



Shoreside power supply

Intelligent solutions for berthed ships based on
SIHARBOR/SIPLINK medium-voltage systems

Answers for Energy.

SIEMENS





Shoreside power supply for ships – environmentally friendly and economical

Cargo shipping carries the bulk of the global traffic in goods. More than 90 percent of the global trade flow is transported across the world's seas and oceans. But while maritime transport contributes about the same proportion of global CO₂ emissions as air transport, maritime transport shows other pollution problems: Combustion of ship diesel fuel releases considerably higher emissions of sulfur and particulate matter than do other fuels.

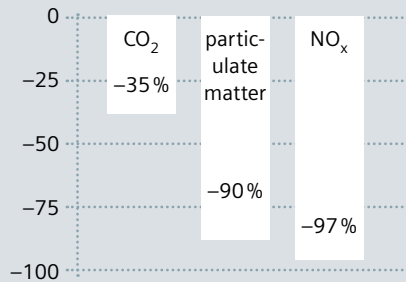
Seaports suffer particularly from pollution, not only due to ships entering and leaving, but also during their lay days. In 2020, experts estimate that in certain port regions, 20 percent of all particulate matter emissions will be caused by ships. In some places today, emissions of relevant pollutants by ships already represent a much higher proportion of total pollution, accounting for as much as 90 percent of nitrogen and sulfur oxides.

In the European Union, these developments have led to a recommendation for installing a shore-side power supply for ships berthed in ports (see text box). A corresponding EN/IEC standard is also being prepared. And there are signs that authorities are taking similar measures in other regions where cargo shipping is a significant source of air-borne pollutants.

SIHARBOR – the clean solution for supplying power to ships in ports

A shoreside power supply provides an effective, convenient solution to the problem of emissions from berthed ships. With the SIHARBOR shoreside power supply system, Siemens offers a standard, modular system concept both onshore and on board the ship. SIHARBOR complies with the EU recommendation 2006/339/EC in every respect. It fulfills the different requirements of port operators, ship-owners, shipyards and power supply

Reduction of pollutants with SIHARBOR*



*based on an European energy mix

Benefits at a glance

SIHARBOR is eco-friendly: It is possible to use electricity generated in power plants where generation is subject to stricter environmental protection standards. SIHARBOR results in 35 percent less carbon dioxide, about 97 percent less nitrogen oxides and 90 percent less particulate matter than does maritime diesel.

SIHARBOR saves costs: In the future, there will be a number of factors that will cause fuel costs to rise. Those will include rising prices for oil and oil-based products and stricter requirements with regard to the permissible sulfur content of a ship's diesel fuel. That is why an onshore supply of electricity will often be the cheaper solution for ship owners.

SIHARBOR reduces noise pollution: An electrical connection eliminates the vibration and noise of on-board generators. That significantly increases the quality of life for passengers, crew and residents in the port area.

companies. And it is suitable for harbors of different sizes. The system can also supply all types of vessels, such as cruise ships, container ships and ferries. Thanks to the modular design of the

system, any solution using the frequency combination of 50 Hz and 60 Hz as well as all voltage levels required in the shipping industry can be adapted and realized.

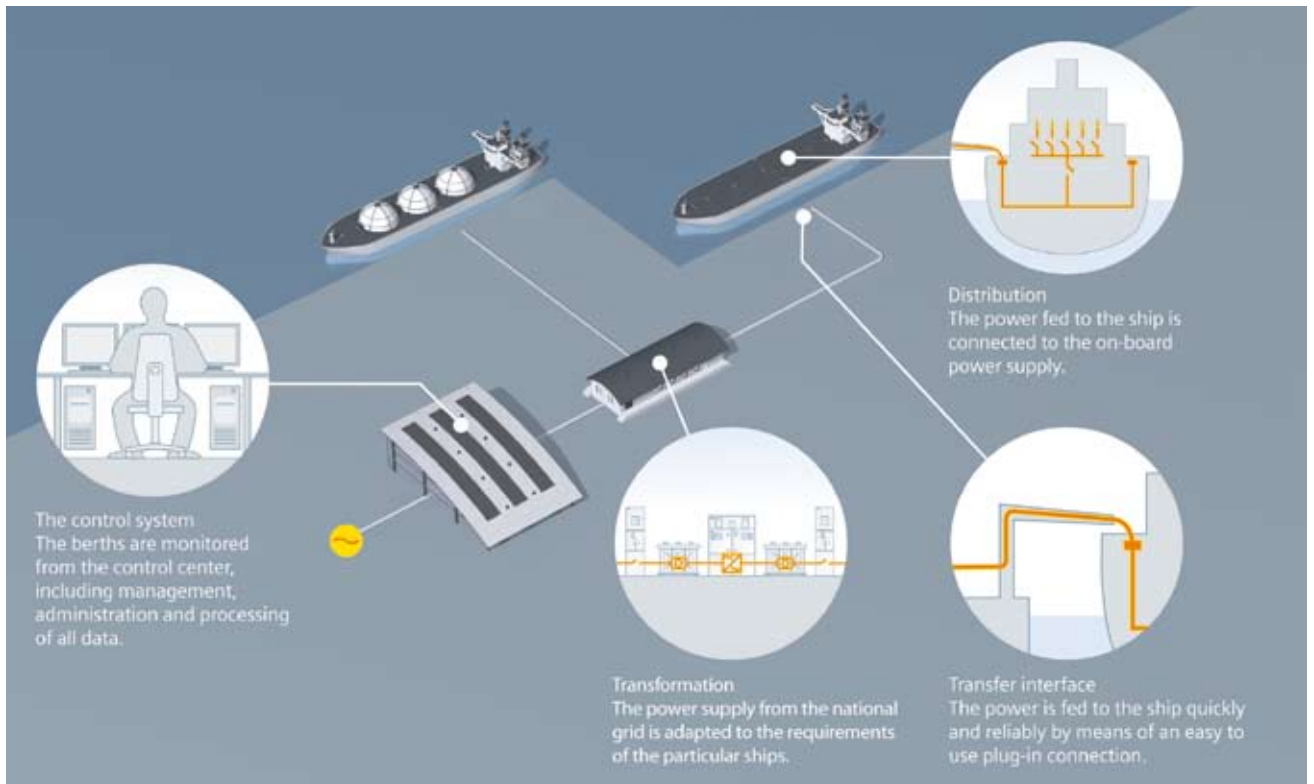
Recommendation 2006/339/EC

In November 2002, the Commission issued a communiqué about the European Union strategy for reducing atmospheric emissions from seagoing vessels using shore-based power sources for berthed ships. This recommendation was finalized in document 2006/339/EC and supplemented with additional measures.

One Commission recommendation addresses the issue of shoreside power supply. Member states should consider the installation of shoreside power supply for use by ships at berth in ports, and consider offering economic incentives to operators to use shoreside power provided to ships.

Member states should work within the International Maritime Organization (IMO), in the context of the ongoing review of the International Convention for the Prevention of Pollution from Ships (MARPOL Convention), to promote the development of harmonized international standards for shoreside electrical connections, taking into account ongoing work.

At the same time, studies were also published on the cost-effectiveness and practicality of using shoreside power to reduce emissions for different types of ships, routes and ports.



SIHARBOR: Shoreside power supply with rugged, proven components

The integrated and modular SIHARBOR system for shoreside power supply offers a perfectly aligned concept with components for medium-voltage shoreside power supply.

Every ship has its individual power supply requirements. SIHARBOR offers the required flexibility as an integral part of the system. Thanks to the modular design of the system, any frequency combination of 50 Hz and 60 Hz can be realized in the supply system.

The SIHARBOR package includes dedicated transformers to adapt the voltage levels on shore to the on-board power system. This way, older ships can also be easily connected as well. In the majority of applications, refitting the existing power cable inlets is no problem. Setting up the shoreside power supply system is a matter of only a few minutes. Staff safety is guaranteed at all times.

SIHARBOR is based on standardized, proven components used by the million from the Siemens portfolio for power supply solutions. The shore-

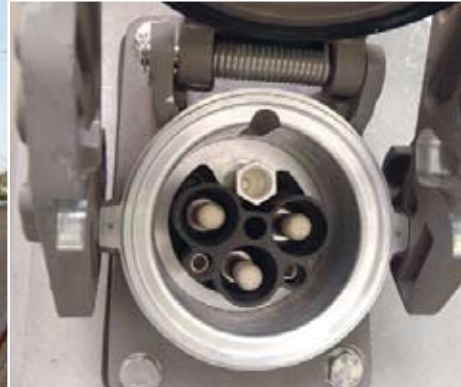
side connection to the ship is controlled via an automation system that is linked to the ship. A fiber-optic cable is used for ship-to-shore communication.

SIPLINK – essential core element of the SIHARBOR system for frequency adaption

On two-thirds of all ships worldwide, the on-board supply system operates at 60 Hertz. Consequently in Europe, the frequency has to be adapted for shoreside power supply. SIPLINK, the core element of the SIHARBOR solution, connects the ship's on-board system with the local power grid. The shoreside voltage and the voltage of the on-board system are adapted via suitable transformers that also isolate the galvanic connection between shoreside and on-board supply systems.

The cable feed – crucial key to success

The dedicated cable feed systems of the SIHARBOR package for the shore-to-ship link take into account all of the flexible connection points that are required for different ship types.



Benefits at a glance

SIHARBOR

- Reduces pollutant emissions
- Provides a fast, simple connection to the ship via a cable feed system
- Covers every power requirement by cascading power modules
- Limits the short-circuit power, which prevents the overloading of the local power grid and of the medium-voltage plug-in connection. No short-circuit limiting measures are required on the ship
- Applies industrial standards and uses proven Siemens components. Those include SIPLINK network coupling, Siemens transformers, type-tested Siemens medium-voltage switchgear and automation systems with SIMATIC S7
- Provides a fast and reliable connection for ships. Requires no specially trained personnel for the shore-ship connection
- Establishes the shoreside power supply via a reliable and standardized plug-in connection with integrated fiber-optic cable
- Makes it possible to record and archive power consumption when berthed
- Reduces fuel consumption on-board
- Reduces energy costs on-board
- Increases the operational life of the ship's diesel engine and auxiliary units
- Allows repair and maintenance work on board to be planned while the ship is berthed

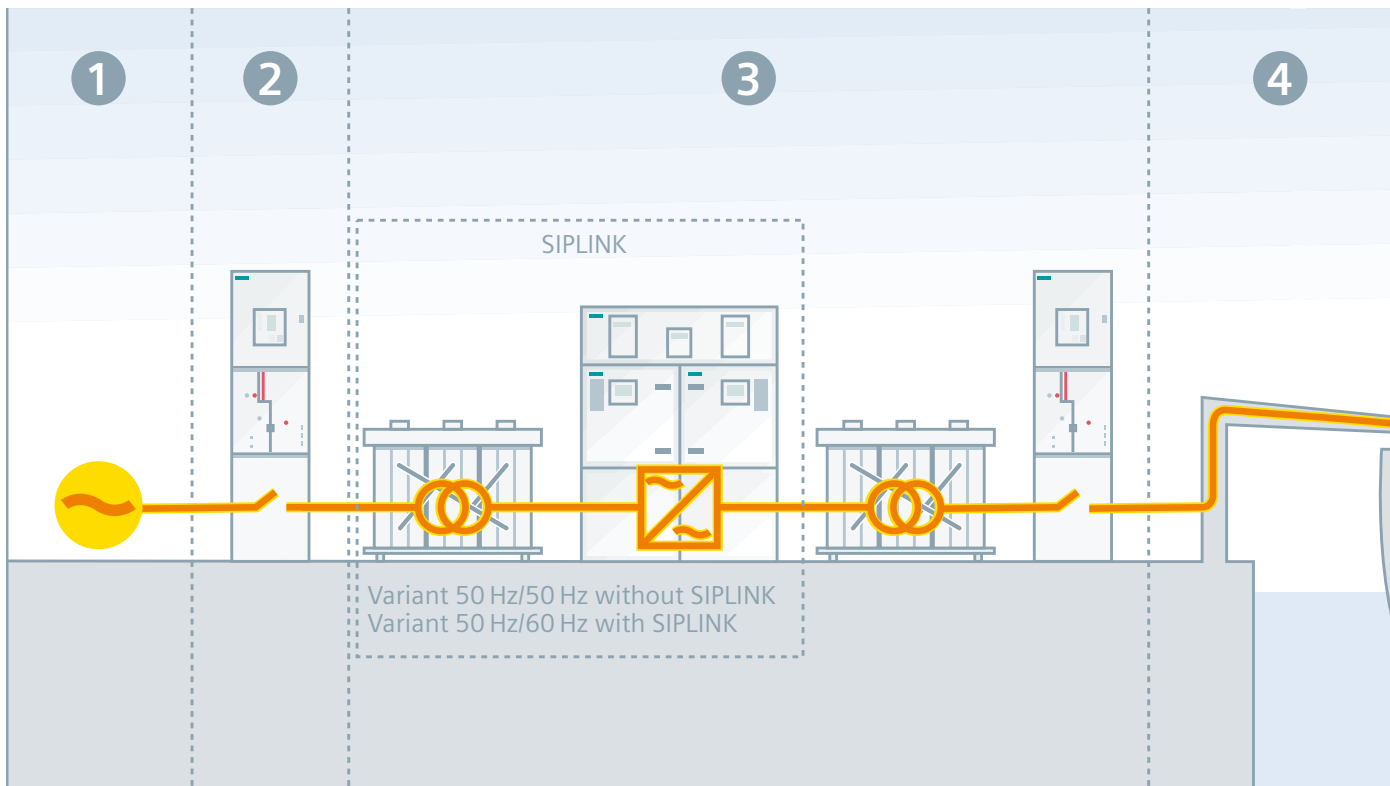
And they automatically compensate for the tidal range.

SIHARBOR – everything from a single source

SIHARBOR offers you an easy way to exploit all of the benefits of shoreside power supply. The Siemens experts adapt the system to your specific

requirements. Siemens delivers all services from a single source, with no interfacing problems, including the utility's substations, medium-voltage switchgear, cable feed systems and automation system.

SIHARBOR is the environmentally friendly, economical solution for your port.



Planning the onshore power supply

When planning a solution for a shoreside power supply, there are a number of various crucial aspects that must be taken into consideration. Right from the planning

stage, the power supply requirements should be specified as comprehensively and precisely as possible.

1 Port infeed

Can the local utility provide the required total power for the planned shoreside connection?

Does the grid dimensioning fulfill the SIHARBOR / SIPLINK requirements?

2 Port grid

What is the nominal voltage?

What is the nominal frequency?

What grid voltage fluctuations exist (in percent)?

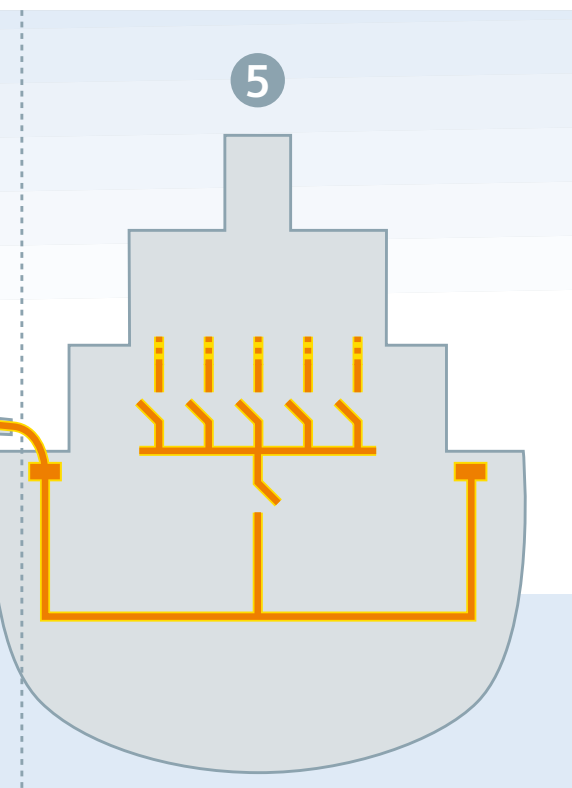
How is the SIHARBOR / SIPLINK system to be fed in?

- ☐ Existing switchgear systems?
- ☐ Additional switchgear systems?
- ☐ New switchgear?

What is the distance from the port grid to the berth (cable length)?

Is power consumption metering required?

- ☐ Yes
- ☐ No



- 1 Port infeed
- 2 Port grid
- 3 SIPLINK and distribution with voltage and frequency matching
- 4 Shoreside ship connection
- 5 On-board ship connection

3 SIPLINK and distribution

Is there an existing building available for installation of the SIPLINK system?

☐ Yes ☐ No

The following items must be taken into account for installation in a building:

■ Will the building support the weight (statics)*?

☐ Yes ☐ No

■ Is there sufficient space available for the components*?

☐ Yes ☐ No

■ Are the rooms air-conditioned?

☐ Yes ☐ No

■ Are the rooms dust-protected?

☐ Yes ☐ No

■ How far is the distance between converter and heat exchanger?

_____ meters (heat exchanger has to be outside)

Is the SIPLINK system to be installed in an outdoor container?

☐ Yes ☐ No

Are there requirements with respect to limiting noise?

_____ dB(A) at a distance of _____ meters

How high are the outside temperatures?

Minimum _____ Maximum _____

4 Shoreside ship connection

How many berths are to be supplied?

How many connection points per berth are feasible?

Shall the system be able to connect to different types of ships (container, RoRo, ferries ...) at berth?

What total power output is necessary for each berth?

What is the maximum permissible distance between ship and SIPLINK (for laying the cable)?

5 Shiplink connection

Which on-board voltages are to be taken into account?

Which on-board frequencies are to be taken into account?

What is the power requirement of each expected type of vessel?

What total power consumption is expected?



SIPLINK – the flexible and reliable network coupling for the shoreside power supply

SIPLINK stands for **Siemens Multifunctional Power Link** and enables linking a ship's on-board power system to the existing onshore power grid even if the system frequencies are different. The two networks are electrically isolated from one another. SIPLINK can generate different voltage levels and frequencies for the on-board system depending on the type of ship berthed at this time.

The power inverter

The power inverter consists of a rectifier for the onshore grid side, an inverter for the on-board supply, a DC intermediate circuit, a closed loop control system, control system and the network filters.

The following requirements can be fulfilled with the power converter:

- On-board system supply
- Different frequencies (50 Hz/60 Hz)
- Parallel operation with on-board system generator during synchronization
- Synchronization in either the ship-to-shore or shore-to-ship direction
- Restriction of the short-circuit power
- Filter per network side – THD of 5 % in line with standard EN-61000-2-4

The transformers

Converter transformers provide the SIPLINK connection to the power supply system. The transformer facing the ship electrically isolates the on-board and onshore power grids so that there is no possibility whatsoever of galvanic corrosion.

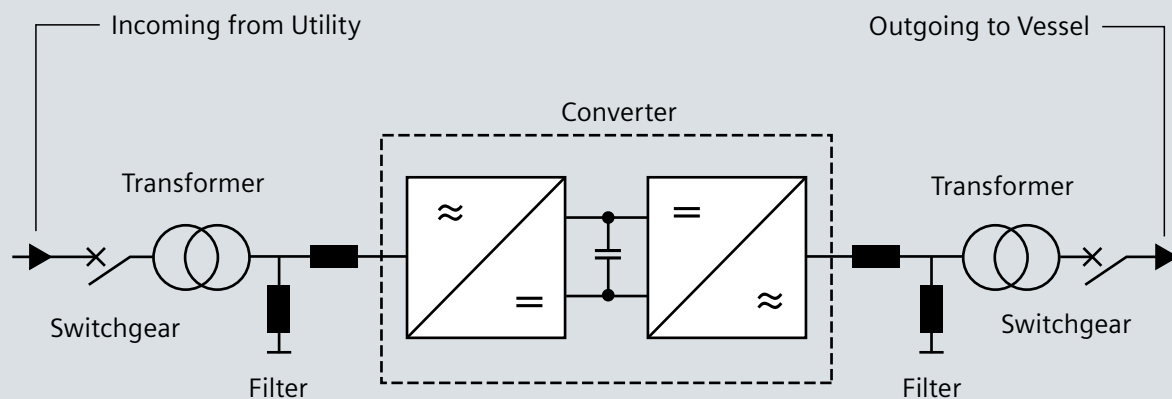
Depending on requirements, either dry-type transformers or oil-cooled transformers can be used to provide the voltages (for example 6.6 kV or 11kV) at the berth.

The cooling system

The SIPLINK system is water-cooled. The heat exchanger is designed either as a water/air exchanger (outdoor installation) or as a water/water exchanger, depending on the application. The dimensions vary according to the required cooling performance. Noise protection requirements are also taken into account.

Key data for a typical application:

- Outside temperature from –20 to +35 °C (water/air cooling with water/glycol mix as coolant)
- Alternatives down to –40 °C and over +40 °C possible



Example* for the installation of a 1.0 MVA SIPLINK

No.	Qty	Component	Dimensions (H x W x D in mm)	Weight (kg)
1	1	Converter	2,200x3,200x1,200	2,300
2	2	Dry-type transformer	1,750x1,000x1,650	2,900
3	1	Cooling System	2,000x900x600	600
4	1	Heat exchanger	1,420x2,200x3,200	630
5	2	Switchgear	2,200x1,100x600	800
6	1	Container	3,200x10,000x3,800	----

*non-binding

- Acoustic pressure level 65 dB(A) at a distance of 10 m
- Acoustic power 100 dB

The switchgear systems

The switchgear systems can be either air-insulated or gas-insulated. Gas-insulated switchgear systems are preferred for ease of maintenance and space reasons.

Human-machine interface systems

The components of the SIPLINK system are equipped with a local control unit with operating and diagnostics options. A master SIMATIC S7

controller with operator panel monitors the state of the system at a central location and displays all operator, alarm and fault data. All data can be transferred to master control systems via standardized bus systems.

Installation

The SIPLINK system can be installed in existing equipment rooms if there is sufficient space.

System solutions in the form of containers or prefabricated concrete substations are also available as options. The components are preassembled and function-tested at the manufacturer.



Qualified planning, project handling and services for your shoreside power supply

We assist you with the planning and implementation of your shoreside power supply system, from the initial idea to the commissioning. We draw up a detailed cost/benefit analysis together with you in order to find the optimal solution for your needs. Our experienced project managers ensure that the project is implemented on schedule and with the right quality. And in any of 150 countries, we can be quickly on the spot with a service team should you need assistance with the start-up or modernization of your shoreside power supply system.

Overview of our services

1. Concept phase

Feasibility studies (for example a power system analysis) help analyze the existing fundamentals correctly.

2. Design phase

In the design phase, solutions for the specific local requirements are developed in consultation with the customer.

3. Implementation

Implementation comprises initial planning, project planning, procurement, deadline monitoring and documentation.

4. Installation and commissioning

The SIPLINK system can be set up and installed in existing buildings, as a container system solution or in prefabricated concrete substations, providing the space is designed as an electrical operating area. The components are preassembled and have been function-tested at the manufacturer. Installation can be carried out by the local Siemens agency or by the customer. This is followed up with commissioning and system testing by specially trained Siemens personnel.

References:

Flender Werft AG, Germany

- Shoreside power supply with SIPLINK for ships under construction from the 50 Hz shipyard grid
- 1 MVA medium-voltage DC back-to-back link for supplying 50/60 Hz on-board systems
- Testing of on-board generator sets with SIPLINK
- Feedback of electrical power into the shipyard grid while generators are running
- Controlled exchange of active power in both directions for improving stability of the network and optimizing load flow in the shipyard and on-board power grids



Flensburger Schiffbaugesellschaft, Germany

- Shoreside power supply for powering ships in the shipyard with different voltages (400 V/50 Hz, 440 V/60 Hz, 690 V/60 Hz) from the 50 Hz shipyard grid
- Converter capacity 1 MVA
- Energy recovery from the on-board generators to the shipyard grid
- Acoustic pressure level 45 dB(A) at a distance of 65 m
- SIPLINK container solution with complete installation of all components, erected at a height of 8 m



Port of Lübeck/TransAtlantic, Germany

- Joint pilot project together with paper company StoraEnso as client of the shipping company as part of the New Hansa project
- Shoreside connection for the three paper ferries – TransPaper, TransPulp and TransTimber – of Finnish shipping line TransAtlantic with 400 V/50 Hz on-board supply systems
- The ships are already equipped for shoreside connection in Finland and have a cable feed system with a plug-in connector, a control unit for the coupling process and a transformer on board
- In Lübeck, Siemens installed the matching connection point at the berth and set up the connection to the medium-voltage system of the Lübeck municipal utility. For control and communication between ship and onshore supply system, Siemens modernized the Finnish relay technology and created a modern software solution using programmable SIPROTEC multifunctional relays from Siemens
- SIHARBOR solution with 10 kV switchgear for the connection to the shoreside supply, 6 kV switchgear for the connection to the on-board power grid, a cast-resin transformer with 10 kV/6 kV for the electrical isolation of the two networks, and another substation on the wharf accommodating the sockets for the 6 kV power circuit and for the control unit and operator panel



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