

ARTICLE

Power Conversion - Shore-to-Ship Power



In the shipping industry, harbour areas have been identified as a prime candidate for enabling significant emission reductions. With this in mind, port authorities, ship-owners, industry suppliers and regulators are now focusing on the decade-old technology known as shore-to-ship power, for which universal electrical standards are on the verge of being ratified by IEEE, ISO and the IEC. Onshore power supply allows commercial ships calling at ports to turn off their diesel engines and tap into cleaner energy sources.

Over 90 percent of the world's goods are transported by sea, and although shipping is a highly efficient means of transporting cargo with lower CO₂ emissions than trucking and far lower emissions than air transport, the industry is still responsible for around four per cent of all global CO₂ emissions (aviation accounts for two per cent). With shore-to-ship power connection technology, a large cruise ship can cut fuel consumption by up to 20 metric tons and reduce CO₂ emissions by 60 metric tons during a 10-hour stay in port – equivalent to the total annual emissions of 25 European cars. It is no surprise then that interest in shore-to-ship power is growing, not only for environmental but also for economical reasons. With a shore-based power connection, a ship is able to turn off its engines without interrupting its port services, such as loading and unloading, hotelling or any other activities that consume power at berth.

The connection and disconnection of the ship takes as little as 15 minutes, and administration of power supply and consumption is handled by the port operator. Establishing a shore-to-ship power connection necessitates investment by both ship owners and port authorities or terminal operators in the form of either a retrofit of existing assets or construction of new ones. The ship needs an additional electrical switchboard, cables connecting it to the ship's main switchboard, and, in many cases, a step-down transformer. The port requires a substation with breakers and disconnectors, an automated earthing switch, a transformer, protection equipment such as transformer and feeder protection relays, communications equipment to link ship and shore, and in most cases a frequency converter to adapt the frequency of electricity from the local grid to match that of each vessel. Further, a cable-management system is needed for either the port or the ship.

Such technology is readily available, and given the emission reductions implicit in onshore power as well as the technology's imminent standardisation, the solution is gaining attention. It is increasingly appearing in regulations and discussions in the European Union, the United States and within the United Nations' organisation for maritime policy, the IMO. EU directive 2005/33/EG, which went into effect January 1, 2010, exempted ships using shore-based electricity from a rule requiring use of reduced sulfur-containing marine fuels while in port. In the United States, legislation proceeds state by state; California, a regulatory forerunner, has begun to require shore side electricity connection for some ship types. At the IMO level, new restrictions on the allowable sulfur content in fuels improves the economical case for onshore power, without explicitly mandating or supporting it. Onshore power supply is a well-established technology, which is already available at several ports, including those in the United States, Belgium, China, Canada, Germany, Sweden, Finland and the Netherlands. With a new set of global shore side electricity standards on the verge of ratification, the practice is expected to rapidly expand for all major types of ships and ports worldwide.

Regulations Point to Onshore Power

As regulators realise that pollution stemming from the shipping industry is having a major impact on public health as well as costs, they have increased their attention on this industry. Since at least the late 1980s, the IMO has focused on how to reduce the environmental impact of shipping (oil spill prevention has a much longer history). National, city and port authorities are also initiating regulation of emissions generated by ships. Currently, there is no law or rule requiring ships at port to connect to an onshore power supply, but standardisation may well lead to increased adoption of onshore power technologies.

Evaluating the Benefits

For port authorities and ship owners, the merits of shore-to-ship power supply versus the competing emissions-abatement technologies are debatable. The operational profile of the ship also has a big impact – eg, a ferry calling into a port everyday is quite different from a container vessel calling into a port once a month. Thus, it is difficult for investors to calculate long-term return on investment as the regulatory picture changes.

Fluctuations in the price of marine bunker fuels compared with shore-based electricity also influence calculations. The environmental profile of electricity generated by power plants on land versus ships' diesel engines running on bunker fuels is one of the main advantages of shore-based power. Generally, when power production can be reduced to as few producers as possible, these producers can be more easily and efficiently optimised to reduce environmental impact.

Another argument for shore-to-ship power is the advantage of jurisdiction. With onshore power arrangements, regulators can deal with the specific, local problem of pollution with a specific, local response. Efforts to capture emissions from auxiliary diesel engines can be used throughout a ship's operations worldwide, but it takes away any scope of action by local or regional authorities. For ports, the ability to supply power to ships at berth enables them to establish a more efficient and powerful overall electrical supply as a utility. The use of state-of-the-art frequency converters can provide both a stabilising effect on the local grid and an improved power factor. Effectively, this means the local power system experiences lower losses.

Onshore power supply has an additional advantage over other emissions abatement technologies in that it reduces both noise and vibration in port areas. This is a benefit to merchant mariners, passengers and crews, port workers and the surrounding community of ports, particularly large ones. Some ports have encountered growth constraints related to their environmental permits, as their operations' emissions, noise or vibration levels have become too high. Finally, shore-to-ship power is easily scalable; infrastructure investments are sustainable over decades with long-term revenues and relatively little maintenance. For each new port that invests in shore connections, the cumulative value of the technology increases by a factor, as more and more ships and sailing schedules are impacted.

A Shore Solution

Shore-to-ship power connections have been implemented in approximately two dozen port terminals worldwide starting in 2000, and on over 100 ships ranging from cruise vessels to oil tankers and container ships. Countless other port operators and ship owners are assessing an investment in the technology, on the condition that global standards for shore connection are realised. Acceptance of and investment in shore based power supply infrastructure has been limited due to the lack of a global standard. A public specification is already available, and this is being used by ship owners and port authorities to assess future installations. Existing technology solutions are largely built up around these specifications. Regulatory moves by local, national and international bodies that spur adoption of shore-to-ship power supply include taxes on fossil fuels, requirements to marine fuels and stipulation of onshore power supply (or alternatives with equivalent emissions reductions).

Shore-to-ship power supply is in most instances a practical and effective means to reduce emissions in heavily used port areas. The technology is available, but its adoption is contingent upon it being available at a large number of ports, and in a large number of ships.

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