ClearSign Combustion Corporation

ClearSign Retrofits And Modifies Standard Commercial Burner To Achieve 80-90% Reduction In NOx Emissions

Proprietary Duplex™ Architecture shows dramatic reductions in NOx emissions performance in standard "firetube" boiler configuration.

SEATTLE, Oct. 29, 2013 /PRNewswire/ -- 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 80 - 90% reduction in NOx emissions by retrofitting a conventional off-the-shelf commercial burner in a system designed to closely resemble a standard commercial firetube boiler.

According to ClearSign CEO, Rick Rutkowski, the system demonstrates that ClearSign's Duplex™ technology may be adapted to many of the hundreds of thousands of similar commercial and industrial boilers in use worldwide.

"The power of the Duplex technology," explained Rutkowski, "is that it promises to dramatically reduce the cost of controlling NOx emissions, reversing the persistent trend that meeting lower NOx standards means increased operating costs.

"Previously, we demonstrated that the Duplex Burner architecture can reduce NOx emissions to as low as 2ppm and can maintain CO at low single digit levels while eliminating costly external flue gas recirculation (EFGR) and providing major improvements in flame shape. These dramatic results were produced in a vertically up-fired configuration, typical of a range of refinery heater types.

"In response to strong interest from prospective development partners and customers, our goal in this most recent effort was to demonstrate that the Duplex architecture can produce similarly disruptive performance improvements in the horizontally-fired configuration that is commonly used in so-called 'package boilers'.

"I'm delighted to report today that we have successfully reduced NOx emissions by more than 80%; from 50ppm to below 10ppm in continuous operation, and have shown periodic reductions in NOx of up to 90% with emissions as low as 5ppm. Moreover, we have also maintained CO at below 10ppm. We have operated the system at thermal output of up to 800,000 Btus/hr. and are on track to increase this to 2 million Btus/hr as early as the end of the current quarter."

According to Rutkowski, the emissions performance of the modified system at 10ppm of NOx is now already superior to many ULNBs in the market, but another significant advantage is the fact that it requires no external flue gas recirculation (EFGR) to attain these low NOx emissions, which represents a major reduction in operating costs including significant savings from improved energy efficiency.

"It's a very exciting business case," offered Geoff Osler, ClearSign's Chief Marketing Officer. "We have taken a standard burner -- a product that occupied a certain position and price point in the market -- and have multiplied its value in pricing terms. But you have to further compound that gain, because by increasing the range of potential applications, the same product can now also address a much broader market. We've further distinguished this modified burner system from competing offerings because, unlike conventional ULNBs, ClearSign's Duplex technology requires no power-hungry fans to recirculate flue gas so it's significantly more energy efficient to operate. This is a major transformation and provides significant leverage to the investment that our prospective partners have already made in product development.

"Our goal in the coming weeks," Osler continued, "is to make further improvements to the system to achieve continuous NOx emissions at or below 5ppm while also reducing CO to low single digit levels. At the level of emissions we are targeting, we will have the potential for an offering that stands alone in a very high value position in the marketplace, because it would be the only ULNB that may allow operators to avoid having to install and operate far more costly and complicated SCR systems that use highly toxic anhydrous ammonia. We think that we may be able to offer enormous savings to system operators and in many cases future proof them against the regulatory trend.

"Operators of industrial boilers today must spend tens of thousands or even hundreds of thousands of dollars per boiler for NOx controls, and then suffer an efficiency penalty, paying very high ongoing operating and maintenance expense simply to meet stringent US and European air quality regulations."

At the emissions levels that this project has already achieved, the modified burner will achieve NOx and CO emissions levels equal or better to Ultra Low-NOx burners on the market that are significantly higher priced than the conventional burner that ClearSign retrofitted for this demonstration. However the Duplex system, unlike conventional ULNBs, achieves these low emissions levels without the use of energy intensive external flue gas

recirculation (EFGR) systems. This allows for substantial reductions in both energy costs and CO2 emissions as compared to currently available ULNBs

ClearSign estimates there are 34,000 large commercial and industrial firetube boilers installed in the US alone today, averaging 21 MMBtu/h each, some 60% of which are located in air quality 'non-attainment' regions. Many of these systems are required to emit no more than an extremely low 9ppm of NOx and, beginning in the Los Angeles region over the next year, no more than 5ppm of NOx, with other regions of the country expected to follow. To reach 9ppm NOX today, these systems must be modified with a combination of Ultra Low-NOx burners, Flue Gas Recirculation and systems to control and monitor their performance. To reach 5ppm, either the entire boiler burner system needs to be replaced, or a Selective Catalytic Reduction (SCR) system must be added. The 5-year cost of ownership of these ranges from between $300,000 to over $600,000 for each of the tens of thousands of boilers impacted.

Further, there are over 110,000 smaller commercial firetube boilers in use in the US averaging 3 - 4 MMBtu/h in size. In most of the non-attainment regions of the country, including most of California, these systems are also required to improve NOx performance, requiring retrofit installation of a combination of Ultra-Low NOx burners and FGR costing as much or more than $50,000 each.

ClearSign CTO, Joe Colannino explained the results in more detail: "Firetube boilers are so named because the burner is fired horizontally into a steel tube which radiates heat into the surrounding water to create steam. While ClearSign's boiler simulator does not raise steam, it is like a commercial firetube boiler in virtually all other respects. Such boilers are commonly used in product development as there is no need to raise steam in order to provide an accurate model of boiler performance.

"In order to simulate real-world operating conditions as closely as possible, we used a standard, off the shelf (non Low or Ultra-Low NOx) burner, retrofitted with Duplex technology in a horizontal orientation. When operating under steady-state conditions, the burner produced over 50ppm NOx, which is typical for such burners. When the ClearSign Duplex technology was engaged, we observed an almost immediate reduction in NOx to the sub-10ppm range, approaching 5ppm at times. The boiler simulator was operating at 800,000 Btu/h at 3% O2 with a stack temperature of 1,000 deg. F."

ClearSign says that it intends to duplicate this successful effort with at least one other existing commercial burner and plans to begin that work in the current quarter. The company intends to enter into commercial partnerships with leading companies in the boiler marketplace to address both the 1 - 10 mmBtu/h and 10 - 50 mmBtu/h market segments and is in active discussions with market leaders in these segments in the US and abroad.

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, 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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