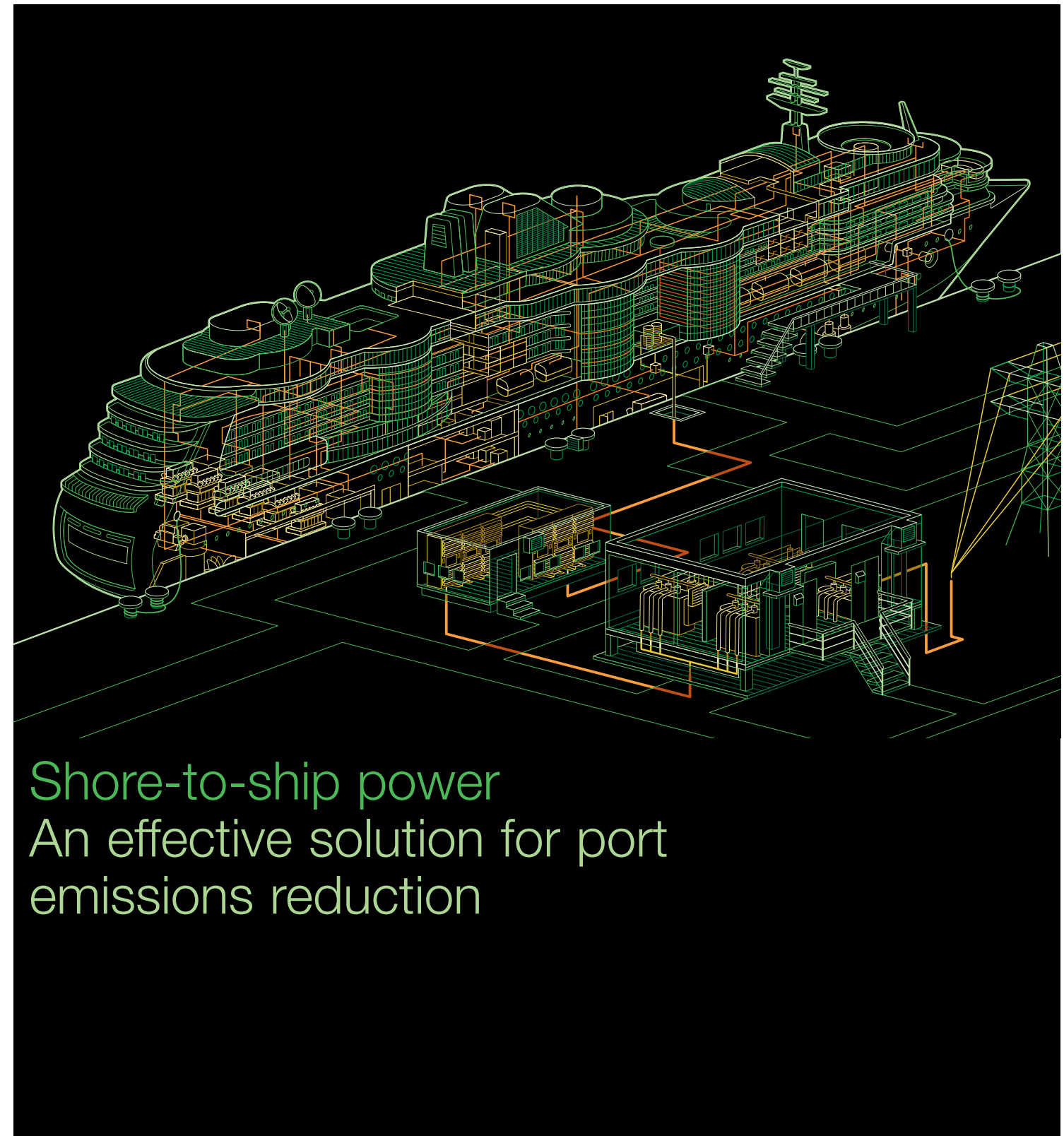


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Plug-in to electric power from shore Cut emissions and noise from ships in port

Ships generate emissions while docked in port by running their auxiliary engines to create onboard electric power. In ports with heavy ship traffic, this practice creates emissions and negative health and environmental impact to the local surrounding communities.

As global trade steadily expands, ship emissions represent an ever-increasing environmental concern. Sustainability is today a key area of focus in the shipping industry, where strong measures are being taken on several fronts to dramatically reduce ship emissions. One such measure is shore-to-ship electric power supply, which eliminates pollution problems such as SO_x, NO_x, CO₂ and particle discharge as well as noise and vibration from ships in port.

Propelled by new environmental regulations

NO_x and SO_x emissions from ships are a major global pollution problem and several regulatory parties including IMO/MARPOL and EU have issued legislation which sets absolute limits on sulfur content in fuel and sulfur oxide and nitrogen oxide emissions from ships.

Meeting these new standards will require cleaner and much more costly marine fuels with low sulfur content, which will stimulate interest in shore power.

Environmental regulations and recommendations include:

- MARPOL 73/78 Annex VI, which places limits on sulfur oxide and nitrogen oxide emissions from ship exhaust and prohibits deliberate emissions of ozone-depleting substances
- EU Directive 2005/33/EC, which limits the amount of sulfur to 0.1% in all marine fuel used while at berth for more than 2 hours in European ports and by vessels on inland waterways
- MEPC 59/6/5, which is a joint proposal from USA and Canada to IMO to designate an Emission Control Area (ECA) for specific portions of U.S. and Canadian coastal waters
- Local government regulations in North America
- EU Recommendation 2006/339/EC, which is a recommendation by the EU commission for its membership countries to promote shoreside electrical facilities
- EU Recommendation 2003/96/EC, which is a recommendation by the EU for subsidizing shoreside power supply for ships by cancellation of electricity taxes

Widespread implementation of shore power?

Broad utilization of shore power may not be so far into the future. An important milestone that will contribute to the growth of shore power is the new global standard "High Voltage Shore Connection (HVSC)" by IEC, ISO and IEEE.

Shore power is especially applicable to ships operating on dedicated routes and vessels that consume large amounts of power and emit high levels of air pollutants when berthed. Typical vessel types include ferries, cruise ships, LNG carriers, tankers and container ships.

In Europe, several harbors have implemented high voltage shore power supply systems within the last decade including Gothenburg, Lübeck, Oulu, Zeebrugge and Antwerp. In addition, many North American cities such as Los Angeles, Long Beach, Seattle, Juneau and Vancouver have already implemented shore-to-ship power for many of the above vessel types in close cooperation with the shipping industry.

A total ABB Shore-to-ship power solution

ABB offers a complete, seamlessly integrated shore-to-ship power solution for safe and reliable power transfer from the public electric power grid to the ship while in port. A total ABB solution encompasses:

- Electrical infrastructure on ships – retrofits or new installations
- Electrical infrastructure in ports – engineered and integrated systems to fit all types of ports
- Connection and control solutions to ensure personnel safety and seamless power transfer

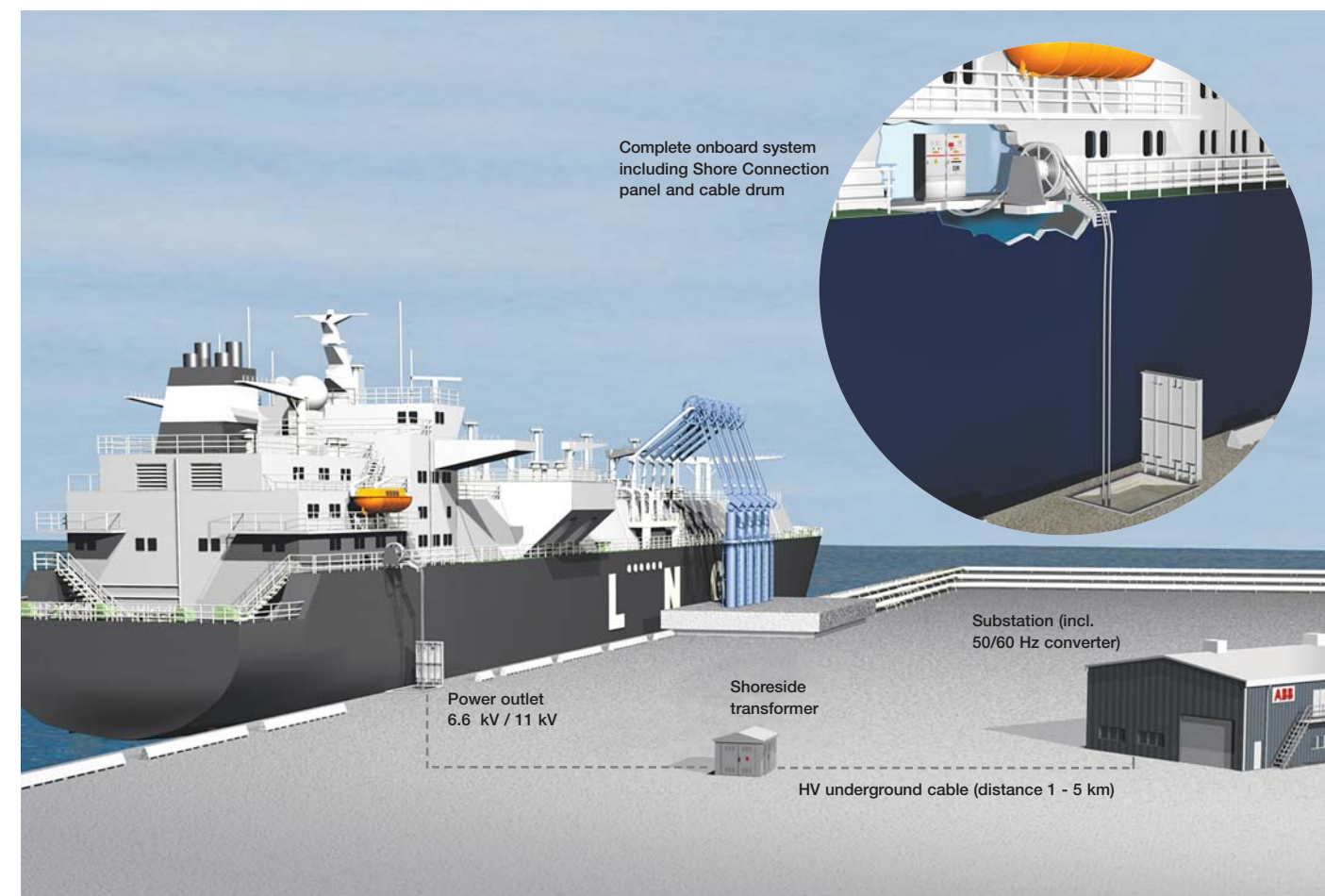


ABB Shore-to-ship power is a modular and highly flexible system that can be adapted to the unique requirements of each project. The system is easy to implement onboard and the shoreside equipment - transformer and substation - is built in modules for both small and large ports.

With shore-to-ship power, ships can shut down their engines while berthed and plug into an onshore power source. The ship's power load is seamlessly transferred to the shoreside power supply without disruption to onboard services, eliminating emissions to the local environment.

ABB Shore-to-ship power Onboard the ship

ABB has been a technology pioneer in High Voltage installations for marine applications. With safety and reliability at the forefront, ABB has developed a complete, compact shore-to-ship power solution for ships that is well suited for both newbuild and retrofit projects.

A complete power & control solution

The ABB shore-to-ship power is a fully integrated system that includes all power and control equipment necessary to connect a ship to a shoreside power point and to secure seamless automated power transfer of the ship load from the onboard power plant to the shoreside source and back. The system has been designed to comply with new international standards.

The shore connection panel is delivered as a finished cabinet solution with both a power module and a control module. Depending on the system configuration and onboard requirements, the cabinet may be supplied with cable connectors located in the front of the cabinet or with openings for cable entry through the cabinet floor. All the equipment is constructed and factory tested according to international standards and classification society rules.

Shore-to-ship power control and operation

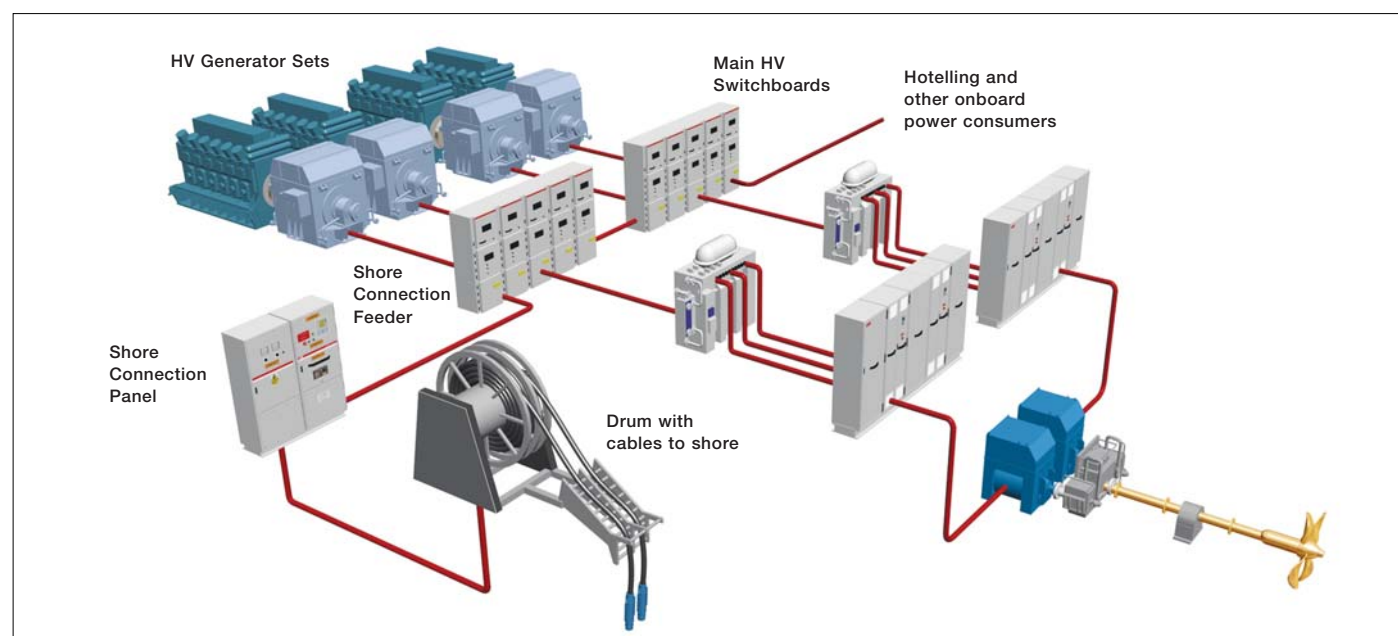
– fully automated power transfer

Synchronization and load transfer of the shore power are controlled in the shore connection panel. Operations are performed smoothly, allowing the two power sources to synchronize and the onboard machinery to respond without the slightest disruption to onboard services.

The shore-to-ship power system has two operation modes:

- Remote auto mode – Shore connection breaker is controlled by IAS/PMS
- Local auto mode – Shore connection breaker is controlled through local operation from the front of the shore connection panel

Figure 1 shows a ship with diesel-electric propulsion and a shore-to-ship power system configured with the shore connection panel located outside the main switchboard room. The ship is equipped with an onboard cable drum to lower the cable down to the quay for onshore termination.



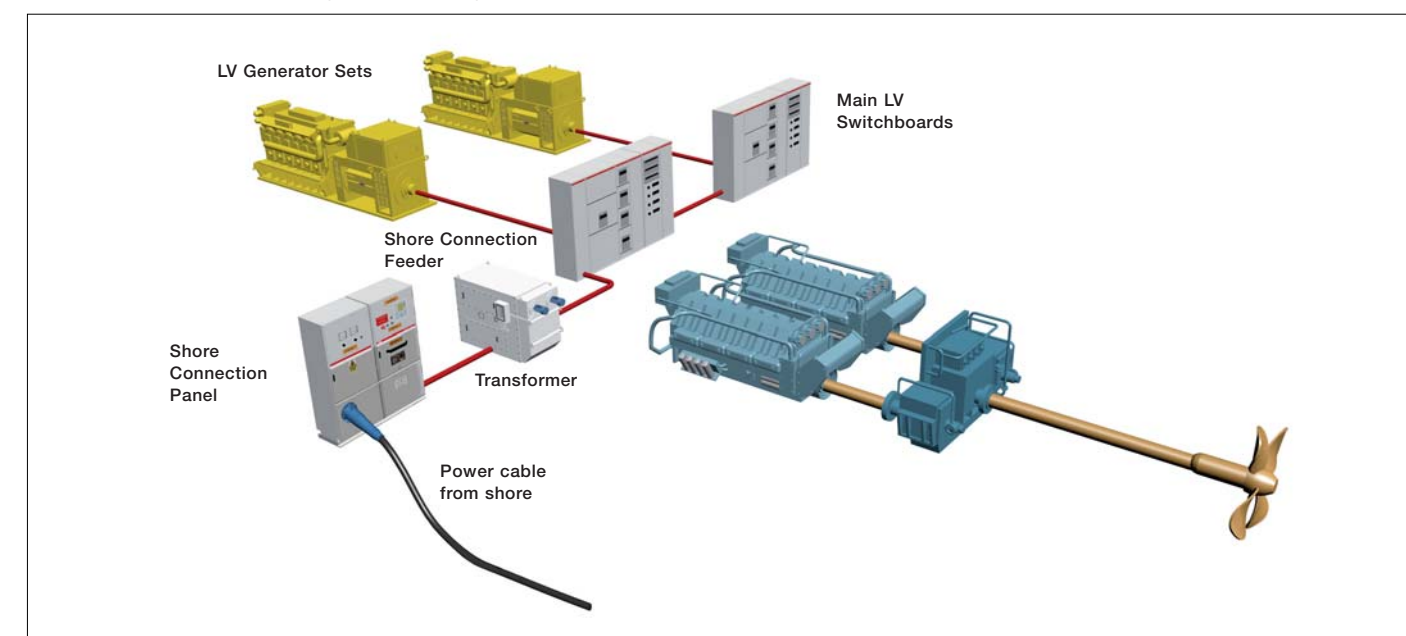
The full sequence to connect or disconnect a vessel to shore power includes the following steps:

- Vessel arrives in port.
- Power cables and control cables are connected.
- The last running engine is synchronized with the shore power grid.
- After the shore connection circuit breaker is closed, the generator is off-loaded and the engine is stopped.
- Before the vessel departs the port, the first engine is started and synchronized with the shore power grid.
- After the load is transferred to the generator, the Shore Connection opens.
- Power cables and control cables are disconnected and the vessel is ready for departure.

As part of a turnkey project, ABB can prepare a complete onboard shore-to-ship power solution so that installation and commissioning give minimal interruption to ship operations.



Figure 2 shows a ship with diesel machinery and low voltage electric system. The shore-to-ship power system is arranged with the shore connection panel located outside the main switchboard room with cable connectors mounted in the front. An onboard transformer steps down the power from high to low voltage.



The advantages of ABB Shore-to-ship power A one-stop solution

In 2000, ABB was the first to deliver a complete shoreside power supply system. Since then, we have supplied our shore-to-ship solutions to various ports and further developed the system for vessel types such as cruise and container ships, Ro-Ro vessels and LNG carriers.

Complete solutions - onshore and onboard

As a full-scope supplier, ABB offers turnkey shore-to-ship power solutions encompassing fully engineered and integrated systems, state-of-the-art equipment, as well as a comprehensive range of services for a complete shore connection solution. The portfolio includes the entire electrical infrastructure needed onshore and onboard – from the receipt of power from the local grid and its adaptation to the vessel's requirements, to the connection of shore power including the onboard system.

The array of ABB solutions is suitable for container terminals and city ports. It covers single and multiple frequency applications as well as single and multiple berth arrangements, with power ratings to serve even the largest ports. Spatial limitations can be overcome by compact indoor concepts accommodating all major components in buildings. These have a small foot print, are located to ensure smooth dockside operations and match the surrounding environment. The modular solutions also support staged implementation and investments.

From the local grid onto the vessel

The onshore solution comprises the entire chain from the main incoming substation receiving power from the local grid to the power outlet at the berth. The system includes transformers and frequency converters to match the grid power, voltage and frequency to the ship's onboard power system. It also comprises the connecting cables and berth terminals.

The solutions allow several vessels to be connected simultaneously and the inclusion of a frequency converter enables the supply of 50 and 60 Hertz power regardless of the local grid frequency. Onboard, the ABB shore-to-ship power equipment is fully integrated with the ship's electrical and automation system, enabling seamless power transfer from onboard generation to shore power.

ABB provides turnkey onshore and onboard solutions and offers a state-of-the-art portfolio of key components for shore-to-ship power such as switchgears, frequency converters and power transformers, control and protection

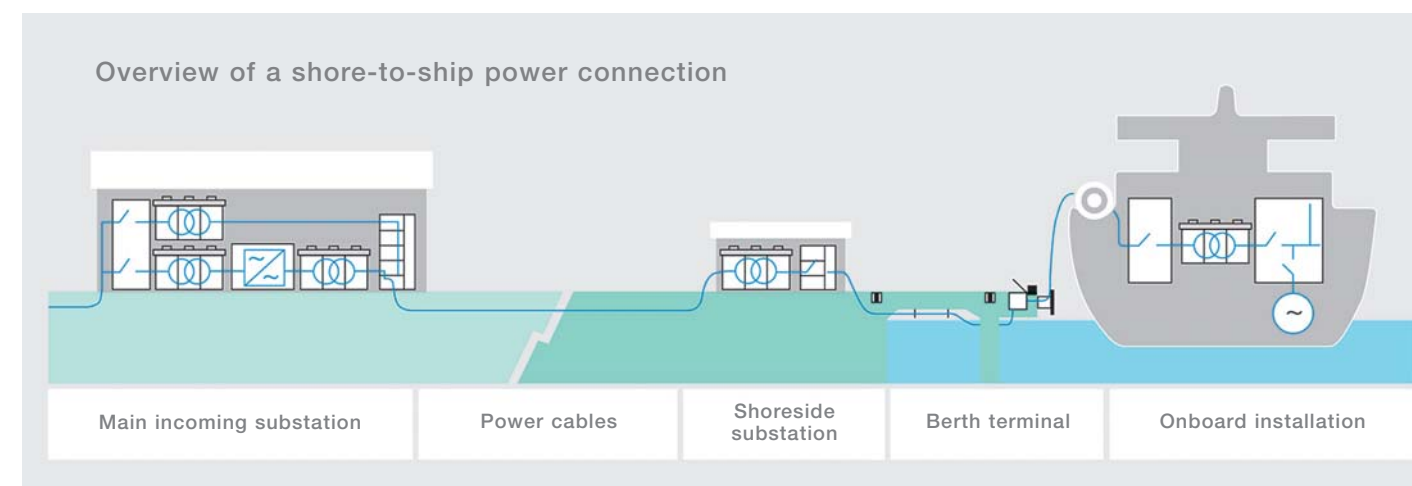


ABB supplies turnkey shore-to-ship power solutions comprising the entire electrical infrastructure needed onshore and onboard – i.e. fully engineered and integrated systems including state-of-the-art equipment such as high and medium voltage switchgears, transformers, frequency converters, control and protection systems, etc. as well as a comprehensive range of services.



In addition to cut the port emissions from ships, vibration and noise associated with the operation of auxiliary engines on board creates an environment that is less hospitable for workers, but is also unpleasant for nearby residents. That can make it difficult for ports to expand their operations.

systems, etc. Apart from adapting the grid power frequency to that of the vessel, ABB's highly efficient, low-maintenance frequency converters offer reactive power compensation and voltage control. These features help to reduce energy cost while stabilizing the grid.

A full range of services

ABB's shore-to-ship power solution portfolio is complemented by a comprehensive scope of services to ensure that the overall electrical connection system is optimized both technically and economically. ABB also offers system studies to assess the impact of the ship-to-shore power solution on the local grid and to recommend optimized solutions to upgrade and strengthen the local grid and port network. By bringing ABB into the project from an early phase, design and implementation risks are minimized. As the project matures, ABB provides proficient project management as well as training courses at ABB's or customer's premises to optimize the utilization of all assets and investments.

Benefits all around

Reduced emissions are the ultimate goal of ABB shore-to-ship power solutions, yet another important benefit is lower noise, which creates a better environment for passengers, crew, dockworkers and local residents. For ship owners, operators and harbor authorities, a one-stop ABB solution provides enhanced safety and availability through comprehensive experience, in-depth application knowledge and, last but not least, competent support from ABB's global service network.