

Engineering Energy Solutions that Reduce Costs and Emissions

Crowley offers one Puerto Rico customer unexpected energy and cost savings and total supply-chain solutions in support of their conversion to liquefied natural gas (LNG) as a fuel source.

Story by Amelia P. Smith



▶ **When Coca-Cola Puerto Rico Bottlers considered** all the ways to make their diesel-run operations more efficient, they never expected a solution that would launch them to the forefront of an energy revolution.

“We were searching for clean energy solutions,” explained Coca-Cola Puerto Rico Bottlers’ Carlos Trigueros, director, operations. “We had heard of natural gas and we always wanted to learn about it, but no one was really acting on it.”

Above: An artist’s rendering of one of Crowley’s LNG-fueled, combination container and roll-on/roll-off (ConRo) ships - *El Coqui* slated for delivery in 2017. *Below:* Drivers are also trained in the safe delivery of LNG at Coca-Cola Bottler’s plant in Puerto Rico.

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Trigueros’ story began in 2010 when his company – a wholly owned subsidiary of CC1 Companies and producer of Coca-Cola products for distribution worldwide – began researching alternative fuel sources for its Cayey and Cidra plants. As time passed, the price of diesel continued to rise, with no end in sight.

“Our search became really intense after oil reached the highest cost. Then it became a need,” he explained. “But the driving factors were both cost and environmental reasons.”

Industrial customers like Coca-Cola Puerto Rico Bottlers, and others throughout the Caribbean, commonly rely on diesel or the local energy grid to power operations, which are not only expensive, but also produce heavy emissions. Alternative options are limited and for a variety of reasons aren’t always plausible.



▶ Story continued on page 2

Greg Buffington, vice president, Carib Energy.



“We provide flange-to-flange solutions,” said Buffington. “LNG can offer a significant reduction [in cost], depending on the price a user is paying for electricity or diesel fuels, and it offers environmental benefits and added safety factors. There is also an abundance of LNG.”

In fact, Carib Energy was the first company to receive a small-scale, 25-year export license from the U.S. Department of Energy (DOE) for LNG transportation from the U.S. into Free Trade Agreement (FTA) countries, and a small-scale, 20-year LNG export license from the U.S. into Non-Free Trade Agreement (NFTA) countries.

Also unique is the fact that Crowley is one of the few companies to offer fully turnkey conversion, thanks to its in-house technical services offerings, which can be combined with those listed previously. Technical solutions include customized regasification systems; design services; mechanical, electrical and site/civil engineering; commissioning (the work needed to get the project site ready); storage and supply management; consultation and training; bunkering; and much more.

All of this makes an attractive offering for clients who want LNG power but don't know how to get started.

Matt Jackson, vice president, LNG



“So, we said, ‘yes, that is what we want,’” said Trigueros.

Buffington and his LNG colleagues, which include Crowley's Matt Jackson, vice president, and Kevin Frantz, engineering manager, got to work, beginning with an assessment of Coca-Cola Puerto Rico Bottlers' power needs.

“We looked at their energy bills and did a power survey. [We then] estimated the savings and offered a solution. We considered the cost factor of putting LNG in and what their return on investment would be,” said Buffington.

Next, Frantz brought in a team of technical experts to convert the plant to LNG power. This included designing, engineering and installing a regasification system, as well as looking at other ways to incorporate additional efficiencies.

In their case, he remembers that they were “... very limited on space in the Cayey plant. It was very tight. There was really only one place to put the regasification system, and it required a very small footprint. It had to be close to the condensing tower.”

The challenge was met and Frantz ultimately designed a system no bigger than two minivans. “It worked out really well,” he said.

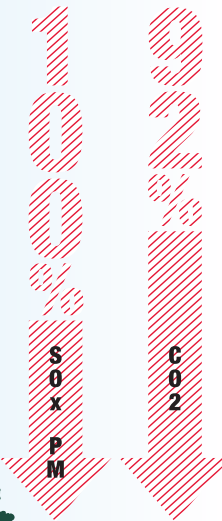
◉ Story continued on page 3

FACTS ABOUT LNG

LNG is a stable gas that is neither toxic nor corrosive and is lighter than air. It is the cleanest fossil fuel

available, netting a 100-percent reduction in sulphur oxide (SOx) and particulate matter (PM), and a 92-percent reduction in nitrogen oxide (NOx). LNG also has the ability to significantly reduce carbon dioxide (CO2), a contributor to greenhouse gas emissions, as compared with conventional fossil fuels.

LNG is not stored under pressure and it is not explosive. LNG vapors (methane) mixed with air are not explosive in an unconfined environment. When exposed to the environment, LNG rapidly evaporates, leaving no residue on water or soil.



“[Crowley’s] engineering solution was very good. They brought in a couple of supporting vendors to help us. All the contracts were there already, so we didn’t waste any time. Crowley had everything prepared,” said Trigueros.

Frantz also found abundant opportunities to incorporate other energy savings into the design. For starters, his design team identified that the system’s waste water could be repurposed, a benefit that would not only reuse valuable resources, but could capture the free cold energy that LNG provides.

“In Puerto Rico, cold energy is very valuable,” he said. “I call this benefit the ‘Seventh Wonder’ of LNG.”

As part of the functioning regasification system, water is pumped into the vaporizers and naturally chilled by the frigid LNG. Thanks to creative engineering, the cold water is reclaimed and repurposed to cool the plant’s

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ammonia condenser tower, providing additional value and reduced waste.

Furthermore, Frantz installed a specially engineered vaporizer to capture the cold energy emitted when the liquefied product, which is stored in a vertical tank at minus 260 degrees Fahrenheit, is slowly warmed into a gaseous, burnable state. That captured cold energy now provides the bottler with 10 tons of free refrigeration annually, which they use to cool the plant.

Amazingly, this improved efficiency also lowered their ammonia refrigeration head pressure and the number of compressors required for operations, from 10 to eight units, thus reducing energy costs further. Unplanned

shutdowns during the summer have also been essentially eliminated – an operational headache that was all-too common before converting to LNG.

Prior to converting, Trigueros was faced with the decision of whether to add a \$35,000 chiller unit to the plant – which also would have required a \$50,000 installation fee plus the cost of monthly electricity – to keep refrigeration operations going. With the free refrigeration generated and reduced compressor usage required, the expensive chiller system was determined not to be needed.

Finally, Frantz learned that carbon dioxide (CO₂) was a product Trigueros

◊ Story continued on page 4



Left: Crowley refills Coca Cola Bottler’s storage tank with efficient LNG in Puerto Rico.



regularly used to carbonate the Coca-Cola products he bottled. It just so happens that one of the byproducts of burning LNG as a fuel source is CO2 exhaust, a recognized greenhouse gas. Together, Frantz and CC1 determined that this very clean emission could be repurposed as carbonation in the bottling process, further lowering total plant emissions. This bubbly efficiency is now eliminating around 200,000 pounds of CO2 from the atmosphere each year and providing free carbonation for the bottler's products.

"We try to reuse everything and not to waste too much," said Trigueros. "This is not only important for our company,

but for our future. It's important to keep our environment clean for the next generation."

All of the efficiencies above, however, don't include the direct fuel savings realized as a result of the conversion.

The first load of LNG was delivered in September 2014, a mere 30 weeks after the conversion began, and Trigueros reported an immediate difference at the two facilities following conversion.

"You don't notice that the distillery in Cidra is running until you get to it," he said. "It's very clean, very clean."

After a single year, Coca-Cola Puerto Rico Bottlers reported a \$305,000 savings in the cost of fuel, a 37 percent reduction in CO2 plant emissions, and a 10 percent increase in boiler efficiency. Additionally, the company is expected to see a return on investment in the conversion costs within three years, even with the recently dropping price of diesel.

"What Coca-Cola Bottlers experienced was remarkable," said Frantz. "Especially in today's world, when everyone's trying to reduce greenhouse gasses and emissions. We aim to bring energy solutions to customers and help them lower total energy costs, but it's really about conservation."

"Our ability to service Coca-Cola Puerto Rico Bottlers in this way is an excellent example of how we can utilize a combination of our core competencies – including marine solutions, logistics planning and execution, and associated technical and project management capabilities – to provide an LNG energy solution in markets within the U.S. and abroad where there is great need and potential benefit," said Jackson.

"[I think that there are] opportunities for other companies and industries to take advantage of this kind of technology on the island," said Trigueros. "My suggestion is to take a look at the whole energy consumption of [each] company. Crowley can help with that."



Left: Kevin Frantz, a Crowley engineering manager

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Crowley's LNG capabilities at crowley.com/LNG.