

INSTALLATION OF ULTRA LOW NOX SUPER BOILER PROTOTYPE

BOILER DIVISION CASE STUDY

Clement Pappas & Co., Inc.

Ontario, California

Super Boiler Prototype Installation

CUSTOMER APPLICATION

The Super Boiler, a prototype design initiated by the U.S. Department of Energy along with the Gas Technology Institute (GTI) and Cleaver-Brooks, Inc. was developed to answer the increasing demand for more efficient industrial steam technology. Clement Pappas is a beverage bottling plant in Ontario, CA. Boilers at this facility are responsible for producing the steam essential to pasteurize the many beverages they package. This location, which has been in operation since 2003, was selected as the second test site for the Cleaver-Brooks 300-BHP Super Boiler with R.F. MacDonald Co. providing installation and service for the unit. Previously, the site was operating off of a Cleaver-Brooks 600 HP boiler, which currently remains on-site in standby mode.



An array of products produced by Clement Pappas

THE SUPER BOILER

R.F. MacDonald Co. has worked closely with Clement Pappas over the previous six years providing maintenance on the 600 HP boiler, as well as planning for implementation of the Super Boiler project. Juan Carrillo, Maintenance Manager, remarked that R.F. MacDonald Co. was chosen to play a part in the project because they "are the biggest and most knowledgeable company for boiler service." The project consisted of several years of planning, followed by installation and start-up of the new 300 BHP Super Boiler, while maintaining the larger, and less efficient 600 HP boiler in standby.

The Super Boiler, an ultra-high fuel efficiency boiler with ultra-low emissions, has an expected performance target of 94% fuel-to-steam ratio efficiency with NOx and CO below 5ppm and a 50% smaller footprint than conventional boilers in use today. Its design includes a combination of innovative industrial steam technologies in combustion, control, heat transfer, and heat recovery.

The test unit at Clement Pappas is composed from a dual-stage combustion system including an air-staged burner integrated with heat removal and steam generation in two stages of high-intensity convection heat transfer. The temperature is reduced through the interstage cooling pass, thus allowing the premixing of the first stage partially combusted fuel with secondary air, while significantly reducing the flame temperature of the secondary flame. In addition, this system uses a proprietary internal extended-surface design to intensify the heat transfer up to 18 times more than bare convection tubes.

The heat recovery system is composed of dual staged economizers with an additional low-pressure (LP) economizer, operating at a lower inlet water temperature, which allows cooling of the flue gas more proximal to the dew point before transit to the transport membrane (TM) condenser. Once reaching this point, the flue gas water vapor passes through a permselective membrane where it is cooled and condensed by direct contact with boiler feed water. The air heater (AH) also provides a recycled water loop cooled by combustion air, thus increasing the temperature of the flue gas to improve the fraction of waste heat that is recoverable in the TM condenser.

BOILERS

PUMPS

SYSTEMS

SERVICE

PARTS

CORPORATE

25920 Eden Landing Road
Hayward, CA 94545
510.784.0110

FRESNO

88 N. Hughes Avenue
Fresno, CA 93706
559.498.6949

LAS VEGAS

3111 S. Valley View Blvd., Ste. E120
Las Vegas, NV 89102
702.220.6680

LOS ANGELES

10261 Matern Place
Santa Fe Springs, CA 90670
714.257.0900

MODESTO

1549 Cummins Drive
Modesto, CA 95358
209.576.0726

RENO

1430 Greg Street, Suite 503
Sparks, NV 89431
775.356.0300

ROHNERT PARK

642 Martin Avenue, Suite B
Rohnert Park, CA 94928
707.586.9234

SAN DIEGO

14781 Pomerado Road
PMB 184
Poway, CA 92064
858.538.5877

www.rfmacdonald.com



Finalized boiler installation

PROJECT RESULTS

The Super Boiler project is being tested as part of the U.S. Department of Energy's plan to go green. Initial reports estimate that implementation of this system will save the industry approximately \$4 billion in fuel and facility costs, while also preventing the emissions of 140,000 tons of NOx and 20 million tons of greenhouse gases each year. The Super Boiler provides facilities with a 50% smaller footprint and weight reduction with its current design of building upwards instead of outwards. In the case of the Clement Pappas prototype, the installation of the Super Boiler has allowed them to operate off of a more condensed unit, while receiving better overall gas and energy efficiency. Carrillo reports they have seen a decrease in gas usage from 2100btu with the 600HP unit to 1600btu with the Super Boiler running at 94% efficiency. The project at Clement Pappas remains under observation by both R.F. MacDonald Co. and GTI for future research and development in the industry. With only 2 units currently in operation, the Gas Technology Institute and Cleaver-Brooks, Inc. anticipate releasing additional field demonstrations in the coming years.



Economizers on mezzanine level