K-Sim

ERS Wärtsilä 12RT-FLEX 82(C) High Voltage

Machinery & Operation

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CHANGES IN DOCUMENT

Issue No.	ECO No.	Paragraph No.	Paragraph Heading/ Description of Change
A			New
A			Corrections
A			Minor change in description of power turbine
B			New chapter “Test Bench” 3.14, Part 3. Added text in 5.22, Part 3. Power Turbine description. General corrections in part 1. General corrections in part 2. General corrections in part 3
B1			Some text changes and updated screenshots
B2			Updated 2.4 in Part 3. Shaft Generator. Added 2.7.1 in Part 3. Emergency generator back-feed.
B3			Minor text change in 2.1 in Part 2
B3			Minor text change in 2.4 in Part 3

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 3 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 is 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.

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Machinery & Operation

Part 1

Vessel & Machinery

Main Particulars

TABLE OF CONTENTS

1 GENERAL DESCRIPTION

1.1 Main ship data

The ship represents a Post Panamax Container Vessel with the following main data:

- Lenght OA 296 m
- Breadth moulded 32,2 m
- Depht moulded 21,8 m
- Summer draught 12.7 m
- Dead weight 62000 tons
- Maximum container capacity 4200 TEU
- Reefer container capacity 600
- Speed knots 26

Main Engine

- Type Wärtsila RT-flex82C
- Continuous Service Rating ME 54.24 MW
- Corresponding Engine Speed 102 rpm

Propeller System

- The propeller system includes both FPP and CPP, selectable from variable page 1940

Electrical power plant

- three 2700 kW/6.6 kV/60Hz diesel engine driven synchronous generators
- One 3000/5000 kW/6.6 kV/60Hz Shaft generator/motor (PTO/PTI)
- One 6500kW/ kW/6.6 kV/60Hz Turbo generator incl. steam and power turbine
- one 250 kW/440 V/60Hz emergency generator

Thrusters

- 1 CPP Bow Thruster 2200 kW

Steering Gear

- Double acting, rotary vane type, IMO Model

Tanks

The following main tanks are included:

- 2 HFO settling tanks
- 1 HFO service tank
- 1 DO service tank
- 1 DO settling tank
- 4 Fuel oil bunker tanks
- 1 DO bunker tank
- 1 Spill oil tank
- 1 Overflow Tank
- 1 Sludge tank
- 1 Sewage Sludge Tank
- 1 Clean bilge tank
- 1 Dirty bilge tank
- 1 Lubrication oil storage tank
- 2 x 6 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 two high-resolution graphic workstations with a dedicated keyboard.
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.

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 is operated from the DataChief consoles.

3 PROPULSION PLANT

3.1 Main engine data

The propulsion machinery is based on one Wärtsilä RT-flex82C, low speed, 12 cylinder configuration, 2-stroke, turbocharged, reversible diesel engine. The main engine is coupled to a propeller shaft with both fixed pitch propeller and controllable pitch propeller (selectable by the instructor).

Main engine particulars

- Cylinder Bore 820 mm
- Piston Stroke 2646 mm
- Number of Cylinders 12
- Number of Air Coolers 6
- Number of Turbo Chargers 3
- Specified MCR 54.24 MW
- Corresponding Engine Speed 102 rpm
- Mean Indicated Pressure 19.5 Bar
- Scavenge Air Pressure 2.30 Bar
- Turbine Speed 9000 rpm
- Number of Prop. Blades 5
- Propeller Pitch 1.08 P/D
- Specific Fuel Oil Consumption 167 g/kwh

The main engine is equipped with the following auxiliary systems:

- HTFW cooling system including pre-heating system.
- LTFW cooling system
- Fuel Oil Servo Oil supply
- Common Rail System
- Main lubrication oil system
- Turbocharger and scavenging air cooling system.
- Manoeuvring system.
- Selective Catalytic Reduction System

The propeller system includes:

- 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 via Wärtsilä Engine Control System (WECS)

The main engines may be operated in two different modes, selectable by the instructor.
The modes are:

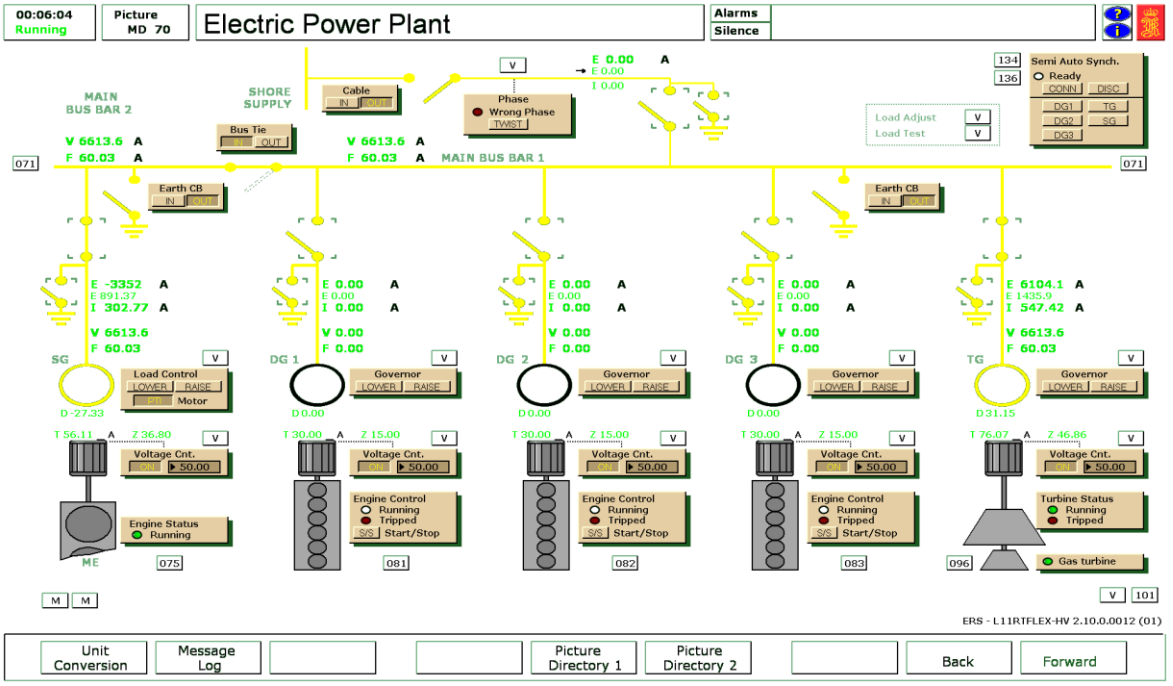
- Combinator for CPP operation
- Fixed pitch

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

- Slow down and shut down functions for the main engine
- Main engine load limitations (scavenge air pressure and torque control)
- Thermal limitations
- Overload control of main engine

4 ELECTRICAL POWER PLANT

4.1 Electrical power supply



The ship's electric power is generated by:

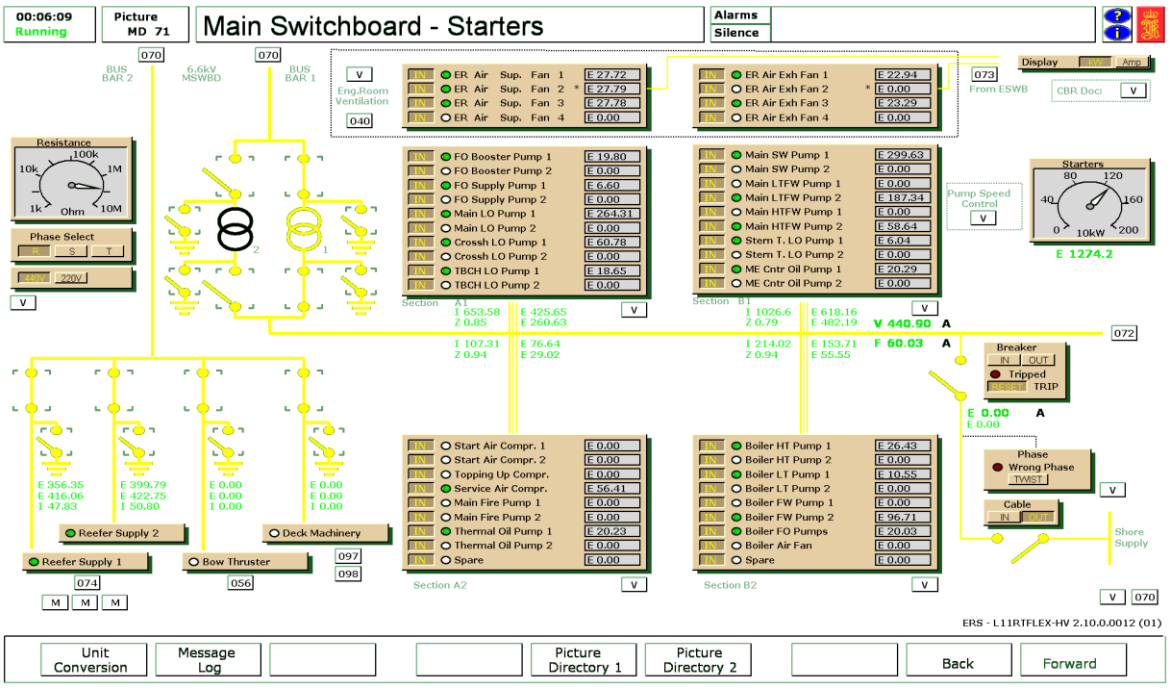
- One 3000/5000 kW/6.6 kV/60Hz Shaft generator/motor (PTO/PTI)
- Three 2500 kW/6.6 kV/60Hz diesel engine driven synchronous generators
- One 6500 kW/6.6 kV/60Hz Turbo generator
- One 250 kW/440 V/60Hz emergency generator

and distributed via:

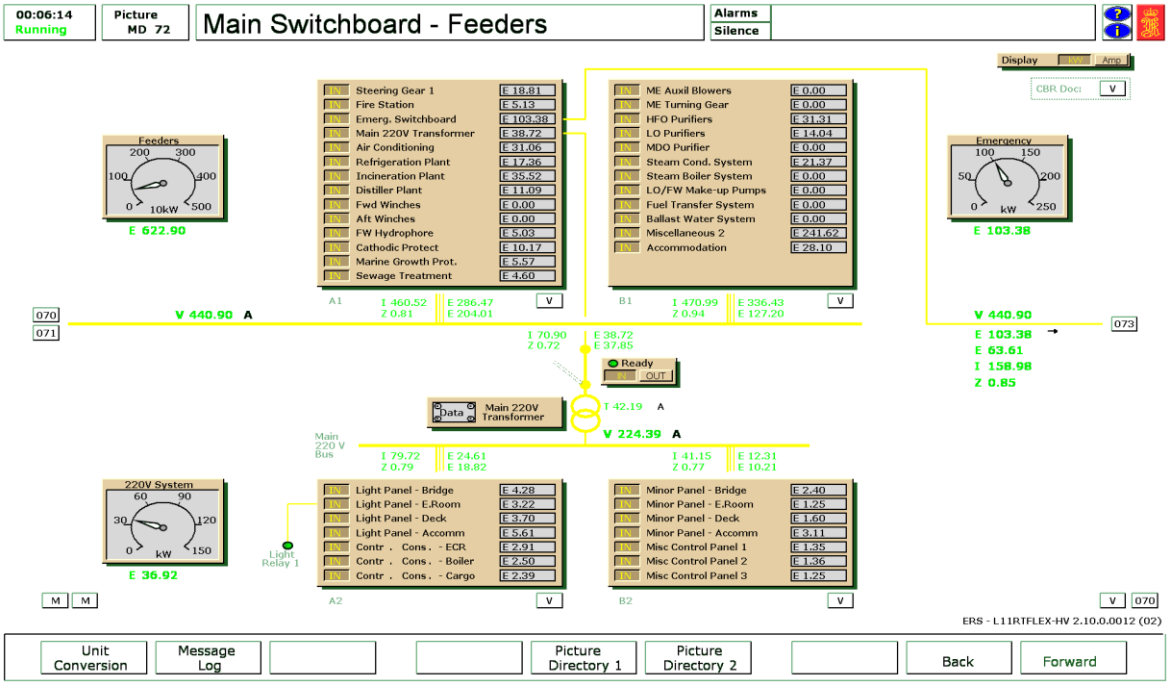
- one main switchboard, divided into two main 6.6V bus bars
- one 440V bus bar
- one 220V bus bar
- one emergency 440V bus bar
- one emergency 220V bus bar
- one 24V bus

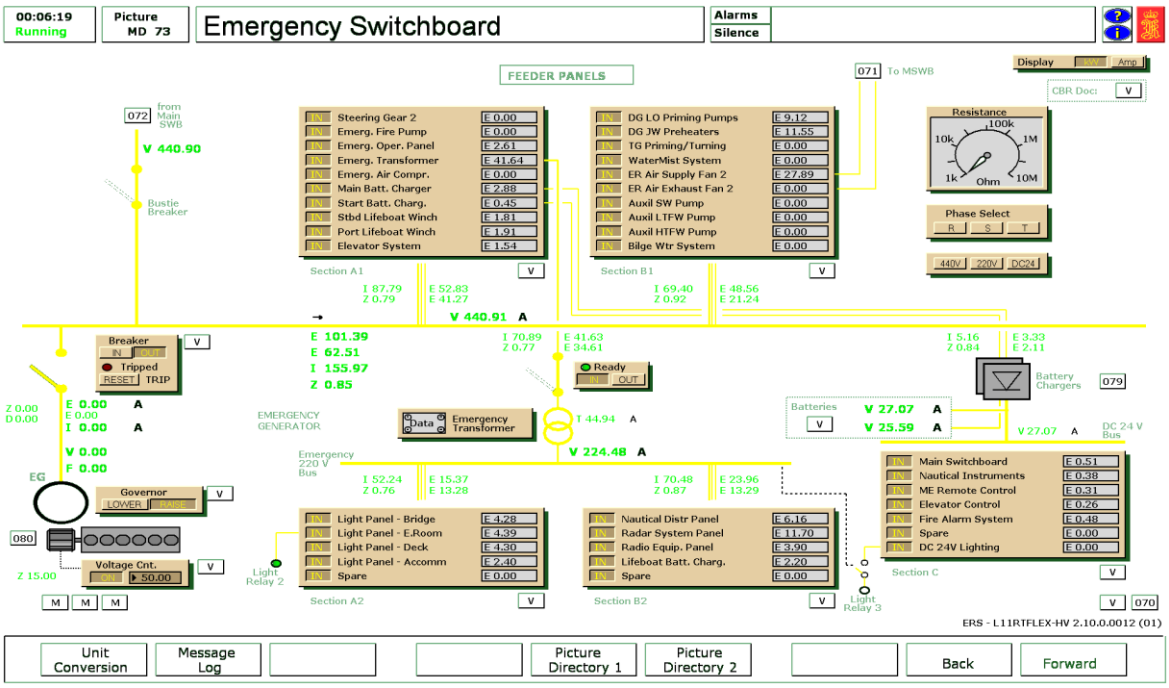
The 6.6kV bus bars can also be supplied via a shore connection link that has the ability to alter phase rotation to ensure that motors turn in the correct direction.

Both generators and bus-bars have earth down devices to ensure safe access to high voltage equipment when maintenance is required.



Bus bar 1 powers all the electrical main consumers and the emergency bus bar.
Bus bar 2 powers the bow thruster and deck machinery.
The 220 V bus bars power the lightning panels, control consoles and various 220 consumers and are supplied from bus bar 1 and the emergency bus via circuit breakers and transformers.





The emergency switchboard supplies circuits necessary for the safety of the vessel. These include communications, navigation lights, fire alarm, fire and flood control etc.

The feeders are grouped into four main sections. Two 440v sections and two 220v sections supplied via a circuit breaker and transformer.

The emergency batteries are supplied by battery chargers via the 440v emergency bus. There are two sets of batteries, one for starting the emergency generator and one for the main 24v supply. Terminal voltage of each battery is displayed.

4.2 Main switch board functions

Main switch board functions
The main switchboard functions include all controls and indicators usually available on real switchboards.

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. AVR settings are available in the pop-up window.

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:

- Fast overload of generator
- Slow overload of generator
- Reversed power
- High voltage, slow acting
- High voltage, fast acting
- Low voltage
- High frequency
- Low frequency

Non essential consumer trip
The generator protection will also initiate non essential consumer trip for the following consumers:

- Cathodic protection
- Distiller plant
- Marine growth protection
- Incinerator
- Accommodation
- ER fans
- Air condition
- Refrigeration

Ref section 2.5 in Machinery & Operation Part 3 for trip setting descriptions.

4.3 Electrical power plant - Operation modes

The electric power system is designed for various operation modes dependant on propeller type (FFP or CPP):

I. Harbour Mode (Valid for both FPP and CPP)
The diesel generators power both bus bars, which are connected by the tie-line breakers.

II. Manoeuvre mode a) CPP
(Thruster in operation)

Bus tie-line breaker is open. The diesel generators power main consumers via bus bar 1. Shaft Generator powers the bow thruster.

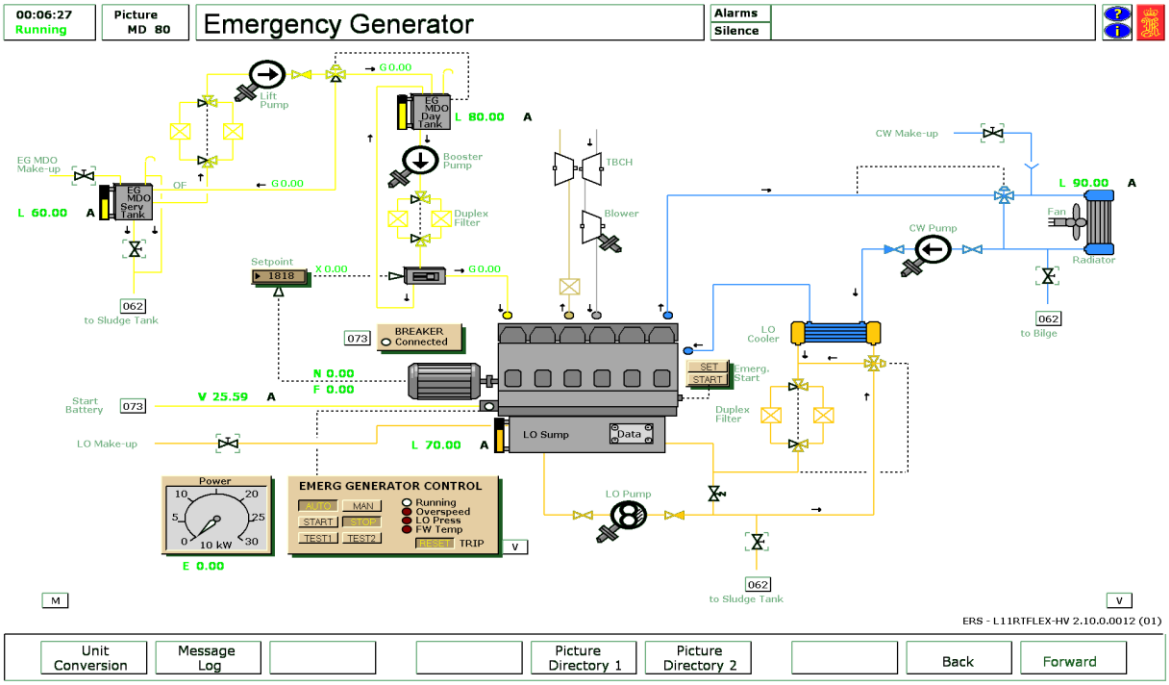
I. Manoeuvre mode b) FPP
(Thruster in operation)

Bus tie-line breaker is closed. The diesel generators supply all power.

II. Sea passage (Valid for both FPP and CPP)
(Diesel generators disconnected)

Bus tie breaker closed. Turbo generator in operation and shaft generator in PTI mode. Diesel generators are stopped and in stand-by mode.

4.4 Emergency generator MD80



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 tie-line breaker is opened
2. The emergency generator is started
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 two **TEST** buttons; TEST 1 and TEST2. TEST 1 and TEST 2 only operate if the emergency generator is in AUTO.
If the TEST1 button is activated a zero-voltage at the bus bar is simulated. The emergency generator will start.
When pressing the TEST 2 button the bus tie breaker will open and a “real black-out” will be detected. The emergency generator will start and connect and feed the emergency bus bar.

NOTE! The various high voltage equipment can be earthed down for safety of the personnel when access to equipment is needed for maintenance.

4.5 Shore power

Bus bar 1 is supplied from 6.6kV 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 electrical 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.

In addition to the 6.6kV shore connection, there is also a 440V shore connection with similar functionality as the 6.6kV shore connection.

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:

- Sea water system
- Ballast system
- Fresh water system
- Bunkering 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 air compressor system
- Service air compressor system
- Sewage treatment plant
- Incinerator plant
- Air ventilation system
- Cathodic protection system
- Marine growth prevention system
- Fresh water generator
- Bilge system including bilge separator
- Refrigerating system
- Steam system
- Oil fired boiler
- Exhaust gas boiler
- Steam condenser
- Thermal oil heating system
- Container loading system
- Reefer containers system
- Battery charging system