Executive Summary
Low NOx Condensing Water 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_X emissions data during testing

2 – Selection Criteria

The condensing water boiler represents new technologies that are just now entering the southern California market. These appliances are very compact and operate at high efficiencies. These units are equipped with an induced gas pre-mix burner system with a zero-pressure regulator that was believed to be sensitive to changing gas compositions. Indeed the manufacturer of the tested unit expressed concern regarding operational and emission response that might occur with the unit when fired with rich natural gas compositions. Factors and concerns that led to selection of the condensing water boiler for this study include:

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

3 – Test Results and Findings

The condensing water boiler was tested over a wide range of operating conditions and gas compositions according to developed test protocols[1]. The Condensing Water Boiler did exhibited NO_X and CO emissions sensitivities.

- CO Levels neared the Critical Point[2] with the 1150 HHV / 1437 Wobbe Number (Gas 3).
- Emission concentrations were affected by gas compositions and increased with increasing Wobbe.
- The highest average NO_X concentration was measured when firing the 1150 HHV / 1437 Wobbe (Gas 3).
- Similarly, the highest average CO concentration was observed when firing 1150 HHV / 1437 (Gas 3).
- The highest differential water temperature across the boiler also occurred with 1150 HHV / 1437 (Gas 3).
- Stack gas temperatures fell within a narrow band during the tests, but also peaked when firing 1150 HHV / 1437 (Gas 3).
- There were no issues, related to ignition of this condensing water boiler, when supplied with different gas compositions.

4 – Condensing Water Boiler Specifications

- **Description:** Gas-fired condensing water boiler utilized for hydronic heating
- **Burner:** Induced pre-mix burner
- **Input rating:** 199,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 3.5 – 14.0” W.C.
- **Required gas manifold pressure:** -0.01” W.C.

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[1] 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.

[2] For purposes of this study the Critical Point is assessed as a change in CO concentration of 75 ppmv between baseline gas and other gas mixtures.