

## PROJECT SUMMARY

### US STEEL COKE OVEN GAS FIRED CHP PLANT COMPREHENSIVE FEASIBILITY STUDY



## PROJECT SUMMARY

The Project was to study in detail the utilization of coke oven gas (COG) in a combined heat and power (CHP) plant at the United States Steel (USS) Clairton Works in the Monongahela River Valley near Pittsburgh, Pennsylvania. Due to a major project and planned changes in the USS manufacturing processes in the Mon Valley plants, the existing use of COG would be reduced significantly. In order to avoid flaring of the excess gas, USS was seeking ways in which to use the gas to generate electricity and steam for internal use within its Mon Valley plants. Bridgestone Associates completed a detailed study in 2016 after which the CHP project was put on hold by USS because their major project was placed on hold. Bridgestone re-worked the study in 2018/2019 when USS re-started their major project development.

## PROJECT STATISTICS

Client:	US Steel
Project Type:	Coke Oven Gas (COG) fired combined heat and power (CHP) plant
Size:	110 - 135 MWe and 750,000 lb/hr 180 psig steam
Estimated Project Cost:	US\$135 – 170 million
Plant Location:	Clairton Plant, Clairton, Pennsylvania, USA
Plant Elevation:	902 feet above sea level

Interconnection Voltage:	13.8 kV
Primary Fuel:	Coke oven gas (510 Btu/scf approx.)
Back-up Fuel:	Natural gas
Fuel Input:	1,700 – 2,000 MMBtu/hr
Plant Steam Conditions:	180 psig, 450 °F and 950 °F, 950 psig

## **PROJECT DESCRIPTION**

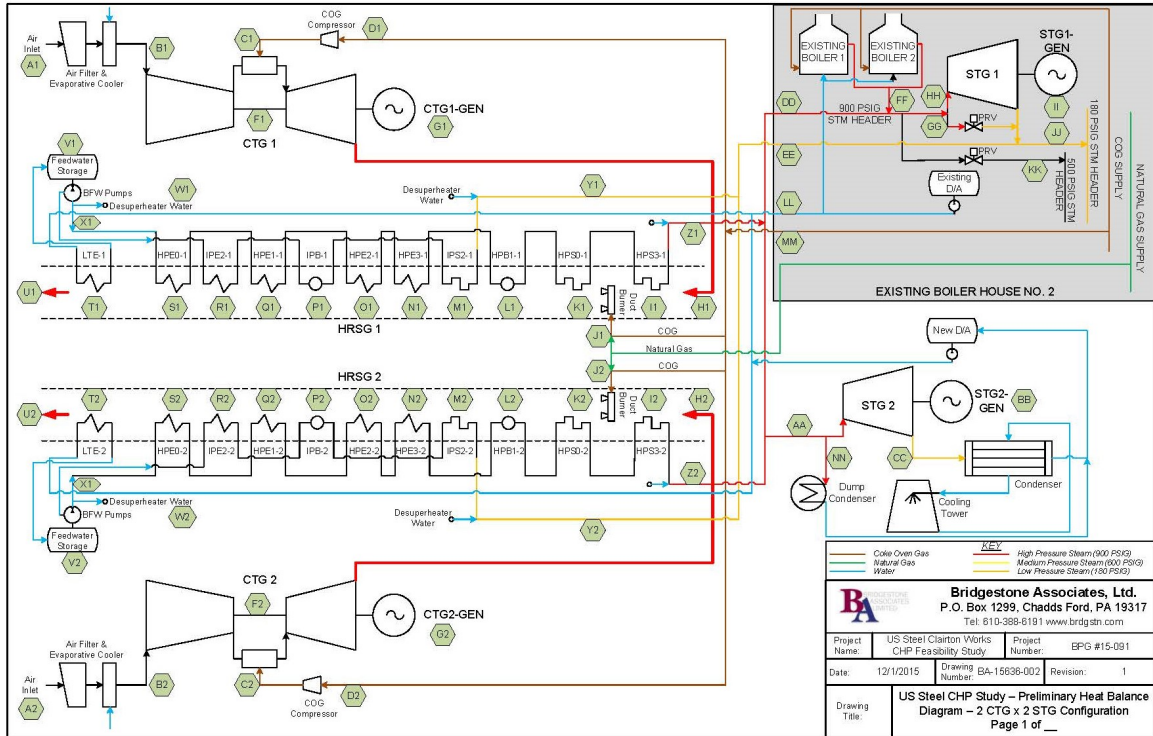
United States Steel Corporation (US Steel) is the second largest producer of steel and steel products in the United States. One of their major production locations is in the Monongahela River valley near Pittsburgh, Pennsylvania. The Mon Valley Works includes four plants: the Clairton Plant, the Edgar Thompson Plant, the Irvin Plant, and the Fairless Plant. The Clairton Plant produces coke used within the Mon Valley and at other USS plants, and in the process generates a large volume of coke oven gas (COG), a low to medium Btu gas. This COG can be used for combustion in boilers, to fuel combustion turbines to generate electricity, and in the steel making processes.

In 2015 USS contracted Bridgestone Associates Ltd.'s client Bryan Power Generation to assist USS in studying the use of excess COG in generating power for the Mon Valley Plants. The excess COG was to be available because of a new processing operation USS was planning that would free up approximately 70 - 90 million standard cubic feet per day (MMSCFD) of COG or 1,500 – 2,000 MMBtu/hr.

Bridgestone Associates, on behalf of Bryan Power, performed a detailed evaluation of the seasonal availability of COG, the existing and planned use of steam, and the electric use of the Mon Valley Plants. Based on the results of that evaluation, Bridgestone developed a number of simple and combined cycle power Combined Heat and Power (CHP) alternatives. Bridgestone evaluated the performance of each of these, and prepared seasonal heat balances using GT-PRO and GT-MASTER software. The data developed were then used as inputs to a comprehensive financial analysis model developed by Bridgestone.



The configurations evaluated included new and secondary market (refurbished used) equipment including GE Frame 6 and LM2500 combustion turbines in simple and combined cycle configuration. The configuration selected as optimum was a combined cycle configuration with two Frame 6 combustion turbines, a new steam turbine, and the existing steam turbine.



Due to the low pressure of the COG (approximately 10 psig), the high volumes, and the composition and impurities within in the gas, extensive work was also required to develop a gas compression and clean-up design suitable for the combustion turbines.

After review of alternative configurations with USS, Bridgestone developed preliminary drawings, steam, gas and electrical interconnection drawings, and a detailed capital cost estimate.

Due to a business decision by USS, the project was suspended in 2016 because the other project that would free up the excess COG was suspended.

In late 2018 USS advised Bridgestone’s client Bryan Power that the project was back on and it was urgent to develop a plan to use the excess COG for power generation, either at the Clairton Plant or at the nearby Irvin Plant. Again Bridgestone Associates was contracted to assist in this evaluation.

Again using the specialist software GT-PRO and GT-MASTER, Bridgestone developed revised power generation configurations based on GE Frame 6 and other combustion turbine models. Particular emphasis was placed on total air emissions due to USS concerns on their overall and individual plant emissions limits in the Mon Valley. Bridgestone worked with a large AE company brought in by USS to develop the detailed emissions data and study electrical interconnection requirements, and provided them with detailed analyses on alternative plant configurations. Once this was completed and a suitable configuration selected for permitting purposes, Bridgestone’s involvement in the project’s further development was concluded.