

## **Fuel Cell/Turbine Ultra High Efficiency Power System**

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FuelCell Energy, INC. (FCE) is currently involved in the design of ultra high efficiency power plants under a cooperative agreement (DE-FC26-00NT40) managed by the National Energy Technology Laboratory (NETL) as part of the DOE's Vision 21 program. Under this project, FCE is developing a fuel cell / turbine hybrid system that integrates the atmospheric pressure Direct FuelCell<sup>®</sup> (DFC<sup>®</sup>) with an unfired Brayton cycle utilizing indirect heat recovery from the power plant. Features of the DFC/T<sup>™</sup> system include: high efficiency, minimal emissions, simplicity in design, direct reforming internal to the fuel cell, no pressurization of the fuel cell, independent operating pressure of the fuel cell and turbine, and potential cost competitiveness with existing combined cycle power plants at much smaller sizes.

Objectives of the Vision 21 Program include developing power plants that will generate electricity with net efficiencies approaching 75 percent (with natural gas), while producing sulfur and nitrogen oxide emissions of less than 0.01 lb/million BTU. These goals are significant improvements over conventional power plants, which are 35–60 percent efficient and produce emissions of 0.07 to 0.3 lb/million BTU of sulfur and nitrogen oxides. The nitrogen oxide and sulfur emissions from the DFC/T system are anticipated to be better than the Vision 21 goals due to the non-combustion features of the DFC/T power plant. The expected high efficiency of the DFC/T will also result in a 40–50 percent reduction in carbon dioxide emissions compared to conventional power plants.

To date, the R&D efforts have resulted in significant progress including proof-of-concept tests of a sub-scale power plant built around a state-of-the-art DFC stack integrated with a modified Capstone Model 330 Microturbine. The objectives of this effort are to investigate the integration aspects of the fuel cell and turbine and to obtain design information and operational data that will be utilized in the design of a 40-MW high efficiency Vision 21 power plant. Additionally, these tests are providing the valuable insight for DFC/Turbine power plant potential for load following, increased reliability, and enhanced operability.

## **Acknowledgements**

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