FONTANA, CALIFORNIA

TST, Inc.
Direct FuelCell® (DFC®) Cogeneration Installation

500 kilowatts of Ultra-Clean Direct FuelCell® Power

Sustainability Context

Direct FuelCell® (DFC®) power plants are among the cleanest, most reliable sources of ultra-clean base load electric power generation today. They provide continuous, high-quality power 24 hours a day with reduced emissions and quiet operation; their exhaust heat byproduct can be used for combined heat and power (CHP) applications using hot water, steam or chilled water for a variety of building or process heating and cooling needs. Demand for electricity from the local utility is also reduced, further limiting the greenhouse gas emissions that would be produced by conventional power plants.

Project Goals

The TST, Inc. foundry in Fontana, California, produces aluminum ingot, billet and other bulk aluminum forms from recycled aluminum scrap. In an effort to control power costs and improve overall plant energy efficiency, TST contracted with Alliance TST Energy, LLC to install a 500 kilowatt (kW) fuel cell cogeneration system to deliver electricity and thermal energy to the TST facility. In a separate, concurrent project, TST installed four 60-kW Capstone C-60 micro-turbines in a similar cogeneration installation at the TST site.

DFC Power Plant Results

> Annually generates approximately 4,000,000 kWh of electricity (approximately 60% of base-load power for the TST foundry).

> Produces approximately 2,600 mm Btu/year of thermal energy in the form of hot air to offset natural gas usage in TST's exhaust system duct burner that preheats the foundry exhaust prior to the emissions control system for the site.

> Overall electrical efficiency of 45% at standard operating conditions (typical efficiency of reciprocating engines is approximately 30%).

> 82% reduction in NOx, 67% reduction in CO_2 and 5% reduction in VOC compared to burning natural gas in the facility's exhaust system duct burner.

> Overall reduction of 47% in NOx, 56% reduction in CO, 12% reduction in VOC, and 15% reduction in CO_2 compared to previous operations (i.e., purchasing electricity from the grid and burning natural gas in the facility's exhaust system duct burner).

The fuel cell cogeneration power plant underscores TST's commitment to environmental sustainability by applying ultra-clean power generation in an industrial setting. The project provides exceptional overall value to the Fontana area by reducing energy costs while reducing environmental impacts.

Dates

Construction initiated
April 2006

Startup completed
August 2006

Facility dedicated
October 2006

Contract Term

5 Years

Project Components

> Two DFC300A carbonate fuel cells producing 500 kW of base load power in parallel with utility grid.

> The 650-degree Fahrenheit exhaust from the facility is used to offset natural gas combustion in a duct burner used to heat foundry process exhaust prior to emission control equipment.

Lead Authority

TST, Inc.

Environmental Benefits

In addition to saving money, the power plant substantially reduces air pollution emissions through the use of ultra-clean fuel cell technology. The power plant benefits the Fontana area by reducing annual emissions by up to 260 pounds of oxides of Nitrogen (NOx) pollutants and 540 pounds of carbon monoxide annually by using fuel cells instead of purchasing electricity from a local natural gas combustion turbine power plant in the Los Angeles area and burning natural gas in the duct burner.

Project Process

Alliance Power and FuelCell Energy initiated a joint venture to sell the electric power and provide recovered thermal energy to the TST facility under a long-term power purchase agreement. Alliance Power was the turnkey provider to the project; FuelCell Energy manufactured the DFC units and provides operations and maintenance services.

The project involved careful planning and management of utility interconnection applications and construction targets to meet the requirements of the California Self-Generation Incentive Program (SGIP) and other financial incentive requirements. In addition to SGIP incentive funding obtained through the Southern California Gas Company, Alliance Power secured a grant from the South Coast Air Quality Management District (SCAQMD) through a competitive bidding process, and obtained another incentive from the Department of Defense (DoD) managed by U.S. Army Engineer Research and Development Center–Construction Engineering Research Laboratory for this project.

All work was required to be completed within a one-year time frame, from conceptual design to a fully operational cogeneration facility. Site work included the concrete equipment pads, underground piping for natural gas and water, and 480-volt electrical service. Alliance Power managed all project activities associated with obtaining funding through the SGIP, SCAQMD, and Bonneville Power Administration incentive programs including completing all applications and working closely with the utility's staff. The fuel cell's performance is continuously observed through FuelCell Energy's web-based control and monitoring system. The monitoring system provides Alliance and FuelCell Energy staff immediate access to pertinent cogeneration system information including electricity production and fuel consumption.

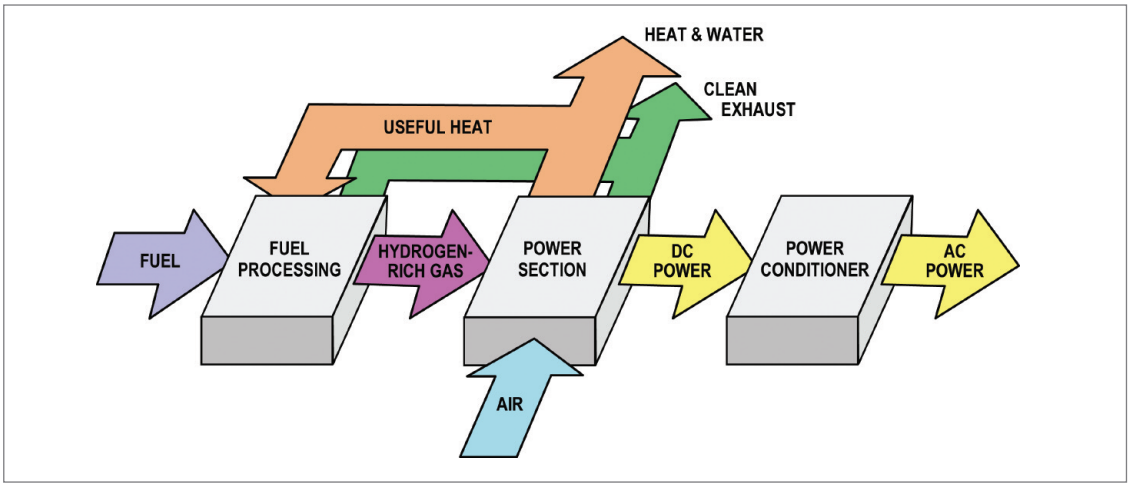
How It Works

Fuel cells are composed of many individual cells grouped together in a stack. Carbonate fuel cells are designed for continuous operation, and generate electricity after their internal temperatures are raised to 1,200 degrees Fahrenheit – a requirement of the electrochemical process to convert the fuel to electricity. To extract hydrogen (H_2) fuel from natural gas (CH_4), natural gas is combined with steam to create hydrogen and carbon dioxide. (Natural gas and water are purified in the plant onsite.) The oxidant gases (O_2 and CO_2) react with electrons returning from the Direct Current (DC) circuit to produce a carbonate ion (CO_3^{-2}). The hydrogen is fed into the anode where it reacts with the negatively charged carbonate ion (CO_3^{-2}) that has traveled through the electrolyte. The resulting reaction produces steam, CO_2, and electrons that feed the DC circuit that generates electricity.

Highlighted Infrastructure

FuelCell Energy integrated all of the fuel cell components within the power plant. Alliance Power ensured that all utility interconnection points were integrated between the fuel cell and the rest of the TST foundry infrastructure. Alliance provided development services and project management from inception to final completion. In addition to the fuel cell equipment, Alliance Power contracted for a new natural gas service, electrical interconnection equipment, and exhaust heat recovery equipment that captures the fuel cell's exhaust heat byproduct. Thermal energy recovered from the fuel cell exhaust is used to offset natural gas use in an adjacent duct burner associated with TST's foundry emissions control system.

The fuel cell plant is connected to and operates in parallel with the local utility grid. It has a continuous output of 500 kW of power with an electrical efficiency of 45% at standard operating conditions. It has a 25-year design life, excluding routine maintenance and stack replacements.



Fuel cells convert chemical energy from fuels containing hydrogen directly into electricity and heat without combustion.

For More Information

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