the ENERGY lab

PROJECT FACTS

Existing Plants, Emissions & Capture

Carbon Absorber Retrofit Equipment (CARE)

Background

The mission of the U.S. Department of Energy/National Energy Technology Laboratory (DOE/NETL) Existing Plants, Emissions, & Capture (EPEC) Research & Development (R&D) Program is to develop innovative environmental control technologies to enable full use of the nation's vast coal reserves, while at the same time allowing the current fleet of coal-fired power plants to comply with existing and emerging environmental regulations. The EPEC R&D Program portfolio of carbon dioxide (CO_2) emissions control technologies and CO_2 compression is focused on advancing technological options for the existing fleet of coal-fired power plants in the event of carbon constraints.

Pulverized coal (PC) plants burn coal in air to produce steam and comprise 99 percent of all coal-fired power plants in the United States. Carbon dioxide is exhausted in the flue gas at atmospheric pressure and a concentration of 10 to 15 percent by volume. Post-combustion separation and capture of CO_2 is a challenging application due to the low pressure and dilute concentration of CO_2 in the waste stream, trace impurities in the flue gas that affect removal processes, and the parasitic energy cost associated with the capture and compression of CO_2. Solvent-based CO_2 capture involves chemical or physical sorption of CO_2 from flue gas into a liquid carrier. Although solvent-based systems are used commercially to remove CO_2 from industrial gases, they have not been applied to the removal of large volumes of gas, as in coal-fired power plant flue gas, due to significant cost and efficiency penalties. Process equipment footprint and cost are important technical challenges for advanced solvent-based CO_2 capture systems.

Project Description

Neumann Systems Group, Inc. (NSG), in collaboration with Colorado Springs Utilities (CSU), will conduct project CARE (Compact Absorber Retrofit Equipment) to design, construct, and test the NeuStream™-C, a patented absorber for CO_2 capture. The focus of the CARE project is to show significant reductions in the process equipment footprint and cost of full-scale CO_2 capture systems through the utilization of NeuStream absorber technology. The NeuStream-C absorber will use a proven nozzle technology and an advanced solvent that efficiently captures CO_2. These technologies are key to demonstrating that the NeuStream-C absorber is scalable to an optimized full-scale system that can achieve 90 percent CO_2 removal with less than 35 percent increase in the cost of electricity (COE). The CARE project benefits from significant technical, process, risk, and cost advantages realized during a recently completed 20 megawatt electric (MWe) NeuStream-S flue gas desulfurization pilot project at the CSU Drake #7 PC power plant. The reuse of pertinent equipment from the Neustream-S project is expected to result in considerable cost-savings for the CARE project.regeneration, lower corrosivity, and better stability to flue gas constituents such as oxygen.

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PARTNERS

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PROJECT DURATION

Start Date	End Date
05/01/2012	06/27/2014

COST

Total Project Value
$9,365,822

DOE/Non-DOE Share
$7,165,423/$2,200,399

AWARD NUMBER

DE-FE0007528

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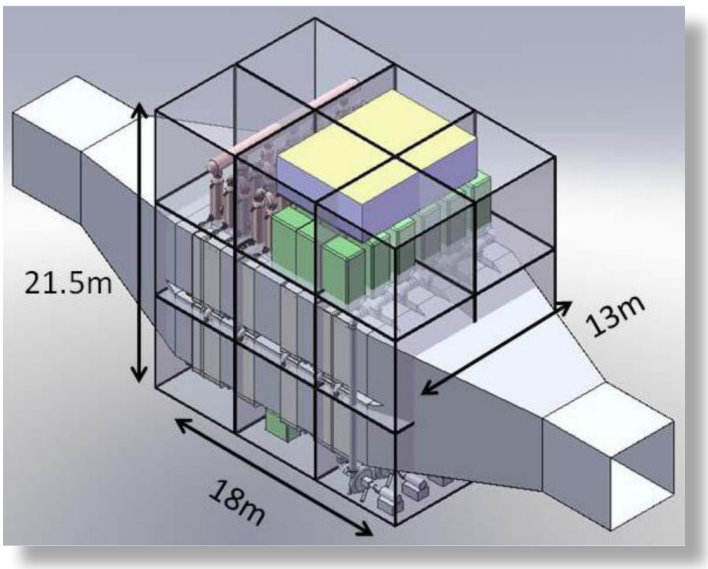
The CARE project will proceed based on previous modeling and analysis validated by bench-scale tests and operations with a variety of solvents. A module of the NeuStream-C absorber technology using a unique patented, compact design and operating with a high mass transfer solvent will be inserted post-baghouse into a 0.5 MWe slipstream at the CSU Drake #7 power plant. The slipstream will be equipped with sulfur oxide (SO_X) scrubbing and amine washing equipment previously utilized in the 20 MWe NeuStream-S slipstream system. The SO_X scrubbing equipment uses compact modular NeuStream technology and can be adjusted to set SO_X residual levels from one part per million (ppm) to 30 ppm prior to CO_2 capture. The CARE project will employ a three-stage, 0.5 MWe NeuStream-C high performance unit and a best available technology CO_2 stripper unit. Long duration testing with piperazine solvent will validate the technology performance. The modular design of the NeuStream-C absorber technology makes it readily scalable to full size systems and results in a decrease in overall construction time for the system.



A conceptual 550MWe NeuStream™-C with carbon capture and stripping component.

Primary Project Goal

The project goal is to design, construct, and test a pilot-scale NeuStream-C absorber unit on a 0.5 MWe slipstream of coal-fired power plant flue gas to show that the absorber system is capable of significantly reducing the process equipment footprint and the cost of CO_2 capture systems.

Objectives

The objectives of the CARE project are to (1) validate the potential contribution of the NeuStream-C absorber to achieve full plant operations with greater than 90 percent CO_2 capture and less than 35 percent increase in COE, and (2) confirm that there are no environmental, health, and safety (EH&S) issues that would prevent scaling the NeuStream-C absorber design and processes to a commercial size plant.

Planned Activities

- Document a full set of requirements for system and subsystem interfaces.
- Complete a preliminary technical and economic feasibility study and a preliminary EH&S analysis.
- Perform process modeling and analysis during preliminary design to identify problems and to optimize the process design prior to fabrication and procurement.
- Fabricate, integrate, and prepare the CARE system for testing, which includes construction to interface with the plant and equipping the slipstream with residual SO_X reduction equipment from the recently completed NeuStream-S system development work.
- Perform a system checkout and a test readiness review and conduct acceptance testing to verify the operational readiness of the system.
- Parametrically vary the system flow rates, temperature, and pressure to determine an optimum operating point for CO_2 capture by the piperazine solvent.
- Demonstrate continuous steady-state operation for a minimum of two months to test proposed technologies under realistic conditions and continuous long-term operation.
- Update the technical and economic analysis to include data obtained during system operation and testing.
- Update the commercial system requirements and model of the proposed technology and processes based on the outcome of system operation and testing.
- Update the evaluation of EH&S implications of the proposed technology.

Accomplishments

- Project awarded in September 2011.
- Project start date delayed until May 2012.

Benefits

A full-scale NeuStream-C system holds potential to reduce the cost of CO_2 capture by 46 percent compared to a conventional monoethanolamine system. The system is also estimated to have approximately 10 percent the volumetric footprint of current best available technology. This absorber technology is applicable to a variety of solvents and can be retrofitted to existing pulverized coal power plants at a reduced cost and footprint. The modularity of the technology enables it to be easily scaled to larger size systems and retrofitted to existing plants with little risk.