraph 7.9.4.2 on page 208***).

Instructions for starting AC Plant are given in Chapter 5, ***the paragraph 3.3 on page 250***..



7.9.4.4. Operating Pressostats

Pressostats are used to setpoint the automatic starting (pressure ≤ **RANGE-DIFF** value) and stopping (pressure ≥ **RANGE** value) the compressors, fans, etc..

Drag the sliders using the mouse to required positions.

7.9.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.12.4 on page 276***, and in other respective paragraphs.

7.10. Ventilation System

7.10.1. General

The machinery spaces are ventilated by forced draught systems. The forced draught system supply and exhaust fans maintain a slight depression within the machinery spaces. The depression ensures that polluted air can not pass to accommodation spaces and public rooms.

Fans are mounted in various Rooms and the funnel casing built into resilient supported and sound insulated modules.

Intake air is drawn around the funnel casing through intakes designed to limit noise transmission to the open deck.

Intake air is ducted into machinery spaces with a distribution system within the space providing fresh air outlets to ensure maximum air circulation, and all openings are fitted with anti-flash gauzes.

All ducts both to supply and exhaust air intakes are fitted with dampers. All supply and exhaust fans are linked to the Fire Alarm/CO2 Fire Extinguishing system to provide a “Crash Stop” in case of fire. The fans can be controlled remotely from the Bridge EM’CY Stop Panel, from Fire Station or manually from the LOPs.

7.10.2. Content

The following fans 440V are modeled in the simulator.

Control from MSB, ESB & LOP

- ER Supply Fan No.1
- ER Supply Fan No.2
- ER Supply/Exhaust Fan No.3
- ER Supply/Exhaust Fan No.4
- Cargo Pump Room Exhaust Fan

Control from ER3 (LGSP 4)

- Purifier Room Exh. Fan

Control from ER4 (LGSP 3 & LGSP 9)

- No. 1/2 Air Handling Unit Fan
- Provision Ref. Fan
- Dry Provision Store Exh. Fan
- Garbage Store Exh. Fan
- Galley & Pantry Exh. Fan
- Galley Supply Fan
- Sanitary Space Exh. Fan
- Bosun Store Supply Fan
- Paint Store Exh. Fan

Control from EMG Room

- EM'CY Gen. Room Supply Fan
- S/G Room & EM’CY Fire Pump Room Supply Fan
- ER Supply/Exhaust Fan No.4

7.10.3. Control

Fans for Inert Gas Generator are described in ***the paragraph 7.3.5 on page 190***.

Fans for Air Conditioning system are described in ***the paragraph 7.9.4.2 on page 208*** and ***the paragraph 7.9.4.3 on page 210***.

Fans for Provision Cooling system are operated within the system control (see ***the paragraph 7.15.4.5 on page 226***).

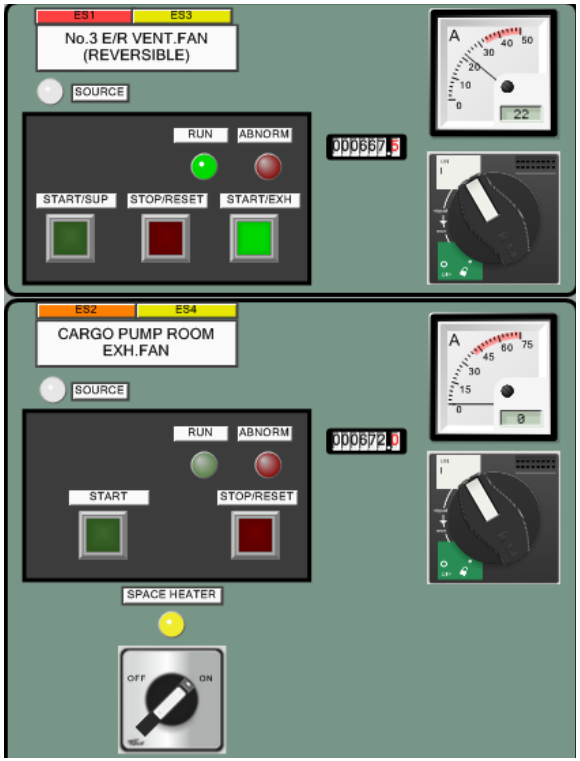
7.10.3.1. Fans Starter Panels and Push Button Boxes

The general description of a starter panel and a push button box controls is given in Introduction ***the section 5 on page 12***.

Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No.1 E/R VENT. FAN** starter panel.

Click the menu item **MSB No 1/2 GSP** of the page **MSB** to open the display with the **No.3 E/R VENT. FAN (REVERSIBLE)** and **CARGO PUMP ROOM EXH.FAN** starter panels.

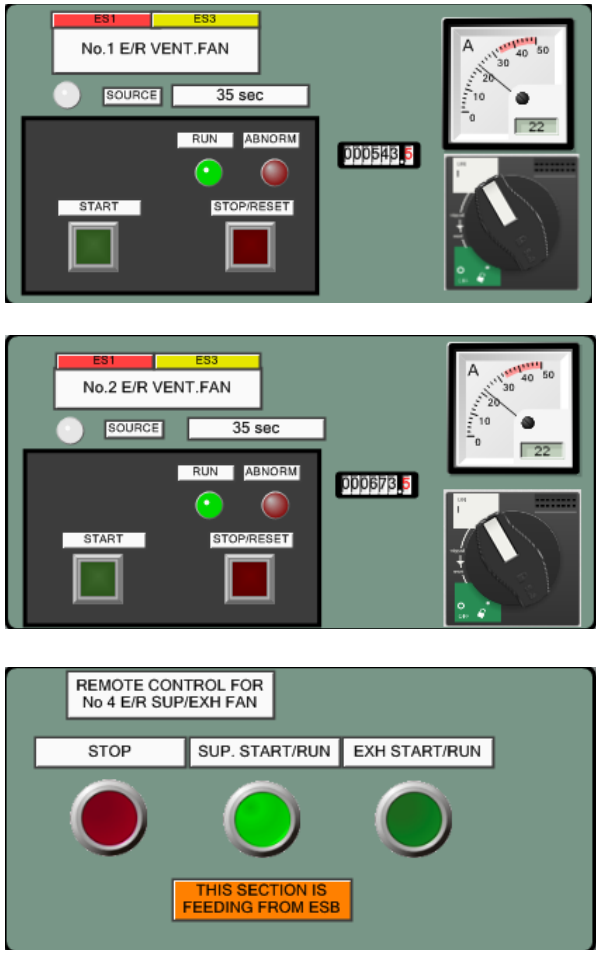
Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No.2 E/R VENT. FAN** starter panel and **REMOTE CONTROL FOR No.4 E/R SUP/EXH FAN** panel.



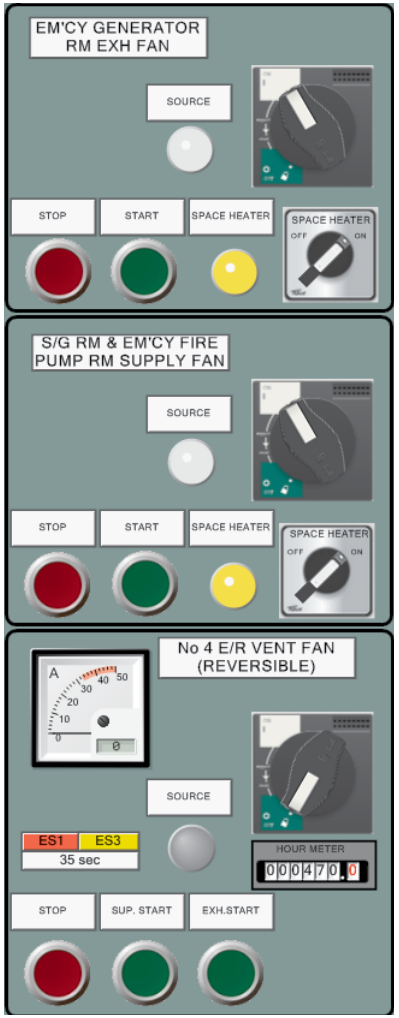
Click the menu item **ESB Consumers** of the page **EmG** to reach the **EM'CY GROUP STARTER PANEL** with starter panels:

EM'CY GENERATOR RM EXH FAN;
SG RM & EM'CY FIRE PUMP RM SUPPLY FAN;
No.4 E/R SUP/EXH FAN.

Remote control of the No.4 fan is possible if ESB is powered.



Note: **To change the direction of a reversible fan No.3 or No.4 the fan should be stopped and then run again by a required button.**



Click the menu item **ER Fans GPBP** of the page **ER3** to open the **E/R FANS PUSH BUTTON BOX** with panels:

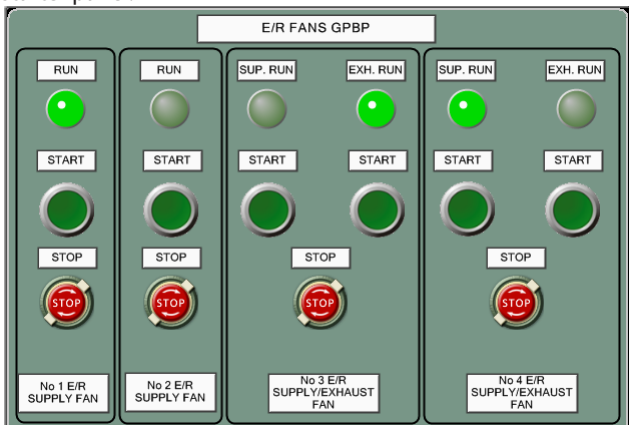
No 1 E/R SUPPLY FAN;
No 2 E/R SUPPLY FAN;
No 3 E/R SUPPLY/EXHAUST FAN;
No 4 E/R SUPPLY/EXHAUST FAN.

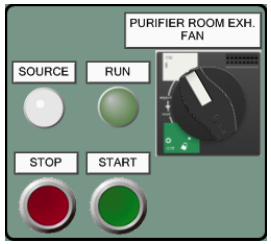
Click the menu item **GSP 4** of the page **ER3** to open the **No.4 GROUP STARTER PANEL** with the **PURIFIER ROOM EXH.FAN** starter panel.

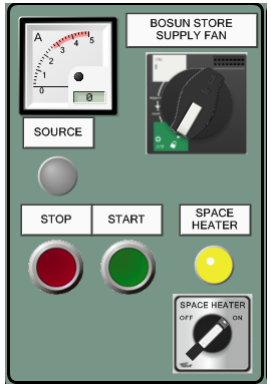
Click the menu item **GSP 3** of the page **ER4** to open the **No.3 GROUP STARTER PANEL** with the starter panels:

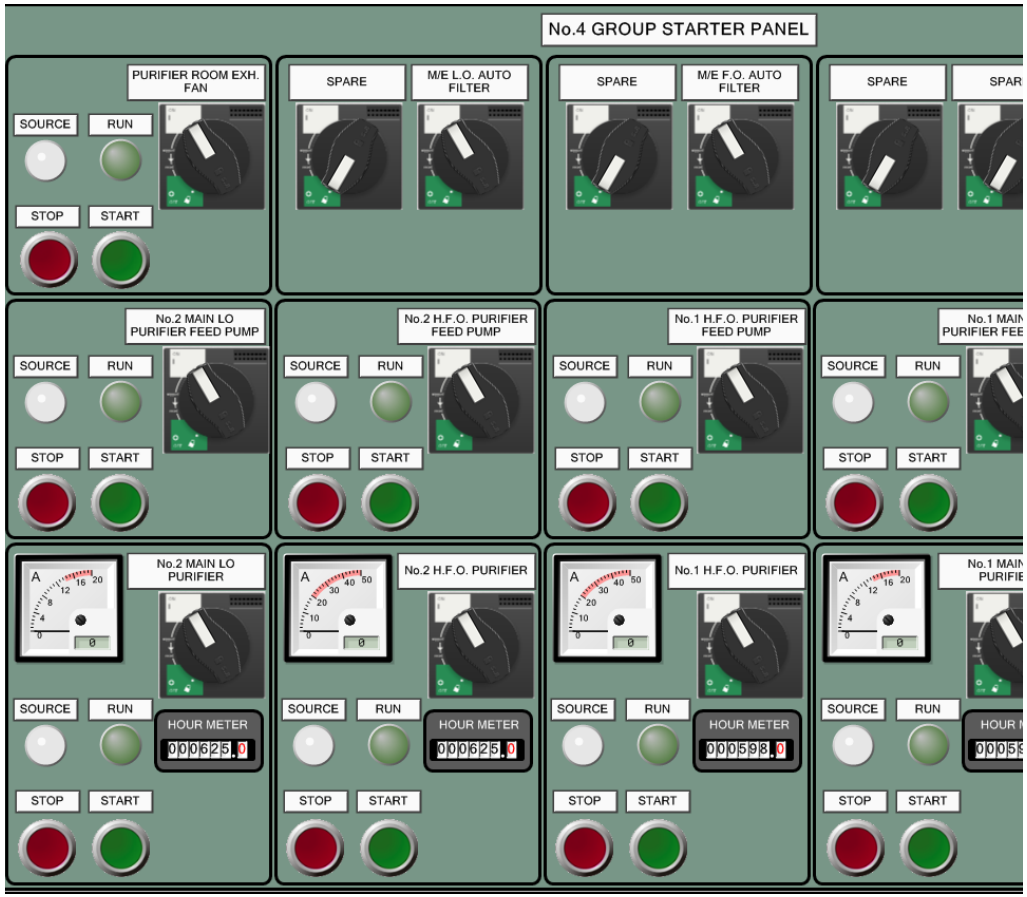
No. 1/2 AIR HANDL. UNIT FAN
PROVISION REF.FAN
GALLEY PACKED AIR CON.
GALLEY SUP.FAN
DRY PROVISION STORE EXH. FAN
GARBAGE STORE EXH. FAN
SANITARY SPACE EXH.FAN
GALLEY & PANTRY EXH.FAN
PAINT STORE EXH. FAN

Click the menu item **GSP 9** of the page **ER4** to open the **No.9 GROUP STARTER PANEL** with the **BOSUN STORE SUPPLY FAN** starter panel:









7.10.4. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7 respective paragraphs (MSB, IGG, AC, Provision systems).

7.11. Bilge & Fire General Service System

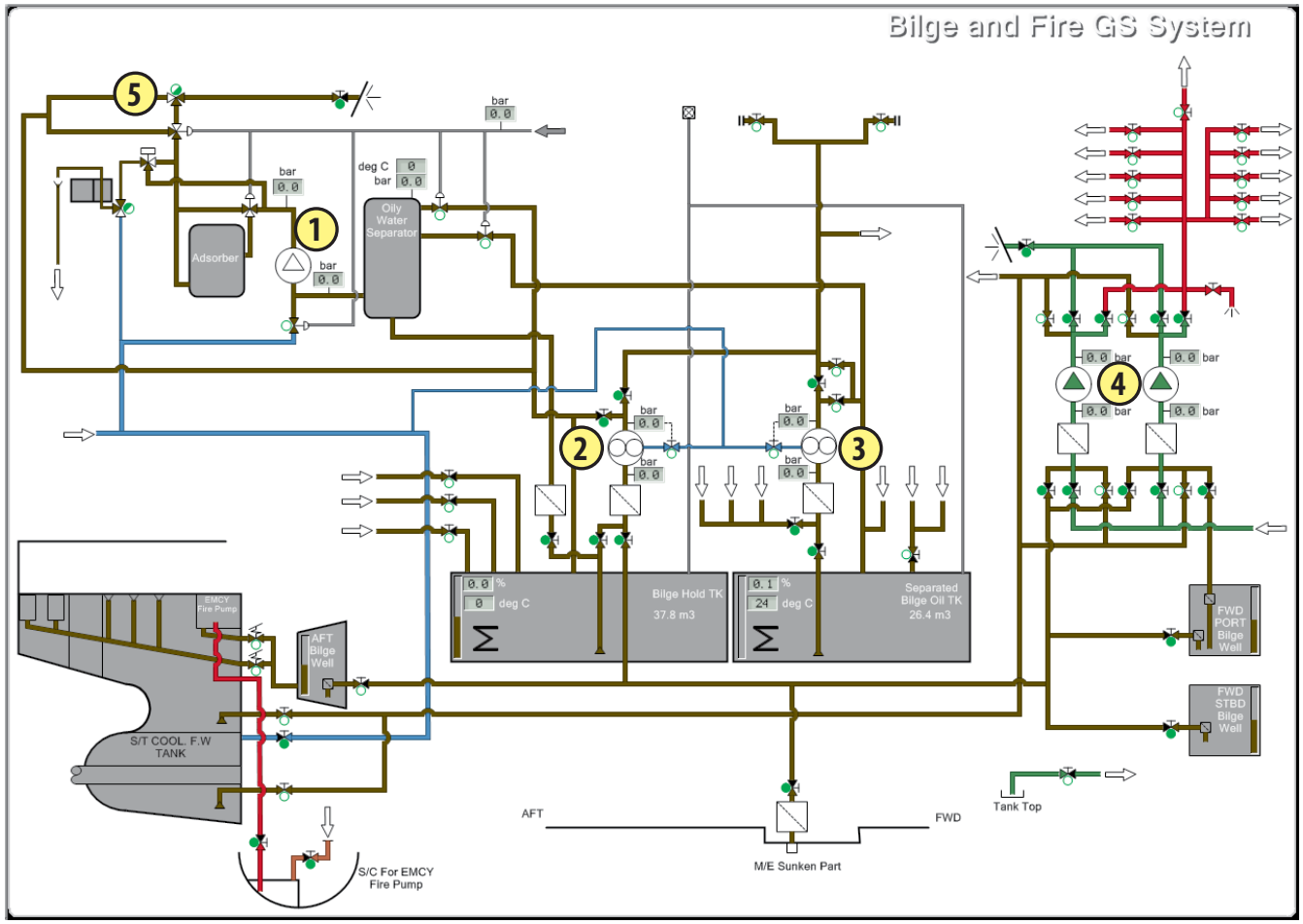
7.11.1. General

The Oily Bilge System is designed to collect all water that may be contaminated from machinery. The system passes the water through the oily water separator (OWS), where contaminants are removed and then the separated water is discharged overboard, whilst the remaining oil and sludge is stored in tanks and then drained to shore.

Click on the menu item **Bilge & Fire G/S System** of the page **SYS** to open the display **Bilge & Fire G/S System**.

7.11.2. Content

- **Oily Water Separator** unit comprising:
  - **Oily Water Separator**;
  - **Adsorber**;
  - (1) **OWS Screw Pump** – 5 m3/h x 2.5 kg/cm2;
  - (5) **3 Way Manually Operated Outlet Valve**.
- (2) **E/R Bilge Pump** – 5 m3/h x 3 kg/cm2;
- (3) **Sludge Pump** – 5 m3/h x 4 kg/cm2;
- (4) **Fire, Bilge, General Service Pump №1 (№2)** – 230 m3/h x 10 bar;
- **FWD PORT Bilge Well**, **FWD STBD Bilge Well**, **AFT Bilge Well** – bilge wells;
- **Bilge Hold TK** – 37.8 m3;
- **Separated Bilge Oil TK** – 26.4 m3;
- **S/C COOL. F.W. Tank**, **S/C for EM'CY Fire Pump** – water sources;
- Pipelines with valves, filters and measuring gauges.



7.11.3. Connections

- Control Air Inlet
- Bilge Alarm Monitor Backflush water Outlet
- From FW Service
- From Accommodation Gray Water
- From Sewage Treat Plant Overflow
- From Air Cleaning Chemical Clean TK & M/E T/C Clean Drain
- Steam Blow Connection
- From Purifiers Sludge TK
- From M/E Scav. Air Drain TK

- From Overflow Drain TK
- From Incinerator WO TKs Overflow
- From LO Steam Turbine Drain System
- From FO & LO Drain System
- To Main CSW Pump 2 Suction
- From SW System
- To Scrubber CSW
- To 2nd DK
- To 3rd DK
- To 4th DK
- To STP System
- To Foam/Fire Deck Wash SYS
- To Soot Drin TK Ejector
- To Floor

7.11.4. Control

7.11.4.1. Controls on Diagram

Use (5) 3 Way **Manually Operated Outlet Valve** to select the flow direction through OWS unit.

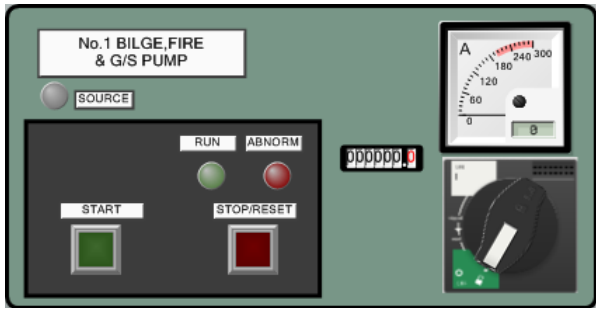
Suction and discharge of the pumps **Fire, Bilge, General Service Pump №1 (№2)** are controlled by:

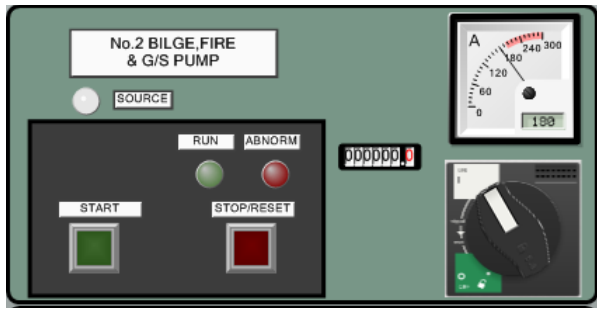
- Suction valves from: bilge wells, sea water system, and S/T Cool. F.W. Tank;
- Discharge valves to: fire system, scrubber CSW, overboard.

7.11.4.2. Bilge, Fire & G/S Pumps

The general description of starter panel and push button box controls is given in Introduction *the section 5 on page 12*.

Push button boxes for **BILGE, FIRE & G/S PUMPs** are available on Emergency Stop Switch Box (use menu item **EM'CY Stop Switch Box** of the page **FFR**) and Bridge Console Section A (use menu item **BCC A** of the page **BCC**). Fire main line pressure and pumps' discharge pressure gauges are available on the Bridge Console Section A.





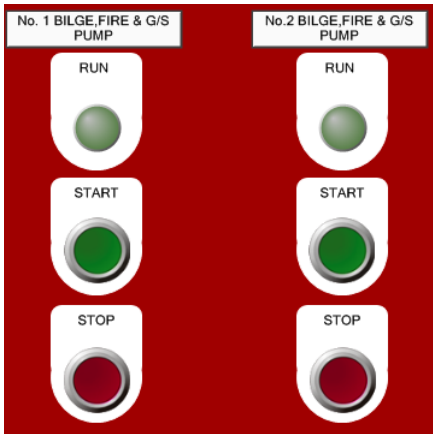
Click the menu item **MSB No 1/1 GSP** of the page **MSB** to open the display with the **No.1 BILGE, FIRE & G/S PUMP** starter panel.

Click the menu item **MSB No 2/2 GSP** of the page **MSB** to open the display with the **No.2 BILGE, FIRE & BILGE PUMP** starter panel.

The **No.1 BILGE, FIRE & G/S PUMP** and **No.2 BILGE, FIRE & G/S PUMP** are shared with the Fire fighting system.

7.11.4.3. E/R Bilge and Sludge Pumps

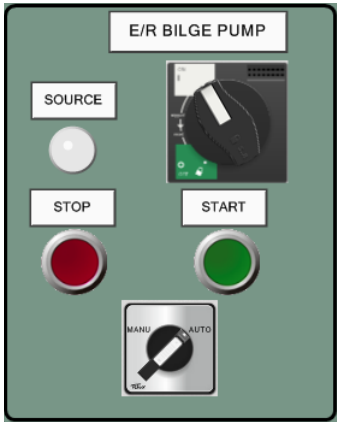
The general description of starter panel controls is given in Introduction *the section 5 on page 12*.

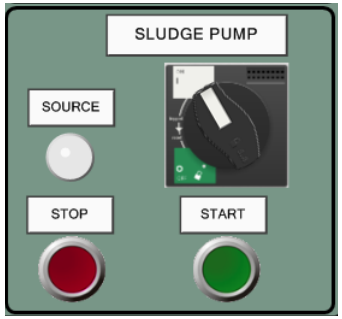


Click the menu item **GSP 7** of the page **ER1** to open the display with the **E/R BILGE PUMP** and **SLUDGE PUMP** starter panels.

Switch the power supply 440 V for the **No. 7 GROUP STARTER PANEL** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **No 7 LOCAL GROUP STARTER PANEL** circuit breaker.

The mode selector switch on the **E/R BILGE PUMP** panel is used to set: **MANU** mode – pump operation from this panel; **AUTO** mode – control from CMS BILGE & FIRE SYSTEM display.



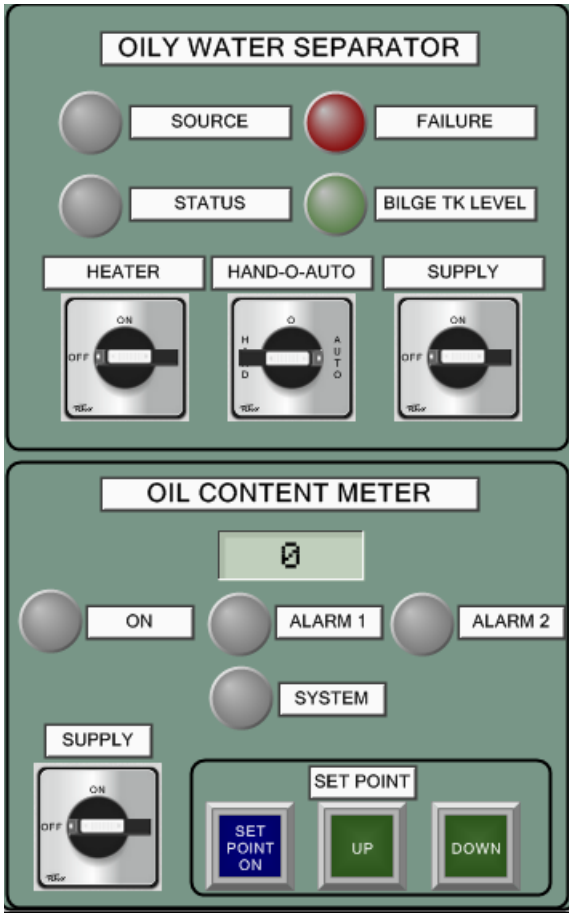


7.11.4.4. Oily Water Separator Local Control Panel

Click on the menu item **OWS LOP** of the page **ER1** to open the display with two local control panels.

The **OILY WATER SEPARATOR** panel (OWS) contains:

- **SOURCE** indicator lamp, which illuminates when the power supply is ON;
- **FAILURE** indicator lamp, which illuminates when the OWS unit failure or breakdown occurs;
- **STATUS** lamp to indicate the unit state by the light color:
  - green – water discharge;
  - red – filtered oil is discharged to Sludge tank;
  - orange – washing the separator.
- **BILGE TK LEVEL** indicator lamp, which illuminates in green when the level in the Bilge Hold TK is sufficiently high for the separator to start: > 10%;
- **HEATER** two-position switch to turn the heater OFF–ON;
- **HAND–O-AUTO** three-position selector switch to choose:
  - **HAND** – separator runs irrespective of the Bilge Hold TK level;
  - **O** – OWS is ready to use;
  - **AUTO** – separator starts at 90% level in the Bilge Hold TK and stops at 10% level in the tank.
- **SUPPLY** two-position switch to turn the OWS unit power OFF–ON.



The **OIL CONTENT METER** panel contains:

- Digital indicator of the oily content;
- **ON** indicator lamp, which illuminates when the power supply is ON;
- Indicator lamps **ALARM 1** and **ALARM 2** illuminate in green when concentration is below the setpoint; lights change to red when concentration exceeds the setpoint; **ALARM 1** signals after 2 sec. delay, and **ALARM 2** signals after 10 sec. delay; in alarm conditions the automatic valve directs water discharge back to the Oily Water Tank;
- **SYSTEM** indicator lamp, which illuminates in red when the meter failure or breakdown occurs;
- Two-position **SUPPLY** switch to turn the content meter unit power OFF–ON; power turns on automatically when the OWS unit is powered on;
- **SET POINT** latched button; the button highlights when pressed; press the button to set-point the content meter; digital indicator then outputs the set-point value; depress the button to confirm the new value;
- **UP** and **DOWN** buttons to lower/raise the content set-point value; press the required button to adjust the value, which will be displayed on the indicator.

Switch the power supply 440 V for:

- **OILY WATER SEPARATOR** (with Screw pump and Oil content meter), on the **No. 7 LOCAL GROUP STARTER PANEL** (use menu item **GSP 7** of the page **ER1**) by the **OILY WATER SEPARATOR** circuit breaker.

7.11.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.2 on page 272***, and in other respective paragraphs.

7.12. Sewage Treatment System

7.12.1. General

The system provides collection of galley, sanitary and lavatory waters throughout the ship.

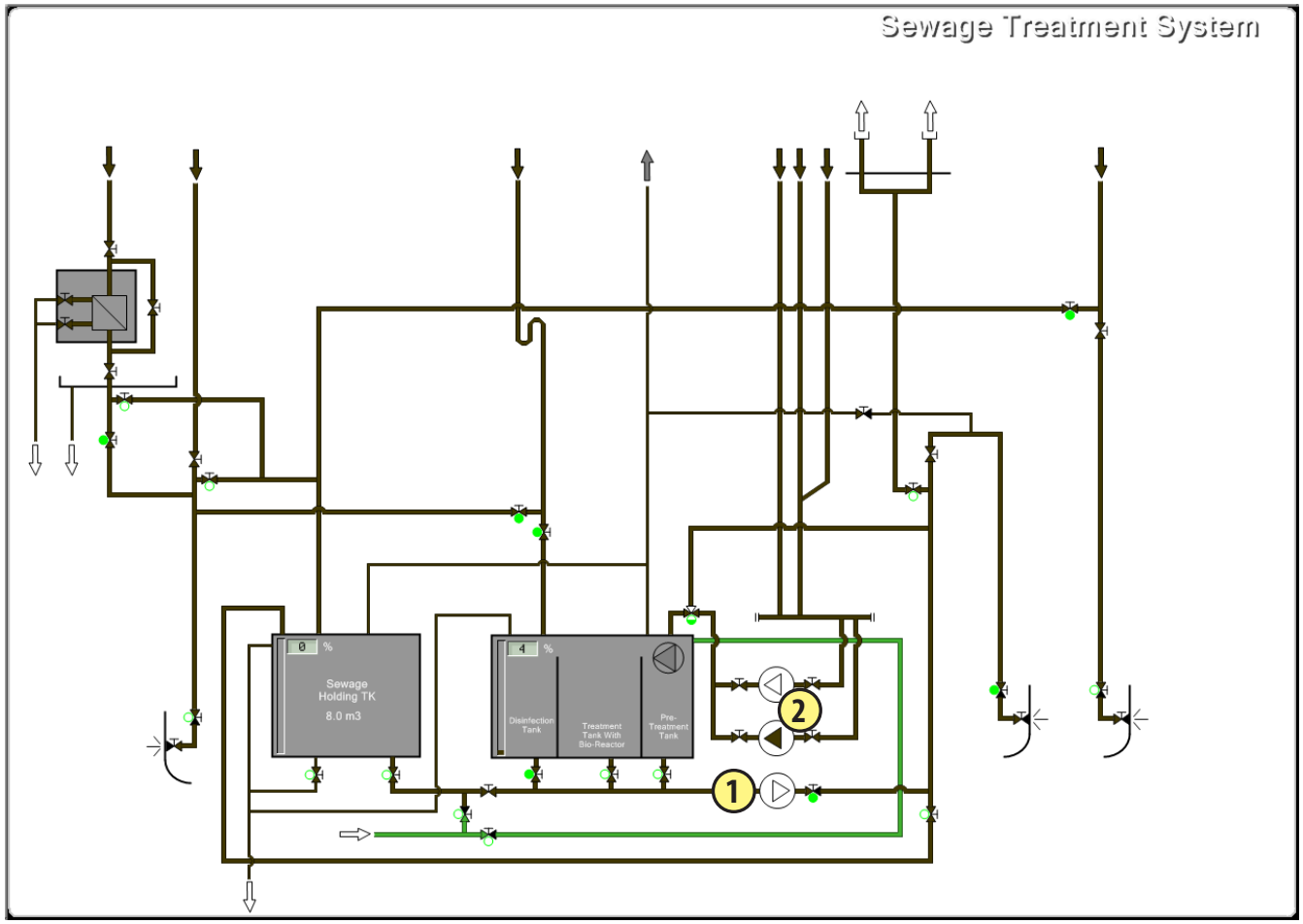
Click on the menu item **Soil & Sewage System** of the page **SYS** to open the system diagram.

7.12.2. Content

- **Sewage Holding Tank** – 8.0 m3;
- Combined **Pre-Treatment Tank**, **Treatment Tank with Bio-Reactor**, **Disinfection Tank** fitted with ventilation **Blower**;
- (1) **Sewage Treatment Discharge Pump** – 3 m3/h x 3.5 kg/cm2;
- (2) **Vacuumator Pump 1** (2);
- Pipelines with valves, filters, measuring gauges.

7.12.3. Connections

- From Galley
- From Grey Water (P)
- To Bilge Holding TK
- To Oily Bilge TK
- From Hospital (Waste Drain)
- To Funnel Top
- From Black Water (P)
- From Black Water (S)
- From Hospital Black Water
- Sewage Shore Connection (P)
- Sewage Shore Connection (S)
- From Grey Water (S)
- From Bilge and Fire G/S Sys



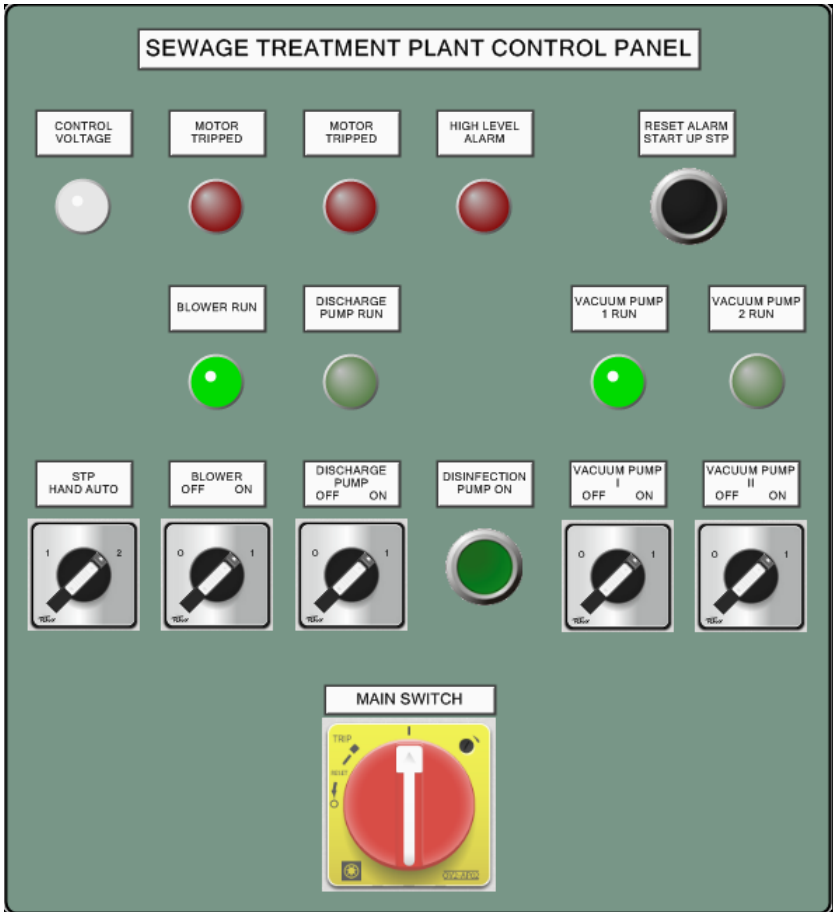
7.12.4. Control

7.12.4.1. Sewage Treatment Plant Control Panel

Click on the menu item **Sewage Treatment Plant LOP** of the page **ER4** to open the display with the STP Control Panel.

The panel contains:

- **CONTROL VOLTAGE** indicator lamp, which is illuminated when the plant is powered on;
- Alarm indicator lamps (faults are introduced by Instructor):
  - **MOTOR TRIPPED** – discharge pump motor tripped;
  - **MOTOR STOPPED** – discharge pump motor stopped;
  - **HIGH LEVEL ALARM** – sewage holding TK level > 90%.
- Indicator lamps, which are illuminated when the respective fan/pump is running:
  - **BLOWER RUN**;
  - **DISCHARGE PUMP RUN**;
  - **VACUUM PUMP 1 RUN** and **VACUUM PUMP 2 RUN**.
- **RESET ALARM START UP STP** push button to reset and start up the STP automatics after an alarm condition has been removed.



- **STP HAND AUTO** two-position switch to select control mode between:
  - **1** – run the plant in manual mode;
  - **2** – run the plant in automatic mode.
- **BLOWER OFF ON** two-position switch to turn the blower off (**0**) or on (**1**) when STP is in HAND mode;
- **DISCHARGE PUMP OFF ON** two-position switch to turn the pump off (**0**) or on (**1**) when STP is in HAND mode;
- **DISINFECTION PUMP ON** button; click to start the pump when STP is in HAND mode;
- **VACUUM PUMP I OFF ON** two-position switch to turn the pump off (**0**) or on (**1**) when STP is in HAND mode;
- **VACUUM PUMP II OFF ON** two-position switch to turn the pump off (**0**) or on (**1**) when STP is in HAND mode;
- **MAIN SWITCH** circuit breaker to power the STP.

Switch the power supply 440 V for **STP** on the **3 PD E/R 440 V DISTR. BOARD** (use menu item **PD DB 3** of the page **ER4**) by the **SEWAGE TREATMENT PLANT** circuit breaker.

Switch power 440V for the **3 PD E/R 440V DIST. BOARD** on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **No. 2 E/R AC 440V DIST.BOARD (3 PD)** circuit breaker.

7.12.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.12.11 on page 277*.

7.13. Incinerator System

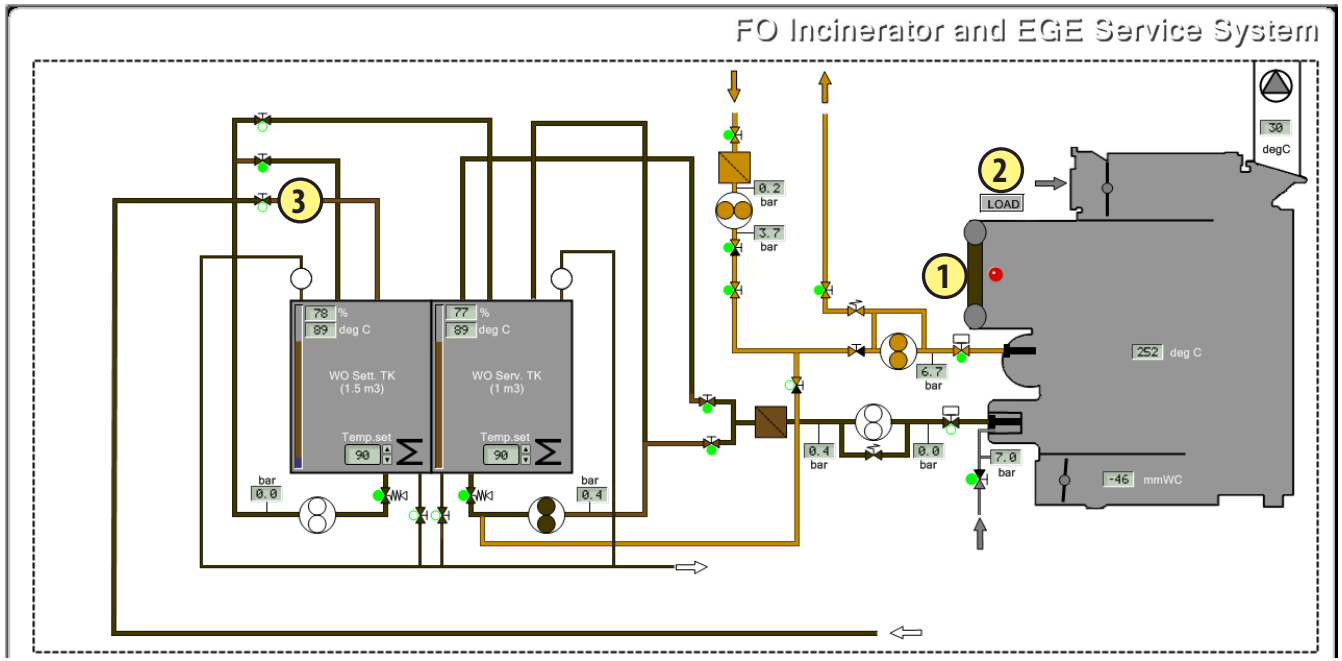
7.13.1. General

The system is designed for disposal of the oil product and solids by burning. The system is designed in accordance with MARPOL requirements.

Marine Diesel Oil is burned in order to raise the combustion chamber to the required temperature for the combustion of solid material and waste oil; DO may also be burned to assist the total combustion when required.

In view of the pressing need to dispose of sludge and waste oil the incinerator is essentially used as a sludge/waste oil burner and is not used for burning garbage. The combustion chamber is fitted with a loading door, to admit garbage. The door may only be opened when the incinerator primary combustion chamber temperature is below 145°C.

Click on the menu item **FO Incinerator & EGE Service System** of the page **SYS** to open the system diagram:



7.13.2. Content

- Incinerator FO service system – contains WO tanks and FO supply pumps as described in *the paragraph 3.6 on page 141*.
- **Main Burner** using both the MDO and the oil product sludge. Fuel is atomized by the compressed atomizing air supplied to the burner from the ship's Compressed Service Air system.
- (1) The door for charging solid matter.
- (2) **LOAD** button.
- (3) Feeding Valve from Sludge Pump.

7.13.3. Connections

Connections are listed in *the paragraph 3.6 on page 141*.

7.13.4. Control

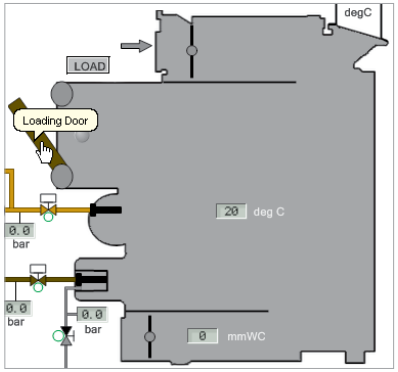
7.13.4.1. Controls on Diagram

To charge solid wastes, the incinerator is provided with a door (1) equipped with an open-status sensor. When open, the charging door disables the starting of the non-operating incinerator. Double-click to open/close the door.

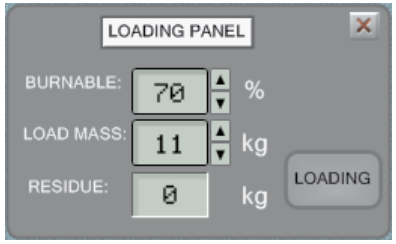
LOAD (2) button is used to open the **LOADING PANEL**, where the solid waste matter is set for burning.

7.13.4.2. Loading Solid Waste Matter

1. Double-click on the burner door to open it. The MDO Feed pump and WO dosing pump stop automatically. The burner stops.



2. Click on the **LOAD** button for the **LOADING PANEL** to pop up:



3. Specify a percentage of combustible materials in the solid waste to be loaded in the **BURNABLE %** using the up and down arrows.
4. Set the required **LOAD MASS kg** using the up and down arrows to the right of the indicator;
5. Click the **LOADING** button. The button highlights, the **LOAD MASS kg** indicator gets empty. The **RESIDUE kg** indicator changes value.
6. Double-click on the burner door to close it.
7. Start the burner manually from the Incinerator LOP (see *the paragraph 3.6.4.2 on page 142*).

7.13.4.3. Overheat Protection

The incinerator is equipped with the local automatic system and overheat protection. The operational principle is based on the monitoring of the exhaust gas temperature and the furnace temperature.

Monitoring the exhaust gas temperature:

- If the exhaust gas temperature increases up to 320 °C, oil supply to the burner nozzles will be cut automatically. After temperature reduction down to 310 °C, it will be resumed;
- If the exhaust gas temperature increases up 350 °C, the dilution damper will open completely and automatically for the purpose of cooling down the exhaust gases and protecting the flue and the exhaust gas fan against overheating.

Monitoring the furnace temperature:

- If the furnace temperature reaches 1100 °C, oil supply to the burner nozzles will be cut automatically. When temperature drops down again to 1050 °C, oil supply will be resumed;
- If the furnace temperature reaches 1200 °C, oil supply to the burner nozzles will be cut automatically, and the WO/DO fuel pumps will be shutdown;
- After Incinerator is shutdown, and temperature in the furnace drops below 60 °C, the exhaust gas fan will stop automatically.

7.13.4.4. Starting Incinerator

Instructions for starting the incinerator are given in Chapter 5, *the paragraph 3.1 on page 249*.

7.13.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.12.9 on page 277*.

7.14. Scrubber System

7.14.1. Purpose

The scrubber system is designed for exhaust gas stream cleaning according to IMO Resolution MEPC.170(57), adopted April 4th, 2008 to specify the requirements for testing, survey certification, and verification of exhaust gas cleaning (EGS) systems to ensure compliance with Annex VI.

The SOx emission limits will require ships to achieve at least a SOx reduction equivalent to 0.1% sulfur fuel by 2015. This requirement can be met by using more expensive, low sulfur fuel, or by scrubbing the exhaust gas stream. The rules essentially require > 97% SOx removal assuming 3.5% sulfur fuel.

In the simulator the generic system is modeled that removes 3% of CO2 and 98% of SOx.

The scrubber system layout has the main principle as follows:

The washing solution is pumped from the process tank through a system cooler to the scrubber. From the scrubber the washing solution returns to the process tank by gravity.

NaOH is fed to the system via a small feed pump. Topping-up of fresh water is needed to the extent that the evaporated or discharged water exceeds the humidity in the exhaust gases (from engine combustion).

A small portion (the "bleed-off") of the scrubbing water flow is conducted to the treatment unit. The treated effluent is discharged overboard or alternatively to a clean bilge water tank or other suitable holding tanks. This feature is unique, as the system can periodically be operated in a "Zero Discharge Mode" without discharging any wash water overboard.

The captured contaminants (sludge) are transferred to the vessel's sludge tank.

The process tank can be large enough to temporarily hold some bleed-off for periods when the scrubber is running but the treatment plant is not, or vice versa.

Caustic soda: The typical commercial solution is 50 %. It has a density of 1.52 t/m^3 and a pH of 14. It solidifies at 12 °C, and is typically transported warm.

The caustic soda can be bunkered from trucks via filling connections in the bunker stations. The storage tank can be of normal shipbuilding steel.

Exhaust gas: The exhaust gas plume in traditional wet scrubbers has a high relative humidity. Marine scrubber includes a feature to minimise the water vapor of the plume, and to minimise the water lost to the atmosphere and, therefore, the need for topping-up water.

7.14.2. Content

Click on the menu item **Exh Gas Scrubber LOP** of the page **ER1** to open the system diagram and LOP.

The mimic contains:

- Scrubber unit with **DEMISTER** heater; washing sprinklers;
- **PROCESS TANK** – 5 m^3, with LAH, LAL alarm lamps; by default, the tank is filled with caustic code solution pH=12~14;
- **NaOH UNIT** with NaOH unit pump;
- **FW CIRC PUMP** – 0.01 m3/h x 2.5 bar;
- **SW COOLING PUMP** and cooler unit;
- Pipelines with valves and measuring gauges.

7.14.3. Connections

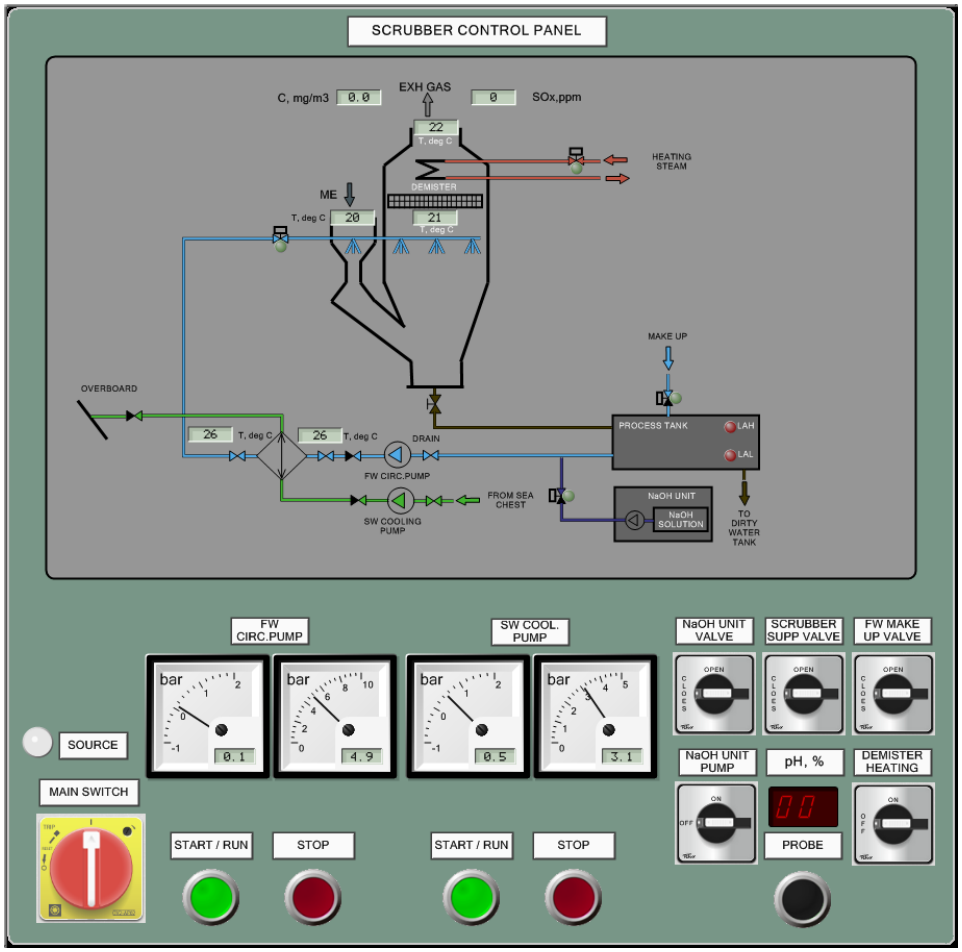
- Exhaust gases from MEs
- Exhaust gases out
- From Sea Chest
- To/From Thermal Oil
- Make Up (fresh water to process tank)
- To Dirty Water tank
- Overboard

7.14.4. Control

7.14.4.1. Control on LOP

The panel contains:

- **MAIN SWITCH** circuit breaker;
- **SOURCE** lamp – illuminates when the panel receives power;



- **FW CIRC PUMP** and **SW COOLING PUMP** identical set of controls:
  - Suction and discharge pressure gauges;
  - **START/RUN** and **STOP** buttons to operate the pump;
- **NaOH UNIT VALVE** switch to CLOSE/OPEN the valve;
- **SCRUBBER SUPP VALVE** switch to CLOSE/OPEN the valve;
- **FW MAKE UP VALVE** switch to CLOSE/OPEN the valve;
- **NaOH UNIT PUMP** switch to stop/start the pump;
- pH, % digital indicator (range 0~16) to display the reading only when the **PROBE** button is pressed;
- **PROBE** button;
- **DEMISTER HEATING** switch to turn heating OFF/ON.

Switch power supply 440 V for **SCRUBBER CONTROL PANEL** on the **No. 2 AC440V FEEDER PANEL** of the MSB (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by **EXH GASES SCRUBBER CONTROL PANEL** circuit breaker.

7.14.5. Faults Introduced by Instructor

The faults are listed in Chapter 7, *the paragraph 2.9.5 on page 274*.

7.15. Provision Cooling System

7.15.1. General

The automatic Provision Cooling System is intended for creating and maintaining the set temperature conditions for the storage of food in two groups of provision storerooms.

The first group includes three provision storerooms for the storage of frozen foods:

- Butter – storage of butter at a temperature of -2 °C;
- Meat – storage of meat at a temperature of -15 °C;
- Fish – storage of fish at a temperature of -15 °C.

The other group includes three provision storerooms for the storage of chilled food:

- Fruit – storage of fruit at a temperature of +2 °C;
- Vegetables – storage of vegetables at a temperature of +2 °C;
- Dry provision – storage of dry provisions at a temperature of +8 °C.

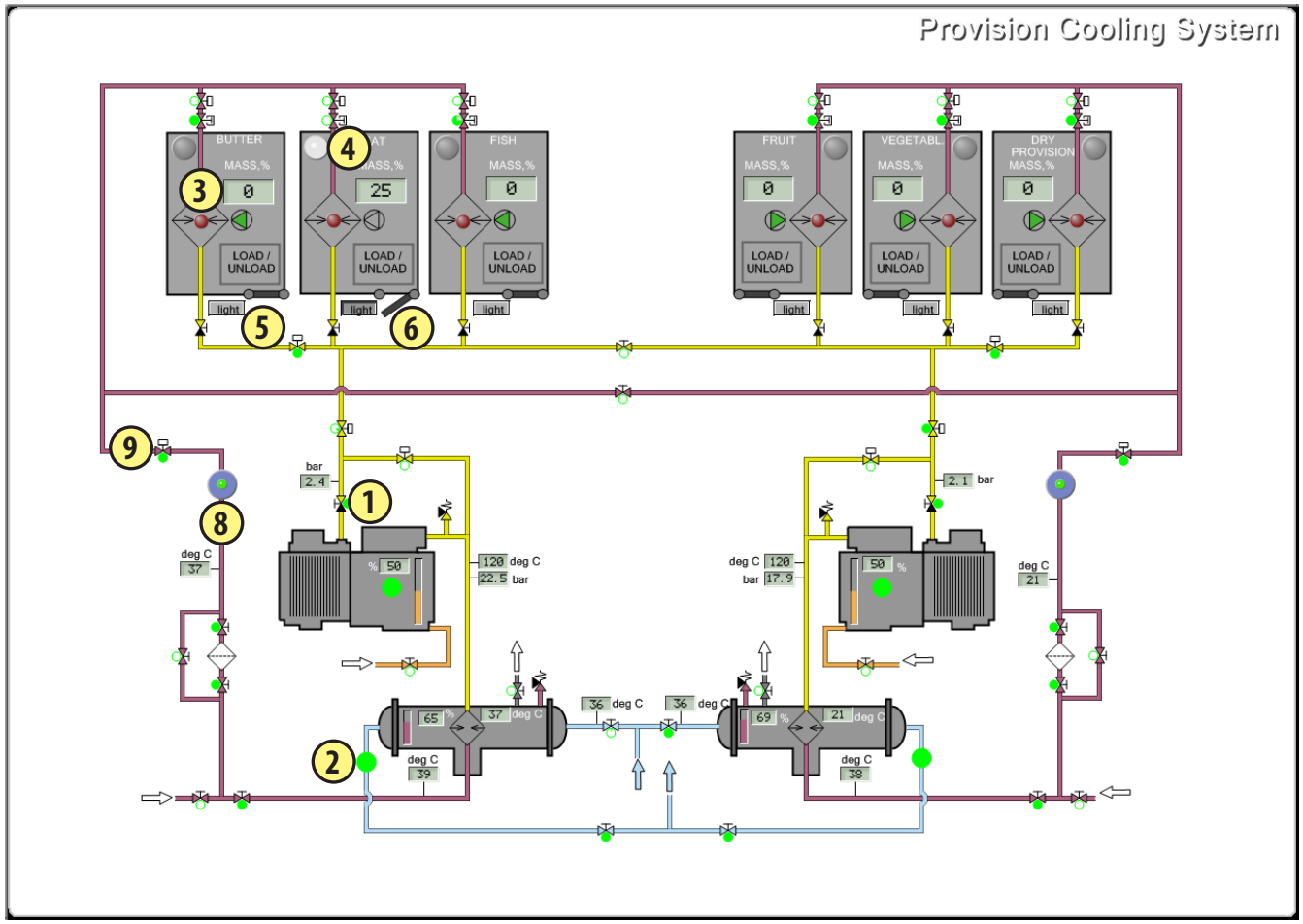
Each of the refrigeration plants operates for its group of consumers. However, any one refrigerator can supply both storeroom groups if required. Freon R494A is the main liquid refrigerant.

The air temperature in the storerooms is maintained with the air coolers. Liquid refrigerant is supplied to the air cooler by the thermostatic expansion valve. The thermo switch monitors the temperature in the pertinent provision storeroom and controls operation of the solenoid valves in the refrigeration chamber, as well as the operation of the air cooler thermostatic valve.

Click on the menu item **Provision Cooling System** of the page **SYS** to open the system diagram.

7.15.2. Content

- 2 x **Compressor** with valves:
  - (1) **Compressor Suction Non Return Valve**;
    (9) **Master Solenoid Valve**;



- (2) 2 x **Condenser** with Compressor SW **Outlet Sight Glass**;
- 6 x storerooms; each storeroom is equipped with:
  - (3) Air cooler fan; fan LED indicator illuminates when the fan is running; red indicator lamp illuminates when the storeroom is powered;
  - (4) Light indicator – illuminates when the light is on;
  - (5) **light** latched button – to switch the light on/off;
  - (6) Storeroom door;
  - **MASS** % digital indicator of actual load in the room;
  - **LOAD/UNLOAD** button to open the panel (see the description in *the paragraph 7.15.4.2 on page 225*);
  - Solenoid and thermostatic expansion valves.

7.15.3. Connections

- Make Up
- Oil Make Up
- Ventilation
- From/To Main L.T.W Cooling System

7.15.4. Control

7.15.4.1. Controls on Diagram

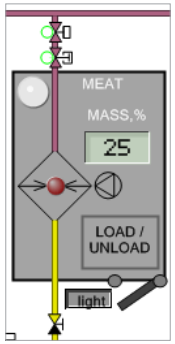
When **Compressors** are operating, operation indicators illuminate. The oil level in the compressor case is displayed on the bar graph and digital indicator. Automatic adjustment of the compressor refrigeration performance is provided. The ① **Compressor Suction Non Return Valve** is used to slowly increase compressor load at starting the mechanism.

Condensers have bar graphs to monitor the liquid refrigerant level in the condenser collector. The water flow for the condenser cooling is controlled in the ② **Compressor SW Outlet Sight Glass**.

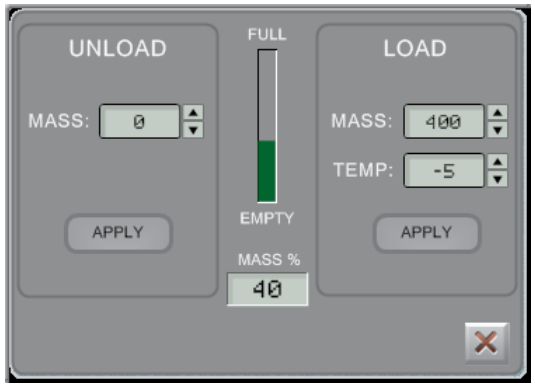
⑧ **Compressor Sight Glass Moisture Content** indicator body flashes when the flow is low, and colors gray when no flow is detected in the line; indicator center colors in yellow when there is water or air detected in the system.

7.15.4.2. Loading Provision

1. Double-click on the required storeroom door ⑥ to open it. The solenoid and thermostatic expansion valves will close automatically.
2. Click the ⑤ **light** button to switch the light on; the indicator ④ illuminates; the lamp will not illuminate when the door is closed.



3. Click on the **LOAD/UNLOAD** button to open the **UNLOAD/LOAD** panel.



The central part of the panel displays the **FULL/EMPTY** bar graph and **MASS %** indicator of the actual storeroom load.

4. On the **LOAD** panel, enter the required provision amount (in kilos) in the **MASS** box and temperature in the **TEMP** box using the up and down arrows.
5. Press the **APPLY** button. The **MASS** box gets empty and the load bar graph changes indication to added amount.
6. Click the **light** button to switch the light off; the indicator lights down.
7. Double-click on the door to close it. The solenoid and thermostatic expansion valves will open automatically.

Attention! The room door cannot be closed while the light is on.

Note: Instructor can carry out the provision loading from the Indicators plugin by selecting respective storerooms and setting the required quantity of products in kilos.

7.15.4.3. Unloading Provision

1. Perform actions described in items 1, 2, and 3 of the Loading procedure.
2. On the **UNLOAD** panel, enter the required amount of provision in the **MASS** box using the up and down arrows.
3. Press the **APPLY** button. The **MASS** box gets empty and the load bar graph changes indication to reduced amount.
4. Perform actions described in items 6 and 7 of the Loading procedure.

7.15.4.4. Starting Provision Cooling System

Instructions for powering and starting the plant are given in Chapter 5, *the paragraph 3.2 on page 250*.

7.15.4.5. Provision Cooling Plant LOP

Click on the menu item **Provision Cooling Plant LOP** of the page **ER4** to open the display.

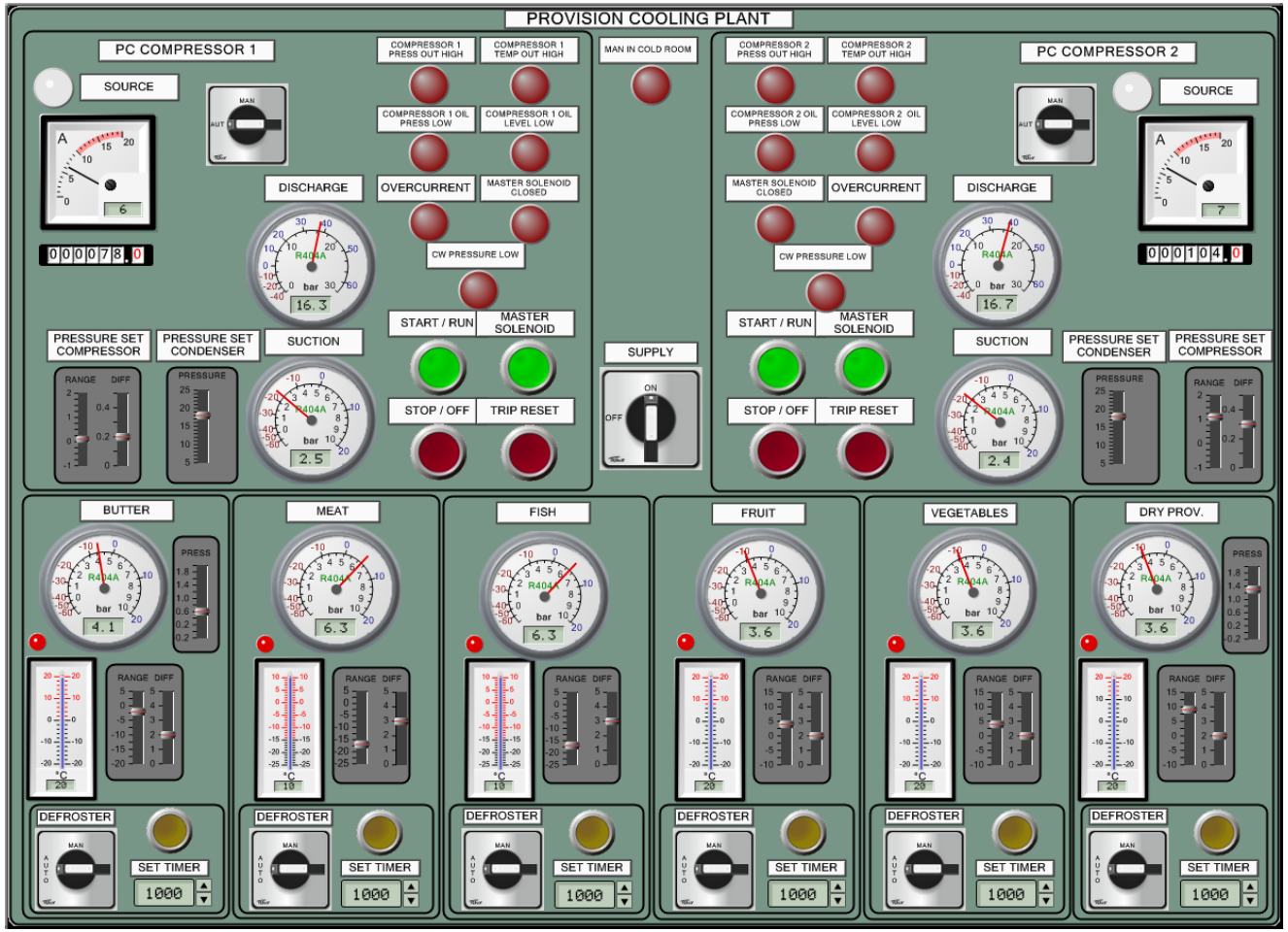
The **PROVISION COOLING PLANT** control panel contains:

- Two identical **PC COMPRESSOR 1** and **PC COMPRESSOR 2** panels (compressor 1 panel is described below);
- Six identical control panels of the storerooms (the BUTTER room panel is described below);
- The central panel comprising:
  - **MAN IN COLD ROOM** alarm indicator;
  - The **SUPPLY** switch **OFF/ON** to turn on the plant power.

Switch the power supply 440 V for
PROVISION COOLING PLANT,
on the **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) by the **PROVISION REF.PLANT** circuit breaker.

Compressor Control Panel contains:

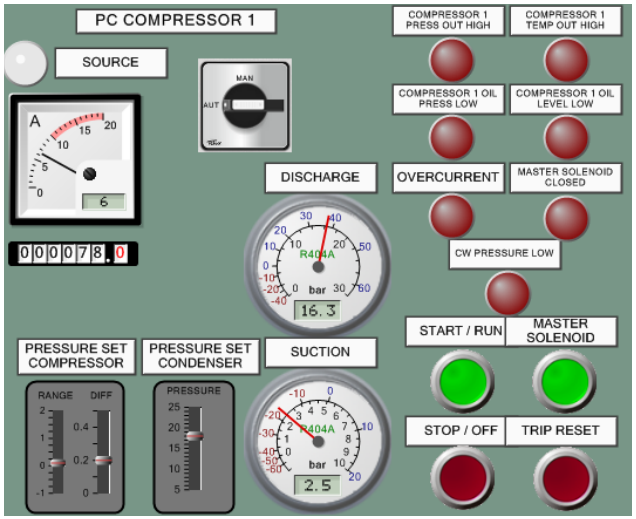
- **SOURCE** indicator lamp, which illuminates when the compressor is powered (the **SUPPLY** switch position is ON;
- The ammeter to display the compressor load;
- The running hours indicator;
- **AUTO–MAN** two-position mode selector switch. In AUTO mode control of the compressor motor operation and solenoid valves is exercised according to the **PRESSURE SET COMPRESSOR** settings;
- A set of alarm indicators (lamps flash in alarm condition):
  - **COMPRESSOR 1 PRESS OUT HIGH**
  - **COMPRESSOR 1 TEMP OUT HIGH**
  - **COMPRESSOR 1 OIL PRESS LOW**
  - **COMPRESSOR 1 OIL LEVEL LOW**
  - **OVERCURRENT**

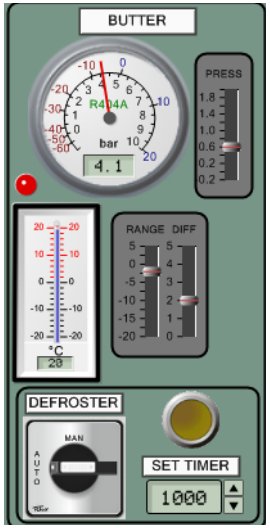


- **MASTER SOLENOID CLOSED**
- **CW PRESSURE LOW**

- **DISCHARGE** pressure gauge;
- **SUCTION** pressure gauge;
- **PRESSURE SET COMPRESSOR** controller to setpoint the automatic starting and stopping the compressor (see *the paragraph 7.9.4.4 on page 211*);
- **PRESSURE SET CONDENSER** controller to setpoint the condensing pressure value; the actual value is displayed on the mimic **Provision Cooling Plant** of the page **SYS**;
- A set of buttons in the right bottom corner to control the compressor in MANUAL control mode:
  - **START** / **RUN** button to start the compressor; the button highlights when the compressor is running;
  - **STOP** / **OFF** button to stop the compressor;
  - **MASTER SOLENOID** button to open the master solenoid; the button highlights and the actual valve state is displayed on the mimic **Provision Cooling Plant** of the page **SYS**;
  - **TRIP RESET** button to reset the trip condition after the cause has been removed.

Note: **In the MANUAL operating mode it is necessary to open the master solenoid valve by pressing the MASTER SOLENOID button before starting the compressor.**





Provision Storeroom Control Panel contains:

- The pressure gauge to display the pressure and boiling point in the air cooler;
- **PRESS** controller to setpoint the evaporation pressure value (for **BUTTER** and **DRY PROV.** rooms only);
- The thermometer to display the actual temperature in the storeroom;
- The controller to setpoint the temperature in the storeroom (automatic motor starting (temperature ≤ **RANGE-DIFF** value) and stopping (temperature ≥ **RANGE** value) see the pressostat operation description in *the paragraph 7.9.4.4 on page 211*);
- **DEFROSTER** two-position switch **AUTO–MAN** to set the defrosting mode;
- The button to start the defrosting in the MANUAL defrosting mode; during defrosting the button highlights and the indication is displayed on the mimic **Provision Cooling Plant** of the page **SYS**;
- **SET TIMER** controller to setpoint the defrosting time in hours using the up and down arrows at the right.

7.15.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, *the paragraph 2.12.8 on page 277*.

7.16. Steering Gear System

7.16.1. General

The steering gears system is designed to provide rudder displacement in the range -35...+35 degrees for manoeuvring ship at sea. Electro-hydraulic SG type is modeled.

The steering gear consists of four hydraulic rams driven by two electrically driven pumps. The pumps are of the variable displacement axial piston type of swashplate design for closed circuit transmissions. The steering gear is capable of operating as two totally isolated steering systems with each pump capable of putting the rudder through the working angle in the specified time. The second pump or standby unit can be connected at any time by starting the motor.

The steering gear is provided with an automatic isolation safety system. Both hydraulic systems are interconnected by means of solenoid operated isolating valves that, in normal operation, allow both systems to produce the torque necessary for moving the rudder. In the event of a failure that causes a loss of hydraulic fluid from one of the systems, the float switches in the expansion tank are actuated. This gives a signal to the isolation system, which automatically divides the steering gear into two individual systems. The defective system is isolated, whilst the intact system remains fully operational so that steering capability is maintained with 50% of the rudder torque. The steering gear is remotely controlled by the autopilot control or by hand steering from the wheelhouse. Emergency control is carried out by the operation of the local pushbuttons on the solenoid valves on the autopilot units. All orders from the bridge to the steering compartment are transmitted electrically and steering gear feedback transmitters supply the actual steering gear position. No.2 pump unit is supplied with electrical power from the emergency switchboard and No.1 pump unit from the main switchboard.

The rudder angle is limited to 35° port and 35° starboard by electrical limit switches but under extreme loads can go to 37° in both directions where mechanical stops will prevent the rudder from turning any further. The variable flow pumps are operated by a control lever, which activates the tilting lever of the pump's swashplate, which causes pressurised oil to be discharged to the hydraulic cylinders. When the tiller reaches the required angle, the tilting lever is restored to the neutral position, which causes the pump to stop discharging.

Under normal circumstances, all four cylinders will be in use, with one pump unit running and the second pump unit ready to start automatically. When manoeuvring or operating in confined waters, it is compulsory that both pump units are running, to reach the recommended time of 14 seconds from 35° one side, to 35° the other side (one pump: 28 seconds).

The emergency local control in SG room is modeled also.

Automatic Isolation System

The steering gear is provided with a Safety hydraulic system which automatically changes the operation to isolate a section of the SG hydraulic system in the event of pipe or other failure. When starting the steering gear with the hydraulic safety system operating the selector switch **main switch hydraulic Supervision steering gear** in the LOP must be turned to position 'on' and the safety system selector switch in the bridge control desk BCC A must be also set to 'on' position. Indicator lamps in the LOP and on the bridge indicate that the hydraulic safety system is operating.

The oil expansion tank is fitted with five float operated alarms and a temperature alarm. The highest float alarm in Safety hydraulic system is the low level alarm, the second float alarm is the low-low alarm.

When the low-low level alarm is activated audible and visual alarms are initiated on the bridge. Additionally No.2 pump is started, if not already operating, and No.1 is stopped, if it is running. This means that pump No.2 is operating on two rams and so the rudder torque is reduced to 50% of the normal torque; the speed of the vessel must be reduced to two thirds of the maximum speed and the rudder angle should not exceed 15° except in emergency cases.

Pumps No.1 and No.2 take suction from different sides of the oil expansion tank baffle and the side of the baffle from which pump No.2 takes suction has a Safety system low-low level float switch. If this low-low level switch is activated it means that the steering gear is still losing oil and so the leak must be in system No.2. The Safety system then starts No.1 pump and stops the No. 2 pump. If, however, the low-low level switch is not activated it means that the leak must be in system No.1 so the system pump No.2 remains operating and the engineer must investigate the leak in system No.1.

The defect must be localized and the hand operated stop valves must be set according to the position plan located at the steering gear. The Safety system switch on the bridge must be turned to the "off" position. After the defect is corrected the hydraulic fluid level must be restored and the Safety system returned to operation.

Click the menu item **Steering Gear System** of the page **SYS** to open the **Steering Gear System** diagram.

7.16.2. Contents

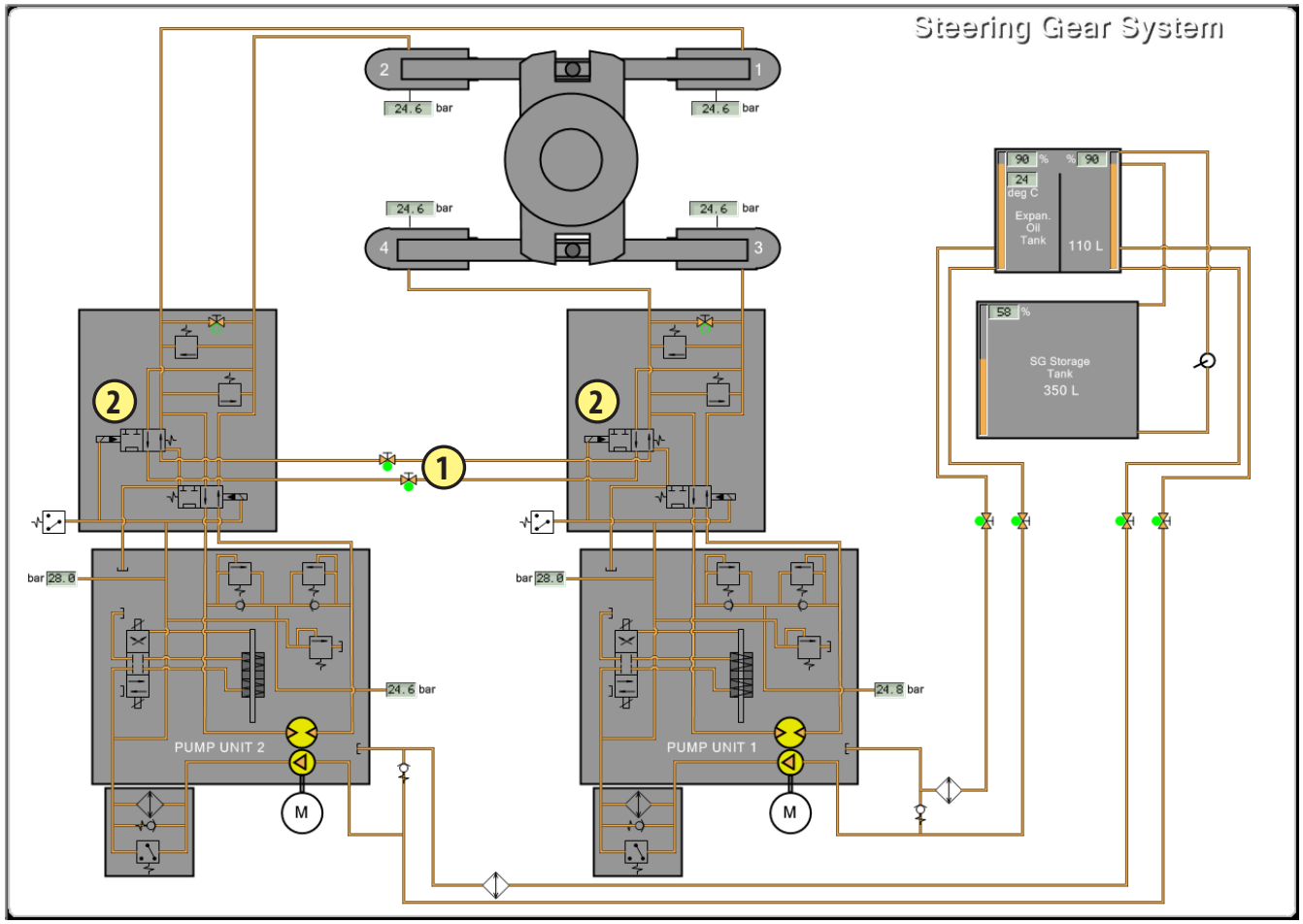
- Actuator;
- Two identical steering gear units; each unit comprises:
  - Steering gear **HPP Oil** tank ;
  - **SG HPP Pump** – 0.43 m3/h x 70 kg/cm2;
  - (1) – **Manual Isolation Valve V1**, **V2**;
  - (2) EM'CY rudder displacement handles (operated from 3D display, see *the paragraph 7.16.4.5 on page 234*);
  - **Hydraulic Oil Filter**;
  - Hydraulic **Oil Cooler**;
  - Pipelines with valves, parameters' indicators.

7.16.3. Connections

- From/To LT Cooling System

7.16.4. Control

Use the (1) **Manual Isolation Valve** on diagram to switch off a tripped pump.



7.16.4.1. Steering Gears LOP in SG Room

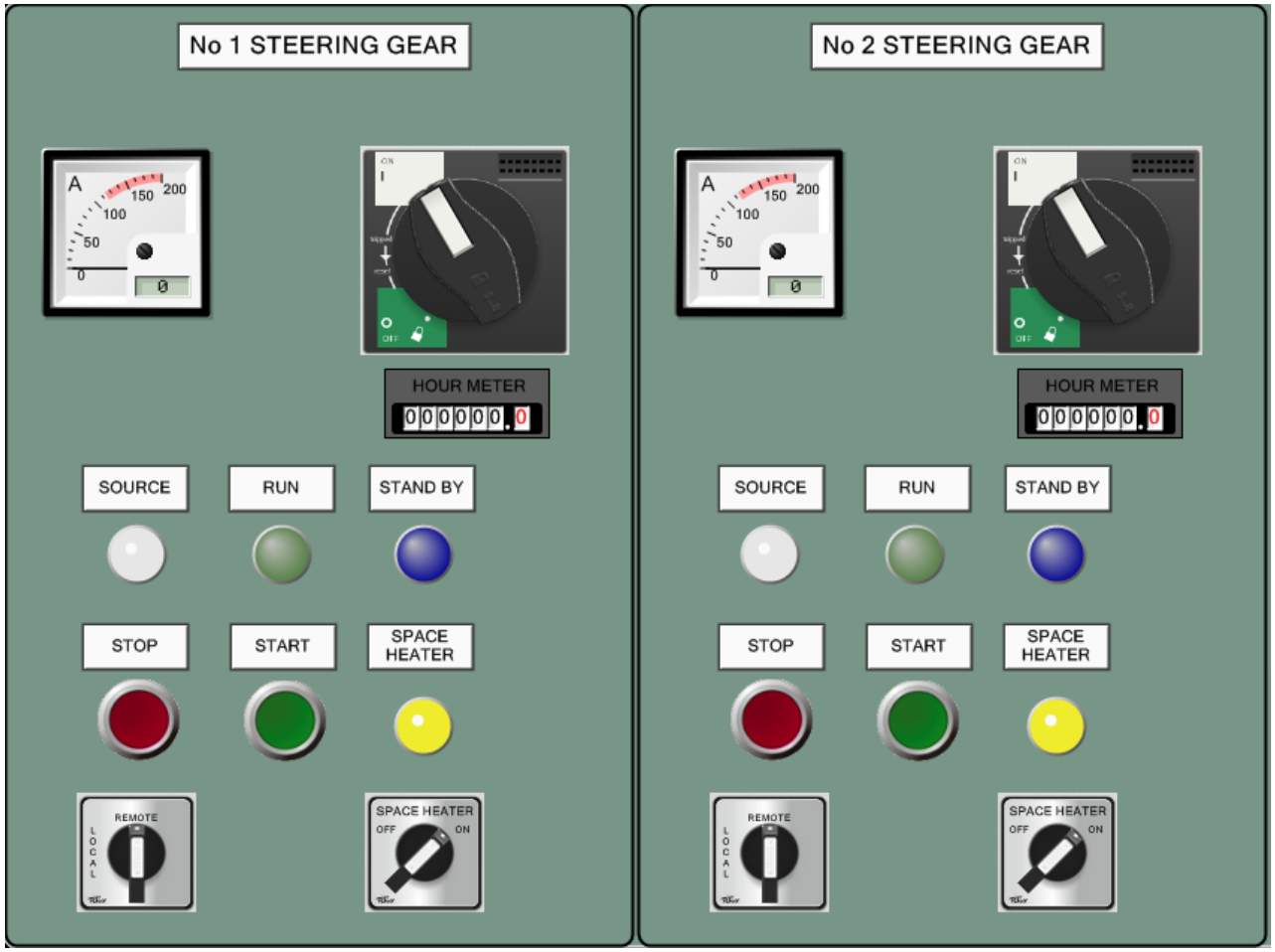
Click the menu item **Steering Gear LOP** of the page **SG** to open the display with **No 1 STEERING GEAR** and **No 2 STEERING GEAR** identical panels.

Each **STEERING GEAR** panel contains:

- Ammeter;
- Power automatic circuit breaker to turn the pump motor and heater power OFF–ON;
- **HOUR METER**;
- **SOURCE**; **PUMP RUN**; **STAND-BY**; **SPACE HEATER** indicator lamps;
- Two-position control mode selector switch:
  - **LOCAL** – start from this LOP, and operate the SG displacement handles from 3D display (see ***the paragraph 7.16.4.5 on page 234***);
  - **REMOTE** – from the Bridge.

Switch power supply 440 V for:

- **No 1 STEERING GEAR** on the **EM'CY AC440v FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**) by **No 1 STEERING GEAR** circuit breaker;
- **No 2 STEERING GEAR** on the **No. 1 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440v Feeder** of the page **MSB**) by **No 2 STEERING GEAR** circuit breaker.

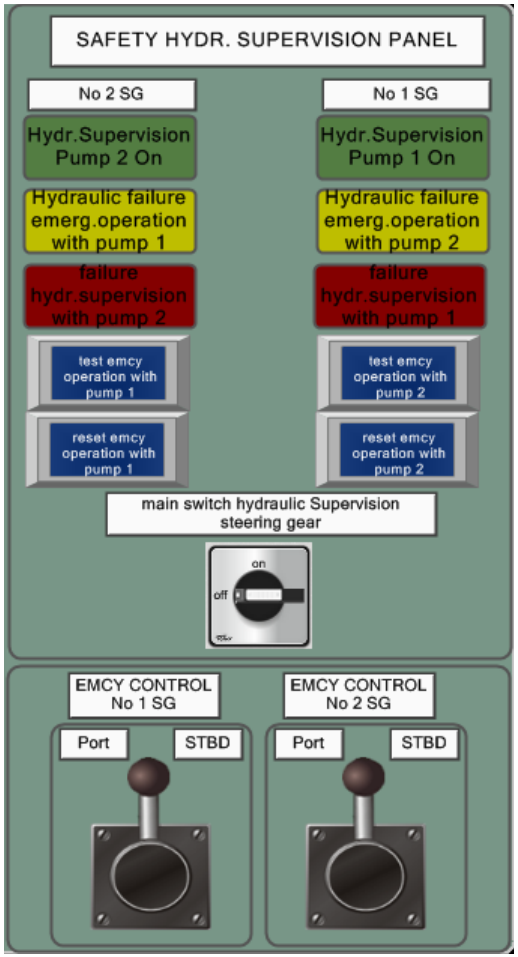


7.16.4.2. Safety Hydraulic Supervision Panel in SG Room

Click the menu item **Steering Gear LOP** of the page **SG** to open the display with **SAFETY HYD. SUPERVISION PANEL**.

The panel contains similar sets of controls for **NO.2 S/G** and **NO.1 S/G**:

- Indicator lamps:
  - **Hydr. Supervision Pump 2 (1) On**;
  - **Hydraulic failure emerg. operation with pump 1 (2)**;
  - **Failure hydr. supervision with pump 2 (1)**.
- Buttons:
  - **test emcy operation with pump 1 (2)** – ;
  - **reset emcy operation with pump 1 (2)** – .
- **main switch hydraulic Supervision steering gear** – two-position switch:
  - **off** – safety system is switched off;
  - **on** – safety system is switched on.
- **EMCY CONTROL SG 1** and **EMCY CONTROL SG 2** handle two-position switches: use the mouse to set required handle position **Port** or **STBD** when in manual operation (safety switch is set to **off** position).



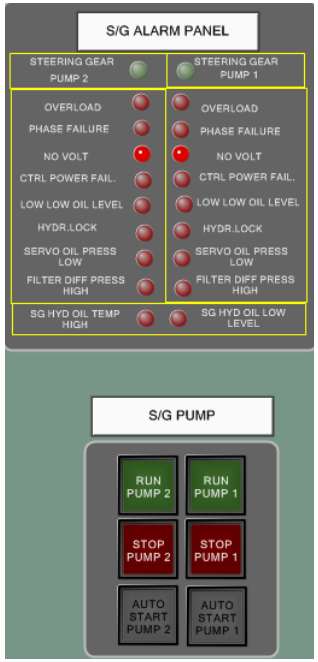
7.16.4.3. SG Supervision from ECR Console Section A

Click the menu item **ECC A** of the page **ECR** to open the **ENGINE CONSOLE SECTION A** with **S/G ALARM PANEL** and **S/G PUMP** panel.

The **S/G ALARM PANEL** contains indicator lamps; each column of the table contains indicators for respective pump. The panel is similar to that on BCC A console (see *the paragraph 7.16.4.4 on page 232*).

The **S/G PUMP** panel contains indicator lamps:

- **RUN PUMP 2 (1)**;
- **STOP PUMP 2 (1)**;
- **AUTO START PUMP 2 (1)**.



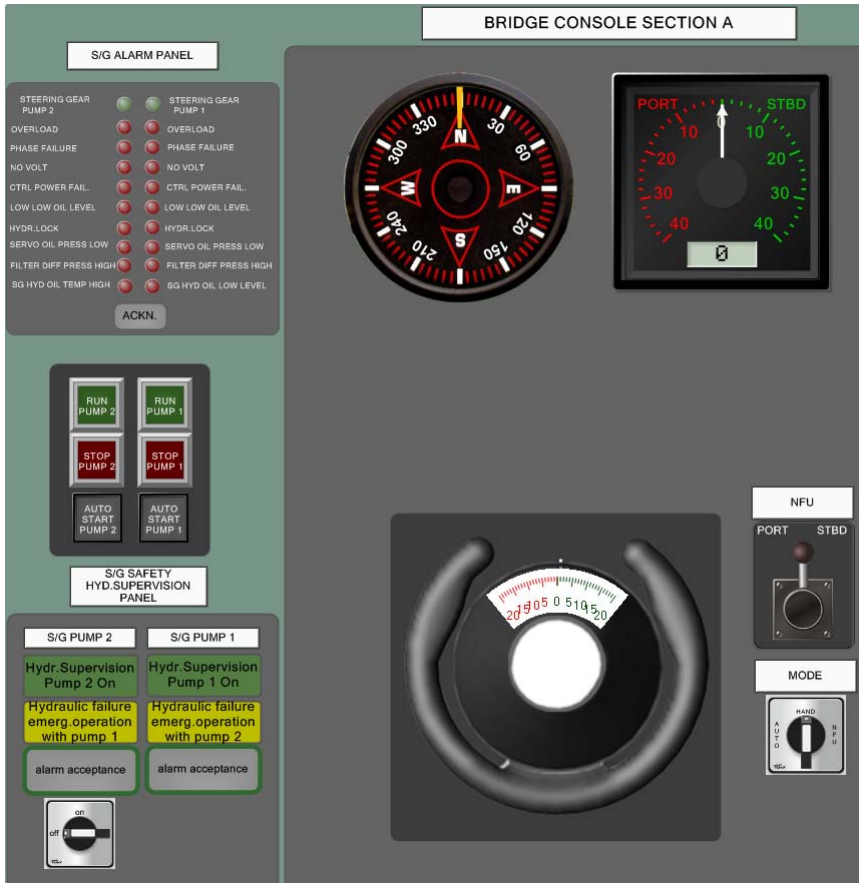
7.16.4.4. SG Control from Bridge Console Section A

Click the menu item **BCC A** of the page **BCC** to open the **BRIDGE CONSOLE SECTION A** for remote control of steering system.

The display left panel contains:

- **S/G ALARM PANEL** indicator lamps; each column of the table contains indicators for respective pump:
  - **STEERING GEAR PUMP NO.1(2)** run indicator;
  - **OVERLOAD** alarm lamp: electric motor overload;
  - **PHASE FAILURE** alarm lamp: one of the phases is out, or main power supply voltage/frequency out of range;
  - **NO VOLT** alarm lamp: main power supply is lost, or motor controller is off;
  - **CTRL POWER FAIL.** alarm lamp: no control power;
  - **LOW LOW OIL LEVEL** alarm lamp: low low oil level alarm in hydraulic oil system;
  - **HYDR. LOCK** alarm lamp: fault on solenoid driver controller, or locked manoeuvre valve;
  - **SERVO OIL PRESS. LOW** alarm lamp: pressure < 15 bar;
  - **FILTER DIFF. PRESS HIGH** alarm lamp;
  - **S/G HYD OIL TEMP HIGH** alarm lamp: broken oil cooler.
- **ACKN.** button to acknowledge SG alarms;
- **RUN PUMP2**, **RUN PUMP1** buttons for starting the SG pumps; the button highlights when the pump is running;
- **STOP PUMP2**, **STOP PUMP1** buttons for stopping the SG pumps; the button highlights when the pump is stopped;
- **AUTO START PUMP2**, **AUTO START PUMP1** indicator lamps; a lamp is illuminated when respective pump automatically starts.

In case of alarm condition is present for more than 3 second the buzzers are turned on and alarm lamps start to flash on both panels independently. By pressing the **ACKN.** button, the local buzzers are turned off, but lamps continue flashing.



At the second push of the **ACKN.** button, the following happens:

Local flashing of the alarm lamps stops; if the alarm condition is still present, the local alarm lamp goes from flashing to steady light, otherwise it is turned off. When the alarm condition finally vanishes, the alarm lamps go out.

In case a second alarm condition occurs before the first had vanished, the buzzers are triggered again, but only the second alarm lamp will flash and the first will light steady.

The **S/G SAFETY HYD. SUPERVISION PANEL** contains:

- **S/G PUMP 2** and **S/G PUMP 1** controls:
  - **Hydr. Supervision Pump 2 (1) On** and **Hydraulic failure emerg. operation with pump 1 (2)** indicator lamps;
  - **alarm acceptance** button.
- Two-position mode selector switch:
  - **off** – safety system is switched off;
  - **on** – safety system is switched on.

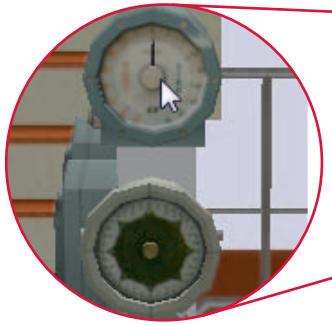
SG supervision is available at the ECR control console **ECC A** (see ***the paragraph 7.16.4.3 on page 231***).

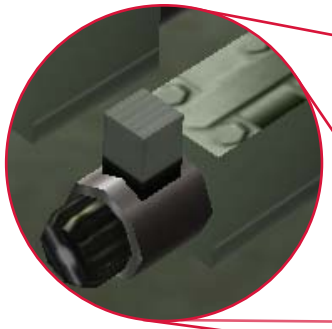
The display central panel contains:

- Navigating compass;
- Rudder angle indicator; green – PORT, red – STBD;
- Helm; control is active in the HAND mode;
- **NFU** tiller **PORT–STBD** to steer in NFU mode; drag and hold the handle to turn to required side;
- **MODE** three-position switch to set the control mode:
  - **AUTO** – from Autopilot;
  - **HAND** – from helm wheel;
  - **NFU** – manual steering.

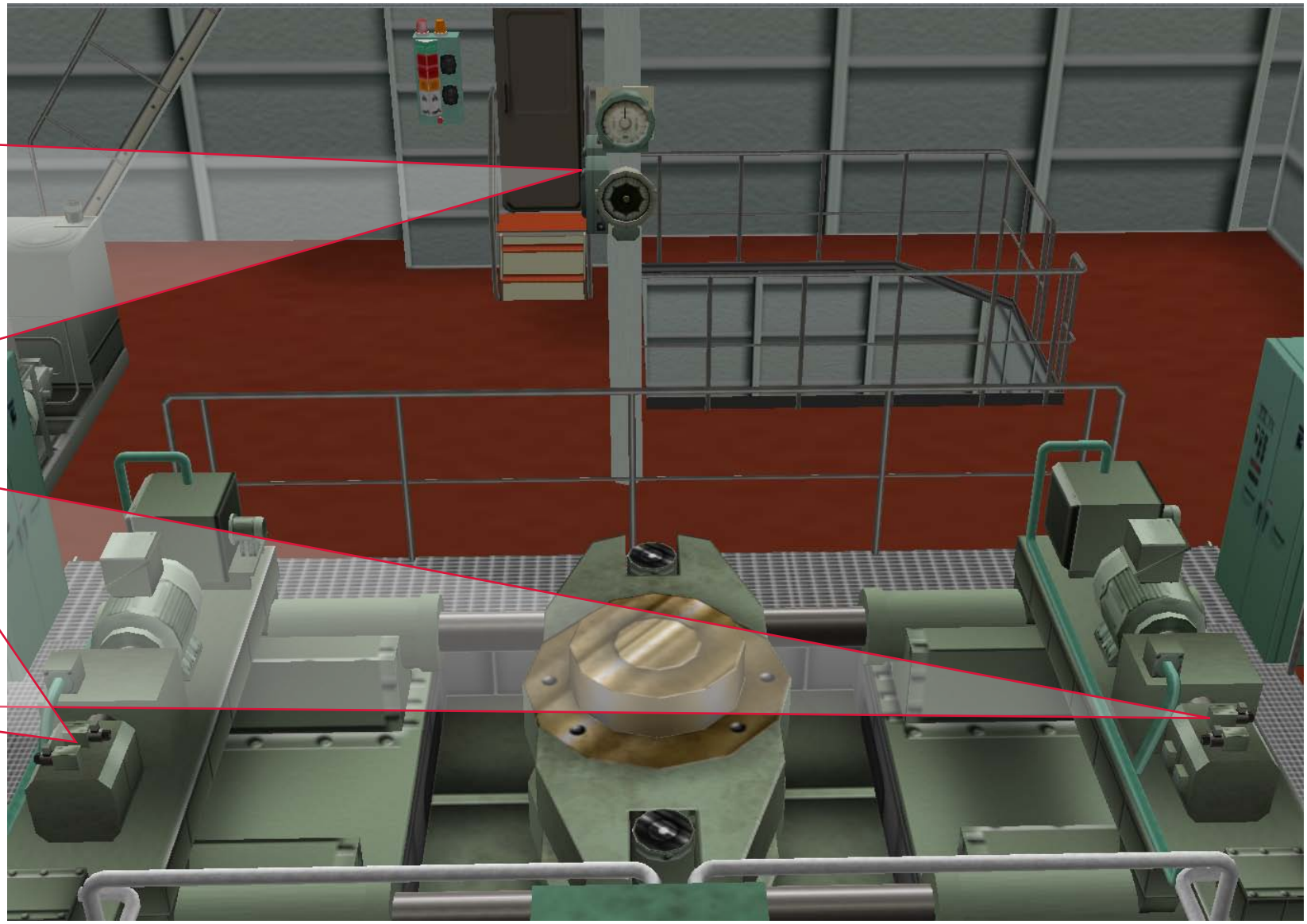
SG Room 3-D view

Compass Repeater;
Rudder Angle indicator





Handles for Emergency
Steering Control



7.16.4.5. SG LOP on 3D

Control of the Steering gear from the SG Room is implemented on the **3D** display of the page **SG** (see ***the figure SG Room 3-D view on page 233***). The controls duplicate the gauges on Bridge console **BCC A** (menu item **BCC A** of the page **BCC**, see the description in ***the paragraph 7.16.4.4 on page 232***).

On 3-D diagram the following actions are available:

- Zoom in/out – by the mouse wheel;
- Pan – drag&drop by left mouse button;
- Rotate – drag&drop by right mouse button;
- Directly operate a controlled object on 3-D display.

Rudder Angle Indicator and Compass Repeater are placed on the bulkhead.

To operate the handles, click and hold required handle while watching the reading of the gauges. When you let go the mouse button the handle returns to default position.

7.16.5. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.7.5 on page 272***.

8. Support of Cargo Handling

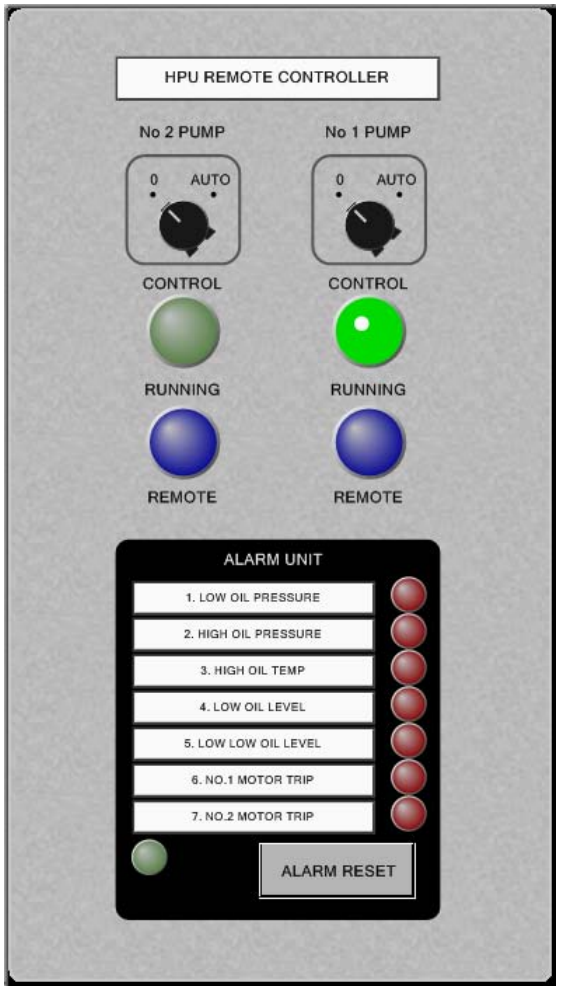
8.1. General

Cargo loading/unloading and ballast operations are supervised from the Cargo Control Room (CCR). The panels are mainly designed to support joint operation with the corresponding LCHS model (see Chapter 6). However some standalone cargo and ballast handling operations are also possible.

8.2. Hydraulic Power Unit for Valves Operation

A closed hydraulic system (Hydraulic Power Unit) is designed to operate the hydraulic valves of the ballast system.

Note: **The HPU should be started prior to operating ballast system hydraulic valves.**



8.2.1. HPU Remote Controller

Click on the menu item **HPU Remote Controller** of the page **CCR** to open the **HPU REMOTE CONTROLLER** panel, which contains:

- **No 2 PUMP** and **No 1 PUMP** controls; each set comprises:
  - **CONTROL** two-position mode selector switch (control mode on **HYDRAULIC POWER PACK FOR VALVE REMOTE CONT. SYSTEM** panel should be set to REMOTE, see ***the paragraph 8.2.2 on page 236***):

    O – the pump is off.

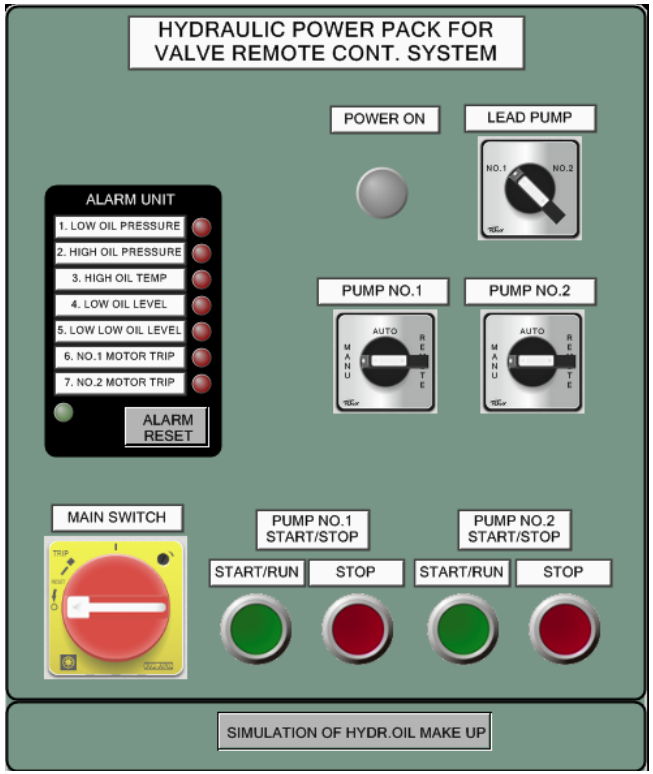
    AUTO – automatic operation.
- **RUNNING** indicator lamp; illuminates to indicate that the HPU is ready for use;
- **REMOTE** indicator lamp; pumps remote control.
- **ALARM UNIT** panel duplicating the alarm panel of the LOP (see ***the paragraph 8.2.2 on page 236***):

8.2.2. HPU LOP

Click on the menu item **Valves Remote Control HPU LOP** of the page **ER4** to open the **HYDRAULIC POWER PACK FOR VALVE REMOTE CONT. SYSTEM** panel.

The panel contains:

- **POWER ON** indicator lamp;
- **LEAD PUMP** two-position switch to select the duty pump **NO.1/NO.2**; second pump automatically is standby;
- **PUMP NO.1**, **PUMP NO.2** three-position switches to select the respective pump control mode between:
  - **MANU** – control from this panel;
  - **AUTO** – automatic operation;
  - **REMOTE** – control on the **HPU REMOTE CONTROLLER** panel (see ***the paragraph 8.2.1 on page 235***).
- **ALARM UNIT** lamps:
  - **1. LOW OIL PRESSURE** – when both pumps are tripped;
  - 2. indicator is not modeled;
  - **3. HIGH OIL TEMP** – depends on oil level <25%;
  - **4. LOW OIL LEVEL** – level < 15%;
  - **5. LOW LOW OIL LEVEL** – level 10%;
  - **6. NO.1 MOTOR TRIP**
    7. NO.2 MOTOR TRIP – by the fault from the instructor;
  - Green LED to indicate power supply for alarm unit;
  - **ALARM RESET** button.



- **MAIN SWITCH** to turn power for the control panel on/off;
- **PUMP NO.1 START/STOP** and **PUMP NO.2 START/STOP** buttons to operate the pumps in MANU mode:
  - **START/RUN** – to start the pump; illuminates when the pump is running;
  - **STOP** – to stop the pump.
- **SIMULATION OF HYDR. OIL MAKE UP** button – to simulate the tank make up process.

Note: Introduction of instructor fault "Oil Leakage" causes the following succession of alarms:

3. HIGH OIL TEMP –->
4. LOW OIL LEVEL –->
5. LOW LOW OIL LEVEL

Click the **SIMULATION OF HYDR. OIL MAKE UP** button to simulate the tank make up and clear the alarm conditions.

Switch the power supply 440 V for:

- **HYDRAULIC POWER PACK FOR VALVE REMOTE CONTROL SYSTEM** on the **EM'CY AC440v FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**) by the **HYD. POWER UNIT FOR VALVE REMOTE CONTROL** circuit breaker.

8.2.2.1. Faults Introduced by Instructor

Introduced faults are listed in Chapter 7, ***the paragraph 2.12.1 on page 276***.

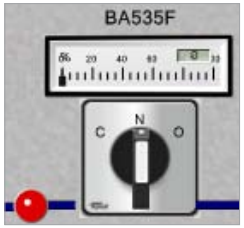
8.3. Operating the Valves

There are hydraulic remote two-position (0/1), hydraulic remote modulating (0–100) and manual modulating (0–100) valves modeled in the simulator. Remote valves are normally operated from the mimics of the page **CCR**. In the case of emergency these valves can be manually operated from the pop up panels (simulating the portable hydraulic pump) on the **SYS** page displays.

The manual modulating (0–100) valves are normally operated from the displays of the **SYS** page.

8.3.1. Remote Control of Modulating Valves

The remote controlled hydraulic modulating (0–100) valves are normally operated from the mimics of the page **CCR** using the three-position **C/N/O** control switch:



The LED indicator illuminates in red when the valve is fully closed: in position 0%. The LED illuminates in green when the valve is fully open: in position 100%. The LED is not illuminated when the valve position is in 1–99% position indicated by the slider above the switch.

To operate the valve:

- Set the switch to position **C** – to activate closing process;
- Set the switch to position **O** – to activate opening process;
- Set the switch to position **N** – to stop operating process; when the valve is not controlled the switch automatically sets to **N** position.

8.3.2. Remote Control of 0/1 Valves

The remote controlled hydraulic 0/1 valves are normally operated from the mimics of the page **CCR** by illuminated buttons:

Closed valve

Open valve

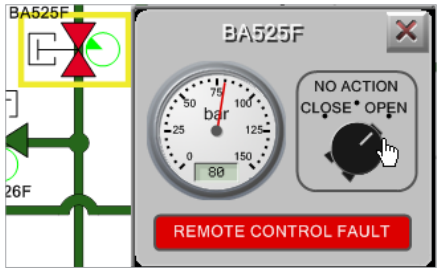
When the valve is closed the Red button is illuminated. To open the valve click and hold the Green button for 3–4 seconds till it starts blinking. The Green button illuminates steadily and Red button lights down when the valve is fully open. To close the valve operate the Red button in similar way.

Valve operation time is 12–15 seconds.

8.3.3. Hydraulic Valve Operation in Emergency

When the instructor introduces the fault '<##> Remote Valve Control Hydraulics Fault' then the respective valve does not obey commands from **CCR** mimic. If the **Hints ON/OFF** button on the simulator main upper toolbar is pressed then the valve sign on the **SYS** display is highlighted in red and can be then operated only from the display of the page **SYS**.

Click on such valve to open the remote valve control panel with the alarm **REMOTE CONTROL FAULT** indicator highlighted:



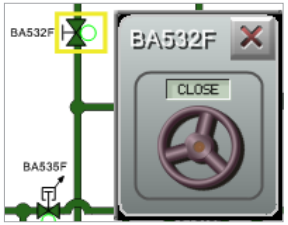
To operate the valve raise the pressure manually using the switch. To open a closed valve, turn the three-position switch to the **OPEN** position watching the pressure gauge readings. The pressure 70 bar indicates that the valve is in the process of changing its state; the pressure 135 bar indicates that the valve is 100% open. To close an open valve turn the three-position switch to the **CLOSE** position watching the pressure gauge readings. The pressure 70 bar indicates that the valve is in the process of changing its state; the pressure 135 bar indicates that the valve is 100% closed. Turn the switch to **NO ACTION** position to stop operating.

On the **CCR** mimic, indication of the valve state will be disabled. The actual valve state will be indicated on the local panel by the pressure raise on the pressure gauge and on the **SYS** display.

Note: The hydraulic valve control panel on SYS displays is functional only in the case of emergency (instructor fault):

8.3.4. Manual Control of Modulating Valves

The manually controlled modulating (0–100) valves are operated using the pop up panel with the wheel simulating the valve handle. To open the panel, click a valve pictogram on any display of the page **SYS**. The panel displays the valve designation:



Rotate the wheel by the mouse: clockwise to close the valve; Counterclockwise to open the valve.

The digital indicator shows the valve state position. On releasing the mouse button the valve picture on the **SYS** display immediately reflects the set state. Click **X** to close the panel.

8.4. Ballast System Remote Control

8.4.1. Ballast System Mimic

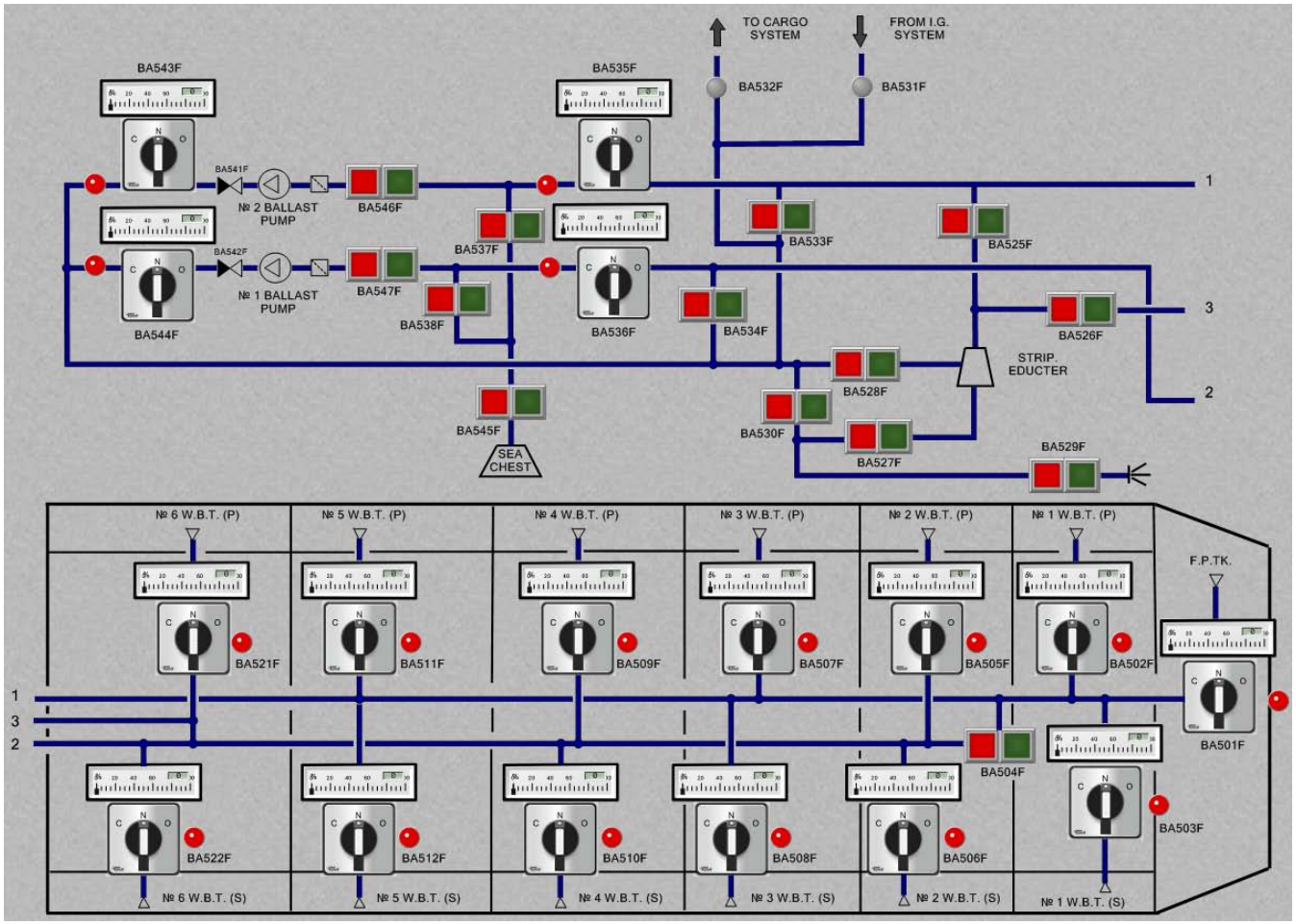
Click the menu item **Ballast System Mimic Panel** of the page **CCR** to open the diagram for remote control of the hydraulic valves, which are operated using the closed hydraulic system, see ***the paragraph 8.2 on page 235***.

The display contains:

- **№ 1 BALLAST PUMP** and **№ 2 BALLAST PUMP**; the pumps are remotely operated from CCR (see);
- Remote 0–100 valves with valve position scales and indicator lamps (see operation description in);
- Remote 0/1 valves illuminated buttons (see operation description in);
- Mimic of the water ballast tanks and piping.

Note: The local control of the tanks piping is presented in the simulator by the display **Ballast System** of the page **SYS** (see ***the paragraph 7.4 on page 194***). In the case of HPU failure the valves can be operated from this display.

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.



8.4.2. Ballast Pumps Remote Control

Click the menu item **Ballast Pumps Panel** of the page **CCR** to open the display for remote control of the **№ 1 WATER BALLAST PUMP, № 2 WATER BALLAST PUMP.**

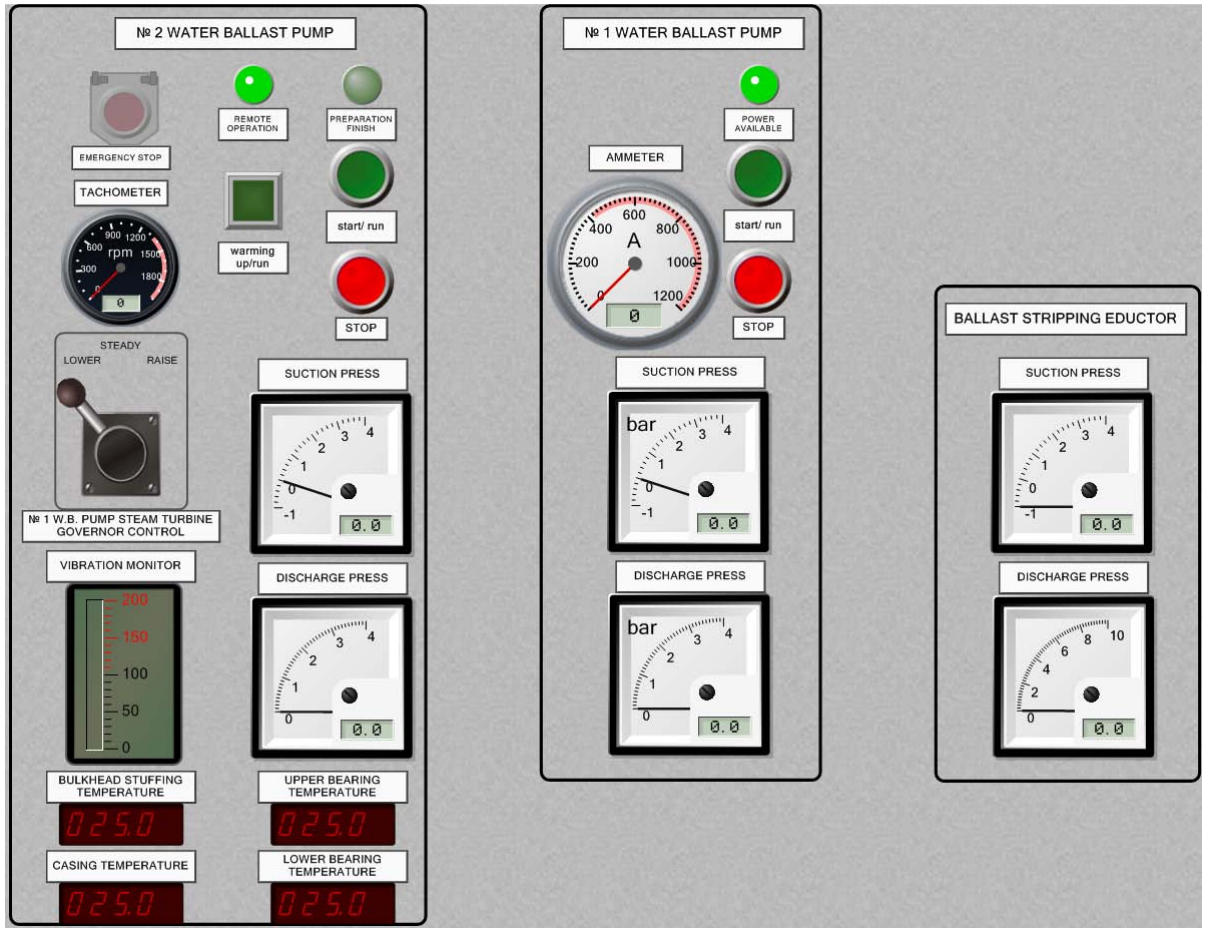
The **№ 1 WATER BALLAST PUMP** is driven by electric motor. The control panel contains:

- **AMMETER;**
- **POWER AVAILABLE** indicator lamp; for the lamp to illuminate, at minimum two generators should be on the bus;
- **START** / **RUN** button;
- **STOP** button;
- **SUCTION PRESS;**
- **DISCHARGER PRESS.**

Local control and supervision of the ballast pump 1 s is described in ***the paragraph 7.4.4.2 on page 195***.

The **№ 2 WATER BALLAST PUMP** is steam driven. The control panel is similar to Cargo Oil pump control panel (see ***the paragraph 8.5 on page 240***). For the pump 2 to run, the steam turbine should be in full operation (see ***the paragraph 7.7.2.2 on page 205***).

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.

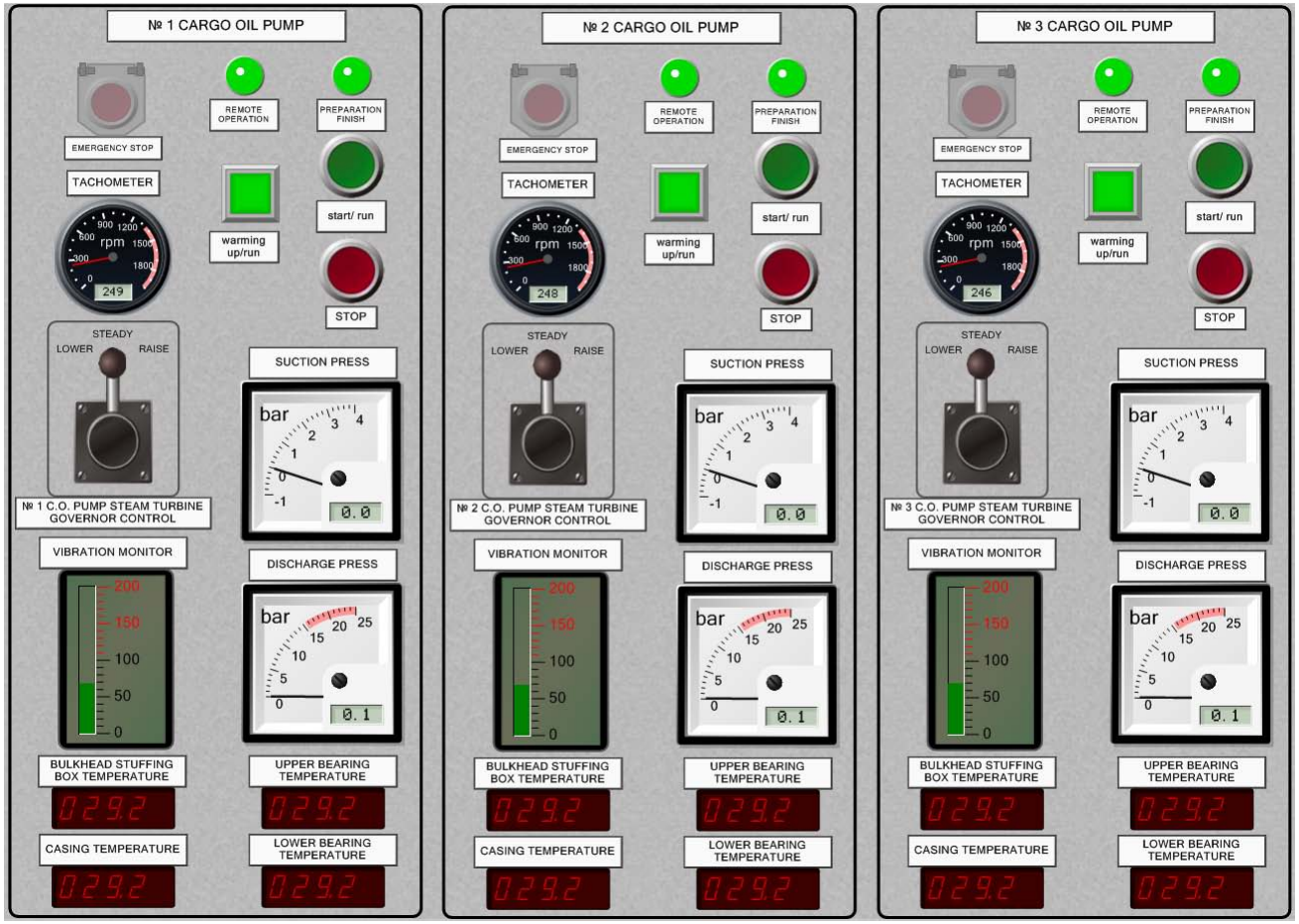


8.5. Cargo Pumps Remote Control

Click the menu item **Cargo Pumps Control Panel** of the page **CCR** to open the display with similar control panels **No.1 CARGO OIL PUMP, No.2 CARGO OIL PUMP, No.3 CARGO OIL PUMP.**

Each panel contains:

- **EMERGENCY STOP** button; when the button is not active, the central circle is green color, and the pump can be operated; when the button is pressed the central circle is red color, and the pump is blocked; click the button to stop the pump urgently;
- **TACHOMETER**;
- **№ 1 W.B. PUMP STEAM TURBINE GOVERNOR CONTROL** three-position control handle to **LOWER** / **STEADY** / **RAISE** the speed;
- **VIBRATION MONITOR** gauge to display the vibration of the pump casing; when the pump is stopped the reading is in the range 1.2–1.5mm/s; during pumping the reading should be in the range 2–4mm/s; maximum allowed vibration is 18mm/s;
- **REMOTE OPERATION** indicator lamp – illuminates when the pump is ready for operation (the steam and condensate systems are ready to serve the turbine mover); at that the button **STOP** also illuminates;
- **PREPARATION FINISH** indicator lamp – illuminates when the pump is ready for cargo operation;
- **WARMING UP/RUN** button: click to start warming the turbine; the pump speed raises up to 200–300 RPM: watch the **TACHOMETER** reading; the button flashes during warm-up time and lights steadily when the pump is ready for operation;



- **START/RUN** button: click to start the pump; the button illuminates and the lights **PREPARATION FINISH** and **WARMING UP/RUN** go down;
- **STOP** button: click to stop the pump;
- **SUCTION PRESS** gauge; when the pump is stopped the reading is +0.3bar; when discharging from full tanks the reading should be -0.3bar at 700RPM; as discharging proceeds the vacuum value increases;
- **DISCHARGE PRESS** gauge; when the pump is stopped the reading is 0bar; during warming up the pressure should be < 4bar; maximum allowed pressure 16bar;
- Digital indicators of:
  - **BULKHEAD STUFFING TEMPERATURE** : max 85°C;
  - **CASING TEMPERATURE** : max 75°C; when the pump is stopped the casing is at environment temperature; during pumping the casing is about the cargo temperature;
  - **UPPER BEARING TEMPERATURE**; **LOWER BEARING TEMPERATURE :** when the pump is stopped the bearings are at environment temperature; during pumping the bearings are about the cargo temperature plus 5–10 degrees.

Note: The similar panel is available in LCHS model during ERS–LCHS joint operation.

8.5.2.1. Starting Cargo Pump Remotely

The following actions need to be taken to start the pump.

1. Check out that the lamp **REMOTE OPERATION** and button **WARMING UP/RUN** are illuminated.
2. Click the button **WARMING UP/RUN**. The button starts flashing and the pump speeds up.
3. Watch the **TACHOMETER** reading raise up to 200–300 RPM. Warming up time is about 2-3 minutes. The **DISCHARGE PRESS** gauge reading should be < 4 bar.

   The button **WARMING UP/RUN** lights steadily and the lamp **PREPARATION FINISH** illuminates.
4. Test the pump stopping:

   › Click the button **STOP** or **EMERGENCY STOP**.

   › Close the pump suction valve on the display **Pump Room** (use the menu item **Pump Room** of the page **SYS).**

   › The lamp **PREPARATION FINISH** and button **WARMING UP/RUN** light down. The button **STOP** illuminates.
5. Repeat the actions 2~3.
6. Click the button **START/RUN**. The button illuminates.

   The button **WARMING UP/RUN** and the lamp **PREPARATION FINISH** light down. The pump is ready for cargo handling.

   It is now time to open the pump suction valve, etc.
7. Use the **GOVERNOR CONTROL** handle to control the pump revolution speed. Keep speed < 1380RPM.

Chapter 5. Instructions for Operating Machinery

This chapter contains the instructions for starting, stopping and running Propulsion Plant, Electrical Plant and other systems machinery of the Tanker LCC ship.

Chapter 5. Instructions for Operating Machinery

This chapter contains:

1. Introduction

The instructions in this chapter are given to help the Trainee familiarize oneself with the Propulsion Plant operations and ship systems and units control in the simulator.

Provided that the Trainee is familiar with the simulator architecture and ways of control, the instructions simply include indication of the menu items to open respective displays.

Note: The instructions given in this Chapter imply that before switching on a mechanism the Trainee verifies that power supply is available. In most starter panels and LOPs there should be the power supply indicator lamp illuminated.

2. Operating ME, EPP and Steam Plant

2.1. Starting Ship Electric Plant on Dead Ship

It is assumed that the shore power supply is ON by default. All generators are stopped.

The following actions need to be taken to start No. 1 Generator Engine, start the generator and put it on MSB.

2.1.1. Pre-start Operations

Check out the fuel oil supply system state

1. On the **No. 2/1 GROUP STARTER PANEL** (use menu item **MSB No 2/1 GSP** of the page **MSB**) confirm that **EM'CY D.O. PUMP (AIR DRIVEN)** is set to **AUTO** mode.
2. On the display **FO ME, GE Service System** (use menu item **FO ME, GE Service System** of the page **SYS**) all supply and circulating pumps are stopped. Open the **Service Air Solenoid Bypass Valve**; then **GE EM'CY MDO Pump** (Air driven) starts automatically.

Prepare for Starting Generator Diesel Engine

3. On **LOP GE 1, 2** panels (use menu item **GE 1–2 LOP** of the page **ER3**):
   - › Check/set the handle to **RUN** position.
   - › Check/set the mode selector switch to position **REMOTE**.

     Note: In the case of emergency, the diesel engine can be started using the **START** button, when the switch is set to ENGINE SIDE control mode. Hovewer, No pre-lubrication of the engine is then performed.
   - › Check out, that the Fuel Oil boost pressure is present.

2.1.2. Start Generator DE & Connect to the Bus Manually

1. On **No. 1 GENERATOR ENGINE CONTROL PANEL** (use menu item **GE 1–2 Control Panel** of the page **ER3**):
   - › Set the **LOCAL–REMOTE&AUTO** selector switch to position **1** for local control.
   - › Click the **START** button to run the **G/E LO PRIMIMG PUMP**. Indicator **RUN** illuminates. Blue **READY TO START** LED illuminates.
   - › Click and hold the button **ENGINE START**, till the **ENGINE RUN** LED illuminates.
2. On **LOP GE 1** panel (use menu item **GE 1–2 LOP** of the page **ER3**): check out the readings on the gauges, to confirm that the engine runs to speed.
3. On **No. 1 GENERATOR ENGINE CONTROL PANEL** (use menu item **GE 1–2 Control Panel** of the page **ER3**): Set the **LOCAL–REMOTE&AUTO** selector switch to position **2** for automatic operation under remote control. The **G/E LO PRIMIMG PUMP** stops.
4. On **SHORE CONNECTION PANEL** (use menu item **ESB Generator & Shore Panels** of the page **EmG**) switch **SHORE CONNECTION BOX** circuit breaker off. The ship is blackout.
5. On **No 1 GENERATOR CONTROL PANEL** (use menu item **MSB Gen 1, 2 Panel** of the page **MSB**):
   - › Switch on **AMMETER** and **VOLTMETER** gauges to obtain the generator parameters readings.
   - › Click the button **I** on the **No 1 GENERATOR ACB** front panel. The **ACB CLOSED** lamp illuminates.
6. On **MAIN CIRCUIT DIAGRAM** (use menu item **MCD** of the page **MSB**) observe that the **G1** is running and connected to the main bus and emergency bus.

2.1.3. Start Generator DE & Connect to the Bus Automatically

1. On **SYNCHRO PANEL** (use menu item **MSB Synchro Panel** of the page **MSB**):
   - › Switch **SHARING AUTO MODE** to position **3.OPTIMAL**.
   - › Switch **SYNCHRO&POWER CONTROL** to position **AUTO**.
   - › Switch **STANDBY SELECTION** to position **G1**.
2. On **SHORE CONNECTION PANEL** (use menu item **ESB Generator & Shore Panels** of the page **EmG**) switch **SHORE CONNECTION BOX** circuit breaker off. The ship is blackout.
3. On **MAIN CIRCUIT DIAGRAM** (use menu item **MCD** of the page **MSB**) watch the following processes:
   - Automatic start of the **DG 1** on blackout;
   - Connecting **GEN 1** to MSB,
   - Connecting ESB.

2.1.4. Provide Fuel Oil Supply & Cooling for Generator Engines

1. On the **No. 1/1~2/2 GROUP STARTER PANEL** (s) (use menu items **MSB No 1/1 GSP**, **MSB No 1/2 GSP**, **MSB No 2/1 GSP**, **MSB No 2/2 GSP**, of the page **MSB**) start the fans, start the pumps and set for **CMS** control mode:
   - › **No. 1 ME & GE F.O. SUP. PUMP**;
   - › **No. 1 ME & GE F.O. CIRC. PUMP**;
   - › **No 1 E/R VENT. FAN**;
   - › **No. 1 MAIN C.S.W. PUMP**;
   - › **No. 1 LOW TEMP C.F.W. PUMP**;
   - › **No 3 E/R VENT. FAN (REVERSIBLE)** – run **START/ EXH**;
   - › **No 2 E/R VENT. FAN**;
   - › **REMOTE CONTROL FOR No 4 E/R SUP/EXH FAN** run – **SUP. START/RUN**;
2. On the display **FO ME, GE Service System** (use menu item **FO ME, GE Service System** of the page **SYS**): close the **Service Air Solenoid Bypass Valve**; then **GE EM'CY MDO Pump** (Air driven) stops.

2.2. Operating Steam Plant

2.2.1. Preparing for Steam Plant Start

Check out the following before starting the Steam plant:

1. On MSB **No. 1** (and/or No. 2) **AC440V FEEDER PANEL** (use menu items **MSB No 1, No 2 440V Feeder** of the page MSB) switch **AUX. BOILER POWER PANEL** (and/or **No. 1 SECTION) AUX. BOILER POWER PANEL (No. 2 SECTION)** and circuit breakers are ON.
2. On the **No. 1/1, 2/2 GROUP STARTER PANEL** (s) (use menu items **MSB No 1/1 GSP**, **MSB No 1/2 GSP**, **MSB No 2/1 GSP**, **MSB No 2/2 GSP**, of the page **MSB**) check/switch power ON:
   - **No. 1 (No. 2) CONDENSATE WATER PUMP** – and set **CMS** control mode;
   - **No. 1 (No. 2) VACUUM COND. C.S.W. PUMP** – and set **CMS** control mode;
   - **No. 1 (No. 2) BOILER WATER CIRC. PUMP**;
   - **No. 1 (No. 2, No. 3) AUX. BOILER FEED WATER PUMP**:
3. On the mimic **AUX. BOILER F.W. SYSTEM** of the page **CMS**, set **No. 1 (No. 2) CONDENSATE WATER PUMP** as duty/standby pairs: double-click to start one pump and click **ST-BY** button for the other pump.
4. On the mimic **S.W. COOLING SYSTEM** of the page **CMS**, set **No. 1 (No. 2) VACUUM CONDENSER SW P/P** as duty/standby pairs: double-click to start one pump and click **ST-BY** button for the other pump.

Set up steam distribution system.

5. On the display **Boilers Feed Water and Condensate System** (use menu item **Boilers Feed Water & Condensate System** of the page **SYS**):
   - › Open the **BLR 1 (BLR 2) Steam Outlet Main Valve**.
   - › Open **To Steam Tracing Valve**.
   - › Open HFO tanks heating valves as required.

2.2.2. Starting Steam Plant in Auto Mode

It is assumed that the pre-start operations described in *the paragraph 2.2.1 on page 246* have been fulfilled.

The following actions need to be taken to start the Boilers in automatic mode.

1. On **BOILER POWER PANEL** (use menu item **Boiler Power Panel** of the page **ER4**) turn the **AUTO/MANUAL** switch to position **1** (AUTO).
2. On **BOILER No 1 LOCAL CONTROL PANEL** (use menu item **Boiler LCP** of the page **ER4**): turn the **AUTO/MANUAL** switch to position **AUTO**.

To start the plant in automatic mode, the displays of the page **BMCS** can be used, as well as LCP(s) on the local control panels.

To operate from* BMCS*: displays:

1. On the display **PUMP OVERVIEW** start the pumps as duty/standby pairs:
   - **Fuel oil pump 1 (2)**;
   - **Circulation pump 1 (2)**.
2. On the display **PUMP OVERVIEW**:
   - Start the **Feed water pump 1** and **Feed water pump 3,** and set each pump to **Auto** control mode; pump 1 feeds boiler 1; pump 3 feeds boiler 2;
   - Set the pump **Feed water pump 2** to **ST-BY** mode; pump 2 can feed both boilers.
3. On the display **BURNER OVERVIEW** check the boilers **Operation** mode.
4. If **Operation** mode is **Shutdown** or **Stopped**, then on the **BOILER No 1 LOCAL CONTROL PANEL** (use menu item **Boiler 1 Control Panel** of the page **ER4**) or/and on the **BOILER No 2 LOCAL CONTROL PANEL** (use menu item **Boiler 2 Control Panel** of the page **ER4**) acknowledge alarms: click **AL RES** button; the red LED lights down.

By default, boilers operate in AUTO control mode, Boiler No 2 is Master and Boiler No 1 is Slave. In case the mode is different, proceed to steps 5~7.

5. On the display **BURNER OVERVIEW** click **Boiler 1** button.
6. On the panel **Boiler 1** click **Auto** button; click **OK** and close.
7. Repeat steps 5, 6 for Boiler 2.

Note: If an alarm condition is detected acknowledge alarm and check the boiler state again.

The boilers then start automatically.

To operate from local control panel.

The description given is for Boiler No 1. Boiler No 2 is started in similar way.

1. On **BOILER No 1 LOCAL CONTROL PANEL** (use menu item **Boiler LCP** of the page **ER4**):
   - › Click a succession of buttons on LCP to start one FO pump, and set second pump to standby state: **CMN CTRL->PUMP CTRL->OIL PUMP->MODE-> Start/St-by**.
   - › Click a succession of buttons on LCP to start one feed water pump and set it to auto mode, and set second pump to standby state: **CMN CTRL->PUMP CTRL->WATER PUMP->FEED PUMP->MODE-> Start+Auto/St-by**.
   - › Click a succession of buttons on LCP to start one water circulating pump, and set second pump to standby state: **CMN CTRL->PUMP CTRL->WATER PUMP->CIRC. PUMP->MODE->Start/St-by**.
   - › Click **AUT** button. Yellow indicator lamp illuminates.
   - › Click **ON** button. Green indicator lamp illuminates. The boiler is started and will run in automatic mode.

2.2.3. Starting Steam Plant in Emergency

Check the following before starting the Steam plant:

1. On MSB **No. 1** (and/or No. 2) **AC440V FEEDER PANEL** (use menu items **MSB No 1, No 2 440V Feeder** of the page MSB) switch **AUX. BOILER POWER PANEL** (and/or **No. 1 SECTION**) **AUX. BOILER POWER PANEL (No. 2 SECTION)** and circuit breakers are ON.
2. On the **No. 1/1, 2/2 GROUP STARTER PANEL** (s) (use menu items **MSB No 1/1 GSP**, **MSB No 1/2 GSP**, **MSB No 2/1 GSP**, **MSB No 2/2 GSP**, of the page **MSB**) check/switch power ON; and:
   - **No. 1 CONDENSATE WATER PUMP** – start and set **CMS** control mode;
   - **No. 1 VACUUM COND. C.S.W. PUMP** – start and set **CMS** control mode;
   - **No. 1 (No. 2) BOILER WATER CIRC. PUMP**;
   - **No. 1 (No. 2, No. 3) AUX. BOILER FEED WATER PUMP**:
3. On **Boilers Feed Water and Condensate System** display (use menu item **Boilers Feed Water & Condensate System** of the page **SYS**):

› Open the **BLR 1 Steam Outlet Main Valve**.

› Open the supply valves for required consumers.

The following actions need to be taken to start the Steam Plant in the case of emergency. The description given is for Boiler 1. Boiler 2 is started in similar way.

4. On **BOILER No 1 LOCAL CONTROL PANEL** (use menu item **Boiler 1 Control Panel** of the page **ER4**) turn the **AUTO/MANUAL** switch to position **MAN**.
5. On **BOILERS POWER PANEL** (use menu item **Boilers Power Panel** of the page **ER4**):

› Turn the **AUTO/MANUAL** switch on **BOILER No 1** panel to position **2** (MANUAL).

› Click **FUEL OIL PUMP 1 START/STOP** button to start the pump; the button illuminates. One pump is sufficient.

› Turn **COMBUSTION AIR FAN STOP/START** switch to position 1. Check out the reading on the fan ammeter.

6. On **BOILER No 1 LOCAL CONTROL PANEL** (use menu item **Boiler 1 Control Panel** of the page **ER4**):

› Click **ATOM. STEAM VALVE** button. Read value on **STEAM ATOMISING PRESSURE** gauge.

› Turn **AIR DAMPER COMBUSTION AIR FAN** knob to position **20**: perform boiler blowing.

› Turn **OIL FLOW REG. VALVE** knob to position **20**.

› Click **IGNITION** button. **FLAME ON** lamp illuminates when ignition is on. Check ignition status on display **BURNER OVERVIEW** of the page **BMCS**. If ignition does not start, check out the alarms condition and acknowledge alarms on the controller by clicking **AL RES** button.

› When the burner has started, click **IGNITION** button to turn ignition off. **FLAME ON** lamp lights down.

7. On **BOILER No 1 LOCAL CONTROL PANEL** (use menu item **Boiler 1 Control Panel** of the page **ER4**) start water pumps:

› Click a succession of buttons on LCP to start one feed water pump and set it to auto mode, and set second pump to standby state: **CMN CTRL->PUMP CTRL->WATER PUMP->FEED PUMP->MODE-> Start+Auto/St-by**.

› Click a succession of buttons on LCP to start one water circulating pump, and set second pump to standby state: **CMN CTRL->PUMP CTRL->WATER PUMP->CIRC. PUMP->MODE->Start/St-by**.

› Adjust **VALVE 1 WATER LEVEL** regulator – to middle position.

› Adjust **AIR DAMPER COMBUSTION AIR FAN** regulator – to middle position.

› Adjust **OIL FLOW REG. VALVE** regulator – to 1/3 position.

8. Click **IGNITION** button. Yellow indicator lamp illuminates.
9. Click **OIL VALVES** button. Green indicator lamp illuminates. The boiler is started and will run in MANUAL mode.
10. Keep balance between produced steam (pressure – it should be ~ 6 bar), water level and temperature in the boiler and the amount of consumed steam for required heating needs: operate the knobs of **VALVE 1 WATER LEVEL**, **OIL FLOW REG. VALVE,** and **AIR DAMPER COMBUSTION AIR FAN**.
11. To switch to automatic mode: on **BOILER No 1 LOCAL CONTROL PANEL** turn the **AUTO/MANUAL** switch to position **AUTO**, and on **BOILER POWER PANEL** turn the **AUTO/MANUAL** switch on **BOILER No 1** panel to position **1**.

Check out the state of FO valves and FO pumps on **FO Aux. Boilers System** display (use menu item **FO Aux Boilers System** of the page **SYS**).

2.3. Starting ME Manually on Dead Ship

It is assumed that Electric Power Plant is running and MSB is powered on by at least one of the diesel generators (see ***the paragraph 2.1 on page 245***).

It is assumed that the Steam plant is in operation or ready to start automatically (see ***the paragraph 2.2 on page 246***).

It is assumed that the main pumps are set for CMS control. On the **CMS** page check out that the main pumps are running in duty/standby configuration on the following displays:

- **FO SERVICE SYSTEM**;
- **S.W. COOLING SYSTEM**;
- **L.T. COOLING F.W. SYSTEM**;

The Main Engine will be started on MDO.

2.3.1. Pre-start Operations

1. On the **E/R FANS GPBP** (use menu item **ER Fan GPBP** of the page **ER3**) check out that fans 1, 2, 3 run for supply, and fan 4 runs for exhaust.
2. On the **AUX BLOWER NO 1 (NO 2) STARTER** panels (use menu item **Aux Blowers 1, 2 LOP** of the page **ER3**), for both blowers:
   - › Turn **MAIN SWITCH** on.
   - › Set **REMOTE** mode of operation. The blowers will then start automatically.
3. On the **H.T. COOLING SYSTEM** display of the page **CMS**: set **No. 1 (No. 2) M/E JACKET C.F.W. PUMP** as duty/standby pair: double-click to start one pump, and click **ST-BY** button for the other pump.
4. On the display **HT Cooling System** (use menu item **HT Cooling System** of the page **SYS**):
   - › Open the Preheater inlet and outlet valves;
   - › Close the Shut-off valve. The Preheater (jacket water) pump is running.
   - › For successful ME start, the temperature of the Engine cylinders, should raise up, to more than 50 degrees. Warming-up time is about 15 minutes.
5. On the **L.O. SERVICE SYSTEM** display of the page **CMS**: set **No. 1 (No. 2) MAIN LO PUMP** as duty/standby pair: double-click to start one pump, and click **ST-BY** button for the other pump.
6. On **ECC C Bottom Panel** (use menu item **ECC C Bottom Panel** of the page **ECR**) start the cylinders pre-lubrication pump:
   - › Set **CYLINDER LUBRICATOR DISPLAY** mode control switch, to **MCU** (Main Control Unit) position.
   - › Click **PUMP 1** button to start the pump. LED illuminates.
7. On the display **HT Cooling System** the page **SYS** when cylinders temperature > 50 °C:
   - › Close the Preheater inlet and outlet valves.
   - › Open the Shut-off valve for normal ME cooling. Otherwise, ME start fails, and further start will be blocked.
8. On the display **3D** (use menu item **3D** of the page **ER1**) open **FO Indicator** valves of all cylinders.
9. On the **TURNING GEAR STARTER** panel (use menu item **Turning Gear LOP** of the page **ER1**):
   - › Set the handle to position **ENGAGE**;
   - › Click and hold **FORWARD** button; the ammeter reading should be about 4;
   - › Click and hold **REVERSE** button; the ammeter reading should be about 4;
   - › Set the handle to position **DISENGAGE**.
10. On the display **3D** the page **ER1** close **FO Indicator** valves of all cylinders.
11. On the display **FO ME, GE Service System** (use menu item **FO ME, GE Service System** of the page **SYS**): open **ME FO Inlet valve**.

2.3.2. Starting ME from the LOP

1. On the ME Local Panel (use menu item **ME LOP**, or **3D** of the page **ER1**):
   - › Set the control mode switch handle to **ENGINE SIDE**.
   - › Set the **HANDWHEEL BLOCKING ARM** handle to **ENGINE SIDE**.
   - › Set the manoeuvring handle to position **START**.
   - › Click and hold the **START** button till the reading on **M/E REVOLUTION** gauge reaches more than 38 RPM.
2. On the ECC C Bottom console (use menu item **ECC C Bottom** of the page **ECR**):
   - › Set the **M/E TELEGRAPH RECEIVER** to position **AHEAD SLOW** to set direction.
   - › Set the **MANOEUVRING HANDLE** to position about 40% (for the ME to run slow).
   - › On the **CYLINDER LUBRICATOR DISPLAY** set mode control switch to Auto, for economy of the lube oil consumption.
3. On the ME Local Panel set both handles to **REMOTE**.

The control is transferred to ECR.

On the CMS acknowledge all alarms.

2.3.3. Starting ME from ECR

ME can be started from ECR without preheating and turning gear engagement if it has been stopped for a short while. Provided, all ship systems are prepared for ME start and the temperature in cylinders is > 50 degrees.

Starting from ECR console ECC C Bottom is performed using the telegraph and manoeuvring handles.

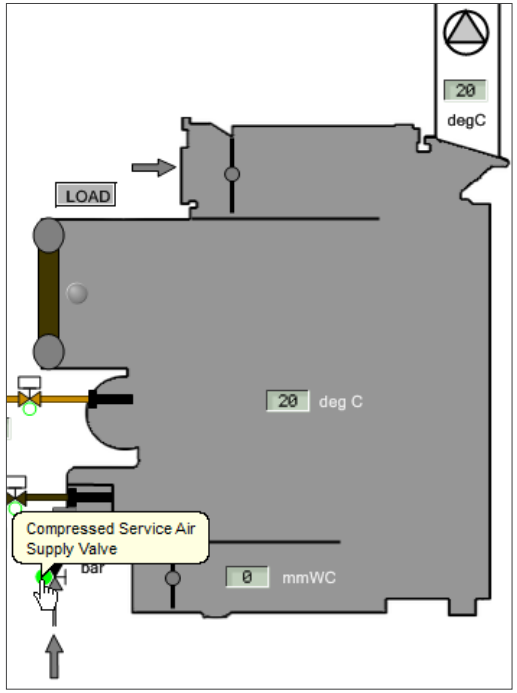
3. Operating Aux Systems

3.1. Starting Incinerator

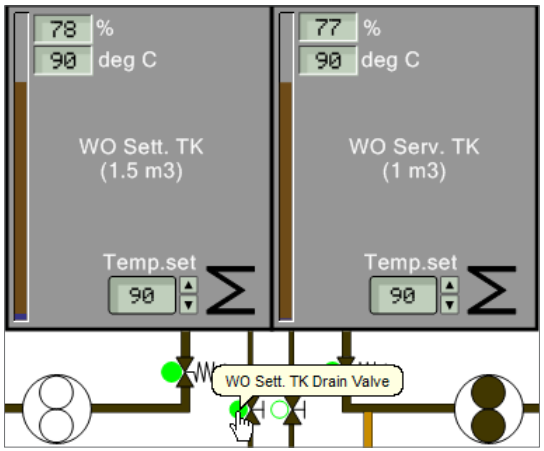
The Incinerator and Sludge System is described in Chapter 4, ***the paragraph 7.10 on page 217***.

The following actions need to be taken in the simulator to start the incinerator.

1. On the display **FO Incinerator & EGE Service System** (use menu item **FO Incinerator & EGE Service System** of the page **SYS**):
   - › Open the valve to supply air for the burner.



   - › Double-click on the incinerator door to open it.
   - › Click the **LOAD** button to open the **LOADING PANEL**.
   - › Load the solid waste matter as described in Chapter 4, ***the paragraph 7.13.4.2 on page 221***.
   - › Double-click on the incinerator door to close it.
   - › Double-click on the **Drain Valve (s)** to drain water from the **WO Sett. (Serv.) TK (s)**. Water is presented by dark blue color at the bottom in the tank level bar graph. When no water is left close the valve.



2. On the display **Boilers Feed Water and Condensate System** (use menu item **Boiler Feed Water & Condensate System** of the page **SYS**):
   - › Double click on the supply valves of the line **To Incin. Waste TKs Heating**, and Tracing line valve.
3. On the **W.O. TANK CONTROL PANEL** (use menu item **Incinerator LOP** of the page **ER4**, see the description in Chapter 4, ***the paragraph 3.6.4.2 on page 142***):
   - › Switch **SUPPLY** circuit breaker to **1** (on) position.
   - › Turn to AUTO position the switches: **SERV. MILL PUMP, SETT. MILL PUMP, MDO FEED PUMP**. (MILL pumps are started when the panel power is on; MDO FEED pump is started in AUTO mode at incinerator start.)
4. On the panel **INCINERATOR** (use menu item **Incinerator LOP** of the page **ER4**):
   - › Switch **SUPPLY** circuit breaker to **1** (on) position.
   - › Set **INCINERATOR START** switch to **START** position.
   - › Set **PRIMARY BURNER** switch to **START** position. When the burner starts the switch jumps back to OFF position and the **PRIMARY BURNER RUN** lamp illuminates.
   - › When the burner temperature rises up to 850 °C, set **SLUDGE BURNER** switch to **START** position. Once the burner starts, the switch jumps to RUN position and the **SLUDGE BURNER RUN** lamp illuminates.

Note: The alarm indicator lamps **FURNACE TEMP LOW** and **WO SERV. TANK TEMP LOW** would normally light down automatically during incinerator work.

3.2. Starting Provision Cooling System

The following actions need to be taken in the simulator to start the Provision cooling plant for automatic operation.

It is assumed that the pumps are running: one of **MAIN C.S.W. PUMP**, and one of **LOW TEMP C.F.W. PUMP**.

1. Check on MSB **No. 2 AC440V FEEDER PANEL** (use menu item **MSB No 1, No 2 440V Feeder** of the page **MSB**) that **PROVISION REF. PLANT** circuit breaker is ON.
2. On the **PROVISION COOLING PLANT** display (use menu item **Provision Cooling Plant LOP** of the page **ER4**):
   - › Switch the power ON by the **SUPPLY** switch.
   - › On both **PC COMPRESSOR 1**, **PC COMPRESSOR 2** panels:
     - Check the **SOURCE** lamp is illuminated;
     - Click the **MASTER SOLENOID** button to open the Master Solenoid valve;
     - Click the **START/RUN** button;
     - Set the mode switch to **AUT** position.

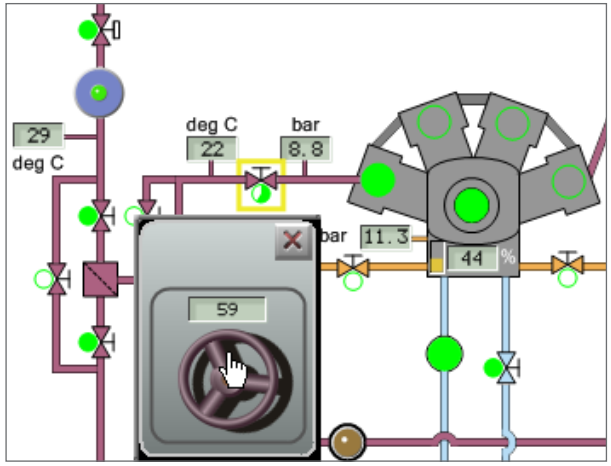
3.3. Starting Air Conditioning Plant

It is assumed that the pumps are running: one of **MAIN C.S.W. PUMP**, and one of **LOW TEMP C.F.W. PUMP**.

On the MSB **No. 1 AC440V FEEDER PANEL** the circuit breaker **AIR CONDITIONING PLANT** in ON.

The following actions need to be taken to start the AC Plant for automatic operation.

1. On the plant LOP (use menu item **AC LOP** of the page **ER4**): turn **MAN–AUTO** switches on **COMPRESSOR 1** and **COMPRESSOR 2** panels to position AUTO.
2. On the plant control panel (use menu item **AC Control Panel** of the page **ER4**)
   - › Set the **TEMPERATURE REGULATION** switch to position **2**.
   - › Switch power for compressors and fans (two circuit breakers).
   - › Click **START I** button to start compressor 1.
   - › Click **START I** button to start compressor 2.
3. On the system diagram (use menu item **Air Conditioning System** of the page **SYS**):
   - › Watch the compressor 1 run indicator to turn green.
   - › Click on the **AC Compressor 1 Suction** valve and use the pop-up panel to slowly increase the valve open state, watching the pressure increase on the digital indicators.
   - › Watch the compressor 2 run indicator to turn green.
   - › Click on the **AC Compressor 2 Suction** valve and use the pop-up panel to slowly increase the valve open state, watching the pressure increase on the digital indicators.
4. On the plant control panels (use menu item **AC Control Panel** of the page **ER4**):
   - › Turn **No. 1 AHU FAN START/STOP** switch to position ON.
   - › Turn **No. 2 AHU FAN START/STOP** switch to position ON.
   - › Set the appropriate (Low or High) performance for Fans speed by **AHU FAN SPEED SELECTOR** switches.



Chapter 6. ERS - LCHS Joint Operation

This chapter contains the description of interconnections and dependencies between systems and units of the Tanker LCC ERS and LCHS simulators during their joint operation.

Chapter 6. ERS - LCHS Joint Operation

This chapter contains:

1. Joint Operation

Joint operation of the MAN B&W 6S60MC-C Tanker LCC ERS model and corresponding LCC Tanker v. 1.0 LCHS model is supported. A special exercise created in the ERS model: "Preparing for cargo operations" should be used for joint operation. It includes starting the boilers, starting steam turbines, starting HPU system. The default exercise can be used for joint operation in the LCHS model.

Important! In the Configuration Editor, the bridge for simulators joint operation should be configured with two (2) tasks Model.

The paragraphs in this section explain the interconnections and dependencies between systems and units modeled in ERS and LCHS. Operation instructions are described in respective paragraphs of the manuals. The references to the "LCHS manual" below in this section are related to the document "**LCHS_5000_LCC_Tanker_v.1.0_Trainee_Manual.pdf**".

The connection diagrams use the following notation:

Notation	Sign
A system, unit (display, panel), etc. in ERS	(1)
A system, unit (display, panel), etc. in LCHS	(1)
Indication of dependency between systems, units	↘
Indication of the systems' (units) identical and simultaneous operation in both simulators	=
Indication of connections between systems (e.g. unit local control panel and system diagram, which includes the unit)	\ \

1.1. Ballast System

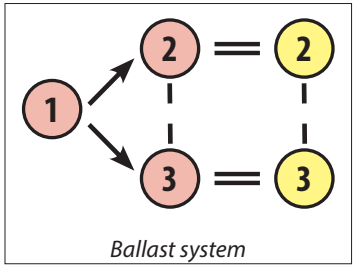
(1) Hydraulic Power Unit should be in operation (use menu item **HPU Remote Controller** of the page **CCR**). See Chapter 4, *the paragraph 8.2.1 on page 235*.

(2) Ballast system valves remote control (use menu item **Ballast System Mimic Panel** of the page **CCR**). See Chapter 4,*the paragraph 8.4.1 on page 238*.

(3) Ballast system valves local control (use menu item **Ballast System** of the page **SYS**). See Chapter 4, *the section 7.4 on page 194*.

(2) Ballast system valves remote control (use menu item **Ballast System Mimic Panel** of the page **CCR**). See the Section 8.2 of the LCHS manual.

(3) Ballast system valves local control (use menu item **Ballast System** of the page **SYS**). See the Section 8.5 of the LCHS manual.



Ballast system

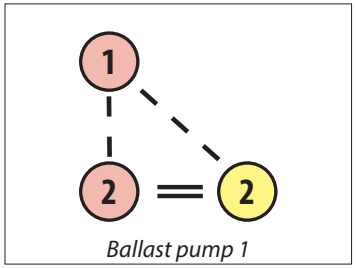
1.2. Ballast Pump 1 (Electric Motor)

(1) Ballast pump 1 starter panel to turn power supply on (use menu item **Ballast Pumps 1 LOP** of the page **ER2**). See Chapter 4, *the paragraph 7.4.4.2 on page 195*.

Note: Two generators should be on the bus.

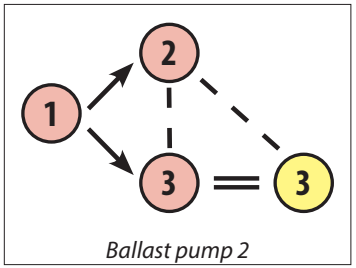
(2) Ballast pump 1 remote control (use menu item **Ballast Pumps Control Panel** of the page **CCR**). See Chapter 4, *the section 8.4.2 on page 239*.

(2) Ballast pump 1 remote control (use menu item **Ballast Pumps and Eductor Console** of the page **CCR**). See the Section 8.3 of the LCHS manual.



Ballast pump 1

1.3. Ballast Pump 2 (Steam Drive)



Ballast pump 2

(1) The Water Ballast Pump steam Turbine should be in operation. See Chapter 4, ***the section 5.3 on page 157***.

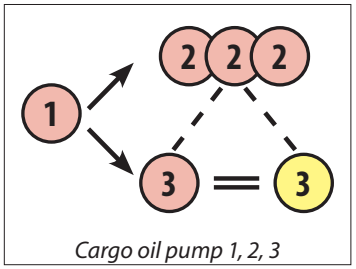
(2) Ballast pump 2 local control (use menu item **WBPT LOP** of the page **ER2**). See Chapter 4, ***the paragraph 7.7.2.2 on page 205***.

Note: The control mode selector switch on the LOP should be set to position **REMOTE** for remote operation of the Ballast pump 2, both in ERS and LCHS simulators.

(3) Ballast pump 2 remote control (use menu item **Ballast Pumps Control Panel** of the page **CCR**). See Chapter 4, ***the section 8.4.2 on page 239***..

(3) Ballast pump 2 remote control (use menu item **Ballast Pumps and Eductor Console** of the page **CCR**). See the Section 8.3 of the LCHS manual.

1.4. Cargo Pumps 1, 2, 3 (Steam Drive)



Cargo oil pump 1, 2, 3

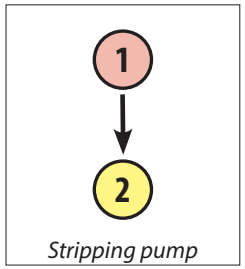
(1) The Cargo Pump 1, 2, 3 steam Turbines should be in operation. See Chapter 4, ***the section 5.3 on page 157***.

(2) The Cargo Oil Pump 1, 2, 3 (COPT 1, COPT 2, COPT 3) local control (use menu items **COPT 1 LOP**, **COPT 2 LOP**, **COPT 3 LOP** of the page **ER2**). See Chapter 4, ***the paragraph 7.7.2.1 on page 203***.

(3) Cargo pumps remote control (use menu item **Cargo Pumps Control Panel** of the page **CCR**). See Chapter 4, ***the paragraph 8.5 on page 240***.

(3) Cargo pumps remote control (use menu item **Cargo Oil Pumps Console** of the page **CCR**). See the Section 6.7 of the LCHS manual.

1.5. Stripping Pump

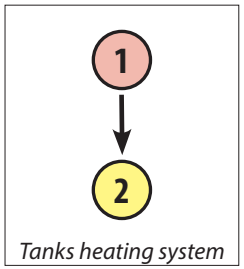


Stripping pump

(1) The steam plant should be in operation, and steam 6 bar supply should be open by **To Stripping Pump Valve** on the Boilers Feed Water and Condensate System diagram (use menu item **Boilers Feed Water & Condensate System** of the page **SYS**). See Chapter 4, ***the section 5.2 on page 155***.

(2) Stripping pump remote control (use menu item **Stripping Pump and Eductor Console** of the page **CCR**). See the Section 6.8 of the LCHS manual.

1.6. Tanks Heating

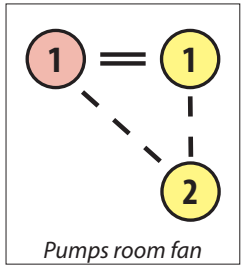


Tanks heating system

(1) The steam plant should be in operation; steam 6 bar supply **To Deck Service** is always open on the Boilers Feed Water and Condensate System diagram (use menu item **Boilers Feed Water & Condensate System** of the page **SYS**). See Chapter 4, ***the section 5.2 on page 155***.

(2) The tank heating manifolds on deck are operated on the Tank Heating diagram (use menu item **Tank Heating** of the page **SYS**). See the Section 10.2 of the LCHS manual.

1.7. Pumps Room Fan



Pumps room fan

(1) The **CARGO PUMP ROOM EXH. FAN** starter panel at MSB (use menu item **MSB No 1/2 GSP** of the page **MSB**). See Chapter 4, ***the paragraph 7.10.3.1 on page 213***.

(1) The **PUMP ROOM FAN** is operated by the button on the Pump Room diagram (use menu item **Pump Room** of the page **SYS**). See the Section 6.11 of the LCHS manual.

(2) The fan off alarm is activated on the basic alarm panel (use menu item **Basic Alarms Panel** of the page **CCR**). See the Section 18.1 of the LCHS manual.

1.8. Inert Gas Generator & Topping Up Generator

① The steam plant should be in operation; one of the Boilers should be set to run in IGS mode. See Chapter 2, ***the section 2.2 on page 76***.

See the Inert Gas system, IGG, and TUG Chapter 4, ***the section 7.3 on page 186***.

② Local control of the IG generation system valves (use menu item **Inert Gas Generation** of the page **SYS**).

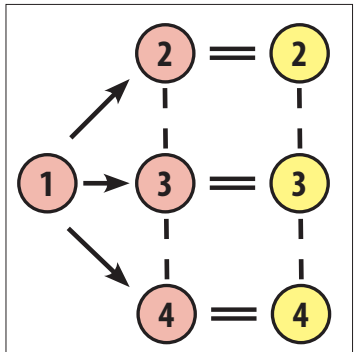
③ Remote control of the IG generation system (use menu item **Inert Gas System Control Panel** of the page **CCR**).

④ Remote control of the Topping Up Generator (use menu item **Topping Up Generator Control Panel** of the page **CCR**).

② Local control of the IG generation system valves (use menu item **Inert Gas Generation** of the page **SYS**). See the Section 11.4 of the LCHS manual.

③ Remote control of the IG generation system (use menu item **Inert Gas Generator Control Panel** of the page **CCR**). See the Section 11.2 of the LCHS manual.

④ Remote control of the Topping Up Generator (use menu item **Topping Up Generator Control Panel** of the page **CCR**). See the Section 11.3 of the LCHS manual.



Inert Gas generation system

1.9. Store Tanks

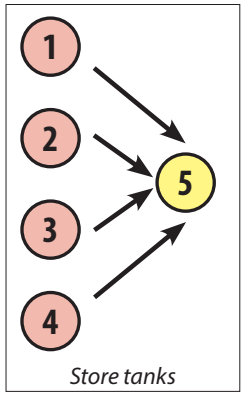
① Fuel oil storage, settling and service tanks state (use menu item **FO Filling & Transfer System** of the page **SYS**). See Chapter 4, ***the section 3.1 on page 129***.

② Lube oil storage, settling and sump tanks state (use menu item **LO Transfer & Purifying System** of the page **SYS**). See Chapter 4, ***the section 4.1 on page 145***.

③ Fresh water tanks state (use menu item **Fresh Water Service System** of the page **SYS**). See Chapter 4, ***the section 7.5 on page 196***.

④ Ballast water tanks state (use menu item **Ballast System** of the page **SYS**). See Chapter 4, ***the section 7.4 on page 194***.

⑤ LSC application **Store Tanks** window tabs (to open in Standard mode) reflect the actual state of the store tanks. See the Section 3.2 of the LCHS manual.



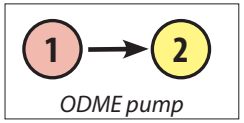
Store tanks

1.10. ODME Pump

① The **O.D.M.S. PUMP** breaker should be switched ON on the **3 PD E/R 440 V DIST.BOARD** (use menu item **PD DB 3** of the page **ER4**).

② ODME unit (use menu item **ODME System Control Unit** of the page **CCR**). See the Section 7.3 of the LCHS manual.

If the **O.D.M.S. PUMP** breaker is OFF, or power supply is OFF on ERS side, the ODME unit **SAMPLE PUMP** stops or cannot start.



ODME pump

1.11. Fire Fighting System & Fires on Deck

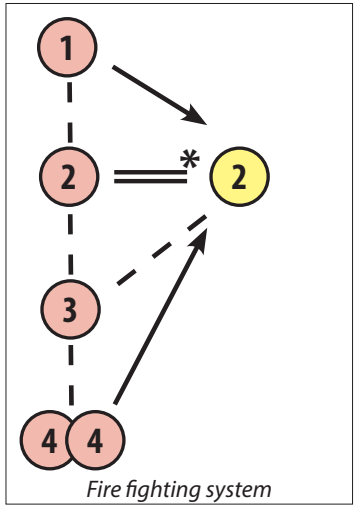
(1) Local control of Fire and Foam pumps. See Chapter 4, ***the section 6.7.4 on page 175***.

(2) Local control of the valves on the deck fire fighting system (use menu item **Local Fire & Foam Systems** of the page **SYS**). See Chapter 4, ***the section 6.7 on page 174***.

(3) Local control of the fire fighting system water supply valves (use menu item **Bilge & Fire GS System** of the page **SYS**). See Chapter 4, ***the section 7.11 on page 215***.

(4) Local control of Bilge & Fire GS pumps. See Chapter 4, ***the paragraph 7.11.4.2 on page 216***. Remote control of Bilge & Fire GS pumps from CMS. See Chapter 2, ***the paragraph 1.3.11 on page 67***.

(2) Local control of the valves on the deck fire fighting system (use menu item **Deck Wash / Fire / Foam Systems** of the page **SYS**). See the Section 15.2 of the LCHS manual. *) The identity of operation is related to the deck area diagram only.



Fire fighting system

In ERS simulator	In LCHS simulator
Instructor can introduce faults to initiate fires (refer to the Instructor manual):	
In the path *BCC->BCC C*: "Fire On Upper Deck Aft (Middle, Fore) Side"	In the path *SYS->Deck Wash Fire Foam->Deck Flames*: "Start/Stop Deck Spills Ignition"
Fire alarm is activated:	
On the bridge console **C** (use menu item **BCC C** of the page **BCC**). See Chapter 4, ***the section 6.1 on page 168***.	On the basic alarm panel (use menu item **Basic Alarms Panel** of the page **CCR**). See the Section 18.1 of the LCHS manual.

Note: Some deck spills should occur before fire is started.

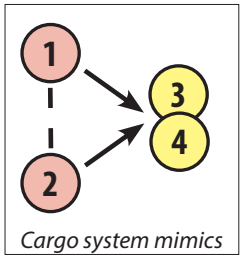
1.12. Cargo System Mimic Panels

(1) The **CARGO HANDLING SYSTEM CONTROL PANEL** breaker should be switched ON on the **EM'CY AC220V FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**),
or (2) The **CARGO HANDLING SYSTEM CONTROL PANEL** breaker should be switched ON on the **BATTERY CHARGING & DISCHARGING BOARD** (use menu item **Battery Charger & 24v DB** of the page **EmG**).

(3) Cargo system valves remote control mimic left (use menu item **Cargo System Mimic Panel (left)** of the page **CCR**). See the Section 6.2 of the LCHS manual.

(4) Cargo system valves remote control mimic right (use menu item **Cargo System Mimic Panel (right)** of the page **CCR**). See the Section 6.3 of the LCHS manual.

If both **CARGO HANDLING SYSTEM CONTROL PANEL** breakers of AC220V and 24VDC are switched OFF, or there is no power supply on ERS side, then all light indication of the valves' state on both cargo mimic panels in LCHS fails. Any one of the power sources is sufficient for the light indication on the mimic panels.



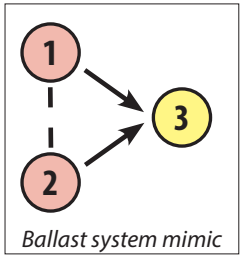
Cargo system mimics

1.13. Ballast System Mimic Panel

(1) The **BALLAST HANDLING SYSTEM CONTROL PANEL** breaker should be switched ON on the **EM'CY AC220V FEEDER PANEL** (use menu item **ESB Consumers** of the page **EmG**),
or (2) The **BALLAST HANDLING SYSTEM CONTROL PANEL** breaker should be switched ON on the **BATTERY CHARGING & DISCHARGING BOARD** (use menu item **Battery Charger & 24v DB** of the page **EmG**).

(3) Ballast system valves remote control mimic (use menu item **Ballast System Mimic Panel** of the page **CCR**). See the Section 8.2 of the LCHS manual.

If both **BALLAST HANDLING SYSTEM CONTROL PANEL** breakers of AC220V and 24VDC are switched OFF, or there is no power supply on ERS side, then all light indication of the valves' state on ballast mimic panel fails. Any one of the power sources is sufficient for the light indication on the mimic panel.



Ballast system mimic

Chapter 7. Alarms & Faults

This chapter contains the list of simulator alarms and the list of faults introduced by the instructor for training purposes.

Chapter 7. Alarms & Faults

This chapter contains:

1. Alarms and Breakdowns

The simulator alarms and breakdowns are listed in the order of the simulator pages and their displays. The alarms in similar systems (e.g. Port and Stbd, or DG1 and DG2, DG3, etc.) are combined together taking into account that the alarms are similar.

1.1. Bridge Control Console Page

1.1.1. BCC A

- SG Hydro Pump 1 (2) Overload
- SG Hydro Pump 1 (2) Phase Failure
- SG Hydro Pump 1 (2) CTRL PowerFail
- SG Hydro Pump 1 (2) Filter Diff Press High
- SG Hydro Pump 1 (2) Hydr Lock
- SG Hydro Pump 1 (2) Servo Oil Press Low
- SG Hyd Oil Temp High
- SG Failure hydr.supervision with pump 1 (2)
- SG Hydraulic failure emerg.operation with pump 1 (2)
- SG Hydro Pump 1 (2) No Volt
- SG Expansion Oil Tank 1 Level LowLow
- SG Expansion Oil Tank 1 Level LowLow
- SG Expansion Oil Tank 1 (2) Level Low
- SG abnormal
- SG Hydro Pump 1 (2) AutoStart

1.1.2. BCC B

- B.C.C. AC Main Power Fail
- B.C.C. AC EM'CY Power Fail
- B.C.C. DC Power Fail
- Bridge Main AC Source Failure
- Bridge EM'CY DC Source Failure
- Control Source Failure
- Safety Source Failure
- Telegraph Source Failure
- E.C.C. AC Main Power Fail
- Control System Abnormal
- E.C.C. AC EM'CY Power Fail
- Safety System Abnormal
- E.C.C. DC Power Fail
- Governor System Abnormal
- Sygnal Light Column Power Fail
- Imperfect Bridge Control
- CO2 System Power Fail
- ME Wrong Way
- Fire Alarm System Abnormal
- ME Repeated Start
- ME Start Failure
- ME Critical Speed
- E/R Dead Man Alarm

1.1.3. BCC C

- Fire Alarm In E/R
- General Alarm
- Fire On Deck
- CO2 Release Alarm

1.2. ECR Page

1.2.1. ECC B

- Viscosimeter Set Point Viscosity Low
- Viscosimeter Set Point Viscosity High
- Viscosimeter Set Point Temperature Low
- Viscosimeter Set Point Temperature High
- Viscosimeter System Alarm
- ME Crancase Oil Mist High
- ME Oil Mist Detector 3 Failure

1.2.2. ECC C Top Panel

- ME Shut Down Prewarning
- ME Slow Down Prewarning

1.2.3. ECC C Bottom Panel

Cylinder Lubricator Display

- Cylinder Lubrication Display Fuel Index Failure
- Cylinder Lubrication Display Feed Back Signal Failure
- Cylinder Lubricator Oil System Press. Low
- Cylinder Lubricator System BCU In Control
- Cylinder Lubricator System Abnormal
- Cyl. Oil Measuring TK Level Low

1.3. MSB Page

1.3.1. MSB No 1 GSP Section 1

- DWS PP1 ABNORM
- MAIN CSW PP1 ABNORM
- VACUUM COND CSW PP1 ABNORM
- No. 1 M/E Jacket C.F.W. Pump Abnormal
- No. 1 Main L.O. Pump Abnormal

1.3.2. No. 1 Generator Panel

- No. 1 Gen. Phase "R" Temp. High
- No. 1 Gen. Phase "S" Temp. High
- No. 1 Gen. Phase "T" Temp. High
- No. 1 Gen. Voltage Low

- No. 1 Gen. Voltage High
- No. 1 Gen. Current High
- No. 1 Gen. Power High
- No. 1 Gen. Frequency Low
- No. 1 Gen. Frequency High
- No. 1 Gen. ACB Overcurrent Trip
- No. 1 Gen. ACB Reverse Power Trip
- No. 1 Gen. ACB Short Circuit Trip

1.3.3. MSB No 1 GSP Section 2

- No. 1 Low Temp. C.F.W. Pump Abnormal

1.3.4. No. 2 Generator Panel

Alarms are similar to alarms for No. 1 Generator Panel (see ***the paragraph 1.3.2 on page 261***).

1.3.5. MSB No 2 GSP Section 1

- VACUUM COND CSW PP2 ABNORM
- CARGO PUMP ROOM EXH.FAN Abnormal
- No. 2 Low Temp. C.F.W. Pump Abnormal

1.3.6. Shaft Generator Panel

- Shaft Gen. Phase “R” Temp. High
- Shaft Gen. Phase “S” Temp. High
- Shaft Gen. Phase “T” Temp. High
- Shaft Gen. Voltage Low
- Shaft Gen. Voltage High
- Shaft Gen. Current High
- Shaft Gen. Power High
- Shaft Gen. Frequency Low
- Shaft Gen. Frequency High
- Shaft Gen. ACB Overcurrent Trip
- Shaft Gen. ACB Reverse Power Trip
- Shaft Gen. ACB Short Circuit Trip

1.3.7. MSB No 2 GSP Section 2

- DWS PP2 ABNORM
- MAIN CSW PP2 ABNORM
- L.O. Transfer Pump Abnormal
- No. 2 M/E Jacket C.F.W. Pump Abnormal
- No. 2 Main L.O. Pump Abnormal

1.3.8. Turbo. Generator Panel

- Turbo. Gen. Phase “R” Temp. High
- Turbo. Gen. Phase “S” Temp. High
- Turbo. Gen. Phase “T” Temp. High
- Turbo. Gen. Voltage Low
- Turbo. Gen. Voltage High
- Turbo. Gen. Current High
- Turbo. Gen. Power High
- Turbo. Gen. Frequency Low
- Turbo. Gen. Frequency High
- Turbo. Gen. ACB Overcurrent Trip
- Turbo. Gen. ACB Reverse Power Trip
- Turbo. Gen. ACB Short Circuit Trip

1.3.9. Synchro Panel

- Bus Short Circuit
- Pref. Trip
- No. 1 G/E Start Fail
- No. 1 G/E Shut Down
- No. 2 G/E Start Fail
- No. 2 G/E Shut Down
- MSB 24V Source Fail
- ESB 24VDC Source Fail
- MSB Pref Trip Source Fail
- Auto Sync. Failure

MSB Abnormal

- MSB 440V Voltage Low
- MSB 440V Voltage High
- MSB 440V Freqency Low
- MSB 440V Freqency High

MSB Abnormal

- Gen ACB Non Closed
- No. 1 (No. 2) Gen. ACB Non Closed
- Shaft Gen. ACB Non Closed
- Turbo. Gen. ACB Non Closed
- Gen ACB Non Closed

Gen ACB Abnormal Trip

- No. 1 (No. 2) Gen. ACB Abnormal Trip
- Shaft Gen. ACB Abnormal Trip
- Turbo. Gen. ACB Abnormal Trip
- ACB_DG_Emcy.Trip
- Gen. ACB Abnormal Trip

1.3.10. No 1 Feeder Panel

- MSB 440V Insulation Resistance Low

1.3.11. AC220V Feeder Panel

- MSB 220V Insulation Resistance Low

1.4. Control Monitoring System Page

- MAIN CSW INLET PRESS LOW
- MAIN CSW PP STBY ST

- DWS PP STBY ST
- VACUUM COND CSW PP STBY ST

1.4.1. Exhaust Gas CMS

- ME SA Cyl1~Cyl6 OutletTemperature Low/High
- ME Exhaust Gas Cyl1~Cyl6 Temperature High
- ME Scavenge Air Manifold Temperature High
- ME T/C Exhaust Gas Outlet Temperature High
- ME Exhaus Gas Cyl1~Cyl6 Temperature Deviation High
- Catcher system clogged

1.4.2. Main Engine Overview CMS

- ME PCO Outlet Temperature Cyl.1~Cyl.6 High
- ME Jacket CFW Outlet Temperature Cyl.1~Cyl.6 High
- ME Control Air Pressure Low
- ME Exh. V-v spring Air P Low
- ME Auto Slow Down
- ME Auto Shut Down
- ME Over Speed Trip
- ME Safety Air Pressure Low
- ME Auto Slow Down TC LO Pressure Low
- ME Auto Slow Down Cam. Shaft Bearing High Temp
- ME Auto Slow Down Jacket CFW Pressure Low
- ME Auto Slow Down Jacket CFW Temp High
- ME Auto Slow Down Scav.Air HT
- ME Auto Slow Down LO Pressure Low
- ME Auto Slow Down Oil Mist High
- ME Auto Slow Down Thtust Pad Temp High
- ME Auto Slow Down Piston C.O. Temp High
- ME Auto Slow Down Cyl. LO Non Flow
- ME Auto Slow Down PCO Non Flow
- ME Auto Slow Down Exh. Gas Temp High
- ME Auto Slow Down Exh. Gas Temp Dev. High
- ME Auto Slow Down PCO Inlet Pressure Low
- ME Auto Slow Down Exh. V/V Spring Air Pressure Low

1.5. BMCS Page

- Boiler MGO Pump Stby Start
- Boiler Fuel Pump Stby Start
- Boilers Feed Pump Stby Start
- Boilers Circ Pump Stby Start

1.5.1. AlarmList

- Boilers System Abnormal
- Boiler MGO Pump Stby Start
- Boiler Fuel Pump Stby Start
- Boilers Feed Pump Stby Start
- Boilers Circ Pump Stby Start
- Boilers Fuel Oil Pressure
- Boiler 1 (2) Water Salinity
- Boiler 1 (2) Water Salinity Shutdown
- Boiler 1 (2) Steam Pressure
- Boiler 1 (2) Steam Pressure
- Boiler 1 (2) Steam Pressure High Shutdown
- Boiler 1 (2) Water Level
- Boiler 1 (2) Water Level
- Boiler 1 (2) Water Level Low Shutdown
- Boiler 1 (2) Water Level High Shutdown
- Boiler 1 (2) Common Shutdown
- Boiler 1 (2) Atomising Pressure
- Boiler 1 (2) Atomising Pressure Low Shutdown
- Boiler 1 (2) Fuel Oil Temperature
- Boiler 1 (2) Fuel Oil Temperature
- Boiler 1 (2) Fuel Temperature High Shutdown
- Boiler 1 (2) Fuel Temperature Low Shutdown
- Boiler 1 (2) Flame Out
- Boiler 1 (2) Exh. Gas Outlet Temperature
- Boiler 1 (2) Fuel Oil Pressure Low Shutdown

1.5.2. EventList

- Boilers System Abnormal
- Boiler MGO Pump Stby Start
- Boiler Fuel Pump Stby Start
- Boilers Feed Pump Stby Start
- Boilers Circ Pump Stby Start
- Boilers Fuel Oil Pressure
- Boiler 1 (2) Water Salinity
- Boiler 1 (2) Water Salinity Shutdown
- Boiler 1 (2) Steam Pressure
- Boiler 1 (2) Steam Pressure
- Boiler 1 (2) Steam Pressure High Shutdown
- Boiler 1 (2) Water Level
- Boiler 1 (2) Water Level
- Boiler 1 (2) Water Level Low Shutdown
- Boiler 1 (2) Water Level High Shutdown
- Boiler 1 (2) Common Shutdown
- Boiler 1 (2) Atomising Pressure
- Boiler 1 (2) Atomising Pressure Low Shutdown
- Boiler 1 (2) Fuel Oil Temperature
- Boiler 1 (2) Fuel Oil Temperature
- Boiler 1 (2) Fuel Temperature High Shutdown
- Boiler 1 (2) Fuel Temperature Low Shutdown

- Boiler 1 (2) Flame Out
- Boiler 1 (2) Exh. Gas Outlet Temperature
- Boiler 1 (2) Fuel Oil Pressure Low Shutdown

1.5.3. Boiler 1

- Boiler 1 Water Salinity
- Boiler 1 Water Salinity Shutdown
- Boiler 1 Steam Pressure
- Boiler 1 Steam Pressure High Shutdown
- Boiler 1 Water Level
- Boiler 1 Water Level Low Shutdown
- Boiler 1 Water Level High Shutdown
- Boiler 1 Common Shutdown
- Boiler 1 Atomising Pressure
- Boiler 1 Atomising Pressure Low Shutdown
- Boiler 1 Fuel Oil Temperature
- Boiler 1 Fuel Temperature High Shutdown
- Boiler 1 Fuel Temperature Low Shutdown
- Boiler 1 Flame Out
- Boiler 1 Exh. Gas Outlet Temperature
- Boiler 1 Fuel Oil Pressure Low Shutdown

1.5.4. Boiler 2

Alarms generated for Boiler 2 are similar to alarms for Boiler 1.

1.6. SYS Page

1.6.1. Compressed Air System

- №1 (№2) Main Air Reservoir Pressure Low
- Control Air Reservoir Pressure Low
- EMCY Shut-Off Air Reservoir Pressure Low
- Air Dryer 1 (2) Abnormal

1.6.2. Bilge and Fire GS System

- FWD STBD Blige Tank Alarm HighLevel
- TankTop Alarm HighLevel
- M/E SunkenPart Tank Alarm High Level
- Separated Blige Oil Tank Alarm HighLevel
- BligeHold Tank Alarm HighLevel
- AFT Blige Tank Alarm HighLevel
- EMCY Fire Tank Alarm HighLevel
- SG Room Tank Alarm HighLevel
- FWD PORT Blige Tank Alarm HighLevel

1.6.3. LO Stern Tube System

- Stern Tube Grav. TK Level Low
- Stern Tube AFT TK Level Low
- Stern Tube Drain TK Level High
- Stern Tube AFT Bearing Temperature High
- Inter Shaft Bearing Temperature High
- Stern Tube Stand By Pump Auto Start

1.6.4. FO Incinerator and EGE Service System

- EM'CY G/E M.G.O. TK Level Low

1.6.5. FO Filling and Transfer System

- №1 HFO Storage TK (P) Level LowHigh
- №2 HFO Storage TK (P) Level LowHigh
- №1 L.S. HFO Storage TK (S) Level LowHigh
- №2 L.S. HFO Storage TK (S) Level LowHigh
- FO Overflow TK Level High
- FO Drain TK Level High
- MDO Storage TK Level LowHigh
- L.S.MDO (MGO)Storage TK Level LowHigh
- MDO Service TK Level Low
- L.S. HFO Service TK Level Low
- HFO Service TK Level Low
- HFO Settling TK Level LowHigh
- HFO Service TK Temp High
- LSHFO Service TK Temp High
- HFO Settling TK Temp High
- MDO Transfer Pump Abnormal
- HFO Transfer Pump Abnormal

1.6.6. FO ME, GE Service System

- FO Viscosity High
- FO Viscosity Low
- FO Auto Filter Pressure Drop Indicator High
- GE 1 (2) FO Filter Pressure Drop High
- ME & G/E F.O. Circ. Pump St-by Started
- ME & G/E F.O. Supp. Pump St-by Started
- No.1 (No.2) STERN TUBE L.O. PUMP Abnormal
- No.1 (No.2) ME & GE F.O. SUP. PUMP Abnormal
- No.1 (No.2) ME & GE F.O. CIRC. PUMP Abnormal
- GE 1 (2) FO Leakage

1.6.7. LO ME Service System

- Cam Shaft Bearing Temperature High
- Scav. Air Drain TK Level High
- Cyl. Oil Storage TK Level Low
- M/E L.O. By-Pass Filter Press. Drop High
- M/E L.O. Automatic Filter Press. Drop High
- ME Main Bearings 1 ~ 7 Temperature High
- ME LO Inlet Temperature High
- Thrust Pad Temperature High

- ME TC Oil Pressure Low
- Main LO Pumps Stby Start
- Cam Shaft Bearing Temperature High
- ME PCO 2 ~ PCO 6 Non Flow
- Cyl. Oil Measuring TK Level Low

1.6.8. Sewage Treatment System

- STP Holding TK Level High
- STP Desinfection TK Level High

1.6.9. LO Steam Turbines System

- LO TGST Cooler Outlet Temp High
- LO WBPT Cooler Outlet Temp High
- LO COPT1 (COPT2, COPT3) Cooler Outlet Temp High
- TGST LO Sump Tank Temp High
- TGST LO Sump TK Level High
- TGST LO Sump TK Level Low
- TGST LO Filter Diff Pressure High
- WBPT LO Sump Tank Temp High
- WBPT LO Sump TK Level Low
- WBPT LO Sump TK Level High
- WBPT LO Filter Diff Pressure High
- COPT1 (COPT2, COPT3) LO Sump Tank Temp High
- COPT1 (COPT2, COPT3) LO Sump TK Level High
- COPT1 (COPT2, COPT3) LO Sump TK Level Low
- COPT1 (COPT2, COPT3) LO Filter Diff Pressure High
- Turbines LO Storage TK Level High
- Turbines LO Storage TK Level Low

1.6.10. FO Purifiers System

- Purifiers Sludge TK Level High

1.6.11. LO Transfer and Purifying System

- G/E L.O. Stor. TK Level High
- G/E L.O. Sett. TK Level High
- No. 1 (No.2) G/E L.O. Sump. TK Level High
- No. 1 (No.2) G/E L.O. Sump. TK Level Low
- Main L.O. Stor. TK Level High
- Main L.O. Sett. TK Level High
- Main L.O. Sump. TK Level Low

1.6.12. HT Cooling System

- M/E J.C.F.W. Inlet Temp. Low
- Cooling F.W. Expansion TK Level Low
- M/E J.C.F.W. PP STBY ST
- M/E C.F.W. Air Detection
- M/E H.T. C.F.W. Oil Detection

1.6.13. LT Cooling System

- M/E Charge Air Cooler Inlet Press. Low
- M/E Charge Air Cooler Inlet Temp, High
- Low Temp. C.F.W. Pumps Auto Start

1.6.14. GE Cooling System

- No. 1 (No. 2) G/E H.T. Water Inlet Press. Low

1.6.15. Boilers Feed Water & Condensate Systems

- Exh. Gas Economizer Outlet Temperature
- Cascade Tank Level
- No.1 (No.2) CONDENSATE WATER PUMP Abnormal
- Oil In Observation Tank

1.6.16. FWG System

- FW Generator Abnormal
- FW Generator Salinity High

1.7. ER1 Page

1.7.1. ME Local panel

- Main Engine LO Inlet Pressure Low
- Main Engine PCO Inlet Pressure Low
- ME Start Air Pressure Low
- Main Engine JCW Inlet Pressure Low

1.7.2. OWS LOP

- Seporator OCM High Oil Content 1
- Seporator OCM High Oil Content 2

1.7.3. MGPS

- M.G.P.S. Abnormal

1.8. ER2 Page

1.8.1. COPT 1 LOP

- COPT1 Lower Bearing Temperature High
- COPT1 Upper Bearing Temperature High
- COPT1 BulkHead Temperature High
- COPT1 Pump Outlet Pressure High
- COPT1 Casing Temperature High
- COPT1 Remote Emergency Stop
- COPT1 EMCY Trip
- COPT1 EMCY Trip Overspeed
- COPT1 EMCY Trip Pump Discharge Pressure High
- COPT1 EMCY Trip Excess Back Pressure
- COPT1 EMCY Trip Rotor Axial Move
- COPT1 EMCY Trip Vibration High
- COPT1 EMCY Trip LO Pressure Low

- COPT1 EMCY Trip Bulkhead Stuff.Box Temp High
- COPT1 EMCY Trip Pump Upper Bearing Temp. High
- COPT1 EMCY Trip Pump Casing Temp. High
- COPT1 EMCY Trip Pump Lower Bearing Temp. High
- COPT1 EMCY Stop

1.8.2. COPT 2 LOP

Alarms are similar to COPT1 LOP alarms.

1.8.3. COPT 3 LOP

Alarms are similar to COPT1 LOP alarms.

1.8.4. WBPT LOP

- WBPT BulkHead Temperature High
- WBPT Upper Bearing Temperature High
- WBPT Lower Bearing Temperature High
- WBPT Casing Temperature High
- WBPT Emergency Stop
- WBPT Remote Emergency Stop
- WBPT EMCY Trip Overspeed
- WBPT EMCY Trip Excess Back Pressure
- WBPT EMCY Trip Rotor Axial Move
- WBPT EMCY Trip LO Low Pressure
- WBPT EMCY Trip Bulkhead Stuff.Box Temp High
- WBPT EMCY Trip Pump Upper Bearing Temp. High
- WBPT EMCY Trip Pump Casing Temp. High
- WBPT EMCY Trip Pump Lower Bearing Temp. High
- WBPT EMCY Trip

1.9. ER3 Page

1.9.1. ER Fan LOP

- No.1~No.4 E/R VENT.FAN Abnormal

1.9.2. DE 1-2 LOP

- No. 1 (No. 2) G/E HT CFW Inlet Press. Low
- No. 1 (No. 2) G/E L.O. Inlet Temp. High
- No. 1 (No. 2) G/E L.O. Press. Low
- No. 1 (No. 2) G/E F.O. Boost Press. Low
- No. 1 (No. 2) G/E H.T. C.F.W. Outlet Temp. High
- No. 1 (No. 2) G/E Starting Air Press. Low
- No. 1 G/E No. 1~No. 6 Cyl. Exhaust Gas Temp. High
- No. 2 G/E No. 1~No. 6 Cyl. Exhaust Gas Temp. High
- No. 1 (No. 2) G/E L.O. Filter Pressure Drop High
- No. 1 (No. 2) G/E Priming L.O. Pump Failure
- No. 1 (No. 2) G/E Pre. L.O. Press. Low

1.9.3. GE 1-2 Control Panel

- No. 1 (No. 2) G/E Control Power Fail
- No. 1 (No. 2) G/E Trip System Fail

1.9.4. HFO Purifiers LOP

- No. 1 (No. 2) H.F.O. Purifier Inlet Temp. Abnormal

HFO Purifiers 1 Alarms

- No. 1 H.F.O. Purifier Leakage
- No. 1 H.F.O. Purifier No-Dis
- No. 1 H.F.O. Purifier Inlet Temp. Low
- No. 1 H.F.O. Purifier Inlet Temp. High
- No.1 H.F.O. Purifier Back Press. Low
- HFO Purifiers 1 Alarms Group Alarm

HFO Purifiers 2 Alarms

Alarms are similar to HFO Purifier 1 alarms (see above).

1.9.5. LOP Aux blower

- Blower 1 (2) Overload
- Blower 1 (2) Failure

1.9.6. Turbogenerator LOP

- TG Steam Turbine Inlet Pressure High
- TG Steam Turbine Inlet Pressure Low
- TG Steam Turbine InletTemperature Low
- TG Steam Turbine InletTemperature High
- TG Bearings Temperature High
- TG Turn Gear Engage
- TG Steam Turbine RPM High
- TG LO Pressure Low
- TG Control Oil Pressure Low
- TG Sealing Steam Pressure Low
- TG Steam Turbine Vibration High
- TG EMCY Trip
- TG Rotor Displacement High
- TG Trip Condenser Vacuum Low Low
- TG Trip LO Pressure Low Low
- TG Trip LO Temp High High
- TG Trip Vibration High High
- TG Trip Rotor Displacement High High
- TG Trip Gen. Stator Temp High High
- TG Trip Overspeed
- TG Trip Condenser Level High

1.9.7. LO Purifiers LOP

- No. 1 (No. 2) L.O. Purifier Inlet Temp. Abnormal

LO Purifiers 1 Alarms

- No. 1 L.O. Purifier Leakage
- No. 1 L.O. Purifier No-Dis
- No. 1 L.O. Purifier Inlet Temp. Low
- No. 1 L.O. Purifier Inlet Temp. High
- No. 1 L.O. Purifier Back Press. Low
- LO Purifiers 1 Alarms Group Alarm

LO Purifiers 2 Alarms

Alarms are similar to LO Purifier 1 alarms (see above).

1.9.8. FW Calorifier LOP

- FW Calorifier High Temp
- FW Calorifier Trip
- FW Calorifier Abnormal

1.10. ER4 Page

1.10.1. Valves Remote Control HPU LOP

- Alarm HPU Tank High Oil Pressure
- Alarm HPU Tank High Oil Temp
- Alarm HPU Tank LowLow Level
- Alarm HPU Tank Low Oil Level
- Alarm HPU Tank Low Oil Pressure
- HPU 1 (2) Motor Trip

1.10.2. Provision Cooling Plant

- PC Compressor 1 (2) EMCY Trip Master Solenoid Closed
- PC Compressor 1 (2) EMCY Trip Pressure Out High
- PC Compressor 1 (2) EMCY Trip Temp Out High
- PC Compressor 1 (2) EMCY Trip SW Pressure Low
- PC Compressor 1 (2) EMCY Trip Oil Pressure Low
- PC Compressor 1 (2) EMCY Trip Oil Level Low
- PC Compressor 1 (2) EMCY Trip OverCurrent
- Cold Room “Fish” Temp. High
- Cold Room “Meat” Temp. High
- Cool Room “Butter” Temp. High
- Cool Room “Fruit” Temp. High
- Cool Room “Vegetable” Temp. High
- Cool Room “Dry Provision” Temp. High

1.10.3. GSP 5

- №1 (№2) Main Air Compressor Oil Level Low
- Control Air Compressor Oil Level Low

№1 (№2) Main Air Compressor

- №1 (№2) Main Air Compressor Outlet Temp High
- №1 (№2) Main Air Compressor Lube Oil Pressure Low
- №1 (№2) Main Air Compressor Over Current Trip
- №1 (№2) Main Air Compressor Group Alarm

Control Air Compressor

- Control Air Compressor Outlet Temp High
- Control Air Compressor Lube Oil Pressure Low
- Control Air Compressor Over Current Trip
- Control Air Compressor Group Alarm

1.10.4. AC Control Panel

- AC1 (AC2) Compressor Shut Down

1.10.5. Incinerator LOP

- Incinerator W.O. Service TK Level High
- Incinerator W.O. Service TK Level Low
- Incinerator Flame Out
- Incinerator W.O. Service TK Temp. High
- Incinerator Fan Failure
- Incinerator W.O. Service TK Temp. Low
- Incinerator Burner Failure
- Incinerator W.O. Settling TK Level High
- Incinerator Shut Down
- Incinerator W.O. Settling TK Level Low
- Incinerator Furnace Temp. High
- Incinerator W.O. Settling TK Temp. High
- Incinerator Furnace Temp. Low
- Incinerator W.O. Settling TK Temp. Low
- Incinerator Exhaust Gas Temp. High
- Incinerator Motor Overload Alarm
- Incinerator W.O. TK Temp Low
- Incinerator Abnormal
- Incinerator W.O. TK Level Abnormal

1.11. FFR Page

1.11.1. Local FF Main Panel

- Local Fire Fighting System Press. Low
- Local Fire Fighting System Fire Signal
- Local Fire Fighting System In Manual Control Mode
- Local Fire Fighting System Mist Detection
- Local Fire Fighting System Main Engine Space Release
- Local Fire Fighting System Main Engine Space Abnormal
- Local Fire Fighting System No. 1, 2 G/E Space Release
- Local Fire Fighting System No. 1, 2 G/E Space Abnormal
- Local Fire Fighting System Turbo. Gen. Space Release
- Local Fire Fighting System Turbo. Gen. Space Abnormal

- Local Fire Fighting System Aux Boiler Space Release
- Local Fire Fighting System Aux Boiler Space Space Abnormal
- Local Fire Fighting System H.F.O. Purifiers Space Release
- Local Fire Fighting System H.F.O. Purifiers Space Abnormal
- Local Fire Fighting System Incinerator Space Release
- Local Fire Fighting System Incinerator Space Abnormal
- Local Fire Fighting System Pump In Manual Control Mode
- Local Fire Fighting System Pump Power Fail
- Local Fire Fighting System Pump Overlod

1.12. EmG Page

1.12.1. ESB Consumers

- Battery Charger and Discharger Insulation Resistance Low

1.12.2. AC440V EM'CY Feeder Panel

- ESB 440V Insulation Resistance Low

ESB Abnormal

- ESB 440V Voltage Low
- ESB 440V Voltage High
- ESB 440V Freqency Low
- ESB 440V Freqency High
- ESB Abnormal

AC220V EM'CY Feeder Panel

- ESB 220V Insulation Resistance Low

1.12.3. EM'CY Generator Panel

- EM'CY Gen. Voltage Low
- EM'CY Gen. Voltage High
- EM'CY Gen. Power High
- EM'CY Gen. Current High
- EM'CY Gen. Frequency Low
- EM'CY Gen. Frequency High
- EM'CY Gen. ACB Short Cirquit Trip
- EM'CY Gen. ACB Overcurrent Trip
- Emergency Generator Abnormal

1.12.4. Shore Connection Panel

- Shore Supply Current High

1.12.5. Battery Charger and Discharger Board

- Battery Charger Load Voltage Low
- Battery Charger Load Voltage High
- BCD Board 24 V DC Main Power Fail
- Battery Charger and Discharger Board Abnormal

1.12.6. EM'CY Gen LOP

- EM'CY G/E LO Press. Low
- EM'CY G/E FW Temp. High
- EM'CY G/E LO Temp. High
- EM'CY G/E Shutdown

1.12.7. EM'CY G/E Set Battery Charger

- EM'CY G/E Set Battery Charger Main Power Fail
- PowerManagement.EmBattary_Voltage_LowAlarm
- EM'CY G/E Set Battery Charger Abnormal

1.13. CCR Page

1.13.1. Topping Up Generator Control Panel

- T.U.G. Control Power Failure
- O2 Content Abnormal
- TUG Flame Failure
- TUG SW Main Press Low
- TUG FO Inlet Press Low
- TUG Drain Level High
- TUG Combustion Air Pressure Low
- TUG Combustion Air Pressure High
- TUG Instrument Air Pressure Low

1.13.2. Inert Gas System Control Panel

- Main I.G.S. Sea Water Pump Press. Low
- I.G. Temp, High
- O2 Content Abnormal
- Deck Press. Main Line Low
- Deck Press. Main Line High
- Deck Press. Secondary Line Low
- Deck Press. Secondary Line High
- I.G. Scrubber Temp High
- I.G. Blower No. 1 (No. 2) Failure
- Deck Seal Water Flow Low
- Deck Seal Water Level Low
- Deck Seal Water Level High
- Deck Press. Main Line Ext. Low
- Deck Press. Secondary Line Ext. Low
- I.G.S. Control Power Failure
- I.G.S. Scrubber Level High

2. Faults Introduced by Instructor

2.1. General

Instructor can introduce faults into trainees' exercises using the **`e-Tutor Performance monitor`** application or **Faults** plugin of the **`Instructor`** application.

In this section possible faults are described for Product Tanker simulator according to respective simulator pages and their displays.

Instructor manual provides detailed information on working with the **Faults** plugin of Instructor application. **e-Tutor** manual provides detailed information on working with the application.

The following description is a brief summary of steps to take for introducing a fault provided that an exercise is selected and assigned to a trainee.

1. Open (start it in the **`Router`**) **`Performance monitor`** application window. **Trainee monitor** tab displays the Trainee status:
2. Create a trainee group with selected Trainee. If the group with the selected Trainee exists, step 1 can be omitted.

   Note! The task e-Tutor Model should be started in the `Router` application.
3. In **`Instructor`** application open the **Faults** plugin in a Desktop window. The **Faults Control** window opens up
4. Click the **Add** button. The window **Select parameter** opens up. The tree root of all simulator faults is displayed in the left column.
5. Navigate the tree and select required fault. Click **OK**.
6. Edit faults' start/end time; enable/disable faults, etc.
7. Use **Force** button to activate a fault immediately.

2.2. Bridge Control Console Page

2.2.1. BCC A

- SG Hydro Pump 1 (2) Control Power Fault
- SG Hydro Pump 1 (2) Motor Phase Failure
- SG Hydro Pump 1 (2) Motor Overload
- SG Hydro Pump 1 (2) Hydr Lock
- SG Hydro Pump 1 (2) Air Cooler Fouling
- SG Remote Control Failure
- SG Auto Pilot Failure

2.2.2. BCC B

- Control Source Failure
- Safety Source Failure
- Telegraph Source Failure

2.2.3. BCC C

- Fire Near Main Engine
- Fire Near G/E No. 1/2
- Fire Near Turbo Generator
- Fire Near Incinerator
- Fire Near Aux Boilers
- Fire Near Purifiers
- Fire On Upper Deck Aft Side
- Fire On Upper Deck Midle Side
- Fire On Upper Deck Fore Side
- Fire Near EM'CY Generator
- Fire Near C.O.P.T.

2.3. ECR Page

2.3.1. ECC B

- Sticking of Viscosity Regulator Steam Valve
- Viscosity Regulator Failure
- ME Oil Mist Detector 3 Failure

2.3.2. ECC C Top Panel

- CENTRAL PROCESSOR UNIT (CPU) MALFUNCTION
- 15 V SOURCE LOST
- TELEGRAPH CONNECTION LOST

2.3.3. ECC C Bottom Panel

- Cylinder Lubrication Display Feedback Signal Failure
- Cylinder Lubrication Display Fuel Index Signal Failure

2.4. MSB Page

2.4.1. MSB No 1 GSP Section 1

- No. 1 Boiler Water Circ. Pump Short Circuit
- No. 1 Boiler Water Circ. Pump Over Current
- No. 1 Boiler Water Circ. Pump Low Insulation
- No. 1 Deck Water Seal Pump Short Circuit
- No. 1 Deck Water Seal Pump Over Current
- No. 1 Deck Water Seal Pump Low Insulation
- No. 1 Condensate Water Pump Short Circuit
- No. 1 Condensate Water Pump Over Current
- No. 1 Condensate Water Pump Low Insulation
- No. 1 M/E Jacket C.F.W. Pump Short Circuit
- No. 1 M/E Jacket C.F.W. Pump Over Current
- No. 1 M/E Jacket C.F.W. Pump Low Insulation

- No. 1 E/R Vent. Fan Short Circuit
- No. 1 E/R Vent. Fan Over Current
- No. 1 E/R Vent. Fan Low Insulation
- No. 1 Bilge, Fire and G/S Pump Short Circuit
- No. 1 Bilge, Fire and G/S Pump Over Current
- No. 1 Bilge, Fire and G/S Pump Low Insulation
- No. 1 Main C.S.W. Pump Short Circuit
- No. 1 Main C.S.W. Pump Over Current
- No. 1 Main C.S.W. Pump Low Insulation
- No. 1 Vacuum Cond. C.S.W. Pump Short Circuit
- No. 1 Vacuum Cond. C.S.W. Pump Over Current
- No. 1 Vacuum Cond. C.S.W. Pump Low Insulation
- No. 1 Stern Tube L.O. Pump Short Circuit
- No. 1 Stern Tube L.O. Pump Over Current
- No. 1 Stern Tube L.O. Pump Low Insulation
- No. 1 Main L.O. Pump Short Circuit
- No. 1 Main L.O. Pump Over Current
- No. 1 Main L.O. Pump Low Insulation

2.4.2. No. 1 Generator Panel

- No. 1 Gen. ACB Spring Charge Motor Failure
- No. 1 Gen. AVR Failure
- No. 1 Gen. Air Filter Clogged

2.4.3. MSB No 1 GSP Section 2

- No. 1 Low Temp. C.F.W. Pump Low Insulation
- No. 1 Low Temp. C.F.W. Pump Short Circuit
- No. 1 Low Temp. C.F.W. Pump Over Current
- No. 1 Aux Boiler Feed Water Pump Low Insulation
- No. 1 Aux Boiler Feed Water Pump Short Circuit
- No. 1 Aux Boiler Feed Water Pump Over Current
- No. 3 E/R Vent. Fan Low Insulation
- No. 3 E/R Vent. Fan Short Circuit
- No. 3 E/R Vent. Fan Over Current
- No. 1 M/E and G/E F.O. Supply Pump Low Insulation
- No. 1 M/E and G/E F.O. Supply Pump Short Circuit
- No. 1 M/E and G/E F.O. Supply Pump Over Current
- No. 1 M/E and G/E F.O. Circ. Pump Low Insulation
- No. 1 M/E and G/E F.O. Circ. Pump Short Circuit
- No. 1 M/E and G/E F.O. Circ. Pump Over Current
- Cargo Pump Room Exh. Fan Low Insulation
- Cargo Pump Room Exh. Fan Short Circuit
- Cargo Pump Room Exh. Fan Over Current
- H.F.O. Transfer Pump Low Insulation
- H.F.O. Transfer Pump Short Circuit
- H.F.O. Transfer Pump Over Current
- M.D.O. Transfer Pump Low Insulation
- M.D.O. Transfer Pump Short Circuit
- M.D.O. Transfer Pump Over Current

2.4.4. No. 2 Generator Panel

- No. 2 Gen. ACB Spring Charge Motor Failure
- No. 2 Gen. AVR Failure
- No. 2 Gen. Air Filter Clogged

2.4.5. MSB No 2 GSP Section 1

- No. 2 Vacuum Cond. C.S.W. Pump Short Circuit
- No. 2 Vacuum Cond. C.S.W. Pump Over Current
- No. 2 Vacuum Cond. C.S.W. Pump Low Insulation
- No. 2 M/E and G/E F.O. Circ. Pump Short Circuit
- No. 2 M/E and G/E F.O. Circ. Pump Over Current
- No. 2 M/E and G/E F.O. Circ. Pump Low Insulation
- No. 2 M/E and G/E F.O. Supply Pump Short Circuit
- No. 2 M/E and G/E F.O. Supply Pump Over Current
- No. 2 M/E and G/E F.O. Supply Pump Low Insulation
- No. 2 Stern Tube L.O. Pump Short Circuit
- No. 2 Stern Tube L.O. Pump Over Current
- No. 2 Stern Tube L.O. Pump Low Insulation
- No. 3 Aux Boiler Feed Water Pump Short Circuit
- No. 3 Aux Boiler Feed Water Pump Over Current
- No. 3 Aux Boiler Feed Water Pump Low Insulation
- No. 2 Aux Boiler Feed Water Pump Short Circuit
- No. 2 Aux Boiler Feed Water Pump Over Current
- No. 2 Aux Boiler Feed Water Pump Low Insulation
- No. 2 Low Temp. C.F.W. Pump Short Circuit
- No. 2 Low Temp. C.F.W. Pump Over Current
- No. 2 Low Temp. C.F.W. Pump Low Insulation

2.4.6. Shaft Generator Panel

- Shaft Gen. ACB Spring Charge Motor Failure
- Shaft Gen. AVR Failure
- Shaft Gen. Air Filter Clogged

2.4.7. MSB No 2 GSP Section 2

- No. 2 Condensate Water Pump Short Circuit
- No. 2 Condensate Water Pump Over Current
- No. 2 Condensate Water Pump Low Insulation
- No. 2 Deck Water Seal Pump Short Circuit
- No. 2 Deck Water Seal Pump Over Current
- No. 2 Deck Water Seal Pump Low Insulation
- No. 2 Boiler Water Circ. Pump Short Circuit
- No. 2 Boiler Water Circ. Pump Over Current
- No. 2 Boiler Water Circ. Pump Low Insulation

- No. 2 Bilge, Fire and G/S Pump Short Circuit
- No. 2 Bilge, Fire and G/S Pump Over Current
- No. 2 Bilge, Fire and G/S Pump Low Insulation
- No. 2 E/R Vent. Fan Short Circuit
- No. 2 E/R Vent. Fan Over Current
- No. 2 E/R Vent. Fan Low Insulation
- No. 2 M/E Jacket C.F.W. Pump Short Circuit
- No. 2 M/E Jacket C.F.W. Pump Over Current
- No. 2 M/E Jacket C.F.W. Pump Low Insulation
- L.O. Transfer Pump Short Circuit
- L.O. Transfer Pump Over Current
- L.O. Transfer Pump Low Insulation
- No. 2 Main C.S.W. Pump Short Circuit
- No. 2 Main C.S.W. Pump Over Current
- No. 2 Main C.S.W. Pump Low Insulation
- No. 2 Main L.O. Pump Short Circuit
- No. 2 Main L.O. Pump Over Current
- No. 2 Main L.O. Pump Low Insulation

2.4.8. Turbo. Generator Panel

- Turbo. Gen. ACB Spring Charge Motor Failure
- Turbo. Gen. AVR Failure
- Turba Gen. Air Filter Clogged

2.4.9. Bus Tie Panel

- Bus Tie ACB Spring Charge Motor Failure

2.4.10. Synchro Panel

- MSB Side Bus Tie ACB Spring Charge Motor Failure
- MSB Pref. Trip Source Failure
- Auto Sync. Failure

2.4.11. No 1 Feeder Panel

- ECR Packeged Air Cond. Short Circuit
- ECR Packeged Air Cond. Over Current
- ECR Packeged Air Cond. Low Insulation
- No. 1/2 Vacuum Pump Auto Unloading Sys Short Circuit
- No. 1/2 Vacuum Pump Auto Unloading Sys Over Current
- No. 1/2 Vacuum Pump Auto Unloading Sys Low Insulation
- No. 1 Hyd. Pump for FWD Deck Machinery Short Circuit
- No. 1 Hyd. Pump for FWD Deck Machinery Over Current
- No. 1 Hyd. Pump for FWD Deck Machinery Low Insulation
- I.G.S. Blower No. 1 Short Circuit
- I.G.S. Blower No. 1 Over Current
- I.G.S. Blower No. 1 Low Insulation
- Topping Up Generator Short Circuit
- Topping Up Generator Over Current
- Topping Up Generator Low Insulation

2.4.12. No 2 Feeder Panel

- I.G.S. Blower No. 2 Short Circuit
- I.G.S. Blower No. 2 Over Current
- I.G.S. Blower No. 2 Low Insulation
- No. 2 Hyd. Pump for FWD Deck Machinery Short Circuit
- No. 2 Hyd. Pump for FWD Deck Machinery Over Current
- No. 2 Hyd. Pump for FWD Deck Machinery Low Insulation
- No. 3 Hyd. Pump for FWD Deck Machinery Short Circuit
- No. 3 Hyd. Pump for FWD Deck Machinery Over Current
- No. 3 Hyd. Pump for FWD Deck Machinery Low Insulation

2.4.13. AC220V Feeder Panel

- Bridge Control Console Short Circuit
- Bridge Control Console Low Insulation
- No. 1 E/R Lighting Dist. Board (6LD) Short Circuit
- No. 1 E/R Lighting Dist. Board (6LD) Low Insulation
- No. 2 E/R Lighting Dist. Board (7LD) Short Circuit
- No. 2 E/R Lighting Dist. Board (7LD) Low Insulation
- Engine Control Console Short Circuit
- Engine Control Console Low Insulation
- Nav. Lighting Control Panel Short Circuit
- Nav. Lighting Control Panel Low Insulation
- Temp. Controllers DB Short Circuit
- Temp. Controllers DB Low Insulation
- I.G.S. Main Control Panel Short Circuit
- I.G.S. Main Control Panel Low Insulation
- T.U.G. Control Panel Short Circuit
- T.U.G. Control Panel Low Insulation
- Nav. and Safety DB Short Circuit
- Nav. and Safety DB Low Insulation
- B Deck Lighting DB 3LD Short Circuit
- B Deck Lighting DB 3LD Low Insulation
- A Deck Lighting DB 4LD Short Circuit
- A Deck Lighting DB 4LD Low Insulation
- Local F.F. Main Control Panel Short Circuit
- Local F.F. Main Control Panel Low Insulation
- Galley 220V DB Short Circuit
- Galley 220V DB Low Insulation
- Fire Alarm Main Panel Short Circuit
- Fire Alarm Main Panel Low Insulation
- Upper Deck Lighting CB 5LD Short Circuit
- Upper Deck Lighting CB 5LD Low Insulation
- CO2 Alarm Panel Short Circuit
- CO2 Alarm Panel Low Insulation

2.5. CMS Page

2.5.1. EXH GAS CMS

- ME TC SA cooler Fouling (air side)
- ME TC Filter Clogged

2.6. Cylinder Indication Diagrams Page

- Clogging Of Injection Valve Nozzle In Cyl 1 ~ Cyl 6
- Injection Pump Wear in Cyl. 1 ~ Cyl. 6
- Injection Pump Jamming on Cyl 1 ~ Cyl 6
- Late Injection In Cyl 1 ~ Cyl 6
- Early Injection In Cyl 1 ~ Cyl 6
- Injection Valve Wear (Poor Atomization) On Cyl 1 ~ Cyl 6
- MainBearing1 ~ MainBearing7 wear
- Piston Ring Wear in Cyl. 1 ~ Cyl. 6
- Injection Pump Cavitation on Cyl.1 ~ Cyl.6

2.7. SYS Page

2.7.1. Compressed Air System

- №1 (№2) Main Air Reservoir Water Content High
- Aiir leakage from the start system
- Air Dryer 1 (2) Abnormal

2.7.2. Bilge and Fire GS System

- Fast Flooding
- Flooding
- OWS Oil Content High
- Bilge Fire GS Pump 1 (2) Failure
- Bilge Fire GS Pump 1 (2) Wear
- Fault EMCY Fire Pump Leakage

2.7.3. LO Stern Tube System

- ST AFT Bearing wear
- ST AFT Seal TK Leakage
- ST Seal Wear
- ST Gravity TK Leakage

2.7.4. LO Steam Turbines System

- TGST LO Filter Fouling
- WBPT LO Filter Fouling
- COPT1 (COPT2, COPT3) LO Filter Fouling
- TGST Main LO PP Wear
- WBPT Main LO PP Wear
- COPT1 (COPT2, COPT3) Main LO PP Wear

2.7.5. Steering Gear System

- SG Pump Unit 1 (2) Wear
- SG Oil leakage from 1 ~ 4 cylinder
- SG Pump 1 (2) Filter Fouling

2.7.6. FO Filling and Transfer System

- MDO Transfer Pump Break
- HFO Transfer Pump Failure

2.7.7. FO ME, GE Service System

- ME/GE FO by-pass filter fouling
- GE 1 FO Filter 1 (2) Fouling
- GE 2 FO Filter 1 (2) Fouling
- ME/GE FO supply pump 1 (2) Break
- ME/GE FO supply pump 1 (2) Wear
- ME/GE FO circulation pump 1 (2) Break
- ME/GE FO circulation pump 1 (2) Wear
- FO back flush filter dirty
- ME FO Leakage
- GE 1 FO Leakage
- GE 2 FO Leakage
- GE MDO Pump Wear
- GE MDO Pump Break
- FO de-aerating valve malfunction
- FO pressure control valve closed

2.7.8. Ballast System

- Ballast Pump 1 Failure
- Ballast Pump 1 Wear
- Fault Oil Leakage

2.7.9. LO ME Service System

- M/E L.O. Auto Back Flush Filter Failure
- M/E L.O. Auto Back Flush Filter Clogging
- M/E L.O. Temp Governor Failure
- Cam.Shaft Bearing Wear
- M/E L.O. Cooler Clogging On L.O. Side
- No. 1 (2) Main L.O. Pump Failure
- No. 1 (2) Main L.O. Pump Wear
- M/E No. 1 ~ No. 6 Piston Oil Clogging
- M/E No. 1 ~ No. 7 Main Bearing Oil Clogging
- M/E Thrust Bearing Oil Clogging
- M/E Camshaft Bearing Oil Clogging
- M/E L.O. Sump TK Leakage
- M/E L.O. System Leakage
- No. 1 (No. 2) Cylinder Lub. Oil Booster Pump Failure
- No. 1 (No. 2) Cylinder Lub. Oil Booster Pump Wear
- Cylinder Lubricator Oil Filter Clogging
- Cylinder Lub. Oil Overheat In M/E

2.7.10. Local Fire and Foam Systems

- HI-EX Foam Liquid Pump Failure
- HI-EX Foam Liquid Pump Wear
- Foam Liquid Pump (Deck) Failure
- Foam Liquid Pump (Deck) Wear

2.7.11. FO Purifiers System

- HFO Settling TK High Water Content
- HFO Settling TK High Impurity Content
- MDO Storage TK High Water Content
- MDO Storage TK High Impurity Content
- L.S.MDO (MGO) Storage TK High Water Content
- L.S.MDO (MGO) Storage TK High Impurity Content

2.7.12. SW Cooling System

- HIGH SEA CHEST SUCTION FILTER CLOGGED
- LOW SEA CHEST SUCTION FILTER CLOGGED
- HIGH SEA CHEST ICE BLOCKAGE
- LOW SEA CHEST ICE BLOCKAGE
- MAIN CSW PP1 (PP2) WEAR
- MAIN CSW PP1 (PP2) BREAKDOWN
- VACUUM COND CSW PP1 (PP2) WEAR
- VACUUM COND CSW PP1 (PP2) BREAKDOWN
- DWS PP1 BREAKDOWN
- DWS PP2 BREAKDOWN
- FWG SUPPLY PP BREAKDOWN
- SW CENTRAL COOLER №1 (№2) CLOGGED ON THE SW SIDE

2.7.13. LO Transfer and Purifying System

- No. 1 (No. 2) G/E L.O. Priming Pump Failure
- No. 1 (No. 2) G/E L.O. Priming Pump Wear
- No. 1 (No. 2) G/E L.O. Driving Pump Failure
- No. 1 (No. 2) G/E L.O. Driving Pump Wear
- No. 1 (No. 2) G/E L.O. Leakage
- No. 1 (No. 2) G/E L.O. Filter Fouling
- L.O. Transfer Pump Failure
- No. 1 (No. 2) G/E L.O. Sump. TK fault High Water Content
- No. 1 (No. 2) G/E L.O. Sump. TK fault High Impurity Content
- G/E L.O. Sett. TK fault High Water Content
- G/E L.O. Sett. TK fault High Impurity Content
- G/E L.O. Stor. TK fault High Water Content
- G/E L.O. Stor. TK fault High Impurity Content
- Main L.O. Sump. TK fault High Water Content
- Main L.O. Sump. TK fault High Impurity Content
- Main L.O. Sett. TK fault High Water Content
- Main L.O. Sett. TK fault High Impurity Content
- Main L.O. Stor. TK fault High Water Content
- Main L.O. Stor. TK fault High Impurity Content

2.7.14. HT Cooling System

- No. 1 (No. 2) M/E Jacket C.F.W. Pump Failure
- No. 1 (No. 2) M/E Jacket C.F.W. Pump Wear
- M/E H.T. Thermostatic Valve Failure
- Air In M/E H.T. System
- M/E No. 1 ~ No. 6 Cylinder C.F.W. Clogging

2.7.15. LT Cooling System

- Oil Leakage in L.O. Cooler
- No. 1 (No. 2) Low Temp. C.F.W. Pump Failure
- No. 1 (No. 2) Low Temp. C.F.W. Pump Wear
- No. 1 (No. 2) Low Temp. C.F.W. Cooler Clogging On C.F.W. Side
- No. 1 (No. 2) Low Temp. C.F.W. Cooler Low Heat Transfer Efficiency
- Turbo Generator L.O. Cooler Fouling
- No. 1 (No. 2, No. 3) C.O.P.T. L.O. Cooler Fouling
- W.B.P.T. L.O. Cooler Fouling
- M/E Charge Air Cooler Fouling
- M/E L.O. Cooler Clogging On C.F.W. Side
- M/E L.O. Cooler Heat Transfer Efficiency
- Intermediate Shaft Bearing Cooler Fouling
- No. 1 (No. 2) Main Air Compressor Cooler Fouling
- Control Air Compressor Cooler Fouling
- No. 1 (No. 2) G/E L.O. Cooler Fouling
- No. 1 (No. 2) G/E Charge Air Cooler Fouling
- Cooling F.W. Expansion TK Leakage

2.7.16. GE Cooling System

- G/E №1 (№2) Cooling Driven Pump Failure
- G/E №1 (№2) Cooling Driven Pump Wear

2.7.17. Fresh Water Service System

- No. 1 (No. 2) Fresh Water Pump Failure
- No. 1 (No. 2) Fresh Water Pump Wear
- Drink F.W. Hyd. Pump Failure
- Drink F.W. Hyd. Pump Wear
- No. 1 (No. 2) Hot Water Circ. Pump Failure
- No. 1 (No. 2) Hot Water Circ. Pump Wear

2.8. SG Page

2.8.1. Steering Gear LOP

- No. 1 (No. 2) Steering Gear Pump Short Circuit
- No. 1 (No. 2) Steering Gear Pump Low Insulation

2.8.2. EM'CY Fire Pump LOP

- EM'CY Fire Pump Short Circuit
- EM'CY Fire Pump Over Current
- EM'CY Fire Pump Low Insulation

2.8.3. HPU Deck Aft

- No. 1 (2) Hyd. Pump for AFT Deck Machinery Short Circuit
- No. 1 (2) Hyd. Pump for AFT Deck Machinery Over Current
- No. 1 (2) Hyd. Pump for AFT Deck Machinery Low Insulation

2.9. ER1 Page

2.9.1. ME Local panel

- ME Cyl.1 ~ Cyl.6 Fuel Cam. Fault
- Main Diesel Broken
- ME GOVERNOR ACTUATOR BROKEN
- Turbo Charger Surging
- ME Turbine Blades Fouling
- ME Compessor Blades Fouling
- ME Turbine Nozzle Fouling
- ME TC Bearing Failure

2.9.2. Turning Gear LOP

- M/E Turning Gear Short Circuit
- M/E Turning Gear Over Current
- M/E Turning Gear Low Insulation

2.9.3. No 7 Group Starter Panel

- Oily Water Separator Short Circuit
- Oily Water Separator Over Current
- Oily Water Separator Low Insulation
- I.G.S. Scrubber C.S.W. Pump Short Circuit
- I.G.S. Scrubber C.S.W. Pump Over Current
- I.G.S. Scrubber C.S.W. Pump Low Insulation
- E/R Bilge Pump Short Circuit
- E/R Bilge Pump Over Current
- E/R Bilge Pump Low Insulation
- Sludge Pump Short Circuit
- Sludge Pump Over Current
- Sludge Pump Low Insulation

2.9.4. No 8 Group Starter Panel

- F.W.G. Distillate Pump Short Circuit
- F.W.G. Distillate Pump Over Current
- F.W.G. Distillate Pump Low Insulation
- M/E Air Cooler Chem. Clean Pump Short Circuit
- M/E Air Cooler Chem. Clean Pump Over Current
- M/E Air Cooler Chem. Clean Pump Low Insulation
- F.W.G. Ejector Pump Short Circuit
- F.W.G. Ejector Pump Over Current
- F.W.G. Ejector Pump Low Insulation

2.9.5. Exh Gas Scrubber LOP

- Exh. Gas Scrubber Short Circuit
- Exh. Gas Scrubber Over Current
- Exh. Gas Scrubber Low Insulation

2.10. ER2 Page

2.10.1. Ballast Pump 1 LOP

- El. Motor Ballast Pump Short Circuit
- El. Motor Ballast Pump Over Current
- El. Motor Ballast Pump Low Insulation

2.10.2. PD DB 2

- Drilling Machine Short Circuit
- Drilling Machine Over Current
- Drilling Machine Low Insulation
- Grinding Machine Short Circuit
- Grinding Machine Over Current
- Grinding Machine Low Insulation
- AFT ICCP Power Supply Unit Short Circuit
- AFT ICCP Power Supply Unit Over Current
- AFT ICCP Power Supply Unit Low Insulation
- Electric Arc Welder Short Circuit
- Electric Arc Welder Over Current
- Electric Arc Welder Low Insulation
- Lathe Short Circuit
- Lathe Over Current
- Lathe Low Insulation
- Workshop Packaged Air Cond. Short Circuit
- Workshop Packaged Air Cond. Over Current
- Workshop Packaged Air Cond. Low Insulation
- Weldind Space Exh. Fan Short Circuit
- Weldind Space Exh. Fan Over Current
- Weldind Space Exh. Fan Low Insulation

2.10.3. COPT 1

- No. 1 C.O.P.T. Control Panel Short Circuit
- No. 1 C.O.P.T. Control Panel Over Current
- No. 1 C.O.P.T. Control Panel Low Insulation

2.10.4. COPT 2

- No. 2 C.O.P.T. Control Panel Short Circuit
- No. 2 C.O.P.T. Control Panel Over Current
- No. 2 C.O.P.T. Control Panel Low Insulation

2.10.5. COPT 3

- No. 3 C.O.P.T. Control Panel Short Circuit
- No. 3 C.O.P.T. Control Panel Over Current
- No. 3 C.O.P.T. Control Panel Low Insulation

2.10.6. WBP Turbine LOP

- No. 2 W.B.P.T. Control Panel Short Circuit
- No. 2 W.B.P.T. Control Panel Over Current
- No. 2 W.B.P.T. Control Panel Low Insulation

2.10.7. Cyl. Lubricator Pumps LOP

- No. 1 (No. 2) Cylinder Lub. Oil Booster Pump Short Circuit
- No. 1 (No. 2) Cylinder Lub. Oil Booster Pump Over Current
- No. 1 (No. 2) Cylinder Lub. Oil Booster Pump Low Insulation

2.11. ER3 Page

2.11.1. GSP 4

- Purifier Room Exh. Fan Short Circuit
- Purifier Room Exh. Fan Over Current
- Purifier Room Exh. Fan Low Insulation
- M/E L.O. Auto Filter Short Circuit
- M/E L.O. Auto Filter Over Current
- M/E L.O. Auto Filter Low Insulation
- M/E F.O. Auto Filter Short Circuit
- M/E F.O. Auto Filter Over Current
- M/E F.O. Auto Filter Low Insulation
- No. 1 (No. 2) H.F.O. Purifier Feed Pump Short Circuit
- No. 1 (No. 2) H.F.P. Purifier Feed Pump Over Current
- No. 1 (No. 2) H.F.O. Purifier Feed Pump Low Insulation
- No. 1 (No. 2) Main L.O. Purifier Feed Pump Short Circuit
- No. 1 (No. 2) Main L.O. Purifier Feed Pump Over Current
- No. 1 (No. 2) Main L.O. Purifier Feed Pump Low Insulation
- No. 3 G/E L.O. Priming Pump Short Circuit
- No. 3 G/E L.O. Priming Pump Over Current
- No. 3 G/E L.O. Priming Pump Low Insulation
- No. 1 (No. 2) H.F.O. Purifier Short Circuit
- No. 1 (No. 2) H.F.O. Purifier Low Insulation
- No. 1 (No. 2) Main L.O. Purifier Short Circuit
- No. 1 (No. 2) Main L.O. Purifier Over Current
- No. 1 (No. 2) Main L.O. Purifier Low Insulation
- G/E D.O. Pump Short Circuit
- G/E D.O. Pump Over Current
- G/E D.O. Pump Low Insulation

2.11.2. GE 1-2 Control Panel

- No. 1 (No. 2) G/E Speed Detector Failure
- No. 1 (No. 2) G/E L.O. Pressure Sensor Failure
- No. 1 (No. 2) G/E H.T. F.W. Temp. Sensor Failure
- No. 1 (No. 2) G/E Exh. Gas Temp. Sensor Failure
- No. 1 (No. 2) G/E L.O. Priming Pump Short Circuit
- No. 1 (No. 2) G/E L.O. Priming Pump Over Current
- No. 1 (No. 2) G/E L.O. Priming Pump Low Insulation

2.11.3. FO Purifiers 1, 2 LOP

- No. 1 (No. 2) H.F.O. Purifier Leakage
- No. 1 (No. 2) H.F.O. Purifier Motor Failure
- No. 1 (No. 2) H.F.O. Purifier Feed Pump Failure
- No. 1 (No. 2) H.F.O. Purifier Water Seal Break
- No. 1 (No. 2) H.F.O. Purifier Closing Water Solenoid Valve Failure
- No. 1 (No. 2) H.F.O. Purifier Opening Water Solenoid Valve Failure
- No. 1 (No. 2) H.F.O. Purifier Coupling Wear
- No. 1 (No. 2) H.F.O. Purifier Outlet Press. Low
- No. 1 (No. 2) H.F.O. Purifier Sludge Discharge Failure

2.11.4. Aux Blowers 1,2 LOP

- No. 1 (No. 2) Aux Blower Short Circuit
- No. 1 (No. 2) Aux Blower Over Current
- No. 1 (No. 2) Aux Blower Low Insulation
- Blower 1 (2) Failure
- Blower 1 (2) Overload

2.11.5. Turbogenerator LOP

- Turbo. Gen. Control Panel Short Circuit
- Turbo. Gen. Control Panel Over Current
- Turbo. Gen. Control Panel Low Insulation

2.11.6. LO Purifiers 1,2 LOP

- No. 1 (No. 2) L.O. Purifier Leakage
- No. 1 (No. 2) L.O. Purifier Motor Failure
- No. 1 (No. 2) L.O. Purifier Feed Pump Failure
- No. 1 (No. 2) L.O. Purifier Water Seal Break
- No. 1 (No. 2) L.O. Purifier Closing Water Solenoid Valve Failure
- No. 1 (No. 2) L.O. Purifier Opening Water Solenoid Valve Failure
- No. 1 (No. 2) L.O. Purifier Coupling Wear
- No. 1 (No. 2) L.O. Purifier Outlet Press. Low
- No. 1 (No. 2) L.O. Purifier Sludge Discharge Failure

2.11.7. FWG LOP

- Heating Failure
- Condenser Fouling
- Vacuum Failure
- Salinometer Failure

2.11.8. Local FF Pump Starter

- Local Fire Fighting Pump Short Circuit
- Local Fire Fighting Pump Over Current
- Local Fire Fighting Pump Low Insulation
- Local Fire Fighting Pump Failure
- Local Fire Fighting Pump Wear

2.11.9. FW Calorifier LOP

- Calorifier Short Circuit
- Calorifier Over Current
- Calorifier Low Insulation

2.11.10. GSP 6

- Drink F.W. Hyd. Pump Short Circuit
- Drink F.W. Hyd. Pump Over Current
- Drink F.W. Hyd. Pump Low Insulation
- No. 1 (No. 2) Hot Water Circ. Pump Short Circuit
- No. 1 (No. 2) Hot Water Circ. Pump Over Current
- No. 1 (No. 2) Hot Water Circ. Pump Low Insulation
- No. 1 (No. 2) Fresh Water Circ. Pump Short Circuit
- No. 1 (No. 2) Fresh Water Circ. Pump Over Current
- No. 1 (No. 2) Fresh Water Circ. Pump Low Insulation

2.12. ER4 Page

2.12.1. Valves Remote Control HPU LOP

- HPU 1 (2) Motor Trip

2.12.2. Economizer Soot Blower LOP

- Soot Blower Short Circuit
- Soot Blower Over Current
- Soot Blower Low Insulation
- Soot Blower System Sequence Fault
- Soot Blower System Motor1 Overload
- Soot Blower System Motor2 Overload
- Economizer Soot Fouling

2.12.3. GSP 5

- No. 1 (No. 2) Main Air Compressor Short Circuit
- No. 1 (No. 2) Main Air Compressor Over Current
- No. 1 (No. 2) Main Air Compressor Low Insulation
- Control Air Compressor Short Circuit
- Control Air Compressor Over Current
- Control Air Compressor Low Insulation
- №1 (№2) Main Air Compressor wear of rings & valves
- №1 (№2) Main Air Compressor Motor Fault
- №1 (№2) Main Air Compressor Lube Oil Leakage
- Control Air Compressor wear of rings & valves
- Control Air Compressor Motor Fault
- Control Air Compressor Lube Oil Leakage
- №1 (№2) Main Air Compressor Water Content High
- №1 (№2) Main Air Compressor Water Drain Failure
- №1 (№2) Main Air Compressor Unload Failure

2.12.4. AC LOP

- AC1 (AC2) Steam Control1 Failure
- AC1 (AC2) Steam Control2 Failure
- AC1 (AC2) Oil Recirc. Sol. Valve Failure
- AC1 (AC2) Air in System
- AC1 (AC2) Condenser Cooler Fouling
- AC1 (AC2) Water in System
- AC1 (AC2) Ref. Leakage
- AC1 (AC2) TEV1 Fault
- AC1 (AC2) TEV2 Fault
- AC1 (AC2) Oil Leakage

2.12.5. GSP 9

- FWD ICCP Power Supply Unit Short Circuit
- FWD ICCP Power Supply Unit Over Current
- FWD ICCP Power Supply Unit Low Insulation
- Bosun Store Supply Fan Short Circuit
- Bosun Store Supply Fan Over Current
- Bosun Store Supply Fan Low Insulation

2.12.6. Boiler 1 Control Panel

- Boiler 1 Water Automatic Valve Failure
- Boiler 1 Igniter Not Inserted
- Sticking of Boiler 1 Fuel Oil Regulation Valve
- Boiler 1 Burner Automatic Failure
- Boiler 1 Water Level Transducer Failure
- Boiler 1 Evaporator Tube Bank Damage
- Boiler 1 Flame Out
- Boiler 1 Air Damper Control Failure
- Boiler 1 Poor Atomising

2.12.7. Boiler 2 Control Panel

Faults are similar to Boiler 1 Control Panel

2.12.8. GSP 3

- Provision Ref. Fan Short Circuit
- Provision Ref. Fan Over Current
- Provision Ref. Fan Low Insulation
- Galley Packaged Air Cond. Short Circuit
- Galley Packaged Air Cond. Over Current
- Galley Packaged Air Cond. Low Insulation
- Galley Supply Fan Short Circuit
- Galley Supply Fan Over Current
- Galley Supply Fan Low Insulation
- Dry Provision Store Exh. Fan Short Circuit
- Dry Provision Store Exh. Fan Over Current
- Dry Provision Store Exh. Fan Low Insulation
- Garbage Store Exh. Fan Short Circuit
- Garbage Store Exh. Fan Over Current
- Garbage Store Exh. Fan Low Insulation
- Life/Rescue Boat Davit and Winch Short Circuit
- Life/Rescue Boat Davit and Winch Over Current
- Life/Rescue Boat Davit and Winch Low Insulation
- Provision Crane Short Circuit
- Provision Crane Over Current
- Provision Crane Low Insulation
- Sanitary Space Exh. Fan Short Circuit
- Sanitary Space Exh. Fan Over Current
- Sanitary Space Exh. Fan Low Insulation
- Galley and Pantry Exh. Fan Short Circuit
- Galley and Pantry Exh. Fan Over Current
- Galley and Pantry Exh. Fan Low Insulation
- Paint Store Exh. Fan Short Circuit
- Paint Store Exh. Fan Over Current
- Paint Store Exh. Fan Low Insulation
- Hose Handling Crane Short Circuit
- Hose Handling Crane Over Current
- Hose Handling Crane Low Insulation

2.12.9. Incinerator LOP

- Inc. WO Sett. TK Mill Pump Failure
- Incinerator Exhaust Gas Fan Failure
- Inc. WO Serv. TK Mill Pump Failure
- Incinerator Primary Burner Failure
- Inc. MDO Feed. Pump Failure
- Incinerator Sludge Burner Failure
- Inc. MDO Supply Pump Failure
- Incinerator Furnace Temp. Controller Failure
- Inc. WO Dosing Pump Failure
- Incinerator Exhaust Gas Temp. Controller Failure

2.12.10. PD DB 3

- O.D.M.S. Pump Short Circuit
- O.D.M.S. Pump Over Current
- O.D.M.S. Pump Low Insulation
- Engine Room Crane Short Circuit
- Engine Room Crane Over Current
- Engine Room Crane Low Insulation

2.12.11. Sewage Treatment Plant LOP

- STP Vacuum Pump No. 1 (No. 2) Failure
- STP No. 1 (No. 2) Vacuum Pump Over Current
- STP Holding TK fault High Level

2.12.12. Boilers Power Panel

- Boiler Fuel Oil Pump 1 (2) Wear
- Boiler Fuel Oil Pump 1 (2) Failure
- MGO PUMP No 1 (2) Wear
- MGO PUMP No 1 (2) Failure
- Boiler Ignition Pump 1 (2) Failure
- Boilers Feed Water Pump 1 (2) Wear
- Boilers Feed Water Pump 1 (2) Failure
- Boilers Feed Water Pump 3 Wear
- Boilers Feed Water Pump 3 Failure
- No 1 (No. 2) .Boiler Water Circ. Pump For E/G ECO Wear
- No 1 (No. 2) .Boiler Water Circ. Pump For E/G ECO Failure
- Boiler 1 (2) Air Fan Failure
- Boiler Water Circ. Pumps Automatic Failure
- Boiler Feed Water Pumps Automatic Failure
- ECO tube failure
- Economiser fire
- Circulation Valve To HFO Settling Tank Open
- Dump Valve Controller Failure
- LO Purifier 1 (2) Heater Leakage
- HFO Purifier 1 (2) Heater Leakage
- HFO heater 1 (2) for Aux. Boilers leakage
- ME/ GE HFO heater 2 leakage
- ME/ GE HFO heater 1 leakage
- Sticking of Boiler FO Temp Regulator

2.12.13. Boilers MGO Pumps LOP

- No. 1 (No. 2) MGO Pump for Aux Boilers Short Circuit
- No. 1 (No. 2) MGO Pump for Aux Boilers Over Current
- No. 1 (No. 2) MGO Pump for Aux Boilers Low Insulation

2.13. FFR Page

2.13.1. Foam Pump LOP

- Hi-Ex Foam Liquid Pump Short Circuit
- Hi-Ex Foam Liquid Pump Over Current
- Hi-Ex Foam Liquid Pump Low Insulation
- Foam Liquid Pump (Deck) Short Circuit
- Foam Liquid Pump (Deck) Over Current
- Foam Liquid Pump (Deck) Low Insulation

2.14. EmG Page

2.14.1. ESB Consumers

AC440V EM'CY Feeder Panel

- Breathing Air Compressor Short Circuit
- Breathing Air Compressor Over Current
- Breathing Air Compressor Low Insulation
- Electric Whistle Short Circuit
- Electric Whistle Over Current
- Electric Whistle Low Insulation
- EM'CY Generator Room Exh Fan Short Circuit
- EM'CY Generator Room Exh Fan Over Current
- EM'CY Generator Room Exh Fan Low Insulation
- S/G RM and EM'CY Fire Pump RM Supply Fan Short Circuit
- S/G RM and EM'CY Fire Pump RM Supply Fan Over Current
- S/G RM and EM'CY Fire Pump RM Supply Fan Low Insulation
- No. 4 E/R Vent. Fan Short Circuit
- No. 4 E/R Vent. Fan Over Current
- No. 4 E/R Vent. Fan Low Insulation

AC220V EM'CY Feeder Panel

- Nav. and Safety Equipment Dist. Board Short Circuit
- Nav. and Safety Equipment Dist. Board Low Insulation
- No. 1 EM'CY Lighting Dist. Board (2ED) Short Circuit
- No. 1 EM'CY Lighting Dist. Board (2ED) Low Insulation
- No. 1 EM'CY Lighting Dist. Board (3ED) Short Circuit
- No. 1 EM'CY Lighting Dist. Board (3ED) Low Insulation
- Engine Control Console Short Circuit
- Engine Control Console Low Insulation
- Cargo Control Console Short Circuit
- Cargo Control Console Low Insulation
- No. 1 EM'CY Lighting Dist. Board (4ED) Short Circuit
- No. 1 EM'CY Lighting Dist. Board (4ED) Low Insulation
- Fire Alarm Main Panel Short Circuit
- Fire Alarm Main Panel Low Insulation
- Coolant Heater for E/Gen Short Circuit
- Coolant Heater for E/Gen Low Insulation
- Nav. Lighting Control Panel Short Circuit
- Nav. Lighting Control Panel Low Insulation
- Bridge Control Console Short Circuit
- Bridge Control Console Low Insulation
- Lights In E/Gen Room Short Circuit
- Lights In E/Gen Room Low Insulation
- Hi-Ex Foam System Short Circuit
- Hi-Ex Foam System Low Insulation
- G/E Control Panel Short Circuit
- G/E Control Panel Low Insulation
- Nav. and Safety Equipment Dist. Board Short Circuit
- Nav. and Safety Equipment Dist. Board Low Insulation
- CO2 Alarm Panel Short Circuit
- CO2 Alarm Panel Low Insulation
- GMDSS Console Short Circuit
- GMDSS Console Low Insulation
- Local F.F. Main Control Panel Short Circuit
- Local F.F. Main Control Panel Low Insulation
- Interfase Unit for Signal Light Column Short Circuit
- Interfase Unit for Signal Light Column Low Insulation
- Cargo Hangling System Control Panel Short Circuit
- Cargo Hangling System Control Panel Low Insulation

2.14.2. EM'CY Generator Panel

- EM'CY Gen ACB Spring Charge Motor Failure
- ESB Side Bus Tie ACB Spring Charge Motor Failure
- EM'CY Gen. AVR Failure

2.14.3. Shore Connection Panel

- Shore Supply Incorrect Phase Sequence
- Shore Supply Phase Break
- Shore Supply Low Voltage

2.14.4. Battery Charger and Discharger Board

- Battery Charger Fuse 1 (2) To Blow
- Battery fault Low Capacity
- Bridge Control Console Short Circuit
- Bridge Control Console Low Insulation
- Cargo Control Console Short Circuit
- Cargo Control Console Low Insulation
- Engine Control Console Short Circuit

- Engine Control Console Low Insulation
- EM'CY Lighting Wheel House Short Circuit
- EM'CY Lighting Wheel House Low Insulation
- EM'YC Lighting A Deck Short Circuit
- EM'YC Lighting A Deck Low Insulation
- EM'YC Lighting B Deck Short Circuit
- EM'YC Lighting B Deck Low Insulation
- I.G.S. Main Control Panel On B.C.C. Short Circuit
- I.G.S. Main Control Panel On B.C.C. Low Insulation
- Navigation Lighting Control Panel Short Circuit
- Navigation Lighting Control Panel Low Insulation
- Nav. and Safety Equipment Dist. Board Short Circuit
- Nav. and Safety Equipment Dist. Board Low Insulation
- EM'YC Lighting C Deck Short Circuit
- EM'YC Lighting C Deck Low Insulation
- EM'CY Lighting Engine Room Short Circuit
- EM'CY Lighting Engine Room Low Insulation
- EM'CY Lighting Upper Deck Short Circuit
- EM'CY Lighting Upper Deck Low Insulation
- MSB Panel Short Circuit
- MSB Panel Low Insulation
- Hi-Ex Foam Control System Short Circuit
- Hi-Ex Foam Control System Low Insulation

2.14.5. EM'CY Gen LOP

- EM'CY G/E Tacho Fail
- EM'CY G/E FW Coller Fouling
- EM'CY G/E LO Coller Fouling
- EM'CY G/E LO Pump Wear
- EM'CY G/E LO Pump Failure
- EM'CY G/E FW Pump Wear
- EM'CY G/E FW Pump Failure
- EM'CY G/E RPM Governor Failure
- EM'CY G/E Fuel Leakage

2.15. CCR Page

2.15.1. Topping Up Generator Control Panel

- TUG scrubber drain valve damage in close position
- TUG drain valve damage in open position
- TUG Diesel Oil Pump Wear
- TUG Combustion Fan Wear

2.15.2. Inert Gas System Control Panel

- I.G. Blower No. 1 (No. 2) Failure
- High I.G. Pressure On Main Line
- Low I.G. Pressure On Main Line
- High I.G. Pressure On Secondary Line
- Low I.G. Pressure On Secondary Line
- High I.G. Temperature In Scrubber
- High Oxygen Content In I.G.