

*MARINE TRAINING SOFTWARE, SIMULATORS AND DIESEL ENGINE TESTERS*

# **MARINE TRAINING SOFTWARE Engineering CBT**

## **Operator's Handbook**

### **Part 6**

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## Installation instruction

1. Do not insert the Hardlock Key before the software installation!
2. Start the computer and load the Windows 98 / Me / 2000 / XP / 2003 / Vista operating system.
3. Please wait for the CD-ROM auto-start sequence, or:
  - a. Insert the CD into the CD-ROM drive.
  - b. Click the “Start” menu.
  - c. Select “Run...”.
  - d. Type “[CD-ROM drive letter]:\setup.exe” (e.g. d:\setup.exe), or click ‘Browse...’ button and locate ‘setup.exe’ file on the CD-ROM.
  - e. Click “OK” button.
4. Follow the instructions shown on the screen.
5. After the installation has completed, please insert the Hardlock Key.
6. In order to read the manual pdf files, please install the “Adobe Reader”, which is included on the CD-ROM.

# AIR CONDITIONING PLANT

## 1. Introduction

The AIR CONDITIONING PLANT simulator is intended for teaching the basic principles of how to operate a typical marine air conditioning plant.

The simulator consists of the following elements:

1. Air Handling Unit (AHU)
2. Refrigerating Condensing Unit
3. Steam valves block
4. Control panel
5. Diagram

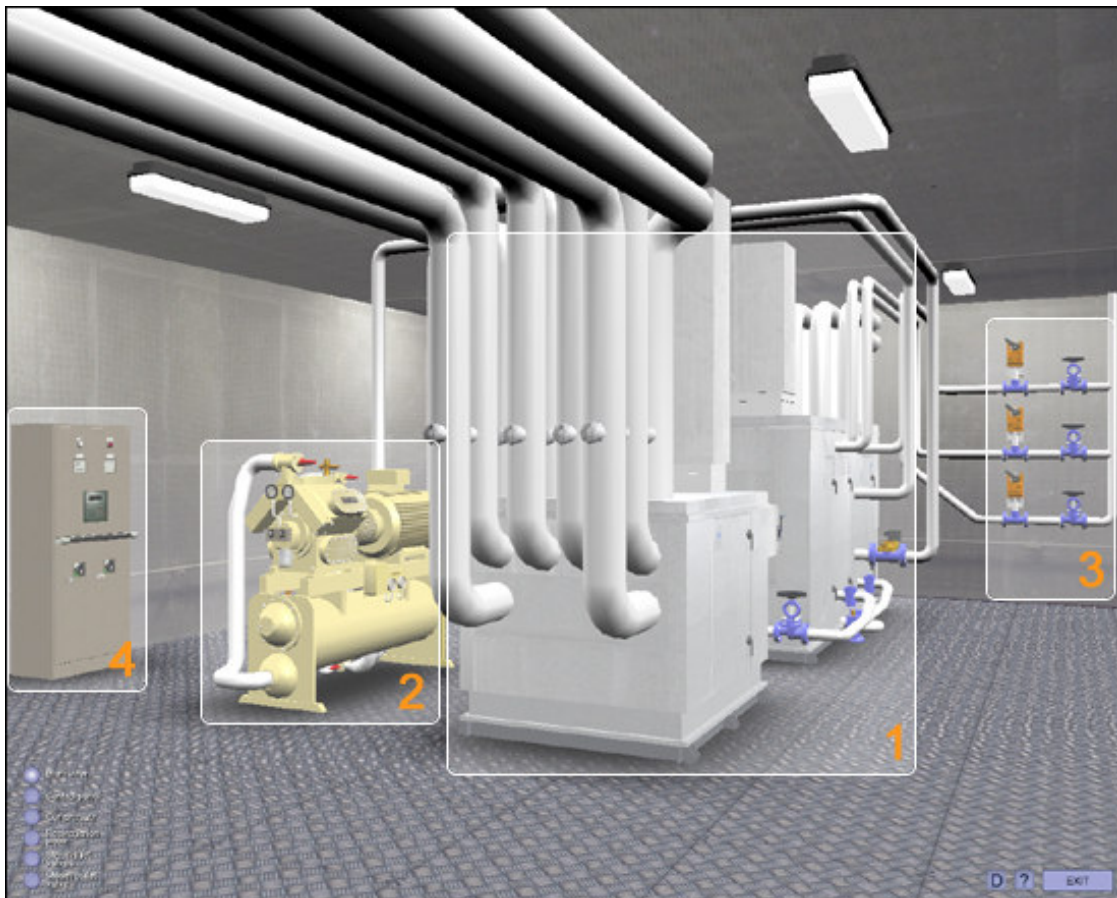


Fig .1. Air Conditioning Plant

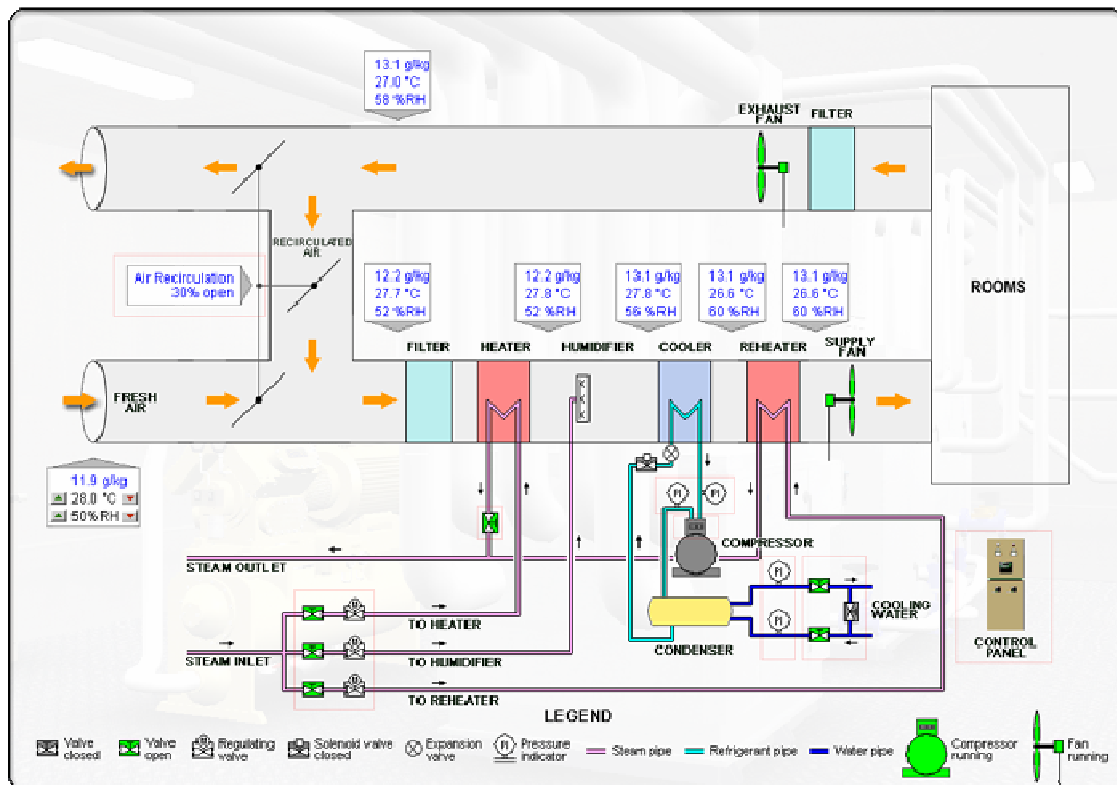


Fig. 2. Simulator diagram

The simulator diagram shows the basic status and configuration of AHU. The following parameters of the air are presented:

- temperature [oC]
- absolute humidity [g/kg]
- relative humidity [%]

## **2. Control system description**

The control system for the AHU (Air Handling Unit) consists of one temperature sensor in the outdoor chamber, one in the supply air chamber and one solenoid valve in the refrigeration line to the cooler.

The control system comprises the following elements:

- Compressor control
- AHU fan control
- AHU cooling regulation
- Outdoor compensation
- Humidity regulation
- Alarm system

The air conditioning plant is controlled by a EX2N PLC and an E200 operator panel.






## Operator Panel




The menu system, which is operated via the operator panel, provide access to all programmable set-points/timers and read-out of selected measured values.



Fig. 3. Control panel

The operator is able to browse through the menu system via the push buttons:

F1, F2, F3	Function buttons – description on LCD panel
PREV. NEXT	Moves the focus to the forward or back in the menu structure
	Moves the focus to the left in the menu structure
	Moves the focus down in the menu structure
	Moves the focus up in the menu structure
	Moves the focus to the right in the menu structure
	MAIN – Move the focus to the Main Menu

	LIST – Move the focus to the alarm list
	CONFIRM – writes entered values to memory
	ERASE – clears entered values
Numeric buttons	Enters numeric values

Set points and timer values which are able to change are displayed with red color.

### 2.1. Menu system

By pushing the MAIN key, the following picture will be shown:



Fig. 4. Main Menu

#### Function keys

The bottom line describes the function of the F1 and F3 keys.

By pressing the F1 key the display picture will change to Compressor.

By pressing the F2 key the display picture will change to AHU.

## 2.2. Compressor control

### Control function

By pushing F1 "COMPR" in the main menu the following display will be shown:



Fig. 5. Compressor control

### Command

On the operator panel the compressor can be started/stopped by pushing F1 or F2:

F1 INCR The compressor increases one capacity step in manual mode

F2 DECR The compressor decreases one capacity step in manual mode

F3 AUTO Toggle between manual and auto mode

The F1 LED will shine green, when the compressor is running

The F2 LED will shine red, when the compressor is shut-down

The F3 LED will shine green, when the compressor is in Auto mode

### Status

On the operator panel the actual status of the compressor can be read. The following kinds of status will be indicated:

- STOPPED The compressor is stopped (Mode set at Manual) RUN STEP 1
- RUN STEP 2 The compressor is running at capacity step 1
- RUN STEP 3 The compressor is running at capacity step 2
- RUN STEP 4 The compressor is running at capacity step 3
- READY The compressor is ready for run in AUTO mode
- SHUT-DOWN The compressor is stopped by a shut-down alarm. (The type of alarm is shown in the alarm list)
- HOURS Compressor running hours
- MAX HOURS High limits for running hours warning



## **Manual mode**

The compressor is manually controlled, if the F3 LED is switched off. Push F3 to switch off the LED. The compressors can be manually controlled by using the F1-F2 function keys.

### Increase capacity step

By pushing F1 the compressor will increase by one capacity step. If the compressor was stopped, the compressor will start by pushing F1(INCR)

### Decrease capacity step

By pushing F2 the compressor will decrease by one capacity step. If the compressor runs at step 1, the compressor will be stopped by pushing F2 (DECR).

## **Automatic Mode**

The compressor is automatically controlled, if the F3 LED is switched on. Push F3 switch on the LED. The compressor capacity is regulated according to the supply air temperature in the AHU coolers. The regulation is a 3-point regulator, with a floating neutral zone.

### Start of the compressor

If the supply air temperature is higher than the setpoint and outside the calculated neutral zone in Tincrease time, the compressor will start in the following sequence:

- The solenoid valve in the cooler inlet will be opened.
- When the suction pressure cut-out switches on, the compressor will start.

### Increase of capacity

If the supply air temperature is higher than the setpoint and outside the calculated neutral zone in Tincrease time, the capacity will be increased by one step.

Step 1	(Start compressor)
Step 2	(Solenoid valve)
Step 3	(Solenoid valve)
Step 4	(Solenoid valve)

### Stop of compressor

If the supply air temperature is lower than the setpoint and outside the calculated neutral zone in Tdecrease time, and the compressor is running at step 1, the compressor will stop in the following sequence:

- The solenoid valve in the cooler inlet will be closed.
- When the suction pressure cut-out switches off, the compressor will stop.

### Decrease of capacity

If the supply temperature is lower than the setpoint and outside the calculated neutral zone in Tdecrease time, the capacity will be decreased by one step.

Step 4	(Solenoid valve)
Step 3	(Solenoid valve)
Step 2	(Solenoid valve)
Step 1	(Stop compressor)

## Shut-downs

The compressor is fitted with 4 shut-down functions:

- High discharge pressure switch
- Low lubrication pressure switch (delay 60 sec)
- High oil temperature
- High discharge temperature
- Overcurrent relay

If one of the above-mentioned pressure switches cuts out, the input on the PLC is shut down and the compressor will stop and alarm is given.

If the overcurrent relay has switched off, or the interlock signal is open, the compressor will be stopped and the alarm list will indicate run error.

If high discharge pressure shut-down function is activated, manual reset on the pressure switch is necessary.

## 2.3. Air Handling Unit (A HU) control

The temperature in the supply air chamber is controlled by a temperature sensor, which - according to the setpoint and neutral zone - controls the capacity of the compressor.

### Control function

By pushing F1 "AHU" in the main menu, the following display will be shown:



Fig. 6. AHU control

### Command

F1	START	The AHU fan will be started
F2	STOP	The AHU fan will be stopped
F3	SET-UP	Shown the set-up picture

The F1 LED will shine green, when the fan is running.

### Status

On the operator panel the actual status of the AHU can be read. The following types of status will be indicated:

OFF		The cooling regulation is switched off. (Stop fan or stop compr. or low outdoor temp.)
COOL		The cooling regulation is active.
SUMMER		The cooling regulation is active, and summer compensation is active.
WINTER		The cooling regulation is active, and winter compensation is active
Outdoor	xxx.x °C	Actual outdoor temperature
Supply air	xxx.x °C	Actual supply air temperature
Act. SP	xxx.x °C	Actual regulation setpoint (with outdoor compensation)

### Parameter

The following limits have to be set:

Start SP	xxx.x °C	Start regulation setpoint (without outdoor compensation)
Nzw	xxx.x °C	Narrow regulation neutral zone
Nzwn	xxx.x °C	Wide regulation neutral zone
Tincr	xxx.x sec	Delay increase one capacity step
Tdecr	xxx.x sec	Delay decrease one capacity step

### **AHU Set-up**

By pushing F3 "SET-UP" in the AHU menu, the following display will be shown:



Fig. 7. AHU Set-up

### Command

F1	COMPEN	Show the compensation parameters picture
F2	HUMIDI	Show the humidity parameter picture

### Status

Outdoor	xxx.x °C	Actual outdoor temperature
---------	----------	----------------------------

Parameter

Start cool	xxx.x °C	Outdoor temperature limit for start cooling
HT outdoor	xxx.x °C	High outdoor temperature limit
LT outdoor	xxx.x °C	Low outdoor temperature limit
HT supply	xxx.x °C	High supply temperature limit
LT supply	xxx.x °C	Low supply temperature limit

**Compensation Parameters**

By pushing F1 "COMPEN" in the SET-UP menu, the following display will be shown:



Fig. 8. Compensation Parameters

Parameter

Summer start	xxx.x °C	Outdoor temperature, for start summer compensation
Summer stop	xxx.x °C	Outdoor temperature, for stop summer compensation
Summer fact.	xxx.x °C	Compensation factor for the supply air temperature
Winter start	xxx.x °C	Outdoor temperature, for start winter compensation
Winter stop	xxx.x °C	Outdoor temperature, for stop winter compensation
Winter fact.	xxx.x °C	Compensation factor for the supply air temperature

**Humidity**

By pushing F3 "HUMIDI" in the SET-UP menu, the following display will be shown:



Fig. 9. Humidity

Parameter

Humidity Setpoint xxx.x % Humidity regulation setpoint

**Outdoor Compensation**

The outdoor temperature can give a compensation factor to the supply air temperature setpoint. This is made to compensate for a big temperature difference between outdoor and indoor temperature in the accommodation.

Two different setpoints for summer and winter compensation can be set.

The regulation setpoint for the supply air will be increased by a percentage of the temperature difference between the outdoor temperature and the start temperature for compensation.

The regulation setpoint will be calculated with a sampling time of 30 minutes.

**2.4. Alarm system**

The alarm handler is function, which handles all alarms registered by the system.

The alarm handler will examine every registered alarm, activate the designated alarm sequence and display the corresponding alarm message.

When a new alarm is registered:

- At the upper right corner of the operator panel display the text "ALARM" will appear
- The common digital alarm outlet on the PLC is opened
- The common alarm lamp at the front will start flashing
- An alarm will be added to the alarm list

When the alarm is acknowledged:

- The common alarm outlet will close
- A symbol is put in the alarm list against the actual alarm
- The common alarm lamp turns to constant light, if the alarm is still active

## Alarm List

By pushing the Alarm key, the following picture will be shown:



Fig. 10. Alarm List

The bottom line describes the function of the F1 and F3 keys.

By pressing the F1 key the alarm on which the cursor is placed is acknowledged.

By pressing the F2 key the time at which the alarm turned up will be shown for the alarm indicated by the cursor.

Press F3 to leave the alarm list.

Against each alarm a symbol will indicate the status of the alarm:

'\*' - The alarm is active and not acknowledged

'\$' - The alarm is not active and not acknowledged

'.' - The alarm is active but acknowledged

If there are no active alarms, the alarm list is blank, and the common alarm lamp will be switched off.

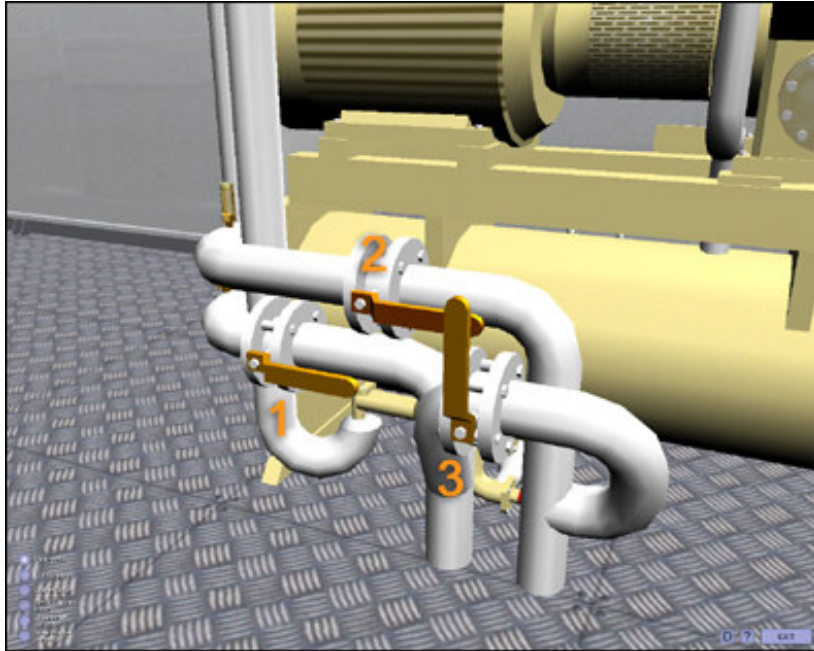
The following alarms can be shown:

HP discharge	High discharge pressure alarm Compressor
LP oil	Low oil pressure alarm Compressor
HT oil/Disch	High discharge/Oil temperature alarm Compressor
Run error	Missing running feed-back from starter Compressor
Run hour	Max running hours warning Compressor
LT outdoor	Low outdoor temperature alarm
HT outdoor	High outdoor temperature alarm
Error outdoor temp.	Outdoor sensor error
LT supply AHU	Low supply air temperature alarm AHU
HT supply AHU	High supply air temperature alarm AHU
Error supply AHU	Supply air sensor error AHU
PLC stopped	PLC program is stopped (switch on PLC)
PLC error	PLC hardware error

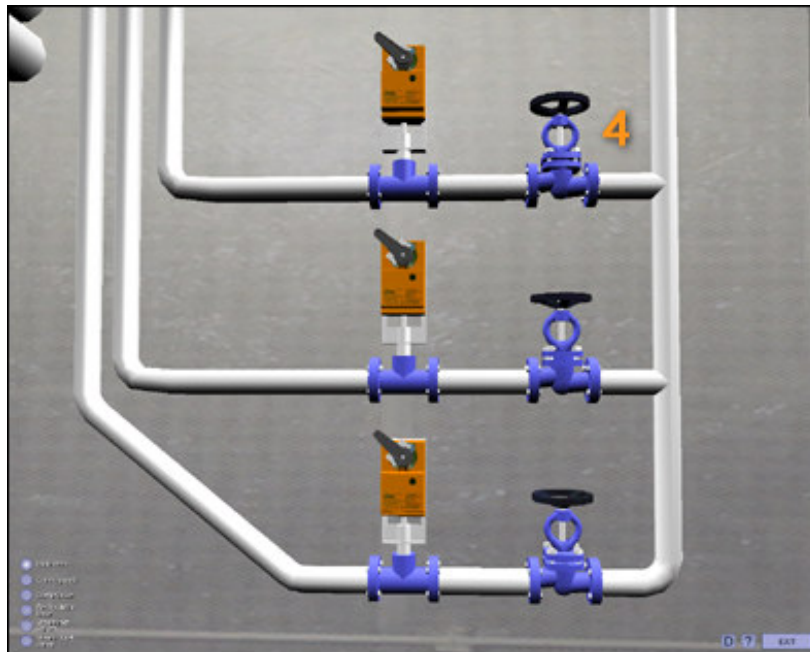
### 3. Operating procedures

#### 3.1. Start the AC Plant– Summer (+25°C to +40°C)

1. Open cooling water inlet valve to condenser.
2. Open cooling water outlet valve from condenser.
3. Close condenser cooling water by-pass valve.



4. Open steam valve to reheater.





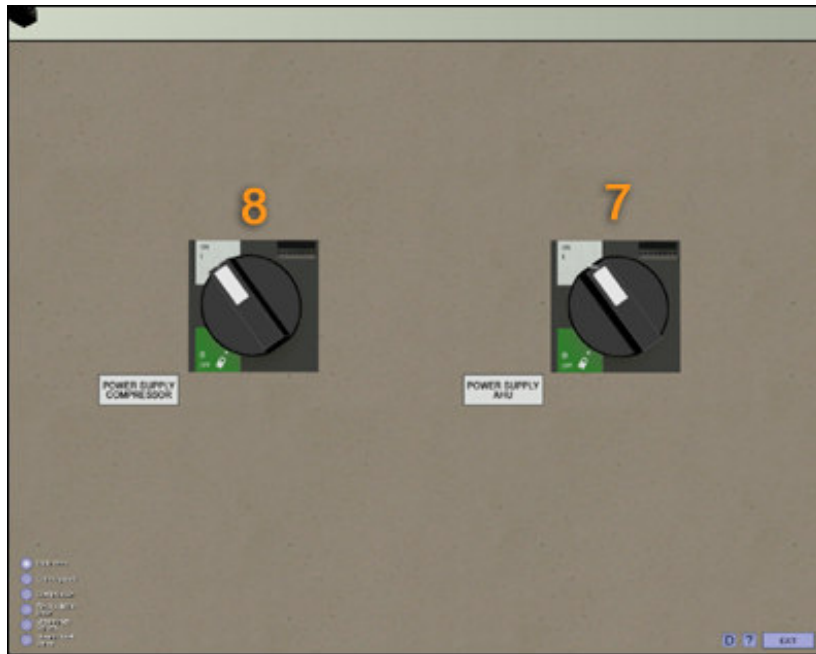
5. Open condensate outlet valve from heaters.



6. Set air recirculation to position 25% open.



7. Set AHU main switch to position ON.
8. Set Compressor main switch to position ON.



9. Set Compressor to automatic operation :
  - a) Press COMPR F1 button on PLC MENU.
  - b) Press AUTO F3 button on PLC MENU.

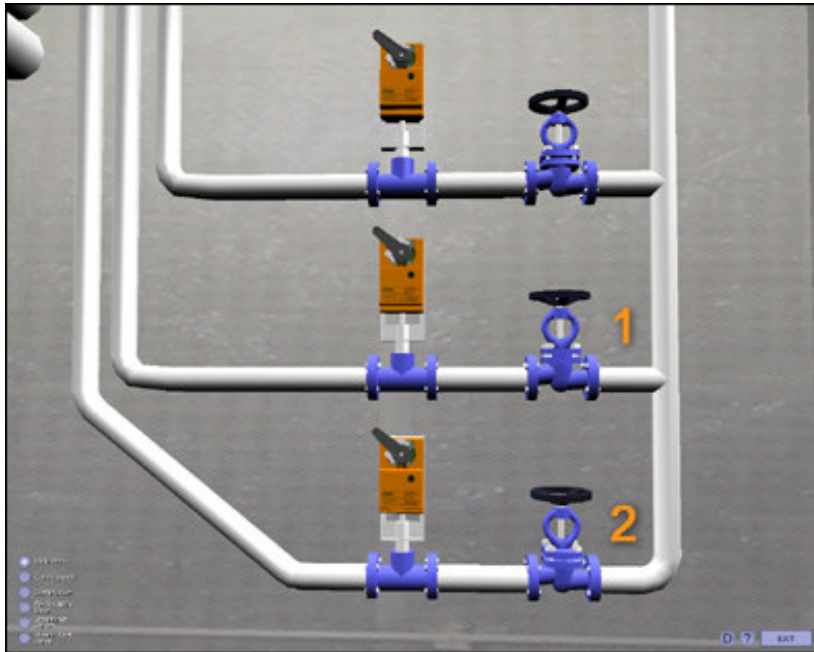


10. Start Air Handling Unit AHU :
- a) Press Main button on PLC MENU.
  - b) Press AHU F2 button on PLC MENU.
  - c) Press START F1 button on PLC MENU.



### 3.2. Start the AC Plant – Winter (+5 °C to -30°C)

1. Open steam valve to humidifier
2. Open steam valve to heater



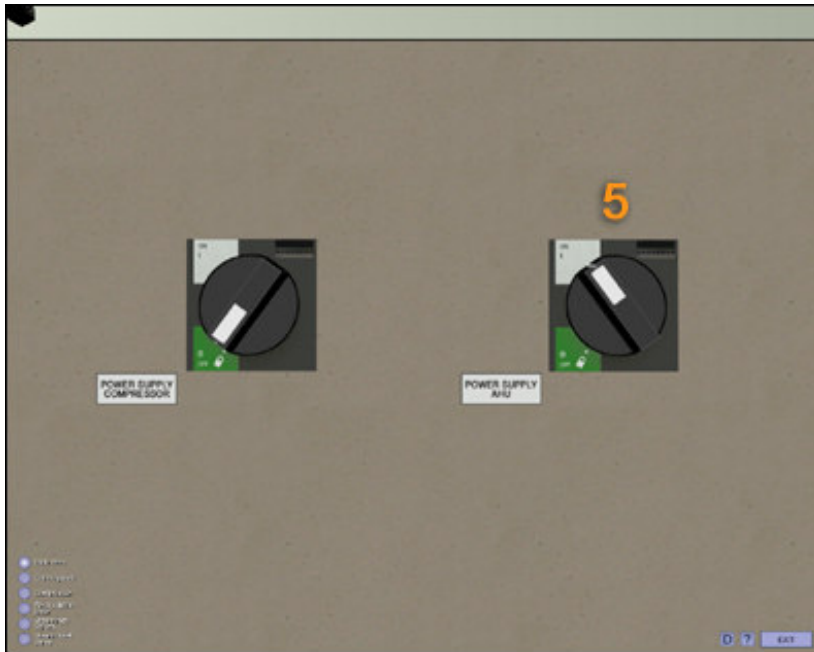
3. Open condensate outlet valve from heaters



4. Set air recirculation to position 25% open



5. Set AHU main switch to position ON



6. Start Air Handling Unit AHU :
  - a) Press Main button on PLC MENU
  - b) Press AHU F2 button on PLC MENU
  - c) Press START F1 button on PLC MENU



### 3.3. Stop the AC Plant

1. Stop Air Handling Unit AHU
  - a) Press Main button on PLC MENU.
  - b) Press AHU F2 button on PLC MENU.
  - c) Press STOP F2 button on PLC MENU.



2. Set AHU main switch to position OFF.
3. Set Compressor main switch to position OFF.
4. Close cooling water inlet valve to condenser.
5. Close cooling water outlet valve from condenser.
6. Open condenser cooling water by-pass valve.
7. Close steam valve to humidifier.
8. Close steam valve to heater.
9. Close steam outlet valve from heater.

# FRESHWATER GENERATOR

## 1. Introduction

The educational program FRESHWATER GENERATOR SIMULATOR is intended for teaching the basic principles of how to operate a typical marine freshwater generator. The program is based on the freshwater generator (vacuum evaporator) type JW26-C produced by ALFA LAVAL.

The freshwater generator consists of the following main components:

1. Freshwater generator vessel with:
  - evaporator section /plate heat exchanger/,
  - demister,
  - condenser section /plate heat exchanger/,
  - fittings / air valve, safety valve, vacuum gauge, thermometer and sigh glass/.
2. Combined air/brine ejector.
3. Ejector pump.
4. Freshwater pump.
5. Control panel with salinometer and Engine Control Room's alarm block.
6. Mineralizer.

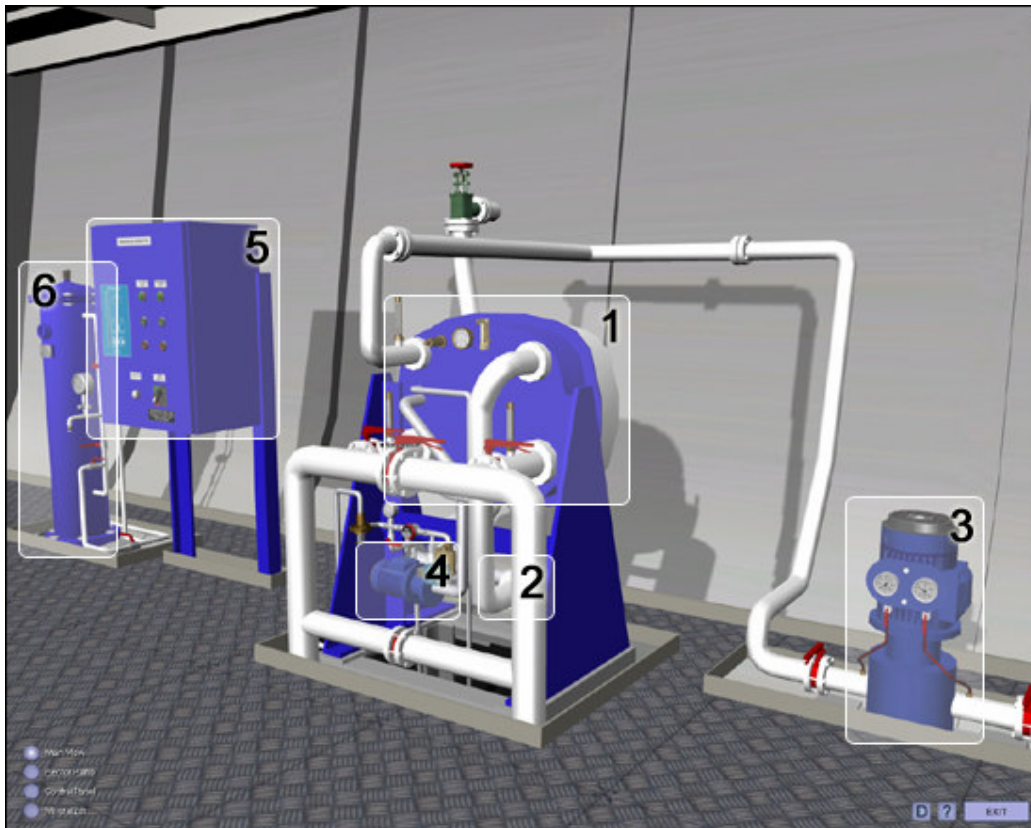


Fig. 1. Freshwater generator – general view



The simulator diagram shows the basic configuration of freshwater generator and status of main element and valves. Basic parameters of the system are also presented.

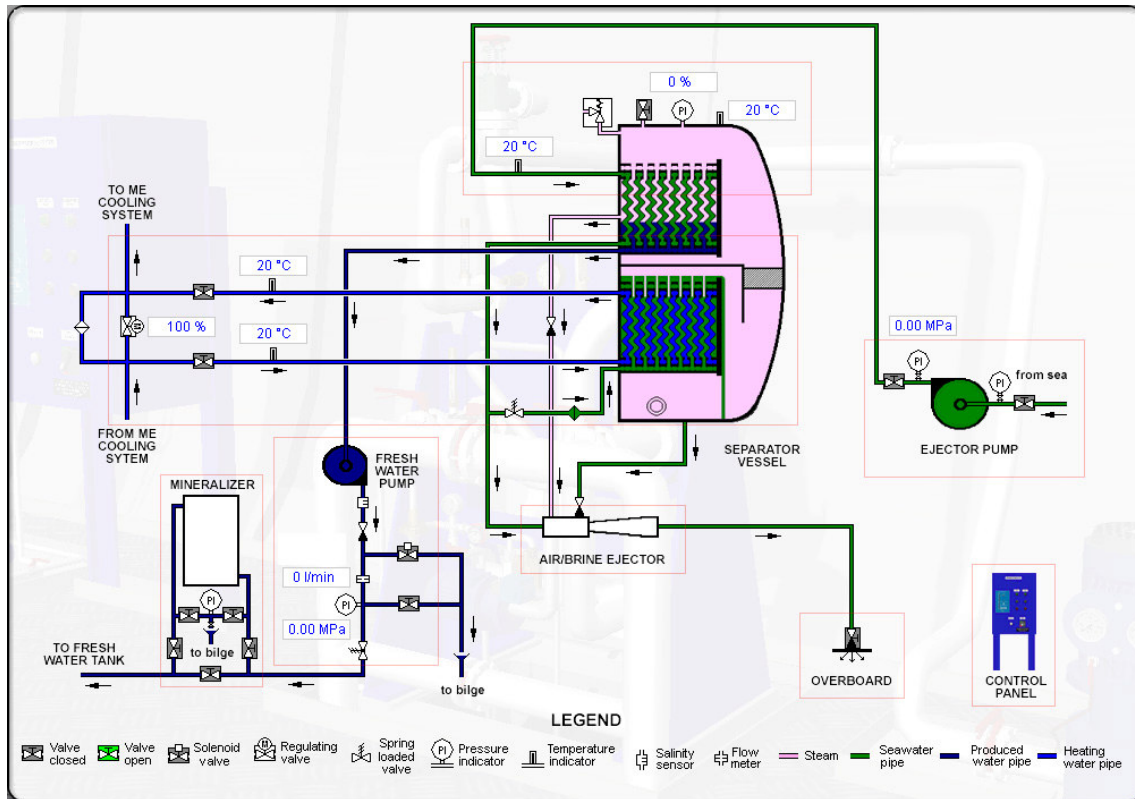


Fig. 2. Freshwater generator plant diagram

This simulator allows two ways of navigation in 3D environment:

1. Selection of system's views (Main View, Ejector Pump, Control Panel, Mineralizer). This items are available from menu (fig.3).
2. Zooming of selected parts of system's elements (by mouse clicking on yellow boxes).

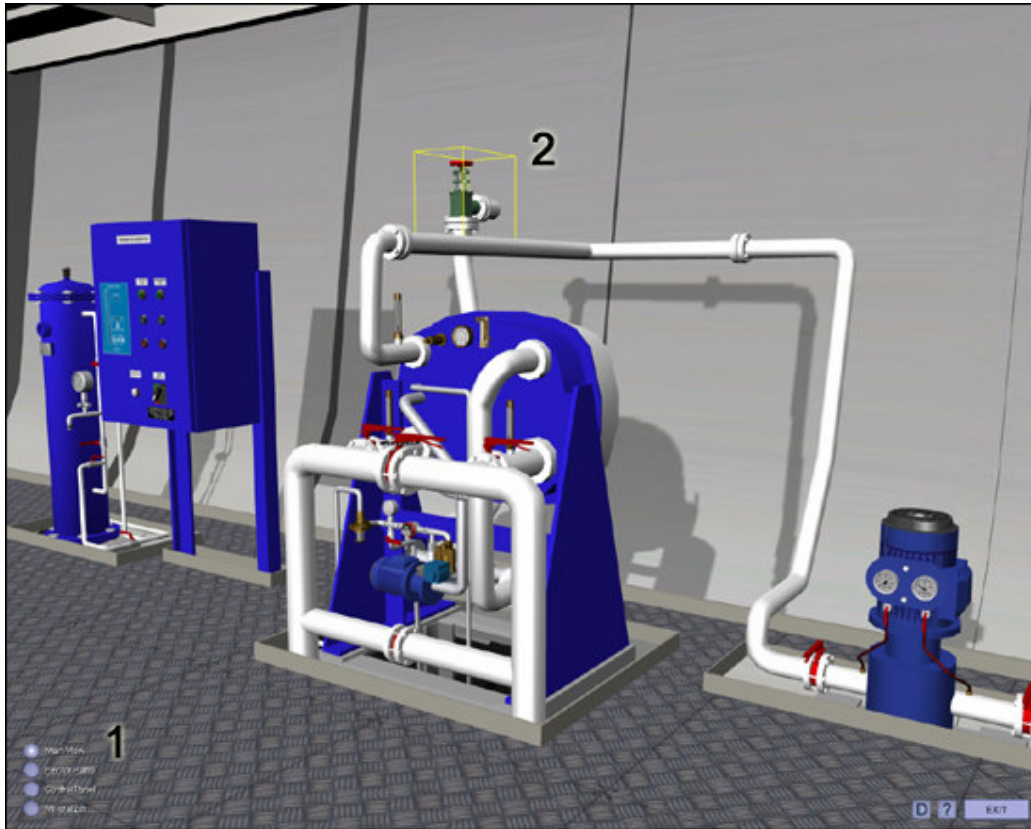


Fig. 3. Zooming possibilities

## **2. Working principles**

The feed water to be distilled is taken from the sea cooling water outlet of the condenser. It enters the evaporator where it evaporates at about 40-50°C as it passes between the plates heated by the heating medium.

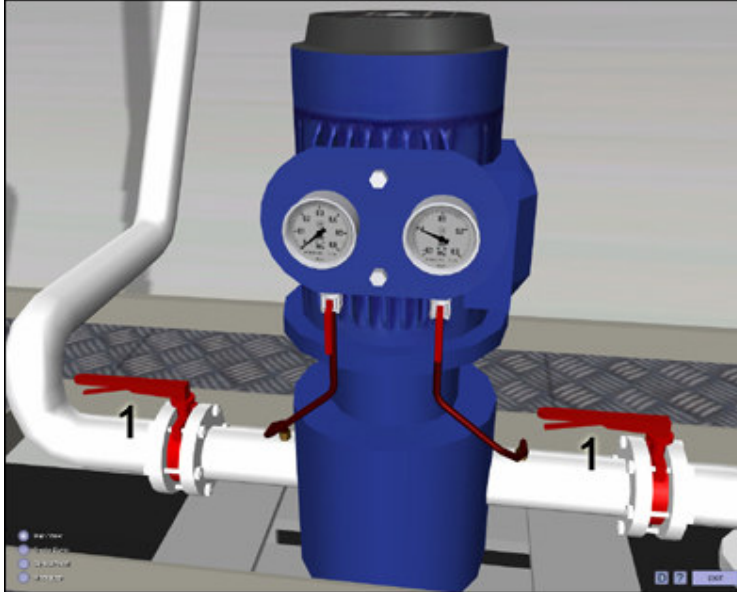
The evaporating temperature corresponds to a vacuum of 90-95%, maintained by the brine/air ejector. The vapours generated pass through a demister where any drops of seawater entrained are removed and fall due to gravity to the brine sump in the bottom of the generator chamber. The clean freshwater vapours continue to the condenser, where they condense into freshwater as they pass between the cold plates cooled by the sea cooling water.

In order to check continuously the quality of the produced freshwater, a salinometer is provided together with an electrode unit fitted on the freshwater pump delivery side. If the salinity of the produced freshwater exceeds the permitted maximum value (2 ppm), the solenoid valve and alarm are activated to dump automatically the produced freshwater to the bilge.

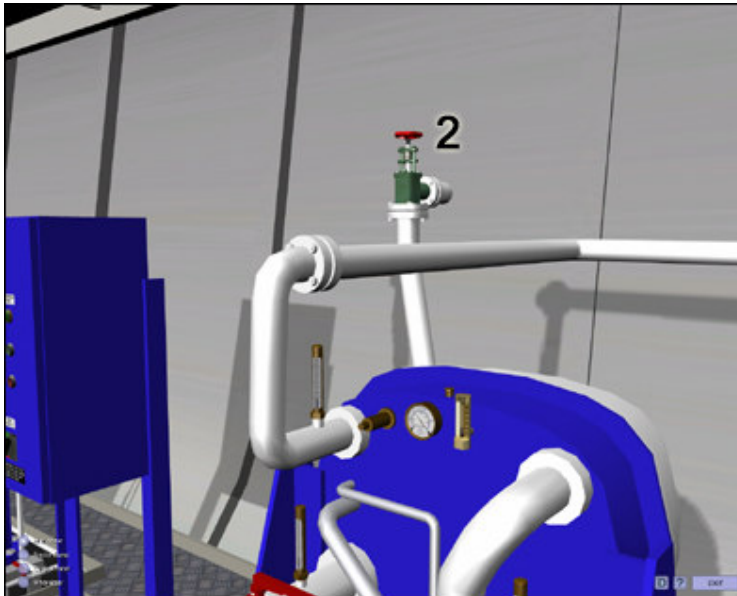
### 3. Operating procedures

Starting procedure:

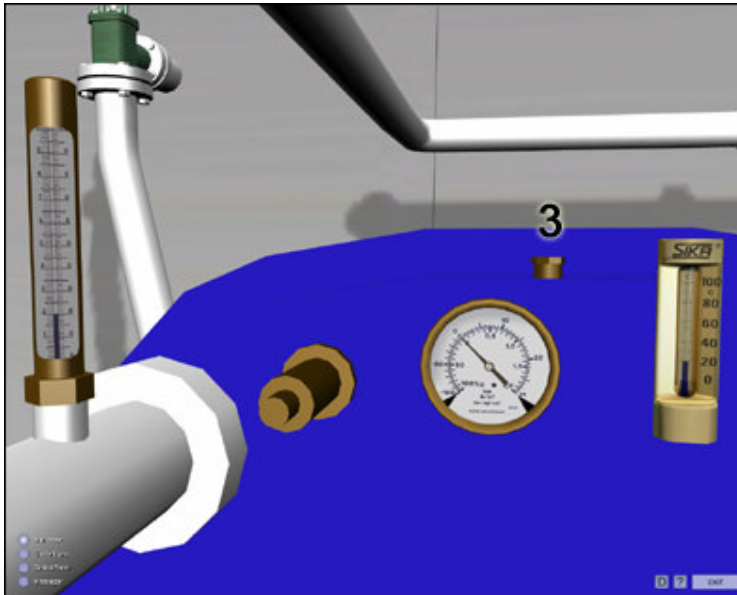
1. Open valves on the suction and discharge side of the ejector pump.



2. Open overboard valve for combined air/brine ejector.



3. Close air valve on the upper part of the freshwater generator vessel.

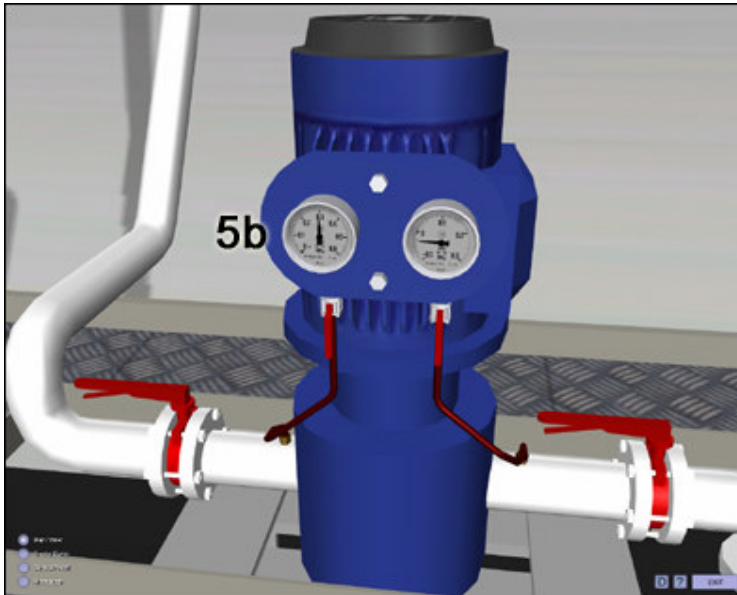


4. Set up the Main switch into position 1.

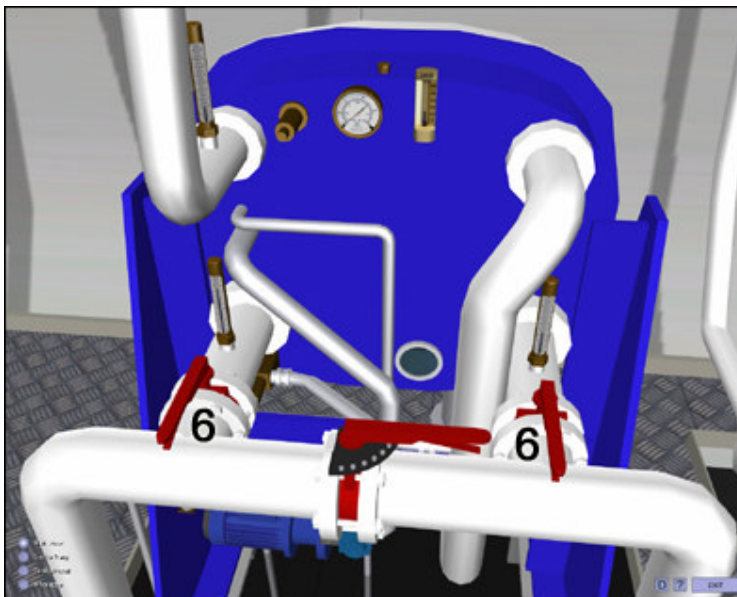
5a. Start ejector pump.



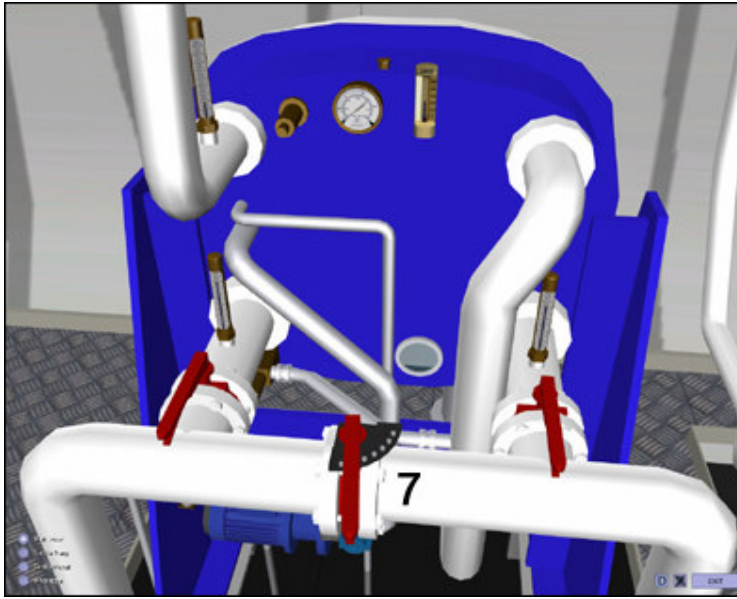
5b. Check ejector pump discharge pressure - min. 0,28 - 0,3 MPa.



6. When there is a minimum of 90% vacuum, open heating water valves on the suction and discharge side of the freshwater generator vessel.



7. Start hot water supply to evaporator section by adjusting by-pass valve, until the desired jacket water temperature is reached / inlet 80 °C, outlet 72 °C/ The boiling temperature inside the freshwater generator vessel should be about 45 °C.



Attention:

- Improper hot water flow /adjust by by-pass / will cause the following effects:
- a. in case the flow is too low- low boiling temperature, drop of freshwater production /high brine level in sight glass in freshwater generator vessel/
  - b. in case the flow is too high - high boiling temperature, drop of freshwater production, increase of salinity and drop of vacuum /low brine level in sight glass in freshwater generator vessel /.

8. Open valves on the suction and discharge side of the mineralizer.



9. Start fresh water pump.



10. When the salinity level drops below the set alarm point, set the Sec. (secondary) alarm on.



**Attention:**

During the first few minutes, after freshwater pump starts, salinity of produced water may be higher than the set alarm point, thus it is recommended to dump it to bilge (solenoid valve on the discharge side of freshwater pump stays open). When evaporation starts, the boiling temperature rises, while the obtained vacuum drops to approx. 93%. After few

minutes normal vacuum and boiling temperature is re-established, salinity drops below the set alarm point and solenoid valve closes.

### Adjustment of alarm level:

1. Set up the Main switch into position 1.
2. Push “Sec. Alarm” off.



3. Adjust Alarm Set to desired alarm level by using arrows (alarm level is indicated by red flashing led).
4. Switch “Sec. Alarm” on.





The salinometer is now ready for use.

If the salinity exceeds the alarm level,

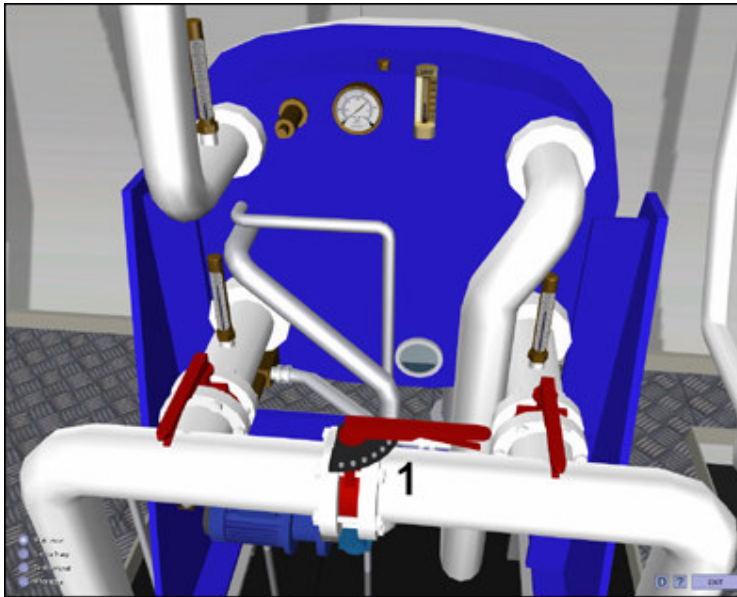
- The two red alarms LEDs flash.
- Solenoid valve is activated.
- Buzzer (if fitted) and external alarm system is activated.

Cancel buzzer and external alarm system by switching “Sec. Alarm” off. Solenoid valve is not affected.

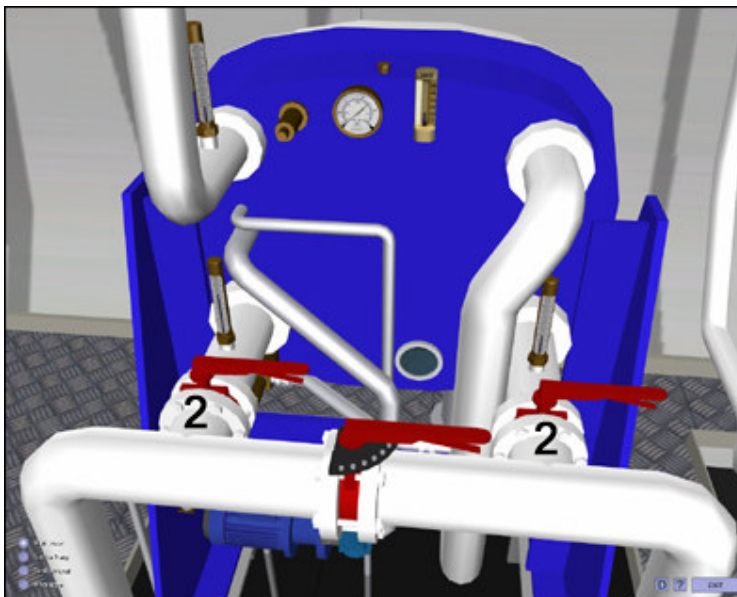
Switch “Sec. Alarm” on as soon as the salinity is normal again; i.e. when the two red LEDs is off.

Stopping procedure:

1. Open heating water by-pass valve fully (100%).



2. Close heating water valves on the suction and discharge side of the freshwater generator vessel.



3. Stop freshwater pump.



4. Set Sec. alarm off.



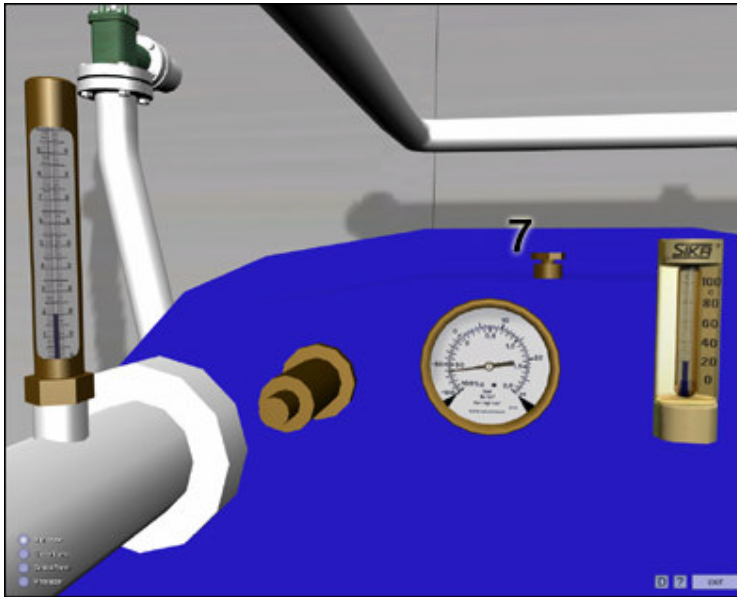
5. Stop ejector pump.



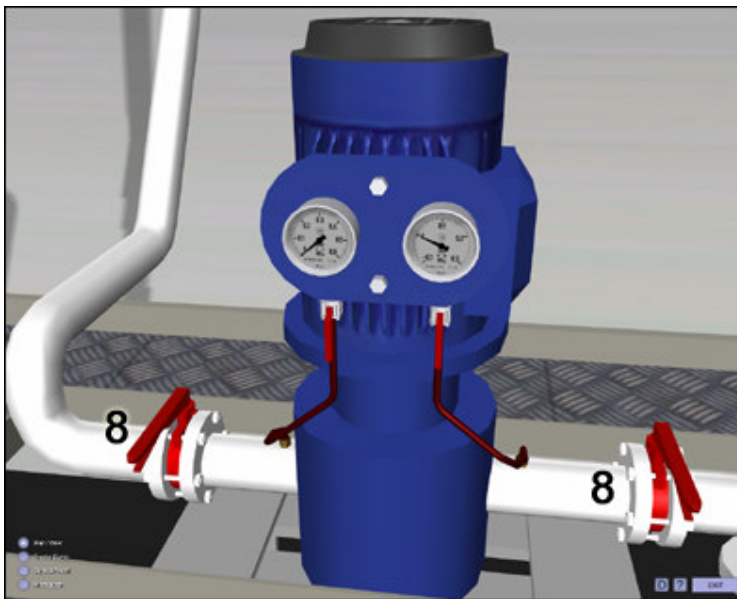
6. Set the Main switch into position 0.



7. Open air valve.



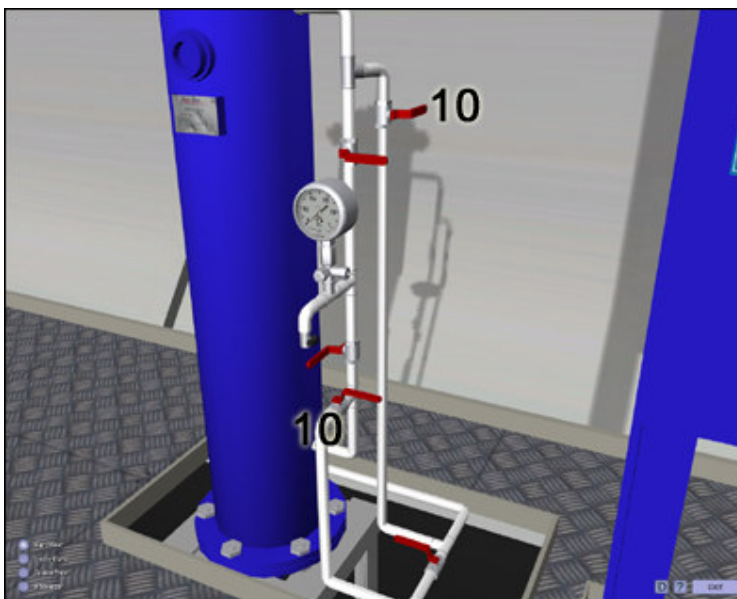
8. Close valves on the suction and discharge side of the ejector pump.



9. Close overboard valve for combined air/brine ejector.



10. Close valves on the suction and discharge side of the mineralizer.



# ECOSTREAM

## 1. Introduction

The ECOSTREAM SIMULATOR is intended for teaching the basic principles of how to operate a typical marine ecostream installation.

The EcoStream bilge water treatment system comprises four main functions:

- Forwarding/pumping
- Pre-treatment
- Separation
- Process control & monitoring

The simulator consists of the following elements:

1. Control Panel.
2. Diagram.

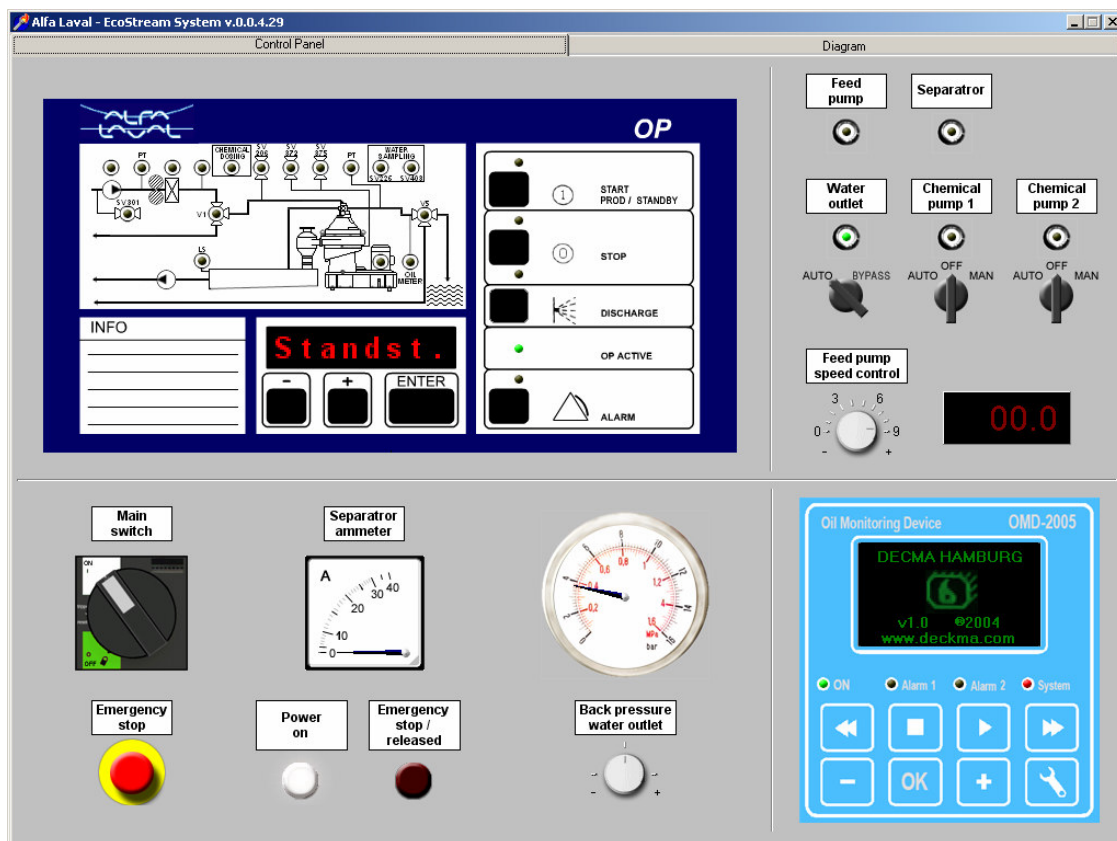


Fig.1 Control Panel

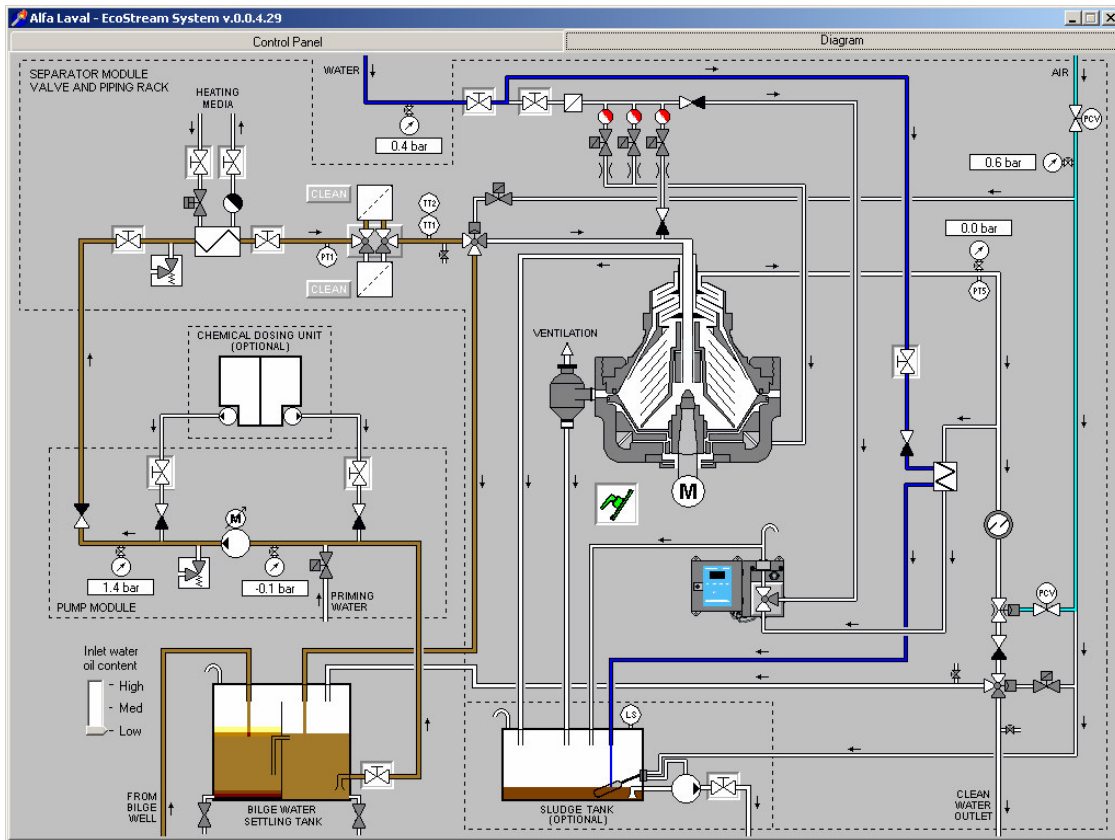


Fig. 2. Diagram

## 2. Working principles

Oily water from a bilge water settling tank or similar is forwarded to the pre-treatment, separation and process control & monitoring stages by a positive displacement feed pump with variable frequency drive.

In the pre-treatment stage the bilge water is fed through a dual basket strainer, which traps large particles from the fluid before it is fed to a heat exchanger, which raises the fluid to required separation temperature.

A three-way change-over valve is located after the heat exchanger in the pre-treatment stage but before the separation stage. The purpose of this valve is to direct the fluid to the separation stage when all process conditions, such as feed temperature, feed pressure and separator speed, are within pre-set process values. If any process condition is not met, the valve will recirculate the fluid back to the bilge water settling tank.

When all process conditions are fulfilled the fluid is directed to the separation stage – a high-speed centrifugal separator designed for continuous, high efficiency separation of large volumes of bilge/oily water.





Fig.3. Alfa Laval EcoStream

Separated oil and emulsions from the bilge water are continuously discharged through the light phase outlet (oil outlet) from the separation stage and directed to the sludge-collecting tank.

At pre-set intervals, solids/sludge collected in the separator bowl periphery are discharged through the sludge outlet via a cyclone which reduces the velocity and energy of the discharged volume, and are directed to the sludge-collecting tank.

Directly after the separation stage, in the heavy phase outlet (water outlet), where the treated bilge water is continuously discharged by the built in water pump (water paring disc), an oil-in-water monitor is connected to an isokinetic sampling point, where the oil content of the treated bilge water is continuously monitored. When the oil content is less than 15 ppm, the treated bilge water will be directed for discharge overboard, and if the oil content is greater than 15 ppm directed back to the bilge water settling tank.

To avoid formation of air bubbles in the system, which may disturb the monitoring accuracy of the oil-in-water monitor, a high precision, fast acting, constant pressure modulating valve is installed in the pre-treatment stage close to the separation stage.

The constant pressure valve is followed by a three-way change-over valve, which directs the treated bilge water for discharge overboard if the oil content is less than 15 ppm, or back to the bilge water settling tank if the oil content is greater than 15 ppm.

Three sampling cocks are installed in the pretreatment stage so that bilge water samples can be taken. These samples can then be analysed to monitor and control the performance of the system, as well as the measuring accuracy of the oil-in-water monitor.

The forwarding, pre-treatment, and separation stages are all controlled and monitored by the Process control & monitoring stage which is designed for fully-automatic unattended operation.

The process control & monitoring stage shows the status of the process, system valves and transmitters, activated or deactivated, and displays process parameters, alarms, and other important data in clear text.

A push button and LED station indicates the status of cleaned bilge water for discharge overboard and for re-circulation, forwarding stage and the optional automatic cleaning unit for the oil-in-water monitor.

Also located in the push button LED panel, is a key locked water discharge control switch. When this switch is in its bypass/locked position, bilge water cannot be pumped overboard, but is re-circulated, even when the oil content is less than 15 ppm.

An optional automatic self-cleaning filter can be installed between the forwarding and pretreatment stage, if a high solids/fibre load is expected.

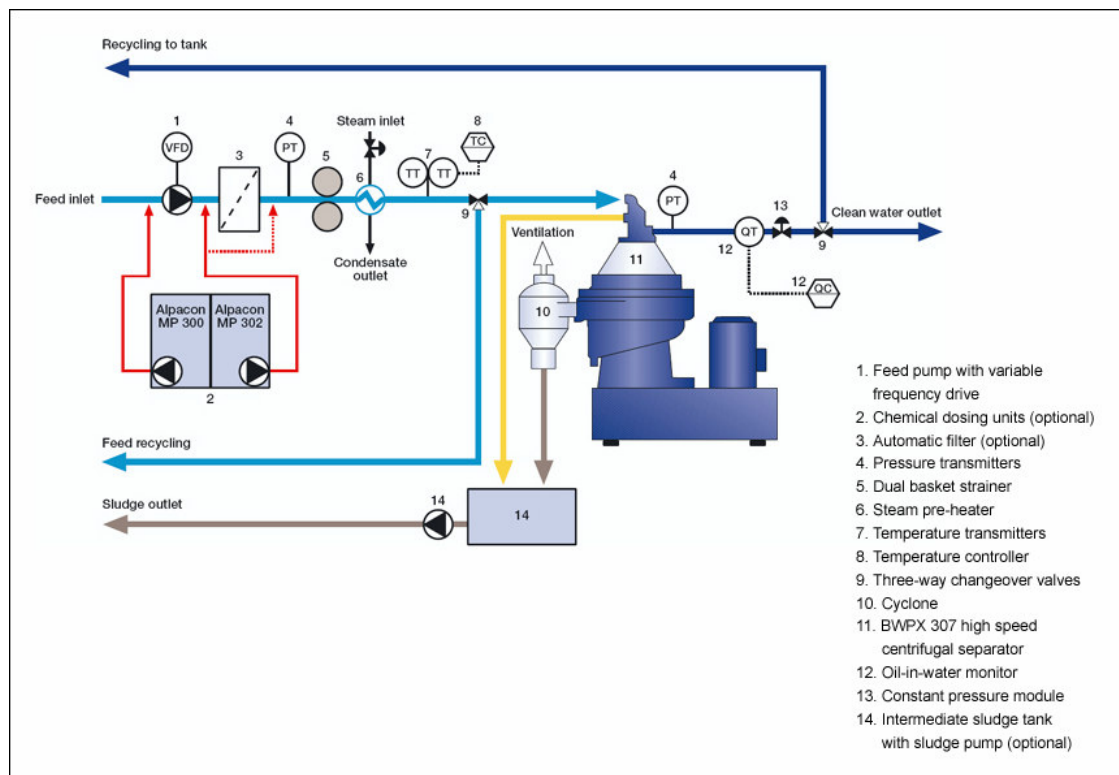


Fig. 4. Schematic diagram of EcoStream cleaning system

### 3. Operating procedures

#### 3.1. The EPC-50 control unit

The EPC-50 control unit can be activated by turning the switch inside the cabinet. Make sure that the control unit is active (LED green) before operating.

#### General principle for changing control parameters

The 'Enter' button is used to:

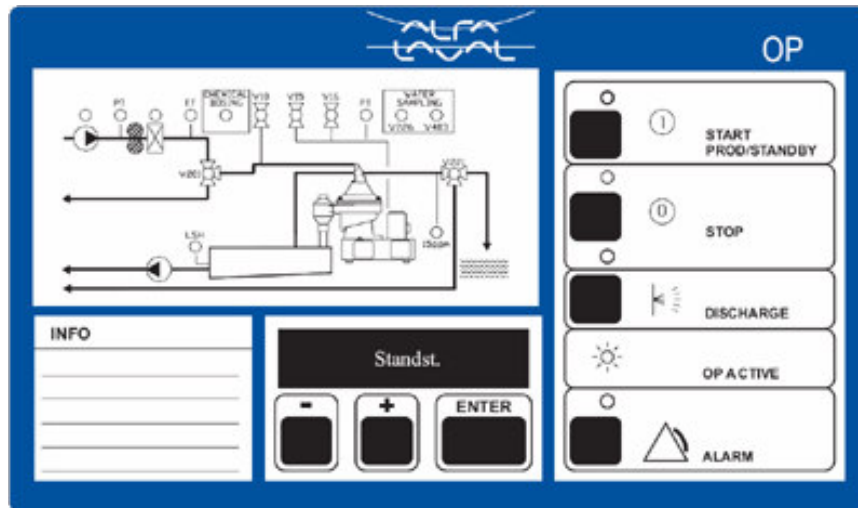
- enter into a parameter list
- enter into a parameter
- accept/store a new parameter value.

The '+' or the '-' buttons are used to change the value flashing in the display window.

#### Process parameters

Set the process parameters to suit the installation as follows:

1. Push 'Enter'. Parameter no. 1 in the process parameter list is shown. You have now come to the process parameter list. Go through the list and set parameters.
2. When the parameters have been set, 'End I/O' (flashing) shows. Push '+'. 'Standst.' now shows in the display.



#### 3.2. Before startup

1. Ensure that the separator is assembled and connected correctly.

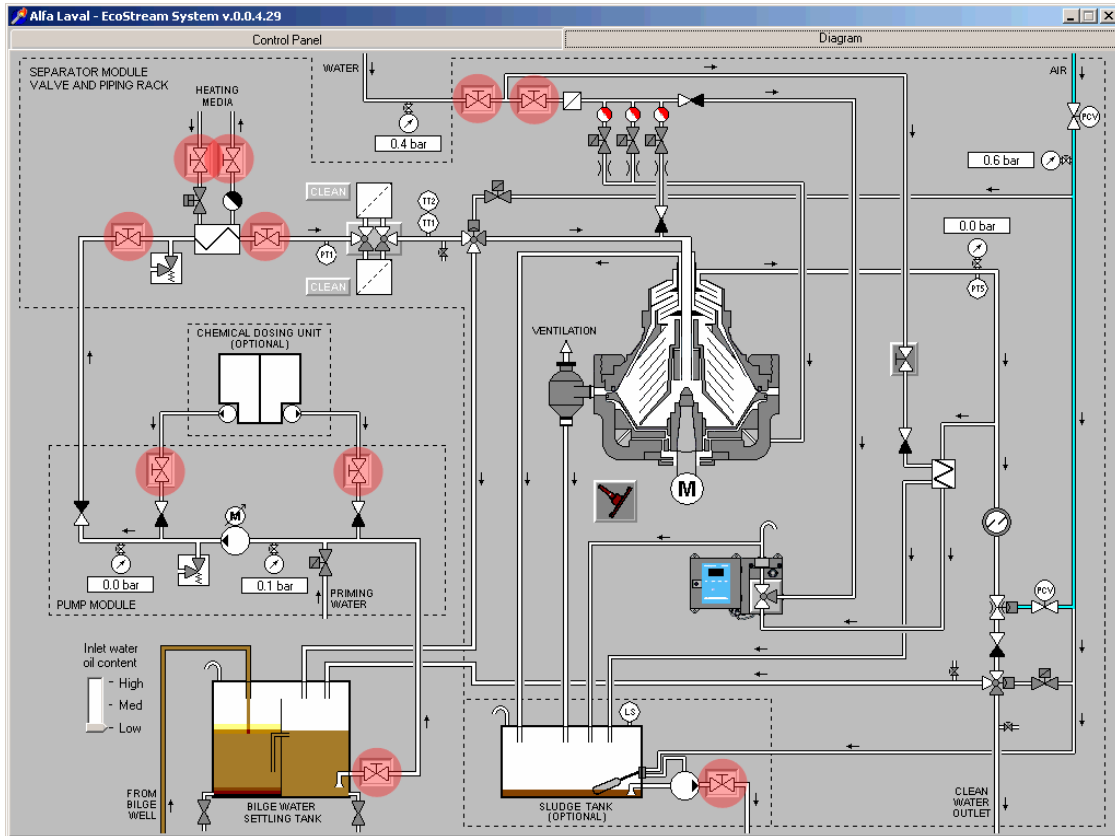
*Disintegration hazard*

*If the separator is not assembled and connected properly, this may lead to disintegration*

2. Check the oil sump level. It should be above the min. line on the glass.

*Too little oil can damage the separator bearings.*

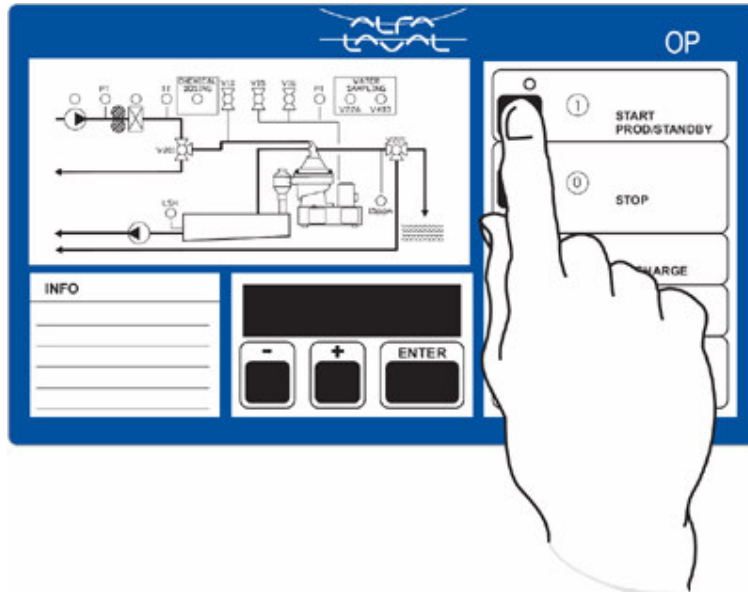
3. Check that the operating water pressure is sufficient (300 – 600 kPa or 3 – 6 bar).
4. Check that all hand operated valves are in the correct position.



5. Release the brake.
6. Turn power on.

### 3.3. Startup

1. Press the 'START' button to start the Bilge Water system.



Before the system can start, the following question scrolls across the display, and has to be answered:

'Assembled according to manual? + = YES, - = NO'

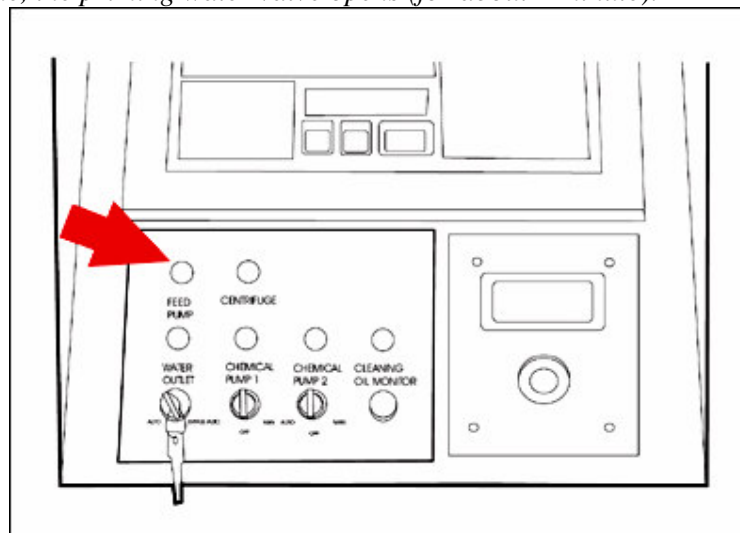
2. If the bowl has been dismantled and assembled according to the instructions in the Separator Manual, press the '+' button.



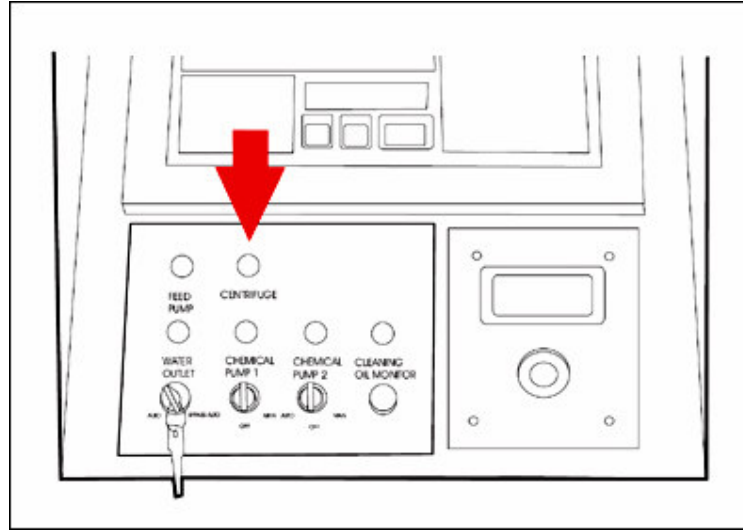
The system will now start automatically.

The feed pump starts, and the feed pump indication light lights up.

At the same time, the priming water valve opens (for about 1 minute).

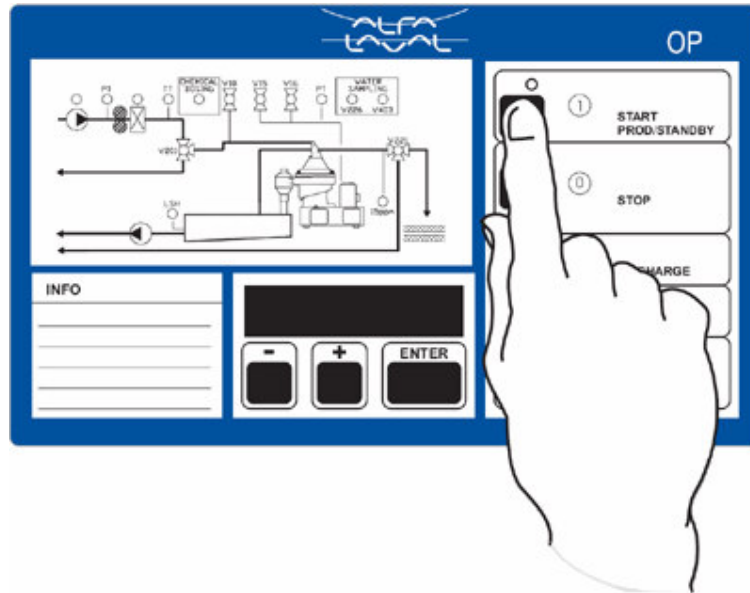


*The separator starts, which is shown by the separator indication light on the control panel.*



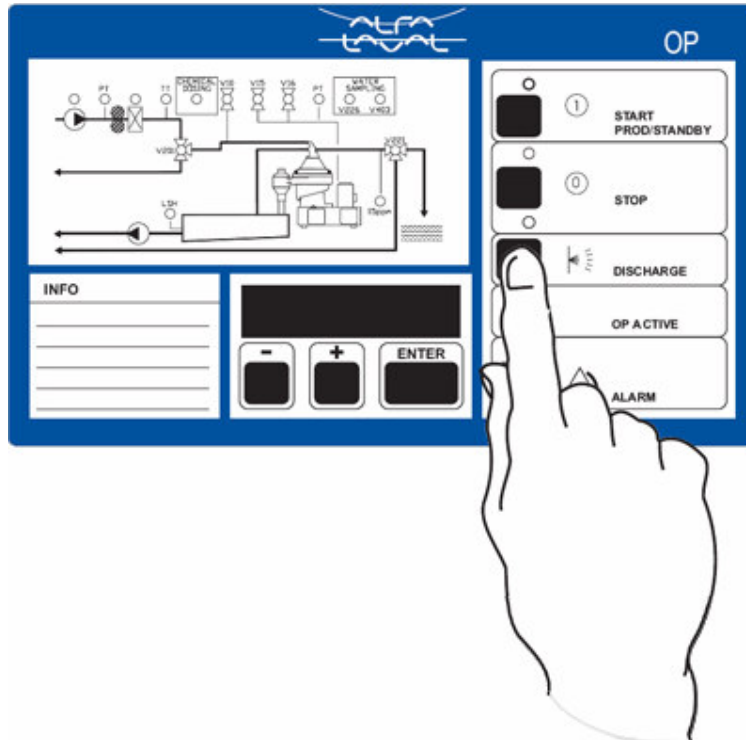
*If there is high level in the optional intermediate sludge tank, the sludge pump will start as soon as the control unit is started.*

3. The separator speed, and 'Wait.' are shown alternately in the display until the separator is at full speed. (During this time, pre-heating has started.) When the separator is at full speed (after 3 – 4 minutes), 'Standby' is shown on the display.
4. Check the bilge water feed temperature by pressing the '+' button until 'TT1' is shown on the display.
5. Wait until the bilge water feed temperature is according to setpoint.
6. Adjust the backpressure to the normal running value. Normal running backpressure is determined at commissioning (approx. 500 kPa or 5 bar).
7. When the separator has reached the correct speed (approx. 8000 rpm), and the bilge water has reached setpoint temperature, press the process 'START' button on the EPC-50 control unit to start the separation process.



*'Pre-prod' shows on the display until the process is in the production stage. 'Prod' is then shown alternating with the time to next sludge discharge. At start, the feed pump gives the lowest flow (circa 1500 liter/hour).*

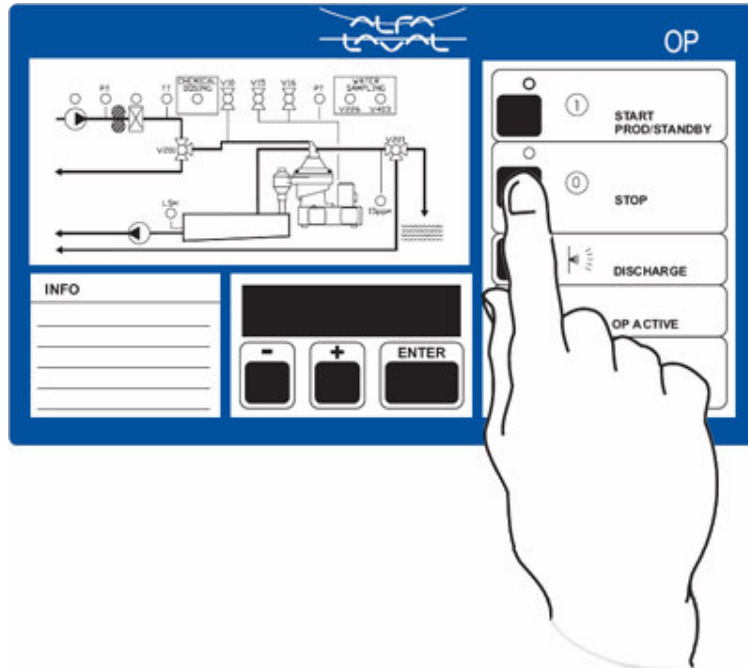
8. After 5 minutes have elapsed, initiate a manual sludge discharge. Make sure that the system is running steadily and that the PPM value is well below the max. set value (15 ppm).



### 3.4. Stop

1. Stop the system by pushing the 'STOP' button on the EPC-50 control unit.

*The yellow LED for separator stop sequence starts to flash.  
A sludge discharge is initiated. The stop sequence LED changes to steady yellow, and the green LED for separation system operation goes out, when the sludge discharge is completed.*



*'Stop' is displayed.*

*The heater is switched off automatically by the EPC 50 control unit.*

*The feed pump is then switched off automatically by the EPC 50 control unit.*

2. Wait until the separator is switched off by the control unit, i.e. when the starter ammeter reading drops to zero.

*'Stop.' is then displayed and the green LED for the centrifugal separator motor is off.*

3. Apply the brake.
4. Wait until the centrifugal separator has come to a complete standstill.
5. Release the brake.

*It is important to empty the bowl from bilgewater.*

6. Set the Man/Auto switch, located in the inside lower part of the EPC-50 control cabinet, to the 'MAN' position. Let the separator run for about 60 seconds.
7. Turn power off.
8. Set the Man/Auto switch to the 'AUTO' position.



### 3.5. Emergency stop

If an emergency situation occurs, press the emergency stop button and evacuate the area. Do not return until the separator has come to a complete standstill.



#### **Disintegration hazard**

If unusually strong vibration occurs, press the Emergency Stop button and evacuate the area. Do not enter the area while the separator is still rotating.