

Executive Summary

Small Low NO_x Boiler

1. Gas Quality and LNG Research Study Objectives

This research study was designed to assess how residential and small commercial/industrial end-use equipment responded to changes in gas quality and to determine if Southern California Gas Company (SCG) needs to modify its current Gas Quality Standards (Rule 30).

The test was conducted for the purpose of evaluating how the boiler will react when ran on both PLG and LNG. The unit ran alternately on PLG and LNG for three intervals - each interval spanning 15 minutes. The major objectives of the study during the test were as follows:

- Evaluate the boiler to determine any issues relating to equipment safety and performance. Equipment safety includes changes in carbon monoxide (CO) levels, flame lifting, flame stability, flashback and yellow tipping. Equipment performance includes ignition, combustion and output stability.
- Collect NO_x emissions data during testing.

2. Selection Criteria

There was concern by industry experts and the manufacturer regarding this boiler's sensitive burner being susceptible to safety, emissions, or operational problems with a higher Btu gas. This unit was selected due to the following factors:

- It has a low NO_x atmospheric burner that is very sensitive to gas manifold pressure, wind draft and other environmental factors.
- Complex for boiler and burner manufacturers in meeting SCAQMD Rule 1146.2 while adhering to the Gas-Fired Low Pressure Steam and Hot Water Boiler Standard (ANSI Z21.13) and/or Underwriters Laboratory Commercial - Industrial Gas Heating Equipment Standard (UL-795)¹.

¹ SCAQMD Rule 1146.2 limits the NO_x and CO emissions for Type 1 boilers (from 75,000 Btu/hr up to and including 400,000 Btu/hr). The ANSI and UL standards cover safety, construction and performance, with each having combustion tests that limit CO emissions.

3. Test Results and Findings

The boiler test consisted of running the unit alternately on PLG and LNG according to developed test protocols². Results obtained from the tests conducted revealed that:

- There were no operational, ignition, flame stability, flame lifting, flashback, or safety problems with the different gases or during transitioning.
- When LNG was introduced the NO_x increased from 15 to 27 ppm (corrected to 3% O₂).
- CO and HC decreased 56% and 59%, respectively.
- Combustion was stable; the flame was a little yellow, but no yellow tipping occurred while running on LNG.

4. Equipment Specifications

- **Description:** Small Steam Low NO_x Boiler
- **Horse Power:** 9.5 hp
- **Input rate:** 400,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Maximum Steam Pressure:** 90 psig

² Testing protocols used in this program were derived from industry standards and regulatory test procedures. Note, however, that based on the needs of this program and the operating and design characteristics of equipment tested, adherence to the industry and regulatory testing standards was not literal. The reader is cautioned that no inference can nor should be drawn as regards certification of these devices to the industry or regulatory requirements as a result of this program.