AIR PRODUCTS AND CHEMICALS, INC.:

Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production

NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

PARTNERS

Denbury Onshore, LLC

PROJECT DURATION

Start Date - 11/16/2009
End Date - 09/30/2017

COST

Total Project Value
$430,648,802
DOE/Non-DOE Share
$284,012,496 / $146,636,306

PROJECT NUMBER

FE0002381

AIR PRODUCTS AND CHEMICALS, INC.

BACKGROUND

Advanced carbon capture and storage (CCS) technologies offer significant potential for reducing CO_2 emissions and mitigating global climate change while minimizing the economic impacts of the solution. Under the Industrial Carbon Capture and Storage (ICCS) program, the U.S. Department of Energy (DOE) collaborated with industry in cost-sharing arrangements to demonstrate the next generation of technologies that captured CO_2 emissions from industrial sources and either stored or beneficially reused them. The technologies included in the ICCS program progressed beyond the research and development stage to a scale that can be readily replicated and deployed into commercial practice within the industry.

PROJECT DESCRIPTION

DOE selected Air Products and Chemicals, Inc. (Air Products) to receive ICCS program funding for its project entitled "Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production." For this project, Air Products demonstrated a state-of-the-art system to concentrate CO_2 from two world-class-scale steam methane reformer (SMR) hydrogen production plants located in Port Arthur, Texas.

Air Products successfully retrofitted its two Port Arthur SMRs with a vacuum swing adsorption system to separate the CO_2 from the process gas stream; separation was followed by compression and drying. This process was designed to concentrate the CO_2 in the reformer process gas stream from 10 to 20 percent to greater than 97 percent CO_2 purity, while capturing more than 90 percent of the CO_2 in that stream. The compressed CO_2 was then delivered to a Denbury pipeline for transport to Texas EOR projects in the West Hastings Unit. There, a monitoring, verification, and accounting (MVA) program ensured the injected CO_2 remained in the underground geologic formation.

The project ended in September 2017, following over 3 years of operation. Project activities included engineering and design, award of all air permits, construction, commissioning, plant startup, and operations. The MVA program to monitor the injected CO_2 was implemented as soon as CO_2 capture began. As of the end of the project, the project had successfully captured and sent for sequestration 3.99 million tonnes of CO_2.

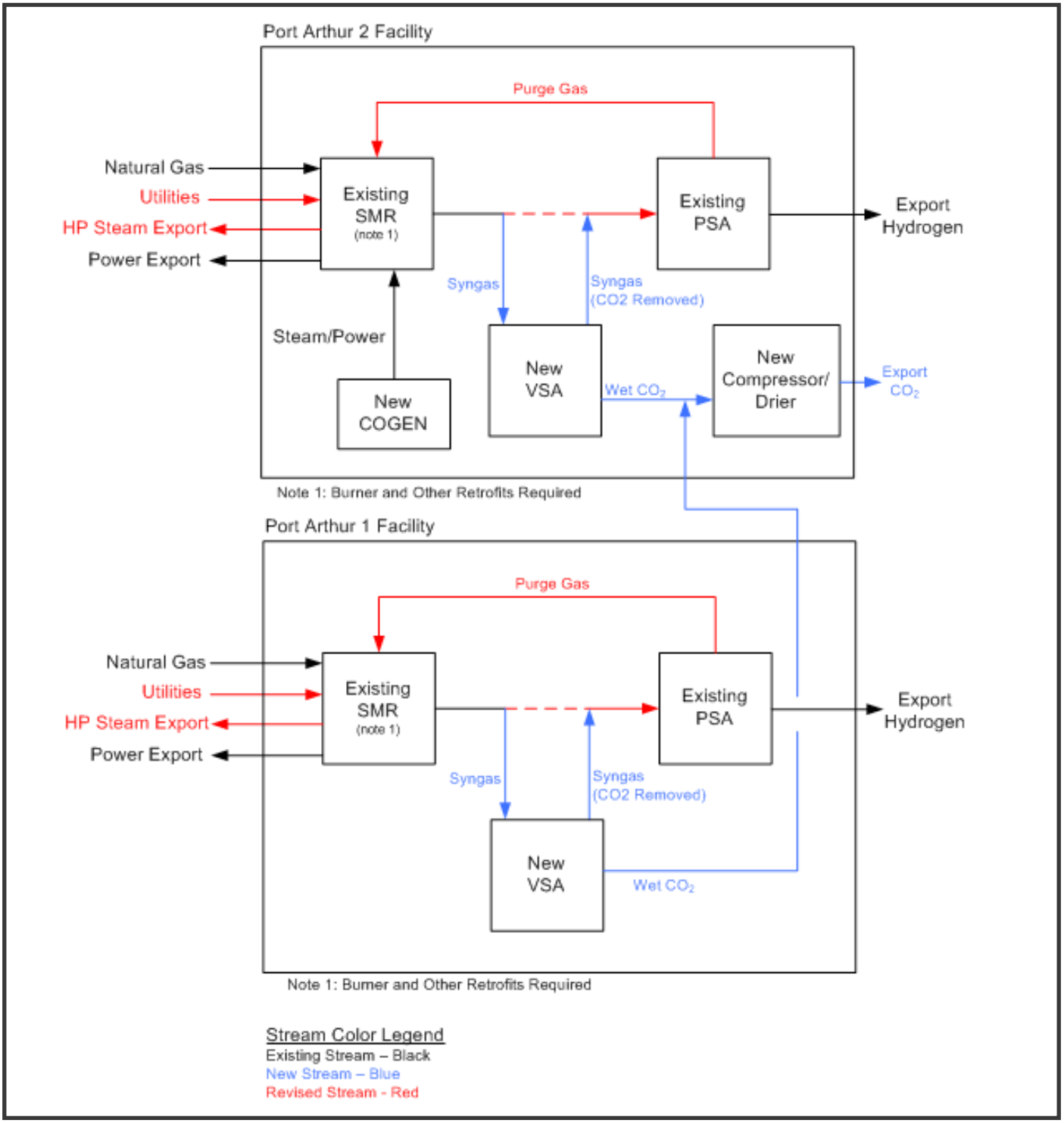
GOALS/OBJECTIVES

- The project goal was to advance CCS technologies from the demonstration stage to commercial viability. The project objective was to capture CO_2 from two steam methane reforming (SMR) hydrogen production plants and store it in an oil reservoir for enhanced oil recovery (EOR). These activities successfully demonstrated the technology and maximized the economic viability of commercial-scale CCS.

BENEFITS

The project addressed climate change concerns, enhanced U.S. economic and energy security, and boosted domestic oil production. Specific project advantages and benefits included:

- Capturing approximately 1 million metric tons per year of CO_2, which would otherwise have been emitted to the atmosphere, for permanent storage in geologic formations.
- Increasing annual domestic oil production by approximately 1.6 to 3.1 million barrels by using CO_2 for EOR applications.
- Enhancing the U.S. on-purpose hydrogen market for refinery use, which was estimated to be almost 4 million tonnes annually at the time of the project. The two Port Arthur SMRs represented 4.3 percent of this market.



CO_2 System Sketch

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