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Jupiter Oxygen Corporation/Albany Research Center Crada 04-08-JUP Progress Report

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Technical Progress Report

Crada 04-08-JUP

Version 8

JUPITER OXYGEN CORPORATION – ALBANY RESEARCH CENTER
JOINT INTERIM CRADA (04-08-JUP) REPORT

The Albany Research Center (ARC) has developed a new Integrated Pollutant Removal (IPR) process for fossil-fueled boilers. Pursuant to a cooperative research and development agreement (CRADA) with Jupiter Oxygen Corporation, ARC currently is studying the IPR process as applied to the oxygen fuel technology developed by Jupiter. As discussed further below, these two new technologies are complementary. This interim report summarizes the study results to date and outlines the potential activities under the next phase of the CRADA with Jupiter.

The Jupiter technology uses pure oxygen as the combustion agent, which excludes air and the nitrogen it contains. The resulting exhaust contains almost no NOx and concentrates other pollutants for efficient capture, thereby reducing exhaust mass flow and increasing radiant heat. The IPR process compresses a portion of the flue gas from the boiler dissolving, reacting, or otherwise entraining non-condensable pollutants and producing liquid exit streams which may then be cleaned to remove those pollutants. Because a portion of the flue gas is recirculated to the combustion process, the amount of nitrogen in the exhaust to be treated is reduced still further. This significantly lower volume of exhaust, low in NOx and relatively high in concentrations of other pollutants (SO2, CO2, and mercury), also has a higher H2O content. The lack of nitrogen in the exhaust allows H2O, CO2 and SO2 to be compressed for economically efficient removal and recovery or disposal. Mercury is concentrated in the flue gas, fly ash and bottom ash as well, leading to more efficient capture and treatment or disposal.

Under the first phase of the CRADA with Jupiter, ARC performed computer modeling to simulate the potential effects of the combination of the IPR and Jupiter technologies. The computer modeling indicated that NOx emissions would be near zero. The concentration of CO2 in the exhaust stream would be nearly 4.5 times greater than conventional air combustion technologies, easing application of compression and condensation techniques expected to remove approximately 85% of the CO2 in the exhaust stream. SO2 emissions, following compression and condensation, would be virtually eliminated[1] Jupiter has projected fuel savings and other increased efficiencies so that the cost of this combined process could be competitive with currently conventional combustion technologies. In addition to being cost competitive, the combined processes are able to effectively handle all emissions from a coal fired power plant, which current designs are incapable of handling at any cost. The modeling results to date have shown a high probability of success

In sum, the results to date under the CRADA between ARC and Jupiter Oxygen strongly indicate that the combination of the Jupiter Oxygen-Fuel technology and the ARC IPR process presents a highly promising pathway for: (1) near zero NOx emissions, (2) enhanced and economical capture and treatment of CO2, SO2, particulates and mercury, and (3) ultra-low emissions coal-fired power plants.

This represents the successful completion of Phase I of the CRADA work plan.

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[1] These results are reported in Tables 1 and 3 of Ochs, et al., *Oxy-Fuel Combustion Systems for Pollution Free Coal Fired Power Generation* (2004).

ARC believes that results from the completion of Phase I activities indicate that further large scale testing is warranted. ARC is willing to continue in the CRADA activities for a Phase II effort provided that Jupiter Oxygen Corporation obtains funding and desires to continue the joint research efforts. Small scale operational demonstration of both a retrofit of a conventional coal-fired power plant ***and*** a new boiler design plant which can fully utilize all of the technological advantages ***could be pursued, both of which are important because each has certain unique issues.*** As with the initial Phase I testing, the pollutants being removed would include CO_2 and mercury, so that the ultra-low emissions can be accomplished including effective CO_2 and mercury capture. Appendix 1, attached; contains Appendix A to the CRADA, the Statement of Work which lists Phases I and II between the Albany Research Center and Jupiter Oxygen Corporation

Appendix 1

Appendix A
Statement of Work – January 1, 2004 to January 1, 2009
Cooperative Research and Development Agreement Between the United States Department of Energy (Albany Research Center) and Jupiter Oxygen Corporation

ARC Project Manager: Paul Turner
ARC Technical Representative: Thomas Ochs
Jupiter Technical Representative: Alex Gross

Objective: To share expertise in the fields of fossil-fuel power plants and fossil fuel-fired burners.

Phase 1

ARC Contribution:

1. Develop models of existing power plants for retrofit of oxy-fuel combustion.
2. Assist with the design of experimental setups to verify the models and subsequent analyses of the resulting data.
3. Assist in translating the design from smaller systems to a larger (400 - 500 MW) system using modeling and experimentation.
4. Work on design of a new technology power plant using oxy-fuel.
5. With Jupiter Oxygen Corporation, co-author a paper for the 29th International Technical Conference on Coal Utilization and Fuel Systems (2004 Clearwater Conference) discussing the use of oxy-fuel combustion in coal-burning retrofit applications and other issues as agreed to by Jupiter and ARC.
6. Determine if further cooperation (Phase II) is needed.

Jupiter Contribution:

1. Work with ARC scientists and engineers to develop models of existing power plants.
2. Develop a staged design leading progressively from oxygen enriched combustion to full recirculation with varying oxygen content.
3. Design experimental setups to verify the models.
4. With ARC, co-author a paper for the 29th International Technical Conference on Coal Utilization and Fuel Systems (2004 Clearwater Conference) discussing the use of oxy-fuel combustion in coal-burning retrofit applications and other issues as agreed to by Jupiter and ARC.
5. Determine if further cooperation (Phase II) is needed.

Phase II

If funding becomes available to Jupiter Oxygen Corporation, the parties will modify this statement of work to encompass cooperation in developing one or more full-scale demonstration projects to show the commercial feasibility of Jupiter's oxy-fuel technology in combination with ARC's compression and condensation technology for integrated removal of particulates, NO_x, SO_x, and other pollutants from flue gas.