

Engine Room Simulator

ERS M22 10 PC4 - Ferry

Operator's Manual

Part 2

Automation & Control

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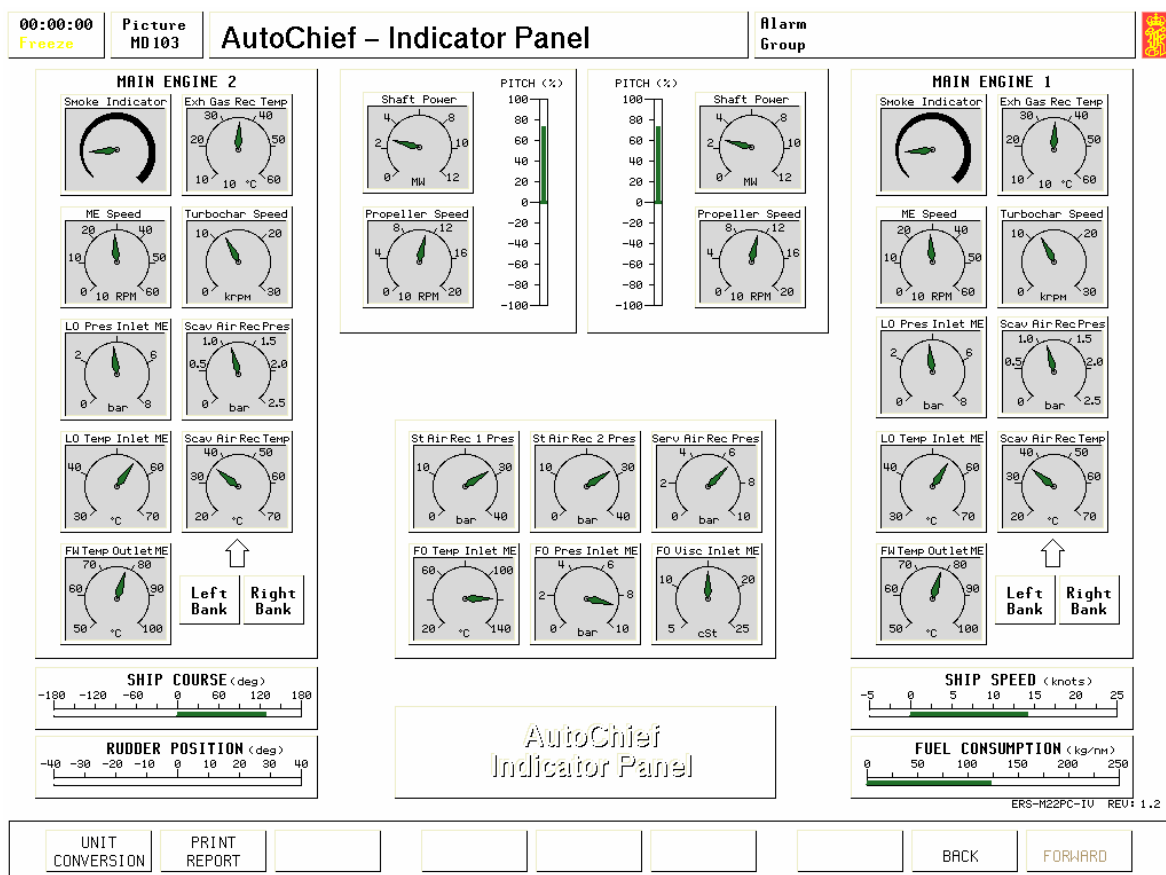
1 PROPULSION PLANT – AUTOCHIEF REMOTE CONTROL

1.1 Main engine - Remote control functions

The main engine remote control system is located at the **AutoChief** panel. The AutoChief panel includes:

- Indicator panel
- Main engine control

1.1.1 Indicator panel description



The AutoChief – Indicator panel includes the following readings:

Standard indication configuration:

- ME 1 & 2 shaft power
- ME 1 & 2 propeller speed
- ME 1 & 2 propeller pitch
- Ship course
- Rudder position
- Ship speed
- Fuel consumption



- ME 1 & 2 smoke indicator
- ME 1 & 2 exhaust gas receiver temperature
- ME 1 & 2 engine rpm
- ME 1 & 2 scavenging air manifold temperature
- ME 1 & 2 scavenging air manifold pressure
- ME 1 & 2 turbocharger rpm
- ME 1 & 2 lubrication oil temperature inlet ME
- ME 1 & 2 lubrication oil pressure inlet ME
- ME 1 & 2 fresh water temperature outlet ME
- Start air pressure receiver 1 & 2
- Service air receiver pressure
- Fuel oil pressure inlet ME
- Fuel oil temperature inlet
- Fuel oil viscosity inlet ME

Left and right bank indication

In the lower corners of the panel there are two push buttons with integrated lamp used to select readings related to the turbocharger and exhaust system of each of the two V-configured main engines. Instead of indicating the mean values of the parameters related to the turbochargers and each of the banks, the select push buttons give the operator opportunity to select left- or right bank indication.

The following parameters are included:

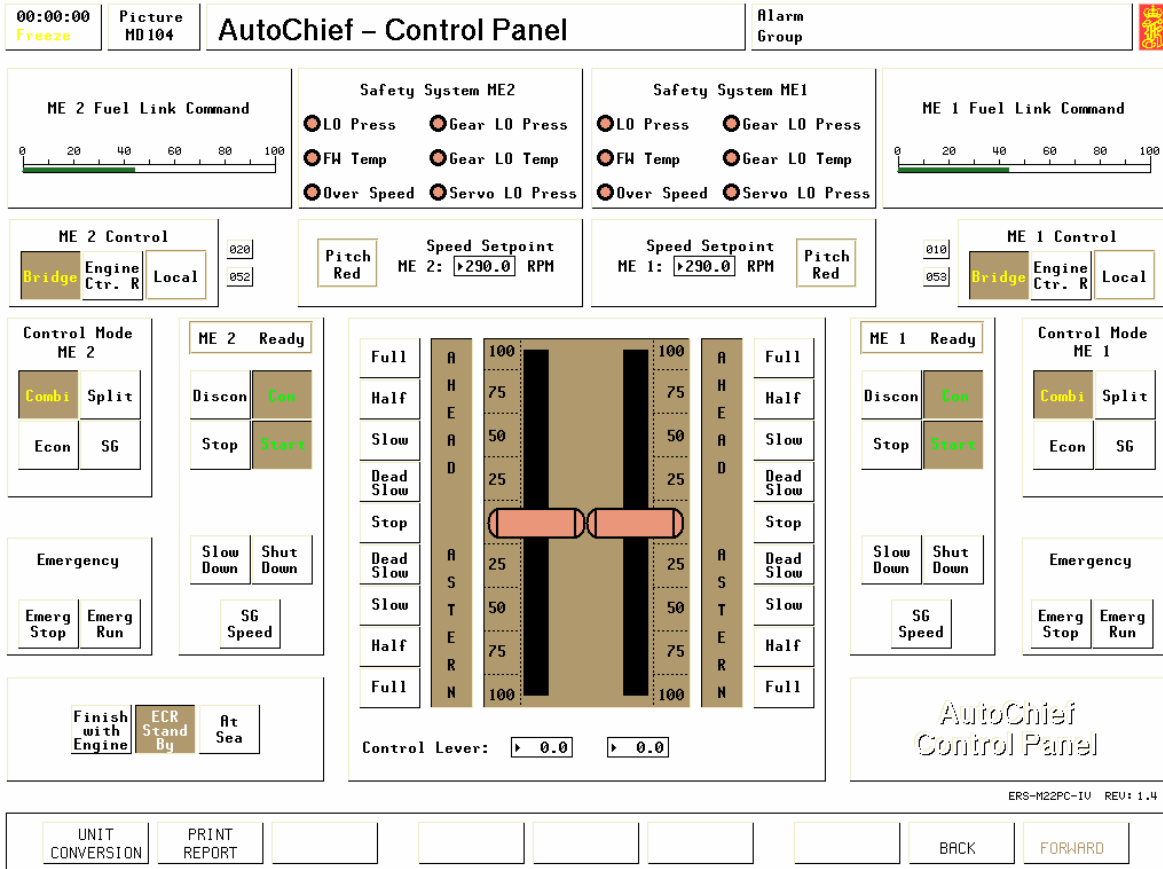
- Scavenging air receiver temperature
- Scavenging air receiver pressure
- Turbocharger speed
- Exhaust Gas receiver temperature

If **LEFT BANK** is activated, the operator can read the values for the left bank.

If **RIGHT BANK** is activated, the operator can read the values for the right bank.

If **none of the push buttons** are activated, the operator can read the mean values of left- and right bank

1.1.2 Control panel description



The AutoChief main engine control panel is equipped with throttles, indicating instruments and push buttons that enables supervision and control of the main engines.

Control commands for each engine

- Throttle rpm / pitch
- Emergency run/stop
- Responsibility transfer
- Control mode
- Main engine start / stop
- Clutch connection in / out
- Manual rpm setting

Status for each engine

- Fuel link command
- Operation mode - (Combinator / Split / ECO / SHAFT GENERATOR)
- Manuel rpm set point
- Emergency telegraph
- Main engine shut down and slow down
- Main engine ready
- Main engine fail status



1.1.2.1 Control panel functions

Start	Starts the ME(s) from the AutoChief control panel.
Stop	Stops the ME(s) from the AutoChief control panel.
Connect	Connects the main engine propeller gear clutch. NOTE! ME speed must be below 200 rpm before connecting in order not to burn off the friction lining
Disconnect	Disconnects the main engine propeller gear clutch.
Speed set point	Manual adjustment of rpm set point. If one of the control modes Combi/Econ/SG has been selected the rpm set point given from the control system is displayed.
Fuel link command	Indicates the actual fuel link command.
SLOWDOWN	When a slowdown occurs, the button starts flashing.
SHUTDOWN	When a shutdown occurs, the button starts flashing.
SG Speed	Indicates that shaft generator mode has been selected and that the ME is running at 380 rpm fixed speed. The shaft generator is ready for connection to main switchboard after clutching in of the generator. The ME rpm governor is controlled from the raise/lower button at the switchboard.
Pitch red.	If the actual rpm leads to a higher shaft power than the AutoChief allows, the ME Remote control system will automatically reduce the pitch setting. As this takes place, the Pitch Reduction indicator lights.

1.1.2.2 Propulsion plant – Operation modes

- Combi** Select button for **combinator mode**
- Split** Select button for **split mode** operation.
The ME rpm is controlled manually from the AutoChief Manual rpm setting device.
- Econ** Select button for **economy mode** operation.
- SG** Select button for **shaft generator mode** operation.
NOTE!
Before SG mode is selected the main engine must be in Split mode and the rpm must be set between **350 and 410 rpm** at the AutoChief Manual rpm setting device.

1.1.2.3 Emergency

- Emergency Stop** Main engines emergency stop button. Disconnects and stops the main engine
- Emergency running** Over rides shut down and slow down functions.

1.1.2.4 Responsibility

There is a separate responsibility transfer system for each main engine. The responsibility transfer system allows transfer of the manoeuvring responsibility between the engine control room and the bridge.

- BRIDGE** Bridge control. Main engine is controlled from the bridge. This means that the instructor takes care of bridge functions and commands.
- ENG. CONTROL ROOM** Engine control room responsibility. Main engine is controlled from the engine control room console.
- LOCAL** The main engine and the propeller pitch is controlled locally in the engine room.
NOTE!
Normally the main engine is set at **380 rpm** locally and only the propeller pitch is controlled locally according to bridge order.



1.2 Propulsion Plant - Operation modes and control

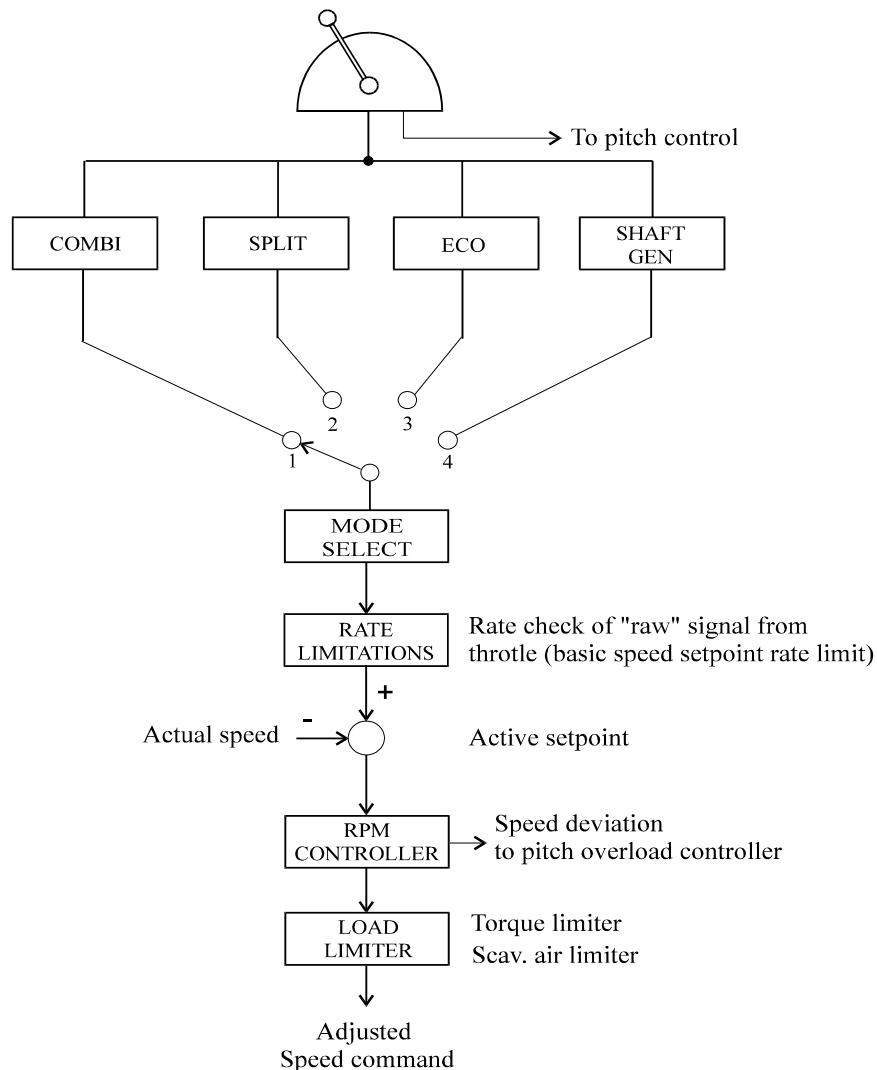
1.2.1 General

The main engines may be operated in any of four different modes and controlled from the engine control room by a throttle located at the AutoChief control panel. Each mode is selected by pressing the corresponding push-button at the AutoChief control panel.

The four modes are:

- Combinator
- Split
- Economy
- Shaft generator

The “raw” signal flow (rpm and pitch) from the throttle is illustrated in the two following figures.

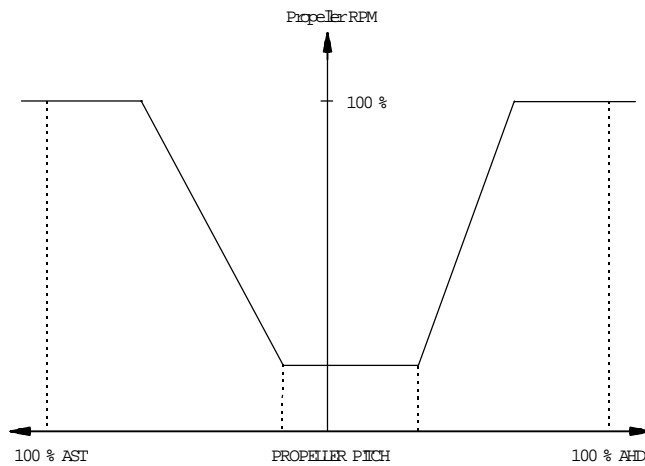


Signal flow for RPM control

1.2.2 Combinator mode

Throttle: Controls the propeller pitch and the main engine rpm.

In combinator mode the throttle controls both the engine speed (rpm) and the propeller pitch. The AutoChief system receives an input signal from the throttle and generates one output signal for the governor (rpm controller) and one output signal for the propeller pitch servo system according to the combinator curve.



Pitch / Rpm relationship

Operation

- Select combinator mode by pressing the COMBI push-button on the AutoChief panel.
- Adjust ship's speed by adjusting the throttle.



1.2.3 Split mode

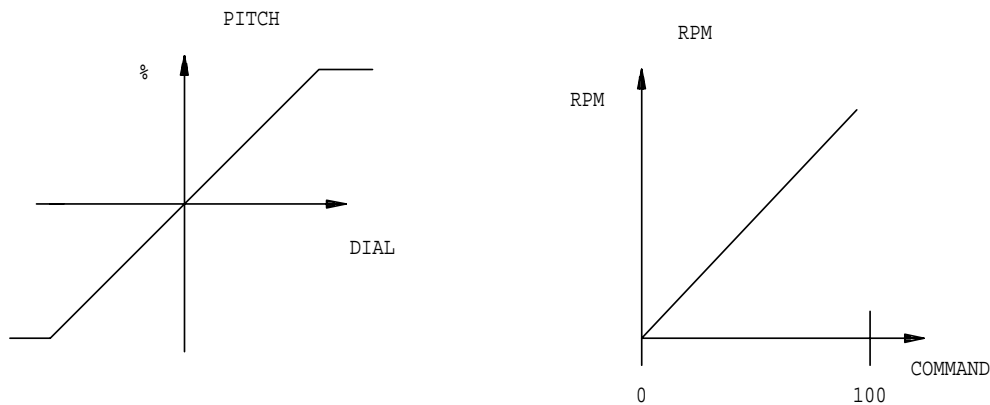
In split mode the pitch and the rpm are controlled separately.

Throttle: Controls the propeller pitch

Main engine rpm: Controlled manually by adjusting the set point from the AutoChief control panel.

When selecting split mode, the engine speed (rpm) remains at its present value until it is changed manually.

The throttle vs. pitch and rpm-command vs. rpm relationships are shown in the figure below.



Throttle vs. Pitch, and Rpm-Command vs. RPM

Operation

- Select split mode by pressing the SPLIT push-button on the AutoChief control panel.
- Adjust ship's speed by adjusting the propeller pitch and main engine separately.

Minimum main engine rpm: 100 rpm

Maximum main engine rpm: 410 rpm

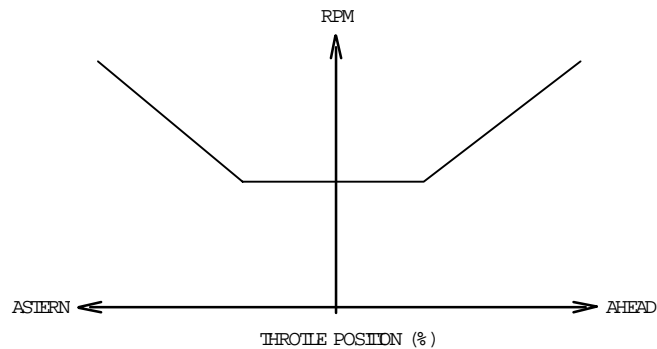
Split mode is used when:

- High manoeuvrability is required using fixed ME rpm
- When preparing shaft generator mode.

1.2.4 Economy mode

The economy mode makes the most efficient use of the combinator control, where the pitch/rpm settings are optimised. However, the acceleration is slower than with normal combinator control.

Throttle: Controls the propeller pitch and the main engine rpm



ECO mode

Operation

- Select economy mode by pressing the ECO push-button on the AutoChief panel.
- Adjust ship's speed by adjusting the throttle.

Economy mode is used during sea passage when **none** of the shaft generators are connected to the main bus bar.



1.2.5 Shaft generator mode

In the shaft generator mode the AutoChief system will allow the shaft generators to be connected to the main bus bar.

Throttle: Controls the propeller pitch
Main engine rpm: Fixed, 380 rpm.

Operation

In order to get the AutoChief system to accept the main engines to be put in shaft generator mode, the following procedure has to be followed:

1. Select split mode by pressing the SPLIT push-button on the AutoChief panel. This implies that only the throttle controls the propeller pitch and that the engine speed is controlled manually.
2. Adjust main engine rpm to be within **350** and **410** rpm.
3. Select shaft generator mode by pressing the SG push-button on the AutoChief panel.
4. The AutoChief system will automatically adjust the main engine speed to 380 rpm (corresponding to 60 Hz from the shaft generator) and turn on the SHAFT GEN SPEED lamp.

1.2.6 Load limitations

1.2.6.1 Rate limitations

The “raw” signal from the throttle is checked against rate limits in order to detect, and avoid the effect of rapid signal variations.

The rate limits for both main engine speed (rpm) and propeller pitch are fixed and set to the following values:

Basic speed set point rate limit: 3.8 rpm/sec.
Basic pitch set point rate limit: 4.5 P/sec.

1.2.6.2 RPM controller

The rpm controller keeps the engine’s actual speed as close to the speed command as possible. This is carried out by comparing the actual speed with the active set point. The result of this calculation gives a signal out of the rpm controller, which varies with the magnitude and direction of the deviation.

The control parameters for the rpm controller may be changed.

1.2.6.3 Load limiter

The purpose of the load limiter is to protect the main engine from:

- Receiving more fuel than it can burn efficiently at the present conditions. If the main engine receives too much fuel and the conditions are not correct, the result will be sooting and excessive exhaust temperatures.
- Running with too high load at reduced shaft revolutions which may cause bearing overload due to insufficient oil wedge.

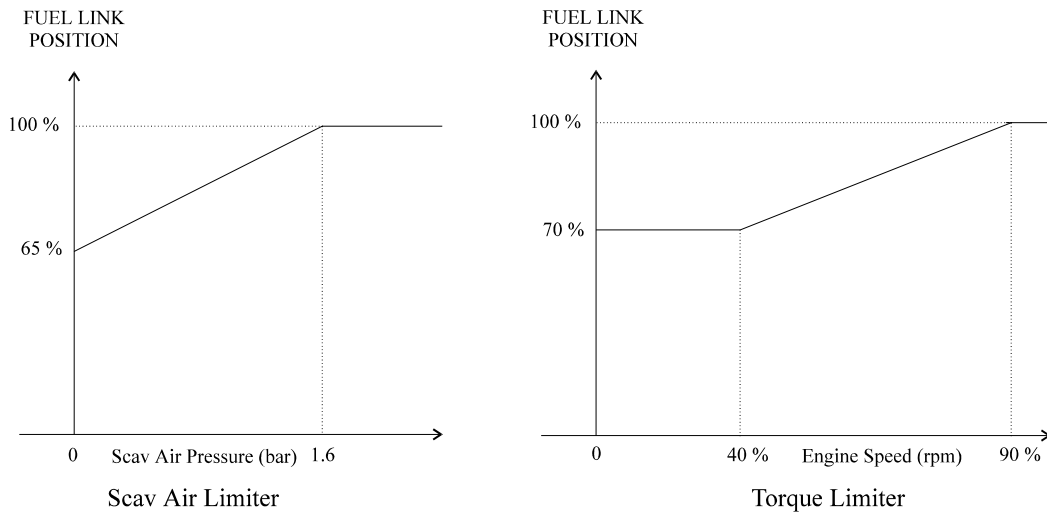
The load limiter receives signals from:

- The rpm controller
- The scavenging air limiter
- The torque limiter

Scavenging air limiter

The figure shows the relationship between scavenging air pressure and maximum fuel link position. As the scavenging air pressure increases from 0 bar to 1.6 bar, the fuel link upper limit increases from 65 % to 100 %.

The limits for scavenging air pressure and fuel link position are fixed.



Load Limiter

Torque limiter

The figure shows the relationship between engine speed (rpm) and maximum fuel link position upper limit.

For engine speed up to 40% the maximum fuel link position upper limit is 75%.

For engine speed between 40 % and 90 % the fuel link position upper limit increases from 75% to 100%.

The limits for engine speed and fuel link position are fixed.

A “minimum signal selector” will select the lowest value, which then is transferred to the governor (Adjusted speed command).

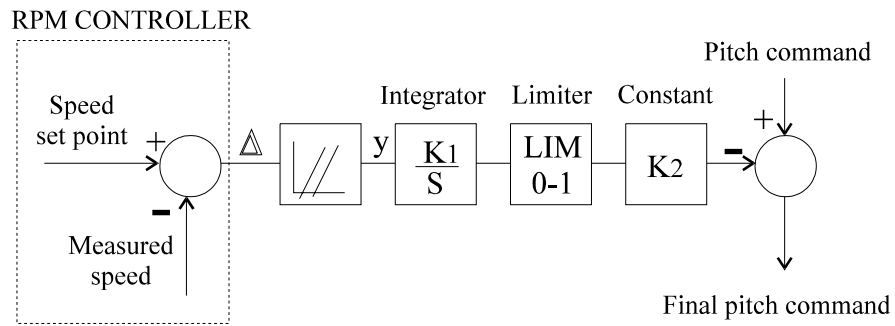
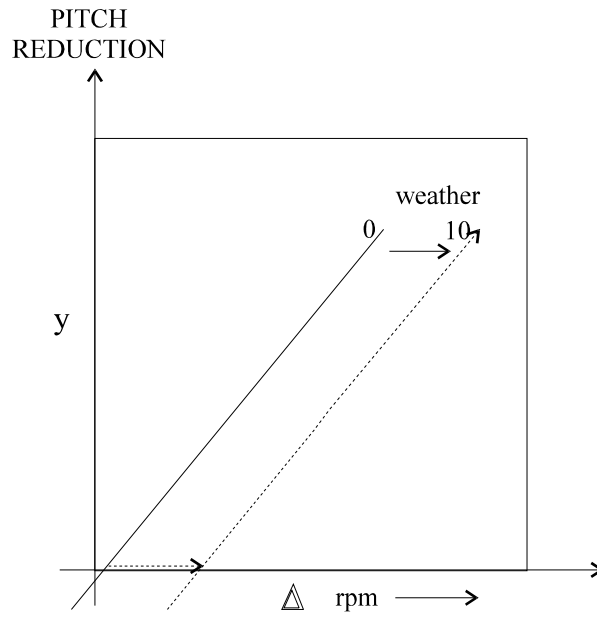
1.2.6.4 Overload controller

The purpose of the overload controller is to prevent the engine from being overloaded. If the reduction of the engine speed (rpm) is too high in relation to the given command (i.e.. because of rough sea), the overload controller reduces the pitch in order to reduce the load on the engine.

The overload controller compares the engine speed (rpm) and the given command, and the resulting deviation will cause an adjustment of the propeller pitch.

In the figure below, y is the pitch reduction and Δ is the deviation between actual engine speed (rpm) and the given command.

The overload controller also takes the weather conditions into consideration. When the sea conditions are getting rougher it will allow larger deviations in the engine speed (rpm) without reducing the propeller pitch and thereby avoid excessive adjustments.



Overload Controller



1.3 Propulsion plant safety system

1.3.1 Automatic slow down/shut down of main engine

All critical parameters are monitored by the AutoChief module activating alarms and /or automatic slow down - or shut down functions.

Slow down functions are based on

- Low Lubricating oil pressure
- Low Fresh water pressure
- High Lubricating oil temperature
- High Fresh water temperature
- High Scavenging air temperature
- Low Rocker arm lubricating oil pressure
- High Rocker arm lubricating oil temperature

Shut down functions are based on

- Low-low Lubricating oil pressure
- High-high Fresh water temperature
- Low-low Rocker arm lubricating oil pressure
- Overspeed

The parameters, that cause these actions and their limits, are set by the engine maker and the classification societies in co-operation.

The parameters are monitored by the DataChief and transferred to the AutoChief, which performs slowdown/shutdown. The slowdown and shutdown parameters are arranged in groups represented by an indicator light on the AutoChief control panel.

When a slowdown occurs, one of the indicator lamps within the group of the safety system at the AutoChief control panel turns **steady**.

When one of the indicator lamps starts **flashing**, shutdown has taken place.

The “max lever command limit” is normally set to 100%. At slow down the max (effective) lever command is gradually reduced to 40%. When the slow down cause is corrected and slow down acknowledged by the operator, the max limit is slowly increased from 40 to 100%, ensuring a smooth power recovery from the slow down situation.

1.3.1.1 Slow down and shut down Limits

The following slow down and shut down limits are recommended.

Description of Variable	Slow down	Shut down	Unit
Main engine speed		> 448	rpm
Lubricating oil pressure inlet main engine	< 0,6	< 0.4	bar
Fresh water pressure outlet main engine	< 0,2		bar
Lubricating oil temperature inlet ME	> 70		°C
Fresh water temperature outlet ME	> 90	> 96	°C
Scavenging air temperature	> 80		°C
Main Bearing temperature	> 80		°C
Rocker arm lubricating oil pressure inlet main engine	< 0.6	< 0.4	bar
Rocker arm lubricating oil temperature outlet main engine	> 75		°C
Gear inlet lubricating oil press	< 0.8	< 0.4	bar
Gear lubricating oil temperature	> 80		°C
Servo lubricating oil press	< 8.0	< 4.0	bar
Servo lubricating oil temperature	> 80		°C
Gear bearings:			
- Bearing no. 1	> 70	> 80	°C
- Bearing no. 2	> 70	> 80	°C
- Thrust bearing	> 80	> 85	°C

1.3.2 Main engine start inhibited

Remote start of the main engines from the AutoChief panel can only be carried out if the ME Ready lamp is lit. Remote start is inhibited by:

- Main engine in local control
- Turning gear in
- Start failure
- Start air press < 16 bar
- Control air press < 2,1 bar
- Rocker arm lubrication oil temperature low < 30 °C
- ME Clutch connected
- Jacket water temperature low < 30 °C
- Lubrication oil temperature low < 30 °C
- ME damage (ruined)



2 MAIN SWITCHBOARD CONTROL FUNCTIONS

2.1 Diesel generators

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

The diesel generator section contains a volt/ampere/watt/frequency/volt ampere reactive meter. A selector switch enables reading of different phases to the generator.

The subsequent details are mainly applicable for full-scale switchboards but it will in principle also to apply the mimic diagrams.

2.1.1 Diesel generator 1 & 2 panel description

- V/A/kW/Hz
kVAr This section is equipped with instruments which all are connected to the generator side.
- R/S/T It is possible to select from which phase the measurement shall take place. If none of the lamp-push buttons are activated, the mean value from each of the phases is displayed.
- 0/RS/ST/TS Selects the phase voltage displayed at the voltage instrument. If 0 is selected the average value is displayed.
- MAGNI-
SATION Turns the generator magnetisation current ON and OFF. 'Increase' and 'Decrease' push-buttons control the magnetisation current.
- CIRCUIT
BREAKER Disconnection / connection of the circuit breaker.
- READY An indication that priming lubricating oil pump is in AUTO, the diesel generator control in remote mode, and all alarms are reset.
- START Start/stop of the diesel generator. Only possible when the diesel generator is ready.
- IN Indication lamp for the circuit breaker position.
- LOWER
RAISE Manual remote control of the governor

- CIRCUIT BREAKER The generator breaker's safety functions.
 - TRIPPED: Breaker has tripped due to one of the safety functions.
 - READY: The generator is ready to be connected.
 - SAFETY: Slow overload
 - Fast overload
 - Reverse power
 - Low voltage
 - Low frequency

2.2 Shaft generators

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

Note: A prerequisite for shaft generator operation is that the main engine remote control is in the shaft generator mode

2.2.1 Shaft generator panel description

- V/A/kW/Hz
 kVAr This section is equipped with instruments which all are connected to the generator side.
- R/S/T It is possible to select from which phase the measurement shall take place. If none of the lamp-push buttons are activated, the mean value from each of the phases is displayed.
- 0/RS/ST/TS Selects the phase voltage displayed at the voltage instrument. 0 is average value.
- MAGNI-
 SATION Turns the generator magnetisation current ON and OFF. The 'Increase' and 'Decrease' push-buttons control the magnetisation current.
- CIRCUIT
 BREAKER Disconnection / connection of the circuit breaker.
- READY An indication that the main engine is in shaft generator mode, there are no alarms and the corresponding controls are in remote.
- START Connection/disconnection of the shaft generator clutch. Only possible when the shaft generator is ready.
- IN Indication lamp for the circuit breaker position.
- LOWER
 RAISE Connected to the main engine governor and lower/raise the rpm of the engine.



- BUS BAR 2 Circuit breaker between the main bus bar I and II. It comprises a connection as well as an indication function.
- FUSE
BREAKERS There are separate fuse breakers for:
 - Bow thruster
 - Stern thruster
 - Deck machinery 1
 - Deck machinery 2
- CIRCUIT
BREAKER The generator Breaker's safety functions.
 - TRIPPED: Breaker has tripped due to one of the safety function.
 - READY: The generator is ready to be connected.
 - SAFETY: Slow overload
 - Fast overload
 - Reverse power
 - Low voltage
 - Low frequency

2.3 Synchronising

Volt and frequency readings of the main bus bar are available from the panel. Together with speed adjustment, the operator is able to verify when a generator might be synchronised to the bus bars.

The synchronising section contains a double-volt meter, a synchro-indicator and a double-frequency meter. A selector switch enables readings of voltage, differential- voltage and frequency of all the generators.

A meg-ohm meter indicates possible earth leakage on the main bus bars. A shore-connecting device enables monitoring of the phase sequence and cross-coupling of the leads (if needed) before the shore connection is made.

2.3.1 Synchronising panel description

- V/Hz This section is set up with instruments, connected to the generator side as well as to the main bus bar.
- 0/ DG1 / DG2
/SG1 / SG2 A selector switch to enable readings of voltage and frequency between the bus bar and the different generators.
- 0/RS/ST/TS Selects the phase voltage, displayed at the voltage instrument. 0 is average value.

- CIRCUIT BREAKER Disconnecting/Connecting of the shore connection circuit breaker.

- IN Indication lamp for the circuit breaker position.
- WRONG ROTATION ON SHORE Wrong phase sequence of shore source. Press to shift the phase sequence of the shore source. Rotation direction on the shore-connection should be clock-wise.

- SHORE CON Indication lamp for the shore connection circuit.

2.3.2 Semi-automatic synchronising

From the main switchboard the generators can be connected manually, using the synchrony scope or semi-automatic.

Semi-automatic includes remote start of the diesel engine and automatic synchronisation while voltage and frequency must be adjusted manually. The procedure when using semi-automatic is:

1. The engines may be remote started from the switchboard panel if REMOTE has been selected at the local engine panel.
2. Press the button RESET on the BREAKER panel, if necessary.
3. Select generator to be connected at the semi-auto panel
4. Adjust voltage and frequency until Ready lamp is lit.
5. Press connect button.
6. Generator will automatically synchronise and connect within 180 sec.

If the breaker is not connecting, fine adjustment of frequency and voltage may be necessary until breaker connects.

The limits for ready signal and for connection can be viewed and adjusted from the variable page 7005

Recommended settings are (VP 7005):

Synchronisation - Time limit:	180 sec
Ready lamp indication - frequency:	
- Low frequency	0,00 Hz
- High frequency	0,10 Hz
Connect:	
- Low frequency limit	0,00 Hz
- High frequency limit	0,10 Hz
Ready lamp indication - voltage	
- Low voltage (generator)	440 V
- High voltage (generator)	450 V
- Diff. voltage (bus bar)	0.00 V (below)
- Diff. voltage (bus bar)	+10.0 V (above)



2.4 Shore power

Shore connection can only be activated when the "STOP SHIP" function from the instructor variable page 9000.

When the shore cable is connected, the electric phase will be selected randomly by the simulator. The lamp called "Wrong Phase" indicates a wrong sequence. When pressing the same button, the cables are interchanged, and the light will distinguish.

When the electric phase is correct, the shore power can be connected to the main bus bar.

2.5 Emergency generator

The emergency generator section contains indicators for voltage and for power consumption. The emergency generator can be controlled automatically. When in AUTO, the emergency generator starts and connects automatically after a blackout. As soon as one of the main generators is connected, the emergency generator is disconnected and stopped after an idling period.

2.5.1 Emergency panel description

- AUTO Automatic start and connection of emergency generator.
- START Command to start the emergency generator manually and an indication that it is running.
- IN Indication lamp for the circuit breaker status.
- CONNECT Command to connect the generator in MAN
- DISCONNECT Command to disconnect the generator in MAN
- TEST When activated it is possible to test the emergency generator with out disturbing the power supply for other consumers.

2.6 Miscellaneous

The miscellaneous section contains indicating instruments for the temperature in the control and engine room. There is a fire monitor with indication and activating of fire fighting equipment and push buttons for control of ventilation and oil conditioning.

2.6.1 Miscellaneous panel description

The miscellaneous section contains the following indicators:

- Air temperature control room
- Air temperature engine room

Start/stop buttons

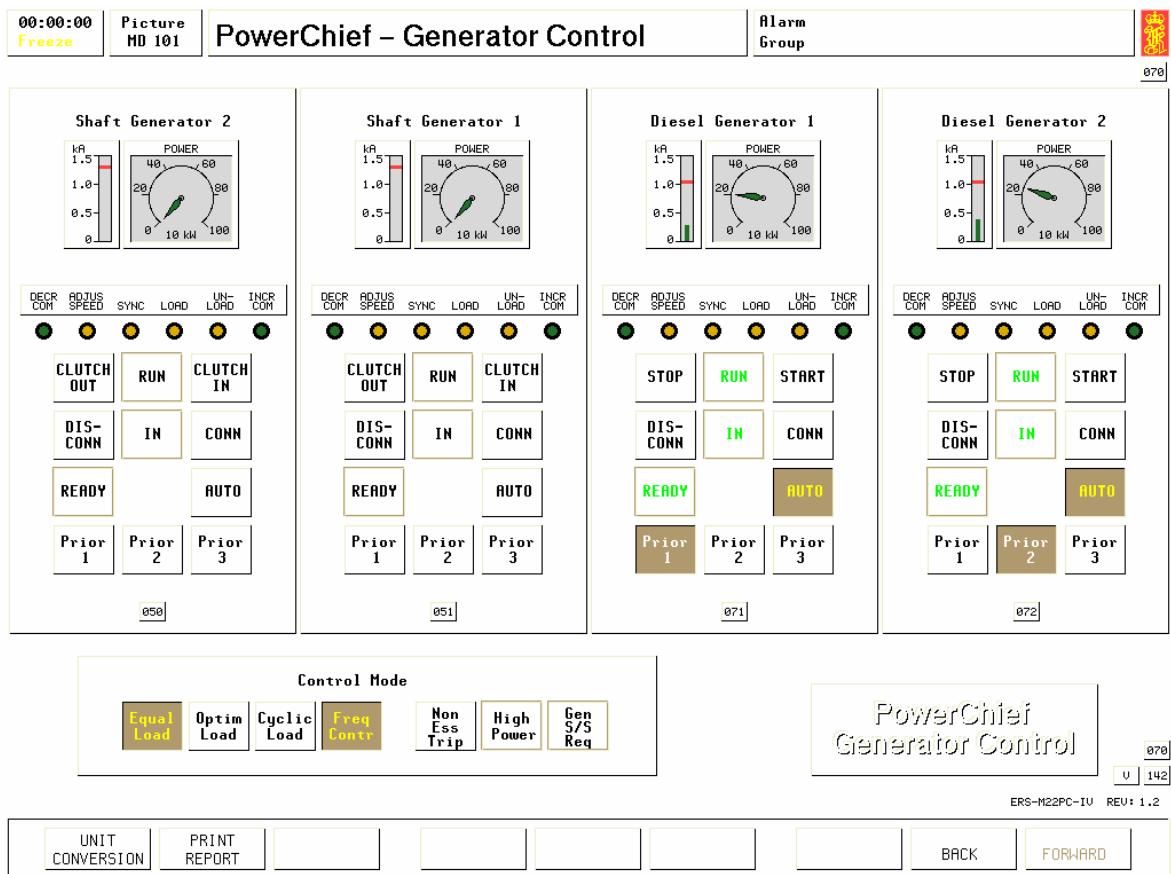
- Engine room ventilation fan no. 1 & 2
- Engine control room air conditioning system

Fuse breakers

Fuse breakers are provided for all major electrical consumers.

3 GENERATORS – POWERCHIEF REMOTE CONTROL

3.1 Power Chief - Generator control



The Power Chief - Generator Control panel is the power management system that monitors and controls the main generators.

A separate generator control program controls each generator. The control program monitors and controls the generators and their connection to the main switchboard. The program also takes care of load sharing and automatic load dependent prime mover start and stop.

The consumption of, and demand for, electric power is constantly monitored and compared to the present power production potential. When deviation exceeds pre-set limits, the PowerChief system will act in order to establish normal condition. The risk for blackout is therefore reduced and a more economical use of the auxiliary engines is achieved. The PowerChief system also performs continuous control of the line frequency and of load sharing between the diesel generators.



The PowerChief Generator Control includes the following functions:

- Remote start and stop of diesel generators
- Remote operation of shaft generators clutch
- Remote operation of the generator circuit breakers, including automatic synchronising
- Automatic monitoring of the demand for power and automatic synchronising and control of generator circuit breakers. This mode also includes automatic monitoring and control of the prime mover condition
- Priority setting of diesel generator starting and stopping sequence
- Non essential trip
- Constant frequency mode
- Three control modes of load-sharing

3.2 Diesel generator - Remote control functions

The PowerChief generator control panel offers the following functions:

- READY** Indicating lamp that is lit provided that :
- Diesel generator is in REMOTE control mode (local diesel engine panel)
 - Diesel generator pre-lubrication oil pump in AUTO mode
 - No alarms on the diesel engine
- START** Manual, remote start of the diesel generator.
- It is only possible to perform manual remote start of the diesel generator if the **READY** lamp is lit and the **AUTO**-mode is switched off.
- STOP** Manual, remote stop of the diesel generator.
- The diesel generator circuit breaker must be disconnected before it is possible to stop the diesel engine.
- CONN** Manual, remote connection of the generator breaker:
- To manually connect a running diesel generator via the power management system, switch off the **AUTO** and activate the **CONNECT** button. The power management system will automatically synchronise and connect the generator to the bus bar.
- DISCONN** Manual, remote disconnection of the generator breaker.
- To manually disconnect a generator via the power management system switch off the **AUTO** and activate the **DISCONNECT** button. The system will automatically reduce the load and disconnect.

- RUN** Lamp indicating that the diesel generator is running
- IN** Lamp indicating that the generator breaker is connected.
- AUTO** Puts the diesel generator into auto mode provided that:
- READY lamp is lit. See the conditions related to the READY lamp.
 - In this mode the PowerChief will take care of starting and stopping, connecting and disconnecting and load sharing of the generators.
 - If the lamp is flashing, the Auto mode is cancelled because of the READY conditions is no longer met.
- PRIOR 1** Lamp push-button to select highest priority, that is first in and last out.
- PRIOR 2** Lamp push-button to select medium priority, that is later in and earlier out than number 1.

3.2.1 Diesel generators - Control modes

The diesel generators may be operated in four different control modes, selected by pressing the dedicated push buttons at the PowerChief Generator Control panel.

- Equal load
- Optimal load
- Cyclic load
- Frequency control

3.2.1.1 Equal load (symmetrical load sharing)

Equal load is selected by pressing the EQUAL LOAD push-button. In this mode the load is distributed equally between the diesel generators connected to the bus bar, provided that the generator are in AUTO mode.

These limits may be adjusted in the variable page 7013.

NOTE! In the first place the prime mover speed controller carries out the main control of the load sharing, while the PowerChief carries out the fine adjustment.

The settings for start and stop load can be read and changed at variable page.

3.2.1.2 Optimal load (asymmetrical load sharing)

Optimal load is selected by pressing the OPTIMAL LOAD push-button. In this mode the generator with the highest priority will take the entire load up to approximately 70% of normal rating. The rest of the load is shared between the other diesel generators connected to the bus bar, provided that the generator is in AUTO mode

The settings for start and stop load can be read and changed at Variable Page.



3.2.1.3 Cyclic load

Cyclic load is selected by pressing the CYCLIC LOAD push-button. This mode is similar to the "Optimal load" mode, but after a certain period of time generator 1 and 2 will change in taking the highest load.

The cycling period can be read and changed at Variable Page.

3.3 Shaft generators - Remote control functions

READY	Indicates that the shaft generator is ready for remote engaging and connecting. The preconditions are: <ul style="list-style-type: none">- Air supply for the clutch- Main engine in shaft generator mode- Shaft generator clutch in Remote
CLUTCH IN	Manual, remote engaging of the shaft generator clutches. <ul style="list-style-type: none">- It is only possible to engage the clutch if the READY lamp is lit and the AUTO-mode is not chosen.
CLUTCH OUT	Manual, remote disengaging of the clutch. <ul style="list-style-type: none">- The shaft generator circuit breaker must be disconnected before it is possible to disengage the clutch.
CONN	Manual, remote connection of the generator breaker. <ul style="list-style-type: none">- To manually connect an engaged shaft generator via the power management system, switch off the AUTO and activate the CONNECT button. The power management system will automatically synchronise and connect the shaft generator to the bus bar.
DISCONN	Manual, remote disconnection of the generator breaker. <ul style="list-style-type: none">- To manually disconnect a shaft generator via the power management system switch off the AUTO and activate the DISCONNECT button. The system will automatically reduce the load and disconnect.
RUN	Lamp indicating that the shaft generator is running (clutch engaged)
IN	Lamp indicating that the generator breaker is connected.
AUTO	Not applicable – the shaft generators must always be managed manually!

PRIOR 1 **Not applicable – the shaft generators must always be managed manually!**

PRIOR 2 **Not applicable – the shaft generators must always be managed manually!**

Shaft generator overload

If bus bar 1 is supplied from a shaft generator the system will check for overload of the shaft generator. Normally the shaft generator may be loaded 100% continuously.

Main engine overload

The main engine over load controller protects the main engine against over load due to high shaft generator load by reducing the propeller pitch. Pitch reduction is indicated at the main engine control panel in the control room and at the bridge.

3.4 Common generator controls

The following functions are common to all main generators.

3.4.1 Alarms and messages

3.4.1.1 Alarms

The PowerChief generates alarms if automatic actions fail i.e. the expected action is not accomplished within the normal period of time.

Alarms are announced by an acoustic signal, a flashing light in the group alarm lamp on the alarm console and/or messages at the alarm printer.

The PowerChief system may activate a number of alarms of which the following are represented by alarm lamps at the PowerChief console:

- None essential trip
- High power
- Generator start/stop request

3.4.1.2 Messages

The PowerChief generates messages when manual or automatic actions are successful and important messages when manual or automatic actions are unsuccessful. Events related to the PowerChief system may also be printed if selected.



3.4.2 Non essential trip

If high load occurs The NON ESSEN TRIP lamp is lit and a Non Essential Trip alarm is given. The PowerChief disconnects non-essential consumers in order to compensate for lack of power reserves.

The trip limit can be read and changed at variable page

3.4.3 High power

The HIGH POWER lamp is lit if the demand for power exceeds the normal rating for the connected generators. If high power is active large consumers like air compressors and thrusters can not be started.

3.4.4 Generator start/stop request

The GEN S/S REQ lamp is lit if the following conditions are true:

- Start and synchronisation of a generator are requested due to increased demand for electrical power.
- One generator may be unloaded, disconnected, and stopped without violating the limit for power reserves.

3.4.5 Frequency control

Frequency control is selected by pressing the FREQ CONTROL push-button at the PowerChief – Generator Control panel. In this mode the frequency is monitored continuously and adjusted in order to maintain 60 Hz.

Frequency control is normally to be active.



4 PUMP AND COMPRESSOR CONTROL

00:00:00 Freeze	Picture HD 102	PowerChief – Pump / Compressor	Alarm Group
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ME 2 LO Pump AUX START AUTO	ME 1 LO Pump AUX START AUTO	FO Supply Pumps No 1 START No 2 START AUTO	Start Air Compr. 1 START AUTO
ME 2 Jacket Cool Water Pump AUX START AUTO	ME 1 Jacket Cool Water Pump AUX START AUTO	FO Booster Pumps No 1 START No 2 START AUTO	Start Air Compr. 2 START AUTO
ME 2 Inj. Cool Water Pump No 1 START No 2 START AUTO	ME 1 Inj. Cool Water Pump No 1 START No 2 START AUTO		Service Air Compr. START AUTO
ME 2 SW Pumps No 1 START No 2 START AUTO	ME 1 SW Pumps No 1 START No 2 START AUTO	Main SW Pumps No 1 START No 2 START AUTO	ME 1 Rocker Arm LO Pumps No 1 START No 2 START AUTO
Port Propeller Gear Pump AUX START AUTO	Stbd Propeller Gear Pump AUX START AUTO	Steering Gear Pumps No 1 START No 2 START AUTO	ME 2 Rocker Arm LO Pumps No 1 START No 2 START AUTO
Port Prop. Servo LO Pump AUX START AUTO	Stbd Prop. Servo LO Pump AUX START AUTO		PowerChief Pump/Compressor Control

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UNIT CONVERSION	PRINT REPORT						BACK	FORWARD
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Remote and automatic management of pumps and compressors are carried out from the PowerChief – Pump and Compressor section panel.

4.1 Automatic start and stop

In AUTO mode the pumps and compressors are automatically started and stopped by the control functions including:

- Stand-by start at low pressure
- Auto stop at high pressure
- Restart after black-out
- Power check (start inhibit at “High Power”) on generators
- Cyclic operation of units



The pumps and compressors with stand-by logic includes:

Pump	Automatic start	Automatic stop
ME electrical lubricating oil pump	X	X
ME jacket cooling water pumps	X	X
ME injector cooling water pumps	X	
ME sea cooling water pumps	X	
ME rocker arm lubricating oil pumps	X	
FO supply pumps	X	
FO booster pumps	X	
ME sea water pumps	X	
Propeller gear lubricating oil pump	X	X
Propeller servo lubricating oil pump	X	X
Steering gear pumps	X	X
Start air compressor	X	X
Service air compressor	X	X

Above parameters can be set from variable page 7023.

4.1.1 Pump control

All pumps can be started and stopped locally from the engine room independently of the AUTO/MANUAL.

4.1.1.1 Manual remote control

If the automatic control is not active (AUTO lamp button is not lit) the pumps may be started and stopped manually from the panel.

4.1.1.2 Automatic stand by start

If the AUTO lamp button is activated the pumps are automatically started and stopped by the PowerChief control functions which include:

- Stand-by start at low pressure.
 - Stand-by start at trip.
 - Restart after blackout.
 - Power check on heavy consumers. Start inhibit of the pump if the generators are at "High Power" limit at start attempt.
- NOTE!** As for AUTO mode, it is not possible to carry out a manual remote start of the pump if the generators are at "High Power" limit.
- Generation of the start and stop messages.

If there has been a disturbance in the AUTO system, for instance, a local start/stop or an alarm has occurred, the auto lamp and the start lamp start flashing.

4.1.1.3 Auto cycle

Each pump with stand by function may be set in auto cycle mode. In this mode the pump in service is automatically changed between pump no 1 and no 2.

The functions can be set on or off and the time period can be changed from variable page 7024.

Operation

Local stop when in AUTO mode: The start/stop button is flashing. To reset press the button.

If stand by start due to malfunction or erroneous operation of the system or other disturbances the AUTO lamp is flashing which means that the auto function has been turned off. To reset press the AUTO button.

4.1.1.4 Stand-by at low pressure

When pressure drops below the "stand-by start limits", the stand-by unit is started automatically. Most of the low-pressure alarms are subject to "Automatic alarm blocking". The stand-by start function will be blocked as well during the same period of time.

The stand-by limits can be viewed and changed from variable page 7023.

Most of the low-pressure alarms are subject to "Automatic alarm blocking". The stand-by start function will be blocked as well during the same period of time.

4.1.1.5 Automatic restart after black-out

After recovery from blackout, the PowerChief will restart all units, which were running at the time blackout occurred. Start conditions like AUTO-mode, no active alarm etc., also apply for this restart. The restart procedure follows a pre-set time sequence.

The restart time can be viewed and changed from variable page 7024.



4.2 Compressor control

The compressor control is based on the same principles as for the pump control system.

Auto mode: In this mode the compressors are automatically started and stopped by the PowerChief. Automatic start takes place when the pressure drops below a certain limit.

The compressors are also connected to the power check system, so the start of a stand-by compressor may be delayed if sufficient power is not available. The compressor will start automatically as soon as the stand-by generator is connected.

NOTE! As for AUTO mode, it is not possible to carry out a remote, manual start of the compressor if the generators are at “High Power” limit.

A flashing AUTO or START lamp indicates a disturbance in the system. To reset, press the start push-button to check whether the compressor is running or not, then press the auto push-button to get back to auto mode.

The start air compressors will automatically alter to be the Master/Slave compressor.

If the Master compressor is not able to increase the pressure within a certain period of time (approx. 2-2.5 minutes) the slave compressor will also start.

Manual mode: In this mode (AUTO lamp not lit) starting and stopping of the pumps must be carried out manually from the control panel.

The start and stop limits can be viewed and changed from variable page 7023.

4.2.1.1 Compressor running time

The PowerChief is monitoring the compressor running time. If a compressor is started too often due to unusual high air consumption the alarm Auto Time On is given.

The monitoring is based on compressor ON time in percent of OFF time. If the ON time exceeds the set value of OFF time the alarm becomes active. The value is changeable and can be adjusted from variable page.

5 PURIFIER CONTROL

The control of purifiers with gravity rings is part of the PowerChief and includes both automatic and manual control. The interval between each shooting sequence can be adjusted and the purifiers can be shot individually.

NOTE For Alcap purifier – please refer to instructions in the manual Machinery and Operation.

Start of the purifiers:

The purifiers are started and stopped from their local panels.

Modes of operation

The following modes of operation are selected by a mode selector on the local panels, MANUAL, and AUTO.

Switching from "MANUAL" to "AUTO"

The purifier is shot periodically according to the shooting sequence recommended by the manufacturer. If the purifier is stopped in auto mode, the first part of a normal shooting sequence is performed immediately, and the bowl remains open; ready for later operation. The purifier has sufficient rotating moment of inertia to make this short shooting possible.

Switching from "AUTO" to "MANUAL"

Current shooting is interrupted immediately. The electrical connection to the control relays is broken. Alarms are reset. No monitoring or control functions are performed.



6 BRIDGE CONTROL PANELS

6.1 Main engine – Bridge control

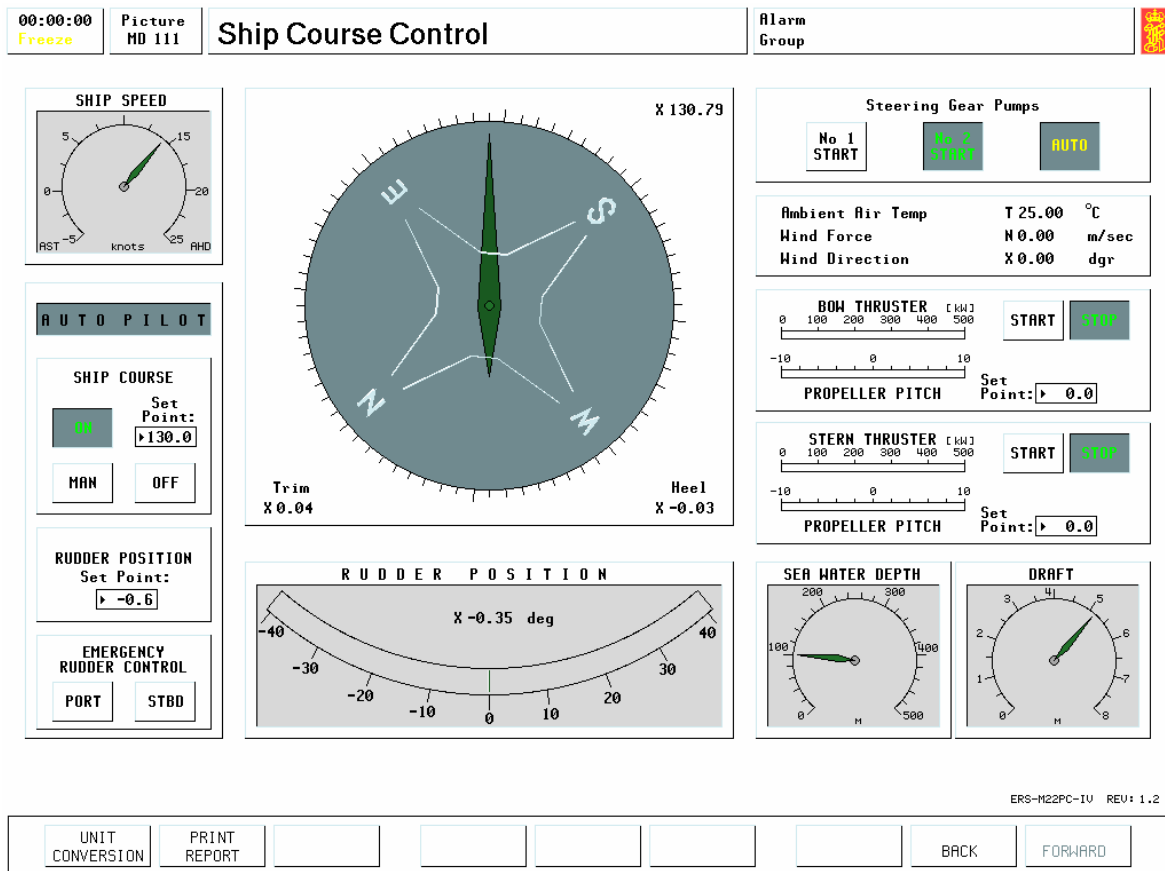
00:00:00 Freeze Picture MD 110 Main Engine – Bridge Control Alarm Group

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Description

The bridge panel includes the same functions as the main engine panel in the control room.

6.2 Ship course control



An auto pilot controls the rudder position. Like most modern auto pilots, it is in principle a PD controller. The proportional gain ("course gain") and the derivative gain ("counter rudder gain") can be adjusted. The weather adjustment feature often found is represented by the course deadband.

The steering gear pumps supply necessary hydraulic power for the rudder. The maximum rudder rate is dependent of hydraulic pressure. The rate of turning is displayed in degree per second, deg/sec.

6.2.1 Ship course control modes

Autopilot

Activate ON button and set course set point.

Manual rudder control (Follow up control)

Activate ON button and set required rudder position.

Emergency rudder control (Non-follow up control)

Activate OFF button at Ship Course panel and control rudder manually by pressing the STBD/PORT button.



The rudder may also be locally controlled from the steering gear room.

Operation

Steering gear pumps

- Start the steering gears pumps manually from panel.
- During sea passage one pump is running and the other is stand by (select Auto).
- During manoeuvring and in congested waters both steering gear pumps must be running.
- Always test both steering gear pumps and remote and local control modes before leaving port.

6.2.2 Bow and stern thrusters

The vessel is equipped with two thrusters:

- One 600 kW CPP Bow Thruster
- One 600 kW CPP Stern Thruster

Operation

- Start/stop thrusters by activating the buttons at the thruster panel.
- Control thruster propeller pitch by entering set point (0 - ± 10).
- Always test thrusters and remote control before first manoeuvre.