

ICAT Grant #04-1

Abstract

Field Demonstration of Prototype Super Boiler

This is the final report for ICAT Grant 04-1 to perform a Field Demonstration of the Prototype Super Boiler. The Super Boiler consists of a firetube boiler with a unique staged furnace design, a two-stage burner system with engineered internal recirculation and interstage cooling integral to the boiler, unique boiler convective pass design with extended internal surfaces for enhanced heat transfer, and a novel integrated heat recovery system to extract maximum energy from the flue gas. With these combined innovations, the Super Boiler technical goals were set at 94% HHV fuel efficiency, emissions on natural gas of <5 ppmv NO_x, <5 ppmv VOC, and <30 ppmv CO (ref 3%O₂), and 50% smaller foot print than conventional boilers of similar steam output. To demonstrate these technical goals, the stated objectives of the project were to select a host site, fabricate and install the Super Boiler, evaluate system performance, and perform a SCAQMD market analysis.

The industrial demonstration site selected was Clement Pappas located in Ontario, California and the boiler size was a 300 HP firetube boiler. The Clement Pappas Company makes canned and bottled, apple, cranberry, and other fruit juices, as well as cocktail mixers and cranberry sauce.

The averages for NO_x and CO for both the parametric and the long term testing conducted met the goal of 5 ppmv and 30 ppmv, respectively, even though there were some short term conditions where the goals were exceeded. The actual 93.0% efficiency was close to the goal of 94% HHV and the goal could have been achieved if the host site had used higher amounts of makeup water. Finally it should be noted that the parametric test data collected under steady state conditions is somewhat biased because the produced steam was vented during these test and therefore makeup water usage was higher than normal, making the TMC more efficient when compared to normal unvented operation.