Executive Summary
FVIR Water Heater

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 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 3 (highest heating value and highest Wobbe number). The major objectives of the study during these tests 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, lifting, flashback and yellow tipping. Equipment performance includes ignition and combustion stability.
- Collect NO_X emissions data during testing.

2. Selection Criteria

The Flammable Vapor Ignition Resistant (FVIR) Water Heater represents modern technology that is required in all new water heaters. This technology limits flammable vapor fires from water heaters. The FVIR system incorporates a mechanism that prevents flames from propagating outside the water heater in the event of vapor ignition. On these units the openings for combustion air are smaller than found on previous water heaters. This led to a concern that there could be air/fuel ratio problems when rich Natural Gas fuel is supplied. This type of water heater was selected for a second test to:

- Verify the results obtained in the first phase of testing (June 2004) on a water heater made by a different manufacturer but with similar flammable vapor ignition resistance (FVIR) and burner technologies
- Evaluate how it will react to the test gases after tuning it with the highest heating value and Wobbe number gas (Gas 3)
- Determine if there was a difference in the emissions when testing with and without a vent stack installed on the water heater

3. Test Results and Findings

The water heater was tested over a wide range of operating conditions and gas compositions according to developed test protocols[1]. Results obtained from all tests conducted revealed that:

- There were no operational , ignition, flame stability or safety problems during testing of each gas or during transitions between gases
- NO_X emissions did not exceed 100 ppm (corrected to 3% O_2)

Results while the water heater was tuned with Base Gas corroborate with results from testing conducted in June 2004 on a water heater made by a different manufacturer but with similar flammable vapor ignition resistance (FVIR) and burner technologies.

There were no notable differences in emissions when the test was conducted with or without the vent stack.

4. Equipment Specifications:

- **Description:** 40 Gallon Residential FVIR Water Heater
- **Burner:** 4½ inch diameter atmospheric FVIR burner
- **Input rate:** 40,000 Btu/hr
- **Type of fuel:** Natural Gas
- **Required gas supply pressure:** 5 – 14 in. w.c.
- **Required gas manifold pressure:** 4 in. w.c.

[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.