

Using shore connection technology to meet environmental guidelines

Lorène Grandidier, strategic marketing manager, and Daniel Radu, technical expert, Schneider Electric

Ports and the shipping industry are increasingly under pressure to improve their environmental performance and new international regulations are coming into force. New technologies and business models will have to be deployed if those industries are to be compliant with regulations in a cost effective way. Amongst the new technologies, shore connection, which supplies electrical power to ships at berth, is currently the most advanced and sustainable solution in the long term. According to a recent study (University of Louvain, Belgium 2012), there are currently about 150 berths worldwide equipped with a shore connection system. The recently released IEC/ISO/IEEE 80005-1 standard will accelerate the global deployment of this technology.

This article focuses on the capability of the shore connection solution to reduce port pollution and help ships meet current and future regulations. It also presents the best compliant practices that will help ports, terminal operators and ship owners to make shore connection a safe, efficient and green investment.

Concerns about shipping pollution

Over the last decade, public concerns regarding air pollution from shipping have increased. Despite being recognised as the greenest form of transport, most ships burn heavy fuel oils with high sulphur contents. Every year in fact, the shipping industry emits several million tons of particulate matter (PM), sulphur oxides (SO_x), nitrogen oxides (NO_x) and carbon dioxide (CO₂). Studies estimate that this activity is currently responsible for three to five percent of global CO₂ emissions, 15 percent of NO_x emissions and five to eight percent of SO_x emissions. Given that nearly 70 percent of those emissions occur within 400 kilometres of land, ships make a significant contribution to air pollution in coastal and ports areas. The consequences for human health and the surrounding environment can be serious: recent European studies assume that international shipping kills about 50,000 people a year in Europe and costs society about 60,000 million.

Stricter environmental regulations

The International Maritime Organization (IMO) takes the problem of shipping air pollution seriously. The MARPOL Annex VI regulations already set a timeframe to progressively reduce fuel NO_x and SO_x content. Ships will have no other choice but to use lower sulphur fuel or opt for alternative technologies.

The IMO environmental committee (MEPC) meets several times a year to address current topics. Last year, existing regulations were reinforced by adding two new tools to the MARPOL VI convention of July 2011 to reduce ships' CO₂ emissions: the energy efficiency design index (EEDI) and the ship energy efficiency management plan (SEEMP). Both will be mandatory by 2013. The latest MEPC, to be held in London, should make progress on market-based measures to tackle CO₂ emissions. Some countries, where shipping emissions are a major

source of port pollution, have implemented stricter regulations for ships at berth. In Europe, vessels berthing for more than two hours have to switch to a 0.1 percent sulphur fuel or use alternative technologies such as shore side electricity. In the US, the California Air Resource Board requires ships to be equipped with a shore connection system; otherwise they will not be able to berth in a Californian port from 2014.

Shore connection cuts pollution

The shore connection system is probably the most environmentally efficient technology. It is estimated that this technology enables a global reduction of ships' emissions of CO₂ by 50 percent, of sulphur by 96 percent, of NO_x by 97 percent and of PM by 96 percent compared with the use of 2.7 percent sulphur residual oil. Of course, the global reduction is dependent on the type of power generation sources on land, but the pollution generated is likely to be produced in less densely populated areas than those surrounding the bigger ports and many improvements have been introduced to limit air pollution from power plants. Ports that have implemented a shore connection solution report major local environmental benefits. For example, the Port of Los Angeles, which has been a pioneer in the implementation of this technology, reports a 95 percent NO_x, SO_x and PM reduction per vessel call.

Meeting regulations in a cost effective way

With this technology, ships can turn off their engines while at berth and use electricity from the grid. This enables them to cut their energy bills now that marine fuel oil is reaching record highs. In most countries, electricity is not only greener than the use of heavy fuel but also much cheaper. By saving fuel, ships save money and so, depending on several parameters mentioned below, ships can enjoy a quick payback time. This trend is expected to increase, as the American coasts join the Baltic, the North Sea and the English Channel to become emissions control areas. In these special zones, ships are currently allowed to burn one percent sulphur content fuel. After several debates, the European sulphur directive has finally been approved (14 September 2012) by the European parliament in Strasbourg and ships sailing in these zones will have to switch to a 0.1 percent fuel by 2015, which will increase demand for marine diesel oil and so prices.

By selling electricity to ships, shore connection technology also opens up new opportunities for ports. Depending on several parameters, such as the occupation rate of berths and electricity prices, ports could reduce the payback time of these installations while preserving air quality.

Confident in this technology, several states and federal organisations provide financial incentives as well as funding to support the development of shore connection. Sweden and Germany have sought approval from the European Union (EU) to cut tax levels on electricity for shore side power sold to ships. Payback for ships berthing in those countries is much quicker and this promising initiative could be expanded

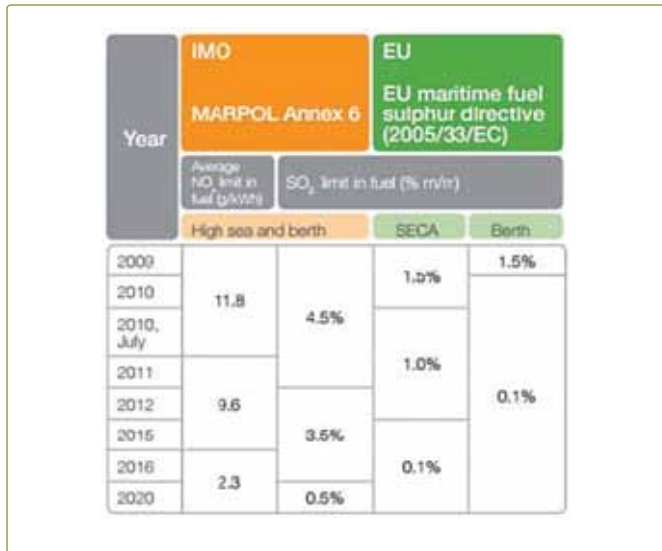


Figure 1: Regulations for fuel reduction.

to other EU member countries. And the EU is going even further by including the implementation of shore connection in the criteria for allocating subsidies to various infrastructure development programmes such as Marco Polo or TEN T. Those programmes can help marine operators to co-finance shore connection projects by up to 20 percent.

The role of international standards

Shore connection is of worldwide relevance; the main maritime freight routes are inter-continental. Starting from this fact, the

main international standardisation bodies have decided to create a single standard for shore connection solutions, both for the system and connection plugs and sockets. Today therefore, a ship with shore connection capabilities could be connected to any berth providing an installation is designed in compliance with the new standard.

The aim of the standard is to set out the following requirements: for shore connection design and construction; to guarantee the safety of high-voltage shore connection and for the ship connection to the high-voltage shore connection.

This provides the benefits of standard, straightforward connection without the need for adaptation and adjustment at different locations. Ships that do not comply with the standard may find it impossible to connect to compliant shore supplies.

There are currently two main international standards dedicated to shore connection design and construction. General requirements for HV shore connection are dealt with in IEC/ISO/IEEE 80005-1, released in 2012. Plugs and sockets for high voltage shore connection are covered in IEC 62613-1 & 2, released in 2011.

Best practices for implementing shore connection technology

To meet the long-term sustainable technology needs of both ports and ships, Schneider Electric has developed an innovative solution called ShoreBoX™, designed to reduce investment, lead time and operational costs.

Optimised footprint & flexible solution

The ShoreBoX solution consists of a range of standard components and all shore connection modules include

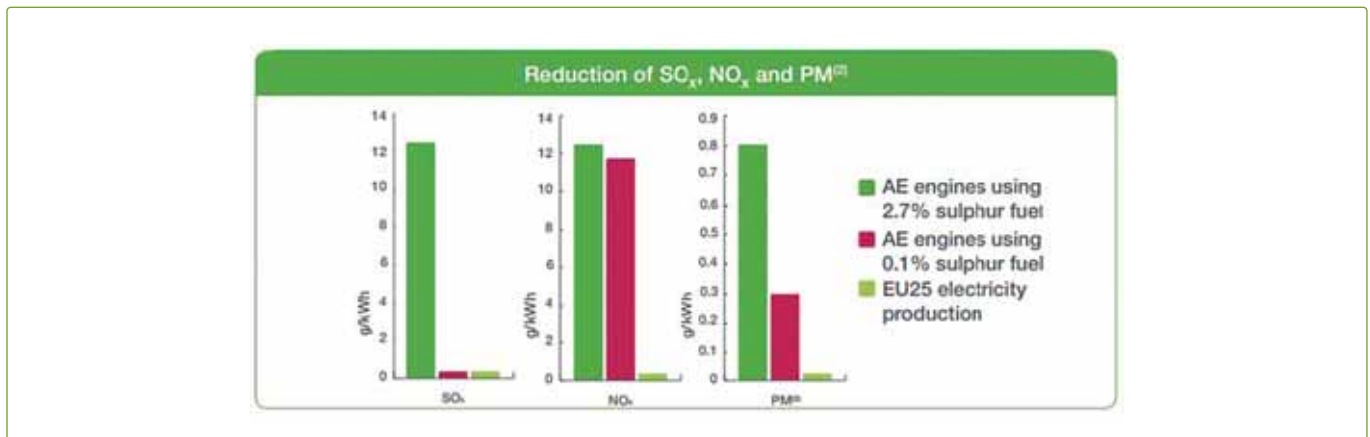


Figure 2: Emission reductions with electricity.

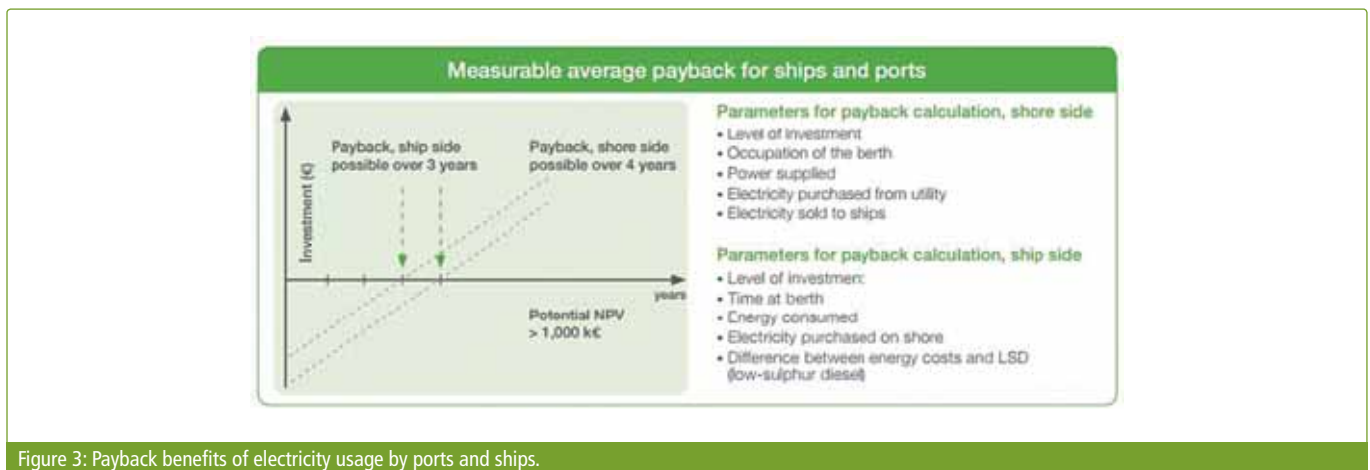


Figure 3: Payback benefits of electricity usage by ports and ships.

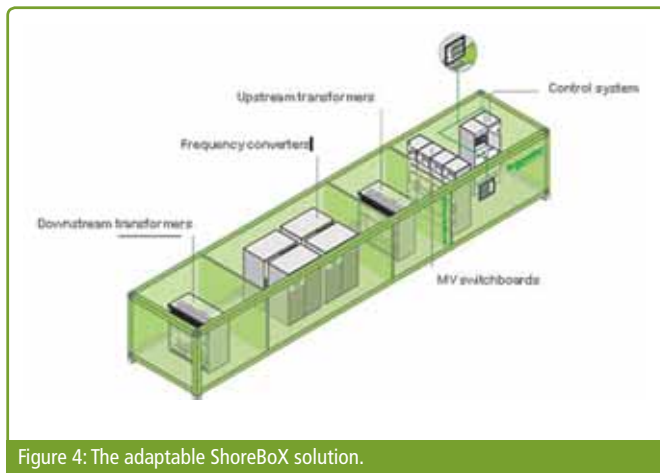


Figure 4: The adaptable ShoreBoX solution.

tested, validated, and documented architectures, guaranteeing system reliability. Fully packaged in a single metal enclosure, ShoreBoX has been designed with the utmost concern for space and cost optimisation. To be able to deal with such complex investment, ports have to be supported throughout the entire project, including design, execution and post-sales services, by dedicated local teams.

Ports are a moving environment, as port traffic is likely to change constantly. Since the berth profile or the electrical power needed by the ship could change, the ShoreBoX solution is able to accommodate the ships of tomorrow's ports. This solution can be implemented and operated without disturbing port activities. The ShoreBoX solution is adaptable to the different power needs and electrical frequency of the ships and to a variety of port infrastructures.

Safety

The safety issue is mainly linked to the protection of those operating the shore connection and staff or others moving in the vicinity of the installations.

With the shore connection solution, particular attention has to be paid to the following safety issues as well: protection of individuals against direct and indirect electrical shocks by means of appropriate measures such as envelopes, barriers, equipotential bonding, interlocks and safety instructions; protection against internal arcing in HV and LV switchboards; protection of operatives handling, plugging and unplugging HV plug/socket-outlets by means of appropriate mechanical interlocks and verification that flexible high-voltage cables are discharged prior to unplugging.

All these functionalities are already embedded in the ShoreBoX solution, and tested and validated during the design phase.

Energy Management System

The ShoreBoX includes an energy management and control system enabling ports to optimise their electricity consumption and thereby reduce operational costs. The system tracks and reports all data in real time, giving ports visibility of energy-source selection, forecasts, simulation, metering and billing. The system also supplies data on the port environmental indicators to make a shore connection investment as green and efficient as possible.

Conclusion

Air pollution and regulations are forcing the whole maritime industry to look for greener technologies. These new investments are often viewed as a constraint. Nevertheless, shore connection systems can lead to fuel, energy, and money savings for ships. It also opens up new opportunities for ports and preserves air quality around them. Recently, the main barriers to development have been removed. In fact, the standard ensures global compatibility between ports and ships and existing solutions, such as the ShoreBoX, are safe, flexible, and efficient enough to be deployed in other ports. Consequently, shore connection is likely to be further expanded in the coming years.

ABOUT THE AUTHOR

Daniel Radu was born in 1975 in Bucharest, Romania. He obtained a PhD in Electrical Engineering, in 2004, from the University 'POLITEHNICA' of Bucharest, Romania. He is currently with Schneider Electric, France. His interests include shore connection systems, low voltage power systems transient analysis, power systems modelling, LV and MV equipment and system design. He participates as a technical expert in IEC committees TC 18 & TC 23 and has been an IEEE member since 2006.

Lorène Grandidier is a graduate in Marketing Management from Grenoble Business School. She joined Schneider Electric two years ago, working in the shore connection programme as the strategic marketing manager.

ABOUT THE COMPANY

As a global specialist in energy management with operations in more than 100 countries, Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in utilities & infrastructures, industries & machine manufacturers, non-residential buildings, data centres & networks and in residential. Focused on making energy safe, reliable, efficient, productive and green, the Group's 130,000 plus employees achieved sales of €22.4 billion in 2011, through an active commitment to help individuals and organisations make the most of their energy.

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Website: www.schneider-electric.com/shore-connection

Email: lorene.grandidier@schneider-electric.com