

## Executive Summary

### Low NO<sub>x</sub> Steam Boiler

#### 1 - Gas Quality and LNG 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 major objectives of the study were as follows:

- Evaluate each selected unit to determine any issues relating to equipment safety and performance. Equipment safety includes changes in Carbon Monoxide (CO) levels, combustion stability and Lifting, Flashback, and Yellow Tipping.
- Compare measured and observed results against the major natural gas interchangeability indices, including Wobbe Number, Lifting, Flashback, Yellow Tipping and Incomplete Combustion.
- Collect NO<sub>x</sub> emissions data during testing

#### 2 - Selection Criteria

The Low NO<sub>x</sub> Steam Boiler was selected for this study as it represents an appliance and a burner system that are widely used in the Southern California Gas service territory. It was noted that boiler and burner manufacturers have experienced difficulty in meeting the requirements of SCAQMD Rule 1146.2 while still adhering to the Gas-Fired Low Pressure Steam and Water Boilers Standard (ANSI Z21.13) and Underwriters Laboratory Standard UL-795. Factors and concerns that led to the selection of the Low NO<sub>x</sub> Steam Boiler for this study include:

- Performance/safety may be dependent on flame characteristics
- Safety concerns related to flue gases
- Sophisticated heat exchanger/combustion system
- High density in southern California
- Recommendations from credible industry experts

#### 3 - Test Results and Findings

It was concluded that there were no operational or safety problems with this unit during the test program. The Low NO<sub>x</sub> Steam Boiler was tested over a wide



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range of operating conditions and gas compositions according to developed test protocols<sup>1</sup>. Also included in the test matrix were a series of hot and cold ignition tests performed with the high 1150 HHV / 1437 Wobbe number (Gas 3) and the Low 970 HHV/ 1270 Wobbe Number (Gas 2).

- Ignition results were normal and in all cases the cross over tube smoothly carried the flame to the second burner.
- NO<sub>x</sub> and CO emissions concentrations remained consistent for the range of test gases used in this program, except for an increase in the CO emission when Low 970 HHV/ 1270 Wobbe Number (Gas 2) was supplied.
- NO<sub>x</sub> emissions increased with all richer study gas blends.
- Flame and stack temperatures of this appliance correlated with the Btu and Wobbe Numbers of the test gas blends.
- The highest temperatures were recorded with the richest gases.

#### 4 - Low NO<sub>x</sub> Steam Boiler Specifications

- **Description:** 7 HP Low NO<sub>x</sub> Steam Boiler
- **Burner:** Surface-type pre-mixed burner operating on blue flame mode
- **Maximum input rating:** 301,000 Btu/hr
- **Minimum input rating:** 150,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 7.0 - 14.0" W.C.

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<sup>1</sup> 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.