

# Engine Room Simulator

## Pielstick 10 PC 4 – M22

# Operator's Manual

Department/Author:

Arild Hermansen (s)

Approved by:

Harald Kluken (s)

© 2009 KONGSBERG MARITIME AS

All rights reserved

No part of this work covered by the copyright  
hereon may be reproduced or otherwise copied  
without prior permission from  
KONGSBERG MARITIME AS



### DOCUMENT STATUS

Issue No.	Date/Year	Inc. by	Issue No.	Date/Year	Inc. by
SO-1031-A	24-Nov-03	SELE/HK			
SO-1031-B	17-Dec-04	HD/beba			
SO-1031-C	21-Oct-05	AHE/beba			

### CHANGES IN DOCUMENT

Issue No.	ECO No.	Paragraph No.	Paragraph Heading/ Description of Change
B	MP-1535		Updated a few pictures.
C	MP-1571		Updated according to latest version.



## PREFACE

The Operators Manual contains only operator relevant information.

The purpose of Operators Manual is to provide detailed information of the vessel and the machinery modelled and on the operation of the machinery and systems.

The Operators Manual is divided into 4 parts.

### **Part 1 - Vessel and Machinery - Main particulars**

The purpose of this part is to introduce the vessel type and main data, the configuration of the propulsion plant and of the electrical plant. Also an overview of the available service systems is included in the part.

### **Part 2 - Automation and Control**

The purpose of Part 2 is to describe the functions and the features of the automation and the remote control systems on board the vessel.

### **Part 3 - Machinery and Operation**

The purpose of Part 3 is to provide a comprehensive manual describing system details and giving guidelines to operating procedures of each system.

Each system includes a system drawing and a description divided into 4 parts:

- **General** - describing the purpose of the system and also including system features and international regulations when relevant.
- **Description** – describing the system details.
- **Operation procedures** – giving a detailed guideline on the operation of each system. Importance is attached to the use of appropriate and safe procedures.
- **Model particulars** – focusing on special model features or limitations to be aware of.

**Engine Room Simulator**

**ERS M22 10 PC4 - Ferry**

**Operator's Manual**

**Part 1**

**Vessel and Machinery**

**Main Particulars**



## TABLE OF CONTENTS


Section		Page
<b>1</b>	<b>GENERAL DESCRIPTION .....</b>	<b>1</b>
1.1	Main ship data .....	1
<b>2</b>	<b>ALARM, MONITORING AND REMOTE CONTROL SYSTEM .....</b>	<b>3</b>
<b>3</b>	<b>PROPULSION PLANT.....</b>	<b>4</b>
3.1	Main engine data .....	4
3.2	Main propulsion plant - Operation and control modes .....	5
<b>4</b>	<b>ELECTRICAL POWER PLANT.....</b>	<b>6</b>
4.1	Electrical power supply .....	6
4.2	Main switch board functions.....	7
4.3	Electrical power plant - Operation modes.....	9
4.3.1	Tie line and circuit breaker's mode configuration.....	10
4.4	Emergency generator .....	12
4.5	Shore power.....	12
<b>5</b>	<b>SERVICE SYSTEMS .....</b>	<b>13</b>
<b>6</b>	<b>FIRE MONITORING AND EXTINGUISHING EQUIPMENT .....</b>	<b>14</b>

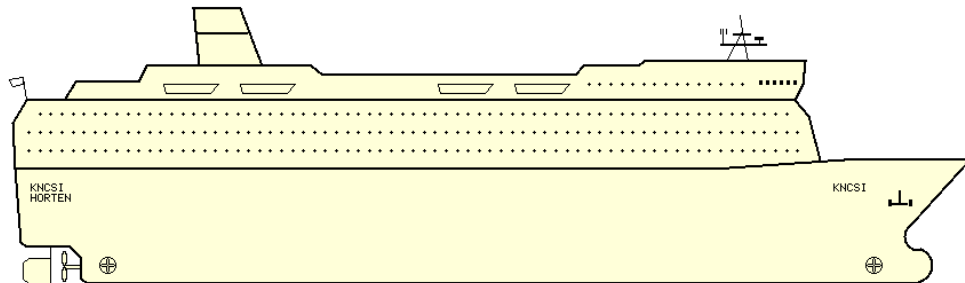




# 1 GENERAL DESCRIPTION

## 1.1 Main ship data

00:00:41 Freeze	Picture MD 112	Ship Load	Alarm Group																																																																																																					
<table border="1"> <thead> <tr> <th colspan="2">SHIP LOAD</th> <th colspan="2">BUNKER TANKS</th> <th colspan="2">SETTLING TANKS</th> <th colspan="2">STORAGE TANKS</th> <th colspan="2">DRAFT</th> </tr> </thead> <tbody> <tr> <td>Deadwth.</td> <td>M2668.8 ton</td> <td>Aft</td> <td>M262.50 ton</td> <td>HFO 1</td> <td>M120.00 ton</td> <td>DO</td> <td>M80.00 ton</td> <td>Trim (stern)</td> <td>X0.09 m</td> </tr> <tr> <td>Rel. Draft</td> <td>X78.49 %</td> <td>Port</td> <td>M306.25 ton</td> <td>HFO 2</td> <td>M120.00 ton</td> <td>LO</td> <td>M40.00 ton</td> <td>Heel (stbd)</td> <td>X0.00 deg</td> </tr> <tr> <td></td> <td></td> <td>Stbd</td> <td>M297.50 ton</td> <td></td> <td></td> <td>FW</td> <td>M100.00 ton</td> <td>Draft (mean)</td> <td>X5.13 m</td> </tr> <tr> <td></td> <td></td> <td>Fore</td> <td>M232.50 ton</td> <td colspan="2"><b>SERVICE TANKS</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="2"><b>TOTAL LOAD</b></td> <td colspan="2"><b>SEA WATER TANKS</b></td> <td>HFO</td> <td>M80.00 ton</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cargo</td> <td>M800.00 ton</td> <td>Aft</td> <td>M0.00 ton</td> <td>DO</td> <td>M79.99 ton</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>HFO</td> <td>M1418.8 ton</td> <td>Port</td> <td>M0.00 ton</td> <td colspan="2"><b>TANK CONTENT</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>DO</td> <td>M159.99 ton</td> <td>Stbd</td> <td>M0.00 ton</td> <td>Spill Oil</td> <td>M0.01 ton</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>SW</td> <td>M0.00 ton</td> <td>Fore</td> <td>M0.00 ton</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					SHIP LOAD		BUNKER TANKS		SETTLING TANKS		STORAGE TANKS		DRAFT		Deadwth.	M2668.8 ton	Aft	M262.50 ton	HFO 1	M120.00 ton	DO	M80.00 ton	Trim (stern)	X0.09 m	Rel. Draft	X78.49 %	Port	M306.25 ton	HFO 2	M120.00 ton	LO	M40.00 ton	Heel (stbd)	X0.00 deg			Stbd	M297.50 ton			FW	M100.00 ton	Draft (mean)	X5.13 m			Fore	M232.50 ton	<b>SERVICE TANKS</b>						<b>TOTAL LOAD</b>		<b>SEA WATER TANKS</b>		HFO	M80.00 ton					Cargo	M800.00 ton	Aft	M0.00 ton	DO	M79.99 ton					HFO	M1418.8 ton	Port	M0.00 ton	<b>TANK CONTENT</b>						DO	M159.99 ton	Stbd	M0.00 ton	Spill Oil	M0.01 ton					SW	M0.00 ton	Fore	M0.00 ton						
SHIP LOAD		BUNKER TANKS		SETTLING TANKS		STORAGE TANKS		DRAFT																																																																																																
Deadwth.	M2668.8 ton	Aft	M262.50 ton	HFO 1	M120.00 ton	DO	M80.00 ton	Trim (stern)	X0.09 m																																																																																															
Rel. Draft	X78.49 %	Port	M306.25 ton	HFO 2	M120.00 ton	LO	M40.00 ton	Heel (stbd)	X0.00 deg																																																																																															
		Stbd	M297.50 ton			FW	M100.00 ton	Draft (mean)	X5.13 m																																																																																															
		Fore	M232.50 ton	<b>SERVICE TANKS</b>																																																																																																				
<b>TOTAL LOAD</b>		<b>SEA WATER TANKS</b>		HFO	M80.00 ton																																																																																																			
Cargo	M800.00 ton	Aft	M0.00 ton	DO	M79.99 ton																																																																																																			
HFO	M1418.8 ton	Port	M0.00 ton	<b>TANK CONTENT</b>																																																																																																				
DO	M159.99 ton	Stbd	M0.00 ton	Spill Oil	M0.01 ton																																																																																																			
SW	M0.00 ton	Fore	M0.00 ton																																																																																																					



**The ship represents a ferry with the following main data:**

Length overall:	160 m
Length between p.	145 m
Breadth (moulded)	24 m
Draught	5,5 m
Grt	18000 ton
Dwt	3400 ton
Displacement	12000 ton
Steel weight	8600 mt

**Main Engines**

Two Pielstick 10 PC 4.2 2\*5V each with a continuous service rating of 10930 kW shaft power which gives the ship a speed of 22.5 knot at 133 propeller shaft rpm.

**Propeller System**

- two sets of reduction gears with air operated clutches for propeller shafts and shaft generators
- two propeller shafts with CP-propeller



Reduction gear ratio            1:3  
Propeller diameter            4.60 m

**Electrical power plant**

- two 600 kW/1040A/440 V/60Hz diesel engine driven synchronous generators
- two 700 kW/1040A/440 V/60Hz synchronous shaft driven generators
- one 180 kW/440 V/60Hz emergency generator

**Thrusters**

1 CPP Bow Thruster            600 kW  
1 CPP Stern Thruster           600 kW

**Steering Gear**

Double acting, rotary vane type, IMO Model

**Tanks**

The following main tanks are included:

- 2 Fuel oil settling tanks
- 1 Fuel oil service tanks
- 4 Fuel oil bunker tanks
- 1 Spill oil tank
- 1 Sludge tank
- 1 Clean bilge tank
- 1 Diesel oil storage tank
- 1 Lubrication oil storage tank
- 2 x1 Ballast wing tank
- 1 Fore peak tank
- 1 Aft peak tank

## 2 ALARM, MONITORING AND REMOTE CONTROL SYSTEM

The alarm, monitoring and remote control is handled by the following modules:

- The **DataChief** module for general alarm and monitoring of machinery and vessel.
- The **AutoChief** module for remote control and management of the propulsion plant.
- The **PowerChief – Generator Control** module for remote control and management of the generators.
- The **PowerChief – Pump and Compressor Control** module for remote control and management of the pumps and air compressors.

The DataChief consists of a high-resolution graphic workstation.

Alarms are announced by an audible signal and the alarm group is indicated in the upper part of the monitor. Alarm log, alarm acknowledgement and general alarm handling is described in a separate section in the document, Instructor Manual.

The DataChief also act as the operator station. All functions incorporated in a general workstation, such as mimic drawings, trend system, PID Controllers, general numeric indicators, status signal and alarm limits are available.

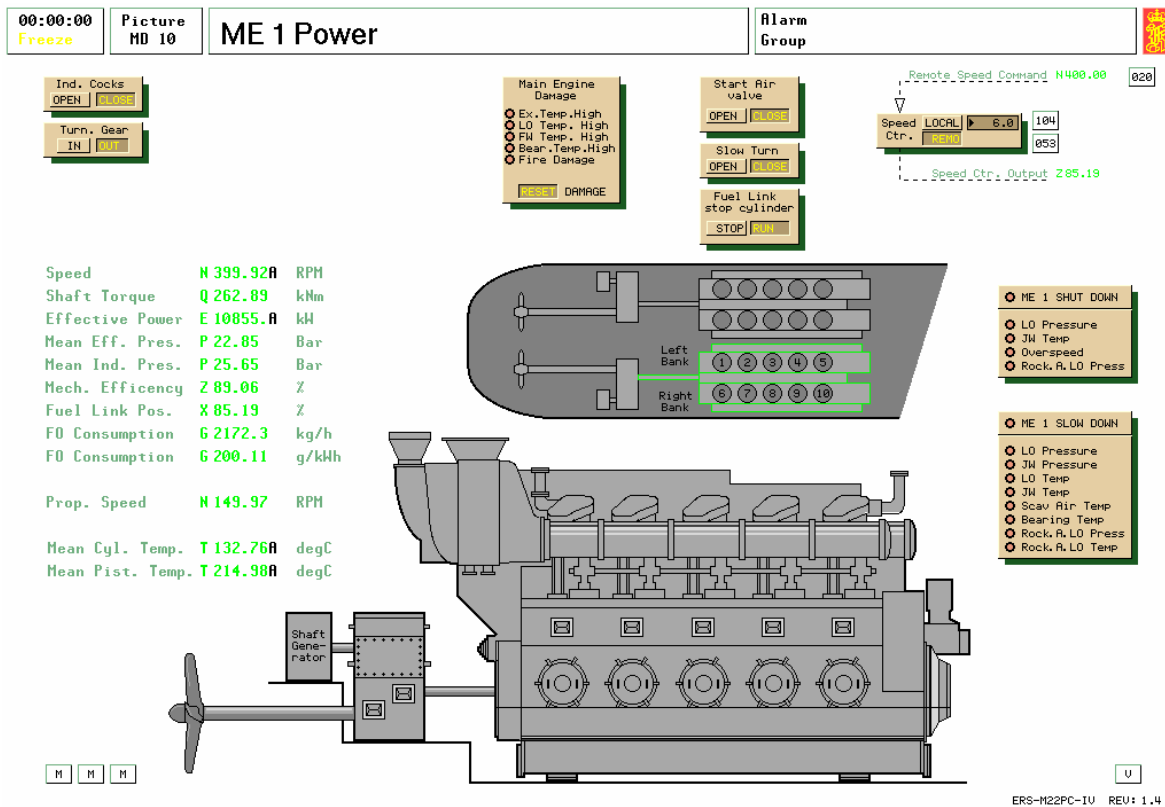
The AutoChief is handled from a separate AutoChief panel.

The Power Chief – Generator Control and the PowerChief - Pump and Compressor Control modules may be operated from a separate panel or directly from the DataChief operator station.



### 3 PROPULSION PLANT

#### 3.1 Main engine data



The propulsion machinery is based on two Pielstick 10 PC 4.2 2\*5V, medium speed, 10 cylinder/V-configuration, 4-stroke, turbocharged, non-reversible diesel engines. Each main engine is coupled to a propeller shaft with controllable pitch propeller, via a reduction gear and an air-operated clutch. Also a shaft generator is attached to each reduction gear.

#### Main engine particulars

Cylinder bore / piston stroke	570 mm / 620mm
Number of cylinders	2 x 5, Vee-configuration
Number of air coolers	2
Number of turbochargers	2
Maximum power	11500 kW (shaft power)
Continuous service rating (CSR)	10930 kW (shaft power) at 400 rpm
Mean effective pressure	23 bar
Specific fuel oil consumption, max	186g/kWh
Specific fuel oil consumption, 85%	183g/kWh

#### Gear and propeller shaft

Reduction gear	1:3
Propeller diameter	4.60 m
Propeller speed	133 rpm

**Ships speed at CSR** 22.5 knots

Each main engine is equipped with the following auxiliary systems:

- Jacket cooling water system including pre-heating system.
- Injector cooling water cooling system.
- Main lubrication oil system.
- Rocker arm lubrication system.
- Turbocharger and scavenging air cooling system.
- Main engine sea water cooling system.

The gear and propeller system includes:

- Propeller gear lubrication oil system
- Propeller servo system
- Stern tube lubrication oil system
- Steering gear system

### **3.2 Main propulsion plant - Operation and control modes**

When remote controlled from the engine control room or from the bridge control panel, the AutoChief controls the propulsion plant.

The main engines may be operated in four different modes.

**The four modes are:**

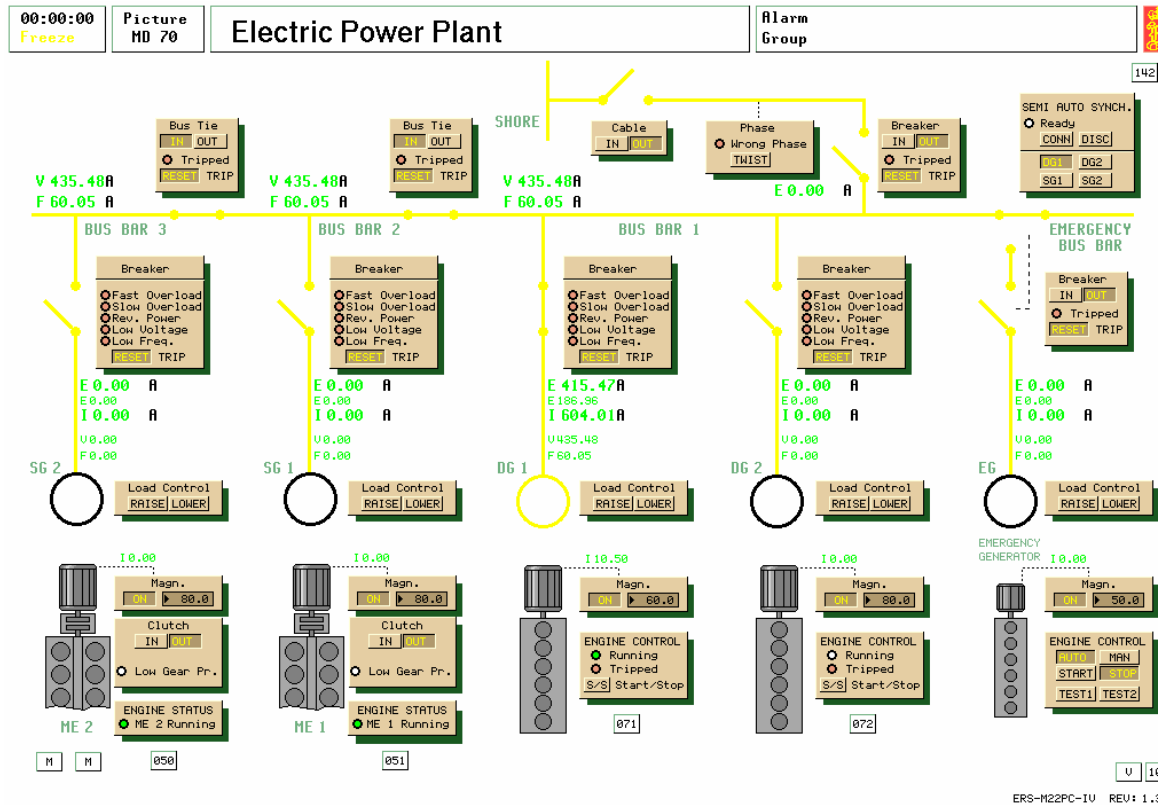
- Combinator
- Split
- Economy
- Shaft Generator

The AutoChief also handles the propulsion plant safety and over load control system including:

- Slow down and shut down functions for the main engine and the gear
- Min engine load limitations (scavenge air pressure and torque control)
- Rpm/pitch rate limitations
- Overload control of main engine

## 4 ELECTRICAL POWER PLANT

### 4.1 Electrical power supply



The ship's electric power is generated by:

- two 600 kW/1040A/440 V/60Hz/1200 rpm diesel engine driven synchronous generators - diesel generator 1 (DG1) and diesel generator 2 (DG2)
- two 600 kW/1040A/440 V/60Hz/1200 rpm synchronous generators - shaft generator 1 (SG1) and shaft generator 2 (SG2), driven via the port and the starboard main propeller gear respectively.
- one 180 kW/440 V/60Hz emergency generator

and distributed via:

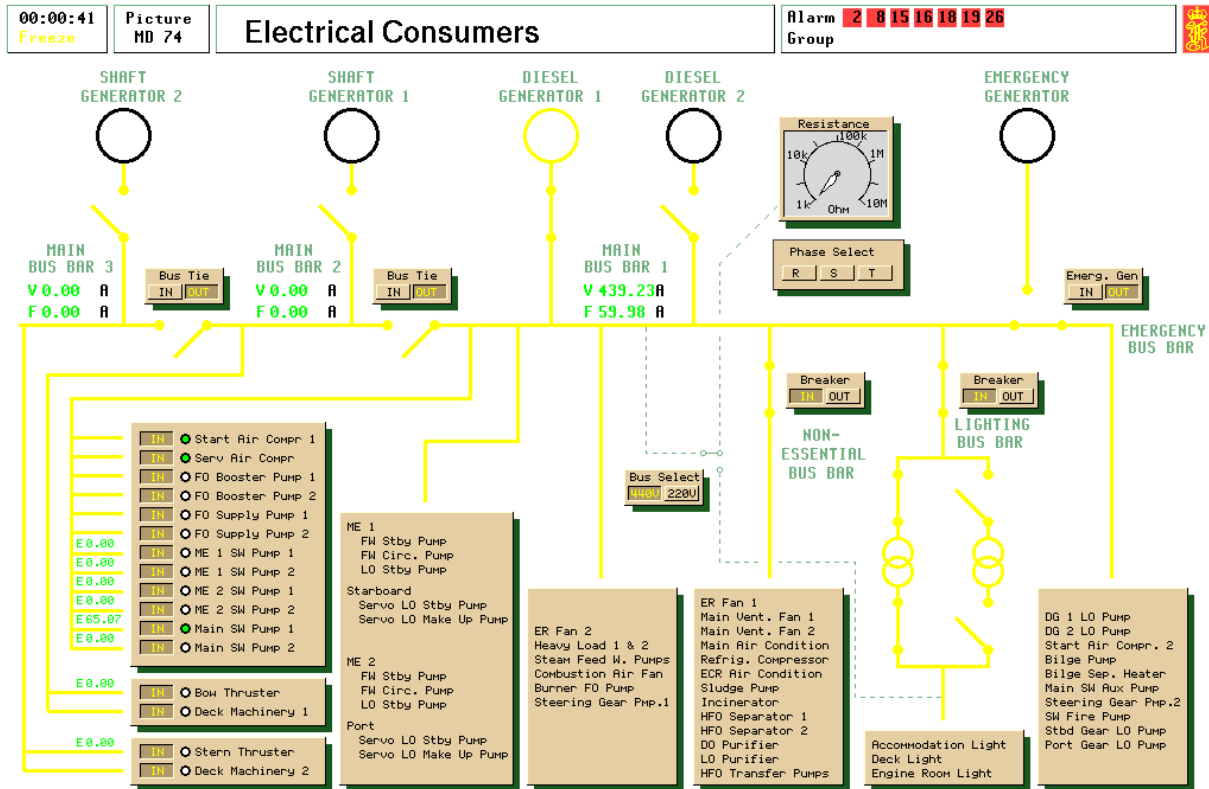
- one main switchboard, divided into three main 440V bus bars
- one 220 lightning bus bar
- one emergency bus bar

Bus bar 1 powers all the electrical main consumers and the emergency bus bar.

Bus bar 2 powers the bow thruster.

Bus bar 3 powers the stern thruster and the heavy consumers (reefer container switchboards and the deck crane).

The 220 V lightning bus bar is supplied from bus bar 1 via the lightning bus bar circuit breaker and two transformers.



## 4.2 Main switch board functions

### Main switch board functions

The main switchboard functions includes all controls and indicators usually available on real switchboards and includes the following sections:

- Bus bar 3 with shaft generator 2 and stern thruster and deck machinery
- Bus bar 2 with shaft generator 1 and bow thruster and deck machinery 2
- Diesel Generator 1 section
- Diesel Generator 2 section
- Turbo generator section
- Synchronisation w/ Shore power section
- Emergency Generator w/ Emergency bus bar section
- Miscellaneous including fuse breakers for main consumers

Each of the generator sections contains meters for V, A, kW, kVAr and Hz. A selector switch enables the reading of the separate phases.

### Voltage control

The field voltage (magnetisation)-setting device enables voltage control and balancing between active and reactive load when the generators are operating in parallel.

**RPM control**

The rpm of each generator, can be adjusted from the main switchboard (Electrical Power Plant)

**Generator breakers**

Automatic disconnection of the generators from the bus bar is activated by the following functions:

- Overload of generator
- Slow overload of generator
- Reversed power
- Low voltage
- Low frequency



### 4.3 Electrical power plant - Operation modes

The electric power system is designed for four operation modes:

#### I Shaft generators disconnected

The diesel generators power all three bus bars, which are connected by the tie-line breakers.

This mode is normally used during:

- Harbour, main engine stopped.
- Sea passage with main engines in Combinator mode, Economy or Split mode.

#### II Manoeuvre mode - Fixed speed (Shaft generators and thrusters connected)

Tie-line breaker 1 and 2 are open. The diesel generators power main consumers via bus bar 1. Shaft Generator 1 powers the stern thruster. Shaft Generator 2 powers the bow thruster and the heavy consumers.

- Main engines are operated in Shaft Generator mode.

**Note:** If very high load from heavy deck consumers (reefers or other) it may be necessary to disconnect deck consumers in order to have sufficient power for the bow thruster.

#### III Sea passage - Fixed speed - Shaft generators connected (Diesel generators disconnected)

Tie-line breaker 2 is open and Shaft Generator 2 powers the heavy consumers. Tie-line breaker 1 is closed and Shaft Generator 1 powers the main consumers via bus bar 1. Diesel generators are stopped and stand by.

- Main engines are operated in Shaft Generator mode.

In this mode the pitch change rate is reduced in order to avoid too heavy frequency fluctuations. Thus the manoeuvre ability is reduced.

#### IV Sea Passage – Diesel generators connected (High electrical load at bus bar 1)

Tie-line breaker 1 and 2 are open. - The diesel generator powers main consumers via bus bar 1. - Shaft Generator 2 powers the heavy consumers.

This mode is used during sea passage if high electrical load at bus bar 1.

- Main Engines may be operated in any of the four modes.

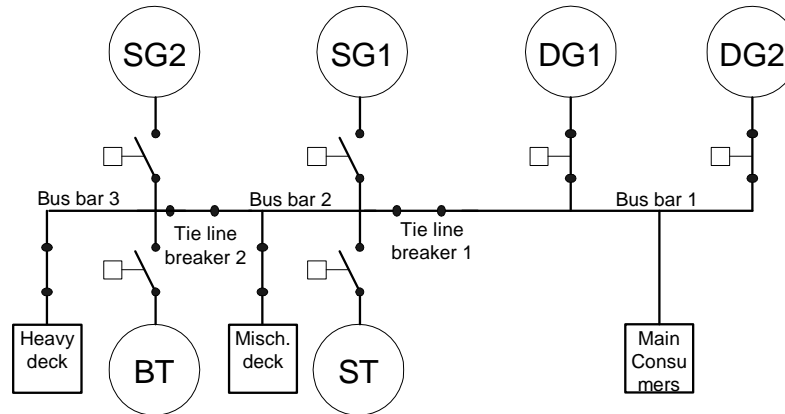
#### **NOTE!**

**The shaft generator and the diesel generators must only be operated in parallel during synchronising and load transfer.**

**Two shaft generators may never be operated in parallel.**

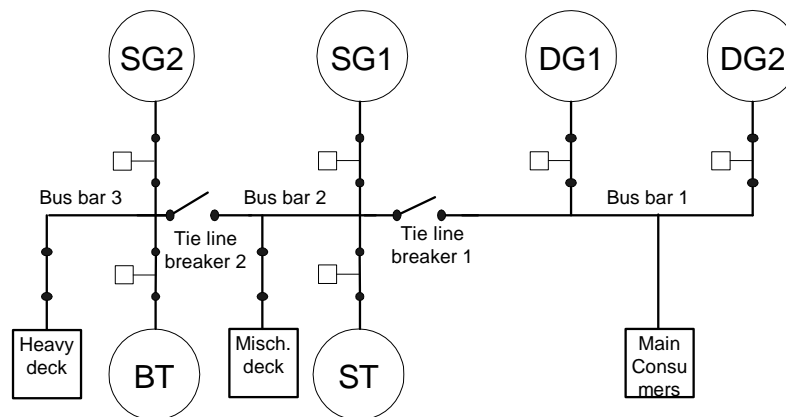
### 4.3.1 Tie line and circuit breaker's mode configuration

#### I - Shaft generators disconnected



- **Harbour** ME stopped
- **At sea** ME mode: Combi, Economy or Split

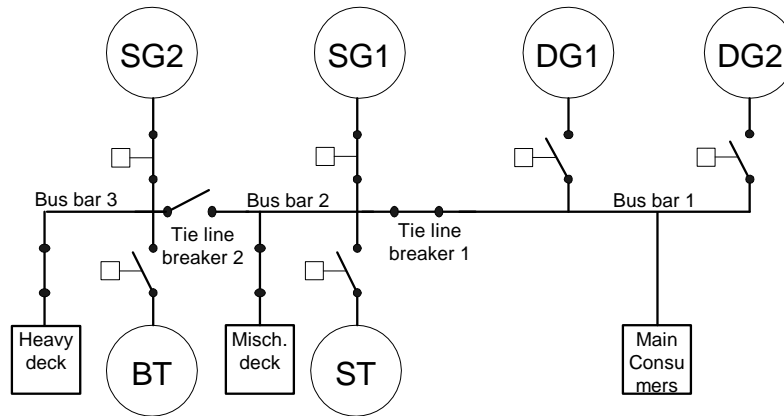
#### II - Manoeuvre - Fixed speed (Shaft generators and thrusters connected)



ME mode: SG Speed

**Note:** During manoeuvre it may be necessary to disconnect heavy deck consumers

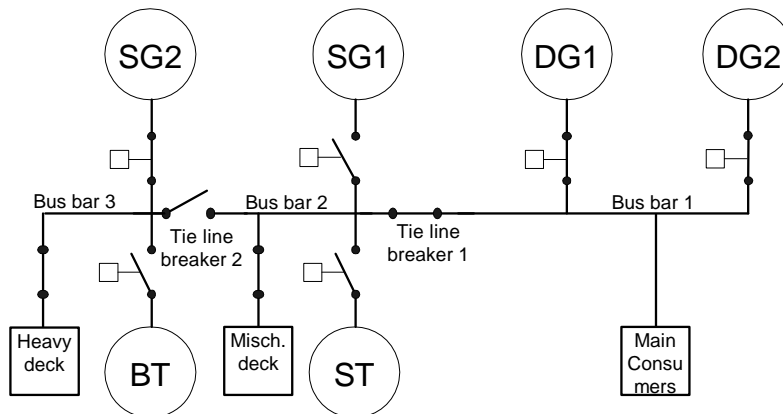
**III - Sea passage - Fixed speed - Shaft generators connected (Diesel generators disconnected)**



ME mode:SG speed

**Note:** Pitch change rate is reduced

**IV - Sea passage - Diesel generators connected (High electrical load bus bar 1)**



ME mode:SG speed



## 4.4 Emergency generator

The emergency generator is arranged for automatic start and connection to the emergency switchboard in the event of failure of normal supply from bus bar 1.

In the event of low voltage at bus bar 1 the following sequence will take place, provided that the emergency generator is in AUTO:

1. The emergency generator is started
2. The emergency tie-line breaker is opened
3. The emergency generator is connected to the emergency bus bar.

and when the voltage at bus bar 1 is re-established the sequence is

1. The emergency generator circuit breaker is disconnected
2. The emergency tie-line breaker is closed
3. The emergency generator stops after a few minutes of idling.

The emergency switchboard is equipped with a **TEST** button. If the TEST button is activated a zero-voltage at bus bar 3 is simulated. The emergency generator will start, the emergency tie-line breaker is opened and the generator will connect provided that the emergency generator is in AUTO. A lamp indicates when the test function is active. When pressing the TEST button again the test function is cancelled and the power supply from bus bar 3 to emergency bus bar is re-established.

If the emergency generator is not in AUTO it can be manually started and connected. The emergency tie-line breaker and the emergency generator circuit breaker are interlocked, i.e. the emergency generator circuit breaker cannot connect unless the emergency bus bar tie-line breaker is open and vice versa.

### NOTE

**It is not possible to run the emergency generator in parallel with the main generators.**

## 4.5 Shore power

Bus bar 1 is supplied from shore connection via the shore cable and the shore connection circuit breaker. The maximum electric load obtained via the shore connection is 280 kW. At cable connection, the electric phase will be chosen at random. A rotating light-wheel indicates the phase sequence. Clockwise rotation is correct. Pressing the “WRONG PHASE” button simulates a corrective phase change and the shore connection can be set.

## **5 SERVICE SYSTEMS**

All service systems can be operated from the operator station or locally from the engine room. The following machinery and systems are included:

- Main sea water system
- Fuel oil transfer system
- Fuel oil settling tanks
- Fuel oil supply system
- Fuel oil service tanks
- Fuel oil separators system
- Diesel oil separator system
- Lubrication oil purifier system
- Start and service air compressor system
- Fresh water generator
- Bilge system including bilge separator
- Refrigerating system
- Steam boiler system



## **6 FIRE MONITORING AND EXTINGUISHING EQUIPMENT**

A fire indication system indicates when:

- Fire in engine room
- Fire deck area

The engine room is protected by a CO<sub>2</sub> system with remote release.

Additionally the vessel is equipped with 1 seawater fire pump and a fire main. Fire hydrant is opened from variable page (water canon).

<This page is intentionally left blank>