Long Beach Container Terminal EcoCrane™

Technology Manufacturer
R.J. Corman EcoPower Hybrid Systems, Inc., formerly Railpower Technologies, Inc.

Co-Participants
Port of Long Beach, Port of Los Angeles, Long Beach Container Terminal

Project Objective

The demonstration of a rubber tired gantry crane (RTG) equipped with an advanced energy capture and battery storage system. The system, called EcoCrane™, was developed by R.J. Corman EcoPower Hybrid Systems, Inc., formerly Railpower Technologies, Inc. The project was sponsored by the Port of Long Beach (POLB) and Port of Los Angeles (POLA) under the joint Technology Advancement Program (TAP).

A conventional diesel-electric RTG uses a diesel-fueled engine to generate electricity that powers electric motors used in container lifting as well as the motive power to move the RTG along the container stack. An RTG diesel genset used in port operations has a diesel engine rated, on average, at greater than 600 horsepower.

In the EcoCrane™ configuration, the diesel genset is equipped with a much smaller diesel engine – less than half of the rated horsepower of a conventional RTG. The reduced engine size and ability to turn the engine off during idling results in significantly lower fuel consumption and exhaust emissions. In addition, the smaller engine used in the EcoCrane™ genset is rated by the U.S.EPA at Tier 3, representing the current state-of-the-art diesel engines for off-road applications. This enables the EcoCrane™ to achieve substantial emission reductions as compared to a conventional RTG.

Technology Description

During operation of a conventional diesel genset RTG, electric motors are used to lift the container and reposition the RTG along the container stack. Once in the proper position, the RTG lowers the container at a controlled rate. In a conventional RTG, the energy available when a container is lowered is wasted. In contrast, a hybrid RTG configuration captures the energy associated with lowering a container and stores in an energy storage system.

The EcoCrane™ uses a regenerative braking energy capture and storage system, similar to a hybrid-electric automobile. When a container is lowered using the EcoCrane, the motor used to lift the container is "reversed"; the motor becomes a generator, and the electricity produced as the container is lowered is directed to a bank of batteries - the electric energy storage system. The energy stored in the batteries can then be used to augment the EcoCrane's™ electric motor during the crane's subsequent lift.

Because batteries provide a portion of the energy used by the EcoCrane™ during container lifting, the amount of energy required from the diesel genset is substantially reduced. In the EcoCrane™ hybrid electric configuration, the reduction in power required from the diesel genset is greater than 50 percent. This means that the existing diesel genset can operate at a much lower load factor. The EcoCrane™ hybrid RTG is equipped with a 134 kW (180 brake horsepower (bhp)) Tier 3 John Deere diesel engine. This engine replaced a Cummins KTA-19 diesel engine rated at approximately 507 bhp at an engine speed of 1,800 RPM. Therefore, the EcoCrane™ diesel engine is approximately 65 percent smaller than the conventional RTG diesel engine in terms of rated power. A comparison of the EcoCrane™ diesel engine as compared to the original RTG diesel engine is shown below.

EcoCrane™ Diesel Genset Engine as Compared to RTG Diesel Genset Engine

	Conventional RTG Cummins KTA-19	EcoCrane™ RTG Tier 3 John Deere
Rated Horsepower (bhp)	507	180
Fuel Consumption (1,800 RPM)	27.3 gallons per hour	9.1 gallons per hour
NOx + Hydrocarbon Emissions Standard	4.8 g/bhp-hr	3.0 g/bhp-hr

Results

The experience gained from the LBCT project resulted in EcoPower Hybrid Systems modifying the original EcoCrane design and developing a second-generation EcoCrane™ hybrid RTG system. The new design is equipped with alternating current (AC) motors and eliminates the high power inverter. Control, power electronics, and hardware have also been improved. In addition, the new EcoCrane™ configuration is equipped with a dual battery pack with a total capacity of 440 amp-hours (Ah), compared to the LBCT EcoCrane™ battery capacity of 180Ah. This new battery configuration was designed to adapt to the voltage and energy requirements of existing RTG drive systems. The project final report is available on the TAP website.

Ports America demonstrated the next generation of EcoCrane™ at the Port of Los Angeles' West Basin Container Terminal. The new design reduced greenhouse gases on the order of 70 percent and more important, received verification for diesel particulate matter reductions of 85 percent.

Benefits

The LBCT EcoCrane™ project demonstrated the application of hybrid-electric technology to cargo handling equipment in a marine terminal environment. Significant reductions in criteria air pollutant emissions, as well as reductions in fuel consumption and greenhouse gases, are being achieved by the EcoCrane™ as compared to a conventional diesel-electric RTG. Specifically, NO_x plus hydrocarbon emissions of the Tier 3 John Deere engine are approximately 38 percent lower than RTG original equipment engine. Fuel consumption of the smaller John Deere engine is also significantly lower than a conventionally-equipped RTG.

Project Costs

The cost of the demonstration project was $169,870, with LBCT providing a fifty-percent cost share. The balance of funds, $84,935, was provided by the TAP.

Updated: May, 2012