FuelCell Energy
Ultra-Clean, Efficient, Reliable Power

Project Fact Sheet

High Efficiency Direct FuelCell/Turbine® Power Plant

Ultra-clean, near-zero emission, fossil fuel-based energy plants will be needed in the coming decades of the 21st century. FCE is committed to bring its research, engineering, and manufacturing expertise to develop ultra-high efficiency power plants based on FCE's Direct FuelCell/Turbine® (DFC/T®) hybrid power plant technology. The broad objectives of this project include a commercially viable, multi-megawatt hybrid DFC/T® system providing 75% efficiency and S/NOx emissions below 0.01 lb/million BTU.

Technology: FCE's DFC/T hybrid system concept is based on integration of the company's internal reforming Direct FuelCell® with an unfired gas turbine (Figure 1) that utilizes heat recovered from the plant. The fuel cell produces over 80% of the output power while the gas turbine generates additional power using the fuel cell byproduct heat in a Brayton cycle. The turbine also provides process air for the fuel cell, eliminating the need for a separate cathode air blower.

The DFC/T system features electrical efficiency approaching 75% on natural gas and 60% on coal gas. This hybrid plant provides negligible pollutant emissions, greatly reduced carbon dioxide release, simple system design, and cost competitiveness with existing combined cycle power plants.

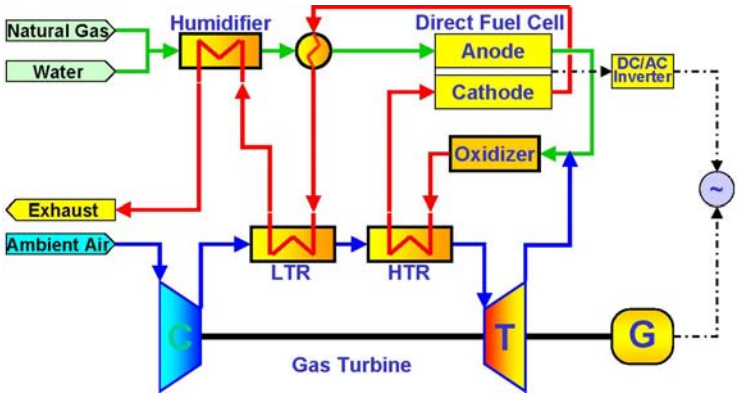

Figure 1. DFC/T Ultra-High Efficiency System Concept

Development Plan. The technology development plan includes design, construction, and testing of a pre-Alpha sub-MW DFC/T unit prior to fabrication of the Alpha unit. The DFC/T system concept was implemented in FCE's Danbury power plant test facility by integration of a 250kW DFC stack and a 60 kW Capstone microturbine. The focus of the pre-Alpha test was verification of the DFC/T concept, development of critical system components, and gathering of design data for power plant development. Results obtained from this proof-of-concept test established the foundation for the design of the packaged sub-MW unit.

Sub-MW Power Plant Demonstration. The Alpha technology demonstrator unit comprises three modules on separately transportable equipment skids: Mechanical Balance-of-Plant, DFC Stack Module, and Electrical Balance-of-Plant. The modular design of the power plant facilitates field installation and service.

Factory testing of the Alpha unit prior to shipment to the demonstration site in Montana was conducted in FCE's Danbury, CT facility. Testing included grid-connected operation, validation of plant performance, and emission tests. The hybrid power plant achieved power output over 320 kW with 56% (LHV) efficiency operating on natural gas. As shown in Table 1, the plant easily met CARB 2007 emission standards for NO_x, carbon monoxide, and volatile organic compounds (VOC).

Table 1. DFC/T® Emission Test Results

	lb/MW-hr		
	NOx	VOC	CO
DFC/T® Alpha Unit @ 307 kW	0.004	0.002	0.075
CARB '07 weighted emission limit	0.07	0.02	0.1

The Alpha unit was installed at Billings Clinic in Billings, Montana for field tests is shown in Figure 2. The unit completed over 8000 hours of operation at this facility, generating over 1145 MWh of clean energy with 91% availability. During the grid-connected power generation tests, the unit achieved 323 kW net AC output at 56% electrical efficiency – a record for a sub-MW power plant.

Figure 2. Alpha DFC/T Unit Installed at the Billings Clinic, Montana Demonstration Site

Multi-MW Power Plant Design. A preliminary conceptual design of a 56 MW hybrid power plant is shown in Figure 3. The design is based on a scalable approach, using FCE's M-10 fuel cell modules. Five modules are arranged in a cluster with common distribution piping for the fuel and oxidant gases. The plant is arranged in three power blocks that share the centralized equipment. Each power block consists of two clusters of fuel cell modules together with supporting equipment. The centralized equipment, which supports all three sections, includes a gas turbine, an anode gas oxidizer, and other common site equipment including fuel cleanup and a water treatment subsystem.

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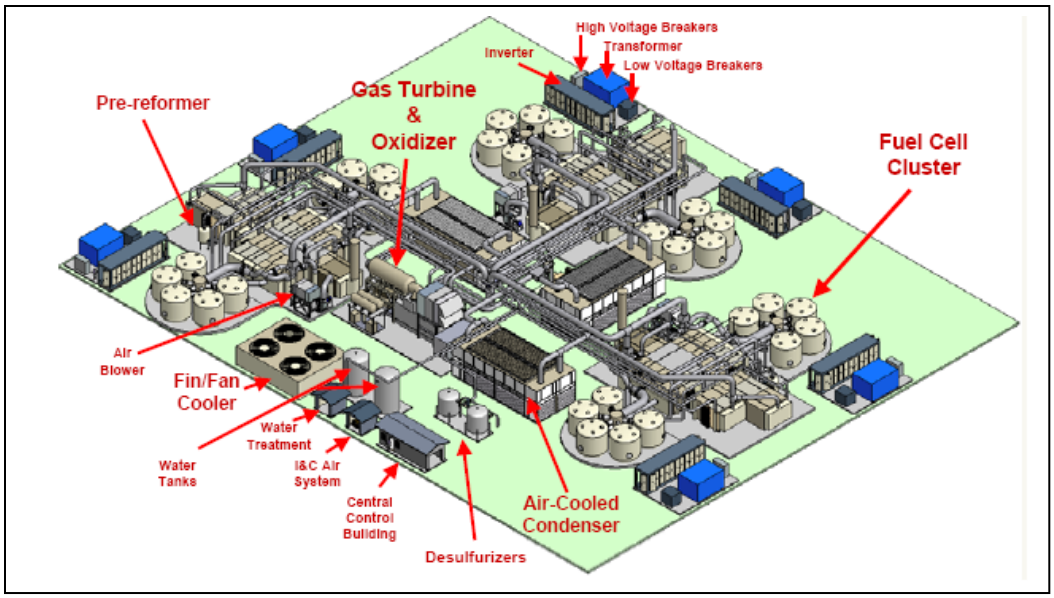

Figure 3. 56-MW DFC/T Power Plant Layout and Site Plan for Near-Term High Efficiency Power Generation

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