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Shore Power for the Ship Operator

Prepared by Fathom Eco-Efficiency Consultants Ltd.- November 2014

What is 'Shore Power'?

The term 'Shore Power' is commonly known as 'Cold Ironing' within the maritime industry.

'Cold Ironing' refers to the historic process whereby the iron of iron-clad engines would go cold when shut down whilst the ship was in port.

In the modern maritime industry, cold ironing, or shore power connection, reflects the process through which shore-side electrical power is provided to ocean-going vessels to power onboard systems and equipment, when they are docked, allowing them to shut down auxiliary engines and/or generators.

A Mature Solution For The Commercial Shipping Industry

Shore power connection is a practice that has been exploited for several decades by the naval sector.

Within the global commercial shipping industry, shore connection technology has been used since the 1980s to supply commercial vessels with electricity. Ferries were the first vessels to be equipped with the infrastructure required to utilise shore power, largely due to the fact that they always dock in the same position, facilitating connection to a shore-side energy supply.

Today, an expanding range of commercial vessel types, including cruise, container, and Ro-Ro, are connecting to shore power supplies in ports across the globe.

Shore connection technology is emerging as the most cost-effective means of reducing pollution from vessels at berth. A recommendation by the European Commission (2006/336/EC) highlights and describes shore connection technology as the optimal solution in terms of both cost savings and pollution control.

Shore power connection provides a number of benefits, including:

- Dramatic reductions in vessel engine emissions in the port area.
- Elimination of noise and vibrations.
- Facilitating maintenance and repairs on machinery while not in operation.
- Financial savings, as onshore electricity supply may be more cost-effective than bunker fuel use.

Case Study - Retrofit Installation on Stena Line Ferries

Port of Gothenburg, Sweden

Schneider Electric installed high-voltage shore connection (HVSC) systems onboard five Stena Line ferries operating from Sweden, with the aim of improving the air quality in ports used by several of their ferries, and to reduce the consumption of costly and polluting marine gas oil.

Stena Line Needs:

- Equip ships to be able to connect to the existing low voltage shore-to-ship power systems in Göteborg port ferry terminals.
- Onboard installation with minimum footprint to optimise available space
- Reduce ships' energy costs while at berth, moving from electricity produced onboard, to grid supply.

Results

- Minimised footprint onboard.
- 50% energy cost reduction on ships while at berth
  (Note: Sweden has a tax incentive to use green power)

What Was Done?

This extensive project included an interface-to-shore grid, high-voltage transformer, flex-cable management systems, hull openings for flex cables, transformer room, high-voltage switchgear, connection to the ferries' power network, and synchronisation and alarm equipment. The capacity of the ferries' shore connection systems ranges from 2.2MVA- 3.15MVA

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Future Proof Your Vessel

Key Driver For Investment: Regulatory Compliance

Nearly 70% of ship emissions are released within 400 kilometres of land [1], therefore there is an increasing volume of legislation and regulatory instruments that enforce limits for gaseous emissions and pollution in and around ports.

Also, market forces such as the EU Sulphur Directive which dictates a two hour limit at berth for vessels before switching to shore-side power or low sulphur fuel could help to drive the demand for shore power connection technology.

The concept of "plugging in" a vessel at port practically eliminates all gaseous pollution that would ordinarily result from burning diesel fuel while in port. Additional to curbing gaseous emissions, shore power connection also helps reduce low-frequency noise and vibrations.

Key Driver For Investment: 2025 Mandatory Shore Power in EU

The European Commission approved the Directive on the Deployment of Alternative Fuel Infrastructures in April 2014.

This Directive obliges member states to implement activities that improve environmental performance such as the provision of shore-side power technology or emission scrubbers by December 2025.

Article 4 of this directive specifically states:
"Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels and sea-going ships in maritime and inland ports is assessed in their national policy frameworks. Such shore-side electricity supply shall be installed as a priority in ports of the TEN-T Core Network, and in other ports, by 31 December 2025, unless there is no demand and the costs are disproportionate to the benefits, including environmental benefits."

Therefore, the provision of shore power at EU ports will become a mandatory requirement by 2025.

Under this Directive, Member States shall ensure:

- Shore-side electricity supply for waterborne vessels is installed in ports provided that it is cost-effective and has environmental benefits.
- Shore-side electricity supply shall comply with the technical specifications by 31 December: relevant EN standard, to be adopted by 2014, and, pending the publication of this standard, with the technical specifications of the IEC/ISO/IEEE 80005-1 standard.

Key Driver For Investment: Financial Benefits

The differential in fuel cost between running a vessel's engine and/or generators and equipment on bunker fuel versus at-port electricity supply creates a principal driver for investment in shore power connection technology.

Running engines and/or generators at berth using bunker fuel can be much more expensive than using shore power connection. Although many ship operators in the past have burnt regular bunker fuel (HFO) whilst in port; in the face of increasing regulations, internationally and also from the ports themselves, the current tendency for many operators is to switch to cleaner fuels when in port areas. However, such cleaner fuels are generally more expensive than HFO.

The differential cost between generating shipboard electricity as opposed to utilising power from the local national electricity grid is likely to increase as the cost of marine fuels is predicted to continue to escalate.

"A cruise liner could save £319k per year by using a shore power connection" *Source: Schneider Electric*

Key Driver For Investment: Machinery Maintenance

If a vessel is 'plugged in' to shore power and the engine and/or generators are not in use, this allows crews to undertake maintenance activities on the machinery while the vessel is berthed. Reducing generator use can also lead to substantial maintenance reductions.

Motor maintenance costs (estimated at £1.3/h/motor) fall sharply when shore-side electricity is used as the main source of power. The annual average saving per ship is estimated at £7,684. *Source: Schneider Electric*

Key Driver For Investment: Green Scheme Benefits

Vessels that opt for utilising shore power may be able to reap the benefits from environmental schemes that offer incentives such as lower port fees when berthed.

For example, the Environmental Ship Index, a voluntary scheme, offers rebates for cleaner vessels at many global ports.

1. Environ Sci Technol. 2007 Dec 15;41(24):8512-8.
Mortality from ship emissions: a global assessment. Corbett JJ et al.

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Equipping a Vessel for Shore Power

One Connection Standard For The Industry

Until recently, a crucial barrier to making shore power connection a feasible option for global deployment was the lack of standard connection specifications.

Various vessel voltages and frequencies, and vendor- and site-specific cable connector designs meant that a vessel was more likely to be tied to a single port than to be able to take advantage of other ports with shore power available.

The adoption of the international standard IEC/ISO/IEEE 80005-1 Ed.1: Utility Connections in Port- Part 1: High Voltage Shore Connection (HVSC) Systems has catalysed the global deployment of shore connection technology.

This standard has enabled worldwide compatibilities between vessels and ports by standardising voltage, cables, plugs and major safety requirements for each vessel type. Effectively, this standard enables vessels to be able to plug in to any port worldwide.

The standard guarantees a simple, straightforward connection - eliminating the need for vessels to adapt their equipment at different ports.

The aim of the standard is to set forth:

- Requirements for shore connection design and construction.
- Requirements to guarantee the safety of high-voltage shore connection systems.
- Requirements for compatibility between ships and high-voltage shore connection systems.

Technology Requirements & Considerations for Your Vessel

In order to be 'shore power ready', the installation of shore-power cable receptacles and an associated electrical management system is required onboard the vessel.

A key factor to consider with regards to space is that a plug-in cubicle needs to be mounted on the vessel but a space bigger than its actual size needs to be reserved as it will be needed for service and connecting the cables. An additional plug-in cubicle as well as cabling between the plug-in cubicle and the additional cubicle are also required.

The majority of operating commercial, ocean-going vessels have a distribution voltage of either 440V or 6.6 kV and frequency of 60Hz.

Low voltage systems are not ideal for shore-based connections as the current demand can be high, which leads to higher power losses. Typically, high voltage connections are provided to reduce cable size and losses. The local supplies onboard are then transformed down to low voltage.

The step-down transformer and the cable management system should reside onboard for smoother operation.

A typical installation will consist of:

- High voltage transformer or converter.
- Cable management system.
- Openings in hull for cable/plug.
- Preparing space for intake room.
- Local control and monitoring station including steel modifications, hydraulic pipe installations, sprinkler and electrical installations.
- High Voltage switchboards.Connection to vessel's power network.

Therefore consider the following aspects for your vessel:

- Required power onboard.
- Available space on shore, civil engineering considerations, and docking patterns at port
- Space and weight restrictions for onboard transformer when required.
- Installation practicalities.
- Onboard cable installation practicalities and distances.

Onboard Installation: How To Do It, Cost And Time

Time:

- No need to immobilise the ship.
- Potential to work with partners who are used to undertake onboard operations while at sea.

Space:

- ~3x3m^2 for the transformer, ~2x2m^2 for the new panels, etc.
- Cabling length depends on location of auxiliary engines.

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Newbuilding Versus Retrofit Application

Installing Shore Connection Technology On Newbuild Vessels

For newbuildings, the ship owner can request an onboard shore-power ready system to be included as part of the vessel's electrical system design, the additional cost of which is negligible and amounts to around €8,000 *(Source: Schneider Electric).*

Most new vessels are now built to be shore connection ready but it is important to check that it is part of the specification for the vessel from the blueprint stage.

With regards to space requirements, in newer vessels there is often a space reserved for future cold ironing possibilities, therefore adapting or finding space for the required shore connection technology and equipment is not a major barrier.

Retrofitting on Existing Vessels

For vessels already in service without shore-power capabilities, retrofitting the shore connection technology can be undertaken.

Within retrofit application, lack of space can be problematic especially when there is a difference in frequency among the vessel and the shore-side, and thus there is a need for a frequency converter to be placed onboard.

Retrofitting a vessel in order to allow for high voltage shore connection requires a case by case evaluation and the application of the shore power connection technology onto an existing vessel will require a higher capital investment than if applying the required components during the vessel's construction. A vessel can be fitted with shore power connection technology for between €200,000 and €500,000 when they are in dry dock for maintenance. This figure can vary highly depending on the size and power requirements of the vessel. *(Source: Schneider Electric)*

Vessel Retrofitting Operations

- Make a door on the hulk to receive the socket outlet and the cable(s).
- Install a MV electrical panel to receive the power.
- Install the MV cells to manage the vessel connection and the grounding.
- Install a transformer to step down from 6.6 or 11kV to the LV level of the vessel.
- Modify the existing LV panel to host the reception of the onshore power.
- For containerships, install cable reel.
- Request the certification of the installation by the corresponding classification society/ies (including the door).

(Source: Schneider Electric)

Timeframe to Retrofit a Large Vessel

Design and regulatory approval	12 Months
Equipment and delivery lead time	12 Months
Shipyard installation	1 Month
System testing at port	24 Hours

(Source: Schneider Electric)