ClearSign Combustion Corporation

ClearSign Demonstrates Novel Method to Improve Energy Efficiency in Turbines and Other Systems

Technique May Boost Turbine Efficiency and Increase Lifetime by More Effectively Cooling Blades

SEATTLE, WA -- (MARKETWIRE) -- 10/11/12 -- ClearSign Combustion Corporation (NASDAQ: CLIR), an emerging leader in combustion and emissions control technology for industrial, commercial and utility markets, reported today that it has successfully demonstrated an experimental concept proof of a technique for cooling turbine blades that the Company believes may point the way to significant improvements in the design and performance of combustion turbines.

According to industry estimates, the combined annual market for both land-based natural gas turbines for power generation and jet engines for civil aviation is in excess of $40 billion annually. The Congressional Research Service stated that the use of gas turbines accounted for 19% of energy production in 1989, increasing to 39% in 2008, and projects this trend to continue for the next two decades. Turbomachinery Magazine's 2011 report projects that 11,480 land-based turbines will be delivered before 2019.

The market for aircraft jet engines is also projected to experience significant growth. General Electric, which accounts for approximately 50% of the global market, projects its current installed base of 26,000 engines to increase to over 45,000 by 2020.

Depending upon its size, a gas turbine running in single cycle mode can range from as little as 20% to as much as 45% efficiency. This is why small gains in energy efficiency are prized and sought after in the world of turbine engines.

Turbine efficiency is limited by the capacity of turbine blades and metal structures within the turbine to withstand high levels of sustained heat loading without suffering structural damage. In order to minimize mechanical stresses on the blades, turbines are designed so that hot combustion gases are cooled to well below their peak temperature before coming in contact with the rotor blades. Since the mechanical output of a turbine derives directly from the expansion of the gas as temperature is increased, cooling the hot inlet gases, while necessary to protect the blades, has the consequence of severely limiting turbine efficiency.

"If the blades can be cooled you're going to see a gain in efficiency," said ClearSign CEO Rick Rutkowski, "because you will be able to increase the peak temperature. The economic value of effective blade cooling is enormous since it translates directly into fuel savings for both jet engines and power generators. A gain of just one percent in efficiency is seen by industry experts as being very significant. We believe that it may be possible to realize gains of as much as a few percent in energy efficiency, if we can sufficiently cool the blade surfaces."

Currently, turbine designers employ "film-cooling" techniques to deliver cooling air to the blades in order to reduce heat buildup. However, shear forces from the high-speed rotation of the blades quickly pull this cooling air away.

The ClearSign blade-cooling concept involves electrically charging both the hot gas cloud and the turbine blades so that the hot gases are pushed away and cooling air is sandwiched between the charged blade and the gas cloud. The boundary layer of cool air effectively insulates the blade to reduce heat loading.

According to the Company, cooler turbine blades should also lengthen the life of the equipment by reducing metal fatigue and "creep" which eventually lead to failure of costly parts like turbine blades and guide vanes.

"We built this prototype system in order to demonstrate to prospective commercial partners that electrostatic forces can be used to push heat away from a surface and measurably reduce temperature," said ClearSign Chief Technology Officer Joe Colannino.

"We conducted our experiments using a stream of hot gas from a pre-mixed combustor to heat a stationary electrically conductive surface simulating a turbine blade. An array of sensors placed at various locations on the surface recorded operating temperatures. Both the gas cloud and the heat transfer surface were charged. Remarkably, we observed absolute temperature reductions approaching 160 Kelvin (290 Fahrenheit). Depending on the location along or near the blade surface, this represents electrically induced thermal rejection of 1% to 16% when the voltage is applied.

"We were especially pleased to see that the effect did not diminish with distance from the combustor: The gas cloud appears to maintain its charged state and continue to be repulsed by the electrostatic forces even at distances exceeding 15 times the flame length of the combustor source.

"While it's important to emphasize that this is an early experimental prototype, we regard these experiments as having been highly successful," Rutkowski added. "Our technique for rejecting heat from a charged surface functioned extremely well and yielded very positive results. There is much additional work to do to advance this technology toward commercialization and to continue to scale to real world operating conditions. We have devised an experimental program and described a business case in consultation with prospective customers and commercial partners. We expect subsequent developments will incorporate increases in gas flow rates, temperature and pressure and the transition from a stationary plate to rotary blades."

In addition to turbine blade cooling, ClearSign is investigating other ways in which electrostatic forces can be applied to simplify and improve turbine design and performance and to further increase fuel efficiency.

Dr. Robert Breidenthal, a professor at the University of Washington's Department of Aeronautics and Astronautics and a ClearSign technical advisor, will be presenting selected experimental results in his paper, "Turbine Blade Cooling Using Coulomb Repulsion," at the 2012 American Physical Society Division of Fluid Dynamics Annual Meeting. Since 1948, the DFD annual meeting has grown into one of the largest conferences in fluid dynamics, with 2800 attendees from all over the world. Information about the conference, which will be held November 18-20 in San Diego, can be found on the web at http://apsdfd2012.ucsd.edu

For further information about ClearSign, including our calendar of upcoming events and a recent feature article on Forbes.com, please visit www.clearsign.com or text "CLIR" to 90210.

About ClearSign Combustion Corporation

ClearSign Combustion Corporation designs and develops technologies that aim to improve key performance characteristics of combustion systems including energy efficiency, emissions control, and fuel flexibility and overall cost effectiveness. Our Electrodynamic Combustion Control™ (ECC™) platform technology improves control of flame shape and heat transfer and optimizes the complex chemical reactions that occur during combustion in order to minimize harmful emissions. For more information about the Company, please visit www.clearsign.com

Cautionary note on forward-looking statements

This press release includes forward-looking information and statements within the meaning of the Private Securities Litigation Reform Act of 1995 and the provisions of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. Except for historical information contained in this release, statements in this release may constitute forward-looking statements regarding our assumptions, projections, expectations, targets, intentions or beliefs about future events that are based on management's belief, as well as assumptions made by, and information currently available to, management. While we believe that our expectations are based upon reasonable assumptions, there can be no assurances that our goals and strategy will be realized. Numerous factors, including risks and uncertainties, may affect our actual results and may cause results to differ materially from those expressed in forward-looking statements made by us or on our behalf. Some of these factors include the acceptance of existing and future products, the impact of competitive products and pricing, general business and economic conditions, and other factors detailed in our Quarterly Report on Form 10-Q and other periodic reports filed with the SEC. We specifically disclaim any obligation to update or revise any forward-looking statement whether as a result of new information, future developments or otherwise.

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