Executive Summary
Direct Vent Water 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).

Two main tests were conducted to evaluate how the appliance will react to the different test gases when (a) tuned to the rated input while using Base Gas (low heating value and low Wobbe Number) and (b) tuned to the rated input using Gas 8 (medium heating value and medium Wobbe Number). The major objectives of the study during these two tests were as follows:

- Evaluate the selected unit 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 stability and output.
- Collect NO_X emissions data during testing.

2. Selection Criteria

This type of direct vent water boiler was selected to verify and evaluate how it will react to different test gases when tuned with a low Wobbe Number and low heating value gas (Base Gas) and with a medium Wobbe Number and medium heating value gas (Gas 8).

Tuning the appliance included adjusting the input rate by changing the orifice and/or adjusting the manifold pressure and adjusting the primary air until the emissions matched the ones when tuned with Base Gas or the ones recommended by the manufacturer.

In addition, this type of hot water boiler was selected to be tested because of the following factors:

- Large number of these units in the Southern California Gas Company territory.

- Complexity for boiler and burner manufacturers in meeting SCAQMD Rule 1146.2[1] while adhering to the Gas-Fired Low Pressure Steam and Hot Water Boilers Standard (ANSI Z21.13) and/or Underwriters Laboratory Commercial - Industrial Gas Heating Equipment Standard (UL-795).

3. Test Results and Findings

The hot water boiler was tested over a wide range of operating conditions and gas compositions according to developed test protocols[2]. Results obtained from all tests conducted revealed that:

- There were no operational, ignition, flame stability, flame lifting, flashback, yellow tipping or safety problems with the different gases or during transitioning.
- None of the temperatures monitored had critical changes.
- Average CO emissions were highest with Gas 3.
- NO_X and CO emissions followed the same pattern as the equivalence ratio and the Wobbe Number.

4. Equipment Specifications

- **Description:** Direct Vent Hot Water Boiler
- **Burner:** Leaned Premixed Power Combustion System with 8 Cylindrical Barb Burners
- **Input rate:** 500,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 7 – 14 in. w.c.

[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 Z21.13 and UL standards cover safety, construction and performance, with each having combustion tests that limit CO emissions.

[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.