Name of the Applicant: TDA Research, Inc.

Project Director/ Principal Investigator: Dr. Gokhan Alptekin

Project Title: Advanced Reactor Design for Integrated WGS/Pre-combustion CO_2 Capture

Project Summary/ Abstract

TDA Research, Inc (TDA) proposes to develop a new high-hydrogen synthesis gas production technology and demonstrate its techno-economic viability for use in the Integrated Gasification Combined Cycle (IGCC) power plants and coal-to-chemical (CTL) plants that process coal (including low rank coals and woody biomass). The new system uses a warm gas CO_2 scrubber integrated with a Water-Gas-Shift (WGS) catalyst to capture greater than 90% of the carbon emissions, while maintaining the cost of electricity (COE) increase to less than 10% compared to an IGCC plant without carbon capture.

In a previous DOE/NETL project (Contract No. DE-FE0007966), in collaboration with Phillips66 and Southern Company, we successfully demonstrated the integration of the CO_2 scrubber/WGS catalyst in two slipstream demonstrations at the Wabash River IGCC plant and the National Carbon Capture Center (NCCC), achieving all of the predicted efficiency improvements. During these tests, we also identified the need for a reactor design that can provide better heat management to dissipate the CO_2 adsorption and WGS reaction exotherms. Effective heat removal is necessary for the sorbent to achieve a high CO_2 capacity.

In the proposed effort TDA will work with UCI, Southern Company and Pall Corporation to design an integrated CO_2 scrubber/WGS reactor with effective heat removal and demonstrate its capabilities in bench-scale and slipstream evaluations. We will first identify the best design option by using Computational Fluid Dynamics (CFD) simulations and then fabricate prototype reactors to validate the ability of the new design in removing heat and controlling the reactor temperature. We will modify an existing test skid (which has already been qualified for use in the NCCC and Wabash River IGCC plant) to carry out a 3 week test, using 60 SCFH synthesis gas slipstream generated at Southern's air-blown pilot-scale gasifier in Wilsonville, AL. These results will feed into a techno-economic analysis using Aspen Plus^{TM} simulation to fully assess the merits of the proposed system both for an IGCC plant and a CTL plant that converts the synthesis gas into valuable liquids. All the analyses will be consistent with the DOE/NETL Cost Estimation Guidelines.