Unique Ship-to-Shore Power System Helps Accelerate Decarbonization Efforts in Maritime Sector



Innovative electrical substation design is at heart of cold-ironing system that allows cruise ships to shut down and plug into shore-side power and significantly reduce greenhouse gas emissions at ports.

In 2018, the UN International Maritime Organization set a goal to cut the maritime greenhouse gas emissions by at least half by 2050. One approach to decarbonization is cold ironing, where a vessel shuts down all on-board power generation from diesel engines and connects to shore power supplied by the local utility. With this approach, the industry can lower CO₂ and other pollutant emissions up to 98% almost overnight. As a result, custom shore power systems are increasingly popping up at ports throughout North America. Converting to shore power for an ocean-going vessel, however, requires proprietary equipment and the ability to accommodate a variety of ship conditions. Ships operate on either 6.6 or 11 KV and have power requirements anywhere from 4 to 16 megawatts with unique load profiles specific to each ship. As a result, the substation in this environment must be able to protect both the vessel and the utility providing the power.

So, it is not surprising that the SCADA systems used in electrical utility substations can be found monitoring and controlling power in coldironing systems shore-side as well. As in the case of traditional substations, protection relays and redundant safety systems ensure reliable and safe power transmission while monitoring and control equipment provide real-time management and remote access with in-depth



reporting. For ship-to-shore systems, only a few minor customizations are required to provide a full range of power quality and usage reports for the ship and operator billing requirements.

Ensuring shore power is 'ship shape'

Adapting substations to facilitate 'cold ironing' or connecting an ocean-going ship to shore power while in port originated with the cruise line industry. In 2005, Princess Cruises was looking for a partner to build a shore power system at the Port of Seattle. The company reached out to a large electrical contractor with deep experience in commercial high-voltage projects. Design, engineering, manufacturing, installation, and commissioning of the first project was completed in under six months.

The development of the custom solution eventually led to the formation of a shore power division for the contractor which has now become a stand-alone shore power contractor for ports. Today Watts Marine supports ten installations in seven ports across Canada and the U.S.

The patented custom shore power system consists of proprietary equipment designed specifically for the cruise ship industry. It includes dual-voltage electrical service equipment, custom-developed electrical cable handling equipment, and customized electronic monitoring and control equipment.

Once a cruise ship or ocean transport vessel is equipped to receive shore power docks in port, an operator selects the ship to be connected from a database that is integrated into the customized automation system which determines the proper operating parameters.

The Watts Marine Shore Power System does the rest. In this process, five flexible power and control cables are lifted by a specially designed cable positioning device and connected to the ship's electrical system through marine standard plugs and sockets. A shore-side operator then closes the breaker and power is supplied to the vessel.



Protection relays and redundant safety systems are used to protect both the ship and shore electrical systems; all the ship's systems then convert to the shore power. The operator constantly communicates with the ship to ensure a safe transition. Everything is monitored locally, and all systems are also monitored remotely from the main office.

Monitoring and control

"We were looking for a partner that would understand our needs and provide us with the monitoring side," said Mike Watts, Principal of Kingston, WAbased Watts Marine located in greater Seattle and designers of the shore-to-ship power solution. "Within the footprint of our system, there is a lot of high-voltage equipment that you would find in a traditional substation, and so the monitoring and protection side is very similar to what utilities install."

Because ships have varying loads, the substation must adjust and change its monitoring points to match each ship's power needs. Customized solutions are required to address key variables such as voltage, loads and secondary voltage.

"With cruise ships, we are plugging into different power requirements that can be anywhere from four to twelve megawatts," said Watts. "In addition, the ships operate on either 6.6 KV or



11 KV voltage classes. We needed a solution that would work with different load profiles.

After initially meeting at a trade show in 2008, the company selected NovaTech Automation, a Pennsylvania-based provider of the industryleading Orion automation systems, to provide the remote monitoring and reporting capabilities required for their shore-to-ship power solution.

"At the time, we only had two systems installed but it was still important for us to monitor everything at each location remotely," says Watts, adding that at the home office there is the ability to see all their systems' status in a single line item.

The Orion automation system collects data from Bitronics panel meters which provide electrical measurements such as voltage, amp and currents, fault and event records, as well as trend logs. An operator uses custom HMI frames that are fed by customized Orion web pages for local and remote visualization. Alarms are triggered automatically when things fall outside of range operating like a traditional SCADA system. The Orion also provides detailed reporting of key metrics of the shore power connection including (KWH) of energy consumed and connection start and stop times.

With the ability to condition, manage and remotely monitor the use of shore power to meet a ship's electrical needs while in port by adapting traditional substation automation solutions, there is an opportunity to use this technology with other ocean-going vessels in the future as well. This is sure to have significant environmental benefits by reducing harmful emissions in residential, commercial, and industrial areas near busy ports.

For more information on substation automation solutions, visit **novatechautomation.com** or call (844) 668-2832.



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